



## Using RJ45 Category 7 Cabling for 2 Lane, 1 and 2.5Gbps Serial Data Transmission

Test 8561 (Category 7, 2 lane)  
J Sawdy, Sr. SI Engineer  
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### Forward

The RJ45 connector is found in enterprise installations by the millions. This report takes a look at applying the RJ45 connector to short reach cables in today's digital environment.

### Purpose

Determine the performance of Siemon's shielded RJ45 (MC6AS) connectors for serial data applications when used in combination with Category 7 cable.

### Samples Tested and Simulated

MC6AS to MC6AS cable assembly, with various lengths of 26awg cable, wired with 2 lanes (4 pairs) using Category 7, 26awg stranded, S/FTP cable.

### Conclusions

Using a maximum jitter of 0.25UI as the limiting criteria, the MC6AS connector is suitable for serial data rates of 1Gbps per lane and below for cable lengths up to 6 meters. At 2.5Gbps per lane, the connector/cable combination is suitable for cable lengths of 1 meter and less.

Data rates above 2.5Gbps per lane are not suitable for this connector when all pairs are wired. If only 2 pairs are wired, crosstalk is significantly decreased and higher data rates can be achieved. This configuration would be wired GSSGGSSG at the connector, where G = ground and S = signal.

If cable equalization is included, the reach at 1Gbps per lane can be increased to 11 meters. See Figure 1a.

Rate (Gbps)	1	2.5	3.125
Length (meters)*	6.6	1	1
Jitter (%UI)	24	27	41
See Figure	1	2	3

\*based on 26awg cable

Red exceeds 0.25UI jitter criteria

All simulations are without equalization

Table 1) Two lane (4 pairs), all pairs wired

## Eye Diagram Simulations

Using a minimum eye height of 200mv and a maximum jitter of 0.25UI as the limiting criteria, these tables show the maximum length that can be used and the resulting eye parameters. These limits are based on the eye requirements of the InfiniBand SDR (2.5Gbps) specifications. All eyes are shown at a BER of  $10^{-12}$ . Cable equalization was only used in Figure1a.

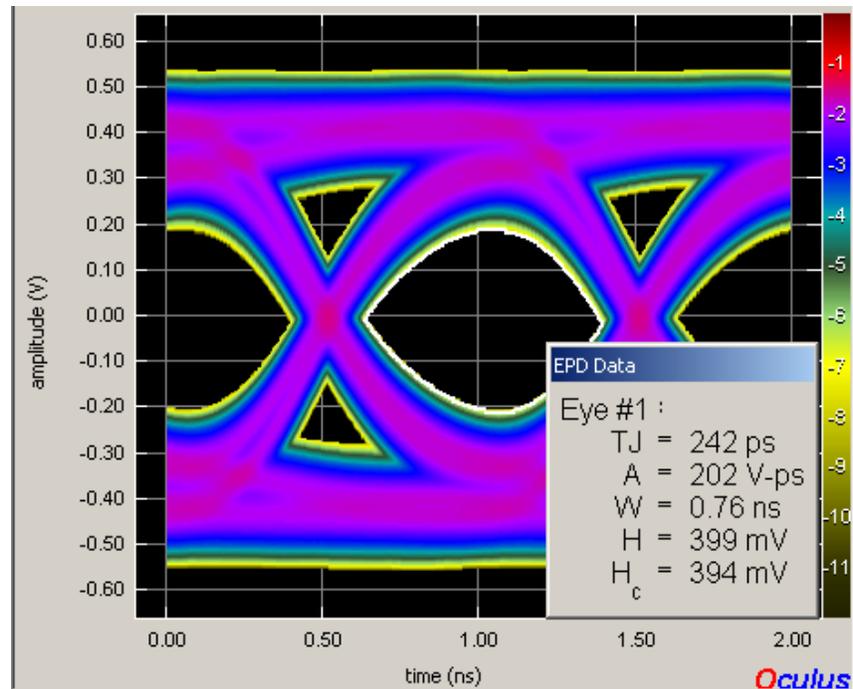


Figure 1) Simulation of a 6.6 meter cable at 1Gbps per lane; total jitter = 242ps (.24UI) and eye height = 394mv

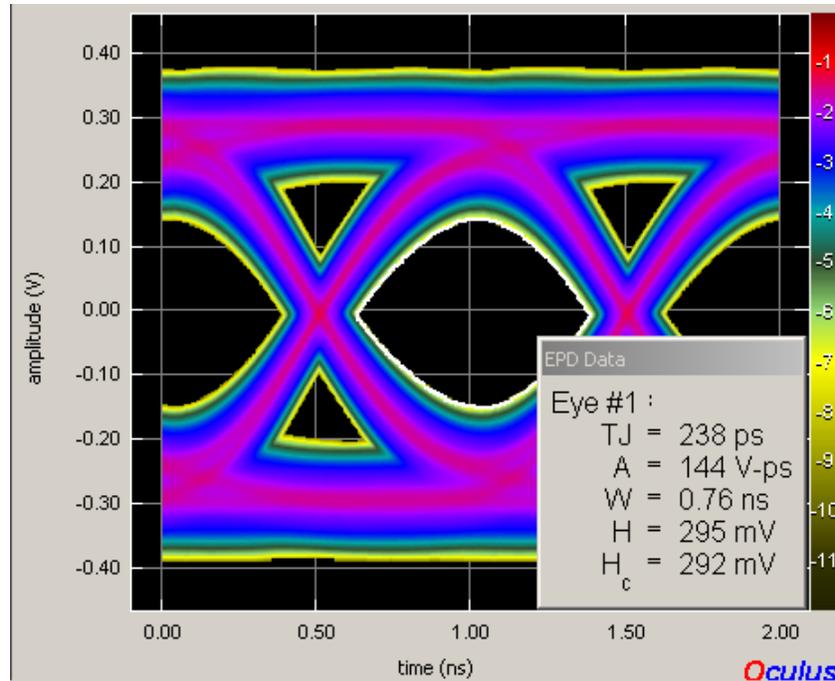


Figure 1a) Simulation of an equalized 11 meter cable at 1Gbps per lane; total jitter = 238ps (.24UI) and eye height = 292mv

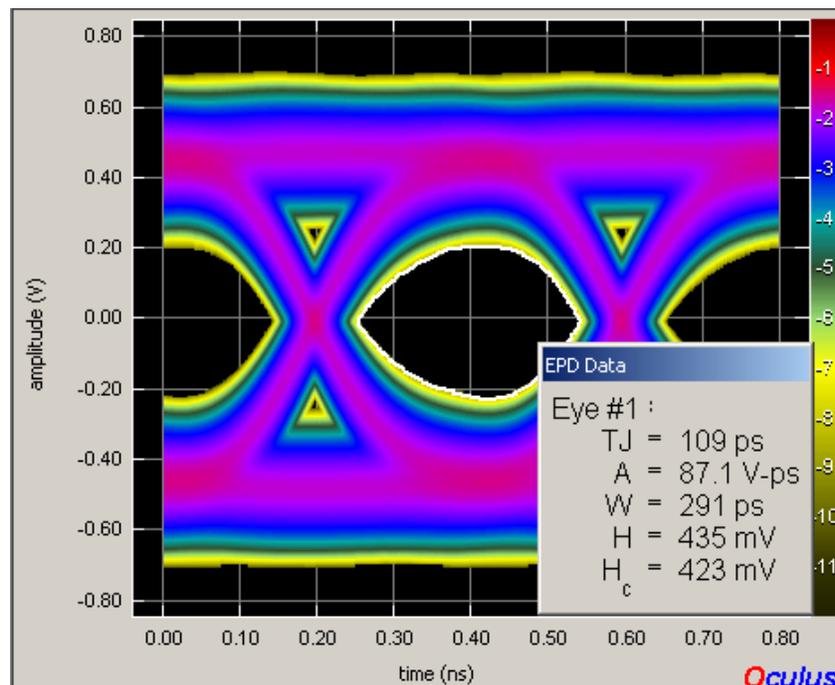


Figure 2) Simulation of a 1 meter cable at 2.5Gbps per lane; total jitter = 109ps (.27UI) and eye height = 423mv

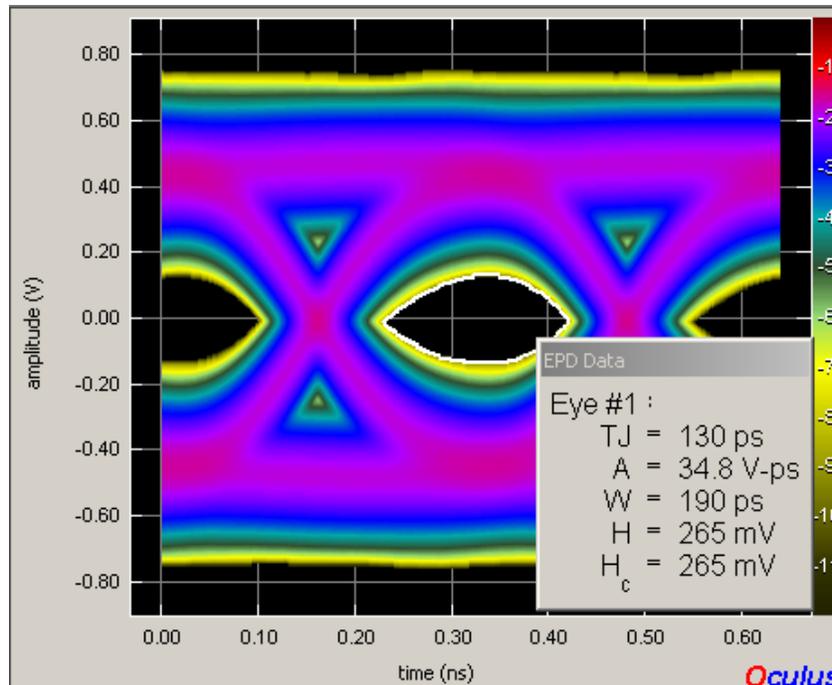


Figure 3) Simulation of a 1 meter cable at 3.125Gbps per lane; total jitter = 130ps (.41UI) and eye height = 265mv

### Test Equipment

Tektronix DSA8200 sampling oscilloscope with two 80E04 TDR sampling modules  
 atSpeed's Oculus software for s-parameter extractions and eye diagram simulations  
 Siemon RJ45 SMA test boards, with semi-rigid traces and RJ45 receptacles

### Testing Notes

The insertion loss and crosstalk, both near-end and far-end, were measured. Lengths of cable were added in the simulations to determine maximum lengths meeting the performance criteria.

The attenuation measurements include the loss in the test board traces. Slightly better performance could be shown if the test boards were de-embedded.

In order to improve crosstalk, the MC6AS connectors were wired so that they do not have any split pairs; the pairs are pins 1&2, 3&4, 5&6 and 7&8.

MC6AS pin layout: (12) (34) (56) (78) "(XX)" indicate the pairs

Because this is a 4 pair connector, two pairs were chosen as transmit pairs and two pairs were chosen as receive pairs.

The following simulations were set up so that one of the pairs in the middle of the connector was used as the quiet pair (pair 34 or 56). The end pairs (12 and 78) will see less crosstalk degradation because their near end aggressors are further away.

The simulations include crosstalk from 2 near end aggressors (Tx3 and Tx4) and 1 far end aggressor (Tx1). The aggressors are shown in red. The victim or quiet line is shown in blue.



In the eye diagram simulations, the signal source and the aggressors are 1 volt peak-peak, bit pattern of 2<sup>10</sup>-1 PRBS, with 25% risetime when measured at 20-80%. Standard data rates of 1, 2.5 and 3.25Gbps per lane were used for illustration purposes. Other data rates and cable lengths may be suitable depending on the performance required.

*This report is valid only for the samples tested.*

*Because we continuously improve our products, Siemon reserves the right to change specifications and availability without prior notice.*

*For further information, please contact the author at: [John\\_Sawdy@Siemon.com](mailto:John_Sawdy@Siemon.com)*