

To: T10 working group
From: SCSI cable performance study group
Date: July 28, 1999
Subject: Recommendations for content in SPI-3 relating to cable performance

This document contains the recommendations of the SCSI cable performance study group for specification limits for all the requirements on the cable media. Specific test procedures for measuring these parameters are specified in a normative annex presently undergoing the final editing for the proposal.

The following indented material was added by the study group for enhanced understanding of the recommendations. This additional material contains some context and background information relating to these new requirements. It does not constitute a formal part of the ad hoc recommendations.

This is a new set of requirements that include performance requirements that have not been specified previously in SCSI. These new requirements include extensions of the required ranges for some previously specified parameters, detailed specification of the measurement procedure to be used to obtain the values for all parameters (in a separate document), and new tests that are required to ensure performance at higher data rates. Therefore, any cable built to previous specifications may not meet these new, more stringent requirements. The performance requirements specified in this document are intended to be consistent with the performance typically exhibited by high quality SCSI cables built for use with SPI and SPI-2. However, re-qualification of previous cables for use with SPI-3 is required to ensure conformance with these new specifications.

The limitations on the use of flat cable have been replaced by a set of purely performance based requirements (that includes cross talk) for all cables. The limits specified are consistent with the actual performance of high quality flat cable constructions. Note, however, that flat cables have significantly inferior cross talk performance compared to more balanced constructions (twisted pair for example) and that eliminating flat cables is one way to significantly decrease the cable contribution to cross talk noise in a system. Such a need may be seen in future versions of SCSI.

For length dependent parameters both total and per unit length requirements are specified. This ensures performance compliance when concatenating cables in the same SCSI bus segment. Implementers have the practical option to use only the total requirements and to loosen the per unit length requirements in non-concatenated applications; however, this practice will create non conforming cables. Any cable media not meeting the per unit length requirements shall be labeled in a manner indicating that it is not suitable for use in cable assemblies that might be used in a concatenated manner. [Need a common way to do this indication.]

End of indented material

1. Local transmission line impedance

Cable construction	Local SE transmission line impedance **		Local DIFF transmission line impedance **	
	Min	Max	Min	Max
All	84*	96	110	135

All values are measured by time domain reflectometry
* If SCSI loads attached to the cable media are separated by more than 1.0 m this value is 78 Ohms
** Ideally one design will meet both SE and DIFF criteria

2. Extended distance transmission line impedance

Swept frequency (extended distance) differential impedance limits: max peak to peak variation of 30 ohms over the frequency range 1 MHz to 1 GHz on a 30 meter cable.

3. Capacitance

Capacitance limits: SE 66 pF/m max at 100 kHz and 1 MHz

Differential max 46 pF/m max at 100 kHz and 1 MHz

Dielectric constant variation between 100 kHz and 1 GHz 5% max peak to peak [measurement procedure not yet established]

4. Propagation time and propagation time skew

Differential propagation time: 5.4 ns/m max within the cable plant AND 135 ns max terminator to terminator

Differential propagation time skew (pair to pair): 82 ps/m max within the cable plant AND 2.0 ns max terminator to terminator

5. Attenuation

Differential attenuation:

Distance between SCSI bus terminators (meters)	Attenuation per meter max (dB) @ 200 MHz	Attenuation terminator to terminator max (dB) @ 200 MHz	Lengths are consistent with these minimum size conductors:
0 to 9	0.63	6	32 AWG solid
0 to 12	0.5	6	30 AWG solid
>12 to 25	0.4	10	28 AWG stranded
Both the per meter and the terminator to terminator requirements shall be simultaneously met			

6. Cross talk

Cross talk: Aggressor signals on each of the DATA, PARITY, and REQ or ACK pair induces near end cross talk (NEXT) noise on the ACK or REQ pair respectively. Each DATA, PARITY, and REQ or ACK pair shall be separately excited, the induced absolute peak noise (deviation from zero differential) on the ACK or REQ pair measured at a time position not associated with the test fixture and the results added to yield the total cross talk. The allowed limit for the total cross talk is 3.0% of the aggressor signal amplitude at 1.0 ns rise time. Cross talk percent is calculated as follows:

$$\%NEXT = \frac{\sum \text{peak absolute differential victim voltages}}{\text{peak to peak differential aggressor voltage}}$$

Note: 3.0% NEXT yields 58.9 mV peak max at 1963 mV pp aggressor signal amplitude (135 ohm max cable impedance at 7.3 mA max driver current). The cross talk requirement is based only on percentage as that is all the cable can influence.