# The advantages of IBM servowrite self-timing technology

*Continually increasing storage capacities in hard disk drives require innovations in magnetic hard disk drive design. One of the most unique and innovative advances in hard disk drive design is a new manufacturing technology for servowriting called no-clock-head (NCH) servowriters. Using patented IBM servowrite self-timing technology, NCH servowriters are key to a non-invasive servowriting process that replaces the clock heads used in traditional servowriting. As a result, performance, reliability, and quality are much higher for hard disk drives manufactured with this new process. NCH servowriters have already been used successfully in the manufacture of many IBM Ultrastar* drives (such as the 9LZX, 18ZX, 18LZX, 36XP, and 36ZX) for both 7200 and 10,000 RPM speeds and a variety of capacities.*

### The need for precision manufacturing

Hard disk drives store data in concentric tracks, and the density of those tracks has increased along with linear bit density over time. In fact, the application of advanced read/write elements has resulted in areal densities of 7.0 Gbits/sq. in. and track densities of 20,000 tracks per inch in IBM Ultrastar server disk drives.

To read and write data, the disk drive head must remain accurately centered on a selected track. At today's track densities, the head must stay centered on the narrow tracks to within a staggering tolerance of one-millionth of an inch. To achieve this level of precision, the head must read position information along the track that is permanently written onto the disk. The position information is used by a precision electronics control system that servos the recording head onto the track.

The process by which the position information is written onto the disks is referred to as servowriting and is performed only once—during the manufacture of the device. The information remains on the disk for the life of the product. The machines that write these servo patterns—called servowriters—must be very precise instruments.

Traditional servo writing has been performed in a clean room environment with external sensors invading the head disk assembly to provide the precise angular and radial position information to write the servo patterns. While such instruments have been satisfactory to set the patterns in the past, today's increased track density has become so precise that the mechanical vibration of the file (relative to these external sensors) can limit the accuracy or increase the complexity of these systems.

### A more precise servowriting technology

In response to this need for greater precision in hard disk drive servowriting, IBM has developed a new manufacturing technology called no-clock-head (NCH) servowriters, which use patented IBM servowrite self-timing technology. This new class of NCH servowriters replaces the clock heads used in traditional servowriters with an electronic non-invasive process to create the nanosecond-level time alignment of servo patterns between adjacent tracks.

A digital signal processor executing proprietary mathematical algorithms is used to accomplish this task. In this method, the hard disk drive generates its own timing information while the drive is being servo written, using only the product data head. The patterns are self-propagated and aligned by a digital signal processor (DSP), resulting in a substantial increase in time alignment over other servowriting methods used in IBM products.

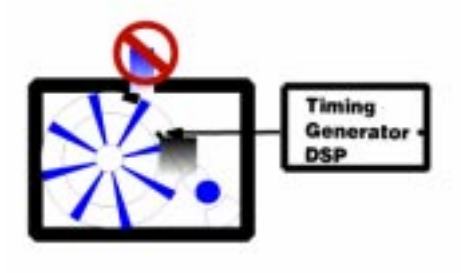


*Figure 1. A disk drive with an external clock head, typically located on the disk outer diameter. This provides the angular information used to write the servo patterns that are shown as pie-shaped sectors. End-user data is stored in the larger white regions between the pie-shaped sectors.*

**The wide-ranging benefits of NCH servowriting**

NCH servowriters are already being used in the manufacture of many IBM Ultrastar drives (such as the 9LZX, 18ZX, 18LZX, 36XP, and 36ZX) for both 7200 and 10,000 RPM speeds and a variety of capacities. These disk drives feature significantly improved performance, quality, and reliability:

- *Performance*—The NCH process eliminates mechanical vibrations associated with external clocking while significantly improving servo pattern time alignment. This results in fewer servo errors—and thus fewer write inhibits—to improve drive performance. The improved time alignment also enables a reduction in the size of the sector fields, thereby increasing data capacity.
- *Reliability*—The NCH servowriter eliminates external invasive clock heads, which can damage the drives during manufacture. With the NCH servowriter, the drive leaves the manufacturing facility with a clean bill of health, having been assembled and tested in a manner to preserve its quality and integrity. Improved time alignment in the servo pattern fields means fewer servo substitutions, which further increases data reliability.
- *Quality*—The NCH servowriter includes in-process algorithms to detect and correct servowriter errors as they occur. The result of this monitoring of the servowriting process (catching and correcting errors "on the fly") is that disk drives are servo written with fewer errors. This improves product quality and makes the manufacturing process more efficient—all of which can reduce the cost for end users.

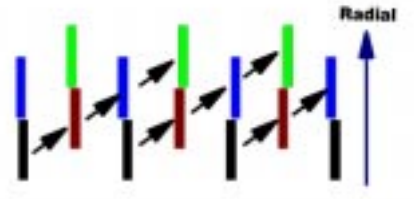


*Figure 2. Angular propagation marks, generated by the data head itself and used to create the precise angular position of a clock head. In this case, there is no clock head.*

### A strategic technology for ongoing improvements

IBM servowrite self-timing technology is a breakthrough in manufacturing technology and a first in the disk drive industry. This new technology eliminates pattern errors caused by traditional external sensors, improving data accuracy and drive performance. In addition, the technology provides a pattern accuracy designed to scale up with ever-increasing areal densities—enabling even greater gains in future products.

**For more information**

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