

This is a preview - click here to buy the full publication



ISO/IEC 14776-121

Edition 1.0 2010-10

INTERNATIONAL STANDARD



**Information technology –
Small computer system interface (SCSI)
Part 121: Passive interconnect performance (PIP)**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

X

ICS 35.200

ISBN 978-2-88912-220-2

1 Scope	13
2 Normative references	13
3 Terms, definitions and abbreviations	13
3.1 Terms and definitions	13
3.2 Acronyms	20
3.3 Symbols and abbreviations	21
3.4 Keywords	22
3.5 Conventions	22
3.6 Specification of measurement equipment	23
4 Overview	24
4.1 General	24
4.2 Open versus closed systems related to this standard	24
4.3 Structural considerations	24
4.3.1 SCSI interconnects	24
4.3.2 SCSI passive interconnect topology	25
4.3.3 Interconnect sub-assemblies, transition regions and bulk cable	25
4.3.4 Interconnect assemblies	25
4.3.5 Relationship between SE and DF in this document	25
4.4 Relationship between requirements on bulk cable and requirements on interconnect assemblies	26
4.5 Physical measurement points	26
4.6 Concatenated configurations	26
4.7 Interoperability points	26
4.8 Constructions considered	27
4.9 Identification, constraints and loading requirements	28
4.9.1 Connector function identification	28
4.9.2 Constraints	28
4.9.3 Standard loads	29
4.9.3.1 Targets and initiators with no enabled terminator	29
4.9.3.2 Targets and initiators with enabled terminator	29
4.10 Nature of requirements	29
4.10.1 Measurements and tests	29
4.10.2 Performance levels and applications	29
4.10.3 Basic performance requirements for interconnect assemblies	30
4.10.3.1 Overview	30
4.10.3.2 Measurement conditions for non-precomp received signal quality requirements	31
4.10.3.3 Measurement conditions for precomp received signal quality requirements	31
4.10.4 Deriving the launch signal requirements for this standard from the signal requirements in SPI-x ..	31
4.11 Local neighborhood concepts	32
4.12 Length specifications	32
4.13 S21 relationship among point-to-point and multidrop configurations	32
4.14 Accommodation of receiver compensation in interconnect requirements	33
4.15 Instrumentation and text fixture considerations	33
4.16 Signals covered by this standard	34
4.17 Error rate considerations	36
5 Summary bulk cable	37
6 Bulk cable samples, test fixtures and setups	39
6.1 Bulk cable samples and sample preparation	39
6.1.1 Overview	39
6.1.2 Summary	39
6.1.3 Point-to-point bulk cable	39
6.1.3.1 Point-to-point bulk cable sample preparation (SP_Bulk_PP3)	39

6.1.3.2 Point-to-point bulk cable sample preparation (SP_Bulk_PP10)	40
6.1.3.3 Point-to-point bulk cable sample preparation (SP_Bulk_PP25)	40
6.1.4 Sample preparation for multi-drop bulk cable or printed circuit boards	40
6.1.4.1 Multi-drop bulk cable sample preparation (SP_Bulk_MD3)	40
6.1.4.2 Printed circuit boards sample preparation	40
6.2 Bulk cable and printed circuit board test fixture specifications	41
6.2.1 Overview	41
6.2.2 Summary	41
6.2.3 Test fixture (FIX_Bulk_1)	41
6.2.4 Test fixture (FIX_Bulk_2)	42
6.2.5 Test fixture (FIX_Bulk_3)	43
6.2.6 Test fixture (FIX_Bulk_4)	43
6.2.7 Printed circuit boards test fixture (FIX_PCB_1)	43
6.3 Bulk cable measurement equipment and setups	44
6.3.1 Summary	44
6.3.2 Setup (SET_Bulk_1)	45
6.3.3 Setup (SET_Bulk_2)	45
6.3.4 Setup (SET_Bulk_3)	46
6.3.5 Setup (SET_Bulk_4)	46
6.3.6 Setup (SET_Bulk_5)	47
6.4 STD calibration	47
7 Level 1 bulk cable tests	49
7.1 SE tests	49
7.2 Differential local impedance	49
7.2.1 Overview	49
7.2.2 Point-to-point bulk cable	49
7.2.2.1 Sample preparation for point-to-point bulk cable	49
7.2.2.2 Test fixtures for point-to-point bulk cable	49
7.2.2.3 Measurement equipment and setup for point-to-point bulk cable	49
7.2.2.4 Calibration and verification procedure for point-to-point bulk cable	49
7.2.2.5 Test procedure and data output format	50
7.2.2.6 Acceptable values for point-to-point bulk cable	51
7.2.3 Multi-drop bulk cable	51
7.2.3.1 Sample preparation for multi-drop bulk cable	51
7.2.3.2 Test fixtures for multi-drop bulk cable	51
7.2.3.3 Measurement equipment and setup for multi-drop bulk cable	51
7.2.3.4 Calibration and verification procedure for multi-drop bulk cable	52
7.2.3.5 Test procedure and data output format for multi-drop bulk cable	52
7.2.3.6 Acceptable values for multi-drop bulk cable	53
7.2.4 Unpopulated printed circuit board (PCB)	53
7.3 Differential propagation time and propagation time skew	53
7.3.1 Overview	53
7.3.2 Point-to-point bulk cable	53
7.3.2.1 Sample preparation for point-to-point bulk cable	53
7.3.2.2 Test fixtures for point-to-point bulk cable	53
7.3.2.3 Measurement equipment and setup for point-to-point bulk cable	54
7.3.2.4 Calibration and verification procedure for point-to-point bulk cable	54
7.3.2.5 Test procedure and data output format for point-to-point bulk cable	54
7.3.2.6 Acceptable values for point-to-point bulk cable	55
7.3.3 Multi-drop bulk cable	55
7.3.3.1 Sample preparation for multi-drop bulk cable	55
7.3.3.2 Test fixtures for multi-drop bulk cable	55
7.3.3.3 Measurement equipment and setup for multi-drop bulk cable	55
7.3.3.4 Calibration and verification procedure for multi-drop bulk cable	56
7.3.3.5 Test procedure and data output format for multi-drop bulk cable	56
7.3.3.6 Acceptable values for multi-drop bulk cable	56

7.3.4 Unpopulated PCB	56
7.4 Differential capacitance by calculation	56
7.4.1 Overview	56
7.4.2 Differential capacitance by calculation for all constructions of bulk cable	56
7.4.3 Acceptable differential capacitance values for all constructions of bulk cable	56
7.5 Differential capacitance by frequency domain measurement	57
7.5.1 Point-to-point bulk cable	57
7.5.1.1 Sample preparation for point-to-point bulk cable	57
7.5.1.2 Test fixtures for point-to-point bulk cable	57
7.5.1.3 Measurement equipment and setup for point-to-point bulk cable	57
7.5.1.4 Calibration and verification procedure for point-to-point bulk cable	57
7.5.1.5 Test procedure and data output format for point-to-point bulk cable	57
7.5.2 Multi-drop bulk cable	57
7.5.3 Unpopulated PCB	57
7.5.4 Acceptable differential capacitance values for all constructions of bulk cable	57
7.6 Differential insertion loss	58
7.6.1 Overview	58
7.6.2 Point-to-point bulk cable	58
7.6.2.1 Sample preparation for point-to-point bulk cable	58
7.6.2.2 Test fixtures for point-to-point bulk cable	58
7.6.2.3 Measurement equipment and setup for point-to-point bulk cable	58
7.6.2.4 Calibration, verification and measurement procedure for point-to-point bulk cable	58
7.6.2.5 Acceptable values for point-to-point bulk cable	59
7.6.3 Multi-drop bulk cable	59
7.6.3.1 Overview	59
7.6.3.2 Sample preparation for multi-drop bulk cable	59
7.6.3.3 Test fixtures for multi-drop bulk cable	59
7.6.3.4 Measurement equipment and setup for multi-drop bulk cable	60
7.6.3.5 Calibration, verification and measurement procedure for multi-drop bulk cable	60
7.6.3.6 Acceptable values for multi-drop bulk cable	60
7.6.4 Unpopulated PCB	60
7.7 Near end cross talk (NEXT)	60
7.7.1 Overview	60
7.7.2 Point-to-point bulk cable	61
7.7.2.1 Sample preparation for point-to-point bulk cable	61
7.7.2.2 Test fixtures for point-to-point bulk cable	61
7.7.2.3 Measurement equipment and setup for point-to-point bulk cable	61
7.7.2.4 Calibration and verification procedure for point-to-point bulk cable	61
7.7.2.5 Test procedure and data output format for point-to-point bulk cable	63
7.7.2.6 Acceptable values for point-to-point bulk cable	63
7.7.3 Multi-drop bulk cable	63
7.7.3.1 Sample preparation for multi-drop bulk cable	63
7.7.3.2 Test fixtures for multi-drop bulk cable	64
7.7.3.3 Measurement equipment and setup for multi-drop bulk cable	64
7.7.3.4 Calibration and verification procedure for multi-drop bulk cable	64
7.7.3.5 Test procedure and data output format for multi-drop bulk cable	64
7.7.3.6 Acceptable values for multi-drop bulk cable	65
7.7.4 Unpopulated PCB	65
8 Summary - Interconnect assemblies	66
9 Interconnect assemblies samples, test fixtures and setups	67
9.1 Interconnect assembly samples and sample preparation	67
9.2 Test fixtures for interconnect assemblies	67
9.2.1 Overview	67
9.2.2 Summary	67
9.2.3 Test fixture (FIX_ASY_1)	68

9.2.4 Test fixture (FIX_ASY_2)	69
9.2.5 Test fixture (FIX_ASY_3)	70
9.2.6 Test fixture (FIX_ASY_4)	70
9.3 Interconnect assembly measurement equipment and setups	71
9.3.1 Summary	71
9.3.2 Setup (SET_ASY_1)	72
9.3.3 Setup (SET_ASY_2)	72
9.3.4 Setup (SET_ASY_3)	73
9.3.5 Setup (SET_ASY_4)	73
9.4 STD calibration	74
10 Level 1 interconnect assembly tests	74
10.1 Differential impedance	74
10.1.1 Overview	74
10.1.2 Point-to-point interconnect assemblies	74
10.1.2.1 Test fixtures for point-to-point interconnect assemblies	74
10.1.2.2 Measurement equipment and setup for point-to-point interconnect assemblies	74
10.1.2.3 Calibration and verification procedure for point-to-point interconnect assemblies	74
10.1.2.4 Test procedure and data output format for point-to-point interconnect assemblies	74
10.1.3 Multi-drop interconnect assemblies	74
10.1.3.1 Test fixtures for multi-drop interconnect assemblies	74
10.1.3.2 Measurement equipment and setup for multi-drop interconnect assemblies	74
10.1.3.3 Calibration and verification procedure for multi-drop interconnect assemblies	75
10.1.3.4 Test procedure and data output format for multi-drop interconnect assemblies	75
10.1.4 Connectorized backplanes	75
10.1.5 Acceptable values for all constructions of interconnect assemblies	75
10.2 Differential propagation time and propagation time skew	75
10.2.1 Overview	75
10.2.2 Point-to-point interconnect assemblies	75
10.2.2.1 Test fixtures for point-to-point interconnect assemblies	75
10.2.2.2 Measurement equipment and setup for point-to-point interconnect assemblies	75
10.2.2.3 Calibration and verification procedure for point-to-point interconnect assemblies	75
10.2.2.4 Test procedure and data output format for point-to-point interconnect assemblies	75
10.2.3 Multi-drop interconnect assemblies	75
10.2.4 Connectorized backplanes	76
10.2.5 Acceptable values for all constructions of interconnect assemblies	76
10.3 Signal integrity diagrams	76
10.3.1 Overview	76
10.3.2 Requirements for all constructions of interconnect assemblies	78
10.3.2.1 Test fixtures for all constructions of interconnect assemblies	78
10.3.2.2 Measurement equipment and setup for all constructions of interconnect assemblies	78
10.3.2.3 Calibration and verification procedure for all constructions of interconnect assemblies	78
10.3.2.3.1 Overview	78
10.3.2.3.2 Non-precomp driver requirements	78
10.3.2.3.3 Precomp driver requirements	79
10.3.2.4 Test procedure and data output format for all constructions of interconnect assemblies	79
10.3.2.5 Acceptable values for all constructions of interconnect assemblies	80
10.4 Differential to common mode conversion	81
10.4.1 Overview	81
10.4.2 Requirements for all constructions of interconnect assemblies	81
10.4.2.1 Test fixtures for all constructions of interconnect assemblies	81
10.4.2.2 Measurement equipment and setup for all constructions of interconnect assemblies	81
10.4.2.3 Calibration and verification procedure for all constructions of interconnect assemblies	81
10.4.2.4 Test procedure and data output format for all constructions of interconnect assemblies	81
10.4.2.5 Acceptable values for all constructions of interconnect assemblies	81
10.5 Differential insertion loss	81
10.5.1 Overview	81

10.5.2 Requirements for all constructions of interconnect assemblies	82
10.5.2.1 Test fixtures for all constructions of interconnect assemblies	82
10.5.2.2 Measurement equipment and setup for all constructions of interconnect assemblies	82
10.5.2.3 Calibration, verification and measurement procedure for all constructions of interconnect assemblies	82
Annex A (normative) Single ended bulk cable requirements	83
A.1 General	83
A.2 Impedance	83
A.2.1 Local impedance for SE transmission	83
A.2.1.1 Local impedance for SE transmission overview	83
A.2.1.2 Sample preparation	83
A.2.1.3 Test fixture and measurement equipment	83
A.2.1.4 Calibration and verification procedure	84
A.2.1.4.1 Instrument verification	84
A.2.1.4.2 Measurement system (with test fixture) calibration	84
A.2.1.4.3 Single ended signal transition duration (STD) calibration	85
A.2.1.5 Testing procedure	86
A.3 Capacitance	87
A.3.1 Single ended capacitance	87
A.3.1.1 Sample preparation	87
A.3.1.2 Test fixture for single ended capacitance	88
A.3.1.3 Calibration procedure	88
A.3.1.4 Measurement procedure	88
A.3.1.4.1 Planar cables - G-S-G	88
A.3.1.4.2 Round cables - shielded	88
Annex B (informative) Periodic structure effects	89
Annex C (informative) SCSI signal driver boards (SSDB)	90
Annex D (informative) Mirage effects in multi-drop subassembly TDR impedance measurement	91
D.1 Overview	91
D.2 Mirages	91
D.3 Average impedance	94
D.4 Recommendations	94
D.4.1 Overview	94
D.4.2 Fixture	95
D.4.3 Twisted region	95
D.4.4 Flat region	96

List of figure

Figure 1 -Relationship between S21 for different configurations	33
Figure 2 -Example cable/backplane frequency response test setup	34
Figure 3 -Test fixture (FIX_Bulk_1)	42
Figure 4 -Test fixture (FIX_Bulk_2)	42
Figure 5 -Test fixture (FIX_Bulk_3)	43
Figure 6 -Equipment setup for SET_Bulk_1	45
Figure 7 -Equipment setup for SET_Bulk_2	45
Figure 8 -Equipment setup for SET_Bulk_3	46
Figure 9 -Equipment setup for SET_Bulk_4	46
Figure 10 -Equipment setup for SET_Bulk_5	47
Figure 11 -Signal transition duration calibration	48
Figure 12 -Differential calibration	50
Figure 13 -Cursor placement for bulk cable	51
Figure 14 -Cursor placement for constant interval multi-drop cable	52
Figure 15 -TDR launch de-skew	54
Figure 16 -Propagation time measurement	55
Figure 17 -Calibration configuration	58
Figure 18 -Near end cross talk measurement region	62
Figure 19 -Measure aggressor voltage and victim voltage	63
Figure 20 -Measure aggressor voltage and victim voltage	64
Figure 21 -Test fixture (FIX_ASY_1)	68
Figure 22 -Test fixture (FIX_ASY_2)	69
Figure 23 -SCSI signal driver board (FIX_ASY_3)	70
Figure 24 -Test fixture (FIX_ASY_4)	70
Figure 25 -Detail for balun board shown in figure 24	71
Figure 26 -Interconnect assembly setup 1 (SET_ASY_1)	72
Figure 27 -Interconnect assembly setup 2 (SET_ASY_2)	72
Figure 28 -Interconnect assembly setup 3 (SET_ASY_3)	73
Figure 29 -Interconnect assembly setup 4 (SET_ASY_4)	73
Figure 30 -Distinction between parallel and serial data in the same signal path	77
Figure A.1 -Test configuration for SE impedance	84
Figure A.2 -SE impedance calibration	85
Figure A.3 -Signal transition duration calibration	86
Figure A.4 -SE impedance measurement	87
Figure A.5 -Test fixture for single ended capacitance measurement	88
Figure D.1 -Typical multi-drop cable	91
Figure D.2 -Mirage – Missing flat	92
Figure D.3 -Mirage – Obscured flat	93
Figure D.4 -Filtered traces	93
Figure D.5 -Average impedance conundrum	94
Figure D.6 -Long test fixture	95
Figure D.7 -Long twist, no flats	95
Figure D.8 -Short twist into various loads	96
Figure D.9 -Flat	96

List of tables

Table 1 -SE and DF map.....	25
Table 2 - Signals covered by this standard	35
Table 3 -Bulk cable level 1 test summary.....	37
Table 4 -Bulk cable level 2 measurement summary.....	38
Table 5 -Bulk cable sample preparation	39
Table 6 -Bulk cable and printed circuit board test fixtures.....	41
Table 7 -Bulk cable measurement equipment and setups	44
Table 8 -Interconnect assembly level 1 test summary	66
Table 9 -Interconnect assembly level 2 measurement summary	66
Table 10 -Test fixtures for interconnect assemblies	67
Table 11 -Interconnect assembly measurement equipment and setups	71
Table 12 -Test array example for a three port interconnect assembly	80

INFORMATION TECHNOLOGY – SMALL COMPUTER SYSTEM INTERFACE (SCSI)–

Part 121: Passive interconnect performance (PIP)

FOREWORD

- 1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards. Their preparation is entrusted to technical committees; any ISO and IEC member body interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with ISO and IEC also participate in this preparation.
- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.
- 3) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO member bodies.
- 4) IEC, ISO and ISO/IEC publications have the form of recommendations for international use and are accepted by IEC and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 5) In order to promote international uniformity, IEC and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.
- 6) ISO and IEC provide no marking procedure to indicate their approval and cannot be rendered responsible for any equipment declared to be in conformity with an ISO/IEC publication.
- 7) All users should ensure that they have the latest edition of this publication.
- 8) No liability shall attach to IEC or ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC or ISO member bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication of, use of, or reliance upon, this ISO/IEC publication or any other IEC, ISO or ISO/IEC publications.
- 9) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 10) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 14776-121 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 14776 series, under the general title *Information technology - Small computer system interface (SCSI)*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its content. Users should therefore print this publication using a colour printer.

Introduction

The Parallel Interface Performance standard defines requirements for measuring the electrical performance of bulk cable and interconnect assemblies for use in SPI-x applications and specification of performance limits.

The Parallel Interface Performance standard is divided into the following clauses:

- Clause 1 is the scope;
- Clause 2 enumerates the normative references;
- Clause 3 describes the definitions, symbols, conventions and abbreviations;
- Clause 4 provides a general overview of the concepts;
- Clause 5 contains a summary of bulk cable requirements;
- Clause 6 contains sample preparation, fixtures and setups for bulk cable;
- Clause 7 contains bulk cable test procedures;
- Clause 8 contains a summary of interconnect assembly requirements;
- Clause 9 contains sample preparation, fixtures and setups for interconnect assemblies;
- Clause 10 contains interconnect test requirements;

Annex A, Single ended bulk cable requirements, forms an integral part of this standard.

The following informative annexes are provided:

- Annex B, Periodic structure effects;
- Annex C, Requirements for SCSI signal driver board (SSDB);
- Annex D, Mirage effects in multi-drop subassembly TDR impedance measurement.

1 Scope

In the past only the performance requirements for uniform bulk cable (called "media" in earlier standards) have been specified in SCSI standards. Since bulk cable provides only part of the electrical path in a SCSI bus segment, the performance requirements of the interconnect comprising the path is incomplete if only bulk cable is considered. This document expands the coverage to the complete assembled interconnect including connectors, uniform bulk cable, and non-uniform bulk cable. A syntax and framework is described for all types of passive interconnect. The methodology for performing the electrical measurements required to determine compliance with the performance requirements for bulk cable of several types, various assembled interconnects and printed circuit board designs is included.

Details of the measurement methodology are specified to minimize the difference in measured results from different electrical testing laboratories. Details include calibration, fixturing and sample preparation, equipment, measurement procedure and data output format.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14776-112, *Information technology – Small computer system interface (SCSI) – Part 112: Parallel interface-2 (SPI-2)*

ISO/IEC 14776-113, *Information technology – Small computer system interface (SCSI) – Part 113: Parallel interface-3 (SPI-3)*

ISO/IEC 14776-115, *Information technology – Small computer system interface (SCSI) – Part 115: Parallel interface-5 (SPI-5) [T10/1525D]*

INCITS 362-2002, *Information technology – Small computer system interface (SCSI) – Parallel Interface-4 (SPI-4)*