GOODRAM Industrial
Compact Flash Memory Card MLC type
DATASHEET

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CF Card for Industrial Applications

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REVISION HISTORY

VERSION	CHANGES	DATE
1.0	Initial release	15.07.2020

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PRODUCT OVERVIEW

- Capacity:
  - 4GB – 128GB
- Flash Type
  - Kioxia 15nm MLC
- Controller
  - PS3016-P9
- Performance Note1
  - Read: Up to 68MB/s
  - Write: Up to 72MB/s
- Power Consumption Note2
  - Active mode: < 800mW
  - Idle mode: < 20mW
- TBW Note3
  - 68 TBW for 128GB
- RoHS compliant
- MTBF
  - More than 1 000 000 hours
- Endurance
  - Up to 100000 erase/program cycles in whole capacity
  - Data retention over 10 years in room temperature (25^{0}C) Note4
- Advanced Flash Management
  - Error Correction Code
  - Wear Leveling
  - Static and Dynamic Wear Levelling
  - Bad Block Management
  - Firmware Update
- Temperature Range Note5
  - Operation
    - Silver: 0°C ~ +70°C
    - Diamond: -40°C ~ +85°C
  - Storage: -40C ~ +85°C

Notes:
1. Measured by CrystalDiskMark v3.0
2. Please see "Power Consumption" for details.
3. Please see "TBW (Terabyte Written)" for details.
4. In new product.
5. According to standards IEC-60068-2-1/2/14/38

PRODUCT DETAILS

GENERAL DESCRIPTION

CompactFlash™ Card is one of the most popular flash storage elements in the memory card market. By offering excellent performance and wide compatibility, GOODRAM's CompactFlash™ Card also provides a wide range of capacities available for users. In addition, industrial-grade CompactFlash™ cards are available for any applications under rigorous environmental conditions including extensive temperature, shock and vibration.

FLASH MANAGEMENT

GOODRAM CF 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, CompactFlash™ controller applies the BCH 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

CF Card provides automatic power saving modes and the descriptions which address the conditions and reactions when a CompactFlash card goes into a specific mode:

Standby Mode:	When CF Card finishes the initialization routine after power reset, it goes into Standby Mode and will wait for Command In or Soft Reset.
Active Mode:	If CF Card receives any Command In or Soft Reset, it goes into Active Mode. In Active Mode, CF card is capable of executing any ATA commands and therefore, power consumption is the greatest under this mode.
Idle Mode:	After CF Card executes any ATA Commands or Soft Reset, it goes into Idle Mode. Power consumption is reduced from Active Mode.
Sleep Mode:	A CF Card will enter Sleep Mode if there is no Command In or Soft Reset from the host. Sleep Mode provides the lowest power consumption. During Sleep Mode, the main clock of the system is stopped. Hardware reset, software reset or any ATA command assertion will awake the controller from Sleep Mode.

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.

PERFORMANCE AND POWER CONSUMPTION

Capacity	Flash Structure	Performance		Power Consumption		
		CrystalDiskMark		Read (mW)	Write (mW)	Idle (mW)
		Read (MB/s)	Write (MB/s)			
4GB	4GB x 1, TSOP	30	10	360	250	20
8GB	4GB x 2, TSOP	40	25	415	330	20
16GB	4GB x 4, TSOP	63	45	565	485	20
	8GB x 2, TSOP	36	25	435	373	20
32GB	32GB x 1, BGA	40	23	432	405	20
	8GB x 4, TSOP	58	43	643	575	20
64GB	32GB x 2, BGA	68	44	481	575	20
	16GB x 4, TSOP	59	43	632	565	20
128GB	64GB x 2, BGA	68	72	667	800	20

NOTES:

1. The performance was measured using CrystalDiskMark.
2. Samples were built using Kioxia 15nm MLC 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	Symbol	Min	TYP	MAX	Unit
V_{DD} Voltage	V_{DD}	3.0	3.3	3.6	V
		4.5	5.0	5.5	V

Temperature specification

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
T_a	Operating Temperature Silver	0	+70	°C
T_a	Operating Temperature Diamond	-40	+85	°C
T_{st}	Storage Temperature	-40	+85	°C

TBW

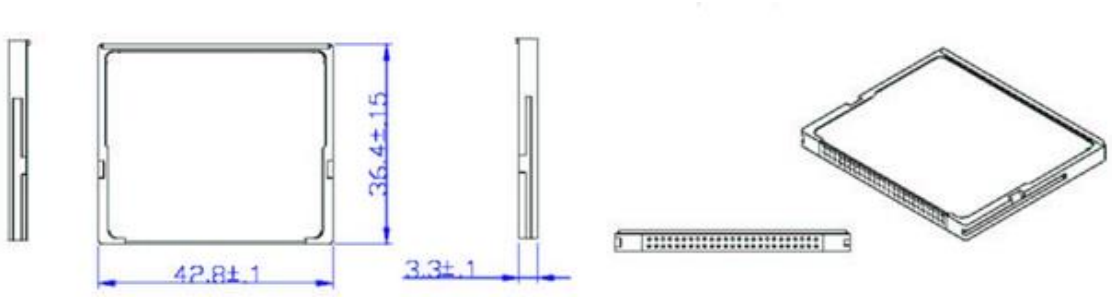
Capacity	Flash Structure	TBW
4GB	4GB x 1	2
8GB	4GB x 2	5
16GB	4GB x 4	9
	8GB x 2	
32GB	32GB x1	17
	8GB x 4	
64GB	32GB x 2	34
	16GB x 4	
128GB	32GB x 4	68
	64GB x 2	

NOTES:

1. Samples were built using Kioxia 15nm MLC 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

Dimension: 42.8mm(L) x 36.4mm (W) x 1.00mm (H)



PIN ASSIGNMENT AND DESCRIPTIONS

PC Card Memory Mode			PC Card I/O Mode			True IDE Mode		
Pin #	Signal Name	Pin Type	Pin #	Signal Name	Pin Type	Pin #	Signal Name	Pin Type
1	GND		1	GND		1	GND	I/O
2	D03	I/O	2	D03	I/O	2	D03	I/O
3	D04	I/O	3	D04	I/O	3	D04	I/O
4	D05	I/O	4	D05	I/O	4	D05	I/O
5	D06	I/O	5	D06	I/O	5	D06	I/O
6	D07	I/O	6	D07	I/O	6	D07	I
7	-CE1	I	7	-CE1	I	7	-CSO	I
8	A10	I	8	A10	I	8	A10	I
9	-OE	I	9	-OE	I	9	-ATA SEL	I
10	A09	I	10	A09	I	10	A09	I
11	A08	I	11	A08	I	11	A08	I
12	A07	I	12	A07	I	12	A07	I
13	VCC		13	VCC		13	VCC	
14	A06	I	14	A06	I	14	A06	I
15	A05	I	15	A05	I	15	A05	I
16	A04	I	16	A04	I	16	A04	I
17	A03	I	17	A03	I	17	A03	I
18	A02	I	18	A02	I	18	A02	I
19	A01	I	19	A01	I	19	A01	I
20	A00	I	20	A00	I	20	A00	I/O
21	D00	I/O	21	D00	I/O	21	D00	I/O
22	D01	I/O	22	D01	I/O	22	D01	I/O
23	D02	I/O	23	D02	I/O	23	D02	I/O
24	WP	O	24	-IOIS16	O	24	-IOIS16	O
25	-CD2	O	25	-CD2	O	25	-CD2	O
26	-CD1	O	26	-CD1	O	26	-CD1	I/O
27	D11	I/O	27	D11	I/O	27	D11	I/O
28	D12	I/O	28	D12	I/O	28	D12	I/O
29	D13	I/O	29	D13	I/O	29	D13	I/O
30	D14	I/O	30	D14	I/O	30	D14	I/O
31	D15	I/O	31	D15	I/O	31	D15	I/O
32	-CE2	I	32	-CE2	I	32	-CS1	I
33	-VS1	O	33	-VS1	O	33	-VS1	O
34	-IORD	I	34	-IORD	I	34	-IORD	I
35	-IOWR	I	35	-IOWR	I	35	-IOWR	I
36	-WE	I	36	-WE	I	36	-WE	I
37	RDY/BSY	O	37	IREQ	O	37	INTRQ	O
38	VCC		38	VCC		38	VCC	
39	-CSEL	I	39	-CSEL	I	39	-CSEL	I
40	-VS2	O	40	-VS2	O	40	-VS2	O
41	RESET	I	41	RESET	I	41	RESET	I
42	-WAIT	O	42	-WAIT	O	42	IORDY	O
43	-INPACK	O	43	-INPACK	O	43	DMARQ	O
44	-REG	I	44	-REG	I	44	-DMACK	I
45	BVD2	O	45	-SPKR	O	45	-DASP	I/O
46	BVD1	O	46	-STSCHG	O	46	-PDIAG	I/O
47	D08	I/O	47	D08	I/O	47	D08	I/O
48	D09	I/O	48	D09	I/O	48	D09	I/O
49	D10	I/O	49	D10	I/O	49	D10	I/O
50	GND		50	GND		50	GND	

SUPPORTED ATA COMMAND LIST

Word Address	Default Value	Total Bytes	Data Field Type Information
0	848AH	2	General configuration bit-significant information
1	XXXX	2	Default number of cylinders
2	0000H	2	Reserved
3	XXXX	2	Default number of heads
4	0000H	2	Retired
5	0200H	2	Retired
6	XXXX	2	Default number of sectors per track
7-8	XXXXh	4	Number of sectors per card
9	0000H	2	Retired
10-19	XXXX	20	Serial Number in ASCII
20	0002H	2	Retired
21	0002H	2	Retired
22	0004H	2	Obsolete
23-26	XXXX	8	Firmware revision in ASCII
27-46	XXXX	40	Model number in ASCII
47	0001H	2	Maximum number of sector that shall be transferred on Read/Write Multiple commands
48	0000H	2	Reserved
49	0300H	2	Obsolete
50	0000H	2	Reserved
51	0200H	2	PIO data transfer cycle timing mode 2
52	0000H	2	Retired
53	0007H	2	Word 54-58, 64-70 and 88 are valid
54	XXXX	2	Current numbers of cylinders
55	XXXX	2	Current numbers of heads
56	XXXX	2	Current sectors per track
57-58	XXXX	4	Current capacity in sectors (LBAs)(Word 57= LSW, Word 58= MSW)
59	0101H	2	Multiple sector setting is valid
60-61	XXXX	4	Total number of sectors addressable in LBA Mode
62	0000H	2	Retired
63	0007H	2	Multiword DMA mode 2 and below are supported
64	0003H	2	Advance PIO transfer modes supported
65	0078H	2	Minimum Multiword DMA transfer cycle time 120nsec
66	0078H	2	Manufacturer's recommended Multiword DMA transfer cycle time 120nsec
67	0078H	2	Minimum PIO transfer cycle time without flow control 120nsec
68	0078H	2	Minimum PIO transfer cycle time with IORDY flow control 120nsec
69-81	0000H	26	Reserved
82	0002H	2	Supports Security Mode feature set
83-87	0000H	10	Reserved
88	0X3FH	2	Ultra DMA mode 5 and below are supported
89-127	0000H	78	Reserved
128	0021H	2	Enhanced security erase supported
129-159	0000H	62	Reserved vendor unique bytes
160-255	0000H	192	Reserved

PRODUCT ORDERING INFORMATION

PN	Type	Capacity	Technology	Temp range	Grade
RUCPFM00400SB-P3AKI5	CompactFlash	4 GB	MLC	0~70°C	silver
RUCPFM00800SB-P3AKI5	CompactFlash	8 GB	MLC	0~70°C	silver
RUCPFM01600SB-P3AKI5	CompactFlash	16 GB	MLC	0~70°C	silver
RUCPFM03200SB-P3AKI5	CompactFlash	32 GB	MLC	0~70°C	silver
RUCPFM06400SB-P3AKI5	CompactFlash	64 GB	MLC	0~70°C	silver
RUCPFM12800SB-P3AKI5	CompactFlash	128GB	MLC	0~70°C	silver
RUCPFM00400DB-P3AKI5	CompactFlash	4 GB	MLC	-40~85°C	diamond
RUCPFM00800DB-P3AKI5	CompactFlash	8 GB	MLC	-40~85°C	diamond
RUCPFM01600DB-P3AKI5	CompactFlash	16 GB	MLC	-40~85°C	diamond
RUCPFM03200DB-P3AKI5	CompactFlash	32 GB	MLC	-40~85°C	diamond
RUCPFM06400DB-P3AKI5	CompactFlash	64 GB	MLC	-40~85°C	diamond
RUCPFM12800DB-P3AKI5	CompactFlash	128GB	MLC	-40~85°C	diamond

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/
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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