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Industrial Flash products
Industrial DRAM
Flash Controllers

Cactus
Technologies

hyperstone

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High Performance Flash

About Cactus Technologies

Since its foundation in 2005, Cactus Technologies has focused on the main industrial needs for high quality and high performance flash memory devices. Over time, the name Cactus Technologies has been established and is well known in the high-end aerospace, military, medical and industrial markets.

The ability to understand and fulfill the needs for those markets, in addition to the longterm support of the products, proves Cactus Technologies' whole hearted commitment to the industrial grade area where "*failure is not an option*".

Their primary focus is on the high performance, high endurance industrial grade SLC NAND Flash products, which shows specialized features like full BOM control, long term availability, security features and massive customization options.

To meet the requirements of applications that are more price sensitive, but still need a higher reliability than MLC can provide, Cactus Technologies offers a complete range of OEM grade products based on MLC NAND using a newer controller technology feature called pSLC. With pSLC mode, the endurance of the used MLC NAND memoryis drastically enhanced and shows a good balance between cost efficiency and quality. All features like BOM control and the customization options are also available for the new series.

Cactus Technologies also offers low cost commercial grade MLC NAND Flash product series for price sensitive applications. Special features include a BOM control and a PCN/EOL Management, which are unique in this price segment.

Product grade overview

Flash comparison			
	Industrial Grade	**OEM Grade**	**Commercial Grade**
NAND Types	SLC (Single Level Cell)	pSLC (Pseudo SLC)	MLC (Multi Level Cell)
Bits/Cell	1	1	2
Endurance Cycles	100k / 80k / 50k (*)	20k	3k
Reliability	★★★★★	★★	★
Data Retention	★★★★★	★★	★
Life Cycle	★★★★★	★★	★★
Locked BOM	✓	✓	✓
Cost	$$$$$	$$$	$$

 (*) Physical NAND cell endurance depending on the used NAND technology (4X nm / 3X nm / 2X nm)

General Features

- Production standard according to DIN ISO 9001 & ISO014001
- Fixed BOM, PCN and PDN service
- Serialization and Lot Code Tracking
- 5 years warranty (SLC Products)

- Long term availability
- MIL-STD specifications available
- PRO-Feature Set with extended security and Military compliant Fast Erase Options
- Extended SMART, TRIM and NCQ support
- Customized modifications

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Industrial Grade (SLC)

Features

- Up to ~100k erase-/write-cycles (physical)
- >4 Million hours MTBF
- Up to 70k IOPS
- MIL-STD specifications available
- 5 years warranty
- Life cycle monitoring and prediction via Utility
- SMART support
  - Standard, Extended & Extra Commands via Utility
- Customized modifications:
  - Programmable CID register of SD-Card
  - Customized drive size and geometry (C/H/S)
  - Individual labeling and serial number
  - Preload service
  - Changed physical dimensions and sockets
  - Additional Interfaces (e.g. USB)
  - Erase Button
- Full BoM Control with PCN-/EOL-Management

Pro Version Features

- ATA Security Feature Set
- CTPurge: erase only, erase and random overwrite of data once or n-times, several specs available
- CTLock: Lock card to host system
- Write Protect: by soft- or hardware (write-protect switch)
- Set Password, Unlock, Erase, Disable

Product Range							
Interface	Flash Type	Capacity	Temperature Range		BOM	Warranty	Options
			Standard	Extended			
SATA SSD 2,5"	SLC	4 GB - 256 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Contact us
mSATA	SLC	4 GB - 128 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Contact us
CFAST	SLC	4 GB - 128 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Contact us
M.2 (2242)	SLC	8 GB - 64 GB	0°C - 70°C	-40°C - 85°C	✓	5 years	Contact us
IDE SSD 2,5"	SLC	128 MB - 64 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Pro features available
IDE DOM	SLC	128 MB - 8 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Pro features available
CompactFlash	SLC	128 MB - 64 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	Pro features available
SD Card	SLC	128 MB - 16 GB	-25°C - 85°C	-45°C - 90°C	✓	5 years	
SD Chip	SLC	128 MB - 8 GB	-25°C - 85°C	-45°C - 90°C	✓	5 years	
microSD Card	SLC	1 GB - 4 GB	-25°C - 85°C	-45°C - 90°C	✓	5 years	
USB Thumbdrive	SLC	128 MB - 32 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	
USB DOM	SLC	128 MB - 8 GB	0°C - 70°C	-45°C - 90°C	✓	5 years	

OEM Grade (pSLC)

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What is pseudo-SLC (pSLC)?

Pseudo-SLC NAND uses MLC NAND Memory in a different way by storing only one bit of information per cell instead of the two bits usually stored in a MLC NAND cell. This is effective enough to raise the endurance of a standard MLC NAND cell up to 6 times, depending on the data profile used. The OEM Grade flash storage devices are built using that feature and provide a solution for all applications which are in need of a fair balance between endurance and pricing.

Additional features, like a locked BOM, PCN/EOL management and extended temperature range are also provided by Cactus Technologies for the OEM Grade products.

Features

- Cost effective, high quality MLC Flash in pSLC Mode
- Designed for standard and price sensitive applications where commercial Grade MLC does not meet endurance requirements
- > 20k erase-/write cycles (physical)
- SMART support
  - Standard, Extended & Extra Commands via Utility
- Standard and ext. temperature range
- Long term availability
- Locked BOM available
- PCN Management
- 2 years warranty (1 year at ext. temp)
- Complete customization available
- Available custom modifications (examples):
  - Programming PNM field in CID register of SD-Card
  - Customized drive size and geometry (C/H/S)
  - Individual labeling and serial number
  - Preload service

Product Range							
Interface	Flash Type	Capacity	Temperature Range		BOM	Warranty	Options
			Standard	Extended			
SATA SSD 2,5"	pSLC	8 GB - 512 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
mSATA	pSLC	4 GB - 128 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
CFAST	pSLC	4 GB - 128 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
SATA M.2 (2242&2260)	pSLC	4 GB - 128 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
SD Card	pSLC	4 GB - 64 GB	-25°C - 85°C	-40°C - 85°C	✓	2 years	

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Commercial Grade (MLC)

Why Commercial Grade?

For the most price sensitive industrial/embedded applications, which are still in need of a higher endurance than any consumer product can provide, Cactus Technologies offers an industrial version of cost effective MLC NAND products. Due to the strict use of 2-bit per cell Flash memory, a much higher endurance can be achieved. While current 3-bit per cell (TLC) consumer products show a physical endurance of merely 300 write/erase cycles per cell, the 2-bit per cell (MLC) memory achieves an physical endurance of around 3000 write/erase cycles.

Additional features, like a locked BOM, PCN/EOL management and extended temperature range are also available for the Commercial Grade products, as well as a wide range of customization options, which makes it a cost effective solution with a wide variety of interfaces and form factors.

Features

- Cost effective, high quality MLC Flash
- Designed for standard and price sensitive applications
- > 3k erase-/write cycles (physical)
- SMART support
    - Standard, Extended & Extra Commands via Utility
- Standard and ext. temperature range (dep. on model)
- Long term availability
- 2 years warranty (1 year at ext. temp)
- Available custom modifications (examples):
    - Programming PNM field in CID register of SD-Card
    - Customized drive size and geometry (C/H/S)
    - Individual labeling and serial number
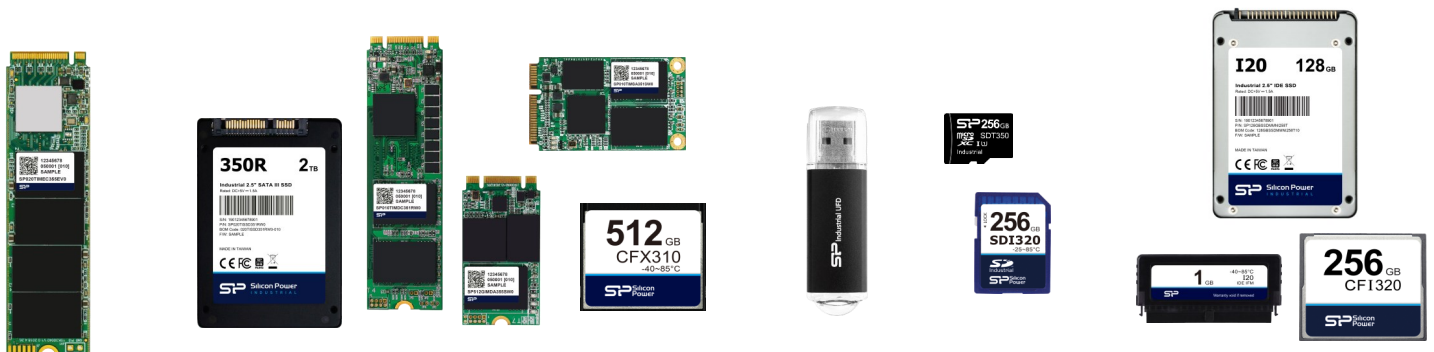   - Preload service

Interface	Flash Type	Capacity	Temperature Range		BOM	Warranty	Options
			Standard	Extended			
Crypto SATA SSD 2,5"	MLC	512 GB - 1 TB	0°C - 70°C	-40°C - 85°C	✓	2 years	Contact us
SATA SSD 2,5"	MLC	16 GB - 1 TB	0°C - 70°C	-40°C - 85°C	✓	2 years	
mSATA	MLC	8 GB - 512 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
CFAST	MLC	8 GB - 128 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
SATA M.2 (2242&2260)	MLC	8 GB - 256 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
NVMe M.2 (2242&2280)	MLC	16 GB - 256 GB	0°C - 70°C	-40°C - 85°C	✓	2 years	
NVMe M.2 (2280)	3D NAND	128 GB - 1 TB	0°C - 70°C	-40°C - 85°C	✓	2 years	
CompactFlash	MLC	4 GB - 128 GB	0°C - 70°C	n/a	✓	2 years	
SD Card	MLC	4 GB - 128 GB	-25°C - 85°C	-40°C - 85°C	✓	2 years	
microSD Card	MLC	8 GB - 32 GB	-25°C - 85°C	n/a	✓	2 years	

Industrial Flash Solutions

SP Silicon Power INDUSTRIAL

About Silicon Power Industrial

Silicon Power, founded in 2003, produces DRAM and Flash products for the consumer and industrial area. Due to the significantly higher requirements in the industrial sector, separate R&D departments have been set up to meet the customer specific challenges in the industrial environment. By testing each and every product, quality features like chip screening, burn-in tests, or a consistent traceability of every product - including the production history - Silicon Power is in a good position to meet even the highest requirements in the areas Industrial, Medical, Military and Aerospace.

Common for all products is a long term availability of at least 5 years and a sophisticated BOM- and EOL-/PCN-Management. Safety comes with a long warranty of 5 years (and within TBW) for SLC products and 3 years (and within TBW) for MLC/3D-TLC products.
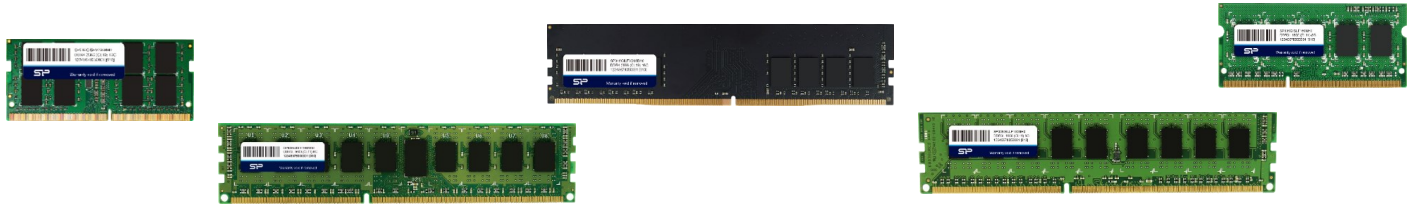
Form Factor	NAND type / Capacities				
	SLC	**MLC**	**3D TLC**	**pSLC (MLC)**	**pSLC (3D TLC)**
M.2 2280 (NVMe)	-	-	64GB - 2TB	-	-
M.2 2242 (NVMe)	-	-	128GB - 1TB	-	-
M.2 2280 (SATA)	8GB - 64GB	16GB - 512GB	64GB - 1TB	8GB - 128GB	16GB - 256GB
M.2 2242 (SATA)	-	-	64GB - 512GB		16GB - 128GB
2.5" SSD (SATA)	8GB - 256GB	32GB - 1TB	64GB - 1TB	16GB - 512GB	16GB - 256GB
Cfast	4GB - 64GB	8GB - 512GB	64GB - 512GB	8GB - 256GB	32GB - 128GB
mSATA	8GB - 32GB	4GB - 256GB	64GB - 1TB	16GB - 128GB	16GB - 256GB
CompactFlash	128MB - 16GB	8GB - 256GB	-	4GB - 128GB	-
2.5" SSD (IDE)	1GB - 128GB	32GB - 128GB	-	-	-
DOM (IDE)	128MB - 1GB	-	-	-	-
SD	256MB - 32GB	8GB - 256GB	32GB - 256GB	4GB - 128GB	-
microSD	256MB - 8GB	8GB - 128GB	32GB - 256GB	4GB - 64GB	16GB - 64GB
USB (3.0)	-	8GB - 64GB	32GB - 512GB	-	-
USB (2.0)	512MB - 16GB	8GB - 32GB	-	4GB - 16GB	-

Silicon Power
INDUSTRIAL

Industrial DRAM Solutions

About Silicon Power DRAM

Silicon Power's DDR3 and DDR4 DRAM modules are produced using the highest quality standards and provide a price effective and reliable solution for any industrial purpose. All products are fully tested to guarantee stability, reliability and compatibility. The DRAM modules are also available with an optional 30µ gold finger plating and/or with an extended temperature range of –40°C to –85°C to enable the usage in more rugged environments.

Silicon Power provides a 10 year warranty for all modules.

DDR3 DRAM Modules						
	SODIMM	**UDIMM**	**VLP-UDIMM**	**ECC SODIMM**	**ECC UDIMM**	**ECC RDIMM**
Capacities	2/4/8GB	2/4/8GB	2/4/8GB	4/8GB	4/8GB	8GB
Clock	1600MHz	1600MHz	1600MHz	1600MHz	1600MHz	1600MHz
CAS Latency	CL11	CL11	CL11	CL11	CL11	CL11
PCB Height	30,50mm	30,50mm	18,90mm	30,50mm	30,50mm	30,50mm
0°C - 85°C	✓	✓	✓	✓	✓	✓
-40°C - 85°C	✓	✓	✓	✓	✓	✓

DDR4 DRAM Modules					
	SODIMM	**UDIMM**	**ECC SODIMM**	**ECC UDIMM**	**ECC RDIMM**
Capacities	4GB, 8GB, 16GB	4GB, 8GB, 16GB	4GB, 8GB, 16GB	4GB, 8GB, 16GB	4GB, 8GB, 16GB
Clock	2400/2666MHz	2400/2666MHz	2400/2666MHz	2400/2666MHz	2400/2666MHz
CAS Latency	CL17/CL19	CL17/CL19	CL17/CL19	CL17/CL19	CL17/CL19
PCB Height	30,13mm	31,40mm	30,13mm	31,40mm	31,40mm
0°C - 85°C	✓	✓	✓	✓	✓
-40°C - 85°C	✓	✓	✓	✓	✓

Highly reliable flash memory controller

About Hyperstone

Hyperstone is a fabless semiconductor and microprocessor design company. It was founded in 1990 and is based in Konstanz, Germany. Hyperstone's portfolio includes microcontrollers for Serial-ATA and Parallel-ATA Solid State Disks (SSD), Disk-on-Module (DoM), Disk-on-Board (DoB) as well as embedded Flash solutions such as eMMC. Flash cards such as CompactFlash, SD & microSD and USB controllers complete the portfolio.
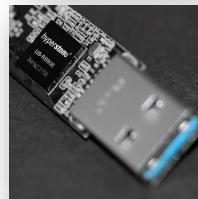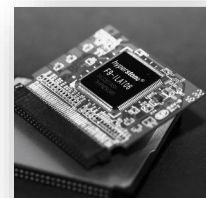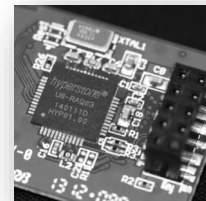
Flash controller firmware is supplied complementary to the controllers and is customized for each flash type and application. Together with subsidiaries in Taiwan, USA and with other worldwide partners, Hyperstone serves a global customer base. The company's research and development departments are based in Germany and Taiwan. Industry-leading partners provide world-class wafer subcontracting, packaging, and testing services.

General Features

- Industrial flash memory controllers for
  - USB
  - SD/eMMC
  - CompactFlash/ATA
  - SATA

- hyReliability™ Flash Management ensuring highest reliability and endurance, including
  - Superior wear leveling
  - Read disturb management
  - Power fail management

- hyMap® page-based firmware
- FlashXE® (advanced ECC algorithms, etc.) (X1 only)
- Individual Firmware customization
- High performance 32-bit RISC/DSP Architecture (Dual Core 32-bit Architecture for X1)
- ISO7816 Interface for SmartCard or GPIO applications
- Turnkey Solution: Hardware & complementary firmware delivery
- Continuous support for all new flash generations
- Long term service and support

Product overview											
Product	Interface	Flash Type				Channel	Temp. Range	Max. Speed (to host)		ECC	Packages	In-field FW Update
		SLC	MLC	pSLC	3D			Read (MB/s)	Write (MB/s)			
X1	SATA	✓	✓	✓	✓	2	0°C...70°C -40°C...85°C	550	500	FlashXE®	TFBGA-124 | TFBGA-144 Die/Wafer	✓
F9	CF/PATA	✓	✓	✓	✓	2	0°C...70°C -40°C...85°C	120	120	Up to 96-Bit/1K	TQFP-128 | TFBGA-144 TFBGA-124 | Die/Wafer	✓
A2	SATA	✓	✓			4	-40°C...85°C	150	130	24-Bit	TFBGA-201 | Die/Wafer	✓
S9	SD/eMMC	✓	✓	✓	✓	1	-40°C...85°C	90	90	FlashXE®	LGA-52 | LGA-64 Die/Wafer	✓
U8B	USB 2.0	✓	✓	✓	✓	1	-40°C...85°C	60	60	Up to 96-Bit/1K	QFN 76	✓
U9	USB 3.1	✓	✓	✓	✓	2	-40°C...85°C	200	150	Up to 96-Bit/1K	TFBGA-124 | Die/Wafer	✓

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