ISO/IEC 14776-454:2018-04 (E)

Information technology - Small computer system interface (SCSI) - Part 454: SCSI Primary Commands - 4 (SPC-4)

Contents

Page

1 Scope ... 40

2 Normative references ... 40

3 Terms, definitions, symbols, abbreviations, and conventions ... 45
3.1 Terms and definitions ... 45
3.2 Abbreviations and symbols ... 65
3.2.1 Abbreviations ... 65
3.2.2 Symbols ... 67
3.2.3 Mathematical operators ... 67
3.3 Keywords ... 68
3.4 Conventions ... 69
3.5 Numeric and character conventions ... 70
3.5.1 Numeric conventions ... 70
3.5.2 Units of measure ... 70
3.5.3 Byte encoded character strings conventions ... 71
3.6 Bit and byte ordering ... 71
3.7 Notation conventions ... 73
3.7.1 Notation for procedure calls ... 73
3.7.2 Notation for state diagrams ... 74
3.7.3 Notation for flowcharts ... 75
3.7.4 Notation for UML figures ... 75
3.7.4.1 Overview ... 75
3.7.4.2 Class notation ... 77
3.7.4.3 Class association relationships notation ... 77
3.7.4.4 Class aggregation relationships notation ... 78
3.7.4.5 Class generalization relationships notation ... 80
3.7.4.6 Class dependency relationships notation ... 81
3.7.4.7 Object notation ... 81
3.7.5 Notation for EXTENDED COPY command segment descriptors ... 81

4 General concepts ... 82
4.1 Introduction ... 82
4.2 Command Descriptor Block ... 82
4.2.1 CDB usage and structure ... 82
4.2.2 Fixed length CDB formats ... 83
4.2.2.1 Formats for 6-byte CDBs ... 83
4.2.2.1.1 Generic 6-byte CDB format ... 83
4.2.2.1.2 Typical 6-byte CDB format ... 83
4.2.2.2 Formats for 10-byte CDBs ... 84
4.2.2.2.1 Generic 10-byte CDB format ... 84
4.2.2.2.2 Typical 10-byte CDB format ... 85
4.2.2.3 Formats for 12-byte CDBs ... 86
4.2.2.3.1 Generic 12-byte CDB format ... 86
4.2.2.3.2 Typical 12-byte CDB format ... 86
4.2.2.3.3 MAINTENANCE IN CDB format ... 87
4.2.2.3.4 MAINTENANCE OUT CDB format ... 88
4.2.2.3.5 SERVICE ACTION IN(12) CDB format ... 88
4.2.2.3.6 SERVICE ACTION OUT(12) CDB format ... 89
4.2.2.4 Formats for 16-byte CDBs ... 89
4.2.2.4.1 Generic 16-byte CDB format ... 89
4.2.2.4.2 Typical 16-byte CDB format, if eight-byte LBAs not supported ... 90
4.2.2.4.3 Typical 16-byte CDB format with eight-byte LBAs supported ... 91
4.2.2.4.4 SERVICE ACTION IN(16) CDB format ... 92

4.2.2.4.5 SERVICE ACTION OUT(16) CDB format 92
4.2.2.4.6 SERVICE ACTION BIDIRECTIONAL CDB format 93
4.2.3 Variable length CDB formats 93
4.2.3.1 Generic variable length CDB format 93
4.2.3.2 Typical 32-byte variable length CDB format 95
4.2.4 Extended CDBs 96
4.2.4.1 XCDB model 96
4.2.4.2 The XCDB format 96
4.2.5 Common CDB fields 98
4.2.5.1 Operation code 98
4.2.5.2 Service action 98
4.2.5.3 Logical block address 98
4.2.5.4 Transfer length 99
4.2.5.5 Parameter list length 99
4.2.5.6 Allocation length 99
4.3 Data field requirements 99
4.3.1 ASCII data field requirements 99
4.3.2 Null data field termination and zero padding requirements 100
4.3.3 Variable type data field requirements 100
4.3.4 Port identifier field requirements 100
4.4 Secure random numbers 101
4.5 Sense data 101
4.5.1 Sense data introduction 101
4.5.2 Descriptor format sense data 102
4.5.2.1 Descriptor format sense data overview 102
4.5.2.2 Information sense data descriptor 104
4.5.2.3 Command-specific information sense data descriptor 105
4.5.2.4 Sense key specific sense data descriptor 106
4.5.2.4.1 Sense key specific sense data descriptor overview 106
4.5.2.4.2 Field pointer sense key specific information 107
4.5.2.4.3 Actual retry count sense key specific information 108
4.5.2.4.4 Progress indication sense key specific information 108
4.5.2.4.5 Segment pointer sense key specific information 109
4.5.2.4.6 Unit attention condition queue overflow sense key specific information 109
4.5.2.5 Field replaceable unit sense data descriptor 110
4.5.2.6 Another progress indication sense data descriptor 110
4.5.2.7 Forwarded sense data 111
4.5.2.8 Vendor specific sense data descriptors 112
4.5.3 Fixed format sense data 113
4.5.4 Returning a value in the INFORMATION field in the sense data 114
4.5.5 Returning a value in the COMMAND-SPECIFIC INFORMATION field in the sense data 115
4.5.6 Current information 115
4.5.7 Deferred errors 116
4.5.8 Sense key and additional sense code definitions 117

5 Model common to all device types 136
5.1 Introduction to the model common to all device types 136
5.1.1 Overview 136
5.1.2 Important commands for all SCSI device servers 136
5.1.2.1 Commands implemented by all SCSI device servers 136
5.1.2.2 Commands recommended for all SCSI device servers 136
5.1.2.3 Using the INQUIRY command 136
5.1.2.4 Using the REPORT LUNS command 136
5.1.2.5 Using the TEST UNIT READY command 137
5.1.2.6 Using the REQUEST SENSE command 137
5.1.3 Implicit head of queue 137
5.2 Device clocks and timestamps 137

5.3 Device specific background functions 138
5.3.1 Introduction 138
5.3.2 Suspending and resuming device specific background functions 139
5.4 Downloading and activating microcode 140
5.4.1 Downloading microcode 140
5.4.2 Activating microcode 144
5.5 Error history 145
5.5.1 Error history overview 145
5.5.2 Retrieving error history with the READ BUFFER command 145
5.5.3 Adding application client error history with the WRITE BUFFER command 148
5.5.4 Clearing error history with the WRITE BUFFER command 148
5.6 Identifying information 149
5.7 Medium auxiliary memory 149
5.8 Parameter rounding 150
5.9 Parsing variable length parameter lists and parameter data 151
5.10 Pollable condition information 152
5.10.1 Information that does not represent an exception condition 152
5.10.2 REQUEST SENSE pollable sense data 152
5.10.2.1 Making information available for the REQUEST SENSE command 152
5.10.2.2 Selecting pollable sense data to return 152
5.10.2.3 Returning one or more progress indications 152
5.10.3 Log parameter pollable device condition information 153
5.11 Power management 153
5.11.1 Power management overview 153
5.11.2 Power consumption management 153
5.11.3 Power conditions management 154
5.11.4 Active power condition 155
5.11.5 Idle power conditions 155
5.11.6 Standby power conditions 156
5.11.7 Power condition pollable sense data 156
5.11.8 Power condition state machine 157
5.11.8.1 Power condition state machine overview 157
5.11.8.2 PC0:Powered_On state 158
5.11.8.2.1 PC0:Powered_On state description 158
5.11.8.2.2 Transition PC0:Powered_On to PC4:Active_Wait 159
5.11.8.3 PC1:Active state 159
5.11.8.3.1 PC1:Active state description 159
5.11.8.3.2 Transition PC1:Active to PC5:Wait_Idle 159
5.11.8.3.3 Transition PC1:Active to PC6:Wait_Standby 159
5.11.8.4 PC2:Idle state 159
5.11.8.4.1 PC2:Idle state description 159
5.11.8.4.2 Transition PC2:Idle to PC4:Active_Wait 160
5.11.8.4.3 Transition PC2:Idle to PC5:Wait_Idle 160
5.11.8.4.4 Transition PC2:Idle to PC6:Wait_Standby 160
5.11.8.5 PC3:Standby state 160
5.11.8.5.1 PC3:Standby state description 160
5.11.8.5.2 Transition PC3:Standby to PC4:Active_Wait 161
5.11.8.5.3 Transition PC3:Standby to PC6:Wait_Standby 161
5.11.8.6 PC4:Active_Wait state 161
5.11.8.6.1 PC4:Active_Wait state description 161
5.11.8.6.2 Transition PC4:Active_Wait to PC1:Active 162
5.11.8.7 PC5:Wait_Idle state 162
5.11.8.7.1 PC5:Wait_Idle state description 162
5.11.8.7.2 Transition PC5:Wait_Idle to PC2:Idle 162
5.11.8.8 PC6:Wait_Standby state 163
5.11.8.8.1 PC6:Wait_Standby state description 163
5.11.8.8.2 Transition PC6:Wait_Standby to PC3:Standby 163

5.12 Reservations 163
5.12.1 Persistent Reservations overview 163
5.12.2 Third party persistent reservations 168
5.12.3 Exceptions to SPC-2 RESERVE and RELEASE behavior 168
5.12.4 Persistent reservations interactions with IKEv2-SCSI SA creation 169
5.12.5 Preserving persistent reservations and registrations 169
5.12.5.1 Requirements for preserving persistent reservations and registrations 169
5.12.5.2 Preserving persistent reservations and registrations through power loss 169
5.12.5.3 Nonvolatile memory considerations for preserving persistent reservations and registrations 170
5.12.5.4 Loss of persistent reservation information 170
5.12.5.4.1 Loss of persistent reservation information overview 170
5.12.5.4.2 Recoverable loss of persistent reservation information 170
5.12.5.4.3 Unrecoverable loss of persistent reservation information overview 171
5.12.6 Finding persistent reservations and reservation keys 171
5.12.6.1 Summary of commands for finding persistent reservations and reservation keys 171
5.12.6.2 Reporting reservation keys 171
5.12.6.3 Reporting the persistent reservation 171
5.12.6.4 Reporting full status 172
5.12.7 Registering 172
5.12.8 Registering and moving the reservation 176
5.12.9 Reserving 177
5.12.10 Persistent reservation holder 178
5.12.11 Releasing persistent reservations and removing registrations 178
5.12.11.1 Releasing persistent reservations, removing registrations, and lost reservation information 178
5.12.11.2 Service actions that release persistent reservations and remove registrations 179
5.12.11.2.1 Service actions that release persistent reservations and remove registrations overview 179
5.12.11.2.2 Releasing 180
5.12.11.2.3 Unregistering 180
5.12.11.2.4 Preempting 182
5.12.11.2.4.1 Commands that preempt reservations 182
5.12.11.2.4.2 Failed persistent reservation preempt 184
5.12.11.2.4.3 Preempting persistent reservations and registration handling 184
5.12.11.2.5 Removing registrations 185
5.12.11.2.6 Preempting and aborting 185
5.12.11.2.7 Clearing 186
5.12.11.3 Replacing lost reservations 187
5.13 Security features 188
5.13.1 Security goals and threat model 188
5.13.1.1 Introduction 188
5.13.1.2 Security goals 188
5.13.1.3 Threat model 189
5.13.1.4 Types of attacks 189
5.13.1.5 SCSI security considerations 190
5.13.2 Security associations 190
5.13.2.1 Principles of SAs 190
5.13.2.2 SA parameters 192
5.13.2.3 Creating an SA 194
5.13.3 Key derivation functions 195
5.13.3.1 KDFs overview 195
5.13.3.2 IKEv2-based iterative KDF 195
5.13.3.3 HMAC-based KDFs 196
5.13.3.4 AES-XCBC-PRF-128 IKEv2-based iterative KDF 197
5.13.4 Using IKEv2-SCSI to create an SA 198
5.13.4.1 Overview 198
5.13.4.2 IKEv2-SCSI Protocol summary 201
5.13.4.3 IKEv2-SCSI Authentication 204
5.13.4.3.1 Overview 204

5.13.4.3.2 Pre-shared key authentication 205
5.13.4.3.3 Digital signature authentication 205
5.13.4.3.3.1 Overview 205
5.13.4.3.3.2 Certificates and digital signature authentication 206
5.13.4.3.3.3 Example of certificate use for digital signature authentication 206
5.13.4.3.3.4 Handling of the Certificate Request payload and the Certificate payload 207
5.13.4.3.4 Constraints on skipping the Authentication step 207
5.13.4.4 Summary of IKEv2-SCSI shared keys nomenclature and shared key sizes 209
5.13.4.5 Device Server Capabilities step 210
5.13.4.6 IKEv2-SCSI Key Exchange step 212
5.13.4.6.1 Overview 212
5.13.4.6.2 Key Exchange step SECURITY PROTOCOL OUT command 212
5.13.4.6.3 Key Exchange step SECURITY PROTOCOL IN command 213
5.13.4.6.4 Key Exchange step completion 214
5.13.4.6.5 After the Key Exchange step 214
5.13.4.7 IKEv2-SCSI Authentication step 214
5.13.4.7.1 Overview 214
5.13.4.7.2 Authentication step SECURITY PROTOCOL OUT command 215
5.13.4.7.3 Authentication step SECURITY PROTOCOL IN command 216
5.13.4.8 Generating shared keys 217
5.13.4.8.1 Overview 217
5.13.4.8.2 Generating shared keys when the Authentication step is skipped 218
5.13.4.8.3 Generating shared keys when the Authentication step is processed 218
5.13.4.8.4 Initializing shared key generation 218
5.13.4.8.4.1 Initializing for SA creation shared key generation 218
5.13.4.8.4.2 Initializing for generation of shared keys used by the created SA 219
5.13.4.8.5 Generating shared keys used for SA management 219
5.13.4.8.6 Generating shared keys for use by the created SA 220
5.13.4.9 IKEv2-SCSI SA generation 221
5.13.4.10 Abandoning an IKEv2-SCSI CCS 222
5.13.4.11 Deleting an IKEv2-SCSI SA 223
5.13.5 Security progress indication 223
5.13.6 Command security 224
5.13.6.1 Overview 224
5.13.6.2 Secure CDB Originator class 224
5.13.6.3 Secure CDB Processor class 224
5.13.6.4 Enforcement Manager class 225
5.13.6.5 Security Manager class 225
5.13.6.6 The relationship between SAs and command security 226
5.13.6.7 Capability-based command security technique 226
5.13.6.7.1 Overview 226
5.13.6.7.2 Security Manager class 229
5.13.6.7.3 CbCS Management Device Server class 230
5.13.6.7.3.1 CbCS Management Device Server class overview 230
5.13.6.7.3.2 Decision Database attribute 230
5.13.6.7.4 CbCS Management Application Client class 230
5.13.6.7.5 Secure CDB Originator class 230
5.13.6.7.6 Secure CDB Processor class 230
5.13.6.7.7 Enforcement Manager class 231
5.13.6.7.8 CbCS methods 232
5.13.6.7.8.1 Overview 232
5.13.6.7.8.2 The BASIC CbCS method 232
5.13.6.7.8.3 The CAPKEY CbCS method 233
5.13.6.7.9 CbCS trust assumptions 233
5.13.6.7.10 CbCS security tokens 234
5.13.6.7.11 CbCS shared keys 235
5.13.6.7.11.1 Overview 235

5.13.6.7.11.2 CbCS shared key identifiers 236
5.13.6.7.11.3 Specifying which CbCS shared key to change 236
5.13.6.7.11.4 Updating a CbCS master key 237
5.13.6.7.11.5 Changing a CbCS working keys 237
5.13.6.7.12 CbCS credentials 237
5.13.6.7.12.1 Overview 237
5.13.6.7.12.2 CbCS capability key computations for the secure CDB originator 238
5.13.6.7.12.3 CbCS capability key computations for general use 238
5.13.6.7.13 CbCS capability descriptors 239
5.13.6.7.13.1 Overview 239
5.13.6.7.13.2 CbCS extension descriptor validation 239
5.13.6.7.13.3 CAPKEY CbCS method capability integrity validation 240
5.13.6.7.14 Association between commands and permission bits 241
5.13.6.7.15 CbCS parameters 244
5.13.6.7.15.1 Overview 244
5.13.6.7.16 CbCS extension descriptor format 246
5.13.7 ESP-SCSI encapsulations for parameter data 247
5.13.7.1 Overview 247
5.13.7.2 ESP-SCSI required inputs 247
5.13.7.3 ESP-SCSI data format before encryption and after decryption 248
5.13.7.4 ESP-SCSI outbound data descriptors 249
5.13.7.4.1 Overview 249
5.13.7.4.2 ESP-SCSI CDBs or Data-Out Buffer parameter lists including a descriptor length 250
5.13.7.4.2.1 Initialization vector absent 250
5.13.7.4.2.2 Initialization vector present 252
5.13.7.4.3 ESP-SCSI Data-Out Buffer parameter lists for externally specified descriptor length 253
5.13.7.4.3.1 Initialization vector absent 253
5.13.7.4.3.2 Initialization vector present 254
5.13.7.5 ESP-SCSI Data-In Buffer parameter data descriptors 254
5.13.7.5.1 Overview 254
5.13.7.5.2 ESP-SCSI Data-In Buffer parameter data including a descriptor length 255
5.13.7.5.2.1 Initialization vector absent 255
5.13.7.5.2.2 Initialization vector present 257
5.13.7.5.3 ESP-SCSI Data-In Buffer parameter data for externally specified descriptor length 258
5.13.7.5.3.1 Initialization vector absent 258
5.13.7.5.3.2 Initialization vector present 259
5.13.8 Security algorithm codes 260
5.14 Self-test operations 261
5.14.1 Self-test types 261
5.14.2 Default self-test 262
5.14.3 The short self-test and extended self-test 262
5.14.4 Self-test modes 263
5.14.4.1 Self-test modes overview 263
5.14.4.2 Foreground mode 263
5.14.4.3 Background mode 263
5.14.4.4 Features common to foreground and background self-test modes 264
5.15 Target port group asymmetric access states 267
5.15.1 Target port group access overview 267
5.15.2 Asymmetric logical unit access 267
5.15.2.1 Introduction to asymmetric logical unit access 267
5.15.2.2 Explicit and implicit asymmetric logical unit access 268
5.15.2.3 Discovery of asymmetric logical unit access behavior 268
5.15.2.4 Target port asymmetric access states 269
5.15.2.4.1 Target port asymmetric access states overview 269
5.15.2.4.2 Active/optimized state 269
5.15.2.4.3 Active/non-optimized state 269
5.15.2.4.4 Standby state 269

5.15.2.4.5 Unavailable state 270
5.15.2.4.6 Offline state 271
5.15.2.4.7 Logical block dependent state 271
5.15.2.5 Transitions between target port asymmetric access states 271
5.15.2.6 Preference indicator 272
5.15.2.7 Target port asymmetric access state reporting 272
5.15.2.8 Implicit asymmetric logical units access management 273
5.15.2.9 Explicit asymmetric logical units access management 273
5.15.2.10 Behavior after power on, hard reset, logical unit reset, and I_T nexus loss 274
5.15.2.11 Behavior of target ports that are not accessible from the service delivery subsystem 274
5.15.3 Symmetric logical unit access 274
5.16 Third-party copies 274
5.16.1 General considerations for third-party copies 274
5.16.2 Copy manager model 275
5.16.3 Third-party copy commands 278
5.16.4 Third-party copy command usage 279
5.16.4.1 Prior to sending a third-party copy command 279
5.16.4.2 List identifiers for third-party copy commands 280
5.16.4.3 Third-party copy commands and operations 280
5.16.4.4 Monitoring progress of and retrieving results from third-party copy commands 281
5.16.4.5 Held data 282
5.16.4.6 Aborting third-party copy commands and copy operations 283
5.16.4.7 The COPY OPERATION ABORT command 283
5.16.5 Responses to the conditions that result from SCSI events 284
5.16.6 RODs and ROD tokens 284
5.16.6.1 RODs and ROD related tokens overview 284
5.16.6.2 ROD types 285
5.16.6.2.1 ROD types overview 285
5.16.6.2.2 Access upon reference type RODs 285
5.16.6.2.3 Point in time copy RODs 286
5.16.6.2.3.1 Point in time copy RODs overview 286
5.16.6.2.3.2 Point in time copy – default type RODs 286
5.16.6.2.3.3 Point in time copy – change vulnerable type RODs 286
5.16.6.2.3.4 Point in time copy – persistent type RODs 286
5.16.6.2.3.5 Point in time copy – any type RODs 286
5.16.6.3 Populating a ROD or ROD token 287
5.16.6.4 ROD token format 288
5.16.6.5 Generic ROD tokens 290
5.16.6.5.1 Generic ROD token format 290
5.16.6.5.2 Validating generic ROD tokens 292
5.16.6.5.2.1 Overview of validating generic ROD tokens 292
5.16.6.5.2.2 Inexact validation of generic ROD tokens 293
5.16.6.5.2.3 Validation errors for generic ROD tokens 293
5.16.6.6 ROD token usage 295
5.16.6.7 ROD token lifetime 296
5.16.7 The EXTENDED COPY command 297
5.16.7.1 EXTENDED COPY parameter list 297
5.16.7.2 EXTENDED COPY command processing 297
5.16.7.3 EXTENDED COPY command errors detected before segment descriptor processing starts 302
5.16.7.4 EXTENDED COPY command errors detected during processing of segment descriptors 302
5.16.7.5 EXTENDED COPY considerations for RODs and ROD tokens 304
5.16.7.5.1 EXTENDED COPY command CSCD ROD identifiers 304
5.16.7.5.2 Populating an EXTENDED COPY command ROD 305
5.16.7.6 EXTENDED COPY command use of RODs when the peripheral device type is 00h (i.e., block device) 306
5.16.7.7 EXTENDED COPY command interactions with aliases 306

6 Commands for all device types 307
6.1 Summary of commands for all device types 307
6.2 CHANGE ALIASES command 309
6.2.1 CHANGE ALIASES command introduction 309
6.2.2 Alias entry format 311
6.2.3 Alias designation validation 312
6.2.4 Alias entry protocol independent designations 312
6.2.4.1 Alias entry protocol independent designations overview 312
6.2.4.2 NULL DESIGNATION alias format 312
6.3 COPY OPERATION ABORT command 313
6.4 EXTENDED COPY(LID4) command 313
6.4.1 EXTENDED COPY(LID4) command introduction 313
6.4.2 EXTENDED COPY(LID4) parameter data 315
6.4.3 Shared EXTENDED COPY parameter list fields 317
6.4.3.1 STR bit 317
6.4.3.2 LIST IDENTIFIER field and LIST ID USAGE field 318
6.4.3.3 PRIORITY field 320
6.4.3.4 CSCD DESCRIPTOR LIST LENGTH field and CSCD descriptor list 320
6.4.3.5 SEGMENT DESCRIPTOR LIST LENGTH field and segment descriptor list 320
6.4.3.6 INLINE DATA LENGTH field and inline data 321
6.4.4 Descriptor type codes 321
6.4.5 CSCD descriptors 322
6.4.5.1 CSCD descriptors introduction 322
6.4.5.2 The CSCD descriptor extension 324
6.4.5.3 Device type specific CSCD descriptor parameters for block device types 325
6.4.5.4 Device type specific CSCD descriptor parameters for sequential-access device types 326
6.4.5.5 Device type specific CSCD descriptor parameters for processor device types 327
6.4.5.6 Identification Descriptor CSCD descriptor format 328
6.4.5.7 Alias CSCD descriptor format 329
6.4.5.8 IP Copy Service CSCD descriptor 330
6.4.5.9 ROD CSCD descriptor 332
6.4.6 Segment descriptors 337
6.4.6.1 Segment descriptors introduction 337
6.4.6.2 Block device to stream device functions 340
6.4.6.3 Stream device to block device functions 342
6.4.6.4 Block device to block device functions 343
6.4.6.5 Stream device to stream device functions 345
6.4.6.6 Inline data to stream device function 346
6.4.6.7 Embedded data to stream device function 348
6.4.6.8 Stream device to discard functions 349
6.4.6.9 Verify CSCD function 350
6.4.6.10 Block device with offset to stream device function 352
6.4.6.11 Stream device to block device with offset function 353
6.4.6.12 Block device with offset to block device with offset function 355
6.4.6.13 Write filemarks function 356
6.4.6.14 Space function 357
6.4.6.15 Locate function 358
6.4.6.16 Tape device image copy function 359
6.4.6.17 Register persistent reservation key function 360
6.4.6.18 Third party persistent reservations source I_T nexus function 361
6.4.6.19 Block device image copy function 362
6.4.6.20 Populate a ROD from one or more block ranges function 364
6.4.6.21 Populate a ROD from one block range function 366
6.5 EXTENDED COPY(LID1) command 367
6.6 INQUIRY command 370
6.6.1 INQUIRY command introduction 370
6.6.2 Standard INQUIRY data 371

6.6.3 SCSI Parallel Interface specific INQUIRY data 387
6.7 LOG SELECT command 389
6.7.1 Introduction 389
6.7.2 Processing LOG SELECT when the parameter list length is zero 391
6.8 LOG SENSE command 394
6.9 MANAGEMENT PROTOCOL IN command 396
6.9.1 MANAGEMENT PROTOCOL IN command description 396
6.9.2 Management protocol information description 397
6.9.2.1 Overview 397
6.9.2.2 CDB description 397
6.9.2.3 Supported management protocols list description 398
6.10 MANAGEMENT PROTOCOL OUT command 399
6.11 MODE SELECT(6) command 400
6.12 MODE SELECT(10) command 402
6.13 MODE SENSE(6) command 403
6.13.1 MODE SENSE(6) command introduction 403
6.13.2 Current values 404
6.13.3 Changeable values 405
6.13.4 Default values 405
6.13.5 Saved values 405
6.13.6 Initial responses 405
6.14 MODE SENSE(10) command 406
6.15 PERSISTENT RESERVE IN command 407
6.15.1 PERSISTENT RESERVE IN command introduction 407
6.15.2 READ KEYS service action 408
6.15.3 READ RESERVATION service action 408
6.15.3.1 READ RESERVATION service action operation 408
6.15.3.2 Persistent reservations scope 410
6.15.3.3 Persistent reservations type 411
6.15.4 REPORT CAPABILITIES service action 412
6.15.5 READ FULL STATUS service action 416
6.16 PERSISTENT RESERVE OUT command 418
6.16.1 PERSISTENT RESERVE OUT command introduction 418
6.16.2 PERSISTENT RESERVE OUT service actions and parameter list formats 420
6.16.3 Basic PERSISTENT RESERVE OUT parameter list 423
6.16.4 Parameter list for the PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action 426
6.17 READ ATTRIBUTE command 428
6.17.1 READ ATTRIBUTE command introduction 428
6.17.2 ATTRIBUTE VALUES service action 430
6.17.3 ATTRIBUTE LIST service action 431
6.17.4 LOGICAL VOLUME LIST service action 431
6.17.5 PARTITION LIST service action 432
6.17.6 SUPPORTED ATTRIBUTES service action 432
6.18 READ BUFFER command 433
6.18.1 READ BUFFER command introduction 433
6.18.2 Vendor specific mode (01h) 434
6.18.3 Data mode (02h) 434
6.18.4 Descriptor mode (03h) 435
6.18.5 Read data from echo buffer mode (0Ah) 436
6.18.6 Echo buffer descriptor mode (0Bh) 436
6.18.7 Error history mode (1Ch) 437
6.18.7.1 Error history overview 437
6.18.7.2 Error history directory 438
6.18.7.3 Error history data buffer 441
6.18.7.4 Clear error history I_T nexus 441
6.18.7.5 Clear error history I_T nexus and release snapshot 441

6.19 READ MEDIA SERIAL NUMBER command 442
6.20 RECEIVE COPY DATA(LID4) command 443
6.21 RECEIVE COPY DATA(LID1) command 445
6.22 RECEIVE COPY OPERATING PARAMETERS command 446
6.23 RECEIVE COPY FAILURE DETAILS(LID1) command 450
6.24 RECEIVE COPY STATUS(LID4) command 452
6.25 RECEIVE COPY STATUS(LID1) command 456
6.26 RECEIVE CREDENTIAL command 458
6.26.1 RECEIVE CREDENTIAL command description 458
6.26.1.1 Overview 458
6.26.1.2 CbCS logical unit credential request descriptor 460
6.26.1.3 CbCS logical unit and volume credential request descriptor 460
6.26.2 RECEIVE CREDENTIAL parameter data 461
6.26.2.1 RECEIVE CREDENTIAL parameter data encryption 461
6.26.2.2 RECEIVE CREDENTIAL decrypted parameter data 461
6.26.2.3 CbCS capability descriptor 462
6.26.2.3.1 Overview 462
6.26.2.3.2 Logical unit designation descriptor format 465
6.26.2.3.3 Volume designation descriptors 465
6.27 RECEIVE DIAGNOSTIC RESULTS command 466
6.28 RECEIVE ROD TOKEN INFORMATION command 467
6.29 REMOVE I_T NEXUS command 470
6.30 REPORT ALIASES command 472
6.31 REPORT ALL ROD TOKENS command 474
6.32 REPORT IDENTIFYING INFORMATION command 475
6.32.1 REPORT IDENTIFYING INFORMATION command overview 475
6.32.2 Peripheral device identifying information parameter data 477
6.32.3 Identifying information supported parameter data 477
6.33 REPORT LUNS command 478
6.34 REPORT PRIORITY command 481
6.35 REPORT SUPPORTED OPERATION CODES command 483
6.35.1 REPORT SUPPORTED OPERATION CODES command introduction 483
6.35.2 All_commands parameter data format 485
6.35.3 One_command parameter data format 486
6.35.4 Command timeouts descriptor 487
6.35.4.1 Overview 487
6.35.4.2 WRITE BUFFER command timeouts descriptor COMMAND SPECIFIC field usage 488
6.36 REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command 489
6.37 REPORT TARGET PORT GROUPS command 493
6.38 REPORT TIMESTAMP command 498
6.39 REQUEST SENSE command 499
6.40 SECURITY PROTOCOL IN command 501
6.41 SECURITY PROTOCOL OUT command 503
6.42 SEND DIAGNOSTIC command 505
6.43 SET IDENTIFYING INFORMATION command 511
6.44 SET PRIORITY command 513
6.45 SET TARGET PORT GROUPS command 515
6.46 SET TIMESTAMP command 519
6.47 TEST UNIT READY command 520
6.48 WRITE ATTRIBUTE command 522
6.49 WRITE BUFFER command 524
6.49.1 WRITE BUFFER command introduction 524
6.49.2 Vendor specific mode (01h) 525
6.49.3 Data mode (02h) 526
6.49.4 Download microcode and activate mode (04h) 526
6.49.5 Download microcode, save, and activate mode (05h) 526
6.49.6 Download microcode with offsets and activate mode (06h) 526

6.49.7 Download microcode with offsets, save, and activate mode (07h) 527
6.49.8 Write data to echo buffer mode (0Ah) 527
6.49.9 Download microcode with offsets, select activation, save, and defer activate mode (0Dh) 527
6.49.10 Download microcode with offsets, save, and defer activate mode (0Eh) 528
6.49.11 Activate deferred microcode mode (0Fh) 528
6.49.12 Download application client error history mode (1Ch) 529

7 Parameters for all device types 533
7.1 Overview 533
7.2 Diagnostic parameters 533
7.2.1 Summary of diagnostic page codes 533
7.2.2 Diagnostic page format for all device types 533
7.2.3 Protocol Specific diagnostic page 535
7.2.4 Supported Diagnostic Pages diagnostic page 535
7.3 Log parameters 537
7.3.1 Summary of log page codes 537
7.3.2 Log page structure and log parameter structure for all device types 538
7.3.2.1 Log page structure 538
7.3.2.2 Log parameter structure 540
7.3.2.2.1 Introduction 540
7.3.2.2.2 Parameter control byte 541
7.3.2.2.2.1 Introduction 541
7.3.2.2.2.2 Parameter control byte values for bounded data counter parameters 543
7.3.2.2.2.3 Parameter control byte values for unbounded data counter parameters 544
7.3.2.2.2.4 Parameter control byte values for ASCII format list log parameters 545
7.3.2.2.2.5 Parameter control byte values for binary format list log parameters 546
7.3.3 Resetting and setting log parameters 547
7.3.4 Application Client log page 547
7.3.4.1 Overview 547
7.3.4.2 General Usage Application Client log parameter 548
7.3.5 Buffer Over-Run/Under-Run log page 549
7.3.5.1 Overview 549
7.3.5.2 Buffer Over-run/Under-run log parameter 551
7.3.6 Cache Memory Statistics log page 552
7.3.6.1 Overview 552
7.3.6.2 Read Cache Memory Hits log parameter 553
7.3.6.3 Reads To Cache Memory log parameter 554
7.3.6.4 Write Cache Memory Hits log parameter 555
7.3.6.5 Writes From Cache Memory log parameter 556
7.3.6.6 Time From Last Hard Reset log parameter 557
7.3.6.7 Time Interval log parameter 558
7.3.7 General Statistics and Performance log pages 559
7.3.7.1 Overview 559
7.3.7.2 General Access Statistics and Performance log parameter 561
7.3.7.3 Idle Time log parameter 563
7.3.7.4 Force Unit Access Statistics and Performance log parameter 564
7.3.8 Group Statistics and Performance (n) log pages 565
7.3.8.1 Overview 565
7.3.8.2 Group n Statistics and Performance log parameter 568
7.3.8.3 Group n Force Unit Access Statistics and Performance log parameter 569
7.3.9 Informational Exceptions log page 571
7.3.9.1 Overview 571
7.3.9.2 Informational Exceptions General log parameter 572
7.3.10 Last n Deferred Errors or Asynchronous Events log page 573
7.3.10.1 Overview 573
7.3.10.2 Deferred Error or Asynchronous Event log parameters 574
7.3.11 Last n Error Events log page 575

7.3.11.1 Overview 575
7.3.11.2 Error Event log parameters 576
7.3.12 Non-Medium Error log page 576
7.3.12.1 Overview 576
7.3.12.2 Non-Medium Error Count log parameter 577
7.3.13 Power Condition Transitions log page 578
7.3.13.1 Overview 578
7.3.13.2 Accumulated Transitions log parameter 579
7.3.14 Protocol Specific Port log page 580
7.3.14.1 Overview 580
7.3.14.2 Generic protocol specific port log parameter 581
7.3.15 Read Error Counters log page 582
7.3.15.1 Overview 582
7.3.15.2 Read Error Counter log parameter 583
7.3.16 Read Reverse Error Counters log page 584
7.3.16.1 Overview 584
7.3.16.2 Read Reverse Error Counter log parameter 585
7.3.17 Self-Test Results log page 586
7.3.17.1 Overview 586
7.3.17.2 Self-Test Results log parameters 588
7.3.18 Start-Stop Cycle Counter log page 590
7.3.18.1 Overview 590
7.3.18.2 Date of Manufacture log parameter 591
7.3.18.3 Accounting Date log parameter 592
7.3.18.4 Specified Cycle Count Over Device Lifetime log parameter 593
7.3.18.5 Accumulated Start-Stop Cycles log parameter 593
7.3.18.6 Specified Load-Unload Count Over Device Lifetime log parameter 594
7.3.18.7 Accumulated Load-Unload Cycles log parameter 595
7.3.19 Supported Log Pages log page 596
7.3.20 Supported Log Pages and Subpages log page 597
7.3.21 Supported Subpages log page 598
7.3.22 Temperature log page 599
7.3.22.1 Overview 599
7.3.22.2 Temperature log parameter 600
7.3.22.3 Reference Temperature log parameter 600
7.3.23 Verify Error Counters log page 601
7.3.23.1 Overview 601
7.3.23.2 Verify Error Counter log parameter 602
7.3.24 Write Error Counters log page 603
7.3.24.1 Overview 603
7.3.24.2 Write Error Counter log parameter 604
7.4 Medium auxiliary memory attributes 606
7.4.1 Attribute format 606
7.4.2 Attribute identifier values 607
7.4.2.1 Attribute identifier values overview 607
7.4.2.2 Device type attributes 607
7.4.2.2.1 REMAINING CAPACITY IN PARTITION and MAXIMUM CAPACITY IN PARTITION 608
7.4.2.2.2 LOAD COUNT 608
7.4.2.2.3 MAM SPACE REMAINING 608
7.4.2.2.4 INITIALIZATION COUNT 609
7.4.2.2.5 VOLUME IDENTIFIER 609
7.4.2.2.6 DEVICE VENDOR/SERIAL NUMBER AT LAST LOAD, DEVICE VENDOR/SERIAL NUMBER AT LOAD –1, DEVICE VENDOR/SERIAL NUMBER AT LOAD –2 and DEVICE VENDOR/SERIAL NUMBER AT LOAD –3 609
7.4.2.2.7 TOTAL MEBIBYTES WRITTEN IN MEDIUM LIFE and TOTAL MEBIBYTES READ IN MEDIUM LIFE 609
7.4.2.2.8 TOTAL MEBIBYTES WRITTEN IN CURRENT/LAST LOAD and TOTAL MEBIBYTES

READ IN CURRENT/LAST LOAD 609
7.4.2.2.9 LOGICAL POSITION OF FIRST ENCRYPTED BLOCK 610
7.4.2.2.10 LOGICAL POSITION OF FIRST UNENCRYPTED BLOCK AFTER THE FIRST ENCRYPTED BLOCK 610
7.4.2.2.11 MEDIUM USAGE HISTORY 610
7.4.2.2.12 PARTITION USAGE HISTORY 613
7.4.2.3 Medium type attributes 615
7.4.2.3.1 MEDIUM MANUFACTURER 615
7.4.2.3.2 MEDIUM SERIAL NUMBER 615
7.4.2.3.3 MEDIUM MANUFACTURE DATE 615
7.4.2.3.4 MAM CAPACITY 616
7.4.2.3.5 MEDIUM TYPE and MEDIUM TYPE INFORMATION 616
7.4.2.3.6 NUMERIC MEDIUM SERIAL NUMBER 616
7.4.2.4 Host type attributes 617
7.4.2.4.1 APPLICATION VENDOR 617
7.4.2.4.2 APPLICATION NAME 617
7.4.2.4.3 APPLICATION VERSION 617
7.4.2.4.4 USER MEDIUM TEXT LABEL 617
7.4.2.4.5 DATE & TIME LAST WRITTEN 618
7.4.2.4.6 TEXT LOCALIZATION IDENTIFIER 618
7.4.2.4.7 BARCODE 618
7.4.2.4.8 OWNING HOST TEXTUAL NAME 618
7.4.2.4.9 MEDIA POOL 618
7.4.2.4.10 PARTITION USER TEXT LABEL 618
7.4.2.4.11 LOAD/UNLOAD AT PARTITION 618
7.4.2.4.12 APPLICATION FORMAT VERSION 619
7.5 Mode parameters 620
7.5.1 Summary of mode page codes 620
7.5.2 Mode page policies 620
7.5.3 Mode parameters overview 621
7.5.4 Mode parameter list format 621
7.5.5 Mode parameter header formats 621
7.5.6 Mode parameter block descriptor formats 623
7.5.6.1 General block descriptor format 623
7.5.7 Mode page and subpage formats and page codes 624
7.5.8 Control mode page 625
7.5.9 Control Extension mode page 630
7.5.10 Disconnect-Reconnect mode page 631
7.5.11 Extended mode page 634
7.5.12 Extended Device-Type Specific mode page 634
7.5.13 Power Condition mode page 635
7.5.14 Power Consumption mode page 640
7.5.15 Protocol Specific Logical Unit mode page 640
7.5.16 Protocol Specific Port mode page 641
7.6 Protocol specific parameters 643
7.6.1 Protocol specific parameters introduction 643
7.6.2 Alias entry protocol specific designations 643
7.6.2.1 Introduction to alias entry protocol specific designations 643
7.6.2.2 Fibre Channel specific alias entry formats 643
7.6.2.2.1 Summary of Fibre Channel specific alias entry formats 643
7.6.2.2.2 Fibre Channel world wide port name alias entry format 644
7.6.2.2.3 Fibre Channel world wide port name with N_Port checking alias entry format 645
7.6.2.3 RDMA specific alias entry formats 646
7.6.2.3.1 Summary of RDMA specific alias entry formats 646
7.6.2.3.2 RDMA target port identifier alias entry format 646
7.6.2.3.3 InfiniBand global identifier with target port identifier checking alias entry format 647
7.6.2.4 Internet SCSI specific alias entry formats 648

7.6.2.4.1 Summary of Internet SCSI specific alias entry formats 648
7.6.2.4.2 iSCSI name alias entry format 649
7.6.2.4.3 iSCSI name with binary IPv4 address alias entry format 650
7.6.2.4.4 iSCSI name with IPname alias entry format 652
7.6.2.4.5 iSCSI name with binary IPv6 address alias entry format 654
7.6.3 EXTENDED COPY protocol specific CSCD descriptors 655
7.6.3.1 Introduction to EXTENDED COPY protocol specific CSCD descriptors 655
7.6.3.2 Fibre Channel N_Port_Name CSCD descriptor format 655
7.6.3.3 Fibre Channel N_Port_ID CSCD descriptor format 656
7.6.3.4 Fibre Channel N_Port_ID With N_Port_Name Checking CSCD descriptor format 657
7.6.3.5 SCSI Parallel T_L CSCD descriptor format 658
7.6.3.6 IEEE 1394 EUI-64 CSCD descriptor format 659
7.6.3.7 RDMA CSCD descriptor format 660
7.6.3.8 iSCSI IPv4 CSCD descriptor format 661
7.6.3.9 iSCSI IPv6 CSCD descriptor format 662
7.6.3.10 SAS Serial SCSI Protocol CSCD descriptor format 663
7.6.4 TransportID identifiers 664
7.6.4.1 Overview of TransportID identifiers 664
7.6.4.2 TransportID for initiator ports using SCSI over Fibre Channel 665
7.6.4.3 TransportID for initiator ports using a parallel SCSI bus 665
7.6.4.4 TransportID for initiator ports using SCSI over IEEE 1394 666
7.6.4.5 TransportID for initiator ports using SCSI over an RDMA interface 666
7.6.4.6 TransportID for initiator ports using SCSI over iSCSI 667
7.6.4.7 TransportID for initiator ports using SCSI over SAS Serial SCSI Protocol 669
7.6.4.8 TransportID for initiator ports using SCSI over PCI Express 669
7.7 Security protocol parameters 670
7.7.1 Security protocol information description 670
7.7.1.1 Overview 670
7.7.1.2 CDB description 670
7.7.1.3 Supported security protocols list description 671
7.7.1.4 Certificate data description 672
7.7.1.4.1 Certificate overview 672
7.7.1.4.2 Public Key certificate description 672
7.7.1.4.3 Attribute certificate description 672
7.7.1.5 Security compliance information description 673
7.7.1.5.1 Security compliance information overview 673
7.7.1.5.2 Compliance descriptor overview 674
7.7.1.5.3 FIPS 140 compliance descriptor 675
7.7.2 SA creation capabilities 676
7.7.2.1 Overview 676
7.7.2.2 SA creation capabilities CDB description 676
7.7.2.3 SA creation capabilities parameter data formats 677
7.7.2.3.1 Supported device server capabilities formats parameter data format 677
7.7.2.3.2 IKEv2-SCSI device server capabilities parameter data format 677
7.7.3 IKEv2-SCSI 678
7.7.3.1 Overview 678
7.7.3.2 IKEv2-SCSI SECURITY PROTOCOL IN CDB description 678
7.7.3.3 IKEv2-SCSI SECURITY PROTOCOL OUT CDB description 679
7.7.3.4 IKEv2-SCSI parameter data format 680
7.7.3.5 IKEv2-SCSI payloads 687
7.7.3.5.1 IKEv2-SCSI payload format 687
7.7.3.5.2 No Next payload 688
7.7.3.5.3 Key Exchange payload 689
7.7.3.5.4 Identification – Application Client payload and Identification – Device Server payload 690
7.7.3.5.5 Certificate payload 691
7.7.3.5.6 Certificate Request payload 692
7.7.3.5.7 Authentication payload 693

7.7.3.5.8 Nonce payload 695
7.7.3.5.9 Notify payload 696
7.7.3.5.10 Delete payload 697
7.7.3.5.11 Encrypted payload 698
7.7.3.5.11.1 Combined mode encryption 698
7.7.3.5.11.2 Encrypted payload introduction 699
7.7.3.5.11.3 IKEv2-SCSI AAD 701
7.7.3.5.11.4 Processing a received Encrypted payload 702
7.7.3.5.12 IKEv2-SCSI SA Creation Capabilities payload 704
7.7.3.5.13 IKEv2-SCSI SA Cryptographic Algorithms payload 705
7.7.3.5.14 IKEv2-SCSI SAUT Cryptographic Algorithms payload 707
7.7.3.5.15 IKEv2-SCSI Timeout Values payload 708
7.7.3.6 IKEv2-SCSI cryptographic algorithm descriptors 709
7.7.3.6.1 Overview 709
7.7.3.6.2 ENCR IKEv2-SCSI cryptographic algorithm descriptor 711
7.7.3.6.3 PRF IKEv2-SCSI cryptographic algorithm descriptor 713
7.7.3.6.4 INTEG IKEv2-SCSI cryptographic algorithm descriptor 715
7.7.3.6.5 D-H IKEv2-SCSI cryptographic algorithm descriptor 716
7.7.3.6.6 IKEv2-SCSI authentication algorithm IKEv2-SCSI cryptographic algorithm descriptor 718
7.7.3.7 Errors in IKEv2-SCSI security protocol commands 721
7.7.3.8 Errors in IKEv2-SCSI security protocol parameter data 723
7.7.3.8.1 Overview 723
7.7.3.8.2 Errors with high denial of service attack potential 723
7.7.3.8.3 Errors with low denial of service attack potential 724
7.7.3.9 Translating IKEv2 errors 724
7.7.4 CbCS security protocol 725
7.7.4.1 Overview 725
7.7.4.2 CbCS SECURITY PROTOCOL IN CDB description 726
7.7.4.3 CbCS SECURITY PROTOCOL IN parameter data 727
7.7.4.3.1 Supported CbCS SECURITY PROTOCOL IN Pages CbCS page 727
7.7.4.3.2 Supported CbCS SECURITY PROTOCOL OUT pages CbCS page 728
7.7.4.3.3 Unchangeable CbCS Parameters CbCS page 728
7.7.4.3.4 Security Token CbCS page 731
7.7.4.3.5 Current CbCS Parameters CbCS page 731
7.7.4.3.6 Set Master Key – Seed Exchange CbCS page 734
7.7.4.4 CbCS SECURITY PROTOCOL OUT CDB description 736
7.7.4.5 CbCS SECURITY PROTOCOL OUT parameter list 737
7.7.4.5.1 Set Policy Access Tag CbCS page 737
7.7.4.5.2 Set Minimum CbCS Method CbCS page 737
7.7.4.5.3 Invalidate Key CbCS page 738
7.7.4.5.4 Set Key CbCS page 740
7.7.4.5.5 Set Master Key – Seed Exchange CbCS page 741
7.7.4.5.6 Set Master Key – Change Master Key CbCS page 742
7.8 Vital product data parameters 744
7.8.1 Vital product data parameters overview and page codes 744
7.8.2 VPD page format for all device types 745
7.8.3 ASCII Information VPD page 746
7.8.4 CFA Profile Information VPD page 747
7.8.5 Device Constituents VPD page 748
7.8.6 Device Identification VPD page 751
7.8.6.1 Device Identification VPD page overview 751
7.8.6.2 Device designation descriptor requirements 753
7.8.6.2.1 Designation descriptors for logical units other than well known logical units 753
7.8.6.2.2 Designation descriptors for well known logical units 754
7.8.6.2.3 Designation descriptors for SCSI target ports 754
7.8.6.2.3.1 Relative target port identifiers 754
7.8.6.2.3.2 Target port names or identifiers 754

7.8.6.2.4 Designation descriptors for SCSI target devices 754
7.8.6.3 Vendor specific designator format 755
7.8.6.4 T10 vendor ID based designator format 755
7.8.6.5 EUI-64 based designator format 756
7.8.6.5.1 EUI-64 based designator format overview 756
7.8.6.5.2 EUI-64 designator format 756
7.8.6.5.3 EUI-64 based 12-byte designator format 757
7.8.6.5.4 EUI-64 based 16-byte designator format 757
7.8.6.6 NAA designator format 758
7.8.6.6.1 NAA identifier basic format 758
7.8.6.6.2 NAA IEEE Extended designator format 758
7.8.6.6.3 NAA Locally Assigned designator format 759
7.8.6.6.4 NAA IEEE Registered designator format 759
7.8.6.6.5 NAA IEEE Registered Extended designator format 760
7.8.6.7 Relative target port designator format 760
7.8.6.8 Target port group designator format 761
7.8.6.9 Logical unit group designator format 761
7.8.6.10 MD5 logical unit designator format 761
7.8.6.11 SCSI name string designator format 763
7.8.6.12 Protocol specific port identifier designator format 763
7.8.6.12.1 Protocol specific port identifier designator format overview 763
7.8.6.12.2 USB target port identifier designator format 764
7.8.6.12.3 PCI Express routing ID designator format 764
7.8.7 Extended INQUIRY Data VPD page 765
7.8.8 Management Network Addresses VPD page 769
7.8.9 Mode Page Policy VPD page 770
7.8.10 Power Condition VPD page 772
7.8.11 Power Consumption VPD page 773
7.8.12 Protocol Specific Logical Unit Information VPD page 775
7.8.13 Protocol Specific Port Information VPD page 777
7.8.14 SCSI Ports VPD page 778
7.8.15 Software Interface Identification VPD page 781
7.8.16 Supported VPD Pages VPD page 782
7.8.17 Third-party Copy VPD page 782
7.8.17.1 Third-party Copy VPD page overview 782
7.8.17.2 Third-party copy descriptor format 783
7.8.17.3 Third-party copy descriptor type codes 784
7.8.17.4 Supported Commands third-party copy descriptor 785
7.8.17.4.1 Supported Commands third-party copy descriptor overview 785
7.8.17.4.2 Command support descriptor format 786
7.8.17.5 Parameter Data third-party copy descriptor 787
7.8.17.6 Supported Descriptors third-party copy descriptor 788
7.8.17.7 Supported CSCD Descriptor IDs third-party copy descriptor 789
7.8.17.8 ROD Token Features third-party copy descriptor 790
7.8.17.8.1 ROD Token Features third-party copy descriptor overview 790
7.8.17.8.2 Block ROD device type specific features descriptor 792
7.8.17.8.3 Stream ROD token device type features descriptor 794
7.8.17.8.4 Copy manager ROD token device type features descriptor 795
7.8.17.9 Supported ROD Types third-party copy descriptor 796
7.8.17.10 General Copy Operations third-party copy descriptor 798
7.8.17.11 Stream Copy Operations third-party copy descriptor 800
7.8.17.12 Held Data third-party copy descriptor 800
7.8.18 Unit Serial Number VPD page 801

8 Well known logical units 802
8.1 Model for well known logical units 802
8.2 REPORT LUNS well known logical unit 802

8.3 ACCESS CONTROLS well known logical unit 803
8.3.1 Access controls model 803
8.3.1.1 Access controls commands 803
8.3.1.2 Access controls overview 803
8.3.1.3 Access Control List 804
8.3.1.3.1 ACL overview 804
8.3.1.3.2 Access identifiers 805
8.3.1.3.3 Logical Unit Access Control Descriptor 805
8.3.1.4 Managing the ACL 806
8.3.1.4.1 ACL management overview 806
8.3.1.4.2 Authorizing ACL management 806
8.3.1.4.3 Identifying logical units during ACL management 807
8.3.1.4.4 Tracking changes in logical unit identification 807
8.3.1.5 Enrolling AccessIDs 807
8.3.1.5.1 Enrollment states 807
8.3.1.5.1.1 Summary of enrollment states 807
8.3.1.5.1.2 Not-enrolled state 808
8.3.1.5.1.3 Enrolled state 809
8.3.1.5.1.4 Pending-enrolled state 809
8.3.1.5.2 ACL LUN conflict resolution 809
8.3.1.6 Granting and revoking access rights 810
8.3.1.6.1 Non-proxy access rights 810
8.3.1.6.2 Proxy access 810
8.3.1.6.2.1 Proxy tokens 810
8.3.1.6.2.2 Proxy LUNs 811
8.3.1.7 Verifying access rights 811
8.3.1.8 The management identifier key 812
8.3.1.8.1 Management identifier key usage 812
8.3.1.8.2 Overriding the management identifier key 813
8.3.1.8.2.1 The OVERRIDE MGMT ID KEY service action 813
8.3.1.8.2.2 The override lockout timer 813
8.3.1.9 Reporting access control information 814
8.3.1.10 Access controls log 814
8.3.1.11 Interactions of access controls and other features 815
8.3.1.11.1 Task set management and access controls 815
8.3.1.11.2 Existing reservations and ACL changes 816
8.3.1.12 Access controls information persistence and memory usage requirements 816
8.3.1.13 Access identifier formats 818
8.3.1.13.1 Access identifier type 818
8.3.1.13.2 AccessID access identifiers 818
8.3.2 ACCESS CONTROL IN command 818
8.3.2.1 ACCESS CONTROL IN introduction 818
8.3.2.2 REPORT ACL service action 819
8.3.2.2.1 REPORT ACL introduction 819
8.3.2.2.2 REPORT ACL parameter data format 820
8.3.2.2.2.1 REPORT ACL parameter data introduction 820
8.3.2.2.2.2 Granted ACL data page format 821
8.3.2.2.2.3 Granted All ACL data page format 822
8.3.2.2.2.4 Proxy Tokens ACL data page format 824
8.3.2.3 REPORT LU DESCRIPTORS service action 825
8.3.2.3.1 REPORT LU DESCRIPTORS introduction 825
8.3.2.3.2 REPORT LU DESCRIPTORS parameter data format 827
8.3.2.4 REPORT ACCESS CONTROLS LOG service action 831
8.3.2.4.1 REPORT ACCESS CONTROLS LOG introduction 831
8.3.2.4.2 REPORT ACCESS CONTROLS LOG parameter data format 832
8.3.2.4.2.1 REPORT ACCESS CONTROLS LOG parameter data introduction 832
8.3.2.4.2.2 Key Overrides access controls log portion page format 833

8.3.2.4.2.3 Invalid Keys access controls log portion page format 834
8.3.2.4.2.4 ACL LUN Conflicts access controls log portion page format 835
8.3.2.5 REPORT OVERRIDE LOCKOUT TIMER service action 836
8.3.2.6 REQUEST PROXY TOKEN service action 837
8.3.3 ACCESS CONTROL OUT command 839
8.3.3.1 ACCESS CONTROL OUT introduction 839
8.3.3.2 MANAGE ACL service action 840
8.3.3.2.1 MANAGE ACL introduction 840
8.3.3.2.2 The Grant/Revoke ACE page 843
8.3.3.2.3 The Grant All ACE page 846
8.3.3.2.4 The Revoke Proxy Token ACE page 847
8.3.3.2.5 The Revoke All Proxy Tokens ACE page 848
8.3.3.3 DISABLE ACCESS CONTROLS service action 848
8.3.3.4 ACCESS ID ENROLL service action 849
8.3.3.5 CANCEL ENROLLMENT service action 850
8.3.3.6 CLEAR ACCESS CONTROLS LOG service action 850
8.3.3.7 MANAGE OVERRIDE LOCKOUT TIMER service action 851
8.3.3.8 OVERRIDE MGMT ID KEY service action 852
8.3.3.9 REVOKE PROXY TOKEN service action 853
8.3.3.10 REVOKE ALL PROXY TOKENS service action 854
8.3.3.11 ASSIGN PROXY LUN service action 855
8.3.3.12 RELEASE PROXY LUN service action 856
8.4 TARGET LOG PAGES well known logical unit 857
8.5 SECURITY PROTOCOL well known logical unit 857
8.6 MANAGEMENT PROTOCOL well known logical unit 858

9 Security manager command set 859

Annex A (informative) Terminology mapping 860

Annex B (informative) REPORT LUNS command examples 861

Annex C (informative) Replacing RESERVE/RELEASE functionality with PERSISTENT RESERVE IN/OUT equivalents 865
C.1 Introduction 865
C.2 Replacing the reserve/release method with the PERSISTENT RESERVE OUT COMMAND 865
C.3 Third party reservations 866

Annex D (informative) Third-party copy implementation and usage 867
D.1 Embedded and dedicated copy manager implementations 867
D.1.1 Overview 867
D.1.2 Embedded copy manager implementations 867
D.1.3 Dedicated copy manager implementations 867
D.2 Tracking copy operation progress 868
D.2.1 Overview 868
D.2.2 Detecting lack of progress in active copy operations 868

Annex E (informative) Variations between this standard and equivalent security protocols 869
E.1 IKEv2 protocol details and variations for IKEv2-SCSI 869
E.2 ESP protocol details and variations for ESP-SCSI 872

Annex F (informative) Numeric order codes 873
F.1 Numeric order codes introduction 873
F.2 Additional sense codes 873
F.3 Operation codes 891
F.3.1 Operation codes 891
F.3.2 Additional operation codes for devices with the ENCSERV bit set to one 896

F.3.3 MAINTENANCE IN service actions and MAINTENANCE OUT service actions 897
F.3.4 SERVICE ACTION IN service actions and SERVICE ACTION OUT service actions 898
F.3.5 SERVICE ACTION BIDIRECTIONAL service actions 898
F.3.6 Variable length CDB service action codes 899
F.4 Diagnostic page codes 900
F.5 Log page codes 901
F.6 Mode page codes 904
F.7 VPD page codes 907
F.8 ROD type codes 909
F.9 Version descriptor values 910
F.10 T10 IEEE binary identifiers 930

Annex G (informative) T10 vendor identification 931

Bibliography 948