

To: T10 working group 99-111r7
From: SCSI cable performance study group
Date: September 28, 1999
Subject: Recommendations for content in SPI-3 relating to cable performance

This document contains the recommendations of the SCSI working group as of the September 28, 1999 meeting in Lisle, IL for the performance requirements on the cable media. Specific test procedures for measuring these parameters are specified in a normative annex (that will replace the present Annex F) that was recommended for inclusion in SPI-3 by the referenced working group (document 98-219r6).

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The limitations on the use of flat cable have been replaced by a set of purely performance based requirements (that includes cross talk) for all cables.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 eliminating flat cables is one way to significantly decrease the cable media 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

The following sections are the performance requirements for uniform SCSI cable media.

1. Applicability of requirements for SCSI cable media

The requirements in this clause apply to uniform cable media. Uniform media is media that is not designed to be non-uniform for the purposes of enabling connector attachment. These non-uniformities (for example a flat section created for connector attachment within a normally round cable media) is considered to be part of a cable assembly or harness whose performance is affected by the attached (sometimes unused) connectors as well as by the non-uniformity in the media.

Meeting the SCSI signal requirements in complete SCSI segments may require allowances beyond the uniform media requirements specified in this clause. See annex F.

The requirements in this clause apply to all the SCSI signals in the cable except where otherwise specified.

2. Local transmission line impedance

Cable construction	Local SE transmission line impedance **		Local DIFF transmission line impedance **	
	Min	Max	Min	Max
All	84 (78*)	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 use the value of 78 Ohms
 ** Ideally one design will meet both SE and DIFF criteria
 Lower impedance values may be desirable when attaching directly to a backplane or other heavily loaded environments

3. Extended distance transmission line impedance

Swept frequency (extended distance) differential impedance limits: max peak to peak variation of 50 ohms over the frequency range 30 MHz to 600 MHz on a 30 meter cable.

4. Capacitance

Capacitance limits: SE 40 min to 66 pF/m max at 100 kHz and 1 MHz

DIFF 26 min to 46 pF/m max at 100 kHz and 1 MHz

Dielectric constant variation between 300 kHz and 600 MHz: max dielectric constant in the frequency range divided by the min dielectric constant in the frequency range is less than 1.10

5. 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

6. Attenuation

The attenuation requirements (all differential) are specified in Table 1.

Table 1 - Attenuation requirements for SCSI cable media

Distance between SCSI bus terminators (meters)	Attenuation per meter max (dB) @ 200 MHz	Attenuation of length equivalent to terminator to terminator distance max (dB) @ 200 MHz	Distances are consistent with these minimum size conductors when used with high quality dielectrics:	Notes:
0 to 9	0.63	6	32 AWG solid/ 30 AWG stranded	multiple loads allowed
0 to 12	0.48	6	30 AWG solid/ 28 AWG stranded	multiple loads allowed
>12 to 25	0.48	12	30 AWG solid/ 28 AWG stranded	point to point only
Both the per meter and the length equivalent to the terminator to terminator spacing requirements shall be simultaneously met				

7. Cross talk

The maximum near end cross talk (NEXT) on REQ or ACK is 3.0% of the 1.0 ns rise time aggressor signal amplitude. Cross talk percent is calculated as follows:

$$\%NEXT = \frac{\sum \text{peak absolute differential induced voltages on REQ or ACK}}{\text{peak to peak differential aggressor voltage}}$$

The aggressor signals are each of the DATA, PARITY, and REQ or ACK pairs. If REQ is the victim line DATA, PARITY, and ACK shall constitute the set of aggressor signals. If ACK is the victim line DATA, PARITY, and REQ constitute the set of aggressor signals. Each aggressor signal is separately excited, the induced absolute peak noise (deviation from zero differential) on the victim pair measured at a time position not associated with the test fixture and the results added to yield the total cross talk.

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.