HEWLETT PACKARD

Roseville Networks Division
8000 Foothills Blvd., Roseville, CA 95678

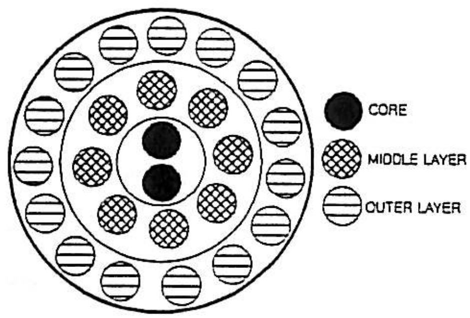
X3T9.2/90- 106

Date:	6 July 90
From:	Kurt Chan, X3T9.2 Principal, Hewlett-Packard
To:	X3T9.2 Membership
Subject:	Best/Worst Case Cable Crosstalk Comparison

As noted in X3T9.2/90-077R0, some follow up tests were planned to determine the degree to which selective pair positioning within shielded SCSI cables affects crosstalk noise. I tested three cable samples using identical raw cable, and a fourth cable from a different manufacturer with a different construction than the previous 3.

Cable 1:
Core (2): REQ, ACK
Middle (8): DB(0)-DB(7)
Outer (15): DB(P) and control lines, TERMPWR/GND/RESERVED

Cable 2:
Core (2): REQ, ACK
Middle (8): DB(P) and control lines
Outer (15): DB(0)-DB(7), TERMPWR/GND/RESERVED



Cable 3:
Core (2): REQ, ACK
Middle (8): 1 control pair and TERMPWR/GND/RESERVED
Outer (15): DB(0)-DB(7), DB(P) and remaining control pairs

Cable 4:
Randomly terminated cable, core filler with two-layer 10/15 construction

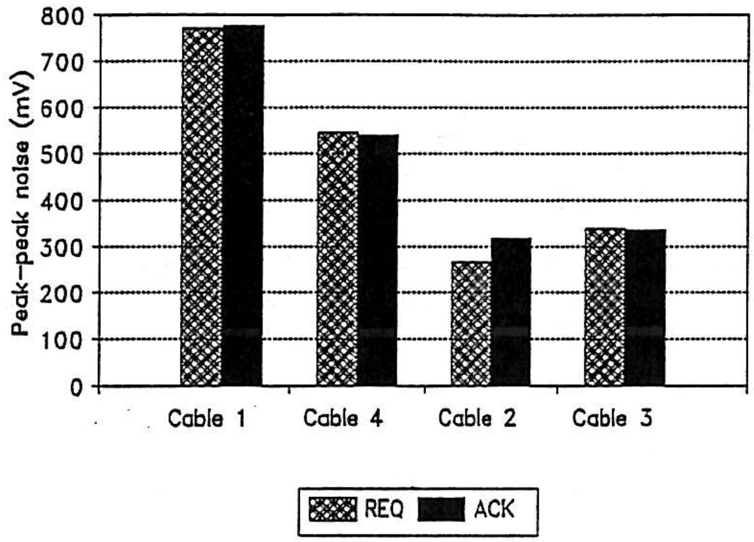
The cables were driven with DB(0)-DB(7) toggling at a 1MHz 50% rate, and the REQ and ACK lines were measured for crosstalk. The control lines were left undriven, but terminated. The TERMPWR/GND/RESERVED lines were all grounded. The attachment cabling for the test fixture was slightly different from that of X3T9.2/90-077R0 due to the use of high-density shielded connectors.

Results

The results were fairly dramatic - cable 1 had significantly greater crosstalk than cables 2 and 3, with cable 4 falling somewhere in-between (see next page). In fact, the REQ/ACK lines of cables 2 and 3 showed none of the traditional crosstalk pulse waveforms - the "crosstalk" measured appears to consist primarily of fixture noise (see oscilloscope plots on last page).

The peak-peak crosstalk noise on cable 2 was lower than the worst-case cable 1 by an average of 480mV. Taking half of this number as an approximation of the reduction in high-level noise margin, we get a 240mV difference. In 90-077R0 the average difference between the best and worst pairs across all cable samples was only about .2V, which leads me to conclude that Cable 1 does indeed approximate the worst possible crosstalk scenario on a shielded cable.

Cable Crosstalk Comparison



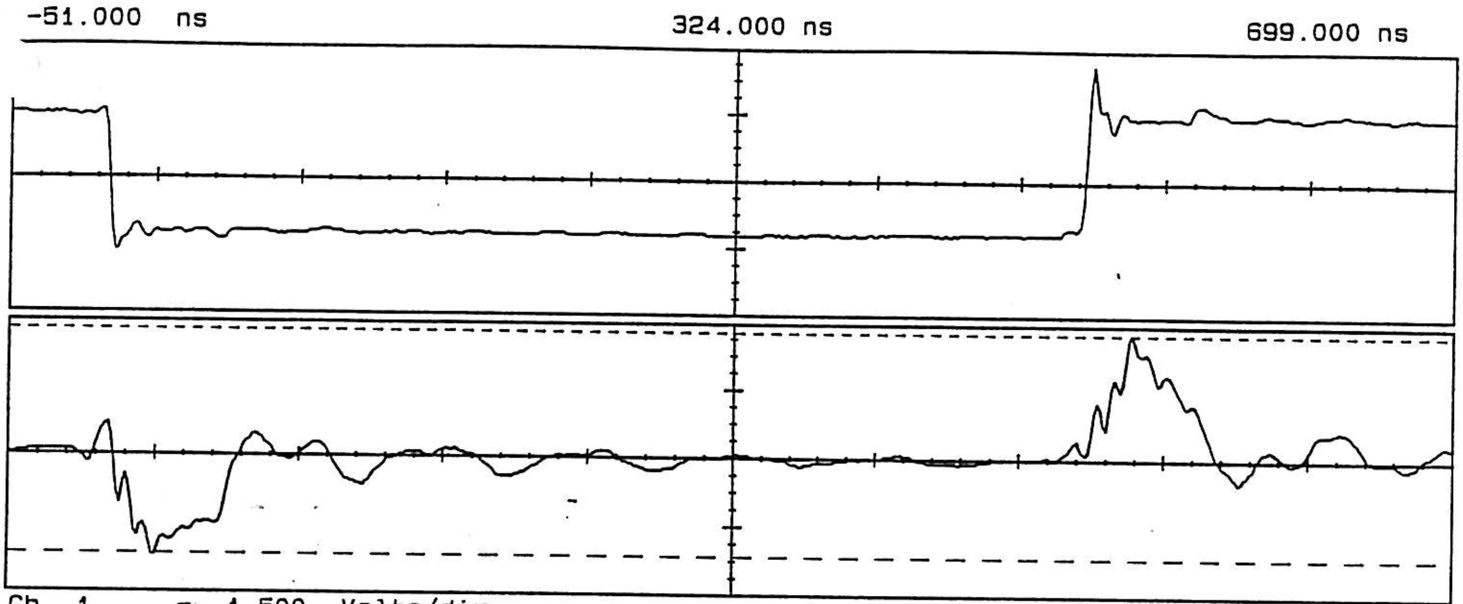
The particular raw cable tested had the following impedance characteristics:

	Min	Max	Avg
Core	88	92	90
Middle	86	92	88.9
Outer	85	90	86.9

which indicates that we give up about 2 ohms, on the average, in putting data on the outer layer versus the middle layer.

Conclusions

The cables tested showed that 240mV of high level noise margin (while data is switching) can be gained at the expense of 2 ohms (average) of characteristic impedance on the data lines. For a typical SCSI system, two ohms corresponds to about a 40mV difference in initial step voltage. For implementors who feel their systems are susceptible to crossttalk, putting REQ/ACK at the core of a high-impedance cable and data lines on the outer layer would be one method of reducing crosstalk without significantly affecting other aspects of signal quality.



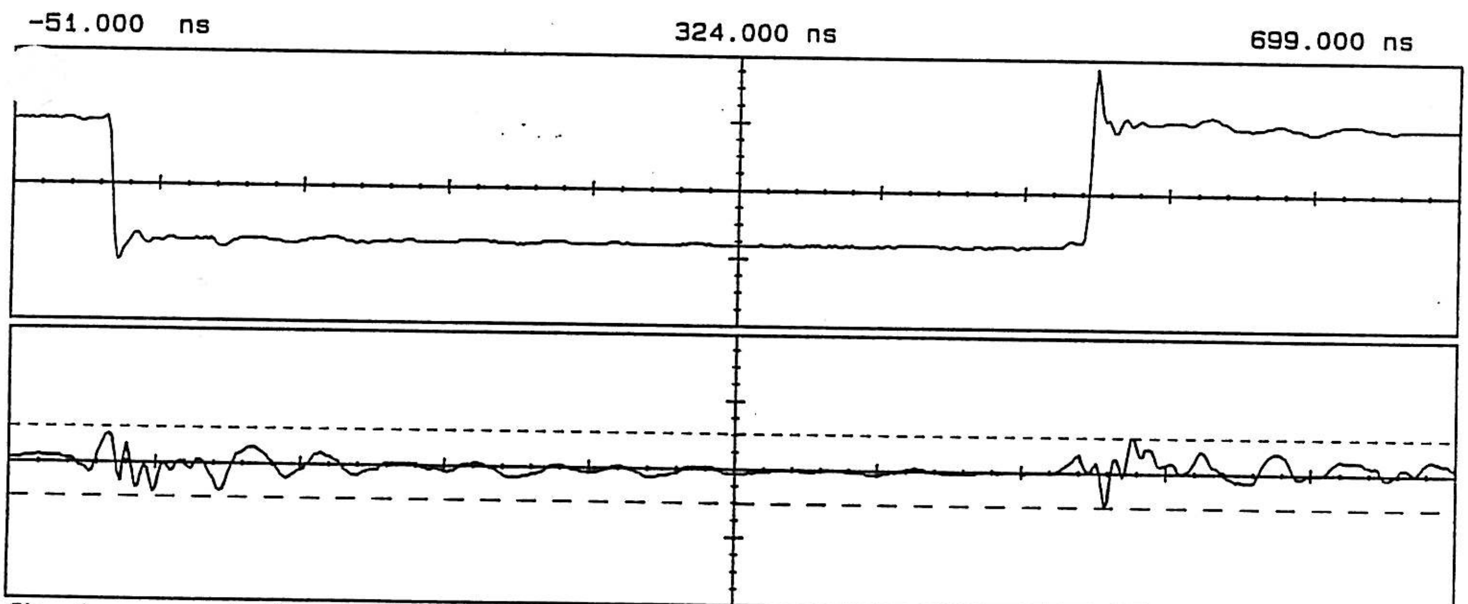
CABLE 1

Ch. 1 = 1.500 Volts/div
Ch. 2 = 250.0 mVolts/div
Timebase = 75.0 ns/div
Channel 2 Parameters
Vmarker1 = -360.0 mVolts

P-P Volts = 820.0 mVolts
Vmarker2 = 460.0 mVolts

Offset = 0.000 Volts
Offset = 0.000 Volts
Delay = -51.000 ns

Delta V = 820.0 mVolts



CABLE 2

Ch. 1 = 1.500 Volts/div
Ch. 2 = 250.0 mVolts/div
Timebase = 75.0 ns/div
Channel 2 Parameters
Vmarker1 = -120.0 mVolts

P-P Volts = 252.5 mVolts
Vmarker2 = 132.5 mVolts

Offset = 0.000 Volts
Offset = 0.000 Volts
Delay = -51.000 ns

Delta V = 252.5 mVolts