



Moving forward with mSATA



mSATA SSD

SATA 3Gbps mSATA **SMG3B series**



A thin form, mini-size and long life mSATA SSD to support the new big data era.

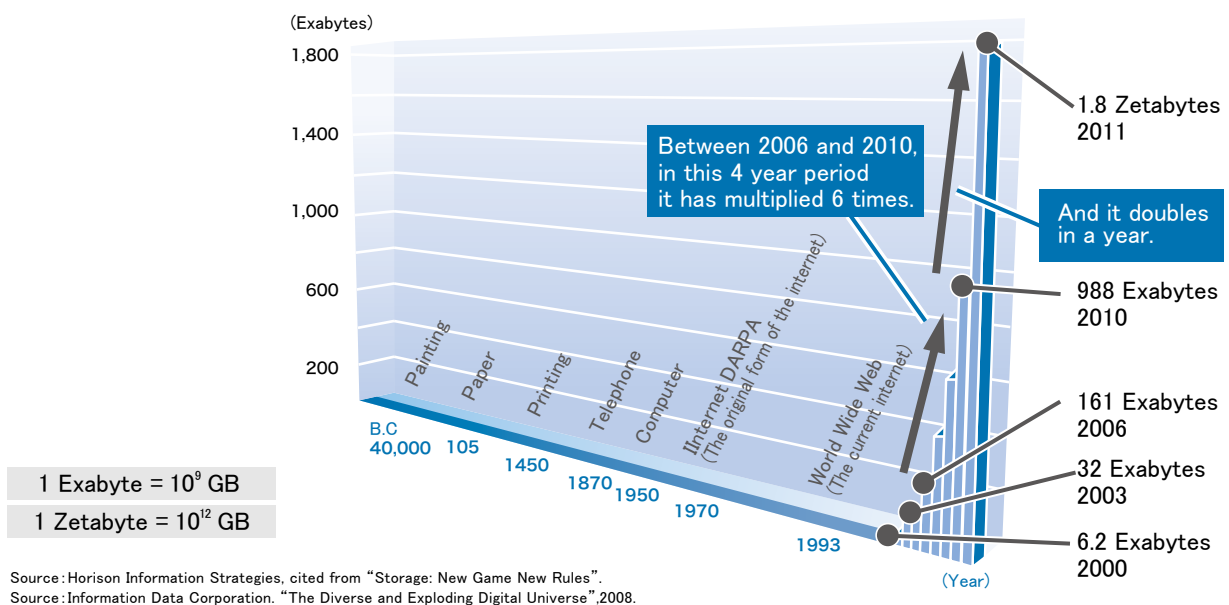
Small and lightweight, shock resistance, high speed access and low power usage are the features of SSDs (Solid State Drive), which are now being used in the place of HDDs for a number of various purposes. mSATA SSD is a small form SSD utilizing the new serial ATA standard 'mSATA' set by the Serial ATA International Organization (SATA-IO). Although at the time of development, the new format was mainly designed for use in tablet PCs and netbooks, recently it is being more widely used as a way of embedding to meet demands for saving space and other industrial purposes. TDK's mSATA SSD 'SMG3B Series' is an mSATA flash module for industrial use that excels at data reliability, durability, data security and more. Through the use of a proprietary 'Small Writes Accumulation Method' and advanced Global Static Wear Leveling, storage lifetime is dramatically improved. For the big data age of accumulating vast amounts of unstructured and real time data, it is the ideal storage solution.

Due to the arrival of the big data era, appropriate management for data servers has become an issue (1)

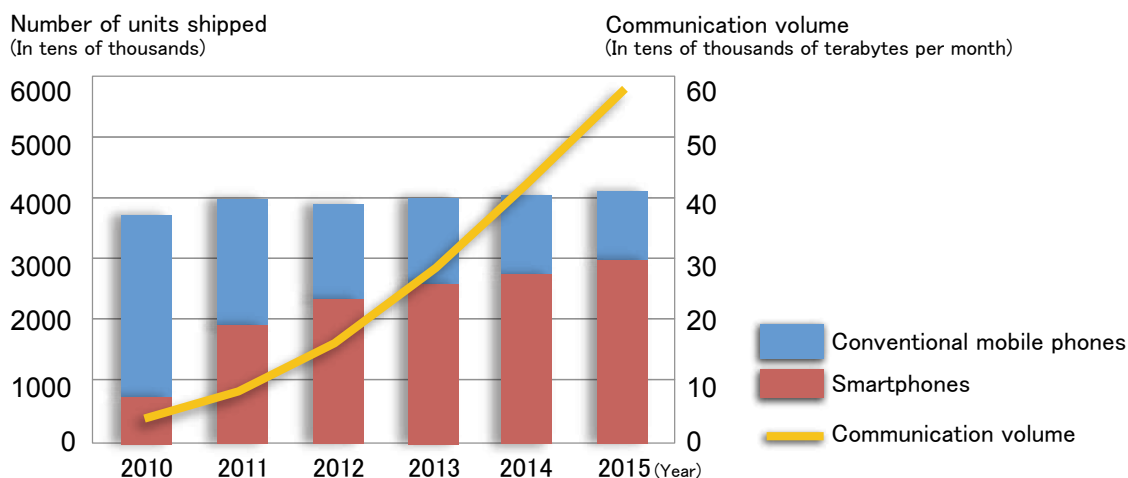
Due to the widespread adoption of smartphones, the volume of communications traffic has rapidly increased since around 2006. In 2011, a rate of 1.8ZB (zetabytes) transferred per year was reached, and by 2015 it is predicted that it will reach 600,000 TB (terabytes) per month on average for domestic traffic alone. This is not being caused just by an increase in movies and other

large file data streaming. Rather, control signals and positional data are now becoming automatically transmitted, so it is comparatively small size data that is being frequently updated and in large volumes, and a focus on the rapid development of the so called 'big data' change is now necessary.

□ An explosive increase in information volume



□ The transition between the number of domestic mobile phones and smartphones shipped and communication volume (expected).



Source: MM General research, CISCO VNI Mobile, 2011

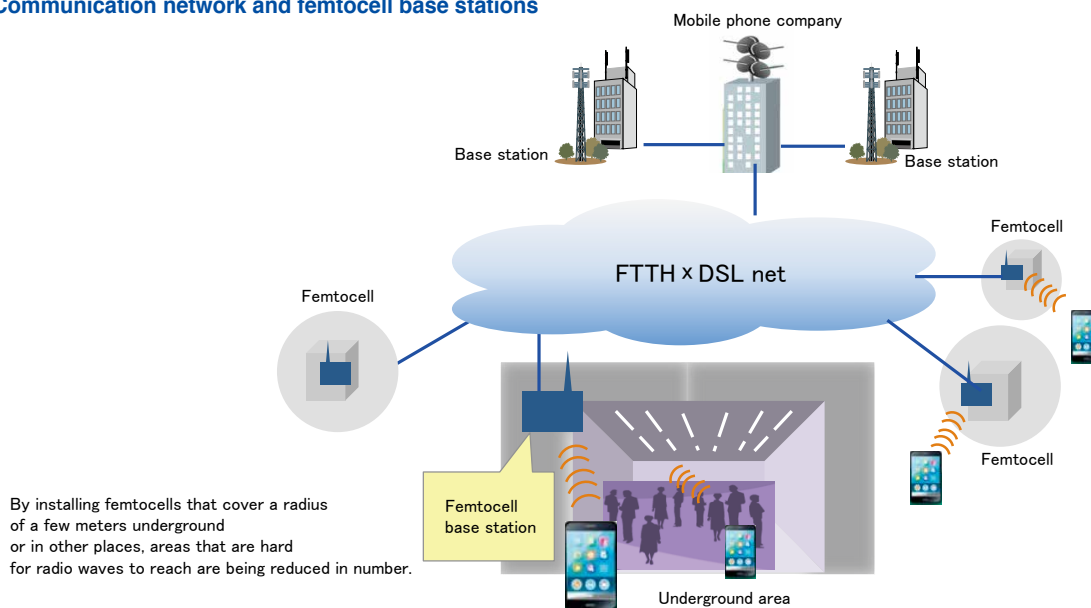
Due to the arrival of the big data era, appropriate management for data servers has become an issue (2)

For this reason, in data centers and base stations, we are now seeking to optimize processing in data servers. One option is to make data centers and base stations more local. For example, mobile phones on a cell transmission system are covered by a network of a number of base stations that operate on a radius of 500m to multiple kilometers in range (cell). However, even in a major city center, there are areas that radio waves have difficulty in reaching, so now there are very small form base stations installed that operate on a radius of only a few meters in range. These are called 'femtocells', which means 'extremely small' cells. Even in underground areas, the reason why mobile phones can be used now is due to the spread of these femtocells. On the other hand, the advancement of the hierarchical storage system to support 'big data' is accelerating. This means that

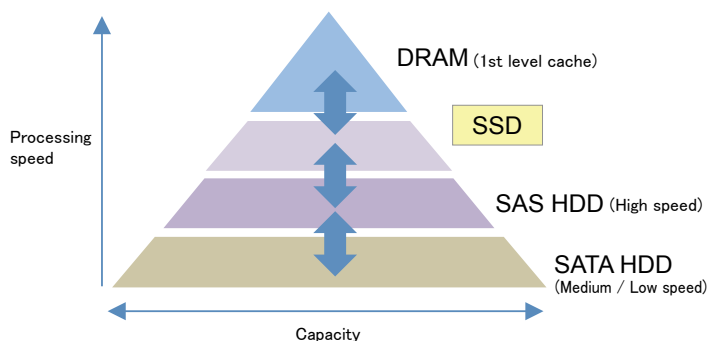
while using large volume HDDs as main storage, SSDs which feature fast access are being used as cache storage, and each type of storage is now being organized in a hierarchical system as a technique to increase efficiency.

In the previously mentioned femtocell access base stations, the demand for small servers using both HDDs and SSDs together is growing. However, in most of the underground femtocells used by the majority of users, it tends to be a large compilation of relatively small size data, which results in fragmentation of the data inside the SSD. And on top of this, when used in this way, the frequency of writes increases, which becomes an issue for SSD's weak point of longevity. To address this problem in the current age of big data, an SSD solution has been developed which is TDK's mSATA SSD "SMG3B Series".

Communication network and femtocell base stations



Hierarchy for optimized processing of storage systems



By automatically separating highly frequently used data to the SSD and seldom used frequency data to the lower tiers of storage, overall system efficiency is improved.

Minimizing erases using the "Small Writes Accumulation (SWA) method", storage life is drastically improved (1)

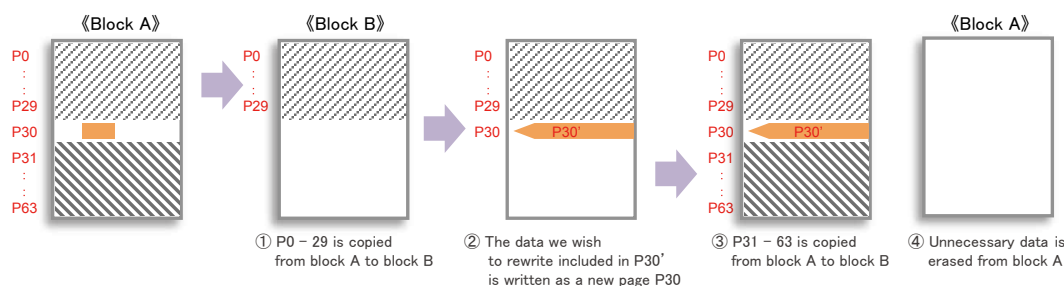
TDK's mSATA SSD "SMG3B Series" features the SSD controller IC "GBDriver RS3", which is equipped with the "Small Writes Accumulation (SWA)" function that minimizes erases and by efficiently writing, is able to dramatically improve storage life.

This method is especially effective in situations of writing small data. The difference between the procedures of writing between the standard method and the SWA method are outlined below.

An example of standard method writing procedure

In a particular block A, we wish to rewrite the data inside P30 (the orange section)
 Note) P30 refers to page 30

In the standard write procedure, according to the following diagram, the ratio of Write:Erase is 1:1, so especially in the case of writing only a few sectors, this leads to the consumption of block erases, which is undesirable from a drive longevity point of view.

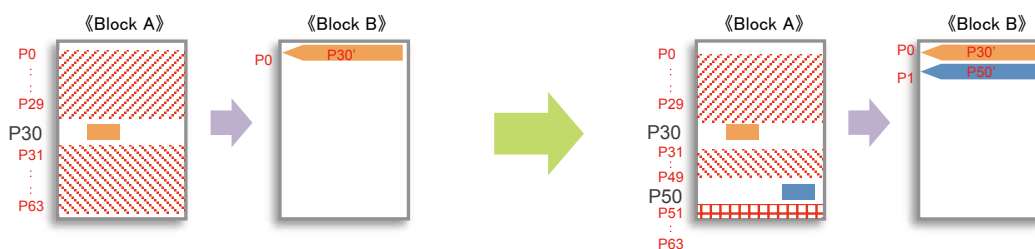


In this case, in order to rewrite one page of P30, we must rewrite 64 lots of 64 pages (Write Amplification = 64), which leads to accelerated degradation of write longevity.

An example of the SWA method writing procedure

In a particular block A, we wish to rewrite the data inside P30 (the orange section)
 Note) P30 refers to page 30

The SWA method utilized by TDK's mSATA SSD "SMG3B Series" works in the following way to avoid storage life degradation.



In this case, only the part of block A we wish to rewrite, P30 (the orange section), is written as a new page in block B in the first page (P0) as New Page (P30), which completes the write function. In other words, instead of copying all the applicable pages before and after as in the standard method, it maintains it as 2 blocks while waiting for the next write function.

The next write, for example in the case where we wish to rewrite the data in P50 of block A (the blue section), below the second page of block B, it is written in new page (P50) as the corresponding page. In this case too, it is maintained as two blocks while waiting for the next write command.



On the other hand, if the next write is not in block A but a different block, for example if we wish to rewrite the data in P20 of block C (the green section), block A and block B are maintained as two blocks, block D is prepared for copying and in the first page (P0) the data is written in new page (P20') as the corresponding page.

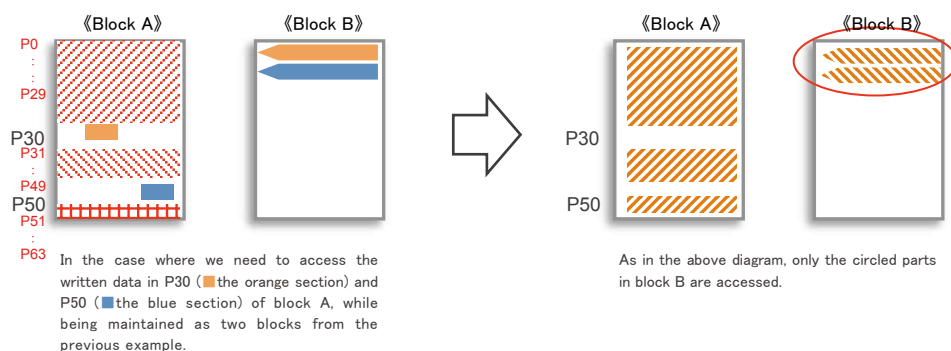
Minimizing erases using the "Small Writes Accumulation (SWA) method", storage life is drastically improved (2)

In TDK's mSATA SSD "SMG3B Series", due to this SWA method, despite DRAM or other cache memory not being installed, efficient writing can be achieved at a Write Amplification of 1.8 (actual observed value).

[Write Amplification] (Actual observed value)

- Total number of erases : **42,192,018 Block**
- Total amount of data : **11,060,384,366,592 Byte (4KB * 64 page * 42,192,018 Block)**
- Amount of writes : **6,104,472,852,992 Byte**
- Write amplification : **1.8 (11,060,384,366,592 Byte / 6,104,472,852,992 Byte)**

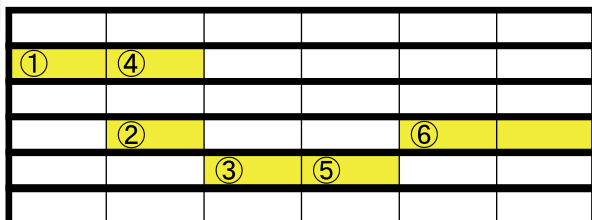
Supplement: Accessing data
(accessing all the data in this block)



□ By supporting NCQ, the number of writes is reduced

NCQ is an acronym for Native Command Queuing, which is a technique that allows SSDs and other devices to work at high speeds. By using NCQ, a number of commands are received in sequence and are processed simultaneously. Since the received commands are reordered in a way that the SSD can process at a faster speed, processing speed is improved and at the same time, flash access is reduced which improves writing longevity as well.

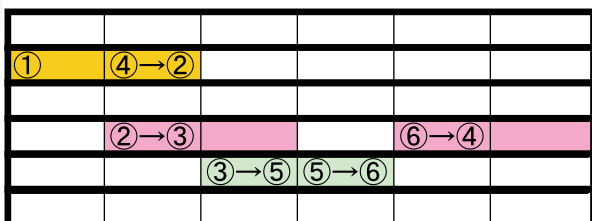
Without NCQ



The thick border represents an image of a single block (erasable units)

Processing occurs in the order indicated by the host. Due to this, even when accessing the same block, the entered commands are processed separately in the received order.

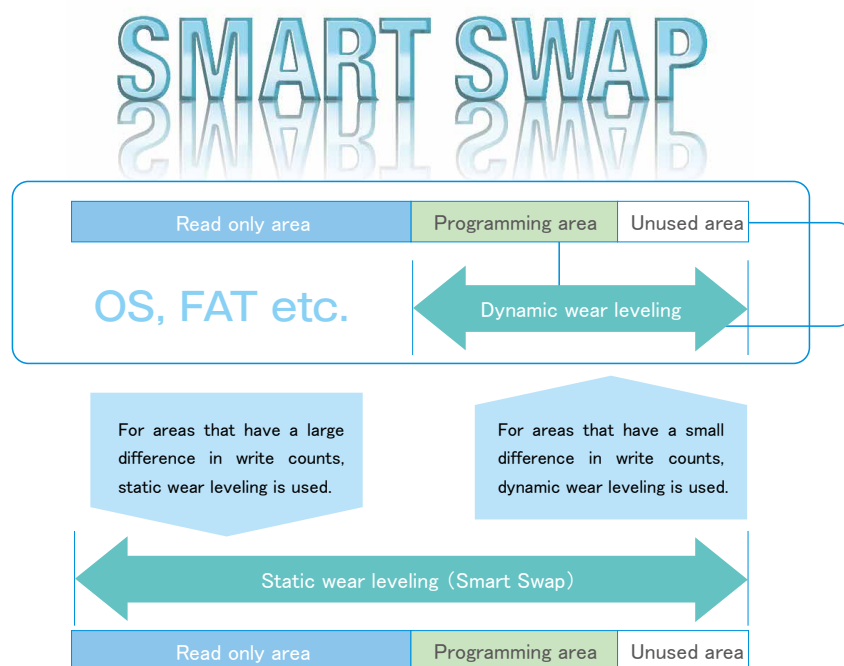
With NCQ



In the left diagram, the data to be received and sent is reordered and the commands are processed. This can reduce accesses to the NAND flash. The host processes multiple commands for data located in sequential addresses, so sometimes an incoming command is stopped midway which makes for a more efficient writing method. TDK's SSD controller IC "GBDriver RS3" optimizes command processing efficiency, which has the result of improving performance and extending life.

By utilizing Global Static wear leveling (TDK Smart Swap), SSD lifespan is drastically improved (1)

TDK's advanced write dispersion algorithm (TDK Smart Swap) spreads writes across the drive including fixed areas of the OS and FAT etc. Since the life of the flash memory can be used to its maximum limit, SSD lifespan is drastically improved.



For example, in the case of the SMG3B16G Series, even when there are 10 programs/erases occurring every second, you can expect a rewriting lifespan of 10 years, which reduces the frequency of replacement and helps reduce total costs.

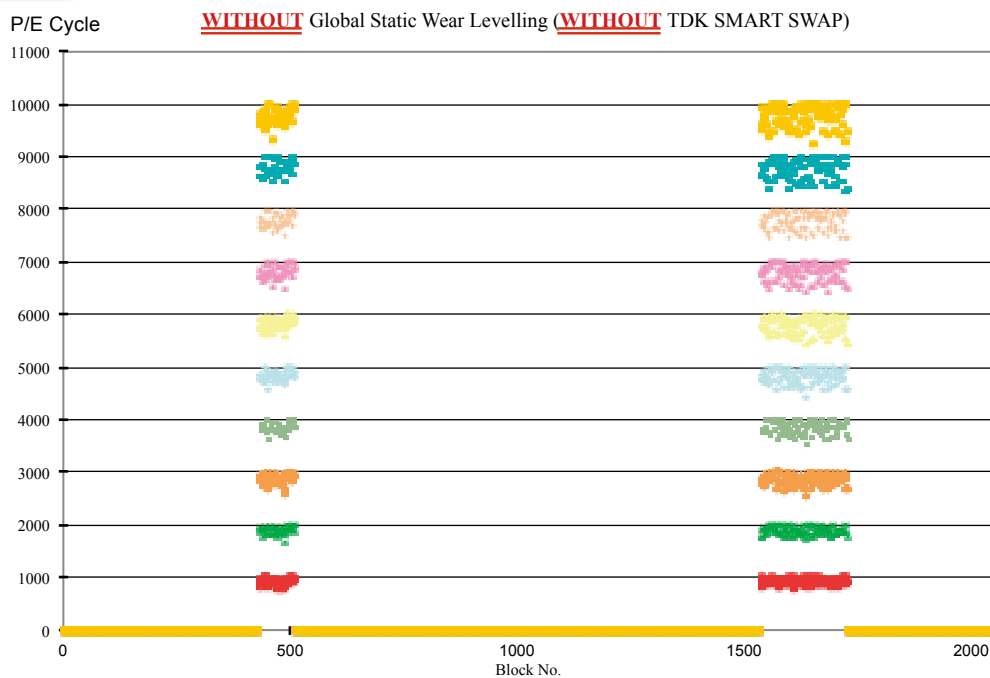
□ Estimated rewriting lifespan

Data capacity	Part No.	Expected program/erase cycles (Units: 1,000,000 times)	Allowable accesses per second according to age of equipment (When operated 24 hours a day, 365 days a year)		
			1 year	5 years	10 years
1GB	SMG3B01GVABCS-SSA	197	6.25	1.25	0.62
2GB	SMG3B02GVBBCS-SSA	394	12.47	2.50	1.25
4GB	SMG3B04GVDBCS-SSA	788	24.99	5.00	2.50
8GB	SMG3B08GVDBCS-SSA	1,576	49.97	9.99	5.00
16GB	SMG3B16GVDBCS-SSA	3,152	99.95	19.99	9.99

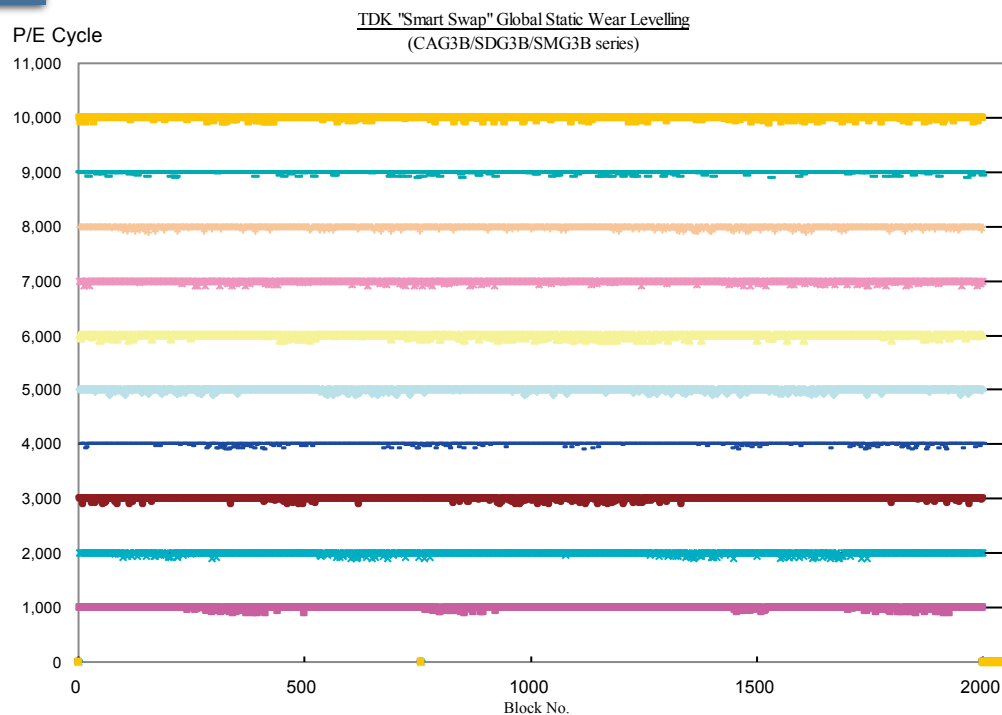
By utilizing Global Static wear leveling (TDK Smart Swap), SSD lifespan is drastically improved (2)

By using TDK Smart Swap, it is confirmed that the number of actual writes to the flash memory are not concentrated in any specific area according to the following graph.

Without Smart Swap



With Smart Swap

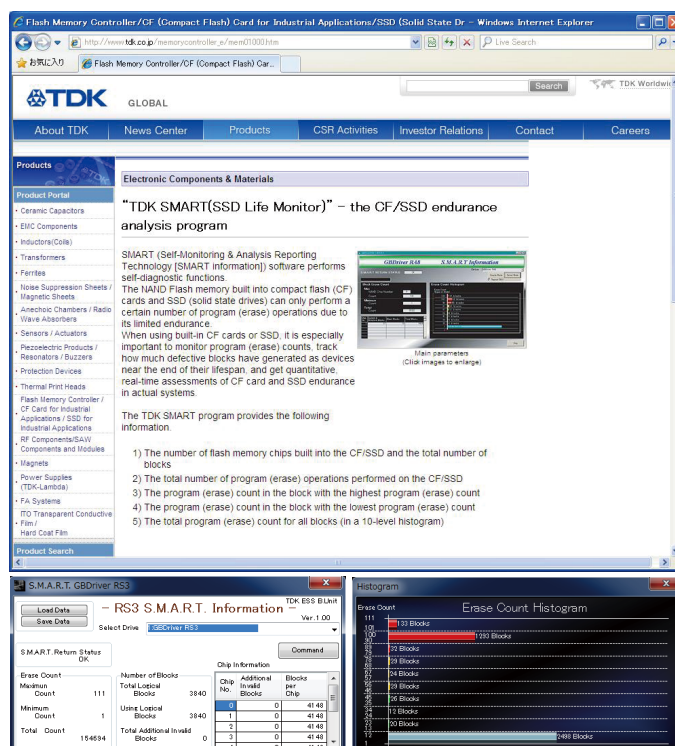


With TDK Smart, SSD life monitor software, drive management is also taken care of

"TDK SMART" is a completely license free SSD life monitor software, so for not only SSD device manufacturers, but also for the user, remaining life of the SSD and other information can be shared.

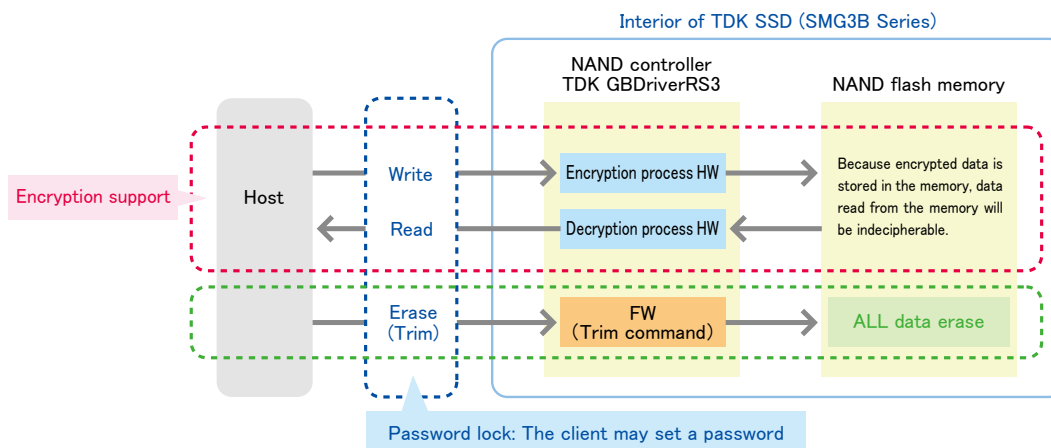
□ "TDK SMART" download

<https://product.tdk.com/info/en/products/flash-storage/tdksmart.html>



Security functions are also well supported

From personal information and business information, if any sensitive information is leaked, companies could suffer damage to their brand image, a loss of trust, large amounts of compensation fees could be incurred, and extensive operational damage could result. Also, if design information or other intellectual property is leaked, the amount of damage cannot be known. In order to address these kinds of security risks, TDK's SMG3B Series is installed with the ability to prevent any tampering, leakage or unauthorized copying of information.



□ Main features

- 1** Employed TDK SSD Controller GBDriver® RS3.
(Designed by us and domestically-manufactured)
- 2** Employed 4KB/page SLC NAND type flash memory. (High-speed, high-durability, and domestically-manufactured.)
- 3** Compatible with Serial ATA Standard Rev.2.6 (Gen 1:1.5Gbps/Gen 2: 3.0Gbps).
- 4** Equipped with 15bit/512Byte ECC (BCH).
- 5** Reinforced power fail tolerance. (Equipped with rewinding function)
- 6** Equipped with TDK global Static Wear leveling function. (TDK SMART SWAP)
- 7** Equipped with data randomizer function and auto refresh function.
- 8** Compatible with NCQ (Native Command Queuing)
- 9** Compatible with ATA Trim
- 10** Equipped with AES 128bit (Advanced Encryption Standard) encryption function (CBC mode)
- 11** SSD life monitor software (TDK SMART) is included.
- 12** Optional functions
- 13** Solution support



□ Main applications

**For uses in embedding where it is required to save space or for industrial applications.
For use in local servers or femtocell base stations which have a high frequency of writes.**

□ Specifications

Series	Serial ATA 3Gbps mSATA Type SSD RS3 series
Model	SMG3B series
Data capacity	1GB/2GB/4GB/8GB/16GB
Form factor	mSATA Type SSD
Memory type	SLC (single level cell) NAND type flash memory (4KByte/Page)
Controller	TDK GBDriver RS3
Interface	Serial ATA Revision 2.6
Transfer mode	SATA Gen1: 1.5Gbps, Gen2: 3.0Gbps
Transfer speed*	Read (max.) 160MByte/sec Write (max.) 80MByte/sec
Error check and correction (ECC)	15bit/512Byte
Endurance	Effective blocks×50,000 times (e.g. : 16GB mSATA : 3.1 billion times)
Ambient operating temperature	0 to +70°C [−40 to +85°C Industrial Option]
Ambient storage temperature	−25 to +85°C [−40 to +85°C Industrial Option]
Operating/storage humidity	0 to 90(%)RH [Non condensation]
Power supply voltage	3.3V±5%
Conformed standards	CE/FCC/VCCI
Environmental specifications	RoHS compliant

* In 4ch mode, measured by CrystalDiskMark 3.0.
The speed may vary depending on the actual use environment/conditions.

□ Shapes and dimensions

