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Subject: Proposal for Ultra320 SCSI timing skew specification for SPI-4

Introduction

For parallel SCSI transfer rates of 320 megabytes per second, skew compensation must be performed at the receiver on data and clock signals to achieve adequate margin. The following is a concise set of requirements for timing skew for Ultra320 SCSI systems. This proposal specifies only the timing skew requirements between DATA BUS, DB(P1), and REQ(ACK) signals, assuming that other amplitude and timing specifications are provided separately.

The timings in this proposal are derived from the timings in Table 33 in the draft standard SCSI Parallel Interface – 4 (SPI-4) revision 2. All non-compensatable receiver errors in Table 33 are accounted for in this proposal. This accounting does not include REQ(ACK) period tolerance, system noise at launch, and near-end crosstalk as these are not non-compensatable receiver errors. All numbers are listed as \pm peak values to clearly indicate symmetrical tolerance around the nominal. SPI-4 rev 2 is available at <ftp://ftp.t10.org/t10/drafts/spi4/spi4r02.pdf>.

Revision 1 of this proposal addresses comments from the December SPI-4 working group including: doubling the allowable transmitter skew and skew correction range and separating the figures for transmitter time asymmetry and transmitter skew. All references in the following are to SPI-4 rev 2.

The following additions are proposed for Table 32 – SCSI bus data & information phase DT timing values:

Table 32 - SCSI bus data & information phase DT timing values

Sub-clause	Timing description	Type	Timing Values (note 4)				
			Fast-10	Fast-20	Fast-40	Fast-80	Fast-160
	...						
9.2.a	Transmitter skew	max	N/A	N/A	N/A	N/A	$\pm 0,75$ ns
9.2.b	Transmitter time asymmetry	max	N/A	N/A	N/A	N/A	$\pm 0,25$ ns
9.2.c	Skew correction range (see note)	min	N/A	N/A	N/A	N/A	$\pm 3,65$ ns
9.2.d	De-skewed data-valid window (see note)	min	N/A	N/A	N/A	N/A	$\pm 2,1$ ns
Note: Measured at the receiver terminal using clean input signals with 500 mV peak amplitude and 1 ns rise and fall time (at 20% to 80%).							

The following are proposed to be added to clause 9.2

9.2.a Transmitter skew

The maximum difference in time allowed between the rising or falling edge of a “1010...” pattern on the DATA BUS or DB(P1) and its clocking signal on ACK(REQ) as measured at their zero-crossing points. The signals for the output waveforms shall be measured at the connector of the transmitting device and generated under the test conditions as described in A.2.6 (i.e., 500 mV peak amplitude and 1 ns rise and fall time (20% to 80%)).

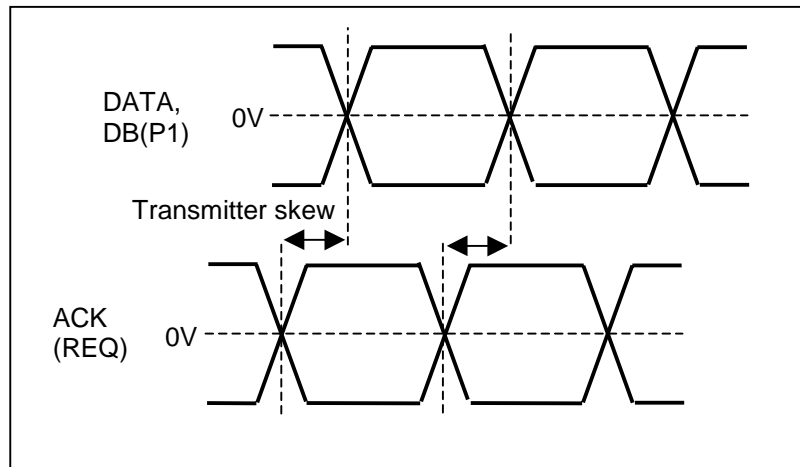


Figure y – Example of transmitter skew

9.2.b Transmitter time asymmetry

The maximum time on DATA BUS, DB(P1), or ACK(REQ) from a rising edge to the subsequent falling edge of a “1010...” pattern as measured at their zero-crossing points minus the data transfer period or a falling edge to the subsequent rising edge of a “1010...” pattern as measured at their zero-crossing points minus the data transfer period. The signals for the output waveforms shall be measured at the connector of the transmitting device and generated under the test conditions as described in A.2.6 (i.e., 500 mV peak amplitude and 1 ns rise and fall time (20% to 80%)).

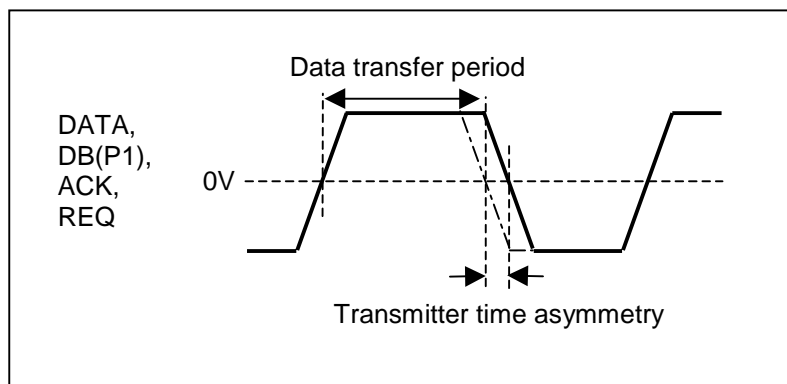


Figure x – Example of transmitter time asymmetry

9.2.c Skew correction range

The minimum skew correction capability of the receiver of a signal as measured at the receiver's connector. The skew correction range shall be equal to $\pm [(\text{transmitter chip skew}) + (\text{cable skew}) + (\text{two times trace skew})]$. Receiver chip skew is not included, as it is internal to the receiver's ASIC. The signals for the output waveforms from the transmitting device shall be generated under the test conditions as described in A.2.6 (i.e., 500 mV peak amplitude and 1 ns rise and fall time (20% to 80%)).

9.2.d De-skewed data-valid window

The minimum difference in time allowed between the rising or falling edge of a "1010..." pattern on the DATA BUS or DB(P1) and its clocking signal on ACK(REQ) as measured at their zero-crossing points after skew compensation is applied by the receiver without allowing any error in the received data. The de-skewed data-valid window shall be equal to $\pm [(\text{data transfer period}) - (\text{residual skew error}) - (\text{strobe offset tolerance}) - (\text{clock jitter}) - (\text{receiver amplitude skew}) - (\text{chip noise}) - (\text{system noise at receiver}) - (\text{receiver asymmetry})] \div 2$. The signals for the output waveforms from the transmitting device shall be generated under the test conditions as described in A.2.6 (i.e., 500 mV peak amplitude and 1 ns rise and fall time (20% to 80%)).

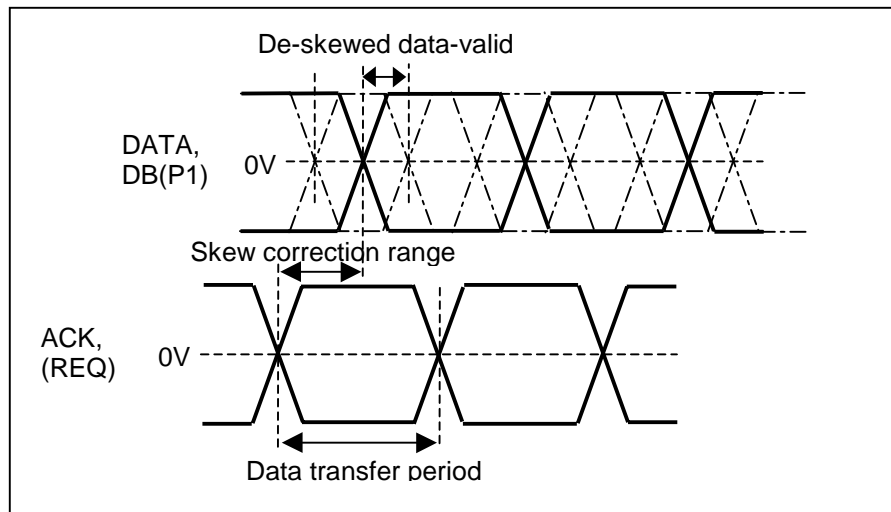


Figure z – Example of receiver de-skew parameters