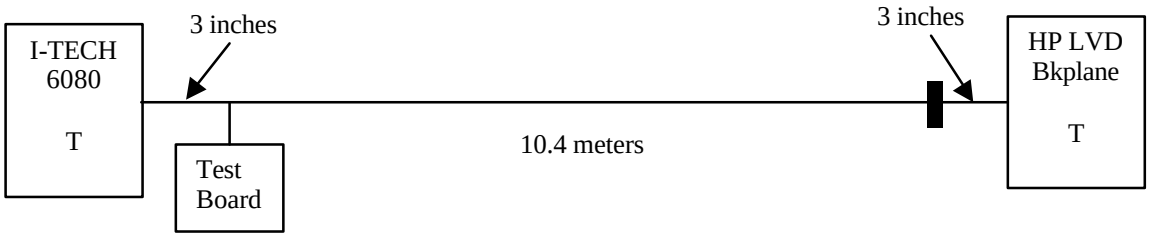
Fast-80 Case Study – One Bit Across a 6-device Backplane

Objective: Evaluate one bit in a fixed data pattern on an LVD backplane, under different load conditions and at different locations on the backplane.

This is intended to establish a baseline against which random and worst case ISI patterns can be evaluated in subsequent studies.

Physical
Configuration: This was a "simulated host" configuration with the target test board only 3" from the ITECH initiator. The 6-device backplane was connected on the other side of the target test board through a 10.4m shielded cable and a 3" ribbon cable (for physical compatibility). The REQ and data signals should appear at the backplane with essentially the same characteristics as ACK and data in a real system.



Device Loads: PCBs from QuantumViking II LVD SCSI drives were plugged into slots in the backplane and power was applied. The nominal node capacitance of the Viking II is 15pf.

Transfer Rate: All measurements were made while executing a 512 byte READ BUFFER command with Fast-80 double transition transfers enabled on the test board. The buffer was loaded originally in Fast-40 mode from the I-TECH 6080.

Data Pattern: The buffer pattern used was a repeating sequence of 0x0000FFFF. On a wide bus this generates an alternating 01010…. pattern on each individual data bit.

Test Equipment: HP 1.5 GHz scope with Tektronix 1GHz differential probes

Cables: SPI-2 compliant round and ribbon cable for LVD.

******See T10/98-192r0 for detailed specs of test equipment and cable plant.

Measurement Description

The following data was gathered, using multiple transfers of the same data pattern. Data bit 5 was used for the measurements. This was an arbitrary choice. All bits except the parity bits switched each bit time, so crosstalk is a major consideration while ISI should not be an issue.

1. Trace captures of a single 'one bit' and a single 'zero bit', showing REQ and DB5 with a single device installed, at each of the 6 slots of the backplane.
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   On previous measurements it was shown that a single data bit exhibits considerable variation in amplitude and timing across a large block transfer, even with a stable data pattern. However, the variation in the same bit at the same offset on many repetitions of the pattern is more stable. E.g., DB5 may vary by +/-5% across a 512 byte transfer, but the 10^{th} bit in one transfer will be very close to the 10^{th} bit in all others, as long as the same physical configuration is maintained. The reasons for this are complex and are still under investigation.
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   To minimize uncontrolled variation, DB5 in the 9^{th} and 10^{th} words transferred was selected for measurement. This is the 5^{th} zero and the fifth one clocked on the DB5 line. The selection was arbitrary and these transitions seemed reasonably representative.

2. One configuration was measured with 2 loads installed; loads were in slots 1 and 6.

3. Three configurations were measured with 3 devices installed.

4. Three configurations were measured with 4 devices installed.

5. Four configurations were measured with 5 devices installed.

6. Traces were taken at all 6 slots with 6 devices installed.

Results are shown on the following 2 pages in table form. Representative traces with 6 loads are attached.

Captured .bmp files of all traces are available to anyone who wants to study them.

Summary of Measurement Results

Case 1: A single load moved through all six slots. Measurements were taken at the connector of the PCB supplying the load.

Slot Number	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1	294	12.7	-317	12.2
2	283	12.7	-306	12.0
3	278	12.9	-300	12.0
4	267	12.9	-300	12.2
5	278	12.8	-289	12.2
6	261	12.9	-289	12.4

Observation: Individual assertion/negation pairs don't necessarily add to exactly 25.0ns with this configuration and data pattern, although the average over even a few bits is exactly 25.0. Slot 2 had the worst deviation in this case, 24.7ns.

Case 2: Loads installed in slots 1 & 6. Measurements were taken at the connector of the PCB in slot 1.

Slot Number	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1	283	12.7	-294	12.0

Case 3: Loads installed in 3 slots. Measurements were taken at the connector of the PCB in slot 1.

Slot Numbers	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1, 2, 6	288	12.7	-317	12.0
1, 2, 3	275	12.7	-306	12.0
1, 5, 6	272	12.8	-269	12.2

Case 4: Loads installed in 4 slots. Measurements were taken at the connector of the PCB in slot 1.

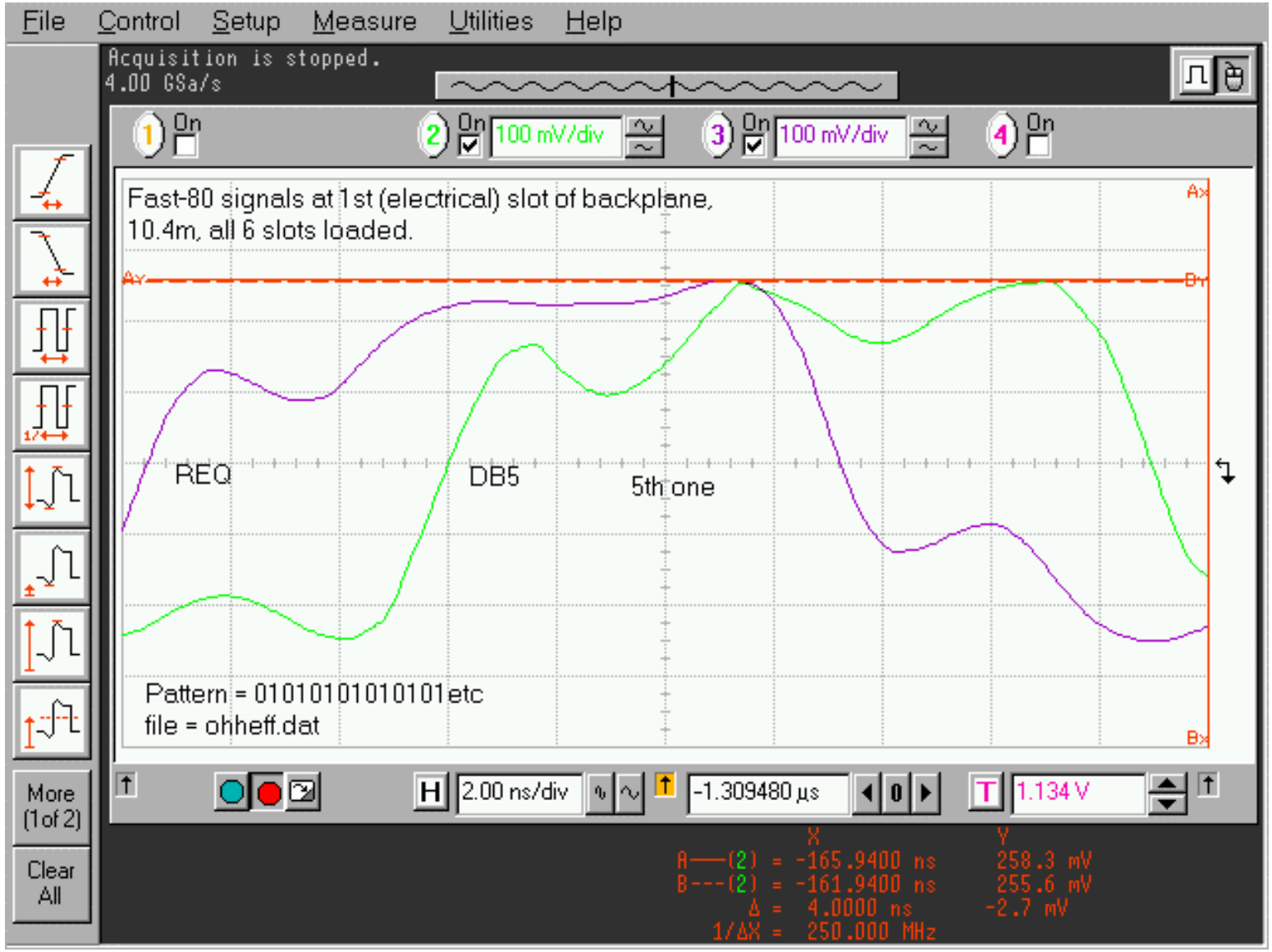
Slot Numbers Loaded	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1, 2, 3, 6	261	12.7	-291	12.0
1, 4, 5, 6	255	12.8	-272	11.9

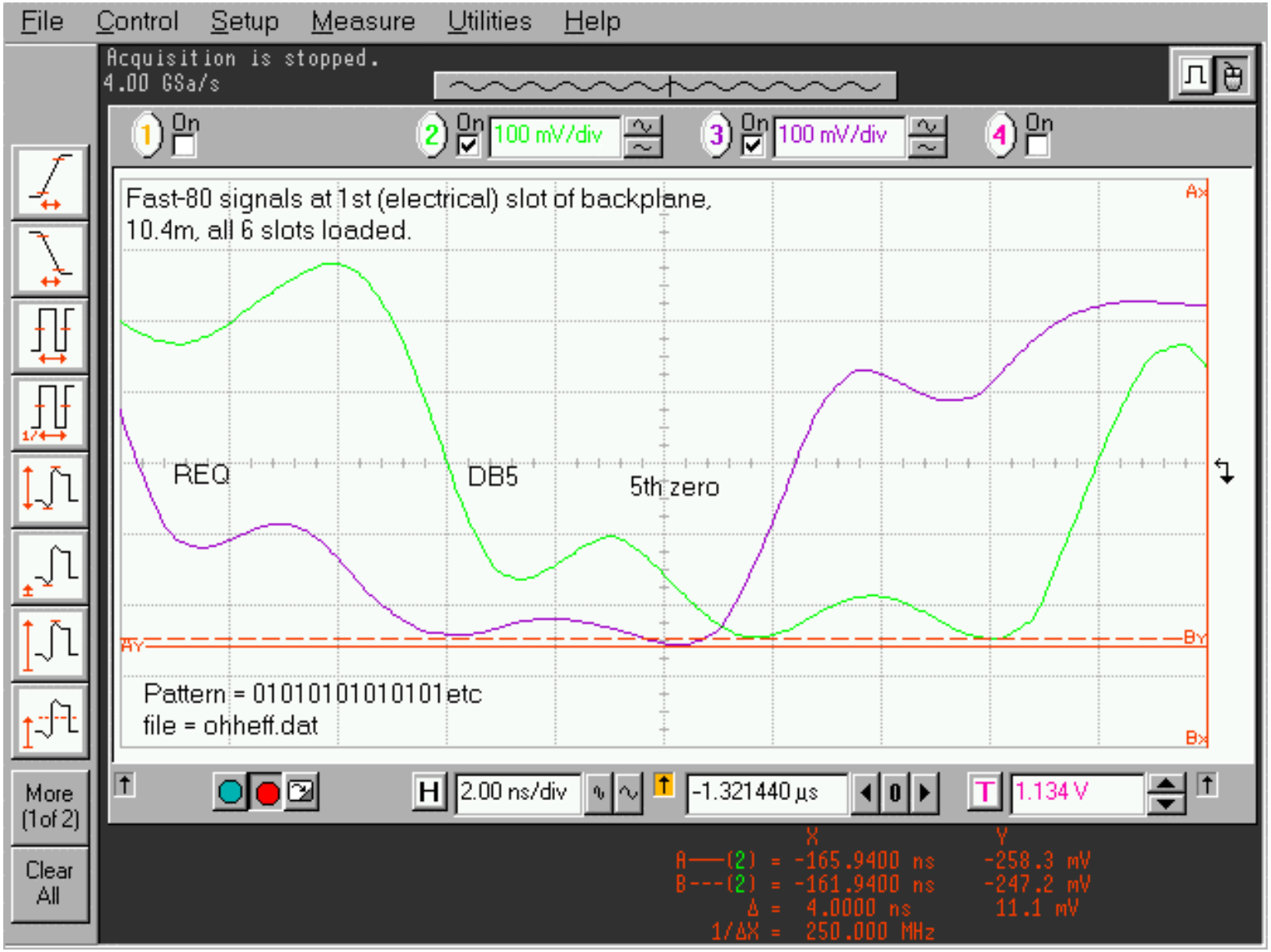
Case 5: Loads installed in 5 slots. Measurements were taken at the connector of the PCB in slot 1 except for the last configuration where slot 1 wasn't populated.

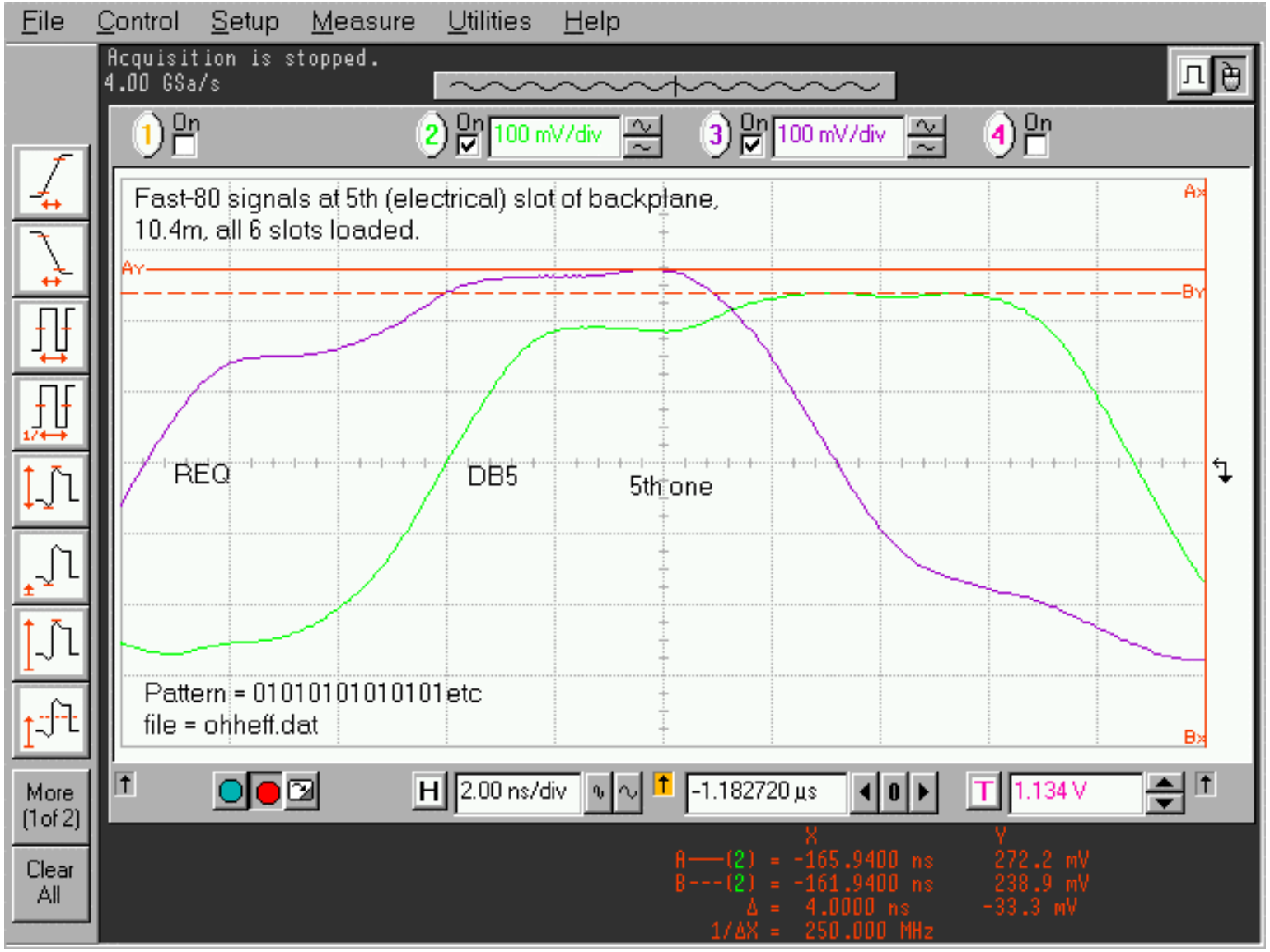
Slot Numbers Loaded	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1, 2, 3, 4, 6	255	12.9	-253	11.8
1, 2, 3, 4, 5	261	12.7	-261	12.0
1, 3, 4, 5, 6	255	12.8	-236	11.9
2, 3, 4, 5, 6	272	12.8	-261	12.2

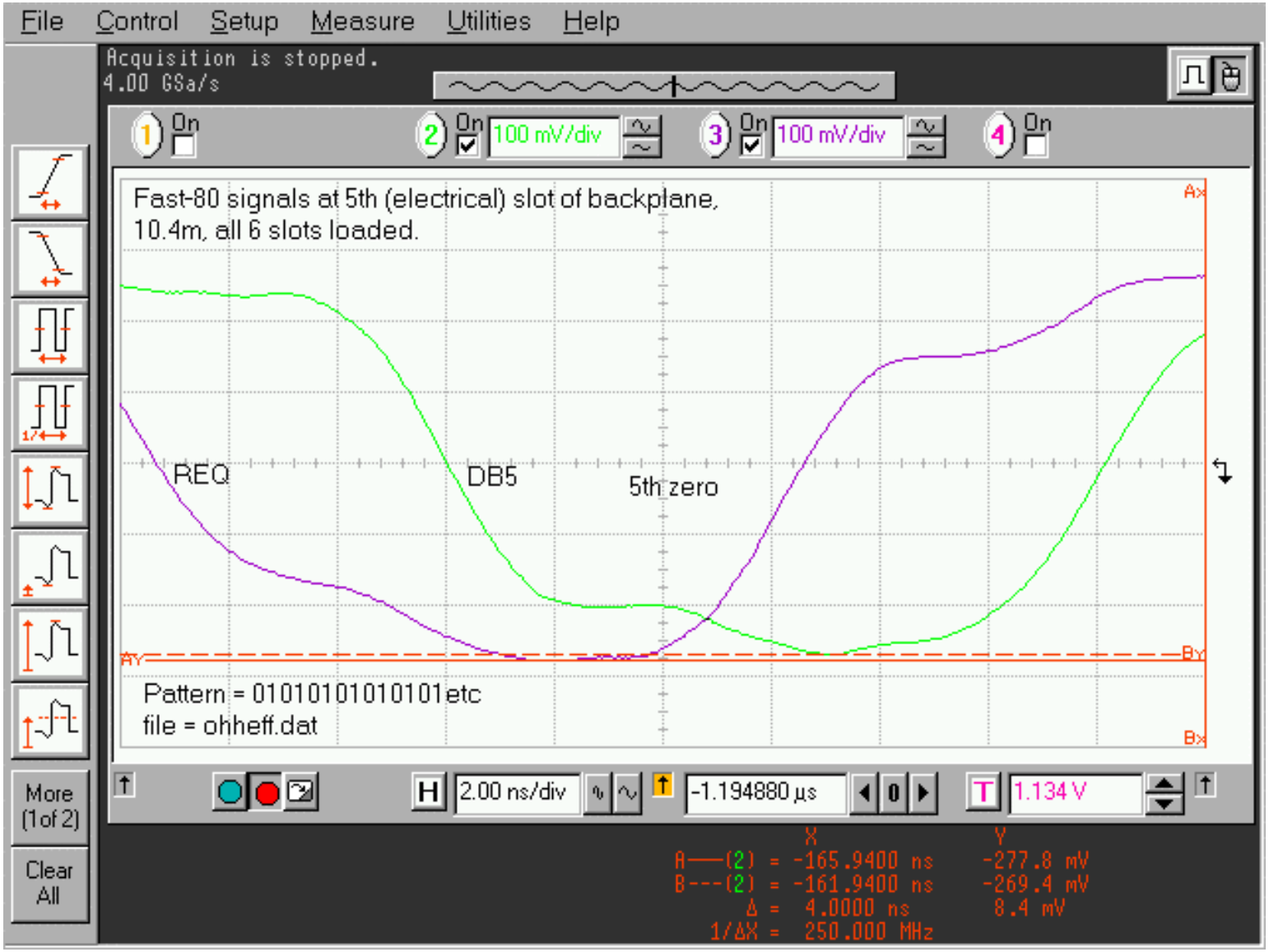
Case 6: Loads installed in 6 slots. Measurements were taken at the connector of the PCB in each slot.

Measured at Slot Number	Amplitude of 'one' (mv)	Assertion Period (ns)	Amplitude of 'zero' (mv)	Negation Period (ns)
1	255	12.9	-247	12.0
2	266	12.6	-236	12.2
3	255	12.8	-261	12.0
4	252	12.6	-275	12.3
5	238	12.7	-269	12.2
6	244	12.6	-266	12.2


File Control Setup Measure Utilities Help
Acquisition is stopped.
4.00 GSa/s
1 On
2 On 100 mV/div
3 On 100 mV/div
4 On
Fast-80 signals at 1st (electrical) slot of backplane,
10.4m, all 6 slots loaded.
REQ
DB5
5th one
Pattern = 0101010101010101etc
file = ohheff.dat
More (1of 2)
Clear All
H 2.00 ns/div
-1.309480 µs
T 1.134 V
X Y
A—(2) = -165.9400 ns 258.3 mV
B---(2) = -161.9400 ns 255.6 mV
Δ = 4.0000 ns -2.7 mV
1/ΔX = 250.000 MHz


File Control Setup Measure Utilities Help
Acquisition is stopped.
4.00 GSa/s
1 On
2 On 100 mV/div
3 On 100 mV/div
4 On
Fast-80 signals at 1st (electrical) slot of backplane,
10.4m, all 6 slots loaded.
REQ
DB5
5th zero
Pattern = 0101010101010101etc
file = ohheff.dat
More (1of 2)
Clear All
H 2.00 ns/div
-1.321440 µs
T 1.134 V
X Y
A—(2) = -165.9400 ns -258.3 mV
B---(2) = -161.9400 ns -247.2 mV
Δ = 4.0000 ns 11.1 mV
1/ΔX = 250.000 MHz


File Control Setup Measure Utilities Help
Acquisition is stopped.
4.00 GSa/s
1 On
2 On 100 mV/div
3 On 100 mV/div
4 On
Fast-80 signals at 5th (electrical) slot of backplane,
10.4m, all 6 slots loaded.
AY
BY
REQ
DB5
5th one
Pattern = 0101010101010101etc
file = ohheff.dat
More (1of 2)
Clear All
H 2.00 ns/div
-1.182720 µs
T 1.134 V
X Y
A—(2) = -165.9400 ns 272.2 mV
B---(2) = -161.9400 ns 238.9 mV
Δ = 4.0000 ns -33.3 mV
1/ΔX = 250.000 MHz


File Control Setup Measure Utilities Help
Acquisition is stopped.
4.00 GSa/s
1 On
2 On 100 mV/div
3 On 100 mV/div
4 On
Fast-80 signals at 5th (electrical) slot of backplane,
10.4m, all 6 slots loaded.
REQ
DB5
5th zero
Pattern = 0101010101010101etc
file = ohheff.dat
More (1of 2)
Clear All
H 2.00 ns/div
-1.194880 µs
T 1.134 V
X Y
A—(2) = -165.9400 ns -277.8 mV
B---(2) = -161.9400 ns -269.4 mV
Δ = 4.0000 ns 8.4 mV
1/ΔX = 250.000 MHz