

This is a preview - [click here to buy the full publication](#)

# INTERNATIONAL STANDARD

# ISO/IEC 14776-112

First edition  
2002-05

---

---

## Information technology – Small computer system interface (SCSI) – Part 112: Parallel Interface-2 (SPI-2)

© ISO/IEC 2002

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

ISO/IEC Copyright Office • Case postale 56 • CH-1211 Genève 20 • Switzerland

---

---



PRICE CODE **XC**

*For price, see current catalogue*

## Contents

	Page
Introduction .....	xiv
1 Scope .....	1
2 Normative references .....	2
2.1 Normative references .....	2
2.2 Approved references .....	2
2.3 References under development .....	3
3 Definitions, symbols, abbreviations, and conventions .....	3
3.1 Definitions .....	3
3.2 Symbols and abbreviations .....	11
3.3 Keywords .....	11
3.4 Conventions .....	12
3.5 Notation for Procedures and Functions .....	13
4 General .....	14
4.1 Overview .....	14
4.1.1 Data transfer modes .....	14
4.1.2 Cables, Connectors, Signals, Transceivers .....	14
4.1.3 Physical architecture of bus .....	14
4.1.4 Physical topology details and definitions .....	15
4.1.5 Bus loading .....	17
4.1.6 Termination requirements .....	18
4.1.7 Device Addressing .....	18
4.1.8 Protocol .....	18
5 SCSI parallel interface connectors .....	21
5.1 SCSI parallel interface connectors overview .....	21
5.2 Nonshielded connector .....	21
5.2.1 Nonshielded connector alternative 1 - A cable .....	21
5.2.2 Nonshielded connector alternative 2 - A cable .....	21
5.2.3 Nonshielded connector alternative 3 - P cable and Q cable .....	21
5.2.4 Nonshielded connector alternative 4 .....	22
5.3 Shielded connector .....	27
5.3.1 Shielded connector alternative 1 - A cable .....	28
5.3.2 Shielded connector alternative 2 - A cable .....	28
5.3.3 Shielded connector alternative 3 - P cable and Q cable .....	28
5.3.4 Shielded connector alternative 4 - P cable and Q cable .....	28
5.4 Connector contact assignments .....	37
5.4.1 SE assignments .....	38
5.4.2 Differential connector contact assignments .....	42
6 SCSI bus interconnect .....	49
6.1 SCSI bus interconnect overview .....	49
6.2 SCSI bus cables .....	49
6.3 Interconnect characteristics for signals .....	50
6.4 Decoupling characteristics for TERMPWR and TERMPWRQ lines .....	52
6.5 Connection requirements for RESERVED lines .....	53
6.6 Cables used with SE transceivers .....	53
6.6.1 SE ground offset .....	54
6.7 Cables used with differential transceivers .....	54
6.7.1 HVD stub length and spacing .....	54
6.7.2 LVD stub length and spacing .....	55
7 SCSI parallel interface electrical characteristics .....	56
7.1 SCSI parallel interface electrical characteristics overview .....	56
7.2 SE alternative .....	57

7.2.1 SE termination .....	57
7.2.2 SE output characteristics .....	57
7.2.3 SE input characteristics .....	60
7.2.4 SE input and output characteristics .....	61
7.3 LVD alternative .....	62
7.3.1 LVD termination .....	62
7.3.2 LVD driver characteristics .....	66
7.3.3 LVD receiver characteristics .....	66
7.3.4 LVD capacitive loads .....	67
7.3.4.1 Management of LVD release glitches .....	69
7.3.5 SE/HVD transmission mode detection .....	69
7.3.5.1 LVD DIFFSENS driver .....	70
7.3.5.2 LVD DIFFSENS receiver .....	70
7.4 LVD/MSE multimode alternative .....	72
7.4.1 LVD/MSE multimode termination .....	72
7.4.2 LVD/MSE multimode transceiver characteristics .....	73
7.4.3 Power for LVD/MSE multimode transceivers .....	74
7.4.4 Ground drivers .....	74
7.5 HVD alternative .....	75
7.5.1 HVD termination .....	75
7.5.2 HVD output characteristics .....	76
7.5.3 HVD input characteristics .....	78
7.5.4 SE driver protection .....	79
7.6 Terminator power .....	80
8 SCSI bus signals .....	82
8.1 SCSI bus signals overview .....	82
8.2 Signal descriptions .....	83
8.3 Parity checking rules .....	84
8.4 Signal states .....	84
8.4.1 SE .....	84
8.4.2 Differential .....	85
8.5 OR-tied signals .....	86
8.6 Signal sources .....	86
9 SCSI parallel bus timing .....	88
9.1 SCSI parallel bus timing values .....	88
9.2 Timing description .....	89
9.2.1 Arbitration delay .....	89
9.2.2 Bus clear delay .....	90
9.2.3 Bus free delay .....	90
9.2.4 Bus set delay .....	90
9.2.5 Bus settle delay .....	90
9.2.6 Cable skew .....	90
9.2.7 Data release delay .....	90
9.2.8 Disconnection delay .....	90
9.2.9 Power on to selection .....	90
9.2.10 Receive assertion period .....	90
9.2.11 Receive hold time .....	91
9.2.12 Receive negation period .....	91
9.2.13 Receive setup time .....	91
9.2.14 Receive period tolerance .....	91
9.2.15 Reset hold time .....	91
9.2.16 Reset to Selection .....	91
9.2.17 Selection abort time .....	91
9.2.18 Selection time-out delay .....	91
9.2.19 Signal Timing Skew .....	91
9.2.20 System deskew delay .....	91
9.2.21 Transmit assertion period .....	92
9.2.22 Transmit hold time .....	92
9.2.23 Transmit negation period .....	92

9.2.24	Transmit setup time .....	92
9.2.25	Transmit period tolerance .....	92
9.3	Measurement points .....	92
9.3.1	SE fast-10 data transfer rates .....	92
9.3.2	SE fast-20 data transfer rates .....	93
9.3.3	LVD .....	94
9.3.4	HVD .....	95
9.4	Setup and hold timings .....	96
9.4.1	Fast-10 data transfer rates .....	96
9.4.2	Fast-20 data transfer rates .....	98
9.4.3	Fast-40 data transfer rates .....	100
10	Removal and insertion of SCSI devices .....	102
10.1	Removal and insertion of SCSI devices overview .....	102
10.2	Case 1 - Power-off during removal or insertion .....	102
10.3	Case 2 - RST signal asserted continuously during removal or insertion .....	102
10.4	Case 3 - Current I/O processes not allowed during insertion or removal .....	102
10.5	Case 4 - Current I/O process allowed during insertion or removal .....	103
11	Logical characteristics .....	104
11.1	SCSI bus phases .....	104
11.1.1	SCSI bus phase overview .....	104
11.1.2	BUS FREE phase .....	104
11.1.3	Unexpected bus free .....	104
11.1.4	ARBITRATION phase .....	105
11.1.5	SELECTION phase .....	105
11.1.6	SELECTION time-out procedure .....	106
11.1.7	RESELECTION phase .....	106
11.1.7.1	RESELECTION phase overview .....	106
11.1.7.2	RESELECTION .....	106
11.1.7.3	RESELECTION time-out procedure .....	107
11.1.8	Information transfer phases .....	107
11.1.8.1	Information transfer phases overview .....	107
11.1.8.2	Asynchronous information transfer .....	108
11.1.8.3	Synchronous data transfer .....	108
11.1.8.4	Wide data transfer .....	109
11.1.9	COMMAND phase .....	111
11.1.10	Data phase .....	111
11.1.10.1	Data phase overview .....	111
11.1.10.2	DATA IN phase .....	111
11.1.10.3	DATA OUT phase .....	111
11.1.11	STATUS phase .....	111
11.1.11.1	STATUS phase overview .....	111
11.1.11.2	STATUS phase exception condition handling .....	111
11.1.12	Message phase .....	111
11.1.12.1	Message phase overview .....	111
11.1.12.2	MESSAGE IN phase .....	111
11.1.12.3	MESSAGE IN phase exception condition handling .....	112
11.1.12.4	MESSAGE OUT phase .....	112
11.1.12.5	MESSAGE OUT phase exception condition handling .....	112
11.1.13	Signal restrictions between phases .....	112
11.2	SCSI bus conditions .....	113
11.2.1	SCSI bus conditions overview .....	113
11.2.2	Attention condition .....	113
11.2.3	Hard reset .....	113
11.2.4	Reset events .....	114
11.2.5	Transceiver mode change reset event .....	114
11.3	SCSI bus phase sequences .....	114
11.4	SCSI pointers .....	115
11.5	SCSI interlocked protocol messages .....	115
11.5.1	SCSI interlocked protocol messages overview .....	115

11.5.2 Message protocols and formats .....	116
11.5.2.1 Message protocol rules .....	116
11.5.2.2 Message formats .....	116
11.5.2.2.1 Message formats overview .....	116
11.5.2.2.2 One-byte messages .....	117
11.5.2.2.3 Two-byte messages .....	117
11.5.2.2.4 Extended messages .....	117
11.5.3 Link control messages .....	118
11.5.3.1 Link control message codes .....	118
11.5.3.2 CONTINUE TASK .....	118
11.5.3.3 DISCONNECT .....	119
11.5.3.4 IDENTIFY .....	119
11.5.3.5 IGNORE WIDE RESIDUE .....	120
11.5.3.6 INITIATOR DETECTED ERROR .....	121
11.5.3.7 MESSAGE PARITY ERROR .....	121
11.5.3.8 MESSAGE REJECT .....	121
11.5.3.9 MODIFY DATA POINTER .....	122
11.5.3.10 NO OPERATION .....	122
11.5.3.11 RESTORE POINTERS .....	122
11.5.3.12 SAVE DATA POINTER .....	122
11.5.3.13 SYNCHRONOUS DATA TRANSFER REQUEST .....	122
11.5.3.13.1 SYNCHRONOUS DATA TRANSFER REQUEST overview .....	122
11.5.3.13.2 Target initiated SDTR negotiation .....	125
11.5.3.13.3 Initiator initiated SDTR negotiation .....	125
11.5.3.14 TARGET TRANSFER DISABLE .....	125
11.5.3.15 TASK COMPLETE .....	126
11.5.3.16 WIDE DATA TRANSFER REQUEST .....	126
11.5.3.16.1 WIDE DATA TRANSFER REQUEST overview .....	126
11.5.3.16.2 Target initiated WDTR negotiation .....	128
11.5.3.16.3 Initiator initiated WDTR negotiation .....	128
11.5.4 Task attribute messages .....	129
11.5.4.1 Task attribute messages overview .....	129
11.5.4.2 ACA .....	130
11.5.4.3 HEAD OF QUEUE .....	130
11.5.4.4 LINKED COMMAND COMPLETE .....	131
11.5.4.5 LINKED COMMAND COMPLETE (WITH FLAG) .....	131
11.5.4.6 ORDERED .....	131
11.5.4.7 SIMPLE .....	131
11.5.5 Task management messages .....	132
11.5.5.1 Task management message codes .....	132
11.5.5.2 ABORT TASK .....	132
11.5.5.3 ABORT TASK SET .....	132
11.5.5.4 CLEAR ACA .....	133
11.5.5.5 CLEAR TASK SET .....	133
11.5.5.6 LOGICAL UNIT RESET .....	133
11.5.5.7 TARGET RESET .....	133
11.5.5.8 TERMINATE TASK .....	133
11.6 Command processing considerations and exception conditions .....	133
11.6.1 Command processing considerations and exception conditions overview .....	133
11.6.2 Asynchronous event notification .....	134
11.6.3 Incorrect initiator connection .....	134
11.6.4 Unexpected reselection .....	135
11.7 Use of disconnect-reconnect page parameters .....	135
11.8 SCSI parallel interface services .....	136
11.8.1 SCSI parallel interface services overview .....	136
11.8.2 Procedure terms .....	136
11.8.3 Application client SCSI command services .....	138
11.8.3.1 Application client SCSI command services procedure call .....	138
11.8.3.2 Send SCSI command service .....	139
11.8.4 Device server SCSI command services .....	139
11.8.4.1 Device server SCSI command services procedure call .....	139

11.8.4.2 Data-in delivery service .....	139
11.8.4.3 Data-out delivery service .....	140
11.8.5 Task management services .....	140
11.8.5.1 Task management services procedure call .....	140
11.8.5.2 Task management function service .....	140
11.8.5.2.1 Task management function service overview .....	140
11.8.5.2.2 ABORT TASK .....	140
11.8.5.2.3 ABORT TASK SET .....	141
11.8.5.2.4 CLEAR ACA .....	141
11.8.5.2.5 CLEAR TASK SET .....	141
11.8.5.2.6 LOGICAL UNIT RESET .....	141
11.8.5.2.7 RESET SERVICE DELIVERY SUBSYSTEM .....	141
11.8.5.2.8 TARGET RESET .....	141
11.8.5.2.9 TERMINATE TASK .....	141
11.8.5.2.10 WAKEUP .....	141
Annex A Additional requirements for LVD SCSI drivers and receivers .....	142
A.1 System level requirements .....	142
A.2 Driver requirements .....	142
A.2.1 Differential output voltage, VS .....	143
A.2.2 Offset (common-mode output) voltage, VCM .....	145
A.2.3 Short-circuit currents, IO-S and IO+S .....	146
A.2.4 Open-circuit output voltages, $V_{O-(OC)}$ and $V_{O+(OC)}$ .....	147
A.2.5 Output signal waveform .....	147
A.2.6 Dynamic output signal balance, VCM(PP) .....	149
A.3 Receiver characteristics .....	150
A.3.1 Receiver steady state input voltage requirements .....	151
A.3.2 Compliance test .....	151
A.3.3 Receiver setup and hold times .....	152
A.4 Transceiver characteristics .....	152
A.4.1 Transceiver output/input currents, II-L and II+L .....	152
A.4.2 Transceiver maximum input voltages .....	153
Annex B SCSI configured automatically (SCAM) .....	154
B.1 Model .....	154
B.2 Glossary .....	154
B.3 SCAM requirements .....	155
B.3.1 Configuration requirements .....	155
B.3.2 Timing requirements .....	155
B.3.2.1 SCAM tolerant power-on to selection delay .....	156
B.3.2.2 SCAM tolerant reset to selection delay .....	156
B.3.2.3 SCAM tolerant selection response time .....	156
B.3.2.4 SCAM unassigned ID selection response delay .....	156
B.3.2.5 SCAM power-on to SCAM selection delay .....	156
B.3.2.6 SCAM reset to SCAM selection delay .....	156
B.3.2.7 SCAM selection response time .....	156
B.3.2.8 Recommended SCAM selection response time .....	156
B.3.2.9 Wide arbitration time .....	156
B.3.3 Device requirements .....	157
B.3.3.1 SCAM tolerant target .....	157
B.3.3.2 Level 1 SCAM initiator .....	157
B.3.3.3 Level 1 SCAM target .....	157
B.3.3.4 Level 2 SCAM initiator .....	158
B.3.3.5 Level 2 SCAM target .....	158
B.4 SCAM protocol .....	159
B.4.1 Initiation .....	159
B.4.1.1 Transfer cycles .....	159
B.4.1.2 Wired-OR glitch filtering .....	160
B.4.1.3 Isolation stage .....	161

B.4.1.4 Function sequences .....	164
B.4.1.4.1 Isolate function .....	165
B.4.1.4.2 Isolate and set priority flag function .....	166
B.4.1.4.3 Configuration process complete function .....	166
B.4.1.4.4 Dominant initiator contention function .....	167
B.5 SCAM operations .....	167
B.5.1 SCAM initiator .....	167
B.5.1.1 Dominant SCAM initiator .....	168
B.5.1.1.1 SCSI ID categorization .....	168
B.5.1.1.2 SCSI ID assignment .....	168
B.5.1.2 Subordinate SCAM initiator .....	168
B.5.2 Level 1 SCAM target .....	169
B.5.3 Level 2 SCAM target .....	170
 Annex C SCSI bus fairness .....	 172
C.1 Model .....	172
C.2 Determining fairness by monitoring prior bus activity .....	172
C.3 Fairness algorithm .....	172
C.4 Additional comments .....	173
 Annex D SCA-2 Connector pinouts .....	 175
D.1 SCA-2 Signal Definitions .....	175
D.1.1 VOLTAGE and GROUND signals .....	175
D.1.2 CHARGE signals .....	175
D.1.3 SPINDLE SYNC .....	176
D.1.4 ACTIVE LED OUT .....	177
D.1.5 Motor Start Controls .....	177
D.1.6 SCSI ID Selection .....	178
D.1.7 MATED Signals .....	179
D.1.7.1 MATED 2/Drive Side .....	179
D.1.7.2 MATED 2/Backplane Side .....	180
D.1.7.3 MATED 1/Drive Side .....	180
D.1.7.4 MATED 1/Backplane Side .....	180
 Annex E Interconnecting buses of different widths .....	 182
 Annex F Cabling and cable measurement method recommendations .....	 185
F.1 Cabling .....	185
F.2 Cable measurement .....	185
F.2.1 Impedance, TDR, single-ended .....	185
F.2.2 Impedance, TDR, differential .....	185
F.2.3 Attenuation, differential .....	186
F.2.4 Velocity (propagation delay) and skew .....	186
 Annex G Transmission line considerations for fast-20 data transfer rates .....	 187
 Annex H Measuring SE pin capacitance .....	 190
 Annex I SCSI ICONS .....	 191
 Annex J Example of HVD terminator network .....	 193
 Annex K SCSI-3 to SCSI-2 terminology mapping .....	 194
 Annex L SCA-2 Unshielded Connections .....	 195
L.1 Definitions and Conventions .....	196
L.1.1 Definitions .....	196

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

L.2 General Description ..... 198

Annex M VHDCI Shielded Configurations ..... 200

M.1 Definitions and Conventions ..... 200

    M.1.1 Definitions ..... 200

M.2 General Description ..... 202



## Tables

	Page
1 Transceiver/speed support map .....	14
2 Cross-reference to A cable contact assignments .....	37
3 SE contact assignments - A cable .....	38
4 SE contact assignments - P cable .....	39
5 SE contact assignments - Q cable .....	40
6 SE contact assignments - nonshielded alternative 4 connector .....	41
7 LVD contact assignments - A cable .....	42
8 LVD contact assignments - P cable .....	43
9 LVD contact assignments - Q cable .....	44
10 HVD contact assignments - A cable .....	45
11 HVD contact assignments - P cable .....	46
12 HVD contact assignments - Q cable .....	47
13 HVD and LVD contact assignments - nonshielded alternative 4 connector .....	48
14 Recommended minimum conductor size .....	50
15 SE characteristic impedance of cable at maximum indicated data transfer rate .....	51
16 Differential characteristic impedance of cable at indicated data transfer rate .....	52
17 SE maximum distance between terminators .....	53
18 Differential maximum distance between terminators .....	54
20 Minimum stub connection spacing rules for HVD SCSI devices .....	55
19 HVD stub length and spacing requirements .....	55
21 Minimum stub connection spacing rules for LVD SCSI devices .....	55
22 Electrical input requirements at the device connector .....	56
23 Input current requirements at the device connector for lines not being driven by the device .....	57
24 SE steady state output voltage characteristics .....	58
25 SE input voltage characteristics .....	61
26 SE input and output electrical characteristics .....	62
27 I-V requirements for LVD impedance, common mode impedance, and $V_{BIAS}$ tests .....	64
28 Values for LVD termination balance test .....	65
29 Values for LVD capacitive loads .....	68
30 Glitch management requirements for devices using LVD drivers .....	69
31 LVD DIFFSENS driver specifications .....	70
32 DIFFSENS receiver operating requirements .....	71
33 I-V requirements for HVD impedance and common mode impedance tests .....	76
34 Values for HVD termination balance test .....	76
35 HVD output voltage characteristics .....	77
37 Values for HVD capacitive loads .....	79
36 HVD input voltage characteristics .....	79
38 Terminator power characteristics at the terminator .....	81
39 Arbitration priorities by SCSI ID .....	83
40 Parity checking rules .....	84
41 Signal sources .....	87
42 SCSI bus timing values .....	89
43 Information transfer phases .....	108
44 Wide SCSI byte order .....	110
45 Message format .....	117
46 Extended message format .....	117
47 Link control message codes .....	118
48 IDENTIFY message format .....	119
49 IGNORE WIDE RESIDUE message format .....	120
50 IGNORE field definition .....	121
51 MODIFY DATA POINTER message format .....	122
52 SYNCHRONOUS DATA TRANSFER message format .....	123
53 TRANSFER PERIOD FACTOR field .....	123
54 SDTR messages implied agreements .....	124
55 WIDE DATA TRANSFER message format .....	126
56 WDTR messages implied agreements .....	128
57 Task attribute message codes .....	130
58 ACA message format .....	130
59 HEAD OF QUEUE message format .....	130

60 ORDERED message format .....	131
61 SIMPLE message format .....	131
62 Task management message codes .....	132
63 DATA TRANSFER DISCONNECT CONTROL .....	136
64 SCSI Parallel Interface-2 Standard terms mapped to terms from other SCSI-3 standards .....	136
65 Procedure terms .....	138
66 Processing of send SCSI command service procedure .....	139
67 Processing of data-in delivery service procedure .....	140
68 Processing of data-out delivery service procedure .....	140
A.1 System level requirements .....	142
A.2 Driver steady-state test limits and conditions .....	143
A.3 Driver switching test circuit parameters .....	148
A.4 Dynamic output balance limits .....	150
A.5 Receiver steady state input voltage ranges .....	151
A.6 Receiver minimum and maximum input voltages. ....	151
B.1 SCAM timing values .....	155
B.2 Transfer cycle conditions .....	162
B.3 Identification string .....	163
B.4 Type code .....	163
B.5 MAXIMUM ID CODE .....	163
B.6 ID VALID .....	164
B.7 Function codes .....	165
B.8 Action codes .....	166
B.9 Dominance preference code .....	167
D.1 Voltage specification limits .....	175
D.2 Charge supply to SCSI device .....	176
D.3 Output characteristics of drive 'ACTIVE LED OUT signal .....	177
D.4 Definition of motor start controls .....	178
D.5 Electronic requirements for input controls .....	178
D.6 SCSI device ID selection signals .....	179
K.1 SPI-2 to SCSI-2 terminology mapping .....	194

## Figures

	Page
1 General Structure of SCSI .....	2
2 Differential SCSI bus .....	15
3 SE SCSI bus .....	15
4 SCSI bus topology details .....	17
5 SCSI Parallel Interface service reference mode .....	19
6 Model for a four step confirmed services .....	19
7 Model for a two step confirmed services .....	20
8 50/68-contact alternative 1/alternative 3 nonshielded SCSI device connector .....	23
9 50/68-contact alternative 1/alternative 3 nonshielded mating connector .....	24
10 50-contact alternative 2 nonshielded SCSI device connector (A cable) .....	25
11 50-contact alternative 2 nonshielded mating connector (A cable) .....	26
12 80-contact alternative 4 nonshielded SCSI device connector (P cable) .....	27
13 80-contact alternative 4 nonshielded contact positions .....	27
14 50-contact alternative 1 shielded SCSI device connector (A cable) .....	29
15 50-contact alternative 1 shielded mating connector (A cable) .....	30
16 50-contact alternative 2 shielded SCSI device connector (A cable) .....	31
17 50-contact alternative 2 shielded mating connector (A cable) .....	32
18 68-contact alternative 3 shielded SCSI device connector (P cable/Q cable) .....	33
19 68-contact alternative 3 shielded mating connector (P cable/Q cable) .....	34
20 68-contact alternative 4 shielded SCSI device connector (P cable/Q cable) .....	35
21 68-contact alternative 4 shielded contact positions (P cable/Q cable) .....	36
22 Terminator decoupling example .....	53
23 Active negation current vs. voltage .....	59
24 SE A.C. test circuit .....	60
25 Differential SPI-2 bus terminator .....	62
26 Test circuit for terminator differential impedance .....	63
27 Termination I-V characteristics for differential and common mode impedance tests .....	63
28 Test circuit for termination common mode impedance test .....	64
29 Termination balance test configuration .....	65
30 Termination balance test data definition .....	65
31 LVD transceiver architecture .....	66
32 LVD receiver example .....	67
33 Capacitive loads .....	68
34 LVD DIFFSENS driver signal definitions .....	70
35 DIFFSENS receiver function .....	71
36 LVD DIFFSENS receiver example .....	72
37 Multimode terminator architecture .....	73
38 Multimode transceiver architecture .....	74
39 HVD test circuit .....	78
40 SE driver protection circuit .....	80
41 Voltage and current definitions .....	85
42 Signaling sense .....	86
43 Fast-10 SE timing measurement points .....	93
44 Fast-20 SE timing measurement points .....	94
45 LVD timing measurement points .....	95
46 HVD timing measurement points .....	96
47 Fast-10 setup and hold times for SE applications .....	97
48 Fast-10 setup and hold timing for HVD applications .....	97
49 Fast-20 setup and hold times for SE applications .....	99
50 Fast-20 setup and hold timing for HVD applications .....	99
51 Fast-40 System setup and hold timings (all times in ns) .....	101
52 Phase sequences .....	115
A.1 Differential steady-state output voltage test circuit .....	144
A.2 Domain for driver assertion and negation levels .....	145
A.3 Driver offset steady-state voltage test circuit .....	146
A.4 Common mode output voltage test .....	146
A.5 Driver short-circuit test circuit .....	147
A.6 Open-circuit output voltage test circuit .....	147
A.7 Differential output switching voltage test circuit .....	148

A.8 Driver output signal waveform .....	149
A.9 Driver offset switching voltage test circuit .....	150
A.10 Receiver input voltage threshold test circuit .....	152
A.11 Transceiver off-state output current test circuit .....	153
B.1 Transfer cycles .....	160
B.2 Level 1 SCAM target states .....	169
B.3 Level 2 SCAM target states .....	170
D.1 Sample circuit for mated indications .....	181
E.1 Interconnecting single-ended A and P cables .....	183
E.2 Interconnecting HVD A and P cables .....	184
F.1 Differential impedance measurement .....	186
G.1 Minimum device spacing versus bus and device capacitance .....	189
I.1 SE icon for SCSI .....	191
I.2 LVD icon for SCSI .....	191
I.3 SE/LVD multimode icon for SCSI .....	192
I.4 HVD icon for SCSI .....	192
J.1 Example of termination network for HVD devices .....	193
L.1 Mating side gender definition .....	198
L.2 Contact positioning architecture .....	199
M.1 Mating side gender definition .....	202

**INFORMATION TECHNOLOGY –  
SMALL COMPUTER SYSTEM INTERFACE (SCSI) –  
Part 112: Parallel Interface-2 (SPI-2)**

**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 through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. 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) 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 14776-112 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

ISO/IEC 14776-112 is intended to be used in conjunction with ISO/IEC 14776-311<sup>1</sup>. The resulting interface facilitates the interconnection of computers and intelligent peripherals and thus provides a common interface standard for both system integrators and suppliers of intelligent peripherals.

Annexes A, B, C and D form an integral part of this standard.

Annexes E, F, G, H, I, J, K, L and M are for information only.

---

<sup>1</sup> Under consideration.

## Introduction

The SCSI protocol is designed to provide an efficient peer-to-peer I/O bus with the maximum number of hosts and peripherals determined by the bus width (typically 8 or 16 with 32 allowed). Data may be transferred asynchronously or synchronously at rates that depend primarily on device implementation and cable length.

SCSI is an I/O interface that may be operated over a wide range of media and transfer rates. The objectives of the parallel interface in SCSI are:

- a) To provide host computers with device independence within a class of devices. Thus, different disk drives, tape drives, printers, optical media drives, and other devices may be added to the host computers without requiring modifications to generic system hardware. Vendor unique indications are accommodated. Reserved areas are provided for future standardization.
- b) To provide interoperability with SCSI-2 devices. Devices meeting SCSI-2 and the SCSI Parallel Interface-2 standards co-exist on the same bus. SCSI-3 devices should be permissive of the SCSI-2 or SCSI-3 compliant behavior of other devices including those not implementing optional extensions of the SCSI Parallel Interface-2 Standard.

The interface protocol includes provision for the connection of multiple initiators (SCSI devices capable of initiating a task) and multiple targets (SCSI devices capable of responding to a request to perform a task). Distributed arbitration (i.e., bus-contention logic) is built into the architecture of parallel SCSI. A default priority system awards interface control to the highest priority SCSI device that is contending for use of the bus and an optional fairness algorithm is defined.

This international standard combines the functionality of the SCSI-3 Interlocked Protocol (SIP) standard, the SCSI-3 Parallel Interface (SPI) standard, and the SCSI-3 Fast-20 standard. This international standard is intended to be the choice for new designs over the above standards. In addition to combining the above standards several new features have been added into this international standard. Some of those features are; Low Voltage Differential (LVD), fast-40 data transfers, multimode signal-ended (MSE), and additional connectors.

The SCSI Parallel Interface-2 standard is divided into the following clauses:

- Clause 1 is the scope;
- Clause 2 enumerates the normative references that apply to this standard;
- Clause 3 describes the definitions, symbols, conventions and abbreviations used in this standard;
- Clause 4 describes the SCSI parallel interface model used in this standard;
- Clause 5 describes the connectors;
- Clause 6 describes the cable characteristics;
- Clause 7 describes the electrical characteristics;
- Clause 8 describes the SCSI bus signals;
- Clause 9 describes the bus timing;
- Clause 10 describes the removal and insertion of parallel SCSI devices;
- Clause 11 describes the SCSI parallel protocol characteristics;

# Small Computer System Interface - Part 112: Parallel Interface-2 (SPI-2)

## 1 Scope

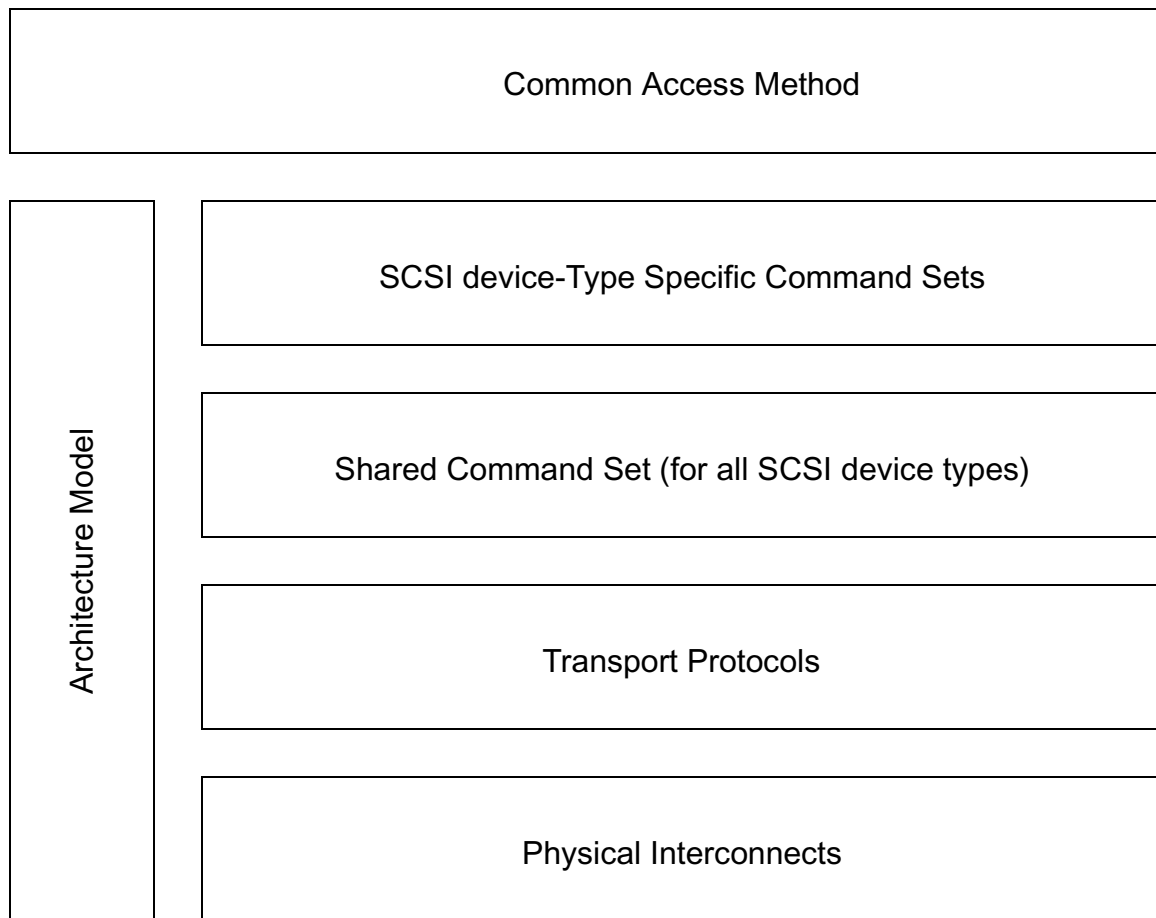
This international standard defines the mechanical, electrical, timing, and protocol requirements of the SCSI parallel interface to allow conforming devices to interoperate. The SCSI parallel interface is a local I/O bus that may be operated over a wide range of transfer rates. The objectives of the SCSI parallel interface are

- a) To provide host computers with device independence within a class of devices. Thus, different disk drives, tape drives, printers, optical media drives, and other devices may be added to the host computers without requiring modifications to generic system hardware. Provision is made for the addition of special features and functions through the use of vendor-specific options. Reserved areas are provided for future standardization.
- b) To provide compatibility such that properly conforming SCSI-2 devices may interoperate with SCSI-3 devices given that the systems engineering is correctly done. Properly conforming SCSI-2 devices should respond in an acceptable manner to reject SCSI-3 protocol extensions. SCSI-3 protocol extensions are designed to be permissive of such rejections and thus allow the SCSI-2 devices to continue operation without requiring the use of the extension.

The interface protocol includes provision for the connection of multiple initiators (SCSI devices capable of initiating an I/O process) and multiple targets (SCSI devices capable of responding to a request to perform an I/O process). Distributed arbitration (i.e., bus-contention logic) is built into the architecture of SCSI. A default priority system awards interface control to the highest priority SCSI device that is contending for use of the bus and an optional fairness algorithm is defined.

This standard defines the physical attributes of an input/output bus for interconnecting computers and peripheral devices.

Figure 1 is intended to show the general structure of SCSI standards. The figure is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture.



**Figure 1 - General Structure of SCSI**

This international standard is intended as an alternate to the SCSI-3 Parallel Interface Standard. This international standard, in addition to containing all the information in the SCSI-3 Parallel Interface Standard contains information and specifications for LVD and fast-40 along with many other improvements.

## **2 Normative references**

### **2.1 Normative references**

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14776. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 14776 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

### **2.2 Approved references**

ISO/IEC 9316:1995, *Small Computer System Interface - 2*

ISO/IEC 8482:1993, *Information technology - Telecommunications and information exchange between*



*systems - Twisted pair multipoint interconnections*

ISO/IEC 14776-411, 1999, *SCSI-3 Architecture Model standard*

IEC 60512-2:1985, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods - Part 2: General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests*

IEC 60512-11-7:1996, *Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 11-7: Climatic tests - Test 11g: Flowing mixed gas corrosion test*

EIA-700A0AE (SP-3651), *Detail Specification for Trapezoidal Connectors with Non-removable Ribbon Contacts on 1,27 mm Pitch Double Row used with Single Connector Attachments (SCA-2)*

EIA-700A0AF (SP-3652), *Detail Specification for Trapezoidal Connector 0,8mm Pitch used with Very High Density Cable Interconnect (VHDCI)*

### **2.3 References under development**

ISO/IEC 14776-412, *SCSI Architecture Model-2 standard*

ISO/IEC 14776-311, *SCSI-3 Primary Commands Standard*