

WESTERN DIGITAL CORPORATION
SCSI DIAGNOSTIC COMMAND SET
DRAFT PROPOSAL

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TO : John Lohmeyer, Chairman, X3T9.2 Committee (SCSI)
FROM : Doug Pickford, Western Digital Corporation
Subject : Draft Proposal for a SCSI Diagnostic Command Set (DCS)
Document : X3T9.2/89-1XX, Rev 0

1.0 Introduction

Within the SCSI model described in the ANSI specification X3T9.2/131-19xx, the provision for diagnostics is made through the SEND DIAGNOSTICS and RECEIVE DIAGNOSTIC RESULTS commands. Unfortunately, this method is entirely vendor unique and does not allow for any standardization of applications and test equipment for these purposes. Further, the current diagnostic mode does not take advantage of the mechanisms within SCSI to broaden the usefulness of SCSI diagnostics. This specification addresses these requirements. Only those areas of the SCSI specification which require changes are mentioned in any detail.

2.0 Scope

The Diagnostic Command Set and operating methods described herein are completely independent of and transparent to the Standard SCSI operating mode. Further, the SCSI Diagnostic Command Set is an optional extension of the mandatory SCSI command set. Herein only Direct Access Device types are addressed, but there is nothing preventing the logical extension to other device types. This specification covers the following items:

- * Indication of Diagnostic Compliance
- * Enabling of the SCSI Diagnostic mode
- * Disabling of the SCSI Diagnostic mode
- * Overview of the SCSI Diagnostic mode
- * Mandatory Diagnostic Command Support
- * Optional Diagnostic Command Support
- * Vendor Unique Diagnostic Command Support

2.1 Reference Documents

The following is a list of specifications and documents used to formulate the command set herein. Please refer to these for more complete details if required.

- | | |
|----------------------------|-------------------------------|
| * X3T9.2/131-19xx, Rev 10b | SCSI-2 Draft Proposal |
| * X3B7.1/89-xxx, | Preliminary Working Draft DCS |

3.0 The SCSI Diagnostic Mode: An Overview

The main premise of this definition of SCSI diagnostics is that it is unnecessary to define any new mechanism simply to support a diagnostic command set. The SCSI committee has gone to great lengths to make a workable protocol to issue commands and manage the communication links. Further, many manufacturers have gone to even greater lengths to make products that work using the protocol. For these reasons, the rules of diagnostic implementation are:

- 1). Existing silicon must not be broken,
- 2). Support is a matter of firmware extensions, not firmware rewrites, or shoe horns.
- 3). Once in Diagnostic Mode, SCSI operation is identical to the existing SCSI.
- 4). SEND/RECEIVE DIAGNOSTICS will not be removed. This will avoid incompatibilities with existing firmware written to take advantage of these commands.
- 5). Further additions should be straight forward.

3.1 Standard vs. Diagnostic mode

To take into account all of the guidelines listed above, SCSI Diagnostic mode should have no effect on the the standard operations of SCSI and be viewed as simply a different firmware personality from the standard established SCSI mode. Stated more precisely, the standard SCSI commands, which are divided up into Mandatory, Optional and Vendor Unique sets, will cover the logical level requirements. Within the Diagnostic Command Set (hereafter called DCS), the Standard Mandatory commands are replicated (with a single modification to MODE SELECT and MODE SENSE), while additional Mandatory, Optional and Vendor Unique physical level command set extensions are provided.

3.2 Reset State

The addition of a DCS to SCSI products is entirely optional and as such the power up default state of a SCSI Direct Access Device supporting the DCS is always Standard SCSI mode. Further, any reset condition returns the state of the firmware back to Standard SCSI regardless of the previous state.

3.3 DCS Compliance Indication

To indicate to a SCSI Initiator that DCS support is provided, the SCSI target returned INQUIRY Data will be slightly modified. A DCS Bit will be added to indicate the support for the Diagnostic Command Set. For further details, refer to the INQUIRY command, section 4.1.2.

3.4 Operating Mode Detection and Modification

There are four possible modes of operation, two of which will be defined here, two left for future extensions. The first is Standard SCSI, which is defined by ANSI document X3T9.2/131-19xx. The second is Diagnostic SCSI, described herein. The enabling and disabling of modes can be achieved via the MODE SELECT command while the determination of which mode is currently active is accomplished via the MODE SENSE command, using the CONTROL MODE PAGE, page 0Ah. For more details on the MODE SELECT and MODE SENSE commands refer to sections 4.1.11, 4.1.12, 4.3.4 and 4.3.5 of this document.

3.5 Physical Parameters Page

Of greatest concern to the manipulation of the physical layer of a direct access device is the basic drive format. Such items as physical sector format, positioning mechanism used, etc. are collectively presented via the Physical Parameters Page, 41h. This newly added page is accessible only via MODE SENSE in the Diagnostic Mode. Any other attempt to access this read only page will result in the command being terminated in CHECK CONDITION Status. The Sense key will be set to ILLEGAL REQUEST, Invalid Parameter Value.

3.6 Commands, Messages, Status and Sense Keys

Commands: Within the Diagnostic Command Set, the Mandatory SCSI-2 commands are replicated identically except for MODE SELECT and MODE SENSE. Refer to the MODE SELECT and MODE SENSE commands in section 4.1.11, 4.1.12, 4.3.4 and 4.3.5 for further details.

Messages: All of the supported messages in Standard SCSI are applicable to the Diagnostic SCSI. The message system is independent of the current operating mode.

Status: All of the supported status values in Standard SCSI are applicable to the Diagnostic SCSI. The status phase of SCSI is independent of the operating mode.

Sense Keys: All of the supported Sense keys and Sense Key Qualifiers in Standard SCSI are applicable to Diagnostic SCSI. Additional Sense Keys and Sense Key Qualifiers may be added for the purposes of DCS. See section 4.1.3, REQUEST SENSE, for a detailed list of the additional Sense Keys and Sense Key Qualifiers.

3.7 Optional and Vendor Unique Commands

The Mandatory portion of the Diagnostic Command Set is provided to supply Drive Tester Manufacturers the opportunity to access the common physical layer of the SCSI device. But, because devices will use (possibly) significantly different hardware, which may or may not have the capability to perform certain tasks, the Optional and Vendor Unique command groups are used exclusively for Drive Manufacturers to design their own command sets that supplement the Mandatory command set to assist in both the development and manufacturing stages of the direct access device life cycle.

4.0 Diagnostic Command Set

The Diagnostic Command Set is provided below in its entirety. The formulation of the Mandatory and Optional command sets reflects the SCSI-2, Rev 10b Draft Proposal as well as the X3B7.1 Preliminary Working Draft, Diagnostic Command Set for SCSI and SCSI-2.

Table 4.1: Typical Six Byte Diagnostic Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (xxh)							
1	Physical Drive Number (MSB)							
2	Physical Sector Address (if required)							
3	(LSB)							
4	Number of Sectors (if required) Parameter Value (if required) Allocation Length (if required)							
5	Control							

Table 4.2: Typical Ten Byte Diagnostic Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (xxh)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address (if required)							
4								
5	(LSB)							
6	(MSB)							
7	Number of Sectors (if required) Parameter List Length (if required) Allocation Length (if required)							
8	Reserved							
9	Control							

Table 4.3: Typical Twelve Byte Diagnostic Command
(Vendor Unique Only)

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (xxh)							
1	Physical Drive Number							
2	(MSB)							
3								
4	Physical Sector Address (if required)							
5	(LSB)							
6	(MSB)							
7	Number of Sectors (if required)							
8	Parameter List Length (if required)							
9	Allocation Length (if required)							
10	(LSB)							
11	Reserved							
	Control							

The following are the field descriptions as they differ from Standard SCSI:

Operation Code: The use of the three bit group code and five bit command code is modified as described below:

- Group 0 - standard six byte commands (as per SCSI-2 specification)
- Group 1 - standard ten byte commands (as per SCSI-2 specification)
- Group 2 - standard ten byte commands (as per SCSI-2 specification)
- Group 3 - diagnostic six byte commands (see table 4.1)
- Group 4 - diagnostic ten byte commands (see tables 4.2)
- Group 5 - standard twelve byte commands (as per SCSI-2 specification)
- Group 6 - vendor specific (see tables 4.1, 4.2, 4.3)
- Group 7 - vendor specific (see tables 4.1, 4.2, 4.3)

If an operation code other than those presented in tables 4.5, 4.6 and 4.7 is detected by the SCSI target, the command shall be terminated with CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Operation Code.

Physical Drive Number: This is the actual physical drive number attached to the target device. For example, if SCSI target ID 3 has logical units 0 and 1 partitioned amongst physical drive 0 then in Diagnostic SCSI there is only physical drive 0 attached to SCSI ID 3. The logical identity is not present. If the Physical Drive Number presented in the CDB is unknown to the SCSI target, the command will be terminated in CHECK CONDITION Status. The Sense Key shall be set to Physical Device Not Supported.

Physical Sector Address: This is the physical location request on the attached device expressed in terms of Cylinder, Head and Sector. The diagrams below show the differentiation between the different sized CDBs. If the Physical Sector Address provided in the CDB is beyond the scope of the device, the command shall be terminated in CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Physical Sector Address out of Range.

Table 4.4a 6 Byte CDB Physical Sector Address

Bit	7	6	5	4	3	2	1	0
Byte								
1	Physical Drive Number (MSB)							
2	Cylinder (0-8191)							(LSB)
3	Physical Head (0-7)			Physical Sector (0-31)				

Table 4.4b 10 and 12 Byte CDB Physical Sector Address

Bit	7	6	5	4	3	2	1	0
Byte								
2	(MSB)							
3	Physical Cylinder (0-65535)							(LSB)
4	Physical Head (0-255)							
5	Physical Sector (0-255)							

Number of Sectors: This is a count field of the number of physical sectors that are to be affected by the requested operation. If the Starting Physical Sector (Physical Cylinder, Physical Head, Physical Sector) plus the Number of Sectors equals a number greater than the total number of physical sectors on the physical drive, the command shall be terminated with CHECK CONDITION Status. The Sense key shall be set to ILLEGAL REQUEST, Invalid Field in CDB.

Parameter Value: If there is only a single parameter that must be passed to the target it will be contained directly in the CDB instead of creating a page to pass the data. If parameter checking is required for a specific command, and an invalid value is passed, the command shall be terminated in CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Parameter Value Invalid.

The following fields have the same meaning as in Standard SCSI:

- * Parameter List Length
- * Allocation Length
- * Control Byte

Table 4.5: Mandatory Diagnostic Commands for Direct Access Devices

Command Name	Operation Code	Section
Format Unit	04h	4.1.1
Inquiry	12h	4.1.2
Request Sense	03h	4.1.3
Read (6)	08h	4.1.4
Read (10)	28h	4.2.1
Read Capacity	25h	4.2.2
Read ID	87h	4.5.2
Read Physical (6)	68h	4.4.2
Read Physical (10)	88h	4.5.3
Release	17h	4.1.5
Reserve	16h	4.1.6
Send Diagnostic	1Dh	4.1.7
Test Unit Ready	00h	4.1.8
Translate Address	80h	4.5.4
Write (6)	0Ah	4.1.9
Write (10)	2Ah	4.2.3
Write Physical (6)	6Ah	4.4.3
Write Physical (10)	8Ah	4.5.6

Table 4.6: Optional Diagnostic Commands for Direct Access Devices (1)

Command Name	Operation Code	Section
Change Definition	40h	4.3.1
Compare	39h	4.2.4
Copy	18h	4.1.10
Copy and Verify	3Ah	4.2.5
DC Erase (6)	63h	4.4.4
DC Erase (10)	83h	4.5.7
Format Sector	86h	4.5.8
Format Track (6)	64h	4.4.1
Format Track (10)	84h	4.5.1
Lock-Unlock Cache	36h	4.2.6
Log Select	4Ch	4.3.2
Log Sense	4Dh	4.3.3

Table 4.6: Optional Diagnostic Commands for Direct Access Devices (2)

Command Name	Operation Code	Section	WD Support
Mode Select (6)	15h	4.1.11	
Mode Select (10)	55h	4.3.4	
Mode Sense (6)	1Ah	4.1.12	
Mode Sense (10)	5Ah	4.3.5	
Pre-Fetch	34h	4.2.7	
Prevent Media Removal	1Eh	4.1.13	
Read Buffer	3Ch	4.2.8	
Read Defect Data	37h	4.2.9	
Read Long	3Eh	4.2.10	
Reassign Blocks	07h	4.1.14	
Receive Diagnostic	1Ch	4.1.15	
Rezero Unit	01h	4.1.16	
Search Data Equal	31h	4.2.11	
Search Data Low	30h	4.2.12	
Search Data High	32h	4.2.13	
Seek (6)	0Bh	4.1.17	
Seek (10)	2Bh	4.2.14	
Seek Physical (6)	6Bh	4.4.7	
Seek Physical (10)	8Bh	4.5.9	
Set Cylinder Offset	81h	4.4.5	
Set Data Separator	82h	4.4.6	
Set Limits	35h	4.2.15	
Start Stop Unit	1Bh	4.1.18	
Synchronize Cache	35h	4.2.16	
Verify	2Fh	4.2.17	
Write Buffer	3Bh	4.2.18	
Write and Verify	2Eh	4.2.19	
Write ID	89h	4.5.5	
Write Long	3Fh	4.2.20	
Write Same	41h	4.3.6	

4.1 Group 0, Standard Six Byte Commands:

The Group 0 commands belong to both the standard SCSI and Diagnostic Command Sets.

4.1.1 Format Unit: See SCSI-2 Specification.

4.1.2 Inquiry:

When operating in Diagnostic SCSI, the INQUIRY CDB is unchanged. But, the target returned INQUIRY Data is slightly modified to include an indication of DCS Compliance. Below is the layout of the new INQUIRY Data.

Table 4.8 Standard INQUIRY Data Format

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
2	ISO Version		ECMA Version			ANSI Version		
3	AENC TrmIOP		Reserved			Response Data Format		
4	Additional Length (n-4)							
5	Reserved							
6	Reserved							
7	RelAdr	WBus32	WBus16	Sync	Linked	DCS	CmQue	SftRe
8	(MSB)							
Vendor Identification								----
15	(LSB)							
16	(MSB)							
Product Identification								----
31	(LSB)							
32	(MSB)							
Product Revision Level								----
35	(LSB)							
36	(MSB)							
Vendor Specific								----
55	(LSB)							
56								
Reserved								----
95								
Vendor Specific Parameters								
96 to n	(MSB)							
Vendor Specific Parameter Bytes								----
	(LSB)							

Changes to the Standard INQUIRY Data Format:

DCS: This bit is used to indicate the ability to operate in Diagnostic Command Mode. If this bit is set to one, the device will respond to operating mode change requests (see Operating Mode Detection and Modification, section 3.4). If this bit is set to zero, the device does not support the Diagnostic Command Set.

4.1.3 Request Sense:

The Standard SCSI REQUEST SENSE CDB and Standard SCSI supported Sense information is also replicated in Diagnostic mode. Below is a table of Additional Sense information added for the purpose of the DCS.

Table 4.9 DCS Sense Information

<u>SENSE Key</u>	<u>(Additional Sense Qualifier)</u>
(05h) Illegal Request	(26h,03h) Diagnostic ID Failure
	(21h,01h) Physical Sector Address Out of Range
	(21h,02h) Physical Cylinder Address Out of Range
	(25h,01h) Physical Drive Not Supported

4.1.4 Read (6): See SCSI-2 Specification.

4.1.5 Release: See SCSI-2 Specification.

4.1.6 Reserve: See SCSI-2 Specification.

4.1.7 Send Diagnostic: See SCSI-2 Specification.

4.1.8 Test Unit Ready: See SCSI-2 Specification.

4.1.9 Write (6): See SCSI-2 Specification.

4.1.10 Copy: See SCSI-2 Specification.

4.1.11 Mode Select (6): OPTIONAL

The six byte MODE SELECT command can only access the Control Mode Page while operating in Diagnostic SCSI mode. All other page accesses shall result in a CHECK CONDITION status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Field in Parameter List. The CDB and use of the MODE SELECT is otherwise identical to Standard SCSI.

Below is a description of the CONTROL MODE PAGE as modified to support DCS.

Table 4.10 Control Mode Page (SELECT)

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved		Page Code (0Ah)						
1	Page Length (0Eh)								
2	Reserved							RLEC	
3	Queue Algorithm Modifier				Operating Mode	QErr	DQue		
4	EECA	Reserved			REANP	UENP	EAENP		
5	Reserved								
6	Ready EAN Holdoff Period								----
7									
8	(MSB)								
Diagnostic Pattern ID								----	
15									(LSB)

Note: The field labeled UENP is referred to as UAAENP in the SCSI-2 Draft Proposal.

The following is a description of the fields not defined by the SCSI-2 document:

Operating Mode: This two bit field describes the current operating mode of the attached device.

Operating Mode	Description
00	Standard SCSI operation
01	Diagnostic Command Mode
10	Reserved
11	Reserved

If the attached device does not support DCS, these bits are reserved.

Diagnostic Pattern ID: This is an 8 byte, Vendor Unique field used to confirm the Diagnostic mode change request in a MODE SELECT command. This field not reported via MODE SENSE. If the target device does not support DCS, this field is reserved.

If the supplied 8 byte pattern matches the internal pattern within the DCS device, the returned status will be GOOD and the Operating Mode shall be reported as Diagnostic SCSI (01b in INQUIRY Operating Mode) until a reset condition or subsequent MODE SELECT changes the operating mode to Standard SCSI.

If the supplied 8 byte pattern does not match with the internal pattern of the DCS device, the command will terminate in CHECK CONDITION status. The Sense Key will be set to ILLEGAL REQUEST, Diagnostic ID Failure.

4.1.12 Mode Sense (6): OPTIONAL

The six byte MODE SENSE command is identical to the Standard SCSI MODE SENSE with the exception of an additional page. This page is read only and is used to convey physically related characteristics typically hidden and/or not required in the Standard mode of SCSI (i.e., not provided in either the Format Page or the Rigid Disk Page). This page is called the Physical Parameters Page. Any attempt to write to this page with MODE SELECT while in any operating mode or attempting to access in any manner while operating in Standard SCSI mode will result in the command being terminated with CHECK CONDITION Status. The Sense Key will be set to ILLEGAL REQUEST, Invalid Field in Parameter List. Below is a preliminary template of what might be useful information for the purposes of diagnostics.

Table 4.11 Physical Parameters Page (SENSE)

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS	[Reservd]	Page Code (41h)					
1		Page Length (0Eh)						
2		Sector ID Length, CYL						
3		Sector ID Length, HEAD						
4		Sector ID Length, SECTOR						
5		Register Length						
6	(MSB)	Reserved						----
7								(LSB)
8	(MSB)	Vendor Unique						----
15								(LSB)

PS: (Parameters Savable). This bit shall always be returned as zero.

Sector ID Length, CYL: This field is the number of bytes used to report the Cylinder portion of a Physical Sector Address within the Sector ID component.

Sector ID Length, HEAD: This field is the number of bytes used to report the Head portion of a Physical Sector Address within the Sector ID component.

Sector ID Length, SECTOR: This field is the number of bytes used to report the Sector portion of a Physical Sector Address within the Sector ID component.

The following is the MODE SENSE version of the CONTROL MODE PAGE (0Ah) as reported while in Diagnostic mode:

Table 4.12 Control Mode Page (SENSE)

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved		Page Code (0Ah)						
1	Page Length (0Eh)								
2	Reserved						RLEC		
3	Queue Algorithm Modifier				Operating Mode		QErr	DQue	
4	EECA	Reserved			REANP UENP		EAENP		
5	Reserved								
6	Ready EAN Holdoff Period								----
7									

The following is a description of the fields not defined by the SCSI-2 document:

Operating Mode: This two bit field describes the current operating mode of the attached device.

Operating Mode	Description
00	Standard SCSI operation
01	Diagnostic Command Mode
10	Reserved
11	Reserved

If the attached device does not support DCS, these bits are reserved.

4.1.13 Prevent Media Removal: See SCSI-2 Specification.

4.1.14 Reassign Blocks: See SCSI-2 Specification.

4.1.15 Receive Diagnostic: See SCSI-2 Specification.

4.1.16 Rezero Unit: See SCSI-2 Specification.

4.1.17 Seek (6): See SCSI-2 Specification.

4.1.18 Start Stop Unit: See SCSI-2 Specification.

4.2 Group 1, Standard Ten Byte Commands

- 4.2.1 Read (10): See SCSI-2 Specification.
- 4.2.2 Read Capacity: See SCSI-2 Specification.
- 4.2.3 Write (10): See SCSI-2 Specification.
- 4.2.4 Compare: See SCSI-2 Specification.
- 4.2.5 Copy and Verify: See SCSI-2 Specification.
- 4.2.6 Lock-Unlock Cache: See SCSI-2 Specification.
- 4.2.7 Pre-Fetch: See SCSI-2 Specification.
- 4.2.8 Read Buffer: See SCSI-2 Specification.
- 4.2.9 Read Defect Data: See SCSI-2 Specification.
- 4.2.10 Read Long: See SCSI-2 Specification.
- 4.2.11 Search Data Equal: See SCSI-2 Specification.
- 4.2.12 Search Data Low: See SCSI-2 Specification.
- 4.2.13 Search Data High: See SCSI-2 Specification.
- 4.2.14 Seek (10): See SCSI-2 Specification.
- 4.2.15 Set Limits: See SCSI-2 Specification.
- 4.2.16 Synchronize Cache: See SCSI-2 Specification.
- 4.2.17 Verify: See SCSI-2 Specification.
- 4.2.18 Write Buffer: See SCSI-2 Specification.
- 4.2.19 Write and Verify: See SCSI-2 Specification.
- 4.2.20 Write Long: See SCSI-2 Specification.

4.3 Group 2, Standard Ten Byte Commands:

- 4.3.1 Change Definition: See SCSI-2 Specification.
- 4.3.2 Log Select: See SCSI-2 Specification.
- 4.3.3 Log Sense: See SCSI-2 Specification.
- 4.3.4 Mode Select (10):

See the description of the MODE SELECT (6) command, section 4.1.11.

4.3.5 Mode Sense (10):

See the description of the MODE SENSE (6) command, section 4.1.12.

4.3.6 Write Same: See SCSI-2 Specification.

4.4 Groups 3, Diagnostic Six Byte Commands**4.4.1 Format Track (6): OPTIONAL**

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (64h)							
1	Physical Drive Number (MSB)							
2	Physical Cylinder Number (LSB)							
3	[HeadSw] Physical Head Number							
4	Number of Tracks							
5	Control							

Command Description: The Format Track command provides the Initiator a method of selectively formatting a specified range of tracks.

Physical Cylinder Number: This is the physical cylinder from which format shall start. The maximum physical starting cylinder is 2047.

HeadSw: If this bit is set to one, then the target device is not to switch heads when formatting the range of tracks specified. If this bit is set to zero, then all of the heads are to be used in the formatting process.

Physical Head Number: This is the physical head from which formatting shall start. This field is only valid if the HeadSw bit is set to one. If the Head Sw bit is set to zero, this field is reserved. Any non-zero value in this field when the HeadSw bit is set to zero shall terminate the command in CHECK CONDITION status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Field in CDB.

Number of Tracks: The count of tracks that are to be formatted. If the Starting Cylinder Address plus the Number of Tracks equals a number greater than the physical number of cylinders on the drive, the command shall be terminated in CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid field in CDB.

4.4.2 Read Physical (6): MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (68h)							
1	Physical Drive Number (MSB)							
2	Physical Sector Address							
3	(LSB)							
4	Number of Sectors							
5	Control							

Command Description: The Read Physical (6) command ignores the logical mapping that typically hides that actual physical location of sectors. The initiator specifies exactly the sector requested for the purposes of reading data from the disk. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST, Physical Sector Address Out of Range.

4.4.3 Write Physical (6): MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (6Ah)							
1	Physical Drive Number (MSB)							
2	Physical Sector Address							
3	(LSB)							
4	Number of Sectors							
5	Control							

Command Description: The Write Physical (6) command ignores the logical mapping that typically hides that actual physical location of sectors. The initiator specifies exactly the sector requested and transfers data to the target for writing to the disk. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST, Physical Sector Address Out of Range.

4.4.4 DC Erase (6): OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (63h)							
1	Physical Drive Number (MSB)							
2	Physical Sector Address							
3	(LSB)							
4	Number of Sectors							
5	Control							

Command Description: The DC Erase (6) command allows the initiator to request that an entire area of disk be "wiped clean". If the target device does not support this feature (no facilities or operation critical information), the command shall be terminated in CHECK CONDITION status. The Sense Key shall be set to ILLEGAL REQUEST. Invalid Operation Code. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST. Physical Sector Address Out of Range.

4.4.5 Set Cylinder Offset: OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (81h)							
1	Physical Drive Number (MSB)							
2	Reserved							
3	(LSB)							
4	Offset Value							
5	Control							

Command Description: The Set Cylinder Offset passes a value to the target to be applied to the position algorithm. What these values are and how they affect the off-track calculations is vendor unique. If the value in the CDB is invalid for the attached target, the command will terminate in CHECK CONDITION Status. The Sense Key will be set to ILLEGAL REQUEST. Invalid Field in CDB.

Offset Value: Vendor Specific.

4.4.6 Set Data Separator: OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (82h)							
1	Physical Drive Number (MSB)							
2	Reserved							
3								(LSB)
4	Data Separator Value							
5	Control							

Command Description: The Set Data Separator passes a value to the target to be applied to the Data Window calculations. What these values are and how they affect the Data Margins is vendor unique. If the value in the CDB is invalid for the attached target, the command will terminate in CHECK CONDITION Status. The Sense Key will be set to ILLEGAL REQUEST, Invalid Field in CDB.

Data Separator Value: Vendor Specific.

4.4.7 Seek Physical (6): OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (82h)							
1	Physical Drive Number (MSB)							
2	Physical Cylinder Address (LSB)							
3	Reserved							
4	Reserved							
5	Control							

Command Description: The Seek Physical (6) command provides a manner for a SCSI initiator to instruct a DCS compliant target to position the data heads over a specific physical cylinder.

Physical Cylinder Address: This field is the actual cylinder to which the data heads are to be moved. If the value provided is outside the bounds of the physical device, the command shall be terminated with CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Physical Cylinder Address Out of Range.

4.5 Group 4, Diagnostic Ten Byte Commands:**4.5.1 Format Track (10): OPTIONAL**

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (84h)							
1	HeadSw	Physical Drive Number						
2	(MSB)							
3								
4		Physical Cylinder Number						
5		(LSB)						
6		Physical Head Number						
7	(MSB)	Number of Tracks						
8		(LSB)						
9		Control						

Command Description: The Format Track command provides the Initiator a method of selectively formatting a specified range of tracks.

HeadSw: If this bit is set to one, then the target device is not to switch heads when formatting the range of tracks specified. If this bit is set to zero, then all of the heads are to be used in the formatting process.

Physical Cylinder Number: This is the physical cylinder from which format shall start. The maximum physical starting cylinder is 65535.

Physical Head Number: This is the physical head from which formatting shall start. This field is only valid if the HeadSw bit is set to one. If the Head Sw bit is set to zero, this field is reserved. Any non-zero value in this field when the HeadSw bit is set to zero shall terminate the command in CHECK CONDITION status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Field in CDB.

Number of Tracks: The count of tracks that are to be formatted. If the Starting Cylinder Address plus the Number of Tracks equals a number greater than the physical number of cylinders on the drive, the command shall be terminated in CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid field in CDB.

4.5.2 Read ID: MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (87h)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address							
4								
5								(LSB)
6	(MSB)							
7	Number of Sectors							(LSB)
8	Allocation Length							
9	Control							

Command Description: The Read ID command requests that the sector IDs of a range of physical sectors be passed back to the initiator during an ensuing data phase.

Number of Sectors: If this value is non-zero, then the Physical Sector ID of the sector specified in the Physical Sector Address is passed back. The Allocation Length should match or exceed the total bytes required to identify a sector as specified via the Physical Parameters Page. (See MODE SENSE (6), section 4.1.12).

If this field is zero, then the initiator is requesting the entire track of IDs. The target shall return as much data as is available or the number of bytes specified in the Allocation Length field, whichever is less. Further, the Physical Sector Address will be rounded down to align on a cylinder boundary.

Allocation Length: This is the number of bytes allotted for the returned data. If the Number of Sectors value is non-zero and the Allocation Length does not meet or exceed the requirement for identifying a sector (as reported in the Physical Parameters Page), the command shall be terminated with CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Field in CDB. If the Allocation Length provided is greater than the amount required, the target shall return only the number of bytes required to identify the sector.

If the Number of Sectors field is set to zero (return the entire track), then the Allocation Length shall be used as an upper bound on the amount of data bytes returned for this request.

4.5.3 Read Physical (10): MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (88h)							
1	Physical Drive Number							
2	(MSB)							
3								
4	Physical Sector Address							
5								
6	(MSB)							
7	Number of Sectors							
8								
9	Control							

Command Description: The Read Physical (10) command ignores the logical mapping that typically hides that actual physical location of sectors. The initiator specifies exactly the sector requested for the purposes of reading data from the disk. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST, Physical Sector Address Out of Range.

4.5.4 Translate Address: MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (80h)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address or Logical Block Address							
4								
5	(LSB)							
6	Phys	Reserved						
7	Reserved							
8	Reserved							
9	Control							

Command Description: The Translate Address command requests that either a Physical Sector address be converted into a Logical Block Address or vice versa. The result of the conversion is passed back during a data phase in four bytes. If the conversion was physical to logical, the result is a 32 bit LBA. If the conversion is logical to physical, the result is as illustrated below:

Bit	7	6	5	4	3	2	1	0
Byte								
0	Physical Cylinder Number							
1								
2	Physical Head Number							
3	Physical Sector Number							

If the conversion is from Physical to Logical, the return data shall be in the format:

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB)							
1	Logical Block Address							
2								
3								(LSB)

Phys: If this bit is set to one, then a Physical to Logical conversion is being requested. If this bit is set to zero, then a Logical to Physical conversion is being requested.

4.5.5 Write ID: OPTIONAL

This command intentional left incomplete to review its feasibility and desireability.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (89h)							
1	Physical Drive Number							
2	Physical Sector Address							
3								
4								
5								(LSB)
6	Number of Sectors							
7								(LSB)
8	Reserved							
9	Control							

Command Description: The Write ID command requests that the sector IDs of a range of physical sectors be written to the sector ID fields of the specified range of physical sectors. The format of the ID field is as follows:

**** Complete this...Is it vendor Unique?? ****

The data phase that follows the command phase consists of (Number of Sectors) * (Size of ID Field) bytes long.

**** Account for invalid ID field data passed ****

4.5.6 Write Physical (10): MANDATORY

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (8Ah)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address							
4								
5								(LSB)
6	(MSB)							
7	Number of Sectors							(LSB)
8	Reserved							
9	Control							

Command Description: The Write Physical (10) command ignores the logical mapping that typically hides that actual physical location of sectors. The initiator specifies exactly the sector requested and transfers data to the target for writing to the disk. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST, Physical Sector Address Out of Range.

4.5.7 DC Erase (10): OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (83h)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address							
4								
5								(LSB)
6	(MSB)							
7	Number of Sectors							(LSB)
8	Reserved							
9	Control							

Command Description: The DC Erase (10) command allows the initiator to request that an entire area of disk be "wiped clean". If the target device does not support this feature (no facilities or operation critical information), the command shall be terminated in CHECK CONDITION status. The Sense Key shall be set to ILLEGAL REQUEST, Invalid Operation Code. If the requested sector(s) is (are) not within the physical limits of the device, the command is terminated with CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST, Physical Sector Address Out of Range.

4.5.8 Format Sector: OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (86h)							
1	Physical Drive Number							
2	(MSB)							
3	Physical Sector Address							
4								
5								
6								
7	Reserved							
8	Reserved							
9	Control							

Command Description: The Format Sector command instructs the target to format a single physical sector.

4.5.9 Seek Physical (10): OPTIONAL

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (8Bh)							
1	Physical Drive Number							
2	(MSB)							
3								
4	Physical Cylinder Address							
5								
6	(MSB)							
7	Reserved							
8								
9	Control							

Command Description: The Seek Physical (10) command provides a manner for a SCSI initiator to instruct a DCS compliant target to position the data heads over a specific physical cylinder.

Physical Cylinder Address: This field is the actual cylinder to which the data heads are to be moved. If the value provided is outside the bounds of the physical device, the command shall be terminated with CHECK CONDITION Status. The Sense Key shall be set to ILLEGAL REQUEST, Physical Cylinder Address Out of Range.

4.6 Group 5, Standard Twelve Byte Commands:

There are currently no command opcodes used in group 5.

4.7 Groups 6 and 7, Standard and Diagnostic Vendor Specific Commands:

This command group provides the flexibility for design specific test commands to be specified for the purposes of Development and/or Manufacturing debug, etc.