Ultra640 SCSI with Receiver Equalization, 25 meters into a Backplane with 6 loads

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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 second test was to use the same setup (25m round cable into a loaded 6-slot backplane) at U640 rates.

The signals were measured to find the eye opening with ISI and reflections.

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.
- Because of the higher frequency the transmitted pattern was 1µs of a"101010..." training pattern followed by 4µs random data.
- The equalizer input signals were captured differentially with a Tektronix TDS694C oscilloscope by probing at the backplane.
- The equalizer output signal is generated by Spectre, simulating linear models and using captured data as the input stimulant.

- The boost used for the equalizer simulation was 3x
- Crosstalk could not be measured for this test as our current pulse generator cannot generate a synchronized clock at 320MHz.
U640 25m Cable Test Schematic

50 Ω random data source*

50 Ω random data source*

All other lines are idle

Termination 100Ω, located at end of backplane

Perfect terminators

receiver board identification:
- bpN are on the back-plane
- bdN are on connectors along cable

* TEK 2041
• 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.

*This has been scaled to be half the value as that used for U320 analysis
Conclusion: No Margin
(Increasing amplitude would still fail)
U640, Rx Equalized, 25m Cable, bp6

25m round cable + loaded 6-slot backplane @ bp6

Conclusion: Good Set-up Margin*

(*Increased amplitude would improve margin)
Set-up and Hold vs Eye Opening, bp6

25m round cable + loaded 6-slot backplane @ bp6

Rx Equalizer Output

Solid line = set-up time

Dashed line = hold time

Eye Opening Amplitude (mV)

Eye Opening Amplitude

Solid line = set-up time

Dashed line = hold time

U640 Eye Mask

Unequalized Signal

(no eye opening)

0 0.5 1.0 1.5

Set-up and Hold Time (ns)
Though this test was a "rough cut", it demonstrates that a receiver equalization scheme is so robust, it can adapt a signal to having sufficient margin from a signal having no margin at the receiver input.

In addition, the data indicate that a receiver equalization scheme could be developed to operate at U640 transfer rates without changing the SPI specification for the maximum bus path length between terminators (25 meters point-to-point and 12 meters multidrop interconnect).