



# UDO30 Drive

## Product Specification

## Modifications Since Last Revision

Rev A – No revisions (first release)

Rev B – Add second eject position, add spec for back force in eject position, update drawings and dimensions, revised function connector specification, add power and current estimates, update SCSI section

Rev C – Airflow specification modified for direction, revised bezel drawing, revised function connector specification, revised SCSI specification to reduce changes from 14X MO

Rev D – Updated power specification, changed media terminology from R to Write Once and RW to Rewritable, updated drawings, vertical orientation only allowed left side up.

Rev E – Corrected definition of Drive Ready pin on the Function Connector, added note regarding Prevent Media Removal on the Function Connector, clarified Function Connector as +5V tolerant, updated Performance specifications, added Read/Write Error Rate, updated SCSI commands, revised Serial Interface section, updated Power Dissipation, added Weight specifications

Rev F – Added buffer size, eliminated DAIR support, updated SCSI commands

Rev G – Updated SCSI commands, update disk rotation rate and maximum data rates for latest version of WO media

Rev H – Changed maximum load force (section 4.10) to 10,000gf, changed burst data transfer rate for synchronous LVD (section 2.9) to 40MB/sec, updated Read Sector Location command

Rev J – Changed average seek time to 35 msec (section 2.7), changed minimum operating temperature to 15°C (section 7.1), changed 3 msec non-operating shock to 75g, eliminated trapezoidal non-operating shock specification (section 7.6), updated serial commands (section 12.3.2), added Disable Read-Ahead, No Blank Check and Busy Timeout to Vendor Unique Page (section 11.8.7), updated DC current specification (section 3.1), added Type 5 to defect list format, added DFKF bit to Defect Descriptor for Defect List Format 0 (section 11.15), updated Additional Sense Codes (section 11.20.2), updated Bezel Drawing (section 5.1), updated Indicator LED table (section 5.2), updated Transfer Period Values table (section 9.8.4.1), removed column on which commands may disconnect from SCSI commands table (section 11.1).

## UDO Product Specification

Rev K – Added TIN control to function connector (section 6.3), Corrected description of Log Sense Page 7 and log size from 50 to 200 events (section 11.6.4).

Changed “Mean Swaps Before Failure” for Vertical Loads from 50,000 to 500,000 (section 8.2). Changed max burst size from 256K to 1024K(section 11.8.3). Changed Microcode download description (section 11.31). Changed Mode Sense Disconnect-Reconnect Parameter page number from 01H to 02H (section 11.9.3). Added Disable Read Ahead, MMSU, Sleep Time, BTC, NoBC, Busy Timeout to Mode Sense Page 21. (section 11.9.7). Added UnRq bit and description to Mode Sense page 21 (section 11.9.7). Changed page breaks to allow for commands to start at top of page. Changed average and full stroke seek times (section 2.7).

Rev K – Added log sense page 3E description (section 11.6). Added tilt specification (section 4.5). Added additional definition of Request Sense block (section 11.20). Added Recovered error description for spares full early warning. (section 11.2, 11.29, 11.30). Changed Information Bytes description, added description for Command Specific bytes, Additional Sense Code, and Additional Sense Code Qualifier. (section 11.20). Remove cache bit from mode sense header. (section 11.9). Added Compliant Write Once Media support and Shred Command support (section 1.0, 2.6, 2.10, 2.11, 11.1, 11.7, 11.9, 11.16, 11.20.2, 11.25, 11.29, 11.33, 13.0).

Rev L – Changed Field Pointer to Information bytes under ASC/ASCQ 04/04 (section 11.20.2). Added BPC Values to Request Sense bytes 160-163. Added Security Command (section 11.23). Added sense asc/ascq for security command (section 11.20.2). Added LED display description for WPC failure. (section 5.2).

**Table of Contents**

UDO30 Drive..... 1

Product Specification..... 1

1 – Overview..... 9

2 – Performance ..... 9

    2.1 – Power on to Ready Time ..... 9

    2.2 – Load Time ..... 9

    2.3 – Unload Time..... 9

    2.4 – Spin-up Time ..... 9

    2.5 – Spin-down Time ..... 9

    2.6 – Disk Rotation Speed ..... 9

    2.7 – Seek Times ..... 10

    2.8 – Buffer Size..... 10

    2.9 – Burst Data Transfer Rate ..... 10

    2.10 – Maximum Sustained Read Data Transfer Rate ..... 10

    2.11 – Maximum Sustained Write and Verify Data Transfer Rate ..... 10

3 – Electrical ..... 11

    3.1 – Supply Voltages and Currents ..... 11

    3.2 – Power Dissipation..... 11

    3.3 – Power Supply Rise and Fall Time ..... 11

4 – Mechanical..... 12

    4.1 – Drive Dimensions (not including bezel)..... 12

    4.2 – Bezel Dimensions (not including eject button) ..... 12

    4.3 – Mounting Hole Location ..... 12

    4.4 – Orientation..... 12

    4.5 – Eject Distance ..... 12

    4.6 – Eject Force..... 12

    4.7 – Back Force in Eject Position ..... 13

    4.8 - Pull-out Force..... 13

    4.9 – Insertion Distance ..... 13

    4.10 – Insertion Force..... 13

    4.11 – Weight ..... 13

5 – Bezel ..... 14

    5.1 – Bezel Drawing ..... 14

    5.2 – Indicator LEDs ..... 14

6 – Drive Interface Connectors ..... 15

    6.1 – DC Power Connector..... 15

    6.2 – SCSI Connector ..... 16

## UDO Product Specification

6.3 – Function Connector .....	17
6.4 – Connector Location and Orientation .....	19
7 – Environmental/Safety .....	19
7.1 – Ambient Temperature.....	19
7.2 – Cooling Requirements .....	19
7.3 – Humidity.....	20
7.4 – Random Vibration .....	20
7.5 – Swept Sine Vibration.....	20
7.6 – Shock.....	21
7.7 – Drop (Packaged).....	21
7.8 – Altitude .....	21
7.9 – Acoustical Noise.....	21
7.10 – Electrostatic Discharge Susceptibility.....	21
7.11 – Magnetic Field Susceptibility.....	22
7.12 – Radiated Field Susceptibility.....	22
7.13 – Magnetic Field Interference .....	22
7.14 – Radiated Interference.....	22
7.15 – Safety Compliance.....	22
8 – Reliability.....	23
8.1 – Mean Time Before Failure .....	23
8.2 – Mean Swaps Before Failure .....	23
8.3 – Read/Write Error Rate .....	23
8.4 – Seek Error Rate.....	23
9 – SCSI Bus Phases and Conditions.....	24
9.1 – Arbitration Phase .....	24
9.2 – Bus Free Phase .....	24
9.3 – Selection Phase .....	24
9.4 – Reselection Phase .....	24
9.5 – Information Transfer Phases.....	24
9.6 – Data Phase .....	24
9.7 – Command Phase .....	25
9.8 – Message Phase.....	25
9.8.1 – Message Protocol .....	25
9.8.2 – Target Supported Messages .....	27
9.8.3 – Command Complete Message.....	27
9.8.4 – Extended Message.....	28
9.8.4.1 – Synchronous Data Transfer Request (SDTR).....	28
9.8.4.2 – Wide Data Transfer Request (WDTR) .....	31
9.8.5 – Save Data Pointer Message.....	33
9.8.6 – Restore Pointers Message.....	33
9.8.7 – Disconnect Message.....	34
9.8.8 – Initiator Detected Error Message .....	34
9.8.9 – Abort Message.....	34

## UDO Product Specification

9.8.10 – Message Reject Message.....	34
9.8.11 – No Operation Message .....	35
9.8.12 – Message Parity Error Message.....	35
9.8.13 – Bus Device Reset Message .....	36
9.8.14 – Abort Tag Message .....	36
9.8.15 – Clear Queue Message.....	36
9.8.16 – Queue Tag Messages.....	36
9.8.16.1 – Simple Queue Tag Message .....	37
9.8.16.2 – Head of Queue Tag Message .....	37
9.8.16.3 – Ordered Queue Tag Message.....	37
9.8.17 – Ignore Wide Residue Message.....	37
9.8.18 – Identify Message .....	38
9.9 – Status Phase .....	38
9.9.1 – Target Supported Status Codes .....	39
9.9.2 – Good Status .....	39
9.9.3 – Check Condition Status.....	39
9.9.4 – Condition Met Status.....	39
9.9.5 – Busy Status.....	39
9.9.6 – Reservation Conflict Status.....	39
9.9.7 – Queue Full Status .....	40
9.10 – Attention Condition .....	40
9.11 – Reset Condition .....	41
9.12 – Unit Attention Condition.....	42
10 – SCSI Command Structure.....	42
10.1 – Command Implementation Requirements.....	42
10.2 – Reserved .....	42
10.3 – Command Descriptor Block (CDB) .....	42
10.3.1 – Operation Code .....	43
10.3.2 – Typical Command Descriptor Block for 6 Byte Commands .....	43
10.3.3 – Typical Command Descriptor Block for 10 Byte Commands .....	44
10.3.4 – Typical Command Descriptor Block for 12 Byte Commands .....	44
10.3.5 – Logical Unit Number (LUN).....	44
10.3.6 – Control Field .....	44
10.3.6.1 – Physical Block Address (PBA).....	44
10.3.6.2 – Control .....	45
10.4 – Selection of a Logical Unit.....	45
10.5 – Disconnect Conditions.....	45
10.6 – Cache Operations.....	45
11.1 – SCSI Commands .....	46
11.2 – Erase Command.....	48
11.3 – Format Unit Command.....	50
11.4 – Inquiry Command.....	53
11.4.1 – Supported Vital Product Data Pages .....	54
11.4.2 – Unit Serial Number Page.....	54
11.4.3 – Media ID Page.....	55

## UDO Product Specification

11.4.4 – DMA Serial Number Page .....	55
11.4.5 – Standard Inquiry Command Returned Data .....	55
11.5 – Log Select Command .....	59
11.6 – Log Sense Command.....	61
11.6.1 – Log Sense Pages.....	62
11.6.2 – Supported Log Pages.....	62
11.6.3 – Error Counter Pages (02H,03H,05H,33H,34H) .....	63
11.6.4 – Error Event Page (07H).....	64
11.6.5 – Error Statistics Log Page (37H) .....	65
11.6.6 – Debug Log Pages (38H-3BH) .....	66
11.6.7 – Certification Statistics Log Page (3DH).....	66
11.6.8 – ASCII Configuration/Error Event Log Page (3EH).....	67
11.7 – Medium Scan Command .....	68
11.8 – Mode Select Command .....	71
11.8.1 – Mode Select Page Codes .....	73
11.8.2 – Read-Write Error Recovery Parameters Page (01H) .....	74
11.8.3 – Device Disconnect-Reconnect Control Parameters Page (02H) .....	75
11.8.4 – Caching Page (08H) .....	76
11.8.5 – Control Mode Page (0AH) .....	77
11.8.6 – Medium Types Supported Page (0BH) .....	78
11.8.7 – Vendor Unique Page (21H).....	79
11.9 – Mode Sense Command.....	82
11.9.1 – Mode Sense Page Codes .....	86
11.9.2 – Read-Write Error Recovery Parameters Page (01H) .....	86
11.9.3 – Device Disconnect-Reconnect Control Parameters Page (02H).....	87
11.9.4 – Caching Page (08H) .....	88
11.9.5 – Control Mode Page (0AH) .....	88
11.9.6 – Medium Types Supported Page (0BH) .....	89
11.9.7 – Vendor Unique Page (21H).....	89
11.9.8 – Return All Supported Pages .....	90
11.10 – Pre-Fetch Command.....	91
11.11 – Prevent-Allow Media Removal Command .....	92
11.12 – Read Command .....	93
11.13 – Read Buffer Command.....	95
11.14 – Read Capacity Command .....	97
11.15 – Read Defect Data Command .....	98
11.16 – Read Long Command.....	103
11.17 – Read Sector Location Command.....	105
11.18 – Receive Diagnostic Results Command .....	106
11.19 – Release Command .....	108
11.20 – Request Sense Command .....	110
11.20.1 – Sense Keys .....	114
11.20.2 – Additional Sense Codes .....	115
11.21 – Reserve Command.....	120
11.22 – Rezero Unit Command .....	122
11.23 - Security Control Command.....	123

## UDO Product Specification

11.24 – Seek Command.....	127
11.25 – Send Diagnostic Command .....	128
11.26 – Shred Command .....	130
11.27 – Start/Stop Unit Command .....	132
11.28 – Synchronize Cache Command .....	133
11.29 – Test Unit Ready Command .....	134
11.30 – Verify Command.....	135
11.31 – Write Command .....	137
11.32 – Write and Verify Command .....	139
11.33 – Write Buffer Command.....	141
11.34 – Write Long Command.....	144
12 – Serial Interface .....	146
12.1 – Physical Characteristics.....	146
12.2 – Packet Protocol.....	146
12.2.1 – Protocol Control Characters.....	146
12.2.2 – General Packet Format and Framing.....	146
12.2.3 – Character Stuffing .....	147
12.2.4 – Checksum.....	147
12.2.5 – Packet Transmission.....	148
12.3 – Command Set .....	149
12.3.1 – General Command Format .....	149
12.3.2 – Command Byte Definition .....	149
12.3.3 – Drive Command Descriptions.....	151
12.3.3.1 – Get Drive Status Command.....	152
12.3.3.2 – Get Drive Information Command.....	153
12.3.3.3 – Get Error Information Command .....	153
12.3.3.4 – Get Media ID Command.....	153
12.3.3.5 – Get Drive Configuration Command .....	154
12.3.3.6 – Set Drive Configuration Command .....	154
12.3.3.7 – Dump Memory Command.....	155
12.3.3.8 – Load Media Command .....	155
12.3.3.9 – Eject Media Command .....	155
12.3.3.10 – Spin Up Media Command .....	156
12.3.3.11 – Spin Down Media Command .....	156
12.3.3.12 – Move Loader to Short Unload Position .....	156
12.4 – Packet Protocol Example.....	157
13 – Compliant Write Once Media.....	158



## 1 – Overview

The Plasmon UDO drive is a 5 ¼” half high form factor optical disk drive. The drive can read and write both Write Once, Compliant Write Once, and Rewritable media. The media capacity is 30GB. The media sector size is 8KB. The drive attaches to the host computer via a Wide Ultra 2 LVD SCSI interface (40MB/sec transfer rate).

## 2 – Performance

### 2.1 – Power on to Ready Time

The time required from when the drive power is applied until the drive comes ready.

Power on to Ready Time      20 sec maximum

### 2.2 – Load Time

The time required from when the drive recognizes that a cartridge has been inserted until it will respond ready to a SCSI command.

Load Time                      5 sec typical

### 2.3 – Unload Time

The time required from when an eject command is issued to the drive until the cartridge is ejected.

Unload Time                    3 sec typical

### 2.4 – Spin-up Time

2 sec typical

### 2.5 – Spin-down Time

2 sec typical

### 2.6 – Disk Rotation Speed

Write Once Media              2100 rpm +/- 0.5%

Compliant Write Once Media 1950 rpm +/- 0.5%

Rewritable Media                1950 rpm +/- 0.5%

## UDO Product Specification

### 2.7 – Seek Times

The time required for the optical head to move, not including SCSI command overhead.

Single Track	2 msec typical
Average	28 msec typical
Full Stroke	68 msec typical

### 2.8 – Buffer Size

32 Mbytes

### 2.9 – Burst Data Transfer Rate

Synchronous LVD	40MB/sec
Synchronous Single Ended	40MB/sec

### 2.10 – Maximum Sustained Read Data Transfer Rate

	<u>OD</u>	<u>ID</u>
Write Once Media	8.03 MB/sec	3.73 MB/sec
Compliant Write Once Media	7.99 MB/sec	3.73 MB/sec
Rewritable Media	7.99 MB/sec	3.73 MB/sec

### 2.11 – Maximum Sustained Write and Verify Data Transfer Rate

	<u>OD</u>	<u>ID</u>
Write Once Media	4.01 MB/sec	1.86 MB/sec
Compliant Write Once Media	3.99 MB/sec	1.86 MB/sec
Rewritable Media	3.99 MB/sec	1.86 MB/sec

# UDO Product Specification

## 3 – Electrical

### 3.1 – Supply Voltages and Currents

DC Voltage +5V +/- 5% (maximum ripple voltage 50mV peak to peak)  
+12V +/- 5% (maximum ripple voltage 100mV peak to peak)

		<u>Minimum</u>	<u>Typical</u>	<u>Maximum</u>
DC Current	+5V	0.5A	1.9A	2.5A
	+12V	0.0A	0.6A	2.8A (Peak – 100msec Max)

### 3.2 – Power Dissipation

	<u>Typical</u>
Idle (no media in drive)	9W
Disk Spin Up	22W (2.1 sec Max)
Reading	13.5W
Writing	14.5W
Seeking	21W

### 3.3 – Power Supply Rise and Fall Time

Power supply must achieve 90% of final value in <0.5 seconds for both power on and off.

# UDO Product Specification

## 4 – Mechanical

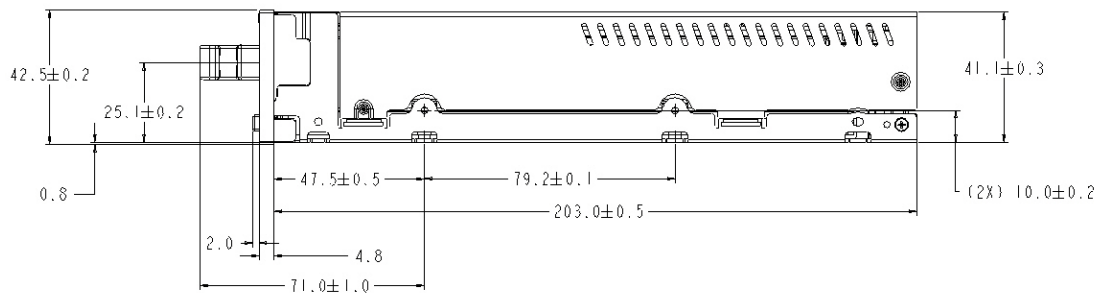
### 4.1 – Drive Dimensions (not including bezel)

Height	41.1 +/-0.3 mm
Width	146 +/-0.3 mm
Depth	203.0 +/- 0.5 mm

### 4.2 – Bezel Dimensions (not including eject button)

Height	42.5 +/- 0.2 mm
Width	148.0 +/- 0.2 mm
Depth	4.8 +/- 0.2 mm

### 4.3 – Mounting Hole Location



### 4.4 – Orientation

The drive may be mounted in either a horizontal or vertical (left side – power connector up only) orientation. Tilt less than +/- 10 degrees.

### 4.5 – Eject Distance

The cartridge eject distance measured from the bottom front mounting holes to the protruding edge of the cartridge.

71.0 +/- 1 mm – Standalone mode
51.3 +/- 1 mm – Automation mode

### 4.6 – Eject Force

The force applied to the cartridge by the drive during the cartridge ejection process.

300 gf maximum

## UDO Product Specification

### 4.7 – Back Force in Eject Position

The back force that may be applied to the cartridge without damaging the drive when in the eject position.

6000 gf

### 4.8 - Pull-out Force

The pull-out force required to remove the cartridge from the drive after it has been ejected the distance specified in section 4.5.

400gf maximum

### 4.9 – Insertion Distance

The cartridge insertion distance required to complete the loading process, measured from the bottom front mounting holes to the protruding edge of the cartridge.

71.0 +/- 1 mm

### 4.10 – Insertion Force

The force applied to the cartridge to cause the drive to complete the loading process.

500 gf maximum

The force applied to the cartridge without damaging the drive.

10000 gf

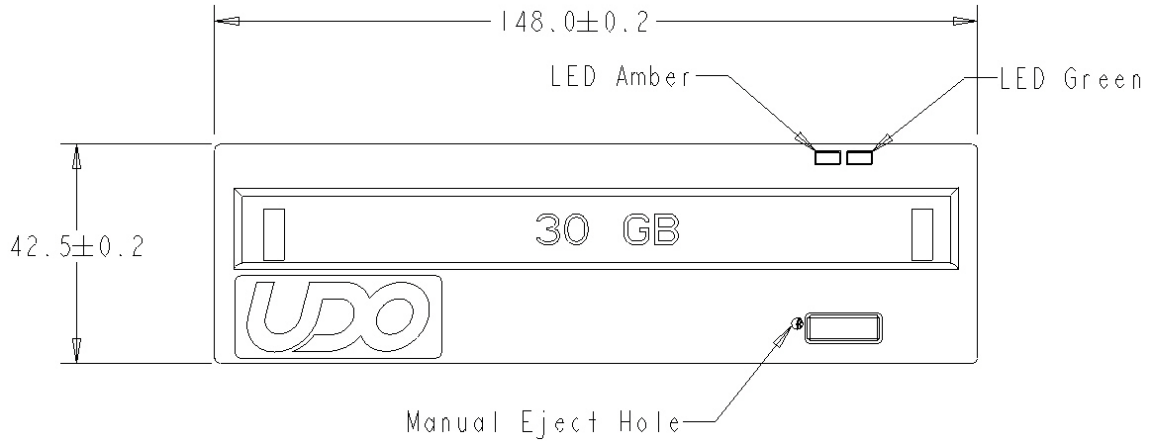
### 4.11 – Weight

Drive (without cartridge or bezel)	1180 g typical
Bezel	17 g typical

# UDO Product Specification

## 5 – Bezel

### 5.1 – Bezel Drawing



### 5.2 – Indicator LEDs

LED PATTERN	ACTIVE (Amber)	READY (Green)
On	Accessing disk Power on diagnostic	Media ready Power on diagnostic
Flashing 0.8 sec cycle ON:OFF = 1:1	NA	Inaccessible disk inserted (Drive Not Ready)
Rapid Flashing 0.2 sec cycle ON:OFF = 1:1	NA	Loading (Spin up)
Slow Flashing Variable cycle Alternating LEDs	Amber/Green irregular alternating: Drive is in Fail-Safe mode Power on diagnostic error	
Off	Disk not inserted After spin down Power off (Drive Not Ready)	
Slow Flashing 1.2 sec ON, 1.2 sec OFF	Both LEDs ON for 1.2 sec and then OFF for 1.2 sec.. Indicates drive failed write power calibration and should be cleaned.	

## 6 – Drive Interface Connectors

### 6.1 – DC Power Connector

The DC Power connector is an industry standard keyed 4 pin power connector. See section 6.4 for connector location and orientation.

<b>PIN</b>	<b>DESCRIPTION</b>
1	+12V DC
2	+12V DC Return
3	+5V Return
4	+5V DC

## UDO Product Specification

### 6.2 – SCSI Connector

The SCSI connector is a keyed 68 pin micro-D connector consisting of two rows of 34 pins with 1.27 mm (50 mil) spacing. See section 6.4 for connector location and orientation.

PIN	DESCRIPTION (SE/LVD)	PIN	DESCRIPTION (SE/LVD)
1	SR/+DB12	35	-DB12/-DB12
2	SR/+DB13	36	-DB13/-DB13
3	SR/+DB14	37	-DB14/-DB14
4	SR/+DB15	38	-DB15/-DB15
5	SR/+DBP1	39	-DBP1/-DBP1
6	SR/+DB0	40	-DB0/-DB0
7	SR/+DB1	41	-DB1/-DB1
8	SR/+DB2	42	-DB2/-DB2
9	SR/+DB3	43	-DB3/-DB3
10	SR/+DB4	44	-DB4/-DB4
11	SR/+DB5	45	-DB5/-DB5
12	SR/+DB6	46	-DB6/-DB6
13	SR/+DB7	47	-DB7/-DB7
14	SR/+P_CRCA	48	-DBP/-P_CRCA
15	GND/GND	49	GND/GND
16	DIFFSENSE	50	GND/GND
17	TPWR/TPWR	51	TPWR/TPWR
18	TPWR/TPWR	52	TPWR/TPWR
19	RSVD/RSVD	53	RSVD/RSVD
20	GND/GND	54	GND/GND
21	SR/+ATN	55	-ATN/-ATN
22	GND/GND	56	GND/GND
23	SR/+BSY	57	-BSY/-BSY
24	SR/+ACK	58	-ACK/-ACK
25	SR/+RST	59	-RST/-RST
26	SR/+MSG	60	-MSG/-MSG
27	SR/+SEL	61	-SEL/-SEL
28	SR/+C/D	62	-C/D/-C/D
29	SR/+REQ	63	-REQ/-REQ
30	SR/+I/O	64	-I/O/-I/O
31	SR/+DB8	65	-DB8/-DB8
32	SR/+DB9	66	-DB9/-DB9
33	SR/+DB10	67	-DB10/-DB10
34	SR/+DB11	68	-DB11/-DB11
SR = Signal Return GND = Ground		RSVD = Reserved TPWR = Term Power	



## UDO Product Specification

### 6.3 – Function Connector

The Function connector is a shrouded, keyed, 24 pin connector consisting of two rows of 12 pins with 2 mm spacing. See section 6.4 for connector location and orientation. The Function connector operates in Standalone (S) mode when Pin11 is high (or not connected) and in Automation (A) mode when Pin 11 is driven low. All Function connector I/O is +5V tolerant.

PIN	DESCRIPTION (S/A MODE)	DEFINITION
1	SCSI ID3	Bit 3 of the SCSI ID; ID3, ID2, ID1 and ID0 make up the drive SCSI ID (S) – A jumper on pins 1-2 sets this bit (A) – This pin is driven active low by the automation to set this bit and is pulled high by the drive
2	GND/Drive Sense	Ground pin (A) – This pin is used by the automation to sense drive present, it is pulled high by the automation
3	SCSI ID2	Bit 2 of the SCSI ID (S) – A jumper on pins 3-4 sets this bit (A) – This pin is driven active low by the automation to set this bit and is pulled high by the drive
4	VGND/Status	(S) – Virtual Ground (A) – This pin indicates that the drive has status available from the serial port, it is driven active low by the drive and is pulled high by the automation
5	SCSI ID1	Bit 1 of the SCSI ID (S) – A jumper on pins 5-6 sets this bit (A) – This pin is driven active low by the automation to set this bit and is pulled high by the drive
6	VGND/LED1 Pipe	(S) – Virtual Ground (A) – This pin is a representation of the drive's front panel activity indicator green LED, allowing the LED to be displayed on the automation front panel, it is driven active low by the drive when the LED is active and is pulled high by the automation
7	SCSI ID0	Bit 0 of the SCSI ID (S) – A jumper on pins 7-8 sets this bit (A) – This pin is driven active low by the automation to set this bit and is pulled high by the drive
8	VGND/LED2 Pipe	(S) – Virtual Ground (A) – This pin is a representation of the drive's front panel activity indicator amber LED, allowing the LED to be displayed on the automation front panel, it is driven active low by the drive when

## UDO Product Specification

		the LED is active and is pulled high by the automation
9	TIN (Target Initiated Negotiations)	A jumper on pins 9-10 will cause the drive to initiate Scsi Synchronous and Wide negotiations after a reset or power cycle. With no jumper installed the drive will not initiate negotiations, unless, mode select parameters indicate that it should.
10	GND	Ground
11	S/A	This pin determines which environment the drive is operating in High indicates Standalone mode Low indicates Automation mode This pin is driven active low by the automation and is pulled high by the drive
12	Spin Down	This pin causes the drive to spin down, it is drive active low by the automation and is pulled high by the drive
13	Short Eject Select	This pin causes the drive to use its shorter eject position, which is required for some autoloaders. This pin is driven active low by the automation and is pulled high by the drive
14	Eject	This pin causes the drive to eject the cartridge, it is driven active low by the automation and is pulled high by the drive
15	Limit SCSI to 40MB/sec	This pin causes the drive to limit the SCSI bus to 40MB/sec in any mode (LVD or Single Ended), it is driven active low by the automation and is pulled high by the drive
16	Cartridge Present *	This pin indicates that a cartridge is present in the drive, it is driven active low by the drive and is pulled high by the automation
17	Disable Autospin	This pin is driven active low by the automation to disable autospin and is pulled high by the drive
18	Cartridge Loaded *	This pin indicates that a cartridge is loaded onto the spindle, it is driven active low by the drive and is pulled high by the automation
19	Automation Reset	This pin indicates to the drive that the state of the function connector pins has changed and should be read by the drive (i.e. at automation power up or reset), it is pulled high by the drive and driven active low by the automation
20	Drive Ready	This pin indicates that the drive is ready to accept access commands, it is driven active low by the drive and is pulled high by the automation
21	Serial I/O TXD	Serial Communications Transmit
22	Serial I/O RXD	Serial Communications Receive

## UDO Product Specification

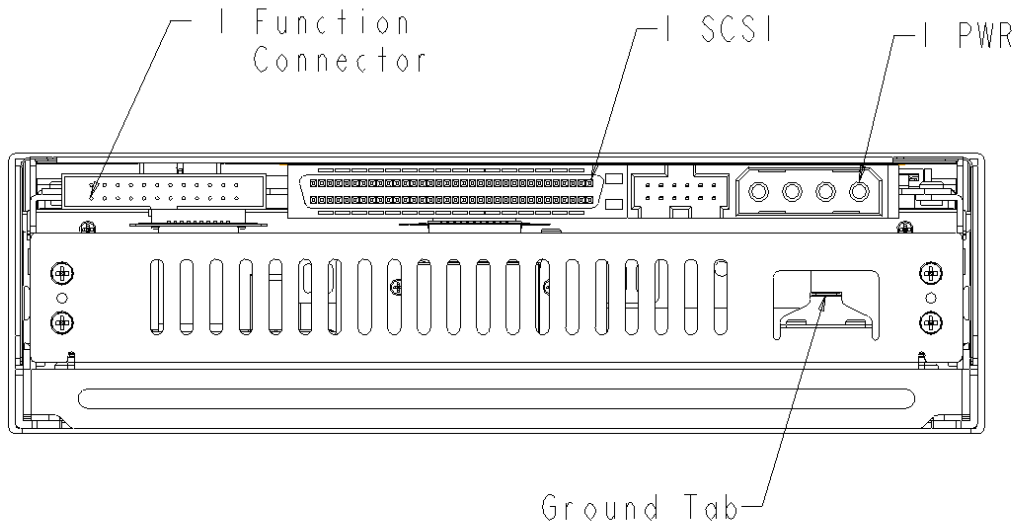
23	Term Power	This pin is connected to SCSI bus TERMPWR line
24	Term Power Source	This pin supplies +5V DC through an isolation diode for termination power to the SCSI bus TERMPWR line, connecting pins 23 and 24 enables the drive to supply SCSI TERMPWR

\* If Cartridge Present is deasserted and Cartridge Loaded is asserted, this indicates a Prevent Media Removal condition.

### Virtual Ground

These pins are pulled low by the drive so that in Standalone mode a jumper will pull the opposing pin low.

### 6.4 – Connector Location and Orientation



## 7 – Environmental/Safety

### 7.1 – Ambient Temperature

Operating (No User Perceivable Errors)	15 to 45 °C
Non-operating, Without Media (No Damage)	-40 to 60 °C
Maximum Gradient	10 °C per hour

### 7.2 – Cooling Requirements

Airflow shall be maintained to ensure that the temperature inside the cartridge in the region of the media shall be 55 °C maximum.

## UDO Product Specification

The airflow direction shall be from the rear of the drive to the front.

### 7.3 – Humidity

Operating (No User Perceivable Errors)	5% to 90% RH (non condensing)
Non-operating, Without Media (No Damage)	5% to 95% RH (non condensing)
Maximum Gradient	10% per hour
Absolute Humidity	1 g/m <sup>3</sup> to 30 g/m <sup>3</sup>
Maximum Wet Bulb Temperature	29 °C

### 7.4 – Random Vibration

Operating (tested in all 3 axes for 10 minutes/axis). No Data Loss.

5 to 350 Hz	PSD: 0.0002 g <sup>2</sup> /Hz
350 to 500 Hz	-6 dB/Octave
500 Hz	PSD: 0.0001 g <sup>2</sup> /Hz

Non-operating (tested in all 3 axes for 10 minutes/axis). No Permanent Damage.

5 to 100 Hz	PSD: 0.02 g <sup>2</sup> /Hz
100 to 137 Hz	-6 dB/Octave
137 to 350 Hz	PSD: 0.0107 g <sup>2</sup> /Hz
350 to 500 Hz	-6 dB/Octave
500 Hz	PSD: 0.0052 g <sup>2</sup> /Hz

Non-operating, Packaged (tested in all 3 axes for 30 minutes/axis). No Product or Package Damage.

5 to 100 Hz	PSD: 0.015 g <sup>2</sup> /Hz
100 to 200 Hz	-6 dB/Octave
200 Hz	PSD: 0.0038 g <sup>2</sup> /Hz

### 7.5 – Swept Sine Vibration

Non-operating (tested in all 3 axes, 1 octave per minute with 5 minute dwell at 4 resonances per axis). No Permanent Damage.

5 to 500 to 5 Hz	1G (0 to peak)
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Non-operating, Packaged (tested in all 3 axes, 1 octave per minute with 5 minute dwell at package resonance). No product or package damage.

5 to 200 to 5 Hz	0.5G (0 to peak)
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## UDO Product Specification

### 7.6 – Shock

Operating (11 msec half sine, tested on all 6 faces)

No User Perceivable Errors	2G
No Data Loss	10G

Operating (3 msec half sine, tested on all 6 faces)

No Data Loss	30G
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Non-operating (11 msec half sine, tested on all 6 faces)

No Permanent Damage	25G
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Non-operating (3 msec half sine, tested on all 6 faces)

No Permanent Damage	75G
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### 7.7 – Drop (Packaged)

No product or unacceptable package damage when the package is dropped a distance of 760mm on each of the 6 package faces and 4 bottom corners.

### 7.8 – Altitude

Operating (No User Perceivable Errors)	305m (1000 ft) below sea level to 4,572m (15,000 ft) above sea level
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Non-operating, Packaged (No Damage)	305m (1000 ft) below sea level to 12,192m (50,000 ft) above sea level
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### 7.9 – Acoustical Noise

Measured with a microphone located 1 meter from the drive front.

Cartridge Loading/Unloading	55dB (A)
All Other Conditions	45dB (A) maximum

### 7.10 – Electrostatic Discharge Susceptibility

Continued Functionality (Continuous uninterrupted operation with no loss of data, retries allowed, after a discharge to any surface including the front panel, cartridge and cartridge opening).

## UDO Product Specification

Air Discharge                      0 to 10kV  
Direct Contact Discharge        0 to 4 kV

Hardware Survival (No permanent damage after a discharge to any surface including the front panel, cartridge and cartridge opening, temporary hang-ups requiring power cycling are allowed).

Air Discharge                      10 to 25 kV  
Direct Contact Discharge        4 to 8 kV

### 7.11 – Magnetic Field Susceptibility

Operating                          Uniform field of 4 gauss peak to peak from 47.5 to 198 Hz

### 7.12 – Radiated Field Susceptibility

Operating                          3 V/m from 30 Mhz to 1 GHz

### 7.13 – Magnetic Field Interference

Operating                          5 gauss peak to peak maximum (AC and DC magnetic field intensity measured on the top, bottom, right side and left side of the drive)

Non-operating, Packaged        2 milligauss maximum at a distance of 2.1 meters from any point on the shipping container  
5.25 milligauss maximum at a distance of 4.6 meters from any point on the shipping container

### 7.14 – Radiated Interference

The drive conforms to the following specifications:

CISPR 22 Class B (1985)  
EN55022 Class B (1988)  
FCC 47 CFR Part 15 Class B

### 7.15 – Safety Compliance

The drive will have the following approvals/certifications and marks:

Approved to UL 1500: 1993 (2<sup>nd</sup> edition) and marked with UL Recognized Component mark  
Approved to IEC950: 1991+A1 : 1992+A2 : 1993+A3 : 1995 and EN60950 (1992) + A1(1992) +A2(1993) + A3(1995) and marked with TUV or VDE component mark

## UDO Product Specification

Certified to CSA 950-93 (2<sup>nd</sup> edition) and marked with CSA mark  
Approved to IEC825-1;1993/EN60825-1(1994)  
Compliance with 21CFR chapter 1, subchapter J of the Center for Devices of  
Radiological Health (CDRH) of the US Department of Health and Human  
Services (DHHS)  
DHHS Laser compliance 21 CFR Subchapter J, USA

### 8 – Reliability

#### 8.1 – Mean Time Before Failure

>100,000 hours

#### 8.2 – Mean Swaps Before Failure

Horizontal orientation	750,000 load/unload cycles
Vertical orientation	500,000 load/unload cycles

#### 8.3 – Read/Write Error Rate

Uncorrectable Errors	< 1 per 10 <sup>20</sup> bytes read
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#### 8.4 – Seek Error Rate

Recoverable Seek Errors	< 1 per 100,000 seeks
Hard Seek Errors	< 1 per 10,000,000 seeks

## 9 – SCSI Bus Phases and Conditions

The drive supports all phases specified in the SCSI standard (ANSI X3.131-1994). The following paragraphs briefly describe each phase.

### 9.1 – Arbitration Phase

When the drive tries to reconnect to an initiator for the purpose of continuing command operation, it waits for the Bus Free phase to occur and then enters the Arbitration phase.

### 9.2 – Bus Free Phase

When no device is active on the SCSI bus.

### 9.3 – Selection Phase

The drive detects that it is selected when SEL and its SCSI ID bit are asserted and BSY and I/O are negated for at least a bus settle delay. The drive examines the Data Bus in order to determine the SCSI ID of the selecting initiator and if it cannot detect the SCSI ID of the initiator the drive does not respond to this selection.

### 9.4 – Reselection Phase

When the drive tries to reconnect to an initiator for the purpose of continuing command operation, after winning the arbitration, it reselects the initiator. If the initiator does not respond to the Reselection within the Selection Timeout Delay (250 msec), the drive releases the SCSI Bus and after a short period of time (about 100  $\mu$ sec), retries the Reselection after winning the arbitration. The drive retries the Reselection up to 5 times. If the initiator cannot respond to the Reselection within the retry, the drive terminates the current I/O process and no pending data, status, and ending message is sent for the operation.

### 9.5 – Information Transfer Phases

The Data, Command, Message and Status phases are grouped together as the Information Transfer phases. When the information is transferred from an initiator to the drive, the drive performs a parity check. When the information is transferred from the drive to the initiator, parity is always generated by the drive.

### 9.6 – Data Phase

The Data In and Data Out phases are used to transfer data to and from the drive. synchronous and asynchronous data transfers are supported.



The drive checks for parity during the Data Out phase. When a parity error is detected, the drive returns the Check Condition status and sets the Sense Key/Additional Sense Code to Aborted Command/SCSI Parity Error.

When an Initiator Detected Error message is sent from an initiator during the data transfer from the drive to the initiator, the drive returns the Check Condition status and sets the Sense Key/Additional Sense Code to Aborted Command/Initiator Detected Error Message Received.

### 9.7 – Command Phase

The Command phase is used to send the Command Descriptor Block (CDB) from the initiator to the drive. The CDB is used to communicate to the drive which operation the initiator wants to perform. The drive checks the parity during the Command phase. When a parity error is detected, the drive returns the Check Condition status and sets the Sense Key/Additional Sense Code to Aborted Command/SCSI Parity Error.

### 9.8 – Message Phase

The Message In and Message Out phases are used to send messages between the drive and an initiator.

The drive checks the parity during the Message Out phase. When a parity error is detected, the drive retries the Message Out phase according to the following sequence:

- 1 – Continue the REQ/ACK handshakes until the initiator negates ATN (all message bytes received).

- 2 – Notify the initiator to re-send all of the previous message byte(s) within the current phase, by not changing the phase and asserting REQ.

If the message is not received correctly, the drive terminates the present command with a Check Condition status and sets the Sense Key/Additional Sense Code to Aborted Command/Message Error.

#### 9.8.1 – Message Protocol

The drive implements the mandatory SCSI messages.

The first message sent by the initiator after the Selection phase shall be either the Identify, Abort or Bus Device Reset message. The Identify message establishes the physical path for a particular logical unit specified by the initiator. After the Reselection phase, the drive's first message is Identify. This allows the physical path to be re-established for the drive

## UDO Product Specification

specified logical unit number. Only 1 logical unit number can be identified for any 1 selection sequence; a second Identify message with a new logical unit number must not be issued before the SCSI bus has been released (Bus Free phase). The treatment of other logical unit addressing errors is described in the following sections for each message.

All initiators shall support the mandatory messages as indicated in the Initiator Support column of the following section. The drive supports messages as indicated in the Drive Sends and Drive Accepts columns.

Whenever a physical path that is utilizing disconnection and reconnection is established by an initiator, the initiator shall ensure that the active pointers of the physical path are equal to the saved pointers for that particular logical unit number. An implied restore pointers operation occurs as a result of a re-selection.

The drive will respond with a Message Reject message to messages with a No in the Drive Accepts column. Messages that are not applicable (NA), are referred to as inappropriate messages. The drive will terminate the command and report a Sense Key/Additional Sense Code of Aborted Command/Invalid Message Error, if a Request Sense command is the next command.

## UDO Product Specification

### 9.8.2 – Target Supported Messages

HEX CODE	DESCRIPTION	DIRECTION	DRIVE SENDS	DRIVE ACCEPTS	INITIATOR SUPPORT
00	Command Complete	In	Yes	NA	M
01	Extended Message <sup>(1)</sup>	In / Out	Yes	Yes	--
02	Save Data Pointer	In	Yes	NA	O <sup>(2)</sup>
03	Restore Pointers	In	Yes	NA	O <sup>(2)</sup>
04	Disconnect	In / Out	Yes	No	O <sup>(2)</sup>
05	Initiator Detected Error	Out	NA	Yes	O
06	Abort	Out	NA	Yes	O
07	Message Reject	In / Out	Yes	Yes	O <sup>(3)</sup>
08	No Operation	Out	No	Yes	O
09	Message Parity Error	Out	No	Yes	O
0C	Bus Device Reset	Out	No	Yes	O
0D	Abort Tag	Out	No	Yes	O
0E	Clear Queue	Out	No	Yes	O
0F	Initiate Recovery	In / Out	NA	No	--
10	Release Recovery	Out	No	No	--
12 - 1F	Reserved	--	No	NA	--
20	Simple Queue Tag	In / Out	No	Yes	O
21	Head of Queue Tag	Out	No	Yes	O
22	Ordered Queue Tag	Out	No	Yes	O
23	Ignore Wide Residue	In	Yes	Yes	O
24 - 2F	Reserved for 2-Byte Message	--	No	No	--
30 - 7F	Reserved	--	No	NA	--
80 - FF	Identify	In / Out	Yes	Yes	O <sup>(2)(3)</sup>
Key: M = Mandatory Support    O = Optional Support    NA = Not Applicable In = Drive to Initiator    Out = Initiator to Drive					

<sup>(1)</sup> Synchronous Data Transfer Request and Wide Data Transfer Request only

<sup>(2)</sup> SCSI Bus Disconnect/Reconnect

<sup>(3)</sup> Data Transfer Retries

### 9.8.3 – Command Complete Message

This message is sent from the drive to the initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the drive goes to the Bus Free phase by releasing BSY. The drive considers the message transmission to be successful when it detects the negation of ACK for the Command Complete message with the ATN signal false.

NOTE: The command may have been executed successfully or unsuccessfully as indicated in the status.

9.8.4 – Extended Message

This message is sent from either the initiator or the drive as the first byte of a multiple-byte message to indicate that the message is an Extended Message. The drive supports the Synchronous Data Transfer Request (SDTR) extended message and the Wide Data Transfer Request (WDTR) extended message.

9.8.4.1 – Synchronous Data Transfer Request (SDTR)

A SDTR message exchange should be initiated by the initiator whenever a previously arranged synchronous data transfer agreement may have become invalid. Examples of the agreement becoming invalid are:

- after a hard reset condition
- after a Bus Device Reset message
- after a power cycle
- after any condition which may leave the data transfer agreement in an indeterminate state

In addition, an initiator may initiate an SDTR message exchange whenever it desires to negotiate a new data transfer agreement (either synchronous or asynchronous). The SDTR message exchange establishes the permissible transfer period and the REQ/ACK offset between the initiator and the drive. SCSI devices that are capable of synchronous data transfers must not respond to an SDTR message with a Message Reject message.

Synchronous Data Transfer Request Format.

BIT BYTE	7	6	5	4	3	2	1	0
00	Extended Message (01H)							
01	Extended Message Length (03H)							
02	Synchronous Data Transfer Request (01H)							
03	Transfer Period Factor (m)							
04	REQ/ACK Offset (00H – 3FH)							

The transfer period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses.

The REQ/ACK offset is the maximum number of REQ pulses allowed to be outstanding before the leading edge of the first corresponding ACK pulse is received at the drive. This value is chosen to prevent overflow conditions in the device's reception buffer and offset counter. The maximum REQ/ACK offset is 3FH.

## UDO Product Specification

A REQ/ACK offset of 0 results in an asynchronous data transfer mode.

The initiator sets its values according to the rules contained in the previous paragraphs to permit it to receive data successfully. If the drive can also receive data successfully with these values, it returns the same values in its SDTR message. If the drive requires a larger transfer period, a smaller REQ/ACK offset, or both in order to receive data successfully, it substitutes values in its SDTR message as required, returning unchanged any value not required to be changed. When transmitting data, each device must respect the limits set by the other's SDTR message, but it is permitted to transfer data with larger transfer periods or smaller REQ/ACK offsets than specified in the other's SDTR message, or both. The successful completion of an exchange of SDTR messages implies an agreement as shown.

<b>RESPONDING DEVICE SDTR RESPONSE</b>	<b>IMPLIED AGREEMENT</b>
Non-zero REQ/ACK Offset	Each device transmits data with the agreed transfer period equal to or greater than and REQ/ACK offset equal to or less than the values received in the other device's SDTR message.
REQ/ACK Offset Equal to Zero	Asynchronous Transfer
Message Reject Message	Asynchronous Transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends an SDTR message to begin the negotiating process. After successfully completing the Message Out phase, the drive respond with the proper SDTR message. If an abnormal condition prevents the drive from returning an appropriate response, both devices go to asynchronous data transfer mode for data transfers between the two devices. The drive responds to each initiator requested transfer period as shown in the following table.

## UDO Product Specification

### Transfer Period Values

<b>INITIATOR REQUESTED TRANSFER PERIOD FACTOR</b>	<b>DRIVE RESPONSE</b>	<b>TRANSFER PERIOD</b>	<b>MEGA TRANSFERS/SEC</b>
$0 \leq m_i \leq 12$	$m_t = 12$	50 nsec	20.0
$12 < m_i \leq 18$	$m_t = m_i$	75 nsec	13.3
$18 < m_i \leq 25$	$m_t = m_i$	100 nsec	10.0
$25 < m_i \leq 31$	$m_t = m_i$	125 nsec	8.0
$31 < m_i \leq 37$	$m_t = m_i$	150 nsec	6.7
$37 < m_i \leq 43$	$m_t = m_i$	175 nsec	5.7
$43 < m_i \leq 50$	$m_t = m_i$	200 nsec	5.0
$50 < m_i \leq 56$	$m_t = m_i$	225 nsec	4.4
$56 < m_i \leq 62$	$m_t = m_i$	250 nsec	4.0
$62 < m_i \leq 68$	$m_t = m_i$	275 nsec	3.6
$68 < m_i \leq 75$	$m_t = m_i$	300 nsec	3.3
$77 < m_i \leq 255$	$m_t = m_i$	Asynchronous (REQ/ACK offset 0)	

The drive responds to each initiator requested REQ/ACK offset as shown in the following table.

### REQ/ACK Offset Values

<b>INITIATOR REQUESTED REQ/ACK OFFSET</b>	<b>DRIVE RESPONSE</b>	<b>REQ/ACK OFFSET</b>
$0 \leq x_i \leq 63$	$x_t = x_i$	$x_t$
$63 < x_i \leq 255$	$x_t = 63$	63

The implied agreement for synchronous operation, following the drive response is considered to be negated by both the initiator and the drive if the initiator asserts ATN and the first message out is either Message Parity Error or Message Reject. In this case, both devices go to asynchronous data transfer mode for data transfers between each other. For the Message Parity Error case, the implied agreement is re-instated if a re-transmittal of the second of the pair of messages is successfully accomplished. If the drive receives a Message Parity Error message after one retry attempt, it terminates the retry activity. This may be done by either changing to any other information transfer phase and transferring at least one byte of information or by going to the Bus Free phase. The initiator must accept such action as aborting the negotiation, and both devices will go to asynchronous data transfer mode for data transfers between the two devices.

If a parity error is detected during the receipt of an SDTR message sequence the drive will remain in the message out phase. One retry will be attempted.

## UDO Product Specification

The implied synchronous agreement remains in effect until a power cycle, Bus Device Reset message is received, a hard reset condition occurs or the initiator devices elect to modify the agreement. The default data transfer mode is asynchronous data transfer mode and is entered at power on, after a Bus Device Reset message or after a hard reset condition.

### 9.8.4.2 – Wide Data Transfer Request (WDTR)

A WDTR message exchange should be initiated by the initiator whenever a previously arranged wide data transfer agreement may have become invalid. Examples of the agreement becoming invalid are:

- after a hard reset condition
- after a Bus Device Reset message
- after a power cycle
- after any condition which may leave the data transfer agreement in an indeterminate state

In addition, an initiator may initiate a WDTR message exchange whenever it desires to negotiate a new data transfer agreement. SCSI devices that are capable of wide data transfers (greater than eight bits) must not respond to a WDTR message with a Message Reject message.

Wide Data Transfer Request Format.

BIT BYTE	7	6	5	4	3	2	1	0
00	Extended Message (01H)							
01	Extended Message Length (02H)							
02	Wide Data Transfer Request Code (03H)							
03	Transfer Width Exponent							

Transfer Width Exponent values.

TRANSFER WIDTH	HEX VALUE
8 bits	00H
16 bits	01H
32 bits	02H
Reserved	03H - FFH

NOTE: The drive supports a maximum Transfer Width of 16 bits.

## UDO Product Specification

The WDTR message exchange establishes an agreement between two SCSI devices on the width of the data path to be used for Data phase transfers between the two devices. This agreement applies to Data In and Data Out phases only. All other information transfer phases shall use an eight bit data path.

If a SCSI device implements both the wide data transfer option and the synchronous data transfer option, then it shall negotiate the wide data transfer agreement prior to negotiating the synchronous data transfer agreement. If a synchronous data transfer agreement is in effect, then a SCSI device that accepts a WDTR message shall reset the synchronous agreement to asynchronous mode.

The transfer width is two to the transfer width exponent bytes wide. The transfer width that is established applies to all logical units on both SCSI devices.

The originating SCSI device (the SCSI device that sends the first of the pair of WDTR messages) sets its transfer width value to the maximum data path width it elects to accommodate. If the responding SCSI device can also accommodate this transfer width, it returns the same value in its WDTR message. If it requires a smaller transfer width, it substitutes the smaller value in its WDTR message.

The successful completion of an exchange of WDTR messages implies an agreement as shown.

<b>RESPONDING DEVICE WDTR RESPONSE</b>	<b>IMPLIED AGREEMENT</b>
Non-zero Transfer width	Each device transmits and receives data with a transfer width equal to the responding SCSI devices transfer width.
Transfer Width Equal to Zero	8-bit Data Transfer
Message Reject Message	8-bit Data Transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a WDTR message to begin the negotiation process. After successfully completing the Message Out phase, the target shall respond with the proper WDTR message. If an abnormal condition prevents the target from returning an appropriate response, both devices shall go to eight bit data transfer mode for data transfers between the two devices.



Following target response 1) above, the implied agreement for wide data transfers shall be considered to be negated by both the initiator and the target if the initiator asserts ATN and the first message out is either Message Parity Error or Message Reject. In this case, both devices shall go to eight bit data transfer mode for data transfers between the two devices. For the Message Parity Error case, the implied agreement shall be reinstated if a re-transmittal of the second of the pair of messages is successfully accomplished. If the drive receives a Message Parity Error message after one retry attempt, it terminates the retry activity. This may be accomplished by either changing to any other information transfer phase and transferring at least one byte of information or by going to the Bus Free phase. The initiator must accept such action, as aborting the negotiation and both devices will go to eight bit data transfer mode for data transfers between the two devices.

The implied transfer width agreement shall remain in effect until a Bus Device Reset message is received, until a hard reset condition occurs, or until one of the two SCSI devices elects to modify the agreement. The default data transfer width is eight bit data transfer mode. The default data transfer mode is entered at power on, after a Bus Device Reset message, or after a hard reset condition.

### 9.8.5 – Save Data Pointer Message

This message is sent from the drive to direct the initiator to save a copy of the present active data pointer for the currently attached logical unit. The drive issues this message when it disconnects from the SCSI Bus during data transfer or when the block of data, that of which length is specified by the Buffer Full Ratio for reading or by the Buffer Empty Ratio for writing, is transferred.

### 9.8.6 – Restore Pointers Message

This message is sent from the drive to direct the initiator to restore the most recently saved pointers (for the currently attached logical unit) to the active state. Pointers to the command, data and status locations for the logical unit shall be restored to the active pointers. Command and status pointers shall be restored to the beginning of the present command and status areas. The data pointer shall be restored to the value at the beginning of the data area in the absence of a Save Data Pointer message or to the value at the point at which the last Save Data Pointer message occurred for that logical unit. The drive may send this message when Initiator Detected Error message is sent from the initiator during Data In or Status phase.

### 9.8.7 – Disconnect Message

This message is sent from the drive to inform an initiator that the present physical path is going to be broken (the drive plans to disconnect by releasing BSY), but that a later reconnect will be required in order to complete the current operation. This message shall not cause the initiator to save the data pointer. After successfully sending this message, the drive goes to the Bus Free phase by releasing BSY. The drive considers the message transmission to be successful when it detects the negation of ACK for the Disconnect message with the ATN signal false.

NOTE: The drive will always send a Save Data Pointer before each Disconnect message.

### 9.8.8 – Initiator Detected Error Message

This message is sent from an initiator to inform the drive that an error (e.g. parity error) has occurred that does not preclude the drive from retrying the operation. Although present pointer integrity is not assured, a Restore Pointers message shall cause the pointers to be restored to their defined prior state.

### 9.8.9 – Abort Message

This message is sent from the initiator to the drive to clear the current operation. If a logical unit has been identified, all pending data and status for the issuing initiator from that logical unit is cleared, and the drive goes to the Bus Free phase. If a command from the initiator is in progress, the drive creates sense data indicating an Aborted Command Sense Key. Pending data and status for other initiators are not cleared. If a logical unit has not been identified, the drive goes to the Bus Free phase. No status or ending message shall be sent for the operation.

It is not an error to issue this message to a logical unit that is not currently performing an operation for the initiator.

### 9.8.10 – Message Reject Message

This message is sent from either the initiator or the drive to indicate that the last message it received was inappropriate or has not been implemented.

In order to indicate its intentions of sending this message, the initiator asserts the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that is to be rejected. If the drive receives this message under any other circumstance, it rejects this message.

When the drive sends this message, it will change to the Message In phase and send this message prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message is rejected.

When the drive receives a Message Reject message from the initiator, it takes the following action based on which message is rejected:

Command Complete – The drive goes to the Bus Free phase and does not consider this an error.

Disconnect – The drive does not disconnect and continues the current command.

Identify – The drive goes to the Bus Free phase and aborts the command. Sense Key/Additional Sense Code is set to Aborted Command/Message Error.

Message Reject – The drive terminates the command with Check Condition status and sets the Sense Key/Additional Sense Code to Aborted Command/Message Error.

Restore Pointers – The drive goes to the Bus Free phase and sets the Sense Key/Additional Sense Code according to the error condition.

Save Data Pointer – The drive does not disconnect and continues the current command.

### 9.8.11 – No Operation Message

This message is sent from an initiator in response to the drive's request for a message when the initiator does not currently have any other valid message to send. This message is ignored by the drive.

### 9.8.12 – Message Parity Error Message

This message is sent from the initiator to the drive to indicate that one or more bytes in the last message it received had a parity error.

In order to indicate its intentions of sending this message, the initiator asserts the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the drive can determine which message has the parity error.

When the drive receives this message, it retries the operation by re-sending the original message once. If the message cannot be sent successfully, the drive immediately will go the Bus Free phase and abort the current SCSI command. No further reconnection is attempted and no status or Command Complete message is returned for the command.

If the drive receives this message under any other circumstance, it will signal a catastrophic error condition by releasing the BSY signal without any further information transfer attempt. Should this occur during the course of a command, the drive will create sense data with the Sense Key/Additional Sense Code set to Aborted Command/Invalid Message Error.

### 9.8.13 – Bus Device Reset Message

This message is sent from an initiator to direct the drive to clear all current commands on that SCSI device. This message forces the SCSI device to an initial state with no operations pending for any initiator. Upon recognizing this message, the drive shall go to the Bus Free phase.

### 9.8.14 – Abort Tag Message

This message is sent from an initiator to direct the drive to clear the current I/O process. If the drive has already started the execution of the I/O process, the execution will be halted. The media contents may be modified before the execution is halted. Upon receipt of this message, the drive will go to the Bus Free phase.

### 9.8.15 – Clear Queue Message

This message is sent from an initiator to direct the drive to clear the all I/O processes from all initiators in the queue for the specified logical unit from the queue. All the active I/O processes are terminated. The media may have been partially altered by partially executed commands. All the pending status and data for the specified logical unit are cleared. The Unit Attention condition is generated for all other initiators with I/O processes that either were active or were queued for that logical unit. The Sense Key/Additional Sense Code is set to Unit Attention/Command Cleared by Another Initiator.

### 9.8.16 – Queue Tag Messages

The drive supports Simple Queue Tag, Head of Queue Tag, and Ordered Queue Tag. The Queue Tag Message consists of two consecutive bytes, Message Code and Queue Tag to distinguish each I/O process. The Queue

## UDO Product Specification

Tag must be unique for each I/O process, but the numeric values of queue tags have no effect on the order of execution.

### 9.8.16.1 – Simple Queue Tag Message

BIT	7	6	5	4	3	2	1	0
00	Simple Queue Tag (20H)							
01	Queue Tag (00H-FFH)							

The Simple Queue Tag (20H) message specifies that the I/O process will be placed in the drive's command queue. Order of execution may be altered by the drive.

### 9.8.16.2 – Head of Queue Tag Message

BIT	7	6	5	4	3	2	1	0
00	Head of Queue Tag (21H)							
01	Queue Tag (00H-FFH)							

The Head of Queue Tag (21H) message specifies that the I/O process will be placed first in the drive's command queue. When the drive receives a subsequent I/O process with a Head of Queue Tag message, the previous I/O process which had been requested is not interrupted.

### 9.8.16.3 – Ordered Queue Tag Message

BIT	7	6	5	4	3	2	1	0
00	Ordered Queue Tag (22H)							
01	Queue Tag (00H-FFH)							

The Ordered Queue Tag (22H) message specifies that the I/O process will be placed in the drive command queue for execution in the received order. All the queued I/O processes for the drive received prior to this I/O process are executed before this I/O process is executed. All the queued I/O processes received after this current process will be executed after this current process, except for a new I/O process received with a Head of Queue Tag message.

### 9.8.17 – Ignore Wide Residue Message

This 2 byte message is sent from the drive to the initiator to indicate that the number of valid bytes sent in the last REQ/ACK handshake of the

Data In phase was less than the negotiated transfer width. The Ignore Wide Residue message is sent immediately after the Data In phase and before any other messages. It is always followed by a second byte, the ignore field, which indicates the number of invalid bytes transferred. The drive will always return a value of 01H for the ignore field because the maximum transfer width that it supports is 16 bits wide. An Ignore Wide Residue message may be sent after each Data In phase causing multiple Ignore Wide Residue messages in a single I/O process.

### 9.8.18 – Identify Message

This message is sent by either the initiator or the drive to establish the physical path connection between an initiator and the drive for a particular logical unit. The Logical Unit Number (LUN) addresses one of up to eight physical or virtual devices attached to the drive as indicated in the following bit definitions.

Bit 7 This bit shall be set to 1 to distinguish this message from other messages.

Bit 6 This bit is set to 1 by the initiator to grant the drive the permission to initiate disconnection. If this bit is 0, the drive will not disconnect.

Bits 5-3 Reserved

Bits 2-0 These bits specify a LUN in the drive.

Only one LUN shall be identified for any one selection sequence. A second Identify message with a new LUN shall not be issued before the bus has been released (Bus Free phase). The initiator may send one or more Identify messages during a selection sequence. However, the LUN in any additional Identify messages shall be the same as the LUN specified in the first Identify message sent by the initiator. The drive only supports LUN 0.

When sent from the drive to an initiator during reconnection, an implied Restore Pointers message shall be performed by the initiator prior to completion of this message.

### 9.9 – Status Phase

A status byte is sent from the drive to the initiator during the Status phase at the termination of each command unless the command is cleared by an Abort message, by a Bus Device Reset message, by an Abort Tag message, by Clear Queue message or by a hard reset condition.

## UDO Product Specification

### 9.9.1 – Target Supported Status Codes

CODE	STATUS
00H	Good
02H	Check Condition
04H	Condition Met
08H	Busy
10H	Intermediate/Good
14H	Intermediate Condition Met
18H	Reservation Conflict
28H	Queue Full

### 9.9.2 – Good Status

This status indicates that the drive has successfully completed the command.

### 9.9.3 – Check Condition Status

Any error, exception or abnormal condition that causes sense data to be set will cause a Check Condition status. The Request Sense command should be issued following a Check Condition status to determine the nature of the condition.

### 9.9.4 – Condition Met Status

This status or Intermediate Condition Met status is returned when the Pre-Fetch command or the Medium Scan command operation is satisfied.

### 9.9.5 – Busy Status

This status is returned whenever the drive is unable to execute a command from an otherwise acceptable initiator. The drive responds to drive mechanism accessing commands with Busy during power up until all diagnostics have been completed. Busy is also returned when a command is in progress and this command cannot be stored for later execution (e.g. disconnect not permitted). The normal recovery action is to re-issue the command later.

### 9.9.6 – Reservation Conflict Status

This status is returned whenever a SCSI device attempts to access the drive while it is reserved for another initiator (see Reserve and Release commands). The normal initiator recovery action is to re-issue the command later.

### 9.9.7 – Queue Full Status

This shall be returned whenever the drive's command queue is full, in response to initiator's message Simple Queue Tag, Head of Queue Tag, or Ordered Queue Tag. The I/O process is not placed onto the command queue. The drive can handle a maximum of 32 I/O processes at one time.

### 9.10 – Attention Condition

The Attention condition allows an initiator to inform the drive that the initiator has a message ready. The drive receives this message by performing a Message Out phase.

The initiator creates the Attention condition by asserting ATN at any time except during the Arbitration or Bus Free phases.

The initiator should assert the ATN signal before releasing ACK for the last byte transferred in a bus phase so the Attention condition can be honored before a transition to a new bus phase. An ATN asserted later might not be honored until a later bus phase and then may result in an unexpected action. The drive responds with Message Out phase as follows:

- 1) If ATN occurs during a Command phase, Message Out occurs after transfer of all Command Descriptor Block (CDB) bytes.
- 2) If ATN occurs during a Data phase, Message Out will occur at the drive's convenience at a logical block boundary. The initiator must continue REQ/ACK handshakes until it detects the phase change. Normally, Data phase transfers are controlled by the drive SCSI processor, however, once Attention is asserted, the REQ/ACK handshake is controlled by firmware. Therefore, to ensure maximum performance, the initiator should assert Attention during the last ACK of a logical block transfer.
- 3) If ATN occurs during a Status phase, the Message Out shall occur after the status byte has been acknowledged by the initiator.
- 4) If ATN occurs during a Message In phase, Message Out phase shall occur after the current Message In byte has been acknowledged by the initiator.
- 5) If ATN occurs during a Selection phase and before the initiator releases the BSY signal, Message Out shall occur immediately after that Selection phase.
- 6) If ATN occurs during a Reselection phase, Message Out shall occur after the drive has received an ACK for its Identify message during that Reselection phase.



The initiator must keep ATN asserted if more than one byte is to be transferred. The initiator may negate the ATN signal at any time, however it shall not negate the ATN signal while the ACK signal is asserted during a Message Out phase. Normally, the initiator negates ATN while REQ is true and ACK is false during the last REQ/ACK handshake of the Message Out phase.

### 9.11 – Reset Condition

The Reset condition is used to immediately clear all SCSI devices on the bus. This condition takes precedence over all other phases and conditions. Any SCSI device may create the Reset condition by asserting RST for a minimum of a reset hold time. During the Reset condition, the state of all SCSI bus signals other than RST is not defined. The drive will also enter the Reset condition upon receiving a Bus Device Reset message.

The drive will not create the Reset condition and never asserts the RST signal.

All SCSI devices will release all SCSI bus signals (except RST) within a bus clear delay of the transition of RST to true. The Bus Free phase always follows the Reset condition.

The ANSI SCSI standard defines two alternative responses by a Target to a Reset condition. The drive implements hard reset handling. Upon detection of the Reset condition, the drive:

- Attempts to write any unwritten data residing in the cache that had previously received a Good status
- Clears all I/O processes including queued I/O
- Releases all SCSI device reservations
- Returns any SCSI device operating modes (such as Mode Select and Prevent/Allow Media Removal commands) to their saved or default conditions, whichever is appropriate
- Ensures that Unit Attention condition is set for all initiators.

NOTE: Even though at the SCSI interface the drive implements hard reset handling, internally the drive will only reset individual hardware components as necessary (i.e. after a SCSI Reset or Bus Device Reset message). The drive will usually be ready much more quickly than if power on the drive was cycled.

### 9.12 – Unit Attention Condition

The Unit Attention condition is entered by the drive to report events of interest to initiators. These events include:

- Successful completion of a spin up
- Bus Device Reset message
- SCSI Bus Reset
- Power on
- Self reset (due to controller-detected error)
- Send Diagnostic command
- Drive executes self test

The drive attempts to report a Unit Attention condition by responding with a Check Condition status to the next command with the exception of the Inquiry and Request Sense commands.

A Unit Attention condition is pending for each initiator until cleared by that initiator. Clearing occurs following any command after a Check Condition status response (except Inquiry and Request Sense).

An initiator determines that a Unit Attention condition has occurred because a Unit Attention Sense Key is found in the sense data returned in response to the Request Sense command.

## 10 – SCSI Command Structure

### 10.1 – Command Implementation Requirements

The first byte of all SCSI commands contains an operation code as defined in this document. Three bits (bits 7 – 5) of the second byte of each SCSI command specify the logical unit if it is not specified using the Identify message. The last byte of all SCSI commands contains a control byte.

### 10.2 – Reserved

Reserved bits, fields, bytes and op codes are set aside for future use. A reserved bit, field or byte must be set to 0. A drive that receives a reserved bit, field or byte that is not 0, or receives a reserved op code, terminates the command with a Check Condition status and the Sense Key set to Illegal Request.

### 10.3 – Command Descriptor Block (CDB)

A request to a peripheral device connected on the SCSI bus is performed by sending a Command Descriptor Block (CDB) to the drive. For several

## UDO Product Specification

commands, the request is accompanied by a list of parameters sent during a Data Out phase. See the specific commands for detailed information.

The CDB always has an operation code as the first byte of the command. This is followed by an optional logical unit number, command parameters (if any) and a control byte.

If there is an invalid parameter in a CDB, the command is terminated without altering the media.

### 10.3.1 – Operation Code

The operation code of the CDB has a Group Code field and a Command Code field. The 3 bit Group Code field provides for 8 groups of command codes. The 5 bit Command Code field provides for 32 command codes in each group. Thus, a total of 256 possible operation codes exist. Operation codes are defined as follows.

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

The group code specifies one of the following groups:

GROUP	BIT 7	BIT 6	BIT 5	NUMBER OF COMMAND BYTES
0	0	0	0	Six
1	0	0	1	Ten
2	0	1	0	Ten (new in SCSI-2)
3	0	1	1	Reserved
4	1	0	0	Reserved
5	1	0	1	Twelve
6	1	1	0	Vendor Specific (Six)
7	1	1	1	Vendor Specific (Ten)

### 10.3.2 – Typical Command Descriptor Block for 6 Byte Commands

BIT BYTE	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Number							
02	Command Specific							
03								
04								
05	Control Byte							

## UDO Product Specification

### 10.3.3 – Typical Command Descriptor Block for 10 Byte Commands

BIT BYTE	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Number							
02	Command Specific							
03								
04								
05								
06								
07								
08								
09	Control Byte							

### 10.3.4 – Typical Command Descriptor Block for 12 Byte Commands

BIT BYTE	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Number							
02	Command Specific							
03								
04								
05								
06								
07								
08								
09								
10								
11	Control Byte							

### 10.3.5 – Logical Unit Number (LUN)

The drive supports LUN 0 only. Refer to the Identify message section for a description of the LUN selection on the SCSI bus.

### 10.3.6 – Control Field

The control field is the last byte of every SCSI command descriptor block. The control field is defined as follows:

BIT	7	6	5	4	3	2	1	0
	PBA	Control	Reserved					

#### 10.3.6.1 – Physical Block Address (PBA)

## UDO Product Specification

A PBA bit of 0 indicates that the normal SCSI access via LBA, or Logical Block Address, is in use. A PBA bit of 1 indicates that the contents of the LBA field specify a PBA, or Physical Block Address. The PBA bit is only defined for certain commands as specified in the command descriptions. All physical sectors of the disk are accessible when this bit is utilized. When the PBA bit is set, there is no parameter checking in the drive.

### 10.3.6.2 – Control

The Control bit is used in certain commands with its use being command specific.

### 10.4 – Selection of a Logical Unit

The logical unit for which a command is destined is specified by the Identify message or in the CDB if no Identify message was received. The drive supports LUN 0. If an invalid logical unit is selected, the drive takes the following action:

The CDB is accepted by the drive. If the command is a Request Sense command, the drive will return sense data. The Sense Key/Additional Sense Code will be set to Illegal Request/Logical Unit Not Supported. If the command is an Inquiry command, the command will be executed normally. The Peripheral Device Type Code (Inquiry Data, Byte 0) will be 7FH - Device Not Present. Any other command will be immediately terminated with Check Condition Status. Sense data is generated with a Sense Key/Additional Sense Code set to Illegal Request/Logical Unit Not Supported.

### 10.5 – Disconnect Conditions

The drive disconnects from the SCSI bus when it cannot use the bus to transfer information without delay, unless disconnects are disabled. Disconnects are disabled as described in the Identify message section.

### 10.6 – Cache Operations

When the Write Cache is active the drive will always attempt to Synchronize the cache prior to performing an operation which may corrupt data in the cache or result in being unable to write the data to the media. Examples of this include a reset, executing a diagnostic, unloading the disk and performing a Write Buffer command.

## UDO Product Specification

### 11 – SCSI Command Specifications

#### 11.1 – SCSI Commands

This section defines the SCSI command set implemented by the drive. The drive commands supported are listed below. Each command in this section is listed in alphabetical order.

COMMAND	OP CODE
Erase (10 Byte)	2CH
Erase (12 Byte)	ACH
Format Unit	04H
Inquiry	12H
Log Select	4CH
Log Sense	4DH
Medium Scan	38H
Mode Select (6 Byte)	15H
Mode Select (10 Byte)	55H
Mode Sense (6 Byte)	1AH
Mode Sense (10 Byte)	5AH
Pre-Fetch	34H
Prevent-Allow Media Removal	1EH
Read (6 Byte)	08H
Read (10 Byte)	28H
Read (12 Byte)	A8H
Read Buffer (10 Byte)	3CH
Read Capacity	25H
Read Defect Data (10 Byte)	37H
Read Defect Data (12 Byte)	B7H
Read Long (10 Byte)	3EH
Read Sector Location	E6H
Receive Diagnostic Results	1CH
Release (6 Byte)	17H
Release (10 Byte)	57H
Request Sense	03H
Reserve (6 Byte)	16H
Reserve (10 Byte)	56H
Rezero Unit	01H
Security Control (10 Byte)	EAH
Seek (6 Byte)	0BH
Seek (10 Byte)	2BH
Send Diagnostic	1DH
Shred (10 Byte)	EEH
Start/Stop Unit	1BH
Synchronize Cache	35H
Test Unit Ready	00H
Verify (10 Byte)	2FH
Verify (12 Byte)	AFH
Write (6 Byte)	0AH
Write (10 Byte)	2AH
Write (12 Byte)	AAH
Write and Verify (10 Byte)	2EH

## UDO Product Specification

Write and Verify (12 Byte)	AEH
Write Buffer	3BH
Write Long (10 Byte)	3FH

## UDO Product Specification

### 11.2 – Erase Command

The Erase (2CH, ACH) command requests that the drive erase the specified number of blocks starting at the specified logical block address on the media. If Write Once media is installed, the drive will return a Check Condition with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code.

#### Erase (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Erase (2CH)							
01	LUN 0			Reserved		ERA	Reserved	
02	(MSB) <span style="float: right;">(LSB)</span> Logical Block Address							
03								
04								
05								
06								
07	(MSB) <span style="float: right;">(LSB)</span> Transfer Length							
08								
09								

#### Erase (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Erase (ACH)							
01	LUN 0			Reserved		ERA	Reserved	
02	(MSB) <span style="float: right;">(LSB)</span> Logical Block Address							
03								
04								
05								
06								
07								
08								
09								
10	Reserved							
11	Reserved							

#### Erase All (ERA)

An ERA bit of 1 indicates that all remaining blocks, starting at the specified Logical Block Address to the end of the disk will be erased. An ERA bit of 0 indicates that the number of blocks specified by the Transfer Length will be erased starting at the specified Logical Block Address.



### Transfer Length

The Transfer Length field indicates the number of contiguous logical blocks to be erased starting at the Logical Block Address supplied in the CDB. A value of 0 indicates that no blocks will be erased and is not considered an error.

Note: A Check Condition with a Sense Key set to Recovered error will be returned when the drive is close to, or has run out of, spare sectors for relocations. This Recovered error sense key will be returned when the amount of free spares reaches 2000, 1000, 500, and 0. Examining byte 21 of the sense data will indicate the situation that occurred, where 0xE1 indicates 2000, 0xE2 indicates 1000, 0xE3 indicates 500, and 0xE4 indicates 0.

11.3 – Format Unit Command

The Format Unit (04H) command formats the media into initiator addressable logical blocks. In addition, the media may be certified and control structures may be created for the management of the media and defects.

Format Unit (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Format Unit (04H)							
01	LUN 0		FmtData	CmpLst	Defect List Format			
02	Reserved					MkCDA	MkPlst	
03	Reserved							
04	Reserved							
05	Resrvd	ErsCntl	Reserved					

Format Data (FmtData)

A FmtData bit set to 1 indicates that the command includes a Data Out Phase consisting of a 4 byte Defect List Header followed by 0 or more Defect Descriptors. A FmtData bit set to 0 indicates that defect information will not be supplied by the host.

Complete List (CmpLst)

This bit has no effect on the drive.

Defect List Format

The only Defect List Format supported by the drive is Block Format (0).

Note: For Write Once media this command can only be executed once per disk. If a second format is attempted on a disk, a Check Condition with a Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code will be returned to the host.

MkCDA, MkPlst, ErsCntl

These bits have no effect on the drive.

## UDO Product Specification

### Defect List Header

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved							
01	FOV	DPRY	DCRT	Reserved			Immed	Resrvd
02	(MSB)		Defect List Length					
03								(LSB)

#### Format Options Valid (FOV)

A FOV bit of 1 indicates that the DCRT and Immed fields contain valid information. A FOV bit of 0 indicates that the DCRT and Immed bits are not valid.

#### DPRY

This bit has no effect on the drive.

#### Disable Certification (DCRT)

A DCRT bit of 1 indicates that the drive does not certify the disk during the format process. A DCRT bit of 0 indicates that drive certifies the disk during the format process.

#### Immediate (Immed)

An Immed bit of 1 indicates that status is returned as soon as the command has been validated. An Immed bit of 0 indicates that status is returned after the command completes.

When an Immediate format is executed and the format is executing, any subsequent media access command (including Test Unit Ready) will return a Sense Key/Additional Sense Code set to Not Ready/Format in Progress. When this Sense Key is returned, the information bytes will contain a number between 0 and 99 indicating the percentage format complete and the command specific bytes will contain the number of defects that have been found thus far. A Log Sense command for Page Code 3DH can be issued to get information on the defects found thus far in the certification process.

# UDO Product Specification

## Defect List Length

The Defect List Length is the total length in bytes of the Defect Descriptors that follows.

### Block Format Defect Descriptor

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Physical Block Address							
01								
02								
03								

## UDO Product Specification

### 11.4 – Inquiry Command

The Inquiry (12H) command requests parameter information about the drive be sent to the initiator.

#### Inquiry (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Inquiry (12H)							
01	LUN 0			Reserved			EVPD	
02	Page Code							
03	Reserved							
04	Allocation Length							
05	Reserved							

#### Enable Vital Product Data (EVPD)

An EVPD bit of 1 specifies that the drive will return the optional vital product data specified by the Page Code field. An EVPD bit of 0 specifies that the drive will return the standard Inquiry data.

#### Page Code

The Page Code field specifies which page of vital product data information the drive will return.

#### Vital Product Data Page Codes

PAGE CODE	DESCRIPTION
00H	Supported Vital Product Data Pages
80H	Unit Serial Number Page
C1H	Unique Media ID (UMID)
C2H	DMA Serial Number

#### Allocation Length

The Allocation Length is the number of bytes that the drive will return to the initiator during the data phase. The drive will return the Allocation Length or the maximum number of bytes of Inquiry Data available, whichever is less. An Allocation Length of 0 will result in no Inquiry Data being transferred and is not considered an error.

## UDO Product Specification

The Inquiry command returns Check Condition status only when the drive cannot return the requested Inquiry data. If an Inquiry command is received from an initiator with a pending Unit Attention condition, the Inquiry command is executed and the Unit Attention condition will not be cleared.

### 11.4.1 – Supported Vital Product Data Pages

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Peripheral Qualifier			Peripheral Device Type				
01	Supported Vital Product Data Pages (00H)							
02	Reserved							
03	Page Length (04H)							
04	First Supported VPD Page (00H)							
05	Second Supported VPD Page (80H)							
06	Third Supported VPD Page (C1H)							
07	Fourth Supported VPD Page (C2H)							

### 11.4.2 – Unit Serial Number Page

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Peripheral Qualifier			Peripheral Device Type				
01	Unit Serial Number Page (80H)							
02	Reserved							
03	Page Length (0AH)							
04	(MSB)          Product Serial Number (ASCII)          (LSB)							
05								
06								
07								
08								
09								
10								
11								
12								
13								

## UDO Product Specification

### 11.4.3 – Media ID Page

BIT BYTE	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Unique Media ID Page (C1H)							
02	Reserved							
03	Page Length (08H)							
04	(MSB) <span style="float: right;">(LSB)</span>  Unique Media ID Bytes							
05								
06								
07								
08								
09								
10								
11								

The Media ID Bytes 1-2 identify the media brand. Bytes 3-8 are a binary representation of the media serial number.

### 11.4.4 – DMA Serial Number Page

BIT BYTE	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	DMA Serial Number Page (C2H)							
02	Reserved							
03	Page Length (08H)							
04	(MSB) <span style="float: right;">(LSB)</span>  DMA Serial Number							
05								
06								
07								
08								
09								
10								
11								

### 11.4.5 – Standard Inquiry Command Returned Data

BIT BYTE	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	RMB	Reserved						
02	ISO Version (0)		ECMA Version (0)			ANSI Approved Ver (2)		
03	Reserved				Response Data Format (2)			
04	Additional Length (33H)							
05	Reserved							
06	Reserved							
07	RelAdr (0)	Wbus32 (0)	WBus16 (1)	Sync (1)	Linked (0)	Resvd (0)	CmdQue (1)	SftRe (0)





## UDO Product Specification

The drive will respond with a 000b for LUN 0 and 011b for LUN 1-7 since the drive only supports LUN 0.

### Peripheral Device Type

For LUN 0, the Peripheral Device Type field will return a 07H, indicating Optical Memory Device. For LUN 1-7, the Peripheral Device Type field will return 1FH indicating Unknown Device Type.

### Removable Medium (RMB)

A RMB bit of 1 indicates that the medium is removeable.

### Response Data Format

The drive will return Inquiry data as defined in the SCSI-2 specification.

### Relative Address (RelAdr)

A RelAdr bit of 0 indicates that the drive does not support Relative Addressing mode.

### Wbus32

A Wbus32 bit of 0 indicates that the drive does not support a 32 bit wide data transfers.

### Wbus16

A Wbus16 bit of 1 indicates that the drive supports 16 bit wide data transfers.

### Sync

A Sync bit of 1 indicates that the drive supports synchronous data transfers.

### Linked

A Linked bit of 0 indicates that the drive does not support Linked Commands.

### Command Queue (CmdQue)

A CmdQue bit of 1 indicates that the drive supports command queuing.

## UDO Product Specification

### Soft Reset (SftRe)

A SftRe bit of 0 indicates that the drive supports the Hard Reset option.

The Vendor Identification field returns "Plasmon~".

The Product Identification field returns "UDO1~~~~~".

The Product Revision Level field returns the current firmware version.

The Manufacturing Date Code field returns the date of manufacture in the form "YMDD" where:

Y = Last digit of the year of manufacture

M = Month of manufacture (Jan=1, ... Sep=9, Oct=A, ... Dec=C)

DD = Day of manufacture

Note: ~ = ASCII space (20H)

## UDO Product Specification

### 11.5 – Log Select Command

The Log Select (4CH) command clears the drive logs.

Log Select (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0	
00	Log Select (4CH)								
01	LUN 0			Reserved					
02	PC		Reserved						
03	Reserved								
04	Reserved								
05	Reserved								
06	Reserved								
07	(MSB)		Parameter List Length				(LSB)		
08									
09	Reserved								

Page Control (PC)

The PC field defines the type of parameter values to be cleared.

Page Control Field

PC	Log Select parameter values	Supported
00b	Current threshold values	No
01b	Current cumulative values	Yes
10b	Default threshold values	No
11b	Default cumulative values	No

Only Page Control of 01b is supported.

The only capability the initiator is given via the Log Select command is to reset the cumulative logs.

Parameter List Length

The Parameter List Length field specifies the length, in bytes, of the Parameter List Data which will be transferred from the initiator to the drive. A Parameter List Length of 0 indicates that no pages will be transferred and this condition is not considered an error.

## UDO Product Specification

### Parameter List Data

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Page Code							
01	Reserved							
02	Reserved							
03	Page Length							
04	Parameter Code							
05	(LSB)							
06	Reserved							
07	Password Parameter Length							
08	(MSB)							
09	Password Parameter Information							
10	(LSB)							
11	(LSB)							

<b>PAGE CODE</b>	<b>DESCRIPTION</b>	<b>PARAMETER CODE</b>
02H	Write Error Counter Page	8000H
03H	Read Error Counter Page	8000H
05H	Verify Error Counter Page	8000H
07H	Last n Error Events Page	1000H
33H	Erase Counter Page	8000H
34H	Blank Check Counter Page	8000H
35H	ASCII Drive Statistics Page	8000H
36H	ASCII Certification Statistics Page	8000H
37H	Error Statistics Log	8000H
38H	Debug Log	8000H
39H	Debug Log	8000H
3AH	Debug Log	8000H
3BH	Debug Log	8000H
3DH	Certification Statistics Log	8000H
3EH	ASCII Configuration/Error Event Log	8000H

The Password Parameter Length and the Password Parameter Information fields are ignored by the drive.

Note: The Debug Log Page will not be cleared by this command.

11.6 – Log Sense Command

The Log Sense (4DH) command provides a means for the initiator to retrieve statistical information maintained by the drive. It is a complementary command to the Log Select command.

Log Sense (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0	
00	Log Sense (4DH)								
01	LUN 0			Reserved					
02	PC		Page Code						
03	Reserved								
04	Reserved								
05	(MSB)			Parameter Pointer					
06									(LSB)
07	(MSB)			Allocation Length					
08									(LSB)
09	Reserved								

Page Control (PC)

The PC field defines the type of parameter values to be returned.

Page Control Field

PC	Log Sense parameter values	Supported
00b	Threshold values	No
01b	Cumulative values	Yes
10b	Default threshold values	No
11b	Default cumulative values	No

Only Page Control of 01b is supported.

Parameter Pointer

This field allows the initiator to request parameter data beginning from a specific parameter code to the maximum Allocation Length or the maximum Parameter Code supported by the drive, whichever is less. If the value of the Parameter Pointer field is larger than the largest available Parameter Code that can be returned by the drive on the specified page, the drive will terminate the command with a Check Condition status. The Sense Key/Additional Sense Code will be set to Illegal Request/Illegal Field in CDB.

Allocation Length

## UDO Product Specification

This field is set to the number of bytes allocated for the returned log page.

### Page Code

Indicates which Log Sense Pages are available from the drive.

#### 11.6.1 – Log Sense Pages

PAGE CODE	DESCRIPTION
00H	Supported Log Pages
02H	Error Counter Page for Write Errors
03H	Error Counter Page for Read Errors
05H	Error Counter Page for Verify Errors
07H	Last n Error Events Page
33H	Error Counter Page for Erase Errors
34H	Error Counter Page for Blank Check Errors
35H	ASCII Drive Statistics Log
36H	ASCII Certification Statistics Log
37H	Binary Drive Statistics Log
38H-3BH	Debug Log Pages
3DH	Certification Statistics Log
3EH	ASCII Error Event Log

#### 11.6.2 – Supported Log Pages

The Supported Log Pages (00H) returns the list of log pages maintained by the drive and is returned in the following format.

BIT BYTE	7	6	5	4	3	2	1	0	
00	Reserved		Page Code (00H)						
01	Reserved								
02	(MSB)		Page Length (n-3)					(LSB)	
03									
04	Supported Page List								
..	.....								
n	Supported Page List								

## UDO Product Specification

### 11.6.3 – Error Counter Pages (02H,03H,05H,33H,34H)

Log pages 02H, 03H, 05H, 33H and 34H will be returned in the following format.

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Page Code (02H,03H,05H,33H,34H)					
01	Reserved							
02	(MSB)		Page Length (n-3)				(LSB)	
03								
04	Log Parameter(s) follow with each page formatted as shown below in the Log Parameter Table							
..								
..								

#### Log Parameter Table

BIT BYTE	7	6	5	4	3	2	1	0
00	(MSB)		Parameter Code				(LSB)	
01								
02	Parameter Control							
03	Parameter Length (n-3)							
04	(MSB)		Parameter Value				(LSB)	
..								
n								

The following parameters are supported and are returned, where applicable, with log pages 02H, 03H, 05H, 33H and 34H.

PARAMETER CODE	PARAMETER LENGTH	DESCRIPTION
0	46	All Pages Returned
1	12	Sectors Requiring Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors

## UDO Product Specification

### 11.6.4 – Error Event Page (07H)

The Last n Error Event Page (07H) has the following format.

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Last n Error Event Page (07H)					
01	Reserved							
02	(MSB)		Page Length (n-3)				(LSB)	
03								
04	Log Parameter(s) follow with each page formatted as shown below in the Log Parameter Table							
..								
..								

#### Log Parameter Table

BIT BYTE	7	6	5	4	3	2	1	0
00	(MSB)		Parameter Code				(LSB)	
01								
02	Reserved							
03	Parameter Length (n-3)							
04	(MSB)		Parameter Value				(LSB)	
..								
n								

The following parameters are supported and returned.

PARAMETER CODE	PARAMETER LENGTH	DESCRIPTION
0	10	Number of Events in Log (max 200)
0	7610	All Pages Returned
1	38	Most Recent Error Event Log
2	38	
..		
200	38	Oldest Error Event Log



## UDO Product Specification

Each Error Event Log is formatted as follows.

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Log Type (1-Read, 2-Write, 3-Erase, 4-Verify, 5-BlankCheck, 6-Spin-up Error, 7-Loading Error, 8-Check Condition,9-Spurious Power Up Reset,12-Controller Detected Error,13-Diagnostic Failure)							
01	Occurrence Count							
02-05	Power-On Minutes at Failure							
06-09	Power-Up uSec at Failure							
10-13	Logical Block Address							
14-17	Physical Block Address							
18-21	Error Symptom Code							
22-26	Media Id							
27	Sense Key							
28	ASC							
29	ASCQ							
30-33	Failure Specific Data							

### 11.6.5 – Error Statistics Log Page (37H)

The Error Statistics Log Page (37H) contains several counters tracking detailed error information. It will be returned with a 4 byte header followed by the error counters.

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved							
01	Reserved							
02	(MSB) Log Transfer Count (LSB)							
03								
00-XX	Error Counters							

## UDO Product Specification

### 11.6.6 – Debug Log Pages (38H-3BH)

The Debug Log Pages (38H-3BH) are used to retrieve internal trace logs and data to be used in problem definition and debug. These pages are variable in length and are broken up (if required) into multiple 65534 byte transfers. Each 65534 byte transfer consists of a 4 byte header followed by 65530 bytes of log data. The log header, which is the first 4 bytes of the log page shown in the table below, returns the number of calls required to retrieve the full log. The parameter pointer field in the CDB is used to access the subsequent log sections.

BIT BYTE	7	6	5	4	3	2	1	0	
00	Reserved								
01	Reserved								
02	(MSB)		End Parameter Pointer						
03									(LSB)
00- 65529	Log Data								

For example, to retrieve a 150,000-byte log, the End Parameter Pointer in the log header would be 3. This would mean that 3 log sense commands would need to be issued, the first with the parameter pointer set to 0, the second with the parameter pointer set to 1, and the final with the parameter pointer set to 2. Note that the drive will generate pad data during the final transfer if required to ensure that the transfer consists of 65534 bytes. Note that a snap shot of the current debug log is taken whenever a Log Sense for page 38H is received with a Parameter Pointer field of 0, and that snap shot of the log is what will be returned.

### 11.6.7 – Certification Statistics Log Page (3DH)

The Certification Statistics Log Page (3DH) contains several counters tracking detailed error information. It will be returned with a 4 byte header followed by the error counters.

BIT BYTE	7	6	5	4	3	2	1	0	
00	Reserved								
01	Reserved								
02	(MSB)		Log Transfer Count						
03									(LSB)
00-XX	Error Counters								

11.6.8 – ASCII Configuration/Error Event Log Page (3EH)

The ASCII Configuration/Error Event Log Page (3EH) is returned in the same format as the debug logs are returned. This page will return ASCII data representing various drive configuration data and the drive Error Event Log page (log page 7).

## UDO Product Specification

### 11.7 – Medium Scan Command

The Medium Scan (38H) command requests the drive to scan the media for a contiguous set of written or blank logical blocks.

#### Medium Scan (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Medium Scan (38H)							
01	LUN 0		WBS	ASA(0)	RSD(0)	PRA(0)	Resrvd	
02	(MSB) <span style="float: right;">(LSB)</span> Logical Block Address							
03								
04								
05								
06								
07	Reserved							
08	Parameter List Length							
09	Reserved							

#### Written Block Search (WBS)

A WBS bit of 0 indicates that the scan is for blank blocks. A WBS bit of 1 indicates that the scan is for written blocks.

#### Advanced Scan Algorithm (ASA)

An ASA bit of 0 indicates that the scan area is scanned in sequential order beginning with the address specified in the Logical Block Address field. This bit cannot be set.

#### Reverse Scan Direction (RSD)

A RSD bit of 0 indicates that the scan will begin from the first logical block of the scan area. This bit cannot be set.

#### Partial Results Acceptable (PRA)

A PRA bit of 0 indicates that the scan will not be satisfied until a contiguous set of blocks is found within the scan area, which is greater than or equal in size to the number of blocks requested, and meets the other criteria for the scan. This bit cannot be set.

The Logical Block Address specifies the first logical block of the scan area.

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 0

## UDO Product Specification

indicates that the number of blocks requested field has a value of 1 and the number of blocks to scan field has a value of 0. This condition shall not be considered an error.

### Medium Scan Parameter List

BIT BYTE	7	6	5	4	3	2	1	0
00	(MSB) <span style="float: right;">(LSB)</span> Number of Blocks Requested							
01								
02								
03								
04	(MSB) <span style="float: right;">(LSB)</span> Number of Blocks to Scan							
05								
06								
07								

### Number of Blocks Requested

The Number of Blocks Requested field specifies the number of blocks needed to meet the specified requirements. The Number of Blocks Requested field, if set to 0, indicates that the scan will not take place. This will not be considered an error condition.

### Number of Blocks to Scan

The Number of Blocks to Scan field specifies the length in blocks of the area to be scanned on the media. The Number of Blocks to Scan field, if set to 0, specifies the length of the scan area to extend to the maximum LBA of the media.

If the scan is satisfied, the command is terminated with a Condition Met status. A Request Sense command should then be issued.

A Request Sense command following a satisfied Medium Scan command will:

- 1) Return a Sense Key of Equal if the scan was satisfied by a contiguous set of blocks equal in size to the number of blocks requested.
- 2) Return the Valid bit set to 1.
- 3) Return the logical block address of the first Logical Block of the contiguous set of blocks that satisfied the scan criteria in the information bytes.
- 4) Return the number of contiguous Logical Blocks meeting the scan criteria in the command specific information bytes.

## UDO Product Specification

If the scan is not satisfied and no error occurs, the command is terminated with Good status. A Request Sense command may then be issued.

A Request Sense command following an unsatisfied Media Scan command shall:

- 1) Return a Sense Key of No Sense if no errors occurred during the command execution
- 2) Return the Valid bit set to 0.

### NOTE:

If Compliant Write Once Media is loaded and a Medium Scan is performed, shredded sectors will be treated as NON-BLANK sectors. The host can therefore use the Medium Scan command to search through both written and shredded sectors for the next set of blank sectors.

## UDO Product Specification

### 11.8 – Mode Select Command

The Mode Select (15H, 55H) command provides a means for the initiator to specify drive operational parameters. The parameter settings can be determined with the Mode Sense command. In auto-configuring systems, the Mode Sense command should be issued before Mode Select to determine supported pages, page lengths and other parameters.

Note: A single set of Mode Parameters is kept in the UDO drive and applies to all initiators. If a given initiator changes the Mode Parameters, a Unit Attention will be generated to all other initiators indicating that the Mode Parameters have been changed.

#### Mode Select (6 Byte)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Mode Select (15H)							
01	LUN 0			PF	Reserved			SP
02	Reserved							
03	Reserved							
04	Parameter List Length							
05	Reserved							

#### Mode Select (10 Byte)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>	
00	Mode Select (55H)								
01	LUN 0			PF	Reserved			SP	
02	Reserved								
03	Reserved								
04	Reserved								
05	Reserved								
06	Reserved								
07	(MSB)			Parameter List Length			(LSB)		
08									
09	Reserved								

#### Page Format (PF)

The PF bit must be set to 1 indicating that the Mode Select parameters are structured as pages of related parameters.

#### Save Pages (SP)

A SP bit of 0 indicates the drive will perform the specified Mode Select operation and not save any pages. Therefore, upon a subsequent reset or power cycle, these

## UDO Product Specification

parameters may be changed. An SP bit of 1 indicates that the drive will perform the specified Mode Select operation and save, to nonvolatile RAM, all the savable pages including any page changes sent during the Data Out phase.

The drive rejects any Mode Select that attempts to change a parameter that is not changeable. The drive rejects a Mode Select that sends a parameter value out of the range supported by the drive. These command rejections cause the drive to return a completion status of Check Condition. The Sense Key/Additional Sense Code will be set to Illegal Request/Invalid Field in Parameter List.

### Parameter List Length

The Parameter List Length specifies the length in bytes of the Mode Select parameter list that is transferred from the initiator to the drive. A Parameter List Length of 0 indicates that no data is transferred. The drive accepts and validates Mode Select parameters up to the Parameter List Length specified in the CDB and according to the Page Specific Parameter Length in each page header. Any multiple byte parameter field not completely supplied is in error. The Sense Key/Additional Sense code will be set to Invalid Request/Invalid Field in Parameter List and no pages will be changed.

The Mode Select parameter list shown in the following table contains a 4 byte header, followed by 0 or more pages of parameters or an 8 byte block descriptor, followed by 0 or more pages of parameters.

If a Mode Select command is terminated with a completion status other than Good, the drive does not modify operating parameters.

The contents of the Medium Type field is 02H for Write Once media and 03H for Rewritable media. The default Medium Type value of 00H will also be accepted. However, any subsequent Mode Sense will report Medium Type as 02H or 03H depending upon the type of media that is loaded in the drive.

### Mode Select Header (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved							
01	Medium Type (00H or 02H or 03H)							
02	Reserved							
03	Block Descriptor Length							



## UDO Product Specification

### Mode Select Header (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved							
01	Reserved							
02	Medium Type (00H or 02H or 03H)							
03	Reserved							
04	Reserved							
05	Reserved							
06	Block Descriptor Length							
07	(MSB)							(LSB)

### Mode Select Block Descriptor

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved							
01	Number of Blocks (00H)							
02								
03								
04								
05	Block Length							
06								
07								
07								

All fields in the Block Descriptor have no effect on the drive.

#### 11.8.1 – Mode Select Page Codes

PAGE CODE	DESCRIPTION
01H	Read-Write Error Recovery Parameters
02H	Disconnect-Reconnect Control Parameters
08H	Caching Page
0AH	Control Mode Page
0BH	Medium Types Supported Page
21H	Vendor Unique Page

## UDO Product Specification

### 11.8.2 – Read-Write Error Recovery Parameters Page (01H)

The Read-Write Error Recovery Parameters (01H) page specifies the error recovery parameters the drive uses during any command that performs a read or write operation to the media.

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Read-Write Error Recovery Parameters (01H)					
01	Page Length (0AH)							
02	AWRE	Resrvd	TB	RC	Resrvd	PER	DTE	DCR
03	Read Retry Count							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Write Retry Count							
09	Reserved							
10	Reserved							
11	Reserved							

#### Automatic Write Reallocation Enabled (AWRE)

The drive always reallocates on Write or Write and Verify commands, therefore the AWRE bit is ignored by the drive. Reallocations are never performed on a Write Long command.

#### Transfer Block (TB)

The TB bit has no effect on the drive.

#### Read Continuous (RC)

The RC bit has no effect on the drive.

#### Post Error (PER)

The drive does not Check Condition on recoverable errors, therefore the PER bit is ignored by the drive.

#### Disable Transfer on Error (DTE)

The DTE bit is ignored by the drive.

#### Disable Correction (DCR)

## UDO Product Specification

Error correction cannot be disabled in the drive, therefore the DCR bit is ignored by the drive.

### Read Retry Count, Write Retry Count

The Read Retry Count and Write Retry Count fields are ignored by the drive.

### 11.8.3 – Device Disconnect-Reconnect Control Parameters Page (02H)

The Device Disconnect-Reconnect Control Parameters (02H) page specifies the parameters that control the drive's SCSI bus usage during data transfer operations.

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Device Disconnect-Reconnect Control Parameters (02H)					
01	Parameter Length (0EH)							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Reserved							
09	Reserved							
10	(MSB)		Maximum Burst Length				(LSB)	
11								
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

#### Parameter Length

The Parameter Length must be set to 14 (0EH).

#### Buffer Full Ratio, Buffer Empty Ratio

These fields have no effect on the drive.

#### Maximum Burst Length

The Maximum Burst Length gives the number of 512 byte blocks the drive transfers on the SCSI bus before attempting to disconnect. The drive transfers exactly this number of blocks on all but the final transfer of a command. A value of 0 indicates that the drive will not disconnect during the data transfer phase of commands.

## UDO Product Specification

The default value is 2048 (800H) resulting in a maximum burst size of 1024KBytes. Since burst length is expressed in increments of 512 bytes and the drive must transfer on 8192 byte boundaries, the value must be a modulus 16. If it is not, the drive will respond with a Check Condition status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Field in Parameter List.

### 11.8.4 – Caching Page (08H)

#### Caching Page (08H)

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Caching Page (08H)					
01	Parameter Length (0AH)							
02	Reserved					WCE	MF	RCD
03	Reserved							
04	(MSB) Disable Pre-Fetch Transfer Length (LSB)							
05								
06	(MSB) Minimum Pre-Fetch (LSB)							
07								
08	(MSB) Maximum Pre-Fetch (LSB)							
09								
10	(MSB) Maximum Pre-Fetch Ceiling (LSB)							
11								

#### Write Cache Enable (WCE)

Setting the WCE bit to 1 causes write commands to be cached with status being returned upon completion of the data transfer into the buffer (i.e. Write Behind). Setting this bit to 0 causes data to be written to the disk before status is returned (i.e. Write Through). The default value for this bit is 1.

#### Multiplication Factor (MF)

The MF bit has no effect on the operation of the drive.

#### Read Cache Disable (RCD)

Setting the RCD bit to 1 causes the read cache to be disabled, so that all data is retrieved from the media. Setting this bit to 0 enables Read Caching of the data. The default value for this bit is 0.

## UDO Product Specification

Note: If WCE and RCD are both set to 1, a Check Condition status is returned with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Field in Parameter List.

Disable Pre-Fetch Transfer Length, Minimum Pre-Fetch, Maximum Pre-Fetch, Maximum Pre-Fetch Ceiling fields

These fields have no effect on the drive.

### 11.8.5 – Control Mode Page (0AH)

Control Mode Page (0AH)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Control Mode Page (0AH)					
01	Parameter Length (06H)							
02	Reserved							
03	Queue Algorithm Modifier			Reserved			Dque	
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							

#### Queue Algorithm Modifier

The Queue Algorithm Modifier field specifies restrictions to be used when reordering commands that are tagged with the Simple Queue Tag Message. Setting this field to 0 causes the drive to inhibit reordering of commands in the queue. Setting this field to 1 allows the drive to reorder commands in the queue. The default value for this field is 1.

#### Disable Queue (Dque)

Setting the Dque bit to 0 indicates that tagged command queuing is enabled. Setting this bit to 1 disables tagged command queuing. The default value for this bit is 0.

## UDO Product Specification

### 11.8.6 – Medium Types Supported Page (0BH)

#### Medium Types Supported Page (0BH)

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved		Medium Types Supported Page (0BH)					
01	Parameter Length (06H)							
02	Reserved							
03	Reserved							
04	Medium Type 1 Supported							
05	Medium Type 2 Supported							
06	Medium Type 3 Supported							
07	Medium Type 4 Supported							

This page is used to set the Medium Type(s) supported by the drive. The drive accepts the following combinations.

Byte	Field Name	Setting 1 (Default)	Setting 2	Setting 3	Setting 4
04	Medium Type 1 Supported	02H	00H	02H	03H
05	Medium Type 2 Supported	03H	00H	00H	00H
06	Medium Type 3 Supported	00H	00H	00H	00H
07	Medium Type 4 Supported	00H	00H	00H	00H
Setting Result		Write Once and Rewritable	Rewritable Only	Write Once Only	Rewritable Only

00H Default (Rewritable medium only)

02H Write Once medium

03H Rewritable medium

## UDO Product Specification

### 11.8.7 – Vendor Unique Page (21H)

#### Vendor Unique Page (21H)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Vendor Unique Page (21H)					
01	Parameter Length (0AH)							
02	Reserved							
03	DWR	Quick Dis- connect	Disable Read- Ahead	Force Verify	Disable Auto- spin	MMSU	SDTR	WDTR
04	Sleep Time							
05	Reserved						BTC	NoBC
06	Reserved							
07	Busy Timeout							
08	Reserved							
09	Reserved							
10	Reserved							
11	Reserved							

#### Disable Write Reordering (DWR)

A DWR bit of 1 indicates that write reordering is not enabled. A DWR bit of 0 indicates that write reordering is enabled. The default value for this bit is 0.

#### Quick Disconnect

A Quick Disconnect bit of 1 enables SCSI bus disconnection before command validation on performance path commands (i.e. reads and writes). A Quick Disconnect bit of 0 disables SCSI bus disconnection before command validation on performance path commands. The default value for this bit is 0.

#### Disable Read-Ahead

Setting the Disable Read-Ahead bit to 1 will prevent the drive from performing its read-ahead operation. The default value for this bit is 0.

#### Force Verify

A Force Verify bit of 1 indicates that all write operations will be verified. The Write commands will operate as if they were Write and Verify commands. A Force Verify bit of 0 indicates that verifies will not be performed on a Write command. When Write Once media is inserted in the drive, a verify will always be performed after a write operation,

## UDO Product Specification

regardless of the state of the Force Verify bit. The default for this bit is set to 1.

Note: Disabling Force Verify is not recommended for any data storage operation as dust and debris on the media may cause the written data to be unreadable if not verified.

### Disable Autospin

Setting the Disable Autospin bit to 1 will keep the drive from spinning up automatically when media is loaded. If this bit is set to 0, the drive will automatically spin up when media is loaded. The default for this bit is set to 0.

Note: Autospin can also be disabled via the function connector.

### Media Management at Spin Up (MMSU)

Setting the MMSU bit to 1 will force the drive to acquire the Media Management structures (DDS, PDL, SDL) at spin up time. This will cause spin up to ready time to be longer. If this bit is set to 0, the Media Management structures will be acquired on the first media access (Write or Read) so the first media access will take longer than normal. The default for this bit is set to 0.

### Synchronous Data Transfer Request (SDTR)

Setting the SDTR bit to 1 will cause the drive to initiate an SDTR negotiation after a reset, power up, self test, send diagnostic, or microcode update command. If this bit is set to 0 the drive will never initiate an SDTR negotiation. Default value for this bit is 0.

### Wide Data Transfer Request (WDTR)

Setting the WDTR bit to 1 will cause the drive to initiate a WDTR negotiation after a reset, power up, self test, send diagnostic or microcode update command. If this bit is set to 0 the drive will never initiate a WDTR negotiation. Default value for this bit is 0.

### Sleep Time

Sleep Time is the value in minutes that the drive will remain spun-up with no SCSI activity. After the Sleep Time expires, the drive will perform a spin-down operation. Setting this value to 0 will inhibit the sleep operation. Sleep mode is transparent to the host. If an access command is



## UDO Product Specification

issued while the drive is sleeping, the drive will automatically spin back up and resume operation. Default is Sleep Time = 10 minutes.

### Busy Timeout Control (BTC)

Setting the BTC bit to 1 will cause the Busy Timeout value to be applied. Default value for this bit is 0.

### No Blank Check (NoBC)

This bit is applicable to RW media only. Setting this bit to 1 will cause the drive to return data filled with zeros for any blank sectors on the disk (i.e. instead of a Check Condition with Sense Key = Blank Check). This mode provides compatibility with native files systems that do not tolerate Blank Check status from RW media. The default for this bit is set to 0.

### Busy Timeout

This value indicates the number of seconds that a command can be accepted by the drive without being executed. Once this timeout expires, the drive will return a Busy status to the command. Setting Busy Time = 0 will inhibit this option. If the BTC bit is set, This timeout value will only be applied if the BTC bit is set. Default is Busy Timeout = 6 seconds.

## UDO Product Specification

### 11.9 – Mode Sense Command

The Mode Sense (1AH, 5AH) command provides a means for the drive to report parameters to the initiator. It is a complementary command to the Mode Select command.

#### Mode Sense (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Mode Sense (1AH)							
01	LUN 0			Resrvd	DBD	Reserved		
02	Page Control (PC)			Page Code				
03	Reserved							
04	Allocation Length							
05	Reserved							

#### Mode Sense (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0	
00	Mode Sense (5AH)								
01	LUN 0			Resrvd	DBD	Reserved			
02	Page Control (PC)			Page Code					
03	Reserved								
04	Reserved								
05	Reserved								
06	Reserved								
07	(MSB)			Allocation Length					
08								(LSB)	
09	Reserved								

#### Disable Block Descriptor (DBD)

A DBD bit of 1 indicates that the block descriptor is not provided. A DBD bit of 0 indicates that the block descriptor is provided.

The Page Control (PC) field, as shown in the following table, defines the type of parameter values to be returned.

#### Page Control Field Definition

BIT 7	BIT 6	TYPE OF PARAMETER VALUES
0	0	Current Values
0	1	Changeable Values
1	0	Default Values
1	1	Saved Values

#### Current Values

## UDO Product Specification

A PC field value of 00b requests that the drive return the current values for the page code specified. The current values returned are:

- Parameters set in the last successful Mode Select command
- Saved values if a Mode Select command has not been executed

Parameters not supported by the drive are set to 0. The parameter length of each page indicates the length of the parameters that are supported.

### Changeable Values

A PC field value of 01b requests that the drive return the changeable values for the page code specified. The page requested is returned with the bits that are allowed to be changed set to 1. Parameters that are not changeable are set to 0.

### Default Values

A PC field value of 10b requests the drive return the default values for the page code specified. The page requested is then returned with the default parameters set. Parameters not supported by the drive are set to 0.

### Saved Values

A PC field value of 11b requests the drive return the saved values for the page code specified. The page requested will be returned with the parameters set to their saved values. Parameters not supported by the drive will be set to 0. All savable pages can be considered saved when a Mode Select command issued with the SP bit set to 1 has returned a Good status.

### Page Code

The Page Code field specifies which page or pages to return. Page Codes are defined in the table in section 11.9.1. The format of supported pages are specified with the Mode Select command.

### Allocation Length

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned Mode Sense data. The drive terminates the Data In phase when the Allocation Length bytes have been transferred or when all available Mode Sense data has been transferred to the initiator, whichever is less. The drive Mode Sense Allocation Length must be 36 bytes or greater to return all supported pages.

### Mode Sense Data

## UDO Product Specification

The Mode Sense data returned by the drive consists of a 4 byte header, followed by either a 0 or 8 byte block descriptor, followed by 1 or more pages. 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 count does not include this byte.

### Mode Sense Header (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Sense Data Length							
01	Medium Type (00H or 02H or 03H)							
02	WP	Reserved						CM
03	Block Descriptor Length							

### Mode Sense Header (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	(MSB) Sense Data Length (LSB)							
01								
02	Medium Type (00H or 02H or 03H)							
03	WP	Reserved						CWO
04	Reserved							
05	Reserved							
06	(MSB) Block Descriptor Length (LSB)							
07								

### Mode Sense Block Descriptor

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserved							
01	(MSB) Number of Blocks (00H) (LSB)							
02								
03								
04	Reserved							
05	(MSB) Block Length (LSB)							
06								
07								

### Medium Type

The contents of the Medium Type field is 02H if Write Once media is loaded and 03H if Rewritable media is loaded. The contents of the Medium Type field is 00H if no media is loaded or the drive is Not Ready.

## UDO Product Specification

### Write Protect (WP)

A WP bit of 0 indicates that the drive or media is write enabled. A WP bit of 1 indicates that the drive or media is write protected.

### CWO

A CWO bit of 1 indicates that Compliant Write Once Media is loaded. A CWO bit of 0 indicates that standard Write Once or Rewriteable media is loaded.

### Block Descriptor Length

The Block Descriptor Length specifies the length in bytes of the block descriptor. The drive supports only 1 block descriptor, thus the value in this field is either a 0 or 8.

The drive will return a Block Descriptor in a Mode Sense command only when the media is ready and available for access. If not ready, the Block Descriptor Length will be 0 and the block descriptor fields will be omitted.

### Number of Blocks

The Number of Blocks field value is 0 for the drive. This specifies that the block length specification that follows applies to the entire media.

### Block Length

The Block Length field specifies the length in bytes of each logical block of the drive logical unit. The block length returned will be 2000H (8192 bytes).

Blocks of parameters called pages follow the block descriptor. Each page is preceded by a header of 2 bytes defining the Page Code and the length of the parameters that follow.

The Page Save (PS) bit indicates the page can be saved to nonvolatile RAM. Following the header, pages consist of a number of fields of related flags and/or values. Savable pages are optional and identified by the PS bit that is returned in the page header by the Mode Sense command. The Parameter Length indicates the number of bytes that the drive supports in each page. The Parameter Length value does not include the 2 byte header. The drive returns, in the pages of the Mode Sense commands, the entire page as defined in this document.

## UDO Product Specification

### 11.9.1 – Mode Sense Page Codes

PAGE CODE	DESCRIPTION
01H	Read-Write Error Recovery Parameters
02H	Disconnect-Reconnect Control Parameters
08H	Caching Page
0AH	Control Mode Page
0BH	Medium Types Supported Page
21H	Vendor Unique Page
3FH	Return All Supported Pages

### 11.9.2 – Read-Write Error Recovery Parameters Page (01H)

The Read-Write Error Recovery Parameters (01H) page specifies the error recovery parameters the drive uses during any command that performs a Read or Write operation to the media.

BIT BYTE	7	6	5	4	3	2	1	0
00	PS(1)	Resrvd	Read-Write Error Recovery Parameters (01H)					
01	Page Length (0AH)							
02	AWRE	Resrvd	TB	RC	Resrvd	PER	DTE	DCR
03	Read Retry Count							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Write Retry Count							
09	Reserved							
10	Reserved							
11	Reserved							

#### Page Save (PS)

The PS bit is set to indicate this page can be saved.

AWRE, TB, RC, PER, DTE and PER

Refer to Mode Select command section 11.8.2 for these definitions.

## UDO Product Specification

### 11.9.3 – Device Disconnect-Reconnect Control Parameters Page (02H)

The Device Disconnect-Reconnect Control Parameters (02H) page specifies the parameters that control the drive's SCSI bus usage during data transfer operations.

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	PS (1)	Resrvd	Device Disconnect-Reconnect Control Parameters (02H)					
01	Parameter Length (0EH)							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Reserved							
09	Reserved							
10	Maximum Burst Length							
11								
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

#### Page Save (PS)

The PS bit is set to indicate this page can be saved.

Buffer Full Ratio, Buffer Empty Ratio, Maximum Burst Length

Refer to Mode Select section 11.8.3 for these definitions.

## UDO Product Specification

### 11.9.4 – Caching Page (08H)

#### Caching Page (08H)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Caching Page (08H)					
01	Parameter Length (0AH)							
02	Reserved					WCE	MF	RCD
03	Reserved							
04	(MSB) Disable Pre-Fetch Transfer Length (LSB)							
05								
06	(MSB) Minimum Pre-Fetch (LSB)							
07								
08	(MSB) Maximum Pre-Fetch (LSB)							
09								
10	(MSB) Maximum Pre-Fetch Ceiling (LSB)							
11								

#### Remaining Cache Parameters

Refer to Mode Select section 11.8.4 for these definitions.

### 11.9.5 – Control Mode Page (0AH)

#### Control Mode Page (0AH)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Control Mode Page (0AH)					
01	Parameter Length (06H)							
02	Reserved							
03	Queue Algorithm Modifier				Reserved			Dque
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							

#### Queue Algorithm Modifier, Dque

Refer to Mode Select command section 11.8.5 for these definitions.



## UDO Product Specification

### 11.9.6 – Medium Types Supported Page (0BH)

#### Medium Types Supported Page (0BH)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Medium Types Supported Page (0BH)					
01	Parameter Length (06H)							
02	Reserved							
03	Reserved							
04	Medium Type 1 Supported							
05	Medium Type 2 Supported							
06	Medium Type 3 Supported							
07	Medium Type 4 Supported							

#### Medium Type Supported

Refer to Mode Select command section 11.8.6 for these definitions.

### 11.9.7 – Vendor Unique Page (21H)

#### Vendor Unique Page (21H)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Reserved		Vendor Unique Page (21H)					
01	Parameter Length (0AH)							
02	Reserved							
03	DWR	Quick Dis- connect	Disable Read Ahead	Force Verify	Disable Auto- spin	MMSU	SDTR	WDTR
04	Sleep Time							
05	Reserved						BTC	NoBC
06	Reserved						DOM	UnRq
07	Busy Timeout							
08	Reserved							
09	Reserved							
10	Reserved							
11	Reserved							

DWR, Quick Disconnect, Disable Read Ahead, Force Verify, Disable Autospin, MMSU,SDTR, WDTR, Sleep Time,BTC, NoBc, Busy Timeout

Refer to Mode Select section 11.8.7 for these definitions.

#### Drive Operating Mode (DOM)

## UDO Product Specification

A DOM bit of 1 indicates that the drive is installed in an automation environment (as set by pin11 of the Function Connector). A DOM bit of 0 indicates that the drive is installed in a standalone environment.

### Unload Request (UnRq)

A UnRq bit of 1 indicates that an attempt was made to unload media that is locked. (i.e. the Prevent/Allow Command was used to prevent media removal). The bit will clear after the media is unloaded.

### 11.9.8 – Return All Supported Pages

The Return All Supported Pages (3FH) command requests that all implemented pages be returned by the drive. All supported pages are returned in ascending order.

## UDO Product Specification

### 11.10 – Pre-Fetch Command

The Pre-Fetch (34H) command requests that the drive transfer the specified logical blocks to the cache memory. No data shall be transferred to the initiator.

#### Pre-Fetch (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Pre-Fetch (34H)							
01	LUN 0			Reserved			Immed	Resrvd
02	(MSB) <span style="float: right;">(LSB)</span> Logical Block Address							
03								
04								
05								
06								
07	(MSB) <span style="float: right;">(LSB)</span> Transfer Length							
08								
09	Reserved							

#### Immediate (Immed)

An Immed bit of 1 indicates that status shall be returned as soon as the command descriptor block has been validated. An Immed bit of 0 indicates that the status will be returned after the operation is complete.

The transfer length field specifies the number of contiguous logical blocks of data that will be transferred to the drive's cache memory. A transfer length of 0 indicates that the contiguous logical blocks up to and including the last logical block of the logical unit will be transferred to the drive's cache memory. Any other value indicates the number of logical blocks that will be transferred. The target may elect to not transfer logical blocks that already are contained in the cache memory.

If the Immed bit is 0 and the specified logical blocks were successfully transferred to the cache memory, the drive will return a Condition Met status.

If the Immed bit is 1, and the unlocked cache memory has sufficient capacity to accept all of the specified logical blocks, the drive will return a Condition Met status.

If the Immed bit is 1, and the unlocked cache memory does not have sufficient capacity to accept all of the specified logical blocks, the target will return Good status. The drive will transfer to cache memory as many logical blocks as will fit.

11.11 – Prevent-Allow Media Removal Command

The Prevent-Allow Media Removal (1EH) command enables or disables the removal of media from the drive.

Prevent-Allow Media Removal (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Prevent-Allow Media Removal (1EH)							
01	LUN 0			Reserved				
02	Reserved							
03	Reserved							
04	Reserved							Prevent
05	Reserved							

Prevent

A Prevent bit of 1 prevents removal of the media. A Prevent bit of 0 allows removal of the media. If any initiator has issued this command with the Prevent bit set, then the media will not be allowed to be removed. This is true even if other initiators issue the command with a Prevent bit of 0. If set by multiple initiators, the lock will be enforced until released by all initiators. The default state of the Prevent bit is 0 (allow media removal).

If media is not installed when this command is received, the command will be rejected and a Sense Key/Additional Sense Code set to Not Ready/Media Not Present.

Prevent Media Removal can only be cleared by an Allow Media Removal command, a SCSI Bus Reset or a power-on cycle, and can only be invoked when a cartridge is inserted and Ready in the drive. If a drive fault occurs when Prevent Media Removal is enabled, no intervention will be possible via the eject button.

## UDO Product Specification

### 11.12 – Read Command

The Read (08H, 28H, A8H) command requests a transfer of data from the media to the initiator.

#### Read (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read (08H)							
01	LUN 0			(MSB)				
02	Logical Block Address							
03								
04								
05	Transfer Length							
05	Reserved							

#### Read (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read (28H)							
01	LUN 0			DPO	FUA	Reserved		
02	(MSB) Logical Block Address							
03								
04								
05								
06	Reserved							
07	(MSB) Transfer Length							
08								
09	Reserved							

#### Read (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read (A8H)							
01	LUN 0			DPO	FUA	Reserved		
02	(MSB) Logical Block Address							
03								
04								
05								
06	(MSB) Transfer Length							
07								
08								
09								
10	Reserved							
11	Reserved							

#### Logical Block Address

## UDO Product Specification

The Logical Block Address specifies the logical block where the read operation will begin.

On an unsuccessful read, the sense information bytes will report the failing logical block address.

### Disable Page Out (DPO)

The drive ignores this field.

### Force Unit Access (FUA)

A FUA bit of 1 will cause the read commands to access the specified logical blocks from the media (i.e. the data is not directly retrieved from the cache). In the case where the cache contains a more recent version of a logical block than the media, the logical block will first be written to the media.

A FUA bit of 0 indicates that the target may satisfy the command by accessing LBAs already contained in the cache memory.

### Transfer Length

The Transfer Length field specifies the number of contiguous Logical Blocks of data to be transferred. For a Read (6 Byte), a Transfer Length of 0 indicates that 256 Logical Blocks will be transferred. For a Read (10 Byte) or a Read (12 Byte), a Transfer Length of 0 indicates that no Logical Blocks will be transferred. This condition will not be considered an error. Any other value indicates the number of Logical Blocks that will be transferred. On a successful read, the sense information bytes are set to the Logical Block Address of the first block not read.

11.13 – Read Buffer Command

The Read Buffer (3CH) command requests a transfer of data from the read/write buffer to the initiator. This command is used in conjunction with the Write Buffer command as a diagnostic tool.

Read Buffer (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read Buffer (3CH)							
01	LUN 0			Reserved		Mode		
02	Buffer ID							
03	(MSB) Buffer Offset (LSB)							
04								
05								
06	(MSB) Parameter List Length (LSB)							
07								
08								
09								

The function of this command and the meaning of fields within the command descriptor block depend on the contents of the mode field. The supported Read Buffer modes are shown in the following table. The mode field indicates which data format is returned.

Read Buffer Mode Field

MODE	DESCRIPTION
000b	Combined Header and Data (Buffer Offset = 0)
001b	Combined Header and Data
010b	Data Only
011b	Header Only

Buffer ID

The Buffer ID field indicates which 16MByte page of the buffer to use as the base address to add to the buffer offset. If the Buffer ID is 0 then the first 16Mbytes of the buffer will be accessed. Incrementing the Buffer ID allows the next 16MBytes of the buffer to be accessed.

Buffer Offset

The Buffer Offset field indicates the address the data should be read from with the offset from the beginning of the data buffer.

Parameter List Length

## UDO Product Specification

The Parameter List Length indicates the maximum amount of data to be returned to the host.

### Read Buffer Header

For the modes, which return a header, the header will be in the following format.

BIT BYTE	7	6	5	4	3	2	1	0
00	Offset Boundary (1)							
01	Buffer Capacity (MSB) (LSB)							
02								
03								
04								
04	Buffer Data (For Modes 0 and 1)							

The Offset Boundary field returns the boundary alignment within the selected buffer for subsequent Read Buffer commands. The value contained in the Offset Boundary field will be interpreted as a power of two. The drive will return a 1 in this field indicating 18 bit word boundaries are supported.

The Buffer Capacity field specifies the total number of data bytes available in drive's data buffer for the requested Buffer ID. This number is not reduced to reflect the Parameter List Length. Following the Read Buffer header, the drive will transfer data from its data buffer. The drive terminates the Data In phase when Parameter List Length bytes of header plus data have been transferred or when all available header and buffer data have been transferred to the initiator, whichever is less.

NOTE: The internal buffer CRC checking is disabled during a Read Buffer command.



11.14 – Read Capacity Command

The Read Capacity (25H) command provides a means for the initiator to request information regarding the capacity of the currently spinning media. Because the capacity is not known until the disk spins, a Not Ready condition will cause this command to be rejected with a Check Condition status and a Sense Key/Additional Sense Code set to Not Ready/Drive Not Ready.

Read Capacity (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read Capacity (25H)							
01	LUN 0			Reserved				
02	Reserved							
03	Reserved							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Reserved							PMI
09	Reserved							

Partial Medium Indicator (PMI)

Partial ROM medium is not support by this drive. The PMI bit is ignored by the drive.

The Read Capacity command returns the Maximum Logical Block Address and Block Length (in bytes) of the logical unit.

The Block Length will be 2000H (8192 bytes).

The 8 bytes of Read Capacity Data, shown in the following table, are sent by the drive during the Data In phase of the command.

Read Capacity Data

BYTE	DESCRIPTION
0	(MSB) Maximum Logical Block Address (LSB)
1	
2	
3	
4	(MSB) Block Length (LSB)
5	
6	
7	

## UDO Product Specification

### 11.15 – Read Defect Data Command

The Read Defect Data (37H, B7H) command requests that drive transfer the media defect data to the initiator.

#### Read Defect Data (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read Defect Data (37H)							
01	LUN 0			Reserved				
02	Reserved			Plist	Glist	Defect List Format		
03	Reserved							
04	Reserved							
05	Reserved							
06	Reserved							
07	(MSB)			Allocation Length				
08								(LSB)
09	Reserved							

#### Read Defect Data (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read Defect Data (B7H)							
01	LUN 0			Reserved				
02	Reserved			Plist	Glist	Defect List Format		
03	Reserved							
04	Reserved							
05	Reserved							
06	Reserved							
07	(MSB)			Allocation Length				
08								
09								
10								(LSB)
11	Reserved							

If the drive is unable to access any media defect data, it will terminate the command with Check Condition status. The sense key will be set to either Medium Error, if a media error occurred, or No Sense, if the list does not exist, and the Additional Sense Code will be set to Defect List Not Found.

The drive will not be able to return medium defect data until after a Format Unit command has been completed successfully.

#### Plist

Setting the Plist bit to 1 will result in the drive returning the Primary Defect List.

## UDO Product Specification

### Glist

Setting the Glist bit to 1 will result in the drive returning the Secondary Defect List.

A Plist bit of 1 and a Glist bit of 1 requests that drive return both the primary and secondary defect lists. The order in which the lists are returned are the Primary Defect List followed by the Secondary Defect List. A Plist bit of 0 and a Glist bit of 0 requests that drive return only the defect list header.

### Defect List Format

The Defect List Format field is used to select either type 0 or 1, or 5. Type 5 will be treated as type 0 and is provided for better compatibility with previous MO products.

Note: A request for Defect List Format 1 could take up to 5 minutes to complete.

The Read Defect Data defect list contains a 8 byte header, followed by 0 or more defect descriptors.

### Read Defect Data

BIT BYTE	7	6	5	4	3	2	1	0								
00	Reserved															
01	Reserved			Plist	Glist	Defect List Format										
02	Reserved															
03	Reserved															
04	(MSB) <span style="float: right;">(LSB)</span>															
05									Defect List Length							
06																
07																
08	Defect Descriptor 0 (if any)															
..	..															
n	Defect Descriptor x															

### Defect List

A Plist bit of 1 indicates that the data returned contains the Primary Defect List. A Plist bit of 0 indicates that the data returned does not contain the Primary Defect List.

A Glist bit of 1 indicates that the data returned contains the Secondary Defect List. A Glist bit of 0 indicates that the data returned does not contain the Secondary Defect List.

### Defect List Format

## UDO Product Specification

The drive returns whatever was received in the Defect List Format field of the Command Descriptor Block.

### Defect List Length

The Defect List Length field specifies the length in bytes of the defect descriptors that follow. The Defect List Length is equal to 4 or 16 times the number of defect descriptors depending on the requested format.

If the Allocation Length is insufficient to transfer all of the defect descriptors, the Defect List Length will not be adjusted to reflect the truncation. The drive will not create a Check Condition status.

The initiator is responsible for comparing the Defect List Length and the Allocation Length to ensure that a partial list was not received.

The initiator may determine the length of the defect list by sending the Read Defect Data command with an allocation length of 8. The drive will return the defect list header that contains the length of the defect list.

The Defect Descriptors will be sent in ascending order unless both the Plist and Glist are specified. The initiator may determine the exact number of defects by dividing the Defect List Length by the length of a single Defect Descriptor for the returned format.

### Defect Descriptor for Defect List Format 0

BIT BYTE	7	6	5	4	3	2	1	0
00	Prime	DFKF	Resrvd	Relocation Code				
01	(MSB) Defective PBA (LSB)							
02								
03								

## UDO Product Specification

### Defect Descriptor for Defect List Format 1

BIT BYTE	7	6	5	4	3	2	1	0
00	(MSB) Defective PBA (LSB)							
01								
02								
03								
04	(MSB) Associated LBA (LSB)							
05								
06								
07								
08	(MSB) Replacement PBA (LSB)							
09								
10								
11								
12	Prime	DFKF	Resrvd	Relocation Code				
13	(MSB) Drive Serial Number that Generated the Defect (LSB)							
14								
15								

#### Defective PBA

The Defective PBA field indicates where the original location of the LBA should reside.

#### Associated LBA

The Associated LBA field indicates the LBA number associated with the Defective PBA.

#### Replacement PBA

The Replacement PBA field indicates where the LBA actually resides.

#### Prime

If the Prime bit is set then this defect is due to a primary relocation, otherwise the defect is a secondary relocation.

#### Defect identified during First Known Format (DFKF)

If the DFKF bit is set, this indicates that the defect was found during the first known format of the media.

#### Relocation Code

## UDO Product Specification

The Relocation Code indicates the reason for the relocation as shown in the following table.

RELOCATION CODE	DESCRIPTION
00H	Reserved
01H	Wobble Error
02H	Focus Error
03H	Hard ECC Error
04H	Soft ECC Error
05H	Too Many Bad Reference Bytes
06H	Control Record Error
07H	ID Threshold Validation Error
08H	Loss of Lock Error
09H	Channel Clock Out Error
0AH	Reserved
0BH	External Error
0CH	Decoder Error
0DH	Write FIFO Underflow Error
0EH	Setup Error
0FH	Past Target Error
10H	DSP Error
11H	BOS Defect
12H	EOS Defect
13H	BOS and EOS Defects
14H	VAP Defect
15H	Tracking Error
16H	Erase Relocation
17H-1CH	Reserved
1DH	Unknown
1EH	Other
1FH	User Supplied Primary Defect (Prime Bit will also be set)

### Media ID

The Media ID is a manufacturing specific code that uniquely identifies the piece of media.

The defect list length is equal to 4 or 16 times the number of Defect Descriptors in the physical sector format depending on the requested format.

Each descriptor is comprised of a PBA of the defect.

11.16 – Read Long Command

The Read Long (3EH) command requests drive to transfer data to the initiator. The data passed during the Read Long command includes the Data, Control, CRC, and ECC Bytes recorded on the media.

Read Long (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Read Long (3EH)							
01	LUN 0			Reserved			CRCT	Resrvd
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06								
07	(MSB) Transfer Length (LSB)							
08								
09	PBA	SC	Reserved					

Corrected (CRCT)

A CRCT bit of 0 causes a logical block to be read without any correction made by the drive. A CRCT bit of 1 causes the data to be corrected by ECC before being transferred to the initiator.

Physical Block Address (PBA)

A PBA bit of 0 indicates that the normal SCSI access via LBA, or Logical Block Address, is in use. A PBA bit of 1 indicates that the contents of the LBA field specify a PBA, or Physical Block Address. All physical sectors of the disk are accessible when this bit is utilized. When the PBA bit is set, there is no parameter checking in the drive.

Sector Count (SC)

A SC bit of 1 indicates that the transfer length is represented in sectors rather than bytes. A SC bit of 0 indicates that the transfer length is represented in bytes.

Transfer Length

If the SC bit is set to 1, the Transfer Length field specifies the number of sectors to be transferred.

If the SC bit is set to 0, the Transfer Length field specifies the number of contiguous logical blocks that will be transferred. Each block will be 9424 bytes

## UDO Product Specification

long. A transfer length of 0 indicates that no blocks will be transferred and will not be considered an error.

### 8KB Sector Read Long Bytes

<b>BYTE</b>	<b>LENGTH</b>	<b>DESCRIPTION</b>
0 – 8191	8192	User Data Bytes
8192 – 8203	12	Control Bytes
8204 – 8207	4	CRC Bytes
8208 – 9423	1216	ECC Bytes

The Read Long is not supported when Compliant Write Once Media is loaded and will return an Illegal Request Check condition.



## UDO Product Specification

### 11.17 – Read Sector Location Command

The Read Sector Location (E6H) command will translate the specified LBA (Logical Block Address) into its PBA (Physical Block Address).

#### Read Sector Location (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0								
00	Read Sector Location (E6H)															
01	LUN 0			Reserved												
02	(MSB) <span style="float: right;">(LSB)</span>															
03									Block Address							
04																
05																
06																
07	Reserved															
08	Reserved															
09	PBA	Reserved														

If the sector location being asked for is beyond the access range of the drive a Check Condition status will be returned with a Request Sense/Additional Sense Code set to Illegal Request/Logical Block Address out of Range.

#### Physical Block Address (PBA)

Setting the PBA bit to 0 will cause the drive to return the PBA which contains the requested LBA set in the block address field.

Setting the PBA bit to 1 will cause the drive to return the LBA associated with the PBA set in the block address field. If the LBA cannot be determined, 7FFFFFFFH will be returned in the LBA field.

#### Sector Location Page

BIT BYTE	7	6	5	4	3	2	1	0								
00	(MSB) <span style="float: right;">(LSB)</span>															
01									Physical Block Address							
02																
03																
04	(MSB) <span style="float: right;">(LSB)</span>															
05									Logical Block Address							
06																
07																

## UDO Product Specification

### 11.18 – Receive Diagnostic Results Command

The Receive Diagnostic Results (1CH) command returns the results of the Send Diagnostic command.

#### Receive Diagnostic Results (6 Byte)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Receive Diagnostic Results (1CH)							
01	LUN 0			Reserved				
02	Reserved							
03	(MSB) Allocation Length (LSB)							
04								
05	Reserved							

#### Allocation Length

The Allocation Length specifies the number of bytes allocated for the returned diagnostic data. The drive returns the number of bytes specified or all available diagnostic data, whichever is less.

#### Receive Diagnostic Results Page Codes

The drive returns two diagnostic pages as listed below.

#### Receive Diagnostic Page Codes

<b>PAGE CODE</b>	<b>LENGTH</b>	<b>DESCRIPTION</b>
00H	6	Supported Diagnostic Pages
80H	10	Controller Test

#### Supported Diagnostic Pages

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Support Diagnostic Pages (00H)							
01	Reserved							
02	Page Length (00H)							
03	Page Length (02H)							
04	Supported Page List (00H)							
05	Supported Page List (81H)							

# UDO Product Specification

## Controller Test Page

BIT BYTE	7	6	5	4	3	2	1	0
00	Controller Test (80H)							
01	Reserved							
02	Page Length (00H)							
03	Page Length (06H)							
04	Reserved							Success
05	Loop Count Completed							
06	(MSB) Internal Error Locator Code (LSB)							
07								
08								
09								

11.19 – Release Command

The Release (17H, 57H) command is used to release previously reserved units.

Release (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Release (17H)							
01	LUN 0		3 <sup>rd</sup> Party	Third Party Device ID			Resrvd	
02	Reserved							
03	Reserved							
04	Reserved							
05	Reserved							

Release (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Release (57H)							
01	LUN 0		3 <sup>rd</sup> Party	Reserved		Long ID	Ext	
02	Reserved							
03	Third Party Device ID							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Reserved							
09	Reserved							

This command causes the drive to terminate any active reservation from the initiator. It is not an error for an initiator to attempt to release a reservation that is not currently active. In this case, the drive returns a Good status.

Long ID

The Long ID bit is not supported and must be set to 0.

Extent (Ext)

Extents are not supported so the Ext bit must be set to 0.

Third Party Release (3<sup>rd</sup> Party)

When the 3<sup>rd</sup> Party bit is set to 0, a third party release is not requested. If set to 1, this field releases the LUN for the Third Party Device and causes any subsequent

## UDO Product Specification

command issued by the Third Party Device to be executed according to the mode parameters in effect for the initiator sending this command.

### Third Party Device ID

Third Party Device ID is the SCSI Bus ID of the device referred to, if the 3<sup>rd</sup> Party bit is set to 1.

11.20 – Request Sense Command

The Request Sense (03H) command requests that the drive transfer sense data to the initiator.

Request Sense (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Request Sense (03H)							
01	LUN 0			Reserved				
02	Reserved							
03	Reserved							
04	Allocation Length							
05	Reserved							

The sense data indicates the status or error conditions existing at the termination of the previous SCSI command. This sense data is preserved for the initiator until retrieved by the Request Sense command or until another command is received from the initiator. The drive stores sense data independently for each SCSI initiator. It is recommended that all 254 bytes of sense data be preserved for errors requiring failure analysis.

Allocation Length

The Allocation Length specifies the maximum number of sense bytes to be returned. The drive terminates the Data In phase when allocation length bytes have been transferred or when all available sense data have been transferred to the initiator, whichever is less. An Allocation Length of 0 means that 0 bytes will be returned. The drive creates a Sense Data block of 254 bytes (FEH).

The Request Sense command returns Check Condition status only to report fatal errors. Examples include:

- The drive receives a nonzero reserved bit in the Command Descriptor Block.
- An unrecovered parity error occurs on the Data Bus.
- A drive malfunction prevents return of the sense data.

Following a fatal error on a Request Sense command, the previously generated sense data is replaced by new sense data indicating the reason Request Sense failed. If a nonfatal error occurs during the execution of the Request Sense command, sense data is returned with Good status. The Sense Data Format Code (70H), and (71H for deferred errors) indicates the drive returns Sense Data in the extended format. Sense format code 71H (deferred error) indicates that the returned Check Condition is a result of an error that occurred during execution of a previous command for which Good status had already been returned.

## UDO Product Specification

### Sense Data Format

BIT BYTE	7	6	5	4	3	2	1	0
00	Valid	Sense Data Format Code (70H or 71H)						
01	Reserved							
02	Reserved	ILI	Resrvd	Sense Key				
03	(MSB) Information Bytes (LSB)							
04								
05								
06								
07	Additional Sense Length (F6H)							
08	(MSB) Command Specific Information Bytes (LSB)							
09								
10								
11								
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15	SKSV	C/D	Reserved		BPV	Bit Pointer		
16	(MSB) Field Pointer (LSB)							
17								
18	(MSB) Internal Error Locator Code (LSB)							
19								
20								
21								
22-33	Failing CDB							
34-37	Failing LBA							
38-41	Failing PBA							
42-51	Reserved							
52-55	Highest Lba Write Attempt							
56-59	Media Interrupt Register							
60-61	ECC Interrupt Register							
62-75	Dsp Status Block							
76-115	Dsp Parameter Block							
116-159	Reserved							
160	Original RW BPC							
161	Last RW BPC							
162	Original WO BPC							
163	Last RW BPC							
164-199	Reserved							
200-209	Drive Serial Number							
210-214	Media Serial Number							
215-222	Media Manufacturer							
223	Reserved							
224	Spinup Disable Reason							
225-228	Firmware Revision							
229-235	Reserved							
236-239	Debug Log Time							
240-241	Rfo Status							
242-243	Qwm Grove							
244-245	Qwm Land							
226-248	Reserved							

## UDO Product Specification

249	Drive Temperature (degrees C)
250-251	Setup Data Revision
252	Sdi Format Revision
253	Drive Operating Configuration

### Information Bytes

If the valid bit is set, the information bytes will will contain data related to the sense key.

### Valid

A Valid bit of 0 indicates that the contents of the information bytes are not defined. A Valid bit of 1 indicates the Information Byte field contain valid information.

### Incorrect Length Indicator (ILI)

An ILI bit of 1 indicates that the requested logical block length did not match the logical block length of the data on the media.

### Additional Sense Length

The Additional Sense Length specifies the number of additional sense bytes to follow. The value is F6H.

### Command Specific Information Bytes

The command specific information bytes will contain data that depends on the command that was executed.

### Additional Sense Code

The Additional Sense Code further defines the Sense Key. See section 11.20.2.

### Additional Sense Code Qualifier.

The Additional Sense Code Qualifier, further defines the Additional Sense Code. See section 11.2.20.

### Sense Key Specific Valid (SKSV)

The SKSV bit set to 1 indicates that the Sense Key Specific Information is valid. This bit is set to 1 only when the Sense Key is set to Illegal Request. If the Sense Key is Illegal Request and the SKSV bit is set to 1, the Sense Key Specific Information is defined by bytes 15-17.



## UDO Product Specification

### Command Data (C/D)

A C/D bit of 1 indicates that the invalid parameter exists in the CDB. If the C/D bit is set to 0 than the invalid parameter was detected in the data received from the host.

### Bit Pointer Valid (BPV)

A BPV bit of 1 indicates that the Bit Pointer field contains valid data.

### Bit Pointer

The Bit Pointer field indicates which bit in the byte pointed to by the Field Pointer contains the invalid data. If multiple errors exist, the Bit Pointer field will point to the most significant bit containing the error.

### Field Pointer

Field Pointer indicates which byte of the CDB or Parameter Data contains the invalid data.

NOTE: Field values from byte 18 decimal and beyond are circumstance dependent and subject to change with any given code revision. Interpretation of this data is intended for Plasmon internal use only.

## UDO Product Specification

### 11.20.1 – Sense Keys

#### Sense Key Descriptions

HEX CODE	SENSE KEY	DESCRIPTION
0	No Sense	Indicates that there is no specific sense key information to be reported for the designated logical unit. This would be the case for a successful command.
1	Recovered Error	Indicates last command completed successfully with some recovery action performed by the drive.
2	Not Ready	Indicates that the drive cannot be accessed. The error code bytes enable a system to determine if operator action is necessary.
3	Media Error	Indicates that the command terminated with a nonrecovered error condition probably caused by a media flaw or an error in the recorded data. This Sense Key may also be returned if the drive is unable to distinguish between a flaw in the media and a specific hardware failure (Sense Key 4H).
4	Hardware Error	Indicates that the drive detected an unrecoverable hardware failure while performing the command or during a self test.
5	Illegal Request	Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data. If the drive detects an invalid parameter in the command descriptor block, or in the additional parameters, it terminates the command without altering the media.
6	Unit Attention	Indicates that the removable media may have been changed or the drive has been reset.
7	Data Protect	Indicates that a command to read or write the media was attempted on a block that is protected from this operation. The read or write operation is not performed.
8	Blank Check	Indicates that the drive encountered a blank sector while reading or a nonblank sector while writing. For a VERIFY command, this indicates that the drive encountered a blank sector during a Verify for written data (BLKVIFY = 0) or a nonblank sector during a Verify for blank (BLKVIFY = 1).
9	Reserved	Reserved
A	Reserved	Reserved
B	Aborted Command	Indicates that the drive aborted the command (possibly due to receiving an ABORT message). The initiator may be able to recover by trying the command again.
C	Equal	Indicates Medium Scan command condition parameters were satisfied.
D - F	Reserved	Reserved

## UDO Product Specification

### 11.20.2 – Additional Sense Codes

Additional Sense Codes are defined in the following table. These bytes provide additional information about the condition that caused Check Condition status.

#### Additional Sense Code Descriptions

<b>ADDITIONAL SENSE CODE (BYTE 12)</b>	<b>ASC QUALIFIER (BYTE 13)</b>	<b>DESCRIPTION</b>	<b>SENSE KEY (BYTE 2)</b>
00H	00H	No Additional Sense No additional sense information to report.	0
03H	00H	Write Fault The Write command failed.	4
04H	00H	Drive Not Ready The Ready signal from the drive was negated.	2
04H	01H	Drive in Process of Becoming Ready The drive is in the process of becoming Ready during loading or spin up.	2
04H	02H	Drive Not Ready, Initializing Command Required The Stop/Start Unit command is required.	2
04H	04H	Drive Not Ready, Format in Progress The drive is in the process of formatting the media due to the Format Unit command. The Information bytes will contain a value between 0 and 100 indicating the percentage of the disk format completed.	2
09H	01H	Tracking Servo Failure The tracking servo failed.	3
09H	02H	Focus Servo Failure The focus servo failed.	3
09H	03H	Spindle Servo Failure The spindle motor is not at speed.	4
0CH	01H	Write Error Recovered with Auto Reallocation Automatic write reallocation executed successfully.	1
0CH	02H	Write Error Auto Reallocation Failed Automatic write reallocation failed to recover the write error.	3
0CH	90H	Shred Failed	3
10H	00H	ID CRC Error The sector ID field could not be read.	4

## UDO Product Specification

11H	00H	Unrecoverable Read Error Data errors could not be corrected by the ECC. The LBA where the fault was detected may be returned in the LBA field or the Information Bytes field of the sense data.	3
15H	00H	Positioning Error Seek failure on not on correct track.	4
16H	00H	Data Synchronization Mark Error The data sync could not be found.	3
18H	00H	Recovered Read Data with ECC Error correction was used to recover the data.	1
18H	01H	Recovered Data with ECC & Retries ECC was successful after 1 or more retries.	1
19H	01H	Defect List Not Available The specified defect list format is not available.	1
1AH	00H	Parameter List Length Error There was an error in the received parameter list length field.	5
1BH	00H	Synchronous Data Transfer Error Synchronous data transfer was missed.	4
1CH	00H	Defect List Not Found The defect list was not found.	3
1CH	01H	Primary Defect List Not Found Cannot read the PDL.	3
1CH	02H	Secondary Defect List Not Found Cannot read the SDL.	3
20H	00H	Invalid Command Op Code The specified command operation code is not implemented or an invalid command is requested.	5
21H	00H	Logical Block Address out of Range The specified Logical Block Address was outside the valid area.	5
24H	00H	Illegal Field in CDB There was an error in the received CDB. This additional sense code is returned when a reserved field in the CDB is not 0.	5
25H	00H	Logical Unit Not Supported LUN 1 through 7 is specified or the specified LUN 0 does not respond to the selection from the SCSI controller block.	5
26H	00H	Invalid Field in Parameter List There was an error in the received parameters.	5
26H	02H	Parameter Value Invalid	5

## UDO Product Specification

27H	00H	Write Protected Erasing or writing was aborted because the write protect switch is on.	7
28H	00H	Media Changed A media was loaded. This additional sense code is used to notify the initiator that the media has been changed since the execution of the last command. This code implies that the Mode Select parameters may have changed.	6
29H	00H	Drive Reset Occurred This additional sense code is used to notify the initiator that a Reset condition has taken place since the execution of the last command. This code implies that the Mode Select parameters may have changed.	6
2AH	00H	Mode Select Parameters Changed This additional sense code is used to notify the initiator that the Mode Select parameters have been changed since the execution of the last command.	6
2CH	00H	Command Sequence Error	6
2FH	00H	Command Cleared by Another Initiator The drive received the Clear Queue message.	6
30H	00H	Incompatible Cartridge The ID hole locations of the cartridge are invalid.	3
30H	02H	Cannot Read Medium – Incompatible Format The format of the media is incompatible.	3
31H	00H	Medium Format Corrupted	3
31H	01H	Format Command Failed	3
32H	00H	No Defect Spare Location Available The number of defective sectors listed in the PDL and SDL exceeded the limit.	3
32H	01H	Defect List Update Failure Updating of the defect table failed after the successful sparing of the data sector.	3
39H	00H	Saving Parameters Not Supported Cannot save the specified parameters.	5
3AH	00H	Media Not Present No media is inserted into the drive.	2

## UDO Product Specification

3DH	00H	Invalid Bits in Identify Message Reserved bits in the Identify message are set to 1.	5
3FH	01H	Microcode Changed The microcode has been changed.	6
40H	00H	Diagnostics Failure	4
40H	81H	Limited Laser Life Over current was detected in the laser diode or the laser power is below the limit.	4
40H	84H	Temperature Alarm The internal temperature of the drive exceeded the limit.	4
40H	85H	Laser Failure No laser diode power.	4
40H	86H	Read Channel / Spin-up Calibration Error Failure.	4
40H	87H	Illegal Servo Signal	4
40H	88H	Sensor Failure Loading sensor failure detected.	4
40H	90H	DSP Diagnostic Error There was a diagnostic error in the DSP.	4
40H	91H	12V Power Failure 12V power has not been supplied.	4
40H	95H	Buffer Memory Test Error There was an error in the buffer memory test.	4
40H	97H	DSP Communication Diagnostic Error The DSP communications test failed during power on a Diagnostic command.	4
40H	98H	DSP Download Error Download of the DSP code failed.	4
40H	99H	RAM Diagnostic Error The RAM test in the Diagnostic command failed.	4
40H	9AH	ODC Diagnostic Error The ODC chip test in the Diagnostic command failed.	4
40H	9DH	Write Calibration Error An error occurred during the write power calibration.	4
43H	00H	Message Error This command is aborted because the initiator rejected the message from the drive by issuing the Message Reject message.	B

## UDO Product Specification

44H	00H	Internal Target Failure The drive detected an error related to the controller block hardware or firmware.	4
44H	80H	A Controller Detected Error (CDE) occurred and the drive was reset.	4
45H	00H	Select or Reselect Failure Exhausted retry of reselection.	B
47H	00H	SCSI Parity Error The command was aborted due to a parity error on the SCSI bus.	B
48H	00H	Initiator Detected Error Message Received The command was aborted because the Initiator Detected Error message was sent from the initiator.	B
49H	00H	Invalid Message Error The command was aborted because of an inappropriate or illegal message from the initiator.	B
4EH	00H	Overlapped Commands Attempted An initiator attempted to reconnect to an I/O process.	B
53H	00H	Media Load/Eject Failure A failure was detected during loading or unloading of the cartridge.	4
53H	02H	Media Removal Prevented The cartridge is prevented from being removed.	5
92H	00H	Overwrite Attempted The drive attempted to write data on the written block.	8
93H	00H	Blank Sector Detected A blank block was detected.	8
93H	01H	Shredded Sector Detected	3
94H	00H	Written Sector Detected A Written block was detected.	8
95H	00H	Attempt to spin-up a locked disk without setting a key	2
95H	01H	Attempt to spin-up a locked disk with an incorrect key	2
95H	02H	Attempt to spin-up a non-locked disk with a key set	2
95H	03H	Unable to lock disk	3
95H	04H	Attempt to lock an already locked disk	5
95H	05H	Security Fault Occurred	2

## UDO Product Specification

### 11.21 – Reserve Command

The Reserve (16H, 56H) command is used to reserve the drive for the exclusive use of the initiator.

This command requests that the drive be reserved for the exclusive use of the initiator until released. A unit reservation is released by a Release command from the same initiator that made the reservation, by a Bus Device Reset message from any initiator, a reset condition or a power off/on cycle.

A logical unit reservation is not allowed if the unit is reserved by another initiator. In this case, the drive responds by returning Reservation Conflict status. It is permissible for an initiator to reserve a logical unit that is currently reserved by that initiator.

#### Reserve (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Reserve (16H)							
01	LUN 0		3 <sup>rd</sup> Party	Third Party Device ID			Resrvd	
02	Reserved							
03	Reserved							
04	Reserved							
05	Reserved							

#### Reserve (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0	
00	Reserve (56H)								
01	LUN 0		3 <sup>rd</sup> Party	Reserved		Long ID	Ext		
02	Reserved								
03	Third Party Device ID								
04	Reserved								
05	Reserved								
06	Reserved								
07	(MSB)		Extent Length						
08								(LSB)	
09	Reserved								

#### Third Party Reservation (3<sup>rd</sup> Party)

When the 3<sup>rd</sup> Party bit is set to 0, a third party reservation is not requested. If set to 1, this field reserves the LUN for the Third Party Device and causes any subsequent command issued by the Third Party Device to be executed according to the mode parameters in effect for the initiator sending this command.



## UDO Product Specification

### Long ID

The Long ID bit is not supported and must be set to 0.

### Extent (Ext)

Extents are not supported so the Ext bit must be set to 0.

### Third Party Device ID

The Third Party Device ID is the SCSI Bus ID of the device referred to, if the 3<sup>rd</sup> Party bit is set to 1.

After the drive responds with Good status to a Reserve command, any command (other than an Inquiry, Request Sense, Release, or Prevent Allow Media Removal with the Prevent bit set to 0) from another initiator is rejected with Reservation Conflict status unless that initiator set the Third Party Device ID and the 3<sup>rd</sup> Party bit.

## UDO Product Specification

### 11.22 – Rezero Unit Command

The Rezero Unit (01H) command executes exactly the same as a Test Unit Ready.

Rezero Unit (6 Byte)

<b>BIT BYTE</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
00	Rezero Unit (01H)							
01	LUN 0			Reserved				
02	Reserved							
03	Reserved							
04	Reserved							
05	Reserved							

11.23 - Security Control Command

Bit Byte	7	6	5	4	3	2	1	0
00	Security Control (EAH)							
01	Security Feature							
02	UDO Guard Command							
03	Reserved							
04	Reserved							
05	Reserved							
06	Reserved							
07	Reserved							
08	Reserved							
09	Reserved							

**Security Feature**

- 00H – Reserved
- 01H – UDO Guard
- 02H -> FFH – Reserved

**UDO Guard Command**

- 00H – Reserved
- 01H – Set Key
- 02H – Set Key and Lock Disk
- 03H – Clear Key
- 04H -> FFH – Reserved

The Set Key (01H) Command must be set prior to attempting a spin-up (or load, in the case where auto-spin is enabled) on a disk that has been previously locked with UDO Guard. The key is transferred from the initiator to the drive upon receipt of the command. The data transfer accompanying the command is 32 bytes in length. The data transfer consists of a 16 byte key (128 bits) in buffer locations 0 – 15 and the compliment to the key in bytes 16 – 31 of the buffer. Each relative location in the key and the key compliment (i.e. Key Byte 0 (Buffer Address 0) corresponds to Key Complement Byte 0 (Buffer Address 16)) must sum to FFH, or else an error will be returned when processing the command. In the event that a disk fails to spin-up because a key was not set or an incorrect key was set, the key should be set before the next spin-up attempt. An attempt to set the key after a disk has been spun-up will fail.

## UDO Product Specification

The Set Key and Lock Disk (02H) Command is used to lock a disk with UDO Guard. The disk to be locked must be in the drive and spun up before sending this command. The key is transferred from the initiator to the drive upon receipt of the command. The data transfer accompanying the command is 32 bytes in length. The data transfer consists of a 16 byte key (128 bits) in buffer locations 0 – 15 and the compliment to the key in bytes 16 – 31 of the buffer. Each relative location in the key and the key compliment (i.e. Key Byte 0 (Buffer Address 0) corresponds to Key Complement Byte 0 (Buffer Address 16)) must sum to FFH, or else an error will be returned when processing the command. A disk may only be locked once. An attempt to lock a disk more than once will result in a failure, unless the key that was originally used to lock the disk is sent in. Attempting to re-lock a disk with the original key doesn't actually do anything, but it can serve as a check to verify that the disk is locked.

The Clear Key (03H) command is used to clear the currently loaded UDO Guard key. This command doesn't ordinarily need to be sent as the key is automatically cleared upon disk unload. This command exists solely to cleanup the error condition caused by attempting to spin-up a non-locked disk with a key set. Alternatively, unloading the disk will clear the non-locked disk/key set error. Sending this command while a disk is spun-up has no effect.

Several check conditions can be generated as a result of the UDO Guard command and these are listed in the following table.

Note: This command is available in UDO firmware versions starting at U05.

## UDO Product Specification

### UDO Guard Error Cases and SCSI Sense

Error Case	SCSI Sense (SK/ASC/ASCQ)
Attempt to spin-up a locked disk without setting a key	02/95/00
Attempt to spin-up a locked disk with an incorrect key	02/95/01
Attempt to spin-up a non-locked disk with a key set	02/95/02
Unable to lock disk	03/95/03
Attempt to lock an already locked disk. Note: If the same key is used on the relock attempt as was used during the lock, no error will be reported.	05/95/04
Invalid Security Feature selected in SCSI Security Control Command	05/24/00
Invalid UDO Guard Command selected in SCSI Security Control Command	05/24/00
Attempt to set key when the drive is in an inappropriate state	05/2C/00
Attempt to lock the disk when the drive is in an inappropriate state	05/2C/00
Attempt to lock a disk that is write-protected	07/27/00
Attempt to send in a key without the correct complement	05/26/02
Lock failure due to internal drive problems	04/44/00 03/0C/02
Unknown security fault occurred	02/95/05

# UDO Product Specification

## UDO Product Specification

### 11.24 – Seek Command

The Seek (0BH, 2BH) command requests a seek to the Physical Block Address which contains the specified Logical Block Address.

#### Seek (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Seek (0BH)							
01	LUN 0			(MSB)				
02	Logical Block Address							
03								
04								
05	PBA	Reserved						

#### Seek (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0	
00	Seek (2BH)								
01	LUN 0			Reserved					
02	Logical Block Address								
03									(MSB)
04									
05									(LSB)
06	Reserved								
07	Reserved								
08	Reserved								
09	PBA	Reserved							

#### Physical Block Address (PBA)

A PBA bit of 0 indicates that the normal SCSI access via LBA, or Logical Block Address, is in use. A PBA bit of 1 indicates that the contents of the LBA field specify a PBA, or Physical Block Address. All physical sectors of the disk are accessible when this bit is utilized. When the PBA bit is set, there is no parameter checking in the drive.

11.25 – Send Diagnostic Command

The Send Diagnostic (1DH) command requests the drive to perform a self diagnostic test. Prior to executing the Send Diagnostic command the cache will be synchronized.

Send Diagnostic (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Send Diagnostic (1DH)							
01	LUN 0			PF	Resrvd	SelfTest	DevOfI	UnitOfI
02	Reserved							
03	(MSB) Parameter List Length (LSB)							
04								
05	Reserved							

Self Test

If the SelfTest bit is set, it directs the drive to complete its default self test.

NOTE: When a Send Diagnostic command is sent to the drive, any pending status mode selection options or sense may be cleared.

On any Send Diagnostic command execution, if the self test is successful, the command will be terminated with Good status. If the self test is unsuccessful, the command will be terminated with Check Condition. A subsequent Request Sense command will yield a Sense Key/Additional Sense Code of Hardware Error/Diagnostics Failure. The Command Specific Information bytes will contain the failed diagnostic test number.

If a drive fails the Send Diagnostic command, the recommended action is to discontinue use of the drive until it can be properly serviced. If a user chooses to continue to use a failed drive, the SCSI host will be required to reset the failed drive via a SCSI Bus Reset, a Bus Device Reset Message or power cycle.

If the SelfTest bit is set along with any nonzero Parameter List Length value, the command will be terminated with Check Condition status and the Sense Key/Additional Sense Code will be set to Illegal Request/Illegal Field in CDB.

Device Offline (DevOfI)

A DevOfI bit of 1 must be set for proper operation of any test besides self test.

Unit Offline (UnitOfI)

A UnitOfI bit of 1 must be set for proper operation of any test besides self test.



## UDO Product Specification

### Page Format (PF)

If the PF bit is set the self test bit cannot be set. The drive will go to a Data Out phase to receive a Diagnostic Tests Page in the following format. The Parameter List Length must be set to 4 or 6 if the PF bit is set. If the Parameter List Length is set to 4, then the test will execute once. If the Parameter List Length is set to 6, then bytes 4 and 5 will determine the number of times to execute the test sequence.

### Diagnostics Tests Page

BIT BYTE	7	6	5	4	3	2	1	0
00	Diagnostic Tests Page (80H)							
01	Page Length							
02	Start Test Number							
03	End Test Number (Inclusive)							
04	(MSB)		Cycle Count					
05							(LSB)	

The cycle count may be set to any value between 1 and 9999 (270FH). Values outside of this range will result in a Check Condition status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Field in Parameter List.

Tests will always start at the Start Test Number and continue through the End Test Number. The only valid test numbers for bytes 2 and 3 are 0 through 9 as defined in the following table. An invalid test number will result in a Check Condition status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Field in Parameter List.

### Diagnostic Self Tests

TEST NUMBER	DESCRIPTION OF TEST
0	Power-on self test.
1	MPU Test
2	Buffer Ram Test
3	ODC Test
4	DSP Test
5-9	Reserved

All Page Format tests require Good status on Test Unit Ready command.

## UDO Product Specification

### 11.26 – Shred Command

The Shred command will permanently destroy the specified extent on the disk. The Shred command completely destroys this extent rendering it forever lost to the user and destroyed on the disk. In addition, the extent on the disk can never again be accessed for writing or reading.

The Shred Command is only supported with UDO Compliant Write Once Media. If a shred command is sent to a drive loaded with standard Write Once or Rewriteable media, a check condition will be returned with a sense key set to “Illegal Request” (0x05) and an ASC/ASCQ set to “Invalid Command Operation Code” (0x20/0x00).

The Shred (EEH) command requests that the drive shred (destroy) the specified number of blocks starting at the specified logical block address on the media.

The Vendor Unique Shred Command has the following format:

Shred (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Shred (EEH)							
01	LUN 0			Reserved				
02	(MSB) Shred Logical Block Address (LSB)							
03								
04								
05								
06	Reserved							
07	(MSB) Shred Length (LSB)							
08								
09	Reserved							

Upon receiving the command from the host the UDO drive will enter a Data Out phase and will expect to receive 14 bytes of data equal to the ASCII string “OBLITERATE EXT” (0x4F 0x42 0x4C 0x49 0x54 0x45 0x52 0x41 0x54 0x45 0x20 0x45 0x58 0x54). If the above data is not received by the drive a check condition will be returned with a sense key set to “Illegal Request” (0x05) and an ASC/ASCQ set to “Invalid Field In Parameter List” (0x26/0x00).

Upon validating this command the UDO drive will, disconnect from the bus, synchronize the cache, disable its overwrite protection and shred (destroy) the user data in the Extent starting at the Shred Lba for the Number of Sectors specified by the Shred Length. For relocated sectors both the prime and secondary sectors will be destroyed.

## UDO Product Specification

Any attempts to overwrite a shredded sector will not be allowed and will receive a check condition with a sense key of “Blank Check” (0x08) and an ASC/ASCQ set to “Overwrite Attempt” (0x92/0x00).

If the shred operation fails, the drive will return a check condition with a sense key of “Media Error” (0x03) and an ASC/ASCQ set to “Shred Failure” (0x0C/0x90) with the failing LBA placed in the request sense info bytes.

The disk must be write enabled for the Shred command to be executed.

If a read is attempted on a shredded sector, the drive will return a check condition with a sense key of “Media Error” (0x03) and an ASC/ASCQ set to “Shredded Sector Detected” (0x93/0x01) with the Shred sector LBA being placed in the Request Sense Info bytes.

11.27 – Start/Stop Unit Command

The Start/Stop Unit (1BH) command requests the drive to spin up and initialize for operation or spin down.

Start/Stop Unit (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Start/Stop Unit (1BH)							
01	LUN 0			Reserved				Immed
02	Reserved							
03	Reserved							
04	Reserved					LoEj		Start
05	Reserved							

Immediate (Immed)

An Immed bit of 1 indicates that status will be returned as soon as the command descriptor block has been validated. An Immed bit of 0 indicates that the status will be returned after the operation is complete.

Load Eject (LoEj)

The LoEj bit will cause a Start/Stop Unit command to operate like the Load switch. A Load Eject bit of 0 requests that no action be taken to load or eject the media. A Load Eject bit of 1 requests the media be unloaded, if the Start bit is 0. If the Start bit is 1, the media will be loaded into the drive.

Start

A Start bit of 1 requests the drive spindle be brought up to speed. A Start bit of 0 requests that the drive spindle be stopped.

If the command results in the media being unloaded, the Cache will be Synchronized prior to the unload operation.

## UDO Product Specification

### 11.28 – Synchronize Cache Command

The Synchronize Cache (35H) command ensures that logical blocks in the cache memory have their most recent data value recorded on the physical media. If a more recent data value exists in the cache memory than on the physical media, then the cache memory will be written to the physical media. Logical blocks are not removed from the cache memory as a result of the Synchronize Cache operation.

#### Synchronize Cache (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Synchronize Cache (35H)							
01	LUN 0			Reserved			Immed	Resrvd
02	(MSB) <span style="float: right;">(LSB)</span> Logical Block Address							
03								
04								
05								
06	Reserved							
07	(MSB) <span style="float: right;">(LSB)</span> Number of Blocks							
08								
09	Reserved							

#### Immediate (Immed)

The Immed bit of 1 indicates that drive will return status as soon as the command descriptor block has been validated. An Immed bit of 0 indicates that the status is not returned until the operation is completed.

The Logical Block Address and Number of Blocks fields are not supported by the drive and will be ignored.

## UDO Product Specification

### 11.29 – Test Unit Ready Command

The Test Unit Ready (00H) command determines if the drive is ready. In this case, Ready means the media is inserted, spun up and is capable of performing media access commands.

#### Test Unit Ready (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Test Unit Ready (00H)							
01	LUN 0			Reserved				
02	Reserved							
03	Reserved							
04	Reserved							
05	Reserved							

If the drive is Not Ready when it receives this command, it returns a Check Condition status with the Sense Key set to Not Ready.

## UDO Product Specification

### 11.30 – Verify Command

The Verify (2FH, AFH) command requests that the drive verify the data on the media.

#### Verify (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Verify (2FH)							
01	LUN 0			DPO	Resrvd	BLKVFY	Reserved	
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06								
07	(MSB) Verify Length (LSB)							
08								
09								

#### Verify (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Verify (AFH)							
01	LUN 0			DPO	Resrvd	BLKVFY	Reserved	
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06								
07								
08								
09								
10	Reserved							
11	Reserved							

#### Disable Page Out (DPO)

The DPO bit is ignored by the drive.

#### Blank Verify (BLKVFY)

A BLKVFY bit of 0 indicates that the blocks will be subjected to ECC. If the verify encounters a blank sector, the command terminates with a Check Condition status and the Sense Key is set to Blank Check. If the verify encounters a sector that cannot be corrected, the command terminates with a Check Condition and the Sense Key/Additional Sense Code is set to Medium Error/Unrecovered Read Error.

## UDO Product Specification

If the BLKVIFY bit is set to 0 and Compliant Write Once Media is loaded and a shredded sector is encountered the command terminates with a Check Condition status with the Sense Key/ASC/ASCQ indicating that a shredded sector has been encountered.

A BLKVIFY bit of 1 indicates that the blocks are attempting to be verified as blank. If the verify is unsuccessful, the command is terminated with a Check Condition status and the Sense Key is set to Blank Check.

If the BLKVIFY bit is set to 1 and Compliant Write Once Media is loaded and a shredded sector is encountered, that sector will be treated as a Non Blank sector.

### Logical Block Address

The Logical Block Address specifies the logical block to begin the Verify.

### Verify Length

The Verify Length specifies the number of contiguous logical blocks to be verified.



## UDO Product Specification

### 11.31 – Write Command

The Write (0AH, 2AH, AAH) command requests that drive write the data transferred by the initiator to the media. If write caching is enabled, a Good status will be returned to the initiator as soon as data has been transferred into the data buffer and before the data has been written to the media.

#### Write (6 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Write (0AH)							
01	LUN 0			(MSB)				
02	Logical Block Address							
03								
04								
05	Transfer Length							
05	Resrvd	ErsCntl	Reserved					

#### Write (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0								
00	Write (2AH)															
01	LUN 0			DPO	FUA	EBP	Reserved									
02	Logical Block Address															
03									(MSB)							
04																
05									(LSB)							
06	Reserved															
07	Transfer Length															
08									(MSB)							
09									(LSB)							
09	Resrvd	ErsCntl	Reserved													

#### Write (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0								
00	Write (AAH)															
01	LUN 0			DPO	FUA	EBP	Reserved									
02	Logical Block Address															
03									(MSB)							
04																
05									(LSB)							
06	Transfer Length															
07									(MSB)							
08																
09									(LSB)							
10	Reserved															
11	Resrvd	ErsCntl	Reserved													

### Logical Block Address

The Logical Block Address specifies the logical block where the write operation begins.

### Transfer Length

The Transfer Length field specifies the number of contiguous Logical Blocks of data to be transferred. For a Write (6 Byte), a Transfer Length of 0 indicates that 256 Logical Blocks will be transferred. For a Write (10 Byte) or a Write (12 Byte), a Transfer Length of 0 indicates that no Logical Blocks will be transferred. This condition will not be considered an error. Any other value indicates the number of Logical Blocks that will be transferred.

### Disable Page Out (DPO)

The DPO bit is ignored by the drive.

### Force Unit Access (FUA)

A FUA bit of 1 will cause the data to be written to the disk prior to returning status. Setting the FUA bit to 0 allows write caching where Good status is returned to the initiator as soon as the write data has been transferred into the data buffer.

### Erase By-Pass (EBP), Erase Control (ErsCntl)

When Rewritable media is inserted in the drive, these bits are ignored by the drive. When Write Once media is inserted in the drive, these bits are reserved.

Note: For Write Once media, the Verify And Protect (VAP) field is checked before writing data. If the VAP field is detected, the drive will return a Check Condition with the Sense Key/Additional Sense Code set to Blank Check/Overwrite Attempted.

Note: If a write error occurs, the entire extent should be considered bad. The highest LBA that a write was attempted on is contained in bytes 52-55 of the sense data.

Note: A Check Condition with a Sense Key set to Recovered error will be returned when the drive is close to, or has run out of, spare sectors for relocations. This Recovered error sense key will be returned when the amount of free spares reaches 2000, 1000, 500, and 0. Examining byte 21 of the sense data will indicate the situation that occurred, where 0xE1 indicates 2000, 0xE2 indicates 1000, 0xE3 indicates 500, and 0xE4 indicates 0.

11.32 – Write and Verify Command

The Write and Verify (2EH, AEH) command requests the drive to write on the media all data transferred from the initiator and then verify that the data is correctly written. If write caching is enabled, a Good status will be returned to the initiator as soon as data has been transferred into the data buffer and before the data has been written to and verified from the media.

Write and Verify (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Write and Verify (2EH)							
01	LUN 0			DPO	Resrvd	EBP	Reserved	
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06	Reserved							
07	(MSB) Transfer Length (LSB)							
08								
09	Resrvd	ErsCntl	Reserved					

Write and Verify (12 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Write and Verify (AEH)							
01	LUN 0			DPO	Resrvd	EBP	Reserved	
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06	(MSB) Transfer Length (LSB)							
07								
08								
09								
10	Reserved							
11	Resrvd	ErsCntl	Reserved					

Logical Block Address

The Logical Block Address specifies the logical block where the Write and Verify operation will begin.

Transfer Length

The Transfer Length specifies the number of contiguous logical blocks of data to be transferred. A Transfer Length of 0 indicates no data is to be transferred. This

## UDO Product Specification

is not considered an error condition. Any other value indicates that number of logical blocks will be transferred.

### Disable Page Out (DPO)

The DPO bit is ignored by the drive.

### Erase By-Pass (EBP), Erase Control (ErsCntl)

When Rewritable media is inserted in the drive, these bits are ignored by the drive. When Write Once media is inserted in the drive, these bits are reserved.

Note: For Write Once media, the Verify And Protect (VAP) field is checked before writing data. If the VAP field is detected, the drive will return a Check Condition with the Sense Key/Additional Sense Code set to Blank Check/Overwrite Attempted.

The errors and conditions for the Write and Verify command are the same as those for Write.

Note: If a write error occurs, the entire extent should be considered bad. The highest LBA that a write was attempted on is contained in bytes 52-55 of the sense data.

Note: A Check Condition with a Sense Key set to Recovered error will be returned when the drive is close to, or has run out of, spare sectors for relocations. This Recovered error sense key will be returned when the amount of free spares reaches 2000, 1000, 500, and 0. Examining byte 21 of the sense data will indicate the situation that occurred, where 0xE1 indicates 2000, 0xE2 indicates 1000, 0xE3 indicates 500, and 0xE4 indicates 0.

11.33 – Write Buffer Command

The Write Buffer (3BH) command is used for diagnostics or for downloading microcode to the drive, depending on the value of the Mode field in byte 1. Prior to executing the Write Buffer command the cache will be synchronized.

The Write Buffer command requests a transfer of data from the initiator to the read/write buffer and is used in conjunction with the Read Buffer command.

Write Buffer (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Write Buffer (3BH)							
01	LUN 0			Reserved		Mode		
02	Buffer ID							
03	(MSB) Buffer Offset (LSB)							
04								
05								
06	(MSB) Parameter List Length (LSB)							
07								
08								
09	Reserved							

NOTE: The internal buffer CRC generation is disabled during the Write Buffer command.

Buffer Offset

This field indicates the address the data will be written into offset from the base address of the corresponding buffer ID. The Buffer Offset must be set to an even value.

Parameter List Length

This field indicates the length of data bytes to be written into the buffer. The Parameter List Length must be set to an even value.

The function of this command and the meaning of the fields within the Command Descriptor Block depend on the contents of the mode field. The supported write buffer modes are defined in the following table.

## UDO Product Specification

### Write Buffer Mode Field

MODE	DESCRIPTION
000b	Combined Header and Data (Buffer Offset = 0)
001b	Combined Header and Data
010b	Write Data
100b	Download Microcode
101b	Download Microcode and Save

### Buffer ID

The Buffer ID field indicates which 16MByte page of the buffer to use as the base address to add to the buffer offset. If the Buffer ID is 0 then the first 16Mbytes of the buffer will be accessed. Incrementing the Buffer ID allows the next 16MBytes of the buffer to be accessed.

### Combined Header and Data Mode (000b, 001b)

These modes consist of a 4 byte parameter header followed by the Write Buffer data. The 4 byte header should consist of all zeros and is only supported for compatibility. For data mode 000b transfers, the Buffer Offset must be set to 0. Write data is transferred into the data buffer using the Buffer Offset as the address into the data buffer.

### Write Data Mode (010b)

In this mode, the Data Out phase contains buffer data.

Data is written to the drive's buffer starting at the location specified by the Buffer Offset. If the Buffer Offset is outside of the range of the buffer, the drive will return a Check Condition status and a Sense Key/Additional Sense Code of Invalid Request/Illegal Field in CDB.

### Download Microcode (100b, 101b)

Downloading microcode utilizes the following two buffer modes:

<u>Mode</u>	<u>Value</u>
Download Microcode	100b (Mode 4)
Download Microcode and Save	101b (Mode 5)

There are two ways to perform the microcode download operation. The first method involves sending several 32KB download files using Write Buffer Mode 4 commands (Download Microcode) followed by a Write Buffer Mode 5 (Download Microcode and Save) command. The second method involves sending one large file and using only the Write Buffer Mode 5 command.

### 32KB File Method

Several 32KB files will be supplied in the form of XXXX.001, XXXX.002 .....XXXX.070, where the main file name designates the name of the code to be downloaded and the file extension designates the sequence number of the file. To download the files, individual Write Buffer Mode 4 commands should be issued to transfer each of the 32KB files with the Buffer Offset field set to the buffer address where the data is to be placed. This should be the file extension minus 1 times 8000H. For example, the file XXXX.001 should be sent with a buffer offset of 0H and the XXXX.002 file should be sent with a buffer offset of 8000H. The Parameter List Length field should be set to 32K (8000H). The files must be transferred in sequence, i.e. XXXX.001, then XXXX.002, ... As each 32KB file is received it is checked to ensure that it is a valid download type file, its internal check characters are OK, and that it is received in the proper sequence. Once all of the files have been transferred, a Write Buffer Mode 5 command should be issued with the Buffer Offset field set to 0 and the Parameter List Length set to 0. This command will validate the data for the microcode update and if valid data is detected, will return a good status. After receiving good status the host should then delay 100ms and enter a polling loop with a command such as a Test Unit Ready and when selection is honored by the drive the download operation will have completed.

### Single File Method

A file in the form of XXXX.XMD will be supplied for the single file download method. The entire file must be sent using the Write Buffer Mode 5 command with the Buffer Offset field set to 0 and the Parameter List Length field set to the file size. This command will validate the data for the microcode update and if valid data is detected, will return a good status. After receiving good status the host should then delay 100ms and enter a polling loop with a command such as a Test Unit Ready and when selection is honored by the drive the download operation will have completed.

11.34 – Write Long Command

The Write Long (3FH) command requests that the drive write the data transferred by the initiator to the media. The data passed during the Write Long command includes the data bytes and the ECC bytes.

Write Long (10 Byte)

BIT BYTE	7	6	5	4	3	2	1	0
00	Write Long (3FH)							
01	LUN 0			Reserved				
02	(MSB) Logical Block Address (LSB)							
03								
04								
05								
06								
07	(MSB) Transfer Length (LSB)							
08								
09	PBA	SC	Reserved					

Note: Reallocations are not performed during a Write Long operation. Any failure during a Write Long command will return a Check Condition to the host.

Note: A “Pseudo Verify” pass is performed on a Write Long with Write Once media. The purpose of the “Pseudo Verify” pass is to write the Verify and Protect (VAP) field of the sector so that the sector is hardware write protected.

Physical Block Address (PBA)

A PBA bit of 0 indicates that the normal SCSI access via LBA, or Logical Block Address, is in use. A PBA bit of 1 indicates that the contents of the LBA field specify a PBA, or Physical Block Address. All physical sectors of the disk are accessible when this bit is utilized.

Note: If the PBA bit is set, the Media Management areas of the disk can be written. In general, this will corrupt the media for normal LBA use. Writing in the Media Management area is not recommended for the general user.

Sector Count (SC)

A SC bit of 1 indicates that the transfer length is represented in sectors rather than bytes. A SC bit of 0 indicates that the transfer length is represented in bytes.



## UDO Product Specification

### Transfer Length

If the SC bit is set to 1, the Transfer Length field specifies the number of sectors to be transferred.

If the SC bit is set to 0, the Transfer Length field specifies the number of contiguous logical blocks that will be transferred. Each block will be 9424 bytes long. A transfer length of 0 indicates that no blocks will be transferred and will not be considered an error.

### 8KB Sector Write Long Bytes

<b>BYTE</b>	<b>LENGTH</b>	<b>DESCRIPTION</b>
0 – 8191	8192	User Data Bytes
8192 – 8203	12	Control Bytes
8204 – 8207	4	CRC Bytes
8208 – 9423	1216	ECC Bytes

The Write Long is not supported when Compliant Write Once Media is loaded and will return an Illegal Request Check condition.

## 12 – Serial Interface

### 12.1 – Physical Characteristics

The Serial Interface utilizes an RS-422 protocol with the following characteristics.

Full asynchronous duplex operation  
 Baud rate of 9600  
 8 data bits  
 No parity  
 1 stop bit

### 12.2 – Packet Protocol

This section defines the protocol packets. The commands defined in section 12.3 are independent of this definition and are simply carried in what is referred to in this section as the Data portion of the packet. This protocol is intended for use in a master/slave configuration. The slave only sends packets in response to a query by the master. In this case the master is the automation device and the slave is the drive.

#### 12.2.1 – Protocol Control Characters

A packet protocol is used to communicate with the drive over the RS-422 interface. This protocol utilizes a special set of control characters as shown in the following table.

CONTROL CHARACTER	BYTE	DESCRIPTION
STX	02H	Beginning of Packet
ETX	03H	End of Packet
ESC	1BH	Special Control Character (Used for Character Stuffing)

#### 12.2.2 – General Packet Format and Framing

The general format of the packet is as follows.

STX	Data(1)	.....	Data(n)	Cksum(1)	Cksum(2)	ETX
-----	---------	-------	---------	----------	----------	-----

After starting the packet with the STX character, the packet can contain up to n bytes of data followed by a two byte checksum and the ETX character. Any characters received prior to the STX character will be ignored. The packet data should be accumulated until the ETX is received. If a second STX (i.e. non stuffed STX – see section 12.2.3) is

received, the receiver should treat the new STX as the start of the packed and disregard the previous data.

### 12.2.3 – Character Stuffing

Since the protocol transfers binary data, the STX and ETX characters can appear within either the data or the checksum of the packet. To prevent the receiver from falsely interpreting these characters as the start or end of a packet, a method known as character stuffing is used.

As the transmitter builds a packet it should insert the ESC (1BH) character prior to any occurrence of the 02H, 03H, or 1BH characters that occur as part of the data or checksum of the packet, so that each of these characters will result in two characters being transmitted. For example if a 02H is to be sent as part of the data, the characters 1BH and 02H would actually be sent.

As the receiver receives the packet, after detecting the first STX, every time it sees an ESC (1BH) character, it should throw that character away and interpret the next character as actual data (or checksum). If an STX or ETX is encountered without the preceding ESC character they will be interpreted as the actual Start or End of the packet.

### 12.2.4 – Checksum

The two characters of checksum used are generated using a method known as Fletcher's Checksum. This method is described in an article by John G. Fletcher in the January 1992 IEEE Transactions on Communications. This checksum is a 2 byte sum that, for data less than 255 bytes in length, gives results comparable to a Cyclic Redundancy Check (CRC), but is easier to compute. The pseudo code for the checksum algorithm is shown below.

```
Part A sum1 = 0;
      sum2 = 0;
      for (X = 0; X < length; X++)
      {
          sum1 = (sum1 + data [X]) modulo 255;
          sum2 = (sum2 + sum1) modulo 255;
      }

Part B cksum1 = 255 - ((sum1 + sum2) modulo 255);
      data[length + 1] = cksum1;
      cksum2 = 255 - ((sum1 + cksum1) modulo 255);
      data[length + 2] = cksum2;
```

## UDO Product Specification

Part A of the algorithm is used to calculate a checksum value on the packet data. Part B produces two values that are appended to the packet before it is sent. When the packet is received, part A is applied to the packet data AND the checksum values which should result in both sum1 and sum2 equaling zero. See Section 12.3.4 for an example of checksum generation.

For this particular packet structure, the checksum is applied only to the data bytes. The checksum does not include the STX and ETX that frame the packet. It is also important to note that the checksum is calculated on the transmit side before the character stuffing described in section 12.4 is done and on the receive side after the stuffed characters are removed.

### 12.2.5 – Packet Transmission

The interface operates in a master/slave mode with the drive acting as the slave. The drive will only send packets to the automation device in response to command packets that the automation device has sent to the drive. If a packet is received by the drive with an invalid checksum, the packet is ignored. It is entirely up to the master, (i.e. the automation device) to handle cases where invalid packets are transmitted or received by using some type of timeout and retry mechanism.

Note: It is important that both the master and the slave resynchronize and start a new packet when an STX is received, even when the receiver thinks it is in the middle of a packet already.

# UDO Product Specification

## 12.3 – Command Set

This section describes the various commands that are carried within the packet structure.

Note: The description of the commands do not include the starting and ending packet elements, such as STX, ETX, and the checksum but these elements must be added prior to sending a command to the drive.

### 12.3.1 – General Command Format

Each command has a Command byte and Parameter bytes. The number of data bytes in a command or response is fixed and depends on the command. Multi-byte parameters are transmitted most significant byte first.



### 12.3.2 – Command Byte Definition

The Command byte contains the following fields.

BIT BYTE	7	6	5	4	3	2	1	0
00	Rspnse	Error	Command					

#### Response (Rspnse)

Always cleared by the master (automation device), always set by the slave (drive).

## UDO Product Specification

### Error

The slave (drive) sets the Error bit when an error response is being sent. When an error response is returned, one additional status byte will be returned as defined in the following table.

DESCRIPTION	ERROR CODE
Unrecognized command	01H
Invalid parameter list length (the length of the parameter list is not appropriate for the given command)	02H
Data not available	03H
Parameter out of range	04H
Media not present	05H
SCSI Sense data available	06H

The following commands are implemented by the drive.

DESCRIPTION	CODE
Get Drive Status	01H
Get Drive Information	02H
Get Error Information	03H
Get Media ID	04H
Get Drive Configuration	05H
Set Drive Configuration	06H
Dump Memory	20H
Load Media	30H
Eject Media	31H
Spin Up Media	32H
Spin Down Media	33H

### 12.3.3 – Drive Command Descriptions

The following sections describe the drive commands. Each description includes a representation of the bytes sent in the request and received in the response. These descriptions do not include the packet framing and checksum bytes, just the command bytes carried in the data portion of the packet as described in the section 12.2.2. The bytes shown are the command byte and parameter bytes (if any).

## UDO Product Specification

### 12.3.3.1 – Get Drive Status Command

The Get Drive Status (01H) command returns 32 status bit flags (4 bytes) representing the status of the drive. Some flags duplicate information on the function connector.

#### Request

01H
-----

#### Response

81H	Flag(3)	Flag(2)	Flag(1)	Flag(0)
-----	---------	---------	---------	---------

Flag(3) contains bits 31-24

Flag(2) contains bits 23-16

Flag(1) contains bits 15-8

Flag(0) contains bits 7-0

#### Flag Definition

BIT	DESCRIPTION
0	Set if a cartridge is present in the drive (not necessarily seated)
1	Set if a cartridge is in the drive and seated on the spindle motor
2	Set if the drive is busy (corresponds to the LED on the drive bezel)
3	Set if a hardware error condition exists in the drive that prevents loading or ejecting the media (See also the Get Error Information command)
4	Set if media removal is prevented
5	SCSI ID (LSB)
6	SCSI ID
7	SCSI ID
8	SCSI ID (MSB)
9	Set if a spin down request is being made on the function connector
10	Set if an eject request is being made on the function connector
11	Set when a new entry has been placed in the error event log, cleared when read
12-15	Set to 0 (Reserved)
16	Set if in Automation mode
17	Set if Autospin is disabled
18	Set if SCSI 40 MB/sec mode selected
19	Set to 0 (Reserved)
20	Set if the drive has status available from the serial port
21	Set when Drive is Ready
22-31	Set to 0 (Reserved)



## UDO Product Specification

### 12.3.3.2 – Get Drive Information Command

The Get Drive Information (02H) command returns the drive type, the firmware revision and the serial number of the drive. The drive type is 4 bytes and should be “UDO1”. The firmware revision is also 4 bytes and is the same as that reported by the SCSI Inquiry command. The serial number is 10 bytes. All values are reported in ASCII.

#### Request

02H
-----

#### Response

82H	Type(3)	Type (2)	Type(1)	Type(0)	FWRev(3)
FWRev(2)	FWRev(1)	FWRev(0)	SN(9)	SN(8)	SN(7)
SN(6)	SN(5)	SN(4)	SN(3)	SN(2)	SN(1)
SN(0)					

### 12.3.3.3 – Get Error Information Command

The Get Error Information (03H) command can be used when the error status bit is set in the command byte (see 12.3.3.1 – Get Drive Status Command – bit 3). It will return the SCSI Additional Sense Code and Additional Sense Code Qualifier along with the 4 byte error locator code that describe the drive failure (see section 11.20 – Request Sense Command). If there is no error, all bytes will be 0.

#### Request

03H
-----

#### Response

83H	ASC	ASCQ	ErrLoc(3)	ErrLoc(2)	ErrLoc(1)
ErrLoc(0)					

### 12.3.3.4 – Get Media ID Command

The Get Media ID (04H) command will return the current media ID for the media residing in the drive. If no media is present, this command will return with the error bit set in the command byte.

#### Request

04H
-----

#### Response

84H	ID(7)	ID(6)	ID(5)	ID(4)	ID(3)
ID(2)	ID(1)	ID(0)			

## UDO Product Specification

### 12.3.3.5 – Get Drive Configuration Command

The Get Drive Configuration (05H) command requests 32 bits of drive configuration information.

#### Request

05H
-----

#### Response

85H	Config(3)	Config(2)	Config(1)	Config(0)
-----	-----------	-----------	-----------	-----------

Config(3) contains bits 31-24

Config(2) contains bits 23-16

Config(1) contains bits 15-8

Config(0) contains bits 7-0

#### Configuration Definition

BIT	DESCRIPTION
0	Set if drive SCSI negotiations are inhibited
1	Set if drive SCSI disconnects are inhibited
2	Set if drive SCSI wide negotiations are inhibited

### 12.3.3.6 – Set Drive Configuration Command

The Set Drive Configuration (06H) command is the companion to the Get Drive Configuration command. This command sets the configuration using the same bit definitions as the Get Drive Configuration command. These values will be saved in non-volatile RAM and restored after power cycle.

#### Request

06H	Config(3)	Config(2)	Config(1)	Config(0)
-----	-----------	-----------	-----------	-----------

#### Response

86H
-----

12.3.3.7 – Dump Memory Command

The Dump Memory (20H) command allows for the dumping of up to 255 bytes of data from the drive’s controller memory space and is intended for engineering debug.

Request

20H	Length	Address(3)	Address(2)	Address(1)	Address(0)
-----	--------	------------	------------	------------	------------

Response

A0H	Data(n)	.....	Data (0)
-----	---------	-------	----------

12.3.3.8 – Load Media Command

The Load Media (30H) command will cause the drive to load the media. If no media is present the command will return with the error bit set in the command byte.

Request

30H
-----

Response

B0H
-----

12.3.3.9 – Eject Media Command

The Eject Media (31H) command will cause the drive to unload and eject any media residing in the drive. If no media is present the command will return with the error bit set in the command byte.

Request

31H
-----

Response

B1H
-----

#### 12.3.3.10 – Spin Up Media Command

The Spin Up Media (32H) command will cause the drive to spin up the media. If no media is present the command will return with the error bit set in the command byte.

Request

32H
-----

Response

B2H
-----

#### 12.3.3.11 – Spin Down Media Command

The Spin Down Media (33H) command will cause the drive to spin down the media, but not eject the media. If no media is present the command will return with the error bit set in the command byte.

Request

33H
-----

Response

B3H
-----

#### 12.3.3.12 – Move Loader to Short Unload Position

The Move Loader to Short Unload Position (34H) command will cause the loader to move to the fully unloaded position and then to the short unloaded position. This command is acted upon as long as the drive is not Ready.

Request

34H
-----

Response

B4H
-----

## UDO Product Specification

### 12.4 – Packet Protocol Example

The following example uses Dump Memory command that will require character stuffing. Step by step checksum generation is shown as the command is formed.

#### Command

20H	1BH	10H	03H	80H	77H
-----	-----	-----	-----	-----	-----

#### Checksum generation

BYTE NUMBER	DATA	SUM 1	SUM 2
1	20H	20H	20H
2	1BH	3BH	5BH
3	10H	4BH	A6H
4	03H	4EH	F4H
5	80H	CEH	C3H
6	77H	46H	0AH
Final Checksum - See Section 12.2.4 Part B		AFH	0AH

To form the packet, note that bytes 2 and 4 will require character stuffing since they are packet control type characters. The actual packet that will be transmitted is shown below.

#### Packet

STX	Byte 1	Stuff	Byte 2	Byte 3	Stuff	Byte 4	Byte 5
02H	20H	1BH	1BH	10H	1BH	03H	80H
Byte 6	Sum 1	Sum 2	ETX				
77H	AFH	0AH	03H				

When receiving the bytes the receiver should detect the STX (02H) character and then start storing the data and generating the checksums as shown below. Note that stuff characters are removed from the data as it is received.

#### Checksum Generation

BYTE NUMBER	DATA	SUM 1	SUM 2
1	20H	20H	20H
2	1BH	3BH	5BH
3	10H	4BH	A6H
4	03H	4EH	F4H
5	80H	CEH	C3H
6	77H	46H	0AH
Sum 1	AFH	F5H	00H
Sum 2	0AH	00H	00H

### 13 – Compliant Write Once Media

Compliant Write Once Media is a new media type introduced by Plasmon and is supported in UDO code versions U03 and beyond.

Compliant Write Once Media supports the SCSI Shred command. If a Shred command is sent to a drive loaded with standard Write Once or Rewriteable media, a check condition will be returned with a sense key set to “Illegal Request”. The Shred command will permanently destroy the specified extent on the disk. Other than supporting the Shred command Compliant Write Once Media will behave as Standard Write Once media. Compliant Write Once Media is shipped preformatted from the factory and subsequent format commands will be rejected.

If a read is attempted on a shredded sector, the drive will return a check condition with a sense key of “Media Error” (0x03) and an ASC/ASCQ set to “Shredded Sector Detected” (0x93/0x01) with the Shred sector LBA being placed in the Request Sense Info bytes.

When Compliant Write Once Media is loaded and upon issuing a 6 byte Mode Sense command (0x1A), the Mode Sense Header Media Type (byte 1) will be set to 0x02, indicating Write Once media and bit 0 of byte 2 will be set to 1 indicating this is Compliant Write Once Media. If a 10 byte Mode Sense command is issued, the Mode Sense Header Media Type (byte 2) will be set to 0x02, indicating Write Once media and bit 0 of byte 3 will be set to 1, indicating that this is Compliant Write Once Media.

If a Compliant Write Once disk is loaded into a drive that has firmware that does not support Compliant Write Once Media, such as, older firmware released before Compliant Write Once Media was introduced (pre U03) then, any attempt to access the disk will receive a check condition with a sense key of “Media Error” ( 0x03) and an ASC/ASCQ of “Media Format Corrupt/SDI Invalid” ( 0x31/0x00).

When running Compliant Write Once Media the drive will always perform a verify pass on any data that is written regardless of the mode select “inhibit verify” setting.

Write Long and Read Long Commands are not supported on CM.