

Addendum 1 to Report C1-1159:

Differential Signal Transmittance Capability of Multiple Gen-X LRM Connector as a Function of Data Rate and Delay/Distance Between Connectors

Purpose:

To explore the differential signal transmittance capability of multiple Gen-X LRM connectors (same as those studied in report C1-1159) via eye diagram simulation for multiple data rates (500 Mbps to 1 Gbps) and multiple electrical delays/distances (100 ps to 3000 ps) between connectors.

Simulation Set Up:

The basic SPICE model used was that shown in Figure 1. This represents two connectors (T15 and T16) connected by a lossless 50 ohm transmission lines (T17 and T18). Each connector is modeled as a differential pair of contacts, and has been driven differentially for the simulation. 1.5 Pf parasitic capacitances were included at the termination of each transmission line in and out of the connectors. See report C1-1159 for the methodology used to generate the eye pattern diagrams of this report.

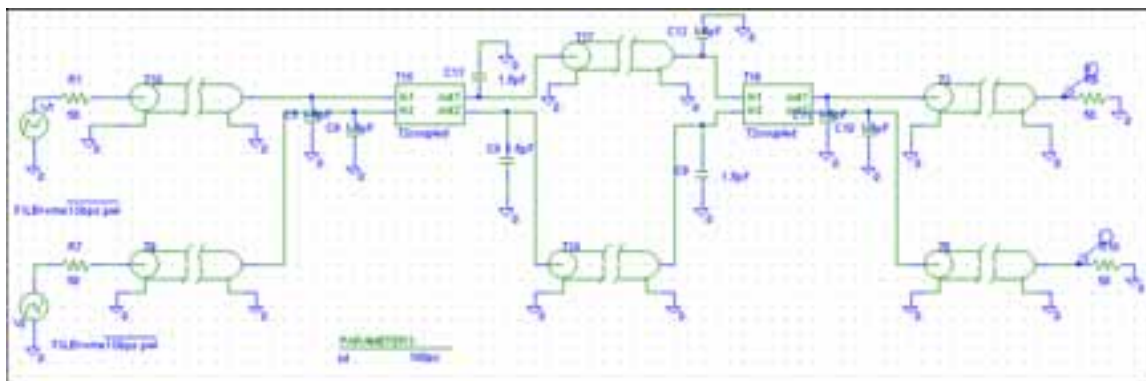


Figure 1. SPICE schematic used to produce eye diagrams. Note that “V1” and “V2” settings are adjusted for the various data rates used. The same applies to “Parameter” (This adjusts the delay between connectors). See Figure 19 for the schematics netlist of the SPICE model.

Results:

Figures 2-6 are of the eye pattern simulations at data rates ranging from 500 Mbps to 1 Gbps with a 100 ps delay between the connectors (approximately 0.8 inches).

Figures 7-11 are of the eye pattern simulations at data rates ranging from 500 Mbps to 1 Gbps with a 500 ps delay between the connectors (approximately 4 inches).

Figures 12-16 are of the eye pattern simulations at data rates ranging from 500 Mbps to 1 Gbps with a 1000 ps delay between the connectors (approximately 8 inches).

Figures 17 and 18 are of the eye pattern simulations at data rates of 500 Mbps and 1 Gbps with a 3000 ps delay between the connectors (approximately 24 inches).

Conclusions:

The simulation data indicated that both data rate and the amount of separation between connectors influenced the ability to pass high data rates through two connectors in an interconnect system.

As the distance between connectors was increased, the eye appeared to “close”. It has been postulated that this was due to the fact the longer lengths permitted the reflections of signals off the second connector to interact with new signals passing through the first connector, resulting in more variations in amplitude than with shorter lengths.

In a real interconnect system, the lossy nature of the transmission lines will negate some of this interaction between signals, but will also attenuate the higher frequency modes of the signals, resulting in eye closure.

Recommendations:

Distance between connectors should be minimized to maximize the data rate of the interconnect system.

The simulation data shown in Figures 9, 10, 11, and 12 of report C1-1159 have been superceded by the simulation results of this addendum report.

Verification testing needs to be performed to validate the results of these simulations. The test boards used for verification testing should include the routing of the differential impedance controlled traces through the dense contact pattern of the Gen-X connector in the backplane. This may require multiple backplane connectors in the test board to properly evaluate.

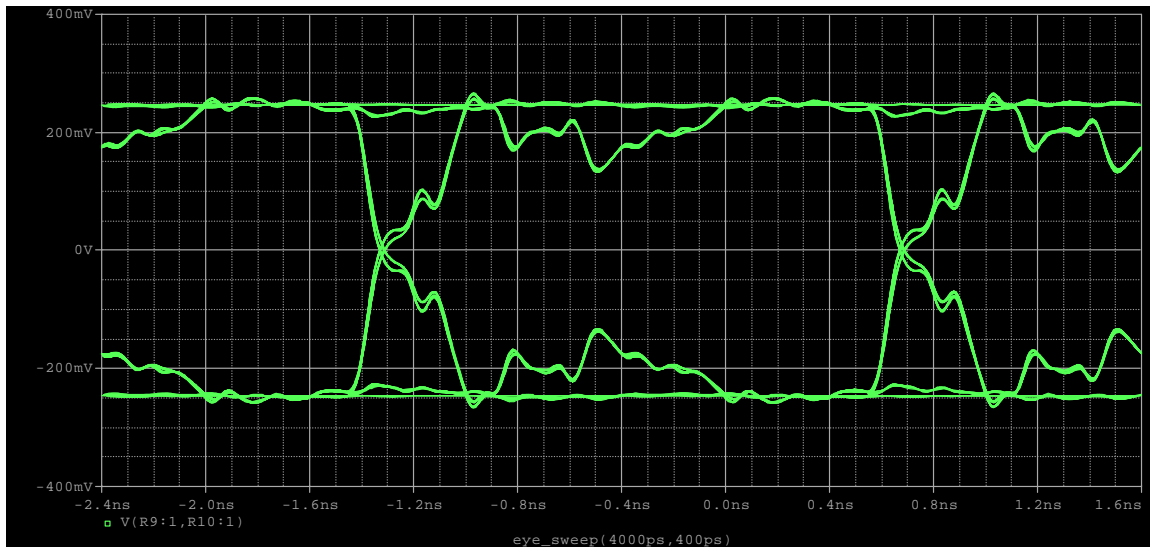


Figure 2. Simulated Eye Sweep at 500Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 100 ps between connectors.

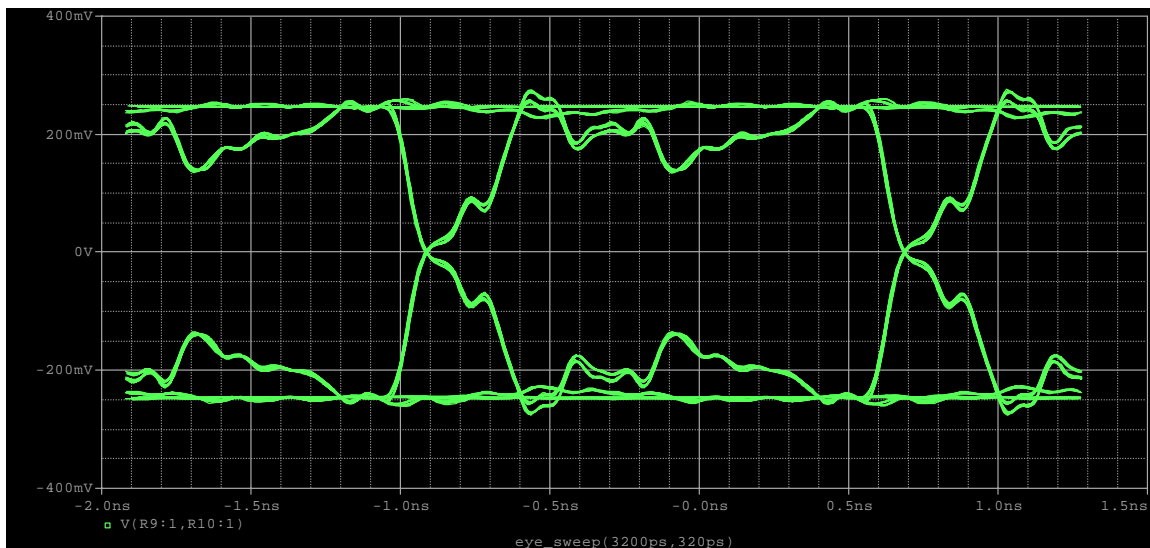


Figure 3. Simulated Eye Sweep at 625Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 100 ps between connectors.

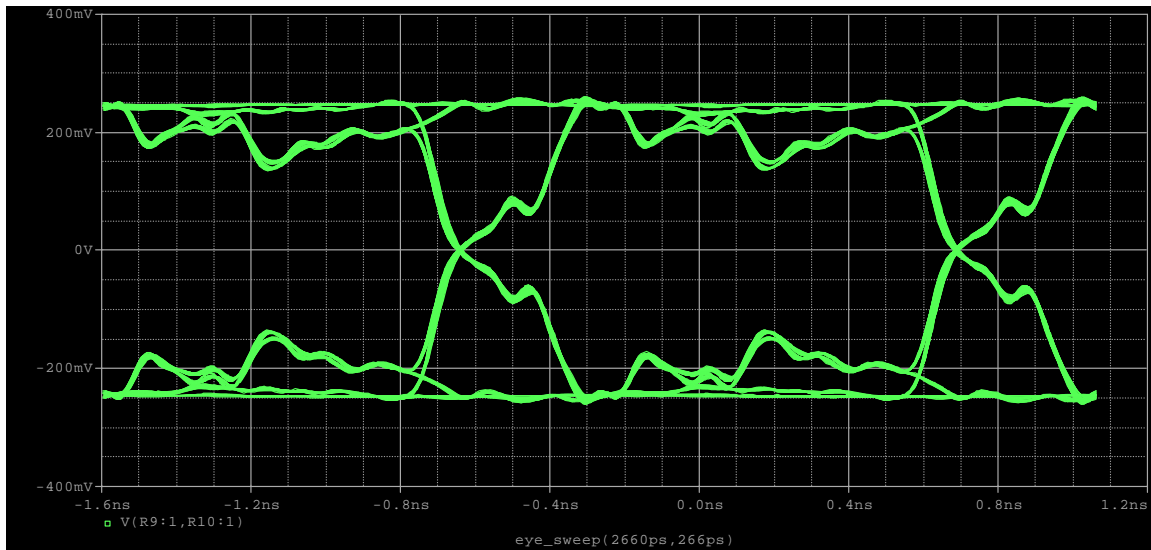


Figure 4. Simulated Eye Sweep at 750Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 100 ps between connectors.

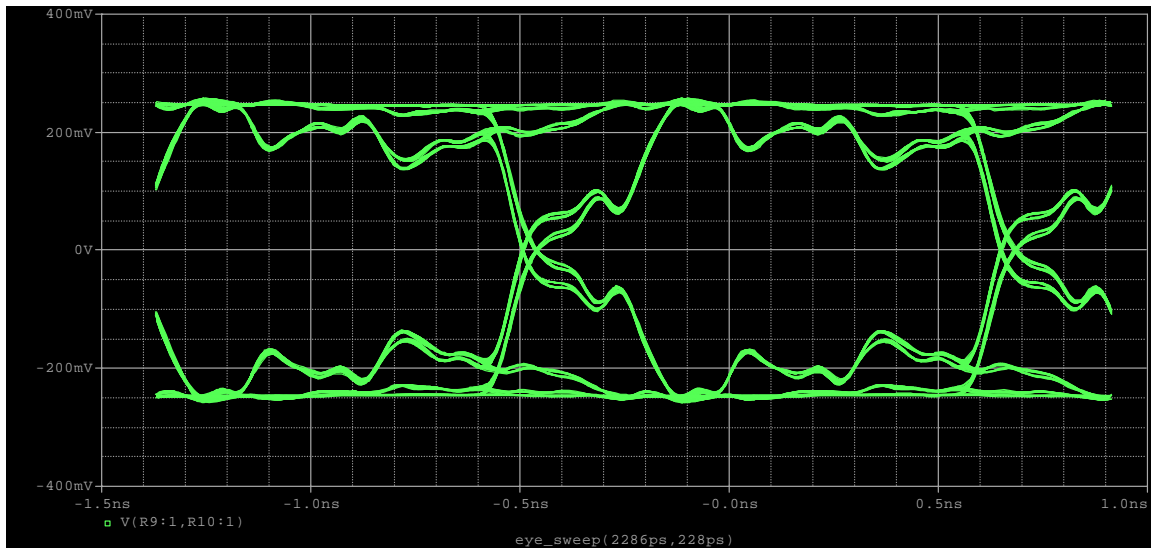


Figure 5. Simulated Eye Sweep at 875Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 100 ps between connectors.

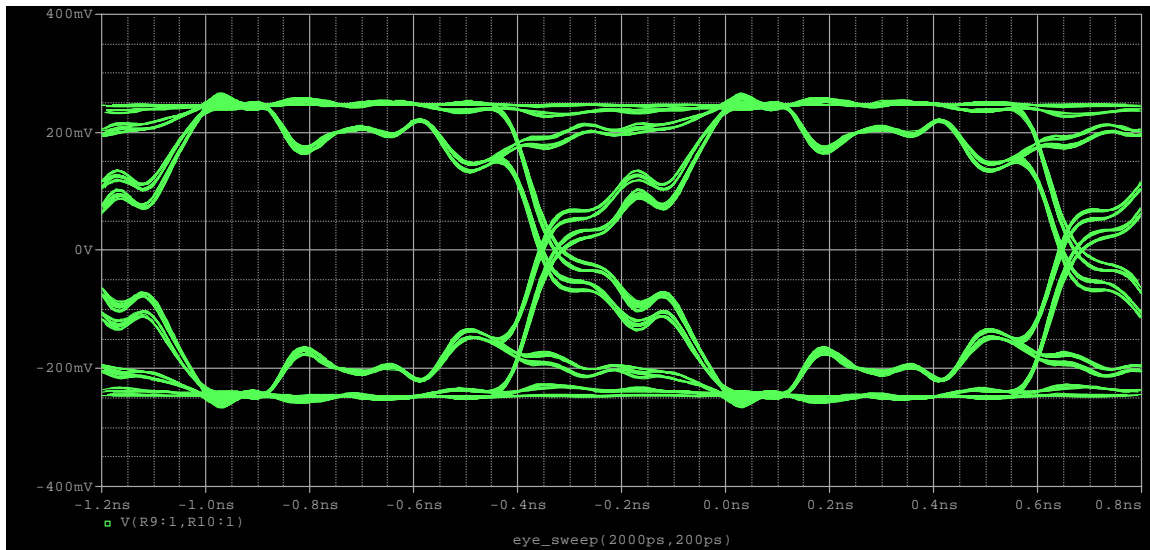


Figure 6. Simulated Eye Sweep at 1Gbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 100ps between connectors.

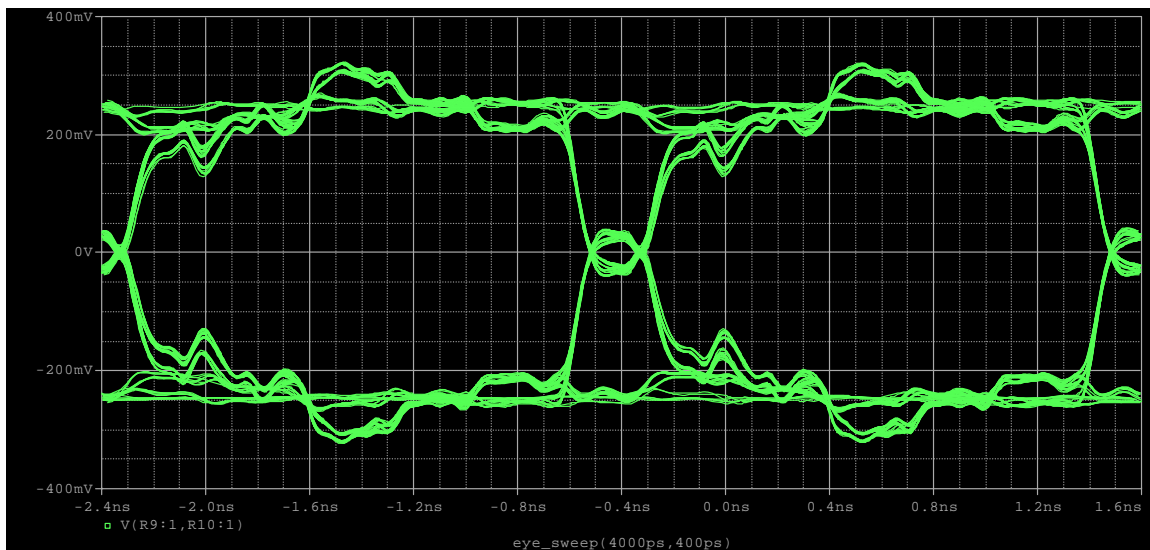


Figure 7. Simulated Eye Sweep at 500Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 500ps between connectors. (This represents approx 4 in. of traces between connectors.)

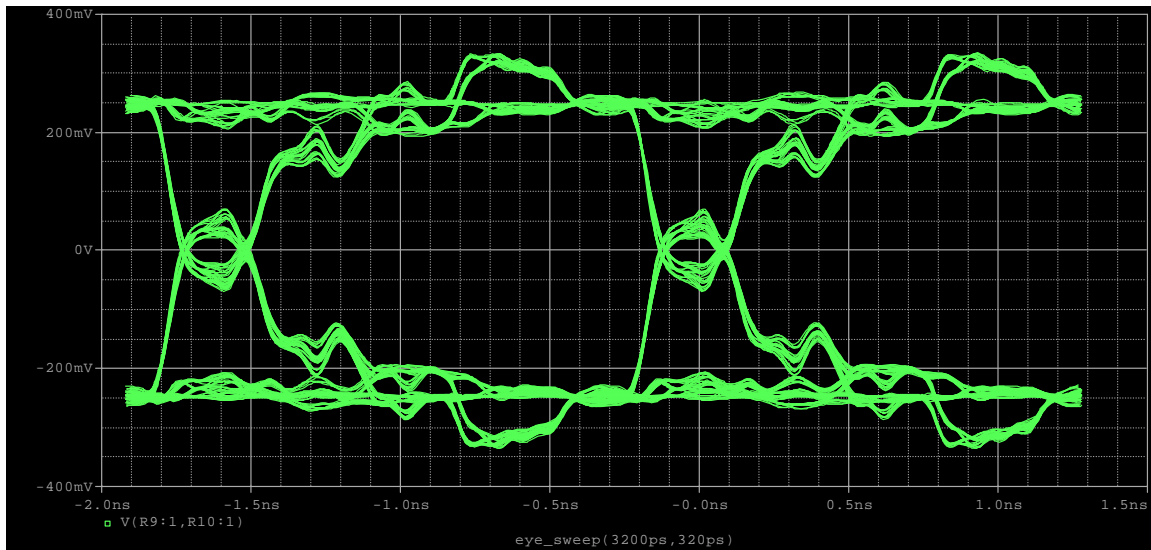


Figure 8. Simulated Eye Sweep at 625Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 500ps between connectors.

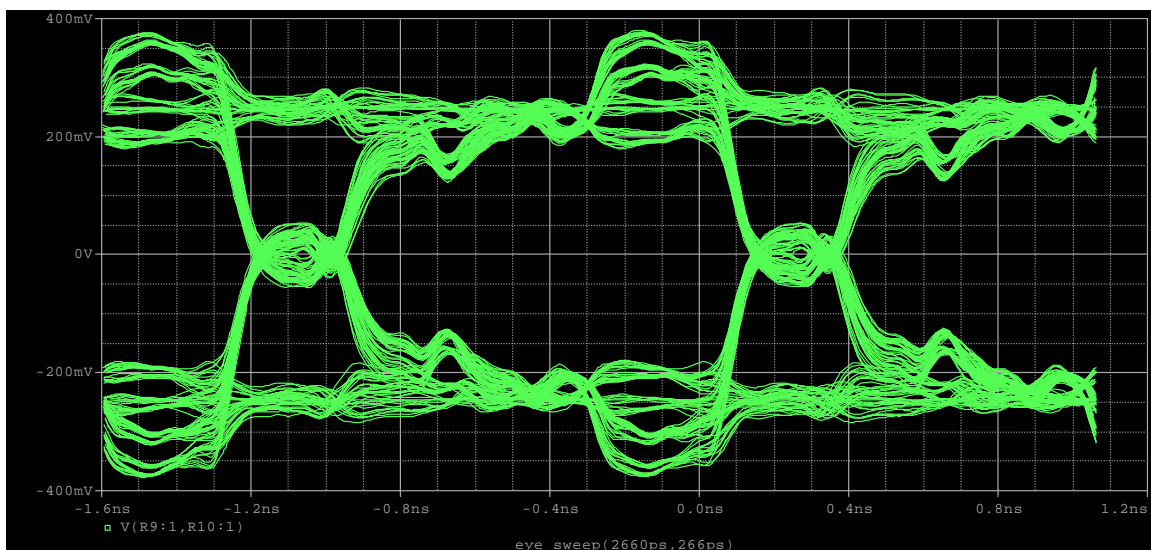


Figure 9. Simulated Eye Sweep at 750Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 500ps between connectors.

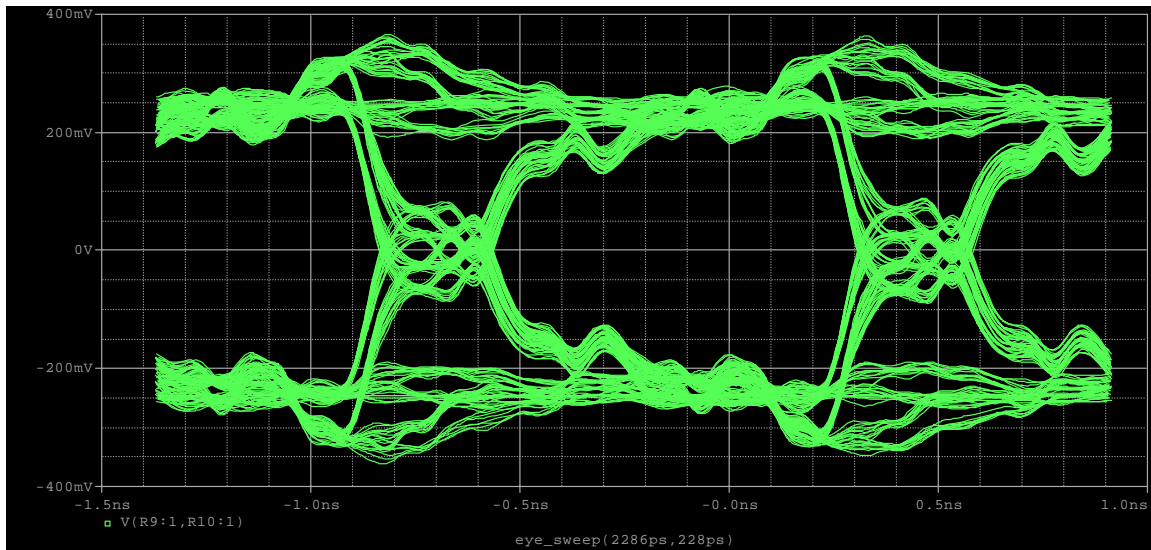


Figure 10. Simulated Eye Sweep at 875Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 500ps between connectors.

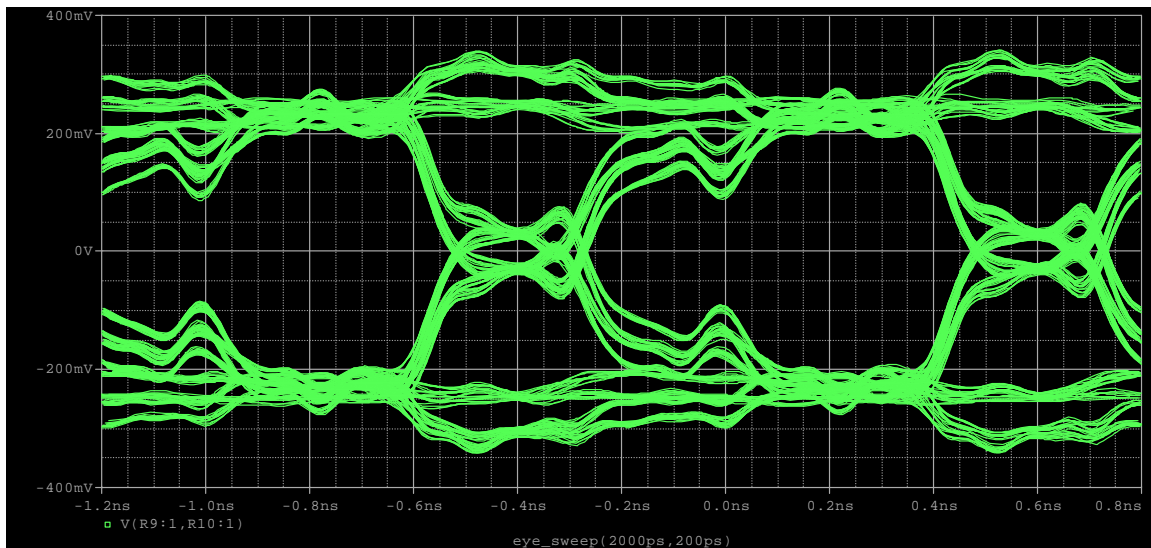


Figure 11. Simulated Eye Sweep at 1 Gbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 500ps between connectors.

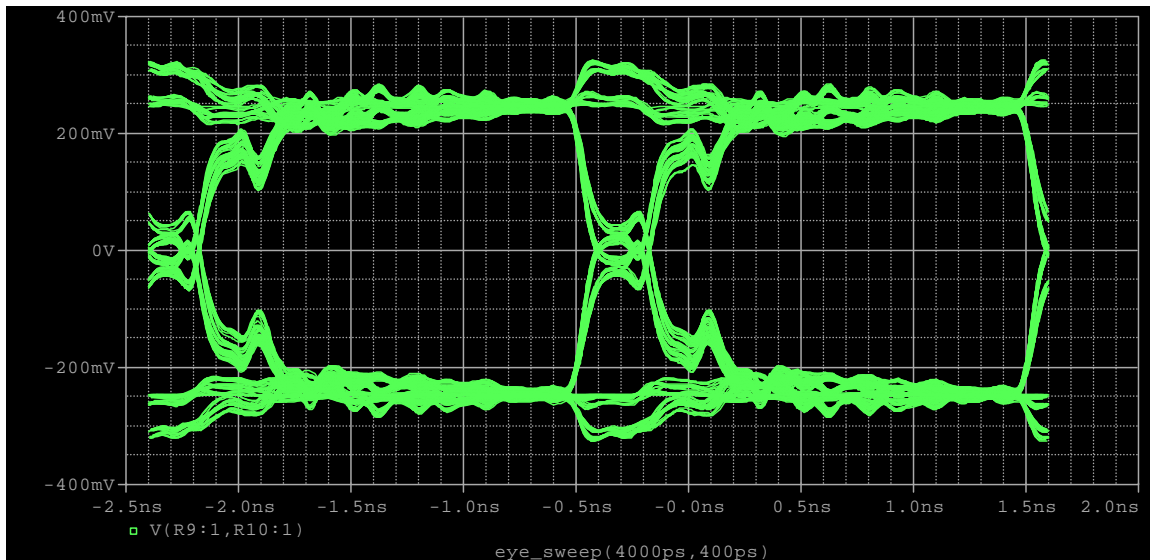


Figure 12. Simulated Eye Sweep at 500Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 1000ps between connectors. (This represents approx 8 in. of traces between connectors.)

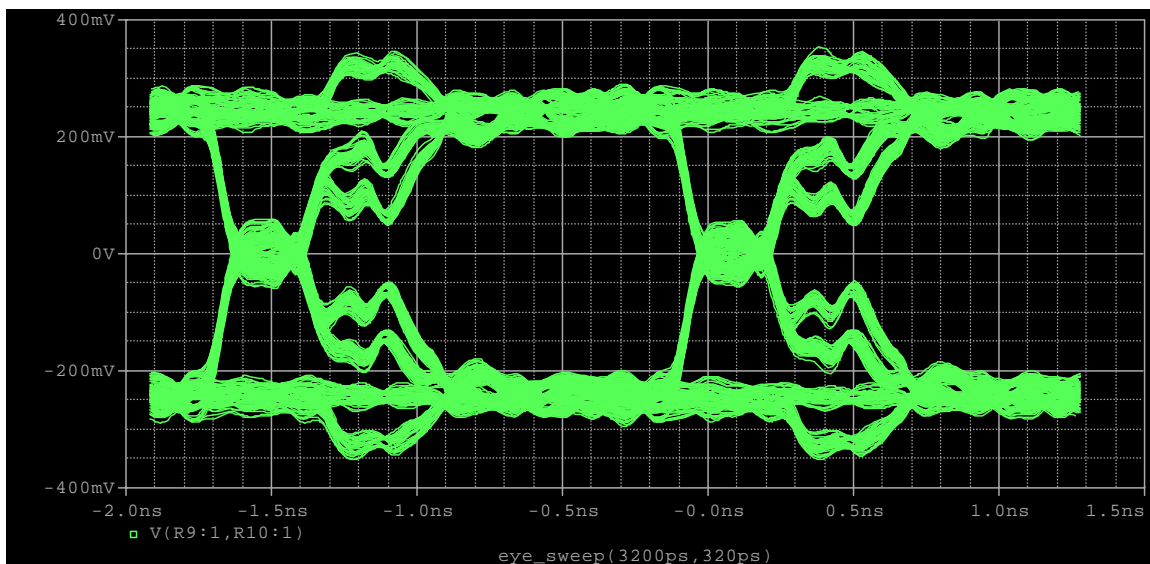


Figure 13. Simulated Eye Sweep at 625Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 1000ps between connectors. (This represents approx 8 in. of traces between connectors.)

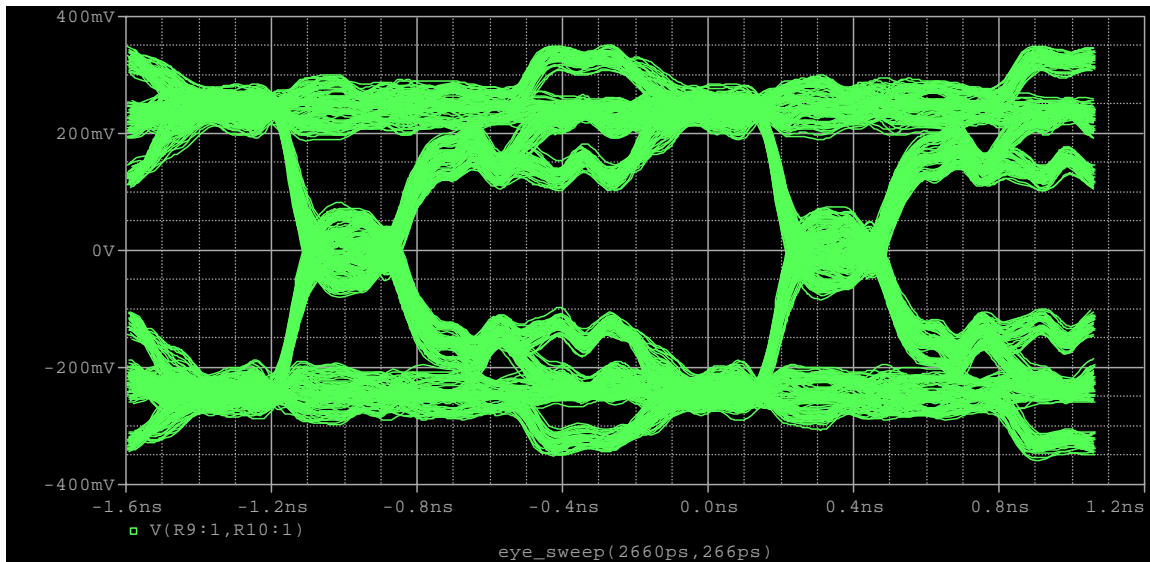


Figure 14. Simulated Eye Sweep at 750Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 1000ps between connectors. (This represents approx 8 in. of traces between connectors.)

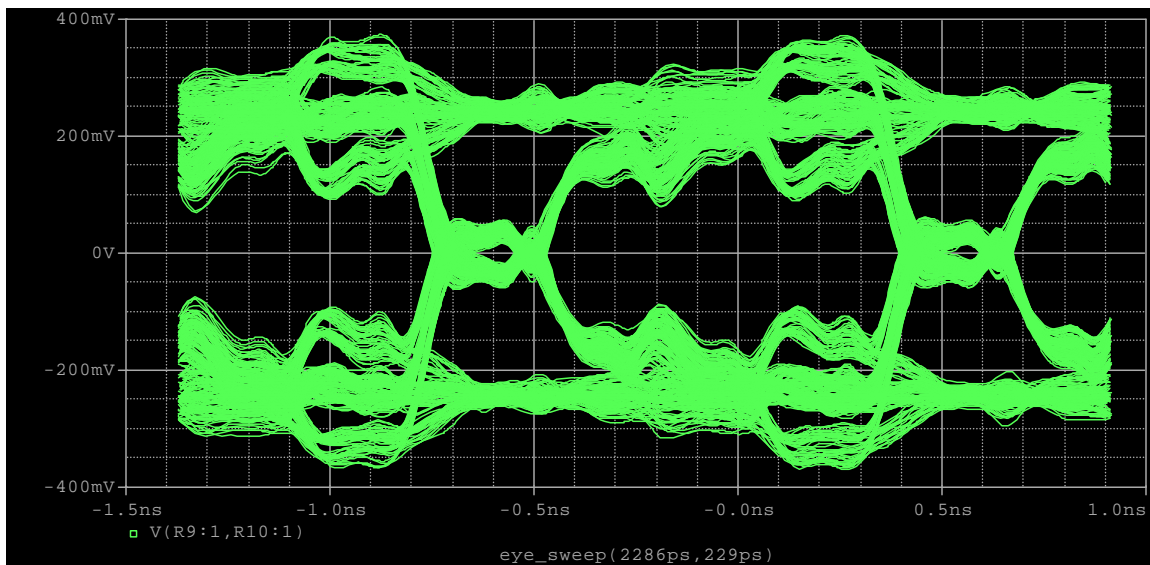


Figure 15. Simulated Eye Sweep at 875Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 1000ps between connectors. (This represents approx 8 in. of traces between connectors.)

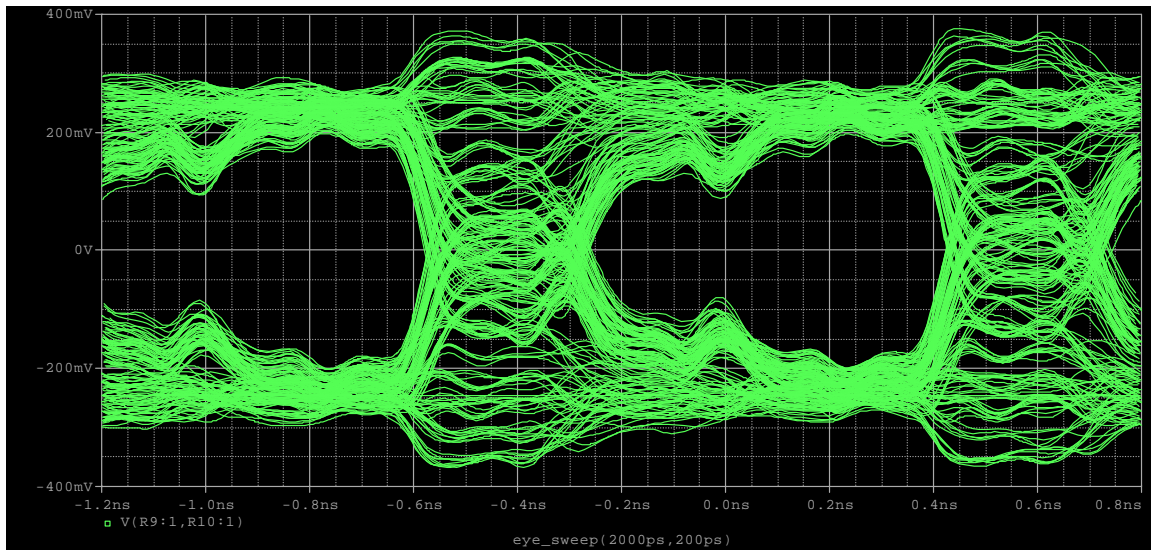


Figure 16. Simulated Eye Sweep at 1Gbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 1000ps between connectors. (This represents approx 8 in. of traces between connectors.)

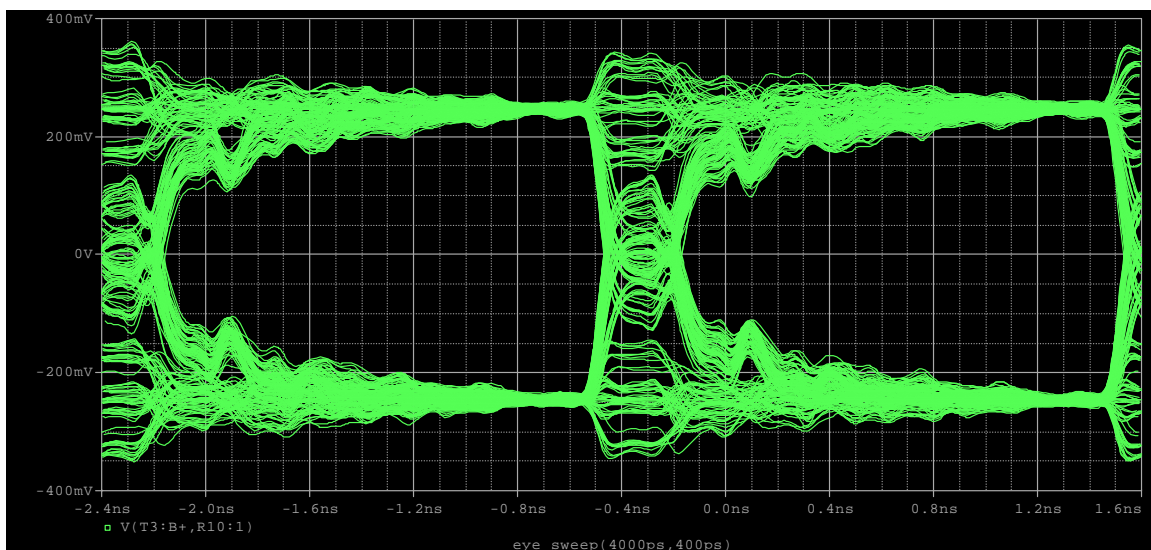


Figure 17. Simulated Eye Sweep at 500Mbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 3000ps between connectors.

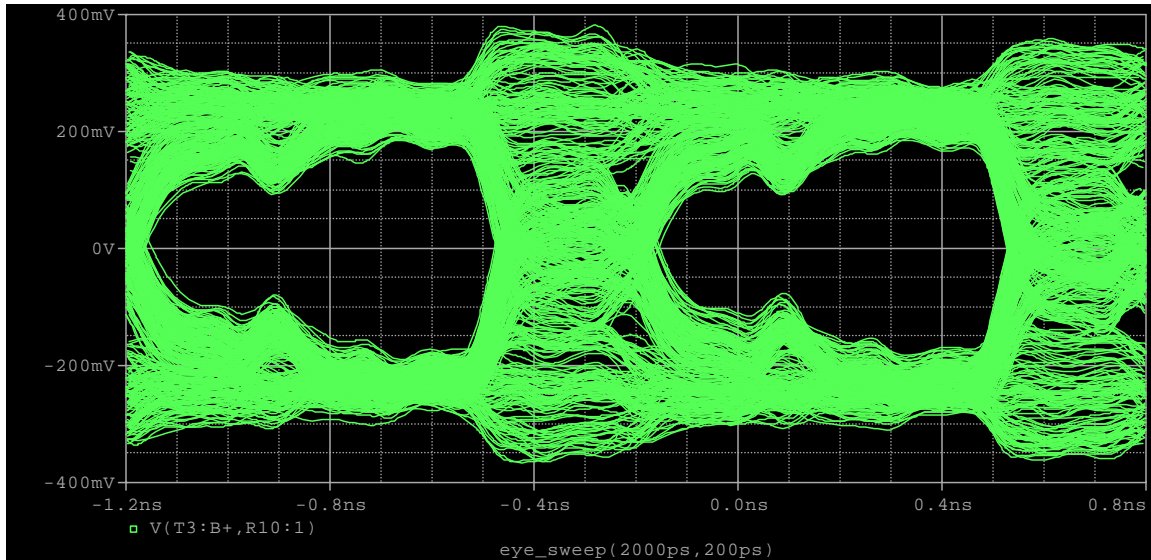


Figure 18. Simulated Eye Sweep at 1Gbps for 2 mated pairs of connectors, plus via capacitance (4 vias @ 1.5 pF each). Full differential. 3000ps between connectors.

Figure 19. Schematics Netlist for the SPICE schematic in Figure 1.

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                                genx2line_2.net
* Schematics Netlist *

C_C10      0 $N_0001  1.5pF
C_C11      0 $N_0002  1.5pF
C_C5       0 $N_0003  1.5pF
C_C6       0 $N_0004  1.5pF
C_C8       0 $N_0005  1.5pF
X_T16      $N_0007 $N_0006 $N_0002 $N_0001 T2coupled
+ PARAMS: R=0 L=2.88e-9 G=0 C=4.086e-12 LM=1.015e-9 CM=1.43e-12 LEN=1
C_C9       0 $N_0006  1.5pF
C_C12      $N_0007 0  1.5pF
X_T15      $N_0003 $N_0004 $N_0008 $N_0005 T2coupled
+ PARAMS: R=0 L=2.88e-9 G=0 C=4.086e-12 LM=1.015e-9 CM=1.43e-12 LEN=1
C_C13      $N_0008 0  1.5pF
T_T18      $N_0005 0 $N_0006 0 ZO=50 TD={td}
T_T3       $N_0002 0 $N_0009 0 ZO=50 TD={td}
T_T6       $N_0001 0 $N_0010 0 ZO=50 TD={td}
R_R9       $N_0009 0 50
R_R10      $N_0010 0 50
T_T9       $N_0011 0 $N_0004 0 ZO=50 TD=100ps
R_R7       $N_0012 $N_0011 50
T_T10      $N_0013 0 $N_0003 0 ZO=50 TD=100ps
R_R1       $N_0014 $N_0013 50
T_T17      $N_0008 0 $N_0007 0 ZO=50 TD={td}
V_V1       $N_0014 0 DC 0 AC 0 PWL TIME_SCALE_FACTOR=1.143e-9
+ VALUE_SCALE_FACTOR=0.247
+ REPEAT FOR 1
+ FILE "vme\875Mbps.pw1"
+ ENDREPEAT
V_V2       0 $N_0012 DC 0 AC 0 PWL TIME_SCALE_FACTOR=1.143e-9
+ VALUE_SCALE_FACTOR=0.247
+ REPEAT FOR 1
+ FILE "vme\875Mbps.pw1"
+ ENDREPEAT

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