Attenuation Data for Fast-160 (Ultra320) SCSI
T10/00-349r0

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September 12, 2000

SCSI Sub-System Setup for Measurements

- Actual SCSI driver (w/offset,asymmetry,process variations,etc) driving all lines to operating drives with a pseudo-random pattern (i.e. w/ crosstalk and noise).
- Backplanes and cables (longest) supplied by Customers for actual systems in the field or in development (w/some exceptions, for reference only)
- Actual SCSI auxiliary system components (Terminators, connectors , etc)

Table 14 - SPI4

Table 11 - Attenuation requirements for SCSI cable media

Distance between SCSI bus terminators (meters)	Attenuation per meter maximum (dB) at 200 MHz	Attenuation of length equivalent to terminator to terminator distance maximum (dB) at 200 MHz	Distances are consistent with these minimum size conductors when used with high quality dielectrics	Notes
0 to 9	0,63	6	0,032 4 mm^2 (32 AWG) solid/ 0,050 92 mm^2 (30 AWG) stranded	multiple loads allowed
0 to 12	0,48	6	0,050 92 mm^2 (30 AWG) solid/ 0,080 42 mm^2 (28 AWG) stranded	multiple loads allowed
>12 to 25	0,48	12	0,050 92 mm^2 (30 AWG) solid/ 0,080 42 mm^2 (28 AWG) stranded	point to point only
Note: Both the per meter and the length equivalent to the terminator to terminator spacing requirements shall be simultaneously met				

Tables 9 & 10

Table 9 - SE and LVD local transmission line impedance

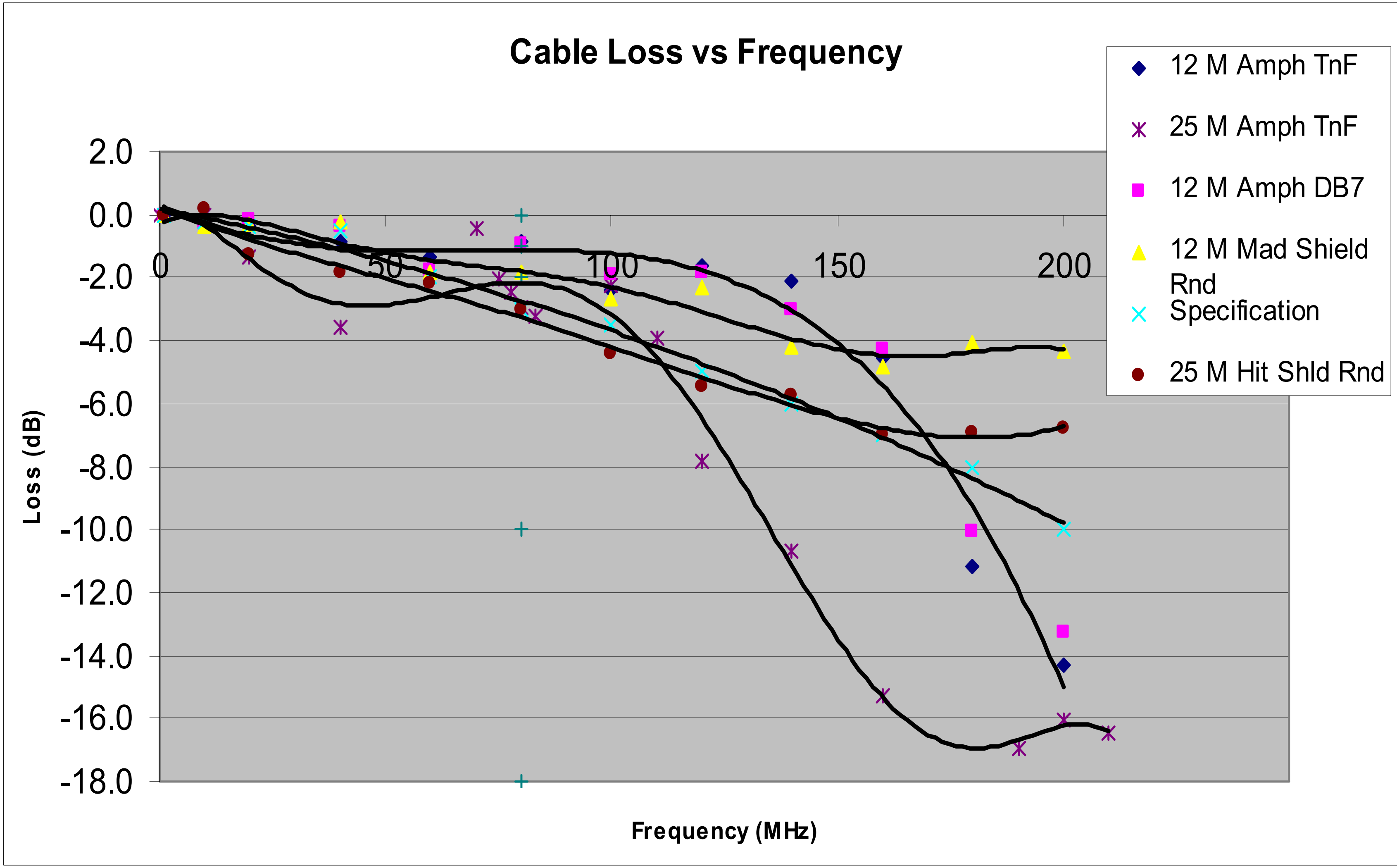
Cable construction	Local SE transmission line impedance (note 2)		Local differential transmission line impedance (note 2)	
	Minimum	Maximum	Minimum	Maximum
All	84 Ohms (78 Ohms) (note 3)	96 Ohms	110 Ohms	135 Ohms

Note:
1 - All values are measured by time domain reflectometry
2 - Ideally one design will meet both SE and differential criteria
3 - If SCSI loads attached to the cable media are separated by more than 1,0 m use the value of 78 Ohms.

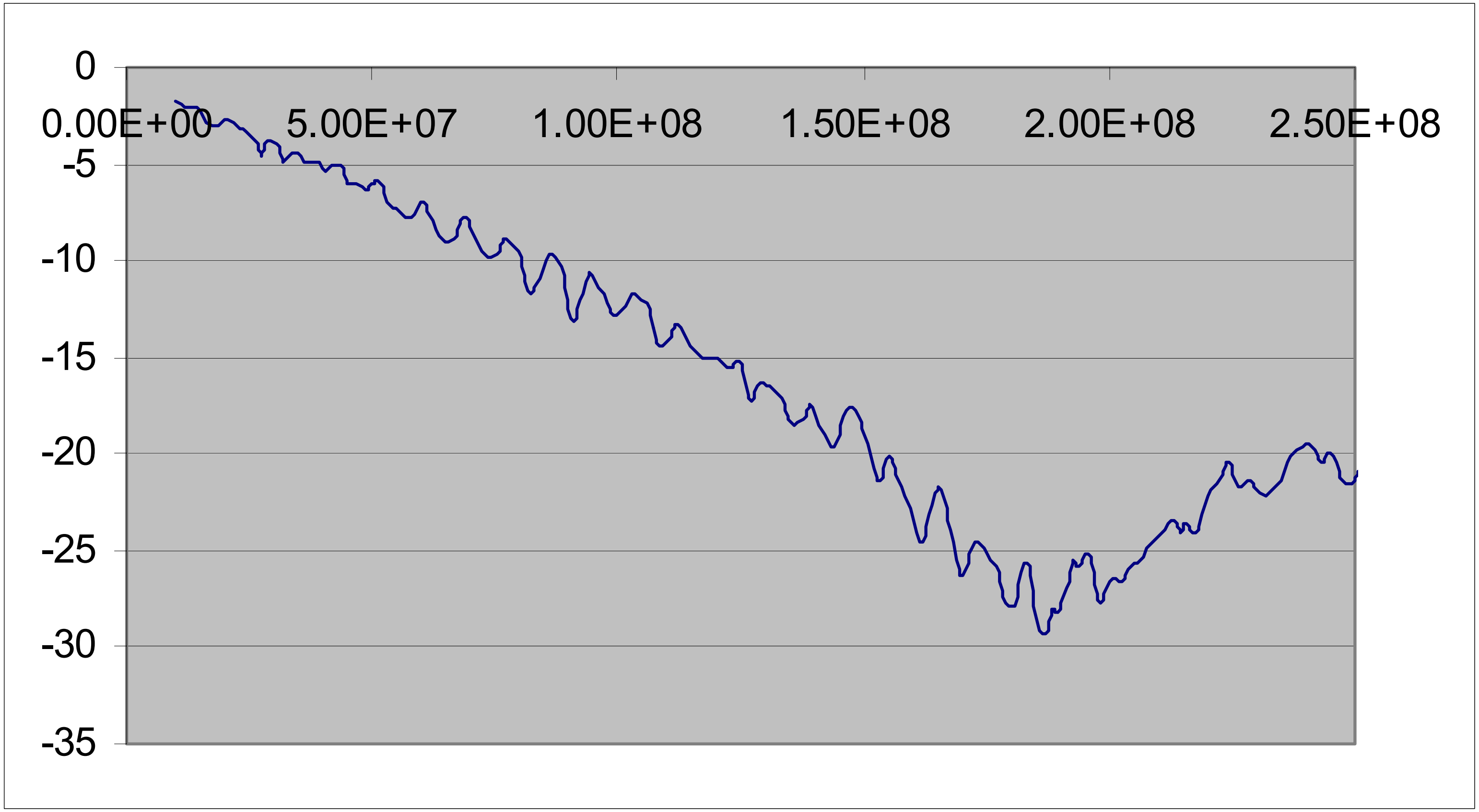
Table 10 - Cable media capacitance limits

	Minimum capacitance	Maximum capacitance	Frequency
SE	30 pF/m	66 pF/m	100 kHz and 1 MHz
Differential	26 pF/m	46 pF/m	100 kHz and 1 MHz

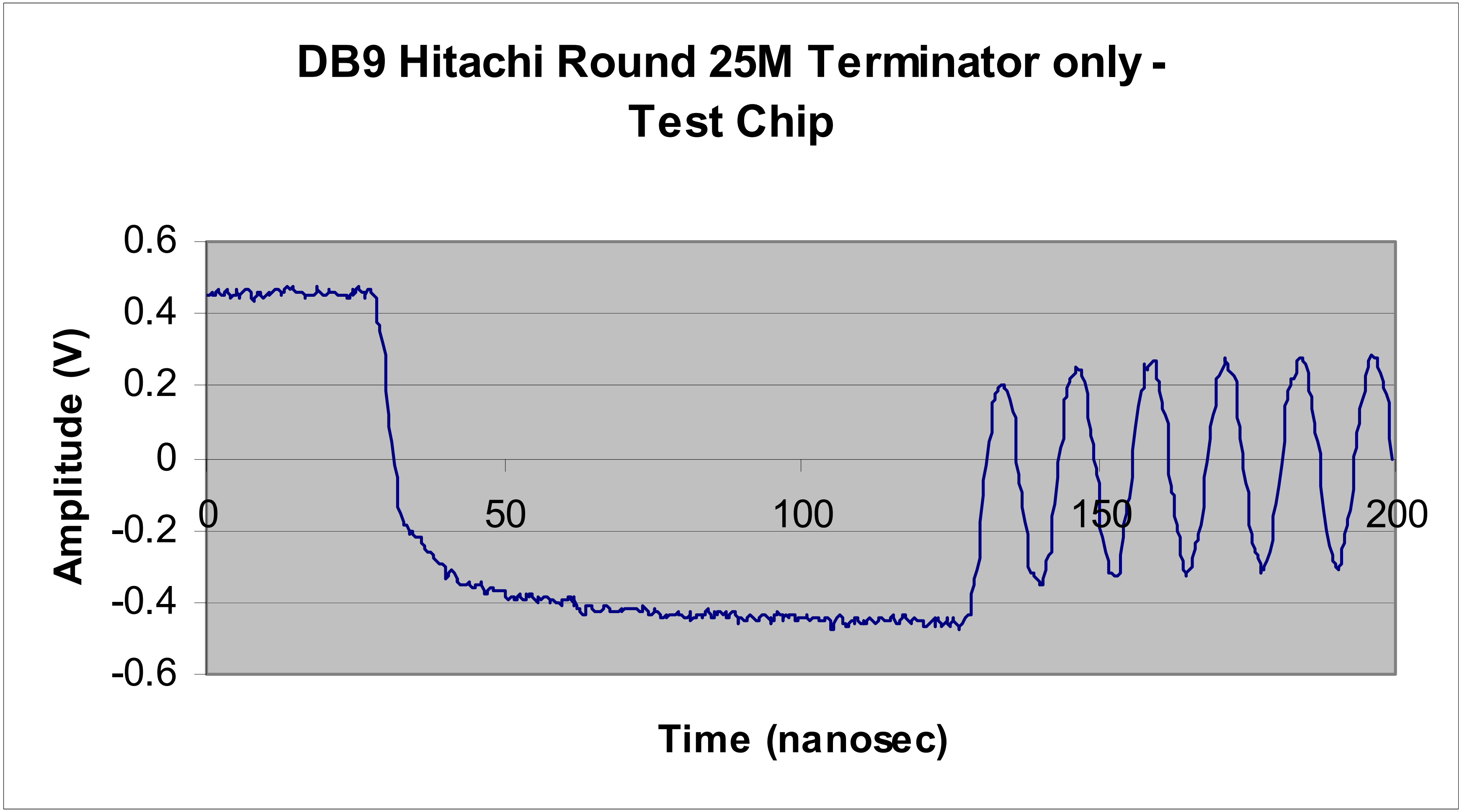
Cable Losses Vs. Frequency



10 M Hitachi ribbon cable loss Vs. Frequency



Test Chip Driving 25 M Hitachi Rnd -Term only



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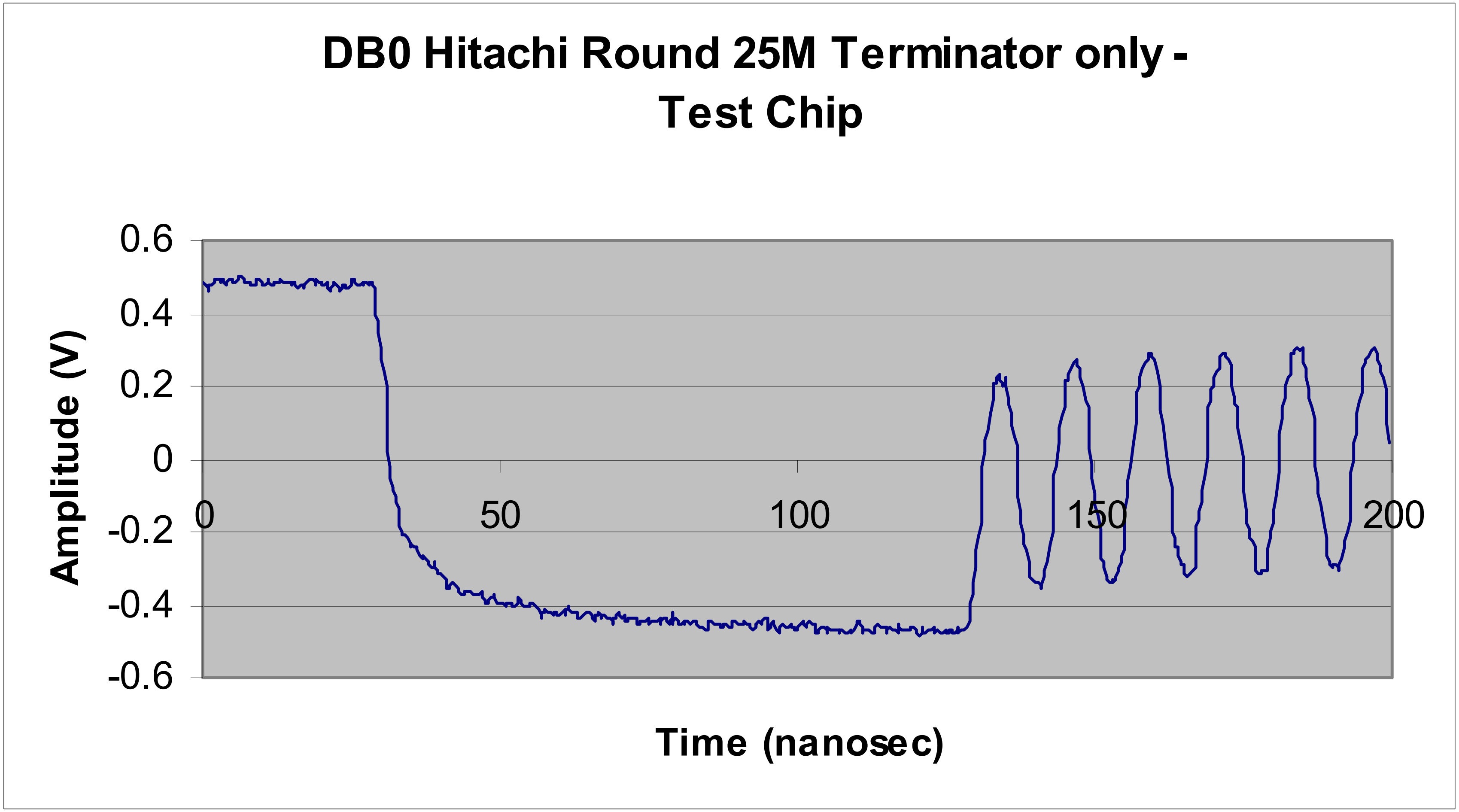
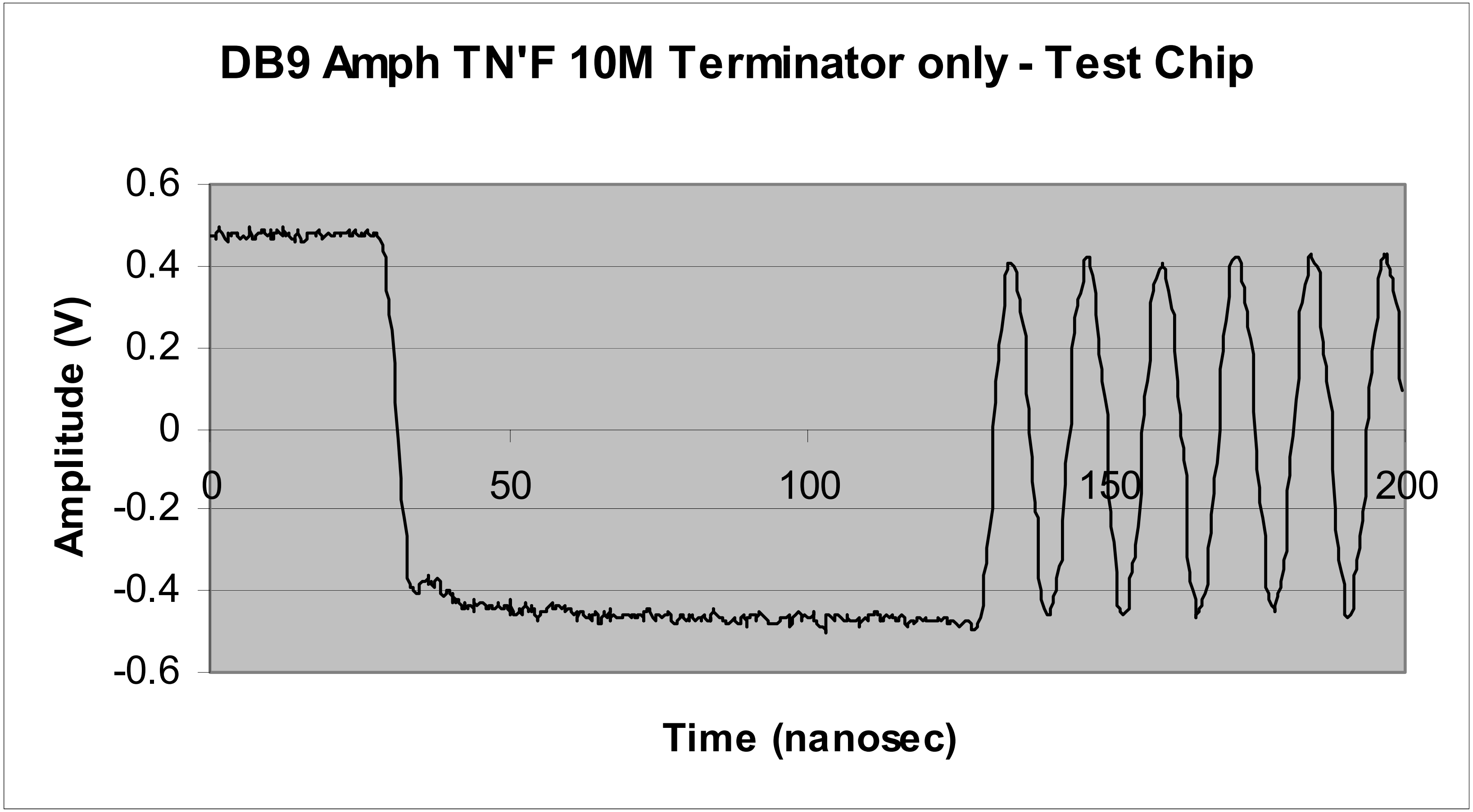
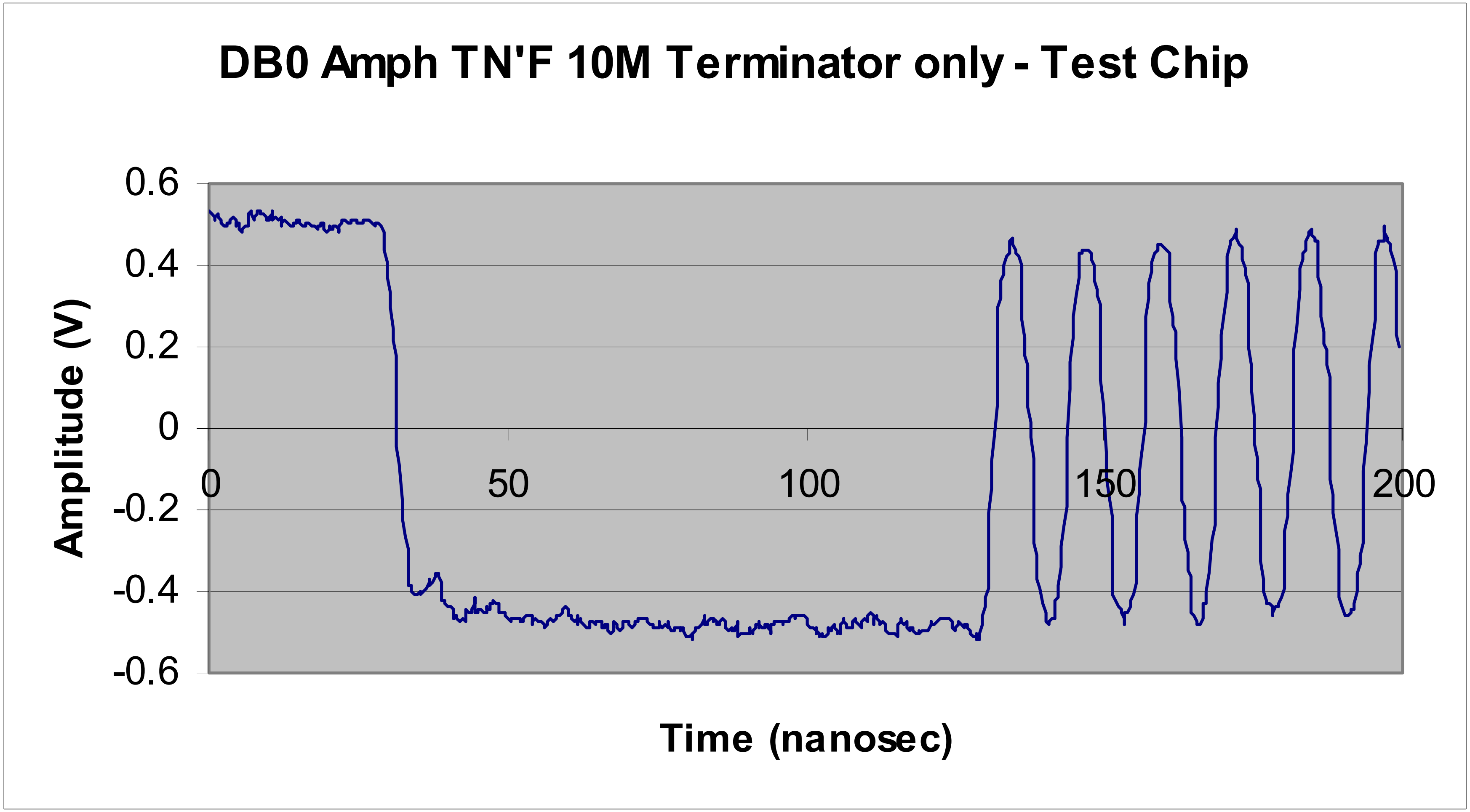


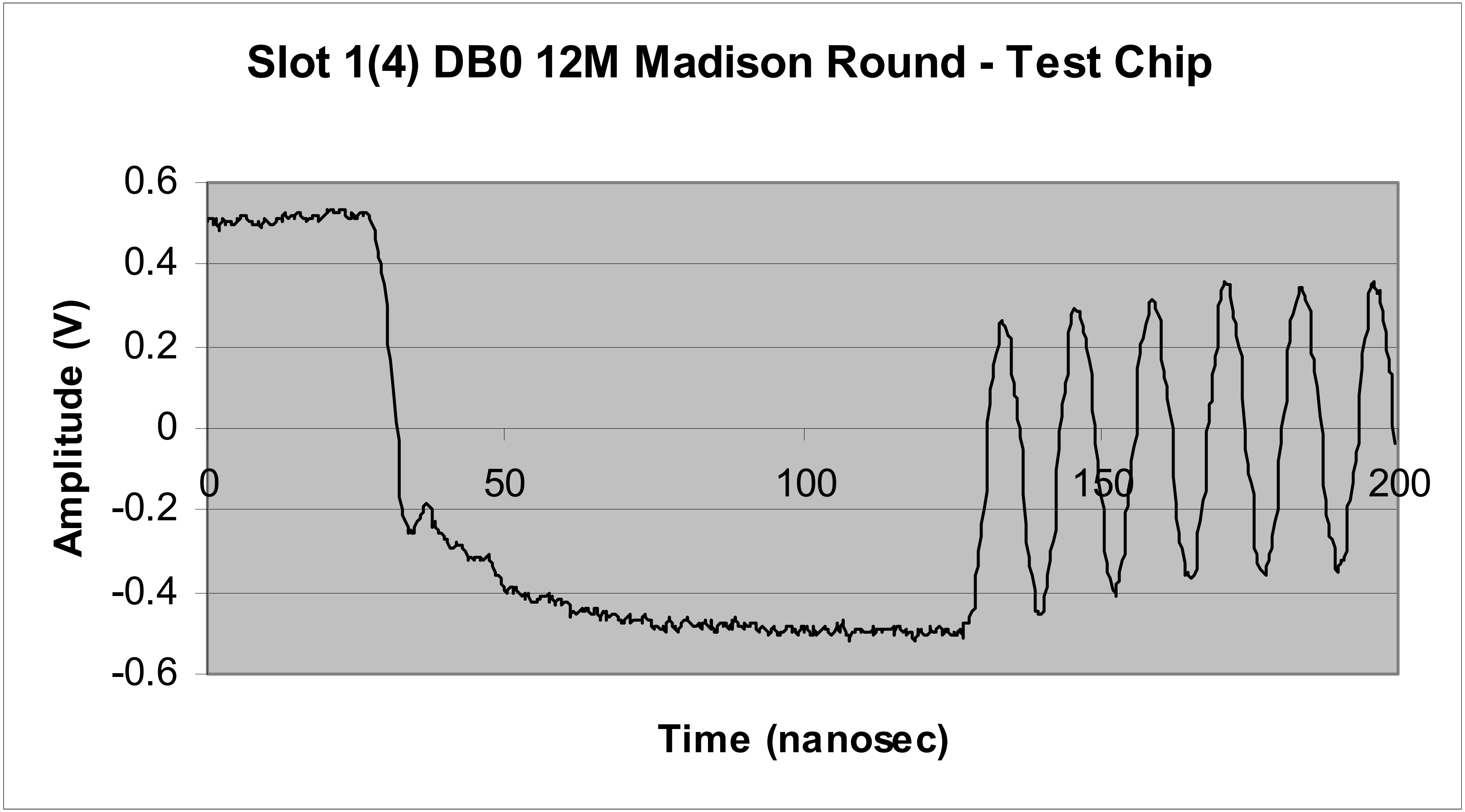
Test Chip Driving 10 M TN'F -Term only



Test Chip Driving 10 M TN’F -Term only



Vendor C - 10 slot backplane w/12 M Madison (round)



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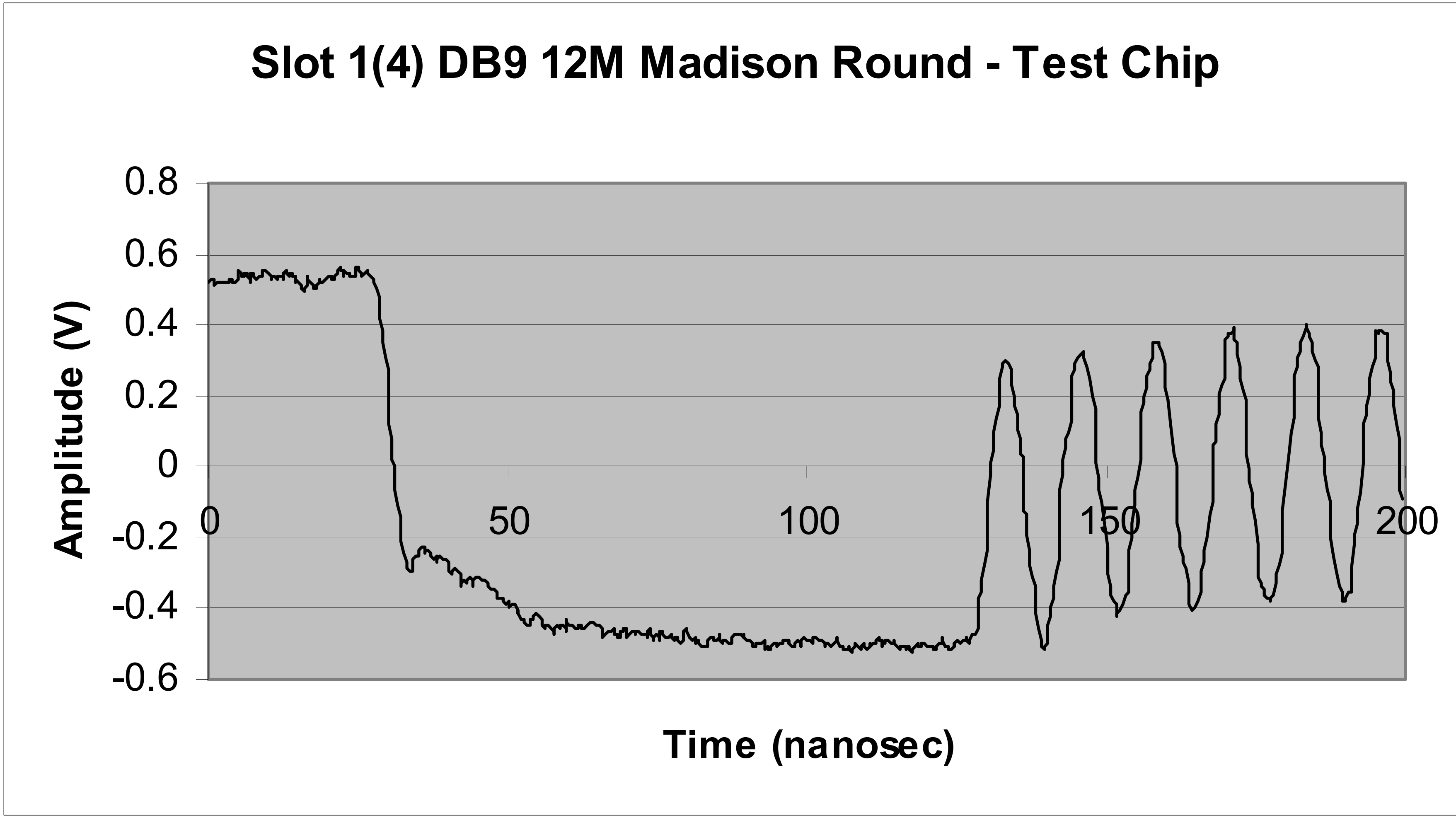
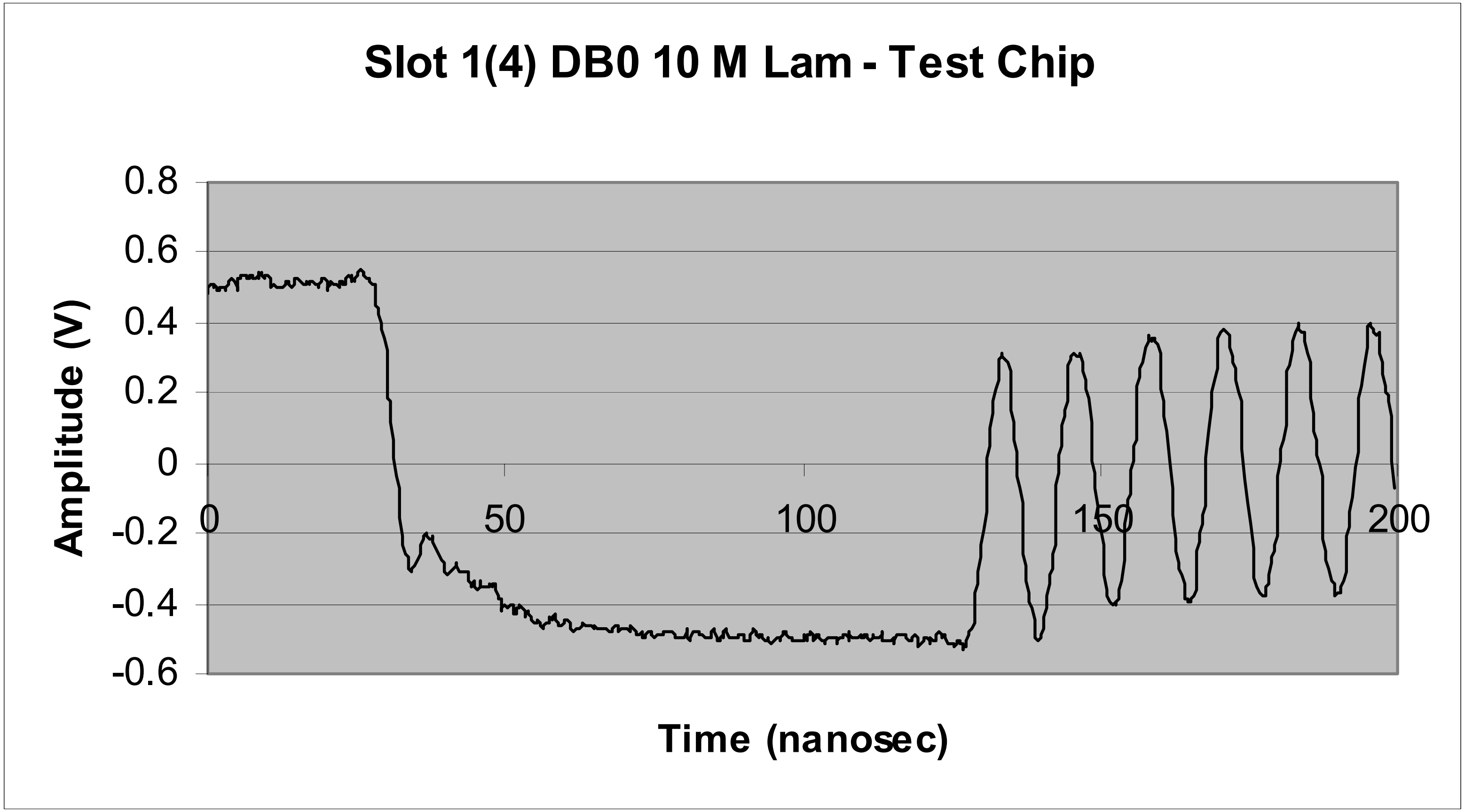


Vendor C - 10 slot backplane w/10 M Laminated



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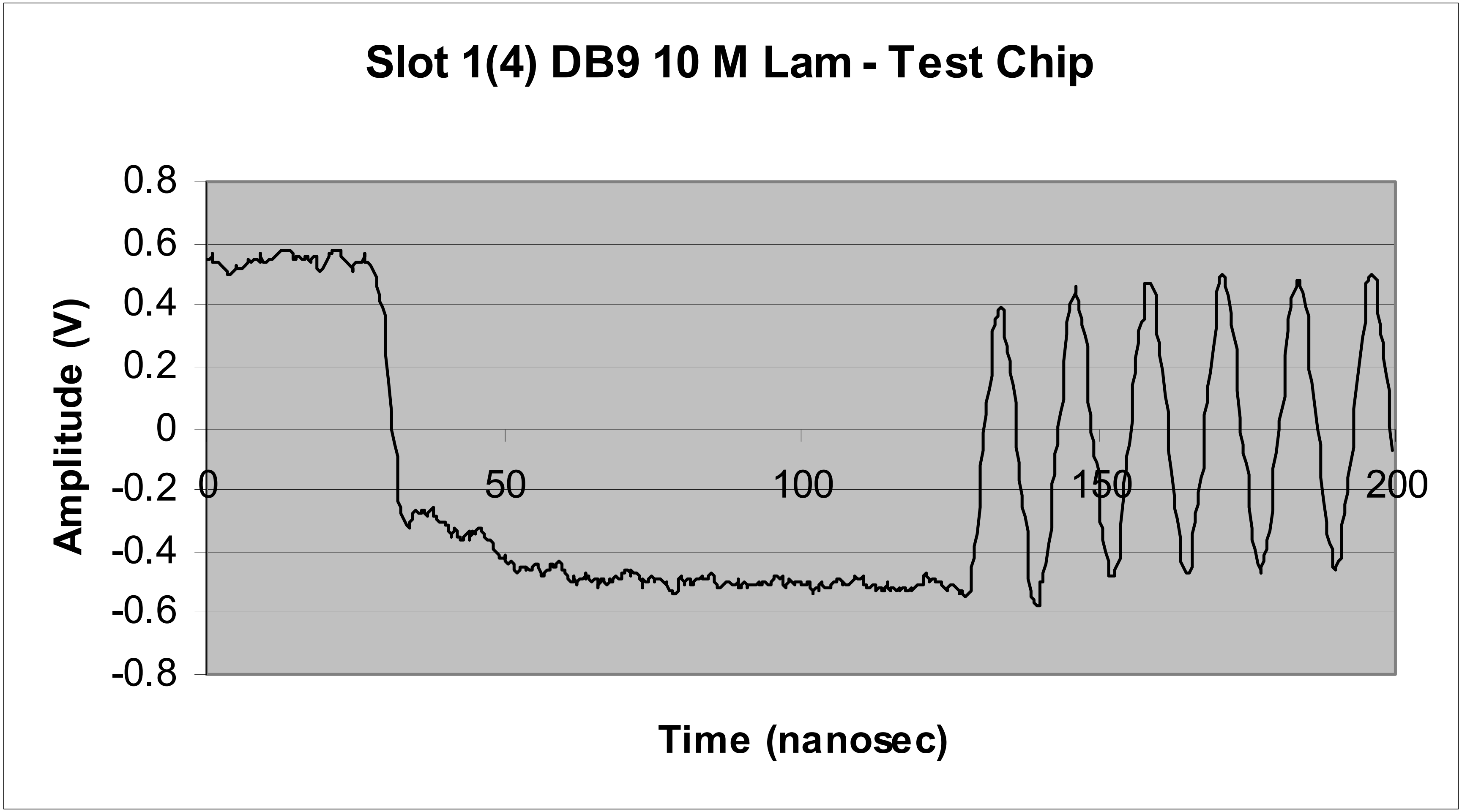
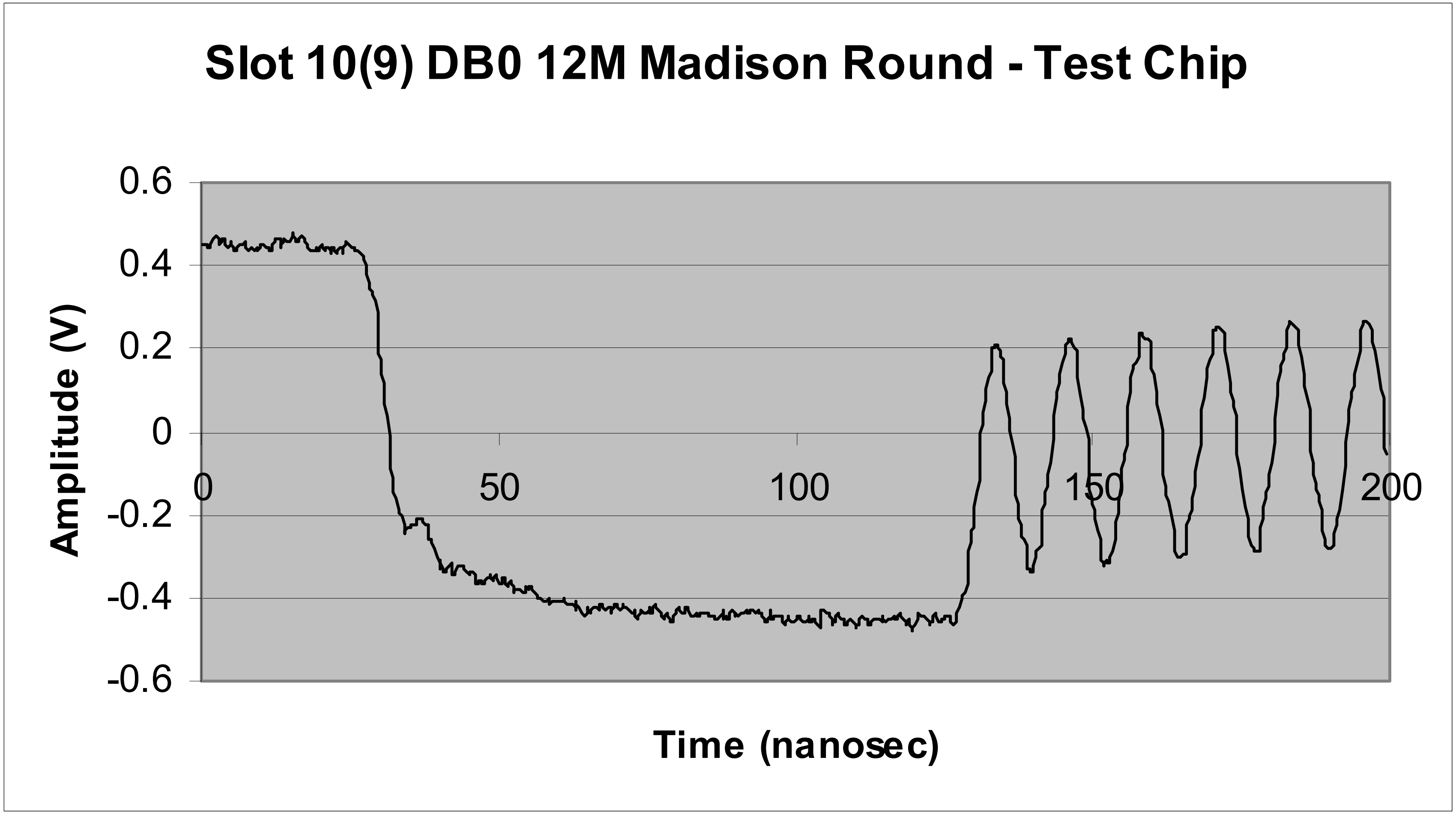


Vendor C - 10 slot backplane w/12 M Madison (round)



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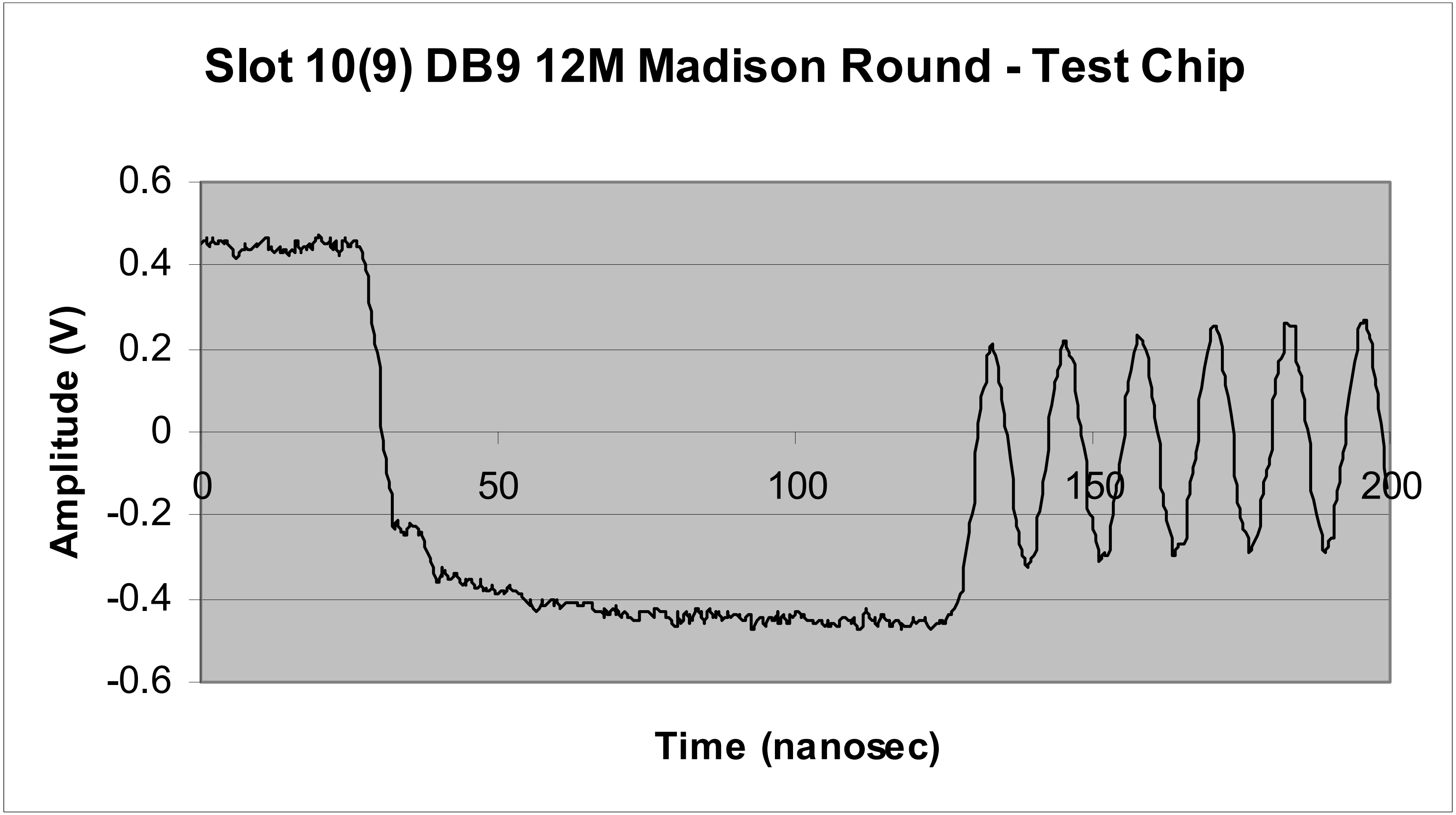

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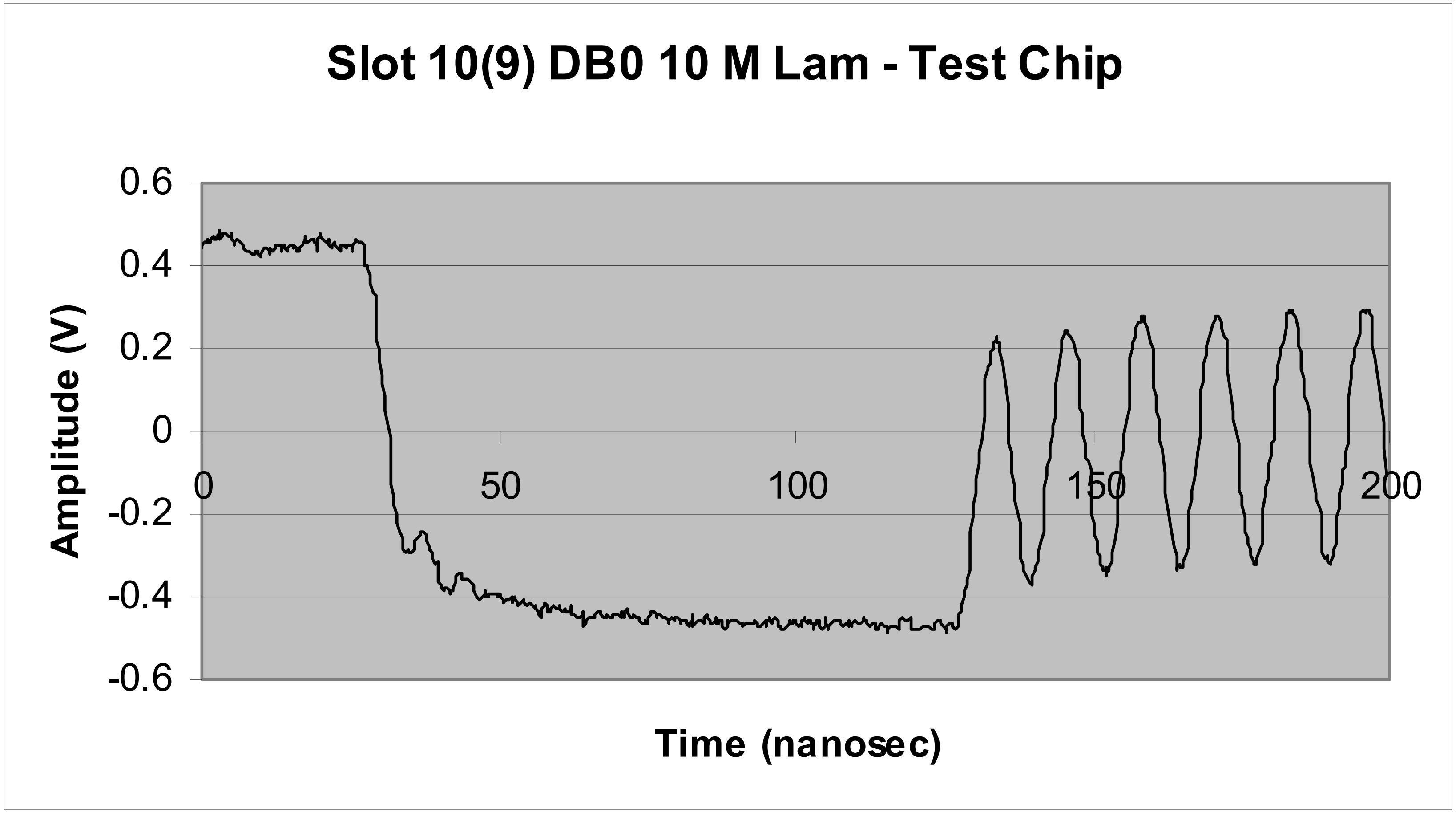

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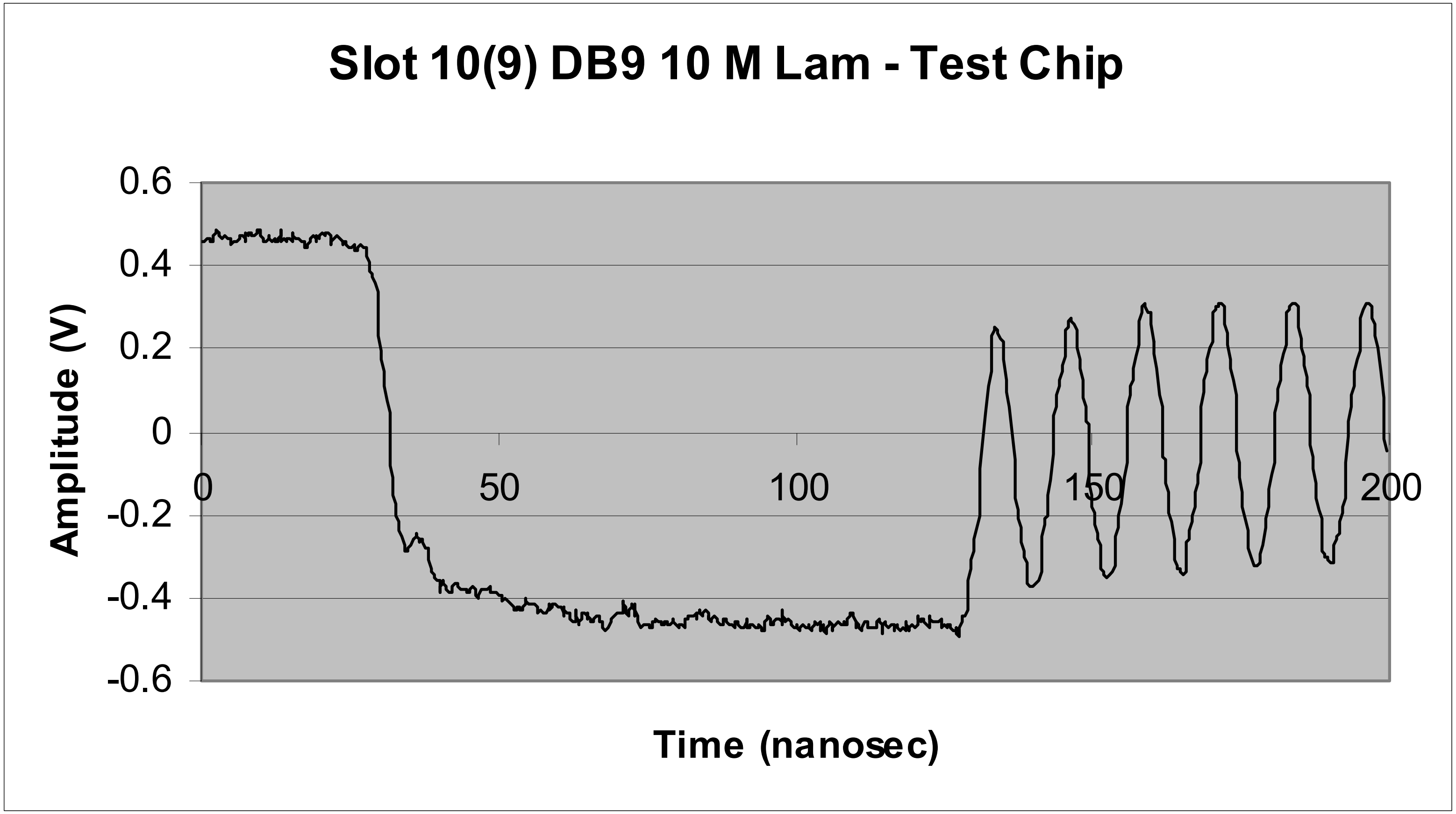
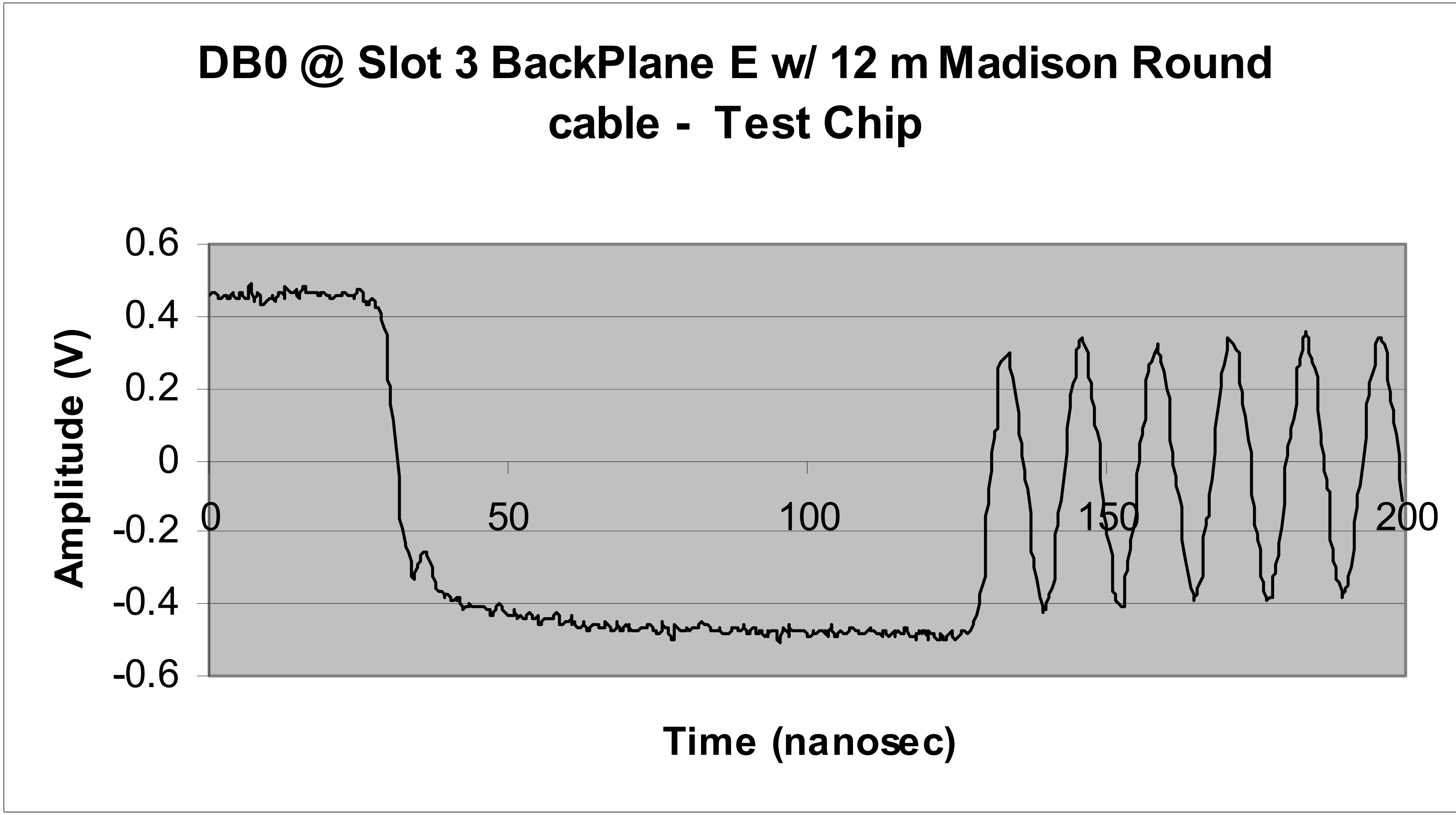


DB0 @ Slot 3 Backplane E Test Chip Driving



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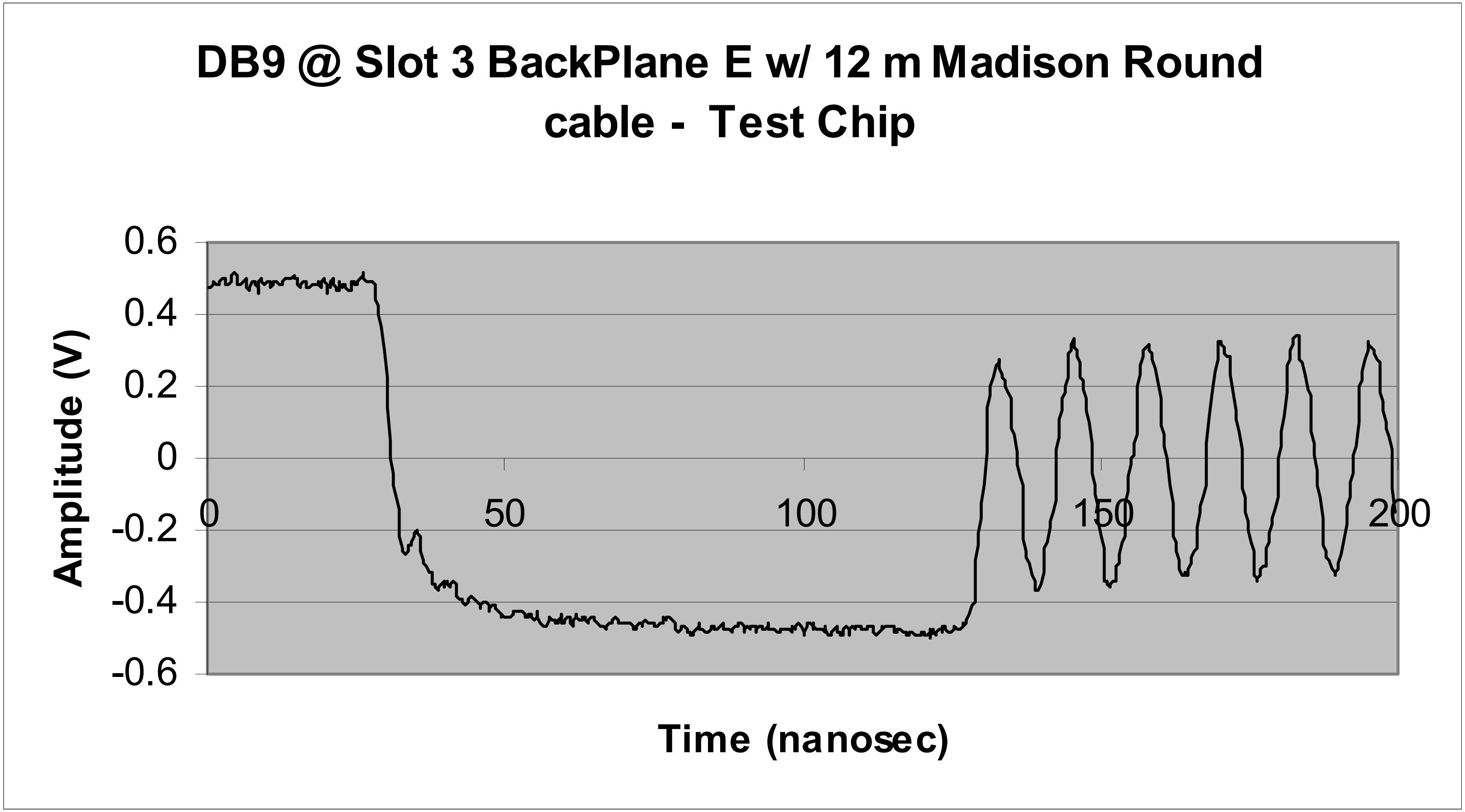
DB9 @ Slot 3 Backplane E Test Chip Driving



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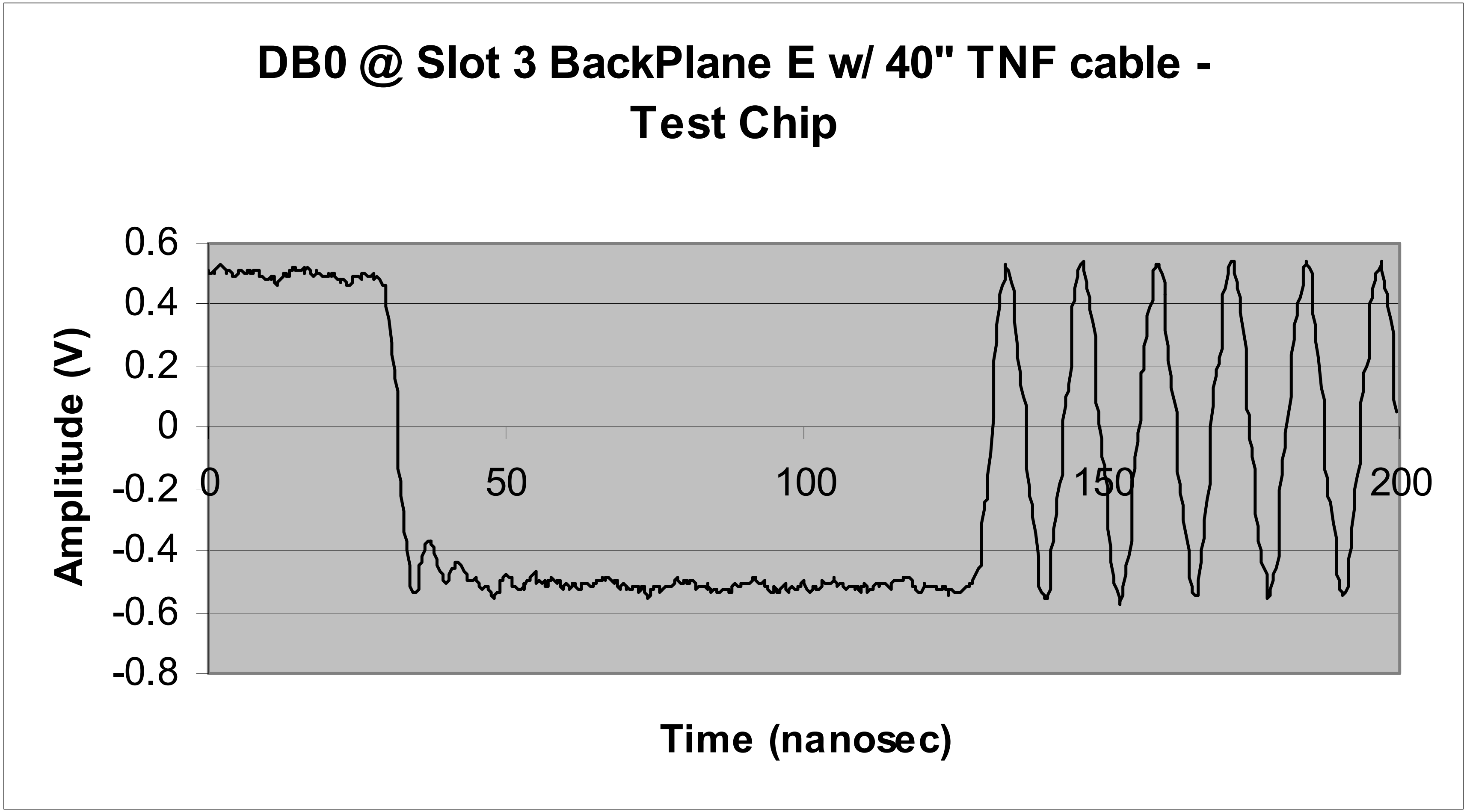

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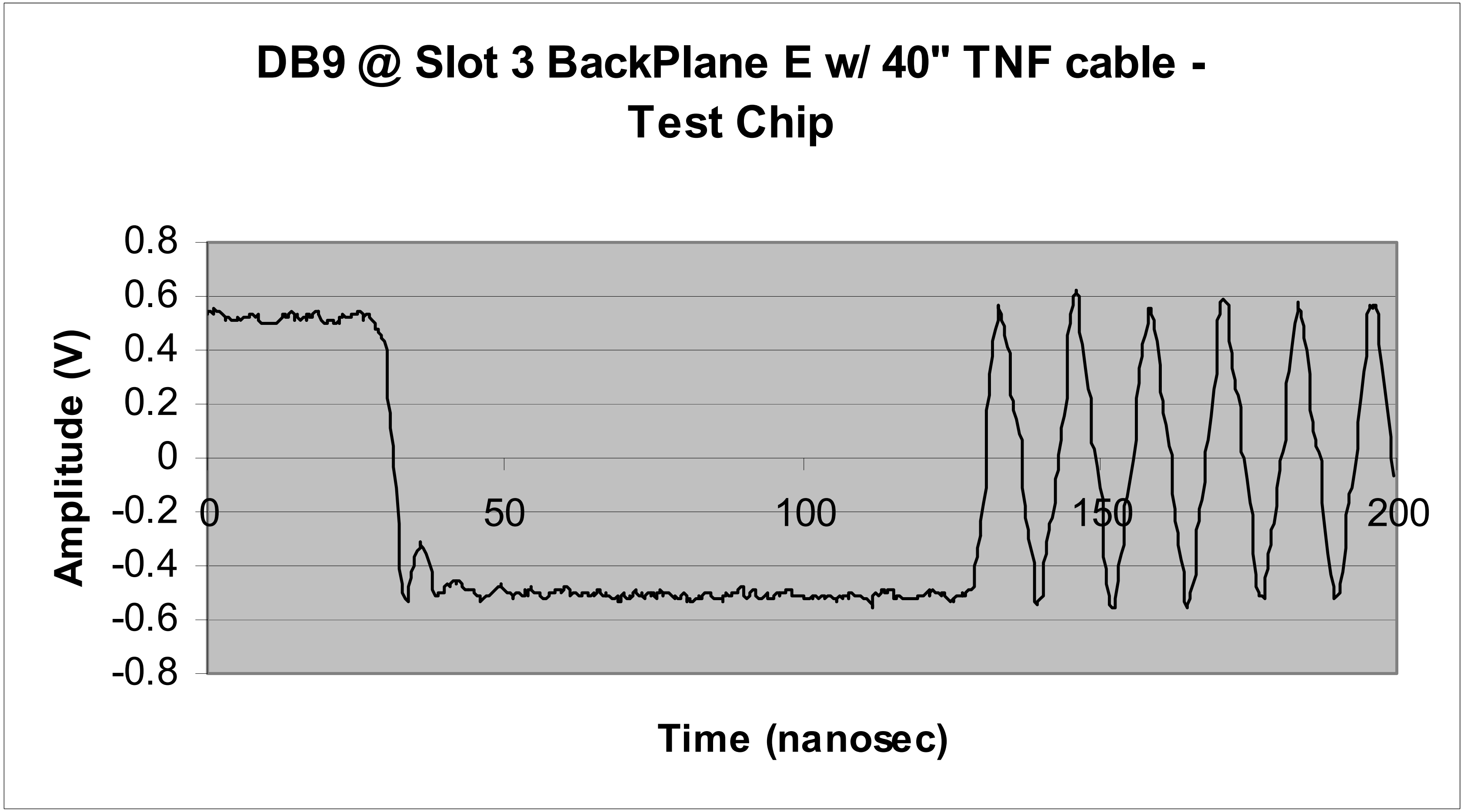

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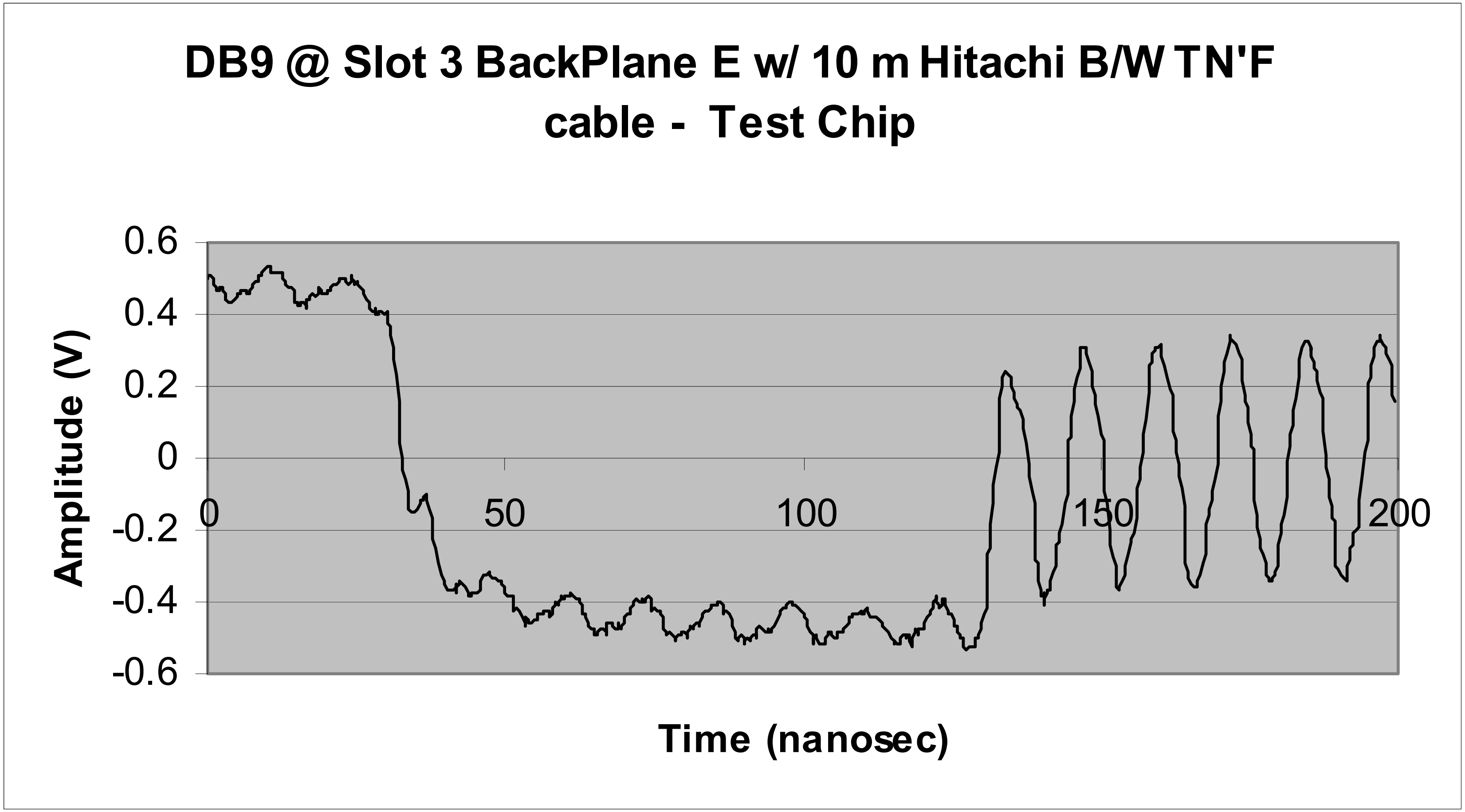
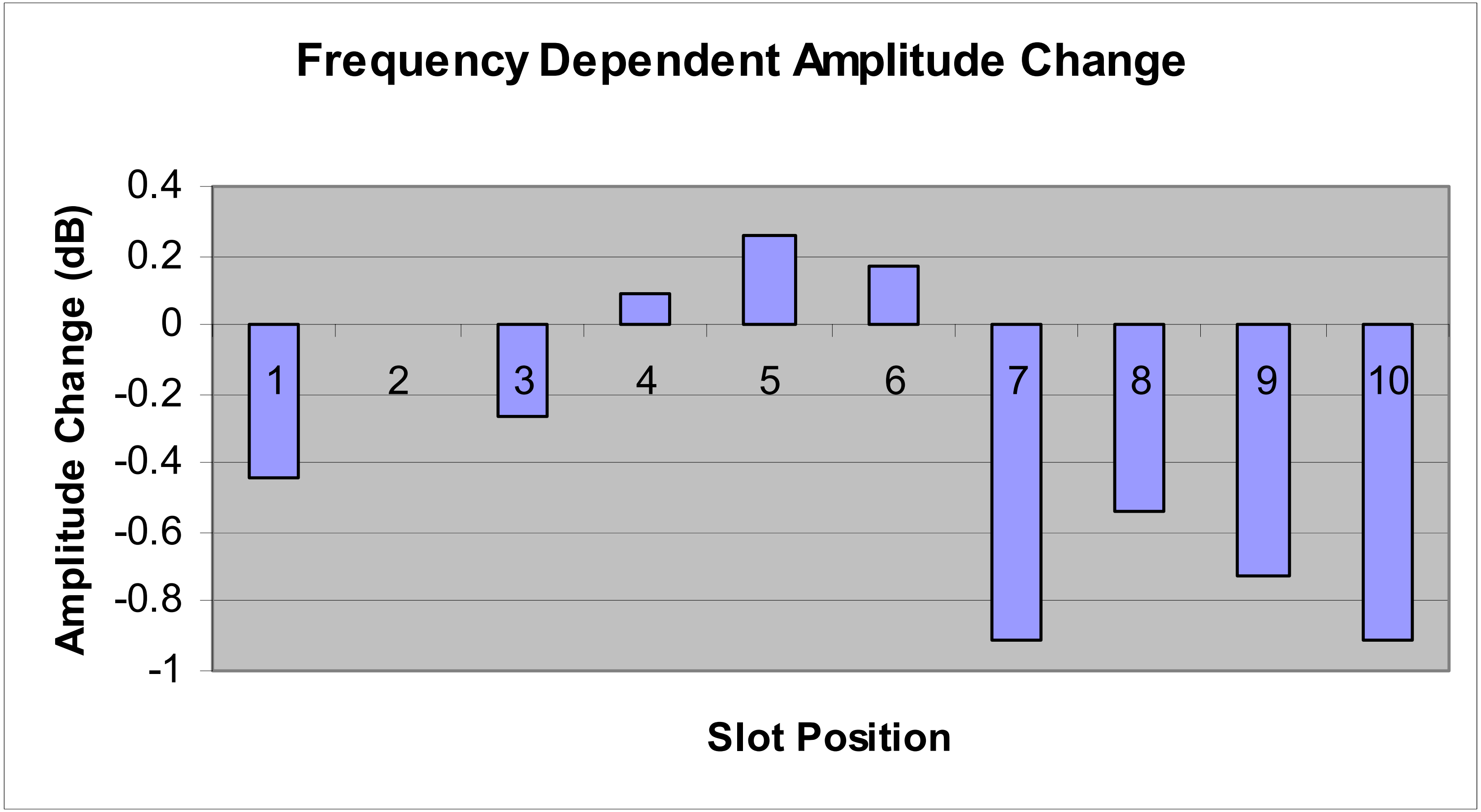
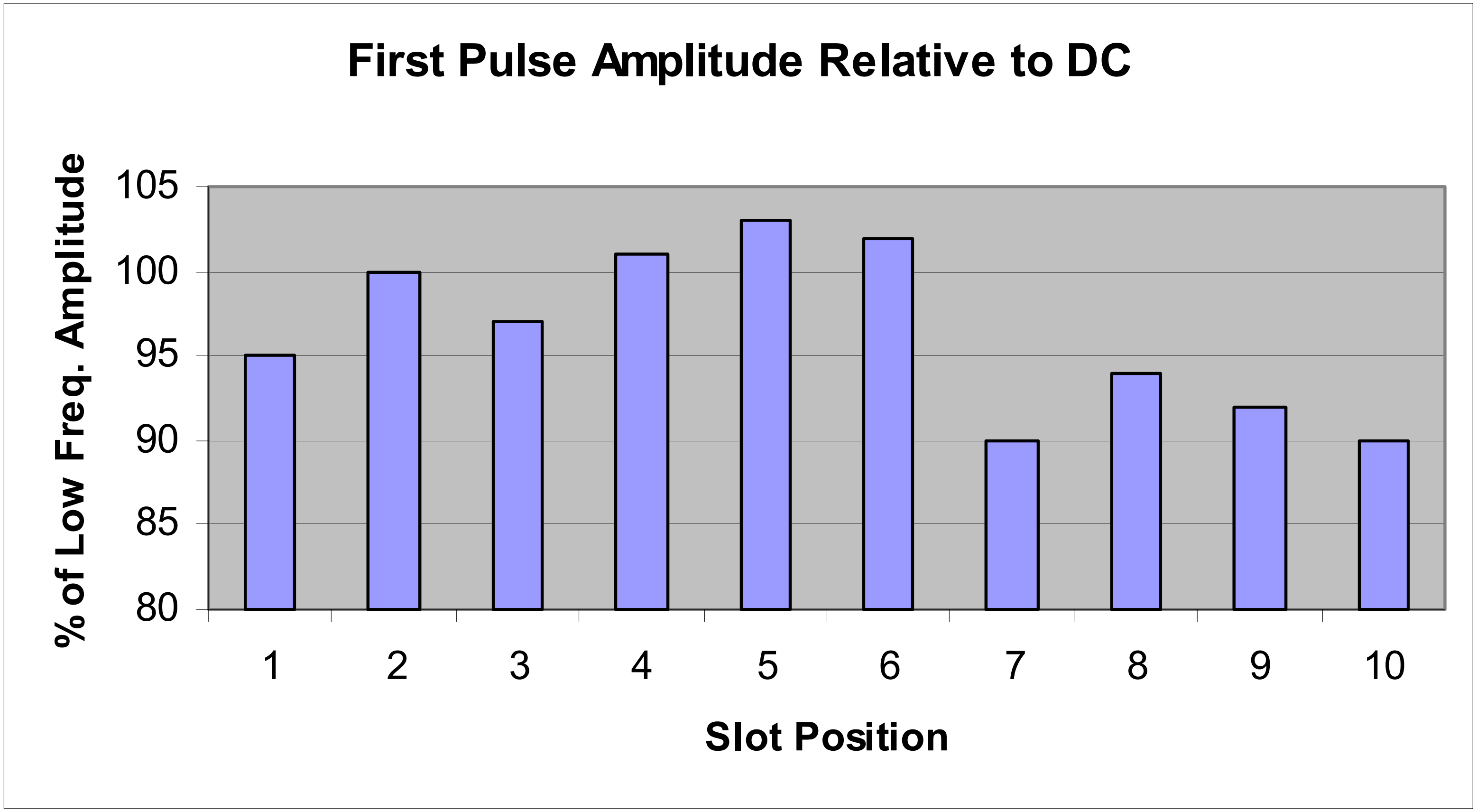


Vendor long cable (40”), 10 slot, all slots



First Pulse Amplitude Vs. DC (low freq.)



Summary

Configuration	Attenuation	V_{iso}/V_s
25m round, point-to-point, term. Only	–4.2 dB	0.73
10m flat, point-to-point, terminator only	–4.5 dB	0.71
10m round, 10-slot bp, @ slot 4	–4.3 dB	0.74
10m laminated ribbon, 10-slot bp, @slot 4	–6.0 dB	0.64
10m round, 10-slot bp, @ slot 9	–7.2 dB	0.53
10m laminated ribbon, 10-slot bp, @slot 9	–10.9 dB	0.42
3.75m ribbon, 5-slot bp, @ slot 3	–4.5 dB	0.72
10m round, 5-slot bp, @ slot 3	–7.7 dB	0.69
10m laminated ribbon, 5-slot bp, @slot 3	–5.0 dB	0.58

note: V_{iso} is measured at the peak of the 'first pulse', not in the middle where data is nominally clocked.

Summary

Configuration	Attenuation	Viso/Vs [1]
25m round, point-to-point, term. only	-3.1 dB	0.73
10m flat, point-to-point, terminator only	-1.0 dB	0.90
12m round, 10 slot bp @ slot position 4[2]	-2.9 dB	0.78
10m lam. ribbon, 10-slot bp @ slot 4	-2.4 dB	0.80
12m round, 10 slot bp @ slot pos. 9 [2]	-3.7 dB	0.76
10m lam. ribbon, 10 slot bp @ slot 9	-2.7 dB	0.83
12m round, 5-slot bp @ slot position 3 [2]	-2.2 dB	0.84
10m lam. ribbon, 5-slot bp @ slot 3	-3.1 dB	0.76

note: 1. Viso is measured in the middle of the ‘first pulse’ where data is normally clocked
2. We used 12 M instead of 10 M round - 20% additional degradition

Conclusions

- Actual subsystems which include backplanes with short ribbon cables do not need pre-compensation or AAF
- Subsystems which include long cables need some sort of frequency compensation.
- No actual subsystem of any type had a high frequency loss of greater than 30% including noise, crosstalk and process variations.

Invitational Challenge

- We set up our lab to facilitate these kind of measurements - and partially automated the collection of data and its presentation
  - First Pulse
  - Frequency attenuation
  - Cable measurements
- We invite you to use our lab
  - Send us you materials and we will measure
  - Come with your materials and we can measure together
  - (If Quantum - we’ll set it up in the park next door)