ISO/IEC 14776-121:2010-10 (E)

Information technology_- Small Computer System Interface (SCSI)_- Part_121: Passive Interconnect Performance (PIP)

Contents

Page

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