

The logo for goodram, featuring the word "goodram" in white lowercase letters on a dark blue rectangular background.

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GOODRAM Industrial 2.5" SSD 3D TLC type

DATASHEET

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REVISION HISTORY

VERSION	CHANGES	DATE
1.0	Initial release	25.02.2022



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PRODUCT OVERVIEW

Capacity	128GB-2TB
Controller	PS3117-S17
Form Factor	2.5" SSD
Interface	- SATA Revision 3.2 - SATA 1.5Gbs, 3Gbs and 6Gbs interface
NAND Flash Type	- Kioxia BiCS5 - 1pc to 4pcs of BGA
Performance ^{Note1}	- Read: up to 550MB/s - Write: up to 510MB/s
Power Consumption ^{Note2}	- Active mode: < 1750mW - Idle mode: < 215mW
TBW ^{Note3}	2900TBW for 2TB
MTBF	More than 2000000 hours
Endurance	- Up to 3000 erase/program cycles in whole capacity - Data retention over 10 years in room temperature (+25°C)^{Note4}
Advanced Flash Management:	- Static and Dynamic Wear Levelling - Error Correction Code (ECC) - Wear Leveling - Bad Block Management - TRIM - SMART - Over-Provisioning - Firmware update - SmartZIP™
Low Power Management	- DIPM/HIPM Mode - DEVSLP Mode
Temperature Range ^{Note5} :	- Operation: Standard 0 ~ +70°C - Operation: Industrial -40°C ~ +85°C - Storage: -40°C ~ +85°C
RoHS compliant	

Notes:

1. Measured by CrystalDiskMark v5.0
2. Please see "Power Consumption" for details.
3. Please see "TBW (Terabyte Written)" for details.
4. In new product.
5. According to IEC-60068-2-1/2/14/38 standard.

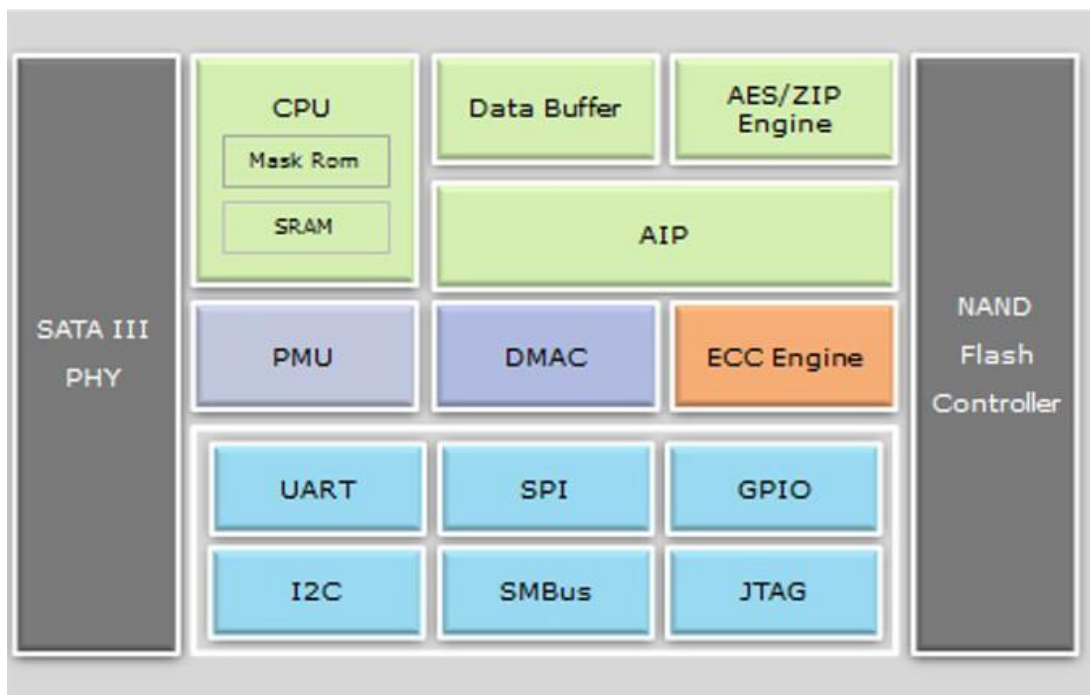
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PRODUCT DETAILS

GENERAL DESCRIPTION

GOODRAM Industrial 2.5" SATA SSD delivers all the advantages of flash disk technology with Serial ATA I/II/III interface and is fully compliant with the standard 2.5 inch form factor. The 2.5" SSD is designed to operate at a maximum operating frequency of 200MHz with 30MHz external crystal. The capacity could provide a wide range up to 2TB and the performance reach up to 550MB/s read as well as 510MB/s write based on Toggle 2.0 TLC (with 32MB SDR cache enabled and measured by CrystalDiskMark). Meanwhile, the power consumption is much lower than traditional Hard Drives.

CONTROLLER BLOCK DIAGRAM



PS3117-S17 2.5" Controller Block Diagram

FLASH MANAGEMENT

GOODRAM Industrial 2.5" 3D TLC SSD utilizes all the state of art technologies to ensure full reliability until the TBW parameter is reached. These technologies include:

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Error Correction Code (ECC)

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, SSD drive applies the LDPC (Low Density parity Check) of ECC algorithm, which can detect and correct errors occur during read process, ensure data been read correctly, as well as protect data from corruption.

Wear Levelling

NAND Flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If some area get updated more frequently than others, the lifetime of the device would be reduced significantly. Thus, Wear Leveling technique is applied to extend the lifespan of NAND Flash by evenly distributing write and erase cycles across the media. Product has advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND Flash is greatly improved.

Bad Block Management

Bad blocks are blocks that include one or more invalid bits, and their reliability is not guaranteed. Blocks that are identified and marked as bad by the manufacturer are referred to as "Initial Bad Blocks". Bad blocks that are developed during the lifespan of the flash are named "Later Bad Blocks". We implement an efficient bad block management algorithm to detect the factory-produced bad blocks and manages any bad blocks that appear with use. This practice further prevents data being stored into bad blocks and improves the data reliability.

TRIM

TRIM is a feature which helps improve the read/write performance and speed of solid-state drives (SSD). Unlike hard disk drives (HDD), SSDs are not able to overwrite existing data, so the available space gradually becomes smaller with each use. With the TRIM command, the operating system can inform the SSD which blocks of data are no longer in use and can be removed permanently. Thus, the SSD will perform the erase action, which prevents unused data from occupying blocks all the time.

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SMART, an acronym for Self-Monitoring, Analysis and Reporting Technology, is an open standard that allows a hard disk drive to automatically detect its health and report potential failures. When a failure is recorded by SMART, users can choose to replace the drive to prevent unexpected outage or data loss. Moreover, SMART can inform users of impending failures while there is still time to perform proactive actions, such as copy data to another device.

Over-Provision

Over Provisioning refers to the inclusion of extra NAND capacity in a SSD, which is not visible and cannot be used by users. With Over Provisioning, the performance and IOPS (Input/Output Operations per Second) is improved by providing the controller additional space to manage P/E cycles, which enhances the reliability and endurance as well. Moreover, the write amplification of the SSD becomes lower when the controller writes data to the flash.

Firmware Upgrade

Firmware can be considered as a set of instructions on how the device communicates with the host. Firmware will be upgraded when new features are added, compatibility issues are fixed or read/write performance gets improved.

SmartZIP™

Write data to the NAND Flash costs time. To improve the write speed performance, controller launches with compression technique – SmartZIP™. Whether a file could be compressed or not depending on the file type, for file types have redundancy data pattern, through our embedded encode engine, we could reduce the amount of data that is actually written to the Flash. Comparing to the SSD without compression, write efficiency is raised and the SSD endurance is also improved since Flash could be benefit from less data written for longer SSD lifetime.

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ADDITIONAL FEATURES

Low Power Management (DIPM/HIPM Mode)

SATA interfaces contain two low power management states for power saving: Partial and Slumber modes. For Partial mode, the device has to resume to full operation within 10 microseconds, whereas the device will spend 10 milliseconds to become fully operational in the Slumber mode. SATA interfaces allow low power modes to be initiated by Host (HIPM, Host Initiated Power Management) or Device (DIPM, Device Initiated Power Management). As for HIPM, Partial or Slumber mode can be invoked directly by the software. For DIPM, the device will send requests to enter Partial or Slumber mode.

DEVSLP Mode (Optional)

With the increasing need of aggressive power/battery life, SATA interfaces include a new feature, Device Sleep (DEVSLP) mode, which helps further reduce the power consumption of the device. DEVSLP enables the device to completely power down the device PHY and other sub-systems, making the device reach a new level of lower power operation. The DEVSLP does not specify the exact power level a device can achieve in the DEVSLP mode, but the power usage can be dropped down to 5mW or less.

Advanced Device Security Features (Secure Erase, Write Protect)

Secure Erase is a standard ATA command and will write all "0xFF" to fully wipe all the data on hard drives and SSDs. When this command is issued, the SSD controller will empty its storage blocks and return to its factory default settings. When a SSD contains too many bad blocks and data are continuously written in, then the SSD might not be used anymore. Thus, Write Protect is a mechanism to prevent data from being written in and protect the accuracy of data that are already stored in the SSD.

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PERFORMANCE AND POWER CONSUMPTION

Capacity	Flash Structure	Performance		Power Consumption		
		CrystalDiskMark		Read (mW)	Write (mW)	Idle (mW)
		Read (MB/s)	Write (MB/s)			
128GB	128GB x 1	550	450	1100	1150	210
256GB	256GB x 1	550	485	1150	1300	210
512GB	256GB x 2	550	500	1200	1520	210
1TB	256GB x 4	550	510	1350	1730	215
2TB	512GB x 4	550	510	1500	1750	215

NOTES:

1. The performance was measured using CrystalDiskMark.
2. Samples were built using Kioxia BiCS5 NAND flash.
3. Performance may differ according to flash configuration and platform.
4. 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.

SUPPLY VOLTAGE

PARAMETER	RATING
Operating Voltage	5V +/- 5%

TEMPERATURE SPECIFICATION

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
T _a	Operating Temperature Standard	0	+70	°C
T _a	Operating Temperature Industrial	-40	+85	°C
T _{st}	Storage Temperature	-40	+85	°C

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TBW

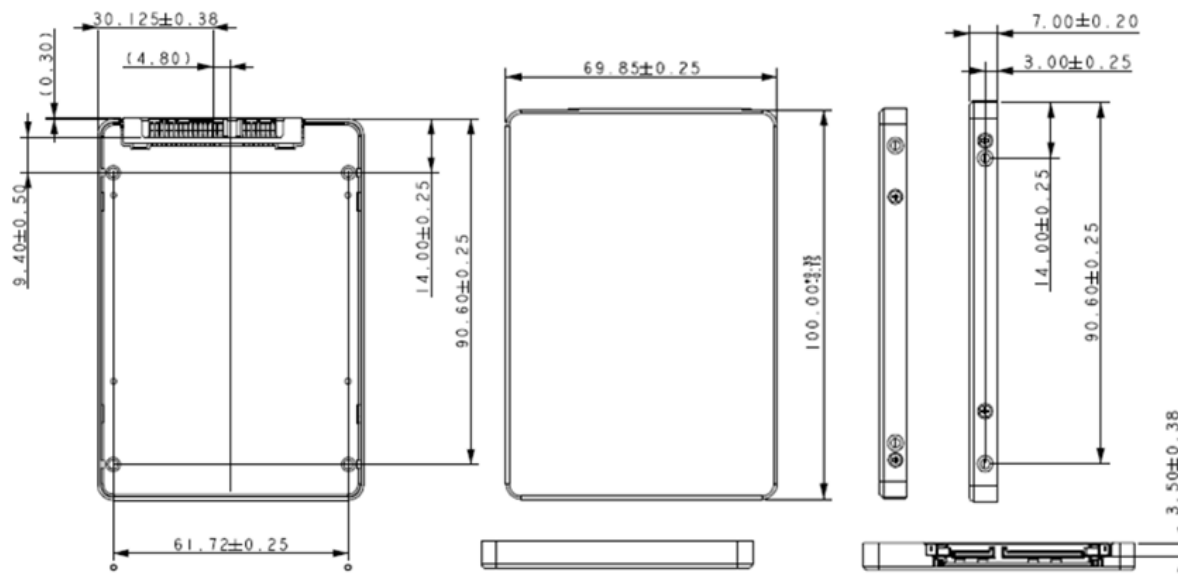
Capacity	Flash Structure	TBW
128GB	128GB x 1	90
256GB	256GB x 1	230
512GB	256GB x 2	550
1TB	256GB x 4	1200
2TB	512GB x 4	2900

NOTES:

1. Samples were built using Kioxia BiCS5 NAND flash.
2. The test followed JEDEC219A client endurance workload.
3. TBW may differ according to flash configuration and platform.
4. The endurance of CF could be estimated based on user behaviour, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

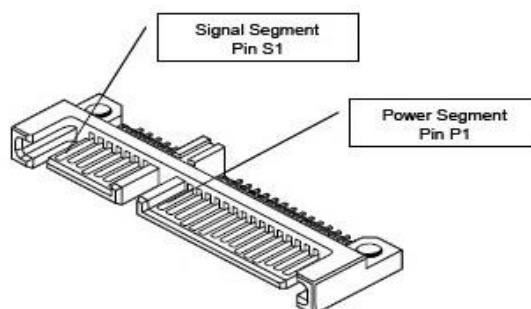
PHYSICAL DIMENSION

Dimensions: 100.00mm (L) x 69.85mm (W) x 7.00mm (H)



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PIN ASSIGNMENT AND DESCRIPTIONS



Signal Segment Pin Assignment and Descriptions

Pin Number	Function
S1	GND
S2	A+ (Differential Signal Pair A)
S3	A – (Differential Signal Pair A)
S4	GND
S5	B – (Differential Signal Pair B)
S6	B+ (Differential Signal Pair B)
S7	GND

Power Segment Pin Assignment and Descriptions

Pin Number	Function
P1	Not Used (3.3V)
P2	Not Used (3.3V)
P3	DEVSLP
P4	GND
P5	GND
P6	GND
P7	5V pre-charge
P8	5V
P9	5V
P10	GND
P11	Reserved
P12	GND
P13	Not Used (12V pre-charge)
P14	Not Used (12V)
P15	Not Used (12V)

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SUPPORTED ATA COMMAND LIST

Op-Code		Command Description	Op-Code		Command Description
00h		NOP	E1h		Idle Immediate
06h		Data Set Management	E2h		Standby
10h-1Fh		Recalibrate	E3h		Idle
20h		Read Sectors	E4h		Read Buffer
21h		Read Sectors without Retry	E5h		Check Power Mode
24h		Read Sectors EXT	E6h		Sleep
25h		Read DMA EXT	E7h		Flush Cache
27h		Read Native Max Address EXT	E8h		Write Buffer
29h		Read Multiple EXT	E9h		READ BUFFER DMA
2Fh		Read Log EXT	EAh		Flush Cache EXT
30h		Write Sectors	EBh		Write Buffer DMA
31h		Write Sectors without Retry	ECh		Identify Device
34h		Write Sectors EXT	EFh		Set Features
35h		Write DMA EXT	90h		Execute Device Diagnostic
37h		Set Native Max Address EXT	91h		Initialize Device Parameters
39h		Write Multiple EXT	92h		Download Microcode
3Dh		Write DMA FUA EXT	93h		Download Microcode DMA
3Fh		Write Long EXT	B0h		SMART
40h		Read Verify Sectors	EFh	02h	Enable volatile write cache
41h		Read Verify Sectors without Retry	EFh	03h	Set transfer mode
42h		Read Verify Sectors EXT	EFh	05h	Enable the APM feature set
47h		Read Log DMA EXT	EFh	10h	Enable use of SATA features et
57h		Write Log DMA EXT	EFh	10h 02h	Enable DMA Setup FIS Auto-Activate optimization
60h		Read FPDMA Queued	EFh	10h 03h	Enable Device-initiated interface power state (DIPM) transitions
61h		Write FPDMA Queued	EFh	10h 06h	Enable Software Settings Preservation (SSP)
70h-76h		Seek	EFh	10h 07h	Enable Device Automatic Partial to Slumber transitions
79h-7Fh		Seek	EFh	10h 09h	Enable Device Sleep
C9h		Read DMA without Retry	EFh	55h	Disable read look-ahead
CAh		Write DMA	EFh	66h	Disable reverting to power-on defaults
CBh		Write DMA without Retry	EFh	82h	Disable volatile write cache
CEh		Write Multiple FUA EXT	EFh	85h	Disable the APM feature set
E0h		Standby Immediate	EFh	90h	Disable use of SATA feature set
C4h		Read Multiple	EFh	90h 02h	Disable DMA Setup FIS Auto-Activate optimization
C5h		Write Multiple	EFh	90h 03h	Disable Device-initiated interface power state (DIPM) transitions
C6h		Set Multiple Mode	EFh	90h 06h	Disable Software Settings Preservation (SSP)
C8h		Read DMA	EFh	90h 07h	Disable Device Automatic Partial to Slumber transitions
B0h	D0h	SMART READ DATA	EFh	90h 09h	Disable Device Sleep
B0h	D2h	00h SMART READ ATTRIBUTE THRESHOLDS	EFh	90h 02h	Disable DMA Setup FIS Auto-Activate optimization
B0h	D2h	F1h SMART ENABLE ATTRIBUTE AUTOSAVE	EFh	90h 03h	Disable Device-initiated interface power state (DIPM) transitions

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B0h	D4h	SMART EXECUTE OFF-LINE IMMEDIATE	EFh	90h	06h	Disable Software Settings Preservation (SSP)
B0h	D5h	SMART READ LOG	EFh	90h	07h	Disable Device Automatic Partial to Slumber transitions
B0h	D6h	SMART WRITE LOG	EFh	90h	09h	Disable Device Sleep
B0h	D8h	SMART ENABLE OPERATIONS	EFh	AAh		Enable read look-ahead
B0h	D9h	SMART DISABLE OPERATIONS	EFh	CCh		Enable reverting to power-on defaults
B0h	DAh	SMART RETURN STATUS		F1h		Security Set Password
B1h	C0h	DEVICE CONFIGURATION RESTORE		F2h		Security Unlock
B1h	C2h	DEVICE CONFIGURATION IDENTIFY		F3h		Security Erase Prepare
B1h	C3h	DEVICE CONFIGURATION SET		F4h		Security Erase Unit
B1h	C4h	DEVICE CONFIGURATION IDENTIFY DMA		F5h		Security Freeze Lock
B1h	C5h	DEVICE CONFIGURATION SET DMA		F6h		Security Disable Password
F9h	01h	SET MAX SET PASSWORD		F8h		Read Native Max Address
F9h	02h	SET MAXLOCK		F9h		Set Max Address
F9h	03h	SET MAX UNLOCK				
F9h	04h	SET MAX FREEZE LOCIC				

PRODUCT ORDERING INFORMATION

PN	Type	Capacity	Technology	Temp range	Grade
SSD10-1283SG-P17KIF	2.5"	128GB	3D TLC	0~70°C	standard
SSD10-2563SG-P17KIF	2.5"	256GB	3D TLC	0~70°C	standard
SSD10-5123SG-P17KIF	2.5"	512GB	3D TLC	0~70°C	standard
SSD10-1T03SG-P17KIF	2.5"	1TB	3D TLC	0~70°C	standard
SSD10-2T03SG-P17KIF	2.5"	2TB	3D TLC	0~70°C	standard
SSD10-1283DG-P17KIF	2.5"	128GB	3D TLC	-40~85°C	industrial
SSD10-2563DG-P17KIF	2.5"	256GB	3D TLC	-40~85°C	industrial
SSD10-5123DG-P17KIF	2.5"	512GB	3D TLC	-40~85°C	industrial
SSD10-1T03DG-P17KIF	2.5"	1TB	3D TLC	-40~85°C	industrial
SSD10-2T03DG-P17KIF	2.5"	2TB	3D TLC	-40~85°C	industrial

STANDARDS & REFERENCES

The following table is to list out the standards that have been adopted for designing the product.

STANDARD USED	ACRONYM/SOURCE
RoHS	Restriction of Hazardous Substances Directive
Serial ATA Revision 3.1	http://www.sata-io.org
ATA-8 spec	http://www.t13.org
CE	Consumer electronics certification; please contact us for further information.

SAFETY PRECAUTIONS

Do not bend, crush, drop, or place heavy objects on top of the Product. Do not use tweezers, pliers or similar items that could damage the Product. Take particular care when inserting or removing the Product. Stop using the Product when the Product does not work properly. Failure to follow these instructions could result in fire, damage to the Product and/or other property, and/or personal injury including burns and electric shock.

Keep out of reach of small children. Accidental swallowing may cause suffocation or injury. Contact a doctor immediately if you suspect a child has swallowed the Product.

Do not directly touch the interface pins, put them in contact with metal, strike them with hard objects or cause them to short. Do not expose to static electricity.

Do not disassemble or modify the Product. This may cause electric shock, damage to the Product or fire.

NOTES ON USAGE

The Product contains nonvolatile semiconductor memory. Do not use the Product in accordance with a method of usage other than that written in the manual. This may cause the destruction or loss of data.

To protect against accidental data loss, you should back up your data frequently on more than one type of storage media. Wilk Elektronik S.A. assumes no liability for destruction or loss of data recorded on the Card for any reason.

When used over a long period of time or repeatedly, the reading, writing and deleting capabilities of the Product will eventually fail, and the performance speed of the Product may decrease below the original speed specific to the Product's applicable class.

If the Product is to be transferred or destroyed, note that the data it contained may still be recoverable unless it is permanently deleted by third-party deletion software or similar means beforehand.

Product is intended for use in general electronics applications and selected industrial applications and any other specific applications as expressly stated in this document. Product is neither intended nor warranted for use in equipment or systems where failure may cause loss of human life, bodily injury, serious property damage or serious public impact ("Unintended Use"). Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment or equipment used to control combustions or explosions. Do not use Product for Unintended Use unless specifically permitted in this document.

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