

Flash Memory Controller

1TB SSD Controller GBDriver RS4 Series with 3 Gbps Serial ATA

- Supports latest 16 kB/page structure as well as 8 kB/page and 4 kB/page NAND type flash memory, latest 1 TB SSD
- Highly reliable high-speed SATA SSD controller with Enhanced ECC and read retry functions

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TDK Corporation has developed the GBDriver RS4 series of NAND type flash memory controllers with support for 3 Gbps serial ATA. Sales will begin in January 2013.

With an effective access speed of 180 MB/sec, the GBDriver RS4 is an advanced high-speed SATA controller chip. It is fully compatible not only with the latest 1xnm generation and 2xnm generation 16 kB/page SLC (single level cell) and MLC (multi level cell) NAND type flash memory, but also with 8 kB/page and 4 kB/page structures. This allows the customer to select the optimal flash memory for the respective application, providing the flexibility to configure high-speed SATA storage with a capacity ranging from 512 MB to 1 TB.

Along with high-speed control, a read retry function has been added which is essential for ensuring data reliability when using the latest MLC type NAND flash memory. Together with the auto-recovery, data randomizer, and auto-refresh functions of the existing GBDriver series, this design accommodates also future developments in the flash memory format. Data reliability is significantly enhanced by the highly acclaimed GBDriver power interruption tolerance algorithm. For customers requiring an even higher level of data reliability, the Enhanced ECC function makes it possible to expand ECC to 71 bits per 512 byte block.

The sophisticated static wear leveling algorithm averages the write and erase process over all blocks of the memory area, thereby drastically improving the lifespan of installed flash memory. SMART (Self-Monitoring & Analysis Reporting Technology) provides information about the number of times that memory blocks have been erased (programmed), which facilitates quantitative lifespan management of flash storage.

Data security has also been enhanced. In addition to ATA standard security functions, AES* 128-bit encryption is also available. This makes it possible to store data in the NAND type flash memory in encrypted form, to guard against the risk of data leaks and tampering. TDK will start releasing a number of NAND modules (SSDs and other products) incorporating the new GBDriver RS4 from April 2013.

Glossary

- AES: Advanced Encryption Standard. A block encryption method registered as United States Department of Commerce Federal Information Processing Standards FIPS PUB197

Main applications

- Semiconductor manufacturing equipment, NC machine tools, sequencers, programmable logic controllers, panel computers, embedded CPU boards and other factory automation equipment
- Automated ticket gates, automated ticket vending machines, commuter pass vending machines, train movement management systems, automated air ticket vending machines, automated check-in systems and other railway and transportation services equipment
- Cashless registers and other point-of-sales (POS) equipment, convenience store and kiosk terminals, ATMs and other banking terminals
- Digital cameras, video cameras, smart TVs, TVs with integrated Blu-ray storage, Blu-ray players, Blu-ray recorders, set-top boxes (STB), CS broadcast tuners, other A/V equipment
- Smartphones and tablet PCs, netbook PCs, mobile internet devices (MID), ultra-mobile PCs (UMPC) and other mobile terminals, thin client computers, SATA RAID SSD installations and other IT equipment for cloud computing systems
- Automotive devices such as car navigation systems, portable navigation devices (PND), digital tachographs, data loggers, drive recorders, and rearview monitors
- Multi-function printers (MFPs), label printers, bar code printers, commercial-use projectors, telephone conferencing systems, electronic blackboards and other office automation equipment
- Karaoke on demand systems, arcade games and other amusement equipment, game consoles
- Digital signage, electronic billboards, electronic point-of-purchase (POP) displays and other advertising display equipment
- Diagnostic imaging systems, blood analysis equipment, medical PCs, electronic patient record systems, DNA microarray systems, automatic biochemistry analyzers, remote medical care devices, automated care systems and other medical equipment and data analysis equipment
- Base station equipment for 4th generation (4G) mobile data communication systems such as LTE-Advanced/WiMAX2 and other communications and broadcasting equipment and information system devices
- Smart electricity meters, power grid infrastructure equipment, automated power equipment control systems, energy management systems, building air conditioning systems and other smart grid equipment
- Biometric authentication systems, entry/exit control systems, security terminals for surveillance cameras and other security equipment
- Earthquake emergency information systems, household fire detectors and other disaster prevention related equipment

Main features

1. Host Interface

Compliant with Serial ATA Standard Revision 2.6. Compatible with Gen1:1.5 Gbps, and Gen2:3.0 Gbps.

Realizes high-speed access: 180 MB/sec read access, 130 MB/sec write access

(Measured with Crystal Disk Mark 3.1. Actual speeds depend on flash connection configuration and system environment.)

2. Supported Flash Memory

4 kB/page, 8 kB/page, 16 kB/page structure NAND type flash memory from various vendors. SLC (single level cell) and MLC (multi level cell) flash memory. With SLC, flash-based SATA storage

with a capacity from 512 MB to 512 GB can be configured. With MLC, the available range is 2 GB to 1 TB.

3. Global Static Wear Leveling

TDK's proprietary global static wear leveling algorithm counts the number of times each memory block is erased (programmed) and replaces blocks uniformly. Static blocks such as OS etc. are also periodically leveled, which drastically improves the lifespan of the installed flash memory. The range for static wear leveling can be freely set. (In this case, dynamic wear leveling is used for other areas.)

4. Power Interruption Tolerance Algorithm

A proprietary algorithm reduces the risk of collateral data errors such as corruption of data other than the data being written if power is interrupted when writing data.

5. Enhanced ECC Function

For regular use, 30-bit ECC, 44-bit ECC or 71-bit/1KByte ECC can be selected, based on flash evaluation. For applications requiring even higher reliability, the GBDriver RS4 provides an Enhanced ECC function which uses 71 bits per 512 bytes.

6. Read Retry Function

As the cells of NAND flash memory get smaller, electric potential fluctuations at the floating gate can occur more easily, especially with MLC flash memory, when data are not accessed after having been programmed. When an ECC error has occurred in a read operation, this function changes the read potential and attempts to read the data again.

7. Data Randomizer Function

Data patterns are automatically randomized during the write process, to minimize the risk of bit errors due to writing the same data repeatedly.

8. Error Correction and Recovery

The auto-recovery function automatically corrects bit errors (read disturbance errors) that can occur when data are read repeatedly. The auto-refresh function reads all data including little used areas and automatically performs error correction if required. The auto-refresh function guards against data loss due to read disturbance errors and data hold errors. The auto-refresh function operates in the background and is paused during access, so there is no delay in response to commands.

9. Automated Encryption Using 128-bit AES

The integrated 128-bit AES encryption function automatically encrypts data when writing to the NAND flash memory, to prevent leaking of and tampering with personal data and confidential information.

10. ATA Trim Command

The ATA Trim command allows complete data erasure which is vital when replacing or discarding a drive. The command also improves write performance when erasing unneeded data.

11. Other Functions

(a) Total sector number setting function (clipping function)

The number of logical blocks allocated to a data area can be adjusted up or down in individual block units. For example, the number of times data can be written to the flash memory can be increased by reducing the number of logical blocks in the data area. Conversely, in the case of applications that do not require an extended life span, the memory capacity can be maximized by increasing the number of logical blocks in the data area.

(b) Protection function

Incorporation of an ATA standard protection function allows customers to set and remove a password to implement independent authentication and protect important data.

(c) SMART command support

The number of times all memory blocks are erased (programmed) can be obtained using the SMART command, which allows for easy determination of the flash memory status and facilitates appropriate lifespan management.

12. Solution Support

TDK has independently developed and marketed the GBDriver series of NAND Flash memory controllers since 2000 and provides technical support to customers in Japan and overseas backed up by its advanced proprietary technologies. This includes dispatch of field application engineers which is a vital service especially in the embedded systems market, and support for implementation of reliability monitoring functions.

About TDK Corporation

TDK Corporation is a leading electronics company based in Tokyo, Japan. It was established in 1935 to commercialize ferrite, a key material in electronic and magnetic products. TDK's portfolio includes electronic components, modules and systems marketed under the product brands TDK and EPCOS, power supplies, magnetic application products as well as energy devices, flash memory application devices, and others. TDK focuses on demanding markets in the areas of information and communication technology and consumer, automotive and industrial electronics. The company has a network of design and manufacturing locations and sales offices in Asia, Europe, and in North and South America. In fiscal 2012, TDK posted total sales of USD 9.9 billion and employed about 79,000 people worldwide.

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