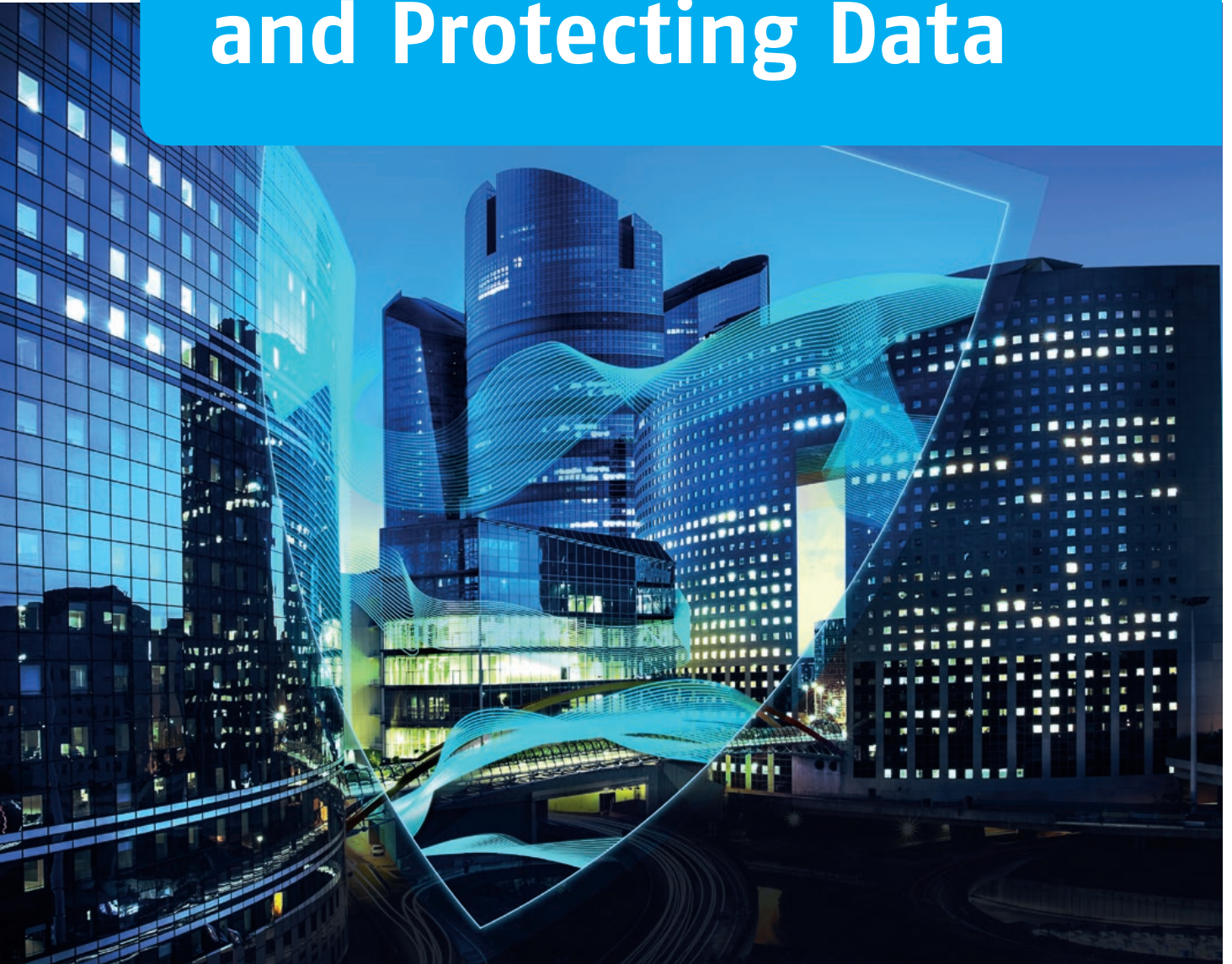


# Reliably Storing and Protecting Data



**Industry • IoT • Automotive • Security  
Networking & Communication • Data Center**

# About Swissbit

## Store. Secure. Trust.

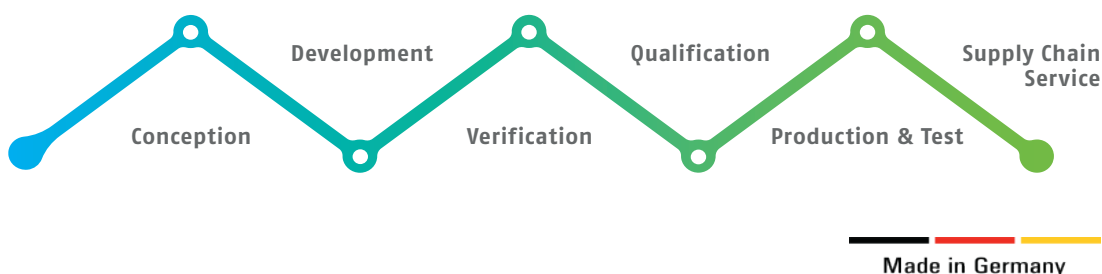
Data is the fuel of the future and is driving global growth and change. As trusted partner Swissbit empowers the digital and connected world by reliably storing and protecting data in industrial, security and IoT applications. As a leader in industrial storage and embedded IoT (Internet of Things) solutions, Swissbit develops and manufactures true industrial storage and security products "Made in Germany" with long-term availability, high reliability, custom optimization and low total cost of ownership.

## Reliably Storing and Protecting Data in Industrial and IoT Applications

More than 5,000 customers around the world including Fortune 500 companies and the world's leading OEM's already rely on Swissbit for their critical data storage and security requirements. With 20 years of experience in the development of removable & embedded storage and embedded IoT solutions for the most demanding markets, coupled with a trusted global distribution and support network, Swissbit is firmly established as a global innovation leader in storage and security products for high-reliability solutions.

## Made in Germany

New technological trends are driving the demand for highly integrated solutions and advanced packaging technologies. Digitization will increase the demand for industrial memory products for industrial, telecommunications, automotive (e.g. autonomous driving), medical, and fiscal applications. In addition, the growing connectivity of devices in the Internet of Things means that the demands on the protection of data and devices, and thus the demand for smart security products, will increase massively. Swissbit has prepared for this with new state-of-the-art production capacities at the new plant in Berlin, Germany.



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A large orange industrial robotic arm is the central focus of the image. It is positioned in a factory or industrial setting, with a complex network of orange steel beams and white corrugated metal walls in the background. The robot's arm is extended, and its joints are visible. A white protective cover is draped over the upper part of the arm. The lighting is bright, highlighting the metallic surfaces of the robot and the structural elements of the facility.

Applications

# Industry

Swissbit's embedded memory and storage solutions are the perfect fit for demanding embedded applications. They offer the highest reliability and quality. Swissbit's strategic cooperation with suppliers allows for long-term availability of products. To guarantee

high-quality standards, each product undergoes thorough functional testing before being released for shipment. The broad portfolio with different NAND technologies and industry-dedicated features guarantee the right solution for each embedded use case.





Memory and non-volatile storage solutions for embedded applications must provide reliable operation even in the most extreme conditions: temperature, shock, and vibration. As such, both the qualification cycle and the support life cycle needed for these products by far exceed those of devices designed for typical consumer applications.

#### Typical Applications:

- Industrial automation
- Energy distribution
- Energy consumption
- Smart grid
- Infotainment
- Transportation
- Aerospace and defense






Applications

# Internet of Things

Especially in the areas of production and building automation, connections between machines, systems, sensors, actuators and the Internet have become indispensable, as production plants are now integrated into a comprehensive network. There is also a trend towards central control in building automation. In smart buildings and factories, data can be collected remotely and devices can be controlled or monitored.

However, the IoT not only brings advantages, but also offers new targets for cybercriminals. If hackers manage to gain access to the flow of information between IoT devices, they can spy out valuable data, spread misinformation or even damage systems. The economic consequences range from loss of image or contractual penalties to loss of production.





A pure software based security solution is not enough. The only remedy here is a holistic security concept that always focuses on a hardware security anchor – the root of trust. The Swissbit SD, microSD and USB products offer the perfect rugged and reliable small form factor security products for edge computing systems. Swissbit security products can be used as a TPM-like, hardware-based root of trust to give IoT devices a unique ID and protect access, boot code, communication, and stored data.

#### Typical Applications:

- Smart buildings & Smart factories
- Industrial connectivity
- Manufacturing / IIoT
- Remote Monitoring & Control
- Surveillance
- Point of Sale (POS)
- Smart infrastructure
- Mobility



Applications

# Networking & Communication



Today's modern life can't be imagined without a wide and stable network for data access, distribution and storage. Exabytes of data travel daily through the internet, zettabytes are already stored. Millions of routers and bridges are spread out over the globe bringing internet access to even the most remote location.

5G technology requires a much higher number of small form factor edge

devices to reach out to the end users and connected devices.

Those networking and communication systems need to operate 24/7 and sometimes under extreme environmental conditions including poor power supply stability. Since many edge devices are positioned on high and prominent locations that are difficult to maintain, the service interval must be extended.





Storage solutions for networking and communication systems must provide reliable operation even in the most extreme conditions: wide temperature changes, sudden power interruptions, environmental influence. Furthermore, small form factors with rather low densities and high endurance ask for specialized solutions while keeping the total cost of ownership low. Boot devices may be inactive for months and need to bring back the system after an unexpected power loss quickly and reliably. The storage data rate must remain high with fully utilized capacity.

#### Typical Applications:

- ATCA blade
- Cable modem
- Content and video delivery
- Enterprise media gateway
- Switches and routers
- Optical network
- Radar / Sonar
- Radio network controller
- Security
- Tetra base station
- Wireless base station
- DSL access multiplexer






Applications

# Data Center

A staggering amount of cloud applications, each with an ever increasing individual complexity is covered by one-size-fits-all SSD solutions provided by the mainstream market. Under real world workloads, a standard Data Center SSD degrades by 50-75 % over a period of 4-10 months. Cloud service providers are confronted

with significant reduction of performance and increased latency that do not meet the service levels required by end customers. Additionally increased cost for early replacement of the storage SSD and additional service costs reduces the profitability of datacenters. Hence, there is significant potential to improve efficiency.





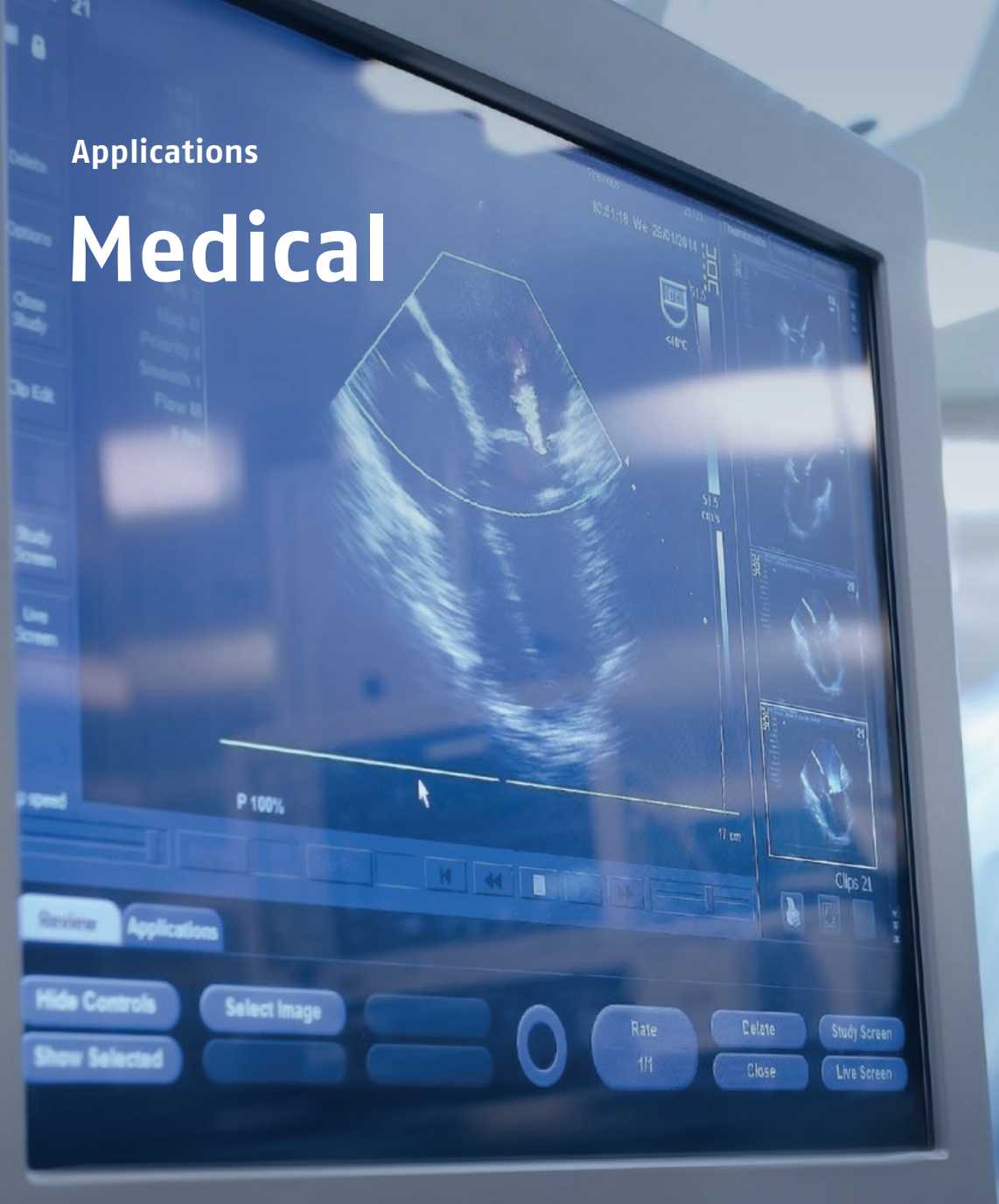
Swissbit individually tunes the SSD Flash management so that the ratio between sustained performance and endurance is optimized to the real world workload of the customer application. This fine-tuning of the flash parameters enables the 2x-5x better steady state performance and the up to 2x higher endurance compared to mainstream data center SSDs.

#### Typical Applications:

- Big Data
- Video Streaming & Production
- Machine Learning
- Artificial Intelligence
- IoT

## Applications

# Medical



There is a vast array of medical applications, ranging from diagnostic instruments as MRI and CT scanners, ultrasound systems, to blood testing and dialysis machines and infusion pumps. The amount of data stored can be small, as in heart rate monitoring equipment for example, or large as in X-Ray imaging. Nonetheless there is one common aspect: qualifying and certifying components for medical use is a lengthy, expensive task and the timeline from the

initial testing to volume production may extend over several years. Any requalification needs to be avoided as much as possible. This requires storage products that have a frozen BOM and long availability for many years. The portfolio of products for medical use ranges from SD/microSD memory cards or CF cards for handheld medical appliances, to 2.5" or M.2 SSDs with high bandwidth and capacity for medical imaging.





We rely on medical instruments in the most critical conditions of our lives. There is no tolerance for malfunctioning systems. Swissbit understands these requirements and serves the medical industry with storage products that fulfill the highest quality standards. Additionally, Swissbit's secure storage products protect the patient's medical data against unauthorized access.

#### Typical Applications:

- Diagnostics
- Medical imaging
- Medical treatment
- Point-of-care testing
- Monitoring systems
- Augmented reality
- Medical vision

Applications

# Automotive

Applications such as ADAS/AV, infotainment, data recorder or instrument cluster fuel the demand for compute scalability resulting in high bandwidth and low latency. Autonomous driving requires seamless/real-time stream of an ever-increasing amount of data exchange between the vehicle and cloud services. OEMs are facing new challenges where Swissbit is a reliable partner.

(1) Decoupling of software from the hardware and serviceability across the entire lifecycle of a vehicle.

(2) No safety without security: Functional safety as defined by the ISO 26262 requires OEMs to demonstrate effective cybersecurity risk mitigation mechanisms as defined in the ISO 21434. Hardware based security solutions can enable OEMs to protect data and devices and comply to standards up to ASIL D.

(3) Customization and optimization of SSDs to application and user specific performance and endurance workloads.





Self-Driving

48  
mph

- /Administration
- /Human Resources
- /Legal
- /Accounting
- /Finance
- /Marketing
- /Publicity
- /Promotion
- /Research
- /Business
- /Development
- /Engineering
- /Manufacturing
- /Planning

The architecture of the new Software Defined Car differs significantly from established automotive architectures. Swissbit offers building blocks that allow OEMs and Tier 1 suppliers to implement secure storage solutions for new software defined car architectures. Beside that, Swissbit has an extensive portfolio of automotive grade Flash Memory products that are manufactured in the IATF 16949 certified fab in Berlin, Germany.

- Typical Applications:**
- Advanced driver assistance systems (ADAS)
  - Autonomous driving platforms
  - Infotainment systems
  - EV charging
  - Drive video recorder
  - Instrument cluster
  - Dashcam

Applications

# Security



Governments, enterprises, banks, and industry demand high-end security to protect their assets. The growing number of IoT devices need to be secured against interception of data transfer and hacking of control systems. But even trusted security solutions like management engines, smartcard chips, or secured CPUs prove to be imperfect.

An upgradeable security solution based on exchangeable hardware cryptography and standard interfaces is the solution to update systems to an always-state-of-the-art security level. Swissbit's security solutions offer smart card functionality coupled with NAND flash storage. Systems with SD card or USB interface can easily be updated to the protection level of a smart card chip.





Hardware-based security offers the highest level of protection but needs a certain effort to be integrated in a system environment. Swissbit's middleware creates the standardized layer to offer security functionality to the system without the need to understand the underlying hardware interfaces.

#### Typical Applications:

- Surveillance
- Fiscal data logging
- E-charging
- Audit trails
- License and IP protection
- Secure update
- Secure boot
- Secure voice communication
- Authentication and authorization
- Data encryption and protection

# Product Features

## Robustness Features



### Shock and Vibration

The design, assembly, and use of selected materials guarantee extreme mechanical robustness.



### Conformal Coating

A thin polyurethane film protects against aggressive environmental conditions such as dust, moisture, or corrosive gas.



### Longevity

These products offer the lowest TCO in demanding applications with high requalification cost.

## Performance Features



### High Performance

Optimized for high sequential data rates and IOPS by use of SLC technology.



### WAF Reduction

The WAF (write amplification factor) for MLC-based products is reduced by combining a page-based firmware block management with a powerful card architecture and configuration settings.

## Temperature Features



### Wide Temperature Support

The products are designed and approved for reliable operation over a wide temperature range.



### Temperature Sensor

The sensor allows the host hardware or software to monitor the storage device temperature.

## Data Features



### Data Care Management

Multiple routines inside the controller firmware improve data quality and eliminate degradation effects.



### Life Time Monitoring (LTM)

The Swissbit Life Time Monitoring feature enables users to access the memory device's detailed Life Time Status and allows remaining life time prediction, thereby avoiding unexpected data loss.



### Secure Erase (Sanitize / Purge) / Fast Erase

This feature uses an uninterrupted sequence of data erase commands.



### Read-only optimized

For cases where content is written to the NAND flash once, the firmware can be optimized to guarantee the highest possible data retention and read disturb.



### Trim Support

Expired data can be released and deleted in the Flash which reduces garbage collection and increases the life time.



### Zone Protection

The device allows the configuration of multiple zones with either no protection, write protection, or access protected settings.



## Electronic Features



### ESD and EMI safe

The product designs are in line with the latest regulations for electrostatic discharge and electromagnetic interference.



### Low Power Consumption

Electronic devices with lower power consumption decrease energy cost, prolong battery life, and reduce heat generation in the device, and hence require less cooling.



### Wear Leveling

Sophisticated wear leveling and bad block management ensure that flash cells are sparingly and equally used to prolong the device's life.



### In Field FW Update

The storage product can be upgraded with new firmware in the field. The upgrade process is protected against power loss.



### Power Fail Protection

During an unintentional shutdown, firmware routines and intelligent hardware architecture ensure that no corruption of user or system data will occur.



### Power Fail Protection & Recovery

Products with the Swissbit powersafe feature use tantalum capacitors to store energy. In case of a sudden power fail the charge will be used to harden the cache content into the NAND flash.

## Security Features



### True Hardware RNG

True random numbers are generated inside the secure element to prevent brute force attacks.



### Digital Signature

Digital signatures are very popular and indispensable to protect against data or code manipulation.



### Hardware Based Data Encryption

Hardware based security is key when it comes to replaceability, simple workflows, and trusted runtime environments.



### Mobile Banking & E-purse

Strong authentication and offline security for mobile banking and payment.



### Device Protection by Dual Factor Authentication

The user needs to have the card and know the PIN.



### Secure Voice

The product is optimal for fast, encrypted, and user-friendly secure voice solutions.



### Elliptic Curve Cryptography Support

Elliptic curves are faster and more efficient than RSA cryptography.



### Data Protection & Encryption

The card offers a data safe function with strong AES encryption and PIN access protection.



### Secure Logging

Any data can be stored securely in write-once mode, queue mode, or random-access mode.



### Secure CD-ROM

Important data can be modified only after PIN authentication.

# How Do Our Customers Benefit?



## Extreme Robustness

- The service life of Swissbit products exceed industry practice by far
- PCB design and soldering process withstand high thermal stress
- True industrial temperature support incl. proven cross temp stability
- Improved signal integrity for reliable and reduced risk and costs in product development



## Customization and Service

- Joint qualification service to optimize performance, endurance and thermal considerations for customer specific projects
- Customized marking/label, device configurations, data preload service, additional test coverage, additional security features and many more
- Field support, direct access to technical experts and full RMA handling service
- Extended access to life time data for predictive maintenance





## Highest Quality Standards

- Zero defect manufacturing with world class product qualification for highest quality
- Products designed, developed and manufactured specifically for industrial, NetCom and automotive markets
- Stringent hardware and firmware qualifications verify design effort
- In-house COB process for maximum mechanical robustness



## Longevity

- Strategic partnerships with world leading NAND Flash suppliers
- Direct access to wafer support and joint development programs
- Long term supply and support agreements
- Locked BOM and drop in replacement products in case of product changes

# NAND Flash Products

Our sophisticated flash handling algorithms optimize the performance and life of the 2D and 3D NAND flash used in our products.

OEMs of various industries require a variety of memory and storage solutions. In contrast to typical consumer devices, Swissbit's embedded memory and storage solutions are designed for the highest reliability under extreme environmental conditions. They come with a large feature set tailored to the demands of the industrial, automotive, and NetCom markets and with our commitment to long-term availability. Swissbit's embedded memory

and storage solutions portfolio covers all relevant interfaces and form factors including SD and microSD memory cards, CompactFlash™, CFast™ and CFexpress™ cards, 2.5" SATA SSDs, SLIM SATA and mSATA SSDs, M.2 in SATA and PCIe NVMe, USB Flash Drives (UFD), and modules. Our sophisticated flash handling algorithms optimize the performance and life of the SLC, MLC and 3D NAND flash used in our products.

	SLC	pSLC	MLC	3D pSLC	3D eTLC	3D TLC	3D QLC
Chip Capacity	.	..	...	...	....	....	.....
Cost per Bit	.....	....	...	..	.	.	.
Reliability & Endurance	....	...	..	....	....	...	.
High Temperature Support	...	....	...	...	.	..	.
Write Performance	..	..	.	....	..	..	..
Data Retention	..	..	..	..	.	..	.
Longevity	...	..	..	..	..	..	.

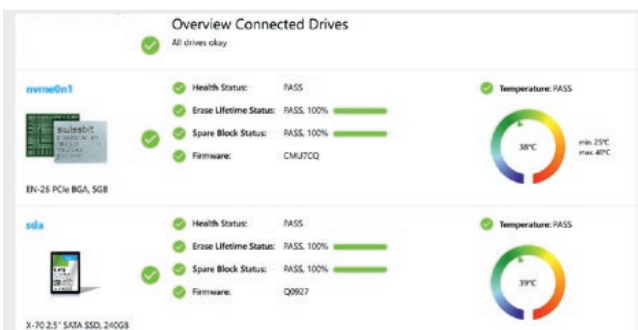
..... maximum; .... highest; ... high; .. medium; . low





## Flash Life Time Prediction

The Swissbit Device Manager Tool (SBDM) provides a detailed overview of the life time status of Swissbit products. This includes the standard S.M.A.R.T. parameter as well as down to the single block Flash utilization numbers. The tool can be used to extrapolate the life time expectation of a product in a real application by taking two snapshots before and after the test and evaluating the consumption through the test phase.



### Swissbit Device Manager Tool

- Shows critical device health data in a user friendly app
- Visualization and accessibility of key telemetry data
- Common interface for any Swissbit storage product
- Identify need for maintenance and service
- Reduces machine down time and field failure costs
- Increases system reliability

# Data Center & Enterprise SSDs

Most off-the-shelf SSDs, even special Data Center versions, degrade both in performance and in endurance due to non optimized Flash management. Swissbit's N4200 U.3 Data Center SSD enables server engineers to achieve reliable, high storage capacity that delivers consistently high performance and low latency. The N4200 firmware can be uniquely tailored to a specific workload profile, e.g. for web, streaming, application and cache servers.

The firmware optimally matched to the workload profile keeps write amplification low and improves endurance. This innovative approach is designed specifically to tackle complex cloud applications delivering the best and most consistent throughput and latency in the industry.

The Swissbit N5200 U.2 Enterprise SSD addresses the constantly growing server market with a high performance, high endurance PCIe architecture.



## Artificial Intelligence

Analysis of data, the evaluation of scenarios and the resulting reactions.



## Big Data

Deep analysis of captured data needs fast storage with parallel operation of writes and reads.



## Video Streaming & Recording

Massive amounts of data is written once and read with multiple streams in parallel.



## IoT

Data Centers are used at the edge to store preprocessed data for further processing.



## Machine Learning

Machine learning takes a multitude of training data samples to build an optimized model.

Swissbit offers different firmware versions optimized to specific use cases or fully customized.



### N4200 U.3 8TB



### N4200 U.3 16TB



### N5200 U.2



## Information

Type	U.3 Data Center SSD		U.2 Enterprise SSD
Standard & Interface	PCIe Gen 4.0 / NVMe 1.4, x4		
Form Factor	U.3, 4 lanes		U.2, 4 lanes
Outline Dimensions	100.4 mm x 69.9 mm x 14.8 mm		
Flash Type	3D NAND eTLC		
Density Range	7.68 TB	15.36 TB	1.92 TB – 7.68 TB
Data Retention	1 year @ life begin   3 months @ life end		
Endurance [DWPD] Enterprise	1 DWPD for 5 years		> 1 DWPD for 5 years

## Temperature

Operating Temperature	Commercial: 0 °C to +70 °C		
Storage Temperature	-40 °C to +85 °C		

## Performance

Sequential Read (MB/s)	up to 7,050	up to 6,900	up to 6,500
Sequential Write (MB/s)	up to 3,750	up to 4,500	up to 4,000
Random 4KB Read (IOPS)	up to 513,000	up to 480,500	up to 1,300,000
Random 4KB Write (IOPS)	up to 272,000	up to 160,500	up to 185,000
FTL/Cache Support	DDR4 DRAM		

## Robustness

MTBF	≥ 2,000,000 hours	≥ 2,500,000 hours
Data Reliability	< 1 sector per 10 <sup>17</sup> bits	

## Electrical Data

Voltage	VCC: 12 V ± 8 %	
Average Power, Mixed Rd/Wr	16.3 W	12.0 W

## Feature List

Features & Tools	<ul style="list-style-type: none"> <li>Modular flash SSD controller architecture designed specifically for the extreme workload demands of cloud and data center environments</li> <li>QoS for Performance and Latency Consistency,</li> <li>Consistent Performance and Latency over life with complex mixed workloads</li> <li>Hot / Cold Data Management</li> <li>Data Care Management &amp; Lifetime Enhancements</li> <li>Over-temperature protection</li> <li>Asynchronous Power Loss Protection</li> <li>Flexible Overprovisioning</li> <li>In-Field Firmware Update</li> <li>Crypto erase</li> <li>Active State Power Management (ASPM) Support</li> <li>Enterprise-Grade Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T., Telemetry)</li> </ul>	<ul style="list-style-type: none"> <li>Dynamic Internal RAID</li> <li>S.M.A.R.T., Telemetry</li> <li>AES256 encryption</li> <li>TCG OPAL 2.01</li> <li>Secure Boot</li> <li>End to end path protection</li> <li>Crypto erase</li> <li>eDrive (IEEE 1667)</li> <li>16 up to 128 namespaces</li> <li>powersafe™ functionality</li> </ul>
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>	

# PCIe SSD Modules

The PCIe interface with NVMe protocol has become the new standard for consumer, enterprise and embedded applications. Although all three use the same SSD architecture, the individual requirements differ significantly. High capacity and speed are most important for enterprise applications. On the other side embedded applications require low power consumption and immunity against data loss at power fail. Swissbit addresses these different needs with the N-20m2 with HMB support, low power consumption

and small form factors, and with the high performance N-30m2 with powersafe™ hardware power fail protection. They feature thermal and data care management and various security options. Both series are also available in pSLC variants with highly increased endurance.

The new N5200 with the server ruler SSD format E1.S and different heat spreader options provide highest capacity and performance for power hungry enterprise applications.



	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Temp. Sensor	Power Loss Protected	powersafe™	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	WAF Reduction
N-20m2 / N-26m2	●	●	●	●	●	●	●	○	●	●	●	●	●
N-30m2 / N-36m2	●	●	●	●	●	●	●	★	●	●	●	●	●
N 3200	○	●	●	●	●	●	●	★	●	●	●	●	●
N 5200	○	●	●	●	●	●	●	●	●	●	●	●	●

★ industry leading ● default implemented ○ not available

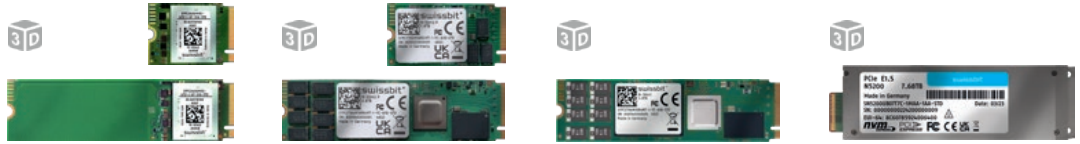


**N-20m2 / N-26m2**  
**N2000 / N2600**

**N-30m2 / N-36m2**  
**N3000 / N3600**

**N3200 M.2**

**N5200 E1.S**



**Information**

Type	M.2 PCIe / NVMe			E1.S PCIe / NVMe
Standard & Interface	PCIe Gen 3.1 / NVMe 1.3, x4		PCIe Gen 4.0 / NVMe 1.4, x4	
Form Factor	M.2 2280, 2242, 2230 M key, 4 lanes	M.2 2280, 2242 M key, 4 lanes	M.2 2280 M key, 4 lanes	E1.S, PCIe (5.9, 9.5, 15, 25 mm)
Outline Dimensions	80, 42, 30 x 22 x 3.5 mm		80 x 22 x 3.58 mm	111.5 x 33.75 x 5.9/9.5/15/25 mm
Flash Type	3D NAND TLC / pSLC		3D NAND eTLC	3D NAND eTLC
Density Range <sup>1)</sup>	TLC: 15 GB – 480 GB pSLC: 5 GB – 160 GB	TLC: 240 GB – 3,840 GB pSLC: 80 GB – 320 GB	240 GB – 3,840 GB	1.92 GB – 7.68 TB
Data Retention	10 years @ life begin 1 year @ life end		1 year @ life begin 3 months @ life end	
Endurance (3D TLC) Sequential Enterprise <sup>2)</sup>	up to 2.7 DWPD up to 0.35 DWPD	up to 3 DWPD up to 0.77 DWPD	> 1 DWPD	> 1 DWPD

**Temperature**

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C	Industrial: -40 °C to +85 °C	Commercial: 0 °C to +70 °C
Storage Temperature	-40 °C to +85 °C		

**Performance**

Sequential Read (MB/s)	up to 1,770 / 1,750	up to 3,500 / 3,500	up to 3,500	up to 6,500
Sequential Write (MB/s)	up to 830 / 830	up to 3,100 / 2,450	up to 3,100	up to 4,000
Random 4KB Read (IOPS)	up to 140,000 / 140,000	up to 475,000 / 190,000	up to 475,000	up to 1,300,000
Random 4KB Write (IOPS)	up to 130,000 / 130,000	up to 525,000 / 525,000	up to 525,000	up to 185,000

**Robustness**

MTBF	≥ 2,000,000 hours	≥ 3,000,000 hours	≥ 2,500,000 hours
Shock	1,500 g, 0.5 ms		
Vibration	50 g, 80 – 2,000 Hz		3 Grms, 7 – 800 Hz
Humidity	85 % RH 85 °C, 1,000 hrs		5 % – 95 % RH

**Electrical Data**

Voltage	3.3 V ± 5 %	12 V ± 8 %
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**Feature List**

Features & Tools <sup>1)</sup>	HMB support (Host Memory Buffer)	DRAM support HW powersafe™ on 2280 (P)	DRAM support HW powersafe™	DDR4 DRAM support HW powersafe™
	Active and Passive Data Care Management AES 256 / E2E Data Path Protection FW Power Fail Data Loss Protection Active State Power Management (ASPM) Support TCG OPAL 2.0 (N-2*m2, N-3*m2 on request) SBDM Tool & SDK for detailed S.M.A.R.T. based Life Time Monitoring			Dynamic Internal RAID S.M.A.R.T., Telemetry AES256 encryption TCG OPAL 2.01 Secure boot End to end path protection Crypto erase eDrive (IEEE 1667) 16 up to 128 Namespaces
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>			

<sup>1)</sup> Not all densities and configurations may be available. Customization on request

<sup>2)</sup> DWPD values are according to JESD219 Enterprise Endurance Workload based on a service life of 3 years for TLC and 5 years for eTLC drives

# 2.5" SATA SSDs

Swissbit's 2.5" SSDs are ideal solutions for embedded applications requiring reliable and long service life storage. The X-60 SATA 6Gb/s series is Swissbit's MLC based solution as a mature, longevity product. X-600 has best in class endurance, using SLC technology while X-66 is the perfect compromise with MLC NAND in pSLC mode. The new X-7x range is based on 3D NAND TLC with focus on best TCO.

The X-76 is the flagship with 3D NAND pSLC offering best endurance per cost. ALL products feature Swissbit's proven Power Fail Safety, Data Care Management, a detailed S.M.A.R.T. based Life Time Monitoring, NCQ, TRIM, advanced wear leveling, bad block management, and in field firmware update functionality. The X-75 P offers true HW based power-safe protection.

	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Conformal Coating	Temp. Sensor	Power Loss Protected	powersafe™	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	Longevity	WAF Reduction
X-600	●	●	●	●	●	○	●	●	○	●	●	●	★	●	●
X-60 / X-66	●	●	●	●	●	○	●	●	○	●	●	●	★	○	●
X-75 / X-73 / X-76	●	●	●	●	●	○	●	●	○	●	●	●	★	○	●
X-75 P	●	●	●	●	●	○	●	●	★	●	●	●	★	○	●

★ industry leading ● default implemented ○ on request ◯ not available



**X-600 / X-66 / X-60**



**X-75 / X-75 P**



**X-73 / X-76**



**Information**

Type	2.5" SATA Gen3 SSD		
Interface	SATA Gen3 –6Gbit/s		
Data Transfer Mode	ATA8		
Connector	15 + 7 pin Serial ATA		
Outline Dimensions	100 x 70 x 7 mm		
Flash Type	SLC / pSLC / MLC	3D NAND TLC	3D NAND TLC / pSLC
Density Range	SLC: X-600: 8 GB – 256 GB pSLC: X-66: 16 GB – 480 GB MLC: X-60: 30 GB – 960 GB	X-75: 60 GB – 1,920 GB X-75 P: 120 GB –1,920 GB	X-73: 30 GB – 1,920 GB X-76: 10 GB – 320 GB
Data Retention	10 years @ life begin   1 year @ life end		
Endurance [DWPD]*	36.3 / 15.1 / 2.3	max 1.2 / 1.2	max 1.2 / 22.7

**Temperature**

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

**Performance**

Sequential Read (MB/s)	up to 520 / 520 / 525	up to 565 / 560	up to 565 / 560
Sequential Write (MB/s)	up to 425 / 450 / 460	up to 495 / 500	up to 495 / 480
Random 4KB Read (IOPS)	up to 79,000 / 80,000 / 74,300	up to 77,200 / 77,700	up to 77,200 / 74,000
Random 4KB Write (IOPS)	up to 76,000 / 75,000 / 77,900	up to 79,400 / 69,600	up to 79,400 / 84,900

**Robustness**

MTBF	≥ 2,000,000 hours
Shock	1,500 g, 0.5 ms
Vibration	50 g, 80 – 2,000 Hz
Humidity	85 % RH 85 °C, 1,000 hrs

**Electrical Data**

Voltage	5 V ± 10 % / 3.3 V ± 5 %	5 V ± 10 %
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**Feature List**

Features & Tools	FW based Power Fail Safety NCQ, TRIM AES 256 Encryption optional SBDM Tool & SDK	HW powersafe™ protection optional	FW based Power Fail Safety
		E2E Data Path Protection AES 256 Encryption optional TCG OPAL optional SBDM Tool & SDK for detailed S.M.A.R.T. based Life Time Monitoring	
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>		

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years

# SATA Modules

Equally to the 2.5" drives, the Swissbit mSATA (M0-300), SLIM SATA (M0-297), and the M.2 SSDs target embedded applications which require solid state storage in small, removable form factors. The SSD modules are designed for robustness against frequent temperature changes within the -40 °C to 85 °C range, withstand high shock and vibration and offer superior performance and endurance. The families X-86, X-75, X-76, X-60, X-66 and X-600 target

different use cases including OS booting, data logging, surveillance recording or vaulting. The X-78m2 targets light enterprise applications. The amount and type of write access defines the required endurance in TBW. The latest addition X-86m2 is targeting true industrial applications with a robust, reliable, low power module design, based on a dedicated industrial controller and firmware.



	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Conformal Coating	Temp. Sensor	Power Loss Protected	powersafe™	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	Longevity	WAF Reduction
X-600m/s/m2	●	●	●	●	●	○	●	●	○	●	●	●	●	●	●
X-60 / X-66m/s/m2	●	●	●	●	●	○	●	●	○	●	●	●	●	○	●
X-75 / 76 / 78m/s/m2	●	●	●	●	●	○	●	●	○	●	●	●	●	○	●
X-75m2 P	●	●	●	●	●	○	●	●	★	●	●	●	●	○	●
X-86m2	●	●	●	●	●	○	●	●	○	●	●	●	★	○	●

★ industry leading ● default implemented ○ on request ◯ not available





## Information

Type	M0-300 mSATA	M0-297 SLIM SATA	M.2 2242	M.2 2280
Interface	SATA Gen3 -6Gbit/s			
Data Transfer Mode	ATA8			
Connector	52 pos. Edge Connector PCI Express (PCIe) mini	15 + 7 pin Serial ATA Connector	75 pos. Edge Connector B & M key	
Outline Dimensions	50.8 x 29.85 mm	54 x 39 mm	22 x 42 mm	22 x 80 mm
Thickness (MAX)	3.8 mm	4.0 mm	3.58 mm	
Flash Type	SLC			
Density Range	8 GB - 128 GB	16 GB - 128 GB	8 GB - 64 GB	16 GB - 128 GB
Data Retention	10 years @ life begin   1 year @ life end			
Endurance [DWPD]*	33.8			

## Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 520	up to 520	up to 520
Sequential Write (MB/s)	up to 405	up to 245	up to 405
Random 4KB Read (IOPS)	up to 76,000	up to 76,000	up to 76,000
Random 4KB Write (IOPS)	up to 73,000	up to 54,000	up to 73,000

## Robustness

MTBF	≥ 2,000,000 hours
Shock	1,500 g, 0.5 ms
Vibration	50 g, 131 - 2,000 Hz
Humidity	85 % RH 85 °C, 1,000 hrs

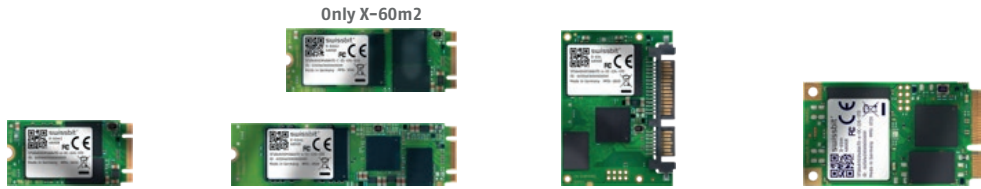
## Electrical Data

Voltage	3.3 V ± 5 %	5 V ± 10 %	3.3 V ± 5 %
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## Feature List

Features & Tools	FW based Power Fail Safety SBDM Tool & SDK for S.M.A.R.T. based Life Time Monitoring AES 256 Encryption (optional)
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years



Information

Type	M.2 2242	M.2 2260 / 2280	M0-297 SLIM SATA	M0-300 mSATA
Interface	SATA Gen3 -6Gbit/s			
Data Transfer Mode	ATA8			
Connector	75 pos. Edge Connector B & M key		15 + 7 pin Serial ATA Connector	52 pos. Edge Connector PCI Express (PCIe) mini
Outline Dimensions	22 x 42 mm	22 x 60 / 80 mm	54 x 39 mm	50.8 x 29.85 mm
Thickness (MAX)	3.58 mm	3.58 mm	4.0 mm	3.8 mm
Flash Type	MLC <b>durabit™</b>   pSLC <b>everbit™</b>		MLC <b>durabit™</b>	MLC <b>durabit™</b>   pSLC <b>everbit™</b>
Density Range				
<b>durabit</b>		30 GB – 960 GB	30 GB – 480 GB	30 GB – 480 GB
<b>everbit</b>	16 GB – 120 GB	16 GB – 240 GB		16 GB – 240 GB
Data Retention	10 years @ life begin   1 year @ life end			
Endurance [DWPD]*	<b>durabit™</b> : 2.0   <b>everbit™</b> : 13.2		<b>durabit™</b> : 2.0	<b>durabit™</b> : 2.0   <b>everbit™</b> : 13.2

Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

Performance

Sequential Read (MB/s)	up to 520	up to 520 / 520	up to 520	up to 520 / 520
Sequential Write (MB/s)	up to 415	up to 460 / 450	up to 450	up to 450 / 450
Random 4KB Read (IOPS)	up to 80,000	up to 75,000 / 80,000	up to 75,000	up to 75,000 / 80,000
Random 4KB Write (IOPS)	up to 73,000	up to 75,000 / 75,000	up to 75,000	up to 75,000 / 75,000

Robustness

MTBF	≥ 2,000,000 hours
Shock	1,500 g, 0.5 ms
Vibration	50 g, 80 – 2,000 Hz
Humidity	85 % RH 85 °C, 1,000 hrs

Electrical Data

Voltage	3.3 V ± 5 %	5 V ± 10 %	3.3 V ± 5 %
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Feature List

Features & Tools	FW based Power Fail Safety SBDM Tool & SDK for S.M.A.R.T. based Life Time Monitoring AES 256 Encryption (optional)
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years





Information

Type	M.2 2242	M.2 2280	M0-297 SLIM SATA	M0-300 mSATA
Interface	SATA Gen3 -6Gbit/s			
Data Transfer Mode	ATA8			
Connector	75 pos. Edge Connector B & M key		15 + 7 pin Serial ATA	52 pos. PCI Express (PCIe) mini
Outline Dimensions	22 x 42 mm	22 x 80 mm	54 x 39 mm	50.8 x 29.85 mm
Thickness (MAX)	3.58 mm	3.58 mm	4.0 mm	3.8 mm
Flash Type	3D NAND pSLC   X-75*: 3D NAND TLC   X-76*: 3D NAND pSLC   X-78*: high endurance 3D NAND pSLC			
Density Range	X-86m2: 10 GB - 160 GB	X-75m2: 30 GB - 960 GB X-76m2: 10 GB - 160 GB X-78m2: 40 GB - 320 GB	X-75m2: 30 GB - 1,920 GB X-75m2P: 240 GB - 1,920 GB X-76m2: 10 GB - 320 GB X-78m2: 40 GB - 640 GB	X-75s: 30 GB - 960 GB X-76s: 10 GB - 320 GB X-78s: 40 GB - 320 GB
Data Retention	10 years @ life begin   1 year @ life end   X-78m2: 3 months at EOL			
Endurance [DWPD]*	X-86: max 13.3	X-75*: max 1.2   X-76*: max 22.7   X-78m2: max 68		

Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

Performance

Sequential Read (MB/s)	up to 370	up to 565 / 560 / 560	up to 565 / 560	up to 565 / 565	up to 565 / 560
Sequential Write (MB/s)	up to 225	up to 495 / 480 / 490	up to 500 / 480	up to 495 / 490	up to 495 / 480
Random 4KB Read (IOPS)	up to 13,100	up to 76,000 / 72,900 / 72,900	up to 77,700 / 74,000	up to 73,600 / 77,400	up to 73,600 / 74,000
Random 4KB Write (IOPS)	up to 8,300	up to 79,400 / 84,900 / 85,900	up to 79,400 / 84,900	up to 79,400 / 84,900	up to 79,400 / 84,900

Robustness

MTBF	≥ 2,000,000 hours
Shock	1,500 g, 0.5 ms
Vibration	50 g, 80 - 2,000 Hz
Humidity	85 % RH 85 °C, 1,000 hrs

Electrical Data

Voltage	3.3 V ± 5 %	5 V ± 10 %	3.3 V ± 5 %
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Feature List

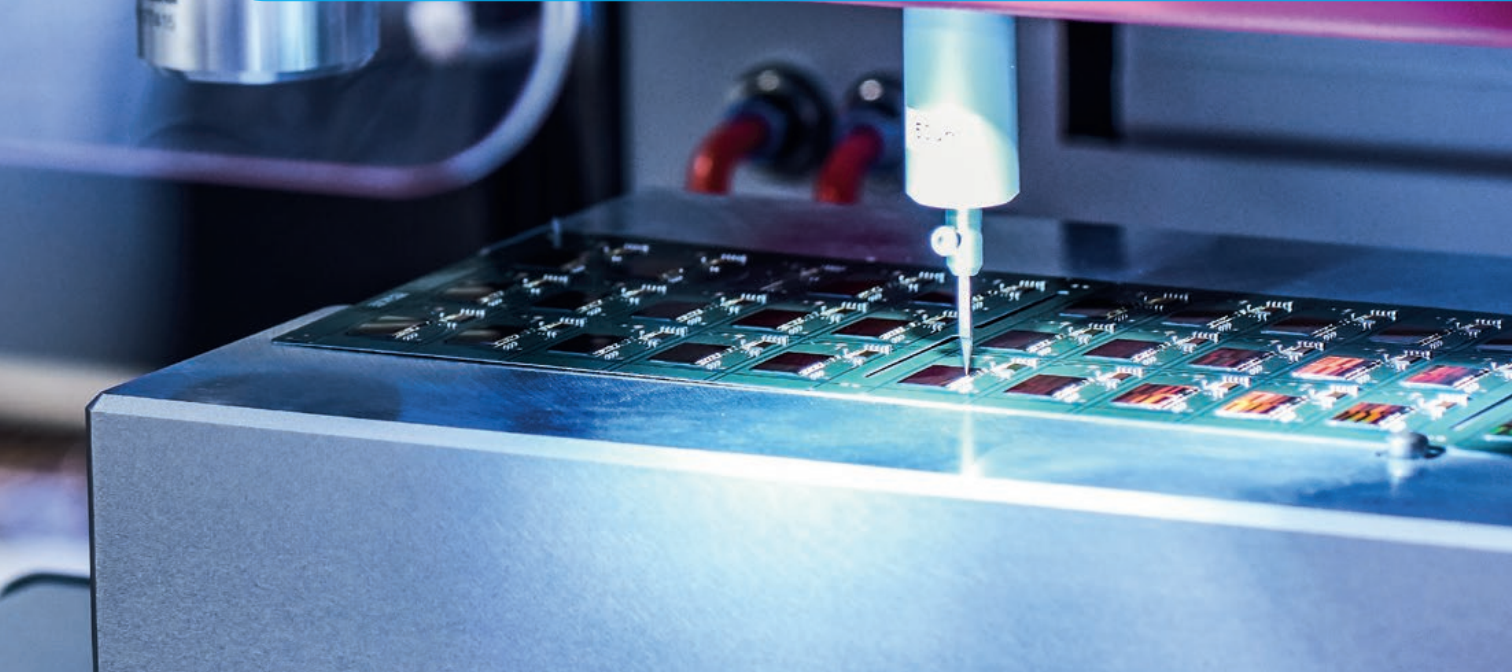
Features & Tools	E2E Data Path Protection AES 256 Encryption (optional) / TCG OPAL 2.0 (optional) FW based Power Fail Safety X-75m2 P: HW powersafe™ protection SBDM Tool & SDK for detailed S.M.A.R.T. based Life Time Monitoring
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years

# CFexpress™ Cards

CFexpress™ is hailed as the successor of the established Compact Flash and CFast-standards, created by the CompactFlash Association. Originally developed for high-end photography and other consumer applications, Swissbit has now applied the storage format to its latest products for use in demanding industrial applications. The CFexpress 2.0 Type B casing offers

excellent mechanical protection in harsh environments. The gold-plated pins are completely covered and shielded from any form of contact, therefore offering protection from dust or moisture penetration, and at the same time, making the cards resistant to any vibration. The G-20 series offers high data rates, low power consumption and wide temperature range.



Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Conformal Coating	Temp. Sensor	Power Loss Protected	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	Longevity	WAF Reduction
●	●	●	●	●	○	●	★	●	●	●	●	●	●

G-20 / G-26

★ industry leading ● default implemented ○ on request





## Information

Type	CFexpress™ Type B Card	
Standard and Interface	CFexpress v2.00 2 lanes PCIe 3.1 / NVMe 1.3	
Connector	CFexpress 30u" AU	
Outline Dimensions	38.5 × 29.6 × 3.8 mm	
Flash Type	3D NAND TLC	3D NAND pSLC
Density Range	15 GB – 960 GB	5 GB – 320 GB
Data Retention	10 years @ life begin   1 year @ life end	
Endurance [DWPD]*	Up to 1.8	Up to 54

## Temperature

Operating Temperature	Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 1,610
Sequential Write (MB/s)	up to 830
Random 4KB Read (IOPS)	up to 115,000
Random 4KB Write (IOPS)	up to 130,000

## Robustness

MTBF	≥ 2,000,000 hours
Shock	500 g, 1 ms
Vibration	20 g, 10 – 2,000 Hz
Humidity	90 % RH 85 °C, 96 hrs

## Electrical Data

Voltage	3.3 V ± 5 %
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## Feature List

Features & Tools	<ul style="list-style-type: none"> <li>HMB Support</li> <li>End to End Data Path Protection</li> <li>AES 256 / TCG OPAL 2.0</li> <li>Firmware based Power Fail Data Loss Protection</li> <li>Active State Power Management (ASPM) Support</li> <li>SBDM Tool &amp; SDK for detailed S.M.A.R.T. based Life Time Monitoring</li> </ul>
More Information	For more details see <a href="http://www.swisbit.com/product-finder">www.swisbit.com/product-finder</a>

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years

# CFast™ Cards

CFast™ cards combine the CompactFlash™ (CF) card form factor and the Serial ATA (SATA) interface into a single product. CFast™ cards can replace both HDDs and CompactFlash™ cards in applications requiring small form factors, high endurance, and the ability to withstand shock, vibration, extreme temperatures (-40 °C to +85 °C), and rough environmental conditions.

Swissbit's CFast™ cards provide rugged and easy replaceable storage for embedded and industrial systems. The Swissbit CFast™ card portfolio covers the range from high end SLC-based high-performance F-600 to the cost/performance optimized 3D NAND F-86. The different product families are equipped with a rich feature set and are fulfilling the high Swissbit quality requirements.



	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Conformal Coating	Temp. Sensor	Power Loss Protected	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	Longevity	WAF Reduction
F-600	●	●	●	★	●	○	●	★	●	●	●	●	●	●
F-60 / F-66	●	●	●	★	●	○	●	★	●	●	●	●	○	●
F-50 / F-56	●	●	●	★	●	○	●	★	●	○	●	●	○	○
F-800 / F-86	●	●	●	★	●	○	●	★	●	●	●	★	●	○

★ industry leading ● default implemented ○ on request ◯ not available



F-800

F-86

F-600

F-60 / F-66

F-50 / F-56



## Information

Type	CFast™ Card				
Interface	CFast™ 2.0 – SATA Gen3				
Data Transfer Mode	6Gbit/s ATAS				
Connector	CFast™ Type I				
Outline Dimensions	36.4 x 42.8 x 3.6 mm				
Flash Type	SLC	3D NAND pSLC	SLC	MLC / pSLC	MLC / pSLC
Density Range	2 GB – 64 GB	10 – 160 GB	4 GB – 64 GB	MLC: 8 GB – 240 GB pSLC: 4 GB – 120 GB	MLC: 8 GB – 256 GB pSLC: 4 GB – 128 GB
Data Retention	10 years @ life begin   1 year @ life end				
Endurance [DWPD]*	max 32	max 13.3	36.3	1.98 / 13.2	max 1.50 / 7.98

## Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C				
Storage Temperature	-40 °C to +85 °C				

## Performance

Sequential Read (MB/s)	up to 320	up to 375	up to 520	up to 520 / 520	up to 500 / 510
Sequential Write (MB/s)	up to 170	up to 225	up to 245	up to 180 / 415	up to 330 / 415
Random 4KB Read (IOPS)	up to 10,500	up to 13,100	up to 76,000	up to 72,000 / 80,000	up to 53,500 / 32,000
Random 4KB Write (IOPS)	up to 7,100	up to 8,500	up to 54,000	up to 43,000 / 75,000	up to 74,000 / 66,000

## Robustness

MTBF	≥ 2,000,000 hours				
Shock	500 g, 0.5 ms	1,500 g, 0.5 ms			500 g, 1 ms
Vibration	20 g, 80 – 2,000 Hz	50 g, 80 – 2,000 Hz			20 g, 80 – 2,000 Hz
Humidity	85 % RH 85 °C, 1,000 hrs				

## Electrical Data

Voltage	3.3 V ± 5 %
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## Feature List

Features & Tools	E2E Data Path Protection	-
More Information	Proven Power Fail Safety SBDM Tool & SDK for detailed S.M.A.R.T. based Life Time Monitoring F-86 / F-6x: AES 256 Encryption (optional)	
	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>	

\* DWPD values are according to JESD219 Client Endurance Workload based on a service life of 3 years

# CompactFlash™ Cards

To this day, CompactFlash™ (CF) cards are widely used as boot and data logging devices in many NetCom and industrial applications. Swissbit's dedication to these markets is shown by the broad portfolio and recent launch of a new product family. Swissbit products are developed with a strong focus on quality, reliability, robustness, and longevity.

All Swissbit's CF Series are offered in both commercial (0 °C to +70 °C) and industrial (-40 °C to +85 °C) temperature ranges. Swissbit's most recent CF Card product families C-500 and C-56 are using page based Flash management and thus provide the highest write IOPS rate as well as outstanding endurance.



	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Secure Erase	Conformal Coating	Power Loss Protected	Wear Leveling	Read-Only Improved	TRIM Support	Data Care Managed	Longevity	WAF Reduction
C-300L / C-350	●	●	●	●	○	○	★	●	○	○	○	★	○
C-500	●	●	●	★	○	○	★	●	★	★	●	●	★
C-56	●	●	●	★	○	○	●	●	★	★	●	○	★

★ industry leading ● default implemented ○ on request ◯ not available



### C-350 / C-300L



### C-500



UDMA6 CF

### C-56



UDMA6 CF

## Information

Type	CompactFlash™ Card		
Interface	CFA4.1		CFA5.0
Data Transfer Mode	True IDE / PC card – Up to UDMA4, MDMA4 & PIO6		True IDE / PC card – Up to UDMA6, MDMA4 & PIO6
Connector	CFC Type I		
Outline Dimensions	36.4 x 42.8 x 3.3 mm		
Flash Type	SLC		pSLC everbit™
Density Range	32 MB – 256 MB 128 MB – 1 GB	128 MB – 64 GB	4 GB – 64 GB
Data Retention	10 years @ life begin   1 year @ life end		
Endurance [DWPD]*	max 3.40	max 3.50	max 1.35

## Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 22	up to 64	up to 115
Sequential Write (MB/s)	up to 10	up to 44	up to 66
Random 4KB Read (IOPS)	up to 3,000	up to 3,200	up to 5,000
Random 4KB Write (IOPS)	up to 50	up to 1,900	up to 3,300

## Robustness

MTBF	≥ 3,000,000 hours
Shock	1,500 g
Vibration	20 g
Humidity	85 % RH 85 °C, 1,000 hrs

## Electrical Data

Voltage	3.3 V ± 10 % / 5 V ± 10 %
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## Feature List

Features & Tools	Proven Power Fail Safety Security & SBZoneProtection features available SBDM Tool & SDK for S.M.A.R.T. based Life Time Monitoring	Page based FTL for maximum Endurance Proven Power Fail Safety Read Disturb Management TRIM Security & SBZoneProtection features available SBDM Tool & SDK for S.M.A.R.T. based Life Time Monitoring
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>	

\* DWPD values are according to JESD219 Enterprise Endurance Workload based on a service life of 3 or 5 years

# SD & microSD Memory Cards

Secure Digital (SD) memory cards have a widespread use in industrial and automotive applications, ranging from read only applications as in navigation systems to utilization as boot media, for video recording, or data logging. Swissbit's Industrial Secure Digital (SD) card series is designed for high sustained performance and endurance and is manufactured and tested in Swissbit's own fab to withstand extreme environmental conditions.

The SLC based S-600 offers highest endurance. The new S-52/50/55 models feature 3D TLC. The S-52 is targeting video streaming or automotive applications and the S-50/55 true industrial use cases such as data logging or other write intensive use cases. The endurance optimized 3D pSLC versions S-56 and S-58 offer best cost/endurance ratio. All families are available as SD and microSD memory cards.

	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Conformal Coating	Power Loss Protected	Wear Leveling	AEC-100-3 AEC-Q100	Data Care Managed	Longevity	WAF Reduction	High Endurance
S-50(u) / S-55(u)	●	●	●	●	●	●	●	○	●	●	●	●
S-56(u) / S-58(u)	●	●	●	●	●	●	●	○	●	●	●	★
S-52(u)	●	●	●	●	●	●	●	●	○	●	●	●
S-600(u)	●	●	●	★	●	●	●	○	●	●	●	★

★ industry leading ● default implemented ○ on request ◯ not available



3D  
TLC

S-52

S-50 / S-55

S-56 / S-58



## Information

Type	microSD Memory Card (SDHC / SDXC)		
Interface	SD 6.1, UHS-I, speed class 10/U3/V30/A2		
Data Transfer Mode	High performance type		High reliability type
Connector	SD		
Outline Dimensions	32 x 24 x 2.1 mm		
Flash Type	3D NAND TLC		3D NAND pSLC
Density Range	32 GB - 512 GB	S-50: 16 GB - 512 GB S-55: 64 GB - 512 GB	S-56: 4 GB - 128 GB S-58: 16 GB - 128 GB
Data Retention	10 years @ life		
Endurance	3k P/E cycles		S-56: 30k up to 100k P/E cycles S-58: 60k P/E cycles

## Temperature

Operating Temperature	Extended: -25 °C to +85 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 95	up to 91 / 97	up to 95 / 97
Sequential Write (MB/s)	up to 84	up to 38 / 60	up to 90 / 84
Random 4KB Read (IOPS)	up to 1,960	up to 2,010 / 1,970	up to 2,190 / 3,950
Random 4KB Write (IOPS)	up to 780	up to 1,360 / 840	up to 1,360 / 1,080

## Robustness

MTBR	≥ 3,000,000 hours
Shock	1,500 g
Vibration	50 g
Humidity	85 % RH 85 °C, 1,000 hrs

## Electrical Data

Voltage	2.7 - 3.6 V
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## Feature List

Features & Tools	Optimized for seq. write use cases such as video recording, dash/body cams Automotive type AEC-100-3	High reliability type Optimized for random write use cases such as industrial data logging
	Support SD SPI mode Proven FW based Power Fail Safety Sophisticated Wear Leveling & Bad Block Management Autonomous Data Care Management SBDM Tool & SDK for detailed Life Time Monitoring	
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>	



## Information

Type	SD-Memory Card (SD / SDHC)	microSD Memory Card (SD / SDHC)
Interface Data Transfer Mode	SD 5.0, UHS-1, speed class 10/U3/V30	SD 3.0, UHS-1, speed class 10/U1
Connector	SD	microSD
Outline Dimensions	32 x 24 x 2.1 mm	15 x 11 x 0.7 / 1 mm
Flash Type	SLC	
Density Range	512 MB – 32 GB	512 MB – 2 GB
Data Retention	10 years @ life begin   1 year @ life end	
Endurance	100k P/E cycles	

## Temperature

Operating Temperature	Extended: -25 °C to +85 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 94	up to 35
Sequential Write (MB/s)	up to 50	up to 21
Random 4KB Read (IOPS)	up to 1,200	up to 850
Random 4KB Write (IOPS)	up to 1,200	up to 1,200

## Robustness

MTBR	≥ 2,000,000 hours
Shock	1,500 g
Vibration	50 g
Humidity	85 % RH 85 °C, 1,000 hrs

## Electrical Data

Voltage	2.7 – 3.6 V
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## Feature List

Features & Tools	<p>Optimized for high read/write traffic for demanding industrial applications  Read Disturb Management, Autonomous Data Care Management  Real industrial temperature range with full cross temperature support  Proven FW based Power Fail Safety</p> <p>Manufactured in a TS 16949 certified factory  SBDM Tool &amp; SDK for detailed Life Time Monitoring</p>
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>





## Information

Type	microSD Memory Card (SDHC / SDXC)		
Interface	SD 6.1, UHS-I, speed class 10/U3/V30/A2		
Data Transfer Mode	High performance type	High reliability type	
Connector	microSD		
Outline Dimensions	15 x 11 x 0.7 / 1 mm		
Flash Type	3D NAND TLC		3D NAND pSLC
Density Range	32 GB - 512 GB	16 GB - 512 GB 64 GB - 256 GB	4 GB - 128 GB 16 GB - 64 GB
Data Retention	10 years @ life begin   1 year @ life end		
Endurance	3k P/E cycles		S-56u: 30k up to 100k P/E cycles S-58u: 60k P/E cycles

## Temperature

Operating Temperature	Industrial: -40 °C to +85 °C	Extended: -25 °C to +85 °C Industrial: -40 °C to +85 °C	
Storage Temperature	-40 °C to +85 °C		

## Performance

Sequential Read (MB/s)	up to 95	up to 91 / 97	up to 95 / 97
Sequential Write (MB/s)	up to 84	up to 38 / 60	up to 83 / 84
Random 4KB Read (IOPS)	up to 1,960	up to 2,010 / 1,970	up to 2,190 / 3,950
Random 4KB Write (IOPS)	up to 780	up to 1,360 / 760	up to 1,360 / 1,080

## Robustness

MTBR	≥ 3,000,000 hours		
Shock	1,500 g		
Vibration	50 g		
Humidity	85 % RH 85 °C, 1,000 hrs		

## Electrical Data

Voltage	2.7 - 3.6 V Normal		
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## Feature List

Features & Tools	Optimized for seq. write use cases such as video recording, dash/body cams Automotive type AEC-100-3	High reliability type Optimized for random write use cases such as industrial data logging	
	Support SD SPI mode Proven FW based Power Fail Safety Sophisticated Wear Leveling & Bad Block Management Autonomous Data Care Management SBDM Tool & SDK for detailed Life Time Monitoring		
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>		

# USB Products

The Universal Serial Bus (USB) is still a widely used interface for NetCom system booting or for update and licensing purposes. Swissbit offers USB 2 and USB 3 products in different form factors and in commercial and industrial operating temperature ranges. State-of-the-art NAND flash handling algorithms, stringent component selection, PCN control, and a 100% final system test at the full temperature range (-40 °C to 85 °C)

qualify Swissbit's USB Flash Drive (UFDs) for embedded and NetCom markets.

All Swissbit USB solutions combine security features and Life Time Monitoring tools for product life control.

USB products are available in SLC, MLC, and pSLC technology to meet the endurance and speed requirements of the different use cases.

	Wide Temp. Support	ESD & EMI Safe	Shock & Vibration	Life Time Monitor	Power Loss Protected	Wear Leveling	Longevity	Data Care Managed	TRIM Support	WAF Reduction
U-56 / U-58 / U-48	●	○	●	●	●	●	●	●	●	●
U-56n / U-50n	●	●	●	●	●	●	●	●	●	●
U-500 / U-450	●	○	●	●	●	●	●	●	●	●
U-500k / U-56k / U-50k	●	●	●	●	●	●	●	●	●	●

● default implemented ○ not available



**U-500**  
**U-56 / U-58**



**U-450**  
**U-48**



**U-500k**  
**U-56k / U-50k**



**U-56n**  
**U-50n Nano**



## Information

Type	eUSB Flash Module		USB Flash Drive	
Interface	USB 3.1		USB 3.1	
Data Transfer Mode	Super Speed / High / Full		Super Speed / High / Full	
Connector	Standard: 2.54 mm -10 Pin (key option) Low Profile: 2.00 mm -10 Pin (key option)		USB 3.0 Type A-Plug	
Outline Dimensions	Standard: 36.8 x 26.65 x 9.7 mm Low Profile: 36.8 x 26.65 x 6.0 mm		67.8 x 18.0 x 8.3 mm	24.0 x 12.1 x 4.5 mm
Flash Type	SLC / pSLC <b>everbit™</b> / 3D pSLC / MLC <b>durabit™</b>			
Density Range	SLC: 4 GB – 32 GB pSLC: 4 GB – 32 GB 3D pSLC: 8 GB – 16 GB	SLC: 1 GB – 16 GB pSLC: 8 GB – 16 GB	SLC: 2 GB – 32 GB pSLC: 8 GB – 64 GB MLC: 16 GB – 128 GB	MLC: 8 – 64 GB pSLC: 4 – 32 GB
Data Retention	10 years @ life begin   1 year @ life end			
Endurance [DWPD]*	U-500: 4.0 / U-58: 4.1 / U-56: 1.8 / U-450: 4.2 / U-48: 6.2			

## Temperature

Operating Temperature	Commercial: 0 °C to +70 °C Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C

## Performance

Sequential Read (MB/s)	up to 174 / 175 / 180	up to 36 / 42	up to 180 / 190 / 150	up to 197 / 156
Sequential Write (MB/s)	up to 91 / 110 / 76	up to 26 / 38	up to 100 / 110 / 60	up to 126 / 64
Random 4KB Read (IOPS)	up to 2,980 / 3,200 / 4,100	up to 1,900 / 2,600	up to 3,700 / 4,000 / 3,200	up to 3,850 / 2,850
Random 4KB Write (IOPS)	up to 1,060 / 1,100 / 1,680	up to 1,400 / 2,000	up to 2,000 / 1,500 / 900	up to 2,600 / 1,800

## Robustness

MTBF	≥ 3,000,000 hours
Shock	1,500 g, 0.5 ms
Vibration	50 g
Humidity	85 % RH 85 °C, 1,000 hrs

## Electrical Data

Voltage	3.3 V ±5 % / 5 V ±10 %	5 V ± 10 %
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## Feature List

Features & Tools	<ul style="list-style-type: none"> <li>Page based FTL for best write performance and endurance</li> <li>Proven Power Fail Safety</li> <li>Windows / Linux – Spare block read out</li> <li>Bootable USB Drive</li> <li>Supports latest OS as Fixed Drive</li> <li>Connector pitch &amp; key variations available</li> <li>Shock &amp; vibration resistant</li> </ul>
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>

\* DWPD values are according to JESD219 Enterprise Endurance Workload based on a service life of 3 or 5 years

# Managed NAND

Small form factor embedded systems have often used NAND components that were directly interfaced and managed by the host controller software. This task has become a challenge due to the increasing complexity of NAND devices and their management.

Managed NAND is the solution: a single small size BGA component incorporates multiple Flash drives, a NAND controller and the management firmware and eases the integration.

Swissbit's e.MMC EM-20 and EM-30 family covers multiple densities and interface speeds. Sophisticated NAND management makes the e.MMC ideal for applications like POS/POI, PLC, IoT, gaming, medical, or as a general boot medium for embedded applications. The EN-20 PCIe/NVMe BGA opens the door for high speed at small size.

	Wide Temp. Support	Life Time Monitor	Secure Erase	Power Loss Protected	Wear Leveling	TRIM Support	Data Care Managed	In-field FW Update	WAF Reduction	Low Power
EM-20 / EM-26	●	●	●	●	●	●	●	●	●	●
EM-30 / EM-36	●	●	●	●	●	●	●	●	●	●
EN-20 / EN-26	●	●	●	●	●	●	●	●	●	●

● default implemented



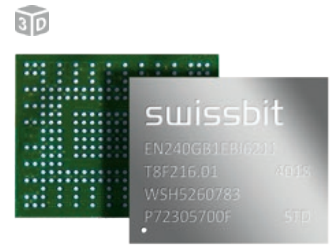
## EM-20 / EM-26



## EM-30 / EM-36



## EN-20 / EN-26



## Information

Type	e.MMC		PCIe M.2 1620 BGA
Standard & Interface	e.MMC 5.0, 1-bit, 4-bit, 8-bit up to HS400	JEDEC e.MMC 5.1 1-bit, 4-bit, 8-bit up to HS400	PCIe Gen 3.1 / NVMe 1.3 4 PCIe lanes
Package	153-ball BGA, 0.5mm pitch	153-ball BGA, 0.5mm pitch 100-ball BGA, 1.0mm pitch	BGA, 0.8mm pitch
Outline Dimensions	11.5 x 13 x 1 mm	11.5 x 13 x 1 mm 14 x 18 x 1.4 mm	16 x 20 x 1.8 mm
Flash Type	MLC / pSLC reliable mode	3D NAND TLC / pSLC	3D NAND TLC / pSLC
Density Range	4 GB – 64 GB MLC / 2 GB – 32 GB pSLC	4 GB – 512 GB TLC / 5 GB – 160 GB pSLC	15 GB – 480 GB / 5 GB – 160 GB
Data Retention	10 years @ life begin   1 year @ life end		
Endurance	3k / 20k P/E cycles	3k / 30k up to 100k P/E cycles	3k / 30k P/E cycles

## Temperature

Operating Temperature	Industrial: -40 °C to +85 °C	Industrial: -40 °C to +85 °C Automotive: -40 °C to +105 °C	Industrial: -40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C		

## Performance

Sequential Read (MB/s)	up to 174 / 240	up to 300	up to 1,770
Sequential Write (MB/s)	up to 21 / 120	up to 230	up to 720
Random 4KB Read (IOPS)	up to 3,800 / 6,700	up to 39,500	up to 150,000
Random 4KB Write (IOPS)	up to 1,400 / 6,700	up to 41,500	up to 100,000

## Electrical Data

Voltage	VCCQ: 1.70 – 1.95 V / 2.70 – 3.60 V ; VCC: 2.70 – 3.60	3.3 V ± 5 %, 1.8 V ± 5 %, 0.9 V ± 5 %
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## Feature List

Features & Tools	High performance up to HS400 mode Sophisticated Wear Leveling & Read Disturb Management Page based FTL Management Production State Awareness Proven Power Fail Safety Security features secure erase & RPMB Data Preload, Customization EM-30, EM-36 AEC-Q Grade 2, ISO 27001, IATF 16949	HMB support Dynamic and Static Wear Leveling Page Mode Flash Translation Layer Data Care Management Write Amplification Reduction Power Fail Data Loss Protection In Field Firmware Update Self Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) AES256 Encryption
More Information	For more details see <a href="http://www.swissbit.com/product-finder">www.swissbit.com/product-finder</a>	

# Security Products



## Unique Hardware Security for Reliably Protecting Data and Devices

Swissbit's modular security products are based on standard interfaces and offer system manufacturers a range of hardware-based cyber security solutions for the protection of data and devices. Security products are variations of storage products with various security features.

The security product series in USB, microSD, and SD form factors address the growing demand for mobile, portable and industrial security. They offer unique hardware security which is very suitable for retrofit and updates in the field.

Swissbit's security products are extremely robust and durable, which makes them ideal for challenging applications with long life time and maintenance cycles.

Valuable data such as sensitive files, videos, photos, licenses, OS images, firmware updates, log files, and audit trails can be protected by encryption, access protection, or made resistant to tampering by digital signature based on secure elements. In Addition, Swissbit allows users to protect online accounts by securely accessing websites, applications, online services, and company networks with an authentication key.

	True Hardware RNG	Digitally Sign & Verify	Hardware based Encryption	2nd factor authentication	Retrofittable Secure Boot	Secure Voice	Elliptic Curve Crypto	Secure CD-ROM	Secure Storage	Secure Logging	Host agnostic plug & play
Standard Edition (SE)	●	●	●	●	○	●	●	○	○	○	○
Premium Edition (PE)	●	●	●	●	○	●	●	●	★	★	○
Data Protection Edition (DP)	○	○	○	○	○	○	○	●	★	○	○
TSE	●	★	○	○	○	○	●	○	○	○	○
Raspberry Pi Edition	○	○	○	○	★	○	○	○	●	○	○
iShield Camera / iShield Archive	○	○	○	○	○	○	○	○	★	○	★
iShield FID02	○	○	○	★	○	○	○	○	○	○	★
iShield HSM	●	●	○	●	○	○	●	○	○	○	★

★ industry leading ● default implemented ○ on request ○ not available

PS-45 / PS-45u / PS-66 / PS-66u  
 PS-46 / PS-46u / PS-600 / PS-600u  
 PS-450 / PS-450u

PU-50n / PU-56n  
 PU-50n iShield HSM

iShield  
 FIDO2



### Information

Compliance	SD 3.0 SD, ASSD V1.1	USB 3.1, CCID, PKCS#11 / PKCS#15 (HSM only)	FIDO2, U2F
Data Transfer	UHS-1 Speed class 10	USB 3.1 SuperSpeed	-
Flash Type	MLC / pSLC / SLC	MLC / pSLC	-

## Security product details

Category	Series	Interface	Standard / Premium	TSE Type	Data Protection Type
Standard Editions	PS-66	SD	16 GB – 64 GB	-	4 GB – 128 GB
	PS-66u	microSD	16 GB – 64 GB	-	16 GB – 64 GB
	PS-45	SD	8 GB – 16 GB	-	8 GB – 64 GB
	PS-45u	microSD	8 GB – 16 GB	-	8 GB – 32 GB
	PS-46	SD	-	-	2 GB – 64 GB
	PS-46u	microSD	-	-	2 GB – 16 GB
	PS-600 / PS-450	SD	0.5 GB – 2 GB	-	0.5 GB – 2 GB
	PS-600u / PS-450u	microSD	0.5 GB – 2 GB	-	0.5 GB – 2 GB
TSE	PU-50n	USB	8 GB – 16 GB	-	8 GB – 64 GB
	PS-45 TSE	SD	-	8 GB	-
	PS-45u TSE	microSD	-	8 GB	-
Raspberry Pi Edition	PS-45u	microSD	-	-	8 GB, 32 GB
iShield Camera	PS-66u	microSD	-	-	16 GB, 32 GB, (64 GB)
	PS-45u	microSD	-	-	16 GB, 32 GB
iShield Archive	PS-66u	microSD	-	-	16 GB – 64 GB
iShield HSM	PU-50n	USB	8 GB	-	-
Security Features			<p>IFX / NXP smart card chip</p> <p>CC EAL up to 6+ HW and OS</p> <p>Java card up to 3.0.5</p> <p>Global Platform up to 2.3</p> <p>IFX Secora / NXP JCOP 3</p> <p>RSA up to 4096 bit</p> <p>optional ECC up to 521 bit</p> <p>AES up to 256 bit</p> <p>SHA2 up to 512 bit</p> <p>RNG AIS31, FIPS 140</p> <p>Up to 145 k EEPROM secure storage</p>	<p>BSI TR-03153 certified TSE</p> <p>SMAERS: EAL2</p> <p>CSP: EAL4</p> <p>384 bit encryption</p> <p>Validity of signature certificate: 5 years + shelf storage buffer</p> <p>Guaranteed 20 Mio signatures. Signature processing time &lt; 250 ms.</p> <p>10 years retention</p>	<p><b>Common Features:</b> AES 256 bit flash encryption, fast crypto, wipe, Unique ID</p> <p><b>Data Protection Edition:</b> Role-based access control with configurable security policies</p> <p><b>Raspberry Pi Edition:</b> Retrofittable secure boot</p> <p><b>iShield Camera / Archive:</b> Host-agnostic, plug&amp;play, self-encrypting memory card</p> <p><b>iShield HSM:</b> Plug&amp;play Hardware Security Module</p> <p><b>iShield FIDO2:</b> USB A/ NFC security key for protecting online accounts with additional support of HOTP &amp; PIV standards</p>
More Information	For more details see <a href="http://www.swissbit.com/en/products/security-products/">www.swissbit.com/en/products/security-products/</a>				



# iShield FID02

## Protecting Online Accounts with Strongest and Most Flexible Hardware Authentication

Swissbit helps to make the digital world safer and more convenient allowing users to protect online accounts by securely accessing websites, applications, online services, and company networks. Swissbit iShield FID02 offers strongest authentication,

that is simple, secure and flexible, and that protects users against online attacks, such as phishing, social engineering and account takeover.



# iShield Camera

## Secure Video and Photo Recording

The microSD card Swissbit iShield Camera is a simple and retrofittable security solution especially for the encryption and access protection of video recordings. It is host-independent, i.e. plug-and-play, and can be used with a large number of camera types.

The solution also includes the "iShield Camera Card Tool" (iCCT) software.



# iShield Archive

## The Easiest and Most Secure Way to Archive Data

The microSD card Swissbit iShield Archive is a simple and retrofittable security solution especially for the encryption and access protection of any data. It is plug and play and can optionally be used in WORM mode with role based access.

The solution also includes the "iShield Archive Card Tool" (iAT) software.



# iShield HSM



## Reliably Storing Security Keys for Device Authentication and Registration

The iShield HSM is a plug-and-play USB security anchor that allows system integrators to upgrade existing IoT devices with a hardware security module, making it the perfect retrofit solution for finished hardware designs & installed devices. iShield HSM securely stores the device's private key and certificate so that they aren't exposed or duplicated in software. The product is available as a high-quality, robust & compact USB memory stick, which supports PKCS#11 and PKCS#15 and is compatible with an open source software stack (e.g. OpenSC). A Secure Element (CC EAL6+) is embedded into iShield HSM's hardware in COB (Chip On Board) technology, making it tamper proof and suited for harsh operating environments.

The iShield HSM is qualified for AWS IoT Greengrass Hardware Security Integration (HSI), providing a secure storage for keys and credentials used for device identification, authentication and registration.



# Raspberry Pi Edition



## Secure Boot Solution for Raspberry Pi

The Swissbit Secure Boot Solution for Raspberry Pi allows encryption and access protection of data stored on the microSD card by various configurable security policies. It protects the boot image and software installation against manipulation, unwanted copying, or removal of a system from a defined network.

The Swissbit Secure Boot Solution for Raspberry Pi consists of a Swissbit PS-45u DP microSD card "Raspberry Edition" and a Swissbit Secure Boot SDK for Raspberry Pi.



# Swissbit TSE (Fiscal Solution)



## Fiscal Solution for Germany

Swissbit is a complete provider of tamper-proof recording solutions for POS data in accordance with the German Cash Security Ordinance (KassenSichV). Whether single devices, networked POS systems in a LAN or online-capable POS systems with a cloud connection, Swissbit provides an easy-to-integrate, flexible and secure TSE connection for all scenarios. All TSE products have an optional connection to the fiscalization platform Mein Fiskal of DATEV with further additional services.



# Security Editions

## Easy-to-integrate and Retrofittable Hardware-based Security Products

Swissbit provides hardware-based security products together with software development kits (SDK) and customization services, enabling manufacturers to offer systems with secured devices, secure data storage, and secure data communication.

- **Data Protection DP**

Recommended for encryption and access protection of stored data.

- **Standard Edition SE**

Recommended for protecting data and systems by providing secure key storage (PKI) through a secure element.

- **Premium Edition PE**

Premium Edition comprises the features of "Data Protection Edition" with the "Standard Edition" to provide full protection of data and systems.





# Integrated Production Process

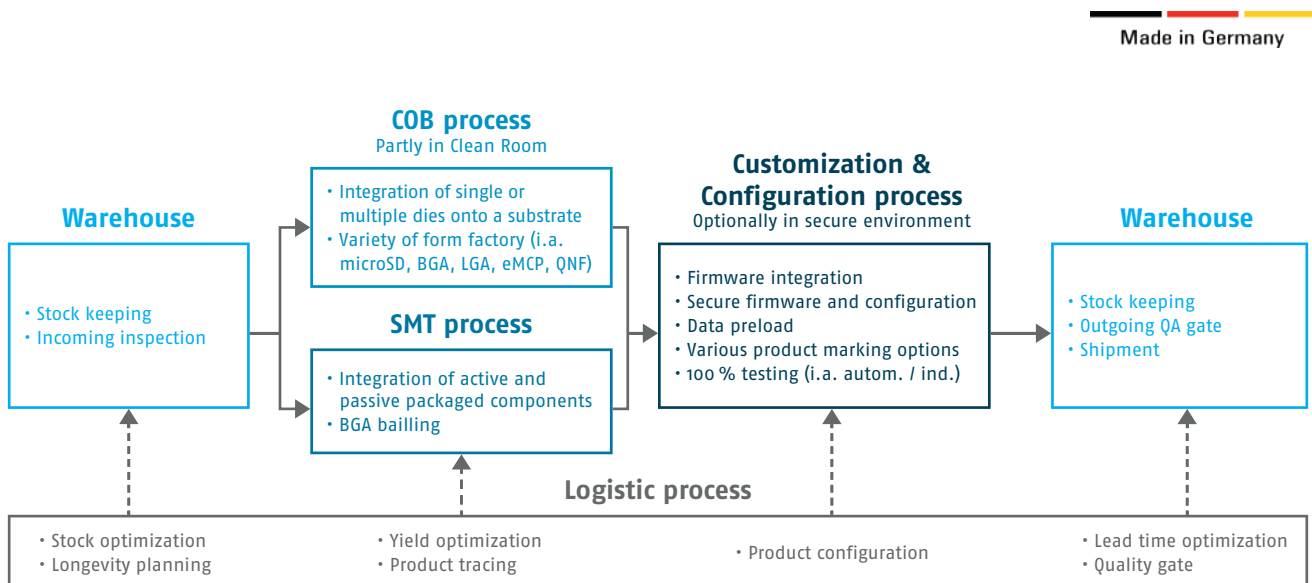
Customization & services  
 Dual source strategy  
 IATF 16949  
 3 Mio. units per month  
 ISO 27001  
 ISO 14001  
 ISO 50001  
 ISO 9001  
 No Subcontractors  
 Supply chain security  
 100% control of supply chain

## Integrated COB & SMT processes:

- Assembly of bare dies and packaged components
- COB and SMT line within same factory
- Highest quality by complete process control
- Full traceability of production
- Flexible and fast prototyping
- High volume production with adjustable prioritization

Advanced Packaging in Berlin, Germany

Swissbit is uniquely capable to develop, manufacture, test and mass produce SiP (system in package) products by advanced packaging – a smart combination of in-house COB and SMT processes. Advanced packaging allows an heterogeneous integration of active/passive SMDs and multiple ICs into a single package. A high vertical integration offers trustworthy turn-key solutions.



# Made in Germany



System-in-Package (SiP) is the umbrella term for using advanced packaging and assembly technologies to integrate and test sensitive bare silicon dies or chips (active circuits) and supporting components (passives) into robust finished modules or components. Together with integrated software or firmware this will create a fully functional system solution.

From the very beginning, Swissbit successfully uses advanced packaging technologies to achieve the smallest form factors and to build multi-chip-packages. Moreover, Swissbit develops unique test hard- and software solutions for dedicated applications and temperature ranges.

With this electronic integration and testing approach, our products provide more functionality inside one package, various functional blocks (RF, digital, sensors, security, and memory) and passive components are combined. Having all necessary capabilities in-house we have the best design for reliability, test and manufacturing.

For our highly-integrated SiPs (e.g. MicroSD Card) we developed processes for stacking multiple large dies, wire bonding the smallest bond pads, and molding the narrowest clearances.

Swissbit provides different assembly and packaging technologies (e.g SMT, CoB, FlipChip) in one single unit. The concentration of strong engineering and design knowhow and experience enables new, innovative electronic packages and devices for a wide range of applications.

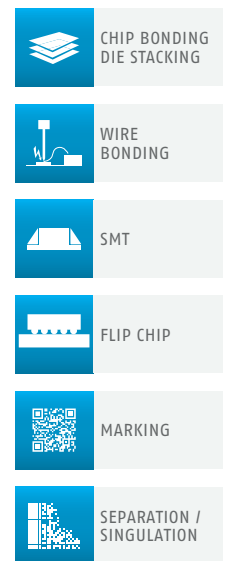
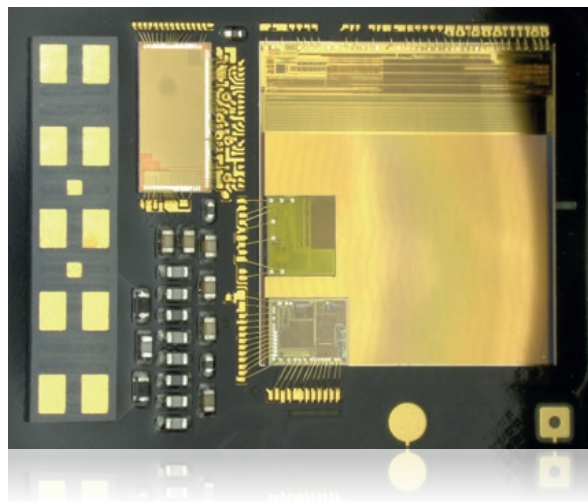
Our customers benefit from a reduced development cost and higher yields and reliability. We use smart production organizations, which allows the production of small volume series with short lead times and on-time delivery in high product variations.

Swissbit produces and develops in accordance with ISO 9001, IATF 16949, ISO 27001 and ISO 14001 approved processes and is an experienced partner for global industrial and automotive accounts.



### System-in-Package Benefits:

- Reduced process complexity
- Lower TCO (total cost of ownership)
- Reduced system board space
- Layer count reduction of system PCB
- Mixed analog / digital design
- Reduced system board test complexity





## Swissbit Locations



### Europe

#### Headquarters Switzerland

R&D, FAE support, Sales  
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sales@swissbit.com

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#### Office Silicon Valley, CA

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