DiamondMax® VL 20

92041U4, 91531U3 and 91021U2

Part #1427/A

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Before You Begin

Thank you for your interest in the Maxtor DiamondMax® VL 20 AT hard disk drives. This manual provides technical information for OEM engineers and systems integrators regarding the installation and use of DiamondMax hard drives. Drive repair should be performed only at an authorized repair center. For repair information, contact the Maxtor Customer Service Center at 800-2MAXTOR or 408-922-2085.

Before unpacking the hard drive, please review Sections 1 through 4.

CAUTION

Maxtor DiamondMax VL 20 hard drives are precision products. Failure to follow these precautions and guidelines outlined here may lead to product failure, damage and invalidation of all warranties.

1 *BEFORE* unpacking or handling a drive, take all proper electro-static discharge (ESD) precautions, including personnel and equipment grounding. Stand-alone drives are sensitive to ESD damage.

2 *BEFORE* removing drives from their packing material, allow them to reach room temperature.

3 During handling, *NEVER* drop, jar, or bump a drive.

4 Once a drive is removed from the Maxtor shipping container, *IMMEDIATELY* secure the drive through its mounting holes within a chassis. Otherwise, store the drive on a padded, grounded, antistatic surface.

5 *NEVER* switch DC power onto the drive by plugging an electrically live DC source cable into the drive's connector. *NEVER* connect a live bus to the drive's interface connector.

Please do not remove or cover up Maxtor factory-installed drive labels. They contain information required should the drive ever need repair.

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Introduction

Maxtor Corporation

Maxtor Corporation has been providing high-quality computer storage products since 1982. Along the way, we've seen many changes in data storage needs. Not long ago, only a handful of specific users needed more than a couple hundred megabytes of storage. Today, downloading from the Internet and CD-ROMs, multimedia, networking and advanced office applications are driving storage needs even higher. Even home PC applications need capacities measured in gigabytes, not megabytes.

Products

Maxtor's products meet those demanding storage capacity requirements with room to spare. They feature proven compatibility and reliability. While **DiamondMax® VL 20** is the latest addition to our family of high performance 5,400 RPM desktop hard drives, DiamondMax® 40 series hard drives deliver industry-leading capacity and performance for demanding desktop and workstation applications.

Support

No matter which capacity, all Maxtor hard drives are supported by our commitment to total customer satisfaction and our *No Quibble*® Service guarantee. One call – or a visit to our home page on the Internet (http://www.maxtor.com) – puts you in touch with either technical support or customer service. We'll provide you the information you need quickly, accurately and in the form you prefer – a fax, a downloaded file or a conversation with a representative.

Manual Organization

This hard disk drive reference manual is organized in the following method:

- ❏ Section 1 – Introduction
- ❏ Section 2 – Description
- ❏ Section 3 – Specifications
- ❏ Section 4 – Installation
- ❏ Section 5 – AT Interface
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- ❏ Section 7 – Interface Commands
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Abbreviations

ABBRV	DESCRIPTION	ABBRV	DESCRIPTION
ATA	AT attachment	MB	megabyte
bpi	bits per inch	Mbits/sec	megabits per second
CHS	cylinder - head - sector	MB/sec	megabytes per second
db	decibels	MHz	megahertz
dBA	decibels, A weighted	ms	millisecond
DMA	direct memory access	MSB	most significant bit
ECC	error correction code	mV	millivolts
fci	flux changes per inch	ns	nanoseconds
G	acceleration	PIO	programmed input/output
GB	gigabyte	RPM	revolutions per minute
Hz	hertz	tpi	tracks per inch
KB	kilobyte	UDMA	ultra direct memory access
LBA	logical block address(ing)	µsec	microsecond
LSB	least significant bit	V	volts
mA	milliamperes	W	watts

Conventions

If there is a conflict between text and tables, the table shall be accepted as being correct.

Key Words

The names of abbreviations, commands, fields and acronyms used as signal names are in all uppercase type (e.g., IDENTIFY DRIVE). Fields containing only one bit are usually referred to as the “name” bit instead of the “name” field.

Names of drive registers begin with a capital letter (e.g., Cylinder High register).

Numbering

Numbers that are **not** followed by a lowercase “b” or “h” are decimal values. Numbers that are followed by a lowercase “b” (e.g., 01b) are binary values. Numbers that are followed by a lowercase “h” (e.g., 3Ah) are hexadecimal values.

Signal Conventions

Signal names are shown in all uppercase type.

All signals are either high active or low active signals. A dash character (-) at the end of a signal name indicates that the signal is low active. A low active signal is true when it is below ViL and is false when it is above ViH. A signal without a dash at the end indicates that the signal is high active. A high active signal is true when it is above ViH and is false when it is below ViL.

When a signal is asserted, it means the signal is driven by an active circuit to its true state.

When a signal is negated, it means the signal is driven by an active circuit to its false state.

When a signal is released, it means the signal is not actively driven to any state. Some signals have bias circuitry that pull the signal to either a true or false state when no signal driver is actively asserting or negating the signal. These instances are noted under the description of the signal.

Product Description

Maxtor DiamondMax® VL 20 AT disk drives are 1-inch high, 3.5-inch diameter random access storage devices which incorporate an on-board ATA-5/Ultra DMA 66 controller. High capacity is achieved by a balanced combination of high areal recording density and the latest data encoding and servo techniques.

Maxtor's latest advancements in electronic packaging and integration methods have lowered the drive's power consumption and increased its reliability. Advanced giant magneto-resistive read/write heads and a state-of-the-art head/disk assembly - using an integrated motor/spindle design - allow up to four disks in a 3.5-inch package.

The new DiamondMax VL 20 (Value Line) series from Maxtor are 1- and 2-disk products expressly designed for entry-level commercial systems and consumer electronics applications where disk storage value is paramount. Available in capacities up to 20 GB, the VL series provides the proven quality and reliability of the original DiamondMax products and includes an UltraDMA 66 interface, 512 KB buffer and 9.5 ms seek performance.

DiamondMax VL 20 Key Features

ANSI ATA-5 compliant PIO Mode 4 interface (Enhanced IDE)

Supports Ultra DMA Mode 4 for up to 66.7 MB/sec data transfers

512 KB buffer with multi-adaptive cache manager

5,400 RPM spin speed

9.5 ms seek time

Zone density and I.D.-less recording

Outstanding shock resistance at 250 Gs

High durability with 50K contact start/stop cycles

Advanced multi-burst on-the-fly Error Correction Code (ECC)

Extended data integrity with ECC protected data and fault tolerant servo synchronization fields

Supports EPA Energy Star Standards (Green PC Friendly) with ATA powering savings commands

Auto park and lock actuator mechanism

Low power consumption

S.M.A.R.T. Capability

Note: Maxtor defines one megabyte as 10^6 or one million bytes and one gigabyte as 10^9 or one billion bytes.

Product Features

Functional / Interface

Maxtor DiamondMax VL 20 hard drives contain all necessary mechanical and electronic parts to interpret control signals and commands from an AT-compatible host computer. See Section 3 Product Specifications, for complete drive specifications.

Zone Density Recording

The disk capacity is increased with bit density management – common with Zone Density Recording. Each disk surface is divided into 16 circumferential zones. All tracks within a given zone contain a constant number of data sectors. The number of data sectors per track varies in different zones; the outermost zone contains the largest number of data sectors and the innermost contains the fewest.

Read/Write Multiple Mode

This mode is implemented per ANSI ATA/ATAPI-5 specification. Read/Write Multiple allows the host to transfer a set number of sectors without an interrupt request between them, reducing transfer process overhead and improving host performance.

UltraDMA - Mode 4

Maxtor DiamondMax VL 20 hard drives fully comply with the new ANSI Ultra DMA protocol, which greatly improves overall AT interface performance by significantly improving burst and sustained data throughput.

Multi-word DMA (EISA Type B) - Mode 2

Supports multi-word Direct Memory Access (DMA) EISA Type B mode transfers.

Sector Address Translation

All DiamondMax VL 20 drives feature a universal translate mode. In an AT/EISA-class system, the drive may be configured to any specified combination of cylinders, heads and sectors (within the range of the drive's formatted capacity). DiamondMax VL 20 drives power-up in a translate mode:

MODEL	CYL	HD	SPT	LZone	WPcom	MAX LBA	CAPACITY
92041U4	39,703	16	63	(*)	(*)	40,020,624	20,490 MB
91531U3	29,777	16	63	(*)	(*)	30,015,216	15,367 MB
91021U2	19,852	16	63	(*)	(*)	20,010,816	10,245 MB

(*) The fields LZone (Landing Zone) and WPcom (Write Pre-comp) are not used by the Maxtor hard drive and the values may be either 0 or the values set by the BIOS. All capacities listed in the above table are based on 10^6 or one million bytes.

Logical Block Addressing

The Logical Block Address (LBA) mode can only be utilized in systems that support this form of translation. The cylinder, head and sector geometry of the drive, as presented to the host, differs from the actual physical geometry. The host AT computer may access a drive of set parameters: number of cylinders, heads and sectors per track, plus cylinder, head and sector addresses. However, the drive can't use these host parameters directly because of zoned recording techniques. The drive translates the host parameters to a set of logical internal addresses for data access.

The host drive geometry parameters are mapped into an LBA based on this formula:

LBA	= (HSCA - 1) + HHDA x HSPT + HNHD x HSPT x HCYA	(1)
	= (HSCA - 1) + HSPT x (HHDA + HNHD x HCYA)	(2)
where	HSCA = Host Sector Address, HHDA = Host Head Address	
	HCYA = Host Cylinder Address, HNHD = Host Number of Heads	
	HSPT = Host Sectors per Track	

The LBA is checked for violating the drive capacity. If it does not, the LBA is converted to physical drive cylinder, head and sector values. The physical address is then used to access or store the data on the disk and for other drive related operations.

Defect Management Zone (DMZ)

Each drive model has a fixed number of spare sectors per drive, all of which are located at the end of the drive. Upon detection of a bad sector that has been reassigned, the next sequential sector is used.

For example, if sector 3 is flagged, data that would have been stored there is "pushed down" and recorded in sector 4. Sector 4 then effectively becomes sector 3, as sequential sectors are "pushed down" across the entire drive. The first spare sector makes up for the loss of sector 3, and so maintains the sequential order of data. This push down method assures maximum performance.

On-the-Fly Hardware Error Correction Code (ECC)

5 symbols, single burst, guaranteed

Software ECC Correction

22 symbols, single burst, guaranteed

Automatic Park and Lock Operation

Immediately following power down, dynamic braking of the spinning disks delays momentarily allowing the read/write heads to move to an inner mechanical stop. A small fixed magnet holds the rotary actuator in place as the disk spins down. The rotary actuator is released only when power is again applied.

Cache Management

Buffer Segmentation

The data buffer is organized into two segments: the data buffer and the micro controller scratch pad. The data buffer is dynamically allocated for read and write data depending on the commands received. A variable number of read and write buffers may exist at the same time.

Read-Ahead Mode

Normally, this mode is active. Following a read request, disk read-ahead begins on the first sector and continues sequentially until the allocated buffer is full. If a read request is received during the read-ahead operation, the buffer is examined to determine if the request is in the cache. If a cache hit occurs, read-ahead mode continues without interruption and the host transfer begins immediately.

Automatic Write Reallocation (AWR)

This feature is part of the write cache and reduces the risk of data loss during deferred write operations. If a disk error occurs during the disk write process, the disk task stops and the suspect sector is reallocated to a pool of alternate sectors located at the end of the drive. Following reallocation, the disk write task continues until it is complete.

Write Cache Stacking

Normally, this mode is active. Write cache mode accepts the host write data into the buffer until the buffer is full or the host transfer is complete. A command complete interrupt is generated at the end of the transfer.

A disk write task begins to store the host data to disk. Host write commands continue to be accepted and data transferred to the buffer until either the write command stack is full or the data buffer is full. The drive may reorder write commands to optimize drive throughput.

Major HDA Components

Drive Mechanism

A brush-less DC direct drive motor rotates the spindle at 5,400 RPM (±0.1%). The dynamically balanced motor/spindle assembly ensures minimal mechanical run-out to the disks. A dynamic brake provides a fast stop to the spindle motor upon power removal. The speed tolerance includes motor performance and motor circuit tolerances.

Rotary Actuator

All DiamondMax VL 20 drives employ a rotary voice coil actuator which consists of a moving coil, an actuator arm assembly and stationary magnets. The actuator moves on a low-mass, low-friction center shaft. The low friction contributes to fast access times and low power consumption.

Read/Write Electronics

An integrated circuit mounted within the sealed head disk assembly (near the read/write heads) provides up to eight head selection (depending on the model), read pre-amplification and write drive circuitry.

Read/Write Heads and Media

Low mass, low force giant magneto-resistive read/write heads record data on 3.5-inch diameter disks. Maxtor uses a sputtered thin film medium on all disks for DiamondMax VL 20 drives.

Air Filtration System

All DiamondMax VL 20 drives are assembled in a Class 100 controlled environment. Over the life of the drive, a 0.1 micron filter and breather filter located within the sealed head disk assembly (HDA) maintain a clean environment to the heads and disks. DiamondMax VL 20 drives are designed to operate in a typical office environment with minimum environmental control.

Microprocessor

The microprocessor controls the following functions for the drive electronics:

Command execution

Cache management

Data correction and error recovery

Diagnostic execution

Data sequencing

Head positioning (including error recovery)

Host interface

Index detection

Spin speed control

Seeks

Servo

S.M.A.R.T.

Subsystem Configuration

Dual Drive Support

Two drives may be accessed via a common interface cable, using the same range of I/O addresses. The drives are jumpered as device 0 or 1 (Master/Slave), and are selected by the drive select bit in the Device/Head register of the task file.

All Task File registers are written in parallel to both drives. The interface processor on each drive decides whether a command written to it should be executed; this depends on the type of command and which drive is selected. Only the drive selected executes the command and activates the data bus in response to host I/O reads; the drive not selected remains inactive.

A master/slave relationship exists between the two drives: device 0 is the master and device 1 the slave. When J50 is closed (factory default, figure 2-1), the drive assumes the role of master; when open, the drive acts as a slave. In single drive configurations, J50 must be closed.

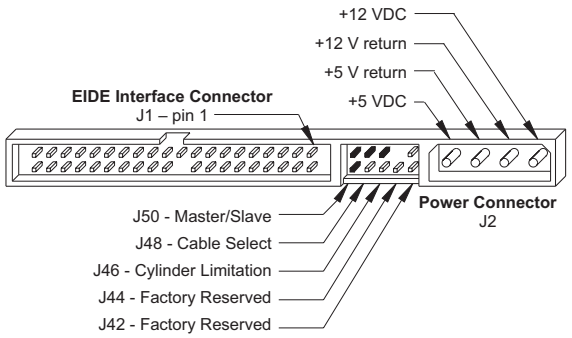
Cable Select Option

CSEL (cable select) is an optional feature per ANSI ATA specification. Drives configured in a multiple drive system are identified by CSEL's value:

– If CSEL is grounded, then the drive address is 0.
– If CSEL is open, then the drive address is 1.

Jumper Location/Configuration

Darkened jumper pins indicate factory-installed (default) shunts.



JUMPER CONFIGURATION	J50	J48	J46	J44	J42
Master/Slave					
Only drive in single drive system*	C				
Master drive in dual drive system*	C				
Slave drive in dual drive system	O				
Cable Select					
Disabled*		O			
Enabled		C			
Cylinder Limitation					
Disabled*			O		
Enabled			C		
Factory Reserved				O	
Factory Reserved					O

Key * = Default C = Closed *(jumper installed)* O = Open *(no jumper installed)*

Figure 2-1
PCBA Jumper Location and Configuration

Cylinder Limitation Jumper Description

On some older BIOS', primarily those that auto-configure the disk drive, a hang may occur. The Cylinder Limitation jumper reduces the capacity in the Identify Drive allowing large capacity drives to work with older BIOS'. The capacity reported when J46 is closed will be as follows: drives less than or equal to 32GB will report 2.1GB. Drives greater than 32GB will report 32GB.