

To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 20 May 2004
Subject: 04-131r1 SAS-1.1 Miscellaneous physical layer changes

Revision history

Revision 0 (21 April 2004) First revision (created from 04-115r0)
Revision 1 (20 May 2004) Incorporated comments from 20 May SAS physical WG teleconference.

Related documents

sas1r04 - Serial Attached SCSI 1.1 revision 4
04-115 SAS-1.1 Miscellaneous changes

Overview

This collects a variety of minor technical (or major editorial) changes.

Suggested changes

A wide variety of topics follow.

- 1 Clause 3 - define intersymbol interference (ISI)
- 2 Clause 5 - clarify "no keying" requirement in external connector
- 3 Clause 5 - raise the 2 x Z2 level at XR to 1600 mV
- 4 Clause 5 - withdrawn

1 Clause 3 - define intersymbol interference (ISI)

Add a definition of *intersymbol interference*, since the ISI acronym appears in the text. Taken from the FC-MJSQ revision 13 definition.

3.1.xx intersymbol interference (ISI): Reduction in the distinction of a pulse caused by overlapping energy from neighboring pulses. ISI may result in data dependent deterministic jitter.

2 Clause 5 - clarify “no keying” requirement in external connector

SFF-8470 terminology concerning keys now differentiates between keys and key slots. Clarify that keys are prohibited in SAS connectors but key slots are not (although there are no definitions for key slots anywhere in SAS).

5.2.3.6 SAS external cable plug connector

SAS external cables shall use the SAS external cable plug connector. The SAS external cable plug connector is defined in SFF-8470 as the four lane free (plug) connector with jack screws. The SAS external cable plug connector shall not include keys and may include key slots. Key slots are not defined by this standard. ~~No special SAS keying is provided.~~ The SAS external cable plug connector attaches to a SAS external receptacle connector, providing contact for up to four physical links.

5.2.3.7 SAS external receptacle connector

SAS devices with external ports shall use the SAS external receptacle connector. The SAS external receptacle connector is defined in SFF-8470 as the four lane fixed (receptacle) connector with jack screws. The SAS external cable receptacle connector shall not include keys and may include key slots. Key slots are not defined by this standard. ~~No special SAS keying is provided.~~ The SAS external receptacle connector attaches to a SAS external cable plug connector, providing contact for up to four physical links.

3 Clause 5 - raise the 2 x Z2 level at XR to 1600 mV

Raise the "2 x Z2" requirement at XR to from 600 mV to 1600 mV. There's no need for and it would be a mistake for a SAS phy (in an expander or initiator) attached to a SATA physical link to enforce a maximum on signals received from the SATA device. SATA port selectors in the drive location may drive more than 600 mV, thus causing the receiver at XR to receive more than 600 mV.

Also, raise the near-end crosstalk allowance to 100 mV. If a 1600 mV signal did arrive, it would probably have more crosstalk than 50 mV. And a maximum including "<" isn't very well defined.

Finally, add an editor's note indicating that more changes are forthcoming as SATA II support (especially 3 Gbps) is added.

5.3.5 Signal characteristics at IR, CR, and XR

Table 1 defines the compliance point requirements of the signal at the receiver end of a TxRx connection as measured into the test loads specified in figure 51 and figure 52.

Table 1 — Signal characteristics at IR, CR, and XR

Compliance point	Signal characteristic	Units	SATA	1,5 Gbps	3,0 Gbps
...					
XR	Jitter (see figure 48) ^b	N/A	See table 28	See table 28	See table 28
	2 x Z2	mV(P-P)	600 <u>1 600</u>	1 600	1 600
	2 x Z1	mV(P-P)	225	325	275
	X1 ^a	UI	0,275	0,275	0,275
	X2	UI	0,50	0,50	0,50
	Skew ^d	ps	50	80	75
	Max voltage (non-op)	mV(P-P)	2 000	2 000	2 000
	Minimum OOB ALIGN burst amplitude ^c	mV(P-P)	240	240	240
	Maximum noise during OOB idle time ^c	mV(P-P)	120	120	120
	Max near-end crosstalk ^f	mV(P-P)	<50 <u>100</u>	100	100

^a The value for X1 shall be half the value given for total jitter in table 28. The test or analysis shall include the effects of a single pole high-pass frequency-weighting function that progressively attenuates jitter at 20 dB/decade below a frequency of ((bit rate) / 1 667).

^b The value for X1 applies at a total jitter probability of 10^{-12} . At this level of probability direct visual comparison between the mask and actual signals is not a valid method for determining compliance with the jitter output requirements.

^c With a measurement bandwidth of 1,5 times the baud rate (i.e. 4,5 GHz for 3,0 Gbps).

^d The skew measurement shall be made at the midpoint of the transition with a repeating 0101b pattern on the physical link. The same stable trigger, coherent to the data stream, shall be used for both the Rx+ and Rx- signals. Skew is defined as the time difference between the means of the midpoint crossing times of the Rx+ signal and the Rx- signal.

^e If being attached to SATA devices is supported at the IR location, requirements of SATA shall be met at IR.

^f Near-end crosstalk is the unwanted signal amplitude at receiver terminals DR, CR, and XR coupled from signals and noise sources other than the desired signal. Refer to SFF-8410.

Editor's Note 1: Add this editor's note to the working draft: Full support for SATA II spec is under discussion in the SAS physical WG. This may significantly change the SATA column. SATA II

defines numerous environments. **1i** = 1.5 Gbps original SATA-1.0a spec for internal cables (transmit 400-600 mV; receive 325 mV). **1m** = 1.5 Gbps for hosts using "short" backplanes and external cables (has the HBA transmit within a tighter range 500-600 mV, and has it receive a lower level of 240 mV). **1x** = 1.5 Gbps for external use and port selectors (bumps transmitter up to 1600 mV). **2i** = 3 Gbps for internal use (transmit 400-700 mV). **2m** = 3 Gbps for "short" backplanes and external cables (transmit 500-700 mV; receive 240 mV). **2x** = 3 Gbps for external use and port selectors (transmit 800-1600 mV; receive 275 mV). SAS expanders and HBAs that support SATA devices should tolerate them all. Supporting a 3 Gbps device 400 mV device will be challenging in some environments; the 225 mV minimum in the current SATA column might not be low enough (perhaps it will be necessary to specify some level of receive equalization). The OOB levels also need to be investigated, given that SATA II is allowing OOB signals to optionally be created from 1.5 Gbps D10.2 characters (0101 patterns) rather than just ALIGN primitives (which have some lower frequency content).

4 Clause 5 - withdrawn

The standard doesn't provide a column for SATA at the transmit compliance points that might attach to SATA drives - XT (expander or SAS initiator phy) and possibly IT (internal connector).

Withdrawn in rev 1 of this proposal - this will be addressed as part of defining SATA II support.