Accredited Standards Committee*
X3, Information Technology

To: Membership of X3T10

From: John Lohmeyer, Chair X3T10

Subject: Minutes of X3T10 SPI-2 LVDS Study Group Meeting
         Denver, CO -- August 14, 1995

Agenda

1. Opening Remarks

2. Approval of Agenda

3. Attendance and Membership

4. Proposed Agreements [Aloisi]

5. Proposal for SPI-2 Electrical Interface (95-307r0) [Ham]

6. The Case for 50 Ohm Cables (95-308r0) [McCall]

7. LVDS (95-269r3) [Aloisi]

8. Single-ended Reset Signal [Gardner]

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Results of Meeting

1.   Opening Remarks

John Lohmeyer, the X3T10 Chair, called the meeting to order at 9:00 a.m., Monday August 14, 1995. He failed to thank the host (himself).

As is customary, the people attending introduced themselves and a copy of the attendance list was circulated.

2.   Approval of Agenda

An agenda was prepared and approved.

3.   Attendance and Membership

Attendance at working group meetings does not count toward minimum attendance requirements for X3T10 membership. Working group meetings are open to any person or organization directly and materially affected by X3T10's scope of work. The following people attended the meeting:

Name	Organization	Email
John Lohmeyer	Symbios Logic	john.lohmeyer@symbios.com
Ed Suder	Texas Instruments	ROBO@msg.ti.com
Kevin Gingerick	Texas Instruments	4307725@mcimail.com
Todd Nelson	National Semionductor	ctwnsc@tevm2.nsc.com
Dennis Haynes	Burr-Brown	haynes_dennis@bbrown.com
Paul Aloisi	Unitrode	Aloisi@uicc.com
Brian Day	Symbios Logic	brian.day@symbios.com
Tracy Spitler	Symbios Logic	tracy.spitler@symbios.com
Frank Gasparik	Symbios Logic	farnk.gasparik@symbios.com
Mark Jander	Symbios Logic	mark.jander@symbios.com
Brian Davis	Seagate	davis@cdg.seagate.com
Wayne Werner	AT&T	aluxpo!wew@att.com
Chris Millsaps	Buslogic	chrism@buslogic.com
Michael Smith	Dallas Semiconductor	msmith@dalsemi.com
Louis Grantham	Dallas Semiconductor	grantham@dalsemi.com
Richard Uber	Quantum	duber@tdh.qntm.com
David McCall	Quantum	dmccall@tdh.qntm.com
Steve Robalino	DPT	robalino@dpt.com
Wally Bridgewater	Adaptec	wally@eng.adaptec.com
Bill Ham	Digital	ham@subsys.enet.dec.com
Edward A. Gardner	Quantum	gardner@acm.org
Vit Novak	Sun Microsystems	vit.novak@sun.com

4.   Proposed Agreements [Aloisi]

John Lohmeyer presented Paul Aloisi's foil outlining the proposed agreements to date on Low Voltage Differential Signaling. The foil is paraphrased here:

- A single chip can work for both single-ended (Async and Fast-5 through Fast-20) or LVDS (Async and Fast-5 through Fast-80)
- Fast-40, -80 will not be defined for single-ended
- Single-ended and LVDS signals will not be mixed (that is, hybrid buses are not defined)
- The Single-ended/LVDS/RS-485 differential sensing circuit defined in 95-269r3 is acceptable
- The Fast-40 and Fast-80 skew budget defined in 95-307r0 is acceptable
- The Single-ended/LVDS/RS-485 differential sensing circuit defined in 95-269r3 permits automatic switching between single-ended and LVDS drivers/receivers and terminators
- When operating in single-ended mode (the sense line is low), a device capable of both single-ended and LVDS shall enable its 'ground drivers' continuously.
- The pin-outs developed at previous meetings are acceptable (see 95-307r0)
- Maximum node capacitance = 15 pF
- Use current mode drivers, no driver output impedance specification
- Terminators bias signal lines with 100 mV, limited to 100 uA maximum current
- Receivers not required to have hysteresis

5.   Proposal for SPI-2 Electrical Interface (95-307r0) [Ham]

Bill Ham reviewed the subject document. As expected, it provoked discussion on several topics -- not all of which are captured here. See 95-307r1, when available, for additional changes that resulted from the discussion.

Kevin Gingerick was concerned about the proposed terminator bias circuit. It includes a "magic" circuit to provided 100 mV bias at no more than 100 uA. He thought a simpler circuit, perhaps just using three resistors should be permitted. However, Bill and Paul Aloisi objected to the higher power levels that would result. The issue was deferred until later in the meeting.

Bill included several tables with first cuts at proposed electrical parameters. The group suggested several refinements to the specifications that will be incorporated in revision 1.

After examining the leakage currents of CMOS driver/receivers, the group agreed to increase the proposed leakage current specification from 10 uA to 20 uA. This also caused the terminator bias current specification to increase from 100 uA to 250 uA.

The minimum DIFFSENS low-pass filtering was changed from an RC value to a minimum time constant. An example circuit will be included. The specification on the input pull-down resistor was changed to be at least 80 K Ohms and small enough to overcome any receiver leakage current. The idea is to bias the circuit so that an open input will cause the receiver "to detect" single-ended state.

Bill's 35 meter maximum cable length specification invoked considerable discussion. While SCSI timing specifications may work at 35 meters, it is not clear that LVDS will support that long of a cable due to attenuation. A related (and equally controversial) discussion ensued on how many devices can be supported on a LVDS bus. Ed Gardner wanted to permit more than 16 devices, while Bill felt that this capability was outside of the scope of SPI-2. Bill plans to do some lab testing to determine the effects of cable length and number of devices on signal attenuation.

After discovering that earlier power calculations had included all receivers powered on even when the drivers were enabled (not necessary and wasteful of power), Bill re-opened Pandora's box and we re-visited the power budget assuming that receivers would be powered off when the corresponding drivers are enabled. As a result of the re-negotiations, we ended up with:

Driver current:	4 mA minimum (up from 3 mA)
	5 mA nominal (up from 3.5 mA)
	6 mA maximum (up from 4 mA)
Receiver sensitivity:	100 mV minimum (up from 50 mV)
Terminator bias:	150 mV maximum at 250 uA maximum (up from 100 mV)

6.   The Case for 50 Ohm Cables (95-308r0) [McCall]

David McCall presented 95-308r0, "Fast 40 Proposal", which proposes that an option for 50 Ohm cables be included in SPI-2. He pointed out that many customers want to configure systems with 50 Ohm backplanes with close stub spacing. A 50 Ohm configuration option would facilitate such systems.

Bill Ham spoke against this proposal as it would invalidate the power budget just agreed to. Furthermore, it would require about twice as much power dissipation for the drivers/receivers. He preferred that we push backplane designers to use higher impedance design techniques. No consensus was reached.

7.   LVDS (95-269r3) [Aloisi]

Paul distributed copies of revision 3 of his proposal. Most of his comments had been covered under item 5, above.

8.   Single-ended Reset Signal [Gardner]

Ed Gardner suggested that it might be desirable to keep the RST signal single-ended in a LVDS system. This would facilitate using the trailing edge of the RST signal to qualify whether the system is single-ended or LVDS. Since the RST signal is highly filtered, it should not be seriously affected by common-mode noise. This topic needs further thought and discussion -- no consensus was reached.

9.   Meeting Schedule

The next meeting of SPI-2 Study Group will be September 11, 1995, in Bedford, NH at the Sheraton Tara Wayfarer Inn (603-622-3766), hosted by Digital Equipment Corp..

10.   Adjournment

The meeting was adjourned at 4:40 p.m. on Monday August 14, 1995.