GOODRAM Industrial
CFExpress Memory Card 3D TLC type

DATASHEET

Version: 1.0
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CFExpress Card for Industrial Applications

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REVISION HISTORY

VERSION	CHANGES	DATE
1.0	Initial release	08.08.2022

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PRODUCT OVERVIEW

- **Capacity:**
  - 15GB, 30GB, 60GB, 120GB, 240GB, 480GB
- **Flash Type**
  - 3D TLC Kioxia BiCS Flash
- **Host Interface**
  - Gen3 x2 Lanes
- **Type B CFExpress**
- **Performance** Note1
  - Sequential Read: Up to 1610 MB/s
  - Sequential Write: Up to 820 MB/s
- **Power Consumption** Note2
  - Idle mode: < 102mW
- RoHS compliant
- REACH compliant
- Host Memory Buffer
- **MTBF**
  - More than 2 000 000 hours
- **Endurance**
  - Up to 3 000 erase/program
  - Data retention 10 years in room temperature (40°C) Note3
- **Advanced Flash Management**
  - Static and Dynamic Wear Levelling
  - LDPC ECC
  - Subpage Mode Flash Translation Layer
  - Data Care Management
  - Lifetime Enhancements
  - Power Fail Data Loss Protection
  - TRIM
  - Active State Power Management
  - Firmware Update
  - S.M.A.R.T
  - TCG Opal (on demand)
  - End-to-End Data Protection
  - AES256 Encryption (on demand, active for 480GB)
- **Low Power Management**
  - Power Sleep Mode
- **Temperature Range**
  - Operation: -40 ~ +85°C
  - Storage: -40 ~ +85°C

Notes:
1. Measured by CrystalDiskMark v3.0
2. Please see “Power Consumption” for details.
3. In new product.

PRODUCT DETAILS

GENERAL DESCRIPTION

CFExpress™ cards are currently the newest solution supported by Compact Flash Association, which is capable of to fulfill the most rigid demands of industrial customer. By offering excellent performance and wide compatibility, GOODRAM's CFExpress™ Card also provides a wide range of capacities available for users. In addition, industrial-grade CFExpress™ cards are available for any applications under rigorous environmental conditions including extensive temperature, shock and vibration.

MAIN FLASH MANAGEMENT TOOLS

GOODRAM CFExpress™ card utilizes all the state of art technologies to ensure full reliability until the specified NAND Flash program/erase cycles parameter is reached. These technologies include but are not limited to:

Error Correction Code (ECC)

Flash memory cells will deteriorate with use, which might generate random bit errors in the stored data. Thus, CFExpress™ controller applies the LDPC 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.

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.

ADDITIONAL FEATURES

Power Management

Active State Power Management (ASPM) is a power management mechanism for PCIe devices to reduce power consumption while running. This is achieved through powering down the PCIe serial link when there is no traffic across it.

PERFORMANCE AND POWER CONSUMPTION

Capacity	Flash Structure	Performance Sequential Read/Write				Power Consumption		
		Read HMB on (MB/s)	Read HMB off (MB/s)	Write HMB on (MB/s)	Write HMB off (MB/s)	Read (mW)	Write (mW)	Idle (mW)
15GB	1x128Gb	290	290	100	60	380	360	102
30GB	1x256Gb	290	290	100	60	380	360	102
60GB	2x256Gb	590	580	200	150	460	410	102
120GB	4x256Gb	1 180	1 140	380	200	610	480	102
240GB	8x256Gb	1 610	1 590	700	370	690	590	102
480GB	8x512Gb	1 610	1 600	820	580	760	700	102

NOTES:
1. The performance was measured using CrystalDiskMark 7.0.0.
2. All values are typical total values recorded at 25 °C
3. HMB – Host Memory Buffer.
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	Symbol	Min	TYP	MAX	Unit
V_{DD} Voltage	VDD	3.1	3.3	3.5	V

Temperature specification

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
T_a	Operating Temperature Diamond	-40	+85	°C
T_{st}	Storage Temperature	-40	+85	°C

TBW

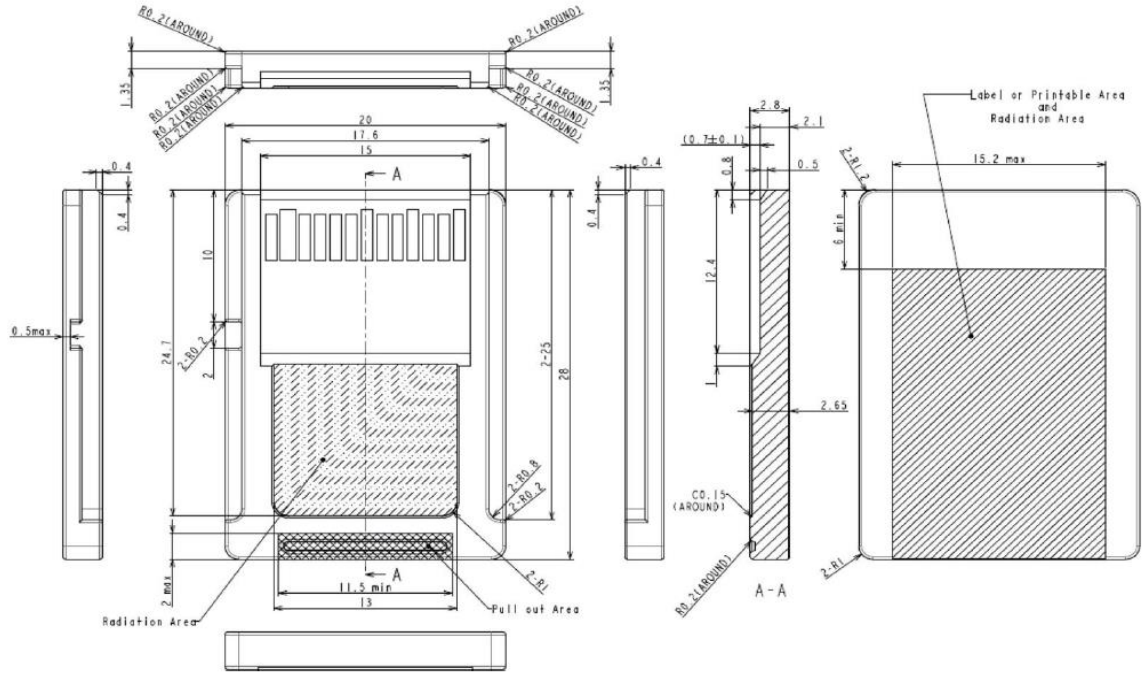
Capacity	Flash Structure	TBW Sequential
15GB	1x128Gb	24
30GB	1x256Gb	51
60GB	2x256Gb	107
120GB	4x256Gb	218
240GB	8x256Gb	444
480GB	8x512Gb	1 420

NOTES:

1. The test followed JEDEC219 client endurance workload.
2. TBW may differ according to flash configuration and platform.
3. The endurance of CFExpress could be estimated based on user behaviour, NAND endurance cycles, and write amplification factor. It is not guaranteed by flash vendor.

PHYSICAL DIMENSION

Dimension: 38.5 ± 0,20 mm (L) x 29.6 ± 0,10 mm (W) x 3.80 ± 0,10 mm (H)



PIN ASSIGNMENT AND DESCRIPTIONS

Pin No.	Signal	I/O	Host	Notes
1	GND		R	
2	PERp1	0	Opt	
3	PERn1	0	Opt	
4	GND		Opt	3
5	PETn1	I	Opt	
6	PETp1	I	Opt	
7	Reserved		NC	
8	Reserved		NC	
9	PERST#	I	R	
10	+3.3V		R	
11	CLKREQ#	0	Opt	2
12	INS#	0	R	1
13	REFCLK-	I	R	
14	REFCLK+	I	R	
15	GND		R	
16	PERn0	0	R	
17	PERp0	0	R	
18	GND		R	
19	PETn0	I	R	
20	PETp0	I	R	
21	GND		R	

Notes:
1. A host pull-up resistor in the range of 100kΩ-200kΩ is required on this pin. This pin is internally strapped to the ground.
2. A host pull-up resistor (≥5kΩ) is required on this pin.
3. In case that PCI Express Transmitter differential pair Lane 1 and Receiver differential pair Lane 1 are implemented, pin 4 shall be connected to ground.

SUPPORTED NVMe COMMAND LIST

Command	Code	Command	Code
Delete I/O Submission Queue	00h	Create I/O Queue	01h
Get Log Page	02h	Delete I/O Completion Queue	04h
Create I/O Completion Queue	05h	Identify	06h
Abort	08h	Set Features	09h
Get Features	0Ah	Asynchronous Event Request	0Ch

Firmware Commit	10h	Firmware Image Download	11h
Device Self-test	14h	Format NVM	80h
Sanitize	84h		
NVM Command Set			
Flush	00h	Write	01h
Read	02h	Write Uncorrectable	04h
Compare	05h	Write Zeroes	08h
Dataset Management	09h		

PRODUCT ORDERING INFORMATION

PN	Type	Capacity	Technology	Temp range
CFEXB-0153DG-S03KID	CFExpress	15 GB	3D TLC	-40 ~85°C
CFEXB-0303DG-S03KID	CFExpress	30 GB	3D TLC	-40 ~85°C
CFEXB-0603DG-S03KID	CFExpress	60 GB	3D TLC	-40 ~85°C
CFEXB-1203DG-S03KID	CFExpress	120 GB	3D TLC	-40 ~85°C
CFEXB-2403DG-S03KID	CFExpress	240 GB	3D TLC	-40 ~85°C
CFEXB-4803DG-S03KIE	CFExpress	480 GB	3D TLC	-40 ~85°C

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; please contact us for further information
CompactFlash™ Card	http://www.compactflash.org/
PC Card Standard Release 8.0	http://www.compactflash.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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