

***RoHS Compliant***

PCIe Gen 5x4 - U.2 - Flash Drive Series

***Datasheet for PCIe Gen 5 x 4 – U.2 3D TLC BICS5 NAND based Flash Drive***

October 22, 2025

Revision 1.0

***This Specification Describes the Features and Capabilities of the Standard and Industrial Temperature 2.5" PCI Express Flash Drives***

***Please Contact Fortasa Memory Systems Sales for any Custom Features Required For Your Specific Application***



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### Features:

- **PCIe Interface**
  - PCI Express® Base Specification Rev. 5.0
  - NVM Express® Base Specification Rev. 2.0
  - NVM Express® Management Interface Rev1.2
  - PCI Express SFF-8639 Module Specification Revision 5.0, Version 0.7
- **Temperature ranges**
  - Operation:  
Standard Temperature: 0°C to 70°C
  - Storage: -40°C to 100°C
- **Capacity**  
1920GB, 3840GB, 7680GB, 15360GB, 30720GB
- **NAND flash type: BiCS5 3D TLC**
- **Performance**
  - Sustained Performance
    - Read: up to 14,800 MB/sec
    - Write: up to 8,700 MB/sec
    - Random read 4K: up to 3,300K IOPS
    - Random write 4K: up to 900K IOPS
- **Form factor**
  - U.2 15mm 100(L)x70(W)x15(H) mm
- **Intelligent endurance design**
  - Built-in hardware LDPC (Low Density Parity Check) ECC
  - Global wear-leveling scheme together with dynamical block allocation to significantly increase the lifetime of a flash device and optimize the disk performance
  - Flash bad-block management
  - SMART Command
    - *Power Failure Management*
    - *ATA Secure Erase*
    - *Trim Command*
- **Thermal Sensor for Temperature Management**
- **MTBF (hours): >2,500,000**
- **Security**
  - AES 256-bit hardware encryption
- **Low power consumption (typical)**
  - Supply voltage: 12V ± 5%V
  - Active mode: 25 W
  - Idle mode: <5W
- **Endurance in Terabytes Written (TBW)**
  - 1920 GB: 3504 TBW
  - 3840 GB: 7008 TBW
  - 7680 GB: 14016 TBW
  - 15360 GB: 28032 TBW
  - 30720 GB: 56064 TBW



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## Table of Contents

1 Product Description.....	4
1.1 General Description.....	4
1.2 Capacity Specification.....	4
1.3 Performance Specification.....	5
1.4 Pin Assignments.....	6
2. Software Interface.....	10
2.1 Command Set.....	10
3. Flash Management.....	11
3.1 Error Correction/Detection.....	11
3.2 Wear Leveling.....	11
3.3 ATA Secure Erase.....	11
3.4 S.M.A.R.T. Technology.....	11
3.5 TRIM Command Support.....	12
3.6 Thermal Throttling.....	12
3.7 Airflow Profile.....	14
4. Environmental Specifications.....	15
4.1 Environments.....	15
4.2 Mean Time Between Failures (MTBF).....	15
4.3 Certification and Compliance.....	15
4.4 Endurance.....	16
5. Electrical Specification.....	17
5.1 Operating Voltage.....	17
5.2 Power Consumption.....	17
6. Physical Characteristics.....	18
7. Product Ordering Information.....	19
7.1 Product Code Designations.....	19
7.2 Valid Combinations.....	20
8. Revision History.....	21

## 1 Product Description

### 1.1 General Description

Fortasa's PCI Express U.2 family is a high-performance, PCI Express interface, solid state drive (SSD) designed to offer a fastest throughput storage solution on a fast PC bus.

The PCIe U.2 drive offers capacities of up to 30 terabyte, providing full compliance with the latest PCIe Gen3 x4 interface specifications. It can operate at sustained access rates of up to 14,000 megabytes per second, which is much faster than other solid-state or traditional HDD drives currently available on the market. **Manufactured using BiCS5 3D TLC NAND-flash, this SSD can work in highly demanding environment and withstand standard range of operating temperature from 0°C to +70°C.**

PCIe U.2 offers high reliability global data wear-leveling scheme to allow uniform use of all storage blocks, increasing the lifetime of Flash media and optimizing drive performance. The PCIe U.2 also offers Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.) feature monitors the drive accesses and provides the host with vital information about drive condition to schedule maintenance and service times.

### 1.2 Capacity Specification

Standard capacity specification of the PCIe U.2 Flash Drive product are shown in Table 1-1. The table lists the specific capacity and useable number of sectors for each product capacity.

**Table 1-1:** Capacity specifications

Capacity	Useable Sectors	Sector Size
1920GB	3,750,748,848	512 bytes
3840GB	7,501,476,528	
7680GB	15,002,931,888	
15360GB	3,750,748,848	
30720GB	7,501,476,528	

NOTES:

1. 1 Gigabyte (GB) is equal to 1,000,000,000 bytes; 1 sector is equal to 512 bytes.
2. The total actual usable capacity of the SSD may be less than the total physical capacity because internal NAND management, SSD format, SSD partition, operating system overhead, etc.
3. Optional for over-provision

*Please contact factory for any non-listed Flash Drive capacity or custom CHS requirement.*

### 1.3 Performance Specification

Performances of the PCIe U.2 Flash Drive are listed in Tables 1-2.

**Table 1-2:** Performance specifications

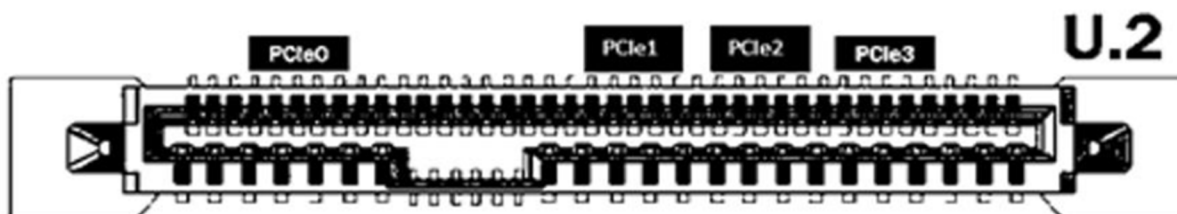
<b>Capacity</b>	<b>1920GB</b>	<b>3840GB</b>	<b>7680GB</b>	<b>15360GB</b>	<b>30720GB</b>
<b>Performance</b>					
<b>Sustained read (MB/s)</b>	14,800	14,800	14,800	14,800	14,000
<b>Sustained write (MB/s)</b>	4,300	8,600	8,700	8,500	7,600
<b>Random Read IOPS (4K)</b>	2,400K	3,300K	3,200K	2,800K	2,300K
<b>Random Write IOPS (4K)</b>	140K	320K	390K	420K	265K

- Note: 1. Performance is measured with the following conditions:  
FIO on Linux: 512KB sequential read/write for full drive  
SSD is unformatted drive.
2. Performance platform:  
Mother board: MS03-CE0-000  
CPU: Intel Xeon Gold 5416S  
DRAM: DDR5 64G  
OS version: Ubuntu 20.04.2 LTS
3. Performance may differ according to flash configuration and platform.

### 1.4 Pin Assignments

Pin assignment of the PCIe U.2 is shown in Figure 1-2 and described in Table 1-3.

**Figure 1-2:** PCIe U.2 pin assignment



**Table 1-3:** PCIe U.2 pin assignment

Pin Number	Name	Description
P1	WAKE#	Signal for Link reactivation
P2	Reserved	
P3	PWRDIS	Power Disable
P4	IfDet#	Interface Type Detect
P5	Ground	Ground
P6	Ground	Ground
P7	+5V	NC
P8	+5V	NC
P9	+5V	NC
P10	PRSNT#	Presence detect
P11	Activity#	Activity Indicator
P12	Ground	Ground

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Pin Number	Name	Description
P13	+12V Precharge	+12V Precharge power for SFF-8639 module
P14	+12V	+12V power for SFF-8639 module
P15	+12V	+12V power for SFF-8639 module
S1	Ground	Ground
S2	NC	NC
S3	NC	NC
S4	Ground	Ground
S5	NC	NC
S6	NC	NC
S7	Ground	Ground
S8	Ground	Ground
S9	NC	NC
S10	NC	NC
S11	Ground	Ground
S12	NC	NC
S13	NC	NC
S14	Ground	Ground
S15	HPT0	Host Port Type 0
S16	Ground	Ground
S17	U.2 TX p1	Transmitter differential pair, Lane 1
S18	U.2 TX n1	Transmitter differential pair, Lane 1
S19	Ground	Ground
S20	U.2 RX n1	Receiver differential pair, Lane 1

# PCIe U.2 2.5" Flash Drive

## FMS-PU5PxxxT-E



Pin Number	Name	Description
S21	U.2 RX p1	Receiver differential pair, Lane 1
S22	Ground	Ground
S23	U.2 TX p2	Transmitter differential pair, Lane 2
S24	U.2 TX n2	Transmitter differential pair, Lane 2
S25	Ground	Ground
S26	U.2 RX n2	Receiver differential pair, Lane 2
S27	U.2 RX p2	Receiver differential pair, Lane 2
S28	Ground	Ground
E1	REFCLKB+	Reference clock (differential pair) for second X2 port
E2	REFCLKB-	Reference clock (differential pair) for second X2 port
E3	+3.3 Vaux	3.3 V auxiliary power
E4	CLKREQ#/PERSTB#	Clock request/Fundamental reset for second x2 port
E5	PERST#	Fundamental reset (if dual-port enabled, first X2 port)
E6	IFDet2#	Interface Type Detect
E7	REFCLK+	Reference clock (if dual-port enabled, first X2 port)
E8	REFCLK-	Reference clock (if dual-port enabled, first X2 port)
E9	Ground	Ground
E10	U.2 TX p0	Transmitter differential pair, Lane 0
E11	U.2 TX n0	Transmitter differential pair, Lane 0
E12	Ground	Ground
E13	U.2 RX n0	Receiver differential pair, Lane 0

# PCIe U.2 2.5" Flash Drive

## FMS-PU5PxxxT-E



Pin Number	Name	Description
E14	U.2 RX p0	Receiver differential pair, Lane 0
E15	Ground	Ground
E16	HPT1	Host Port Type
E17	U.2 TX p3	Transmitter differential pair, Lane 3
E18	U.2 TX n3	Transmitter differential pair, Lane 3
E19	Ground	Ground
E20	U.2 RX n3	Receiver differential pair, Lane 3
E21	U.2 RX p3	Receiver differential pair, Lane 3
E22	Ground	Ground
E23	SMCLK	SMBus (System Management Bus) clock
E24	SMDAT	SMBus (System Management Bus) data
E25	DualPortEn#	Dual-port Enable

**Table 1-3:** Pin Assignment Description

## 2. Software Interface

### 2.1 Command Set

Table 2-1 summarizes the PCIe U.2 command set.

**Table 2-1** Admin Commands

Opcode	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
15h	Namespace Attachment
1Dh	NVMe-MI Send
1Eh	NVMe-MI Receive

**Table 2-2** Admin Commands – NVM Command Set Specific

Opcode	Command Description
80h	Format NVM
81h	Security Send
82h	Security Receive
84h	Sanitize

**Table 2-3** NVM Commands

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

### 3. Flash Management

#### 3.1 Error Correction/Detection

The PCIe U.2 implements a hardware LDPC (Low Density Parity Check) ECC algorithm.

#### 3.2 Wear Leveling

All NAND flash devices are limited by a finite number of write cycles. Under a standard file system, frequent file table updates are mandatory. As a painful side effect of OS file overhead, some areas of flash address space wear out faster than others. As these certain sections get a substantially higher write occurrence the whole Flash Drive can wear out very quickly. This uneven wear would significantly reduce the lifetime of the whole device, even if majority of the Flash sectors are far from the write cycle limit. Fortasa's PCIe U.2 Flash Drive products offer advanced data wear leveling which distributes Flash writes evenly across the Flash Drive memory space. By utilizing this advanced wear leveling feature, the lifetime of the media can be significantly extended.

#### 3.3 ATA Secure Erase

Accomplished by the Secure Erase (SE) command, which is part of the ANSI standards that control disk drives, "ATA Secure Erase" is built into the disk drive itself and thus far less susceptible to malicious software attacks than external software utilities. Execution of this command amounts to electronic data shredding and causes the SSD to internally completely erase all possible user data. Aside from user data, all data erase counters and other internal controller information stored on the Flash media will be also permanently deleted. The erase process will not stop until it is completed. In case of power failure, the erase process will continue when the power is reapplied to the device.

#### 3.4 S.M.A.R.T. Technology

S.M.A.R.T. is an acronym for Self-Monitoring, Analysis and Reporting Technology, an open standard allowing disk drives to automatically monitor their own health and report potential problems. It protects the user from unscheduled downtime by monitoring and storing critical drive performance and calibration parameters. Ideally, this should allow taking proactive actions to prevent impending drive failure.

##### SMART Attributes (Log Identifier 02h)

Bytes Index	Bytes	Description
[0]	1	Critical Warning
[2:1]	2	Composite Temperature
[3]	1	Available Spare
[4]	1	Available Spare Threshold
[5]	1	Percentage Used
[31:6]	26	Reserved
[47:32]	16	Data Units Read
[63:48]	16	Data Units Written
[79:64]	16	Host Read Commands
[95:80]	16	Host Write Commands
[111:96]	16	Controller Busy Time

# PCIe U.2 2.5" Flash Drive

## FMS-PU5PxxxT-E



[127:112]	16	Power Cycles
[143:128]	16	Power On Hours
[159:144]	16	Unsafe Shutdowns
[175:160]	16	Media and Data Integrity Errors
[191:176]	16	Number of Error Information Log Entries
[195:192]	4	Warning Composite Temperature Time
[199:196]	4	Critical Composite Temperature Time
[201:200]	2	Temperature Sensor 1 (Current Temperature)
[203:202]	2	Temperature Sensor 2 (N/A)
[205:204]	2	Temperature Sensor 3 (N/A)
[207:206]	2	Temperature Sensor 4 (N/A)
[209:208]	2	Temperature Sensor 5 (N/A)
[211:210]	2	Temperature Sensor 6 (N/A)
[213:212]	2	Temperature Sensor 7 (N/A)
[215:214]	2	Temperature Sensor 8 (N/A)
[511:216]	296	Reserved

### 3.5 TRIM Command Support

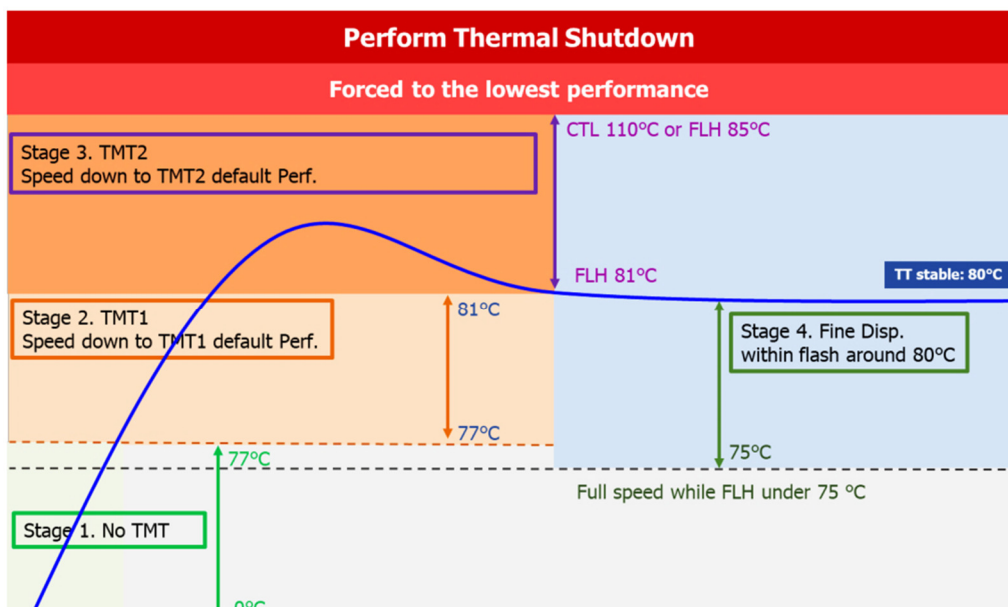
Over time the performance of SSD degrades as user continually writes and erases data. The ATA-TRIM command “formats” the SSD to optimize the drive performance. A TRIM enabled SSD running an OS with TRIM support will stay closer to its peak performance without much performance variance.

### 3.6 Thermal Throttling

The PCIe U.2 SSD contains a Thermal Sensor that measures module temperature. The drive temperature can be obtained by polling SMART Command attribute ID 200h. When the device temperature reaches a pre-set temperature threshold, the drive performance will be reduced to limit the power draw and prevent the module from overheating.

**Table 3-1 Thermal Throttling Mechanism**

Item	Description	NAND Flash CE condition
Stage 1 No TMT	Idle state for entering TMT1 or TMT2 Tflash ~ 76 °C	Full CE
Stage 2 TMT1	When flash temperature reaches TMT1 (77°C ~ 81°C), the drive will speed down to TMT1 with performance (< 7300MB/S)	
Stage 3 TMT2	When flash temperature reaches TMT2 (81°C), the drive will speed down to TMT2 with performance (< 1700MB/S)	
Stage 4 TT Stable	To Keep TT stable within flash temp 77~83°C. Would monitor temperature every second	
TMT Protect	While flash temp reach 84°C	Force 1 ACTIVE DIE PER CH(~500MB)
TMT Fatal	Perform thermal shutdown process when flash temperature ≥ 85°C or controller temperature ≥ 115°C	
Resume TMT2 – TMT1	Tflash ≤ 75°C	Can only exit TT when temperature ≤ 75°C after enter TMT2. Will not change from TMT2 state to TMT 1 state
Resume TMT1 – Normal	Tflash ≤ 75°C	



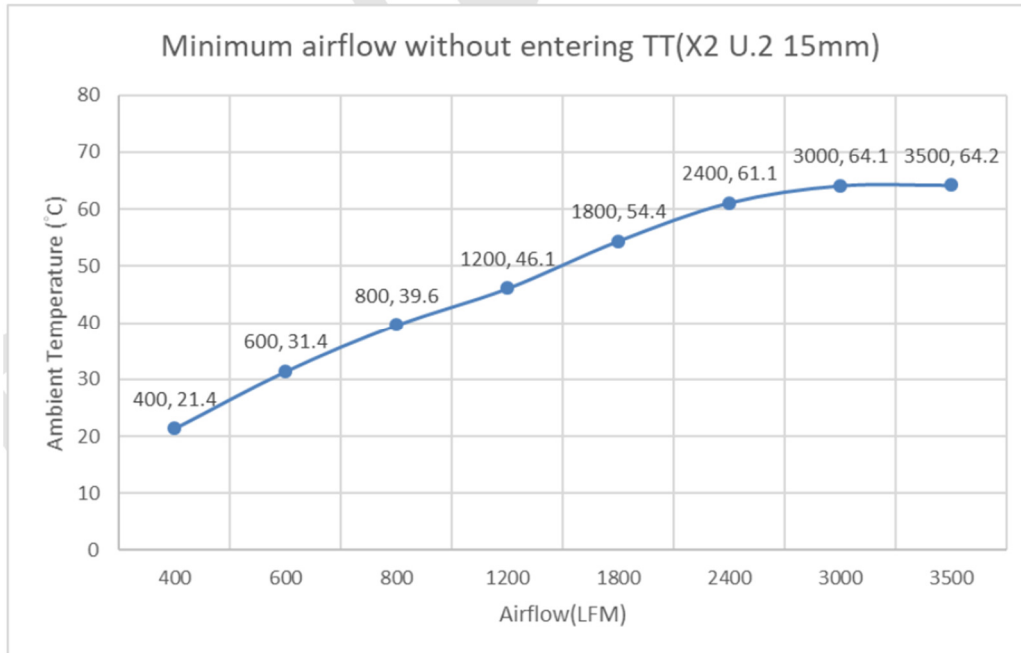
**Figure 3-1 Thermal Throttling Mechanism**

**NOTES:**

- 1.The temperature for TMT is based on Tcase.(Tcase: temperature reading of SSD thermal sensor)
- 2.TMT levels maybe varying by different workloads.

### 3.7 Airflow Profile

Figure 3-2 depicts the minimum airflow a PCIe U.2 SSD 15mm (8TB) needs to operate without triggering thermal throttling at ambient temperatures varied from 35°C to 65°C.



**Figure 3-2 Airflow Curve**

## 4. Environmental Specifications

### 4.1 Environments

Environmental specification of the PCIe U.2 Flash Drive series follows the MIL-STD-810F standard as shown in Table 4-1.

**Table 4-1:** Environmental specifications

Environment		Specification
Temperature	Operation	0°C to 70°C (Standard)
	Storage	-40°C to 100°C
Vibration		Operating: Frequency/Displacement - 7Hz~800Hz/2.17Grms Non-Operating: Frequency/Acceleration - 10Hz~2000Hz/16.3Grms
Shock		Operating / Non-operating: 500G – 2ms / 1500G, 0.5 ms
Altitude		Operating - 0 to 18,000 feet / Non-operating: 0 to 40,000 feet
Relative Humidity		Operating / Non-operating: 5% to 95%

### 4.2 Mean Time Between Failures (MTBF)

Mean Time Between Failures (MTBF) is predicted based on reliability data for the individual components in the The PCIe U.2 drive. Based on provided component data, PCIe U.2 Flash Drive is rated at more than 2.500,000 hours.

Notes about the MTBF:

The MTBF is predicated and calculated based on “Telcordia Technologies Special Report, SR-332, Issue 2” method.

### 4.3 Certification and Compliance

The PCIe U.2 complies with the following standards:

- FCC - EN55032
- CE - ANSI C63.4
- BSMI - CNS 15936
- RoHS
- PCI Express Base 3.0
- UNH-IOL NVM Express Logo

### 4.4 Endurance

The endurance of a storage device is predicted by a JEDEC approved test methodology. The data, reported in TeraBytes Written, is based on several factors related to device architecture and product usage, such as the amount of data written into the drive, block management conditions, and daily workload for the drive. Please contact Fortasa Sales to learn more about the TBW analysis and calculations.

Capacity	TBW
1920GB	3504
3840GB	7008
7680GB	14016
15360GB	28032
30720GB	56064

Notes:

1. Samples were built using Toshiba BiCS5 TLC NAND flash.
2. The test followed JEDEC219A client endurance workload.
3. TBW may differ depending on flash configuration and platform.
4. 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.

## 5. Electrical Specification

### 5.1 Operating Voltage

**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 5-1:** Operating range

Range	Ambient Temperature	Voltage
Standard	0°C to +70°C	12V ±5%

### 5.2 Power Consumption

Tables 5-2 lists the PCIe U.2 power consumption.

**Table 5-2** PCIe U.2 power consumption (typical)

Capacity	1920GB	3840GB	7680GB	15360GB	30720GB
128K Sequential READ (Average RMS, W)	16	17	17	19	21
128K Sequential WRITE (Average RMS, W)	14	21	21	23	24
4KB Random READ (Average RMS, W)	15	17	20	21	23
4KB Random WRITE (Average RMS, W)	16	22	23	24	25
4KB 70/30 Random READ/WRITE (Average RMS, W)	14	18	21	23	24
Idle (Average RMS, W)	5	5	5	5	5

**NOTES:**

1. Power consumption is measured in average RMS on full speed mode.
2. Power consumption is measured with the following conditions
  - (a) Power Consumption: 128KB seq. read/write & 4K random read/write for full drive.
  - (b) SSD is unformatted drive.
3. Power consumption platform:
  - (a) Mother board: MS03-CE0-000
  - (b) CPU: Intel Xeon Gold 5416S
  - (c) DRAM: DDR5 64G
  - (d) OS version: Ubuntu 20.04.2 LTS
4. Power consumption may differ according to flash configuration and platform.
5. The tables are for reference only.

# PCIe U.2 2.5" Flash Drive FMS-PU5PxxxT-E

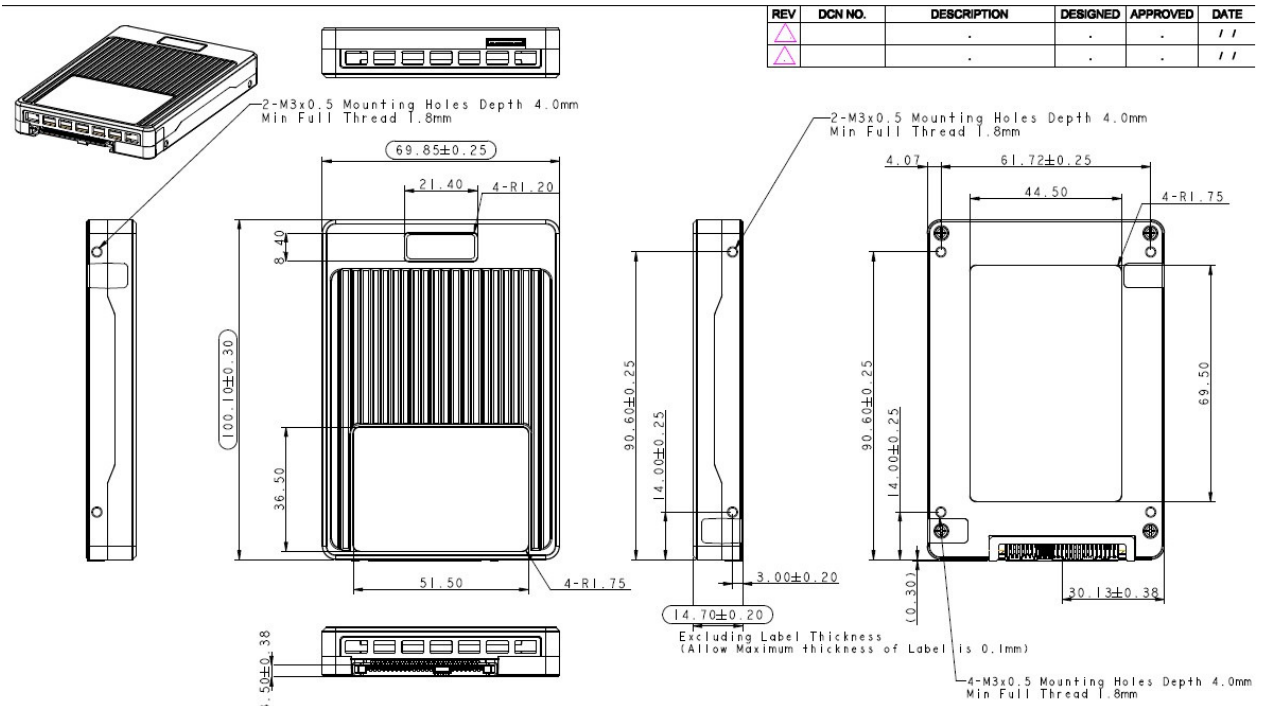


## 6. Physical Characteristics

Tables 6-1 shows the PCIe U.2 mechanical dimensions. All measurements are in mm.

**Table 6-1** PCIe U.2 Mechanical Measurements

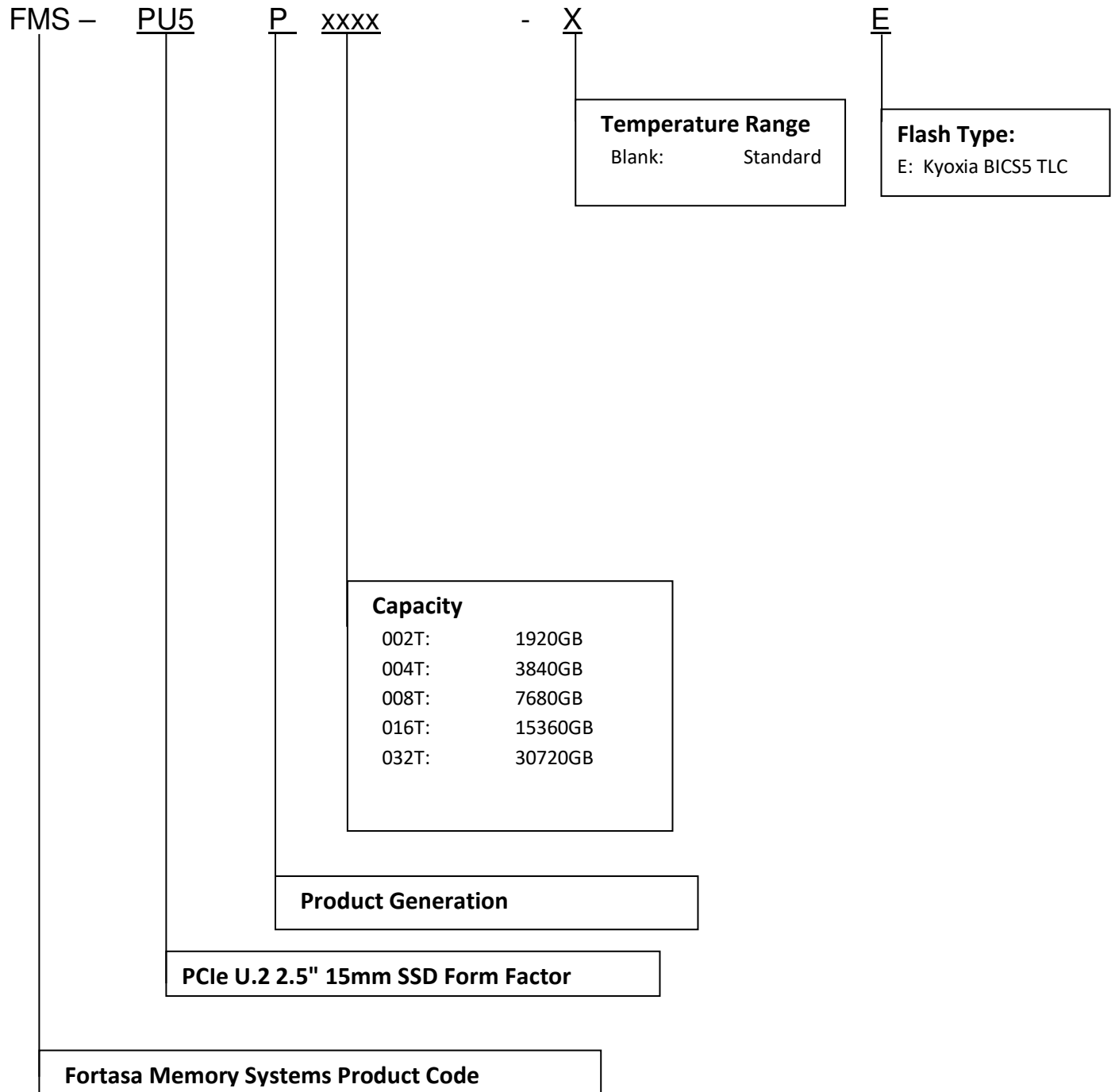
Parameter	Unit	1920GB	3840GB	7680GB	15360GB	30720GB
Length	mm	100.10 ± 0.30				
Width	mm	69.85 ± 0.25				
Height	mm	14.70 ± 0.20				
Weight	g	188	199	201	168	169



**Figure 6-1** PCIe U.2 Mechanical Measurements

### 7. Product Ordering Information

#### 7.1 Product Code Designations



# PCIe U.2 2.5" Flash Drive

## FMS-PU5PxxxT-E



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### 7.2 Valid Combinations

Capacity	Standard Temperature
1920GB	FMS-PU5P002T-E
3840GB	FMS-PU5P004T-E
7680GB	FMS-PU5P008T-E
15360GB	FMS-PU5P016T-E
30720GB	FMS-PU5P032T-E

**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your Fortasa sales representative to confirm availability of valid combinations and to determine availability of new product combinations



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## 8. Revision History

Revision	Date	Description	Comments
1.0	10/22/2025	Initial Release	

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