Accredited Standards Committee*
X3, Information Technology

To: Membership of X3T10

From: Ralph Weber, Secretary X3T10
John Lohmeyer, Chair X3T10

Subject: Minutes of X3T10 SPI-2 Study Group Meeting
Palm Springs, CA -- November 6, 1995

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Agenda

1. Opening Remarks

2. Approval of Agenda

3. Attendance and Membership

4. Report from Marketing Meeting [Lohmeyer]

5. LVDS Terminator Specifications [Aloisi / Brown]

6. LVDS Driver/Receiver Specifications
    6.1 Review of Signal and Power Budgets
    6.2 Common Mode Range [Gasparik]
    6.3 Test Circuits and Limits [Ham]
    6.4 Balance [Ham]
    6.5 How to get off the bus [Uber]

7. LVDS Cable Specifications
    7.1 Crosstalk testing [Spitler]
    7.2 The Case for 50 Ohm Cables (95-308r0) [McCall]

8. LVDS Testing Results [Ham]

9. Other Topics
    9.1 Error in SPI-1 SCAM Annex B [Penokie/Lohmeyer]
    9.2 Error in SPI-1 Cabling Measurement Annex D [Daggett/Lohmeyer]
    9.3 Configuration Rules [Ham]
    9.4 Hot Plugging [Ham]

10. Meeting Schedule

11. Adjournment

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Results of Meeting

1.   Opening Remarks

John Lohmeyer, the X3T10 Chair, called the meeting to order at 9:07 a.m., Monday November 6, 1995. He thanked Jeff Stai of Western Digital Logic for hosting the meeting.

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

2.   Approval of Agenda

The draft agenda was approved with the addition of the following items:

        4. Report from Marketing Meeting [Lohmeyer]
        6.2 Common Mode Range [Gasparik]
        6.3 Test Circuits [Ham]
        6.4 Balance [Ham]
        6.5 How to get off the bus [Uber]
        9.3 Configuration Rules [Ham]
        9.4 Hot Plugging [Ham]

and the removal of the following items:

        9.1 Document review (95-315) [Ham]

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:

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Name                    S  Organization            Electronic Mail Address
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Mr. Norm Harris         P  Adaptec, Inc.           nharris@eng.adaptec.com
Mr. Lawrence J. Lamers  A# Adaptec, Inc.           ljlamers@aol.com
Mr. Wally Bridgewater   V  Adaptec, Inc.           wally@eng.adaptec.com
Mr. Jimmy Lie           V  Adaptec, Inc.           jimlie@eng.adaptec.com
Mr. Edward Fong         P  Amdahl Corp.            esf10@amail.amdahl.com
Mr. Dennis R. Haynes    O  Burr-Brown Corp.        haynes_dennis@bbrown.com
Mr. William C. Gintz    V  Conner Peripherals      bill.gintz@conner.com
Mr. Louis Grantham      P  Dallas Semiconductor    grantham@dalsemi.com
Mr. Charles Monia       P  Digital Equipment Corp. monia@shr.dec.com
Mr. Douglas Hagerman    A# Digital Equipment Corp. hagerman@starch.enet.dec.
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Dr. William Ham         A# Digital Equipment Corp. ham@subsys.enet.dec.com
Mr. Ralph O. Weber      A# ENDL Associate          roweber@acm.org
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Mr. Ruben Yomtoubian    V  Hitachi                 r_yomtoubian@hitachi.com
Mr. Dan Colegrove       A# IBM Corp.               colegrove@vnet.ibm.com
Mr. Pat LaVarre         A# Iomega Corp.            p.lavarre@ieee.org
Mr. Dean Wallace        P  Linfinity Micro         75671.3443@compuserve.com
Mr. Pete McLean         P  Maxtor Corp.            pete_mclean@maxtor.com
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Mr. Jay Neer          A  Molex Inc.           jneer@molex.com
Mr. Edward A. Gardner V  Ophidian Designs     gardner@acm.org
Mr. Skip Jones        P  QLogic Corp.         sk_jones@qlc.com
Mr. Ting Li Chan      A  QLogic Corp.
Mr. James McGrath     P  Quantum Corp.        JMCGRATH@QNTM.COM
Mr. Richard Uber      V  Quantum Corp.        duber@tdh.qntm.com
Mr. Gene Milligan     P  Seagate Technology   Gene_Milligan@notes.
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Mr. Gerald Houlder    A  Seagate Technology   Gerry_Houlder@notes.
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Mr. Stephen G. Finch  P  Silicon Systems, Inc.  steve.finch@tus.ssi1.com
Mr. Dave Guss         A  Silicon Systems, Inc.  dave.guss@tus.ssi1.com
Mr. Robert N. Snively P  Sun Microsystems Computer bob.snively@eng.sun.com
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Mr. John Lohmeyer     P  Symbios Logic Inc.   john.lohmeyer@symbios.com
Mr. Frank Gasparik    V  Symbios Logic Inc.   frank.gasparik@symbios.com
Mr. Tracy Spitler     V  Symbios Logic Inc.   tracy.spitler@symbios.com
Mr. Kevin Gingerich   V  Texas Instruments    4307725@mcimail.com
Mr. Tokayuki Totani   O  Toshiba America      ttotaniAtaisdpd.geis.com
Mr. Kenneth J. Hallam P  UNISYS Corporation   ken.hallam@mv.unisys.com
Mr. Paul D. Aloisi    P  Unitrode Integrated  Aloisi@uicc.com
                         Circuits
Mr. Jeff Stai         P  Western Digital      stai@dt.wdc.com
                         Corporation
Mr. Tak Asami         A  Western Digital      asami@dt.wdc.com
                         Corporation
Mr. Arnold Limjoco    O  Yamaichi Electronics 6371175@mcimail.com
Mr. Don Johnson       V  Zitel Corporation    djohnson@zitel.com
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40 People Present

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Status Key:  P    -  Principal
             A,A# -  Alternate
             O    -  Observer
             L    -  Liaison
             V    -  Visitor
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4.   Report from Marketing Meeting [Lohmeyer]

John reported that the first meeting of a parallel SCSI marketing group was held in the Milpitas on 16 October. The minutes from the meeting were posted on the SCSI Reflector around the end of October.

John reported on a discussion of whether to partition the LVDS work from single-ended SCSI. He described the reasoning behind the partitioning proposal as being a possible need to document LVDS before all of SPI-2 can be documented. He said that the marketing group had preferred expediting the LVDS work, but did have a specific suggestion regarding the standards partitioning -- they left those decisions to the standards body, X3T10.

Gene Milligan asked about low-pin count requirements in the market. Jim McGrath reported that the marketing group discussed pin count in terms of product cost. The current limit for low-cost chips is 208 pins. But, Jim was not certain that an LVDS solution could be supported in 208 pins. The cost transition for more than 208 pins was described as a price cliff. This problem mostly affects disk drive manufacturers as they have very high integration levels.

Norm Harris raised concerns about market confusion that could occur if multiple solutions are used for LVDS and single-ended. Bill Ham stated that the LVDS pin count delta is 27 pins. Gene Milligan noted that 27 might not be

the total pin count delta, because additional pins might needed for caching (DRAM) access. Steve Finch said that, for his company, 27 plus 18 pins for a wider DRAM path will cost $1.

Dean Wallace reported that a supplier uses PLCC packages for 208 pins and BGA for 256 pins. The BGA package costs 40% more but has 10% better yields. The overall board cost is a wash.

Gene Milligan called on the group to include an enhancement to single-ended in SPI-2, for the low-cost interface. John noted that the group could document Fast-40 single-ended, but the cable lengths and numbers of devices would probably have to be cut in half again -- a not very attractive alternative. Also, the signal and cable characterizations must be done by someone qualified -- most likely Bill Ham. Bill's time and resources are limited and Bill is currently placing priority on LVDS.

5.   LVDS Terminator Specifications [Aloisi / Brown]

Dean Wallace and Bill Ham presented Differential Termination I-V Characteristics slides. Dean's slide can be found in document 95-347. The discussion started with Bill Ham questioning attempts to reduce to zero the voltage at the zero current crossing.

Bill said that several discussions had shown that the group (or some members thereof) could design the desired common-mode termination circuits. But, he wanted the group to develop a way to specify that circuit, exclusive of specific circuit specs. The group spent over an hour developing the circuit-independent specifications. Bill Ham will draft a new revision of 95-315 based on the results of the study group discussion. He hopes to have the new draft ready for the November mailing.

6.   LVDS Driver/Receiver Specifications

6.1   Review of Signal and Power Budgets

The working group did not discuss this item due to time constraints.

6.2   Common Mode Range [Gasparik]

Frank Gasparik presented a series of common-mode issues. His slides can be found in 95-346r0. The group took note of Frank's issues and agreed that the issues must be considered when other specific aspects of the LVDS definitions are developed.

Based on the issues Frank presented, Bill agreed to change transmitter on-current to 4.4 mA minimum, off to on skew (-signal to +signal) to 500 pS maximum, on to off skew (+signal to -signal) to 500 pS maximum, common mode compliance voltage to 1.8 volts maximum and 0.7 volts minimum. Also, the receiver common mode dc specification was changed to 1.8 volts maximum and 0.7 volts minimum.

The issue on common-mode voltage was left unresolved until more test data can be presented.

6.3   Test Circuits and Limits [Ham]

With help from Kevin Gingerich, Bill presented several circuit figures from 95-315r3 and asked the group to comment on and correct them. Bill noted the corrections and agreed to include them in the next revision of 95-315.

6.4   Balance [Ham]

Bill noted that test circuit number 3 (in the terminator discussion) has been added to handle balance. Also, the driver balance has been set in the common-mode voltage discussion.

6.5   How to get off the bus [Uber]

Richard Uber presented a concern with impedance mismatch that he felt would necessitate impedance changes in the LVDS design. Bill Ham felt that the situation was similar to high-power differential. Bill noted that protocol features, like bus settle delay, are present to compensate for the concern. Richard presented four possible solutions for the problem. John proposed more study from a protocol point of view. Bill suggested more study on the rate of change to high impedance.

The group agreed to consider the issues raised. but expressed uncertainty that any major changes will be needed.

Richard next presented concerns over incident waves on assertion. After some discussion, the group agreed that driver minimum current requirements may need to be raised, probably to 5 mA. The issue was left open, mostly due to concerns over possible needs to raise the maximum current.

7. LVDS Cable Specifications

7.1 Crosstalk testing [Spitler]

Tracy was prepared to present the same data he had at the Denver meeting, but because of the late hour, review of this testing data was deferred.

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

Because of the late hour, the discussion of 50 ohm cables was removed from the agenda. This item will be dropped from future agendas unless new data is brought in.

8. LVDS Testing Results [Ham]

Bill Ham presented some testing results as part of other discussion topics, but made no specific testing results presentation.

9. Other Topics

9.1 Error in SPI-1 SCAM Annex B [Penokie/Lohmeyer]

John noted that George Penokie has discovered a timing inconsistency in a SCAM state diagram regarding the time from power on to SCAM selections. He reminded the group that the fixes will need to be applied to SPI-2.

9.2 Error in SPI-1 Cabling Measurement Annex D [Daggett/Lohmeyer]

John noted that some gross errors were introduced in converting cable preparation measurements to metric (strip lengths are 10x what they should be). He reminded the group that the fixes will need to be applied to SPI-2.

9.3 Configuration Rules [Ham]

Bill agreed to defer discussion of most of his configuration issues to the December meeting.

The issue that Bill chose to discuss was how to measure capacitance. Bill received guidance regarding several key issues that must be considered when measuring capacitance.

Wally Bridgewater asked about using TERMPWR to operate an LVDS/single-ended translator. John noted that the TERMPWR would most likely have to come from the single-ended side of the translator as the LVDS side would not have adequate power available. The concern about using TERMPWR is that SPI appears to prohibit such usage, but such products would be rather expensive if a separate power source must be used. There were no immediate solutions to the dilemma, however the group did offer some pointers for additional study.

9.4 Hot Plugging [Ham]

Bill stated a belief that LVDS hot plugging will be very likely generate bit errors. If more careful controls on REQ/ACK counting are adopted, then the problems may not be as serious. Bill asked that the agenda item be kept for future meetings.

10.   Meeting Schedule

The next meeting of SPI-2 Working Group will be Friday December 15, 1995, in San Jose, CA at the Holiday Inn in Milpitas, CA (408-321-9500), hosted by Quantum Corp. Another SPI-2 Working Group meeting is scheduled for January 8, 1996 in Dallas, TX hosted by Quantum. Another SPI-2 Working Group meeting is planned for February 5, 1996 in Denver.

11.   Adjournment

The meeting was adjourned at 7:02 p.m. on Monday November 6, 1995.