INDUSTRIAL MEMORY SOLUTIONS

goodram industrial

PRODUCT CATALOGUE

About the Company

GOODRAM Industrial is a brand owned by Wilk Elektronik SA — a Polish memory manufacturer and distributor with over 30 years of experience in the memory business.

Known for its strict quality policy, flexibility and post-sales support, Wilk Elektronik SA is the only European memory manufacturer with its own lab, R&D department, state-of-the-art production site, test field and support team. All in-house, under one roof.

GOODRAM stands for quality, reliability and support — we believe that the industry needs customized solutions for very specific needs. Designing our own testing procedures ensures that the modules we produce are tailored to match our customers' needs perfectly. Add low MOQ, fixed BOM and long-term post-sales support to the mix to achieve the highest possible quality of customer service. It all boils down to guaranteeing our partners the highest reliability possible throughout the module's lifetime.

1991
Establishing Wilk Elektronik SA as a distributor of memory modules in Poland

1996
The company becomes the largest distributor of memory products in Poland

2003
Wilk Elektronik opens the first memory module factory in Central and Eastern Europe

Launching GOODRAM - a brand specializing in memory modules

2008
Wilk Elektronik signs a strategic cooperation agreement with Toshiba Electronics Europe

2009
First GOODRAM SSD is produced using a full automated production line

2013
GOODRAM Industrial is introduced to the market as a sub-brand of GOODRAM

Wilk Elektronik invests in state-of-the-art SMT line, second to none in Europe

2019
Rebranding of GOODRAM Industrial and other brands to create a consistent experience of users communing with GOODRAM products around the world

2022
Factory expansion to double the production capacity and triple storage capacity

How we work

To put it briefly, we consider your needs and do everything we can to provide you with the perfect product to do the job. Every case is a different story of satisfying very specific needs by providing a dedicated, customized and reliable solution. And in our minds “solution” is not only the final module or memory card your company uses. The solution is everything that happens before, throughout the ordering process and after the sale.

Services

Every customer brings different needs and expectations to the table. It’s in our company’s DNA to react to those dynamically changing variables. We provide services that go far beyond a simple sales process:

- pre-sales support which includes meticulous interviews with the customer, giving us a greater understanding of our partner's needs;
- complex customer service throughout the sales process, which means making sure we have a specific solution available for you over a long period of time among other things;
- post-sales support, such as diagnostics, consulting and training.

Quality assurance

Everything we do is oriented towards providing products of the highest quality.
Quality, as we understand it, means complete reliability and satisfaction of the customer's requirements throughout the product's lifetime. It’s the reason why we continuously invest in more advanced machinery, diagnostic equipment and people, who create our LAB, R&D and QC departments. The more complicated cases and issues w solve throughout our design and production processes, the harder we believe this is the right course to take. Constant growth and evolution is the key to our success.

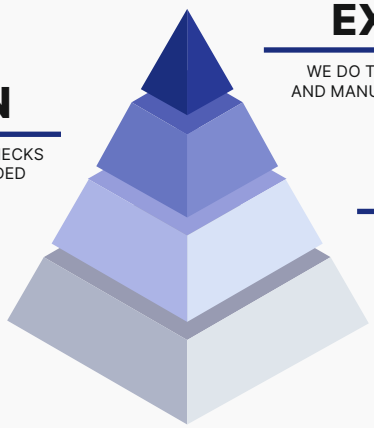
There are four simple steps we take in every project we are involved in:

EXECUTION

WE DO TEST-RUNS, QUALITY CHECKS AND MANUFACTURE THE FINAL PRODUCT

EVALUATION

WE RUN FURTHER TESTS, QUALITY CHECKS AND ON-FIELD EVALUATION IF NEEDED



IN-DEPTH ANALYSIS

WE TAKE A LOOK AT THE SCOPE OF WORK AND POSSIBLE SOLUTIONS

SUPPORT

AFTER-SALES SUPPORT, IN-DEPTH CONSULTING AND TRAINING

CORE FEATURES

PCN AND EOL MANAGEMENT

FIXED BILL OF MATERIAL

EXTENDED TEMPERATURE RANGE

HIGH QUALITY PRODUCTS

LONG TERM SUPPORT

Applications of GOODRAM Industrial solutions

HOME AUTOMATION

Home automation systems are innovative technologies that are getting more popular every day. Setting up your own way to shape and operate within the environment you live in creates more and more need for memory products.

POINT-OF-SALE (POS)

A point-of-sale terminal is an essential part of every modern store. In many cases, to conform with local law, transactions are recorded in the terminal's memory. More and more POS are equipped with NAND flash storage.

INTERNET OF THINGS

The “Internet of Things” is the future that we are just entering. Continuous and seamless communication of devices around us creates new demand within storage and data transfer technologies.

INDUSTRIAL COMPUTING

Supervising production processes is no longer exclusively a human domain. They can be successfully controlled by intelligent computer systems that make them more efficient.

VIDEO SECURITY SYSTEMS

The use of CCTV systems is more and more popular in all fields of human activity. Whole cities, events and large production plants are being monitored and those videos are recorded for safety measures - which creates the need for faster, more reliable and durable storage.

INDUSTRIAL AUTOMATION

Meticulous and precise production processes are now performed by automated devices and robots. Their operations are controlled by advanced computer systems.

WIRELESS SYSTEMS

Digitalization of our everyday life requires introduction of new means of communication. They include wireless data transfer systems which enable global access to the resources we all create.

PUBLIC COMMUNICATION

People commute every day, usually to work or school. New technologies can now make means of public transportation faster, more efficient and safer.

AUTOMOTIVE SOLUTIONS

The car is no longer just a simple means of transport. Today, every vehicle is expected to be equipped with a multimedia system and navigation.

HUMAN–MACHINE INTERFACES

These interface devices enable human operators to communicate with machines and collect data from monitored processes. Modern interfaces feature a touch screen and offer a visual display that makes it easy to control processes and receive alerts in case of potential dangers.

Flash core features

FLASH MEMORY

NAND Flash based memory devices form a distinct group of products with a range of different interfaces and applications. Depending on the type of NAND flash used, these products differ in terms of durability, speed and capacity. All of them, however, have advanced mechanisms to ensure data integrity. We currently offer solutions based on SLC, pSLC, MLC and 3D TLC NAND Flash.

NAND FLASH MANAGEMENT

GOODRAM Industrial storage products utilize the latest technologies to ensure complete reliability up to the specified TBW (Total Bytes Written) value. These technologies include:

ECC (ERROR CORRECTION CODE)

NAND Flash memory cells are subject to wear, potentially causing random errors in the stored data. GOODRAM Industrial implements advanced error detection and correction algorithms (LDPC/BCH) appropriate for the used technology. This guarantees a high level of data security up to the specified TBW.

WEAR LEVELLING

NAND Flash memories have a limited number of program/erase cycles. To ensure product longevity, data must be evenly distributed between the memory blocks. GOODRAM Industrial memories implement advanced wear leveling algorithms for this purpose. This means that the fixed flash blocks will not wear out due to repeated writing to a particular address location.

DAMAGED BLOCK MANAGEMENT

In NAND Flash memory units, certain memory blocks may be rendered unusable. This occurs during manufacturing of the devices and during their subsequent use, for instance as a result of wear. Such blocks must be excluded from use. Methods of fault prediction and exclusion of unusable memory blocks are implemented in all GOODRAM Industrial Flash products.

SMART

SMART (Self-Monitoring Analysis and Reporting Technology) is a technology for self-diagnosis and reporting oriented towards the prediction and detection of basic faults. In the case of SSDs, the self-diagnosis results and wear statistics can be accessed via a standardised interface. In the case of memory cards, such as SD, access to this data requires the use of special software.

TRIM

TRIM is a command defined by the ATA standard, enabling the operating system to inform the SSD controller which sectors contain expired data, so that the flash wear levelling algorithm does not transfer expired data between blocks. It can significantly increase the lifetime of SSD.

OVER-PROVISIONING

This term refers to the memory capacity not available to the user. Thanks to the limit on available capacity, mechanisms used for organizing the stored data are used less frequently, leading to increased operations per second (IOPS) and reduction in write amplification. This results in faster write speeds and longer device lifetime.

DIPM/HIPM/DevSLEEP MODE

The SATA interface utilizes two reduced power modes: partial and slumber. In partial mode the power consumed by the interface is limited to a few tens of mW and the wake-up time is not more than 10 µs. In slumber mode the power consumption is further reduced and the wake-up time may be up to 10 ms. Partial and slumber modes may be initiated by the host computer (HIPM) or by the storage device (DIPM). SSDs may also offer a DevSleep mode, resulting drive to go into a deep “device sleep” significantly reducing power consumption. Reduced power modes enable mobile devices to operate for longer without recharging.

CFast

CFast cards are compliant with the PCMCIA I or II standards with SATA interface. The card's controller, which is functionally compliant with typical SATA SSD controllers, offers low power comsumption and data transfer rates of up to 550 MB/s. Other features include S.M.A.R.T., advanced power management methods and a DRAM cache. CFast is available with 3D TLC, MLC, pSLC and SLC NAND and its capacity may depend on the technology used. It's small size and housing suited for mutiple applications make CFast a good solution form many mobile applications.

	CFast			
Flash type	3D TLC	MLC	pSLC	SLC
Program/Erase cycles	3000	3000	20000	60000
Capacity	64 GB – 256 GB	32 GB – 256 GB	16 GB – 64 GB	8 GB – 32 GB
Interface	SATA III			
Key features	Static and Dynamic Wear Leveling Bad Block Management TRIM S.M.A.R.T. NCQ Over-Provisioning Low Power Management			
Operating temperature (°C)	Carbon grade: 0 – 70 Diamond grade: -40 – 85	Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85		Gold grade: -25 – 85 Diamond grade: -40 – 85
Storage temperature (°C)	-40 – 85			
Maximum transfer speed (MB/s)	Read: up to 550 Write: up to 490	Read: up to 555 Write: up to 465	Read: up to 545 Write: up to 465	Read: up to 540 Write: up to 305
Maximum power consumption (mW)	<1440	<1550	<1475	<1700
MTBF	>2 000 000			
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (0,8 m.) Torque (1,3 N/m, 30 sec/5 times) Bending (>50 N for 1 min/5 times) Contact ESD (±4 KV contact)			
Dimensions (L × W × H/mm)	42,8 × 36,4 × 3,3			

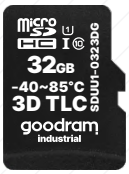
CFexpress

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™ Type B 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.

	CFexpress
Flash yype	3D TLC
Program/Erase cycles	12000
Capacity	15 GB – 960 GB
Interface	PCIe NVMe 3.0 x2
Key features	PCIe NVMe Gen3 x2 Type B Slot 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
Operating temperature (°C)	Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85
Storage temperature (°C)	-40 – 85
Maximum transfer speed (MB/s)	Read: up to 1610 Write: up to 820
Maximum power consumption (mW)	<760
MTBF	>2 000 000
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (0,8 m) Torque (1,3 N/m, 30 sec/5 times) Bending (>50 N for 1 min/5 times) Contact ESD (±4 KV contact)
Dimensions (L × W × H/mm)	38,5 × 29,6 × 3,8

microSD/SD

MicroSD and SD cards are available in three capacity standards: SDSC (Standard Capacity), SDHC (High Capacity) and SDXC (extended Capacity) and with bus up to UHS-I. Selected models have an additional SPI interface. Small dimensions, low power consumption and wide range of available capacities (from 128 MB to 256 GB) and wide selection of NAND types (3D TLC, MLC, pSLC, SLC) make microSD and SD cards a go-to storage solution for many industrial designers.



	microSD				SD			
Flash type	3D TLC	MLC	pSLC	SLC	3D TLC	MLC	pSLC	SLC
Program/Erase cycles	3000	3000	20000	60000	3000	3000	20000	60000
Capacity	16 GB – 256 GB	4 GB – 64 GB	2 GB – 32 GB	128 MB – 4 GB	32 GB – 256 GB	4 GB – 128 GB	2 GB – 64 GB	128 MB – 32 GB
Interface	UHS-I			High Speed	UHS-I			128 MB – 2 GB High Speed 4 GB – 32 GB UHS-I
Key features	Static and Dynamic Wear Leveling Bad Block Management S.M.A.R.T. Auto-Read Refresh Data Clone System Embedded Mode							
Operating temperature (°C)	Gold grade: -25 – 85 Diamond grade: -40 – 85							
Storage temperature (°C)	-40 – 85							
Maximum transfer speed (MB/s)	Read: up to 95 Write: up to 30	Read: up to 95 Write: up to 90		Read: up to 20 Write: up to 20	Read: up to 95 Write: up to 30	Read: up to 95 Write: up to 90		Read: up to 65 Write: up to 55
Maximum power consumption (mA)	<400							
MTBF	>3 000 000							
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock(1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (1,5 m) Torque (0,1 N/m, 30 sec/5 times) Bending (>10 N for 1 min/5 times) Salt Spray (3% NaCl, 35°C/24 h) Waterproof (IPX7, 1 m immersion for 30 minutes) X-Ray (70 – 140 keV for 30 minutes) Switch Cycle (0,4 – 0,5 N/1000 times) Durability test (EIA 364-13 10000 times) Contact ESD (±4 KV contact 25 times, ±8 KV air 10 times)							
Dimensions (L × W × H/mm)	15 × 11 × 1				32 × 24 × 2,1			

USB Flash Drive

USB Flash Drives are available in many housing options and with wide selection of NAND types (3D TLC, MLC, pSLC, SLC). As the USB 3.0 interface is supported by nearly all personal computers and embedded applications, these devices are used as storage media for operating systems, data and application keys. Backwards compatibility with USB 2.0 and USB 1.1 provides flexibility for designers and administrators.

	Industrial USB Flash Drive			
Flash type	3D TLC	MLC	pSLC	SLC
Capacity (PCBA)	32 GB – 256 GB	4 GB – 256 GB	2 GB – 128 GB	128 MB – 32 GB
Program/Erase cycles	3000	3000	20000	60000
Interface	USB 2.0/USB 3.0 (USB 1.1/USB 2.0 compatible)			
Key features	Wear Leveling Bad Block Management ECC			
Operating temperature (°C)	Carbon grade: 0 – 70 Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85			
Storage temperature (°C)	-40 – 85			
Maximum transfer speed (MB/s) (PCBA)	Read: up to 265 Write: up to 175	Read: up to 190 Write: up to 130	Read: up to 150 Write: up to 125	Read: up to 170 Write: up to 120
Maximum power consumption (mA) (PCBA)	<220	<210		<120
Maximum transfer speed (MB/s) (uCOB)	Read: up to 220 Write: up to 100	Read: up to 190 Write: up to 85	Read: up to 140 Write: up to 100	Read: up to 65 Write: up to 50
Maximum power consumption (mA) (uCOB)	<187	<130		<90
MTBF	>2 000 000			
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (1,1 m) Torque (0,5 N/m, 30 sec/5 times) Bending (>50 N for 1 min/5 times) Durability test (Extraction/Insertion 5000 times) Contact ESD (±4 KV contact 25 times)			
Dimensions (L × W × H/mm)	55,8 × 18,6 × 9,6*			

*Dimensions for standard housing. Wide selection of housings is available.

2.5” SATA Solid State Drive

2.5” SATA is the most common form factor of Solid State Drives. All SSDs can be configured with 3D TLC, MLC, pSLC and SLC NAND Flash. They provide up to 550 MB/s of fast data transfer, low power consumption and advanced power management modes. With ruggedness resulting from absence of moving parts and low power consumption, Solid State Drives are optimal for both desktop and mobile applications.

	2.5" SATA Solid State Drive			
Flash type	3D TLC	MLC	pSLC	SLC
Program/Erase cycles	3000	3000	20000	60000
Capacity	32 GB – 1 TB	4 GB – 512 GB	8 GB – 256 GB	8 GB – 128 GB
Interface	SATA III			
Key features	Static and Dynamic Wear Leveling Bad Block Management TRIM S.M.A.R.T. NCQ Over-provisioning Low Power Management			
Operating temperature (°C)	Silver grade: 0 – 70 Diamond grade: -40 – 85	Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85		Gold grade: -25 – 85 Diamond grade: -40 – 85
Storage temperature (°C)	-40 – 85			
Maximum transfer speed (MB/s)	Read: up to 550 Write: up to 500	Read: up to 550 Write: up to 490	Read: up to 545 Write: up to 465	Read: up to 540 Write: up to 425
Maximum power consumption (mW)	<1620	<2650	<2630	<2300
MTBF	>2 000 000			
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (0,8 m) Torque (0,1 N/m, 30 sec/5 times) Bending (>20 N for 1 min/5 times) Contact ESD (±4 KV contact 25 times)			
Dimensions (L × W × H/mm)	100 × 69,85 × 7			

mSATA Solid State Drive

SSD mSATA is a type of Flash memory that can be installed directly on the motherboard, occupying a small amount of space – it is 80% smaller than the 2.5”. Compatibility with the SATA I, II and III standards means that these devices can be installed in any device having an mSATA port. As with the entire range of SSD memories, the absence of moving parts and low power consumption make it an optimum choice of data storage medium in mobile systems.

	mSATA Solid State Drive			
Flash type	3D TLC	MLC	pSLC	SLC
Program/Erase cycles	3000	3000	20000	60000
Capacity	32 GB – 1 TB	4 GB – 1 TB	2 GB – 512 GB	8 GB – 128 GB
Interface	SATA III			
Key features	Static and Dynamic Wear Leveling Bad Block Management TRIM S.M.A.R.T. NCQ Over-Provisioning Low Power Management			
Work temprature (°C)	Silver grade: 0 – 70 Diamond grade: -40 – 85	Silver grade: 0 – 70 Diamond grade: -40 – 85	Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85	Silver grade: 0 – 70 Diamond grade: -40 – 85
Storage temperature (°C)	-40 – 85			
Maximum R/W (MB/s)	Read: up to 550 Write: up to 500	Read: up to 550 Write: up to 490		Read: up to 540 Write: up to 425
Maximum power consumption (mW)	<1620	<2690		<2250
MTBF	>2 000 000			
Environment tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1500 G, Half Sin Pulse) Vibration (80 – 2000 Hz/20 G in 3 Axis) Free Fall (0,8 m) Torque (0,1 N/m, 30 sec/5 times) Bending (>20 N for 1 min/5 times) Contact ESD (±4 KV contact 25 times)			
Dimension (L × W × H/mm)	50,8 × 29,85 × 4			

M.2 SATA / NVMe Solid State Drive

M.2 is another type of SSD with SATA or NVMe interface. M.2 SATA Solid State Drive can be installed directly onto motherboard. It can be configured with 3D TLC, MLC, pSLC and SLC NAND and PCBA can be delivered in two sizes: 42 x 22 mm and 80 x 22 mm. Small footprint, lack of moving parts and low power consumption make M.2 SATA SSD a great solution for mobile applications. Other form factors (2260, 22110) available upon request.

M.2 SATA

M.2 NVMe

M.2 SATA Solid State Drive

Form factor	M.2 2242				M.2 2280			
Flash fype	3D TLC	MLC	pSLC	SLC	3D TLC	MLC	pSLC	SLC
Program/Erase cycles	3000	3000	20000	60000	3000	3000	20000	60000
Capacity	32 GB – 512 GB	4 GB – 512 GB	16 GB – 256 GB	8 GB – 64 GB	32GB – 1TB	4 GB – 512 GB	2 GB – 256 GB	8 GB – 128 GB
Interface	SATA III							
Key features	Static and Dynamic Wear Leveling Bad Block Management TRIM S.M.A.R.T. NCQ Over-provisioning Low Power Management							
Operating temperature (°C)	Silver grade: 0 – 70 Diamond grade: -40 – 85			Gold grade: -25 – 85 Diamond grade: -40 – 85	Silver grade: 0 – 70 Diamond grade: -40 – 85	Silver grade: 0 – 70 Gold grade: -25 – 85 Diamond grade: -40 – 85	Silver grade: 0 – 70 Diamond grade: -40 – 85	Gold grade: -25 – 85 Diamond grade: -40 – 85
Storage temperature (°C)	-40 – 85							
Maximum transfer speed (MB/s)	Read: up to 550 Write: up to 500	Read: up to 555 Write: up to 490	Read: up to 545 Write: up to 460	Read: up to 540 Write: up to 320	Read: up to 550 Write: up to 500	Read: up to 550 Write: up to 490		Read: up to 540 Write: up to 425
Max. power consumption (mW)	<1520	<2100	<2630	<1950	<1800	<2650		<2280
MTBF	> 2 000 000							
Environmental tests resistance	High/Low temperature, High Humidity (55, 95% RH), Temperature Cycle (30 min, 20 cycles), Shock (1500 G, Half Sin Pulse), Vibration (80 – 2000 Hz/20 G in 3 Axis), Free Fall (0,8 m), Torque (0,1 N/m, 30 sec/5 times), Bending (>20 N for 1 min/5 times), Contact ESD (±4 KV contact 25 times)							
Dimensions (L×W×H/mm)	42 × 22 × 3,8				80 × 22 × 3,8			

M.2 NVMe Solid State Drive

Interface	NVMe PCIe 3x2		NVMe PCIe 3x4	
Form factor	M.2 2242	M.2 2280	M.2 2242	M.2 2280
Flash type	3D TLC			
Program/Erase cycles	3000			
Capacity	128 GB – 2048 GB			
Advanced features	Self Encrypting Function(Optional): AES, TCG OPAL, TCG Pyrite • Intelligent FW technology on Data loss Protection: 1) Data Loss Protection End to End Data Path Protection (ETEDPP) 2) SmartFlush™ • Intelligent FW technology on Data Reliability 1) SmartECC™: LDPC + RAID ECC 2) SmartRefresh™ • Thermal Protection Mechanism • Support HMB(Host Memory Buffer), Default Disable • Security Function(Optional): Write Protect, Quick Erase			
Operating temperature (°C)	Silver grade: 0 – 70			
Storage temperature (°C)	-40 – 85			
Maximum transfer speed (MB/s)	Read: up to 1600 Write: up to 1000	Read: up to 1600 Write: up to 1100	Read: up to 2500 Write: up to 2100	
Max. power consumption (mW)	<3750			
MTBF	>2 000 000			
Dimensions (L × W × H/mm)	42 × 22 × 3,8	80 × 22 × 3,8	42 × 22 × 3,8	80 × 22 × 3,8

DRAM

GOODRAM offers industrial modules from the early DDR1 generation to the newest DDR5. Our industrial series includes long DIMMs or SODIMMs, and optionally additional features such as ECC, extended temperature range and fixed bill of materials. We pay great attention to following the Product Change Notification procedure, therefore, our clients are always aware of any changes that may occur in the Bill of Materials in case of orders executed over a longer period of time. Our solutions are a perfect fit for industrial computing, industrial automation, automotive solutions, home automation, POS systems, IOT and healthcare applications.

DDR1 SDRAM – the first memory in the DDR family has a synchronous interface, active on both edges of the clock signal. A DDR1 interface enables data transfer rates up to 400 MHz clock rate and 3200 MB/s transfer rate via a 64-bit bus.

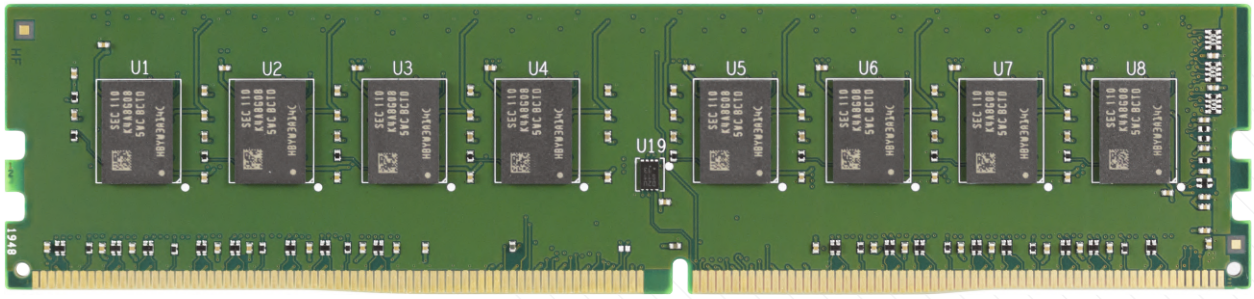
DDR2 SDRAM – the second generation of DDR memory operates with reduced supply voltage and power consumption. The lower voltage allows the maximum clock rate to be increased to 800 MHz, leading to transfer rates up to 6400 MB/s (with a 64-bit interface).

DDR3 SDRAM – The third generation of DDR offers lower power consumption and high capacity which makes it suitable for a wide range of industrial applications. Thanks to the use of a “fly-by” bus, DDR3 may run with a clock rate of up to 1866 MHz clock rate and 15000 MB/s transfer rate.

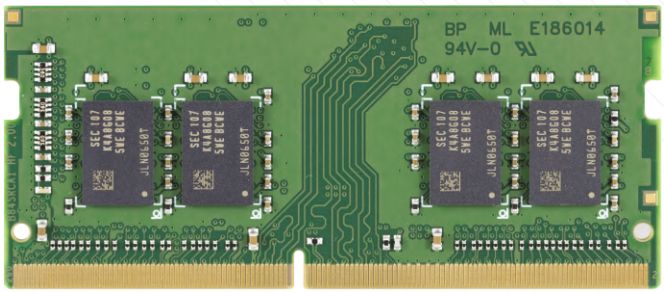
DDR4 SDRAM – currently it's the most commonly used DRAM type. It features a POD12 (Pseudo Open Drain 1,2 V) interface, CRC (Cyclic Redundancy Check) on the data bus, parity control on the address bus, and a DBI (Data Bus Inversion) function. The new features of the DDR4 interface enable memory clock rates above 3200 MHz, making it an ideal solution for high-performance industrial systems. DDR4 enables transfer rates up to 25600 MB/s.

DDR5 SDRAM - the latest generation of memory in the DDR family with a maximum transfer speed of 6400 MHz. Thanks to dropping the voltage from 1,2 V to 1,1 V, the power consumption has been reduced by as much as 15% overall. A further major structural change is the incorporation of power management IC (PMIC) on the module itself. This modification makes it possible to reduce redundant power management circuitry on the motherboard and allows for better power allocation, enhancing signal integrity. An additional technology applied in DDR5 modules is the ODECC (on-die error-correction code), which makes it possible to correct some errors thus increasing the reliability of the module. Finally, the new DDR5 standard comes with two sets of 32-bit channels (40-bit in case of ECC modules) – this sets them apart from modules of the previous generation. Such a solution doubles the bandwidth, which increases the speed and efficiency in accessing the memory.

DDR4 DIMM

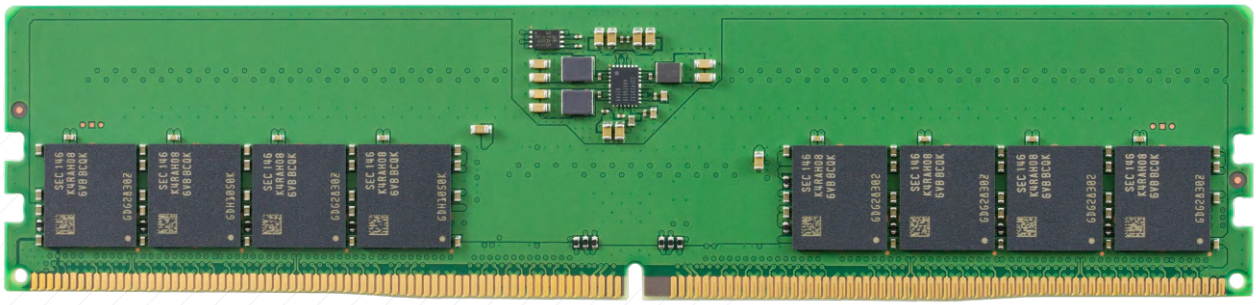


DDR4 SO-DIMM

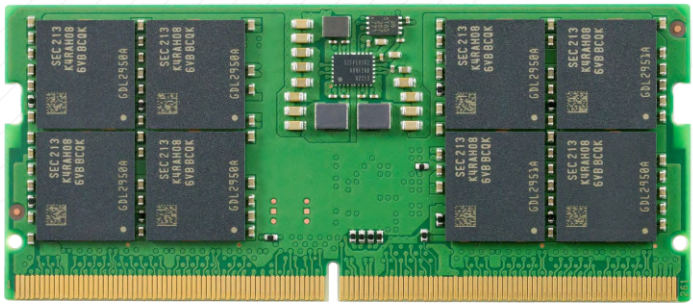


DRAM

DDR5 DIMM



DDR5 SO-DIMM



DRAM Memory Modules

Type	DDR1	DDR2	DDR3	DDR4	DDR5
Form factors	184-pin DIMM 200-pin SO-DIMM	240-pin DIMM 200-pin SO-DIMM	240-pin DIMM 204-pin SO-DIMM	288-pin DIMM 260-pin SO-DIMM	288-pin DIMM 262-pin SO-DIMM
Capacity	128 MB – 1024 MB	512 MB – 2048 MB	1 GB – 8 GB	4 GB – 32 GB	8 GB – 32 GB
Peak transfer rate (MB/s)	up to 3200 (400 MHz)	up to 6400 (800 MHz)	up to 14900 (1866 MHz)	up to 25600 (3200 MHz)	up to 51200 (6400 MHz)
Voltage (V)	2,5	1,8	1,5/1,35	1,2	1,1
ECC option	NO	YES			
Operating temperature (°C)	Standard grade: 0 – 70 Industrial grade: -40 – 85	Standard grade: 0 – 85 Industrial grade: -40 – 85			Standard grade: 0 – 85 Industrial grade: -40 – 85
Storage temperature (°C)	-40 – 100				
Key features & options	Single/Double Rank configuration DDR3/4 Very Low Profile size 100% functional tests High/Low temperature testing Build from major IC grades Long lifetime project support FIX BOM option PCN and EOL notification				Power Management IC On-Die ECC Dual 32-Bit Subchannels Single/Double Rank configuration 100% functional tests High/Low temperature testing Build from major IC grades Long lifetime project support FIX BOM option PCN and EOL notification

Part number decoder

Flash Memory (Memory Cards)

(SD, microSD, CFast, CFexpress)

12M: 128 MB	002: 2 GB	032: 32 GB	512: 512 GB	030: 30 GB	480: 480 GB
25M: 256 MB	004: 4 GB	064: 64 GB	1T0: 1024 GB	060: 60 GB	960: 960 GB
51M: 512 MB	008: 8 GB	128: 128 GB	2T0: 2048 GB	120: 120 GB	1T9: 1920 GB
001: 1 GB	016: 16 GB	256: 256 GB	4T0: 4096 GB	240: 240 GB	3T8: 3840 GB

Capacity

SDC C1-008 M C G

Product Group

SDU: microSD
SDC: SD
CFA: CFAST
CFE: CFexpress

Form Factor + Interface

00: None	V6: UHS I V60
C4: Class 4	V9: UHS I V90
C1: Class 10	X6: UHS II V60
C6: Class 6	X9: UHS II V90
U1: UHS I U1	Y6: UHS III V60
U3: UHS I U3	ST: CFAST
V1: UHS I V10	XB: CFexpress Type B
V3: UHS I V30	

Flash type

M: MLC
S: SLC
P: pSLC
T: TLC
3: 3D TLC
2: 3D pMLC
1: 3D pSLC

Temperature Range

C: Carbon Grade (0°C to 70°C)*
S: Silver Grade (0°C to 70°C)
G: Gold Grade (-25°C to 85°C)
D: Diamond Grade (-40°C to 85°C)

Packaging

G: BULK LOGO Goodram

USB Flash Drives

12M: 128 MB	002: 2 GB	032: 32 GB	030: 30 GB
25M: 256 MB	004: 4 GB	064: 64 GB	060: 60 GB
51M: 512 MB	008: 8 GB	128: 128 GB	120: 120 GB
001: 1 GB	016: 16 GB	256: 256 GB	240: 240 GB

Capacity

U0P 30-008 M C G

Product Group

U0P: PCBA
U0C: COB
U0M: MICRO COB

Form Factor + Interface

20: USB 2.0
30: USB 3.0
31: USB 3.1

Technology

M: MLC
S: SLC
P: pSLC
T: TLC
3: 3D TLC
2: 3D pMLC
1: 3D pSLC
Q: 3D QLC

Temperature Range

C: Carbon Grade (0°C to 70°C)*
S: Silver Grade (0°C to 70°C)
G: Gold Grade (-25°C to 85°C)
D: Diamond Grade (-40°C to 85°C)

Packaging

G: Goodram BULK
B: OEM BULK
L: Goodram BULK LOGO

* Carbon grade available upon request

Part number decoder

Flash Memory (SSD)

(2,5" SATA, mSATA, M.2 SATA, M.2 PCIe)

Product group
- Industrial SSD

Capacity

016: 16 GB	
032: 32 GB	030: 30 GB
064: 64 GB	060: 60 GB
128: 128 GB	120: 120 GB
256: 256 GB	240: 240 GB
512: 512 GB	480: 480 GB
1T0: 1024 GB	960: 960 GB
2T0: 2048 GB	1T9: 1920 GB
4T0: 4096 GB	3T8: 3840 GB

Flash type
- M: MLC
- S: SLC
- P: pSLC
- T: TLC
- 3: 3D TLC
- 2: 3D pMLC
- 1: 3D pSLC

Temperature
- C: Carbon (0°C to 70°C)
- S: Silver (0°C to 70°C)
- G: Gold (-25°C to 85°C)
- D: Diamond (-40°C to 85°C)

Packaging
- G: BULK LOGO Goodram

SSD 10-256 M D G

Form Factor + Interface

10: 2,5" SATA 7mm SSD*	83: M.2 PCIE NVMe gen3 x2 2230	93: M.2 PCIE NVMe gen3 x4 2230	A3: M.2 PCIE NVMe gen4 x4 2230
40: mSATA	84: M.2 PCIE NVMe gen3 x2 2240	94: M.2 PCIE NVMe gen3 x4 2240	A4: M.2 PCIE NVMe gen4 x4 2240
73: M.2 SATA 2230	86: M.2 PCIE NVMe gen3 x2 2260	96: M.2 PCIE NVMe gen3 x4 2260	A6: M.2 PCIE NVMe gen4 x4 2260
74: M.2 SATA 2242	88: M.2 PCIE NVMe gen3 x2 2280	98: M.2 PCIE NVMe gen3 x4 2280	A8: M.2 PCIE NVMe gen4 x4 2280
76: M.2 SATA 2260	81: M.2 PCIE NVMe gen3 x2 22110	91: M.2 PCIE NVMe gen3 x4 22110	A1. M.2 PCIE NVMe gen4 x4 22110
78: M.2 SATA 2280			
71: M.2 SATA 22110			

* 1,8" available upon special request

Part number decoder

DRAM Memory

(UDIMM, SODIMM)

Ranks

S: Single Rank
D: Dual Rank
Q: Quad Rank
O: Octo Rank

Organization

4: X4
8: X8
6: X16
0: not specified

Special Functions

C: standard voltage/standard temperature 0°C to +85°C
I: standard voltage/extended temperature -40°C to +85°C
L: low voltage/standard temperature 0°C to +85°C
Y: low voltage/extended temperature -40°C to +85°C

GR 1 S 1G 400 D 8 C

Prefix

GR: GOODRAM

Technology

1: DDR SDRAM
2: DDR2 SDRAM
3: DDR3 SDRAM
4: DDR4 SDRAM
5: DDR5 SDRAM

Module Type

D: DIMM
E: DIMM with ECC
R: Registered
V : ECC VLP*
U: DIMM VLP
L: LRDIMM
S: SO-DIMM
A: SO-DIMM ECC

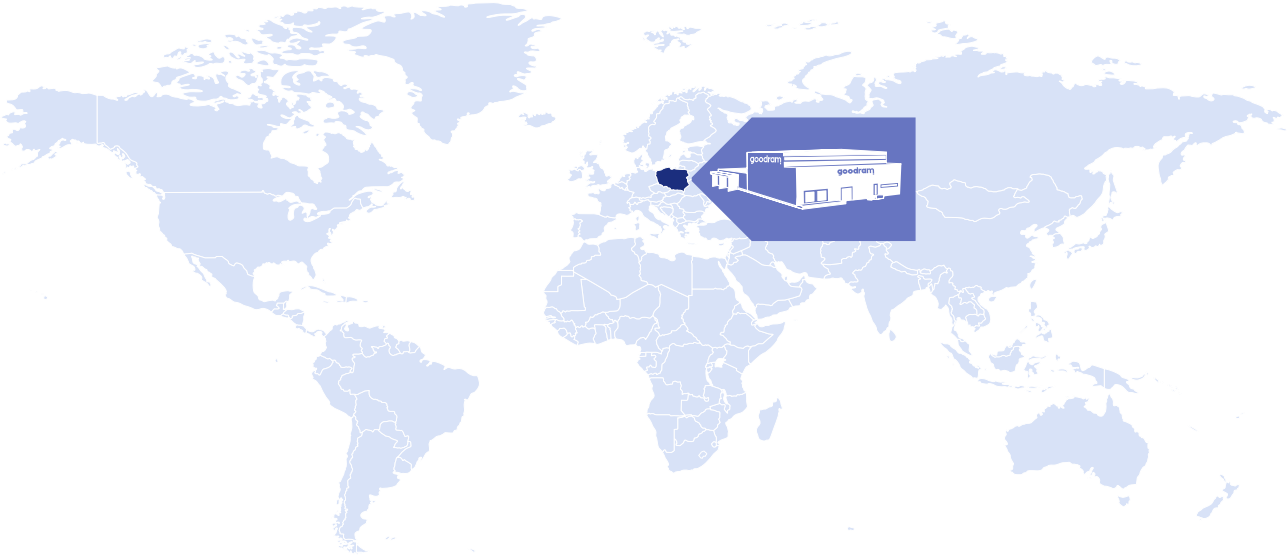
Capacity

128: 128 MB
256: 256 MB
512: 512 MB
1G: 1 GB
2G: 2 GB
4G: 4 GB
8G: 8 GB
16G: 16 GB
32G: 32 GB
64G: 64 GB

Speed Performace

333: DDR1 333
400: DDR1 400
667: DDR2 667
800: DDR2 800
106: DDR3 1066
133: DDR3 1333
160: DDR3 1600
186: DDR3 1866
213: DDR4 2133
240: DDR4 2400
266: DDR4 2666
293: DDR4 2933
320: DDR4 3200
480: DDR5 4800
560: DDR5 5600
640: DDR5 6400

* VLP - Very Low Profile



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