SAS-1.1 PHY transmitter and receiver electrical table updates T10/05-083r1

Date: March 4, 2005
To: T10 Technical Committee
From: Alvin Cox (alvin.cox@seagate.com)
Subject: SAS-1.1 PHY transmitter and receiver electrical table updates

The following proposed changes clarify the requirements of the signal path implementation and move the OOB and system noise values to the general electrical table. The name near-end crosstalk used for the system noise description is now confusing since the definition of near-end crosstalk for the internal and external multilane cable requirements has a different meaning than as defined in the notes of table 33 and table 35. Transmitter and receiver impedance requirements are also being moved from table 27 to the general electrical table 31 since the reordering of sections put them out of place.

Rev 1: Changed and/or to and, restored symbols in note j.

Proposed changes:

Add the highlighted paragraph to section 5.3.3:

5.3.3 General electrical characteristics

A TxRx connection is the complete simplex signal path between the transmitter circuit (see 3.1.235) and receiver circuit (see 3.1.146), over which a bit error ratio (BER) of < 10^{-12} is achieved.

A TxRx connection segment is that portion of a TxRx connection delimited by separable connectors or changes in media.

This subclause defines the electrical requirements of the signal at the compliance points IT, IR, CT, and CR in a TxRx connection.

Each compliant phy shall be compatible with these electrical requirements to allow interoperability within a SAS environment. All TxRx connections described in this subclause shall exceed the BER objective of 10^{-12}. The parameters specified in this subclause support meeting this requirement under all conditions including the minimum input and output amplitude levels.

A TxRx connection shall be designed such that the loss characteristics of the TxRx connection shall be less than the loss of the TCTF plus ISI shown in figure 81 and~~/or~~ figure 82. The delivered signal shall meet the requirements as specified in table 35. A TxRx connection of multiple compliant components may be constructed where the sum of the losses and noise introduced by the compliant components do not meet the delivered signal requirements of table 35.

For external cables, these electrical requirements are consistent with using good quality passive cable assemblies constructed with shielded twinaxial cable with 24 gauge solid wire up to 6 meters in length.

Add the following to table 31 from tables 27, 33, and 35:

Maximum noise during OOB idle time [f]	mV(P-P)	120	
Maximum noise amplitude [g]	mV(P-P)	100	
Receiver device termination			
Differential impedance [h, i, j]	ohm	100 ± 15	
Maximum differential impedance imbalance [h, i, j, k]	ohm	5	
Maximum receiver termination time constant [h, i, j]	ps	150	100
Common mode impedance [h, i]	ohm	20 min/40 max	
Transmitter device source termination			
Differential impedance [h]	ohm	60 min/115 max	
Maximum differential impedance imbalance [h, k]	ohm	5	
Common mode impedance [h, i]	ohm	15 min/40 max	

[f] With a measurement bandwidth of 1,5 times the highest supported baud rate (i.e., 4,5 GHz for 3,0 Gbps), no signal level during the idle time shall exceed the specified maximum differential amplitude.

[g] Noise is the unwanted signal amplitude at IT and CT including contributions from crosstalk coupled from signals and noise sources other than the desired signal introduced into the TxRx connection (see 5.3.3). See SFF-8410. This noise is included in the eye opening specifications, but listed separately for implementation verification.

[h] All measurements are made through mated connector pairs.

[i] The receiver device termination impedance specification applies to all receiver devices in a TxRx connection and covers all time points between the connector nearest the receiver device, the receiver device, and the transmission line terminator. This measurement shall be made from that connector.

[j] At the time point corresponding to the connection of the receiver device to the transmission line, the input capacitance of the receiver device and its connection to the transmission line may cause the measured impedance to fall below the minimum impedances specified in this table. The area of the impedance dip (amplitude as ρ, the reflection coefficient, and duration in time) caused by this capacitance is the receiver termination time constant. The receiver termination time constant shall not be greater than the values shown in this table. An approximate value for the receiver termination time constant is given by the product of the amplitude of the dip (as ρ) and its width (in ps) measured at the half amplitude point. The amplitude is defined as being the difference in the reflection coefficient between the reflection coefficient at the nominal impedance and the reflection coefficient at the minimum impedance point. The value of the receiver device excess input capacitance is given by the following equation:

$$C = \frac{\text{receiver termination time constant}}{(R0 \parallel RR)}$$

where (R0 || RR) is the parallel combination of the transmission line characteristic impedance and termination resistance at the receiver device.

[k] The difference in measured impedance to ground on the plus and minus terminals on the interconnect, transmitter device, or receiver device, with a differential test signal applied to those terminals.

Remove the following two items and the associated notes from Table 33 and 35:

Maximum noise during OOB idle time [e]	mV(P-P)	120
Maximum near-end crosstalk [f]	mV(P-P)	100

Change the title of table 35 from:
Table 35 — Receiver device signal tolerance characteristics as measured with the zero length test load at receiver device compliance points IR and CR

To:
Table 35 — Delivered signal characteristics at receiver device compliance points IR and CR

Remove the following items from table 27:

Receiver device termination			
Differential impedance [b, e, f]	ohm	100 ± 15	
Maximum differential impedance imbalance [b, e, f, g]	ohm	5	
Maximum receiver termination time constant [b, e, f]	ps	150	100
Common mode impedance [b, e]	ohm	20 min/40 max	

Transmitter device source termination		
Differential impedance [b]	ohm	60 min/115 max
Maximum differential impedance imbalance [b, g]	ohm	5
Common mode impedance [b]	ohm	15 min/40 max

[e] The receiver device termination impedance specification applies to all receiver devices in a TxRx connection and covers all time points between the connector nearest the receiver device, the receiver device, and the transmission line terminator. This measurement shall be made from that connector.

[f] At the time point corresponding to the connection of the receiver device to the transmission line, the input capacitance of the receiver device and its connection to the transmission line may cause the measured impedance to fall below the minimum impedances specified in this table. The area of the impedance dip (amplitude as ρ, the reflection coefficient, and duration in time) caused by this capacitance is the receiver termination time constant. The receiver termination time constant shall not be greater than the values shown in this table. An approximate value for the receiver termination time constant is given by the product of the amplitude of the dip (as ρ) and its width (in ps) measured at the half amplitude point. The amplitude is defined as being the difference in the reflection coefficient between the reflection coefficient at the nominal impedance and the reflection coefficient at the minimum impedance point. The value of the receiver device excess input capacitance is given by the following equation:

$$C = \frac{\text{receiver termination time constant}}{(R0 \parallel RR)}$$

where (R0 || RR) is the parallel combination of the transmission line characteristic impedance and termination resistance at the receiver device.