

To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
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Subject: 04-131r0 SAS-1.1 Miscellaneous physical layer changes

Revision history

Revision 0 (21 April 2004) First revision (created from 04-115r0)

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 - add SATA signal characteristics at transmit compliance points

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 they are discouraged).

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 include no keys and may include key slots. No key slots are 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 include no keys and may include key slots. No key slots are 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.

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	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.					

4 Clause 5 - add SATA signal characteristics at transmit compliance points

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).

5.3.4 Signal characteristics at IT, CT, and XT

Table 2 specifies the signal characteristics at IT, XT, and XT.

Table 2 — Signal characteristics at IT, CT, XT

Compliance point	Signal characteristic ^a	Units	SATA^{-h}	1,5 Gbps	3,0 Gbps
IT, CT, XT	Skew ^b	ps	20	20	15
	Tx Off Voltage ^c	mV(P-P)	< 50	< 50	< 50
	Maximum rise/fall time ^d	ps	273	273	137
	Minimum rise/fall time ^d	ps	67	67	67
	Maximum transmitter output imbalance ^e	%	10	10	10
	OOB offset delta ^f	mV	± 25	± 25	± 25
	OOB common mode delta ^g	mV	± 50	± 50	± 50

^a All tests in this table shall be performed with zero-length test load shown in figure 52.

^b 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 Tx+ and Tx- signals. Skew is defined as the time difference between the means of the midpoint crossing times of the Tx+ signal and the Tx- signal.

^c The transmitter off voltage is the maximum A.C. voltage measured at compliance points IT, CT, and XT when the transmitter is unpowered or transmitting D.C. idle (e.g., during idle time of an OOB signal).

^d Rise/fall times are measured from 20 % to 80 % of the transition with a repeating 0101b pattern on the physical link.

^e The maximum difference between the V+ and V- A.C. RMS transmitter amplitudes measured on a CJTPAT test pattern (see 5.3.8) into the test load shown in figure 52, as a percentage of the average of the V+ and V- A.C. RMS amplitudes.

^f The maximum difference in the average differential voltage (D.C. offset) component between the burst times and the idle times of an OOB signal.

^g The maximum difference in the average of the common mode voltage between the burst times and the idle times of an OOB signal.

^h [For IT or XT location if attached to a SATA device.](#)