

Welldisk Corp.

Industrial PCIe SSD

WPE341 Series

Product DataSheet



Welldisk **CORP.**

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Revision History

Revision	Draft Date	History	Author
1.0	2016/8/12	New release	Golden Lee



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Product Overview

- **Capacity**
 - MLC: 240GB (256GB) up to 1920GB (2TB)
- **Form Factor**
 - PCIe
- **PCIe Interface**
 - PCIe Gen3 x4
- **Compliance**
 - NVMe 1.2
 - PCI Express Base 3.0
- **Flash Interface**
 - Flash Type: MLC
 - 2pcs to 16pcs of BGA flash
- **Performance**
 - Read up to 2,800 MB/s
 - Write up to 1,550 MB/s
- **Power Consumption**^{Note1}
 - Active mode: <7300mW
- **TBW (Terabyte Written)**
 - MLC: 2,793 TBW for 2TB
- **MTBF**
 - MLC: 2,000,000 hours
- **Advanced Flash Management**
 - Static and Dynamic Wear Leveling
 - Bad Block Management
 - TRIM
 - SMART
 - Over-Provision
- **Power Saving Modes**
 - Support APST
 - Support ASPM
 - Support L1.2
- **Temperature Range**
 - Operation (Standard): 0°C ~ 70°C
 - Storage: -40°C ~ 85°C
- **Compliant**
 - RoHS
 - CE & FCC

Notes:

1. Please see "Power Consumption" for details.

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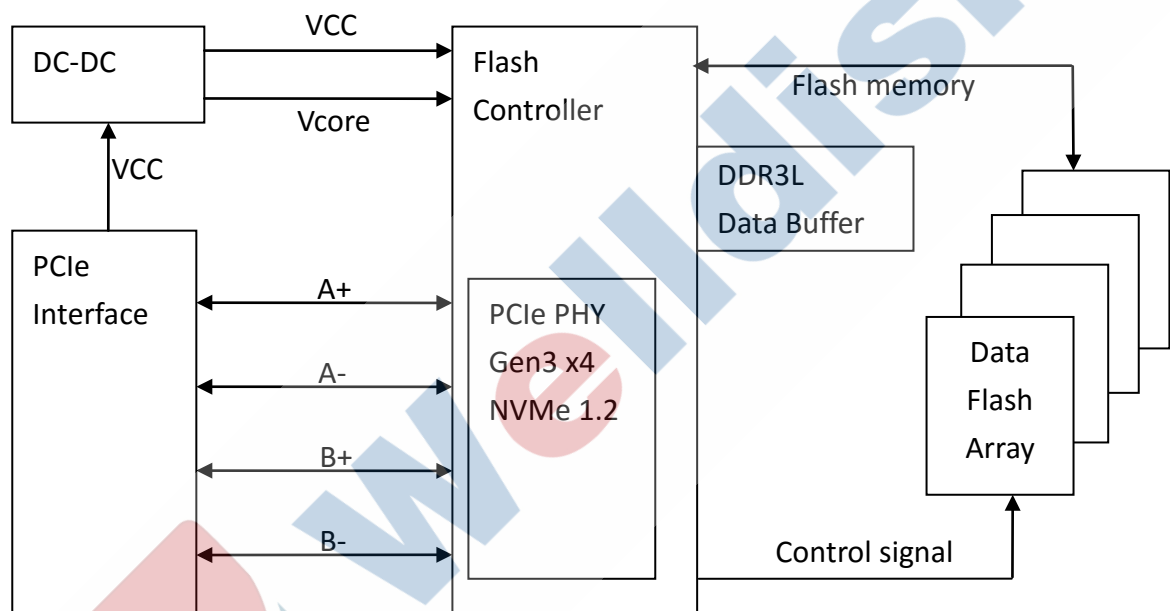
1. INTRODUCTION



1.1. General Description

Welldisk's PCIe SSD delivers all the advantages of flash disk technology with PCIe Gen3 x4 interface, including being compliant with standard PCIe form factor. Its capacity could provide a wide range up to 1,920GB. Moreover, it can reach up to 2,800MB/s read as well as 1,550MB/s write high performance based on Toshiba's 15nm Toggle MLC flash (with 256MB/512MB/1024MB/2048MB DDR3 cache enabled and measured by CrystalDiskMark v5.0). Meanwhile, the power consumption of the PCIe SSD is much lower than traditional hard drives.

1.2. Block Diagram



PCIe SSD Block Diagram

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2. PRODUCT SPECIFICATIONS

- **Capacity**
 - MLC: From 240GB (256GB) up to 1920GB (2TB) (support 48-bit addressing mode)
- **Electrical/Physical Interface**
 - PCIe Interface
 - ◆ Compliant with NVMe 1.2
 - ◆ Compatible with PCIe I/II/III x 4 interface
 - ◆ Support up to queue depth 64K
 - ◆ Support power management
- **Supported NAND Flash**
 - Toshiba 15nm MLC, TLC, Toggle1.0 and Toggle2.0
 - Support all types of MLC/TLC large block: 8KB/page and 16K/page NAND flash
 - Contain 2pcs to 16pcs of BGA flash
- **ECC Scheme**
 - Up to 120 bits / 2K Byte
- **UART function**
- **GPIO**
- **Support SMART and TRIM commands**



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- **Performance**

- **MLC:**

Capacity	Flash Structure	Flash Type	Sequential	
			Read (MB/s)	Write (MB/s)
240GB (256GB)	32GB x 8	15nm, BGA (4-Plane)	2,750	1,500
480GB (512GB)	64GB x 8	15nm, BGA (4-Plane)	2,800	1,550
960GB (1TB)	128GB x 8	15nm, BGA (4-Plane)	2,800	1,550
1920GB (2TB)	128GB x 16	15nm, BGA (4-Plane)	2,800	1,550

Notes:

1. The performance was estimated based on Toshiba MLC NAND flash.
2. Performance may differ according to flash configuration and platform.
3. The table above is for reference only. The criteria for MP (mass production) and for accepting goods shall be discussed based on different flash configuration.

- **TBW (Terabytes Written)**

- **MLC:**

Capacity	Flash Structure	TBW
240GB (256GB)	32GB x 8	349
480GB (512GB)	64GB x 8	698
960GB (1TB)	128GB x 8	1,396
1920GB (2TB)	128GB x 16	2,793

Notes:

1. Samples were built using Toshiba MLC NAND flash.
2. TBW may differ according to flash configuration and platform.
3. The endurance of SSD could be estimated based on user behavior, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

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3. ENVIRONMENTAL SPECIFICATIONS



3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
 - ◆ Storage: -40°C to 85°C
 - ◆ Operational (Standard grade): 0°C to 70°C
- Humidity:
 - ◆ Standard grade: RH 90% under 40°C (operational)

■ High Temperature Test Condition

	Temperature	Humidity	Test Time
Operation (Standard)	70°C	0% RH	72 hours
Operation (Wide)	85°C	0% RH	72 hours

Result: No any abnormality is detected.

■ Low Temperature Test Condition

	Temperature	Humidity	Test Time
Operation (Standard)	0°C	0% RH	72 hours
Storage (Standard)	-40°C	0% RH	72 hours

Result: No any abnormality is detected.

■ High Humidity Test Condition

	Temperature	Humidity	Test Time
Operation (Standard)	40°C	90% RH	4 hours
Storage (Standard)	40°C	93% RH	72 hours

Result: No any abnormality is detected.

■ Temperature Cycle Test

	Temperature	Test Time	Cycle
Operation (Standard)	0°C	30 min	10 cycles
	70°C	30 min	
Storage (Standard)	-40°C	30 min	10 cycles
	85°C	30 min	

Result: No any abnormality is detected.

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3.1.2. Shock

■ Shock Specification

	Acceleration Force	Half Sin Pulse Duration
Non-Operational	1500G	0.5ms

Result: No any abnormality is detected when power in.

3.1.3. Vibration

■ Vibration Specification

	Condition		Vibration Orientation
	Frequency/Displacement	Frequency/Acceleration	
Non-Operational	20Hz~80Hz/1.52mm	80Hz~2000Hz/20G	X, Y, Z axis/30 min for each

Result: No any abnormality is detected when power in.

3.1.4. Drop

■ Drop Specification

	Height of Drop	Number of Drop
Non-operational	80cm free fall	6 face of each unit

Result: No any abnormality is detected when power in.

3.1.5. Bending

■ Bending Specification

	Force	Action
Non-operational	≥ 50N	Hold 1min/5times

Result: No any abnormality is detected when power in.

3.1.6. Torque

■ Contact ESD Specification

	Force	Action
Non-operational	1.263N-m or ±10 deg	Hold 1min/5times

Result: No any abnormality is detected when power in.

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3.1.7. Electrostatic Discharge (ESD)

■ Contact ESD Specification

Device	Capacity	Temperature	Relative Humidity	+/- 4KV	Result
PCIe SSD	480GB / 960GB	24.0°C	49% (RH)	Device functions are affected, but EUT will be back to its normal or operational state automatically.	PASS

3.2. MTBF

MTBF, an acronym for Mean Time between Failures, is a measure of a device's reliability. Its value represents the average time between a repair and the next failure. The measure is typically in units of hours. The higher the MTBF value, the higher the reliability of the device. The predicted result of Welldisk's PCIe SSD is up to 2,000,000 hours.

3.3. Certification

- RoHS
- CE / FCC (TBD)

3.4. Compliance

- PCI Express Base 3.0
- UNH-IOL NVM Express Logo

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4. ELECTRICAL SPECIFICATIONS



4.1. Supply Voltage

Parameter	Rating
Operating Voltage	12V $\pm$ 8%

4.2. Power Consumption

■ MLC

Capacity	Flash Structure	Flash Type	Read	Write	Idle
240GB (256GB)	32GB x 8	15nm, BGA (4-Plane)	2,940	4,690	500
480GB (512GB)	64GB x 8	15nm, BGA (4-Plane)	5,570	7,270	500
960GB (1TB)	128GB x 8	15nm, BGA (4-Plane)	5,580	7,275	500
1920GB (2TB)	128GB x 16	15nm, BGA (4-Plane)	5,580	7,200	500

Unit: mW

NOTES:

1. The average value of power consumption is achieved based on 100% conversion efficiency.
2. The measured power voltage is 12V.
3. Samples were built using Toshiba NAND flash and measured under normal temperature.
4. Sequential R/W is measured while testing 4000MB sequential R/W 5 times by CrystalDiskMark.
5. Power Consumption may differ according to flash configuration and platform.

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5. INTERFACE



5.1. Pin Assignment and Descriptions

The follow table defines the PCIe SSD Connector Pin Assignment and Descriptions.

Pin#	Side B		Side A	
	Name	Description	Name	Description
1	+12V	12 V power	PRSNT1#	Hot-Plug presence detect
2	+12V	12 V power	+12V	12 V power
3	+12V	12 V power	+12V	12 V power
4	GND	Ground	GND	Ground
5	SMCLK	SMBus (System Management Bus) clock	JTAG2	TCK (Test Clock), clock input for JTAG interface
6	SMDAT	SMBus (System Management Bus) data	JTAG3	TDI (Test Data Input)
7	GND	Ground	JTAG4	TDO (Test Data Output)
8	+3.3V	3.3 V power	JTAG5	TMS (Test Mode Select)
9	JTAG1	TRST# (Test Reset) resets the JTAG interface	+3.3V	3.3 V power
10	3.3Vaux	3.3 V auxiliary power	+3.3V	3.3 V power
11	WAKE#	Signal for Link reactivation	PERST#	Fundamental reset
12	RSVD	Reserved	GND	Ground
13	GND	Ground	REFCLK+	Reference clock (differential pair)
14	PETp0	Transmitter differential pair, Lane 0	REFCLK-	
15	PETn0	Transmitter differential pair, Lane 0	GND	Ground
16	GND	Ground	PERp0	Receiver differential pair, Lane 0
17	PRSNT2#	Hot-Plug presence detect	PERn0	Receiver differential pair, Lane 0
18	GND	Ground	GND	Ground
19	PETp1	Transmitter differential pair, Lane 1	RSVD	Reserved
20	PETn1	Transmitter differential pair, Lane 1	GND	Ground
21	GND	Ground	PERp1	Receiver differential pair, Lane 1
22	GND	Ground	PERn1	Receiver differential pair, Lane 1
23	PETp2	Transmitter differential pair, Lane 2	GND	Ground
24	PETn2	Transmitter differential pair, Lane 2	GND	Ground

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Pin#	Side B		Side A	
	Name	Description	Name	Description
25	GND	Ground	PERp2	Receiver differential pair, Lane 2
26	GND	Ground	PERn2	Receiver differential pair, Lane 2
27	PETp3	Transmitter differential pair, Lane 3	GND	Ground
28	PETn3	Transmitter differential pair, Lane 3	GND	Ground
29	GND	Ground	PERp3	Receiver differential pair, Lane 3
30	RSVD	Reserved	PERn3	Receiver differential pair, Lane 3
31	PRSNT2#	Hot-Plug presence detect	GND	Ground
32	GND	Ground	RSVD	Reserved



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6. SUPPORTED COMMANDS

6.1. NVMe Command List

Table 6-1 Admin Commands

Op-Code	Command Description
00h	Delete I/O Submission Queue
01h	Create I/O Submission Queue
02h	Get Log Page
04h	Delete I/O Completion Queue
05h	Create I/O Completion Queue
06h	Identify
08h	Abort
09h	Set Features
0Ah	Get Features
0Ch	Asynchronous Event Request
10h	Firmware Activate
11h	Firmware Image Download

Table 6-2 Admin Commands – NVM Command Set Specific

Op-Code	Command Description
80h	Format NVM
81h	Security Send
82h	Security Receive

Table 6-3 NVM Commands

Op-Code	Command Description
00h	Flush
01h	Write
02h	Read
04h	Write Uncorrectable
05h	Compare
08h	Write Zeroes
09h	Dataset Management

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6.2. Identify Device Data

The following table details the sector data returned by the IDENTIFY DEVICE command.

■ Identify Controller Data Structure

Bytes	Description
Controller Capabilities and Features	
01:00	PCI Vendor ID (VID)
03:02	PCI Subsystem Vendor ID (SSVID)
23:04	Serial Number (SN)
63:24	Model Number (MN)
71:64	Firmware Revision (FR)
72	Recommended Arbitration Burst (RAB)
75:73	IEEE OUI Identifier (IEEE)
76	Controller Multi-Path I/O and Namespace Sharing Capabilities (CMIC)
77	Maximum Data Transfer Size (MDTS)
255:80	Reserved
Admin Command Set Attributes & Optional Controller Capabilities	
257:256	Optional Admin Command Support (OACS)
258	Abort Command Limit (ACL)
259	Asynchronous Event Request Limit (AERL)
260	Firmware Updates (FRMW)
261	Log Page Attributes (LPA)
262	Error Log Page Entries (ELPE)
263	Number of Power States Support (NPSS)
264	Admin Vendor Specific Command Configuration (AVSCC)
265	Autonomous Power State Transition Attributes (APSTA)
511:266	Reserved
NVM Command Set Attributes	
512	Submission Queue Entry Size (SQES)
513	Completion Queue Entry Size (CQES)
515:514	Reserved
519:516	Number of Namespaces (NN)
521:520	Optional NVM Command Support (ONCS)
523:522	Fused Operation Support (FUSES)
524	Format NVM Attributes (FNA)
525	Volatile Write Cache (VWC)

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Bytes	Description
527:526	Atomic Write Unit Normal (AWUN)
529:528	Atomic Write Unit Power Fail (AWUPF)
530	NVM Vendor Specific Command Configuration (NVSCC)
531	Reserved
533:532	Atomic Compare & Write Unit (ACWU)
535:534	Reserved
539:536	SGL Support (SGLS)
703:540	Reserved



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■ Identify Namespace Data Structure & NVM Command Set Specific

Bytes	Description
7:0	Namespace Size (NSZE)
15:8	Namespace Capacity (NCAP)
23:16	Namespace Utilization (NUSE)
24	Namespace Features (NSFEAT)
25	Number of LBA Formats (NLBAF)
26	Formatted LBA Size (FLBAS)
27	Metadata Capabilities (MC)
28	End-to-end Data Protection Capabilities (DPC)
29	End-to-end Data Protection Type Settings (DPS)
30	Namespace Multi-path I/O and Namespace Sharing Capabilities (NMIC)
31	Reservation Capabilities (RESCAP)
119:32	Reserved
127:120	IEEE Extended Unique Identifier (EUI64)
131:128	LBA Format 0 Support (LBAF0)
135:132	LBA Format 1 Support (LBAF1)
139:136	LBA Format 2 Support (LBAF2)
143:140	LBA Format 3 Support (LBAF3)
147:144	LBA Format 4 Support (LBAF4)
151:148	LBA Format 5 Support (LBAF5)
155:152	LBA Format 6 Support (LBAF6)
159:156	LBA Format 7 Support (LBAF7)
163:160	LBA Format 8 Support (LBAF8)
167:164	LBA Format 9 Support (LBAF9)
171:168	LBA Format 10 Support (LBAF10)
175:172	LBA Format 11 Support (LBAF11)
179:176	LBA Format 12 Support (LBAF12)
183:180	LBA Format 13 Support (LBAF13)
187:184	LBA Format 14 Support (LBAF14)
191:188	LBA Format 15 Support (LBAF15)
383:192	Reserved
4095:384	Vendor Specific (VS)

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■ List of Identify Namespace Data Structure for Each Capacity

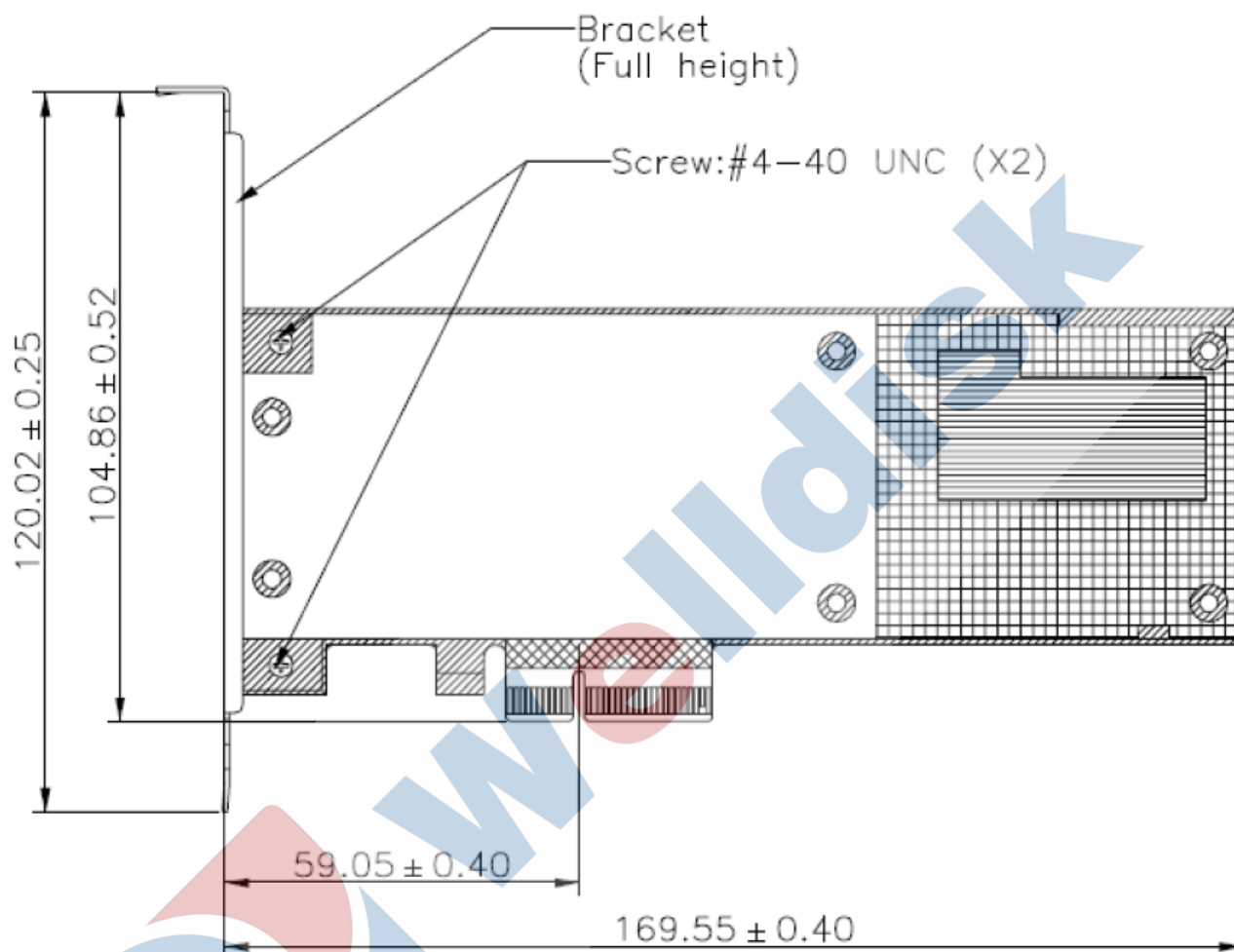
Capacity (GB)	Byte[7:0]: Namespace Size (NSZE)
240	1BF244B0h
256	1DCF32B0h
480	37E436B0h
512	3B9E12B0h
960	6FC81AB0h
1024	773BD2B0h
1920	DF8FE2B0h
2048	EE7752B0h

7. PHYSICAL DIMENSION



Dimension: 167.65mm (L) x 68.90mm (W) x 17.14mm (H) (HHHL)

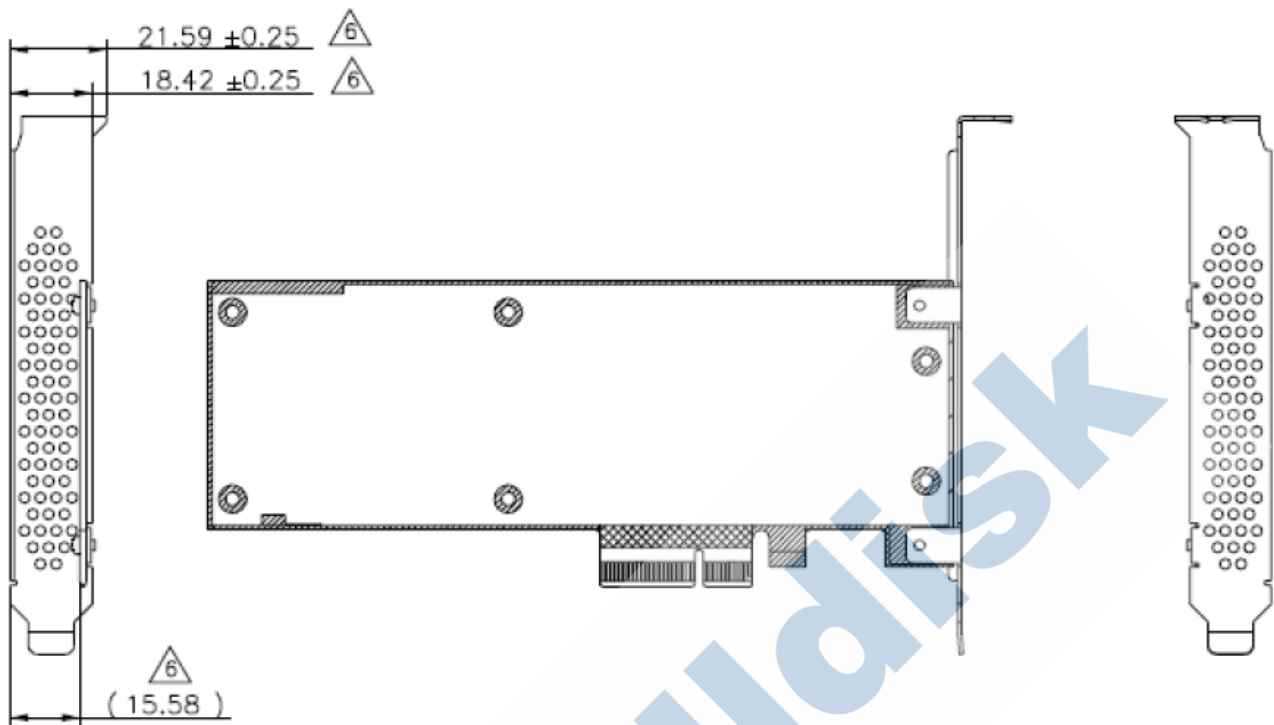
A-side View with Bracket



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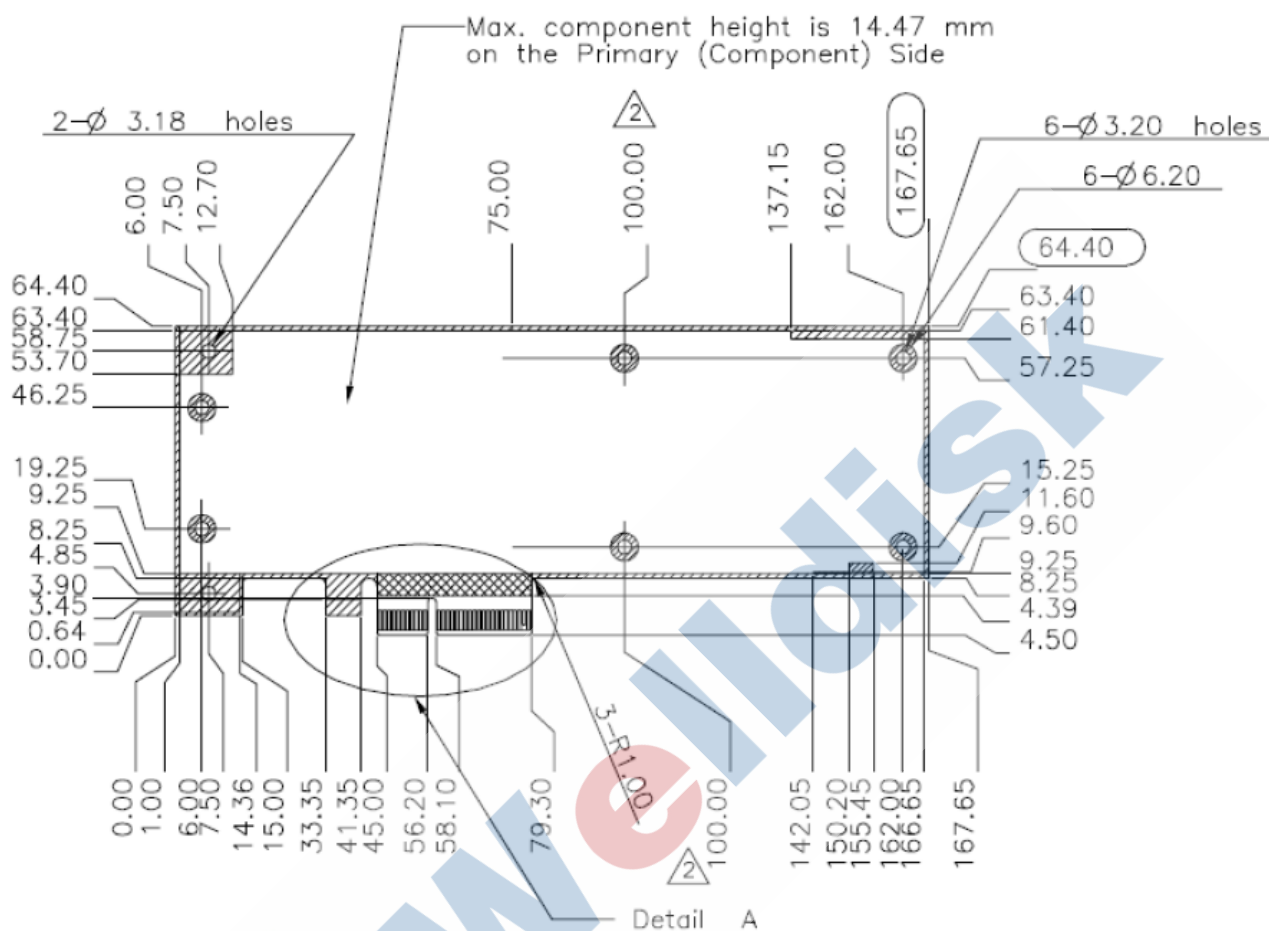
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B-side View with Bracket

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Side View without Bracket


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8. TERMINOLOGY



The following table is to list out the acronyms that have been applied throughout the document.

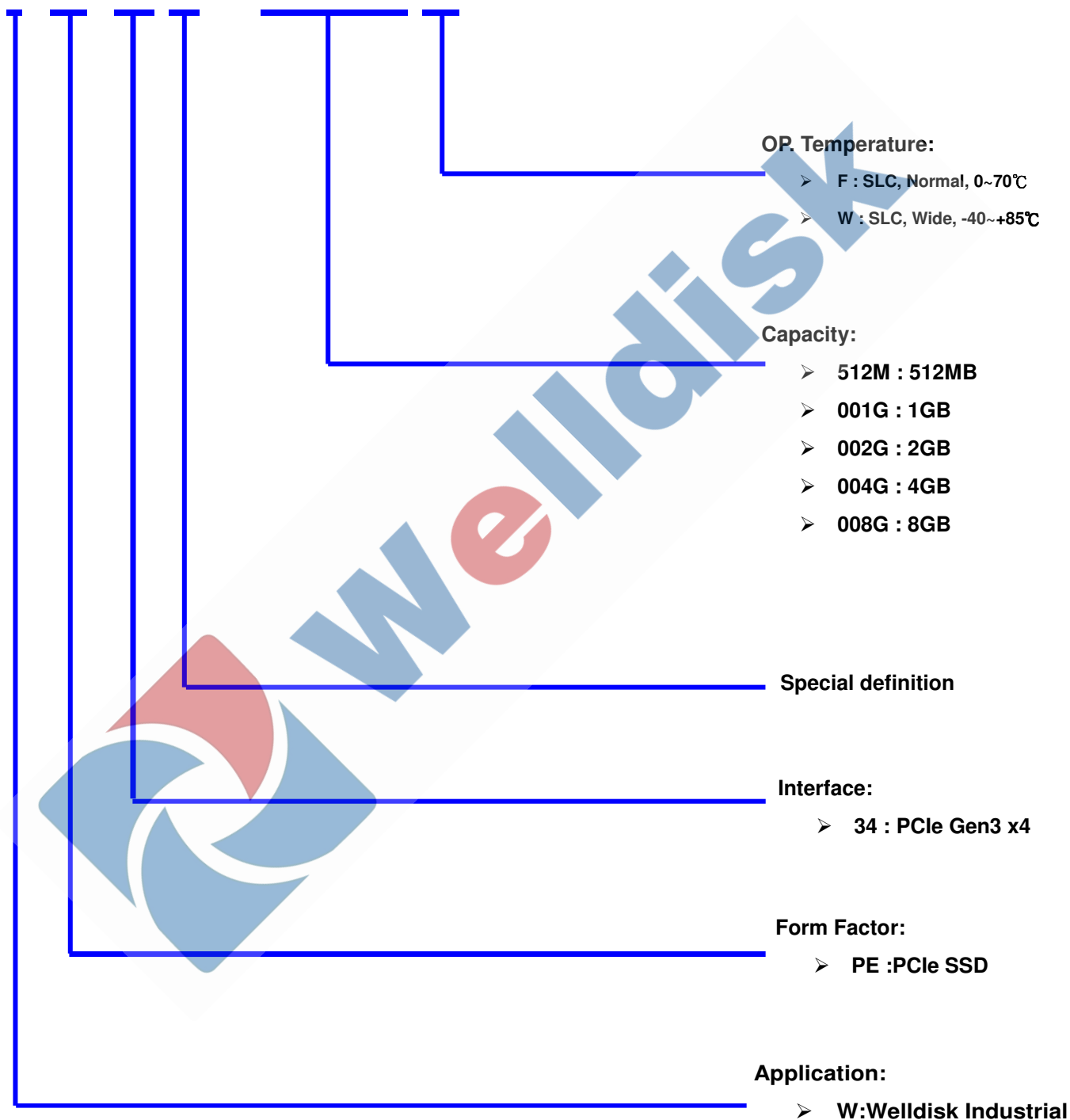
Term	Definitions
ATTO	Commercial performance benchmark application
DDR	Double data rate (SDRAM)
DIPM	Device initiated power management
HIPM	Host initiated power management
LBA	Logical block addressing
MB	Mega-byte
MTBF	Mean time between failures
PCIe	PCI Express / Peripheral Component Interconnect Express
S.M.A.R.T.	Self-monitoring, analysis and reporting technology
SSD	Solid state disk



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9. PARTNUMBER DECODER**7.1 Model Name****WPE341 – XXXX X****WellDisk CORP.***layer 415 newmaterial chuangye building FengHui middle road no.7 Beijing haidian district**TEL: +86-010-56298618 Email:sales@welldisk.com*