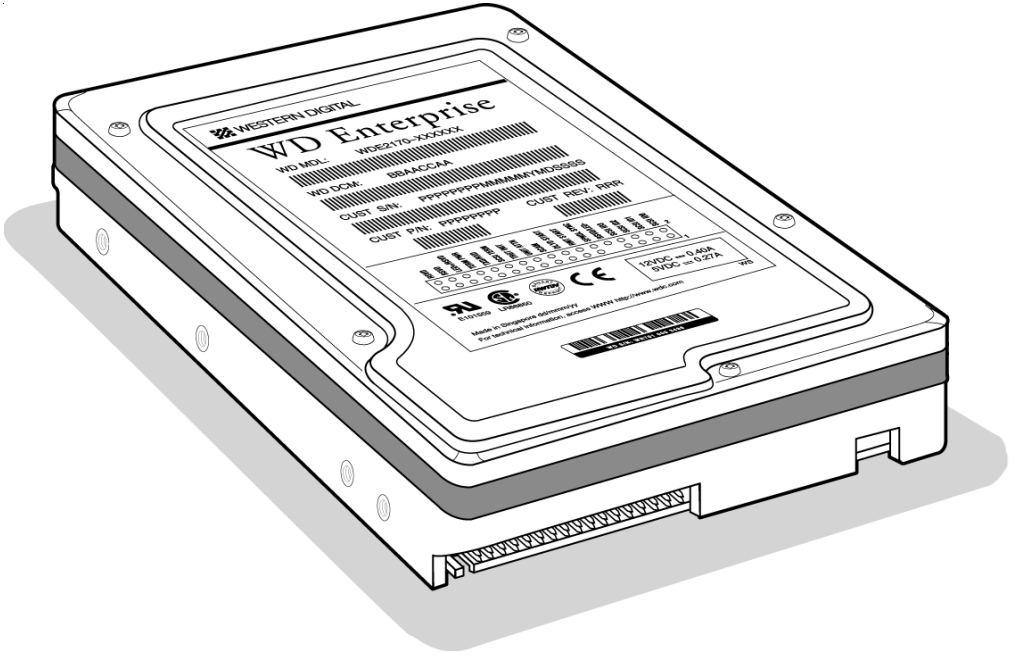
WD Enterprise WDE2170/WDE4360
(CCC: A0)
Technical Reference Manual



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1. DESCRIPTION AND FEATURES

1.1 General Description

Designed to set a new direction in mass storage solutions, the WD Enterprise™ low-profile 3.5-inch hard drives are the first in a family of 7200 RPM products. The outstanding performance, capacity, and reliability of these mass storage solutions make them the most competitive price/performance choice for workstations, servers, and multi-user systems.

The WDE2170 and WDE4360 drives feature formatted capacities of 2.1 and 4.3 gigabytes with media data transfer rates up to 140 Mbits per second. These drives are SCSI-3 SPI compliant and support Ultra Fast and Ultra Fast Wide host transfer rates of up to 40 MB/s. Advanced read/write caching, command queuing, command reordering (seek and rotational), Self Monitoring and Reporting Technology (S.M.A.R.T.) and SCSI Configure Automatically (SCAM) are standard features on the Western Digital Enterprise hard drives.

Western Digital hard drives are designed and manufactured to the highest standards of quality and reliability. WD Enterprise drives incorporate the mechanical platform design and proven recording technologies of Western Digital's award-winning Caviar drives. This quality design means the WD Enterprise drives have fewer disks and heads which translates into many performance and reliability advantages. The WDE2170 and WDE4360 drives deliver the performance, capacity, and reliability demanded by all high performance enterprise systems.

1.2 Advanced Features

Product Features

- Formatted Capacities of 2.17 GB and 4.36 GB
- Low Profile 1-Inch (25.4 mm) in Height
- 7200 RPM Spindle Speed
- SCSI-3 SPI Compliant; Ultra Fast/Ultra Fast Wide with SCA-2 interface supported
- 512 kilobytes Programmable Multi-segmented Data Buffer (1 MB option)
- Zoned Recording
- Headerless Format
- SCAM Plug-N-Play Compliant
- Single-ended or Differential SCSI Drivers/Receivers (optional)
- Active Termination
- Spindle Synchronization
- Downloadable Firmware
- Embedded Servo
- Balanced Spindle
- Dynamic Spindle Brake
- Vertical or Horizontal Mounting

Performance Features

- Media Data Transfer Rate up to 140 Mbits/s
- Average Read Seek Time of 8 ms
- 4.17 ms Rotational Latency
- Command Queuing
- Command Reordering (Seek and Rotational)
- Write/Read Coalescing
- Adaptive Caching Algorithm
- Self Optimizing Buffer Ratios
- Adaptive Segmented Cache
- Auto-Read Reallocation/Auto-Write Reallocation (ARRE/AWRE)
- Adaptive Servo Functions

Reliability Features

- Direct Hot-Plug Capability in SCA-2 Configuration
- Hardware On-The-Fly Error Correction
- CRC Data Buffer Protection
- Sector Slipping Defect Management
- Self Diagnostics on Power Up
- 1,000,000 Hour MTBF Projected

These advanced product features are further defined in section 3. In certain cases we may suggest referencing another document for additional detail. To obtain a document, contact your local Western Digital sales office, authorized Western Digital reseller, or access the Western Digital web page at **www.wdc.com**

1.3 Options

The following options are incorporated at the time of production or are available separately.

- **Data buffer of 1 megabyte**
  The standard data buffer size is 512 kilobytes. You may order a 1 megabyte option. For more details, refer to the interface matrix table in Appendix A
- **Single-unit shipping pack kit**
  The drive is shipped in bulk packaging to provide maximum protection against damage during transit. Units shipped individually require additional protection as provided by the single-unit shipping pack. Contact your local Western Digital sales office for ordering information.
- **Differential SCSI**
  The WD Enterprise drive will provide, as an option, differential SCSI drivers/receivers on the 68-pin and 80-pin interface configurations. For more details, refer to the interface matrix table in Appendix A.

2. SPECIFICATIONS

2.1 Performance Specifications

Table 2-1. WDE2170/4360 Performance Specifications

PERFORMANCE CRITERIA	WDE2170/WDE4360 SPECIFICATIONS
Average Seek • Read • Write	 8 ms 9.5 ms
Track-to-Track Seek • Read • Write	 1 ms 2.5 ms
Full Stroke Seek	< 18 ms
Average Latency	4.17 ms
Rotational Speed	7200 RPM
Data Transfer Rate • Media to Buffer • Buffer to Host	 83-140 Mbits/s 40 MB/s max.
Buffer Size[1]	512 KB 1 MB optional
Error Rate - Unrecoverable	< 1 in 10^{14} bits read
Spindle Start Time	< 30s to ready
Spindle Stop Time	< 20s
Contact Start/Stop Cycles (CSS)[2]	20,000

[1] *User can access the entire 512 KB or 1 MB data buffer.*

[2] *Must not exceed defined environmental specification.*

NOTE: This table represents typical values under nominal conditions.

2.2 Physical Specifications

Table 2-2. WDE2170/4360 Physical Specifications

Physical Specifications	WDE2170	WDE4360
Formatted Capacity[1]	2170 MB	4360 MB
Interface(s)	Ultra Fast • (50-pin) Ultra Fast Wide • (68-pin)[2] • (80-pin SCA-2)[2]	Ultra Fast • (50-pin) Ultra Fast Wide • (68-pin)[2] • (80-pin SCA-2)[2]
Actuator Type	Rotary Voice Coil	Rotary Voice Coil
Media Type	Thin Film	Thin Film
Head Type	Thin Film Inductive	Thin Film Inductive
Servo Type	Embedded	Embedded
Number of Disks	2	4
Number of Data Surfaces	4	8
Number of Heads	4	8
Bytes per Sector[4]	512	512
Tracks per Inch	6150	6150
Bits per Inch (000)	125 (ID)	125 (ID)
Areal Density	769 Mb/in^2	769 Mb/in^2
Total Cylinders	5956	5956
Zones per Surface	20	20
User Sectors per Drive (512 byte)	225 (OD), 133 (ID)	225 (OD), 133 (ID)
Recording Method	0,4,4 RLL	0,4,4 RLL
ECC[3]	144-bit Reed Solomon	144-bit Reed Solomon
RLL = Run Length Limited		

[1] *Western Digital defines a megabyte (MB) as 1,000,000 bytes and a gigabyte (GB) as 1,000,000,000 bytes.*

[2] *Differential option available on 68-pin and 80-pin models.*

[3] *ECC has 144-bit span in hardware for correction on-the-fly.*

[4] *The standard is 512 byte sectors. Optionally, we will support 512-528 bytes per sector in even byte increments.*

2.2.1 Physical Dimensions

Table 2-3. WDE2170/4360 Physical Dimensions

Physical Characteristic	English		Metric	
	Dimension	**Tolerance**	**Dimension**	**Tolerance**
Height	1.00 inch	± 0.02 inch	25.4 mm	± 0.50 mm
Length	5.75 inches	± 0.02 inch	146.05 mm	± 0.50 mm
Width	4.00 inches	± 0.01 inch	101.6 mm	± 0.25 mm
Weight WDE2170	1.1 pounds	± 0.11 lbs.	0.48 kg	± 0.05 kg
Weight WDE4360	1.2 pounds	± 0.11 lbs.	0.53 kg	± 0.05 kg

2.3 Mechanical Specifications

Figure 2-1 through Figure 2-3 show the mounting dimensions and locations of the screw holes for the WDE2170 and WDE4360 drives.

Figure 2-1. 50-pin Drive Dimensions

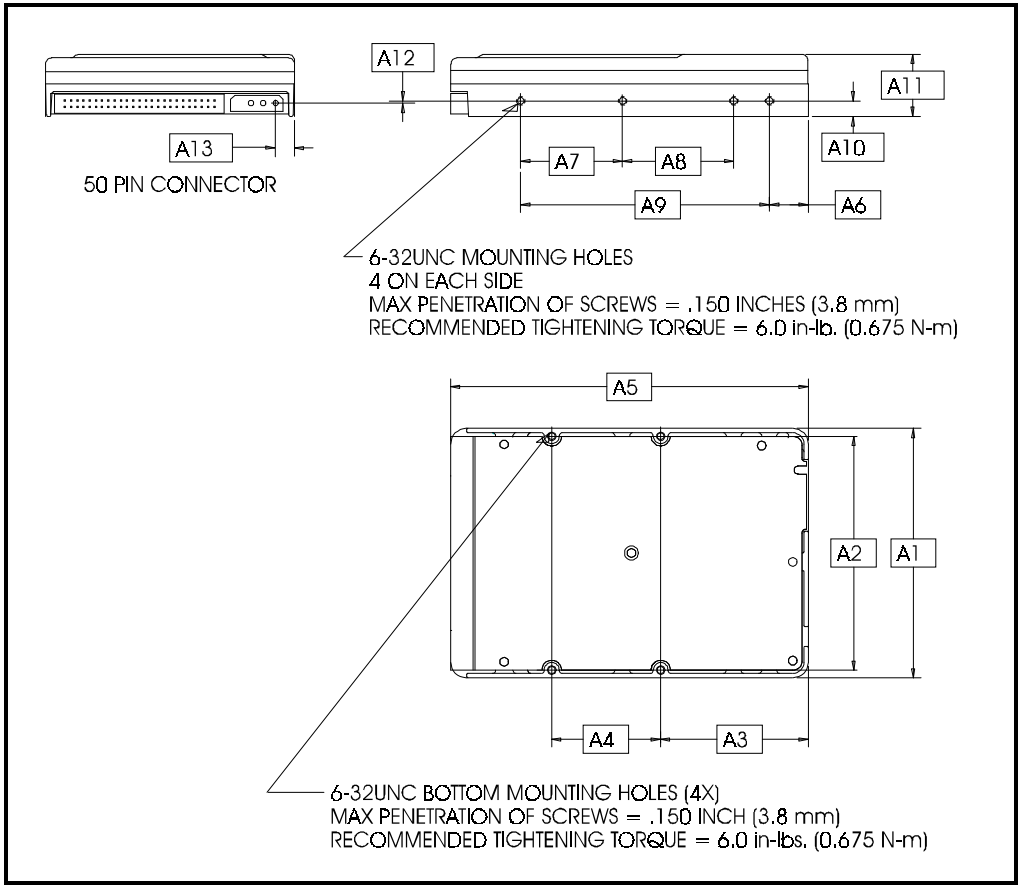


Table 2-4. 50-pin Drive Dimensions

Dimension	Inches	Millimeters
A1	4.000 ± .010	101.60 ± 0.25
A2	3.750 ± .010	95.25 ± 0.25
A3	2.375 ± .010	60.32 ± 0.25
A4	1.750 ± .010	44.45 ± 0.25
A5	5.750 ± .020	146.05 ± 0.50
A6	.625 ± .020	15.87 ± 0.50
A7	1.638 ± .010	41.60 ± 0.25
A8	1.787 ± .010	45.39 ± 0.25
A9	4.000 ± .010	101.60 ± 0.25
A10	.250 ± .010	6.35 ± 0.25
A11	1.000 ± .020	25.40 ± 0.50
A12	.035 ± .020	0.89 ± 0.50
A13	.300 ± .020	7.62 ± 0.50

Figure 2-2. 68-pin Drive Dimensions

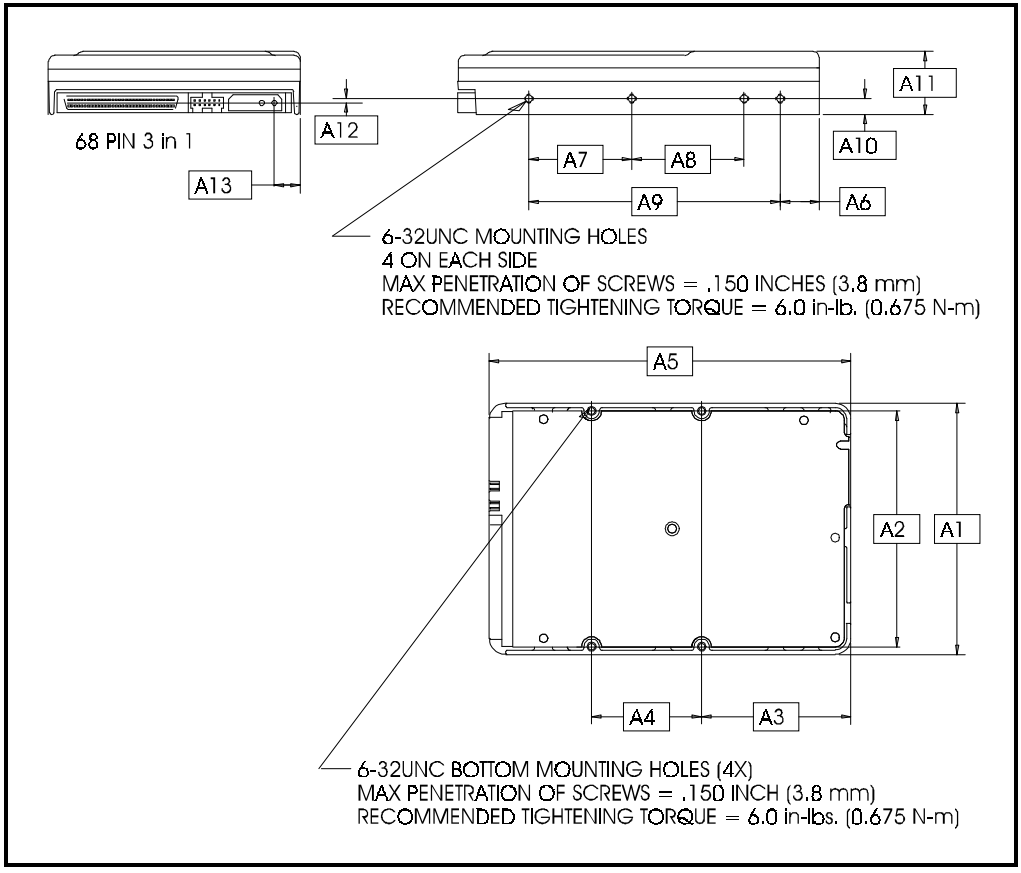


Table 2-5. 68-pin Drive Dimensions

Dimension	Inches	Millimeters
A1	4.000 ± .010	101.60 ± 0.25
A2	3.750 ± .010	95.25 ± 0.25
A3	2.375 ± .010	60.32 ± 0.25
A4	1.750 ± .010	44.45 ± 0.25
A5	5.750 ± .020	146.05 ± 0.50
A6	.625 ± .020	15.87 ± 0.50
A7	1.638 ± .010	41.60 ± 0.25
A8	1.787 ± .010	45.39 ± 0.25
A9	4.000 ± .010	101.60 ± 0.25
A10	.250 ± .010	6.35 ± 0.25
A11	1.000 ± .020	25.40 ± 0.50
A12	.067 ± .020	1.70 ± 0.50
A13	.410 ± .020	10.41 ± 0.50

Figure 2-3. 80-pin Drive Dimensions

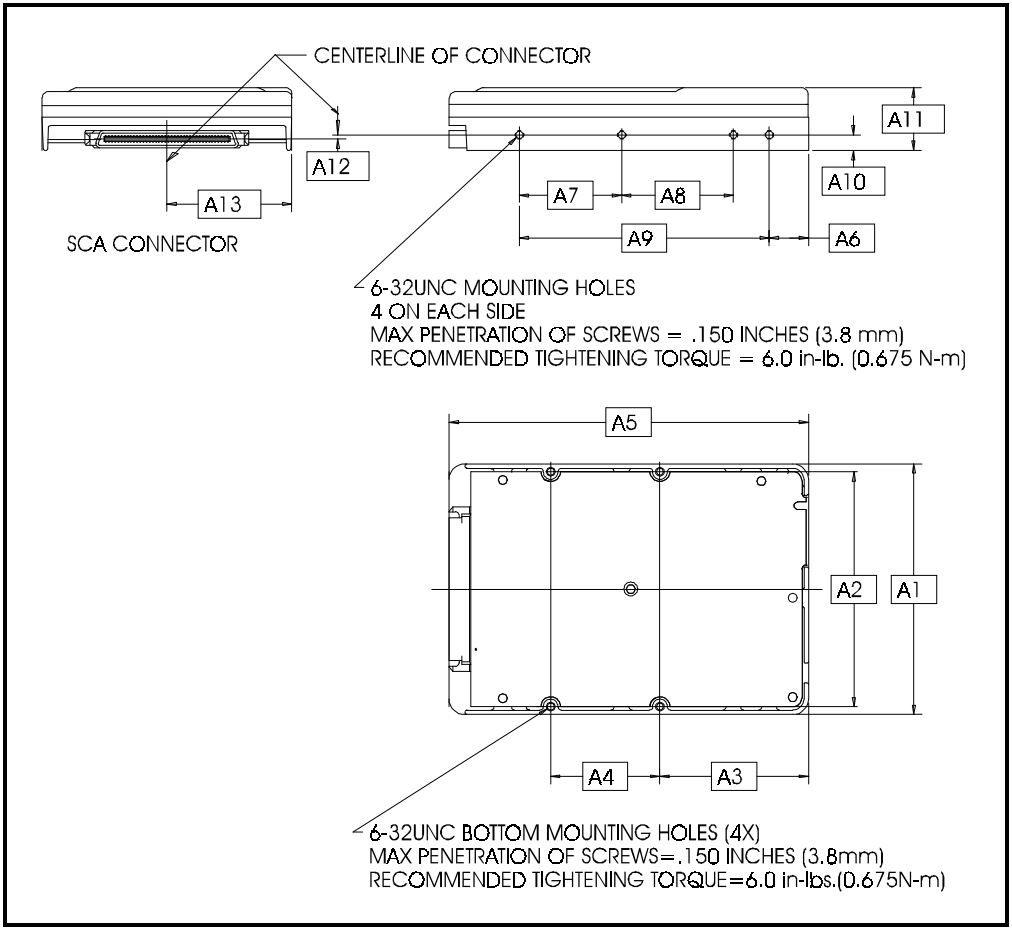


Table 2-6. 80-pin Drive Dimensions

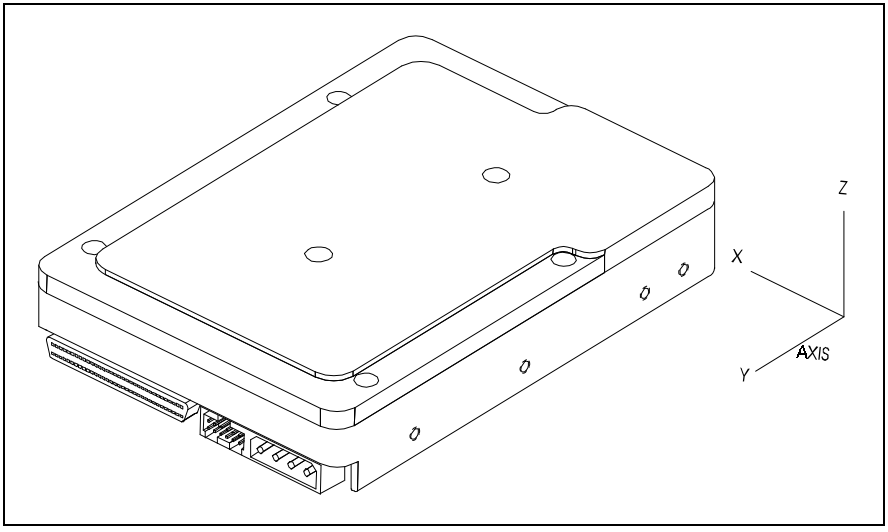
Dimension	Inches	Millimeters
A1	4.000 ± .010	101.60 ± 0.25
A2	3.750 ± .010	95.25 ± 0.25
A3	2.375 ± .010	60.32 ± 0.25
A4	1.750 ± .010	44.45 ± 0.25
A5	5.750 ± .020	146.05 ± 0.50
A6	.625 ± .020	15.87 ± 0.50
A7	1.638 ± .010	41.60 ± 0.25
A8	1.787 ± .010	45.39 ± 0.25
A9	4.000 ± .010	101.60 ± 0.25
A10	.250 ± .010	6.35 ± 0.25
A11	1.000 ± .020	25.40 ± 0.50
A12	.069 ± .020	1.75 ± 0.50
A13	2.000 ± .020	50.80 ± 0.50

2.3.1 Mounting

The WD Enterprise drives feature side and bottom mounting holes, which allows them to be mounted in any orientation. See Figure 2-4 for orientation axes.

The hard drive is a precision mechanical assembly. Improper mounting may distort the drive frame and impair its ability to function. For instructions on installing the drive, including drive handling and mounting, refer to the WD Enterprise Installation Guide (document number 4079-001046).

Figure 2-4. Drive Axis Definition



2.4 Electrical Specifications

2.4.1 Current Requirements and Power Dissipation for Single-ended Drives

Table 2-7. WDE2170 Current Requirements and Power Dissipation for Single-ended Drives

Operating Mode	Maximum Current		Typical Current		Typical Power	Maximum Power
	12 VDC	5 VDC	12 VDC	5 VDC		
Spin-up	1.5A avg. Peak	620 mA RMS	760mA RMS	550 mA RMS	11.9W	15.1W (RMS)
	1.75A Peak		1.43A Peak			24.1W (Peak)
Seek						
Peak	1.6A	950 mA	1.10A	660 mA	16.5W	24.0W
1/3 Stroke RMS	1.2A	950 mA	590 mA	660 mA	10.4W	19.2W
50 ops/s RMS	0.8A	950 mA	390 mA	660 mA	7.9W	14.4W
80 ops/s RMS	0.9A	950 mA	490 mA	660 mA	9.1W	15.6W
Idle	500 mA RMS	650 mA RMS	220 mA	570 mA	5.5W	9.25W

Note: All values at 25°C, 5.0V, 12.0V input.

Table 2-8. WDE4360 Current Requirements and Power Dissipation for Single-ended Drives

Operating Mode	Maximum Current		Typical Current		Typical Power	Maximum Power
	12 VDC	5 VDC	12 VDC	5 VDC		
Spin-up	1.5A avg. Peak	620 mA RMS	800mA RMS	550 mA	12.4W	15.1W (RMS)
	1.75A Peak		1.43A Peak			24.1W (Peak)
Seek						
Peak	1.7A	950 mA	1.30A	660 mA	18.9W	25.2W
1/3 Stroke RMS	1.3A	950 mA	700 mA	660 mA	11.7W	20.4W
50 ops/s RMS	0.9A	950 mA	520 mA	660 mA	9.5W	15.6W
80 ops/s RMS	1.0A	950 mA	610 mA	660 mA	10.6W	16.8W
Idle	600 mA RMS	650 mA RMS	350 mA	570 mA	7.0W	10.5W

Note: All values at 25°C, 5.0V, and 12.0V input.

2.4.2 Current Requirements and Power Dissipation for Differential Drives

Table 2-9. WDE2170 Current Requirements and Power Dissipation for Differential Drives

Operating Mode	Maximum Current		Typical Current		Typical Power	Maximum Power
	12 VDC	5 VDC	12 VDC	5 VDC		
Spin-up	1.5A avg. Peak	755 mA RMS	760mA RMS	640 mA RMS	12.3W	15.8W (RMS)
	1.75A Peak		1.43A Peak		20.4W	24.8W (Peak)
Seek						
Peak	1.6A	1.09 mA	1.10A	750 mA	17.0W	24.7W
1/3 Stroke RMS	1.2A	1.09 mA	590 mA	750 mA	10.8W	19.9W
50 ops/s RMS	0.8A	1.09 mA	390 mA	750 mA	8.4W	15.1W
80 ops/s RMS	0.9A	1.09 mA	490 mA	750 mA	9.6W	16.3W
Idle	500 mA RMS	785 mA RMS	220 mA	660 mA	5.9W	9.9W

Notes: 1. All values at 25°C, 5.0V, 12.0V input.

2. There is a 600 mA spike with a pulse width of 0.2 ms added to the 5V current during a SCSI transfer from the drive to the host.

Table 2-10. WDE4360 Current Requirements and Power Dissipation for Differential Drives

Operating Mode	Maximum Current		Typical Current		Typical Power	Maximum Power
	12 VDC	5 VDC	12 VDC	5 VDC		
Spin-up	1.5A avg. Peak	755 mA RMS	800 mA RMS	640 mA	12.8W	15.8W (RMS)
	1.75A Peak		1.43A Peak		20.4W	24.0W (Peak)
Seek						
Peak	1.7A	1.09A	1.30A	750 mA	19.4W	25.9W
1/3 Stroke RMS	1.3A	1.09A	700 mA	750 mA	12.2W	21.1W
50 ops/s RMS	0.9A	1.09A	520 mA	750 mA	10.0W	16.3W
80 ops/s RMS	1.0A	1.09A	610 mA	750 mA	11.1W	17.5W
Idle	600 mA RMS	785 mA RMS	350 mA	660 mA	7.5W	11.1W

Notes: 1. All values at 25°C, 5.0V, 12.0V input.

2. There is a 600 mA spike with a pulse width of 0.2 ms added to the 5V current during a SCSI transfer from the drive to the host

2.4.3 12V Current Profile

The following graphs show the +12V current profile for the WDE2170 and WDE4360 drives during spin-up and run.

Figure 2-5. WDE2170 Drive +12V Average Current Profile

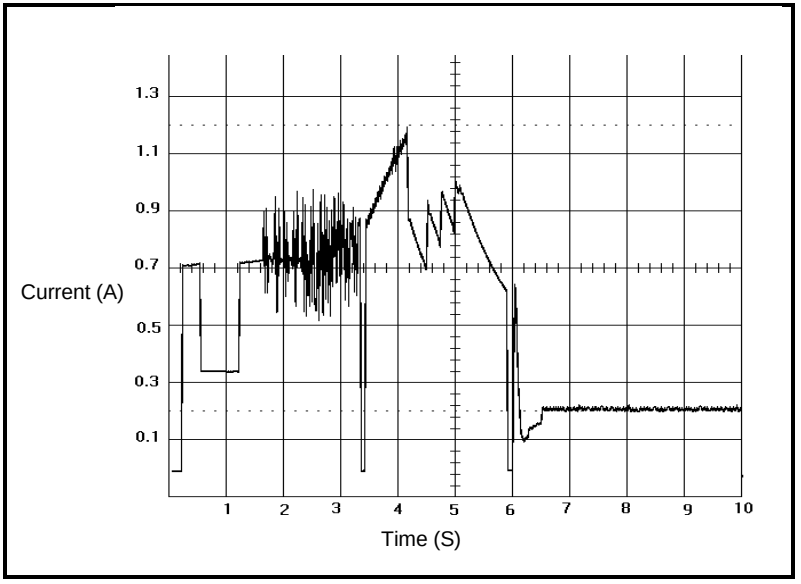


Figure 2-6. WDE2170 Drive +12V Peak-to-Peak Current Profile

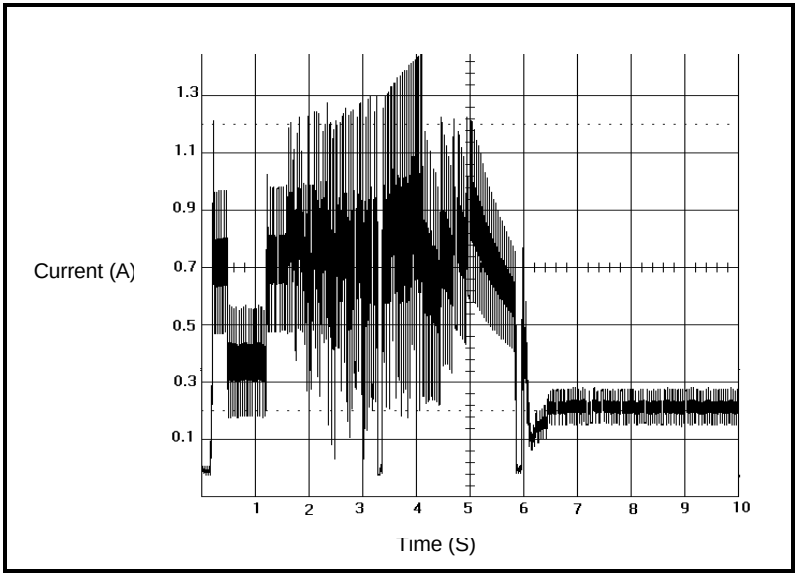


Figure 2-7. WDE4360 Drive +12V Average Current Profile

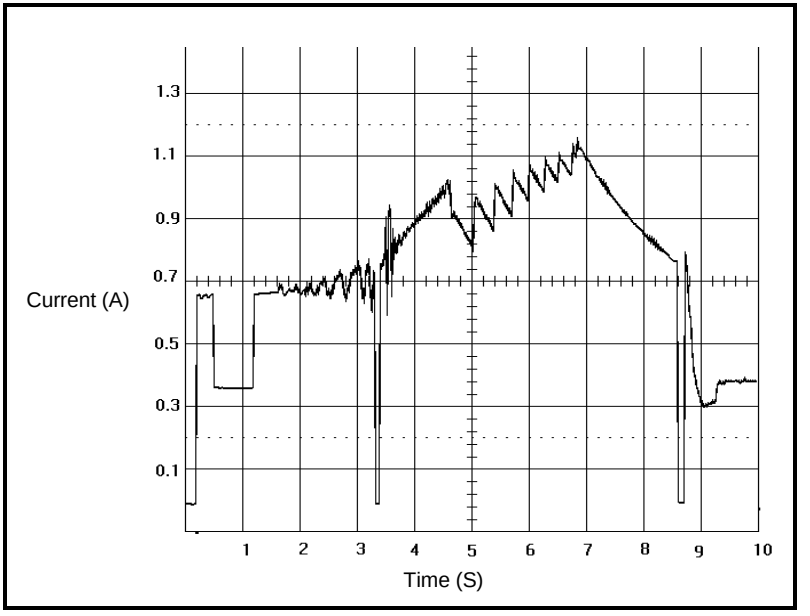
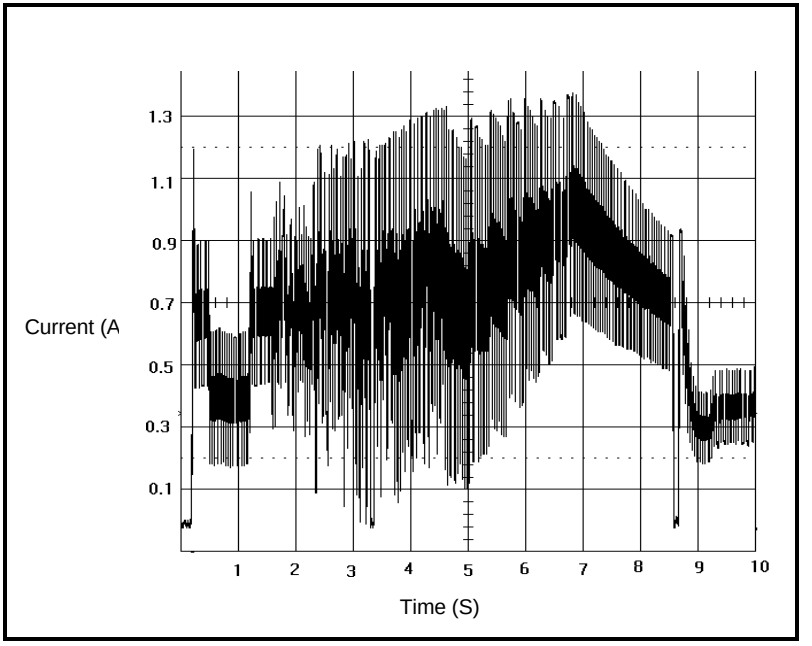


Figure 2-8. WDE4360 Drive +12V Peak-to-Peak Current Profile



2.4.4 Input Voltage Requirements

The input voltage requirements for the WDE2170 and WDE4360 are as follows:

+ 5V ± 5% and + 12V ± 5%

2.4.5 Ripple

Table 2-11. Voltage Ripple

	+12 VDC	+5 VDC
Maximum	Start: 400 mV (peak-to-peak) Run: 150 mV (peak-to-peak)	100 mV (peak-to-peak)
Frequency	0-20 MHz	0-20 MHz

2.4.6 Bring Up Sequence

After power is applied, the following events occur as the drive becomes ready for use.

NOTE: Typical spindle start time is provided in Table 2-1.

1. The microprocessor tests itself, the on-board memory, and components on the printed circuit board assembly (PCBA).
2. The SCSI interface is enabled to accept the following commands: Inquiry, Mode Sense, Request Sense, Start/Stop Unit, Test Unit Ready. Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116) for additionally supported SCSI commands and features.
3. Internal electronic component initialization and testing continues.
4. If the Auto Start option is enabled, the motor will spin up.
5. The servo system calibrates itself.
6. Additional configuration information is read from an area on the disk that is reserved for the drive's internal use.
7. A self test is performed on the read/write path.
8. The drive is ready to read and write data.

If an error occurs during the bring-up sequence, sense data will be available if the SCSI interface is working; otherwise the LED will flash, if installed.

If a reassign was in progress when the drive was turned off, the drive will automatically complete that operation during startup.

2.5 Environmental Specifications

2.5.1 Shock and Vibration

All shock and vibration specifications apply to the mounting and orientation conditions described in section 2.3. Orientation axes are defined in Figure 2-4.

Table 2-12. Shock and Vibration

Shock	
Operating	10G (2 per second maximum)
Non-operating	70G (3 drops per axis maximum)
Non-operating Rotational Shock	10,000 rad/s^2
Note: Half-sine wave of 3 ms duration without non-recoverable errors.	
Vibration	
Operating	5-20 Hz, 0.037 inch (peak to peak) 20-400 Hz, 0.75G (0 to peak)
Non-operating	5-20 Hz, 0.098 inch (peak to peak) 20-400 Hz, 2.0G (0 to peak)
Sweep Rate	One octave per minute (minimum)

Operating Shock

WD Enterprise drives are tested by applying a linear shock in each axis, one axis at a time, at a rate not exceeding two shocks per second.

The drive will incur no physical damage and no hard errors while subjected to intermittent shock not exceeding the level listed in Table 2-12. Operating performance may degrade during periods of shock application.

Non-operating Shock

WD Enterprise drives are tested by applying a linear shock in each axis, one axis at a time. A maximum of three shocks per axis is applied.

The drive will incur no physical damage when subjected to non-repetitive shocks not exceeding the level listed in Table 2-12.

Non-operating Rotational Shock

WD Enterprise drives are tested by applying a rotational shock in each direction, about each axis, one axis at a time.

The drive will incur no physical damage when subjected to rotational shocks not exceeding the level listed in Table 2-12.

Operating Vibration

WD Enterprise drives are tested by applying a continuous swept sine excitation in each linear axis, one axis at a time. Sweep rate is one octave per minute.

The drive will incur no physical damage and no hard errors while subjected to continuous vibration not exceeding the level listed in Table 2-12. Operating performance may degrade during periods of vibration application.

Non-operating Vibration

NOTE: This specification applies to handling and transportation of unmounted drives.

Drives are tested by applying a continuous swept sine excitation in each linear axis, one axis at a time. Sweep rate is one octave per minute.

The drive will incur no physical damage when subjected to continuous vibration not exceeding the level listed in Table 2-12.

Packaged Shock and Vibration

The shipping packaging is designed to meet the National/International Safe Transit Association's (N/ISTA) standards for packaged products.

The drive will incur no physical damage when subjected to the N/ISTA standards.

2.5.2 Temperature and Humidity

Table 2-13. Temperature and Humidity

Temperature and Humidity	
Operating[1]	
Temperature	5°C to 55°C (41°F to 131°F)
Humidity	10-90% RH non-condensing 33°C (maximum wet bulb)
Thermal Gradient	10°C/hour (maximum)
Non-Operating	
Temperature	-40°C to 60°C (-40°F to 140°F)
Humidity	5-95% RH non-condensing 33°C (maximum wet bulb)
Thermal Gradient	20°C/hour (maximum)

[1] *The system environment must provide sufficient air flow to limit maximum surface temperatures as defined in Table 2-14.*

2.5.3 Cooling

Drive component temperatures must remain within the limits specified in Table 2-14. Figure 2-9 and Figure 2-10 show the temperature measurement locations. Sustained operation at temperatures in excess of the reliability values will degrade the MTBF rating. Short excursions up to but not exceeding the maximum values will not affect the MTBF rating. Maximum component temperature ratings must not be exceeded under any operating condition. The drive may require forced air cooling to meet specified operating temperatures.

Table 2-14. Maximum & Reliability Operating Temperature Limits

Component	Location	Maximum	Reliability[1]
Drive Baseplate	#1, Figure 2-9.	65°C (149°F)	55°C (131°F)
4915	#2, Figure 2-10.	95°C (203°F)	65°C (149°F)
64C96	#3, Figure 2-10.	80°C (176°F)	65°C (149°F)
2298	#4, Figure 2-10.	80°C (176°F)	65°C (149°F)
1501	#5, Figure 2-10.	80°C (176°F)	65°C (149°F)

[1] *Sustained operation at temperatures in excess of the reliability values will degrade the MTBF rating.*

2.5.4 Atmospheric Pressure

Table 2-15. Allowable Altitude Ranges

Altitude	
Operating	-1,000 feet to 10,000 feet (-300m to 3,000m)
Non-operating	-1,000 feet to 40,000 feet (-300m to 12,000m)

2.5.5 Acoustics

Table 2-16. Sound Power Level

Mode	Typical	Maximum
Idle	4.0 A-weighted Bels	4.3 A-weighted Bels
Seek	5.0 A-weighted Bels	5.3 A-weighted Bels

Notes:

1. *Sound power is measured in accordance with ECMA-74 and ISO 7779. Seek mode sound power is measured while the drive performs random seeks at a rate of 33 seeks/sec.*

2. *Drives are tested after a 20 minute warm up period.*

Figure 2-9. Drive Baseplate Thermocouple Location

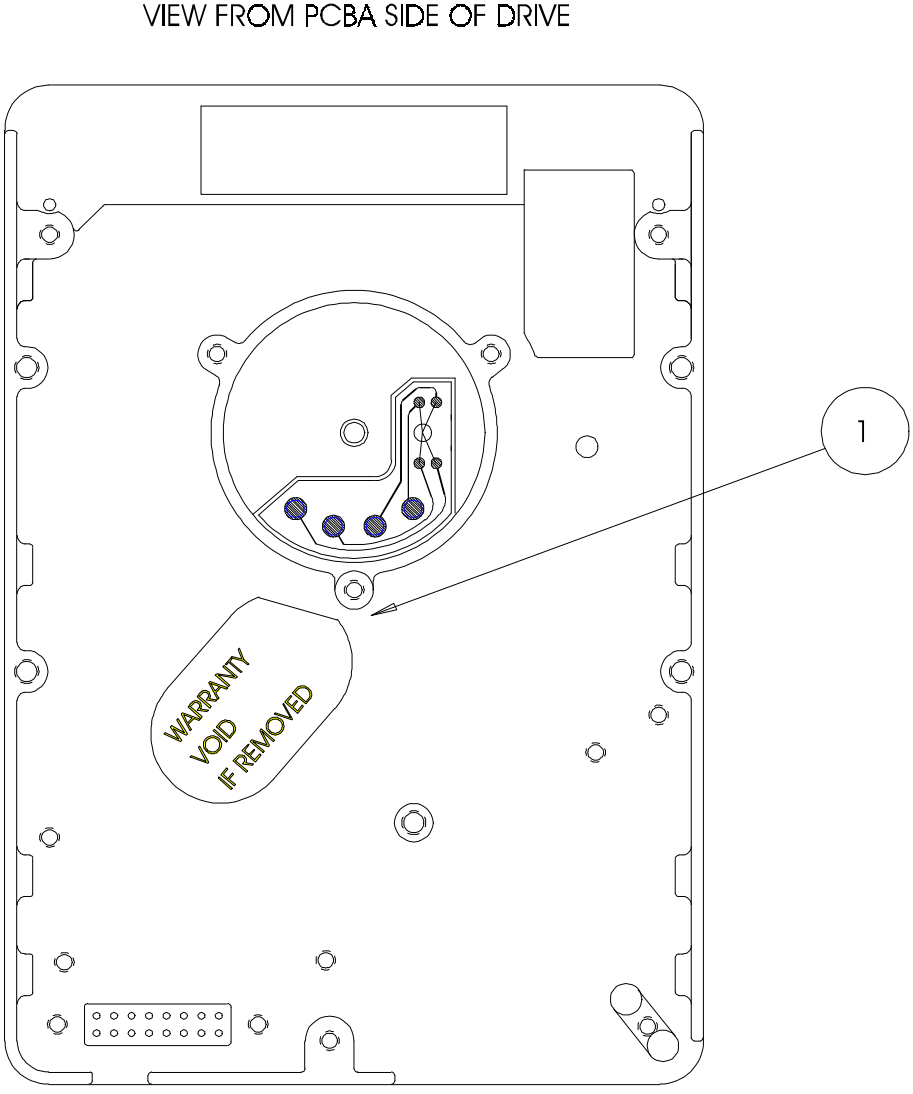
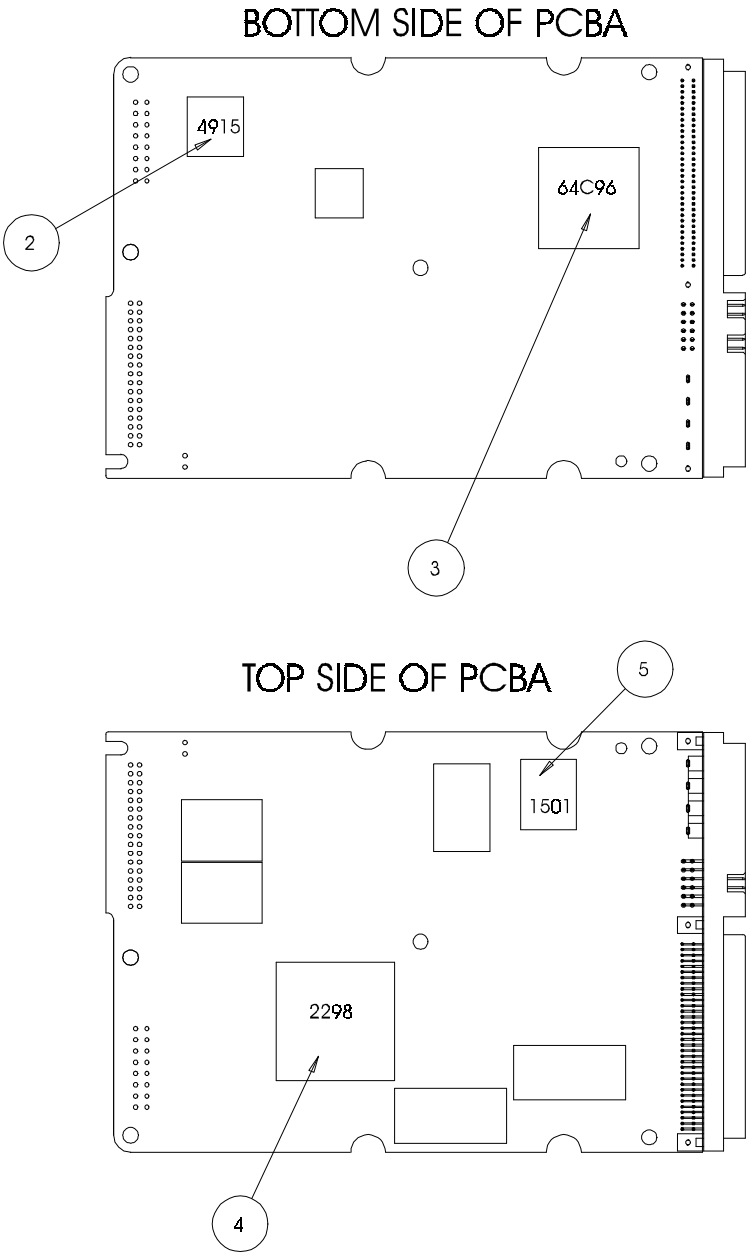


Figure 2-10. PCBA Thermocouple Locations



2.6 Reliability Specifications

Table 2-17. WDE2170 and WDE4360 Reliability Parameters

Recoverable Data Error Rate:	Less than 10 in 10^{11} bits read
Unrecoverable Data Error Rate:	Less than 1 in 10^{14} bits read
Miscorrected Data Error Rate:	Less than 1 in 10^{21} bits read
Seek Error Rate:	Less than 10 in 10^{8} seeks (average)
Projected MTBF:	1,000,000 hours
Service Life:	5 years
Preventive Maintenance:	None required

NOTE: The error rates listed above reflect the drive operating under specified conditions.

2.7 Agency Approvals

2.7.1 Product Safety

Western Digital drives are free of Polychlorinated Biphenyl (PCBs) and Cadmium materials. In addition, prohibited Chlorofluorocarbons (CFCs) are not used in the manufacturing process.

Models WDE2170 and WDE4360 meet the safety standards of the following regulatory agencies:

- **Underwriters Laboratories:** UL-Standard 1950, Standard for Safety of Information Technology Equipment including Electrical Business Equipment (File E101559)
- **Canadian Standards Association:** CSA-Standard C22.2, No. 950-M89, Standard for Safety of Information Technology Equipment including Electrical Business Equipment (File LR68850)
- **TUV Essen Laboratories:** IEC-950 (EN60950) Standard for Safety of Information Technology Equipment including Electrical Business Equipment

2.7.2 Electromagnetic Compatibility (EMC)

Upon request, Western Digital will provide technical information pertaining to compliance testing of the following:

- **Federal Communication Commission (FCC):** Verified to comply with FCC Rules for Radiated and Conducted Emission, Part 15, Subpart B, for Class B Equipment
- **CE Compliance for Europe:** Verified to comply with EN55022 for RF Emissions and EN50082-1 for Generic Immunity as applicable
- **VDE:** VDE 0871/6.78, BZT Class B, Radio Frequency Interference of Radio Frequency Equipment for Industrial, Scientific, and Medical (ISM) and similar purposes
- **VCCI:** VCCI Class 2-CISPR Class B, Radiated and Line Conducted Emissions

3. ADVANCED PRODUCT FEATURES

3.1 Compatibility Testing

Western Digital performs extensive testing in its Functional Integrity Test Lab (FIT Lab™). By equipping the FIT Lab with multiple host systems, adapters, operating systems, and application programs, compatibility is achieved with a broad range of applications implemented on workstations, servers, multi-user, and array systems.

3.2 SCSI-3 SPI Compliant

Drive models WDE2170 and WDE4360 conform to SCSI-3 SPI (SCSI Parallel Interface) standard. The drives also support the Ultra SCSI performance specification and are offered in several configurations like Ultra Fast (8-bit, 50-pin; up to 20MB/s) and Ultra Fast Wide (16-bit, 68-pin, 80-pin SCA-2; up to 40MB/s) host transfer rates.

3.3 Embedded Servo Control

The WD Enterprise drives feature embedded servo technology to generate accurate position information on every track. An embedded servo system has servo bursts written interspersed with customer data on every track. This provides a tight coupling between head positioning and customer data – a necessity for good soft error rates. In addition, embedded servo technology is less susceptible to thermal shifts of the system since customer data and position information are recorded together on the same track.

3.4 Read Caching and Pre-Fetch

Read caching allows the drive to maintain data in the cache for quick transfer to the host when a media access is not required. Pre-fetching takes place after a media access when the drive reads data into the cache that the firmware determines is likely to be requested by the host. Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116) for further details.

3.5 Write Caching

Write caching gives the host the ability to allow the drive to asynchronously write data to the media while other processes may be taking place. Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116) for further details.

3.6 512 Kilobyte Data Buffer

The entire data buffer is user accessible, enabling powerful data caching capabilities.

3.7 Adaptive Caching

The drives are equipped with an adaptive caching capability which enables them to improve performance and throughput based on how the drive is being used. Each drive determines the environment in which it is being used and optimizes the way it handles commands and data.

3.8 Command Queuing and Reordering

The drives support both tagged and untagged queuing. Tagged queuing allows the drive to receive multiple I/O processes from each initiator. Untagged queuing allows the drive to receive a maximum of one I/O process from each initiator.

In order to use tagged command queuing, the initiator must set the disconnect privilege bit. This allows the drive to disconnect the SCSI bus. It also allows the same or other initiators to connect to the drive and send additional commands. The drive returns a status of BUSY if the privilege bit is off and the drive has I/O processes in the command queue. The drive has the capability to queue up to 64 I/O processes. Upon receipt of the 65th I/O process, the drive returns a status of QUEUE FULL.

The drive can reorder I/O processes in the command queue. The order in which the drive executes I/O processes may not be in the same order as was received.

Command reordering employs an algorithm which improves the throughput of the drive by attempting to minimize both the seek time and the rotational latency.

The drive uses a command aging feature to prevent the command reordering algorithm from keeping I/O processes waiting in the command queue for extended periods of time. The drive allows I/O processes to wait in the command queue for only a specified length of time before being scheduled in the next I/O process.

3.9 Media Defect Management

Western Digital drives support a defect management algorithm that uses sector slipping. Defective sites are pushed down during a reassignment operation to maintain a sequential order. Spare sectors are placed throughout the drive to support this algorithm. This routine can be invoked by the drive when Auto-Read Allocation/ Auto-Write Allocation (ARRE/AWRE) is enabled in MODE SELECT Page 1. If these functions are disabled, the drive will report status and allow the host to request reassign.

3.10 Microcode Download

Western Digital drives support downloadable microcode via the SCSI WRITE BUFFER command. The supported modes include Download Microcode and Save, as well as Download Microcode with Offsets and Save. Download Microcode with Offsets is used when the buffer is limited to the full download and requires smaller partial downloads to complete the download task.

3.11 Reed Solomon ECC On-the-Fly

Error Correction Code (ECC) on-the-fly is a correction technique that reduces the uncorrectable read error rate in hardware. This provides a high degree of data integrity with no impact on the drive's performance.

3.12 CRC Data Protection

Cyclic Redundancy Check (CRC) data protection is a feature that enhances data integrity. During a write operation, before a user data block enters the cache (data buffer), the SCSI controller generates CRC data (2 bytes) and attaches it to the user data block (usually 512 bytes). During a read operation, the SCSI controller reads each user data block and its CRC data in the cache, then verifies the CRC data as it transfers each user data block to the SCSI bus.

3.13 Spindle Synchronization

Spindle synchronization is controlled by the RPL (Rotational Position Locking) and Rotational Offset fields in Mode Select Page 4. The physical connection is defined in section 5 of this manual.

The RPL field (byte 17, bits 0-1) is used to define Master and Slave assignments (see Table 3-1). The Rotational Offset field (byte 18) indicates the amount of rotational skew that the Western Digital drive uses when operating in slave mode. The rotational skew is applied in the retarded direction (lagging the synchronized spindle master control). The value in the field is the numerator of a fraction with a denominator of 256 (e.g., a value of 128 indicates a one-half revolution skew). A value of 00h indicates that rotational offset is not used.

Table 3-1. RPL Bits

RPL Bits	Description
00b	Indicates that spindle synchronization is disabled.
01b	The Western Digital drive operates as a synchronized-spindle slave.
10b	The Western Digital drive operates as a synchronized-spindle master.

A change to the spindle synchronization mode is initiated immediately upon the successful completion of a Mode Select command, which changes the RPL field or the Rotational Offset field in Mode Select Page 4. When the drive achieves synchronization, it posts a Unit Attention condition for all Initiators with the additional sense code and qualifier set to Spindle Synchronized (5C01). If the drive is unable to achieve synchronization, it posts a Unit Attention condition to all Initiators with the additional sense code and qualifier set to Spindle Not Synchronized (5C02).

The drive will do one of the following if it loses synchronization:

- If it loses synchronization while no I/O processes are in progress, the drive posts a Unit Attention condition to all initiators with the additional sense code and qualifier set to Spindle Not Synchronized (5C02).
- If an I/O process is in progress when the drive loses synchronization, it will determine what to report as follows:
  - If the I/O process is successfully completed, the drive will return a Check Condition status and report Recovered Error with the additional sense code and qualifier set to Spindle Not Synchronized (5C02). It will set a Unit Attention condition for all other initiators with the same additional sense code and qualifier.
  - If the I/O process is not successfully completed, the drive will return the error from the command and set a Unit Attention condition for all Initiators with the additional sense code and qualifier set to Spindle Not Synchronized (5C02).

3.14 Zoned Recording

The drives employ zoned recording to increase data density on the outer tracks of the drive. Zoned recording allows the adjustment of the number of sectors per track, which provides storage of more sectors on the larger, outer tracks. Formatting packs data uniformly throughout the surface of the platter by dividing the outer tracks into more sectors. With more bytes per track, the drive reads the data in the outer zones at a faster rate.

3.15 Headerless Format

Headerless format is also known as ID-less or No-ID sector format. This format removes the header (or ID fields) and all the information within the header (track format) to provide a dramatic increase in user capacity. Our advanced, integrated SCSI controller assumes the task of determining the physical location of each of the sectors.

3.16 LED Support

If an LED is installed on the drive, the following will be observed:

- The LED is turned off as soon as power is applied. If Auto Start is enabled, the LED is on while the drive is spinning up and turned off when Auto Start is completed.
- The LED is on when a SCSI command is being executed.
- The LED flashes when an error prohibits the use of the SCSI interface.

3.17 Option Block Functions

The firmware uses several pins on the option block to modify the drive characteristics. The definitions for the jumpers are:

- **SCSI ID:** Four jumpers are used to identify the default SCSI ID for the drive.
- **Disable Auto Start:** Use of this jumper disables Auto Start, meaning the drive will not spin-up until a START UNIT command is issued. Without this jumper, the drive will spin-up and prepare itself at power on without having to receive a START UNIT command.
- **Auto Start Delay:** Use of this jumper allows the Auto Start to incorporate a delay. The delay used is equal to the SCSI ID multiplied by 4 seconds.
- **Disable Target Initiated Synchronous/Wide Negotiation:** Use of this jumper dictates that the drive not initiate either synchronous negotiation or wide negotiation. Without this jumper the drive will initiate synchronous and wide negotiation when appropriate.
- **Disable Unit Attention:** This controls whether a CHECK CONDITION status is reported following a Power On or Reset sequence. A REQUEST SENSE command following one of those conditions will still yield the correct sense data for the UNIT ATTENTION condition as sense data is generated regardless of the jumper setting. A jumper on this pin disables the generation of a CHECK CONDITION for the Power On and Reset UNIT ATTENTION conditions. When no jumper is attached, a CHECK CONDITION status will be reported in these situations.
- **SCSI Configure Automatically (SCAM):** The drive is SCAM levels 1 and 2 compliant, which eases user configuration of SCSI IDs and allows for hot plugging on single and multiple drive systems. Use of this jumper allows the drive to function as a SCAM level 2 device. Without the jumper the drive is not a SCAM device.
- **Active SCSI Termination:** To ensure reliable communication, the SCSI bus must be properly terminated. Use of this jumper enables active termination on the drive. Without this jumper, active termination is disabled.

NOTE: For more information on the option block, refer to section 5.

3.18 Error Recovery Operations

Error recovery options are set using MODE SELECT Page 1 (Read/Write Error Recovery Page) and the Write Recovery Threshold and Read Recovery Threshold fields in MODE SELECT Page 0 (WD Vendor Unique Page).

The drive employs a variety of recovery actions based on the type of error that occurs. Separate recovery actions are defined for read errors, write errors, servo errors, and drive fault errors. For a given error type, several different recovery actions may be used. For example, read error recovery may use retries, servo track offsets, channel parameter modification, and software ECC in an attempt to recover the error. Error information is available to the host via the REQUEST SENSE command based on the settings in MODE SELECT Pages 0 and 1.

The drive uses a 3-way interleaved Reed-Solomon ECC operating on 8 bit (1 byte) symbols. On-the-fly ECC is capable of correcting single burst errors up to 1 byte per interleave (24 bits total) with no performance degradation. On-the-fly correction is done in hardware and cannot be disabled. The drive firmware also implements a software ECC, which is capable of correcting single or double burst errors up to 2 bytes per interleave.

Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116) for more information.

3.19 Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.)

Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) is a hard drive firmware technology that performs drive failure prediction by monitoring selected parameters during normal drive operations. The intent of this technology is to minimize unscheduled system downtime caused by drive failures which might have been predicted. By monitoring selected parameters, the S.M.A.R.T. firmware can predict some drive failures before they actually occur, allowing the user to schedule drive replacement and minimize system interruptions.

Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116) for more information.

3.20 Hot Plug/Unplug Support

The conditions for hot-plugging drives into an active SCSI bus are:

- The drive signal ground must be made before the SCSI bus signals.
- Power—both +5V and +12V—cannot be applied until after the SCSI bus signals are connected.
- The host(s) are not actively trying to access the inserted device.
- The drive is not supplying TERMPWR to the SCSI bus.
- The drive is not supplying termination to the SCSI bus.

The conditions for the removal of a device from an active SCSI bus are:

- The host(s) are not actively trying to access the device to be removed.
- The drive is not supplying TERMPWR to the SCSI bus.
- The drive is not supplying termination to the SCSI bus.
- Power, both +5V and +12V must be removed before the SCSI bus signals are disconnected.
- The drive signal ground must be broken after the SCSI bus signals.

The SCA-2 (80-pin) connector allows for proper insertion and extraction by providing an appropriate mechanical mating that makes the signal ground connection first on insertion and breaking of this ground connection last upon extraction. There are also control signals that will allow the proper application of power to adhere to the insertion and extraction rules above. However, the user must guarantee that the three rules listed below apply:

- The host(s) are not actively trying to access the inserted device.
- The drive is not supplying TERMPWR to the SCSI bus.
- The drive is not supplying termination to the SCSI bus.

4. SCSI INTERFACE AND COMMAND SET

Refer to the Western Digital SCSI Implementation Guide (document number 4096-001116).

5. THE OPTION BLOCK

The WD Enterprise drive's PCBA contains an option block that controls the drive's operation. This block is equipped with jumper pins that correspond to various options controlled by SCSI commands. Jumpers are used to enable or disable the options and modify the drive configuration. The user-configurable jumpers are shown in Table 5-1.

Note: Whenever you change a jumper setting, it will take effect the next time the drive is powered on.

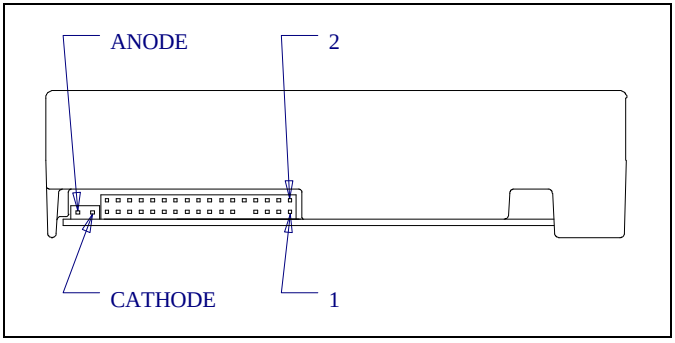
5.1 Physical Characteristics

The block consists of a 2 by 17 male header. Pin-to-pin spacing is 2 mm by 2 mm.

5.2 Pin Designation

The pin layout is shown below. The diagram represents the view as seen by the customer.

Figure 5-1. Option Block and LED Pin Designation



5.3 Option Block Pin Assignments

The option block is used to modify the drive characteristics. The table below shows the pin numbers that correspond to each option or signal, and provides instruction for enabling and disabling these features. Refer to the WD Enterprise Installation Guide (document number 4079-001046) for option definitions.

Table 5-1. Option Block Pin Assignments

OPTION/SIGNAL	JUMPER PINS	CONFIGURATION NOTES
SCSI IDs	1 - 8	Set according to Table 5-2.
(KEY)/LED-	9 - 10	Reserved
SPINDLE SYNC	11 - 12	Install jumper to enable spindle sync.
OPT 1: DISABLE AUTO START	13 - 14	Install jumper to disable auto start.
OPT 2: AUTO START DELAY	15 - 16	Install jumper to enable auto start delay.
OPT 3: SCAM	17 - 18	Install jumper to enable SCAM.
OPT 4: DISABLE UNIT ATTENTION	19 - 20	Install jumper to disable unit attention.
OPT 5: DISABLE TARGET INITIATED SYNCHRONOUS/WIDE NEGOTIATION	21 - 22	Install jumper to disable target initiated synchronous/wide negotiation.
OPT 6: SCSI TERMINATION	23 - 24	Install jumper to enable SCSI termination.
TXD/RXD	25 - 26	Reserved
TPWR/+5V	27 - 28	Install jumper to enable TERMPWR on the SCSI bus.
LED+/+5V	29 - 30	Reserved
+12R/+12R	31 - 32	Reserved
+12V/+12V	33 - 34	Reserved

NOTE: Pins 1,3,5,7,11,13,15,17,19,21, and 23 are ground.

5.4 SCSI ID Jumper Table

Table 5-2. SCSI ID Jumper Table

SCSI ID	JUMPER LOCATION			
	Pins 7 & 8	Pins 5 & 6	Pins 3 & 4	Pins 1 & 2
0	○	○	○	○
1	○	○	○	●
2	○	○	●	○
3	○	○	●	●
4	○	●	○	○
5	○	●	○	●
6	○	●	●	○
7	○	●	●	●
8	●	○	○	○
9	●	○	○	●
10	●	○	●	○
11	●	○	●	●
12	●	●	○	○
13	●	●	○	●
14	●	●	●	○
15	●	●	●	●

applies to 8-bit drives ● jumper installed ○ jumper removed

6. SCSI CONNECTORS

6.1 Power Connectors and Cables

Table 6-1. 50-pin Drive Power Connector and Cable

POWER CONNECTOR	MATING CONNECTOR	WIRE GAUGE
AMP 2-in-1	1x4 PC power connector	18 AWG

Table 6-2. 68-pin Drive Power Connector and Cable

POWER CONNECTOR	MATING CONNECTOR	WIRE GAUGE
Molex 3-in-1 combo (or equivalent)	1x4 PC power connector	18 AWG

6.2 SCSI Physical Interface

All Western Digital SCSI hard drives are designed to conform to the SCSI-3 Parallel Interface as described in the draft of proposed ANSI specification X3T10/855D Revision 15a. In addition, drives equipped with the 80-pin SCA connector are designed to conform to the Small Form Factor Committee draft specification SFF-8046 Rev 2.0 entitled “SCA-2 (Single Connector Attach) for SCSI Disk Drives”. Since tutorials on SCSI-3 and SCA are beyond the scope of this manual, users should review their SCSI implementations as required to ensure compliance. The SCSI-3 spec has several informative annex sections devoted to cabling, bus termination, crosstalk, etc., that can be quite helpful to SCSI system architects and implementors.

6.3 50-Pin SCSI Connector

Figure 6-1. 50-Pin SCSI Connector and Power Connector Pin Numbers

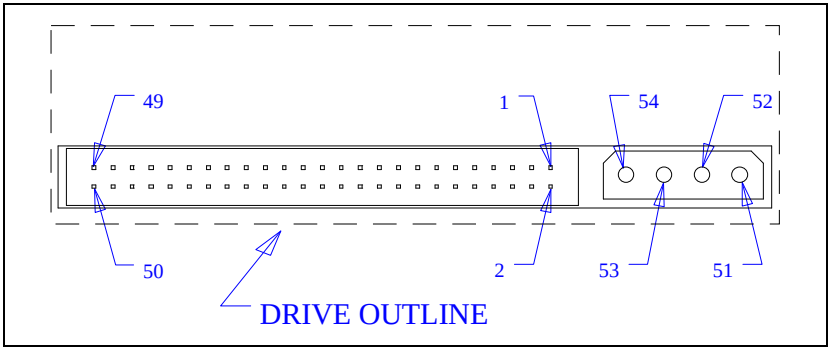


Table 6-3. 50-Pin SCSI Connector Pin Assignments

SINGLE-ENDED SCSI CONNECTOR			
Signal Name	**Pin Number**		**Signal Name**
GROUND	1	2	-DB0
GROUND	3	4	-DB1
GROUND	5	6	-DB2
GROUND	7	8	-DB3
GROUND	9	10	-DB4
GROUND	11	12	-DB5
GROUND	13	14	-DB6
GROUND	15	16	-DB7
GROUND	17	18	-DBP
GROUND	19	20	GROUND
GROUND	21	22	GROUND
GROUND	23	24	GROUND
open	25	26	TERMPWR
GROUND	27	28	GROUND
GROUND	29	30	GROUND
GROUND	31	32	-ATN
GROUND	33	34	GROUND
GROUND	35	36	-BSY
GROUND	37	38	-ACK
GROUND	39	40	-RST
GROUND	41	42	-MSG
GROUND	43	44	-SEL
GROUND	45	46	-C/D
GROUND	47	48	-REQ
GROUND	49	50	-I/O

Table 6-4. DC Power Connector

Signal Name	**Pin Number**		**Signal Name**
+12V (+12 SUPPLY)	51	52	GROUND (+12 RETURN)
GROUND (+5 RETURN)	53	54	+5V (+5 SUPPLY)

6.4 68-Pin SCSI Connector

Figure 6-2. 68-Pin SCSI Connector, Remote Option Connector, and Power Connector Pin Numbers

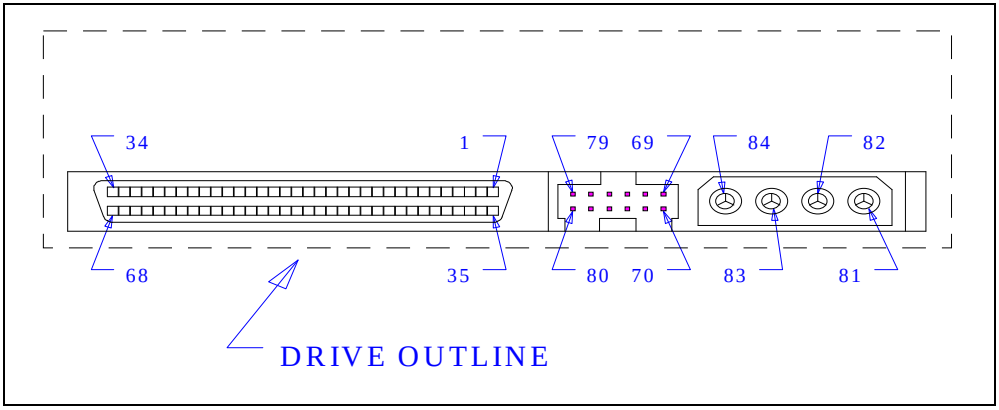


Table 6-5. 68-pin SCSI Connector Pin Assignments

SINGLE-ENDED SCSI CONNECTOR			
Signal Name	**Pin Number**		**Signal Name**
GROUND	1	35	-DB12
GROUND	2	36	-DB13
GROUND	3	37	-DB14
GROUND	4	38	-DB15
GROUND	5	39	-DBP1
GROUND	6	40	-DB0
GROUND	7	41	-DB1
GROUND	8	42	-DB2
GROUND	9	43	-DB3
GROUND	10	44	-DB4
GROUND	11	45	-DB5
GROUND	12	46	-DB6
GROUND	13	47	-DB7
GROUND	14	48	-DBP0
GROUND	15	49	GROUND
GROUND	16	50	GROUND
TERMPWR	17	51	TERMPWR
TERMPWR	18	52	TERMPWR
open	19	53	open
GROUND	20	54	GROUND
GROUND	21	55	-ATN
GROUND	22	56	GROUND
GROUND	23	57	-BSY
GROUND	24	58	-ACK
GROUND	25	59	-RST
GROUND	26	60	-MSG
GROUND	27	61	-SEL
GROUND	28	62	-C/D
GROUND	29	63	-REQ
GROUND	30	64	-I/O
GROUND	31	65	-DB8
GROUND	32	66	-DB9
GROUND	33	67	-DB10
GROUND	34	68	-DB11

DIFFERENTIAL SCSI CONNECTOR (OPTIONAL)			
Signal Name	**Pin Number**		**Signal Name**
+DB12	1	35	-DB12
+DB13	2	36	-DB13
+DB14	3	37	-DB14
+DB15	4	38	-DB15
+DBP1	5	39	-DBP1
GROUND	6	40	GROUND
+DB0	7	41	-DB0
+DB1	8	42	-DB1
+DB2	9	43	-DB2
+DB3	10	44	-DB3
+DB4	11	45	-DB4
+DB5	12	46	-DB5
+DB6	13	47	-DB6
+DB7	14	48	-DB7
+DBP0	15	49	-DBP0
DIFFSENS	16	50	GROUND
TERMPWR	17	51	TERMPWR
TERMPWR	18	52	TERMPWR
open	19	53	open
+ATN	20	54	-ATN
GROUND	21	55	GROUND
+BSY	22	56	-BSY
+ACK	23	57	-ACK
+RST	24	58	-RST
+MSG	25	59	-MSG
+SEL	26	60	-SEL
+C/D	27	61	-C/D
+REQ	28	62	-REQ
+I/O	29	63	-I/O
GROUND	30	64	GROUND
+DB8	31	65	-DB8
+DB9	32	66	-DB9
+DB10	33	67	-DB10
+DB11	34	68	-DB11

Table 6-6. Remote Option for 68-Pin Connector (single-ended and differential versions)

Signal Name	SFF-8009 Signal Name	SFF-8009 Pin Number	Pin Number		SFF-8009 Pin Number	SFF-8009 Signal Name	Signal Name
SCSI ID 0	SEL0-	1	69	70	2	XTFALT-	GROUND
SCSI ID 1	SEL1-	3	71	72	4	VUNIQ-	GROUND
SCSI ID 2	SEL3-	5	73	74	6	SPSYNC-	SPSYNC-
SCSI ID 3	SEL3-	7	75	76	8	XTACTV-	LED-
TERMEN-	ENTERM-	9	77	78	10	GROUND	GROUND
+5V	+5V	11	79	80	12	FAULT-	no connection

Table 6-7. DC Power Connector (single-ended and differential versions)

Signal Name	Pin Number		Signal Name
+12V (+12 SUPPLY)	81	82	GROUND (+12 RETURN)
GROUND (+5 RETURN)	83	84	+5V (+5 SUPPLY)

6.5 80-Pin (SCA-2) SCSI Connector

Figure 6-3. 80-Pin SCSI Connector Pin Numbers

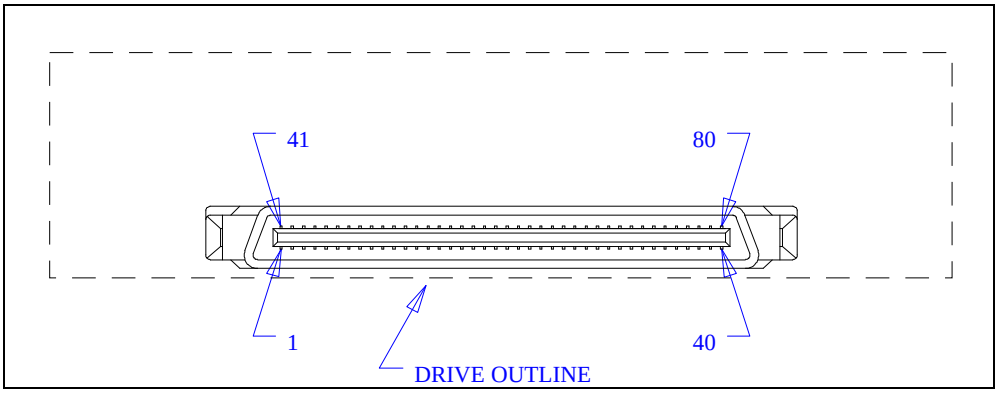


Table 6-8. 80-Pin (SCA-2) SCSI Connector Pin Assignments

SINGLE-ENDED SCSI CONNECTOR			
Signal Name	Pin Number		Signal Name
+12 VOLTS	1	41	+12V GND
+12VOLTS	2	42	+12V GND
+12VOLTS	3	43	+12V GND
+12VOLTS	4	44	+12V GND
reserved	5	45	reserved
reserved	6	46	GROUND
-DB11	7	47	GROUND
-DB10	8	48	GROUND
-DB9	9	49	GROUND
-DB8	10	50	GROUND
-I/O	11	51	GROUND
-REQ	12	52	GROUND
-C/D	13	53	GROUND
-SEL	14	54	GROUND
-MSG	15	55	GROUND
-RST	16	56	GROUND
-ACK	17	57	GROUND
-BSY	18	58	GROUND
-ATN	19	59	GROUND
-DBP0	20	60	GROUND
-DB7	21	61	GROUND
-DB6	22	62	GROUND
-DB5	23	63	GROUND
-DB4	24	64	GROUND
-DB3	25	65	GROUND
-DB2	26	66	GROUND
-DB1	27	67	GROUND
-DB0	28	68	GROUND
-DBP1	29	69	GROUND
-DB15	30	70	GROUND
-DB14	31	71	GROUND
-DB13	32	72	GROUND

DIFFERENTIAL SCSI CONNECTOR (OPTIONAL)			
Signal Name	Pin Number		Signal Name
+12 VOLTS	1	41	+12V GND
+12VOLTS	2	42	+12V GND
+12VOLTS	3	43	+12V GND
+12VOLTS	4	44	+12V GND
reserved	5	45	reserved
reserved	6	46	DIFFSNS
-DB11	7	47	+DB11
-DB10	8	48	+DB10
-DB9	9	49	+DB9
-DB8	10	50	+DB8
-I/O	11	51	+I/O
-REQ	12	52	+REQ
-C/D	13	53	+C/D
-SEL	14	54	+SEL
-MSG	15	55	+MSG
-RST	16	56	+RST
-ACK	17	57	+ACK
-BSY	18	58	+BSY
-ATN	19	59	+ATN
-DBP0	20	60	+DBP0
-DB7	21	61	+DB7
-DB6	22	62	+DB6
-DB5	23	63	+DB5
-DB4	24	64	+DB4
-DB3	25	65	+DB3
-DB2	26	66	+DB2
-DB1	27	67	+DB1
-DB0	28	68	+DB0
-DBP1	29	69	+DBP1
-DB15	30	70	+DB15
-DB14	31	71	+DB14
-DB13	32	72	+DB13

Table continues on the following page.

Table 6-8. 80-Pin (SCA-2) SCSI Connector Pin Assignments (Continued)

SINGLE-ENDED SCSI CONNECTOR			
Signal Name	**Pin Number**		**Signal Name**
-DB12	33	73	GROUND
+5VOLTS	34	74	+5V GND
+5VOLTS	35	75	+5V GND
+5VOLTS	36	76	+5V GND
SLAVE SYNC	37	77	LED OUT
AUTO START	38	78	START DELAY
SCSI ID 0	39	79	SCSI ID 1
SCSI ID 2	40	80	SCSI ID 3

DIFFERENTIAL SCSI CONNECTOR (OPTIONAL)			
Signal Name	**Pin Number**		**Signal Name**
-DB12	33	73	+DB12
+5VOLTS	34	74	+5V GND
+5VOLTS	35	75	+5V GND
+5VOLTS	36	76	+5V GND
SLAVE SYNC	37	77	LED OUT
AUTO START	38	78	START DELAY
SCSI ID 0	39	79	SCSI ID 1
SCSI ID 2	40	80	SCSI ID 3

7. INSTALLATION AND MAINTENANCE

For instructions on installing the drive, including drive handling and mounting, determining the configuration, setting the drive jumpers, and cabling procedures, refer to the WD Enterprise Installation Guide (document number 4079-001046).

7.1 Electrostatic Discharge (ESD) Protection

To prevent drive damage it is essential to keep the drive in an ESD safe environment. Several precautions can be taken to avoid permanent damage to the drive.

- Keep the drive in the shielded anti-static bag prior to testing or installation.
- Gently place the drive on a padded, grounded anti-static surface when it is not in its shipping container.
- A grounded wrist strap must be worn throughout all phases of drive handling.
- Articles of clothing generate static electricity. Do not allow clothing to come in direct contact with the drive or PCBA.
- Do not insert any other items in the shielded anti-static bag with the drive.

7.2 Maintaining the Drive

To keep the drive in optimal working order and prolong the life of the unit:

- Do not attempt to open the sealed compartment of the WDE2170/WDE4360 drive; this will void the warranty.
- Avoid harsh shocks or vibrations.
- Observe the environmental limits specified for this product.
- To protect your data, back it up regularly. Western Digital assumes no responsibility for loss of data. For information about back-up and restore procedures, consult your operating system manual. There are also a number of utility programs available that you can use to back up your data.

Caution: Do not remove any product identification labels.

The drive requires no preventive maintenance and contains no user-serviceable parts. Service and repair of the drive must be performed at a Western Digital Service Center. Contact your Western Digital representative for warranty information and service/return procedures.

8. TECHNICAL SUPPORT

If you have a problem with your WD Enterprise drive, the following tips may help determine the cause of the problem.

- Verify that you have correctly followed the setup procedures for your system.
- Check the physical installation:
  - Jumper selections on the WDE2170 and WDE4360
  - Correct cabling
  - Controller card, properly seated and configured
  - System power supply
- Observe the environmental limits specified for this product.

For literature and additional tips:

- DocuFAX automated FAX system: (714) 932-4300
- Internet WWW site: http://www.wdc.com/
- America Online keyword: Western Digital or WDC
- Microsoft Network keyword: WDC

If the problem persists:

- Call toll-free in the U.S.: 1-888-WDC-SCSI (or 1-888-932-7274)
- Call (507) 286-7972
- Fax (507) 286-7926

9. GLOSSARY

Active Termination - Active termination works to control the impedance at the end of the SCSI bus by using a voltage regulator. This reduces the susceptibility of the bus to noise, particularly when cables are long or when many devices are connected to the bus. Because it is active, regulating the power that it gets from the interface card, active termination is more stable than passive termination.

Adaptive Caching - The drive determines the environment in which its being used and optimizes the way it handles commands and data.

Auto Park - Turning off the drive's power causes the WDE2170/WDE4360 drive to move the read/write heads to a safe non-data landing zone and locks them in place.

Average Read Seek Time - The total time of test divided by 50,000 random length and random head seeks equals the average read seek time.

Block - A group of bytes handled, stored, and accessed as a logical data unit, such as an individual file record.

Buffer - A temporary data storage area that compensates for a difference in data transfer rates and/or data processing rates between sender and receiver.

Command Queuing - A feature that enables the drive to receive I/O processes from one or more initiators.

Command Reordering - A feature that allows the drive to reorder I/O processes in the command queue, thereby minimizing the seek time and rotational latency.

Correctable Error - An error that can be corrected by the use of Error Detection and Correction algorithms.

Customer Configuration Code (CCC) - The CCC is located on the product label attached to the drive. This code is revised only when changes affect the drive's form, fit, or function.

Defect Management - A general methodology of eliminating data errors on a recording surface by mapping out known defects on the media.

Differential SCSI - In differential SCSI, each signal consists of two lines called "–Signal" and "+Signal". Commands and data are carried over two sets of wires, and the difference is taken between each set of signals. Two-wire signaling is a proven way to achieve reliable signal transmission in noisy environments and over long distances.

Data Transfer Rate - Speed at which data is transferred to and from the disk media (actual disk platter) and is a function of recording the frequency. Typical units are bits per second (bps) or bytes per second. Modern hard drives have an increasing range of disk transfer rates from the inner diameter to the outer diameter of the disk. This is called a "zoned" recording technique.

ECC On-the-Fly - A hardware correction technique that corrects errors in the read buffer prior to host transfer without any performance penalties. These error corrections are invisible to the host system because they do not require assistance from the drive's firmware.

Embedded Servo Control - The embedded servo control design generates accurate feedback information to the head position servo system without requiring a full data surface (which is required with a “dedicated” servo control design).

Error Correction Code - A mathematical algorithm that can detect and correct errors in a data field by adding check bits to the original data.

Error Rate - The number of errors of a given type that occur when reading a specified number of bits.

Functional Integrity Testing (FIT) - A suite of tests Western Digital performs on all its drive products to ensure compatibility with different hosts, operating systems, adapters, application programs, and peripherals. This testing must be performed before the product can be released to manufacturing.

Formatted Capacity - The actual capacity available to store data in a mass storage device. The formatted capacity is the gross capacity minus the capacity taken up by the overhead data required for formatting the media.

Hard Error - An error that cannot be corrected by the error recovery process.

Host Transfer Rate - Speed at which the host computer can transfer data across the SCSI interface.

Landing Zone - A non-data position on the disk's inner cylinder where the heads land when power is turned off.

Latency - The average time delay between the head arriving on track and the data rotating to the head. (Calculated as one-half the revolution period).

Logical Address - A storage location address that may or may not relate directly to a physical location. The logical address is used when requesting information from a controller. The controller performs a logical-to-physical address conversion and retrieves the data from a physical location in the storage device.

MB (Megabyte) - Western Digital defines a megabyte as 1,000,000 bytes.

MTBF (Mean Time Between Failures) - The mean number of life units (in 10^6 hours), during which all parts of the drive perform within their specified limits, during a particular measurement interval under stated conditions.

Recoverable Error - A read error, transient or otherwise, that can be corrected by ECC recovery or by re-reading the data.

RPM (Revolutions per Minute) - Rotational speed of the media (disk), also known as the spindle speed. Hard drives spin at one constant speed. Disk RPM is a critical component of hard drive performance because it directly impacts the rotational latency of the disk transfer rate.

SCA-2 (vs. SCA-1) - SCA-2 (Single Connector Attach) interface incorporates a grounding contact, blindmate connector, direct plug misalignment tolerance, ESD protection, hot swap capability, and backplane connector options. SCA is commonly called the 80-pin connector.

SCSI Configure Automatically (SCAM) - Allows users to attach SCSI devices without worrying about configuration options.

SCSI-1 - The Small Computer System Interface (ANSI document X3.131-1986).

SCSI-2 - The Small Computer System Interface (ANSI document X3.131-1994).

SCSI-3 - The ANSI X3T10 Working Documents (under development).

SCSI device - A host computer adapter or a peripheral controller or an intelligent peripheral that can be attached to the SCSI bus.

Sector - A 512-byte packet of data.

Seek Time - A measure (in milliseconds) of how fast the hard drive can move its read/write heads to a desired location.

Servo Burst - Provides positioning information to the actuator arm, usually positioned between sectors or at the end of a track.

Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) - S.M.A.R.T. enables a drive's internal status to be monitored through diagnostic commands at the host level.

Single-ended SCSI - The standard electrical interface for SCSI. Single-ended means an interface with one signal line and one corresponding ground line for each SCSI signal.

Soft Error - A data error that can be corrected by the error recovery process.

Spindle Synchronization - A feature that causes disk assemblies in multiple drive systems to rotate to the same address location at the same time.

Ultra SCSI - Provides 20 MB/s over an 8-bit bus or 40 MB/s over a 16-bit Wide SCSI bus. Known also as Fast-20 SCSI, this feature is most commonly found in SCSI-3 devices.

Unrecoverable Error - A read error that cannot be corrected by an ECC scheme or by re-reading the data when host retries are enabled.

Zoned Recording - Increases the data density on the outer tracks of the drive where most of the sectors are located. This type of recording affords more disk capacity because there can be more sectors on the larger outer tracks than would be possible if the number of sectors per track were constant for the whole drive.

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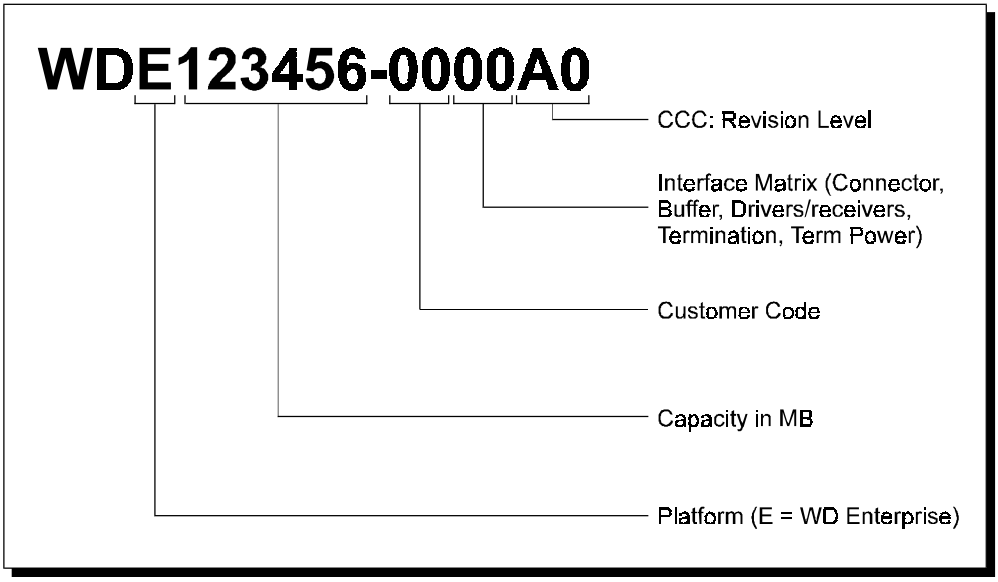
APPENDIX A. — UNDERSTANDING THE MODEL NUMBER

Listed below is the model number strategy for WD Enterprise drives.



The interface matrix portion of the model number is illustrated in the following table.

INTERFACE MATRIX											
Matrix Code	**Interface**		**Connector**			**Buffer**		**Termination Installed**		**Term Pwr Installed**	
	SE	**Diff**	**50-pin**	**68-pin**	**80-pin**	**512K**	**1 MB**	**Yes**	**No**	**Yes**	**No**
01	X		X			X			X	X	
03	X		X			X		X		X	
05	X			X		X			X	X	
07	X			X		X		X		X	
08	X				X	X			X		X
16	X			X			X	X		X	
23		X		X		X			X	X	
26		X			X	X			X		X
32		X		X			X		X	X	
35		X			X		X		X		X