

# ISO/IEC 14776-452 :2005-08 (E)

## Information technology\_ - Small Computer System Interface (SCSI)\_ - Part\_452: SCSI Primary Commands-2 (SPC-2)

---

### Contents

	Page
Foreword.....	13
Introduction .....	14
1 Scope.....	17
2 Normative references.....	17
2.1 General.....	17
2.2 Approved references .....	17
2.3 References under development .....	17
3 Definitions, symbols, abbreviations, and conventions .....	18
3.1 Definitions.....	18
3.2 Acronyms.....	23
3.3 Keywords.....	24
3.4 Conventions.....	25
3.5 Notation for procedures and functions.....	26
4 General concepts .....	27
4.1 Introduction.....	27
4.2 The request-response model.....	27
4.3 The Command Descriptor Block (CDB).....	27
4.3.1 CDB usage and structure .....	27
4.3.2 The fixed length CDB formats .....	28
4.3.3 The variable length CDB formats .....	30
4.3.4 Common CDB fields .....	31
4.3.4.1 Operation code .....	31
4.3.4.2 Service action .....	31
4.3.4.3 Logical block address .....	32
4.3.4.4 Transfer length .....	32
4.3.4.5 Parameter list length.....	32
4.3.4.6 Allocation length .....	32
4.3.4.7 Control .....	32

5 Model common to all device types .....	33
5.1 Introduction to the model common to all device types.....	33
5.2 Commands implemented by all SCSI device servers.....	33
5.2.1 Summary of commands implemented by all SCSI device servers .....	33
5.2.2 Using the INQUIRY command.....	33
5.2.3 Using the REQUEST SENSE command.....	33
5.2.4 Using the TEST UNIT READY command.....	33
5.3 Parameter rounding.....	33
5.4 Self-test Operations.....	34
5.4.1 Default self-test.....	34
5.4.2 The short and extended self-tests .....	34
5.4.3 Self-test modes.....	34
5.4.3.1 Foreground mode .....	34
5.4.3.2 Background mode .....	35
5.4.3.3 Elements common to foreground and background self-test modes .....	36
5.5 Reservations.....	36
5.5.1 Reservations overview .....	36
5.5.2 The Reserve/Release management method.....	39
5.5.3 The Persistent Reservations management method .....	40
5.5.3.1 Overview of the Persistent Reservations management method.....	40
5.5.3.2 Preserving persistent reservations .....	40
5.5.3.3 Finding persistent reservations and reservation keys .....	41
5.5.3.3.1 Summary of commands for finding persistent reservations and reservation keys .....	41
5.5.3.3.2 Reporting reservation keys.....	41
5.5.3.3.3 Reporting persistent reservations.....	42
5.5.3.3.4 Registering .....	42
5.5.3.3.5 Creating a persistent reservation when there is no persistent reservation.....	43
5.5.3.3.6 Removing registrations and persistent reservations.....	44
5.5.3.3.6.1 Overview of removing registrations and persistent reservations .....	44
5.5.3.3.6.2 Releasing a persistent reservation .....	44
5.5.3.3.6.3 Preempting an existing persistent reservation with the PREEMPT service action.....	45
5.5.3.3.6.3.1 Overview of preempting an existing persistent reservation with the PREEMPT service action .....	45
5.5.3.3.6.3.2 Failed persistent reservation preempt .....	46
5.5.3.3.6.3.3 Preempting reservations.....	46
5.5.3.3.6.3.4 Removing registrations.....	47
5.5.3.3.6.3.4 Preempting an existing persistent reservation with the PREEMPT AND ABORT service action.....	47
5.5.3.3.6.3.5 Clearing a persistent reservation.....	48
5.6 Multiple port and multiple initiator behavior .....	49
5.7 Removable medium devices with an attached medium changer .....	49
6 Model for processor devices .....	50

7 Commands for all device types .....	52
7.1 Summary of commands for all device types .....	52
7.2 EXTENDED COPY command .....	53
7.2.1 EXTENDED COPY command introduction .....	53
7.2.2 Errors detected before starting processing of the segment descriptors .....	55
7.2.3 Errors detected during processing of segment descriptors .....	56
7.2.4 Abort task management functions .....	57
7.2.5 Descriptor type codes .....	58
7.2.6 Target descriptors.....	59
7.2.6.1 Target descriptors introduction .....	59
7.2.6.2 Fibre Channel World Wide Name target descriptor format.....	61
7.2.6.3 Fibre Channel N_Port target descriptor format.....	62
7.2.6.4 Fibre Channel N_Port with World Wide Name checking target descriptor format.....	63
7.2.6.5 Parallel Interface T_L target descriptor format .....	64
7.2.6.6 Identification descriptor target descriptor format .....	65
7.2.6.7 Device type specific target descriptor parameters for block device types .....	66
7.2.6.8 Device type specific target descriptor parameters for sequential-access device types.....	66
7.2.6.9 Device type specific target descriptor parameters for processor device types.....	67
7.2.7 Segment Descriptors .....	68
7.2.7.1 Segment descriptors introduction .....	68
7.2.7.2 Segment descriptor processing .....	68
7.2.7.3 Block device to stream device operations .....	72
7.2.7.4 Stream device to block device operations .....	73
7.2.7.5 Block device to block device operations.....	74
7.2.7.6 Stream device to stream device operations .....	75
7.2.7.7 Inline data to stream device operation.....	77
7.2.7.8 Embedded data to stream device operation.....	78
7.2.7.9 Stream device to discard operation .....	79
7.2.7.10 Verify device operation .....	80
7.2.7.11 Block device with offset to stream device operation.....	81
7.2.7.12 Stream device to block device with offset operation.....	82
7.2.7.13 Block device with offset to block device with offset operation .....	83
7.2.7.14 Write filemarks operation .....	84
7.2.7.15 Space operation .....	85
7.2.7.16 Locate operation.....	86
7.2.7.17 Tape device image copy operation.....	87
7.2.7.18 Register key operation.....	88
7.3 INQUIRY command.....	89
7.3.1 INQUIRY command introduction .....	89
7.3.2 Standard INQUIRY data .....	91
7.3.3 SCSI Parallel Interface specific INQUIRY data .....	98

7.3.4 Vital product data.....	99
7.3.5 Command support data.....	100
7.4 LOG SELECT command.....	102
7.5 LOG SENSE command.....	104
7.6 MODE SELECT(6) command.....	106
7.7 MODE SELECT(10) command.....	108
7.8 MODE SENSE(6) command.....	108
7.8.1 MODE SENSE(6) command introduction.....	108
7.8.2 Current values.....	110
7.8.3 Changeable values.....	110
7.8.4 Default values.....	110
7.8.5 Saved values.....	110
7.8.6 Initial responses.....	110
7.9 MODE SENSE(10) command.....	111
7.10 PERSISTENT RESERVE IN command.....	112
7.10.1 PERSISTENT RESERVE IN command introduction.....	112
7.10.2 PERSISTENT RESERVE IN service actions.....	112
7.10.2.1 Summary of PERSISTENT RESERVE IN service actions.....	112
7.10.2.2 Read Keys.....	112
7.10.2.3 Read Reservations.....	113
7.10.3 PERSISTENT RESERVE IN parameter data for READ KEYS.....	113
7.10.4 PERSISTENT RESERVE IN parameter data for READ RESERVATION.....	114
7.10.4.1 Format of PERSISTENT RESERVE IN parameter data for READ RESERVATION.....	114
7.10.4.2 Persistent reservations Scope.....	115
7.10.4.2.1 Summary of persistent reservations Scope.....	115
7.10.4.2.2 Logical unit scope.....	115
7.10.4.2.3 Element scope.....	115
7.10.4.3 Persistent Reservations Type.....	116
7.11 PERSISTENT RESERVE OUT command.....	117
7.11.1 PERSISTENT RESERVE OUT command introduction.....	117
7.11.2 PERSISTENT RESERVE OUT Service Actions.....	118
7.11.3 PERSISTENT RESERVE OUT parameter list.....	119
7.12 PREVENT ALLOW MEDIUM REMOVAL command.....	121
7.13 READ BUFFER command.....	122
7.13.1 READ BUFFER command introduction.....	122
7.13.2 Combined header and data mode (0000b).....	123
7.13.3 Vendor specific mode (0001b).....	123
7.13.4 Data mode (0010b).....	123
7.13.5 Descriptor mode (0011b).....	124
7.13.6 Read Data from echo buffer (1010b).....	124
7.13.7 Echo buffer descriptor mode (1011b).....	125
7.14 RECEIVE COPY RESULTS command.....	126
7.14.1 RECEIVE COPY RESULTS command introduction.....	126
7.14.2 COPY STATUS service action.....	127
7.14.3 RECEIVE DATA service action.....	129
7.14.4 OPERATING PARAMETERS service action.....	130
7.14.5 FAILED SEGMENT DETAILS service action.....	132
7.15 RECEIVE DIAGNOSTIC RESULTS command.....	133
7.16 RELEASE(10) command.....	134
7.16.1 RELEASE(10) command introduction.....	134
7.16.2 Logical unit release.....	134
7.16.3 Third-party release.....	134
7.17 RELEASE(6) command.....	135
7.18 REPORT DEVICE IDENTIFIER command.....	136
7.19 REPORT LUNS command.....	138
7.20 REQUEST SENSE command.....	140
7.20.1 REQUEST SENSE command introduction.....	140
7.20.2 Sense data format.....	141
7.20.3 Sense-key specific.....	143
7.20.4 Current errors.....	144

7.20.5 Deferred errors .....	144
7.20.6 Sense key and sense code definitions .....	146
7.21 RESERVE(10) command .....	158
7.21.1 RESERVE(10) command introduction.....	158
7.21.2 Logical unit reservation.....	158
7.21.3 Third-party reservation .....	159
7.21.4 Superseding reservations.....	160
7.22 RESERVE(6) command .....	160
7.23 SEND DIAGNOSTIC command .....	161
7.24 SET DEVICE IDENTIFIER command .....	163
7.25 TEST UNIT READY command.....	165
7.26 WRITE BUFFER command.....	166
7.26.1 WRITE BUFFER command introduction .....	166
7.26.2 Combined header and data mode (0000b).....	167
7.26.3 Vendor specific mode (0001b).....	167
7.26.4 Data mode (0010b).....	167
7.26.5 Download microcode mode (0100b).....	167
7.26.6 Download microcode and save mode (0101b) .....	167
7.26.7 Download microcode with offsets (0110b).....	168
7.26.8 Download microcode with offsets and save mode (0111b) .....	168
7.26.9 Write data to echo buffer (1010b).....	169
8 Parameters for all device types.....	170
8.1 Diagnostic parameters.....	170
8.1.1 Diagnostic page format and page codes for all device types .....	170
8.1.2 Supported diagnostic pages .....	172
8.2 Log parameters .....	173
8.2.1 Log page structure and page codes for all device types .....	173
8.2.2 Application client page.....	176
8.2.3 Buffer over-run/under-run page .....	177
8.2.4 Error counter pages.....	179
8.2.5 Last n deferred errors or asynchronous events page .....	179
8.2.6 Last n error events page.....	179
8.2.7 Non-medium error page .....	180
8.2.8 Self-test results page.....	180
8.2.9 Start-stop cycle counter page.....	183
8.2.10 Supported log pages .....	185
8.2.11 Temperature page .....	185
8.3 Mode parameters .....	187
8.3.1 Mode parameters overview .....	187
8.3.2 Mode parameter list format.....	187
8.3.3 Mode parameter header formats .....	187
8.3.4 Mode parameter block descriptor formats .....	188
8.3.4.1 General block descriptor format .....	188
8.3.4.2 Direct-access device block descriptor format for LONGLBA=0 .....	189
8.3.4.3 Long LBA block descriptor format .....	190
8.3.5 Mode page format and page codes.....	191
8.3.6 Control mode page .....	192
8.3.7 Disconnect-reconnect page.....	196
8.3.8 Informational exceptions control page.....	198
8.3.9 Power condition page .....	200
8.3.10 Protocol specific LUN page .....	202
8.3.11 Protocol specific port page .....	203
8.4 Vital product data parameters .....	204
8.4.1 Vital product data parameters overview and page codes.....	204
8.4.2 ASCII implemented operating definition page .....	204
8.4.3 ASCII information page .....	205
8.4.4 Device identification page.....	205
8.4.5 Supported vital product data pages.....	208
8.4.6 Unit serial number page .....	209

9 Commands for processor type devices.....	210
9.1 Summary of commands for processor type devices.....	210
9.2 RECEIVE command.....	211
9.3 SEND command.....	211
10 Parameters for processor type devices .....	212
10.1 Diagnostic parameters.....	212
10.2 Log parameters .....	213
10.3 Vital product data parameters .....	213
Annex A	
Procedures for logging operations in SCSI .....	214
A.1 Procedures for logging operations in SCSI introduction .....	214
A.2 Logging operations terminology .....	214
A.3 LOG SENSE command.....	215
A.4 LOG SELECT command.....	218
A.5 Exception conditions during logging.....	221
Annex B	
Commands allowed in the presence of various reservations.....	224
B.1 SBC commands .....	224
B.2 SMC commands.....	228
Annex C	
Numeric order codes.....	230
C.1 Numeric order codes introduction .....	230
C.2 Additional Sense Codes.....	230
C.3 Operation Codes .....	242
C.4 Log Page Codes .....	248
C.5 Mode Page Codes .....	249
C.6 Version Descriptor Values .....	251
C.7 Variable Length CDB Service Action Codes.....	258
Annex D	
Vendor identification .....	259
Annex E	
References and general structure of SCSI .....	266

## Tables

	Page
1 Typical CDB for 6-byte commands .....	28
2 Typical CDB for 10-byte commands .....	28
3 Typical CDB for 12-byte commands .....	29
4 Typical CDB for 16-byte commands .....	29
5 Typical CDB for long LBA 16-byte commands .....	30
6 Typical variable length CDB .....	30
7 Typical variable length CDB for long LBA 32-byte commands .....	31
8 Exception commands for background self-tests .....	35
9 Self-test mode summary .....	36
10 SPC commands that are allowed in the presence of various reservations .....	38
11 PERSISTENT RESERVE OUT service actions that are allowed in the presence of various reservations .....	39
12 Processor commands that are allowed in the presence of various reservations .....	51
13 Commands for all device types .....	52
14 EXTENDED COPY command .....	53
15 EXTENDED COPY parameter list .....	54
16 EXTENDED COPY descriptor type codes .....	58
17 Target descriptor format .....	59
18 Device type specific parameters in target descriptors .....	60
19 Fibre Channel World Wide Name target descriptor format .....	61
20 Fibre Channel N_Port target descriptor format .....	62
21 Fibre Channel N_Port with World Wide Name checking target descriptor format .....	63
22 Parallel Interface T_L target descriptor format .....	64
23 Identification descriptor target descriptor format .....	65
24 Device type specific target descriptor parameters for block device types .....	66
25 Device type specific target descriptor parameters for sequential-access device types .....	66
26 Stream device transfer lengths .....	67
27 Device type specific target descriptor parameters for processor device types .....	67
28 Segment descriptor header .....	68
29 Descriptor Type Code Dependent Copy Manager Processing .....	69
30 PAD and CAT bit definitions .....	71
31 Block device to or from stream device segment descriptor .....	72
32 Block device to block device segment descriptor .....	74
33 Stream device to stream device segment descriptor .....	75
34 Inline data to stream device segment descriptor .....	77
35 Embedded data to stream device segment descriptor .....	78
36 Stream device to discard segment descriptor .....	79
37 Verify device operation segment descriptor .....	80
38 Block device with offset to or from stream device segment descriptor .....	81
39 Block device with offset to block device with offset segment descriptor .....	83
40 Write filemarks operation segment descriptor .....	84
41 Space operation segment descriptor .....	85
42 Locate operation segment descriptor .....	86
43 Tape device image copy segment descriptor .....	87
44 Register key segment descriptor .....	88
45 INQUIRY command .....	89
46 Standard INQUIRY data format .....	91
47 Peripheral qualifier .....	92
48 Peripheral device type .....	92
49 Version .....	93
50 Relationship of BQUE and CMDQUE bits .....	94
51 Version descriptor values .....	95
52 SPI-specific standard INQUIRY bits .....	98
53 Maximum logical device configuration table .....	98
54 CLOCKING field .....	99
55 Command support data format .....	100
56 SUPPORT values and meanings .....	100
57 LOG SELECT command .....	102
58 Page control field .....	102

59 LOG SENSE command .....	104
60 MODE SELECT(6) command .....	106
61 MODE SELECT(10) command .....	108
62 MODE SENSE(6) command .....	108
63 Page control field .....	109
64 Mode page code usage for all devices .....	109
65 MODE SENSE(10) command .....	111
66 PERSISTENT RESERVE IN command .....	112
67 PERSISTENT RESERVE IN service action codes .....	112
68 PERSISTENT RESERVE IN parameter data for READ KEYS .....	113
69 PERSISTENT RESERVE IN parameter data for READ RESERVATION .....	114
70 PERSISTENT RESERVE IN reservation descriptor .....	114
71 Persistent reservation scope codes .....	115
72 Persistent reservation type codes .....	116
73 PERSISTENT RESERVE OUT command .....	117
74 PERSISTENT RESERVE OUT service action codes .....	118
75 PERSISTENT RESERVE OUT parameter list .....	119
76 PERSISTENT RESERVE OUT service actions and valid parameters .....	120
77 PREVENT ALLOW MEDIUM REMOVAL command .....	121
78 PREVENT ALLOW MEDIUM REMOVAL PREVENT field .....	121
79 READ BUFFER command .....	122
80 READ BUFFER MODE field .....	122
81 READ BUFFER header .....	123
82 READ BUFFER descriptor .....	124
83 Buffer offset boundary .....	124
84 Echo buffer descriptor .....	125
85 RECEIVE COPY RESULTS command .....	126
86 RECEIVE COPY RESULTS service action codes .....	126
87 Parameter data for the COPY STATUS service action .....	127
88 COPY STATUS STATUS values .....	128
89 COPY STATUS TRANSFER COUNT UNITS values .....	128
90 Parameter data for the RECEIVE DATA service action .....	129
91 Parameter data for the OPERATING PARAMETERS service action .....	130
92 Parameter data for the FAILED SEGMENT DETAILS service action .....	132
93 RECEIVE DIAGNOSTIC RESULTS command .....	133
94 RELEASE(10) command .....	134
95 RELEASE(10) parameter list .....	135
96 RELEASE(6) command .....	135
97 REPORT DEVICE IDENTIFIER command .....	136
98 REPORT DEVICE IDENTIFIER parameter list .....	137
99 REPORT LUNS command .....	138
100 REPORT LUNS parameter list format .....	139
101 REQUEST SENSE command .....	140
102 Response codes 70h and 71h sense data format .....	141
103 Field pointer bytes .....	143
104 Actual retry count bytes .....	143
105 Progress indication bytes .....	144
106 Segment pointer bytes .....	144
107 Sense key descriptions .....	146
108 ASC and ASCQ assignments .....	147
109 RESERVE(10) command .....	158
110 RESERVE(10) ID only parameter list .....	159
111 RESERVE(6) command .....	160
112 SEND DIAGNOSTIC command .....	161
113 SELF-TEST CODE field values .....	161
114 SET DEVICE IDENTIFIER command .....	163
115 SET DEVICE IDENTIFIER parameter list .....	164
116 TEST UNIT READY command .....	165
117 Preferred TEST UNIT READY responses .....	165
118 WRITE BUFFER command .....	166

119 WRITE BUFFER MODE field.....	166
120 Diagnostic page format.....	170
121 Diagnostic page codes.....	171
122 Supported diagnostic pages .....	172
123 Log page format.....	173
124 Log parameter.....	173
125 Threshold met criteria .....	174
126 Log page codes .....	176
127 Application client page .....	176
128 General usage application client parameter data .....	177
129 Parameter control bits for general usage parameters (0000h through 0FFFh).....	177
130 Parameter code field for buffer over-run/under-run counters.....	178
131 Count basis definition.....	178
132 Cause field definition.....	178
133 Parameter codes for error counter pages .....	179
134 Non-medium error event parameter codes .....	180
135 Self-test results page .....	180
136 Self-test results log parameter format.....	181
137 Parameter control bits for self-test results log parameters.....	181
138 Self-test results values .....	182
139 Start-stop cycle counter page .....	183
140 Parameter control bits for date of manufacture parameter (0001h).....	184
141 Parameter control bits for accounting date parameter (0002h).....	184
142 Parameter control bits for start-stop cycle counter parameters (0003h and 0004h).....	184
143 Supported log pages.....	185
144 Temperature page .....	185
145 Parameter control bits for temperature parameters (0000h and 0001h).....	186
146 Mode parameter list .....	187
147 Mode parameter header(6) .....	187
148 Mode parameter header(10) .....	187
149 General mode parameter block descriptor.....	188
150 Direct-access device mode parameter block descriptor .....	189
151 Long LBA mode parameter block descriptor.....	190
152 Mode page format.....	191
153 Mode page codes .....	192
154 Control mode page .....	192
155 Task set type.....	193
156 Queue algorithm modifier.....	193
157 Queue error management (QERR) field .....	194
158 AUTOLOAD MODE field .....	195
159 Disconnect-reconnect page .....	196
160 Data transfer disconnect control .....	197
161 Informational exceptions control page .....	198
162 Method of reporting informational exceptions (MRIE) field.....	199
163 Power condition page .....	201
164 Protocol specific LUN page.....	202
165 PROTOCOL IDENTIFIER values.....	203
166 Protocol specific port page.....	203
167 Vital product data page codes .....	204
168 ASCII implemented operating definition.....	204
169 ASCII information page.....	205
170 Device identification page .....	206
171 Identification descriptor .....	206
172 Code set.....	206
173 Association.....	207
174 Identifier type .....	207
175 Relative port identifier values .....	207
176 Device identification page example .....	208
177 Supported vital product data pages .....	208
178 Unit serial number page.....	209

179 Commands for processor devices .....	210
180 RECEIVE command .....	211
181 SEND command .....	211
182 SEND command – AER data format.....	212
183 Processor diagnostic page codes .....	212
184 Processor log page codes .....	213
185 Processor vital product data page codes .....	213
A.1 LOG SENSE Command CDB fields .....	215
A.2 LOG SENSE returned parameter values.....	216
A.3 LOG SENSE save options.....	217
A.4 LOG SELECT CDB fields .....	218
A.5 LOG SELECT save options .....	219
A.6 LOG SELECT controller parameter values .....	220
A.7 Log Parameter Control Byte saving definitions .....	221
A.9 Logging exception conditions .....	222
A.8 Log Parameter Control Byte updating definitions .....	222
B.1 SBC direct access commands that are allowed in the presence of various reservations.....	225
B.2 SBC optical memory commands that are allowed in the presence of various reservations .....	226
B.3 SBC write-once commands that are allowed in the presence of various reservations .....	227
B.4 SMC commands that are allowed in the presence of various reservations .....	228
C.1 ASC and ASCQ assignments.....	230
C.2 Operation Codes .....	242
C.3 Log Page Codes.....	248
C.4 Mode Page Codes.....	249
C.5 Version descriptor assignments .....	251
C.6 Standard code value guidelines .....	255
C.7 Revision code value guidelines .....	257
C.8 Variable Length CDB Service Action Code Ranges.....	258
C.9 Variable Length CDB Service Action Codes Used by All Device Types .....	258
D.1 Vendor identification list .....	259

## Figures

	Page
1 SCSI document relationships.....	14
2 Device server interpretation of PREEMPT service action.....	46
3 Power conditions flowchart .....	202