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Product summary

Hitachi Travelstar 4K40

2.5 inch ATA/IDE hard disk drive

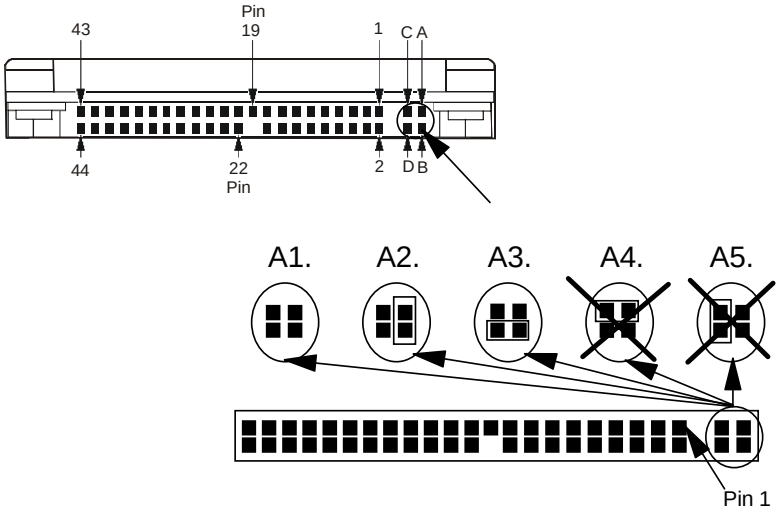
Models: HTS424040M9AT00
HTS424030M9AT00
HTS424020M9AT00

Features	Benefits
▪ Capacities: 40, 30, & 20GB at 512 bytes/sector ▪ Height: 9.5 mm	▪ High capacity in a slim 2.5 inch form factor
▪ Interface transfer rates: up to 100 MB/s	▪ Popular interface with excellent performance
▪ Non-operational shock: 1000 G / 1ms ▪ Operational shock: 300 G / 2ms	▪ Robust design for portable computing applications
▪ Media data transfer rate: 370 Mb/s ▪ Rotational speed: 4200 RPM	▪ Excellent data rate across disk surface
▪ Average seek time: 12 ms (read) ▪ Average latency: 7.1 ms	▪ Fast access to data
▪ Segmented buffer with write cache: 8192 KB - [Upper 294 KB used for firmware] ▪ Enhanced ECC On-The-Fly	▪ Fast access to data and improved throughput ▪ High reliability
▪ Giant Magnetoresistive heads	▪ High areal density, low component count
▪ No-ID sector formatting ▪ PRML data channel ▪ Multizone recording	▪ More data stored per track, increased sustained data transfer rate
▪ Enhanced Adaptive Battery Life Extender (ABLE) 3.0	▪ Power saving
▪ Adaptive power save control: 0.65 W at idle state	▪ Low power for battery powered applications
▪ Load/Unload heads	▪ Quiet drive operation
▪ S.M.A.R.T. function	▪ Increased durability during power save modes and non-operation
▪ Drive Fitness Test (DFT) technology	▪ Protection of user data
▪ Glass substrate disks	▪ Improved data integrity ▪ Longer disk lifetime

Data organization

Capacity	40 GB model	30 GB model	20 GB model
Number of heads	2	2	1
Sectors/track	400-960	400-960	400-960
Number of cylinders		16,383	
Number of sectors	156,301,488	117,210,240	78,140,160
Total cust. usable data bytes	40,007,761,920	30,011,642,880	20,007,761,920

Electrical connector locations
Drive Address



The position of jumpers on the interface connector determines the address of the drive. In the illustration the jumper pins on the interface connector are labeled A, B, C, and D.

- A master drive requires no jumper.
- A slave drive requires a jumper on pins A & B (A2).
- Cable Select requires a jumper on pins D & B (A3).
- All other settings are reserved.

Cabling
Maximum cable length from host system to the drive is 18 inches.

AT Signal Connector
The signal connector for AT attachment mates with the 50-pin plug specified in the ATA/ ATAPI-5 T13/1321D specification, Rev. 3.

DC power requirements

Nominal supply	+5 Volt dc	**Supply rise time**	7–100 ms
Power supply ripple (0-20 MHz)	100 mV p-p max.[1]	**Supply voltage**	–0.3 to + 6.0 V
Tolerance[2]	±5%		

Watts RMS typical			
Performance Idle average [3]	2.0	Seek average[5]	2.6
Active Idle average	1.3	Standby	0.25
Low Power Idle average	0.85	Sleep	0.1
Read average[4]	2.5	Startup (maximum peak)[6]	5.0
Write average	2.5	Average from power on to ready	3.8

Notes:

1. *The maximum fixed disk ripple is measured at the 5 V dc input of the drive*
2. *The drive does not incur damage for an over voltage condition of +25% (max. duration of 20 ms) on the 5-Volt nominal supply*
3. *The idle current is specified at an inner track*
4. *The read/write current is specified based on three operations of 63 sector read/write per 100 ms*
5. *The seek average current is specified based on three operations per 100 ms*
6. *The worst case operating current includes motor surge*

Command descriptions

The following commands are supported by the drive:

Commands	(Hex)	P	Commands	(Hex)	P	Commands	(Hex)	P
Check Power Mode	E5	3	Read Sectors (no retry)	21	1	S.M.A.R.T. Enable/Disable Automatic Off-line	B0	3
Check Power Mode*	98	3	Read Verify Sectors (retry)	40	3	S.M.A.R.T. Enable Operations	B0	3
Enable/Disable Delayed Write	FA	3	Read Verify Sectors (no retry)	41	3	S.M.A.R.T. Execute Off-line Immediate	B0	3
Execute Device Diagnostic	90	3	Recalibrate	1x	3	S.M.A.R.T. Read Attribute Values	B0	1
Flush Cache	E7	3	Security Disable Password	F6	2	S.M.A.R.T. Read Attribute Thresholds	B0	1
Format Track	50	2	Security Erase Prepare	F3	3	S.M.A.R.T. Read Log Sector	B0	1
Format Unit	F7	3	Security Erase Unit	F4	2	S.M.A.R.T. Return Status	B0	3
Identify Device	EC	1	Security Freeze Lock	F5	3	S.M.A.R.T. Save Attribute Values	B0	3
Identify Device DMA	EE	4	Security Set Password	F1	2	S.M.A.R.T. Write Log Sector	B0	2
Idle	E3	3	Security Unlock	F2	2	Standby	E2	3
Idle*	97	3	Seek	7x	3	Standby*	96	3
Idle Immediate	E1	3	Sense Condition	F0	3	Standby Immediate	E0	3
Idle Immediate*	95	3	Set Features	EF	3	Standby Immediate*	94	3
Initialize Device Parameters	91	3	Set Max ADDRESS	F9	3	Write Buffer	E8	2
Read Buffer	E4	1	Set Max FREEZE LOCK	F9	3	Write DMA (retry)	CA	4
Read DMA (retry)	C8	4	Set Max LOCK	F9	3	Write DMA (no retry)	CB	4
Read DMA (no retry)	C9	4	Set Max SET PASSWORD	F9	2	Write Long (retry)	32	2
NOP	00	3	Set Max UNLOCK	F9	2	Write Long (no retry)	33	2
Read Long (retry)	22	1	Set Multiple Mode	C6	3	Write Multiple	C5	2
Read long (no retry)	23	1	Sleep	E6	3	Write Sectors (retry)	30	2
Read Multiple	C4	1	Sleep*	99	3	Write Sectors (no retry)	31	2
Read Native Max ADDRESS	F8	3	S.M.A.R.T. Disable Operations	B0	3	Write Verify	3C	2
Read Sectors (retry)	20	1	S.M.A.R.T. Enable/Disable Attribute Autosave	B0	3			

Protocol
1 : PIO data IN command
2 : PIO data OUT command
3 : Non data command
4 : DMA command

*Note: Commands marked * are alternate command codes for previously defined commands.*

Signal definitions

PIN	SIGNAL	I/O
01	-RESET	I
02	GND	
03	DD07	I/O
04	DD08	I/O
05	DD06	I/O
06	DD09	I/O
07	DD05	I/O
08	DD10	I/O
09	DD04	I/O
10	DD11	I/O
11	DD03	I/O
12	DD12	I/O
13	DD02	I/O
14	DD13	I/O
15	DD01	I/O
16	DD14	I/O
17	DD00	I/O
18	DD15	I/O
19	GND	
(20)	Key	
21	DMARQ	O
22	GND	
23	-DIOW(*)	I
24	GND	
25	-DIOR(*)	I
26	GND	
27	IORDY(*)	O
28	CSEL	I
29	-DMACK	I
30	GND	
31	INTRQ	O
32	-IOCS16(*)	O
33	DA01	I
34	-PDIAG	I/O
35	DA00	I
36	DA02	I
37	-CS0	I
38	-CS1	I
39	-DASP	I/O
40	GND	
41	+5V logic	power
42	+5V motor	power
43	GND	
44	(reserved)	

Notes

1. *"O" - an output from the drive.*
2. *"I" - an input to the drive.*
3. *"I/O" - an input/output common.*
4. *"OD" - an Open-Drain output.*
5. *The signal lines marked with (*) are redefined during the Ultra DMA protocol to provide special functions. These lines change from the conventional to special definitions at the moment the host decides to allow a DMA burst, if the Ultra DMA transfer mode was previously chosen via SetFeatures. The drive becomes aware of this change upon assertion of the –DMACK line. These lines revert back to their original definitions upon the deassertion of DMACK at the termination of the DMA burst.*
6. *"Power" - a power supply to the drive.*
7. *"Reserved" - reserved pins which must be left unconnected.*

	Special definition (for Ultra DMA)	**Conventional definition**
Write operation	-DDMARDY HSTROBE STOP	IORDY -DIOR -DIOW
Read operation	-HDMARDY DSTROBE STOP	-DIOR IORDY -DIOW

5 V power

There are two input pins for the +5 V power supply: the "+5 V Logic" pin and the "+5 V dc Motor" pin. These two input pins are tied together within the drive.

Adaptive Battery Life Extender

Enhanced Adaptive Battery Life Extender 3.0 (ABLE-3) saves power by automatically determining the correct time to start removing power from the drive electronics.

Most software and operating systems make use of a disk drive in bursts. The drive monitors the commands which are sent from the host to detect patterns which indicate that a command sequence is finished by putting the drive into low overall power consumption and longer battery life with no loss in performance. If the host system changes the number or frequency of commands which it sends, the disk drive will adapt automatically to this new pattern.

This feature has three idle modes:

- Performance idle
- Active idle
- Low Power idle

Performance idle

This mode is usually entered immediately after Active mode command processing is complete. All electronic components remain powered and the full frequency servo remains operational. The device is capable of responding immediately to media access requests in this mode.

Active idle

Power consumption is 45–55% less than that of Performance Idle mode. Additional electronics are powered off and the head is parked near the mid-diameter of the disk without servoing. Recovery time to Active mode is about 20 ms.

Low Power idle

Power consumption is 60–65% less than that of Performance Idle mode. The heads are unloaded on the ramp, but the spindle is still rotating at full speed. Recovery time to active mode is about 300 ms.

Operating environment

The drive operates within its performance limits when the following environment is maintained. Product life calculations are based on the nominal environment for a typical application.

Relative humidity (noncondensing)	
Operating	8 to 90%
Nonoperating	5 to 95%

Wet bulb temperature (noncondensing)	
Operating	29.4°C
Nonoperating	40°C

Altitude	
Operating	–300 to 3,048 m (10,000 ft)
Nonoperating	–300 to 12,192 m (40,000 ft)

Temperature	
Operating	5 to 55°C
Nonoperating	–40 to 65°C
Max. gradient	20°C/hour

Note: The system is responsible for providing sufficient air movement to maintain surface temperatures below 60°C at the center of top cover and below 63°C at the center of the drive circuit board assembly.

Operating shock

The drive withstands the following half sine wave shock pulse with no data loss or permanent damage.

Duration	
2 ms (G)	**11 ms (G)**
1960 m/sec^2	147 m/sec^2
(200G)	(15G)

The shock test consists of ten shock inputs in each axis and direction for a total of 60; there is a minimum 3 seconds delay between shock pulses. Soft errors and automatic retries are allowed during the test.

The input level is applied to the normal disk drive subsystem mounting points used to secure the drive in a normal system.

Nonoperating shock

The drive withstands the following half sine wave shock pulse with no data loss or permanent damage.

Duration	
2 ms (G)	**11 ms (G)**
7840 m/sec^2	1176 m/sec^2
(800 G)	(120 G)

All shocks are applied in each direction of the three mutually perpendicular drive axes, one axis at a time. Input levels shall be measured at the base plate where the drive is attached with four screws.

Operating vibration

Random vibration.

The drive withstands the following vibration levels without a hard error. The test consists of 30 minutes of random vibration using the power spectral density (PSD) levels specified in the following table, applied in each of the three mutually perpendicular axes at the normal drive mounting points.

Random vibration PSD profile breakpoint	
Hz	*m x 10n (m^2/sec^4)/Hz*
5	1.9 x E-5
17	1.1 x E-3
45	1.1 x E-3
48	7.7 x E-3
62	7.7 x E-3
65	9.6 x E-3
150	9.6 x E-3
200	4.8 x E-4
500	4.8 x E-4

Note: Overall RMS level of vibration is 0.67G.

Swept Sine Vibration Limits

The drive will operate without a hard error while being subjected to the following swept sine vibration level (applied and measured at the normal drive mounting points): 1G zero-to-peak from 5 to 500 Hz with a sweep rate of 2.0 Octaves/minute.

Nonoperating vibration

Random vibration

The drive withstands the following vibration levels without loss or permanent damage. The test consists of 30 minutes of random vibration applied in each of the three mutually perpendicular axes at the normal drive mounting points. The PSD levels for this test simulating the shipping and relocation environment are shown below.

Random vibration PSD profile breakpoint	
Hz	*G^2/Hz*
2.5	0.096
5	2.88
40	1.73
500	1.73

Note: Overall RMS level of vibration is 3.01G.

Swept Sine Vibration Limits

No permanent damage will occur when the drive is subjected to the following swept sine vibration level (applied and measured at the normal drive mounting points) with no power applied to the drive (heads in the unload position): 5G zero-to- peak from 10 to 500 Hz with a sweep rate of 0.5 Octaves/minute, 25.4 mm double amplitude displacement from 5 to 10 Hz.

Electromagnetic compatibility

The drive, when installed in a suitable enclosure and exercised with a random accessing routine at maximum data rate, shall meet the following worldwide electromagnetic compatibility (EMC) requirements:

- United States FCC (Federal Communications Commission) Rules and Regulations (Class B), Part 15.
- RFI Suppression German National Requirements.
- RFI Japan VCCI Requirements.
- EU EMC Directive Technical Requirements and Conformity Assessment Procedures.

Load/Unload heads

The heads are unloaded by putting into operation one of the following commands:

HARD RESET
SOFT RESET
STANDBY
STANDBY IMMEDIATE
SLEEP

Load/Unload is also invoked as one of the idle modes of the drive. After a short period of inactivity the Adaptive Battery Life Extender power management will unload the heads

to conserve energy. When the heads are unloaded, they rest in a small detent. To prevent the heads from being thrown off the ramp during angular acceleration, a bidirectional, normally open, mechanical latch engages with the actuator to keep it from turning in the head loading direction. This action causes a "rattle" sound which can be mistaken for loose parts

Acoustics

The criteria of A-weighted sound power level are described below.

Measurements are to be taken in accordance with ISO 7779. The mean of the sample of 40 drives is to be less than the typical value. Each drive is to be less than the maximum value. The drives are to meet this requirement in both board down orientations.

A-weighted Sound Power	Typical (Bel)	Max (Bel)
All models GB Models		
Idle	2.1	2.4
Operating	2.4	2.6

The background power levels of the acoustic test chamber for each octave band are to be recorded.

Sound power tests are to be conducted with the drive supported by spacers so that the lower surface of the drive is located 25±3 mm above the chamber floor. No sound absorbing material shall be used.

S.M.A.R.T. function

The intent of Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) is to protect user data and prevent unscheduled system downtime that may be caused by predictable degradation or fault of the device. By monitoring and storing critical performance and calibration parameters, S.M.A.R.T. devices employ sophisticated data analysis algorithms to predict the likelihood of near-term degradation or a fault condition. By alerting the host system of a negative reliability status condition, the host system can warn the user of the impending risk of a data loss and advise the user of appropriate action.

Since S.M.A.R.T. utilizes the internal device microprocessor and other device resources, there may be some small overhead associated with its operation. However, special care has been taken in the design of the S.M.A.R.T. algorithms to minimize the impact to performance the host system. Actual impact of S.M.A.R.T. overhead is dependent on the specific device design and the usage patterns of the host system. For further information refer to the Hitachi Travelstar 60GH & 40GN hard disk drive specification.

Drive usage condition

The expected product life is five years under typical mobile system conditions. The drive is designed to be used under the following conditions:

- Less then 333 power on hours per month.
- Seeking, writing, and reading operation is 20% of power on hours.
- The drive is operated within specifications of shock, vibration, temperature, humidity, altitude, and magnetic field.
- The drive is protected from ESD.
- The breathing hole on top of the drive is not covered.
- Force is not applied to the cover of the drive.
- The specified power requirements of the drive are satisfied.
- The drive frame is grounded electrically to the system by four screws.
- The drive is mounted with the recommended screw depth and torque.
- The physical and electrical requirements of the interface satisfy ATA-6.
- The proper power-off sequence is used.

Refer to the Travelstar 5K80 Hard Disk Drive Specifications for further information.

Mechanical data

Weight (grams - max)	
All models	95

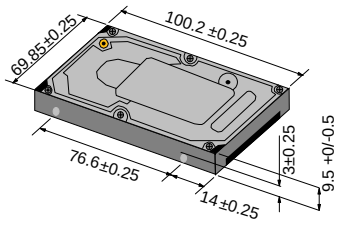
Dimensions (mm)	
Height:	9.5±0.2
Width	69.85±0.25
Length	100.2±0.25

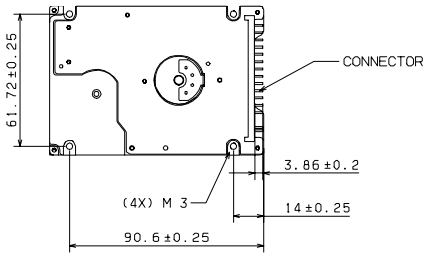
Mounting orientation

The recommended mounting screw torque is 3.0 ± 0.5 kgf-cm.

The recommended mounting screw depth is 3.0 ± 0.3 mm for bottom mounting and 3.5 ± 0.5 mm for horizontal mounting.

The drive mounting hole locations and sizes are shown in the illustrations below.





ATTENTION: The drive must be protected against electrostatic discharge especially when being handled. The safest way to avoid damage is to put the drive in an anti-static bag before ESD wrist straps are removed.

Drives should only be shipped in approved containers. Severe damage can be caused to the drive if the packaging does not adequately protect against the shock levels induced when a box is dropped. Consult your Hitachi representative if you do not have an approved shipping container.

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