TEXT,C,55

QUANTUM
EMPIRE 1440S & 2160S

HIGHEST-PERFORMANCE DRIVES FOR WORKSTATIONS, SERVERS
AND DISK ARRAYS

OVERVIEW
The Quantum Empire 1440 and 2160 products are high-
performance 3.5 inch hard disk drives designed to meet
the most demanding performance and reliability
standards of workstations, network servers and RAIDs
(Redundant Arrays of Independent Disks). The are
ideally suited for storage-intensive applications such
as multimedia, networked databases and graphics.

The Empire 2160, with a formatted capacity 1.6 inch-
high drive. The Empire 1440, with 1.44 GB of formatted
storage, is the company's largest-capacity one-inch-
high disk drive. Both drives have a SCSI-3 bus
interface, and are downward compatible with the SCSI-2
standard.

The Empire 1440 and 2160 drives feature the proven
reliability of the Empire 540 and 1080 drives with very
low levels of power, heat and acoustics. But they also
set a new standard of performance witha PRML (Partial-
Response Maximum-Likelihood) read channel that speeds
data throughput while increasing drive capacity.

Performance faetures common with the Empire 540 and
1080 drives include a command-reordering algorithm that
boosts random performance as much as 20% and an
advanced caching technique, which leads to high
sequential and random throughput. An innovative thermal
update feature is ideal for multimedia applications.

PERFORMANCE FEATURES

PRML TECHNOLOGY
Quantum's patented PRML read channel is based on a
sophiscated data-detection method that improves data
throughput and increases drive capacity. The Empire
1440 and 2160 drives have an industry-leading 64
Mb/second data rate, an increase of up to 50% over
current-generation 1 GB hard drives. This results in a
fast 5 MB/second sustained data transfer rate,

desirable for applications such as graphics and
multimedia.

TAGGED COMMAND QUEUING
Tagged command queuing allows the host computer to send
up to 16 commands to the disk drive for processing.
Each command is tagged for identification purposes so
the host and drive can communicate about the status of
commands.

OPTIMISED REORDERING COMMAND ALGORITHM (ORCA)
Quantum's ORCA firmware is the first in the industry to
calculate the optimum sequence of commands in order to
minimise the combined total of seek time and rotational
latency. ORCA works in conjunction with Quantum's
tagged command queuing scheme and seek reordering
algorithm to achieve very fast time to data.

MULTICACHE
MultiCache is an advanced caching technique that boosts
both random and sequential data transfer rates through
the use of the Empire drive's segmented cache and
tagged command queuing scheme.

INTELLIGENT THERMAL UPDATE (ITU)
ITU ensures high performance in data-intensive
applications by taking advantage of Quantum's embedded
servo design and tagged command queuing. The feature
allows streams of data to be read without interruption,
making the Empire drives well suited for multimedia
applications.

FAST SCSI-3, FAST WIDE SCSI-3 SUPPORT
The Empire drives support Fast SCSI data transfer rates
of 10 MB/second. Fast Wide SCSI-3 data transfers, an
option supported under the SCSI standards, are used in
conjunction with Fast to double data transfer rates to
20 MB/second.

VERSATILITY FEATURES

HOT PLUGGABILITY
With this feature, users can insert and remove Empire
drives from the SCSI bus without interrupting bus
operations. This feature is especially useful in RAID
applications.

SCSI AUTODISCONNECT
SCSI AutoDisconnect improves host system performance by

efficiently moving the Empire drives on and off the SCSI bus, freeing it for use by other SCSI peripherals. For maximum performance, Quantum implements this feature in hardware.

VARIABLE SECTOR SIZES
The Empire drives can be configured in the field with sector sizes of 256, 512, 520, 524 and 1024 bytes to support network and RAID applications.

DOWNLOADABLE FIRMWARE
Using downloadable firmware, the Empire drives can be customised to meet various user requirements, or even upgraded in the field.

SPECIFICATIONS

	1440/2160
Form Factor	3.5 inch
Interface	Fast SCSI-3
	Fast Wide SCSI-3
Unformatted Capacity(MB)	1,650/2,475
Formatted Capacity (MB)	1,440/2,160

DISK DRIVE CONFIGURATION

Disks	
1440	4
2160	6
Heads/ Recording Surfaces	
1440	8
2160	12
Tracks per Surface	3,100
Sectors per Track	74 to 135
Bytes per Sector	512
Track Density (tpi)	3,150
Flux Density (fci)	90,000
Recording Density (bpi)	80,000
Encoding Method	PRML 0,4,4

PERFORMANCE SPECIFICATION

Typical Seek Times (ms)	
Average Seek (read)	9.5
Average Seek (write)	11.0
Track-to-Track	1.8
Full Stroke	19
Average Rotational Latency	5.6 ms
Rotational Speed (RPM)	5,400
Command Overhead (microsecs)	
Sequential Read/Writes	150

Data Rate (Mb/sec)
  Disk-to-Buffer (average) 56
  Disk-to-Buffer (maximum) 64
Data Transfer Rates
(Buffer-to-Host)
  Fast SCSI-3 (MB/sec)   10
  Fast Wide SCSI-3 (MB/sec) 20
  Sustained (MB/sec)   5.0
Buffer Size (KB)   512

RELIABILITY SPECIFICATIONS
Projected Field MTBF   500,000
Preventative Maintenance   Not Required
Data Errors
  Recoverable
  (per bits read)   10 per 10 to the 11
  Nonrecoverable   10 per 10 to the 15
Error Correction Method   Reed Solomon

PHYSICAL SPECIFICATIONS
Dimensions-inches (mm)
  Width   4.0 (101.6)
  Length   5.75 (146.1)
  Height   1.0 (25.4)
Weight-pounds (kg)
  1440   1.25 (0.57)
  2160   1.9   (0.86)
Connector Options
  Fast SCSI-3   50-pin
  Fast Wide SCSI-3   68-pin

ENVIRONMENTAL LIMITS
Operating
  Temperature (deg.C)   0 to 55
  Non-Condensing Humidity   5 to 95%
  Maximum Wet Bulb (deg.C) 40
  Shock (G, 11ms)   10
  Vibration
  (G, base-to-peak)   0.5
  Altitude (ft.)   -200 to 10,000
  Typical Audible Noise
  (dBA @ 1m, any direction,
  idle)   35
Non-Operating
  Temperature (deg.C)   -40 to 75
  Non-Condensing Humidity   5 to 95%
  Max Wet Bulb (deg.C)   50
  Shock (G, 11ms)   60
  Vibration

(G, base-to-peak)   1.0
Altitude (ft.)   -1,000 to 40,000

POWER SPECIFICATIONS
Power Requirements
 +5V DC Idle (A,typical) 0.72
 +12V DC Idle (A,typical)
   1440   0.37
   2160   0.49
Typical Power Draw (W)
 Idle
   1440   8.0
   2160   9.5
 Seek (30%)
   1440   10.5
   2160   12.5

ADDITIONAL FEATURES
Advanced Embedded Servo
AIRLOCK
AutoRead and AutoWrite
WriteCache and DisCache Firmware
Error Correction Code (ECC) On-the-Fly
Power Saving Modes
Seek Reordering
Segmented Cache