

## Product summary

# Travelstar 60GH & 40GN

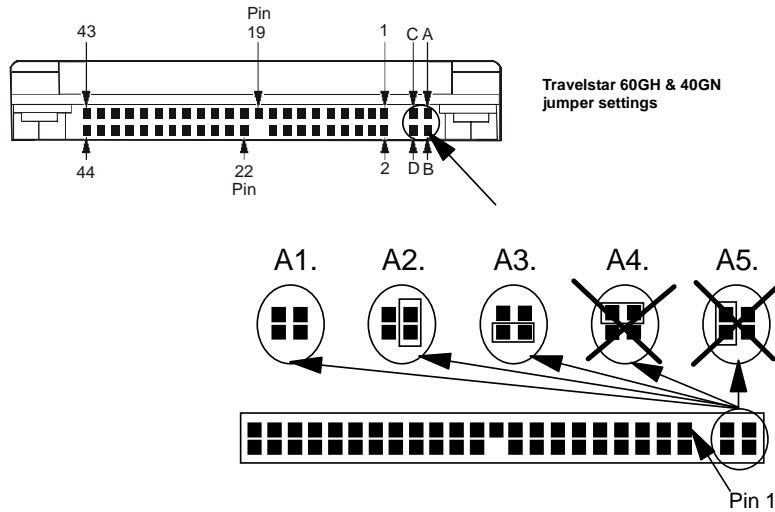
### 2.5 inch ATA/IDE hard disk drive



Models: IC25T060ATCS05  
 IC25N040ATCS04  
 IC25N030ATCS04  
 IC25N020ATCS04  
 IC25N010ATCS04

Features	Benefits
<ul style="list-style-type: none"> <li>▪ Capacities: 10, 20, 30, 40 &amp; 60 GB at 512 bytes/sector</li> <li>▪ Height: 12.5 mm (60-GB model) 9.5 mm (all other models)</li> </ul>	<ul style="list-style-type: none"> <li>▪ High capacity in a slim 2.5 inch form factor</li> </ul>
<ul style="list-style-type: none"> <li>▪ Interface transfer rates: up to 100 MB/s</li> </ul>	<ul style="list-style-type: none"> <li>▪ Popular interface with excellent performance</li> </ul>
<ul style="list-style-type: none"> <li>▪ Nonoperational shock: 700 G/1 ms (60-GB model) 800 G/1 ms (all other models)</li> <li>▪ Operational shock: 150 G/2 ms (60-GB model) 200 G/2 ms (all other models)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Robust design for portable computing applications</li> </ul>
<ul style="list-style-type: none"> <li>▪ Media data transfer rate: 146 - 262 Mb/s (60-GB model) 125 - 245 Mb/s (all other)</li> <li>▪ Rotational speed: 5400 RPM (60-GB model) 4200 RPM (all other models)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Excellent data rate across disk surface</li> </ul>
<ul style="list-style-type: none"> <li>▪ Average seek time: 12 ms (read)</li> <li>▪ Average latency: 5.5 ms (60-GB model) 7.1 ms (all other)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fast access to data</li> </ul>
<ul style="list-style-type: none"> <li>▪ Segmented buffer with 2 MB write cache (upper 277 KB used for firmware)</li> <li>▪ Enhanced ECC On-The-Fly</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fast access to data and improved throughput</li> <li>▪ High reliability</li> </ul>
<ul style="list-style-type: none"> <li>▪ Giant Magnetoresistive heads</li> </ul>	<ul style="list-style-type: none"> <li>▪ High areal density, low component count</li> </ul>
<ul style="list-style-type: none"> <li>▪ No-ID sector formatting</li> <li>▪ PRML data channel</li> <li>▪ Multizone recording</li> </ul>	<ul style="list-style-type: none"> <li>▪ More data stored per track, increased sustained data transfer rate</li> </ul>
<ul style="list-style-type: none"> <li>▪ Enhanced Adaptive Battery Life Extender (ABLE) 3.0</li> </ul>	<ul style="list-style-type: none"> <li>▪ Power saving</li> </ul>
<ul style="list-style-type: none"> <li>▪ Adaptive power save control: 0.9 W at idle state (60 GB model) 0.65 W (all other models)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low power for battery powered applications</li> </ul>
<ul style="list-style-type: none"> <li>▪ Fluid Dynamic Bearing motor technology</li> </ul>	<ul style="list-style-type: none"> <li>▪ Quiet drive operation</li> </ul>
<ul style="list-style-type: none"> <li>▪ Load/Unload heads</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increased durability during power save modes and non-operation</li> </ul>
<ul style="list-style-type: none"> <li>▪ S.M.A.R.T. function</li> <li>▪ Drive Fitness Test (DFT) technology</li> </ul>	<ul style="list-style-type: none"> <li>▪ Protection of user data</li> </ul>
<ul style="list-style-type: none"> <li>▪ Glass substrate disks</li> </ul>	<ul style="list-style-type: none"> <li>▪ Improved data integrity</li> <li>▪ Longer disk lifetime</li> </ul>

**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**

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

Watts RMS typical	10, 20 GB Models	30, 40 GB Models	60 GB Model
Performance Idle average <sup>3</sup>	1.85	1.8	2
Active Idle average	0.85	0.95	1.3
Low Power Idle average	0.65	0.65	0.9
Read average <sup>4</sup>	2.0	2.1	2.5
Write average	2.1	2.2	2.7
Seek average <sup>5</sup>	2.3	2.3	2.6
Standby	0.25	0.25	0.25
Sleep	0.1	0.1	0.1
Startup (maximum peak) <sup>6</sup>	4.7	4.7	5.0
Average from power on to ready	3.3	3.3	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

**Data organization**

Capacity	60 GB model	40 GB model	30 GB model	20 GB model	10 GB model
Number of heads	8	4	3	2	2
Sectors/track	307-556		336-672		
Number of cylinders	16,383				
Total cust. usable data sectors	117,210,240	78,140,160	58,605,120	39,070,080	19,640,880
Total cust. usable data bytes	60,011,642,880	40,007,761,920	30,005,821,440	20,003,880,960	10,056,130,560

## 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	IORDY
	HSTROBE	-DIOR
	STOP	-DIOW
Read operation	-HDMARDY	-DIOR
	DSTROBE	IORDY
	STOP	-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.

Model	Duration	
	2 ms (G)	11 ms (G)
60 GB	150	15
All other	200	15

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.

Model	Duration	
	2 ms (G)	11 ms (G)
60 GB	700	120
All other	800	120

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.

Hz	PSD (G <sup>2</sup> /Hz)
5	2.0 x E-5
17	1.1 x E-3
45	1.1 x E-3
48	8.0 x E-3
62	8.0 x E-3
65	1.0 x E-3
150	1.0 x E-3
200	5.0 x E-4
500	5.0 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.

Hz	G <sup>2</sup> /Hz
2.5	0.001
5	0.03
40	0.18
500	0.18

*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 of IBM products.
- 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)
<b>60 GB Model</b>		
Idle	2.5	2.7
Operating	3.5	3.8
<b>40, 30 GB Models</b>		
Idle	2.4	2.6
Operating	3.1	3.3
<b>20, 10 GB Models</b>		
Idle	2.1	2.4
Operating	2.7	2.9

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 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:

- 333 power on hours per month.
- Seeking, writing, and reading operation is 20% of power on hours at 40° C or lower.
- 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-5.
- The proper power-off sequence is used.

Refer to the Travelstar 60GH & 40GN Hard Disk Drive Specifications for further information.

**Mechanical data**

Weight (grams - max)	
60 GB model	155
40, 30 GB models	99
20, 10 GB models	95

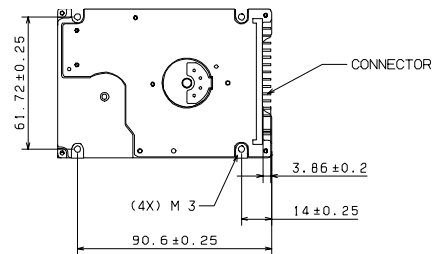
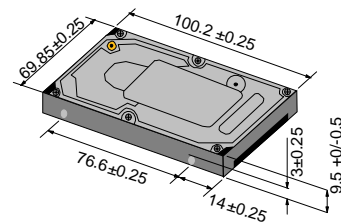
Dimensions (mm)	
Height:	60 GB model 12.5±0.2 All other models 9.5±0.2
Width	69.85±0.25
Length	100.2±0.25

**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 IBM representative if you do not have an approved shipping container



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Hard Disk Drive Specifications for Travelstar 60GH & 40GN, version 3.0

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