Apacer

RoHS Compliant

USB Flash Drive

EH353 Product Specifications

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Version 2.8

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Specifications Overview:

- **USB3.0 Super Speed compatible, and backward compatible with USB2.0 & USB1.1 interfaces**
  - USB3.0 max. transfer rate: 5.0 Gbps
  - Backward compatible with 480Mbps & 12 Mbps
- **Capacity**
  - SLC: 256, 512 MB
    1, 2, 4, 8, 16, 32 GB
  - MLC: 8, 16, 32, 64, 128 GB
- **Performance***

  SLC
  - Sequential read: up to 80 MB/s
  - Sequential write: up to 70 MB/s

  MLC
  - Sequential read: up to 205 MB/s
  - Sequential write: up to 95 MB/s
- **Endurance (in Terabytes Written: TBW)**

  SLC
  - 256 MB: 2 TBW
  - 512 MB: 5 TBW
  - 1 GB: 11 TBW
  - 2 GB: 22 TBW
  - 4 GB: 44 TBW
  - 8 GB: 88 TBW
  - 16 GB: 176 TBW
  - 32 GB: 352 TBW

  MLC
  - 8 GB: 6 TBW
  - 16 GB: 13 TBW
  - 32 GB: 29 TBW
  - 64 GB: 26 TBW
  - 128 GB: 66 TBW
- **Temperature Range**
  - Operating:
    Standard: 0°C to 70°C
    Wide: -40°C to 85°C
  - Storage: -40°C to 100°C
- **Flash Management**
  - Flash bad-block management
  - Built-in hardware ECC
  - Power saving implemented
  - Wear-leveling algorithms
  - S.M.A.R.T.
  - Power Failure Management
- **Power Consumption***
  - Operating voltage: 5V

  SLC
  - Active mode: 225 mA
  - Idle mode: 65 mA

  MLC
  - Active mode: 275 mA
  - Idle mode: 80 mA
- **OS Support**
  - Windows: WinXP/7 or later
  - Mac: 10.2.8 or later
  - Linux: 2.4.10 or later
- **USB Bus-Powered Capability**
- **NAND Flash Type:** MLC/SLC
- **MTBF**
  - SLC: >2,000,000 hours
  - MLC: >1,000,000 hours
- **Dimensions:** 59.0 x 18.4 x 9.1, unit: ㎜
- **RoHS Compliant**

*Varies from capacities. The values for performances and power consumptions presented are typical and may vary depending on flash configurations or platform settings.

Table of Contents

1. General Descriptions

Apacer USB3.0 Handy Flash Drive EH353 is a ultra high-performance flash disk drive designed offering portable storage solutions or external memory expansion. This new generation USB flash drive is compatible with the latest USB specification – USB3.0 Super Speed, with a maximum transfer rate of 5.0 Gbps. The connector is backward employable with USB2.0 and USB1.1 interfaces as well. With compliance with USB3.0 specification, this USB drive can deliver up to 275 MB/s outstanding performance. Reliability wise, the USB comes with various implementations including powerful hardware ECC engine, power saving modes, wear leveling and flash block management. This product is well suited for portable flash storage applications while operating at minimal power consumption.

1.1 Performance-Optimized USB Controller

1.1.1 Power Saving Implemented

The internal controller of the USB model is designed with power saving implementations, allowing the device to operate at low power consumption.

1.1.2 Program RAM Architect

The internal Program RAM implementation allows the host to upgrade firmware codes anytime when needed.

1.1.3 Error Correction Code (ECC)

Flash memory cells can deteriorate with use, which might lead to random bit errors in the stored data. Thus, this USB applies the BCH ECC Algorithm, which can detect and correct errors occurring during Read process, ensure data to be read correctly, as well as protect data from corruption. This device can correct up to 39bit/1K data.

1.1.4 Flash Block Management

Current production technology is unable to guarantee total reliability of NAND flash memory array. When a flash memory device leaves factory, it comes with a minimal number of initial bad blocks during production or out-of-factory as there is no currently known technology that produce flash chips free of bad blocks. In addition, bad blocks may develop during program/erase cycles. When host performs program/erase command on a block, bad block may appear in Status Register. Since bad blocks are inevitable, the solution is to keep them in control. Apacer flash devices are programmed with ECC and block mapping technique to reduce invalidity or error. Once bad blocks are detected, data in those blocks will be transferred to free blocks and error will be corrected by designated algorithms.

1.1.5 Wear-Leveling Algorithms

Flash memory devices differ from Hard Disk Drives (HDDs) in terms of how blocks are utilized. For HDDs, when a change is made to stored data, like erase or update, the controller mechanism on HDDs will perform overwrites on blocks. Unlike HDDs, flash blocks cannot be overwritten and each P/E cycle wears down the lifespan of blocks gradually. Repeatedly program/erase cycles performed on the same memory cells will eventually cause some blocks to age faster than others. This would bring flash storages to their end of service term sooner. Wear leveling is an important mechanism that level out the wearing of blocks so that the wearing-down of blocks can be almost evenly distributed. This will increase the lifespan of flash drives. Commonly used wear leveling types are Static and Dynamic.

1.1.6 S.M.A.R.T.

S.M.A.R.T. is an abbreviation for Self-Monitoring, Analysis and Reporting Technology, a self-monitoring system that provides indicators of drive health as well as potential disk problems. It serves as a warning for users from unscheduled downtime by monitoring and displaying critical drive information. Ideally, this should allow taking proactive actions to prevent drive failure and make use of S.M.A.R.T. information for future product development reference.

1.1.7 Power Failure Management

Power Failure Management plays a crucial role when power supply becomes unstable. Power disruption may occur when users are storing data into the SSD, leading to instability in the drive. However, with Power Failure Management, a firmware protection mechanism will be activated to scan pages and blocks once power is resumed. Valid data will be transferred to new blocks for merging and the mapping table will be rebuilt. Therefore, data reliability can be reinforced, preventing damage to data stored in the NAND Flash.

2. Product & Environmental Specifications

2.1 SLC

Table 2-1 Product & Environmental Specifications (SLC)

<table>
<tr><th colspan="2">Item</th><th colspan="9">Specifications</th></tr>
<tr><td colspan="2">Interface</td><td colspan="9">Super-speed USB3.0 compliant; backward compatible with USB2.0 and USB1.1</td></tr>
<tr><td colspan="2" rowspan="3">Performance* (MB/s)</td><td></td><td>256MB</td><td>512MB</td><td>1GB</td><td>2GB</td><td>4GB</td><td>8GB</td><td>16GB</td><td>32GB</td></tr>
<tr><td>Read</td><td>60</td><td>60</td><td>65</td><td>65</td><td>65</td><td>80</td><td>80</td><td>80</td></tr>
<tr><td>Write</td><td>10</td><td>21</td><td>40</td><td>40</td><td>50</td><td>65</td><td>70</td><td>70</td></tr>
<tr><td colspan="2">Power Consumption**</td><td colspan="9">Active: 225 mA
Idle: 65 mA</td></tr>
<tr><td colspan="2">MTBF</td><td colspan="9">>2,000,000 hours</td></tr>
<tr><td rowspan="2">Temperature</td><td>Operating</td><td colspan="9">0°C to 70°C (Standard); -40°C to 85°C (Wide)</td></tr>
<tr><td>Storage</td><td colspan="9">-40°C to 100°C</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="9">30°C to 60°C , 95% RH; 244hrs (compliant with MIL-STD-810G)</td></tr>
<tr><td rowspan="2">Shock</td><td>Operating</td><td colspan="9">50(G)/11(ms)/half sine (compliant with MIL-STD-202G)</td></tr>
<tr><td>Non-operating</td><td colspan="9">1,500(G)/0.5(ms)/half sine (compliant with MIL-STD-202G)</td></tr>
<tr><td rowspan="2">Vibration</td><td>Operating</td><td colspan="9">7.69(Grms), 20~2000(Hz)/random (compliant with MIL-STD-810G)</td></tr>
<tr><td>Non-operating</td><td colspan="9">4.02(Grms), 15~2000(Hz)/random (compliant with MIL-STD-810G)</td></tr>
<tr><td colspan="2">ESD</td><td colspan="9">CE compliance (Criteria B)</td></tr>
</table>

Note:
Results may vary from flash configurations or host system settings.
*Sequential performance is based on CrystalDiskMark 5.2.1 with file size 1,000MB.
**Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.

2.2 MLC

Table 2-2 Product & Environmental Specifications (MLC)

Item		**Specifications**							
Interface		Super-speed USB3.0 compliant; backward compatible with USB2.0 and USB1.1							
Performance*			**8GB*** **		**16GB**	**32GB**	**64GB**	**128GB********	
		Read	205	95	190	190	185	190	195
		Write	20	29	55	45	95	95	80
Power consumption**			**8GB*** **		**16GB**	**32GB**	**64GB**	**128GB********	
		Active	165	150	270	265	275	265	175
		Idle	75	50	85	80	80	55	35
MTBF		>1,000,000 hours							
Temperature	Operating	0°C to 70°C (Standard); -40°C to 85°C (Wide)							
	Storage	-40°C to 100°C							
Humidity		30°C to 60°C , 95% RH; 244hrs (compliant with MIL-STD-810G)							
Shock	Operating	50(G)/11(ms)/half sine (compliant with MIL-STD-202G)							
	Non-operating	1,500(G)/0.5(ms)/half sine (compliant with MIL-STD-202G)							
Vibration	Operating	7.69(Grms), 20~2000(Hz)/random (compliant with MIL-STD-810G)							
	Non-operating	4.02(Grms), 15~2000(Hz)/random (compliant with MIL-STD-810G)							
ESD		CE compliance (Criteria B)							

Note:
Results may vary from flash configurations or host system settings.
*Sequential performance is based on CrystalDiskMark 5.2.1 with file size 1,000MB.
**Active power is an average power measurement performed using CrystalDiskMark with 128KB sequential read/write transfers.
***Values on the left are measured on 32Gb x2 while those on the right are measured on 64Gb x1.
****Values on the left are measured on 512Gb x2 while those on the right are measured on 1Tb x1.

2.3 Endurance

The endurance of a storage device is predicted by TeraBytes Written based on several factors related to usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Thus, key factors, such as Write Amplifications and the number of P/E cycles, can influence the lifespan of the drive.

Table 2-3 Endurance Specifications (SLC)

Capacity	TeraBytes Written
256 MB	2
512 MB	5
1 GB	11
2 GB	22
4 GB	44
8 GB	88
16 GB	176
32 GB	352

Table 2-4 Endurance Specifications (MLC)

Capacity	TeraBytes Written
8 GB	6
16 GB	13
32 GB	29
64 GB	26
128 GB	66

Note:

- The estimated values are based on sequential write behavior. (Apacer EDTest Tool, test mode – sequential data pattern – 100.00% of disk space)
- Flash vendor guaranteed MLC P/E cycle: Toshiba - 3K.
- The WLE/WAF values may vary with the real application on user platform.
- 1 Terabyte = 1,000 GB.

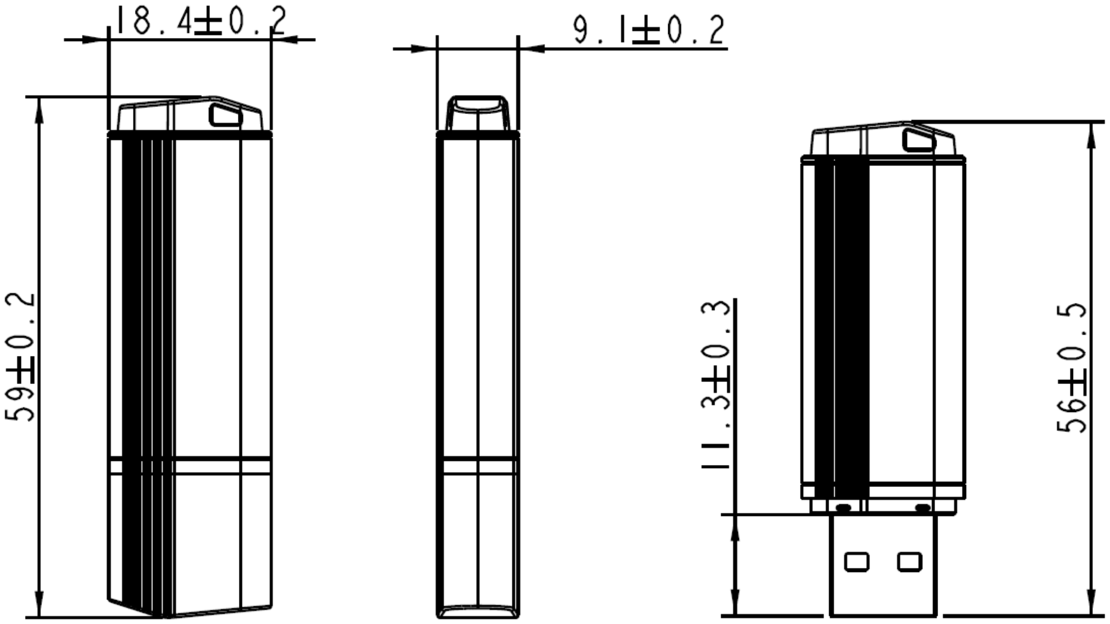
3. Absolute Maximum Rating

Caution: **Absolute Maximum Stress Ratings –** Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.

Table 3-1 Absolute Stress Rating

Item	Range
Required power supply	4.5-5.5V
Operating temperature	0°C to 70°C (Standard); -40°C to 85°C (Wide)
Storage temperature	-40℃ to 100℃

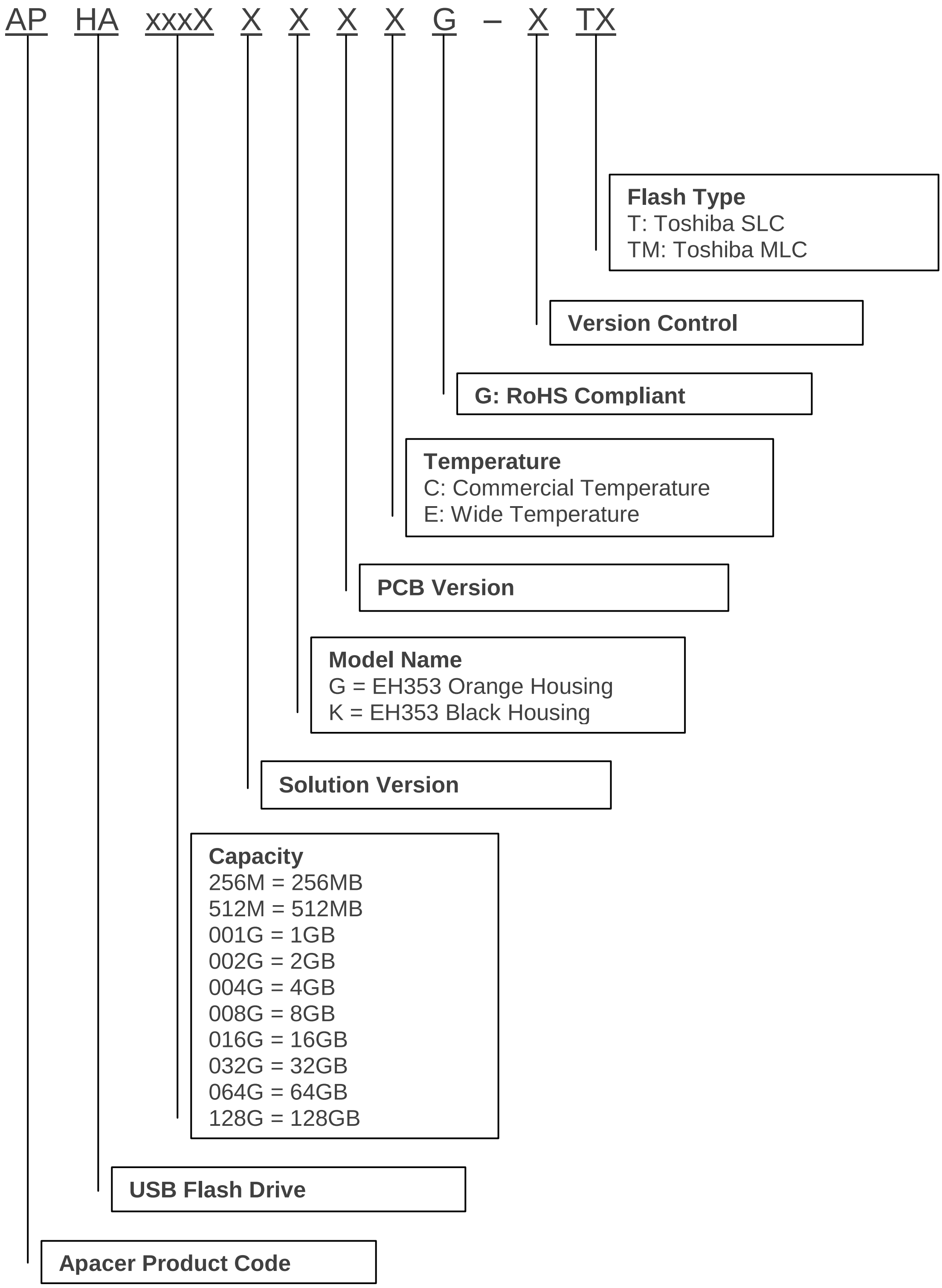
4. Physical Dimensions



Unit: mm

5. Product Ordering Information

5.1 Product Code Designations



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Flash Type
T: Toshiba SLC
TM: Toshiba MLC

Version Control

G: RoHS Compliant

Temperature
C: Commercial Temperature
E: Wide Temperature

PCB Version

Model Name
G = EH353 Orange Housing
K = EH353 Black Housing

Solution Version

Capacity
256M = 256MB
512M = 512MB
001G = 1GB
002G = 2GB
004G = 4GB
008G = 8GB
016G = 16GB
032G = 32GB
064G = 64GB
128G = 128GB

USB Flash Drive

Apacer Product Code

5.2 Valid Combinations

5.2.1 EH353 (SLC)

- **Orange Housing**

Capacity	Standard Temperature	Wide Temperature
256MB	APHA256MAG0CG-2T	APHA256MAG0EG-2T
512MB	APHA512MAG0CG-2T	APHA512MAG0EG-2T
1GB	APHA001GAG0CG-2T	APHA001GAG0EG-2T
2GB	APHA002GAG0CG-2T	APHA002GAG0EG-2T
4GB	APHA004GAG0CG-2T	APHA004GAG0EG-2T
8GB	APHA008GAG0CG-2T	APHA008GAG0EG-2T
16GB	APHA016GAG0CG-2T	APHA016GAG0EG-2T
32GB	APHA032GAG0CG-2T	APHA032GAG0EG-2T

- **Black Housing**

Capacity	Standard Temperature	Wide Temperature
256MB	APHA256MAK0CG-2T	APHA256MAK0EG-2T
512MB	APHA512MAK0CG-2T	APHA512MAK0EG-2T
1GB	APHA001GAK0CG-2T	APHA001GAK0EG-2T
2GB	APHA002GAK0CG-2T	APHA002GAK0EG-2T
4GB	APHA004GAK0CG-2T	APHA004GAK0EG-2T
8GB	APHA008GAK0CG-2T	APHA008GAK0EG-2T
16GB	APHA016GAK0CG-2T	APHA016GAK0EG-2T
32GB	APHA032GAK0CG-2T	APHA032GAK0EG-2T

5.2.2 EH353 (MLC)

- **Orange Housing**

Capacity	Standard Temperature	Wide Temperature
8GB	APHA008GAG0CG-3TM	APHA008GAG0EG-3TM
16GB	APHA016GAG0CG-3TM	APHA016GAG0EG-3TM
32GB	APHA032GAG0CG-3TM	APHA032GAG0EG-3TM
64GB	APHA064GAG0CG-3TM	APHA064GAG0EG-3TM
128GB	APHA128GAG0CG-3TM	APHA128GAG0EG-3TM*
		APHA128G4MCEG-3TM**

- **Black Housing**

Capacity	Standard Temperature	Wide Temperature
8GB	APHA008GAK0CG-3TM	APHA008GAK0EG-3TM
16GB	APHA016GAK0CG-3TM	APHA016GAK0EG-3TM
32GB	APHA032GAK0CG-3TM	APHA032GAK0EG-3TM
64GB	APHA064GAK0CG-3TM	APHA064GAK0EG-3TM
128GB	APHA128GAK0CG-3TM	APHA128GAK0EG-3TM*
		APHA128G4KCEG-3TM**

Note: The part number with one asterisk represents the SSD manufactured based on 512Gb x2 while that with two asterisks based on 1Tb x1.

Revision History

Revision	Description	Date
1.0	Official release	7/24/2015
1.1	- Modified performance and power consumption data for MLC models. - Updated valid combinations for SLC and MLC models.	9/17/2015
1.2	Revised product ordering information.	10/14/2015
1.3	Revised mechanical specifications	12/21/2015
1.4	- Added 128GB support - Added OS support and flash management implementations on Features page	2/19/2016
1.5	Revised performance for MLC series (8GB-64GB)	2/26/2016
1.6	Revised read performance for MLC 16GB	3/31/2016
1.7	Added S.M.A.R.T. and Power Failure Management to Features	10/3/2016
1.8	Added environmental specifications	10/18/2016
1.9	- Added extended temperature - Revised storage temperature	12/13/2016
2.0	Added 64Gbx1 on 8G performance and power consumption for MLC	4/18/2017
2.1	Added 1Tbx1 on 128G performance and power consumption for MLC	7/11/2017
2.2	Updated product ordering information for 128GB	7/24/2017
2.3	Updated product ordering information for 128GB manufactured based on 512Gb x2 (Orange Housing)	8/9/2017
2.4	Updated product ordering information for 128GB with standard temperature support (Orange Housing)	8/10/2017
2.5	Added 2.3 Endurance	12/19/2017
2.6	- Updated the description of 1.1.3 Error Correction Code (ECC) - Renamed extended temperature to wide temperature - Renamed Power Failure Management to DataDefender at Flash Management on Specifications Overview page and 1.1.7 section and updated the technology description	12/13/2018
2.7	Replaced DataDefender with Power Failure Management	5/8/2019
2.8	- Added MTBF to Specifications Overview page - Updated technology description of 1.1.7 Power Failure Management	7/4/2019

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