Berk-Tek

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Date: 4/19/90
To: X3T9.2 SCSI Committee Members
From: John Ellis
Subject: Shielded Cable Evaluation - Digital Near End Crosstalk

As per our offer in X3T9.2/90-44 we have performed digital NEXT testing on a total of fourteen SCSI cable assemblies. It was our original intent to do this testing on unconnectorized cables but there was little response to our request for samples. H.P. is circulating a number of cables for round robin testing. Many thanks to Kurt Chan for allowing us to evaluate these assemblies.

The method used for measurement is outlined by Chuck Grant of Madison in X3T9.2/90-16. This method is designed for bulk cable but with a few modifications in fixturing and procedure I was able to readily characterize each cable.

EQUIPMENT:

1. H.P. 54120 D.S.O. and T.D.R.
2. H.P. 54121 test set
3. "Champ"-style mating headers (2)
4. 4" X 6" copper PC board
5. 133 ohm +/- 1% termination resistors (50)
6. 50.4 ohm to 128 ohm matching pads (2) - these were built using 50 ohm BNC bulkhead jacks (1) 100 ohm resistor and (1) 75 ohm resistor
7. Ground strap

FIXTURE ASSEMBLY:

1. On the non-mating side of the headers solder positions 1 through 25 together and then firmly solder the connectors to the PC board.

2. On both connectors place a 133 ohm resistor into each IDC contact from #26 through #50. Solder the opposite end of each resistor to the board.

3. A ground strap is soldered to the board and to the scope ground during testing.

TEST PROCEDURE:

1. Normalize the risetime of the T.D.R. signal to 1 ns.

2. With the two matching pads tied back to back, determine the input voltage (Vin).

3. Select an "active" pair. Remove the resistor from the IDC slot and replace it with the matching pad of the driving channel (channel 1).

4. Select a "passive" pair. Remove the resistor from the IDC slot and replace it with the matching pad of the receiving channel (channel 4).

5. Measure the magnitude of the output voltage (Vout) on channel 4.

6. Near end crosstalk in % = Vout/Vin X 100.

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THE RESULTS:

A series of sixteen measurements with one pair active and one passive were made on each cable. For all cables the active and passive positions are identical.

| Measurement # | Active Pos. | Passive Pos. |
|---|---|---|
| 1 | 27 | 26 |
| 2 | 27 | 28 |
| 3 | 30 | 29 |
| 4 | 30 | 31 |
| 5 | 33 | 32 |
| 6 | 33 | 34 |
| 7 | 36 | 35 |
| 8 | 36 | 37 |
| 9 | 39 | 38 |
| 10 | 39 | 40 |
| 11 | 42 | 41 |
| 12 | 42 | 43 |
| 13 | 45 | 44 |
| 14 | 45 | 46 |
| 15 | 48 | 47 |
| 16 | 50 | 49 |

With all of these measurements I was able to ensure that each pair is either an active or passive member in at least one measurement, giving us a thorough characterization of each cable. Because these were terminated assemblies the actual proximity of the pairs under test is somewhat in question. Adjacent pin locations were used in all measurements under the assumption that these would be pairs of close proximity. Surely this was not always the case, but using the same active and passive pairs on all cables should compensate for these errors in relative terms.

The mean NEXT varied from a low of 2.5% to a high of 5.7%. I would treat these values as relative and not absolute. An undetermined amount of crosstalk was introduced by the fixturing and the connectors. The Champ connector used for the testing is a .100" centerline connector while the SCSI-2 connector is a .050" connector which can be expected to introduce more crosstalk. Following is a list of all measurements taken with an overall mean and standard deviation for each cable.

DIGITAL NEAR END CROSSTALK (NEXT) IN %

| SAMPLE: | A | B | F | G | H | J | K | M | N |
|---|---|---|---|---|---|---|---|---|---|
| SUPPLIER: | FURUKAWA | MADISON | BELDEN | MONTROSE | C & M | C & M | C & M | BERK-TEK | ASTRO |
| PART NUMBER: | DT-882814 | 4084 | PD-1309 | SCSI-2 | 62327 | NO P/N | 62523 | 270288 | NO P/N |
| MEASUREMENT # | | | | | | | | | |
| 1 | 2.8 | 6.1 | 2.2 | 3.9 | 6.1 | 5.0 | 4.4 | 6.1 | 3.9 |
| 2 | 3.3 | 5.6 | 3.9 | 3.9 | 6.1 | 5.0 | 2.8 | 5.0 | 3.9 |
| 3 | 2.8 | 5.6 | 3.3 | 5.0 | 5.0 | 5.6 | 2.2 | 4.4 | 4.4 |
| 4 | 2.2 | 5.0 | 2.8 | 5.0 | 5.6 | 5.6 | 3.3 | 5.0 | 3.9 |
| 5 | 2.8 | 5.6 | 2.8 | 5.0 | 5.0 | 6.1 | 2.8 | 5.0 | 3.9 |
| 6 | 2.2 | 5.6 | 3.3 | 5.0 | 6.1 | 6.1 | 2.8 | 5.0 | 3.9 |
| 7 | 2.8 | 5.6 | 4.4 | 5.0 | 5.6 | 8.3 | 1.7 | 3.9 | 3.3 |
| 8 | 2.8 | 6.1 | 3.9 | 5.6 | 5.6 | 7.2 | 2.2 | 3.9 | 3.3 |
| 9 | 2.2 | 5.6 | 3.9 | 5.6 | 5.6 | 7.8 | 3.3 | 3.3 | 3.3 |
| 10 | 2.2 | 5.0 | 3.3 | 5.6 | 5.6 | 8.3 | 2.2 | 3.9 | 2.8 |
| 11 | 2.8 | 5.6 | 1.7 | 5.0 | 5.0 | 7.2 | 2.8 | 3.9 | 3.3 |
| 12 | 2.2 | 6.1 | 1.7 | 5.0 | 5.0 | 7.8 | 2.8 | 3.9 | 3.9 |
| 13 | 1.7 | 5.6 | 3.3 | 5.6 | 5.0 | 2.8 | 2.2 | 3.3 | 3.9 |
| 14 | 2.2 | 6.1 | 3.9 | 5.6 | 5.0 | 2.8 | 2.2 | 3.9 | 3.3 |
| 15 | 2.2 | 6.1 | 2.2 | 6.1 | 5.0 | 3.3 | 2.8 | 3.3 | 6.1 |
| 16 | 2.8 | 6.1 | 1.7 | 5.6 | 5.6 | 2.8 | 2.2 | 2.8 | 6.1 |
| MEAN | 2.5 | 5.7 | 3.0 | 5.2 | 5.4 | 5.7 | 2.7 | 4.2 | 4.0 |
| STD | 0.40 | 0.36 | 0.87 | 0.58 | 0.42 | 1.92 | 0.62 | 0.83 | 0.90 |

| O.S<br>P & M<br>52659 | P<br>HELIX<br>#28 AWG | HIT-1<br>HITACHI<br>1REVF-SD | HIT-2<br>HITACHI<br>#8212 | HIT-3<br>HITACHI<br>#8199 | MADISON<br>#4099 | FURUKAWA<br>DT-891055 |
|---|---|---|---|---|---|---|
| 4.4 | 2.8 | 2.8 | 2.8 | 4.4 | 3.9 | 5.0 |
| 3.9 | 3.3 | 2.8 | 3.3 | 4.4 | 2.8 | 5.0 |
| 5.6 | 3.3 | 3.3 | 2.8 | 5.0 | 3.9 | 3.9 |
| 4.4 | 3.3 | 2.8 | 2.2 | 5.0 | 2.8 | 3.3 |
| 3.9 | 3.3 | 2.2 | 2.8 | 4.4 | 3.9 | 4.4 |
| 3.9 | 3.3 | 2.8 | 3.3 | 4.4 | 3.3 | 5.6 |
| 3.9 | 2.8 | 2.8 | 2.8 | 5.0 | 4.4 | 5.0 |
| 2.8 | 3.3 | 2.8 | 2.8 | 4.4 | 3.9 | 4.4 |
| 4.4 | 3.3 | 3.3 | 3.3 | 4.4 | 3.9 | 4.4 |
| 4.4 | 3.9 | 2.8 | 3.3 | 5.0 | 2.8 | 5.0 |
| 4.4 | 2.8 | 4.4 | 3.9 | 6.1 | 2.8 | 4.4 |
| 5.0 | 3.3 | 3.9 | 3.3 | 5.6 | 3.3 | 3.9 |
| 5.0 | 3.9 | 3.9 | 2.8 | 5.0 | 3.9 | 3.9 |
| 4.4 | 3.9 | 3.9 | 2.8 | 5.6 | 3.9 | 3.9 |
| 5.0 | 3.9 | 2.8 | 3.3 | 5.6 | 5.0 | 4.4 |
| 3.3 | 2.8 | 3.3 | 3.3 | 5.0 | 4.4 | 5.0 |
| 4.3 | 3.3 | 3.2 | 3.1 | 5.0 | 3.7 | 4.5 |
| 0.67 | 0.39 | 0.57 | 0.38 | 0.53 | 0.64 | 0.58 |

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