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

Seagate Technology

VLSI Controller Development

Scotts Valley California

Seagate
Information the way you want it.

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
Information the way you want it.

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
Information the way you want it.

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.

OEM Backplanes Tested

- 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.

Seagate
Information the way you want it.

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.

Seagate
Information the way you want it.

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.

Seagate
Information the way you want it.

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.

Seagate
Information the way you want it.

SCSI Signal, Backplane & Cable Analysis
5-Slot Backplane
U320 Target and Initiator Silicon

Seagate Technology

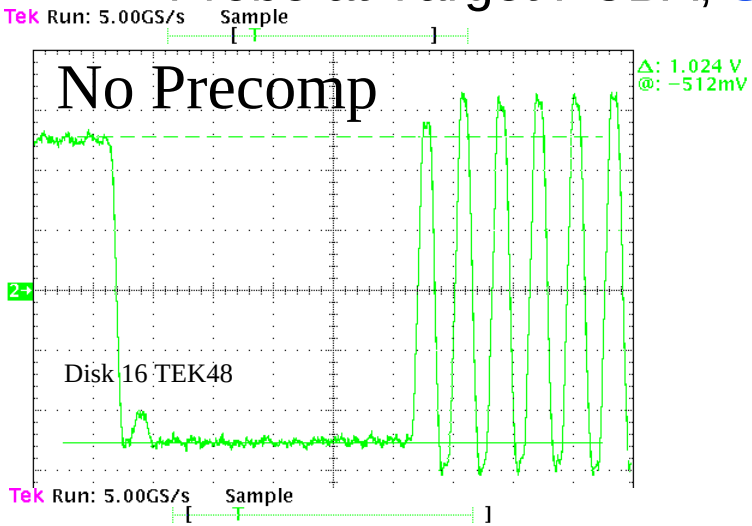
VLSI Controller Development

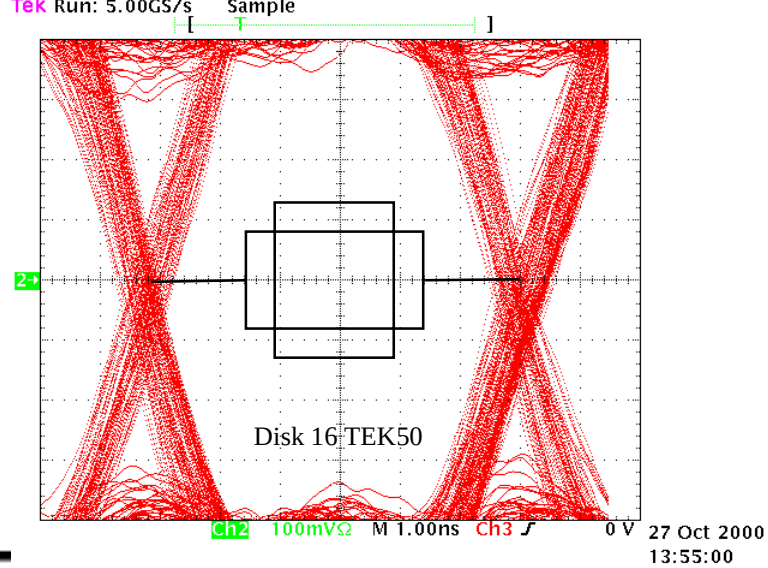
Scotts Valley California

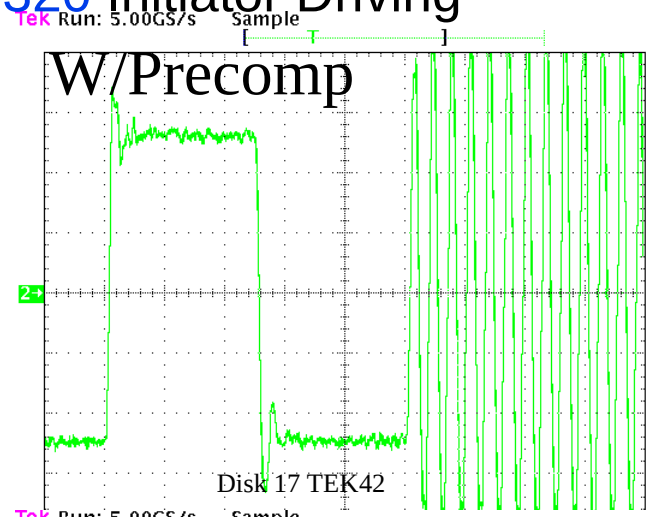
Seagate
Information the way you want it.

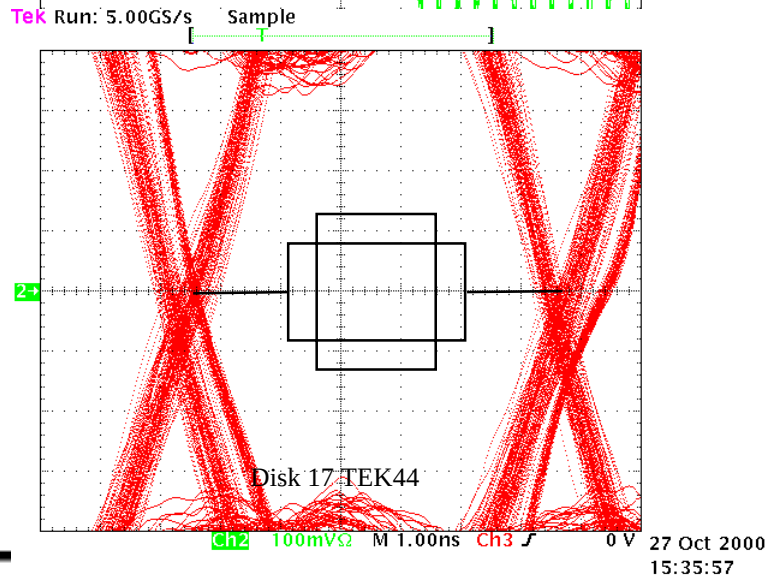
5-Slot Backplane - SU320 Initiator -28" TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





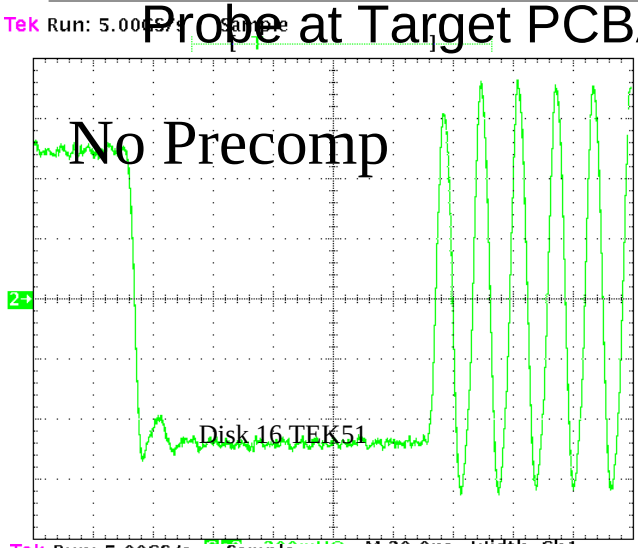


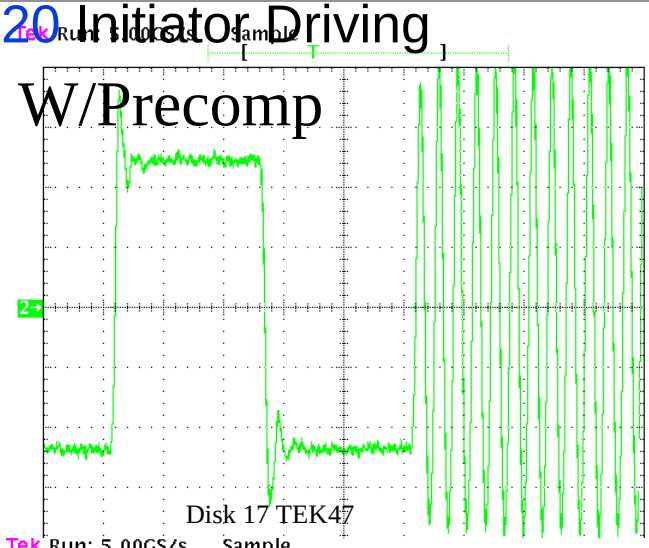


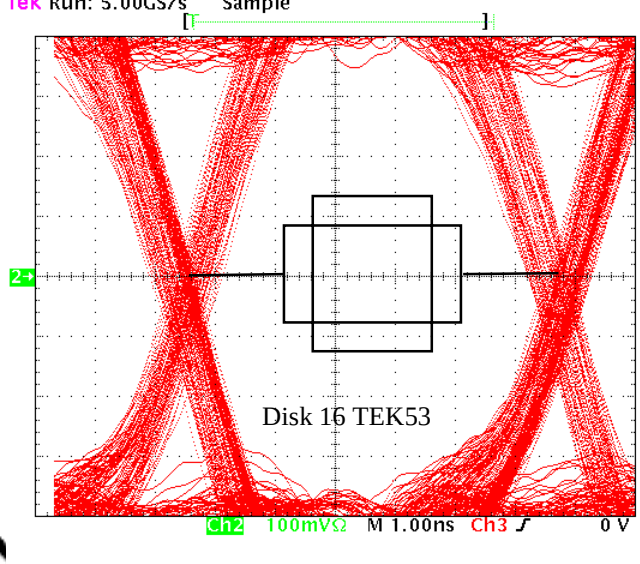
Seagate
Information the way you want it.

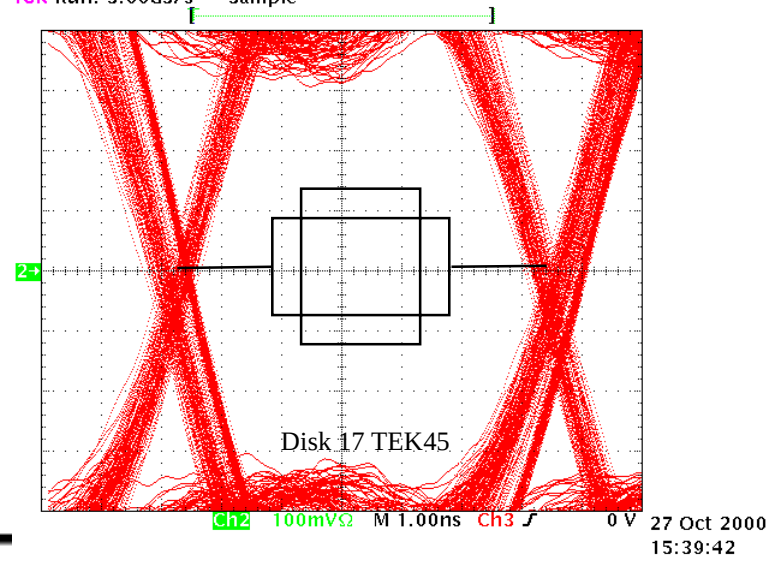
5-Slot Backplane - SU320 Initiator -28" TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving







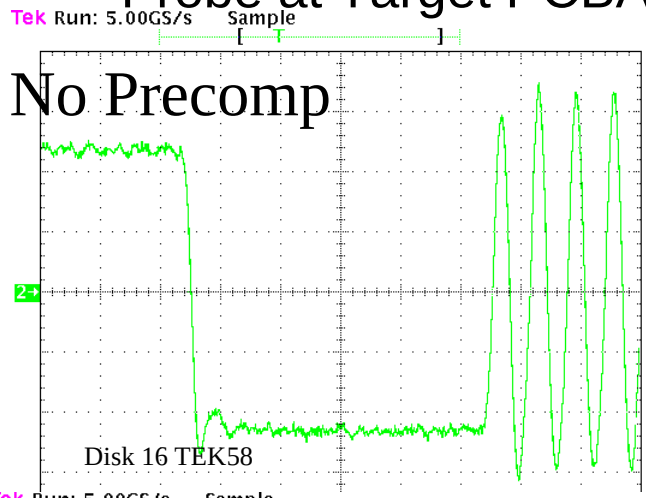


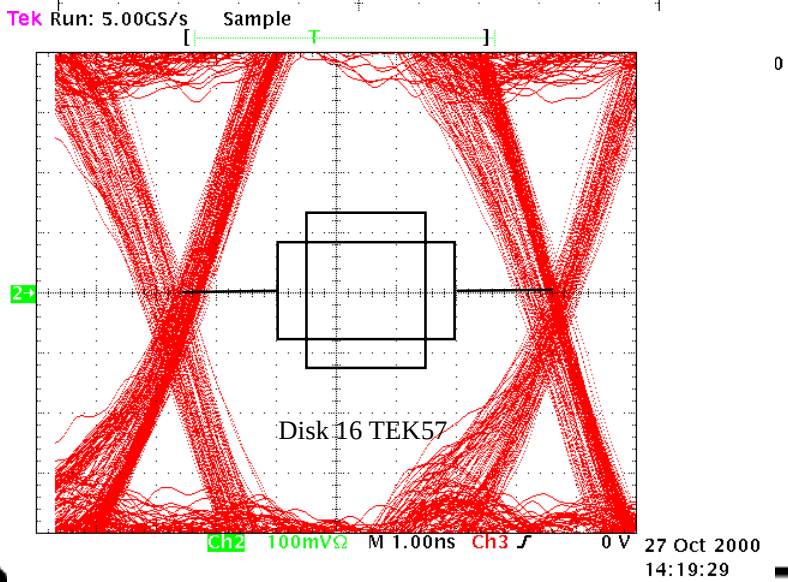
Seagate
Information the way you want it.

5-Slot Backplane - SU320 Initiator -28" TnF, Last Slot

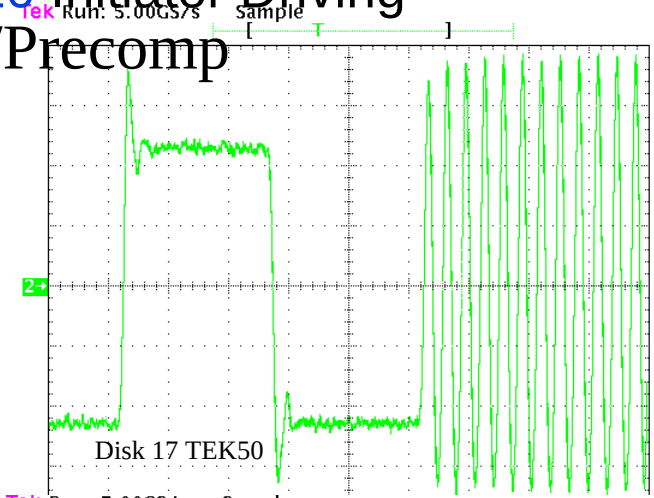
Probe at Target PCBA, Seagate U320 Initiator Driving

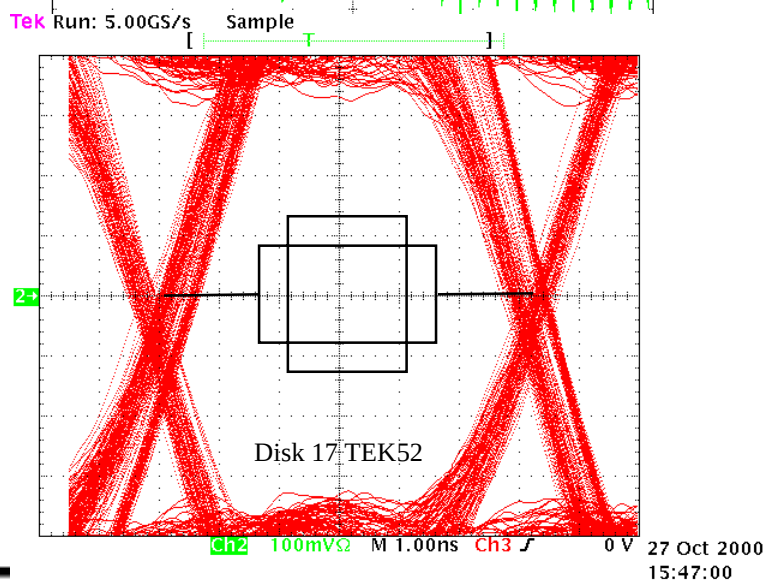
No Precomp





W/Precomp

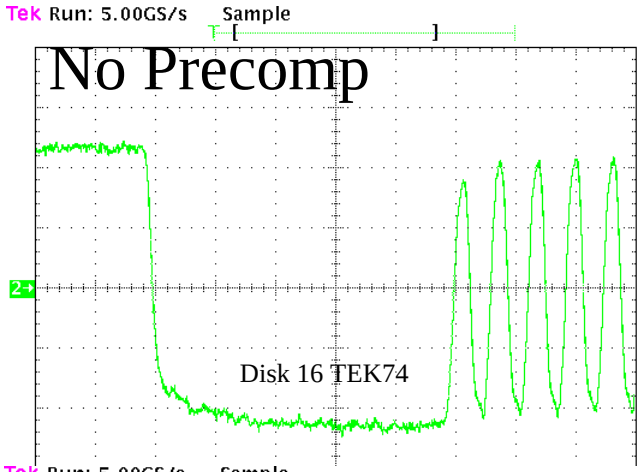


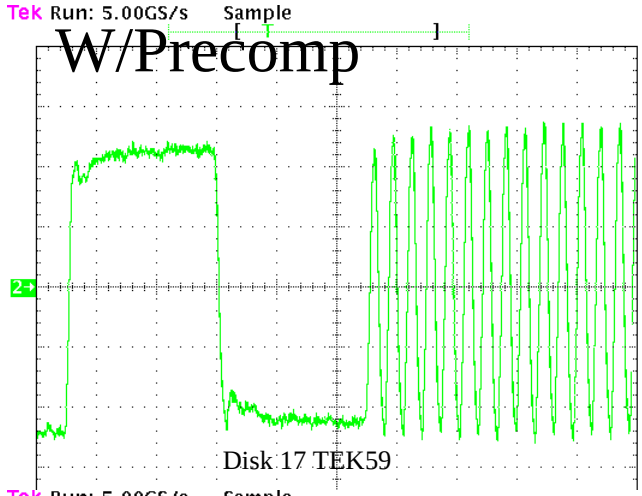


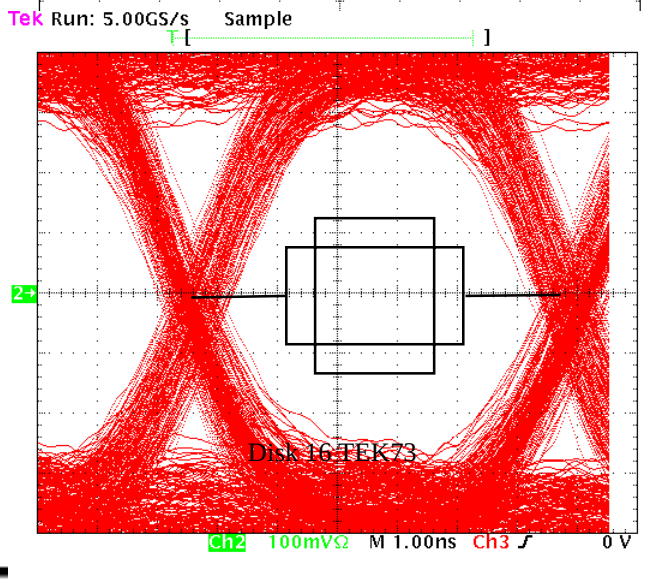
Seagate
Information the way you want it.

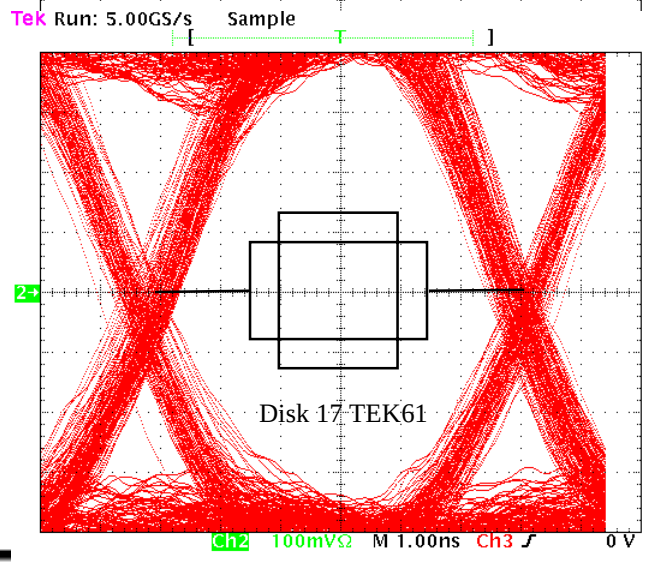
5-Slot Backplane - SU320 Initiator -12m Rnd , First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





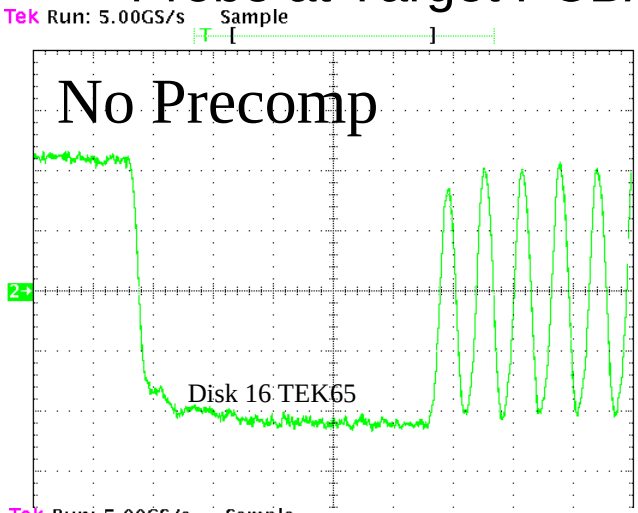


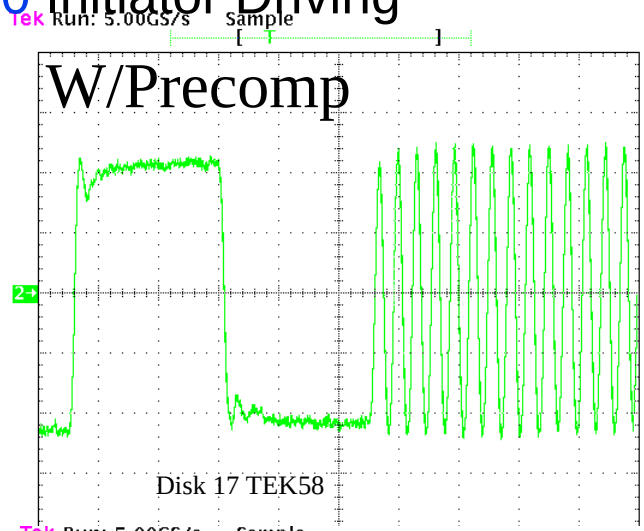


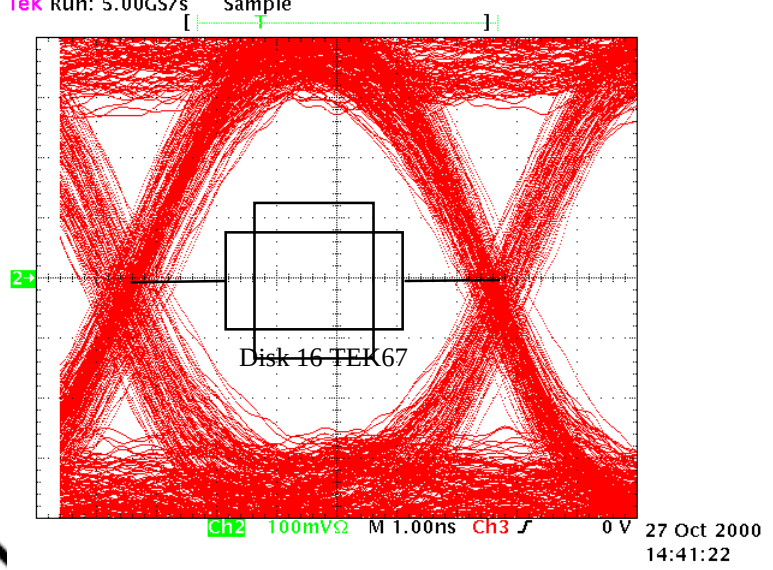
Seagate
Information the way you want it.

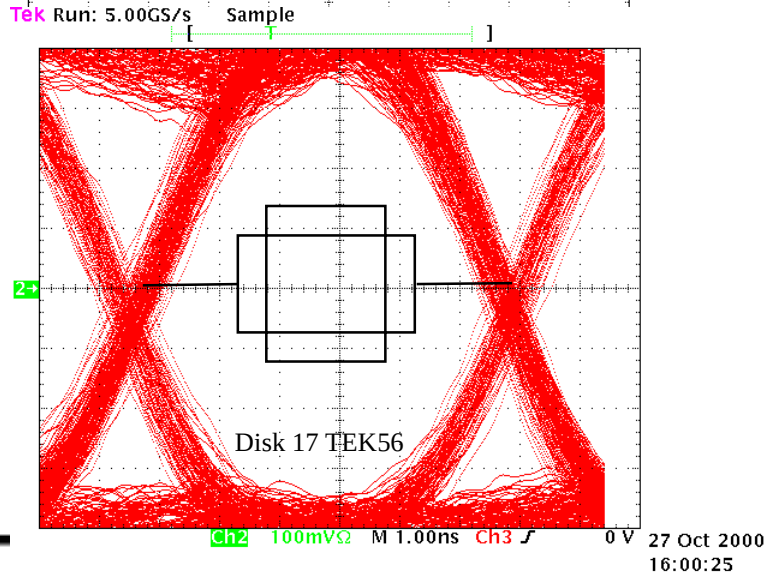
5-Slot Backplane - SU320 Initiator -12m Rnd , Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





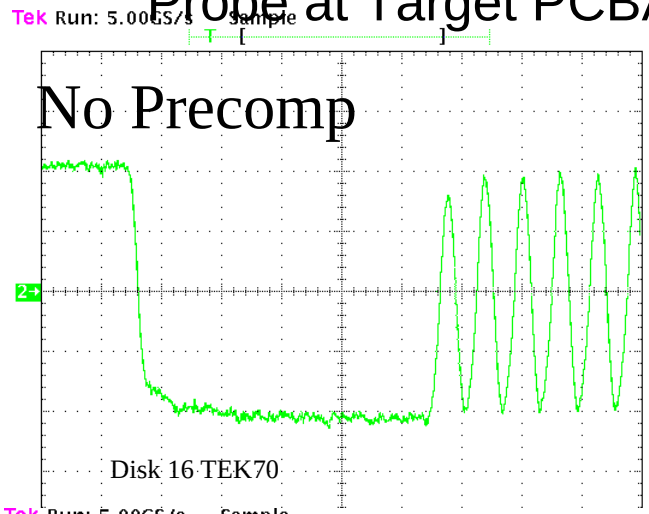


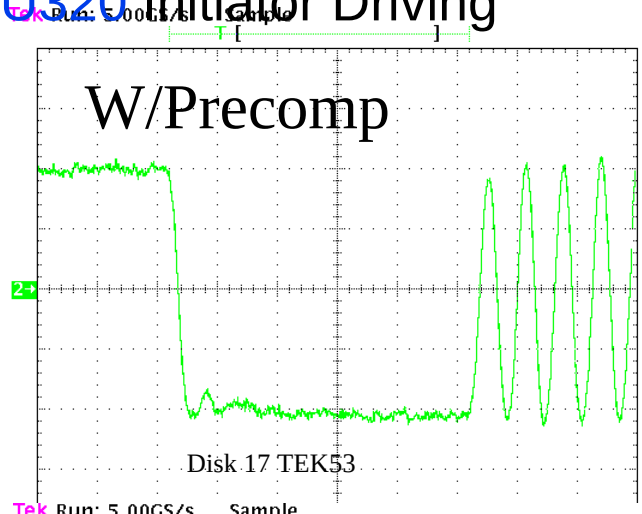


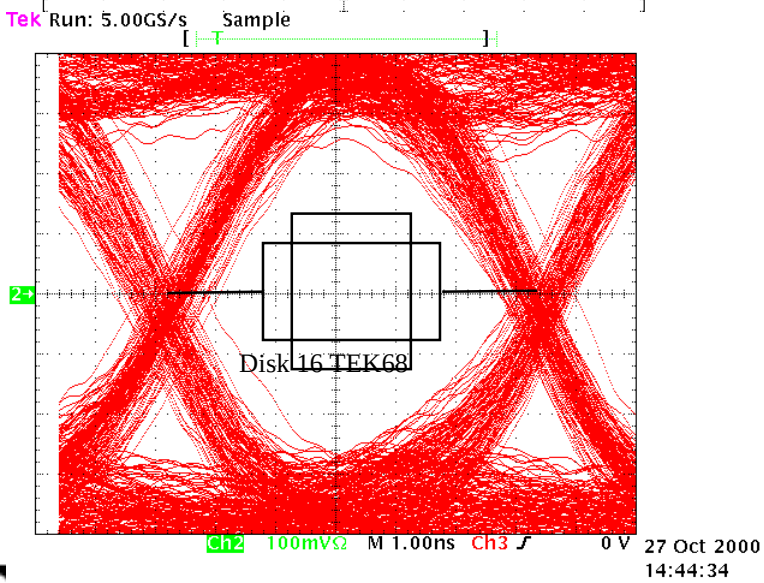
Seagate
Information the way you want it.

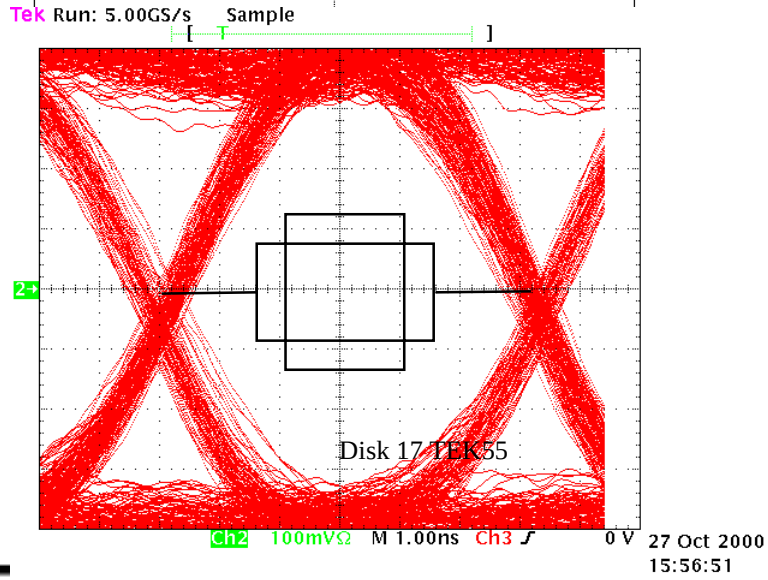
5-Slot Backplane - SU320 Initiator -12m Rnd , Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving









Seagate
Information the way you want it.

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

Seagate Technology

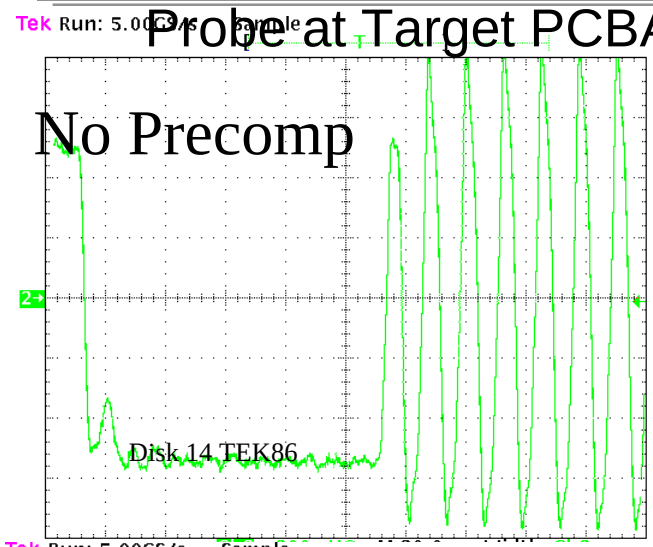
VLSI Controller Development

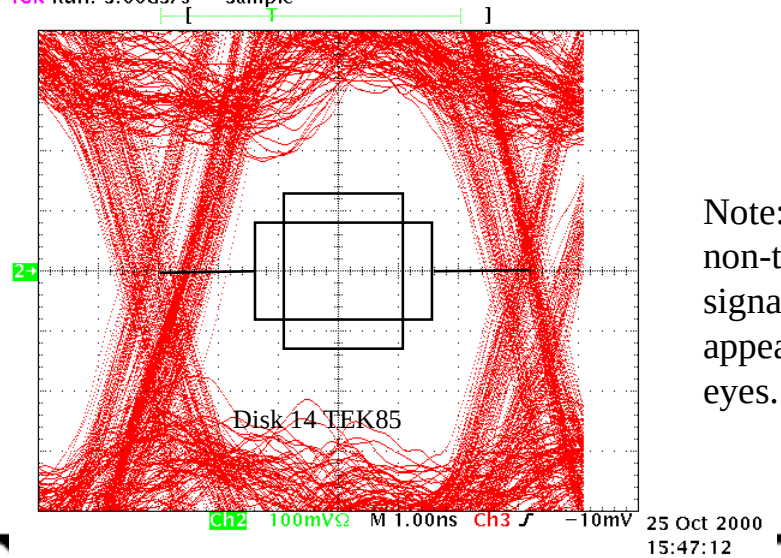
Scotts Valley California

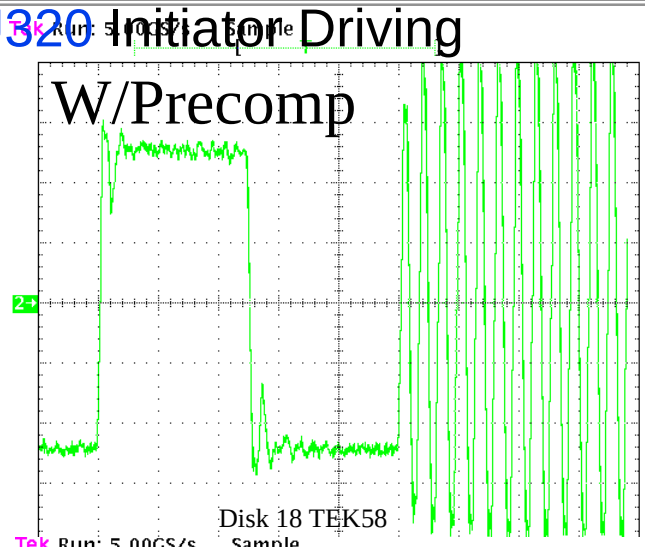
Seagate
Information the way you want it.

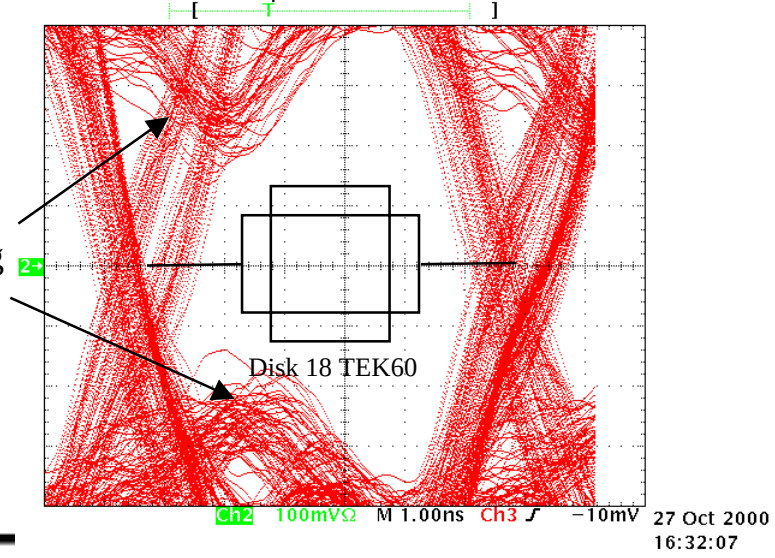
6-Slot Backplane-A - SU320 Initiator -28" TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving







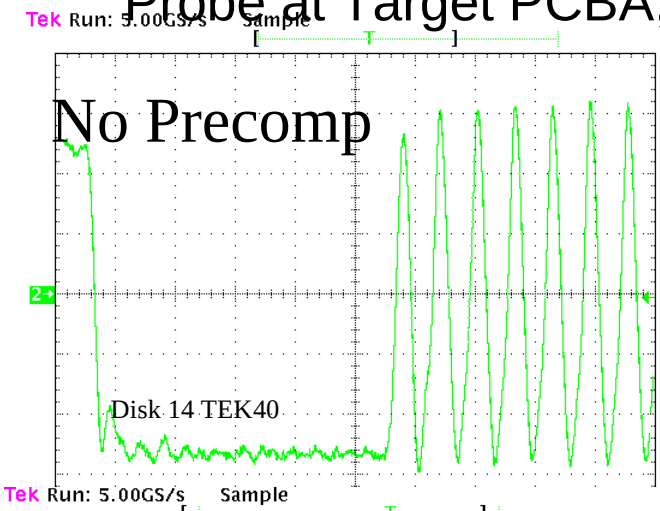


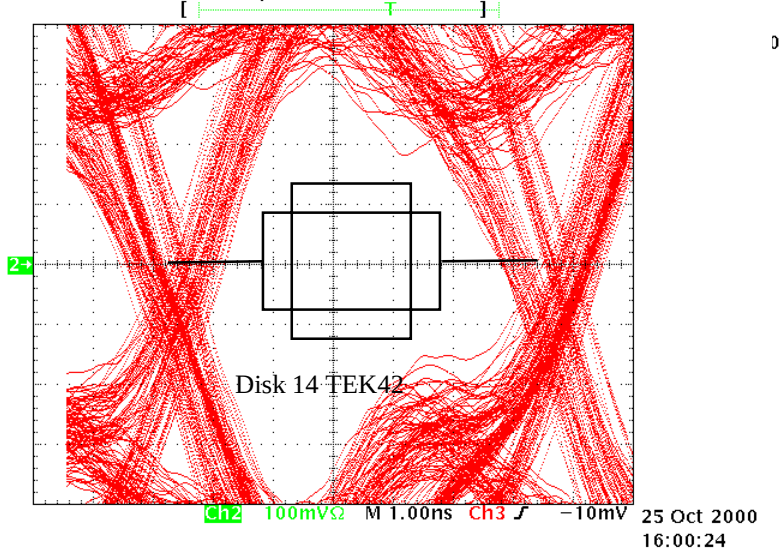
Note: these are non-transitioning signals, and also appear in U160 eyes.

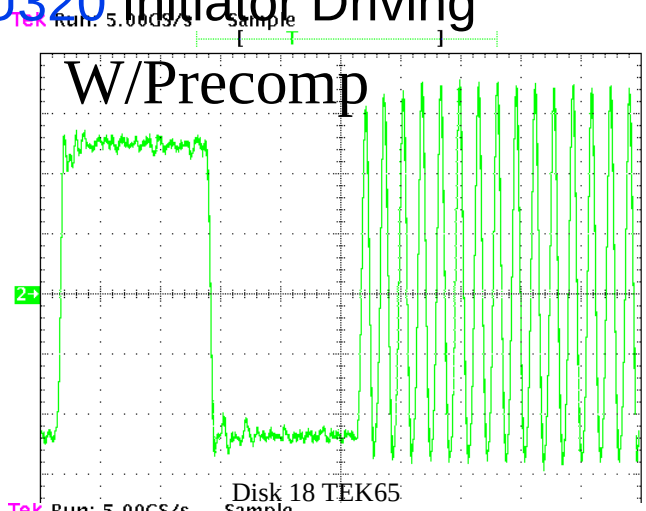
Seagate
Information the way you want it.

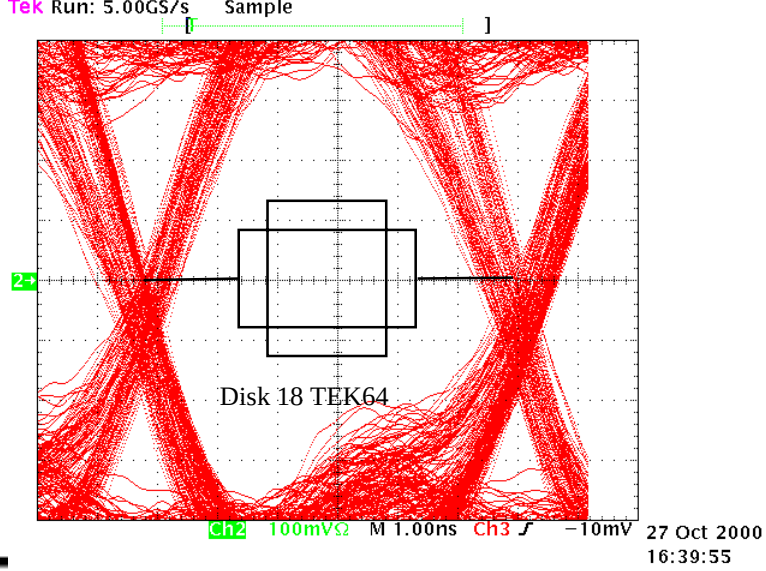
6-Slot Backplane-A - SU320 Initiator -28" TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





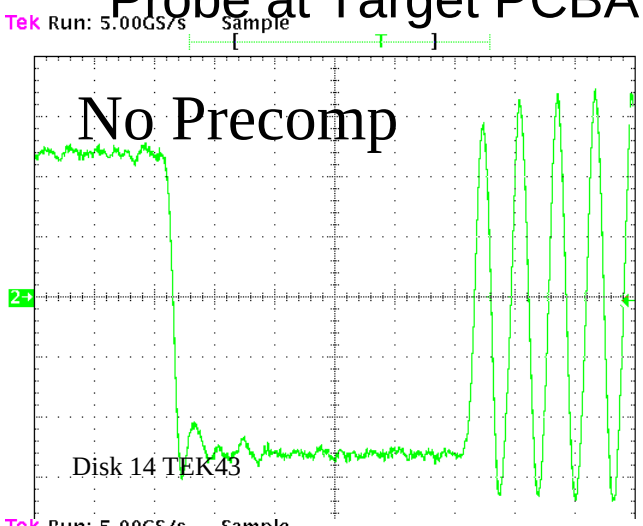


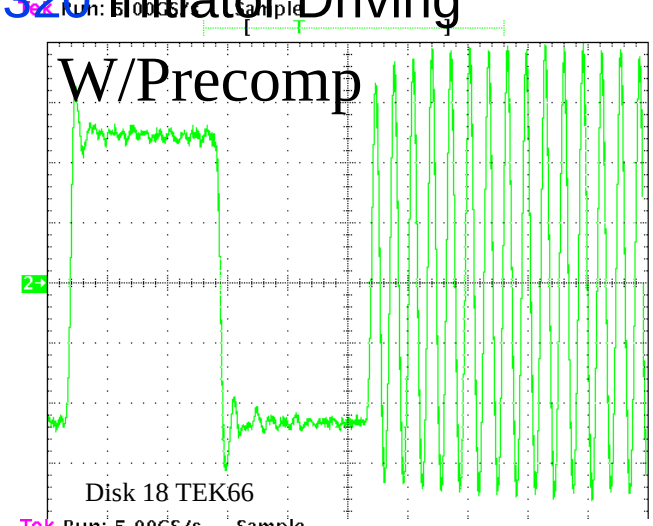


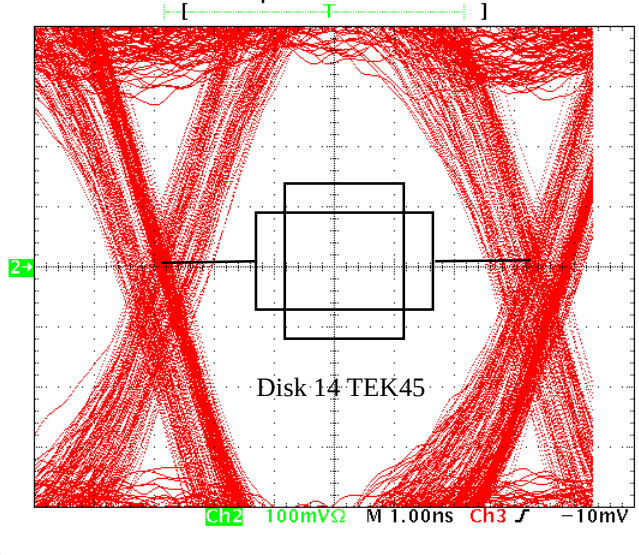
Seagate
Information the way you want it.

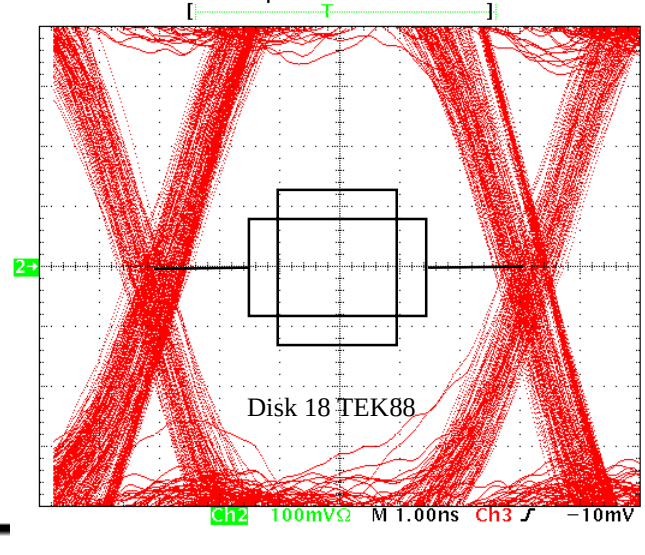
6-Slot Backplane-A - SU320 Initiator -28" TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving









Seagate
Information the way you want it.

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.

Seagate
Information the way you want it.

SCSI Signal, Backplane & Cable Analysis
6-Slot Backplane “B”
U320 Target and Initiator Silicon

Seagate Technology

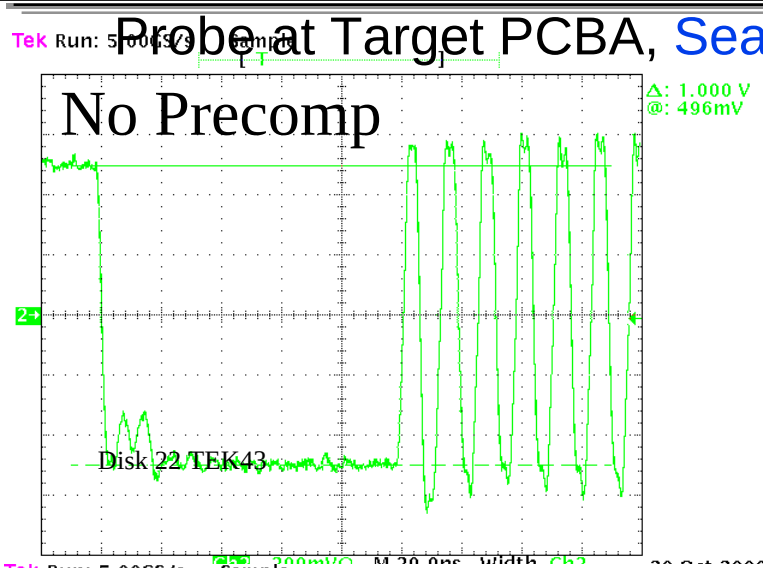
VLSI Controller Development

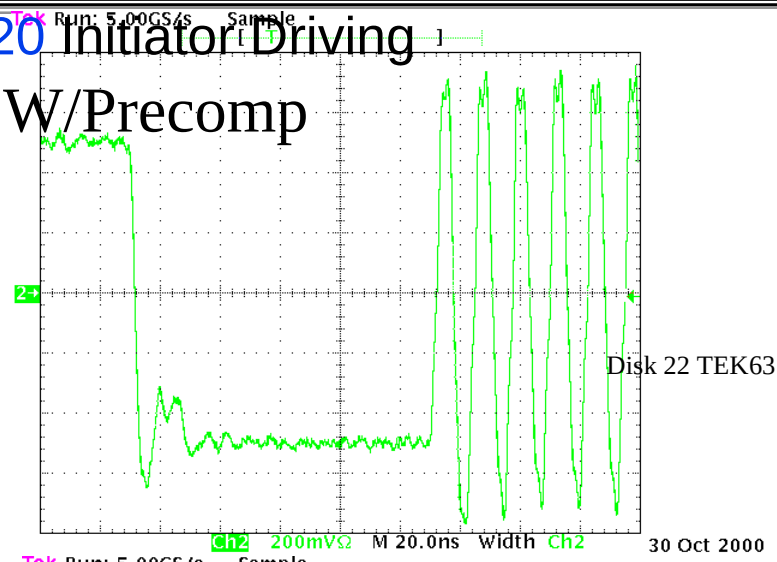
Scotts Valley California

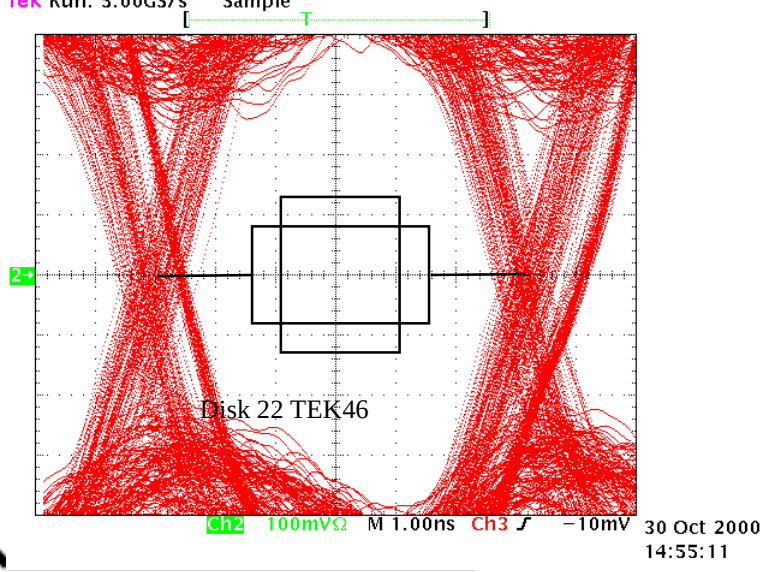
Seagate
Information the way you want it.

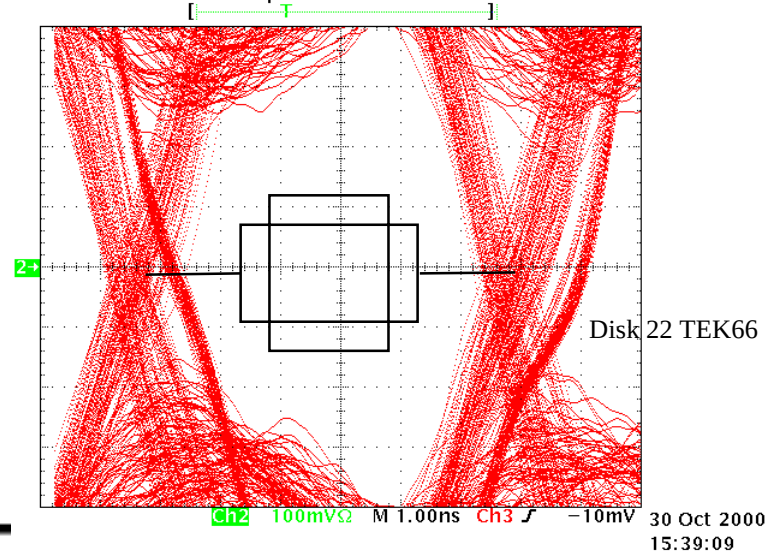
6-Slot Backplane-B - SU320 Initiator -28" TnF, First Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





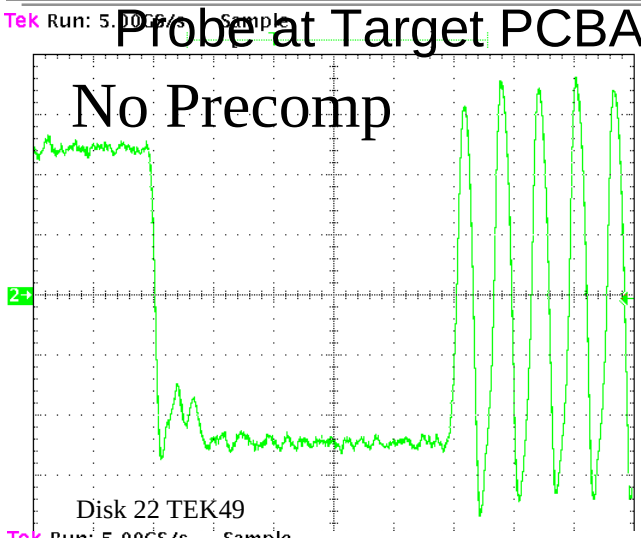


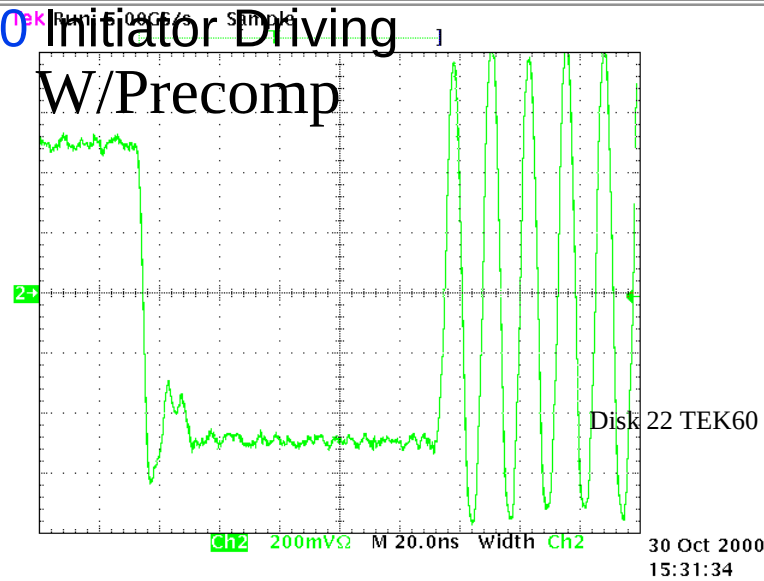


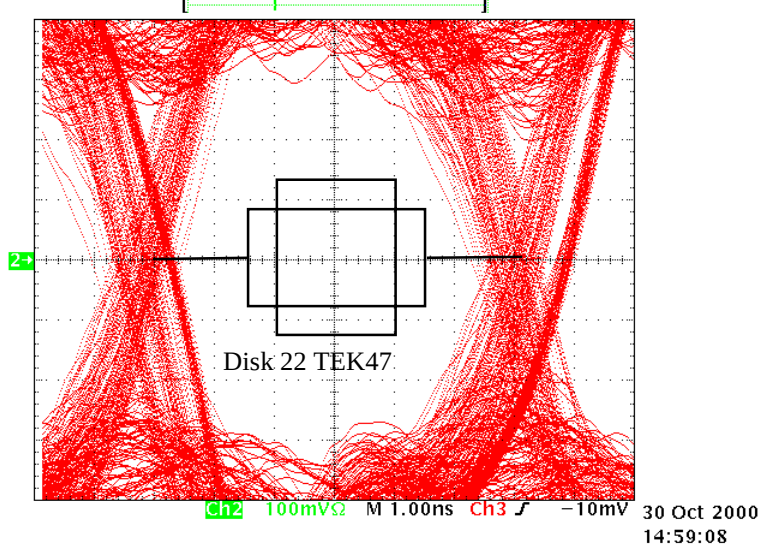
Seagate
Information the way you want it.

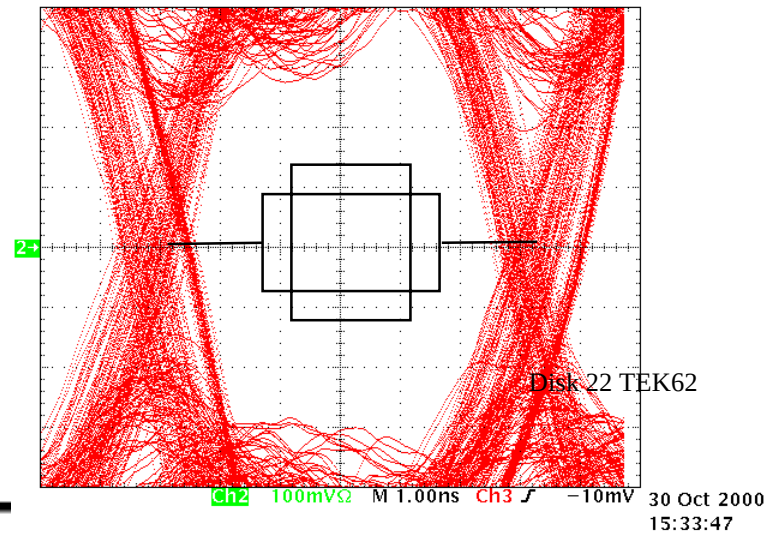
6-Slot Backplane-B - SU320 Initiator -28" TnF, Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





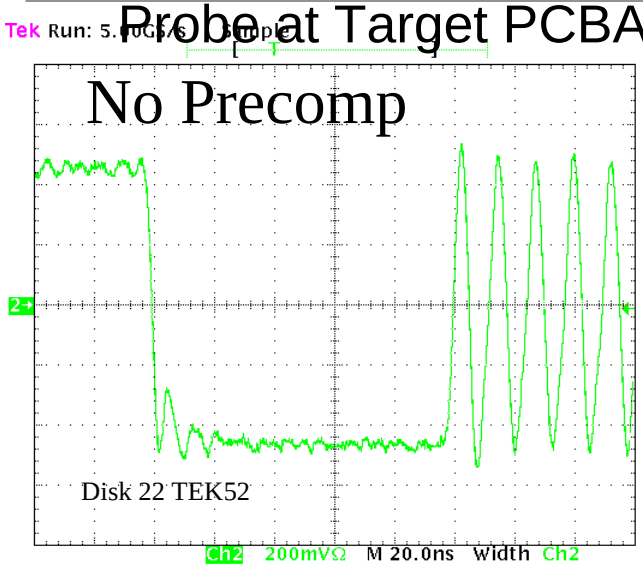


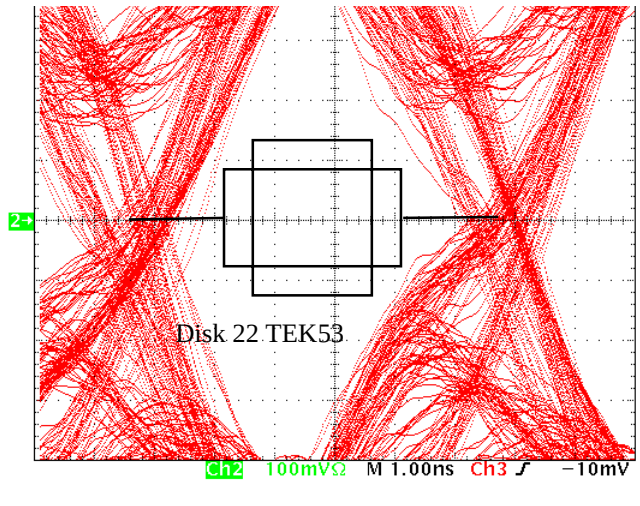


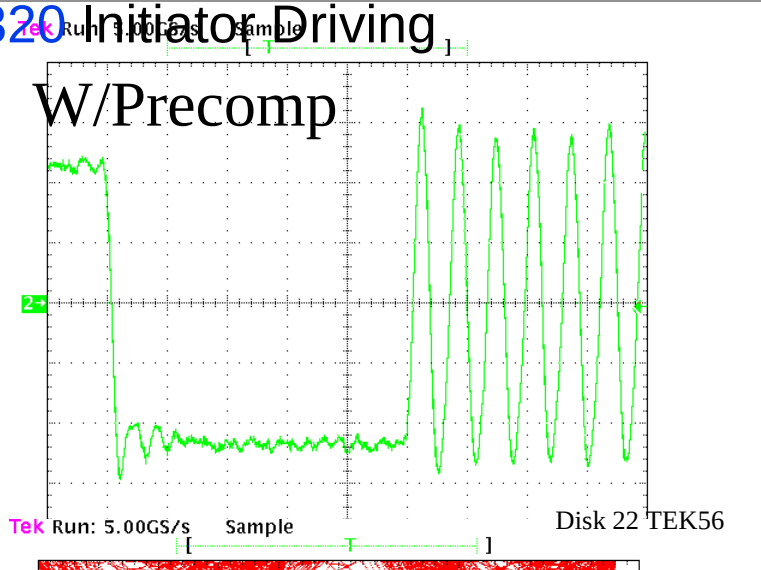
Seagate
Information the way you want it.

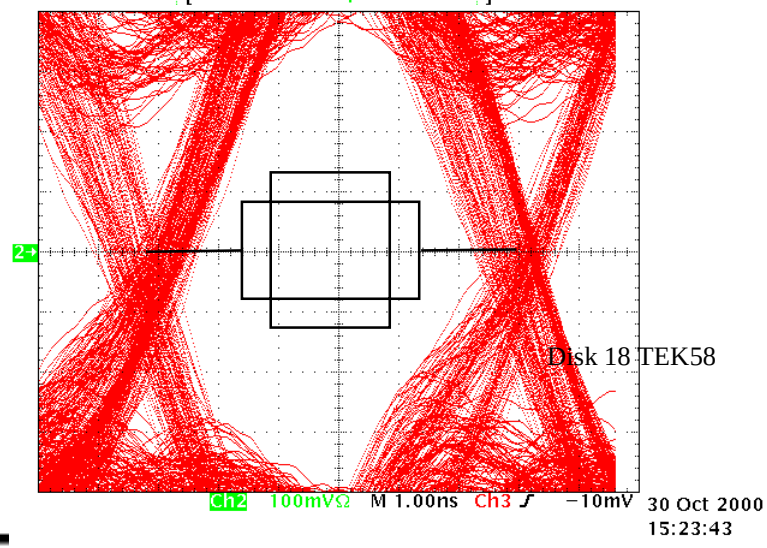
6-Slot Backplane-B - SU320 Initiator -28" TnF, Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





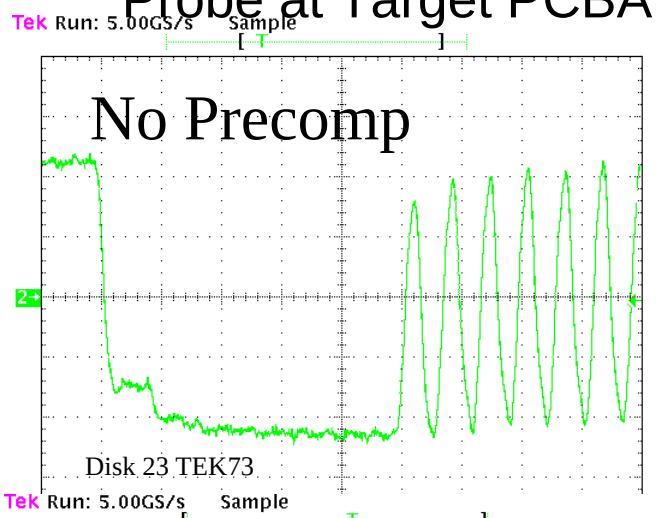


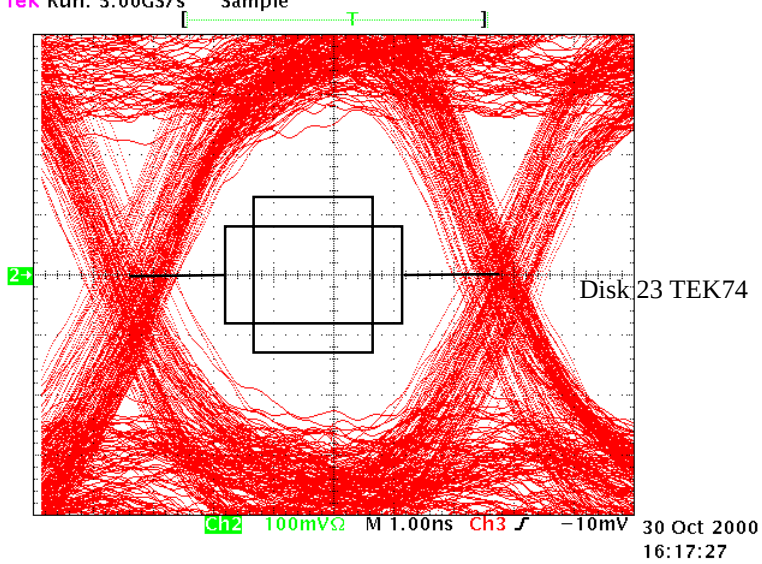


Seagate
Information the way you want it.

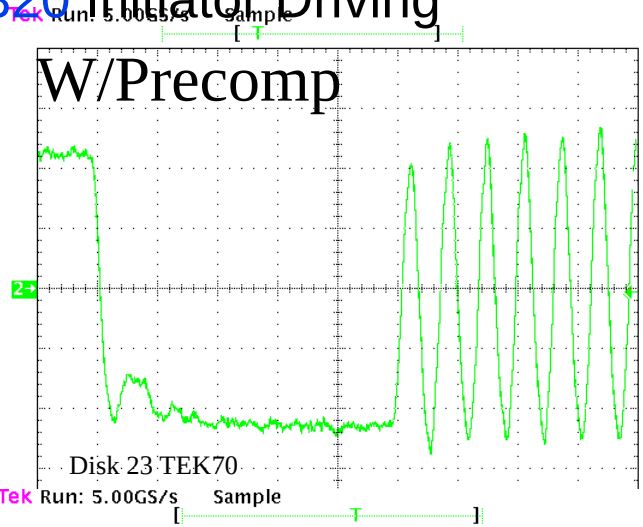
6-Slot Backplane-B - SU320 Initiator -12m Rnd, First Slot

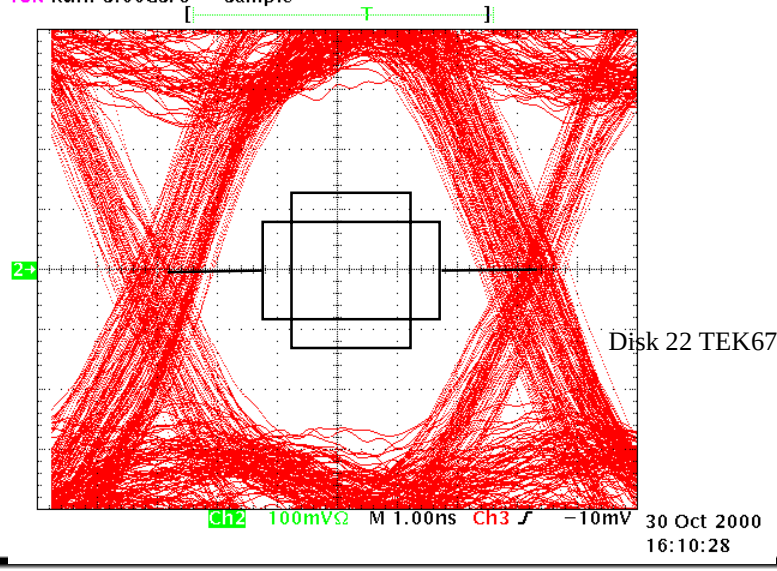
Probe at Target PCBA, Seagate U320 Initiator Driving





Disk 23 TEK74





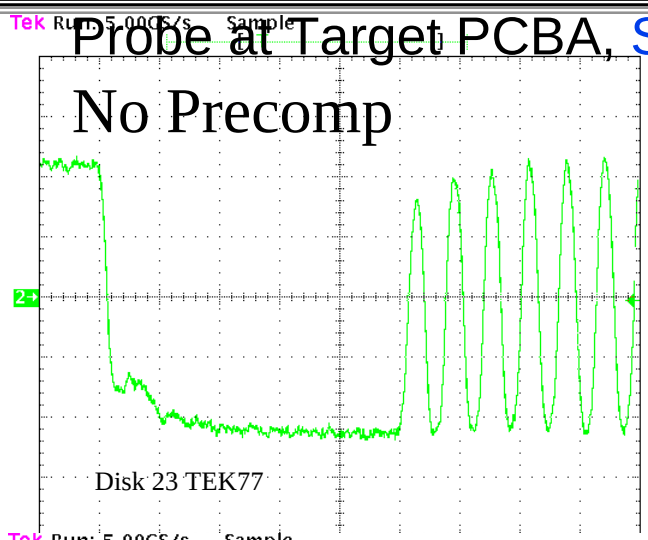
Disk 22 TEK67

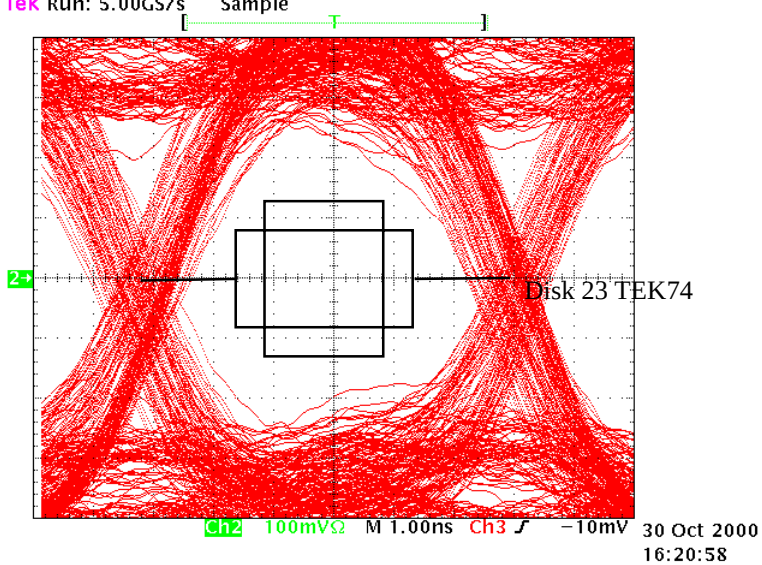
Seagate
Information the way you want it.

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

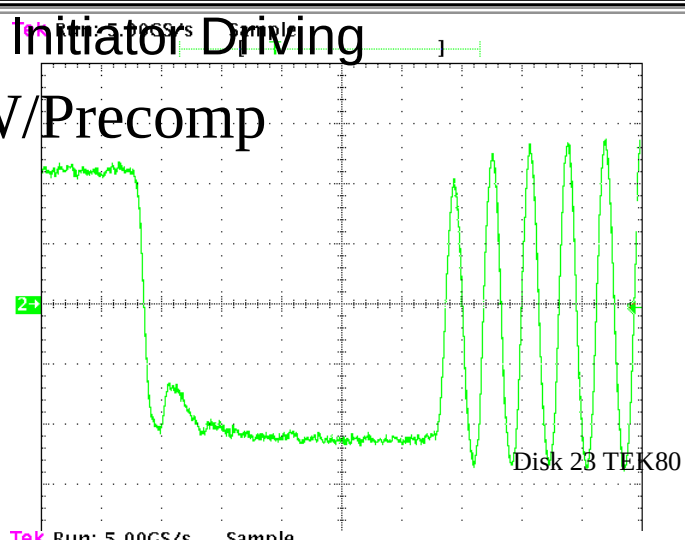
Probe at Target PCBA, Seagate U320 Initiator Driving

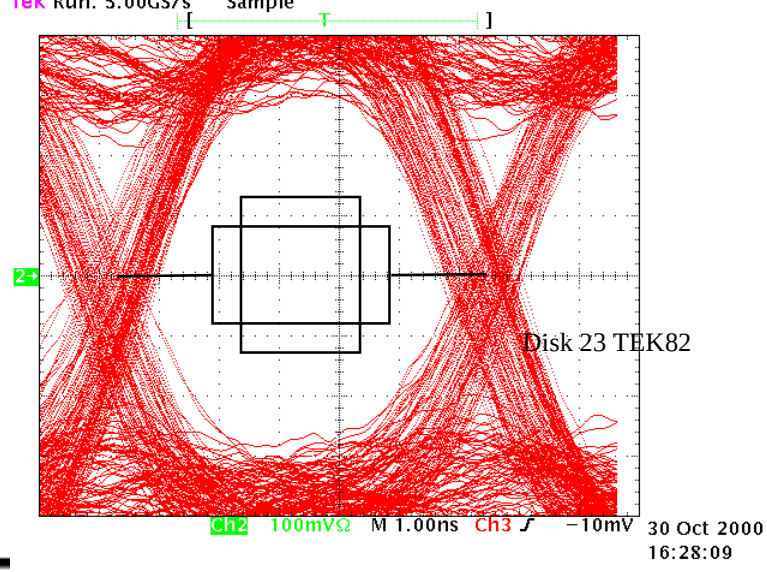
No Precomp





W/Precomp



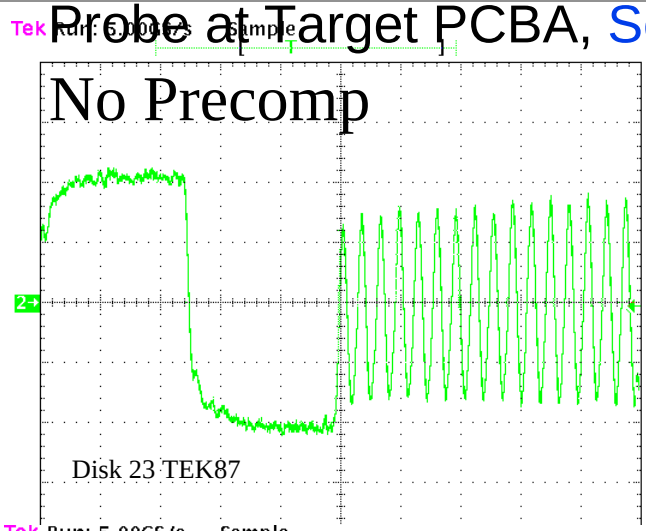


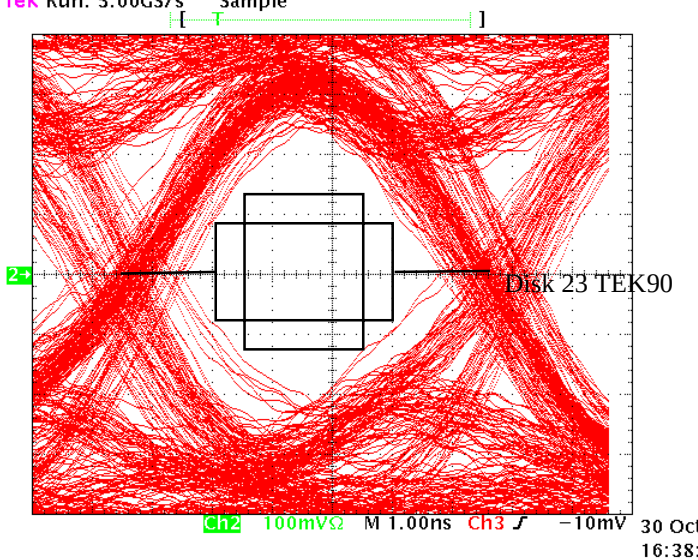
Seagate
Information the way you want it.

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

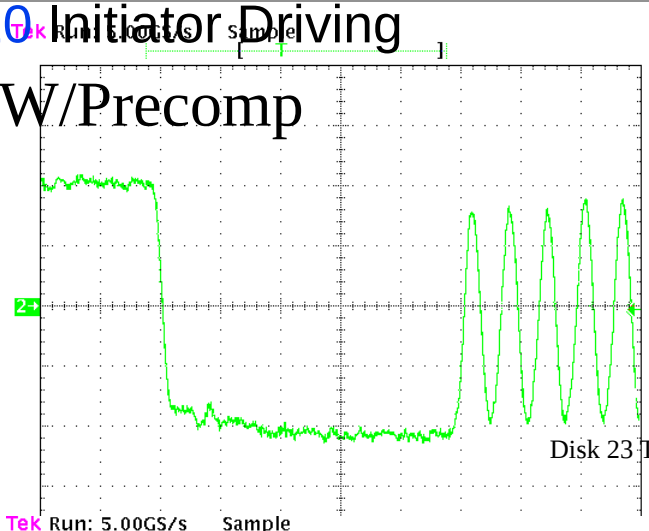
Probe at Target PCBA, Seagate U320 Initiator Driving

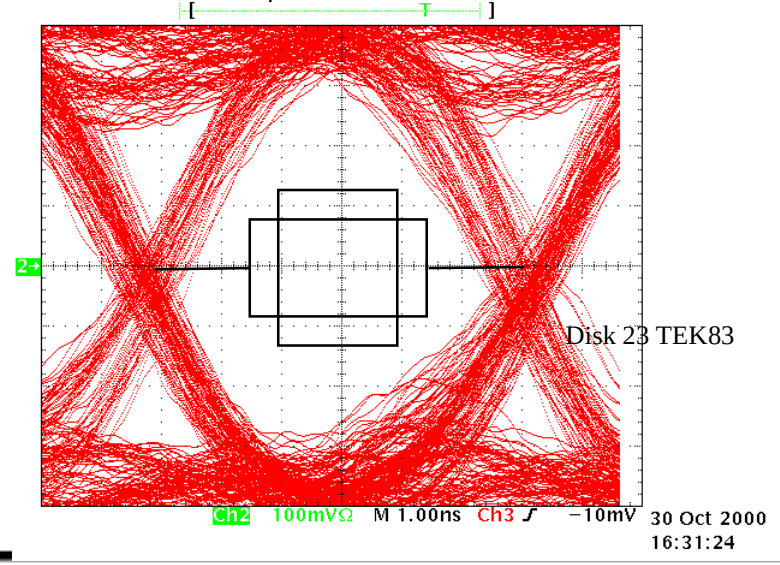
No Precomp





W/Precomp





Seagate
Information the way you want it.

SCSI Signal, Backplane & Cable Analysis
10-Slot Backplane
U320 Target and Initiator Silicon

Seagate Technology

VLSI Controller Development

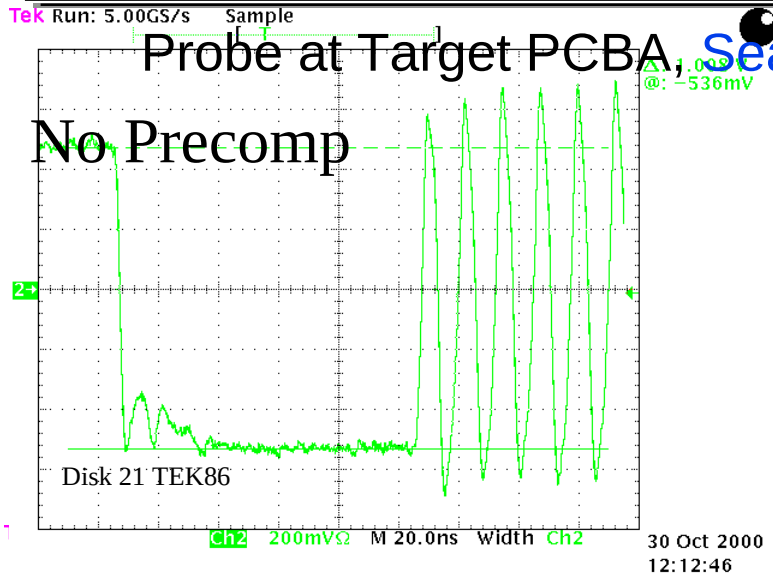
Scotts Valley California

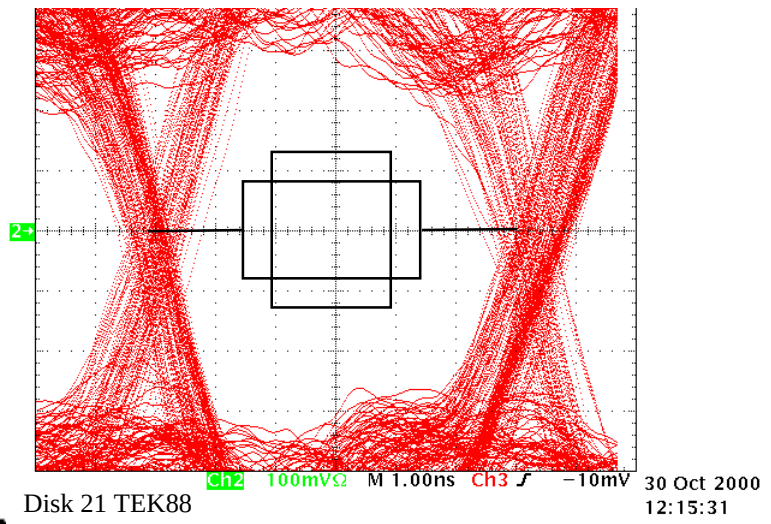
Seagate
Information the way you want it.

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

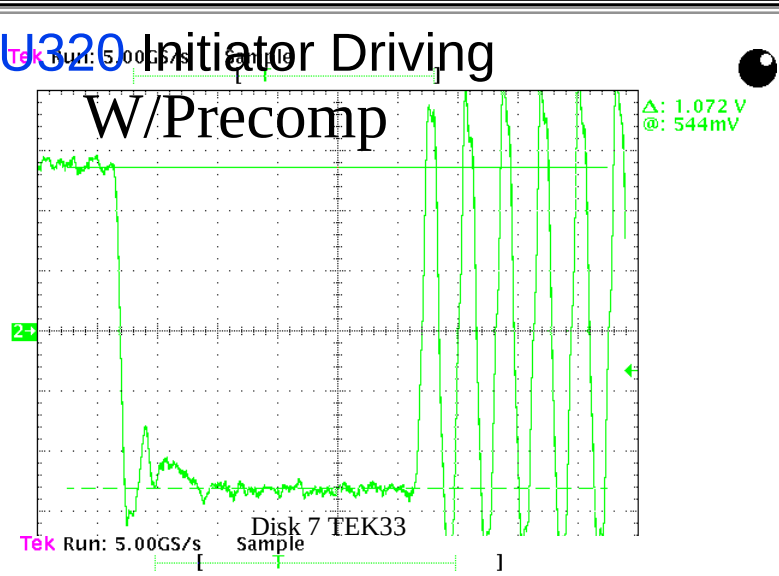
Probe at Target PCBA, Seagate U320 Initiator Driving

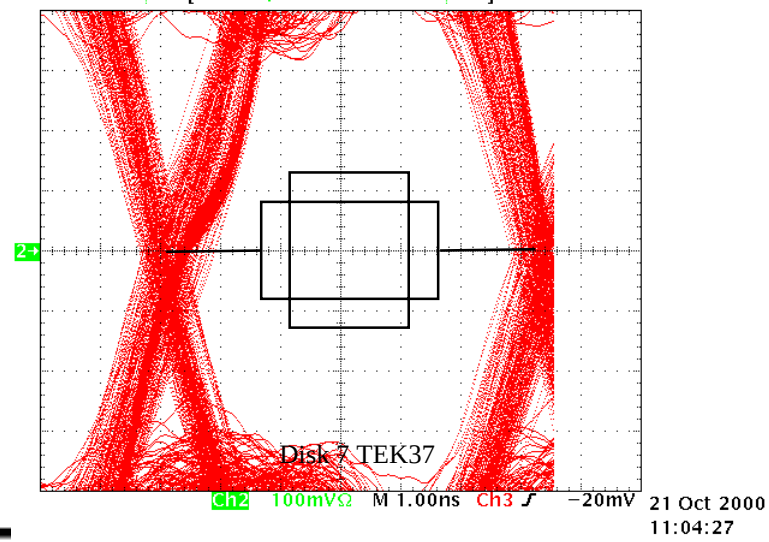
No Precomp





W/Precomp

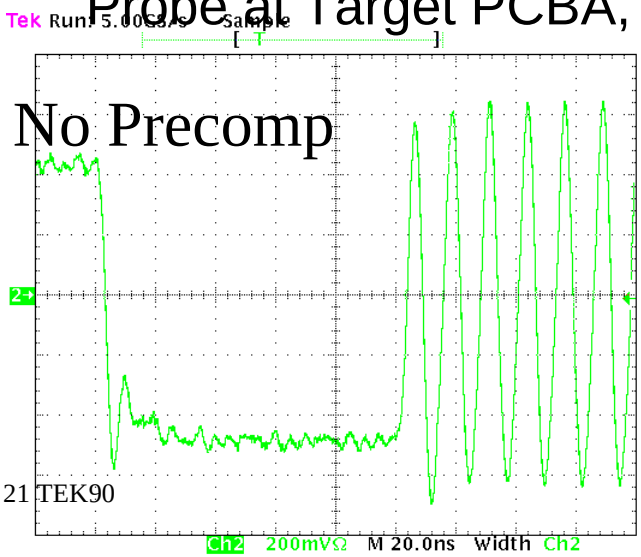




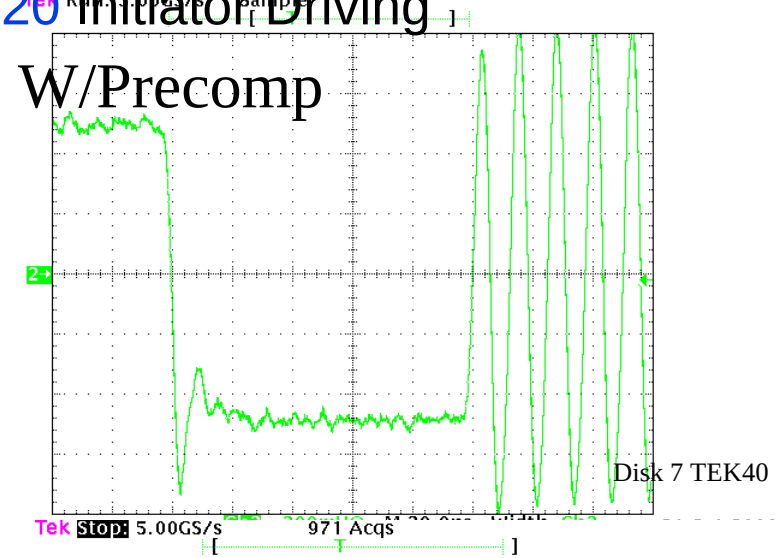
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -28" TnF, Middle Slot

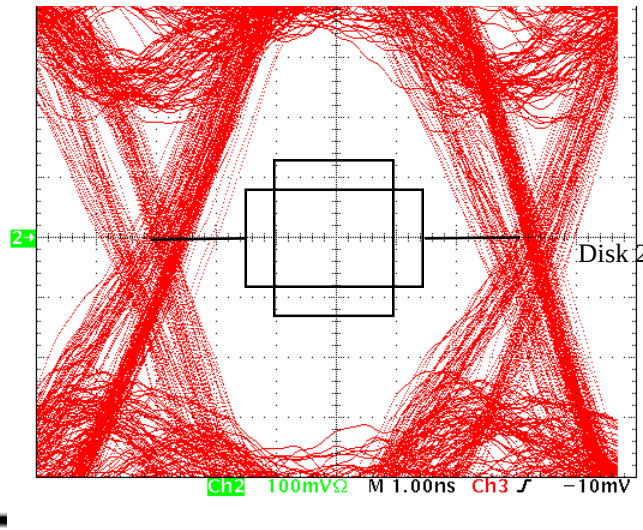
Probe at Target PCBA, Seagate U320 Initiator Driving



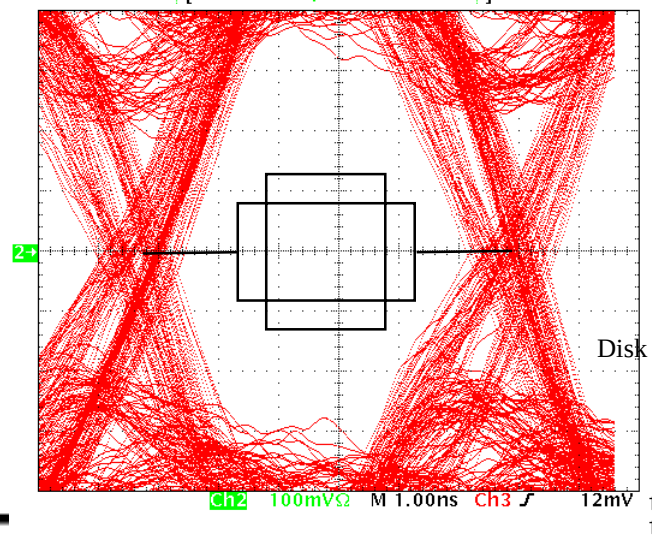
Disk 21 TEK90



Disk 7 TEK40



Disk 21 TEK89



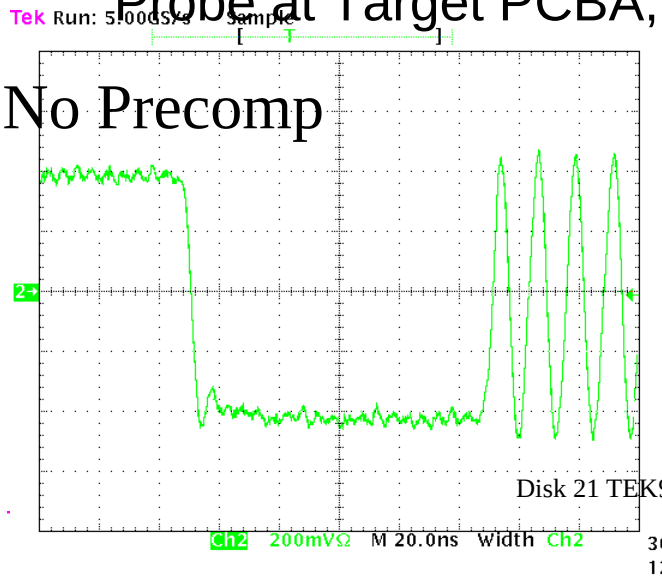
Disk 7 TEK38

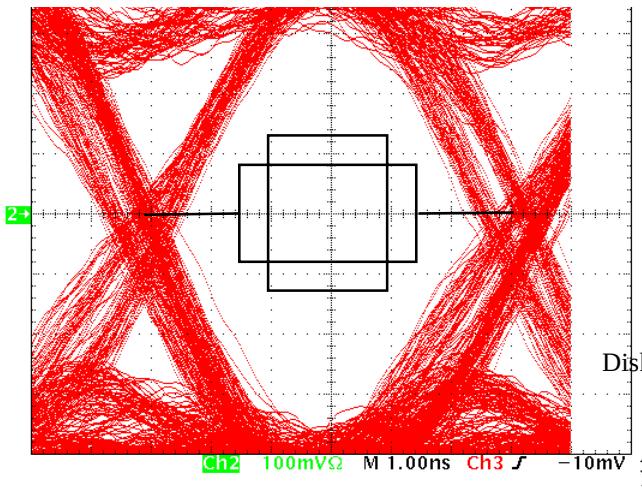
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -28" TnF, Last Slot

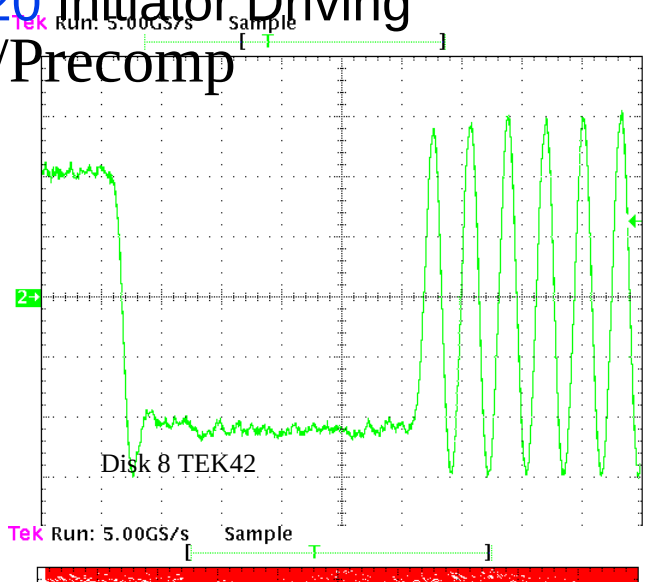
Probe at Target PCBA, Seagate U320 Initiator Driving

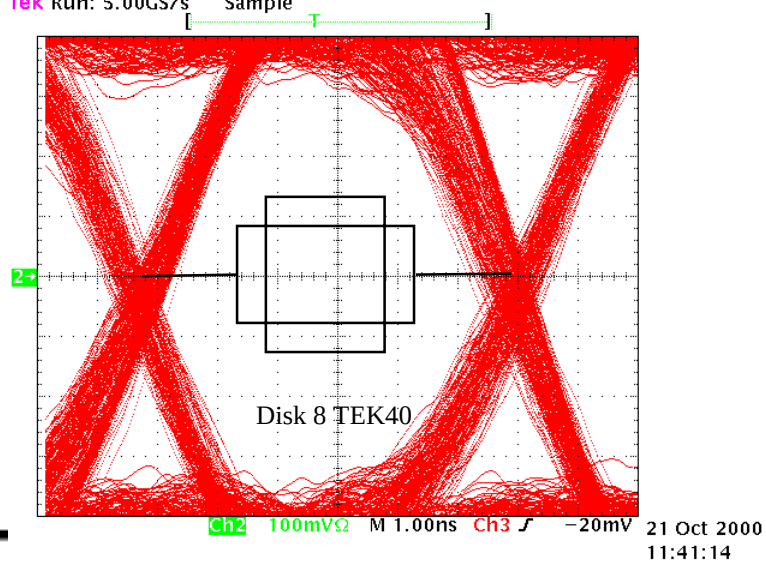
No Precomp





W/Precomp



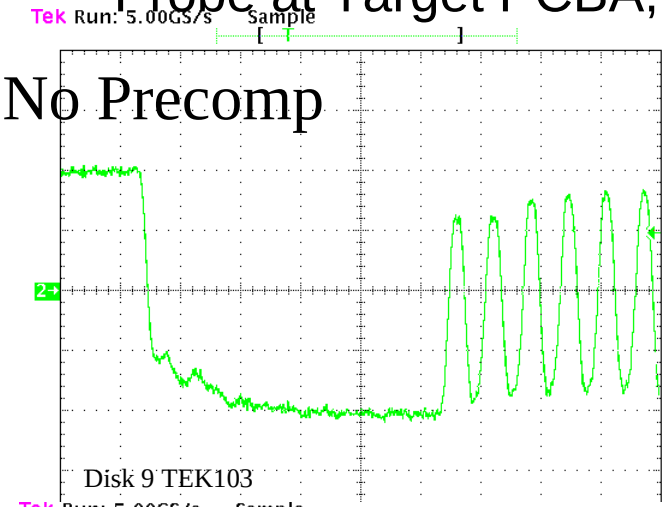


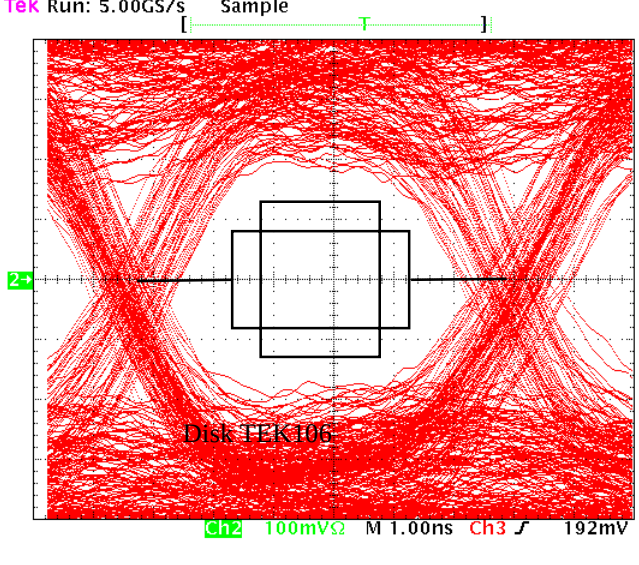
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -12m Rnd , First Slot

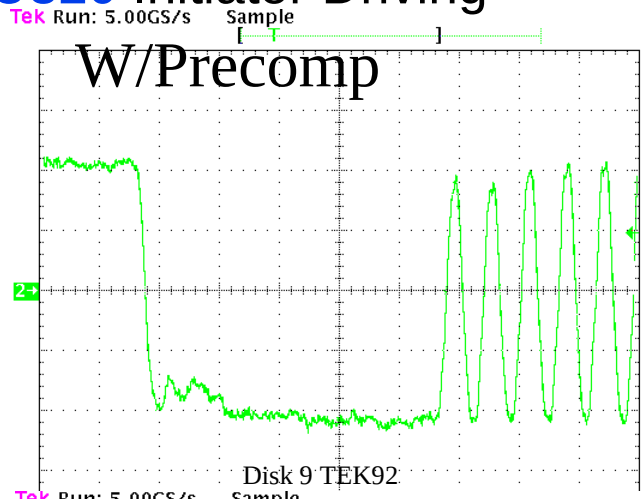
Probe at Target PCBA, Seagate U320 Initiator Driving

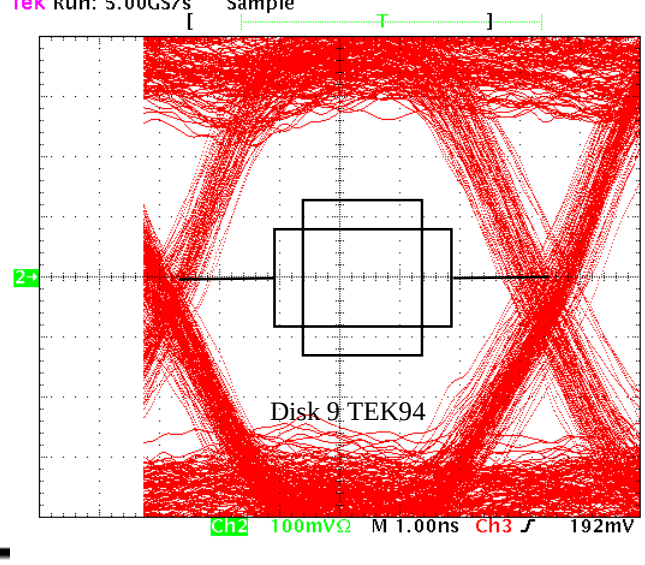
No Precomp





W/Precomp

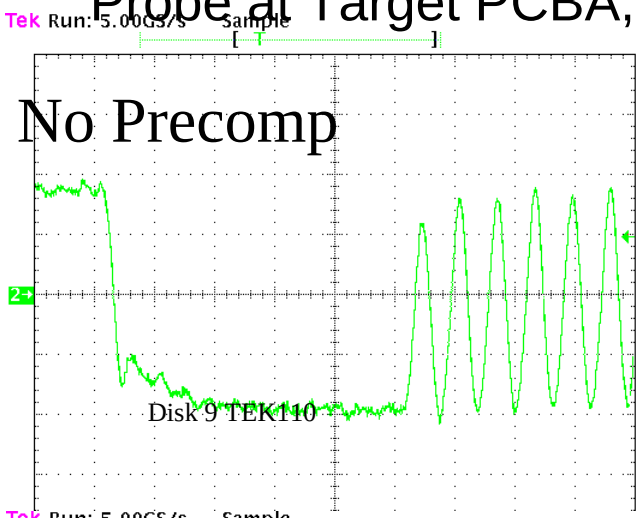


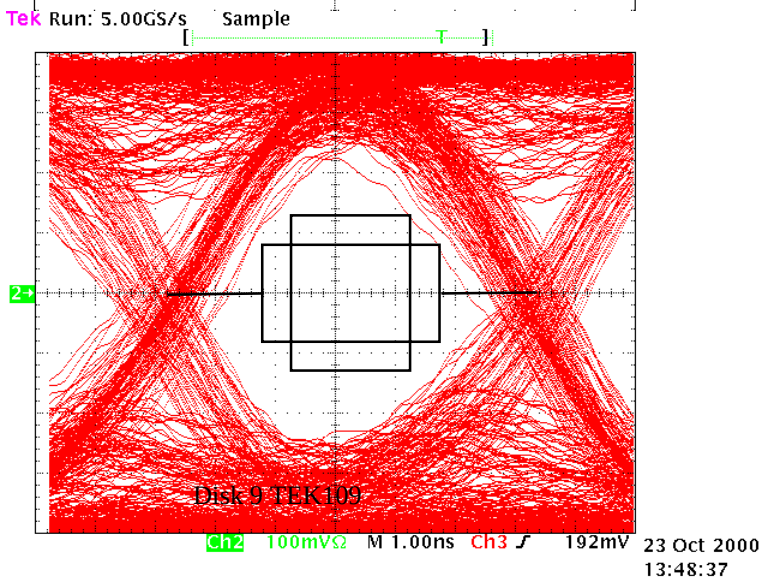


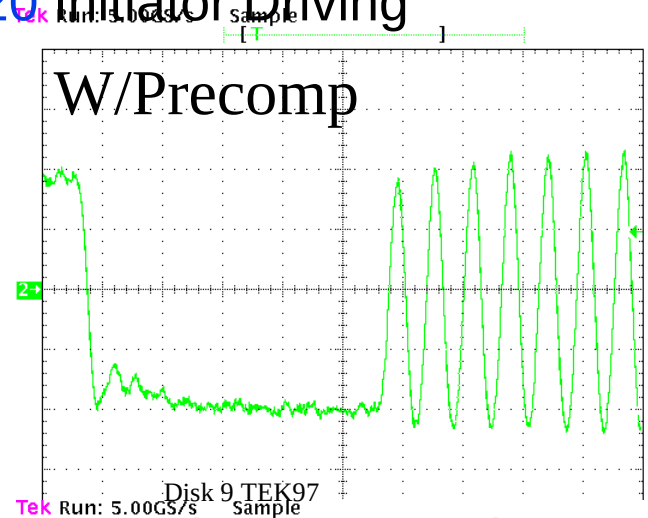
Seagate
Information the way you want it.

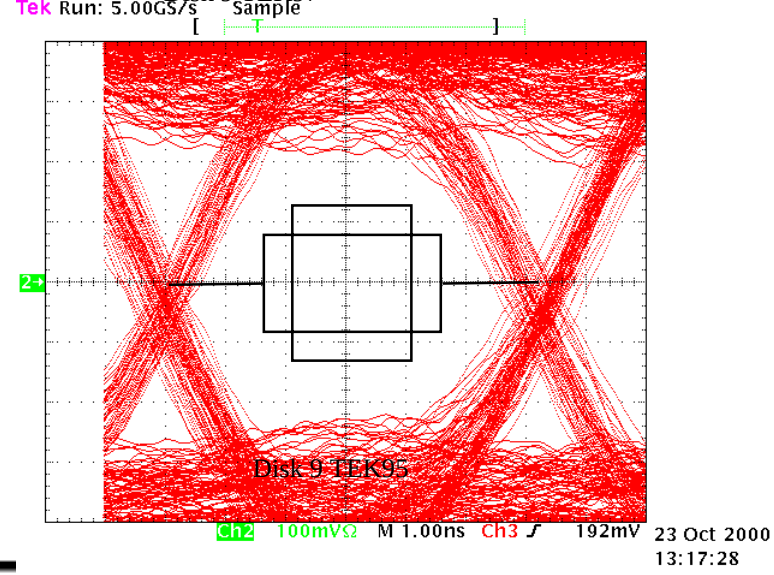
10 - Slot Backplane - SU320 Initiator -12m Rnd , Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





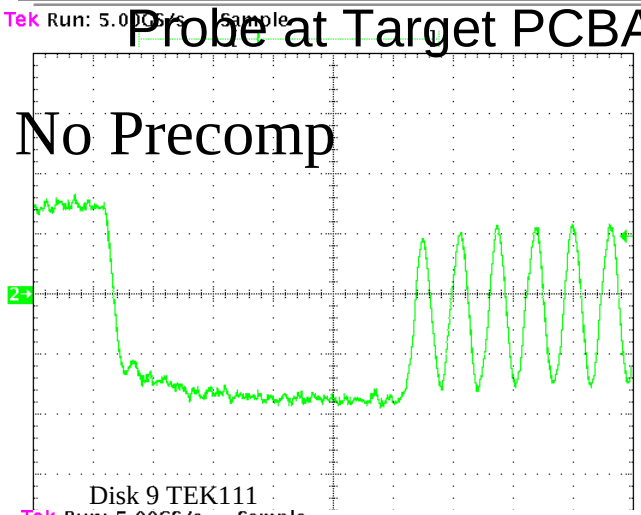


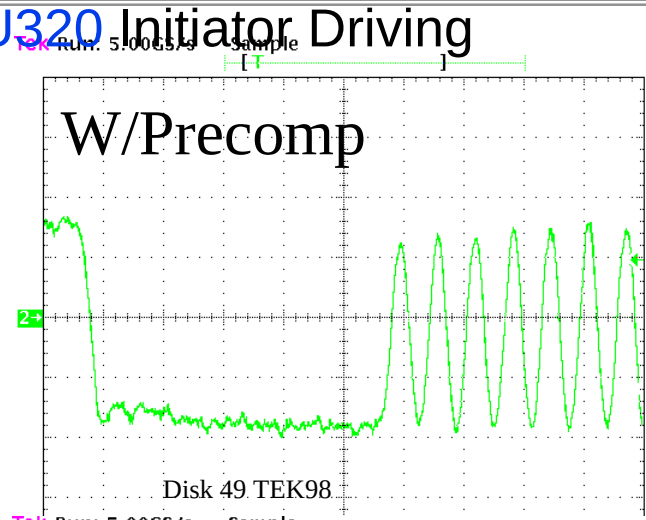


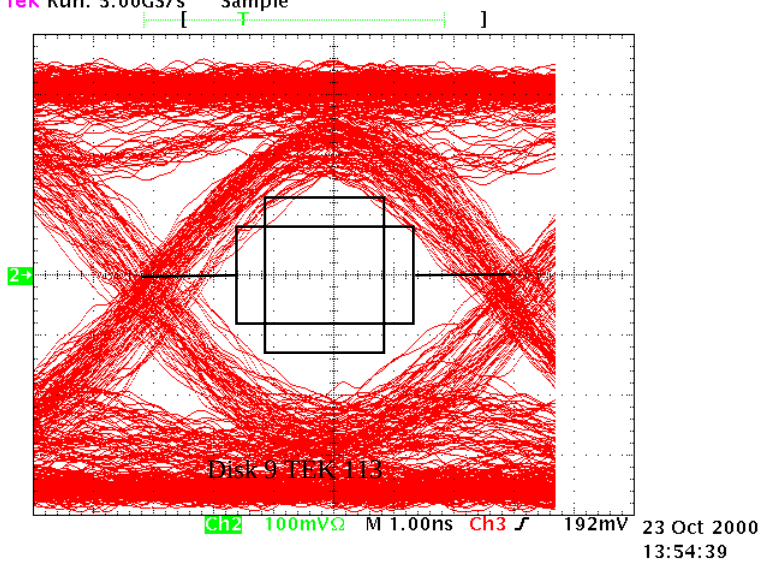
Seagate
Information the way you want it.

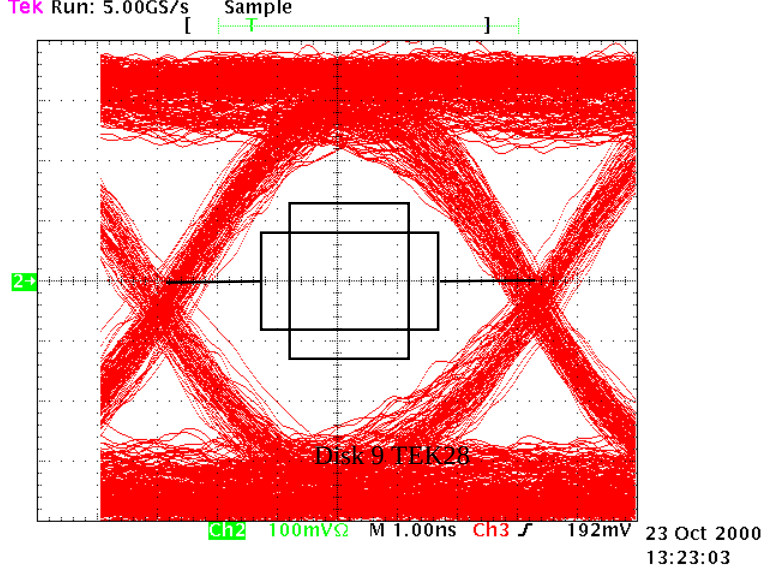
10 - Slot Backplane - SU320 Initiator -12m Rnd , Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving



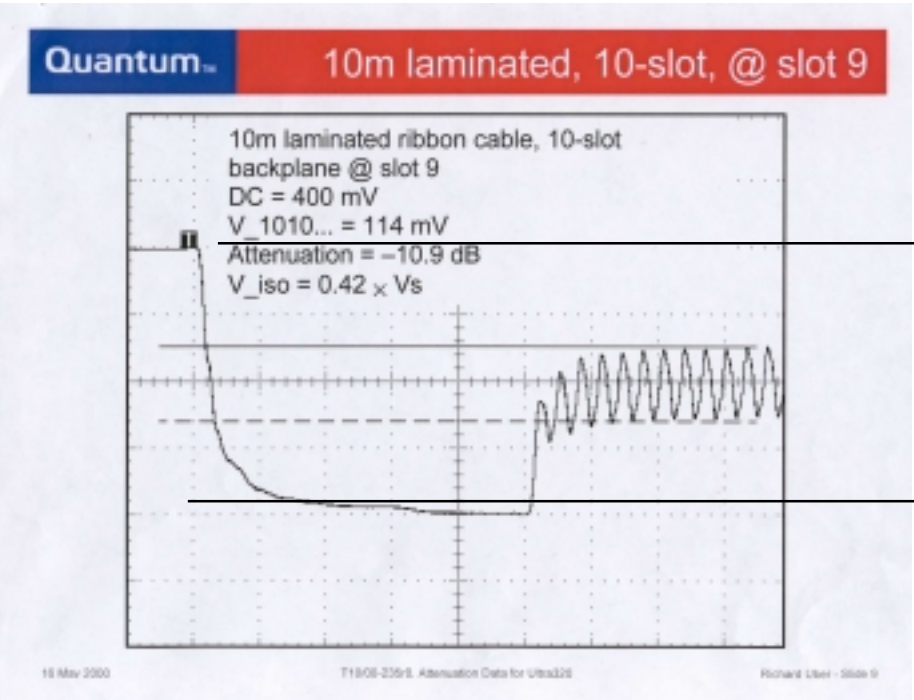


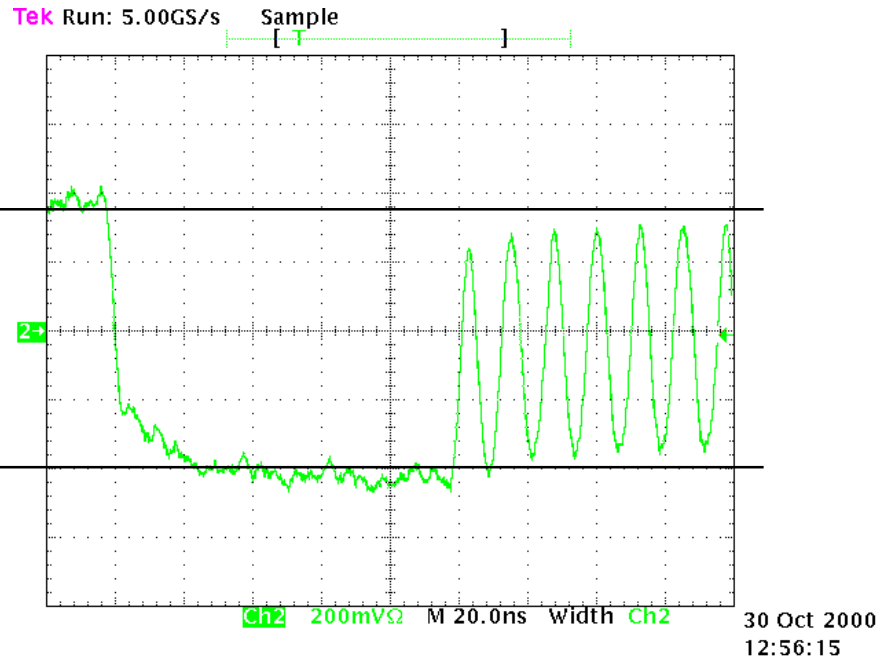




Seagate
Information the way you want it.

Cable & Backplane Attenuation Compared





Quantum Generator-Driver Example, 10m

12m Cable, Same Driver Amplitude, Slot, Backplane, **but** Real U320 Silicon

Seagate
Information the way you want it.

SCSI Signal, Backplane & Cable Analysis
10-Slot Backplane
U320 Target and Initiator Silicon

Seagate Technology

VLSI Controller Development

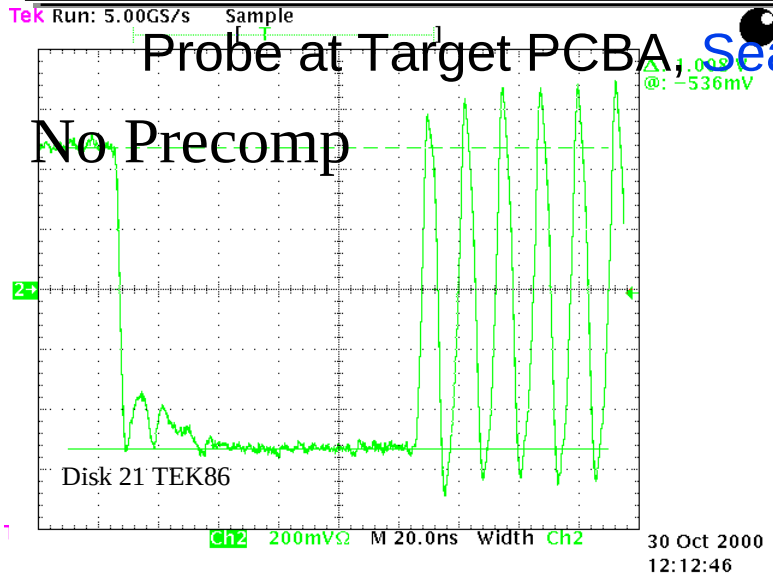
Scotts Valley California

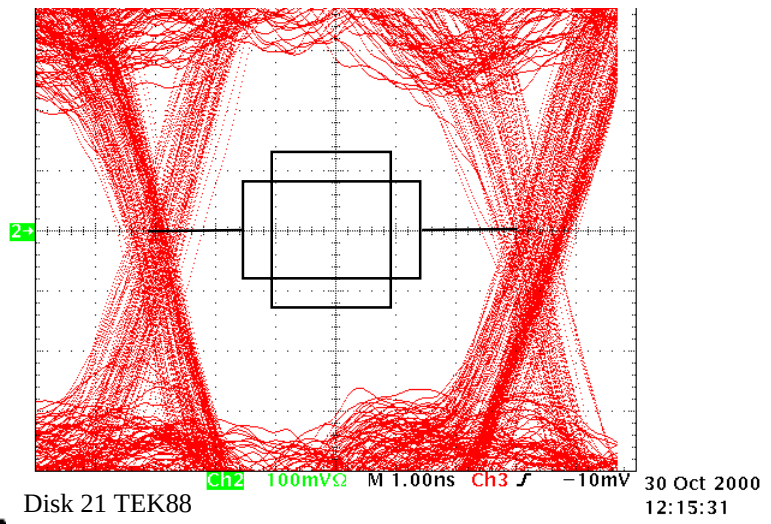
Seagate
Information the way you want it.

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

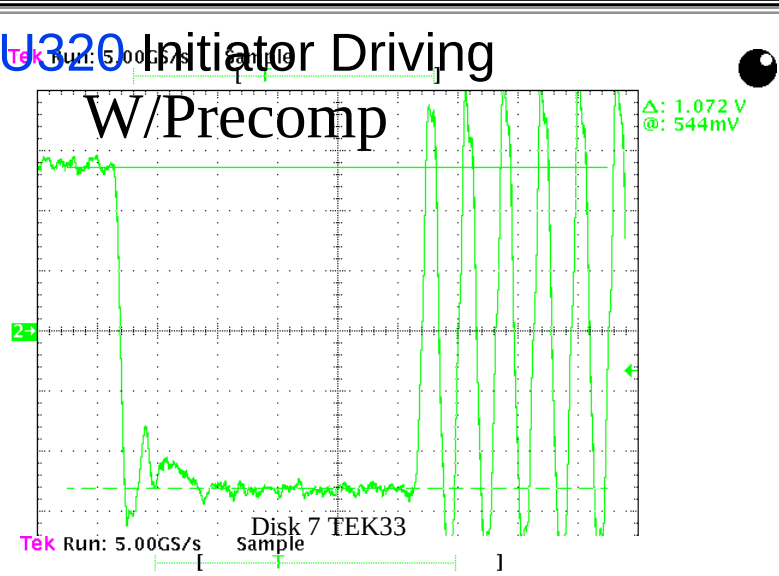
Probe at Target PCBA, Seagate U320 Initiator Driving

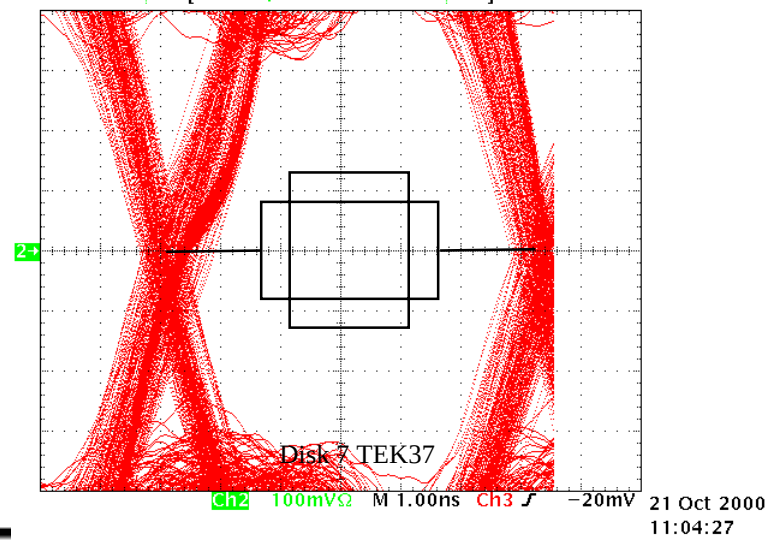
No Precomp





W/Precomp

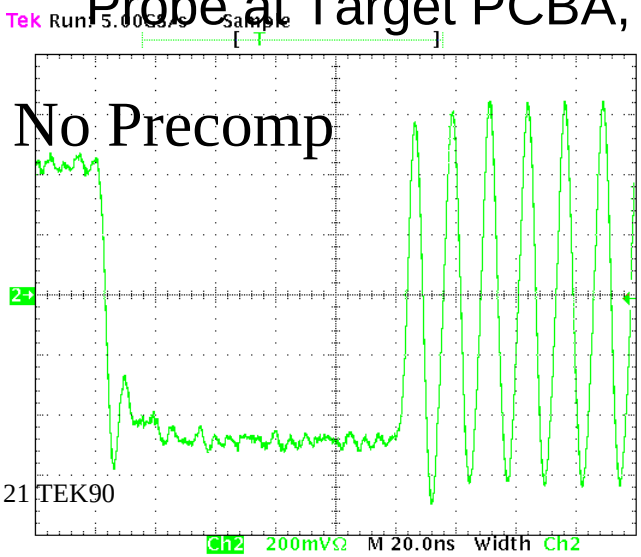




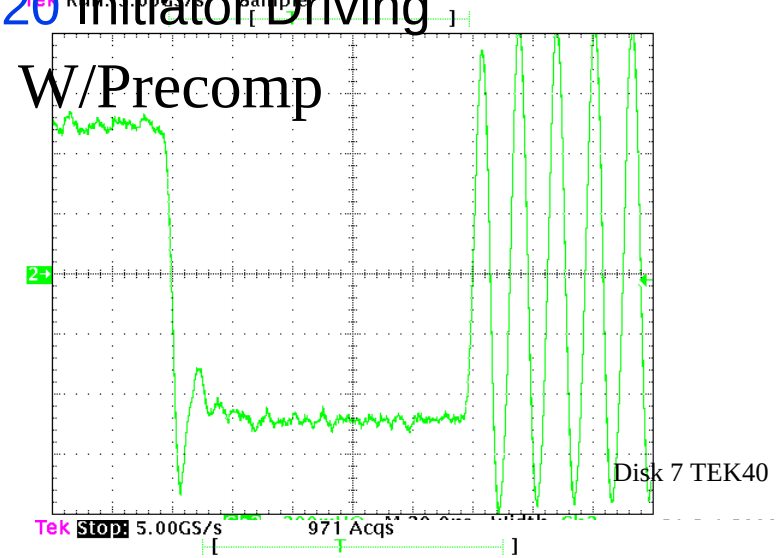
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -28" TnF, Middle Slot

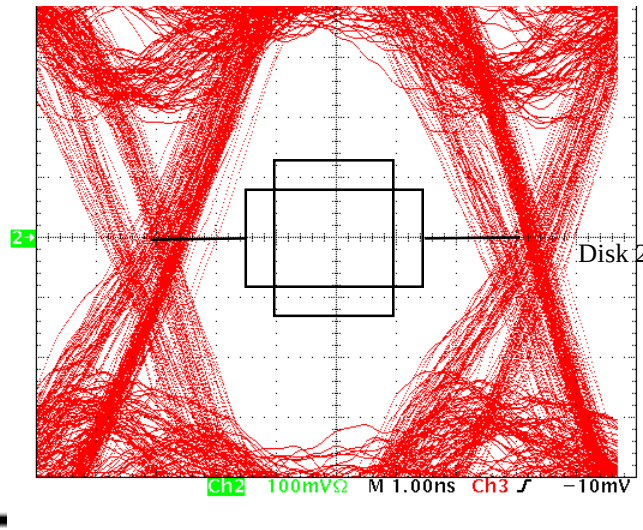
Probe at Target PCBA, Seagate U320 Initiator Driving



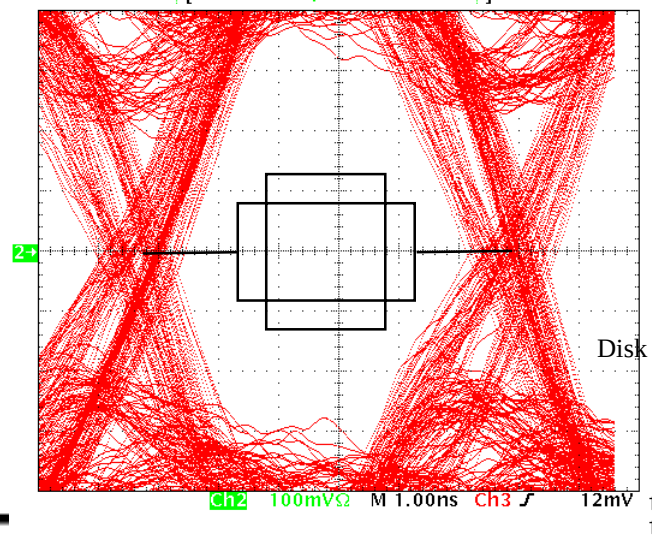
Disk 21 TEK90



Disk 7 TEK40



Disk 21 TEK89



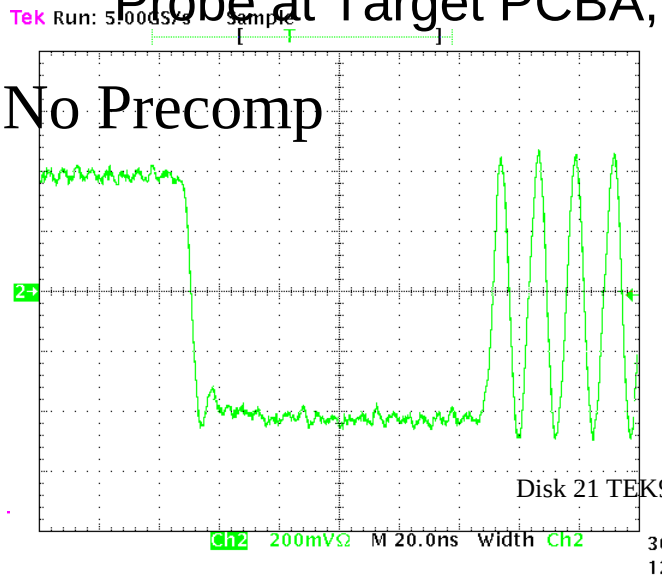
Disk 7 TEK38

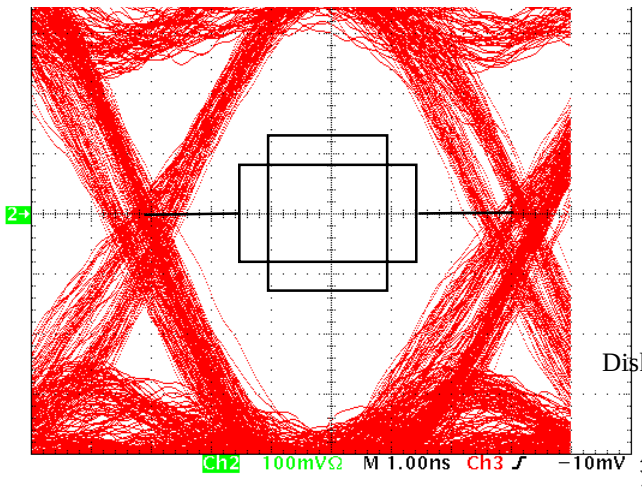
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -28" TnF, Last Slot

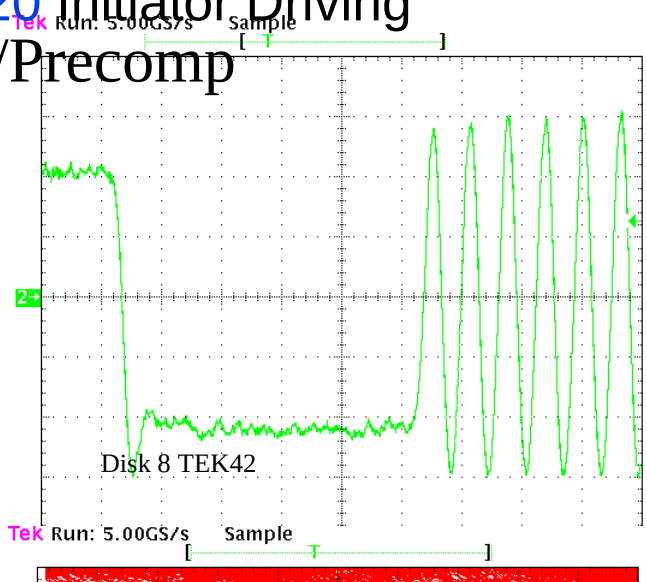
Probe at Target PCBA, Seagate U320 Initiator Driving

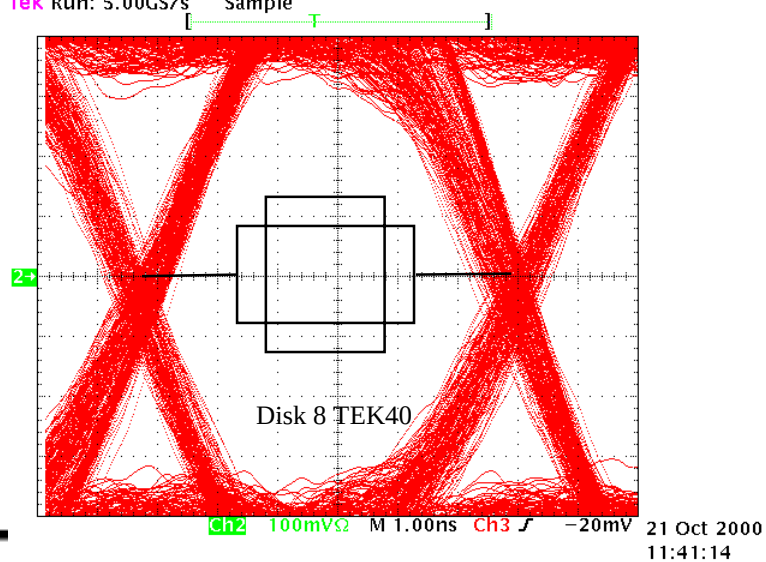
No Precomp





W/Precomp



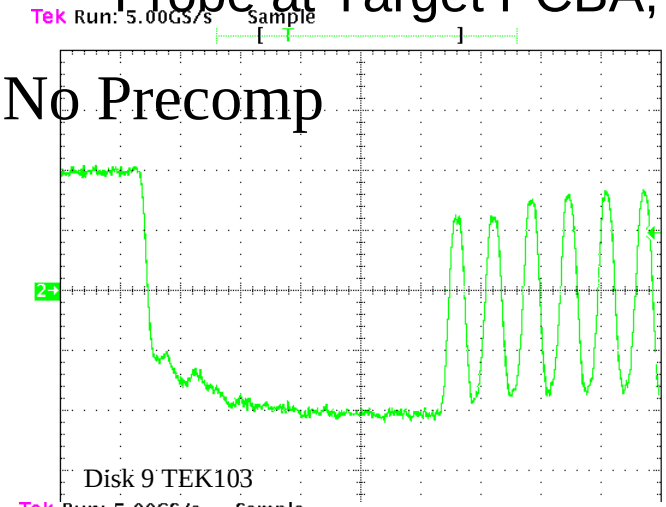


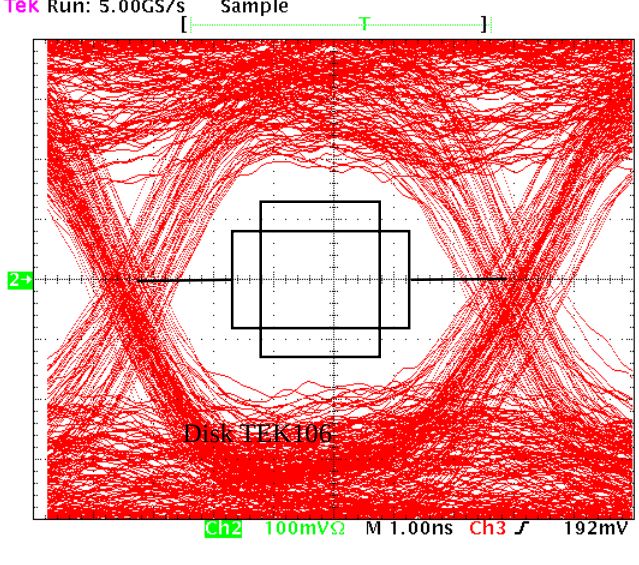
Seagate
Information the way you want it.

10 - Slot Backplane - SU320 Initiator -12m Rnd , First Slot

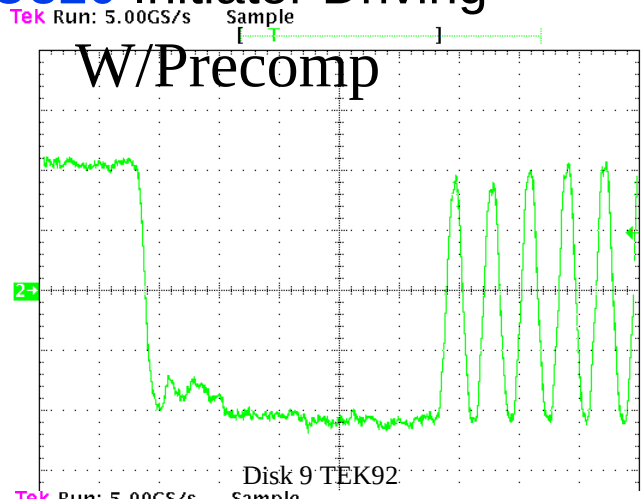
Probe at Target PCBA, Seagate U320 Initiator Driving

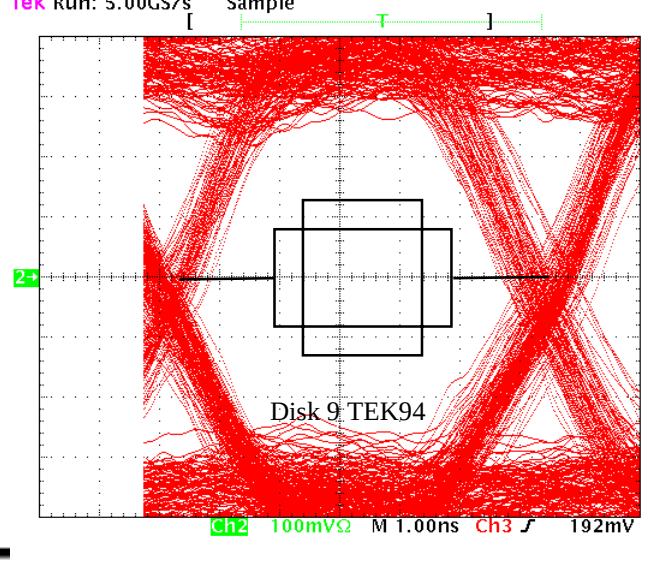
No Precomp





W/Precomp

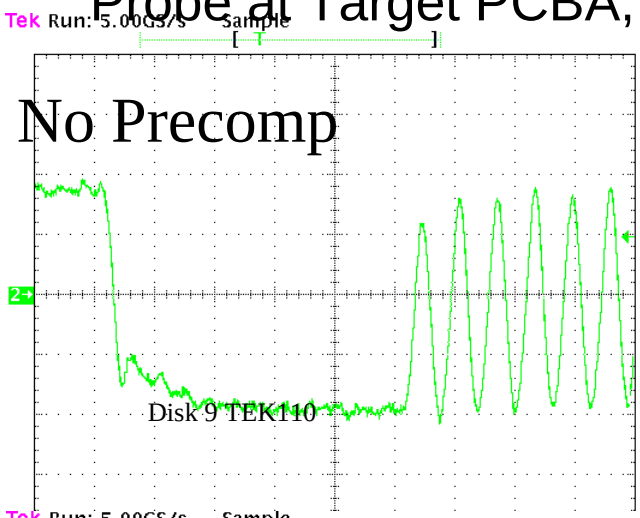


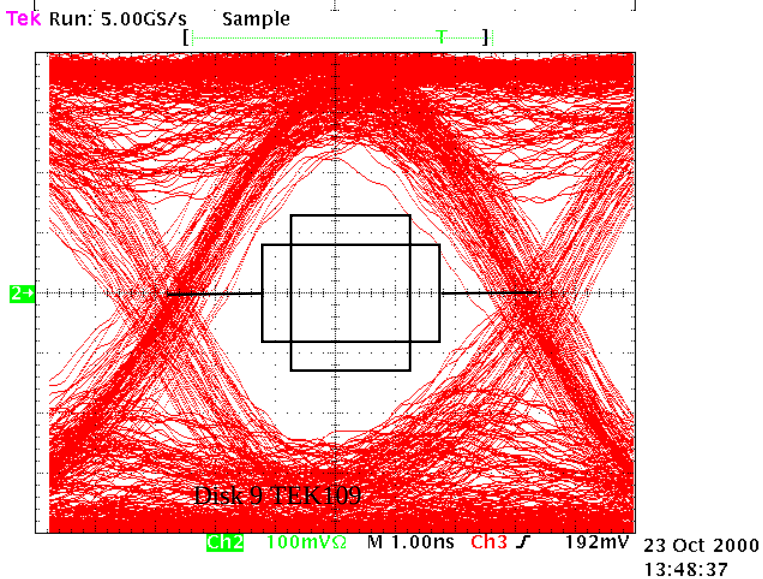


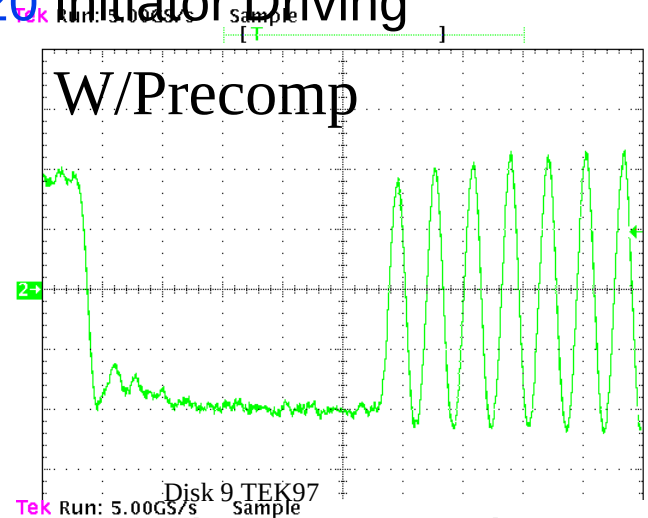
Seagate
Information the way you want it.

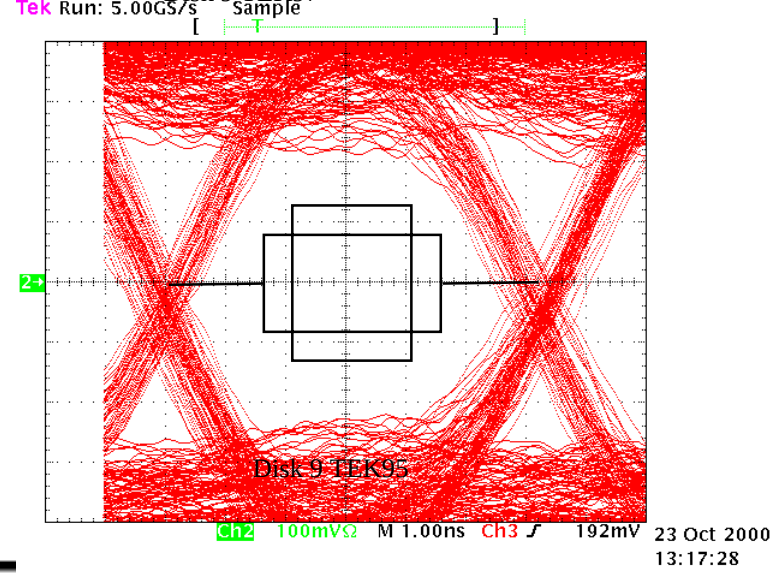
10 - Slot Backplane - SU320 Initiator -12m Rnd , Middle Slot

Probe at Target PCBA, Seagate U320 Initiator Driving





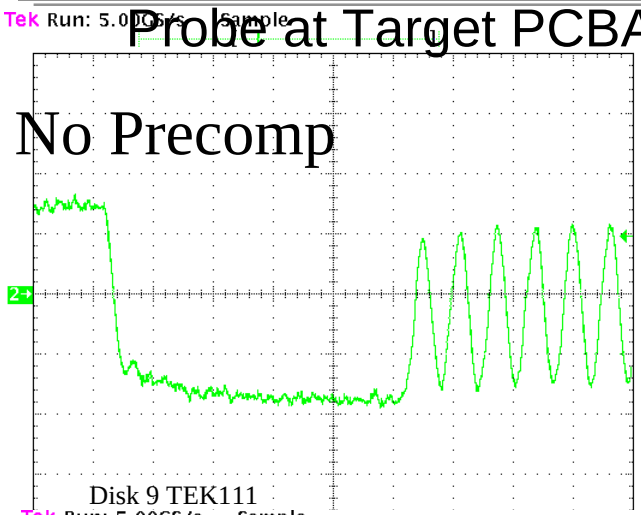


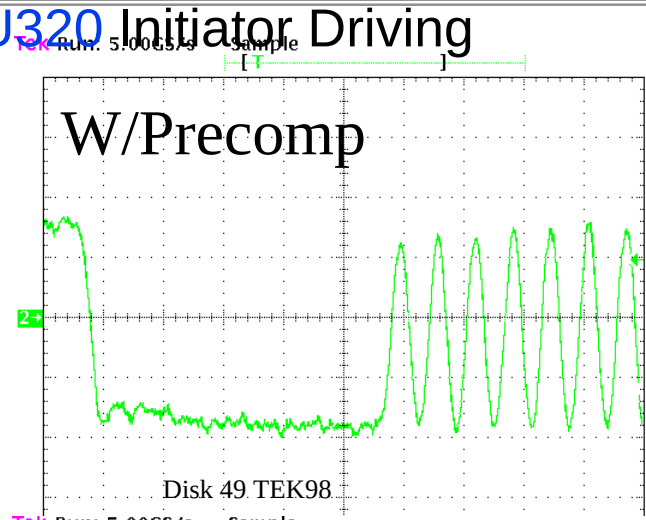


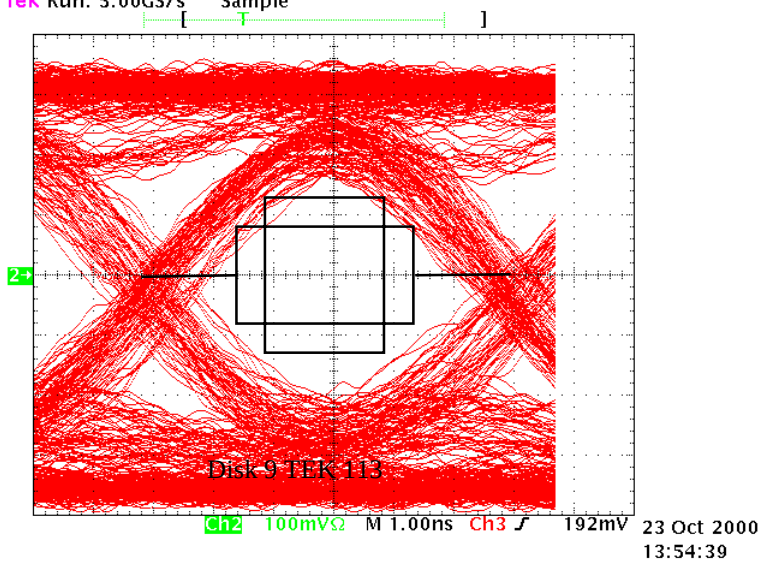
Seagate
Information the way you want it.

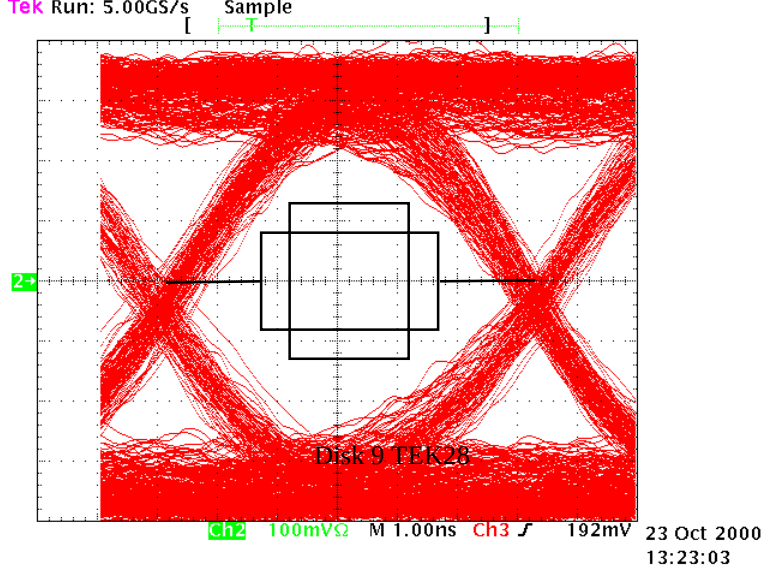
10 - Slot Backplane - SU320 Initiator -12m Rnd , Last Slot

Probe at Target PCBA, Seagate U320 Initiator Driving



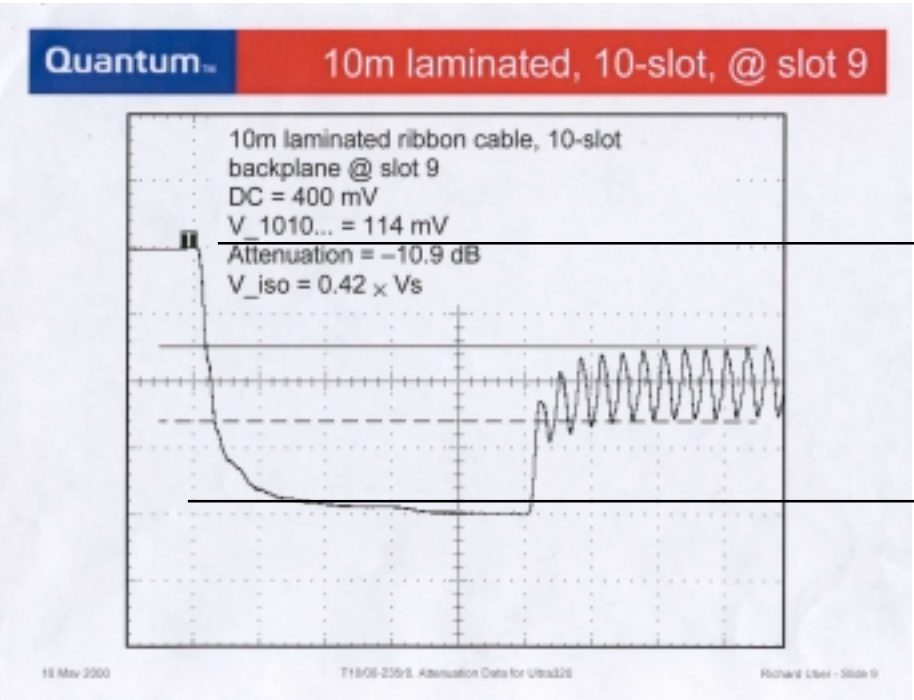


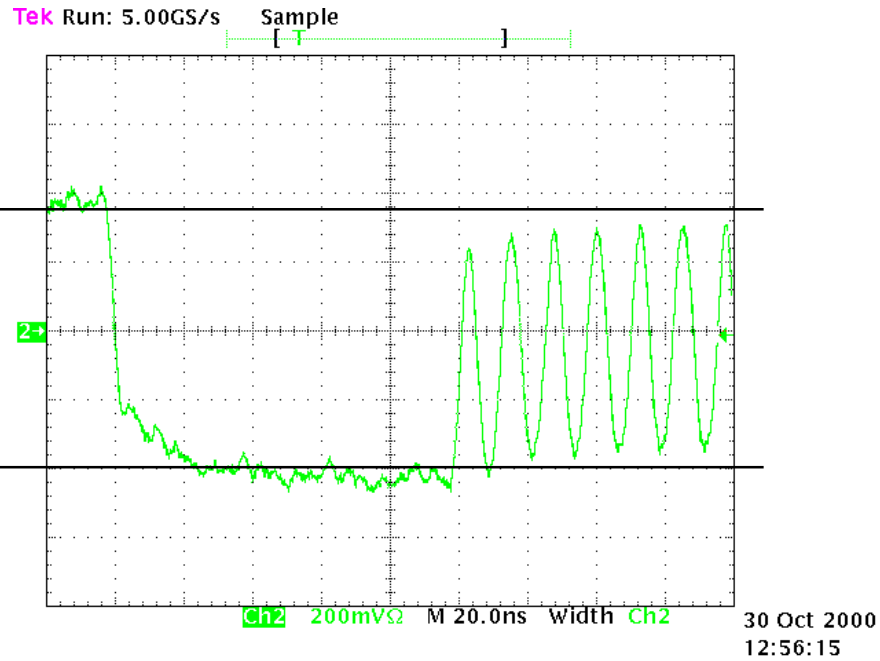




Seagate
Information the way you want it.

Cable & Backplane Attenuation Compared





Quantum Generator-Driver Example, 10m

12m Cable, Same Driver Amplitude, Slot, Backplane, **but** Real U320 Silicon

Seagate
Information the way you want it.

SCSI Signal & Cable Analysis
Point-to-Point Testing
U320 Target and Initiator Silicon

Seagate Technology

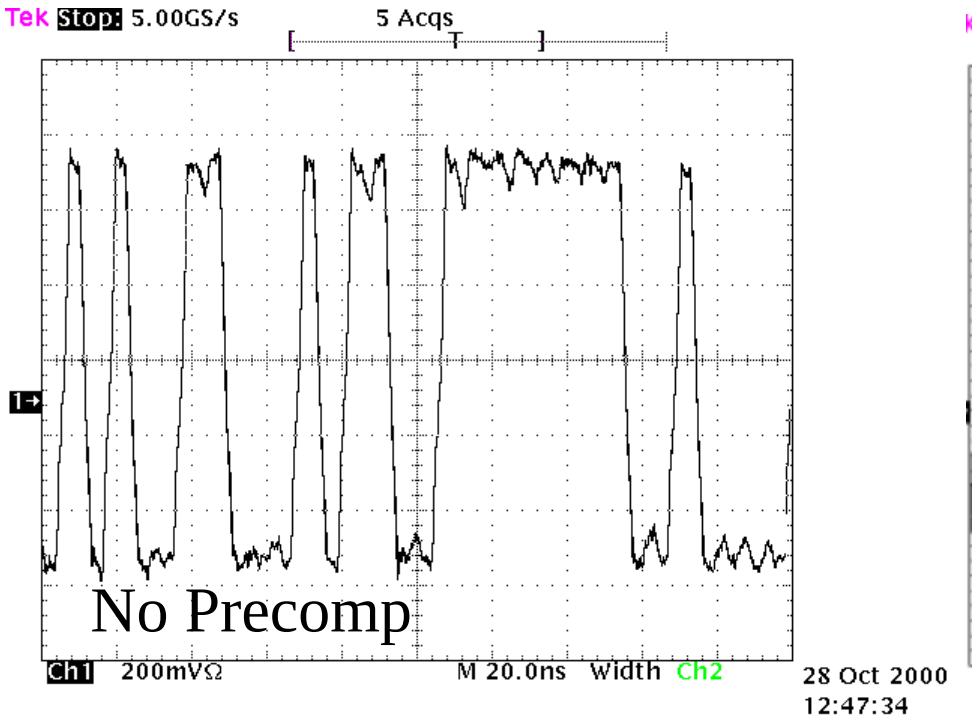
VLSI Controller Development

Scotts Valley California

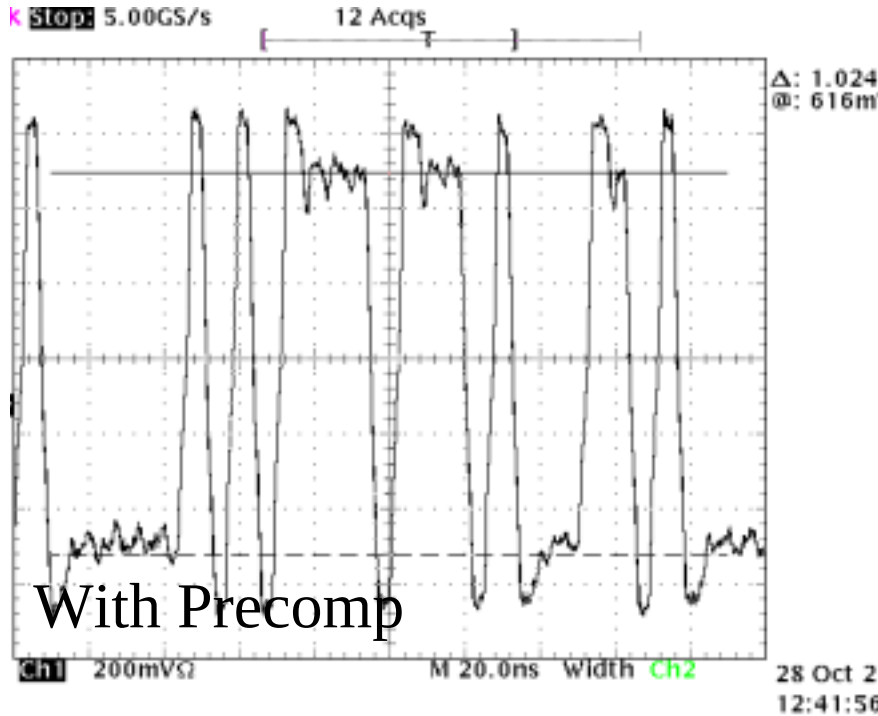
Seagate
Information the way you want it.

SU320 Initiator - Driver Waveshape Example

Probe at Initiator, Seagate U320 Initiator Driving



Disk W TEK77

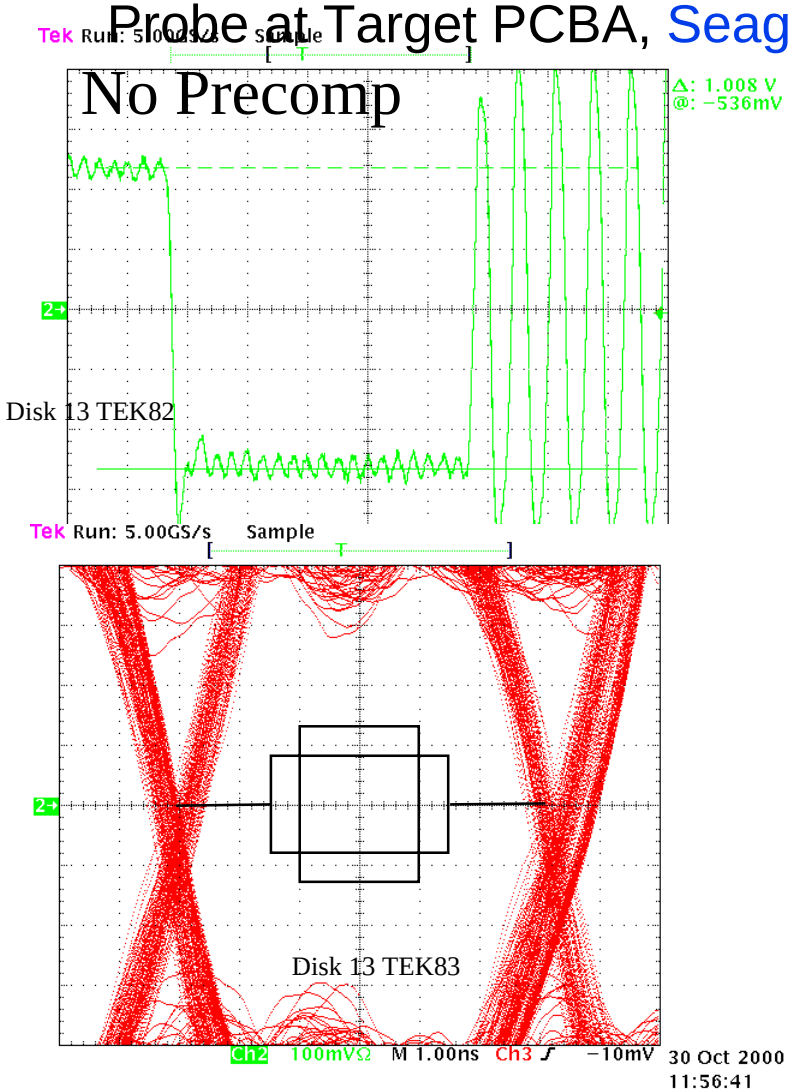


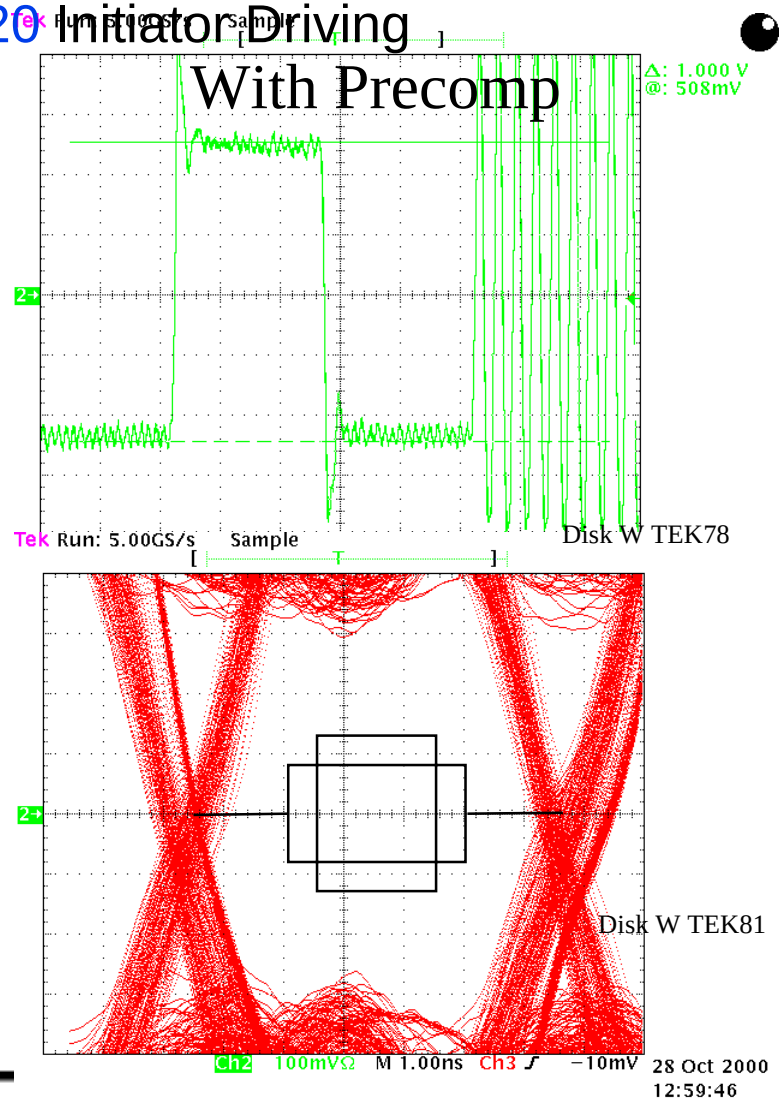
Disk W TEK70

Seagate
Information the way you want it.

SU320 Initiator - 18" TnF, Point-to-Point

Probe at Target PCBA, Seagate U320 Initiator Driving

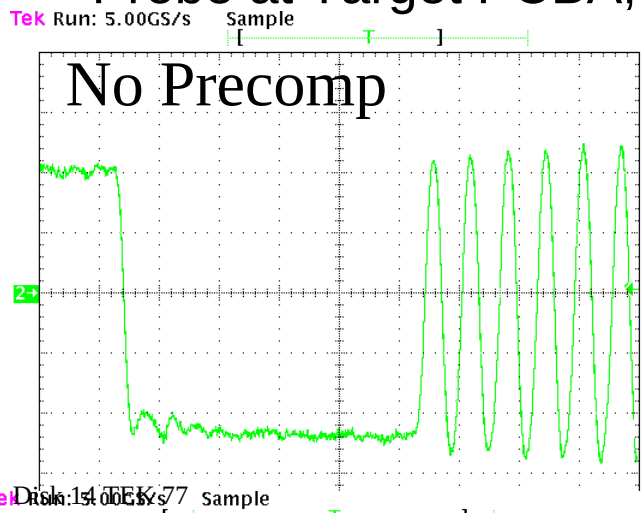


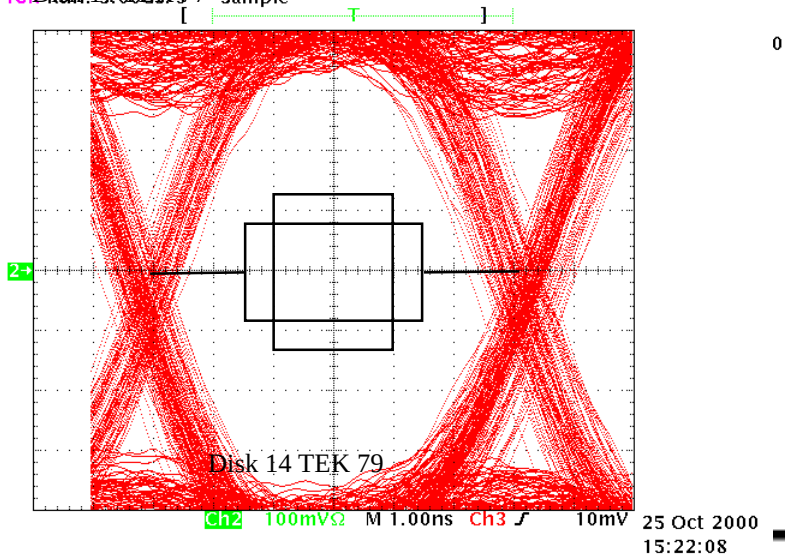


Seagate
Information the way you want it.

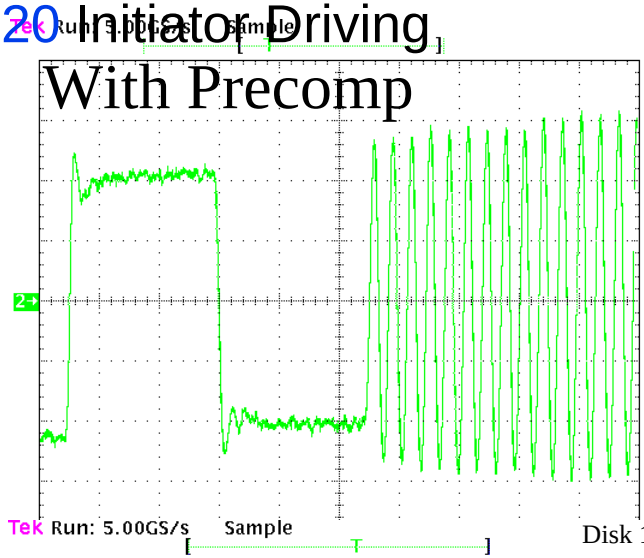
SU320 Initiator -12m Madison Rnd, Point-to-Point

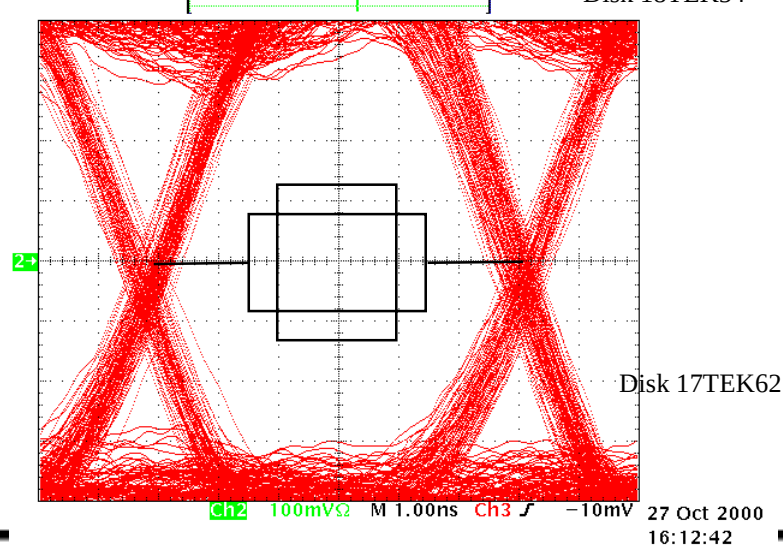
Probe at Target PCBA, Seagate U320 Initiator Driving





0

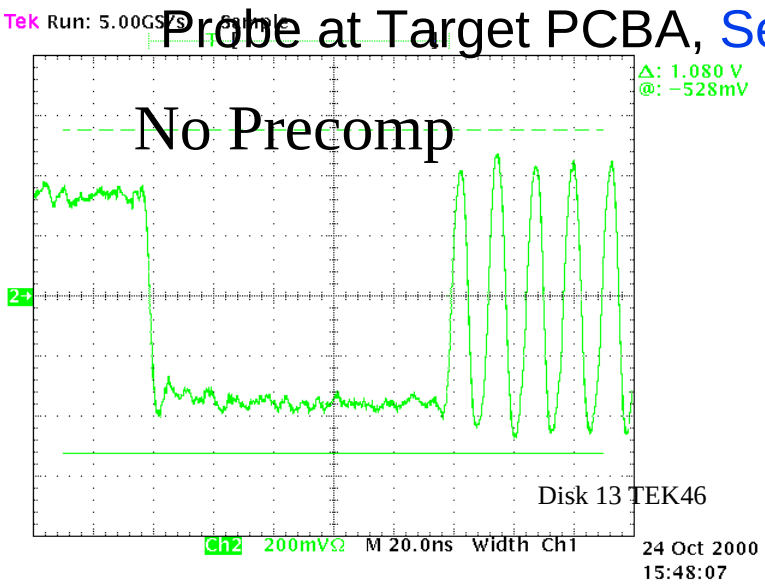




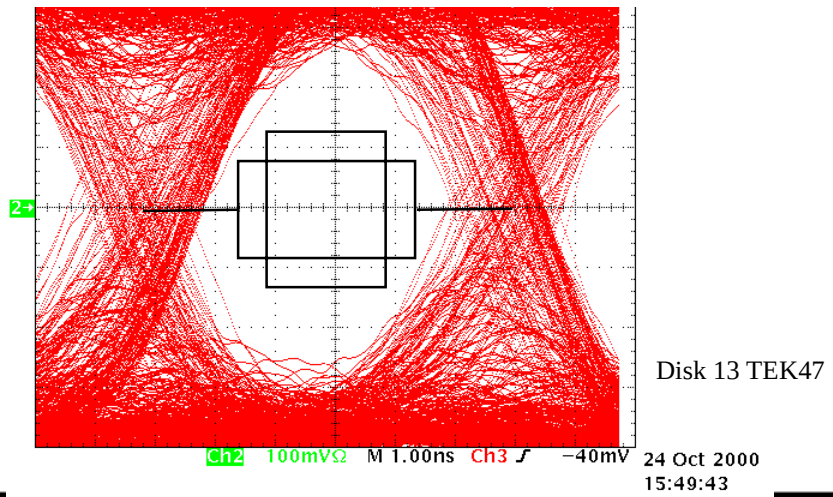
Seagate
Information the way you want it.

SU320 Initiator -12m Amphenol TnF, Point-to-Point

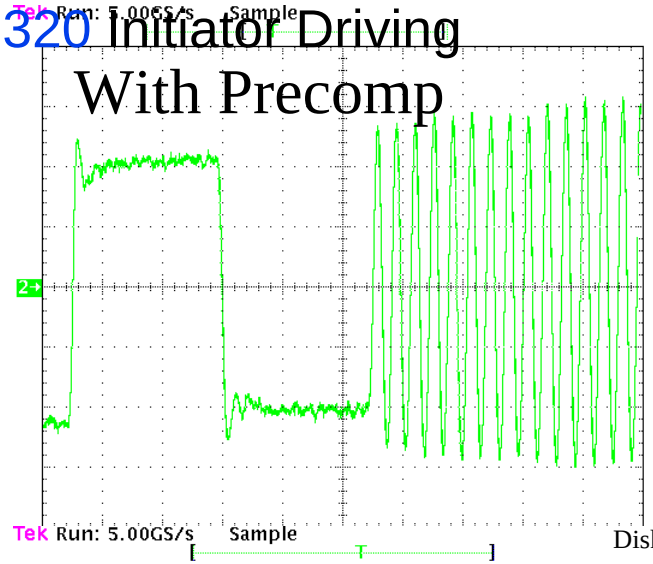
Probe at Target PCBA, Seagate U320 Initiator Driving



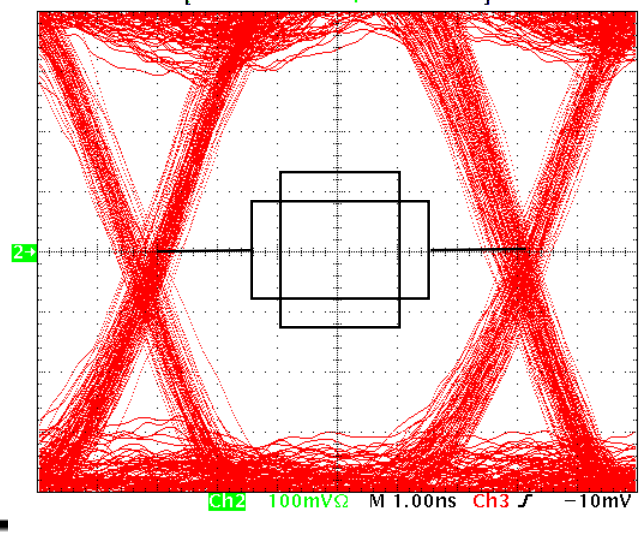
Disk 13 TEK46



Disk 13 TEK47



Disk 18TEK54

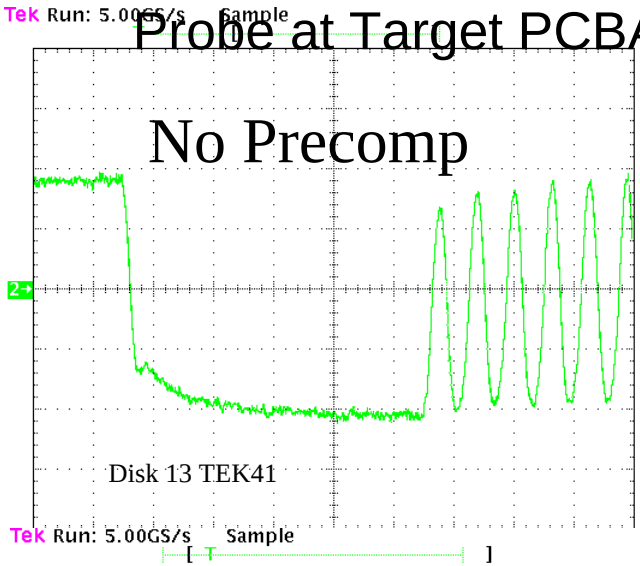


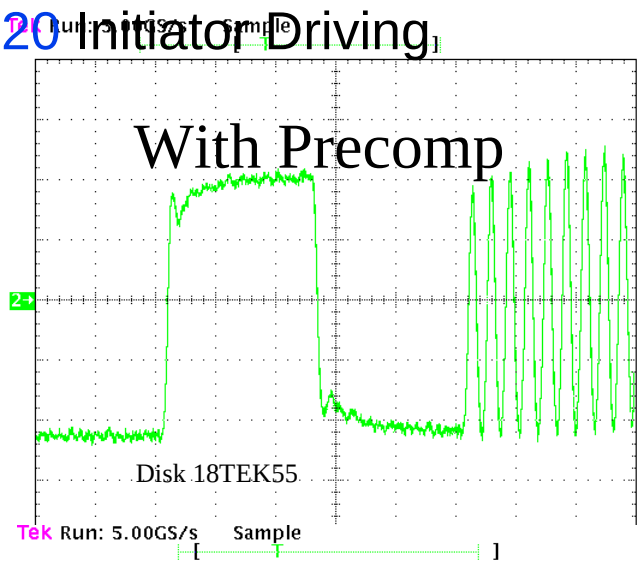
Disk 17TEK62

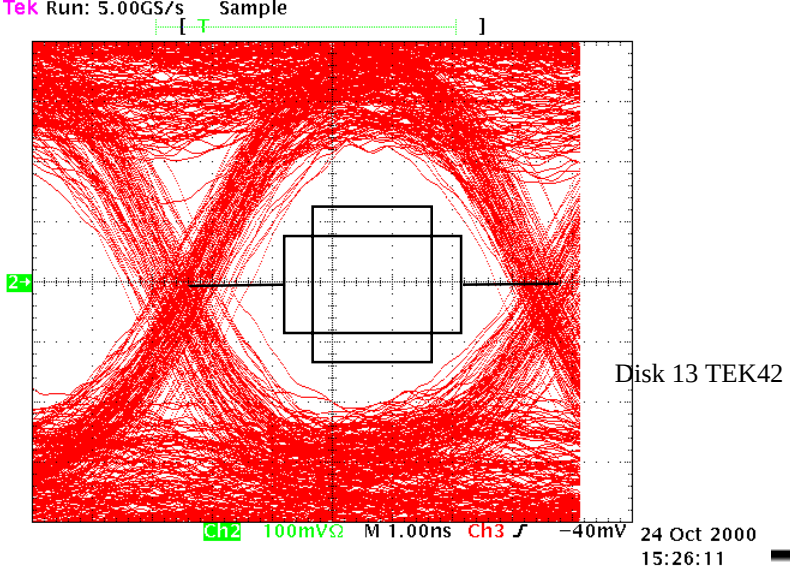
Seagate
Information the way you want it.

SU320 Initiator -25m Hitachi Rnd, Point-to-Point

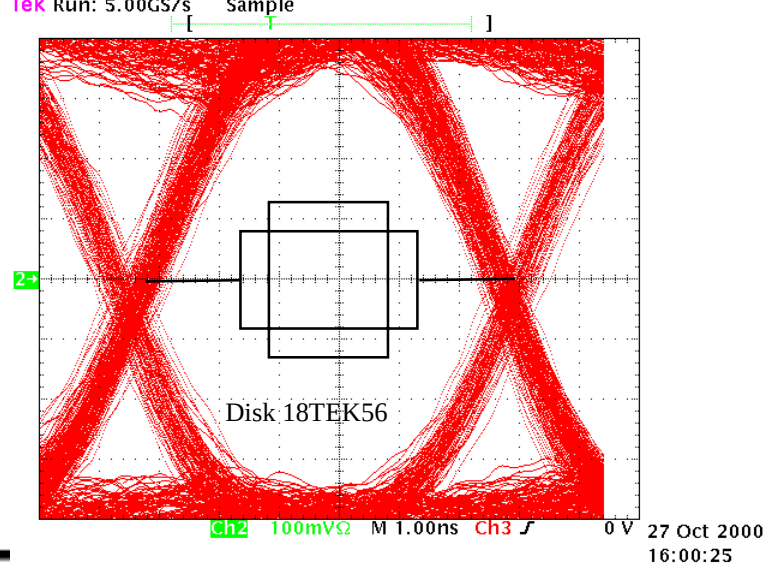
Probe at Target PCBA, Seagate U320 Initiator Driving







Disk 13 TEK42



Disk 18TEK56

Seagate
Information the way you want it.