Subject: Typical SerDes System Characteristics and Displays

Author: John Baprawski; John Baprawski Inc. (JB)

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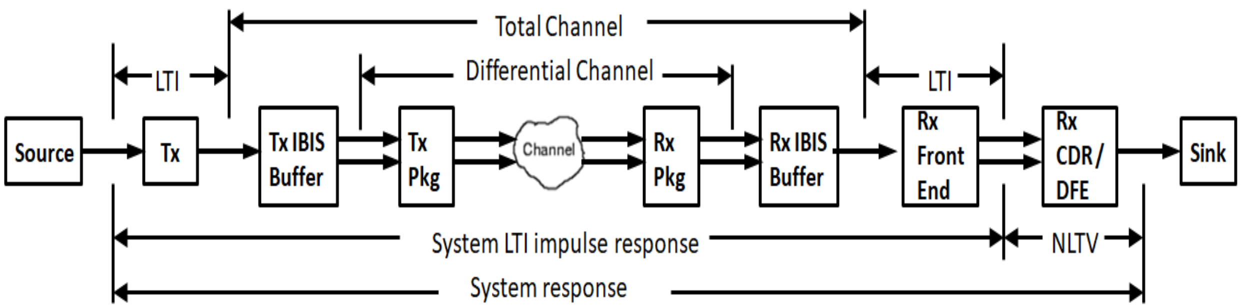
This paper discusses features on the web site: **https://www.serdesdesign.com**

This section discusses typical SerDes system characteristics and displays. Let us know if you would like the tool enhanced with additional capability.

A SerDes system has the typical structure shown in this figure.



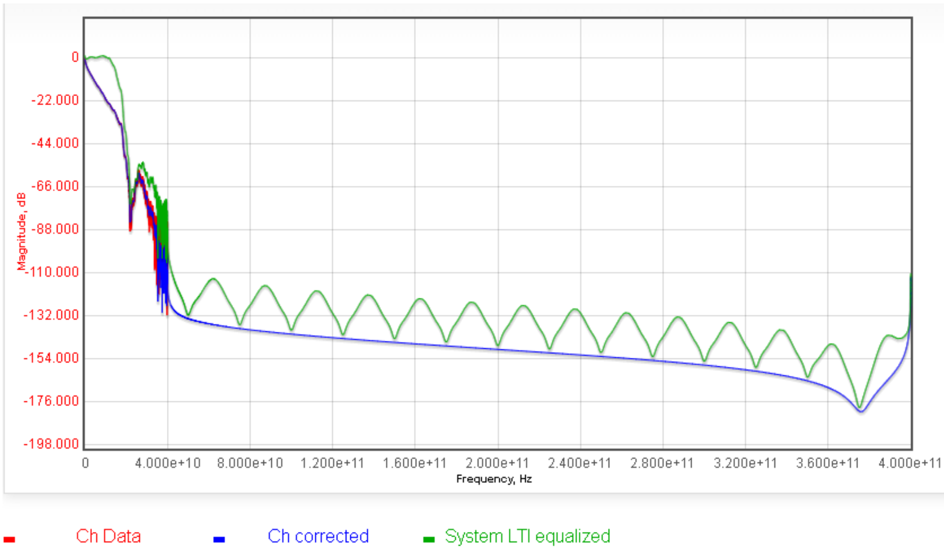
See this link for detail discussion on the **Total Channel Characteristics and Displays**.

For the typical SerDes system discussed here:

- NRZ data is used with a bit rate of 25 Gbps, 32 samples per bit, and 0.5 V peak level.
  - The SampleRate = 25e9 * 32 = 800 GHz
  - The maximum frequency = SampleRate/2 = 400 GHz
- The differential channel is represented with a 4-port S-Parameter file with data from 10 MHz to 40 GHz that inherently has a time delay of about 18 nsec with about 25 dB loss at Nyquist.
- The Tx is LTI and uses an FFE with 3 pre-cursors and 5 post-cursors.
- The Rx is LTI and only has an Automatic Gain Control enabled to restore the output level to the 0.5 V peak level.

Since this SerDes system is LTI, Statistical Analysis will be used. The resultant measurements are discussed here.

1.A. Channel and System LTI spectrum magnitude; full spectrum to 400 GHz



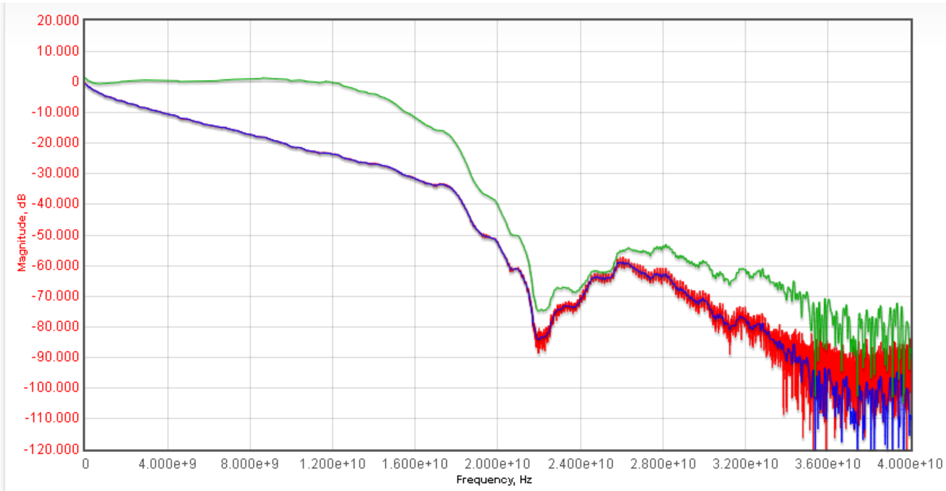
The 'Ch Data' (red) curve is from the channel S-Parameter data.

The 'Ch Corrected' (blue) curve is with corrections applied including meeting physical and causality constraints.

The 'System LTI equalized' (green) curve is the overall SerDes system response including the Tx and Rx models.

Notice that the channel corrections do not exhibit any high frequency aliasing. High frequency aliasing does not occur with the SerDes.com proprietary frequency to time domain conversion process.

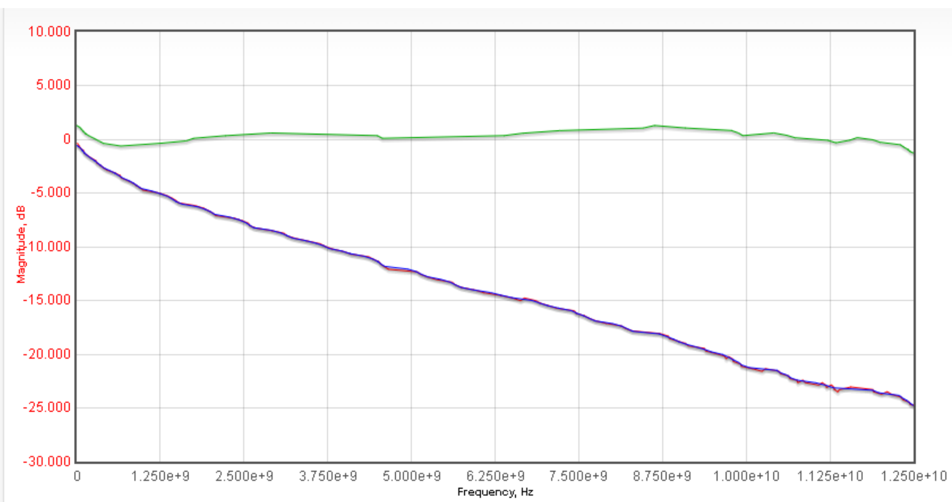
1.B. Channel and System LTI spectrum magnitude; spectrum to 40 GHz which is the upper frequency limit for the S-Parameters.



Ch Data Ch corrected System LTI equalized

Observe that the Corrected curve overlays the original Data and eliminates the high frequency noise in the original data.

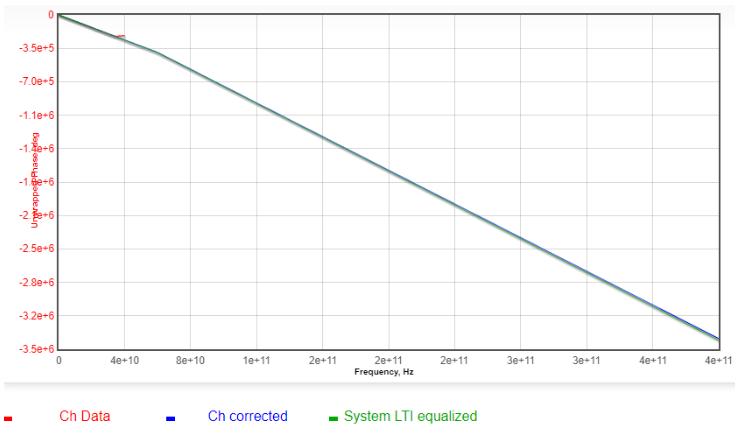
1.C. Channel and System LTI spectrum magnitude; spectrum to 12.5 GHz which is Nyquist frequency



Ch Data Ch corrected System LTI equalized

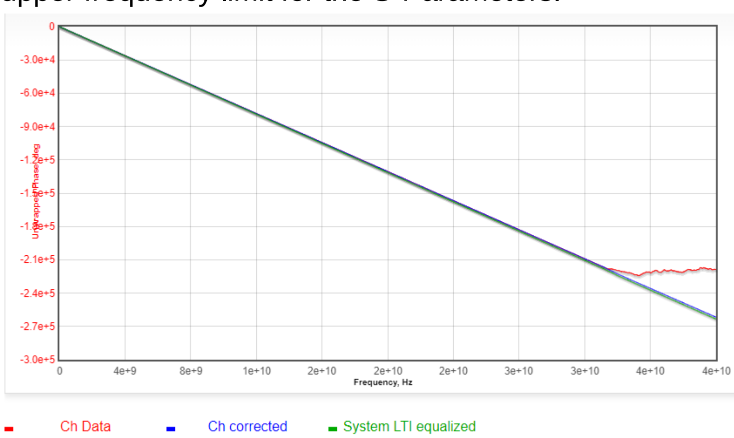
Observe that the Corrected curve overlaps the original Data and removes the fine grain non-causal perturbations in the original data.

2.A. Channel and System LTI spectrum phase, unwrapped; full spectrum to 400 GHz



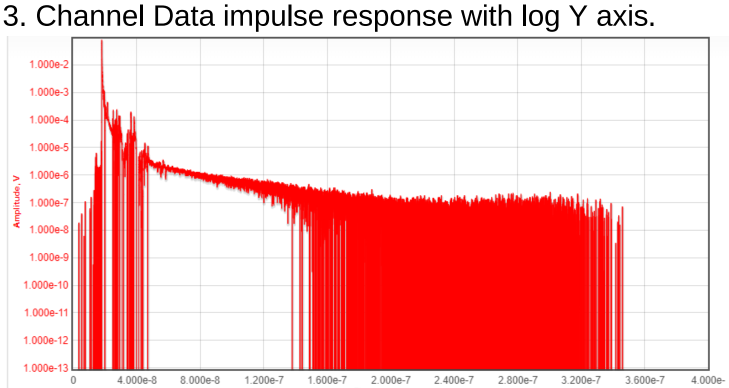
Observe that the Corrected phase smoothly extends beyond the Data 40 GHz upper limit.

2.B. Channel and System LTI spectrum phase, unwrapped; spectrum to 40 GHz which is the upper frequency limit for the S-Parameters.



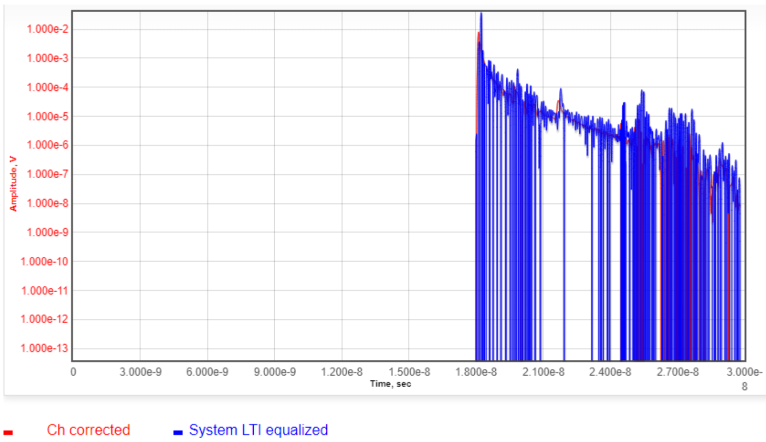
Observe that the original Data phase becomes corrupted beyond 30 GHz and the Corrected phase eliminates that original Data noise.

3. Channel Data impulse response with log Y axis.



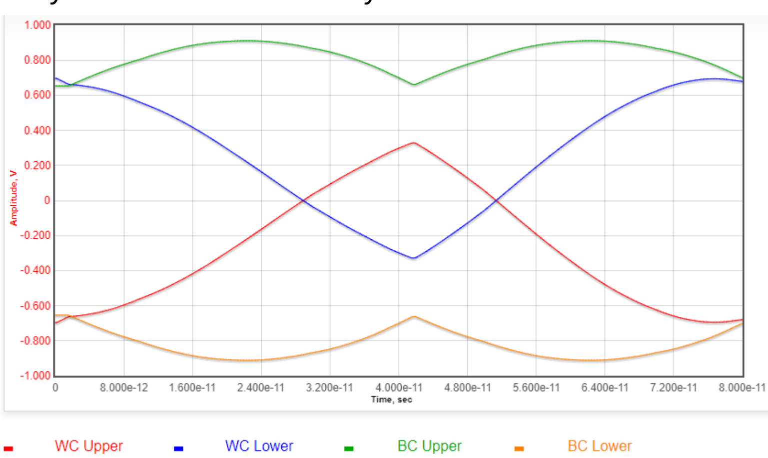
Observe the non-causal impulse artifacts before the 18 nsec channel transit time. Also observe that the original data impulse response extends out in time to 350 nsec.

4. System LTI equalized impulse response with log Y axis.



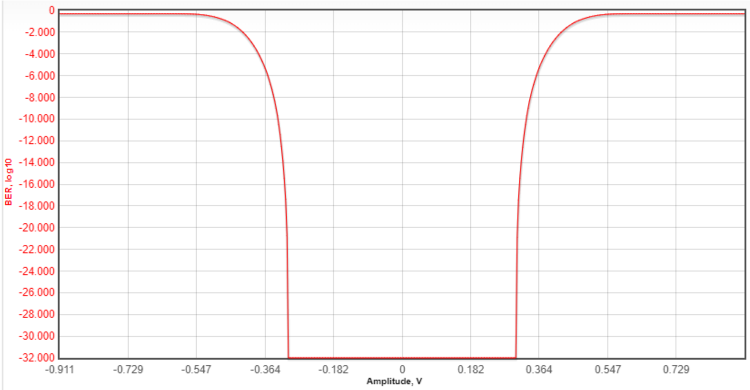
Observe that the Corrected response has no non-causal artifacts before the 18 nsec channel transit time. Also observe that the impulse time duration is only 30 nsec, much shorter than was inherent in the original data.

5. System worst/best case eye contours vs. time.



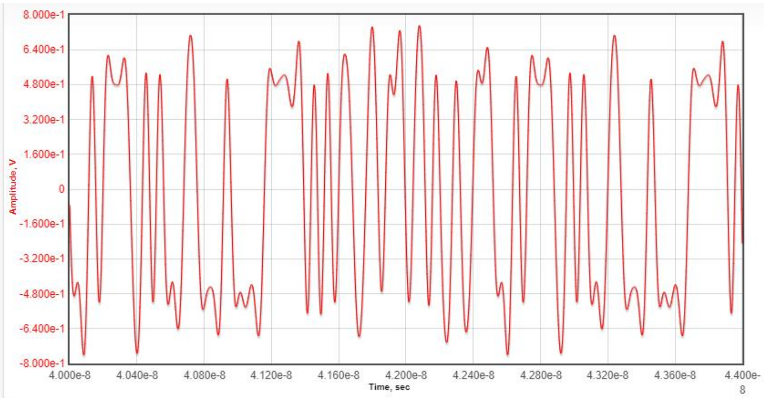
The system impulse response (inclusive of the Tx and Rx models) is statistically analyzed to derive the worst case and best case eye contours. This give a very good representation of the actual eye as would be achieved using a detail bit-by-bit analysis with many analysis bits.

6. Eye amplitude bathtub BER for system



Using statistical analysis on the system impulse response, the amplitude BER curve at the center time of the eye is an accurate representation for an effectively infinitely long PRBS data stream.

7. Waveform response for the system



The waveform is the result of a bit-by-bit analysis for a short segment of time as defined in the Analysis Setup Options. The waveform specification are based on the Analysis Setup Options: **Setup Options**

For detail channel eye analysis, including jitter and BER characteristics, use the **Eye Analysis Tool** after analyzing a SerDes system. The Eye Analysis Tool uses the SerDes system characteristics obtained from this SerDes system analysis.

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