

Development of 16x-speed technology for DVD-RAM
- Five-fold increase in laser-diode modulation control accuracy -

Tokyo, April 22, 2004 ---Hitachi, Ltd. (NYSE:HIT / TSE:6501) has developed high-speed recording technology which realizes 16x-speed for DVD-RAM or a data rate of 176 mega-bit-per-seconds. This enables, for example, 1-hour standard quality video from an HDD recorder to be transferred on to a DVD-RAM in about 2 minutes. *1) This technology was realized by the development of "high-speed recording pulse generator circuit" technology which drives the laser diode, used to record data on to a DVD-RAM, with extremely precise time resolution. Hitachi, Ltd. is planning to present this technology to the DVD-Forum.

DVD-RAM had become popular as the storage media for large-capacity video contents. Various DVD products, such as DVD-recorders and DVD-camcorders, are available on the market from Hitachi and other manufacturers. The recent trends towards broadband, multi-channel, and even more, ubiquity, is increasing the need to transfer large-capacity contents, e.g., from hard disk, to DVD-RAM for archiving or portability, and to be able to do so quickly.

To increase the speed of recording on to optical discs, however, the development of high-speed disc rotation and high-speed recording technology are required. The maximum rotation speed for a disc, without centrifugal force causing disc burst, is about 16-times (16x) that of standard DVD speed. For DVD-ROM, 16x DVD disc drives are already available on the market. In DVD-RAM, high-speed recording is basically achieved by high-speed modulation of the laser diode that irradiates the modulated laser beam on to a phase-change recording media,*2) which results in the formation of small-sized amorphous marks with different reflectivity on the phase-change recording film. To achieve 16x-speed recording at standard quality, it was necessary to enhance the time resolution of the modulation from 700 pico-seconds to 133 pico-seconds.

Hitachi, Ltd. applied high-speed technology, used in the area of optical communication, to optical discs, and successfully developed a high-speed recording pulse generation circuit to achieve 16x recording for DVD-RAM. Main features of the technology developed are as follows:

- (1) High-speed recording pulse generator circuit
- (2) High-speed write strategy
- (3) Reliable high-speed readout technology

(1) High-speed recording pulse generation circuit:

Technology used in the area of optical communication was applied to realize precise time resolution required for high-speed recording. More precisely, several pulse sources at the conventional clock speed, were synchronized and operated in parallel in accordance with the speed desired. The pulses generated were then parallel-to-serial converted by a MUX (multiplexer) circuit, producing high-precision high-speed pulses. Operating speed is increased by increasing the number of parallel pulse sources.

(2) High-speed write strategy:

When recording at high-speed, controllability of the mark position deteriorates if the rise and fall time of the optical pulse is slow, as the power of the laser irradiating the recording film drastically decreases as pulse width narrows. Technology doubling the minimum pulse width was newly developed, improving recording control, and thus enabling highly reliable control of mark positions even during high-speed recording.

(3) Reliable high-speed readout technology:

When the frequency band of the detector and signal processing circuit is expanded for high-speed readout, group delay occurs in the detectors and circuits, resulting in readout signal distortion and thus degrading signal quality. The new signal processing technology developed compensates for the distortion, realizing a highly reliable readout of data at a high data-rate, as well as read-out compatibility with current DVD-RAM.

Further, Hitachi, Ltd. applied these technologies to a high-speed DVD-RAM, which uses BiGeTe (Bismuth-Germanium-Tellurium), a recording film developed by Hitachi Maxell, Ltd. At a constant disc rotation speed, a recording speed of 176 Mbps or 16x-DVD speed at the outermost radial position, and 66 Mbps or 6x-DVD speed at innermost radial position of the disc, were obtained. Jitter, which is the standard index for readout signal quality, was less than 9% under this condition. Further, it was confirmed that this disc, recorded at high-speed, could be successfully read by standard DVD-RAM drives at readout speeds of 2x and 3x.

This technology is applicable not only to DVD-RAM but also, in principle, to increasing the recording speed of the recently released Blu-ray Disc™*3) which uses blue laser. As the Blu-ray™ disc has a higher recording density, the maximum recording speed which depends on the maximum rotation speed, is 450 Mbps. The technology developed by Hitachi, Ltd. will open the way to achieving this.

These results were presented at Optical Data Storage 2004, an international conference, to be held in Monterey, California, U.S.A. from 19th-21st April 2004.

■ **Notes:**

***1) Transferring 1-hour standard quality video on to a DVD-RAM in about 2 minutes:**

When disc rotation speed is constant, the transfer speed at the outermost radius and innermost radius is 16x and 6x, respectively. This results in the average transfer speed of about 11x. Therefore, the recording time for an 1-hour length standard quality video with a data rate of 4.5 Mbps at the average transfer-rate, becomes $4.5 \text{ Mbps} \times 3600 \text{ seconds} / (11 \text{ Mbps} \times 11 \text{ times}) = 133 \text{ seconds}$.

***2) Phase-change recording media:**

With this media, the recorded mark is either in a crystalline phase, the initial state of the recording film, or an amorphous phase. The amorphous mark is achieved after the portion of the recording material irradiated with a laser, is rapidly cooled. Data is retrieved by irradiating the media with a low-power laser, and detecting the difference in the reflectivity between the amorphous mark and the crystalline mark.

***3) Blu-ray Disc™:** Trademark of the Blu-ray Disc Founders

About Hitachi, Ltd.

Hitachi, Ltd., (NYSE:HIT/TSE:6501) headquartered in Tokyo, Japan, is a leading global electronics company, with approximately 326,000 employees worldwide. Fiscal 2003 (ended March 31, 2004) consolidated sales totaled 8,632.4 billion yen (\$81.4 billion). The company offers a wide range of systems, products and services in market sectors, including information systems, electronic devices, power and industrial systems, consumer products, materials and financial services. For more information on Hitachi, please visit the company's Web site at <http://www.hitachi.com>.

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