

## **DIR-2000, 1 Gbit/sec Data Recorder for VERA Project**

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### **Abstract**

This paper will discuss the new technologies used in the DIR-2000, 1 Gbit/sec data recorder: the highest performance in the commercial market. It will briefly explain how the DIR-2000 is implemented in VERA Program [1] of National Astronomical Observatory in Japan.

### **1 Introduction**

More than 1000 units of Sony DIR-1000 Series [2] data recorders are being used for the varieties of applications among government and scientific communities worldwide. Responding to the request of a higher data rate than 512 Mbit/sec, Sony developed the DIR-2000 that offers the highest data rate of 1 Gbit/sec. The data capacity on 19mm metal particle tape is 600 GB and the recording time per cassette tape is 80 minutes at the data rate of 1 Gbit/sec.

### **2 New Format**

Since 1990, ANSI ID-1 19 mm Format has been well accepted as the high performance and reliable format by variety of data recorder communities, and there are many ID-1 users worldwide. However, the data capacity per tape of 100 GB for ID-1 is not enough for a 1 Gbit/sec recorder, since the recording time would be only 13 minutes.

Sony is preparing to propose a new 19 mm format in ANSI Committee for standardization. The new format of 19 mm is not only suitable for data recording of high performance and high reliability demanded in 21<sup>st</sup> century, but also for read compatibility of ID-1 tape and similar interface and control on ID-1 drives. The specifications and parameters of the DIR-2000/new format are shown in terms of the comparison with the DIR-1000H / ID-1 Format in Table 1.

The dimensions of the DIR-2000 are the same as those of the DIR-1000 Series, so that they can be installed in the existing Sony' Mass Storage System such as PetaSite DMS-8800 and the DMS-24.

	<b>DIR-1000H</b>	<b>DIR-2000</b>
Format	ANSI ID-1 Format	New Format. ID-1 Read Compatible
Data Rates	512, 400, 256 Mbit/sec	1024, 512, 256 Mbit/sec
Data Capacity/Tape	100 GBytes	600 GBytes
Recording Time	25 minutes at 512 Mbps	80 minutes at 1024 Mbps
Media	Co-oxide	New Metal Particle
Tape Width	19 mm	19 mm
Tape Thickness	16 $\mu$ m	11 $\mu$ m
Coercive Force (Hc)	900 Oe	2300 Oe
Shortest wavelength	0.89 $\mu$ m	0.45 $\mu$ m
Track Pitch	45 $\mu$ m	19 $\mu$ m
Maximum Tape Speed	847.5 mm/sec	356.6 mm/sec
Recording Bit Rate/Head	88 Mbps	88 Mbps
Record / Playback Heads	16 heads/16 heads	32 heads/32 heads
Processor Channels	8 channels	16 channels
Maximum Writing Speed	39.5 meter/sec	19.7 meter/sec
Scanner Rotation Speed	110 rps at 512 Mbps	55 rps at 1024 Mbps
Data Interface	ECL Parallel with clock	
Control Interface	RS-422/IEEE-488GPIB/RS-232C	
Dimensions (W x H x D)	436 x 432.5 x 633.5 mm (17 1/4 x 17 1/8 x 25 1/8 inches)	
Weight	64 Kg (141 lb 1 oz)	70 Kg (154 lb 5 oz)
Power Requirement	100 V to 240 V AC $\pm$ 10% (50/60 Hz)	
Power Consumption	800 VA	850 VA

Table 1. Specifications and Parameters

### 3 New Technologies

In order to meet the requirements of high data rate, high data capacity, long head life, less tape damage, and backward compatibility all together, new heads and new tapes were developed and implemented in new recorders.

#### 3-1 Ferrite Cover over Heads and ETF Record Heads

There are 32 record heads and 32 playback heads: the total of 64 heads on the scanner of the DIR-2000! Since the spacing between a record head and playback head is small, the cross feed signal from record heads to playback heads would be significant during read-after-write that is an essential function for reliable data recording.

We introduced patented ferrite covers over record and playback heads to shield the magnetic flux. This simple idea of shielding is very effective and improves the cross feed by 12 dB.

The newly developed the ETF (Embedded Thin Film) head has small magnetic core compare with the conventional MIG (Metal In Gap) head, so that the magnetic leakage flux from record head is improved further by 7 dB.

### **3-2 Laminated Amorphous Playback Heads and New Metal Tape**

The shortest wavelength becomes one half of ID-1 ( $0.45 \mu\text{m}$  vs.  $0.89 \mu\text{m}$ ), and the track pitch becomes less than one half of ID-1 ( $19 \mu\text{m}$  vs.  $45 \mu\text{m}$ ). In spite of these reductions, the combination of the laminated amorphous playback heads and newly developed metal particle tape provide even better C/N than ID-1 recorder. This could be achieved by the joint R & D of heads/drums, drives, and media in Sony.

### **3-3 Trench Design Heads**

There are two trenches on record and playback heads of the DIR-2000. This patented head design provides better head-tape contact with lower head projection, larger head contour, and lower tape tension. These result in longer head life and less tape damage. Backward compatibility of format requires playback of tapes of different thickness. Trench design heads provide a good head-tape contact for different kinds of tape thickness throughout head life.

The same technologies of trench ETF/amorphous heads and new metal tapes are used in Sony Computer Tape Drive DTF-2 (24 Mbytes/sec via SCSI or Fiber Channel) that are installed as a few hundred TB Systems at NASDA and ERSDAC in Japan.

## **4 Applications**

The first application for the DIR-2000 was VERA Project of National Astronomical Observatory in Japan. VERA stands for VLBI (Very Long Baseline Interferometer) Exploration of Ratio Astronomy. VERA array consists of four telescopes whose diameter is 20 meters (67 feet). The combination of these telescopes can obtain the resolution power of a telescope whose diameter is 2000km (1250 miles).

The DIR-2000 1 Gbit/sec recorder is one of the key devices for VERA Project. One DIR-2000 drive is used to record the data at each of four VERA telescope stations. The correlator at National Astronomical Observatory in Tokyo supports four tape drives of the DIR-2000 to analyze the data from four telescope stations.

The DIR-2000's are installed in the DMS-24, Mass Storage System for automated operations for data acquisition at the telescope stations and correlation in Tokyo. The DMS-24 library can handle up to 24 large cassette tapes (14.4 TB capacity) and two drives of the DIR-2000's.

Besides VERA Project, a government agency in Japan plans to develop 2.5 Gbit/sec ATM network, and is considering using the DIR-2000 to record the data on the broadband network. Broadband network is one of the important technologies in 21<sup>st</sup> century, and recording of high-speed un-interrupted data will be needed.

## **5 Conclusions**

Sony has developed the DIR-2000: 1 Gbit/sec data recorder with 600 GB data capacity per tape. The DIR-2000 meets the requirement for recording of un-interrupting data at very high data rate. The applications for this recorder are not only scientific researches but also broadband radar and network.

The DIR-2000 will be demonstrated at Vendor Exhibit Area.

## **References**

- [1] M. Homma, et al. "Science with VERA: VLBI Exploration of Radio Astrometry" SPIE Proceeding No. 4015, 2000
- [2] T. Sasanuma. "New 512 Mbit/sec ID-1 Recorder" THIC Conference October 15<sup>th</sup>, 1996