SCSI Signal & Cable Analysis
Using Actual U320
Target and Initiator Silicon

Seagate Technology
VLSI Controller Development
Scotts Valley California
Seagate U320 Hardware

- Seagate’s invitation to bring system interconnect configurations to the lab for test has been taken up by numerous system manufacturers with positive results and the invitation is still open on a RSVP basis. Priorities may require the invitation being narrowed in the future.

- All testing was performed with fully-integrated U320 Initiator and Target Silicon.
  - No external drivers or generators.
  - Initiator is legacy-compatible SCSI with full U320 capability.
  - Target is Seagate Disc controller, full legacy compatible with full U320 capability.
Seagate Testing Conditions

- All testing was with full SCSI data bus, backplanes were populated with real drives, and cables and terminators were legacy U160 hardware.
- Testing was always performed with all data bits running full random data pattern, (256K).
- When known, the worst data bit was selected and the worst slot(s) of the backplane. First & last slot always shown.
  - Some determined by experiment, some by vendor.
- Probes were at drive PCBA, at the chip pins.
- Driver settings were ±500 mV under all conditions to maintain consistency. Slew rates were approximately 400 mV/nS. Precomp at 25%
Seagate Testing Conditions

- Test setup had poor stub and terminator configurations due to emulation and probe hardware, excessive PCBA routing, etc. on Seagate Initiator.
  - This added offset and additional initiator-end noise which will not be seen in the actual HBA’s or drives.
  - This has already been verified with new hardware configurations.
Several OEM Backplanes data will be shown.

- **5-slot, Major OEM Volume Product**
  - Very good quality at U160, good cable-to-first-drive spacing, excellent drive-to-drive routing. About 3cm between drives.

- **6-slot Backplane “A”, Major OEM, Volume Product**
  - Very poor drive-to-drive routing, and poor signal quality at U160. About 3cm between drives. Could not do 12m due to special connector requirements.

- **6-slot Backplane “B”, Major OEM, In Production**
  - Fair to good performance at U160. About 3.5cm between drives.

- **10-slot, Major OEM, High Volume Product**
  - Fair performance at U160, but known problems on certain bits and slots. Very high resistance first to last slot. About 3cm between drives.
Other Backplanes Tested

- Several OEM’s had designs which were tested at our lab, but we cannot show data for confidentiality reasons. In all cases:
  - The signals at U320 were as good or better than at U160.
  - Noisy backplanes showing high reflections at U160 also showed high reflections at U320
    - In some cases the 80 mHz was constructive, and the amplitude at U320 was greater.
- Seagate backplanes not shown for time constraints, but can be provided. No issues noted.
Cables Tested

- Data on several cable configurations will be shown.
  - 28” Twisted-Flat cable.
  - 12m Amphenol Twisted Flat cable.
  - 12 meter Madison Round cable.
  - 25 meter Hitachi Round cable.
- Multiple cable configurations available, and Seagate will provide data on any Cable/Backplane configuration requested, as long as we have hardware or it is provided.
Results

- Data with actual U320 controller and integrated precomp transceiver was in every case better than data taken with prior test chips.
- Data with U320 driver was in every case much better than data taken with generator-driver experiments.
  - The theorized deficiencies in using general purpose test equipment has been confirmed with the physical verification using real SPI-4 transceivers.
- Data with precomp enabled on short-cable to backplane configurations was better than experiments, and in some cases improved signal integrity.
- The viability and effectiveness of Precomp has been confirmed.
More Results

- The proposed signal masks are fully supported by test results of all available system interconnect configurations.
- In all cases, if the signals passed U160, they also passed U320 amplitude margins (at 2nS & 3 nS).
- In all cases, the data “eye” at U320 was as good or better than data “eye” at U160.
  - With the exception of the width, of course.
- There was never a poorer amplitude at U320 than at U160 when precomp was enabled.
- Some backplanes “amplify” 80 MHz signals due to favorable reflections.
SCSI Signal, Backplane & Cable Analysis
5-Slot Backplane
U320 Target and Initiator Silicon

Seagate Technology
VLSI Controller Development
Scotts Valley California
5-Slot Backplane - SU320 Initiator - 28” TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 16 TEK48

W/Precomp

Disk 17 TEK42

Disk 17 TEK44

DOC 00-406r0
5-Slot Backplane U320 Analysis.ppt - - 2
5-Slot Backplane - SU320 Initiator - 28” TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator, Driving

No Precomp

W/Precomp

Disk 16 TEK51

Disk 17 TEK47

Disk 16 TEK53

Disk 17 TEK45
5-Slot Backplane - SU320 Initiator -28" TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 16 TEK58

W/Precomp

Disk 17 TEK50

Disk 16 TEK57

Disk 17 TEK52
5-Slot Backplane - SU320 Initiator - 12m Rnd, First Slot

Probe at Target PCBA, **Seagate U320 Initiator Driving**

**No Precomp**

Disk 16 TEK74

**W/Precomp**

Disk 17 TEK59

Disk 17 TEK61
5-Slot Backplane - SU320 Initiator -12m Rnd, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 16 TEK65

W/Precomp

Disk 17 TEK58

Disk 16 TEK67

Disk 17 TEK56
5-Slot Backplane - SU320 Initiator -12m Rnd , Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 16 TEK70

Disk 16 TEK68

W/Precomp

Disk 17 TEK53

Disk 17 TEK55
SCSI Signal, Backplane & Cable Analysis
6-Slot Backplane “A”
U320 Target and Initiator Silicon

Seagate Technology
VLSI Controller Development
Scotts Valley California
Disk 18 TEK58

No Precomp

Disk 14 TEK85

W/Precomp

Disk 14 TEK86

Disk 14 TEK85

Disk 18 TEK60

Disk 18 TEK58

Note: these are non-transitioning signals, and also appear in U160 eyes.
6-Slot Backplane-A - SU320 Initiator - 28" TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 14 TEK40

Disk 18 TEK65

Disk 14 TEK42

Disk 18 TEK64

25 Oct 2000 16:00:24

6-Slot Backplane-A - SU320 Initiator -28” TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator, Driving

No Precomp

Disk 14 TEK43

Disk 14 TEK45

W/Precomp

Disk 18 TEK66

Disk 18 TEK88
6-Slot Backplane-A - SU320 Initiator - 12m Rnd

Probe at Target PCBA, Seagate U320 Initiator Driving

Sorry, could not take these pictures because special connectors used on this backplane and no 12m Cable available.
SCSI Signal, Backplane & Cable Analysis
6-Slot Backplane “B”
U320 Target and Initiator Silicon

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6-Slot Backplane-B - SU320 Initiator - 28" TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 22 TEK63

Disk 22 TEK66
6-Slot Backplane-B - SU320 Initiator -28” TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 22 TEK49

W/Precomp

Disk 22 TEK60

Disk 22 TEK47

Disk 22 TEK62
6-Slot Backplane-B - SU320 Initiator - 28" TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 22 TEK52

W/Precomp

Disk 22 TEK56

Disk 22 TEK53

Disk 18 TEK58

DOC 00-406r0
6-Slot Backplane-B U320 Analysis.ppt - 4
6-Slot Backplane-B - SU320 Initiator -12m Rnd, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 23 TEK73

W/Precomp

Disk 23 TEK70

Disk 23 TEK74

Disk 22 TEK67
6-Slot Backplane-B - SU320 Initiator -12m Rnd, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 23 TEK77

W/Precomp

Disk 23 TEK74

Disk 23 TEK80

Disk 23 TEK82
6-Slot Backplane-B - SU320 Initiator - 12m Rnd, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

- No Precomp
  - Disk 23 TEK87
  - Disk 23 TEK85
  - Disk 23 TEK90

- W/Precomp
  - Disk 23 TEK83
  - Disk 23 TEK85
SCSI Signal, Backplane & Cable Analysis
10-Slot Backplane
U320 Target and Initiator Silicon

Seagate Technology
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10 - Slot Backplane - SU320 Initiator - 28” TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 21 TEK90

Disk 7 TEK40

Disk 21 TEK89

Disk 7 TEK38

DOC 00-406r0
10-Slot BackplaneU320 Analysis.ppt - 3
Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 21 TEK93

30 Oct 2000
12:27:20

Disk 21 TEK94

30 Oct 2000
12:28:40

W/Precomp

Disk 8 TEK42

Tek Run: 5.00 GS/s
Sample

Disk 8 TEK40

Tek Run: 5.00 GS/s
Sample

10 - Slot Backplane - SU320 Initiator - 28” TnF, Last Slot
10 - Slot Backplane - SU320 Initiator -12m Rnd, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 9 TEK103

Disk 9 TEK92

Disk 9 TEK94
10 - Slot Backplane - SU320 Initiator -12m Rnd , Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp
10 - Slot Backplane - SU320 Initiator -12m Rnd, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 9 TEK111

Disk 49 TEK98

Disk 9 TEK28
Cable & Backplane Attenuation Compared

Quantum Generator-Driver Example, 10m

12m Cable, Same Driver Amplitude, Slot, Backplane, but Real U320 Silicon
SCSI Signal, Backplane & Cable Analysis
10-Slot Backplane
U320 Target and Initiator Silicon

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10 - Slot Backplane - SU320 Initiator - 28” TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 21 TEK86

W/Precomp

Disk 7 TEK33

Disk 7 TEK37
10 - Slot Backplane - SU320 Initiator - 28” TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 21 TEK90

Disk 7 TEK40

30 Oct 2000 12:21:18

Disk 21 TEK89

Disk 7 TEK38

30 Oct 2000 12:19:29

DOC 00-406r0
10-Slot BackplaneU320 Analysis.ppt - - 3
10 - Slot Backplane - SU320 Initiator -28” TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

Disk 21 TEK93

W/Precomp

Disk 8 TEK42

Disk 21 TEK94

Disk 8 TEK40

DOC 00-406r0
10-Slot BackplaneU320 Analysis.ppt - - 4
10 - Slot Backplane - SU320 Initiator -12m Rnd, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp
Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

W/Precomp

Disk 9 TEK97

Disk 9 TEK99

Disk 9 TEK98

Disk 9 TEK99

20 Oct 2000
13:48:37

20 Oct 2000
13:17:28
10 - Slot Backplane - SU320 Initiator -12m Rnd , Last Slot

Probes at Target PCBA, Seagate U320 Initiator Driving

- No Precomp
- W/Precomp

Disk 9 TEK111
Disk 9 TEK28
Disk 49 TEK98

Run: 5.00GS/s
Sample

Cable & Backplane Attenuation Compared

Quantum Generator-Driver Example, 10m

12m Cable, Same Driver Amplitude, Slot, Backplane, but Real U320 Silicon
SCSI Signal & Cable Analysis
Point-to-Point Testing
U320 Target and Initiator Silicon

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Scotts Valley California
Probe at Initiator, **Seagate U320** Initiator Driving

No Precomp

With Precomp

Disk W TEK77

Disk W TEK70
SU320 Initiator - 18” TnF, Point-to-Point

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

With Precomp

Disk 13 TEK82

Disk 13 TEK83

Disk W TEK81

Disk W TEK78

30 Oct 2000 11:56:41

28 Oct 2000 12:59:46
SU320 Initiator -12m Madison Rnd, Point-to-Point

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

With Precomp

Disk 17TEK62

Disk 18TEK54

Disk 14 TEK 79

Disk 17TEK62

DOC 00-406r0
Pt-to-Pt U320 Analysis.ppt - - 4
SU320 Initiator -12m Amphenol TnF, Point-to-Point

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

With Precomp

Disk 17TEK62

Disk 13 TEK47

Disk 13 TEK46

Disk 18TEK54


24 Oct 2000 15:49:43

20 Oct 2000 16:12:42
SU320 Initiator -25m Hitachi Rnd, Point-to-Point

Probe at Target PCBA, Seagate U320 Initiator Driving

No Precomp

With Precomp

Disk 13 TEK41

Disk 18TEK55

Disk 13 TEK42

Disk 18TEK56