PRODUCT CATALOGUE

goodram
industrial

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 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 – Launching Goodram – a brand specializing in memory modules

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

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.

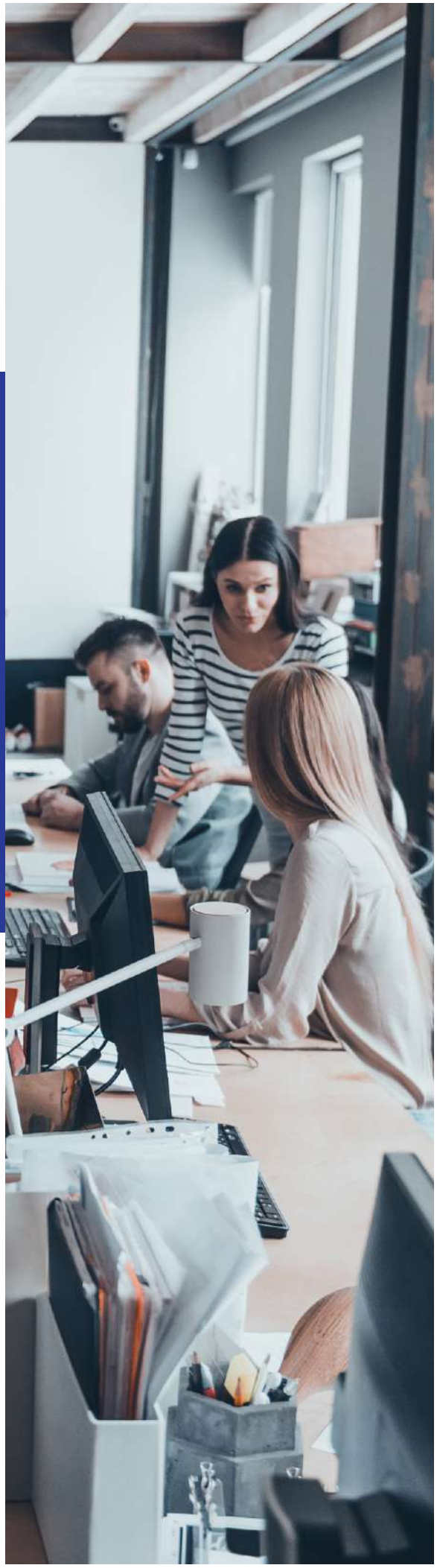
Services

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 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:

IN-DEPTH ANALYSIS

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

EVALUATION

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

EXECUTION

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

SUPPORT

AFTER-SALES SUPPORT, IN-DEPTH CONSULTING AND TRAINING

CORE FEATURES

- EXTENDED TEMPERATURE RANGE
- PCN AND EOL MANAGEMENT
- MAJOR GRADE CHIPS
- FIXED BILL OF MATERIAL
- LONG TERM SUPPORT
- 100% TESTED

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, 3D TLC and 3D pSLC 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, 3D pSLC, 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	3D pSLC	MLC	pSLC	SLC
Program/Erase cycles	3 000	50 000	3 000	20 000	60 000
Capacity	128 GB – 512 GB	32 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 Thermal Sensor TCG Opal Build from major IC grades FIX BOM (optional) PCN and EOL notification				
Operating temperature (°C)	0 – 70 -40 – 85	0 – 70 -40 – 85	0 – 70 -25 – 85 -40 – 85		-25 – 85 -40 – 85
Storage temperature (°C)	-40 – 85				
Maximum transfer speed (MB/s)	Read: up to 550 Write: up to 490	Read: up to 550 Write: up to 500	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)	< 1 550	< 1 300	< 1 550	< 1 475	< 1 700
MTBF	> 2 000 000	> 3 000 000	> 2 000 000		
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1 500 G, Half Sin Pulse) Vibration (80 – 2 000 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 type	3D TLC
Program/Erase cycles	3 000
Capacity	128 GB – 1024 GB
Interface	PCIe NVMe 3.0 x2
Key features	PCIe NVMe Gen3 x2 Type B Slot Wear Levelling LDPC ECC Lifetime Enhancements Power Fail Data Loss Protection TRIM Active State Power Management Firmware upgrade S.M.A.R.T TCG Opal (optional) End-to-End Data Protection AES256 Encryption (optional) Build from major IC grades FIX BOM (optional) PCN and EOL notification
Operating temperature (°C)	-40 – 85
Storage temperature (°C)	-40 – 85
Maximum transfer speed (MB/s)	Read: up to 1 610 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 (1 500 G, Half Sin Pulse) Vibration (80 – 2 000 Hz/20 G in 3 Axis) Free Fall (0.8 m.)
Dimensions ((L × W × H) (mm))	38.5 × 29.6 × 3.8

eMMC

eMMC (Embedded MultiMediaCard) is a type of small memory device used primarily in portable devices. Unlike portable microSD/SD cards or SSDs, the eMMC standard refers to a non-volatile memory chip embedded on the motherboard of a device. An eMMC is a compact storage device that is physically integrated into an application. Due to its small size, it can be successfully used in devices where SSD drives cannot be installed because of limited space. This includes not only mobile phones and tablets, but also advanced automotive and Internet of Things (IoT) applications.

	eMMC			
Form factor	153 Ball FBGA			
Flash type	3D TLC	3D pSLC	MLC	2D pSLC
Capacity	16 GB – 256 GB	8 GB – 32 GB	8 GB – 16 GB	4 GB
Program/Erase cycles	3 000	30 000	3 000	20 000
Interface	eMMC 5.1			
Key features	Power Off Notification HS400 Speed Mode available Enhanced Device Life time Command Queuing Enhanced Strobe Cache Flushing Report BKOPS Control Cache Barrier RPMB Throught Improve Secure Write Protection Secure Erase and Trim commands available Enhanced write Protection Build from major IC grades FIX BOM (optional) PCN and EOL notification Customized engraving (optional)			
Operating temperature (°C)	-40 – 85			
Storage temperature (°C)	-40 – 85			
Maximum transfer speed (MB/s)	Read: up to 320 Write: up to 260	Read: up to 320 Write: up to 260	Read: up to 225 Write: up to 140	Read: up to 225 Write: up to 140
Maximum power consumption (mW)	< 175			< 170
Dimensions ((L × W × H) (mm))	11.5 × 13 × 1			

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 (SLC, pSLC, MLC, 3D TLC and 3D pSLC) make microSD and SD cards a go-to storage solution for many industrial designers.

	microSD					SD				
Flash type	3D TLC	3D pSLC	MLC	pSLC	SLC	3D TLC	3D pSLC	MLC	pSLC	SLC
Program/Erase cycles	3 000	30 000	3 000	20 000	60 000	3 000	30 000	3 000	20 000	60 000
Capacity	16 – 256 GB	16 – 128 GB	4 – 64 GB	2 – 32 GB	128 MB – 4 GB	32 – 256 GB	16 – 128 GB	4 – 128 GB	2 – 64 GB	128 MB – 32 GB
Interface	UHS-I			High Speed for 2 GB, Rest UHS-I	128 MB – 2 GB High Speed 4 GB UHS-I	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 (only for MLC) Build from major IC grades FIX BOM (optional) PCN and EOL notification									
Operating temperature (°C)	0 – 70 -25 – 85 -40 – 85									
Storage temperature (°C)	-40 – 85									
Maximum transfer speed (MB/s)	Read: up to 95 Write: up to 80		Read: up to 95 Write: up to 90		Read: up to 20 Write: up to 20	Read: up to 95 Write: up to 80		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(1 500 G, Half Sin Pulse) Vibration (80 – 2 000 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/1 000 times) Durability test (EIA 364-13 10 000 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

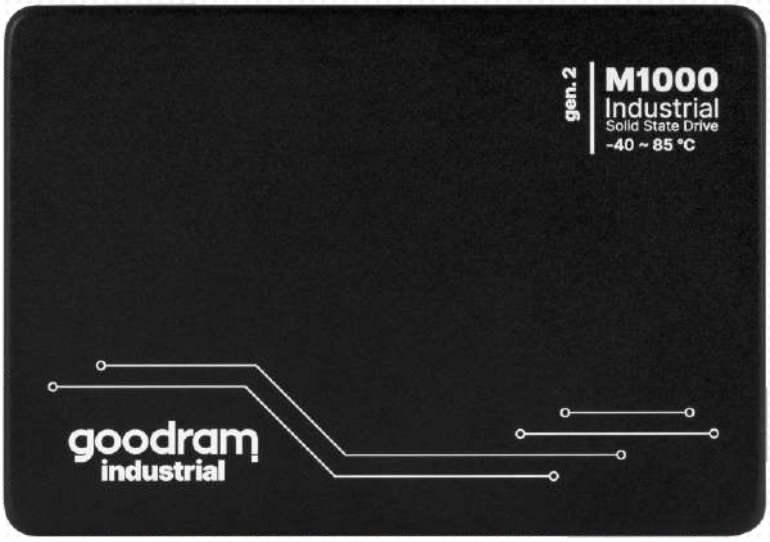
USB Flash Drives are available in many housing options and with wide selection of NAND types (SLC, pSLC, MLC, 3D TLC). As the USB 3.2 gen. 1 interface is supported by nearly all personal computers and embedded applications, these devices are used as storage media for operating systems, data and application 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	3D pSLC
Capacity (PCBA)	32 GB – 512 GB	16 GB – 128 GB
Program/Erase cycles	3 000	30 000
Interface	USB 2.0/USB 3.2 gen. 1 (USB 1.1/USB 2.0 compatible)	
Key features	Wear Leveling Bad Block Management ECC Build from major IC grades FIX BOM (optional) PCN and EOL notification	
Operating temperature (°C)	0 – 70 -25 – 85 -40 – 85	
Storage temperature (°C)	-40 – 85	
Maximum transfer speed (MB/s) (PCBA)	Read: up to 265 Write: up to 175	Read: up to 150 Write: up to 125
Maximum power consumption (mA) (PCBA)	< 220	< 210
Maximum transfer speed (MB/s) (uCOB)	Read: up to 220 Write: up to 100	Read: up to 140 Write: up to 100
Maximum power consumption (mA) (uCOB)	< 187	< 130
MTBF	> 2 000 000	
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1 500 G, Half Sin Pulse) Vibration (80 – 2 000 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 5 000 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

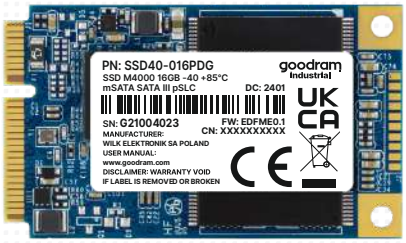
2.5” SATA is the most common form factor of Solid State Drives. All SSDs can be configured with 3D TLC, 3D pSLC, MLC, pSLC and SLC NAND Flash. They provide up to 550 MB/s of fast data transfer, low power consumption and advanced power management modes. With ruggedness resulting from absence of moving 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	3D pSLC	MLC	pSLC	SLC
Program/Erase cycles	3 000	50 000	3 000	20 000	60 000
Capacity	64 GB – 2 TB	32 GB – 512 GB	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 Thermal Throttling DEVSLP Mode (optional) PLP (optional) Build from major IC grades FIX BOM (optional) PCN and EOL notification				
Operating temperature (°C)	0 – 70 -40 – 85	0 – 70 -40 – 85	0 – 70 -25 – 85 -40 – 85		-25 – 85 -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 510	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)	< 1 750	< 1 450	< 2 650	< 2 630	< 2 300
MTBF	> 2 000 000	> 3 000 000	> 2 000 000		
Environmental tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1 500 G, Half Sin Pulse) Vibration (80 – 2 000 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. It is 80% smaller than the 2.5", thus it takes up minimal space. 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	3D pSLC	MLC	pSLC	SLC
Program/Erase cycles	3 000	50 000	3 000	20 000	60 000
Capacity	64 GB – 2 TB	32 GB – 512 GB	4 GB – 512 GB	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 Thermal Throttling DEVSLP Mode (optional) Build from major IC grades FIX BOM (optional) PCN and EOL notification				
Work temprature (°C)	0 – 70 -40 – 85			0 – 70 -25 – 85 -40 – 85	0 – 70 -40 – 85
Storage temperature (°C)	-40 – 85				
Maximum R/W (MB/s)	Read: up to 550 Write: up to 510		Read: up to 550 Write: up to 490		Read: up to 540 Write: up to 425
Maximum power consumption (mW)	< 1 750	< 1 350	< 2 690		< 2 250
MTBF	> 2 000 000	> 2 500 000	> 2 000 000		
Environment tests resistance	High/Low temperature High Humidity (55, 95% RH) Temperature Cycle (30 min, 20 cycles) Shock (1 500 G, Half Sin Pulse) Vibration (80 – 2 000 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))	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, 3D pSLC, 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 type	3D TLC	3D pSLC	MLC	pSLC	SLC	3D TLC	3D pSLC	MLC	pSLC	SLC
Program/Erase cycles	3 000	50 000	3 000	20 000	60 000	3 000	50 000	3 000	20 000	60 000
Capacity	64 GB – 1 TB	32 GB – 256 GB	4 GB – 512 GB	16 GB – 256 GB	8 GB – 64 GB	64 GB – 2 TB	32 GB – 512 GB	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 - Thermal Throttling - DEVSLP Mode (optional) - PLP (optional) Build from major IC grades - FIX BOM (optional) - PCN and EOL notification									
Operating temperature (°C)	0 – 70 -40 – 85				-25 – 85 -40 – 85	0 – 70 -40 – 85		0 – 70 -25 – 85 -40 – 85	0 – 70 -40 – 85	-25 – 85 -40 – 85
Storage temperature (°C)	-40 – 85									
Maximum transfer speed (MB/s)	Read: up to 550 Write: up to 510		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 510		Read: up to 550 Write: up to 490		Read: up to 540 Write: up to 425
Max. power consumption (mW)	< 1 750	< 1 350	< 2 100	< 2 630	< 1 950	< 1 800	< 1 300	< 2 650		< 2 280
MTBF	> 2 000 000	> 3 000 000	> 2 000 000			> 3 000 000		> 2 000 000		
Environmental tests resistance	High/Low temperature, High Humidity (55, 95% RH), Temperature Cycle (30 min, 20 cycles), Shock (1 500 G, Half Sin Pulse), Vibration (80 – 2 000 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 4x4				NVMe PCIe 3x4			
Form factor	M.2 2230	M.2 2242	M.2 2280		M.2 2242		M.2 2280	
Flash type	3D TLC		3D TLC	3D pSLC	3D TLC	3D pSLC	3D TLC	3D pSLC
Program/Erase cycles	3 000		3 000	50 000	3 000	50 000	3 000	50 000
Capacity	256 GB – 512 GB	128 GB – 2 TB	128 GB – 2 TB	120 GB – 960 GB	128 GB – 2 TB	32 GB – 512 GB	128 GB – 2 TB	32 GB – 512 GB
Advanced features	Dynamic SLC Cache TCG Opal/Pyrite (optional) ETEDPP(End to End Data Path Protection) Read Only Mode Build from major IC grades FIX BOM (optional) PCN and EOL notification			TCG Pyrite/Opal (optional) NVME Format Physical Presence (SID) (optional) Manufacturer's Secure ID (MSID) Read Only Mode Build from major IC grades FIX BOM (optional) PCN and EOL notification	Dynamic SLC cache - TCG Pyrite/OPAL (optional) Secure Erase and Crypto Erase - Media Wear Indicator Read Only Mode - Physical Presence SID (optional) PLP (optional) - Build from major IC grades FIX BOM (optional) - PCN and EOL notification			
Operating temperature (°C)	0 – 70 -40 – 85				0 – 70	0 – 70 -40 – 85	0 – 70	0 – 70 -40 – 85
Storage temperature (°C)	-40 – 85							
Maximum transfer speed (MB/s)	Read: up to 4 900 Write: up to 3 200	Read: up to 4 900 Write: up to 3 700		Read: up to 7 200 Write: up to 6 500	Read: up to 2 450 Write: up to 1 900			
Max. power consumption (mW)	< 5 200	< 5 300		< 11 000	< 3 900		< 4 000	
MTBF	> 2 000 000							
Dimensions ((L × W × H) (mm))	30 × 22 × 2.15	42 × 22 × 3.8	80 × 22 × 3.8	80 × 22 × 1.35	42 × 22 × 3.8		80 × 22 × 3.8	

DRAM core features

DRAM MODULES

Goodram Industrial memory leverage state-of-the-art technologies to uphold unparalleled reliability. These features stand as the cornerstone of industrial memory, underlining their paramount significance in ensuring uninterrupted operations in industrial settings. The utilization of advanced technologies underscores the critical role memory plays in industrial environments, where system stability and data integrity are non-negotiable. By prioritizing reliability, Goodram Industrial memory modules become indispensable components, capable of withstanding the rigorous demands of industrial applications.
Their reliability is not just a feature but a fundamental necessity, safeguarding against potential disruptions and downtime in industrial processes.
The technologies used in our memory modules include:

FULL GRADE IC

For industrial applications, reliability is paramount, making the selection of high-quality original integrated circuits a priority, ensuring not only operational stability but also durability in demanding industrial environments. Goodram Industrial closely cooperates with major semiconductor manufacturers such as Samsung and Hynix to ensure that the integrated circuits (ICs) used in Goodram Industrial memory modules are of the highest quality.

ECC (ERROR CORRECTION CODE)

The Error Correction Code (ECC) algorithm plays a crucial role in industrial memories, where operational reliability is absolutely essential. In industrial applications, even the smallest error in data can lead to serious consequences. Therefore, implementing ECC in memory modules allows for the detection and correction of errors that may occur during operation, ensuring data reliability and integrity in industrial environments where system stability is a priority.

FIXBOM (FIXED BILL OF MATERIALS)

In industry, consistency and repeatability are key. Therefore, each Goodram Industrial memory module is manufactured using a fixed set of components, ensuring that each unit is identical in terms of hardware and software. In industrial applications, where accuracy and consistency are required, a fixed Bill of Materials (BOM) ensures that memory modules meet these requirements in all operating conditions.

CONFORMAL COATING

In industrial environments where memory modules are exposed to extreme conditions such as moisture, dust, or chemicals, protection against corrosion and damage is essential. Therefore, coating memory modules with a thin layer of polymer (Conformal Coating) is crucial. This process provides protection against aggressive external factors, increasing the durability and reliability of memory in industrial applications where operating conditions are particularly demanding.

RIGOROUS TESTING

Goodram Industrial DRAM modules undergo a series of rigorous testing stages to ensure their reliability and durability in industrial applications. These multi-stage tests are meticulously designed to evaluate every aspect of the memory module's performance. From temperature extremes to voltage fluctuations, each module is subjected to intense scrutiny to identify any potential weaknesses. Testing process includes stress tests to simulate real-world industrial scenarios. By subjecting the industrial memory modules to thorough testing, Goodram guarantees that they meet the highest standards of quality and reliability, providing peace of mind to industries reliant on stable and dependable memory solutions.

EXTENDED TEMPERATURE RANGE

Goodram Industrial memory modules undergo validation in climate chambers to ensure their proper design and capability of operating in an extended temperature range. This validation confirms their ability to operate within specified parameters. The process follows customer specifications or the IEC60068 standard and covers temperatures ranging from -70°C to 180°C and humidity up to 95%. This validation process includes procedures for equipment preparation and software verification tailored to customer needs.

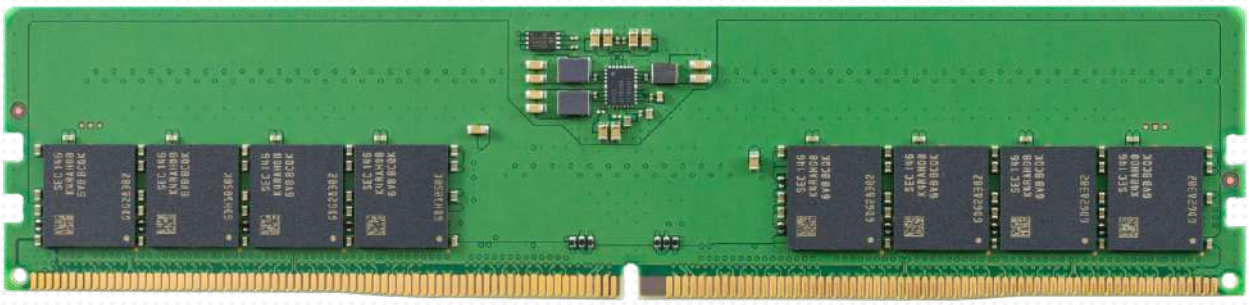
DRAM

Goodram Industrial offers a comprehensive range of industrial memory modules spanning from the early DDR1 generation to the latest DDR5 technology. Within its industrial series, the brand provides a variety of form factors including long DIMMs or SODIMMs, along with optional features such as ECC support, extended temperature range capabilities, and a fixed bill of materials. Goodram Industrial prioritizes adherence to the Product Change Notification procedure, ensuring that clients are informed of any alterations to the bill of materials, particularly for orders spanning extended durations. Its tailored solutions cater to a diverse array of industrial applications including industrial computing, automation, automotive systems, home automation, point-of-sale (POS) systems, Internet of Things (IoT), and healthcare applications.

DDR5 SDRAM

The latest advancement in the DDR family, DDR5 boasts a maximum transfer speed of 6 400 MT/s, achieved by lowering the voltage to 1.1 V, reducing overall power consumption by up to 15%. Incorporating a power management IC (PMIC) on the module and implementing on-die error-correction code (ODECC) enhances reliability and efficiency. Additionally, DDR5 introduces two sets of 36-bit channels (72-bit for ECC modules), doubling the bandwidth for improved memory access speed and efficiency in industrial environments.

DDR5 DIMM



DDR5 SODIMM

	DDR5 Memory Modules			
Module type	UDIMM	UDIMM ECC	SODIMM	SODIMM ECC
Capacity	8 GB – 32 GB	16 GB – 32 GB	8 GB – 32 GB	16 GB – 32 GB
Data Rate	4 800 MT/s 5 200 MT/s 5 600 MT/s 6 400 MT/s	4 800 MT/s 5 200 MT/s 5 600 MT/s 6 400 MT/s	4 800 MT/s 5 200 MT/s 5 600 MT/s 6 400 MT/s	4 800 MT/s 5 200 MT/s 5 600 MT/s 6 400 MT/s
Number of pins	288-pin	288-pin	262-pin	262-pin
Width	64 Bits	72 Bits	64 Bits	72 Bits
Voltage	1.1 V		1.1 V	
PCB Height	31.25 mm		30 mm	
Operating temperature (°C)	0 – 85		0 – 85	
Extended temperature* (°C)	-40 – 85		-40 – 85	
On Die ECC	Yes	Yes	Yes	Yes
Power Management IC	Yes	Yes	Yes	Yes
FIX BOM	*	*	*	*
EOL, PCN notification	Yes	Yes	Yes	Yes
Conformal Coating	*	*	*	*

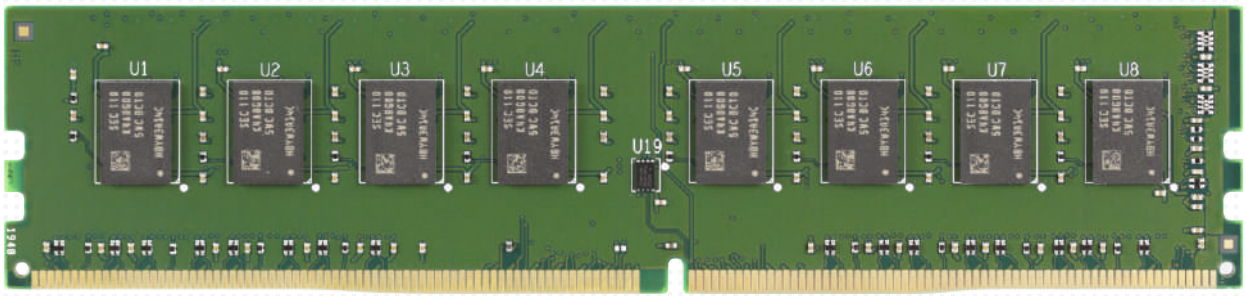
*optional

DRAM

DDR4 SDRAM

Currently the most prevalent type, DDR4 introduced innovative features such as a POD12 interface and CRC on the data bus, enabling transfer rates exceeding 3 200 MT/s. With transfer rates up to 25 600 MB/s, DDR4 became an ideal choice for high-performance industrial systems, prioritizing speed and reliability.

DDR4 DIMM



DDR4 SODIMM

	DDR4 Memory Modules			
Module type	UDIMM	UDIMM ECC	SODIMM	SODIMM ECC
Capacity	4 GB – 32 GB	4 GB – 32 GB	4 GB – 32 GB	4 GB – 32 GB
Data Rate	2 133 MT/s 2 400 MT/s 2 666 MT/s 2 933 MT/s 3 200 MT/s	2 133 MT/s 2 400 MT/s 2 666 MT/s 2 933 MT/s 3 200 MT/s	2 133 MT/s 2 400 MT/s 2 666 MT/s 2 933 MT/s 3 200 MT/s	2 133 MT/s 2 400 MT/s 2 666 MT/s 2 933 MT/s 3 200 MT/s
Number of pins	288-pin	288-pin	260-pin	260-pin
Width	64 Bits	72 Bits	64 Bits	72 Bits
Voltage	1.2 V		1.2 V	
PCB Height	31.25 mm		30 mm	
PCB VLP Height*	19 mm		19 mm	
Operating temperature (°C)	0 – 85		0 – 85	
Extended temperature* (°C)	-40 – 85		-40 – 85	
FIX BOM	*	*	*	*
EOL, PCN notification	Yes	Yes	Yes	Yes
Conformal Coating	*	*	*	*

*optional

DRAM

DDR3 SDRAM

DDR3 marked a significant leap forward, offering lower power consumption and higher capacity for a wide range of industrial applications. With transfer rates of 1 866 MT/s facilitated by a "fly-by" bus design, DDR3 optimized performance while meeting industrial demands.

DDR3 DIMM

DDR3 SODIMM

	DDR3 Memory Modules			
Module type	UDIMM	UDIMM ECC	SODIMM	SODIMM ECC
Capacity	2 GB – 8 GB	2 GB – 8 GB	2 GB – 8 GB	2 GB – 8 GB
Data Rate	1 066 MT/s 1 333 MT/s 1 600 MT/s 1 866 MT/s	1 066 MT/s 1 333 MT/s 1 600 MT/s 1 866 MT/s	1 066 MT/s 1 333 MT/s 1 600 MT/s 1 866 MT/s	1 066 MT/s 1 333 MT/s 1 600 MT/s 1 866 MT/s
Number of pins	240-pin	240-pin	204-pin	204-pin
Width	64 Bits	72 Bits	64 Bits	72 Bits
Voltage	1.35 V, 1.5 V		1.35 V, 1.5 V	
PCB Height	30 mm		30 mm	
Operating temperature (°C)	0 – 85		0 – 85	
Extended temperature (°C)	-40 – 85		-40 – 85	
FIX BOM	*	*	*	*
EOL, PCN notification	Yes	Yes	Yes	Yes
Conformal Coating	*	*	*	*

*optional

DRAM

DDR2 SDRAM

The second generation brought improvements in power consumption by operating at reduced supply voltage. Running at a data rate of 800 MT/s, DDR2 achieved transfer rates of up to 6 400 MB/s, enhancing efficiency while maintaining compatibility.

DDR2 SODIMM

	DDR2 Memory Modules	
Module type	UDIMM	SODIMM
Capacity	512 MB – 2 GB	512 MB – 2 GB
Data Rate	400 MT/s, 533 MT/s, 667 MT/s, 800 MT/s	400 MT/s, 533 MT/s, 667 MT/s, 800 MT/s
Number of pins	240-pin	200-pin
Width	64 Bits	
Voltage	1.8 V	
PCB Height	30 mm	30 mm
Operating temperature (°C)	0 – 85	
FIX BOM	*	*
EOL, PCN notification	Yes	Yes
Conformal Coating	*	*

*optional

DDR1 SDRAM

The first member of the DDR family introduced a synchronous interface active on both edges of the clock signal. With a data rate of 400 MT/s and a transfer rate of 3 200 MB/s over a 64-bit bus, DDR1 laid the foundation for subsequent generations.

DDR1 DIMM

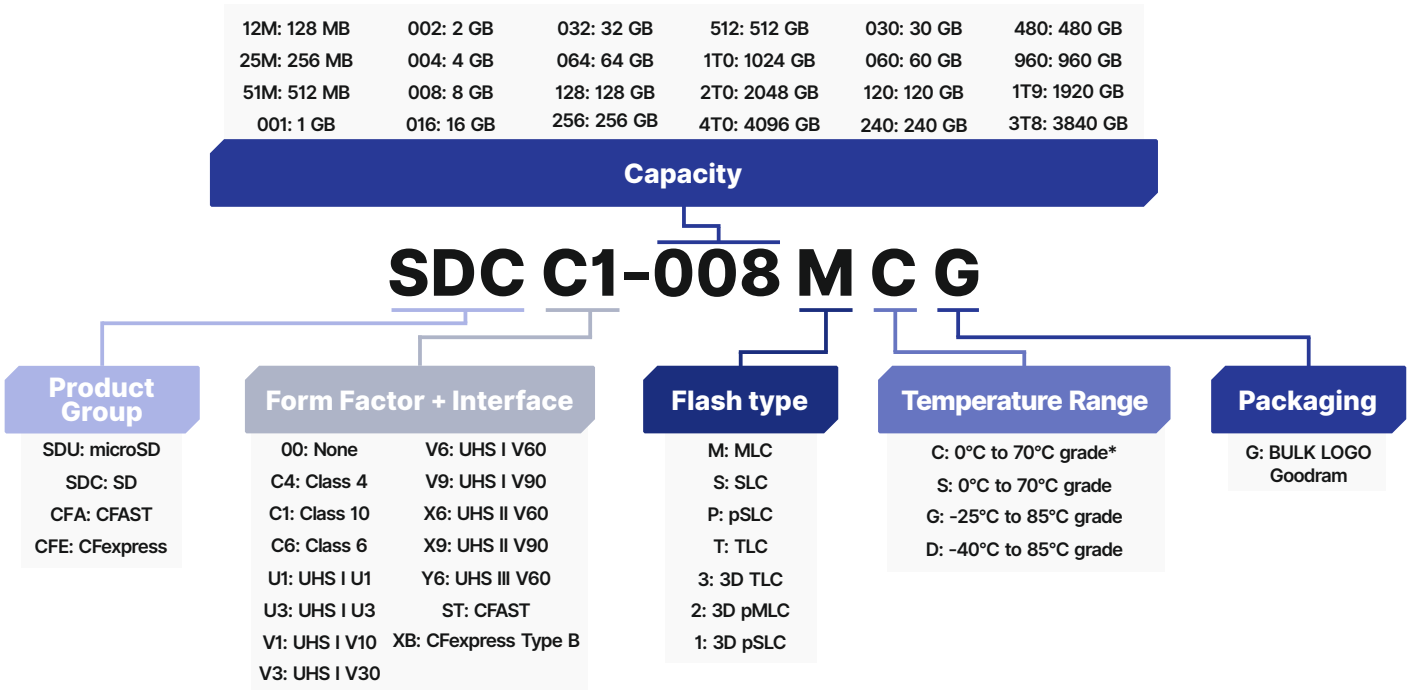
	DDR1 Memory Modules	
Module type	UDIMM	SODIMM
Capacity	128 MB – 1 GB	128 MB – 1 GB
Data Rate	200 MT/s, 266 MT/s, 333 MT/s, 400 MT/s	200 MT/s, 266 MT/s, 333 MT/s, 400 MT/s
Number of pins	184-pin	144-pin
Width	64 Bits	
Voltage	2.5 V	
PCB Height	29.50 mm	31.75 mm
Operating temperature (°C)	0 – 70	
FIX BOM	*	*
EOL, PCN notification	Yes	Yes
Conformal Coating	*	*

*optional

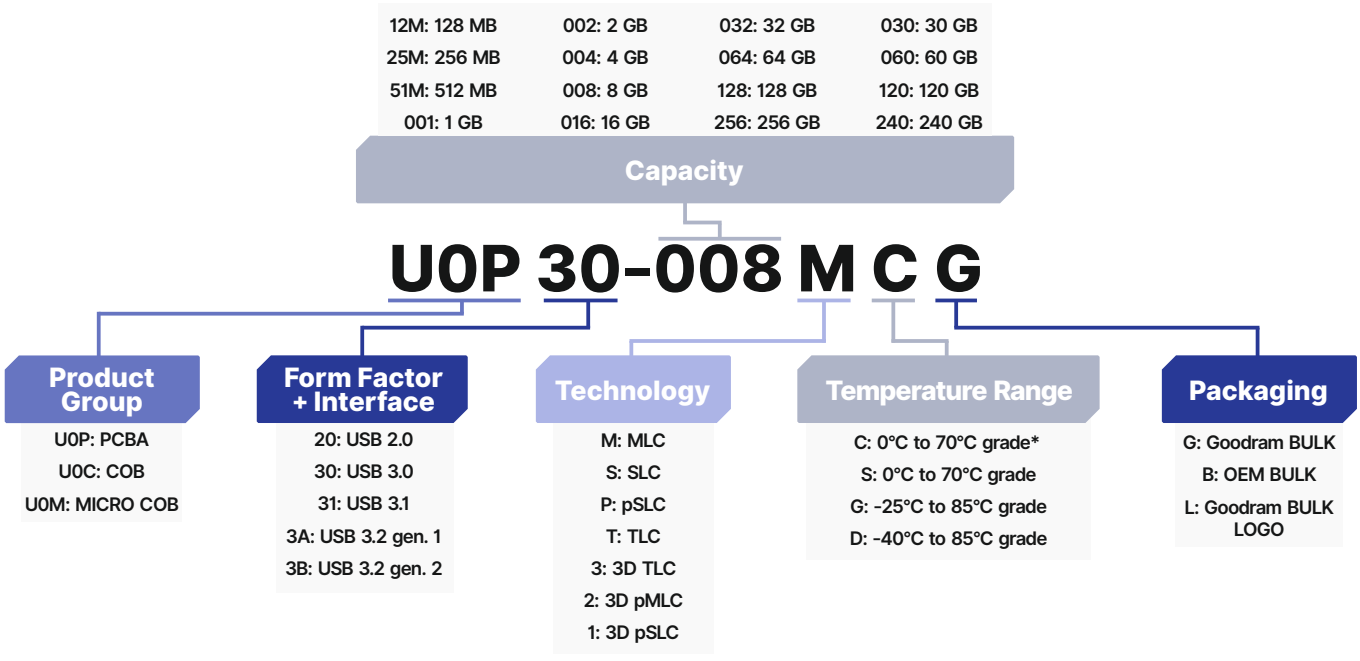
Part number decoder

Flash Memory (Memory Cards)

(SD, microSD, CFast, CFexpress)



USB Flash Drives

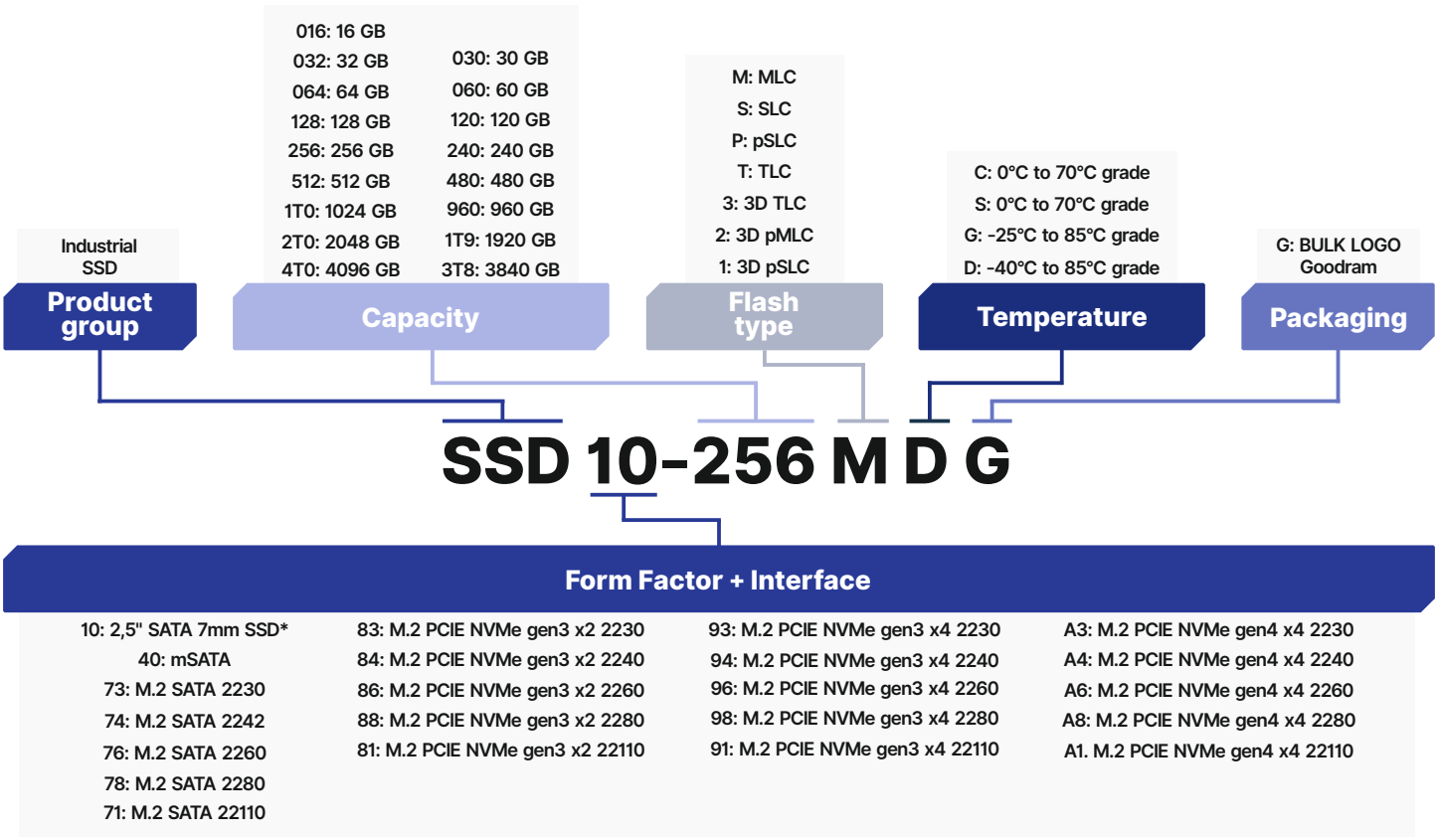


* available upon request

Part number decoder

Flash Memory (SSD)

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

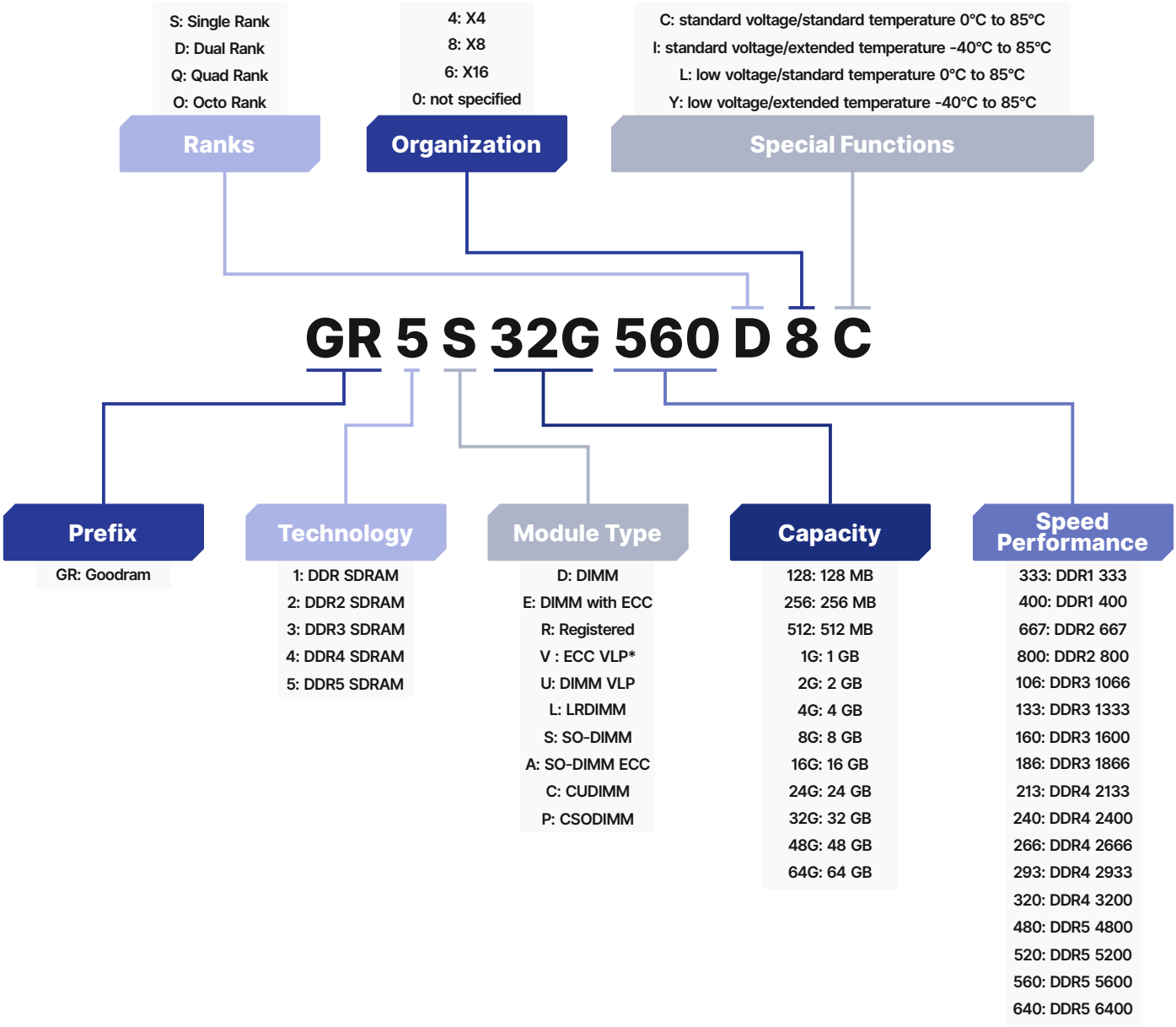


* 1,8" available upon special request

Part number decoder

DRAM Memory

(UDIMM, SODIMM)



* VLP - Very Low Profile

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