Welcome to #FutureMemories – welcome to [KIOXIA](#)

Photos of the family from a recent holiday. The final, signed copy of our business's first contract. A database of medical data we used to cure a serious illness. All of this data has meaning to someone and will invoke in them a burst of memories. Our decision to rebrand to KIOXIA reflects this emotional drive to treat flash memory storage as more than a piece of hardware; it is oftentimes someone's life's work or the solution to a complex challenge. It could have been used to develop uplifting experiences, or even have changed the world.

KIOXIA combines the Japanese word *kioku*, meaning 'memory', with the Greek work *axia*, meaning 'value'. With this, we build upon the technological advances of our past as Toshiba Memory, the inventors of flash memory and the creators of BiCS FLASH™ 3D flash memory. Looking to the future, we will be cultivating a new era of memory that is being defined by a need for larger capacities and higher performance that fulfils the choices our customers need to make for the future.

We find ourselves well positioned for the demands you are telling us you need, both today and tomorrow. The BiCS FLASH™ 3D flash memory is now in its 5th generation, stacking an incredible 112 layers using 3-bit-per-cell (triple-level cell, TLC) technology. This will provide memory devices with capacities of 512 gigabit (64 gigabytes) that will form the basis of flash storage products in the months and years ahead.

KIOXIA also continues to invest significantly in research to ensure that the demand for more capacity can continue to be sustained such as with Twin BiCS FLASH™ that uses semicircular Floating Gate (FG) cells instead of the conventional circular approach. This will deliver the industry with further capacity improvements, overcoming the inherent challenges of continuing to increase the number of layers used in memory chips.

With our future memories in safe hands, we turn to the solutions our customers can integrate today. Our range of Enterprise storage devices (blue) continue to fulfil the exacting needs of the industry's most demanding data storage applications. Where both performance and price come under careful evaluation, the Datacenter (orange) range provides high capacity and competitive total cost of ownership (TCO). Finally, the needs of Client applications (green) ensure ultra-thin, portable and handheld devices can deliver long battery life with plenty of storage.

Blue – Enterprise SSD

The demands of Enterprise customers focus on robustness, reliability, and end-to-end data integrity. Of course, highest performance and drives offering the large capacities are also essential.

With the PM5 range of Enterprise Class storage solutions, the SSD needs of SAS servers is supported with a family of drives that have 10years of excellence. If reliability and endurance play a role in the selection process, the dual-port SAS PM5 is a prime choice, especially for applications such as mission critical workloads, online transaction processing (OLTP), financial trading, or data-mining and analytics. The range offers capacities of up to 15 TB along with endurances of up to 10 DWPD (drive writes per day over 5 years) and a mean-time to failure of 2.5 MPOH thanks to BiCS FLASH™. Energy-efficient and with options for a space-conscious 2.5" footprint, the PM5 also requires 22% less power[1] than equivalent Enterprise NVMe SSD alternatives.

In the CM5 SSD range, the low-latency protocol NVMe™ capitalizes on the parallelism and low-latency of the underlying flash, delivering higher performance than SAS. As such, random read KIOPS performance can be double that (applies to highest capacity drives) of an equivalent SAS drive. Of course, none of this can come at the expense of resilience, and the CM5 provides multi-path support thanks to its dual-port design. Compared to competitor solutions, basic energy consumption can be as much as 28% lower [2], while the power regulation capabilities allow user defined operation in the 9 – 18 W range. All this while still offering a mean-time to

failure of 2.5 MPOH. This makes the CM5 ideal for big data analytics, software defined storage (SDS) implementations, virtualized environments, along with machine learning (ML) and AI.

These Enterprise application storage solutions both provide 24/7 availability together with a long, 5-year warranty for extra piece of mind.

Orange - Datacenter SSD

In Datacenter applications, the search is on for the optimal balance between price and performance. However, this mustn't be at the loss of reliability and warranty period.

Starting with the CD5 range, these NVMe SSDs are ideal for read intensive applications in datacenters requiring high-performance coupled with storage density. They fit especially well in situations where there is no demand for a dual-port or levels of endurance beyond 1 DWPD. Available in capacities of up to 7.68 TB, they deliver almost double the random read performance of entry-level NVMe drives. They can also deliver a 56% lower power consumption compared to competitor PCIe alternatives[3]. Ideal for datacenters looking to reduce their operating expenditure (OpEx) over their existing installations, the CD5 series is well placed for big data analytics, internet of things (IoT), streaming media, and online transaction processing (OLTP).

Targeting datacenter managers who are tasked with the switch from SATA, the XD5 series is well placed to support them in a cost-effective manner. Available in both 2.5" and M.2 form factors, these PCIe SSD storage devices deliver up to 5 times higher performance in read-intensive applications over the SATA drives they replace. Perfect for cloud-based applications, big-data analytics, streaming media, and no-sql databases, they also offer up to 36% lower power consumption over high-performance PCIe offerings[4]. Stacked up against the competition, their quality-of-service is up to 50% better against drives of the same class[5], and they reduce latency in Microsoft SQL Server 2012 by up to 27%[6].

Of course, some datacenters still have much legacy server hardware that features the SATA interface. And why shouldn't they – there are still many applications that do not need PCIe-like performance, and it allows providers to deliver cost-effective datacenter solutions to their clients. The HK6 series of SATA SSDs fill this demand but not at the expense of latency or power consumption. Ideal for general purpose servers and mainstream datacenters, this product series is suitable for cloud applications, transactional databases, data analytics, and business intelligence. A move to the HK6 could deliver 46% more read operations/s[7], or 37% more mixed operations/s, with Apache™ Hadoop® at a power consumption of just 5.5 W [7]. Optimized for both 1 DWPD and 3 DWPD workloads, this 2.5" 7 mm high form factor drive allows space-efficient, high-density implementations.

All three families of SSDs are based upon KIOXIA's advanced BiCS FLASH™ 3D flash memory technology and are provided with a warranty of up to 5 years.

Green – Client SSD

Big on capacity, small on size and low on energy consumption; these are the demands of flash storage for Client applications. The latest KIOXIA storage technology delivers to fulfil precisely these demands.

Gone are the days of huge laptops. Today's portable devices are thinner, streamline and can operate for hours for people on the move. KIOXIA's BG4 series of innovative PCIe SSDs are just what is required. Ranging in capacity up to 1 TB, the BG4 is available in a compact M.2 2230 form factor or, when it needs to be thin and soldered directly on the board, as an M.2 1620 BGA package. That makes it slightly smaller than a 2€ coin. Consuming just 3.7 W in active mode, it delivers 390 KIOPS random read and 2.3 GB/s sequential read performance. Beyond notebooks, desktops, tablets and embedded systems, this range of SSDs is also ideal for booting applications. This DRAM-less design has support for HMB (Host Memory Buffer) and there are options available for TCG Opal v2.1 for higher security.

For those looking for an NVMe solution, the XG6 series offers performance as a boot drive in client and server systems, while also keeping power consumption under control. Offered in the M.2 2280 form factor, the single-sided design is ideal for compact spaces and is easy to integrate into a cooling concept. Power consumption in active mode is just 4.7 W, while the drive is fitted with 96-layer BiCS FLASH™. Sequential read performance of 3.1 GB/s is complemented by 355 KIOPS random read. This makes it ideal for everything from gaming to caching and logging in datacenters.

With the XG6-P series of NVMe SSDs, even more storage capacity is on offer. Available with up to 2 TB it still manages to retain a single-sided design. This range targets the top end applications, from the workstations and high-end PCs used for video production, to systems running artificial intelligence and machine learning algorithms. For datacenters that push the limits on logging, or those that need more space for their boot drive, the XG6-P is also recommended. Power consumption lies at just 4.9 W, while just 3 mW is drawn in stand-by mode.

Footnotes:

1. Compared to NVMe enterprise SSD (18Watt).
2. Compared to other manufacturer's enterprise SSD (25Watt).
3. CD5 1.92TB (11Watt) against competitor's PCIe enterprise drive (25Watts).
4. XD5 1.92TB (7 Watt) compared to CD5 1.92TB (11Watts).
5. Compared to the other manufacturer's drive of a same class as XD5.
6. Compared to the other manufacturer's drive of a same class as XD5 & measured under KIOXIA Corporation test conditions. Read and write speed may vary, depending on the host device, read and write conditions, and file size.
7. Compared to the other manufacturer's drive of a same class & measured under KIOXIA Corporation test conditions. Read and write speed may vary, depending on the host device, read and write conditions, and file size.

Notes:

*NVMe is a trademark of NVM Express, Inc.

*All other company names, product names, and service names mentioned herein may be trademarks of their respective companies.

* All comparison and statement based upon available data as of March, 2020; based on KIOXIA Europe investigations

Disclaimer:

Definition of capacity: KIOXIA defines a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes and a terabyte (TB) as 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1GB = 2^30 = 1,073,741,824 bytes and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software and operating system, such as Microsoft Operating System and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

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