Ultra320 SCSI with Receiver Equalization, 25 meters into a Backplane with 6 loads

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SCSI Physical Working Group Meeting
07 March 2000
Dallas, TX
Quantum's goal for Ultra 320 SCSI is to have a solution that is so robust it could be extensible to Ultra 640.

In order to demonstrate that our Receiver Equalization scheme is extremely robust, we want to test it at conditions beyond the specified limits of Ultra 160.

The first of these was to test U320 using a 25 meter round cable into a fully loaded 6-slot backplane.

The signals were measured to find the eye opening with ISI, reflections and crosstalk including:

- Amplitude errors;
- Timing shift errors;
- Miscellaneous noise.

The following describes the test and results.
Margins were evaluated with the same techniques as used for our other Ultra320 data:

- Transmitter driving voltage: +/- 400mV.
- Transmitted Pattern: 2µs of "101010..." training pattern followed by 8µs random data.
- The equalizer input signals are captured differentially with a Tektronix TDS694C oscilloscope by probing at the backplane.
- The equalizer output signal is generated by Spectre, simulating in transistor level models and using captured data as input stimulant.

For the bit cell: the training pattern ("1010...") defines the cell boundary and cell center.
U320 25m Cable Test Schematic

Cable + backplane configuration 1 or 2

50 Ω aggressor
XTALK source 1†

DB(P1)

50 Ω random
data source*

DB(0)

DB(1)

50 Ω aggressor
XTALK source 2‡

Perfect terminators

Termination
100Ω, located
at end of
back-plane

Differential
probe
on victim

receiver board identification:
-XT8bd1 to XT8bd9 are on ribbon cable,
-XT8bp1 to XT8bp6 or XT8bp10 to XT8bp15 are on the back-plane

* TEK 2041 † HP81130A

06 March 2000
• 25 meter Amphenol cable assembly† using Madison 28AWG round shielded cable plus 6-slot backplane.
• Waveforms captured @ 10Gs/s

†supplied by Amphenol, www.amphenol-aipc.com
Error sources are used to define the range over which a receiver characteristic may typically vary from the ideal sample point, i.e., the actual sample point may lie anywhere within a box defined by 2 times 0-to-peak height and 2 times 0-to-peak width of the errors.

Amplitude error sources define height, and timing error sources define width, e.g., set-up time margin is measured as the distance from the eye diagram waveform to the box.
Conclusion: Failing Margin

(Increasing amplitude would still fail)
Conclusion: Excellent Margin
Set-up and Hold vs Eye Opening, bp1

25m round cable + loaded 6-slot backplane @ bp1

Solid line = set-up time  Dashed line = hold time

Rx Equalizer Output

Unequalized Signal

U320 Eye Mask

Eye Opening Amplitude (mV)

Set-up and Hold Time (ns)
Conclusion: Failing Margin
(Increasing amplitude would still fail)
Conclusion: Excellent Margin
Set-up and Hold vs Eye Opening, bp3

Eye Opening Amplitude (mV)

- Solid line = set-up time
- Dashed line = hold time

Rx Equalizer Output

Unequalized Signal

U320 Eye Mask

Set-up and Hold vs Eye Opening, bp3

25m round cable + loaded 6-slot backplane @ bp3
Conclusion: Failing Margin

(Increasing amplitude would still fail)
25m round cable + loaded 6-slot backplane @ bp6

Output Amplitude (mV)

Time (ns)

Conclusion: Excellent Margin
Set-up and Hold vs Eye Opening, bp6

- 25m round cable + loaded 6-slot backplane @ bp6
- Solid line = set-up time
- Dashed line = hold time
- Rx Equalizer Output
- Unequalized Signal
- U320 Eye Mask

Eye Opening Amplitude (mV) vs Set-up and Hold Time (ns)
A Receiver Equalization scheme is extremely robust, capable at operating beyond the specified limits for Ultra 160.

The specification for the maximum bus path length between terminators (25 meters point-to-point and 12 meters multidrop interconnect) does not need to be changed for U320 in SPI-4.