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Information Technology - Small Computer System Interface - Part 381: Optical Memory Card Device Commands (SCSI OMC)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialised system for world-wide standardisation. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organisation to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organisations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 14776-381 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Subcommittee SC 25, Interconnection of information technology equipment, Working Group 4, Interconnection of Computer Systems and Attached Equipment.*

Introduction

This SCSI command set is designed to provide efficient peer-to-peer operation of SCSI devices by an operating system using. The SCSI command set assumes an underlying command-response protocol.

This SCSI command set provides multiple operating systems concurrent control over one or more SCSI devices. However, proper co-ordination of activities between the multiple operating systems is critical to avoid data corruption. Commands that assist with co-ordination between multiple operating systems are described in this standard. However, details of the co-ordination are beyond the scope of the SCSI command set.

This standard defines the device model for the optical memory card devices. This standard defines the SCSI commands that may apply to optical memory card devices.

This standard is divided into six clauses:

Clause 1 is the scope.

Clause 2 lists the normative references that apply to this standard.

Clause 3 describes the definitions, symbols and abbreviations used in this standard.

Clause 4 describes models for optical memory card devices.

Clause 5 provides the definitions of all commands unique to optical memory card devices. This clause also provides references to the ISO/IEC 14776-311 SCSI-3 SPC standard for primary commands and the ISO/IEC 14776-321 SCSI-3 SBC standard for block commands used with optical memory card device class.

Clause 6 provides the definition of all parameters unique to optical memory card devices.

Information technology - Small Computer System Interface - Part 381: SCSI Optical Memory Card Device Commands (SCSI OMC)

1 Scope

This standard defines the command set extensions to facilitate operation of optical memory card devices. The clause(s) of this standard pertaining to optical memory card device class, implemented in conjunction with the applicable clauses of the ISO/IEC 14776-311 SCSI-3 Primary Commands (SPC) and the ISO/IEC 14776-321 SCSI-3 Block Commands (SBC), fully specify the standard command set for optical memory card devices.

2 Normative References

The following standards contain provisions that, through reference in the text, constitute provisions of this International Standard. At the time of publication, the editions indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Member of ISO and IEC maintain registers of currently valid standards.

ISO/IEC 7810:1995	*Identification cards -- Physical characteristics.*
ISO/IEC 9316:1995	*Information technology -- Small Computer System Interface -2.*
ISO/IEC 11694-4:1996	*Identification cards -- Optical memory cards -- Linear recording method – Part 4: Logical data structures.*
ISO/IEC CD 14776-311	*Information technology -- Small Computer System Interface – Part 311: Primary Commands (SCSI-3 SPC).*
ISO/IEC CD 14776-321	*Information technology -- Small Computer System Interface – Part 321: Block Commands (SCSI-3 SBC).*

3 Definitions, Symbols and Conventions

3.1 Definitions

For purposes of this standard, the following definitions apply.

3.1.1
address type
Addressing methods for optical memory card devices. See 4.2.

3.1.2
device-specific
Something (e.g., a bit, field, code value, etc.) that are not defined by this standard and may be defined differently by each device.

3.1.3
ID-1 card
A card whose size is defined in ISO/IEC 7810:1995.

3.1.4
invalid
An illegal or unsupported bit, byte, word, field or code value.

3.1.5
mandatory
The referenced item is required to claim compliance with this International Standard.

3.1.6
obsolete
The referenced item was defined in prior SCSI standards but have been removed from this International Standard.

3.1.7
optional
The referenced item is not required to claim compliance with this International Standard. Implementation of an optional item must be as defined in this International Standard.

3.1.8
partition
The entire usable region for recording and reading in a recording medium or in a portion of a recording medium. If there is more than one partition, they shall be numbered starting with zero.

3.1.9
reserved
Identifies bits, bytes, words, fields and code values that are set aside for future standardisation.

3.1.10
sector
The minimum unit of data that can be accessed on a recording medium for any read and/or write commands.

3.1.11
type of sector
An identifier which distinguishes kind of sectors defined in ISO/IEC 11694-4:1996.

3.1.12
vendor-specific
Something (e.g., a bit, field, code value, etc.) that are not defined by this standard and may be used differently in various implementations by each vendor.

3.2 References to SCSI Standards

The term SCSI is used wherever it is not necessary to distinguish between the versions of SCSI. The Small Computer System Interface -2 (ISO/IEC 9316:1995) is referred to herein as SCSI-2. The set of SCSI-3 standards are collectively referred to as SCSI-3.

3.3 Symbols and abbreviations

SBC:	SCSI-3 Block Commands standard
SCSI:	Either SCSI-2 or SCSI-3
SCSI-2:	Small Computer System Interface-2
SCSI-3:	Small Computer System Interface-3
SPC:	SCSI-3 Primary Commands standard

3.4 Numerical Conventions

Digits 0 to 9 in the text of this standard that are not immediately followed by lower-case ”h” are decimal values. Digits 0 to 9 and upper case letter ”A” to ”F” immediately followed by lower-case ”h” are hexadecimal values.

4 Optical memory card devices

4.1 Model for optical memory card devices

An optical memory card device is a device that supports an ID-1 card size removable optical recording medium. In several respect, an optical memory card device is similar to a direct-access device and an optical memory device.

The sector is the minimum data recording/reproduction unit for optical memory card devices. Optical memory card devices use variable size sectors to optimize storage performance on the medium.

4.2 Address type

There are two address types for optical memory card devices. Address type specifies the value in the logical block address field of the medium access commands and the sense data information field for optical memory card devices.

If the device supports both address types, address types can be selected using the MODE SELECT command by setting an address type (AT) bit of optical memory card device mode parameter header (see SCSI-3 SPC). If the device supports only one address type, the AT bit is a read-only bit and cannot be changed by the MODE SELECT command. In this case, the device specific default address type will be used. The current operating address type of the device can be obtained using the MODE SENSE command.

If the AT bit of mode parameter header is set to zero, the value in the logical block address field of the medium access commands and the sense data information field consist of the partition number and the logical block address in the partition as shown in table 1.

Table 1 - Logical block address field and information field (AT = 0)

Bit / Byte	7	6	5	4	3	2	1	0
n	Partition number							
n+1	(MSB)	Logical block address in the partition						
n+2								
n+3								(LSB)

If the AT bit is set to one, the value in the logical block address field of the medium access commands and the sense data information field consist of the type of sector, the track address and the sector address as shown in table 2.

Table 2 - Logical block address field and information field (AT = 1)

Bit / Byte	7	6	5	4	3	2	1	0
n	Type of sector							
n+1	(MSB)	Track address						
n+2								(LSB)
n+3	Sector address							
Note The commands using the logical block address field for optical memory card devices are the following commands: e.g. READ(10), SEEK(10), WRITE(10), WRITE AND VERIFY, or READ CARD CAPACITY command.								

4.3 Ready state

The conditions to determine logical unit ready is a vender specific. However, ready state means that the logical unit would accept an appropriate medium access command without returning CHECK CONDITION status, and at least both of following two conditions shall be satisfied;

1) a medium in accordance with a logical unit shall be loaded in a logical unit.
2) basic information (e.g. specific track) in a medium shall be sensed.

4.4 Initialisation

The command for medium initialisation is not defined for optical memory card devices.

4.5 Medium defects

The raw defect rate is typically higher for optical medium than magnetic medium. Data is usually recovered though the use of sophisticated error correction algorithms. The level of error correction used for data recovery can be selected. Control of the error correction algorithms and level of correction depends on the type of sector.

4.6 Error reporting

If any of the following conditions occur during the execution of a command the target shall return CHECK CONDITION status. The appropriate sense key and additional sense code should be set. The following list illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Condition	Sense key
Invalid address	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Target reset or medium change since last command from this initiator	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR
Unrecovered read error	MEDIUM ERROR or HARDWARE ERROR
Recovered read error	RECOVERED ERROR
Overrun or other error that might be resolved by repeating the command	ABORTED COMMAND
Attempt to read a blank or previously unwritten block	BLANK CHECK
Attempt to write a previously written block and blank block checking is enabled	BLANK CHECK
Attempt to write on write protected medium	DATA PROTECT

In the case of an invalid address, the sense data information field shall be set to the first invalid address.

In the case of an attempt to read a blank or previously unwritten block, the sense data information field shall be set to the address of the first blank encountered. At least the data read up to that block shall be transferred.

In the case of an attempt to write a previously written block and blank block checking is enabled, the sense data information field shall be set to the address of the first non-blank encountered.

5 Commands for optical memory card devices

The commands for optical memory card devices shall be as shown in table 3.

Table 3 - Commands for optical memory card devices

Command name	Operation code	Type	Subclause
CHANGE DEFINITION	40h	O	SPC
COMPARE	39h	O	SPC
COPY	18h	O	SPC
COPY AND VERIFY	3Ah	O	SPC
INQUIRY	12h	M	SPC
LOCK UNLOCK CACHE	36h	O	SBC
LOG SELECT	4Ch	O	SPC
LOG SENSE	4Dh	O	SPC
MEDIUM SCAN	38h	O	SBC
MODE SELECT(06)	15h	O	SPC
MODE SELECT(10)	55h	O	SPC
MODE SENSE(06)	1Ah	O	SPC
MODE SENSE(10)	5Ah	O	SPC
PRE-FETCH	34h	O	SBC
PREVENT ALLOW MEDIUM REMOVAL	1Eh	O	SBC
READ(10)	28h	M	SBC
READ BUFFER	3Ch	O	SPC
READ CARD CAPACITY	25h	M	5.1
RECEIVE DIAGNOSTIC RESULTS	1Ch	O	SPC
RELEASE	17h	O	SPC
REQUEST SENSE	03h	M	SPC
RESERVE	16h	O	SPC
REZERO UNIT	01h	O	SBC
SEEK(10)	2Bh	O	SBC
SEND DIAGNOSTIC	1Dh	M	SPC
START STOP UNIT	1Bh	O	SBC
SYNCHRONIZE CACHE	35h	O	SBC
TEST UNIT READY	00h	M	SPC
WRITE(10)	2Ah	O	SBC
WRITE AND VERIFY	2Eh	O	SBC
WRITE BUFFER	3Bh	O	SPC

Key: M = command implementation is mandatory.
O = command implementation is optional.
SPC = SCSI-3 Primary Commands standard
SBC = SCSI-3 Block Commands standard

The following command codes are vendor-specific: 20h, 21h, 22h, 23h, and C0h through FFh.

All remaining command codes for optical memory card devices are reserved for future standardisation.

5.1 READ CARD CAPACITY command

The READ CARD CAPACITY command (see table 4) provides a means for the initiator to request information regarding the capacity of the logical unit.

Note This command has the same operation code (25h) as the READ CAPACITY command (see SCSI-3 SBC). The general function is same but definitions of the logical block address field in the command descriptor block and a READ CARD CAPACITY data are defined depend on setting of an address type (AT) bit of mode parameter header.

Table 4 - READ CARD CAPACITY command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (25h)							
1	Reserved							RelAdr
2	(MSB)							
3	Logical block address field							
4								
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							PMI
9	Control							

See SCSI-3 SBC for a definition of the RelAdr bit.

If the address type (AT) bit of mode parameter header (see SCSI-3 SBC) is set to zero, all bytes of the logical block address field except partition number byte (Byte 2) shall be zero if the partial medium indicator (PMI) bit is zero. If the PMI bit is zero and the all bytes of the logical block address field except partition number byte is not zero, the target shall return a CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN CDB.

A PMI bit of zero indicates that the returned logical block address and the block length in bytes are those of last logical block of specified partition.

A PMI bit of one indicates that returned logical block address and the block length in bytes are those of last logical block of a track which includes the logical block address specified by the RelAdr and logical block address field in the command descriptor block.

If the AT bit is set to one, All bytes of four-byte logical block address field and the PMI bit shall be zero. If not the target shall return a CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN CDB.

The READ CARD CAPACITY data shall be sent during DATA IN phase of the command.

If the AT bit of mode parameter header is set to zero, the READ CARD CAPACITY data is defined in table 5.

Table 5 - READ CARD CAPACITY data (AT = 0)

bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Returned logical block address				
3								(LSB)
4	(MSB)			Block length in bytes				
7								(LSB)

If the AT bit is set to one, the READ CARD CAPACITY data is defined in table 6.

Table 6 - READ CARD CAPACITY data (AT = 1)

bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Maximum track address				
3								(LSB)
4	(MSB)			Maximum track length in bytes				
7								(LSB)

The maximum track address is the address of the highest track accessible by the device on the media currently loaded in the drive.

The maximum track length in bytes is the maximum data length in bytes per track which can be read/written with ECC. Refer to ISO/IEC 11694-4:1996 Annex B.

6 Parameters for optical memory card devices

6.1 Diagnostic parameters

This subclause defines the descriptors and pages for diagnostic parameters used with optical memory card devices.

The diagnostic page codes for optical memory card devices are defined in table 7.

Table 7 - Diagnostic page codes

Page code	Description	Subclause
00h	Supported diagnostics pages	SPC
01h - 3Fh	Reserved (for all device type pages)	
40h - 7Fh	Reserved	
80h - FFh	Vendor-specific pages	

6.2 Log parameters

This subclause defines the descriptors and pages for log parameters used with optical memory card devices. The log page codes for optical memory card devices are defined in table 8.

Table 8 - Log page codes

Page code	Description	Subclause
01h	Buffer over-run/under-run pages	SPC
03h	Error counter (read) page	SPC
05h	Error counter (verify) page	SPC
02h	Error counter (write) page	SPC
07h	Last n error event page	SPC
06h	Non-medium error page	SPC
00h	Supported log pages	SPC
04h	Reserved	
08h - 2Fh	Reserved	
3Fh	Reserved	
30h - 3Eh	Vendor-specific pages	

6.3 Mode parameters

This subclause defines the descriptors and pages for mode parameters used with optical memory card devices.

The mode parameter list, including the mode parameter header and mode parameter block descriptor, are defined in SCSI-3 SPC.

The mode parameter sent by the MODE SELECT command shall be valid until the UNIT ATTENTION condition is generated by the RESET condition occurred or the mode parameters changed.

The medium-type code field is contained in the mode parameter header (see SCSI-3 SPC). Table 9 defines the medium-type code values used for optical memory card devices.

Table 9 - Optical memory card medium-type codes

Code	Description
00h	Default (only one medium type supported)
01h	Write-once medium complied with 11694-4:1996 Annex B
02h	Write-once medium complied with 11694-4:1996 Annex A
03h	Read-only medium complied with 11694-4:1996 Annex B
04h	Read-only medium complied with 11694-4:1996 Annex A
05h - 7Fh	Reserved
80h - FFh	Vendor-specific

The device specific parameter field is contained in the mode parameter header (see SCSI-3 SPC). Table 10 defines the device specific parameter values used for optical memory card devices.

Table 10 - Optical memory card device specific parameter

Bit	7	6	5	4	3	2	1	0
	WP	Reserved		DPOFUA	Reserved		AT	EBC

When used with the MODE SELECT command the WP bit is not defined.

When used with the MODE SENSE command, a write protected (WP) bit of zero indicates that the medium is write enabled. A WP bit of one indicates that the medium is write protected. For read-only media the WP bit is reserved.

When used with MODE SELECT command the DPOFUA bit is reserved.

When used with the MODE SENSE command, a DPOFUA bit of one indicates that the target supports the DPO and FUA bits (see SCSI-3 SBC).

For the MODE SELECT command, an address type (AT) bit of zero indicates the value in the logical block address field of the medium access commands and the sense data information field shall be interpreted as defined in table 1 (see 4.2). The logical block address within a partition begins with block zero and be contiguous up to the last logical block within that partition. The optical memory card devices supports up to 128 partitions by the MODE SELECT command. Each partition can be set the type of sector as a density code (see Table 11) and the number of logical blocks. The MODE SELECT command does not perform any physical recording to the medium, therefore, it is possible to change partition definitions later. This means user must manage partition by himself.

Definition of the partitions by the MODE SELECT command is valid regardless that a card is in a logical unit. The definition for a partition requires eight bytes of a mode parameter block descriptor. When user wants to define multiple partition on a card, he has to set up partitions without blank. The partition number shall be assigned automatically by setting field in the mode parameter block descriptor. The partition zero is defined by from byte 0 to 7, partition one is defined by from byte 8 to 15 in the mode parameter block descriptor.

An AT bit of one indicates the value in the logical block address field of the medium access commands and the sense data information field shall be interpreted as defined in table 2 (see 4.2). All sectors must be of the same type within a track. All track addresses are expressed relative to the whole card. The sector address is expressed relative to the beginning of each track.

For the MODE SENSE command, an AT bit reflects the current operating address type of the device.

For the MODE SELECT command, an enable blank check (EBC) bit of zero advises the target to disable the blank checking operation of the medium during write operations. An EBC bit of one enables blank checking. If a non-blank block is found during a write operations, the command shall be terminated with a CHECK CONDITION status and the sense key shall be set to BLANK CHECK. For read-only media, the EBC bit is reserved.

For the MODE SENSE command, an EBC bit of zero indicates that blank checking of the medium during write operations is disabled. An EBC bit of one indicates that blank checking during write operations is enabled. For read-only media, the EBC bit is reserved.

The density code field is contained in the mode parameter block descriptor (see SCSI-3 SPC). Table 11 defines the density code values used for optical memory card devices.

Table 11 - Optical memory card density codes

Density code	Optical card media	
00h	Default density	
	Logical format	Reference International standard
01h – 0Fh	Reserved	
10h – 1Fh	Vendor-specific	
20h – 2Fh	Reserved	
30h – 3Fh	PWM recording method, 8-10 NRZI modulation	11694-4:1996 Annex A
40h – 4Fh	PPM recording method, MFM/NRZI-RZ modulation	11694-4:1996 Annex B
Code 80h – FFh are vendor-specific, all other codes are reserved.		
NOTE The least significant nibble of the density code (bit 0 to 3) corresponds to the sector type code defined in Reference International Standard.		

For the MODE SELECT command if the AT bit is set to zero, the density code field of optical memory card device block descriptor indicates the sector type code selected by the initiator for use in subsequent read and write operations.

For the MODE SENSE command if the AT bit is set to zero, the density code field reflects the current operating sector type of the device.

The MODE SENSE command shall report the most recent mode parameter block descriptor (Current values). The mode parameter block descriptor respond to the MODE SENSE command shall be as described below. The UNIT ATTENTION condition should be cleared.

a) Following a UNIT ATTENTION condition for a power on or hard reset condition, while not ready, the target shall report the device specific initial default value.

b) When a logical unit becomes ready state after medium loading, the default value described in a) shall be reported, however the number of blocks field shall be set to total logical block number (track number) of the loaded medium. If a logical unit is not ready state after medium loading, the most recent mode parameter block descriptor (initial default value described item a) above when first card was loaded) shall be reported.

c) Following a successful MODE SELECT command execution, the target shall report the mode parameter block descriptor specified by MODE SELECT command.

d) Following a successful card eject operation, the target shall report the most recent mode parameter block descriptor defined by items a) through c) above.

The mode page codes for optical memory card devices are defined in table 12.

Table 12 - Mode page codes

Page code	Description	Subclause
08h	Caching page	SBC
0Ah	Control mode page	SPC
02h	Disconnect-reconnect page	SPC
0Bh	Medium type supported page	SBC
09h	obsolete	
01h	Read-write error recovery page	SBC
07h	Verify error recovery page	SBC
03h - 06h	Reserved	
0Ch - 1Fh	Reserved	
00h	Vendor-specific (does not require page format)	
20h - 3Eh	Vendor-specific (page format required)	
3Fh	Return all pages (Valid only for the MODE SENSE command)	