Considerations & Proposal for CX-4 Compliance Channel

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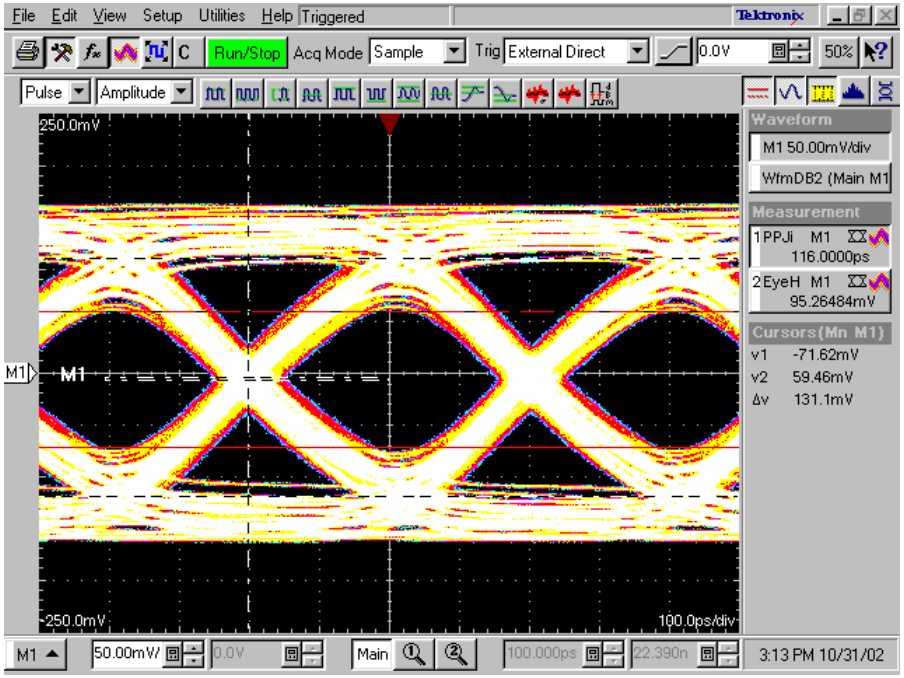
Cable Assembly Specification

- Typical Loss vs. Frequency Curve?
- Goal is to Achieve maximum distance or smallest cable size
- How can link be optimized for compatibility with typical pre-emphasis circuits being developed?

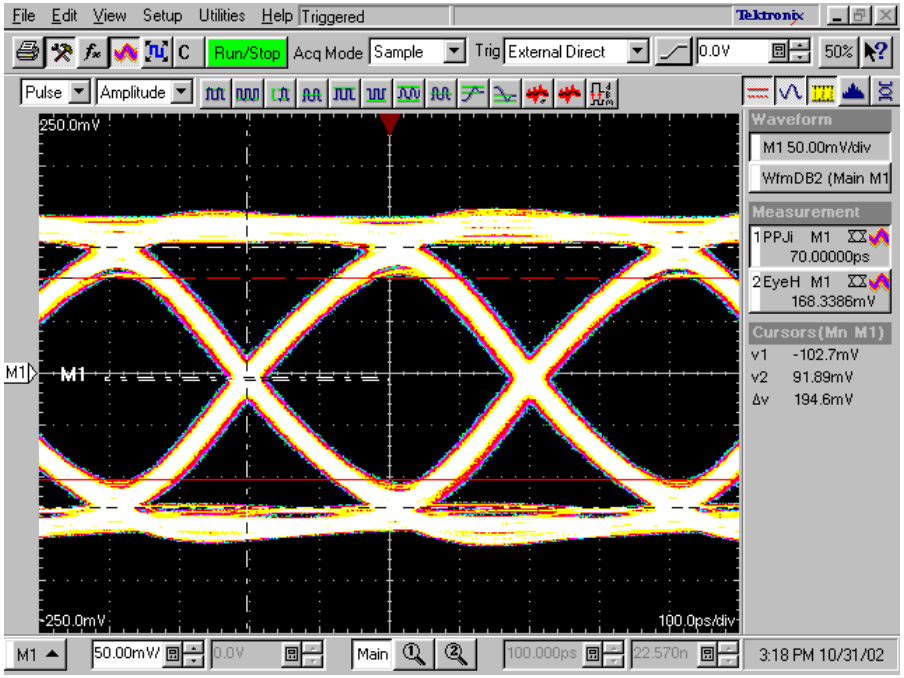
20M Signal Transmission

Standard vs. Equalized Assemblies using pre-emphasis circuits

Jitter Increase = 46 psec (66%) Amplitude Decrease = 64 mV (33%)



Standard Cable Assembly



Equalized Assembly

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Reach Length Comparisons

Equalized vs. Standard Cable Assemblies

IC Company	IC Signal Conditioning	EQ	STD	Notes
ICV1	Peaking	15M	10M	CMOS
ICV2	De-Emphasis Tx	25M	15M	CMOS
ICV3	Adaptive Rx	30+M	15M	SiGe
ICV4	Peaking Tx	TBD	TBD	CMOS Currently Testing
ICV5	Peaking Tx + Adaptive Rx	30M	20M	CMOS
ICV6	Peaking Tx	15M	5M	CMOS

Results are for relative comparison. Absolute maximum reach in 'system realistic' environment would be shorter.

Typical Improvement

- Improved eye height over same distance
- Longer distance with same eye opening

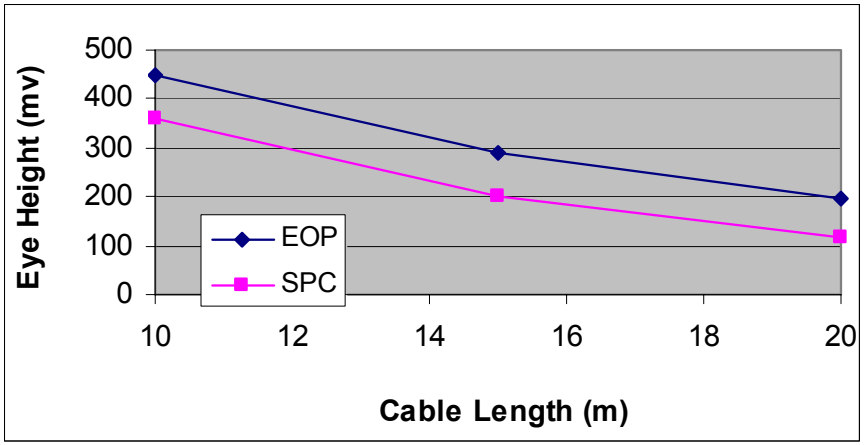
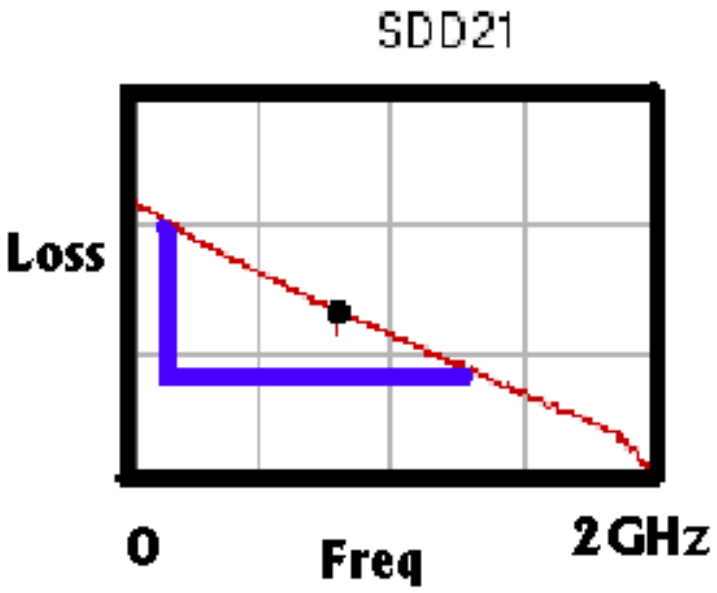


Fig1- eye height of two cable types vs length w/ optimized pre-emphasis levels. (Input amplitude = 1.25 V)

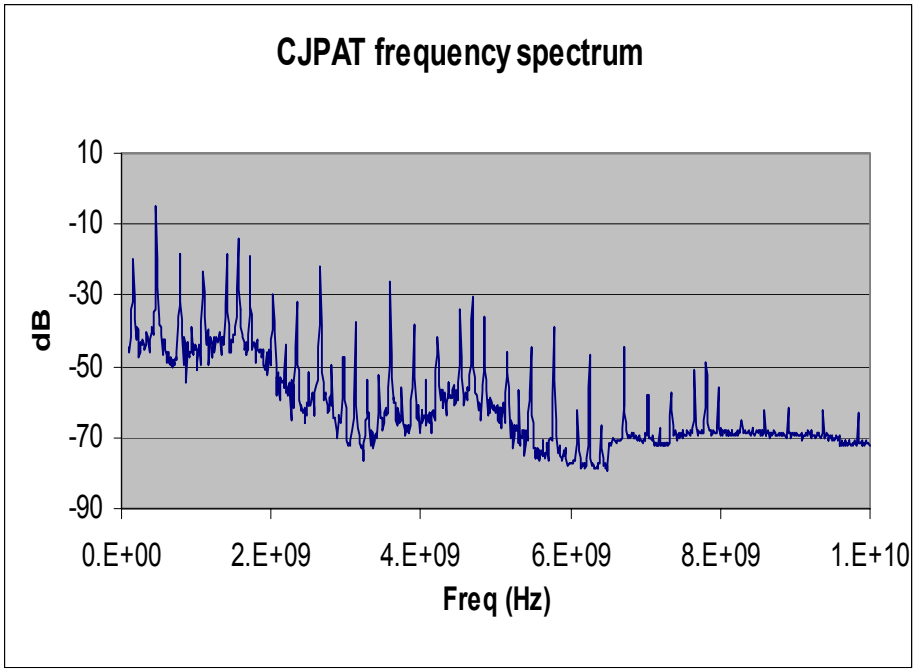
Alternative to cable assembly Insertion Loss specification

- Eye diagrams close when the high frequency loss is much greater than the low-frequency cable loss.
- Specifying a maximum delta between loss at the fundamental and loss at the lowest important frequency component for 8B10B encoding will ensure proper cable loss characteristics.
- Maximum Loss specification at fundamental frequency needed to insure adequate amplitude



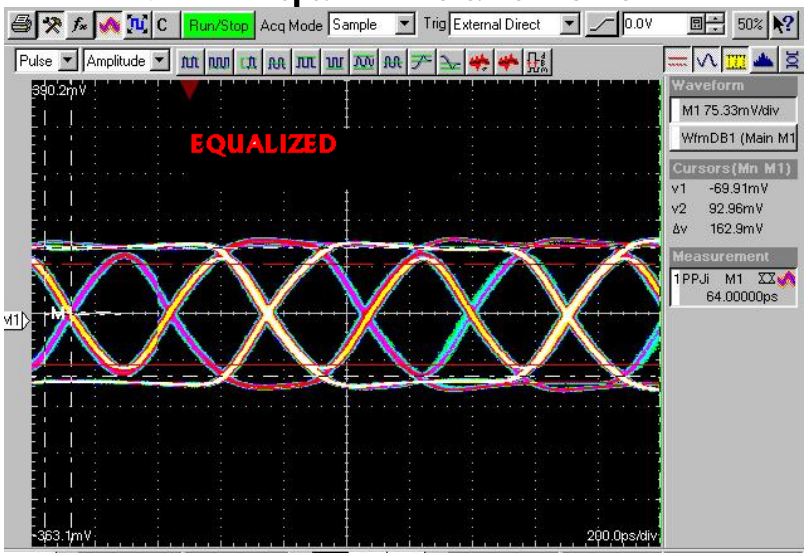
CJPAT Frequency Spectrum

- Frequency spectrum for CJPAT from 100MHz through 10GHz.
- Lowest important frequency content is found at 160MHz

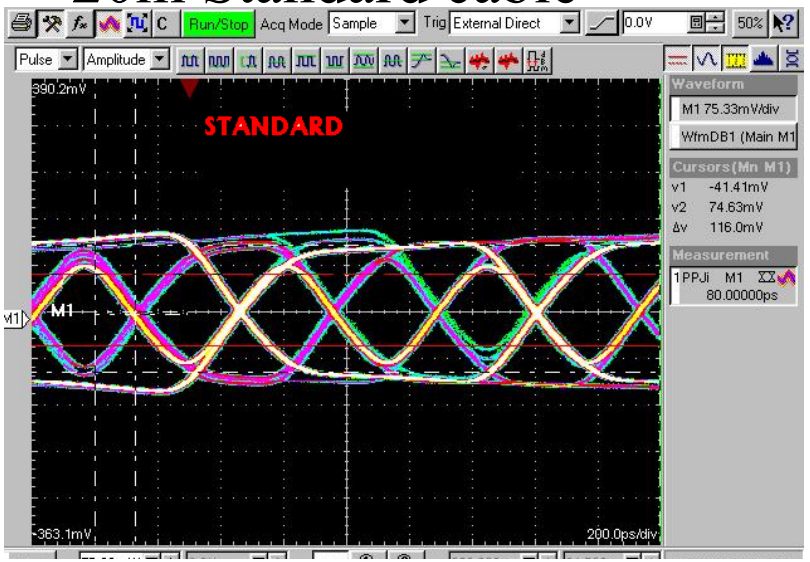


Loss Delta affects Eye Pattern

20m Equalized cable



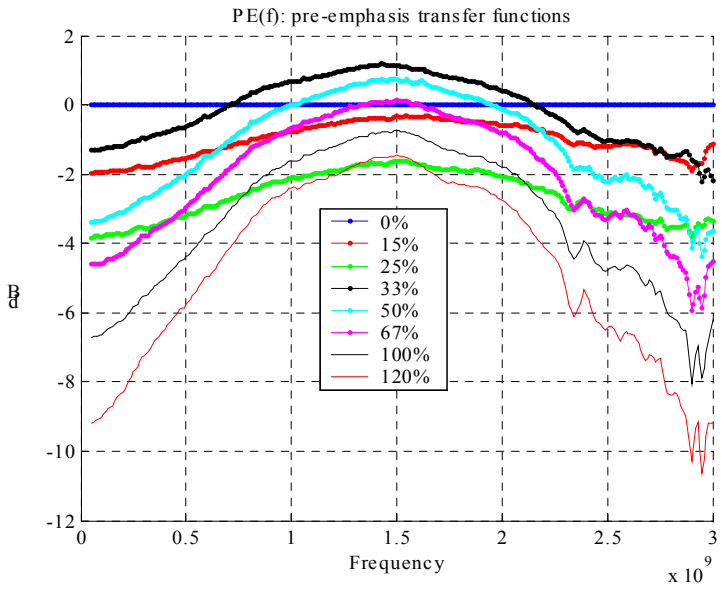
20m Standard cable



The two cables above have deltas of 11.1 for the standard and 7.5 for the equalized cable. The difference in eye height between them is about 50mV

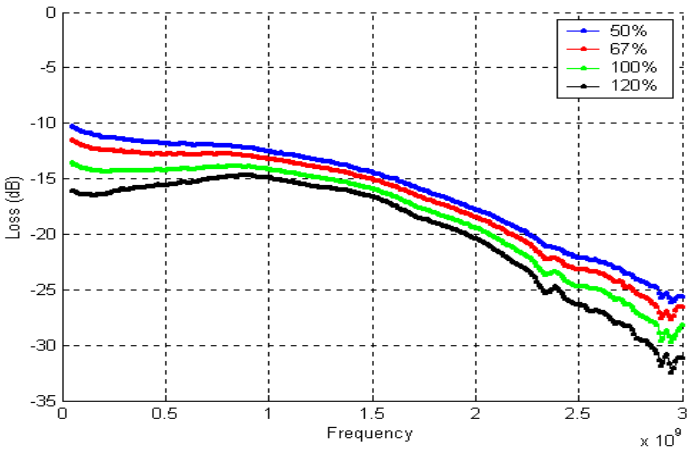
Why equalization works well with pre-emphasis

- Measured Transfer Function of pre-emphasis circuit shows how frequency response is modified
- Low frequency response for standard cable assemblies with pre-emphasis is non-linear (pre-emphasis doesn't remove enough low-frequency content)
- Turning up the pre-emphasis level removes more low-frequency components, but it also attenuates higher frequency components



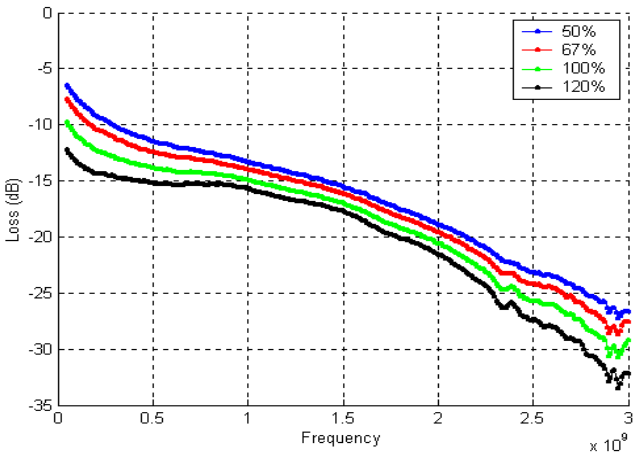
Low frequency response for standard cables with pre-emphasis is non-linear

Transfer function of pre emphasis and equalized cable assembly



Optimal p.e. - 67%

Transfer function of pre emphasis and standard cable assembly



Optimal p.e. - 120%

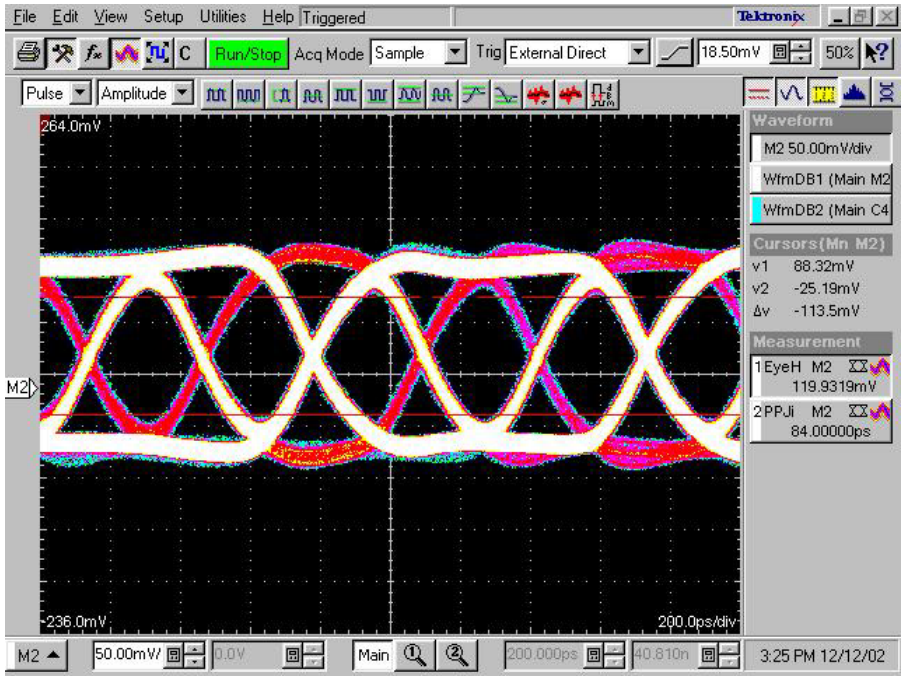
Standard Assembly requires more pre-emphasis for reduced amplitude

Crosstalk Budget

- Crosstalk, as a bounded noise source, can be simply budgeted with deterministic noise (amplitude) and jitter:
  - Noise budget = NEXT Amplitude
  - Jitter Budget = NEXT Amp / Slew Rate of victim
- NEXT Amplitude is typically characterized in time domain w/ data representative test pattern
- Allows inclusion of reflection and bit pattern impact

NEXT Crosstalk Impact

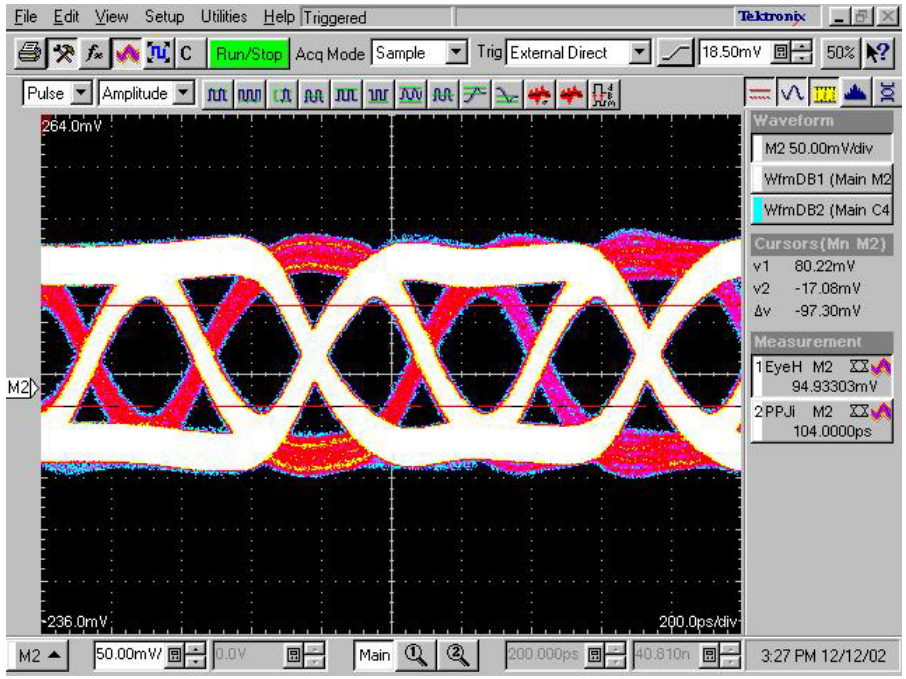
14 mV Crosstalk



Eye Opening Reduction: 11 mV

Jitter Increase: 24 psec

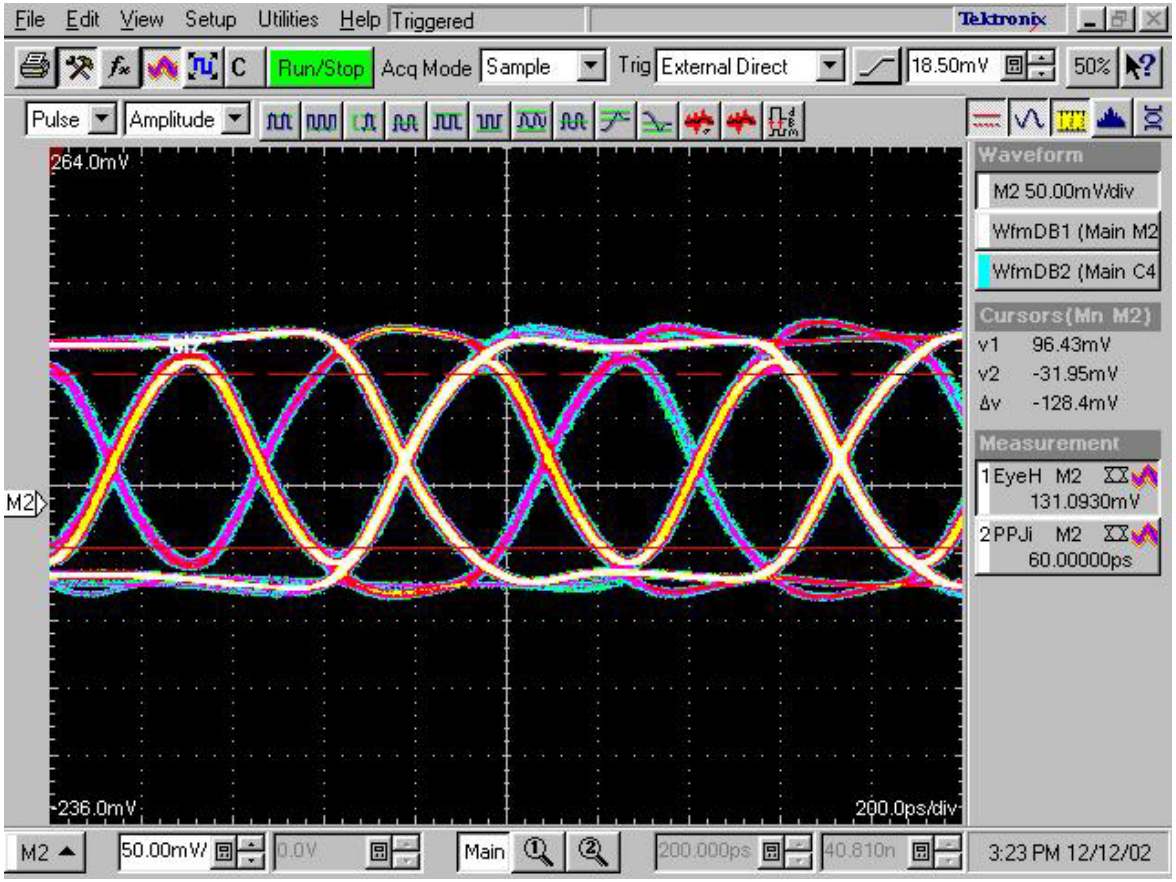
28 mV Crosstalk



Eye Opening Reduction: 36 mV

Jitter Increase: 44 psec

Eye Degradation vs. Crosstalk



15M AWG 24 Equalized Cable w/ De-Emphasis

Input Pattern CJPAT 1V (p-p)

Summary and Recommendations