

World's first 14TB nearline HDD with Conventional Magnetic Recording

Fitting nine platters into the 3.5-inch enclosure using helium-sealed design and high-density assembly design

With the prevalence of IoT, big-data, cloud, and other IT services, the volume of data generated is increasing exponentially. In this situation, demand for high-capacity 3.5-inch hard disk drives (HDDs) is increasing, and manufacturers are facing stiff competition particularly in the market of nearline HDDs for data centers.

> Releasing the Gen-7 MG07ACA nearline HDD series

HDDs for business use are divided into two categories: enterprise HDDs for servers and storage systems and nearline HDDs for data centers. Data transfer rates and reliability are important factors for the selection of enterprise HDDs whereas storage capacity is always the top priority for nearline HDDs.

Although Toshiba Electronic Devices & Storage Corporation ("Toshiba") has released six generations of nearline HDDs before the MG07ACA series.

Aiming to meet higher capacities, Toshiba launched the Gen-7 MG07ACA series in December 2017, the world's first nine-platter nearline HDDs^{*1} in a 3.5-inch^{*2} form factor with a height of 26.1 mm. The MG07ACA series provides a capacity of 14 terabytes^{*3} (TB) using conventional magnetic recording (CMR) technology that does not exhibit any decrease in transfer rates in random read/write environments.

The MG07ACA series realized the world's first 14-TB storage capacity through helium-sealed design and high-density assembly design.

> First Toshiba helium-sealed HDDs in the MG07ACA series

In recent years, the storage capacity of nearline HDDs has been increasing by 2 TB a year from 6 TB initially to 12 TB now. To make it possible to further increase the HDD storage capacity, Toshiba adopted helium-filling technology for the MG07ACA series for the first time.

Being smaller in mass than air, the helium molecule produces less buffeting or disturbance on the rotating disks.

The reduced buffeting helps reduce the vibration of head suspension assemblies and the wobbling of disk platters at high RPMs. This, in turn, helps improve the positioning precision of the actuator arms and therefore increases the areal density. The reduced buffeting also makes it possible to shrink the distance between platters. Consequently, the helium-sealing technology enables an increase in the HDD storage capacity.

In addition, since helium has a viscosity close to that of the air, an existing technology can be used to lift the slider off the platter surface. Furthermore, helium has less drag force acting on the spinning platters than the air, making it possible to reduce power

consumption of a motor. Helium-sealing technology is expected to reduce the overall power consumption of a data center substantially.

> Squeezing in nine platters through high-density assembly design

In order to achieve the 14-TB storage capacity for the MG07ACA series, we managed to fit nine platters into the industry's standard 3.5-inch enclosure with a height of 26.1 mm. This was made possible by Toshiba's expertise in high-density assembly design cultivated through its experience with 2.5-inch and smaller HDDs. To fit so many platters into an enclosure of a fixed size, various modifications and innovations were necessary. We reduced the platter thickness, shrank the distance between platters, and modified the actuator design and printed circuit board assembly (PCBA).

We also created an enclosure design that requires the minimum space to hermetically seal helium gas in the HDD. As a result, a greater amount of space was left for the assembly of platters than in the conventional HDD models.

The platter thickness was also reduced. The nine-platter MG07ACA series uses a platter with a thickness of 0.635 mm, down from the 0.8-mm platters in Toshiba's previous-generation seven-platter nearline HDDs. The MG07ACA series also has less distance between platters.

High-density assembly and manufacturing technologies were required for the actuator having 18 heads for nine platters. We leveraged our expertise for the design and manufacturing of 2.5-inch and smaller HDDs to assemble parts thinner than those in conventional HDD models with high precision.

> 40% increase in storage capacity and 42% reduction in power consumption

As described above, the small helium molecule helps increase the HDD storage capacity. However, it is very difficult to seal helium in the HDD enclosure. To prevent helium from leaking out due to external shock during rack mounting, a high-quality welding technology is required for the top cover of the HDD enclosure.

For the HDD, we adopted laser welding technology developed by the Corporate Manufacturing Engineering Center of Toshiba Corporation that has a proven track record in the laser welding

of lithium-ion batteries.

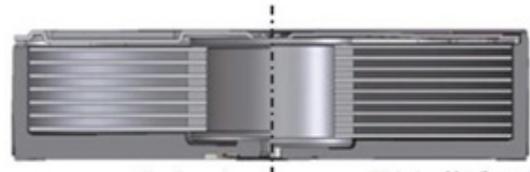
Furthermore, we improved the yields for heads, media, and other parts, drawing on our advanced technologies and extensive expertise cultivated in the field of semiconductor fabrication. We also offered technical assistance to parts suppliers in order to ensure a stable supply of our high-performance nearline HDDs. As a result of the foregoing, the MG07ACA series has achieved a storage capacity of 14 TB, 40% higher than the previous 10-T MG06ACA10T model while reducing power

consumption by 42% from 7.3 watts to 4.22 watts. The MG07ACA series also provides a high data transfer rate of 248 MiB/s⁴ and high reliability with a mean time-to-failure⁵ (MTTF) of 2.5 million hours.

Toshiba Electronic Devices & Storage Corporation will continue to collaborate with Toshiba Group companies and external suppliers in order to develop products that meet customers' needs and contribute to the enhancement of the infrastructure that underpins today's information society.



9-platter helium-filled 14-TB HDD MG07ACA series



Nine platters are housed in the 14-TB HDD through helium-sealed design and high-density assembly design.

*1 As of December 2017 (as surveyed by Toshiba Electronic Devices & Storage Corporation)

*2 "3.5-inch" means the form factor of HDDs. They do not indicate drive's physical size.

*3 Definition of capacity: A terabyte (TB) is 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1TB = 2⁴⁰ = 1,099,511,627,776 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 and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

*4 Read and write speeds may vary depending on the host device, read and write conditions, and file size.

*5 MTTF (mean time to failure) is not a guarantee or estimate of product life; it is a statistical value related to mean failure rates for a large number of products, which may not accurately reflect actual operation. The actual operating life of the product may differ from the MTTF.

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