M E M O X3T9.2 / 87-26

TO: ANSI SCSI Committee X3T9.2

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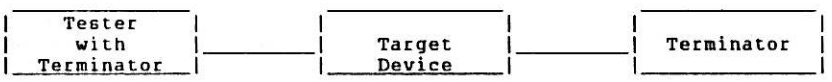
SUBJ: FLAT CABLE PROBLEMS IN DIFFERENTIAL SCSI 3/12/87

ABSTRACT

Problem:

I observed that my differential SCSI got errors beyond a certain cable length. Specifically, I could not run at all with the following setup:

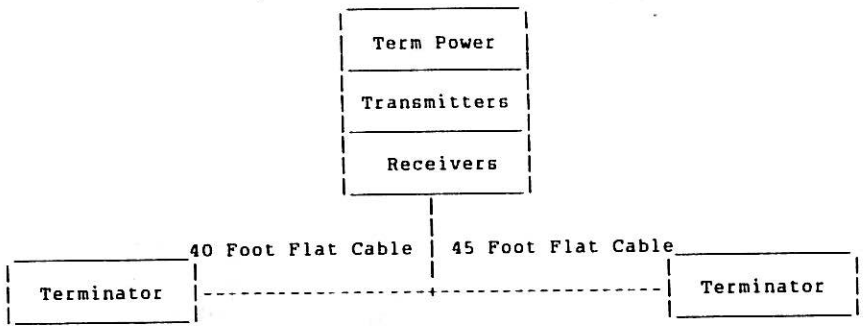


I found that when the target device went from Message phase to Data phase, SEL would glitch, causing the target SCSI IC (WD33C92) to drop BUSY. The problem seemed to be crosstalk between differential signals. Specifically, MSG and C/D dropped at that time. -MSG going high caused +SEL to go high, and +C/D going low caused -SEL to go low. With a long enough cable, -SEL could go higher than +SEL for a significant time, causing the receiver and the SCSI IC to see it.

18

Analysis:

To investigate this problem further, I set up a test circuit (see Appendix A). The total cable length and the location of the transmitters and receivers were varied. I found that the worst case was an 84 foot cable, (using sizes on hand) with both the transmitter and receiver in the middle, as shown:



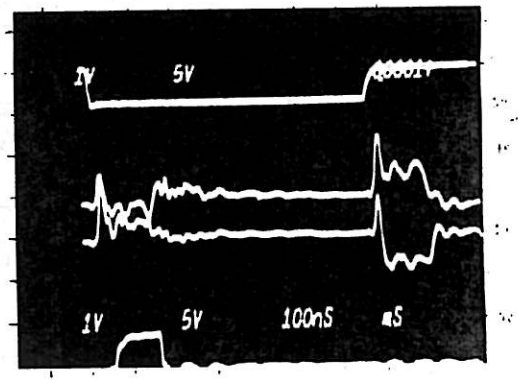
With this setup, driving MSG and C/D differentially, and leaving SEL undriven, TTL SEL received a 110 ns glitch (see photo). With cable lengths of 20 feet and 20 feet, TTL SEL had a 50 ns glitch (no photo). With cable lengths of 5 feet and 7 feet there was no TTL glitch.

Top trace:
+ MSG, C/D (TTL)
(5V/div)

Second trace:
-SEL (differential)
(1V/div)

Third trace:
+SEL (differential)
(1V/div). ± SEL crossed over for about 130 ns.

Fourth trace:
+SEL out (TTL)
(5V/div)
With 110 ns glitch.



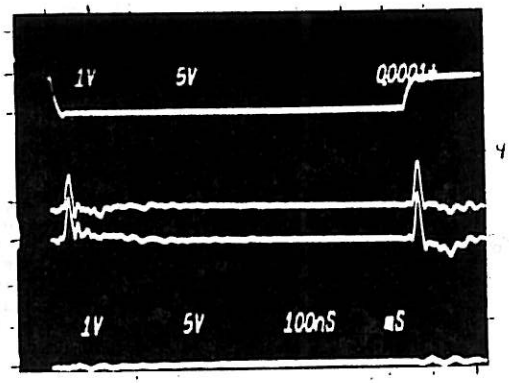
The same experiment was tried for twisted flat cable, except cable lengths were 37 feet and 27 feet. The crosstalk in that case was mostly common mode. See following photo:

Top trace:
+MSG, C/D (TTL)
(5V/div)

Second trace:
-SEL (differential)
(1V/div)

Third trace:
+SEL (differential)
(1V/div)

Fourth trace:
+SEL out (TTL)
(5V/div)



In this trace, there is always at least 0.3 volts between ± SEL, insuring no glitch.

The same test was run with shielded round twisted-pair cables. A photo wasn't taken, but the crosstalk on ± SEL (differential) was very small - about ±0.2 volts.

Conclusions:

Recommendation - disallow non-twisted pair cables (i.e. flat cable). The SCSI standard says, in section 4.2.2, "A 50-conductor cable or 25-signal twisted-pair cable shall be used." The term "50-conductor cable" is vague, and could include flat cable. The standard should be modified so that section 4.2.2 says, "A 25-signal twisted pair cable shall be used." Perhaps it should also specifically mention that twisted flat cable is acceptable.

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82

Appendix
Test setup