X3T9.2/90-65

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Subject: Backward (NEXT) single ended crosstalk testing of 20.5 foot cables and relationship to performance in an operating SCSI system.

I would like to discuss some of the relevant characteristics of near end crosstalk (NEXT) and crosstalk testing that not all members may be aware of. Figures 1 and 2 show a simplified test setup for measuring NEXT. An oscilloscope is connected to point A preferably using a high impedance probe such as the Tektronixs P6201 DC to 900 MHz FET active probe. The pulse generator is then adjusted to produce a 5v, 20ns wide (typical) pulse. The rise time of the pulse being a variable item. Figure 3 shows the input pulse at point A with an adjusted rise time of 2ns. The probe is then moved to point B (quiet line) which shows the amplitude of NEXT crosstalk. In this example the input is 5v and figures 4 and 4A shows the B output is 250mv or converted to percent 5% .

SINGLE ENDED FLAT CABLE

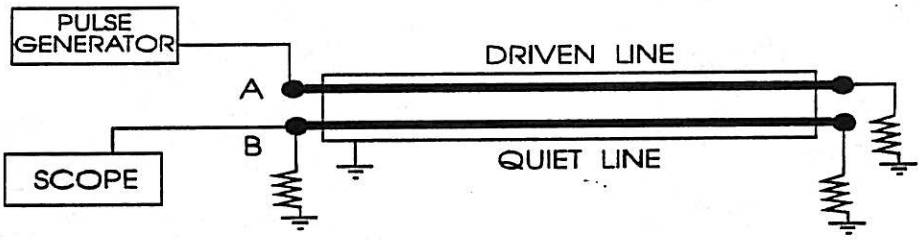


fIGURE 1

TWISTED PAIR CABLE

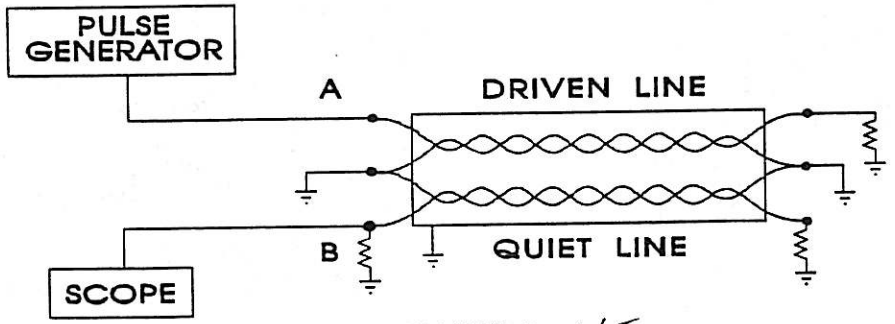


FIGURE 2 4E

Note that NEXT is simply a duplicate of the input signal only at a reduced signal level. What is interesting is that if I shorten the cable from 20 ft. to 10 ft. it has no affect on the level of NEXT. Figures 5, 6 and 6A show the results. The NEXT is still 250mv or 5%. Therefore for SCSI purposes NEXT is independent of cable length. The signal bump to the right of the 5v input signal on figures 3, 5 and 7 is a reflection caused by a mismatch at the far end of the cable. In this case the 133 ohm termination is used by Madison on cables with an impedance lower than 133 ohms. This demonstrates a simple and accurate way to determine the impedance of a cable. Simply adjust a resistor at the end of the cable until there is neither a positive or negative reflection then measure the resistor with an ohmeter. This will then be the impedance of the cable.

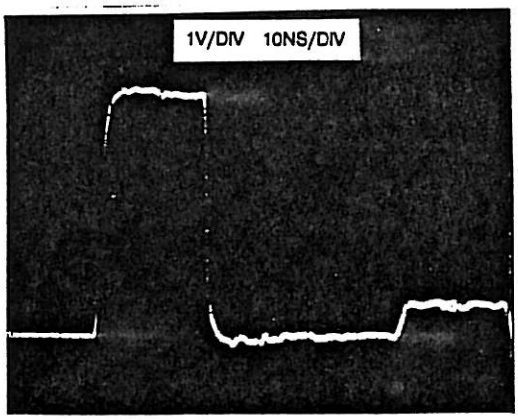


Fig. 3 Driven line 5v, 2ns rise time
20 ft. cable length.

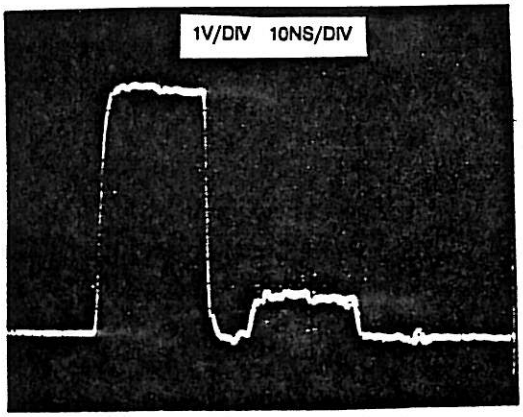


Fig. 5 Driven line 5v, 2ns rise time
10 ft. cable length

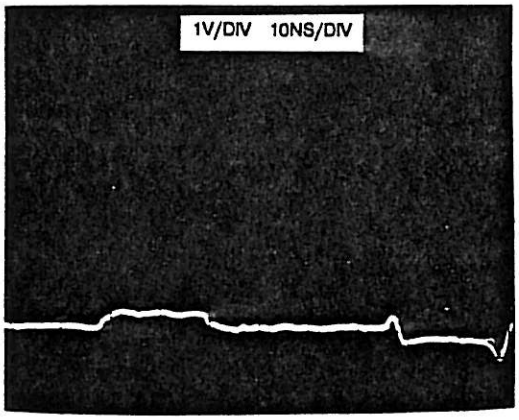


Fig. 4 Quiet line

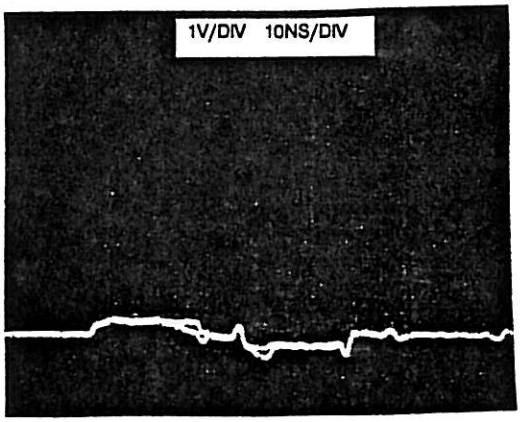
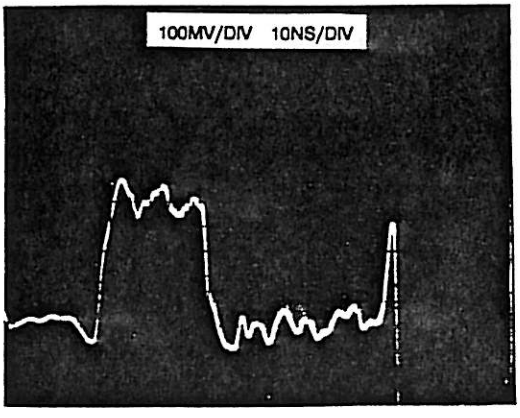


Fig. 6 Quiet line



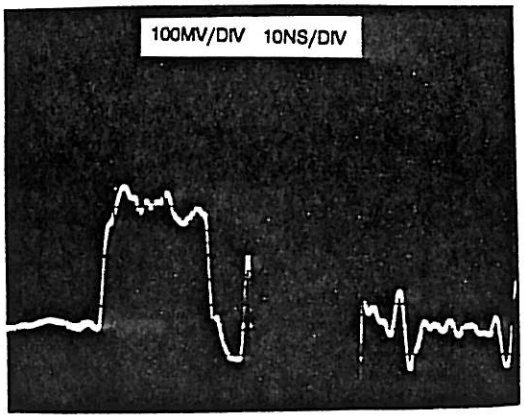


Fig. 6A Quiet line 10X

Figures 7, 8 and 8A show the result of varying the rise time from 2ns to 10ns. The NEXT value remains 250mv or 5% although with this slower rise time it is eaisier to determine NEXT because of abscence of ringing and multiple reflections. It is clear then that for SCSI purposes NEXT is indepedent of both the length of the cable and the rise time of the input signal to the driven line. Some manufactuer's catalog state that the width of the NEXT signal varys with the length of the cable. This also is not the case as shown by figures 4A and 6A.

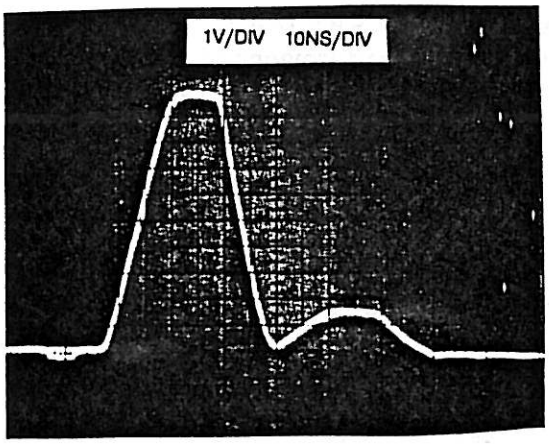


Fig. 7 Driven line 5v, 10ns rise time
10 ft. cable length

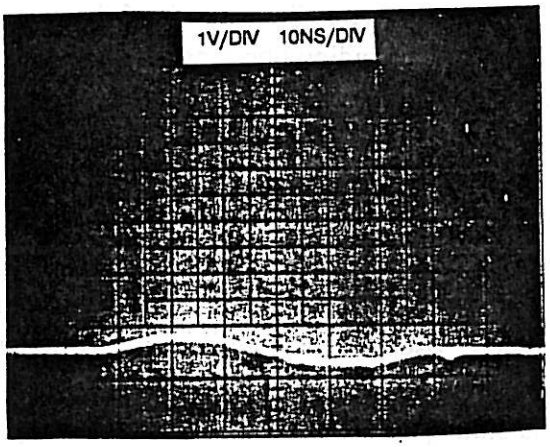


Fig. 8 Quiet line

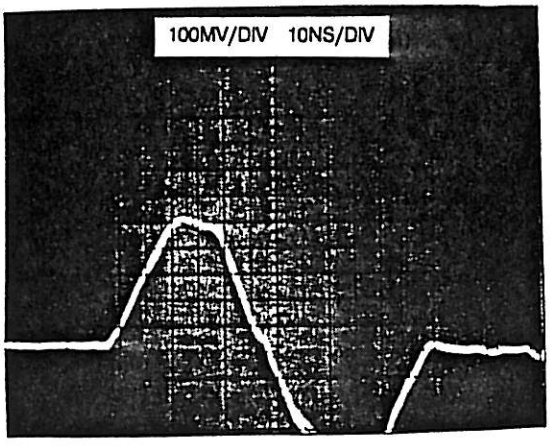


Fig. 8A Quiet line 10X

What the foregoing tests demonstrate is that NEXT is not a measurement indicative of transmission line performance of cable. In other words the NEXT signal level is determined by the capacitive ratio between the driven wire, shield, ground wires and quiet line. NEXT is not affected by inductive coupling, attenuation, rise time degradation or other factors commonly associated with transmission line characteristics.

I can appreciate that in a working SCSI system the concern is with erroneous signals coming back to the transmitting end, however these near end signals in an operating system are not the same signals as the signals in a static NEXT test setup. In an operating system, NEXT signals are a combination of the "pure" NEXT signal, as seen in a static test set up, and multiple forward crosstalk reflections, impedance mismatch reflections, etc. These additive NEXT signals are a direct result of the transmission line characteristics of the cable, including line length, tap offs, stub effects, wire characteristics, etc.

Since static NEXT testing does not reflect transmission line characteristics of cable, I think the committee may not find a very good correlation between static NEXT values and the performance of a cable in an operating SCSI system. The best predictors of the performance of cable in a SCSI system would be, rise time degradation, square wave voltage attenuation, forward crosstalk, differential crosstalk, propagation delay and capacitance. These static parameters will best reflect the performance of cable in an operating system.