CHAPTER 6

Command Specification

6.1 Command Specification

This section defines the SCSI commands supported by this module Intelligent Floppy Disk Drive Controller. Each command consists of a group of command bytes and an associated group of data bytes. After ARBITRATION, SELECTION, and any optional initial messages, this module will enter the COMMAND phase and request the command bytes. The opcode of the command will determine how many bytes this module will request. After receipt of the command bytes, this module will enter DATA phase if a data structure is defined for the command. The data structure in a single command may transfer one or more logical blocks of data. This module may disconnect from the SCSI bus to allow activity by other SCSI devices while it is preparing to transfer data.

Upon command completion (successful or unsuccessful), this module returns a status byte to the initiator. Since most error and exception conditions cannot be adequately described with a single status byte, one status code, CHECK CONDITION, indicates that additional information is available. The initiator may issue a REQUEST SENSE command to retrieve this additional information.

The subsections on each command will describe the sequence of bytes an initiator must transfer to this module during the COMMAND phase in order to request a desired action from this module. The subsections on each command may further describe the format of data bytes that may be transferred to or from the initiator following the COMMAND phase, depending on the function of the command.

6.2 Command Descriptor Block (CDB)

A request to a device is made by transferring a Command Descriptor Block (CDB) to the target device. This module will support two basic command formats, the six-byte commands and the ten-byte commands. The ANSI SCSI Specification refers to the six-byte commands as belonging to group 0 and the ten-byte commands as belonging to group 1. The command format is recognizable from the opcode of the command. Six-byte commands have opcodes in the range of 00 to 1F; ten-byte commands have opcodes in the range of 20 to 3F. This section defines the CDB fields, whose uses in particular commands are more fully described below.

Table 6-1
Operation Code

BYTE	BIT 7	6	5	4	3	2	1	0
00	Group code			Command code				

Table 6-2
Typical Command Descriptor Block for Six-byte Commands

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Log. Block Address MSB				
02	Logical Block Address							
03	Logical Block Address LSB							
04	Transfer Length							
05	Control Byte							

Table 6-3
Typical Command Descriptor Block for Ten-byte Commands

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Reserved				RelAdr
02	Logical Block Address MSB							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address LSB							
06	Reserved							
07	Transfer Length MSB							
08	Transfer Length LSB							
09	Control Byte							

6.2.1 Opcode

The opcodes (operation codes) for groups 0 and 1 are listed below:

Table 6-4
COMMANDS SUPPORTED BY THIS MODULE

OPCODE	COMMAND	SECTION
00	TEST UNIT READY	6.7.1
01	REZERO UNIT	6.7.2
03	REQUEST SENSE	6.7.3
04	FORMAT UNIT	6.7.4
08	READ	6.7.5
0A	WRITE	6.7.6
12	INQUIRY	6.7.7
15	MODE SELECT	6.7.8
16	RESERVE	6.7.9
17	RELEASE	6.7.10
1A	MODE SENSE	6.7.11
1D	SEND DIAGNOSTIC	6.7.12
25	READ CAPACITY	6.7.13
28	READ EXTENDED	6.7.14
2A	WRITE EXTENDED	6.7.15

6.2.2 Logical Unit number (LUN) The logical unit numbers for this module are 0 to 3. LUNs of 4 to 7 are not accepted, except when the command is preceded by an IDENTIFY message in which the LUN is 0 to 3. In this case, the LUN in the command is ignored. (Implementers NOTE: It is a good practice for initiators that implement the IDENTIFY message to specify the same logical unit number in the Command Descriptor Block.) If a LUN other than 0 to 3 is specified in the Command Descriptor Block, and an IDENTIFY message with LUN 0 to 3 specified has not been issued, then the command will be rejected.

6.2.3 Logical Block Address (LBA) The Logical Block Address signifies the first or starting block of an operation. (Each Logical Block can be 128, 256, 512, 1024, 2048, 4096, or 8192 bytes in length.) For this module, Block Length is equivalent to sector size. The MODE SELECT command is used to configure the Block Length.

Value of the LBA field in the CDB is ignored if not required (i.e., no CHECK CONDITION status will result).

6.2.4 Transfer Or Allocation Length The transfer length in blocks, or the allocation length in bytes, is the number of blocks or bytes to be transferred for a single command.

For group 0 commands acceptable values are 00-FF. For block lengths, a value of 00 transfers 256 blocks. See allocation byte lengths under specific commands.

For group 1 commands acceptable values are 0000-FFFF. A value of 0000 transfers no data blocks.

This value is ignored if not required (i.e., no CHECK CONDITION status will result).

6.2.5 Relative Address (RelAdr) Bit This bit must be zero. This module does not accept relative addresses.

6.3 Control Byte

The control byte is the last byte of every command descriptor block. A typical control byte is described in Table 6-5.

Table 6-5
Control Byte

BYTE	BIT 7	6	5	4	3	2	1	0
05	VU			Reserved			F	L

6.3.1 Vendor Unique (VU) Vendor unique bits allow for slight command modifications or special conditions to be selected. Vendor unique bits are to be filled with 0 unless otherwise specified.

6.3.2 Reserved (R) These bits are reserved, must be set to zero by the initiator.

6.3.3 Flag Bit (F) This bit must be zero. This module does not accept linked commands (link bit is set to one).

6.3.4 Link Bit (L) This bit must be zero. This module does not accept linked commands.

6.4 Completion Status Byte

A status byte is sent from the target to the initiator during the STATUS phase at the termination of each command as specified in Tables 6-7 and 6-8 unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, or by a "hard" RESET condition. Table 6-7 defines the status codes as implemented by this module.

Table 6-6
STATUS BYTE

Bit Byte	7	6	5	4	3	2	1
0	Reserved	Vendor Unique		Status Byte Code			VU

Table 6-7
STATUS BYTE CODE BIT VALUES

Bits of Status Byte									
7	6	5	4	3	2	1	0	Status(es) Represented	
R	V	V	0	0	0	0	V	GOOD	Implemented
R	V	V	0	0	0	1	V	CHECK CONDITION	Implemented
R	V	V	0	0	1	0	V	CONDITION MET/GOOD	Not Used
R	V	V	0	0	1	1	V	Reserved	Not Used
R	V	V	0	1	0	0	V	BUSY	Implemented
R	V	V	0	1	0	1	V	Reserved	Not Used
R	V	V	0	1	1	0	V	Reserved	Not Used
R	V	V	0	1	1	1	V	Reserved	Not Used
R	V	V	1	0	0	0	V	INTERM./GOOD	Not Used
R	V	V	1	0	0	1	V	Reserved	Not Used
R	V	V	1	0	1	0	V	INTERM./COND. MET/GOOD	Not Used
R	V	V	1	0	1	1	V	Reserved	Not Used
R	V	V	1	1	0	0	V	RESERVATION CONFLICT	Implemented
R	V	V	1	1	0	1	V	Reserved	Not Used
R	V	V	1	1	1	0	V	Reserved	Not Used
R	V	V	1	1	1	1	V	Reserved	Not Used

KEY: R = Reserved Bit (zero)
V = Vendor Unique Bit (zero)

Table 6-8
STATUS CODES

STATUS BYTE CODE	Meaning
GOOD (00)	COMMAND IS COMPLETED WITH NO ERROR CONDITIONS.
CHECK (02) CONDITION	AN ABNORMAL CONDITION HAS OCCURRED. This code is issued whenever an error, exception or abnormal condition occurred during execution of a command (the command may or may not have completed successfully). A REQUEST SENSE command should be issued following a CHECK CONDITION status to determine the nature of the condition.
BUSY (08)	TARGET IS BUSY. This code is issued if the target is busy executing a previous command, after a disconnection has occurred, or target is otherwise unable to accept a command. The command that received the BUSY status is discarded and no action is taken; it may be reissued as if issued for the first time.
RESERVATION CONFLICT (18)	ATTEMPTED ACCESS OF A RESERVED DEVICE. This code is issued when an initiator attempts to access a reserved LUN, in which case the command will be rejected. See RESERVE command.

6.5 Reading and Writing

6.5.1 Logical Blocks

The basic function of this module is to store and retrieve information on Floppy Disk Drives. The information is stored and retrieved as groups of 8-bit bytes. These groups of bytes have a standard size and are referred to as logical blocks. The size of a logical block, the number of bytes contained in each block, is determined by the user via the MODE SELECT command. This module will support 7 different logical block sizes: 128, 256, 512, 1024, 2048, 4096, and 8192 bytes per block. For this module, a floppy disk is divided into three areas, defined by the three Block Descriptors. The first Block Descriptor describes the format of the first track of the floppy disk; the second Block Descriptor describes the format of the second track of the floppy disk; and the third Block Descriptor describes the format of all the remaining tracks of the floppy disk. These Descriptors and some additional information (Page 20) provided to this module by means of the MODE SELECT command, enables this module to read, write, and format disks of all known variations on the IBM format, or the ECMA(ISO) mini-floppy format.

6.5.2 Logical Block Address Ranges

Included in the information of Page 20 sent to this module by means of the MODE SELECT command is the total number of blocks that the Floppy Disk contains. If an initiator attempts to access a logical block at an address outside the valid address range, the command will not be executed. This module will return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, Invalid LBA.

6.5.3 Transferring Data

The actual storing and retrieving of logical blocks is done with the READ and WRITE commands. WRITE will place data on the disk and READ will retrieve data from the disk. In both the READ and WRITE commands, the user (initiator) must specify the logical block address of the first logical block to be transferred and the total number of blocks to be transferred. The interpretation of a value of zero in the number of blocks to be transferred depends on which form of the READ or WRITE command is used. If the long or extended form of the command is used (opcodes 28 or 2A), then a transfer length of zero implies transfer no data. In this case, this module only checks if the transfer command was a valid one. If the shorter or non-extended form of the command is used (opcodes 08 or 0A), then a transfer length of zero means transfer 256 blocks during the command. This is because the shorter command format has only one byte to specify transfer length.

The number of bytes transferred during the DATA phase following the command bytes is determined by the transfer length specified in the command and the logical block size. Number of Data Bytes = Transfer Length (in Blocks) * Logical Block Size (in Bytes). NOTE: take in consideration that, when transferring more than one Logical Block in one command, an overlap may occur between two or more areas with different logical block sizes. In that case the number of bytes of transferred data is the sum of the bytes contained in each transferred Logical Block.

6.6 Configuring Operating Modes

6.6.1 Operating Modes

The manner in which this module operates can be programmed in order to precisely match its features with that of the user's requirements. This is referred to as changing the Operating Mode of this module and is done through the MODE SELECT and MODE SENSE commands. The MODE SELECT command is used to set the Operating Mode of this module in order to achieve the desired behavior. The MODE SENSE command may be used to determine the current Operating Mode for each of the four drives.

This module has no "default" Operating Mode Parameters. The parameters configure this module for the format it is desired to

read, write and format and must be supplied to this module by the user (initiator) before any access to the Floppy Disk is permitted. The Operating Mode Parameters are maintained separately for each LUN this module must control. The Operating Mode Parameters which determine the characteristics of the medium (i.e., gap lengths, head- and cylinder-count, etc.) are specific for the format used and thereby rather fixed. Other Operating Parameters are more user dependent and may be configured to the need of the user (i.e., motor off timing, retry counts, etc.).

6.6.2 Operating Mode Tables

This module Operating Mode is determined by the contents of the Current Operating Mode Tables. For each LUN (0-3) a separate Current Operating Mode Table is maintained. This table is referenced for each access to the specified LUN. Storing the Current Mode Tables in RAM causes the LUN's Operating Mode Tables to be lost when power is removed or when this module is reset.

6.7 Description of Commands

Following are descriptions of individual commands listed in Table 6-4. Refer to the REQUEST SENSE command (6.7.3 below) for a description of error codes and sense keys. Refer to the Command Descriptor Block section (6.2 above) for definitions of the command CDB fields.

6.7.1 Test Unit Ready Command (00)

Table 6-9
TEST UNIT READY COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Reserved				
02	Reserved							
03	Reserved							
04	Reserved							
05	Control Byte							

The TEST UNIT READY command (Table 6-9) provides a means to check if the selected drive is up to speed and ready to accept commands requiring disk access.

When the selected drive is ready, the completion status byte will indicate GOOD (00). If the selected drive is not ready, the completion status byte will indicate CHECK CONDITION (02), with the sense key set to NOT READY.

The commands which do not require disk access are:
REQUEST SENSE
INQUIRY
MODE SELECT
RESERVE
RELEASE
MODE SENSE
SEND DIAGNOSTICS
READ CAPACITY

These commands will be executed after a delay of Selection Timeout Delay following application of power to this module. They will not return CHECK CONDITION status with the NOT READY sense key even if the selected drive is not ready. All other commands could require disk access.

6.7.2 Rezero Unit Command (01)

Table 6-10
REZERO UNIT COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				Reserved			
02	Reserved							
03	Reserved							
04	Reserved							
05	Control Byte							

The REZERO UNIT command (Table 6-10) requests that the selected drive repositions its head(s) to cylinder zero.

6.7.3 Request Sense Command (03)

Table 6-11
REQUEST SENSE COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Reserved				
02	Reserved							
03	Reserved							
04	Allocation Length							
05	Control Byte							

The REQUEST SENSE command (Table 6-11) requests that the sense data be sent to the initiator.

The sense data applies to the previous command from the initiator. The sense data is saved for the initiator until retrieved by the initiator or until another command is received from the initiator. The allocation length specifies the maximum number of bytes that the initiator has allocated for returned sense data. The exception is a value of 00, which indicates that the first four bytes of data will be returned. The acceptable values are 00-FF. The target will terminate the DATA IN phase when the allocated number of bytes have been transferred or when all available sense data have been transferred to the initiator, whichever is less. For this module, an allocation length of 0D is recommended.

If the allocation length prevents all available sense data from being sent to the initiator, the initiator may not recover the remaining portion with a subsequent REQUEST SENSE command.

This module uses the extended format for sense data (Table 6-12).

Table 6-12
EXTENDED SENSE FORMAT

BYTE	BIT 7	6	5	4	3	2	1	0
00	ADV	Error Class and Code						
01	Segment Number							
02	FM	EOM	ILI	Res.	Sense key			
03	Information Byte (MSB)							
04	Information Byte							
05	Information Byte							
06	Information Byte (LSB)							
07	Additional Sense Length							
08	Reserved							
09	Reserved							
0A	Reserved							
0B	Reserved							
0C	Additional Sense Code							

(1) Information Valid (ADV): Set to one if the information bytes contain valid data.
(2) Error Class and Code: Error class and code is set to 70 to indicate extended status.
(3) Segment Number: The segment number contains the number of the current segment descriptor, if the extended sense is in response to a COPY command; set to zero for this module.
(4) File Mark (FM): Indicate that a filemark has been read; set to zero for this module.
(5) End of Medium (EOM): Indicates that an end-of-medium condition exists; set to zero for this module.
(6) Incorrect Length Indicator (ILI): Indicates that the requested logical block length does not match that on the medium; set to zero for this module.
(7) Reserved (Res): set to zero for this module.
(8) Sense Key: The values for sense key data are found in the Table 6-13.
(9) Information Bytes: If the Information Valid bit is 1, the information bytes are valid and are defined as the Logical Block Address associated with the sense key.
(10) Additional Sense Length: Additional sense length is the number of additional bytes to follow. This value will not be truncated if the allocation length in the command descriptor block is too small to transfer all of the additional sense bytes. This module uses a value of five.
(11) Additional Sense Code: Refer to Table 6-13.

Table 6-13
SENSE ERROR CODES

Sense Key	Add.Sense Code	Description
0		NO SENSE. Indicates that there is no specific sense key information to be reported. This would be the case for a successful command.
	00	no additional information
2		NOT READY. Indicates that the selected target drive cannot be accessed. Operator intervention may be required to correct this problem.
	04	Selected drive indicates a not ready condition. This error condition will occur if there is no Floppy Disk Drive connected at the selected LUN address or no medium is inserted in the drive.
3		MEDIUM ERROR. Indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This error condition can also be caused by reading or writing a Floppy Disk with a format other than that for which this module is configured by means of the MODE SELECT command.
	10	ID CRC error
	11	Unrecovered Read error of data blocks
	12	No Address Mark found in ID Field
	13	No Address mark found in Data Field
	14	No Record Found
	15	Seek Positioning error
4		HARDWARE ERROR. Indicates that this module detected an unrecoverable hardware failure while performing the command.
	02	No Seek Complete
	03	Write Fault
	27	Write Protected
	44	Internal Controller error
	45	Select/Reselect failed

Table 6-13
SENSE ERROR CODES (continued)

Sense Key	Add.Sense Code	Description
5		ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands. If this module detects an invalid parameter in the command descriptor block or in the additional parameters supplied as data for some commands, then it will terminate the command without altering the medium.
	20	Invalid Command Operation Code
	21	Illegal Block Address. Address greater than the LBA returned by the READ CAPACITY data with PMI bit not set in CDB.
	22	Illegal Function for device type
	24	Illegal Field in CDB
	25	Invalid LUN
	26	Invalid Field in Parameter list
6		UNIT ATTENTION. MODE SELECT parameters have been changed by another initiator, or this module has been reset by one of the following: - BUS DEVICE RESET message - "hard" RESET condition (RST asserted) - POWER ON RESET. The Unit Attention condition will persist until receipt of any command other than INQUIRY or REQUEST SENSE; such command will not be performed and will report the CHECK CONDITION status, allowing the initiator to discover and clear the unit attention condition by issuing a REQUEST SENSE command. An INQUIRY command will be performed with no effect on the unit attention condition. A REQUEST SENSE command received before the target reports CHECK CONDITION status for the unit attention condition will cause the condition to be reported and cleared.
	29	Power On or RST or Bus Device Reset occurred
	2A	Mode Select Parameters changed
B		ABORTED COMMAND. Indicates that this module aborted the command. The initiator may be able to recover by trying the command again.
	43	Message Reject error
	47	SCSI Interface Parity error
	48	Initiator Detected error

6.7.4 Format Unit Command (04)

Table 6-14
FORMAT UNIT COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				FMTD	CMPL	DEF LIST FORM	
02	Vendor Unique							
03	Interleave (MSB)							
04	Interleave (LSB)							
05	Control Byte							

The FORMAT UNIT command (Table 6-14) ensures that the medium is formatted so that all of the initiator addressable data blocks can be accessed. A repetitive (one byte) data pattern is written in every block. The medium is altered, so issuing this command causes loss of data. The user should back up data prior to formatting. The medium is certified after formatting and this command will only return a GOOD status when all blocks are read back without error. When a read error occurs during certification, a Format Retry Count of retries will be issued as specified in the MODE SELECT command.

(1) Format Data (FMTD): defective block lists are not supported by this module; this bit must be zero for this module
(2) Complete List (CMPL): defective block lists are not supported by this module; this bit must be zero for this module
(3) Defect List Format (DEF LIST FORM): defective block lists are not supported by this module; these bits must be zero for this module

6.7.5 Read Command (08)

Table 6-15
READ COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Log. Block Address (high)				
02	Log. Block Address (middle)							
03	Log. Block Address (low)							
04	Transfer Length							
05	Control Byte							

The READ command (Table 6-15) requests that the target transfer data to the initiator.

(1) Logical Block Address: The logical block address specifies the logical block at which the READ operation will begin.

(2) Transfer Length: The transfer length specifies the number of contiguous blocks of data to be transferred. A transfer length of zero indicates that 256 blocks shall be transferred. Acceptable values are 00-FF.

6.7.6 Write Command (0A)

Table 6-16
WRITE COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Log. Block Address (high)				
02	Log. Block Address (middle)							
03	Log. Block Address (low)							
04	Transfer Length							
05	Control Byte							

The WRITE command (Table 6-16) requests that the data transferred to the target be written in the area specified by the logical block address.

(1) Logical Block Address: The logical block address specifies the logical block at which the WRITE operation will begin.

(2) Transfer Length: The transfer length specifies the number of contiguous blocks of data to be transferred. A transfer length of zero indicates that 256 blocks shall be transferred. Acceptable values are 00-FF.

6.7.7 Inquiry Command (12)

6.7.7.1 Inquiry Command Structure

Table 6-17
INQUIRY COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				Reserved			
02	Reserved							
03	Reserved							
04	Allocation Length							
05	Control Byte							

The INQUIRY command (Table 6-17) requests that information regarding identification of the target be sent to the initiator.

(1) Allocation Length: The allocation length specifies the maximum number of bytes that the initiator has allocated for returned INQUIRY data. The value of 00 indicates that no data will be returned. The acceptable values are 00-FF. The target will terminate the DATA IN phase when the allocation length bytes have been transferred or when all available INQUIRY data have been transferred to the initiator, whichever is less. For this module, an allocation length of 24 is recommended.

6.7.7.2 Inquiry Data Format

Table 6-18
INQUIRY DATA FORMAT

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Device Type							
01	RMB	Device Type Qualifier						
02	Reserved		ECMA Version			ANSI Version		
03	Reserved					Response Data Format		
04	Additional List Length							

BYTE	Identification Information
05	Vendor Unique = 0
06-07	Reserved = 0
08-0F	Vendor Identification = 'COMPC. '
10-1F	Product Identification = 'CC80/93 Floppy '
20-23	Revision = '0.1 '

(1) Peripheral Device Type: The peripheral device type is always set to zero for this module, standing for Direct Access Device.

(2) Removable Medium Type (RMB): The removable medium type bit is always set to one for this module to indicate removable media.

(3) Device Type Qualifier: The device type qualifier is not supported by this module; it is set to zero.

(4) Version: The ECMA version field is set to zero to indicate that this module does not claim compliance to the European Computer Manufacturers Association version of SCSI. The ANSI version field is set to one to indicate compliance to the ANSI specification for SCSI.

(5) Response Data Format: The response data format field is set to one to indicate compliance to the Common Command Set proposed by an ANSC X3T9.2 working group.

(6) Additional List Length: The additional list length specifies the length in bytes of the following list of controller identification information. If the allocation length of the command descriptor block is too small to transfer all of the vendor unique parameters, the additional length value will not be adjusted to reflect the truncation.

6.7.8 Mode Select Command (15)

6.7.8.1 Mode Select Command Structure

Table 6-19
MODE SELECT COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			PF	Reserved			SP
02	Reserved							
03	Reserved							
04	Parameter List Length							
05	Control Byte							

The MODE SELECT command (Table 6-19) provides a means for the initiator to specify device parameters to the controller concerning the selected LUN (drive).

A MODE SELECT command will override any previous selection of device parameters, even from another initiator. Execution of the command will create a unit attention condition for other initiators for the selected LUN.

When this module is powered up, all device parameters are reset. There are no default settings for the device parameters.

(1) Page Format (PF): If the page format bit is set to one it indicates that the data sent by the initiator after the MODE SELECT Header and the Block Descriptors (if any) complies to the page format. If the page format bit is set to zero it indicates that the data sent by the initiator after the MODE SELECT Header and the Block Descriptors (if any) is vendor unique. This bit should always be set to one for this module.

(2) Save Parameters (SP): This module does not save device parameters; this bit should always be set to zero for this module.

(3) Parameter List Length: The parameter list length specifies the length in bytes of the MODE SELECT parameter list that shall be transferred during the DATA OUT phase. A parameter list length of zero indicates no data shall be transferred. This condition shall not be considered as an error.

    The MODE SELECT parameter list (Table 6-20) contains a four-byte header, followed by zero or three block descriptors, followed by zero or more "pages".

6.7.8.2 Mode Select Parameter List

Table 6-20
MODE SELECT PARAMETER LIST

BYTE	BIT 7	6	5	4	3	2	1	0
MODE SELECT HEADER								
00	Reserved							
01	Medium Type							
02	Reserved							
03	Block Descriptor Length							
BLOCK DESCRIPTORS								
00	Reserved							density
01	Number of blocks (high)							
02	Number of blocks (middle)							
03	Number of blocks (low)							
04	Reserved							
05	Block length (high)							
06	Block length (middle)							
07	Block length (low)							
PAGE DESCRIPTORS								
00	Reserved				Page Code			
01	Page length							
02	Refer to page definition							
to n								

(1) Medium Type: The media types supported by this module are:

- 00, 01 = single sided drive with transfer rates of 125 (FM) or 250 (MFM) kBits per second. This is the transfer rate used by most 5.25 and 3.50 inch sized floppy drives.
- 02 = double sided drive with transfer rates of 125 (FM) or 250 (MFM) kBits per second.
- 80, 81 = single sided drive with transfer rates of 250 (FM) or 500 (MFM) kBits per second. This is the transfer rate for 8.00 inch sized floppy drives.
- 82 = double sided drive with transfer rates of 250 (FM) or 500 (MFM) kBits per second.
  NOTE: When this module is transferring data in the 5.25/3.50 inch mode, it also asserts the DRIVE TYPE SELECT pin (pin 2) of the connector to the Floppy Disk Drives (P3/P4). This signal can be used by floppy drives who can switch between this 8.00 inch and 5.25/3.50 inch compatible mode of operation.

(2) Block Descriptor Length: The block descriptor length specifies the length in bytes of all the block descriptors.

It is equal to the number of block descriptors times eight and does not include the pages, if any. A block descriptor length of zero indicates that no block descriptors shall be included in the parameter list. This condition shall not be considered as an error.
NOTE: To set density codes, track sizes and logical block lengths, the initiator is required to send three block descriptors. The first block descriptor is used to specify density, sector length and sectors per track for the first track of the floppy drive. The second block descriptor is used to specify density, sector length and sectors per track for the second track of the floppy drive. The third block descriptor is used to specify density, sector length and sectors per track for the remaining tracks of the floppy drive.
NOTE: In most cases it is necessary to send also page 20 to specify the gap lengths that should be used with the new formats specified in the block descriptors.

(3) Density Code: This module supports both single and double density for both 8.00 and 5.25/3.50 compatible mode.
00, 01 = single density
02 = double density

(4) Number of Blocks: The number of blocks specifies the count of blocks (sectors) contained on a track.

(5) Block Length: The block length specifies the count of bytes contained in one block (sector). Possible values are 128, 256, 512, 1024, 2048, 4096 and 8192 bytes.

(6) Page Code: Pages may optionally be included (immediately following the block descriptors, if any) in any order. To avoid having to specify all Mode parameters each time a MODE SELECT command is issued, the Mode Parameters are divided up into pages. A page is the minimum unit that can be specified in a MODE SELECT or MODE SENSE command. Each time a page is referenced, all the parameters of that page must be specified. Each page contains parameters which are grouped together by common functionality. This module supports the following Pages: Page 20: Vendor Unique defined page which currently contains all user configurable parameters.

(7) Page Length: The page length indicates the number of bytes of the page that will follow, starting with the first byte of flags or values and continuing consecutively. The page length shall be set to the exact same value returned by this module in the MODE SENSE Page Length byte. Otherwise, a CHECK CONDITION status with a sense key of ILLEGAL REQUEST will result.

6.7.8.3 Unique Drive Control Parameters

Table 6-21
Page Code 20

BYTE	BIT 7	6	5	4	3	2	1	0
00	Reserved			Page Code = 20				
01				Page Length = 16				
02				Gap length track 0				
03				Format Gap length track 0				
04				Gap length track 1				
05				Format Gap length track 1				
06				Gap length				
07				Format Gap length				
08				Step rate / double step				
09				Head load time				
0A				Head unload time				
0B				Motor on time (high)				
0C				Motor on time (low)				
0D				Motor off time (high)				
0E				Motor off time (low)				
0F				Sector offset/Sector offset side 2				
10				Cylinder offset / head bit				
11				Total number of blocks (high)				
12				Total number of blocks (middle)				
13				Total number of blocks (low)				
14				Retry count Read				
15				Retry count Write				
16				Retry count Format				
17				Reserved				

(1) Gap Length and Format Gap Length: requests the number of bytes used for gap 3 excluding VFO SYNC. These are parameters used by the uPD765A and uPD 7265. See the Product Description of the uPD765A and uPD7265 for the required values for the different formats desired.
(2) Step rate: 1 - 16 milliseconds. *) When the highest bit is set number of step pulses will be doubled; this makes it possible to read 40 tracks diskettes in an 80 track drive.
(3) Head load time: 2 - 254 milliseconds. Head must be loaded within this time. *)
(4) Head unload time: 16 - 240 milliseconds. Head will be unloaded after this time. *)
(5) Motor on time: (milliseconds). Motor must have come up to speed within this time. Motor timing will be ignored when this parameter is set to zero.
(6) Motor off time: (milliseconds). Motor will be turned off after this time.
(7) Starting sector number on track.
    00 = starting sector number = 0
         sector numbering not continued on side 2

```
        01 = starting sector number = 1
             sector numbering not continued on side 2
        80 = starting sector number = 0
             sector numbering is continued on side 2
        81 = starting sector number = 1
             sector numbering is continued on side 2
(8) Starting cylinder number.
        00 = starting cylinder number = 0
             head id is 1 on side 2
        01 = starting cylinder number = 1
             head id is 1 on side 2
        80 = starting cylinder number = 0
             head id is 0 on side 2
        81 = starting cylinder number = 1
             head id is 0 on side 2
(9) Total number of blocks that must be allocated on media by
    format or that can be accessed using read and write commands.
(10)Retry count used for Read commands.
(11)Retry count used for Write commands.
(12)Retry count used for Format command (Verify Read).

*) For 5.25-inch drives the given value must be half of the
desired value (e.g. hlt=2, gives a 4ms head load time).
```

6.7.9 Reserve Command (16)

Table 6-22
RESERVE COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				3PTY	3PTY Dev ID		EXTENT
02	Reservation identification							
03	Extent List Length (MSB)							
04	Extent List Length (LSB)							
05	Control Byte							

The RESERVE command (Table 6-22) is used to reserve a logical unit for the use of the initiator or another specified SCSI device. This module can make reservations for each of the four LUN's, separately.

Logical Unit Reservation: The extent bit must be set to zero. This command requests that the selected LUN be reserved for the exclusive use of the initiator until the reservation is superceded by another valid RESERVE command from the same initiator or is released by a RELEASE command from the same initiator, by a BUS DEVICE RESET message from any initiator, or by a "hard" RESET condition (assertion of RST signal). A logical unit reservation will not be granted if the unit is reserved by another initiator. It is permissible for an initiator to reserve the unit when it is currently reserved for that initiator. The reservation identification and the extent list will be ignored.

If the drive is reserved for another initiator, it will respond by returning a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator then subsequently attempts to perform any command on the reserved unit (other than a RELEASE command, which will be ignored), then the command shall be rejected with RESERVATION CONFLICT status.

Extent Reservation: The extent reservation of a unit is not supported by this module. If the extent bit is set to one, the RESERVE command will be rejected with a CHECK CONDITION status with the ILLEGAL REQUEST sense key.

Third Party Reservation: The third party reservation option for the RESERVE command allows an initiator to reserve a logical unit for another SCSI device. This option is intended for use in multiple initiator systems that use the COPY command.

If the third party reservation bit is zero, then the third party reservation option is not requested. If the third party reservation bit is one, then the RESERVE command reserves the

unit for the SCSI device specified in the third party device ID field. The unit shall preserve the reservation until it is superseded by another valid reserve command from the same initiator or until it is released by the same initiator (or by a BUS DEVICE RESET message from any initiator or a "hard" RESET condition). The unit shall ignore any attempt to release the reservation made by any other initiator, including the specified third party.

6.7.10 Release Command (17)

Table 6-23
RELEASE COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			3PTY	3PTY Dev ID			EXTENT
02	Reservation identification							
03	Reserved							
04	Reserved							
05	Control Byte							

The RELEASE command (Table 6-23) is used to release a previously reserved logical unit. It is not an error for an initiator to attempt to release a reservation that is not currently active.

Logical Unit Release: The extent bit must be set to zero. This will cause the selected logical unit to terminate an active reservation from the initiator.

Extent Release: The extent reservation of a unit is not supported by this module. If the extent bit is set to one, the RELEASE command will be rejected with a CHECK CONDITION status with the ILLEGAL REQUEST sense key.

Third Party Release: The third party release option for the RELEASE command allows an initiator to release a logical unit that was previously reserved using the third party reservation option. This option is intended for use in multiple initiator systems that use the COPY command.

If the third party bit is set to zero, then the third party release option is not requested. If the third party bit is set to one, then the target shall release the specified logical unit, but only if the reservation was made using the third party reservation option by the same initiator for the same SCSI device as specified in the third party device ID field.

6.7.11 Mode Sense Command (1A)

6.7.11.1 Mode Sense Command Structure

Table 6-24
MODE SENSE COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				Reserved			
02	PCF		Page Code					
03	Reserved							
04	Allocation Length							
05	Control Byte							

The MODE SENSE command (Table 6-24) provides a means for the target to report its peripheral device parameters to the initiator. It is a complementary command to the MODE SELECT command.

(1) Page Control Field (PCF): The page control field bit 6 and 7 defines the type of page parameters values to be returned. There are four possible options.

(a) Report Current Values (PCF=00): If the page code is equal to 3F, all Pages implemented by the target are returned to the initiator with fields and bits set to the Current values. If the Page Code is different than 3F, the page defined by the Page Code, if supported by the target, is returned to the initiator with fields and bits set to the Current values. The Current values are either:
- as set in the last successfully completed MODE SELECT command.
- or are identical to the Default values.
NOTE: this module does not have Default values; after a reset or power-up all fields and bits are cleared.

(b) Report Changeable Values (PCF=01): If the page code is equal to 3F, all Pages implemented by the target are returned to the initiator with fields and bits that are allowed to be changed by the initiator set to one. Fields and bits not allowed to be changed by the initiator shall be set to zero. If the Page Code is different than 3F, the page defined by the Page Code, if supported by the target, is returned to the initiator with fields and bits that are allowed to be changed by the initiator set to one. Fields and bits not allowed to be changed by the initiator shall be set to zero.

(c) Report Default Values (PCF=10): If the page code is equal

to 3F, all Pages implemented by the target are returned to the initiator with fields and bits set to the Default values. If the Page Code is different than 3F, the page defined by the Page Code, if supported by the target, is returned to the initiator with fields and bits set to the Default values. NOTE: this module does not have Default values; after a reset or power-up all fields and bits are cleared.

(d) Report Saved Values (PCF=11): If the page code is equal to 3F, all Pages implemented by the target are returned to the initiator with fields and bits set to the Saved values. If the Page Code is different than 3F, the page defined by the Page Code, if supported by the target, is returned to the initiator with fields and bits set to the Saved values. NOTE: this module does not have Saved values.

(2) Page Code: For all the above options, the Page Length byte returned indicates the number of bytes this module supports for each page. This same value must be specified in the Page Length field (byte 1 of each Page Descriptor) when issuing the MODE SELECT command.

The page code specifies the particular page information to be returned to the initiator in the MODE SENSE command. This module supports the following pages:
20 Vendor Unique page with configuration parameters

(3) Allocation Length: The allocation length specifies the number of bytes that the initiator has allocated for returned MODE SENSE data. An allocation length of zero indicates that no MODE SENSE data shall be transferred. This condition shall not be considered as an error. Any other value indicates the maximum number of bytes that shall be transferred. The target will terminate the DATA IN phase when allocation length bytes have been transferred or when all available MODE SENSE data have been transferred to the initiator, whichever is less.

(4) Mode Sense Data: The MODE SENSE data (Table 6-25) contain a four byte header, followed by three eight byte block descriptors, followed by zero or more "pages". The meaning and organization of these data are the same as for the corresponding MODE SELECT data, as modified by the option specified in the page control field of CDB byte 2.

6.7.11.2 Mode Sense Data

Table 6-25
MODE SENSE DATA

BYTE	BIT 7	6	5	4	3	2	1	0
MODE SENSE HEADER								
00	SENSE DATA length							
01	Medium Type							
02	WP	Reserved						
03	Block Descriptor Length							
BLOCK DESCRIPTORS								
00	Reserved							density
01	Number of blocks (high)							
02	Number of blocks (middle)							
03	Number of blocks (low)							
04	Reserved							
05	Block size (high)							
06	Block size (middle)							
07	Block size (low)							
PAGE DESCRIPTORS								
00	PS	Res				Page Code		
01	Page length							
02	Refer to page definition							
to n								

(1) Sense Data Length: The sense data length specifies the length in bytes of the following MODE SENSE data that is available to be transferred during the DATA IN phase. The SENSE DATA length does not include itself.

(2) Write Protected (WP): A write protect bit of zero indicates that the medium is write enabled. A WP bit of one indicates that the medium is write protected. This bit is always returned zero by this module.

(3) Block Descriptor Length: The block descriptor length specifies the length in bytes of all the block descriptors. It is equal to three times eight = 18 for this module. The block descriptors specifies the medium characteristics for the unit. The block descriptors contain a density code, a number of blocks, and a block length, which have the same meanings as corresponding fields in the MODE SELECT parameter list.

(4) Parameters Saveable (PS): A parameters saveable bit of zero in each page header indicates the supported parameters of that page cannot be saved by this module. A PS bit of one indicates that the supported parameters of the page can be saved by this module. This module shall always return this

bit cleared.

6.7.12 Send Diagnostic Command (1D)

6.7.12.1 Send Diagnostic Command Structure

Table 6-26
SEND DIAGNOSTIC COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Reserved		ST	DOL	UOL
02	Reserved							
03	Parameter List Length (MSB)							
04	Parameter List Length (LSB)							
05	Control Byte							

The SEND DIAGNOSTIC command (Table 6-26) requests the controller to perform diagnostic tests on itself, on the attached drive, or on both. This command is usually followed by a RECEIVE DIAGNOSTIC RESULTS command, except when the self test bit (ST) is one. The parameter list length specifies the length in bytes of the parameter list that shall be transferred during the DATA OUT phase. A parameter list length of zero indicates that no data shall be transferred. This condition shall not be considered as an error.

(1) A logical unit offline (UOL) bit of one enables write operations on user medium or operations that affect user visible medium positioning. This bit must be zero for this module.

(2) An SCSI device offline (DOL) bit of one enables diagnostic operations that may adversely affect operations to other logical units on the same target. This bit must be zero for this module.

(3) A SELF TEST (ST) bit of one directs the target to complete its default self test. If the self test is requested, the parameter list length shall be set to zero and no data shall be transferred. If the self test successfully passes, the command shall terminate with a GOOD status; otherwise the command shall be terminated with a CHECK CONDITION status with the sense key set to HARDWARE ERROR.

6.7.13 Read Capacity Command (25)

Table 6-27
READ CAPACITY COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number			Reserved				
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	Reserved							
07	Reserved							
08	Reserved							PMI
09	Control Byte							

The READ CAPACITY command (Table 6-27) provides a means for the initiator to request information regarding the capacity of the disk drive.

A partial medium indicator (PMI) bit of zero indicates that the information returned in the READ CAPACITY data shall be the logical block address and block length (in bytes) of the last logical block of the logical unit. The logical block address in the command descriptor block shall be set to zero for this option.

A PMI bit of one indicates that the information returned shall be the logical block address and block length (in bytes) of the last logical block address after which a substantial delay in data transfer will be encountered. This logical block address shall be greater than or equal to the logical block address specified in the command descriptor block.

The eight bytes of READ CAPACITY data shown in Table 6-28 shall be sent during the DATA IN phase of the command.

Table 6-28
READ CAPACITY DATA

BYTE	BIT 7	6	5	4	3	2	1	0
00	Logical Block Address (MSB)							
01	Logical Block Address							
02	Logical Block Address							
03	Logical Block Address (LSB)							
04	Block Length (MSB)							
05	Block Length							
06	Block Length							
07	Block Length (LSB)							

6.7.14 Read Extended Command (28)

Table 6-29
READ EXTENDED COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				Reserved			REL
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	Reserved							
07	Transfer Length (MSB)							
08	Transfer Length (LSB)							
09	Control Byte							

The READ EXTENDED command (Table 6-29) requests that the target transfer data to the initiator.

The logical block address specifies the logical block at which the read operation shall begin.

The transfer length specifies the number of contiguous logical blocks of data that shall be transferred. A transfer length of zero indicates that no logical blocks shall be transferred. This condition shall not be considered as an error. Any other value indicates the number of logical blocks that shall be transferred.

6.7.15 Write Extended Command (2A)

Table 6-30
WRITE EXTENDED COMMAND

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation code							
01	Log. Unit Number				Reserved			REL
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	Reserved							
07	Transfer Length (MSB)							
08	Transfer Length (LSB)							
09	Control Byte							

The WRITE EXTENDED command (Table 6-30) requests that the target write the data transferred by the initiator to the medium.

The logical block address specifies the logical block at which the write operation shall begin.

The transfer length specifies the number of contiguous logical blocks of data that shall be transferred. A transfer length of zero indicates that no logical blocks shall be transferred. This condition shall not be considered as an error, and no data shall be written. Any other value indicates the number of logical blocks that shall be transferred.

6.8 CCS

The software contained in this module complies to the COMMON COMMAND SET (CCS) of the Small Computer System Interface (SCSI):

Disconnection: The module will disconnect only when:
- the Initiator asserted ATN during selection (messages possible)
- the Initiator asserted his own ID during selection
- an Identify message has been received by the Target with the Disconnect bit set
- there is a substantial delay foreseen in the completion of the command:

a) the motor has to be turned on
b) a SEEK operation has to be performed to access the requested data

Control Byte: Linked commands are not supported, therefor both the Link and Flag bits should always be set to zero in the control byte. Thus only a Control Byte of 0 is valid.

Status Byte:
All REQUIRED Status Types are supported:
    GOOD
    CHECK CONDITION
    BUSY
    RESERVATION CONFLICT
no Optional Status Types are implemented.

Message System:
BASIC SET:
All REQUIRED Messages are supported:
    COMMAND COMPLETE
no Optional messages are implemented.
SYSTEMS SET:
All REQUIRED Messages are supported:
    ABORT
    MESSAGE REJECT
    NO OPERATION
    BUS DEVICE RESET
no Optional messages are implemented.
DISCONNECT SET:
IDENTIFY Messages are supported.
Optional Messages supported:
    Disconnect
ERROR RECOVERY SET:
All REQUIRED Messages are supported:
    RESTORE POINTERS
    MESSAGE REJECT
Optional Messages supported:
    Save Data Pointer
    Initiator Detected Error
    Message Parity Error
LINK SET:
There are no REQUIRED Messages.
no Optional Messages are implemented.

Commands:

All CCS REQUIRED Commands are supported:

- TEST UNIT READY
- REQUEST SENSE
- FORMAT UNIT
- READ
- WRITE
- INQUIRY
- RESERVE UNIT
- RELEASE UNIT
- SEND DIAGNOSTIC
- READ CAPACITY
- READ EXTENDED
- WRITE EXTENDED

Optional CCS Commands supported:

- Rezero Unit
- Mode Select
- Mode Sense

Implementation of Commands:

TEST UNIT READY: as defined in the SCSI document. When Motor On Time is zero (specified in Mode Select Command) READY signal from drive is tested. When Motor On Time is not equal to zero, motor is turned on and READY signal from the drive is tested for a maximum time of Motor On Time.

REQUEST SENSE: as defined in the CCS document. Extended Sense Format Data is implemented up to byte 12.

FORMAT UNIT: FmtData, CmpLst and Defect List Format must be zero; no additional data is send. Interleave of zero or one requests that consecutive logical blocks be placed in consecutive physical order. Interleave greater than one requests that consecutive logical blocks be placed with a mutual distance of interleave physical blocks.

READ: as defined in the SCSI document.

WRITE: as defined in the SCSI document.

INQUIRY: as defined in the CCS document. Inquiry Data is implemented up to byte 35.

RESERVE UNIT: as defined in the CCS document. Third party reservations are supported, extent reservations are not supported. Therefor Extent and byte 2, 3 and 4 of the CDB must be set to zero.

RELEASE UNIT: as defined in the CCS document. Third party reservations are supported, extent reservations are not supported. Therefor Extent and byte 2 of the CDB must be set to zero.

SEND DIAGNOSTIC: SelfTest, DevOfl and UnitOfl must be zero. Byte 3 and 4 (parameter list length) must also be zero.

READ CAPACITY: as defined in the CCS document. When PMI bit is set, the logical block address returned will be the address of the last block on the same cylinder as the given block address. RelAdr must be zero.

READ EXTENDED: as defined in the SCSI document.

WRITE EXTENDED: as defined in the SCSI document.

Rezero Unit: as defined in the SCSI document.

Mode Select: Data sent by the initiator must comply to the Page

Format. Thus PF must be set. Pages can not be saved, thus SP must be set to zero. Three Block Descriptors must be send or none. When Block Descriptors are sent, the first one describes the format of track 0 of the selected LUN, the second one describes the format of track 1 of the LUN and the third describes the format of all other tracks. Page 20 (Vendor Unique) contains all other necessary parameters. Pages 0 through 5 are not implemented. Block descriptors and Pages are maintained for the four different LUN's, but not for different initiators.

Mode Sense: Only Current Values are returned, PCF should be set to zero.

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