

Table of Contents

Design	2
Results.....	5
Conclusion	10

List of Figures

Figure 1. Transmission Line with Pre-emphasis and Decision Feedback Equalizer circuit	2
Figure 2. Slicer Schematic	3
Figure 3. 1 Unit delay block - transmission gate delay cell	3
Figure 4. TLine with DFE 10cm	5
Figure 5. TLine without DFE 10cm	5
Figure 6. TLine with DFE 50cm	6
Figure 7. TLine without DFE 50cm	6
Figure 8. TLine with DFE 100cm	7
Figure 9. Tline without DFE 100cm	7
Figure 10. Pre-emphasis unit power consumption.....	8
Figure 11. CTLE unit power consumption	8
Figure 12. DFE unit power consumption.....	9

List of Tables

Table 1. TLine Parameters.....	4
Table 2. FET Sizing	4
Table 3. Current Sources Parameters	4
Table 4. Eye diagram properties for driver with pre-emphasis	9
Table 5. Eye diagram properties for driver with pre-emphasis and DFE	9

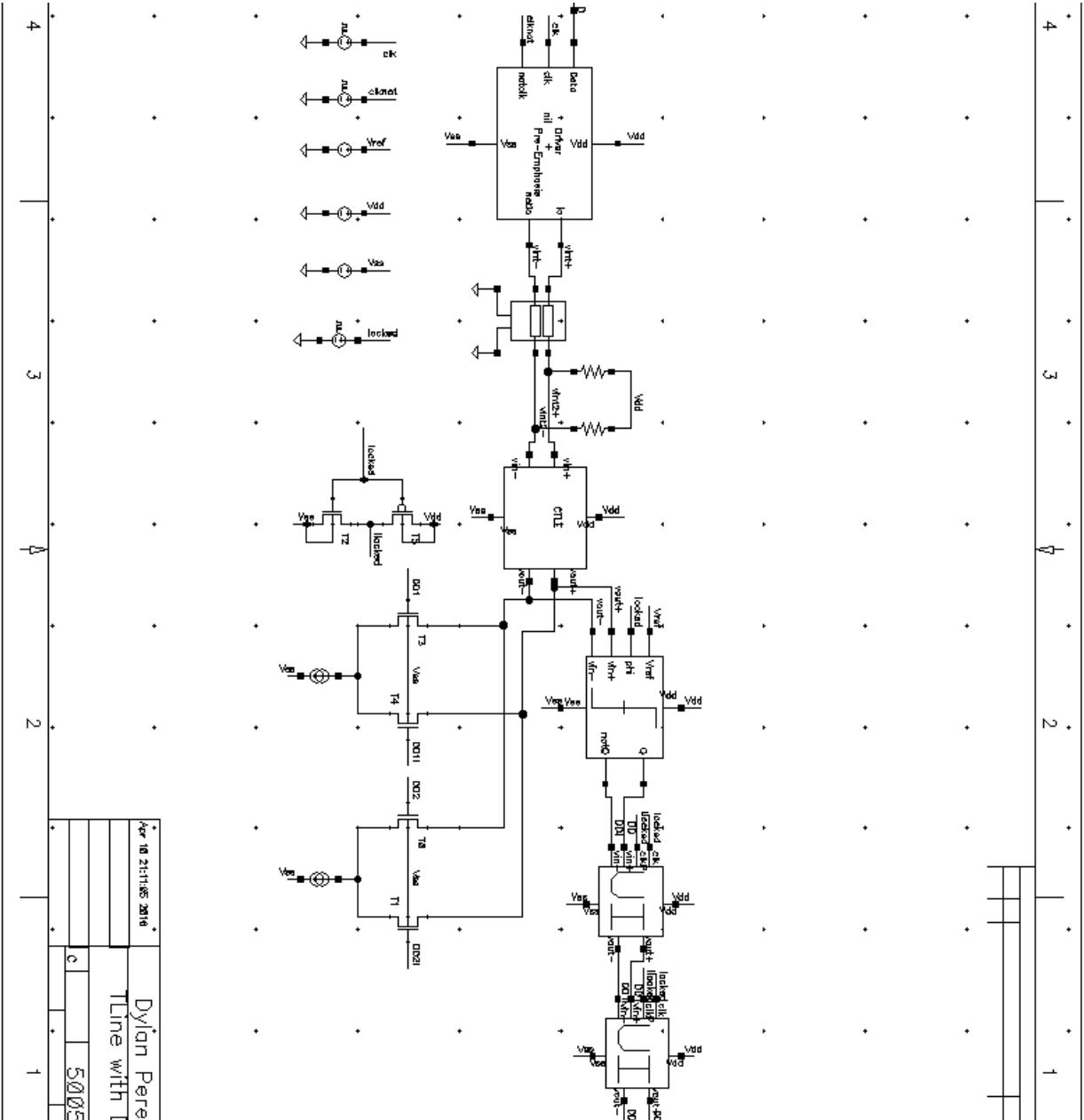


Figure 1. Transmission Line with Pre-emphasis and Decision Feedback Equalizer circuit

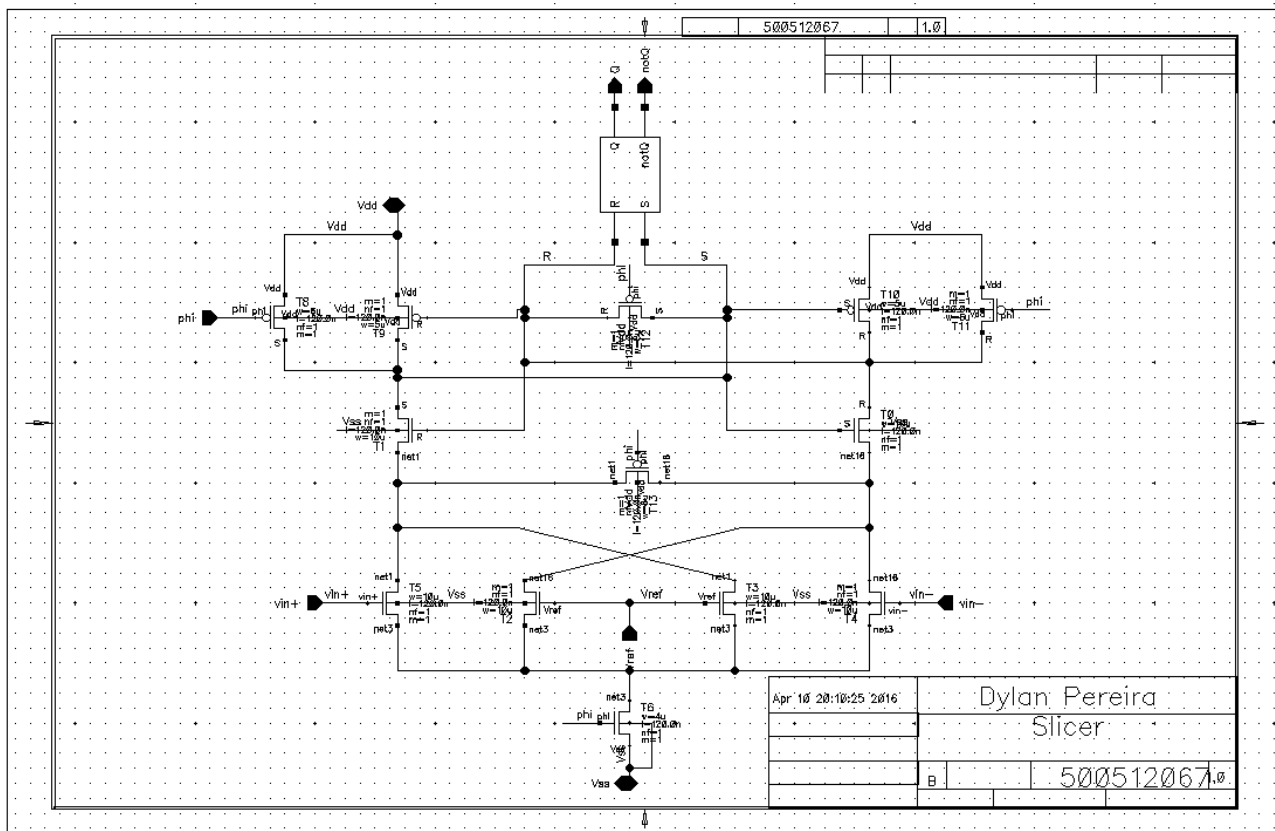


Figure 2. Slicer Schematic

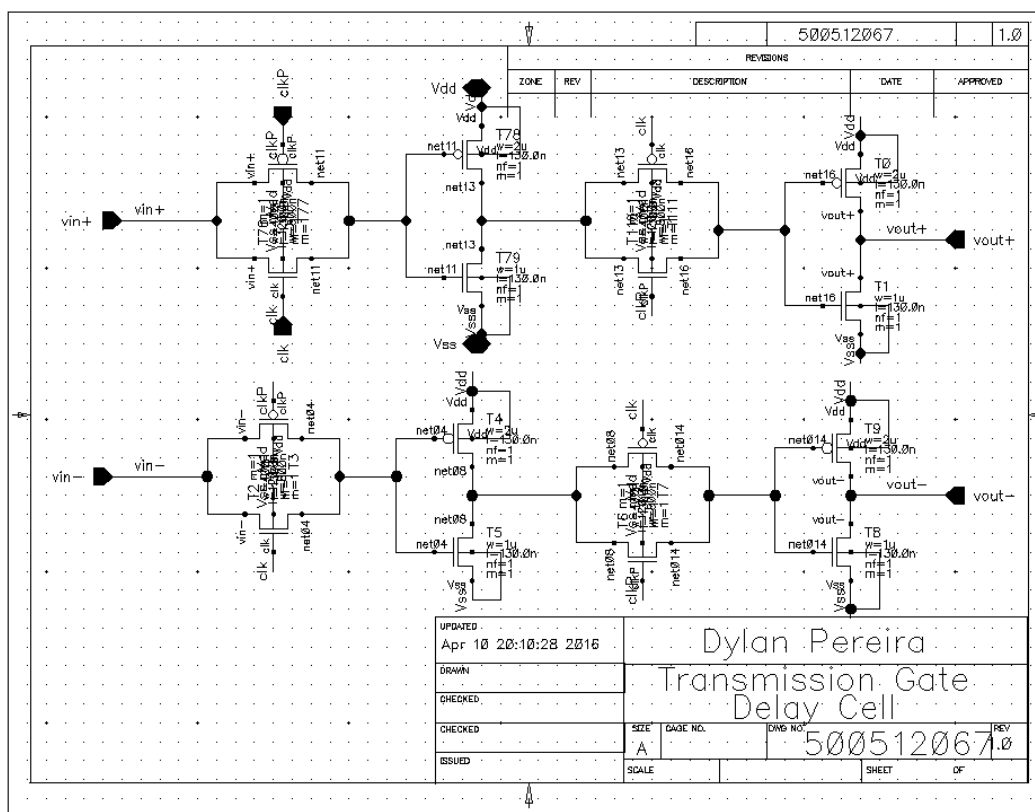


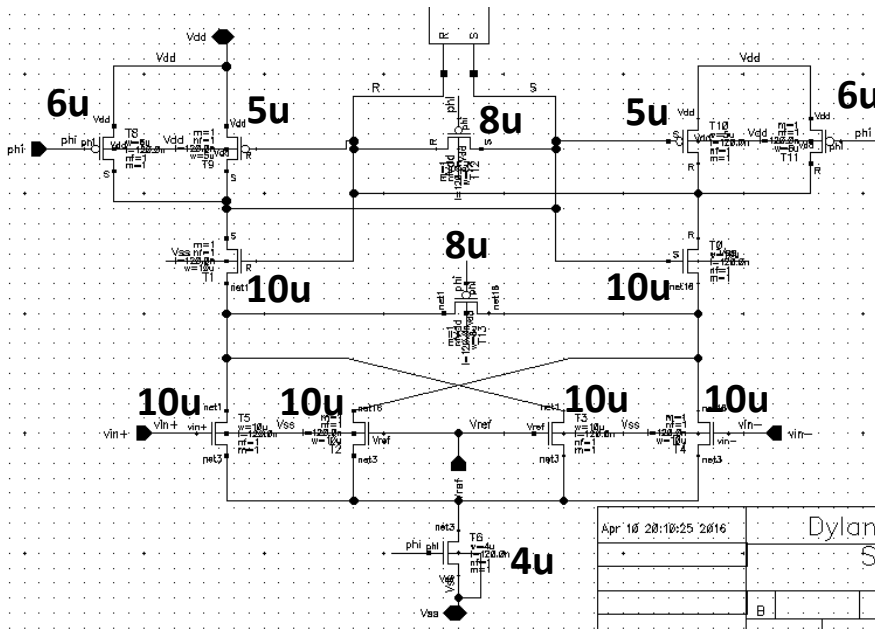
Figure 3. 1 Unit delay block - transmission gate delay cell

Table 1. TLine Parameters

Parameter	Value
Dielectric Constant	5
Dielectric Thickness	300u
Line Width	120u
Line Thickness	20u
Line Spacing	13u

Table 2. FET Sizing

FET	Width P	Width N	L
Latch - NAND	2u	2u	120n
Latch - Inverter	800n	400n	
Driver NMOS		50u	
Tap Mult. 1		2u	
Tap Mult. 2		4u	
Unit delay Tgate	800n	400n	
Unit delay Inverter	2u	1u	
CTLE	37.5u	100u	



Slicer Sizing

Table 3. Current Sources Parameters

Component	Value
Driver IDC	4m
Pre-emp tap 1 current	400u
Pre-emp tap 2 current	200u
CTLE drive current	5.5m
DFE tap current 1	400u
DFE tap current 2	200u

Results

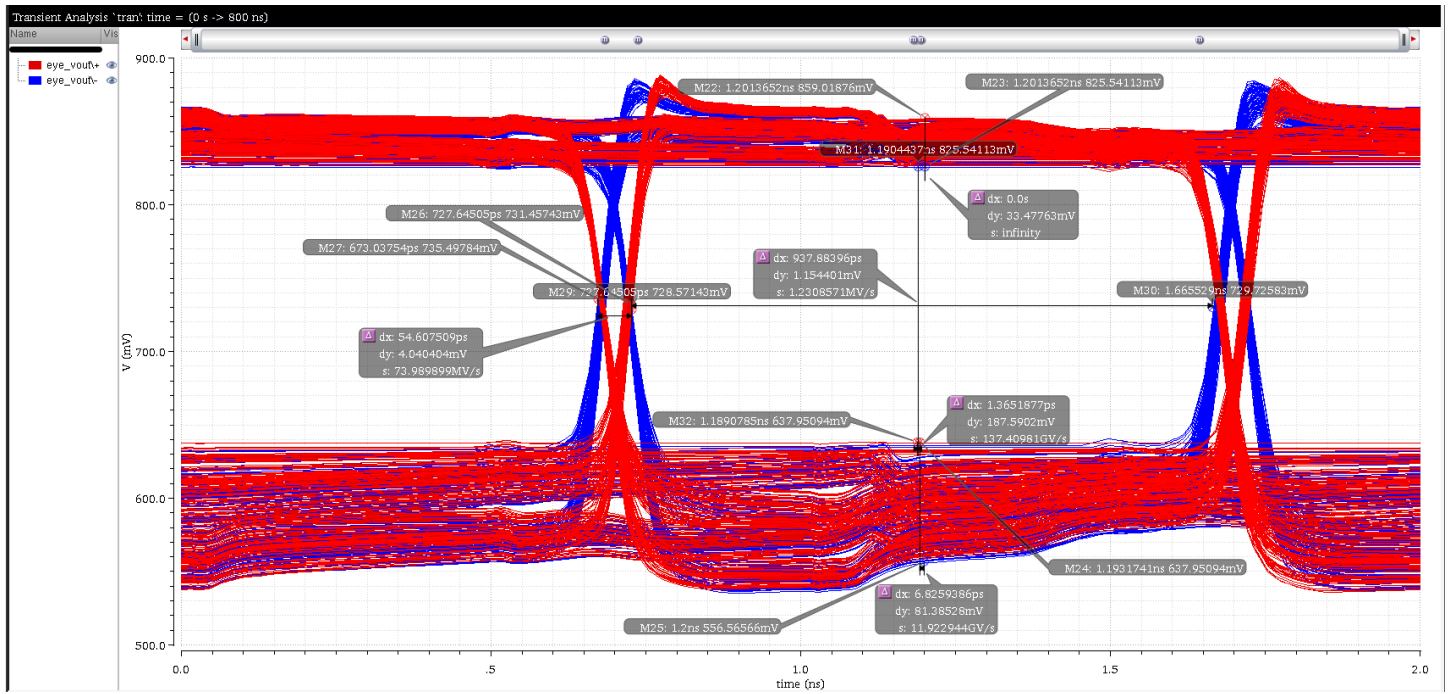


Figure 4. TLine with DFE 10cm

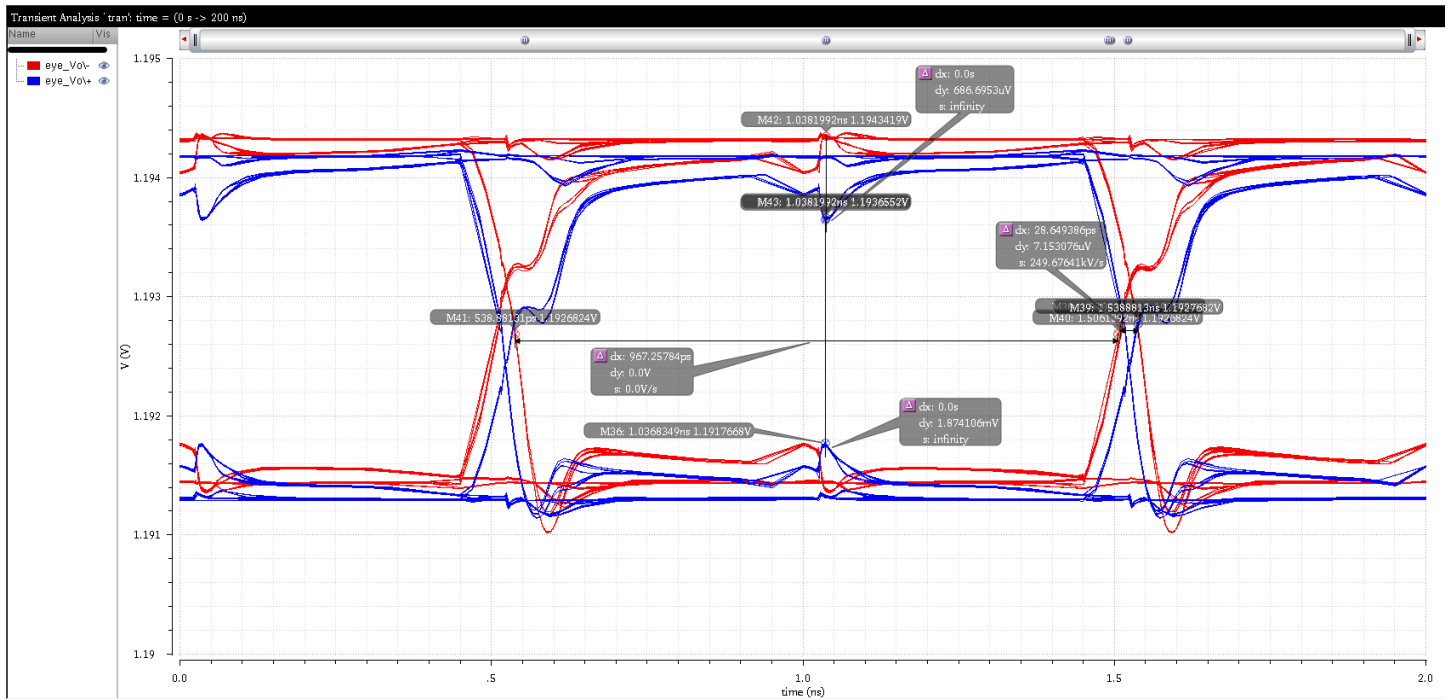


Figure 5. TLine without DFE 10cm

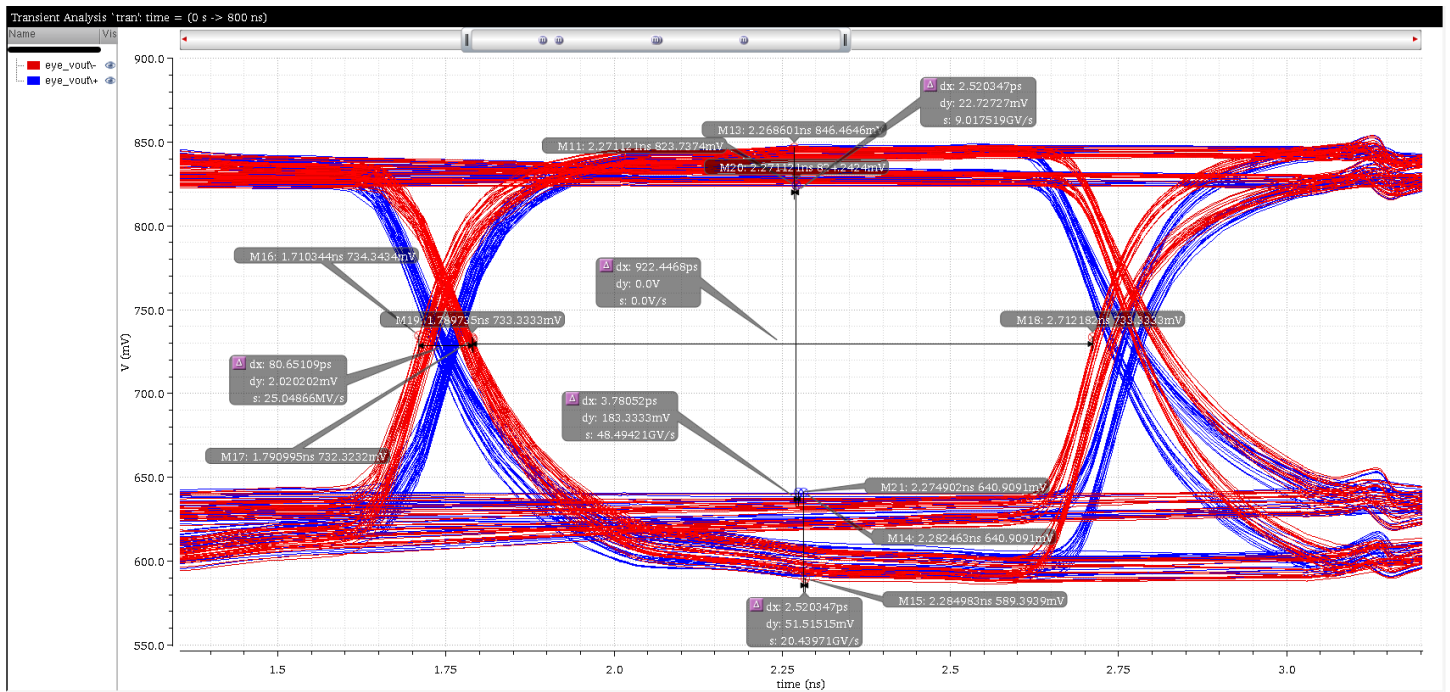


Figure 6. TLine with DFE 50cm

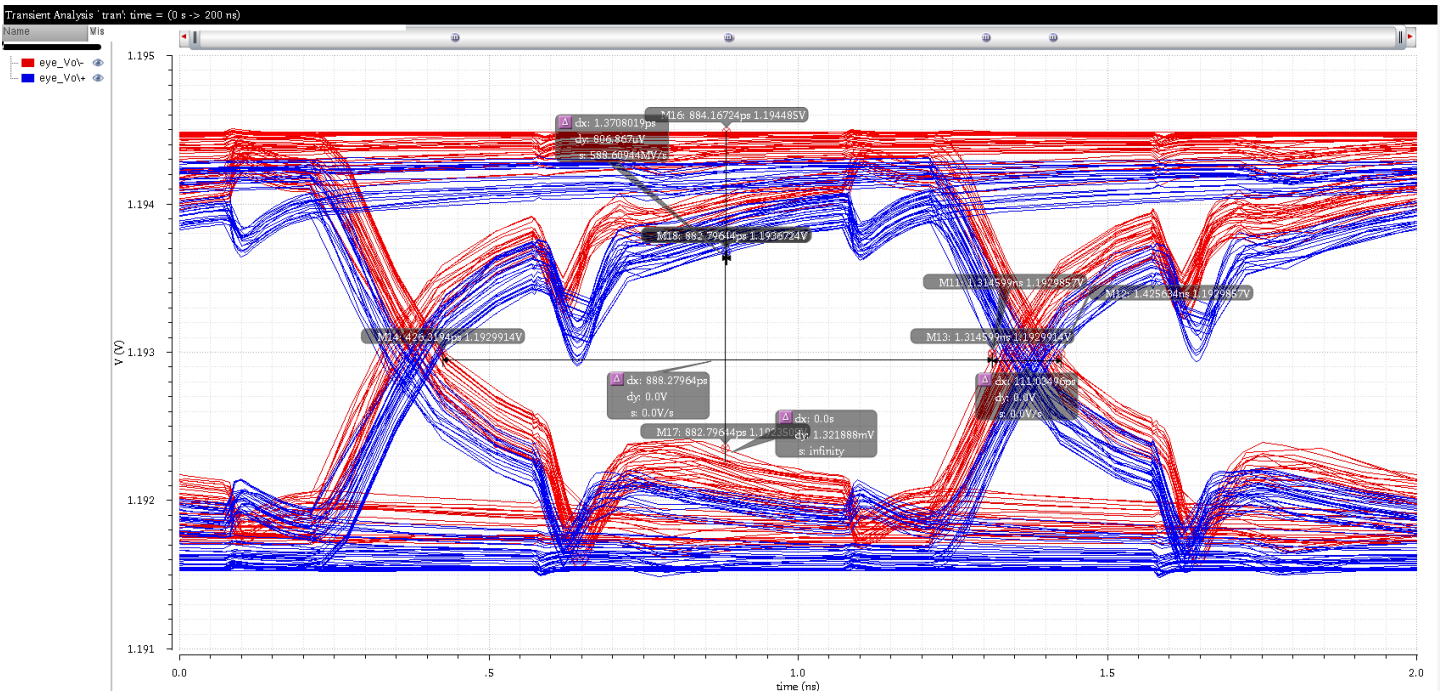


Figure 7. TLine without DFE 50cm

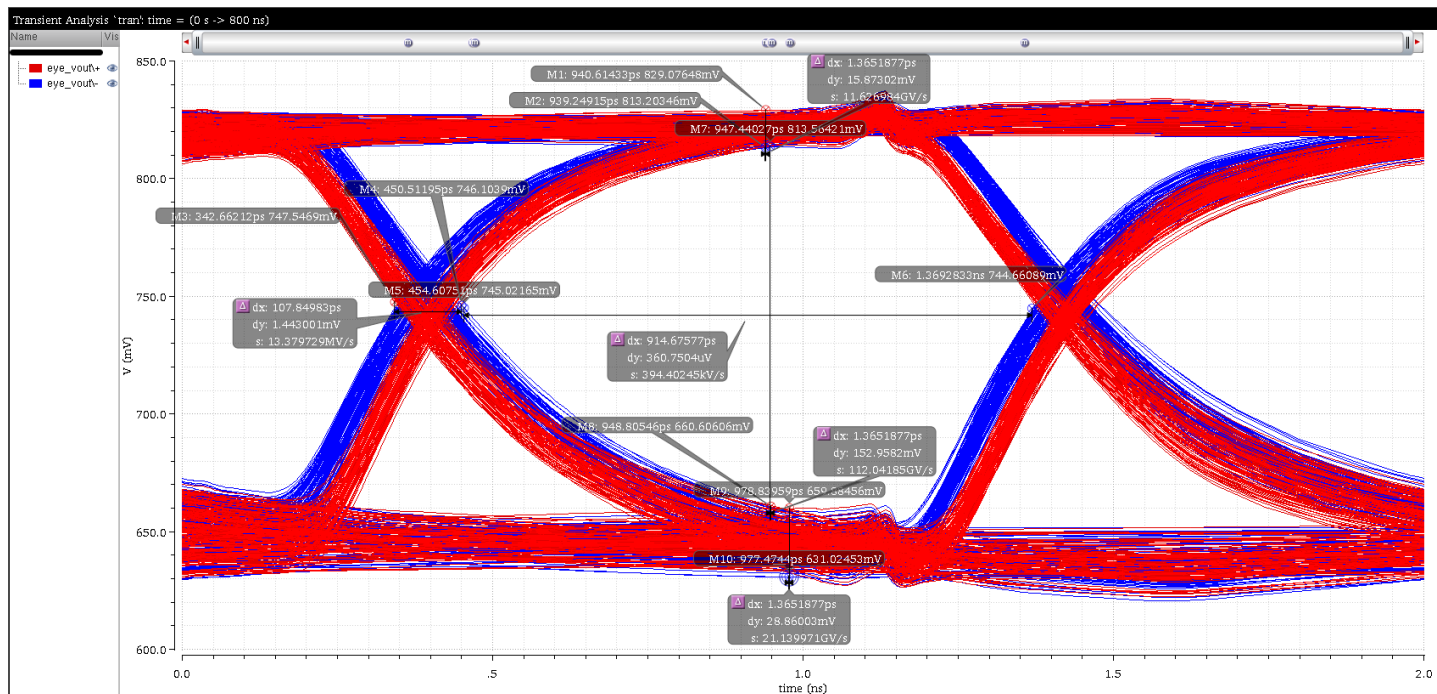


Figure 8. Tline with DFE 100cm

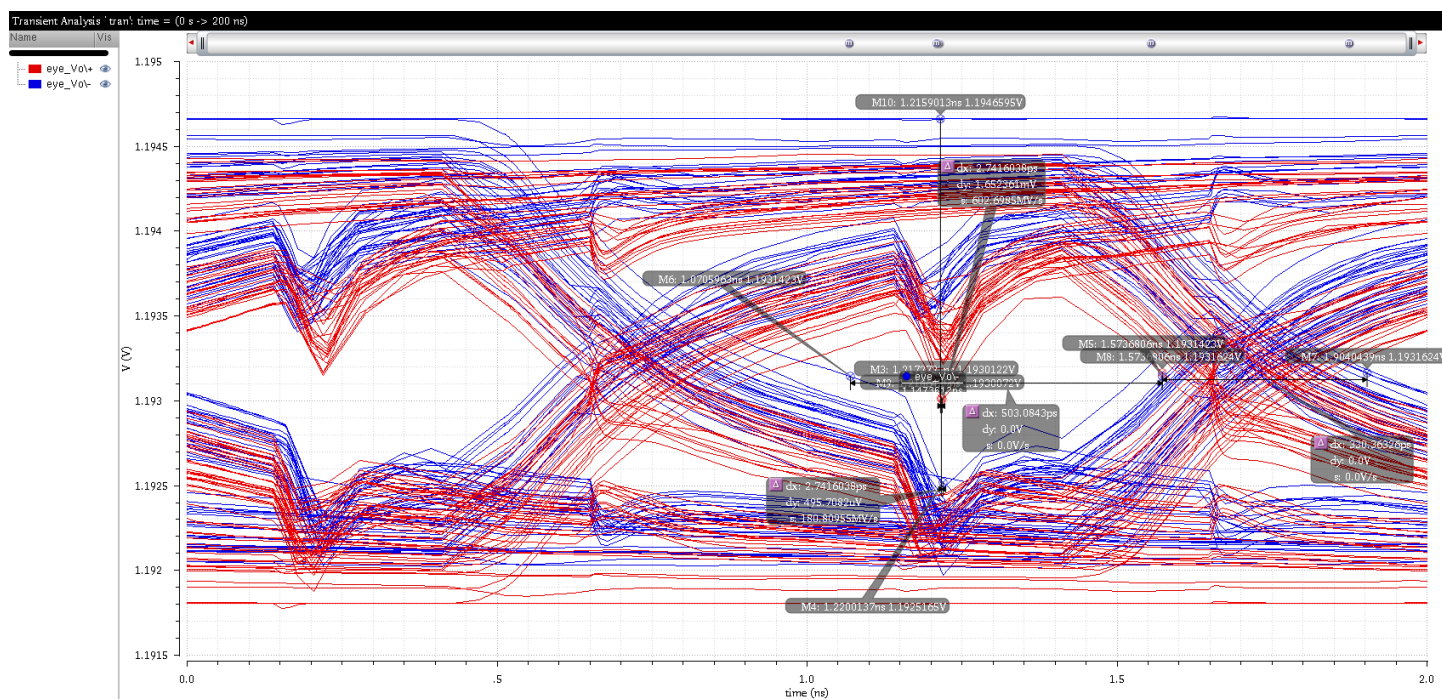


Figure 9. Tline without DFE 100cm

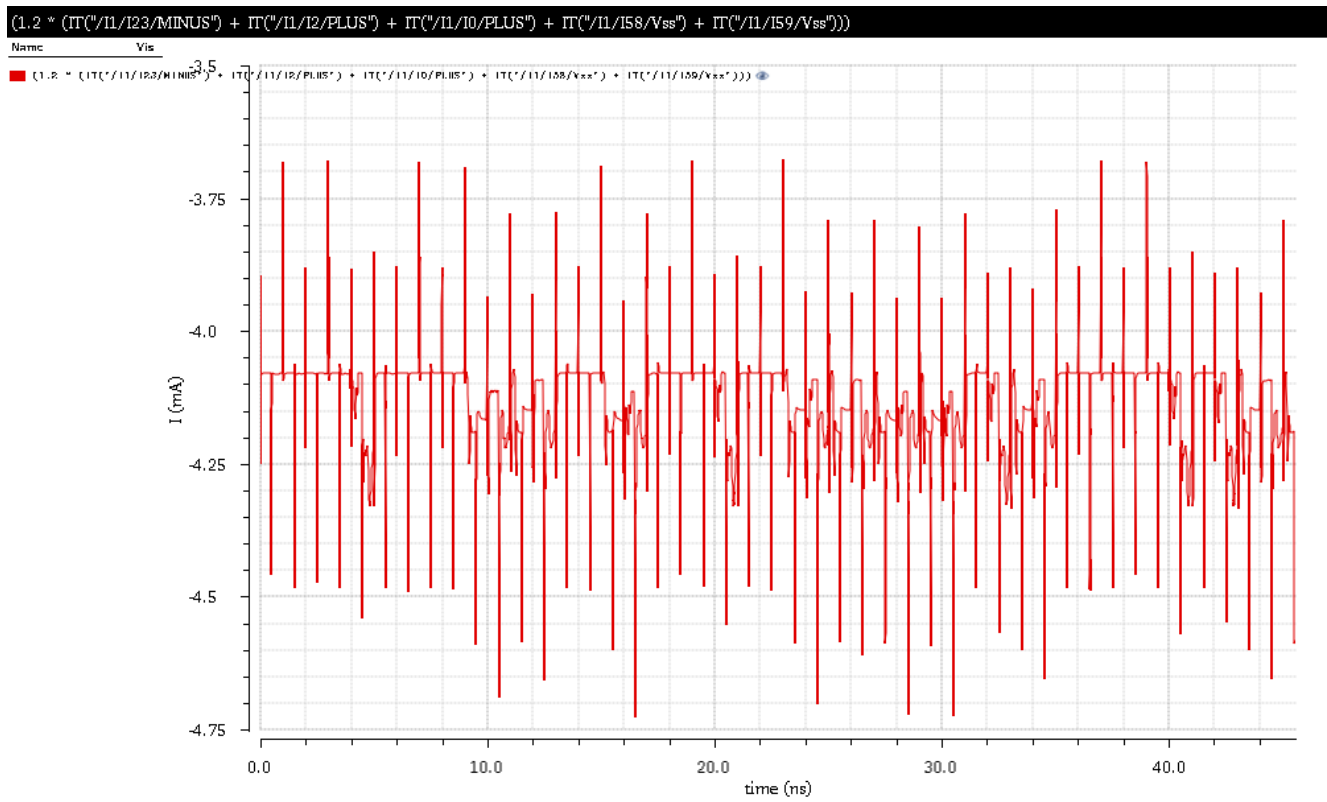


Figure 10. Pre-emphasis unit power consumption

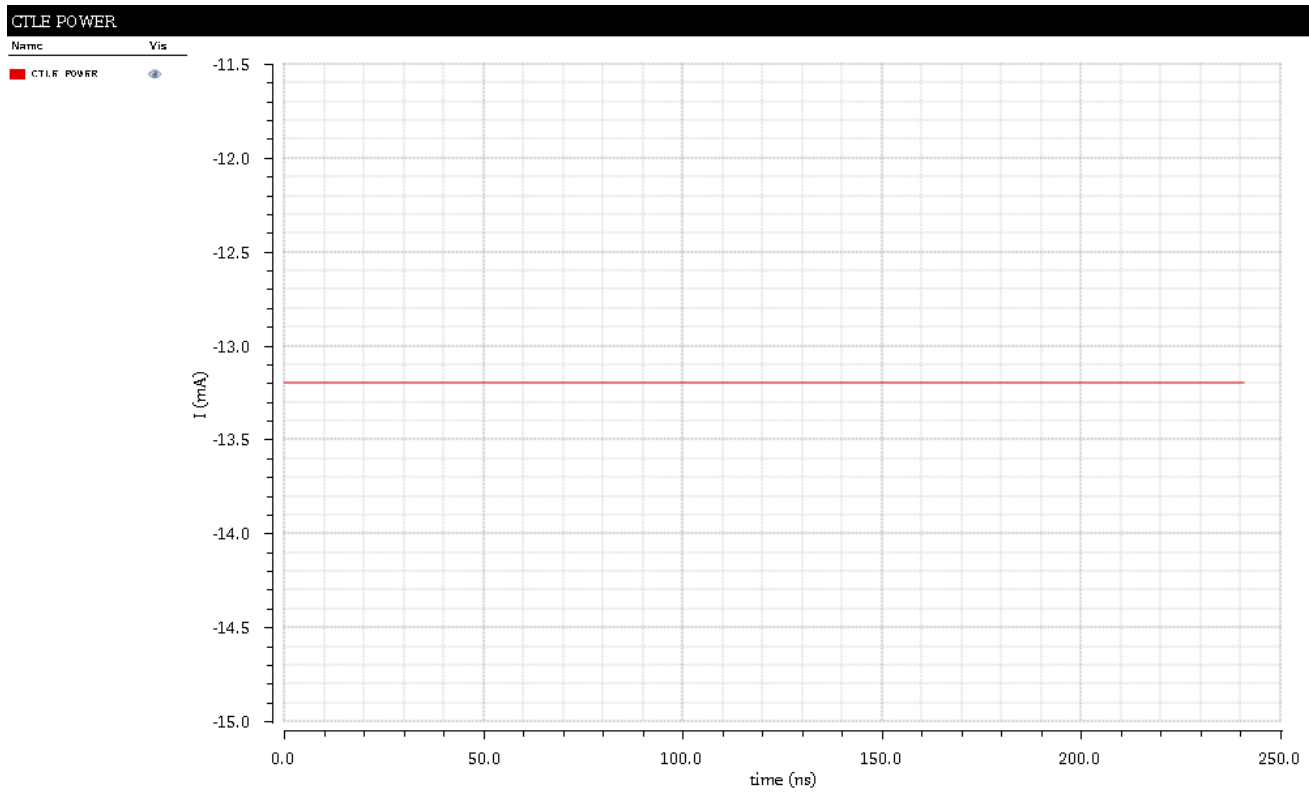


Figure 11. CTLE unit power consumption

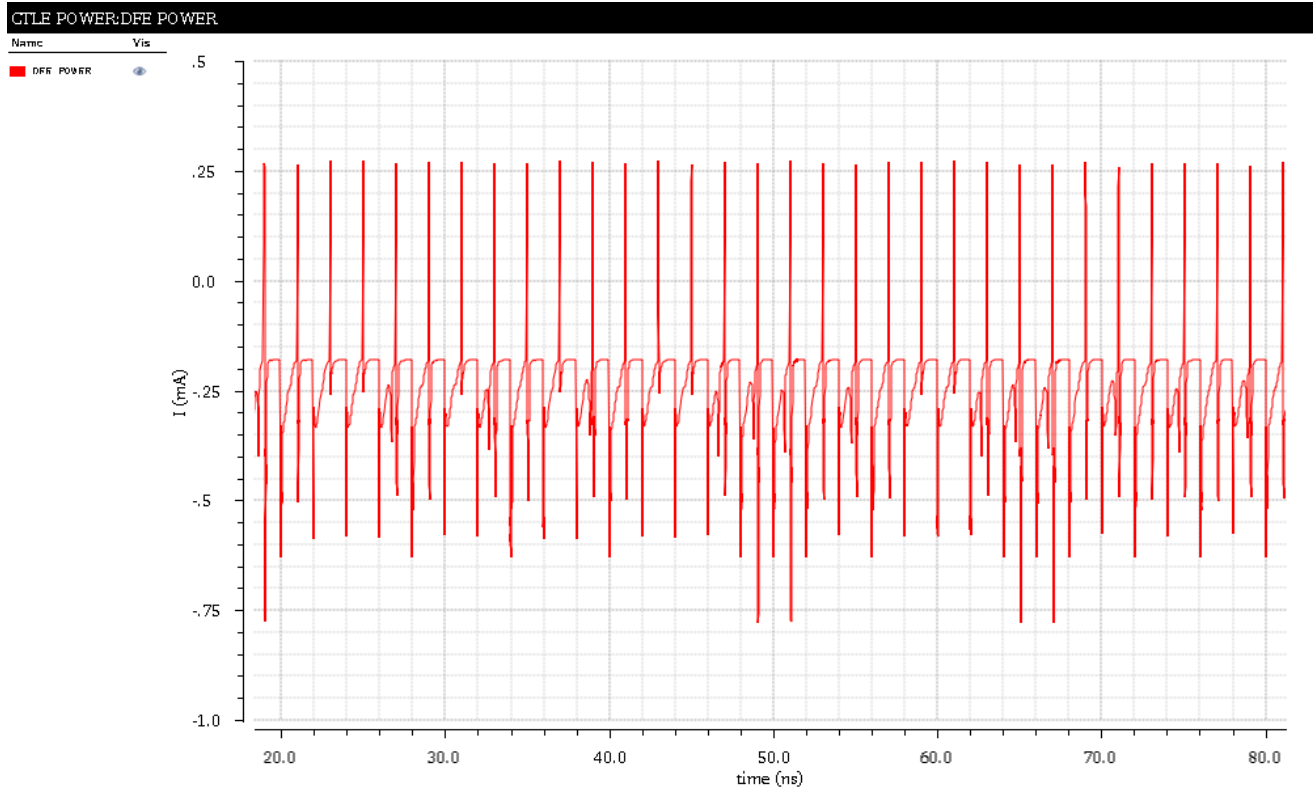


Figure 12. DFE unit power consumption

Table 4. Eye diagram properties for driver with pre-emphasis (Values from last lab)

Transmission line length	Eye opening (peak to peak height)	Eye opening (width between zero crossings)	Zero crossing variation (jitter)	Signal amplitude distortion	SNR at sampling point
10 cm	1.874mV	967.25ps	28.64ps	686uV	2.73
50 cm	1.321mV	888.27ps	111.03ps	806.86uV	1.63
100 cm	495.7uV	503.08ps	330.36ps	1.65mV	0.3

Table 5. Eye diagram properties for driver with pre-emphasis and DFE

Transmission line length	Eye opening (peak to peak height)	Eye opening (width between zero crossings)	Zero crossing variation (jitter)	Signal amplitude distortion (top and bottom)		SNR at sampling point
10 cm	187.59m	937.88m	54.6p	33.47m	81.38m	1.62
50 cm	183.33m	922.44m	80p	22.72m	51.51m	2.46
100 cm	152.95m	914.67m	107.849p	15.87m	28.86m	3.41

Conclusion

1. DFE taps are most effective if the current of the taps are lower than that of the CTLE. This is true for the driver and pre-emphasis taps also. Large currents can affect the output voltage too much and they only need to have minor adjustments to eliminate post cursors' effects. Some offsets were discovered due to mismatch in the currents.
2. The shape of the eye diagrams improves drastically from all previous iterations of the TLine tests. This shows that the DFE is at least able to fix some of the amplitude distortion problems at the sampling point. One key difference is that, as the length of the transmission line increases, the amplitude distortion now increases. At 10 cm the amplitude distortion at the bottom is much larger than at the top. Jitter also improves as the TLine length is larger resulting the larger eye opening. The asymmetric rising and falling edges shows that the pre-emphasis performance can improve.
3. Slicer operation works with very low input voltages and is able to create full swing output successfully. After the slicer, amplitude distortion is eliminated leaving only jitter errors.