

## Product summary

# Travelstar 60GH & 40GN

2.5 inch ATA/IDE hard disk drive

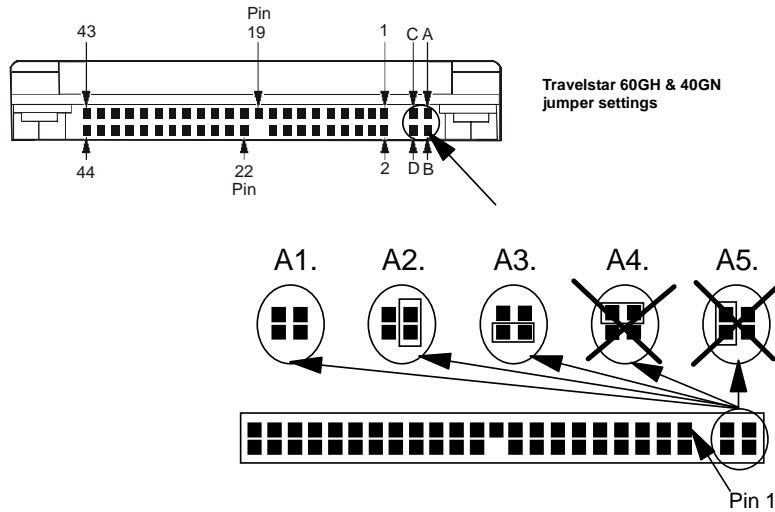


### Enhanced Availability model

Models: IC25T060ATCX05  
IC25N040ATCX04  
IC25N030ATCX04  
IC25N020ATCX04  
IC25N010ATCX04

| 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)<br/>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:<br/>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:<br/>700 G/1 ms (60-GB model)<br/>800 G/1 ms (all other models)</li><li>▪ Operational shock:<br/>150 G/2 ms (60-GB model)<br/>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:<br/>146 - 262 Mb/s (60-GB model) 125 - 245 Mb/s (all other)</li><li>▪ Rotational speed:<br/>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<br/>(upper 280 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>▪ 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           |
| 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 Native Max ADDRESS       | F8    | 3 | S.M.A.R.T. Enable/Disable Attribute Autosave | B0    | 3 |
| Check Power Mode*                | 98    | 3 | Read Sectors                  | 20    | 1 | S.M.A.R.T. Enable/Disable Automatic Off-line | B0    | 3 |
| Device Configuration Restore     | B1    | 3 | Read Sectors                  | 21    | 1 | S.M.A.R.T. Enable Operations                 | B0    | 3 |
| Device Configuration Freeze Lock | B1    | 3 | Read Verify Sectors           | 40    | 3 | S.M.A.R.T. Execute Off-line Immediate        | B0    | 3 |
| Device Configuration Identify    | B1    | 1 | Read Verify Sectors           | 41    | 3 | S.M.A.R.T. Read Attribute Values             | B0    | 1 |
| Device Configuration Set         | B1    | 2 | Recalibrate                   | 1x    | 3 | S.M.A.R.T. Read Attribute Thresholds         | B0    | 1 |
| Enable/Disable Delayed Write     | FA    | 3 | Security Disable Password     | F6    | 2 | S.M.A.R.T. Read Log Sector                   | B0    | 1 |
| Execute Device Diagnostic        | 90    | 3 | Security Erase Prepare        | F3    | 3 | S.M.A.R.T. Return Status                     | B0    | 3 |
| Flush Cache                      | E7    | 3 | Security Erase Unit           | F4    | 2 | S.M.A.R.T. Save Attribute Values             | B0    | 3 |
| Format Track                     | 50    | 2 | Security Freeze Lock          | F5    | 3 | S.M.A.R.T. Write Log Sector                  | B0    | 2 |
| Format Unit                      | F7    | 3 | Security Set Password         | F1    | 2 | Standby                                      | E2    | 3 |
| Identify Device                  | EC    | 1 | Security Unlock               | F2    | 2 | Standby*                                     | 96    | 3 |
| Idle                             | E3    | 3 | Seek                          | 7x    | 3 | Standby Immediate                            | E0    | 3 |
| Idle*                            | 97    | 3 | Sense Condition               | F0    | 3 | Standby Immediate*                           | 94    | 3 |
| Idle Immediate                   | E1    | 3 | Set Features                  | EF    | 3 | Write Buffer                                 | E8    | 2 |
| Idle Immediate*                  | 95    | 3 | Set Max ADDRESS               | F9    | 3 | Write DMA                                    | CA    | 4 |
| Initialize Device Parameters     | 91    | 3 | Set Max FREEZE LOCK           | F9    | 3 | Write DMA                                    | CB    | 4 |
| Read Buffer                      | E4    | 1 | Set Max LOCK                  | F9    | 3 | Write Long                                   | 32    | 2 |
| Read DMA                         | C8    | 4 | Set Max SET PASSWORD          | F9    | 2 | Write Long                                   | 33    | 2 |
| Read DMA                         | C9    | 4 | Set Max UNLOCK                | F9    | 2 | Write Multiple                               | C5    | 2 |
| NOP                              | 0     | 3 | Set Multiple Mode             | C6    | 3 | Write Sectors                                | 30    | 2 |
| Read Long                        | 022   | 1 | Sleep                         | E6    | 3 | Write Sectors                                | 31    | 2 |
| Read Long                        | 23    | 1 | Sleep*                        | 99    | 3 | Write Verify                                 | 3C    | 2 |
| Read Multiple                    | C4    | 1 | S.M.A.R.T. Disable Operations | 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.



**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.

**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.

**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 40°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 50°C at the center of top cover and below 53°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.

#### 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 hard disk drive specification for the Travelstar 60GH & 40GN Hard Disk Drive Specifications, Enhanced Availability Model.

#### Load/Unload heads

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

```
HARD RESET
STANDBY
STANDBY IMMEDIATE
SLEEP
```

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

**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:

- 732 power on hours per month.
- Seeking, writing, and reading operation is 50% 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.

For further information refer to the Travelstar 60GH & 40GN Hard Disk Drive Specifications, Enhanced Availability Model.

**Mechanical data**

**Weight (grams - max)**

|                  |     |
|------------------|-----|
| 60 GB model      | 155 |
| 40, 30 GB models | 99  |
| 20, 10 GB models | 95  |

**Dimensions (mm)**

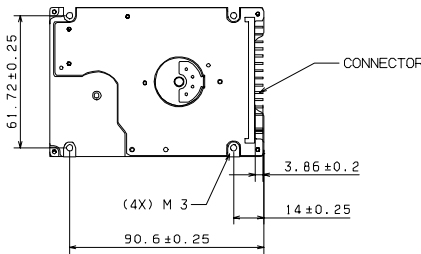
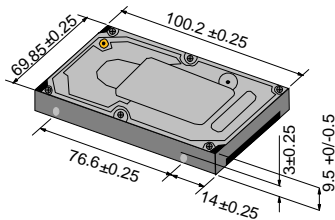
|         |                  |            |
|---------|------------------|------------|
| Height: | 60 GB model      | 12.5±0.2   |
|         | All other models | 9.5±0.2    |
| Width   |                  | 69.85±0.25 |
| Length  |                  | 100.2±0.25 |

**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.



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**IBM Technology Group Support Center**  
Telephone: 888.426.5214 or 507.286.5825  
E-mail: [drive@us.ibm.com](mailto:drive@us.ibm.com)

**Singapore Technology Group Support Center**  
Telephone: (65)6418.9595 or 1800.418.9595  
E-mail: [drive@sg.ibm.com](mailto:drive@sg.ibm.com)

**UK Technology Group Support Center**  
Telephone: 44.1475.898.125  
E-mail: [drive@uk.ibm.com](mailto:drive@uk.ibm.com)

**Germany Technology Group Support Center**  
Telephone: 49.7032.153050  
E-mail: [drive@de.ibm.com](mailto:drive@de.ibm.com)

**IBM Systems Storage Division**

5600 Cottle Road  
San Jose CA 95193  
[www.ibm.com/storage](http://www.ibm.com/storage)

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Hard Disk Drive Specifications for Travelstar 60GH & 40GN, Enhanced Availability model, version 1.0

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