



High Data Rate Head Tape Interface-Update

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THIC Inc.



Goals for Development

Develop High Performance Recorder with

- Higher Data Rate
- Higher Packing Density
- Backward Compatibility

Key Technology Challenges

- **High Density Recording**
Shorter Wavelength / Narrow Track / Thin Tape
- **Backward Compatibility**
Difference of Tape Thickness / Formulation
- **High Data Rate**
Large Number of Heads / Channels
- **Read while Write Cross Feed**
Short Distance from Record to Playback Head
- **Head Life**
Running Cost

High Density Recording (for increased capacity)

- **Shortest Recorded Wavelength**

ID-1	➔	DIR- 1G	$\lambda = 0.89 \mu\text{m}$	➔	0.445 μm
DTF-1	➔	DIR-240 (DTF-2)	0.625 μm	➔	0.312 μm

- Decrease spacing loss
- High Performance Tape

- **Thinner Tape**

ID-1	➔	DIR - 1G	Thickness = 16 μm	➔	10.8 μm
DTF-1	➔	DIR-240 (DTF-2)	13 μm	➔	10.8 μm

- Maintaining backward compatibility

- **Narrow Track**

ID-1	➔	DIR- 1G	TP= 45 μm	➔	19 μm
DTF-1	➔	DIR-240 (DTF-2)	39 μm	➔	19.5 μm

- High Performance Tape

Traditional Solution

To get good Head to Tape contact

- **Higher head projection**
- **Smaller head contour**
- **High tape tension**

Drawback

- **Backward compatibility**
 - different Tape thickness
- **Head life**
 - thinner head tip
- **Tape damage**
 - larger contact pressure

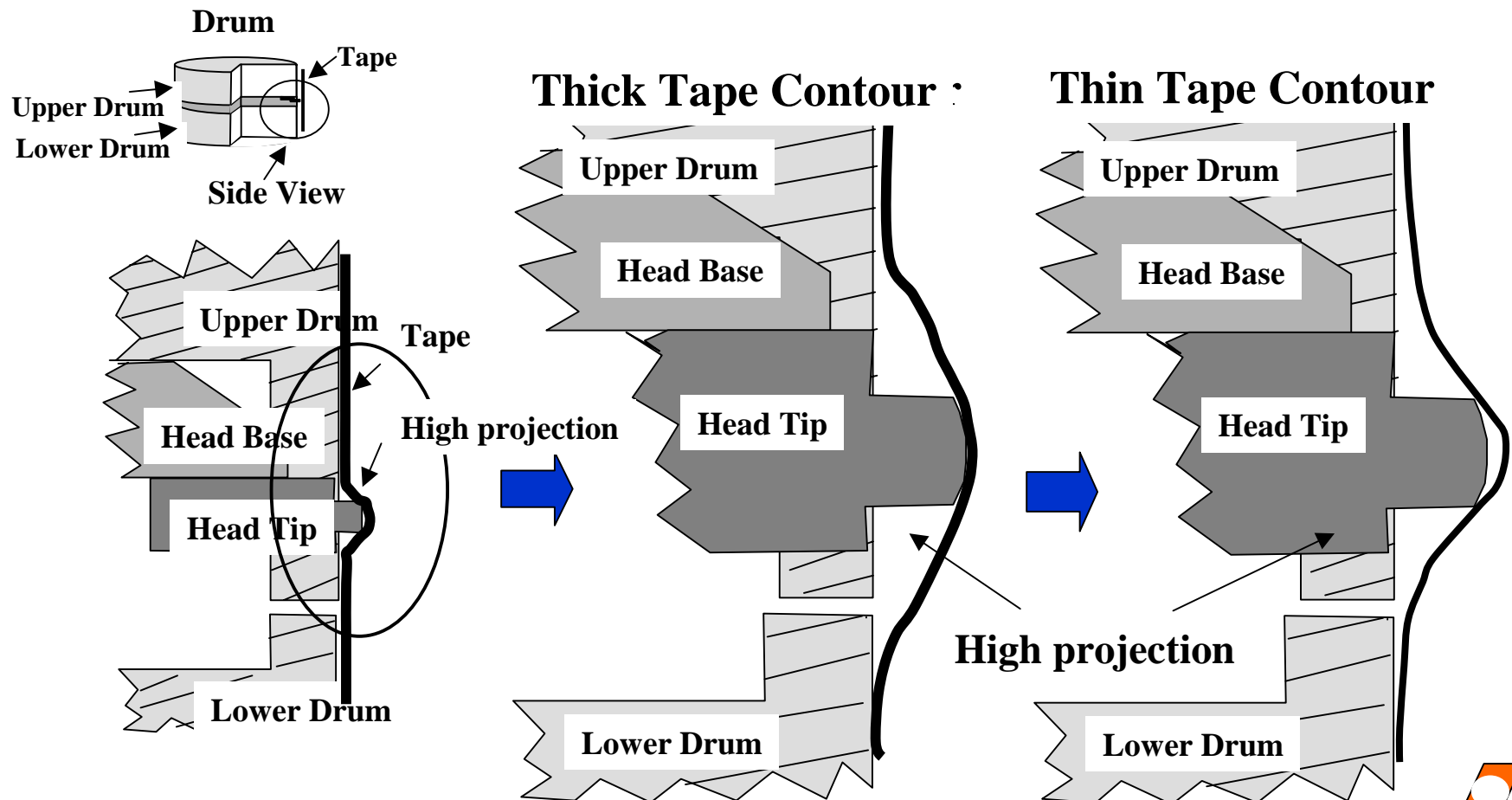
New Solution

To overcome drawback of traditional solution
(by development of new style head)

- **Lower projection**
- **Larger head contour radius**
- **Lower tape tension**
- **Trench Head**

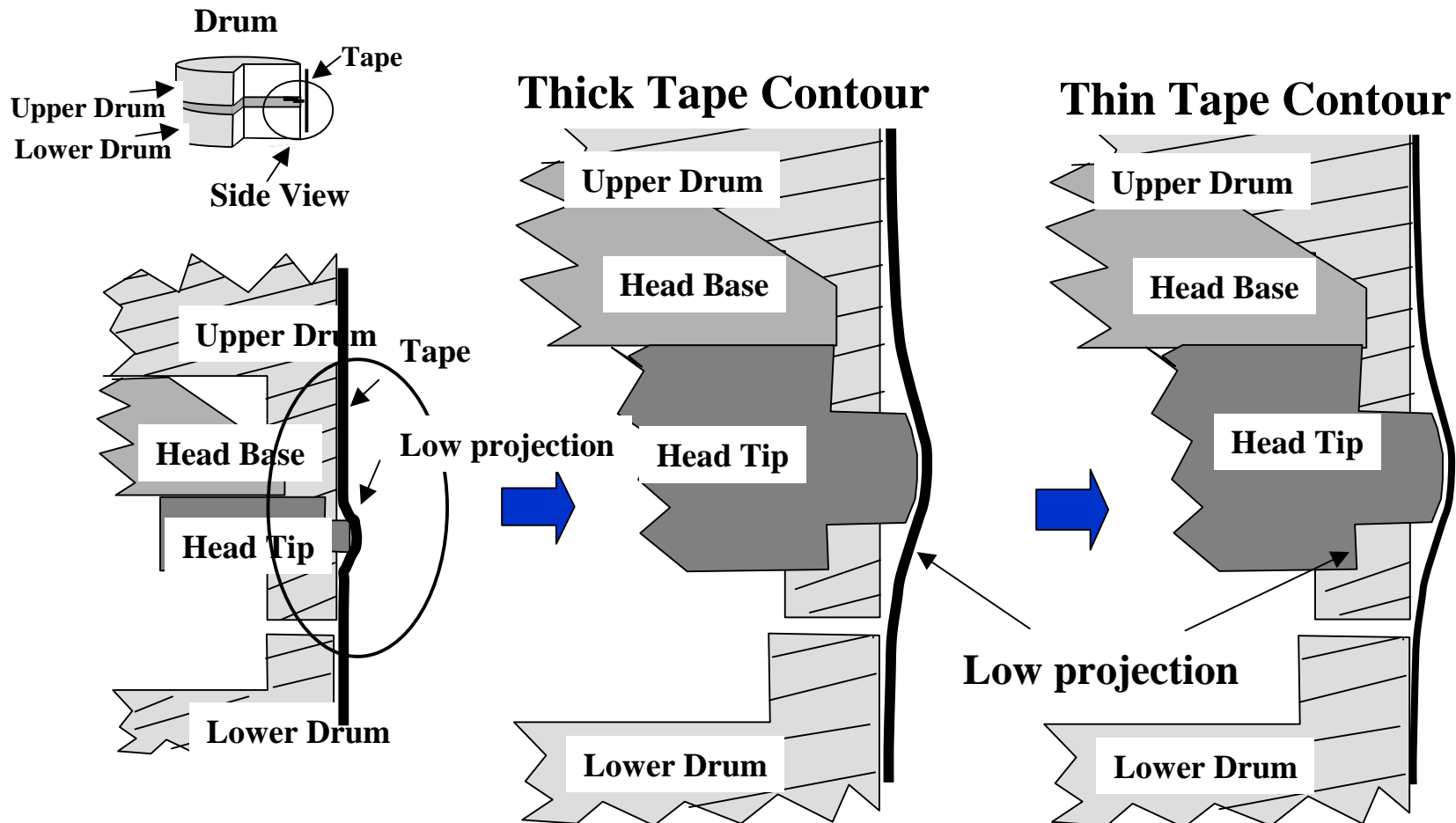
Solution of Higher Head Projection

- Different Contour by Tape Thickness
- Difficult backward compatibility



Solution of Lower Head Projection

- Better Contour by Tape Thickness
- Drawback spacing loss



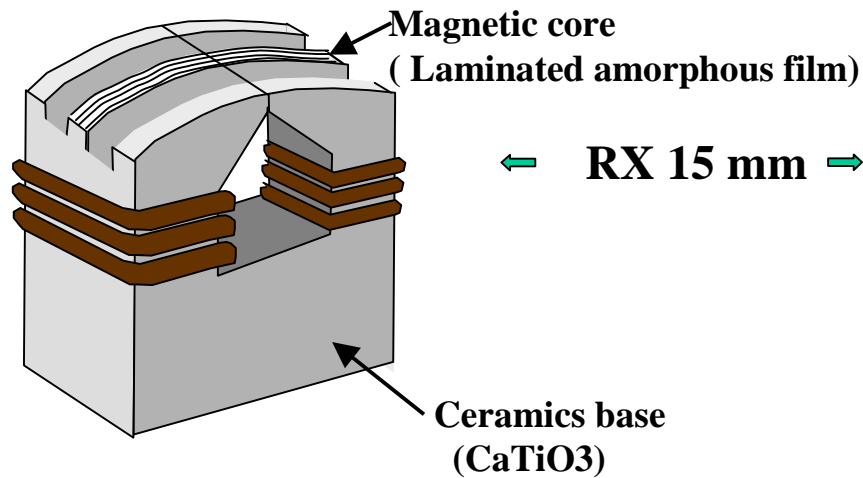
Decrease Spacing Loss

- Development of Trench Head

Playback Head
(Laminated Amorphous)

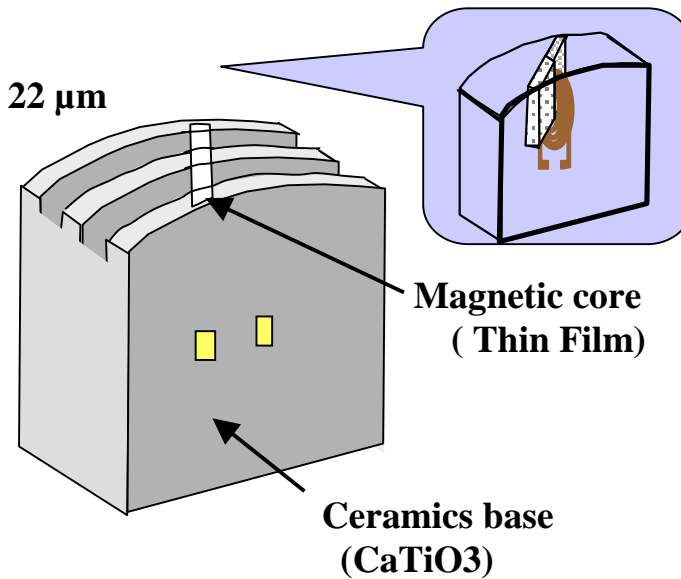
Record Head
(ETF , Embedded Thin Film)

TW 30 μm

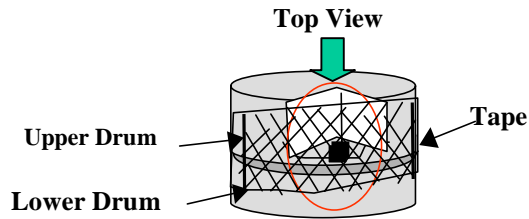


← RX 15 mm →

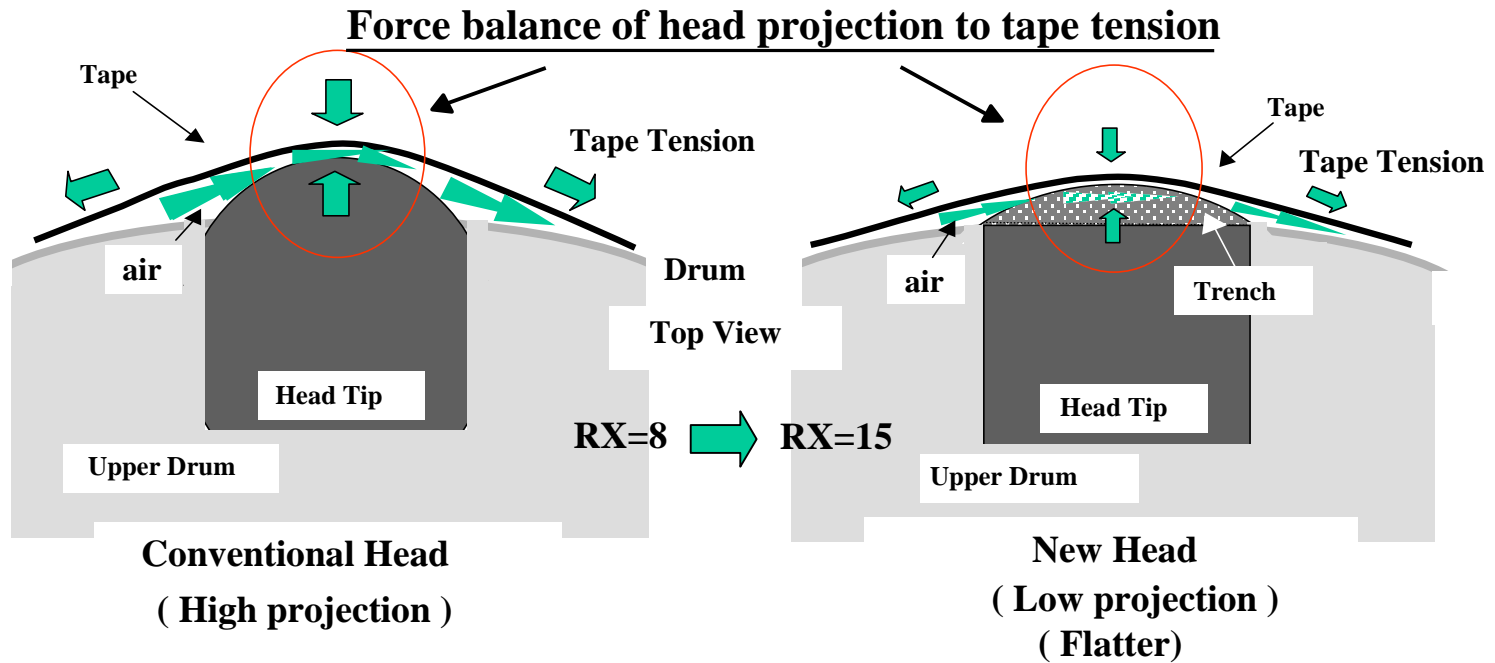
TW 22 μm



Effect of Trench Head (1)

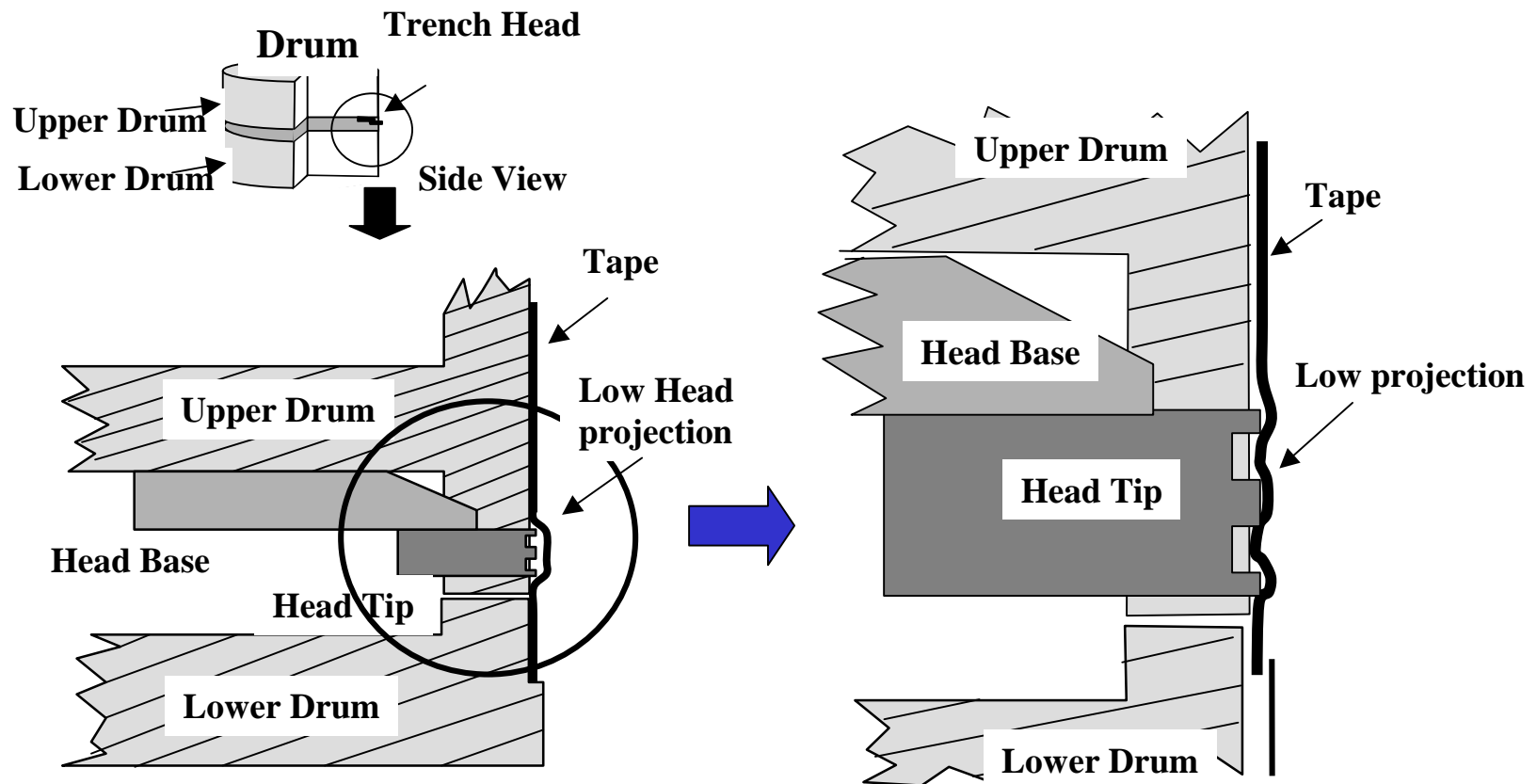


Head to Tape Spacing



Effect of Trench Head (2)

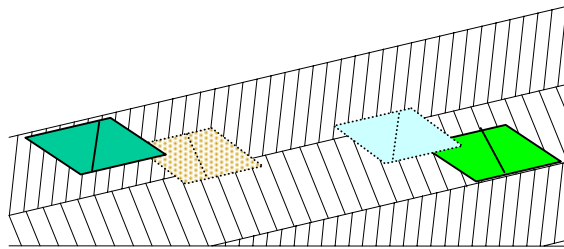
- Head to Tape contact under low projection



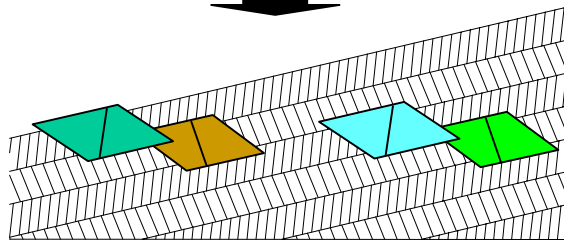


Tracking Backward Compatibility

ID-1 ↔ DIR-1G

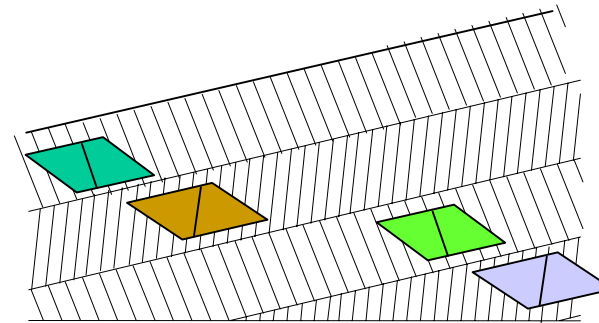


**ID-1 45µm PB Head 30µm
(ID-1 512 M Mode)**

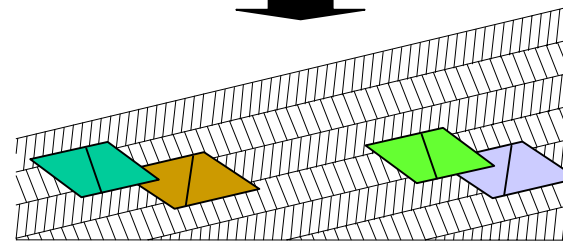


DIR 1G 19µm PB Head 30µm

**DTF-1 ↔ DTF-2
(DIR-240)**



DTF-1 39µm PB Head 30µm



**DTF-2 19.5µm PB Head 30µm
DIR-240**



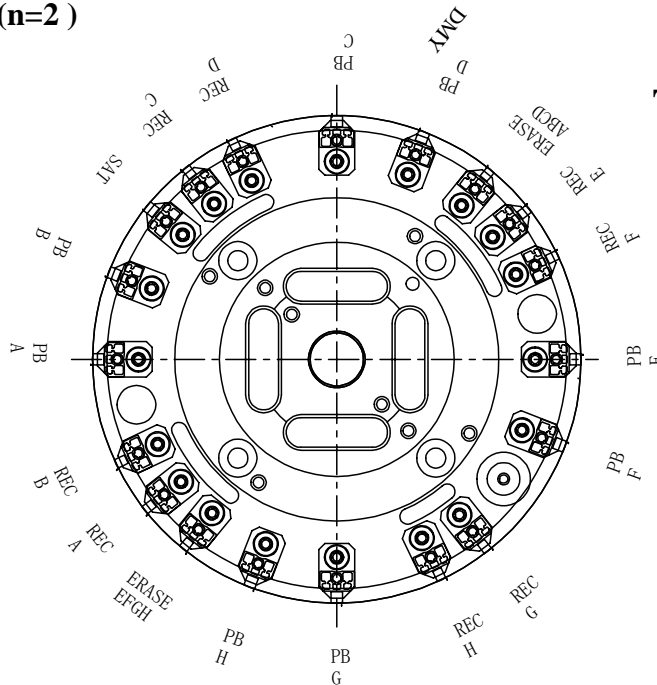
High Data Rate Head Wheel Design

- Large number of heads
- Short distance of record to playback head
- Write to read head Cross Feed when read while write

Head Location

REC (n=8)
PB (n=8)
ERASE (n=2)

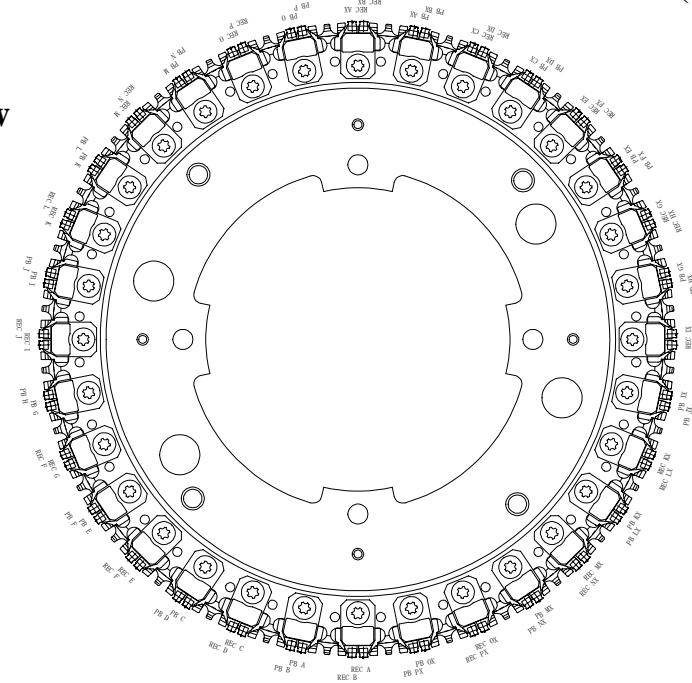
DIR-240



DIR-1G

REC (n=32)
PB (n=32)

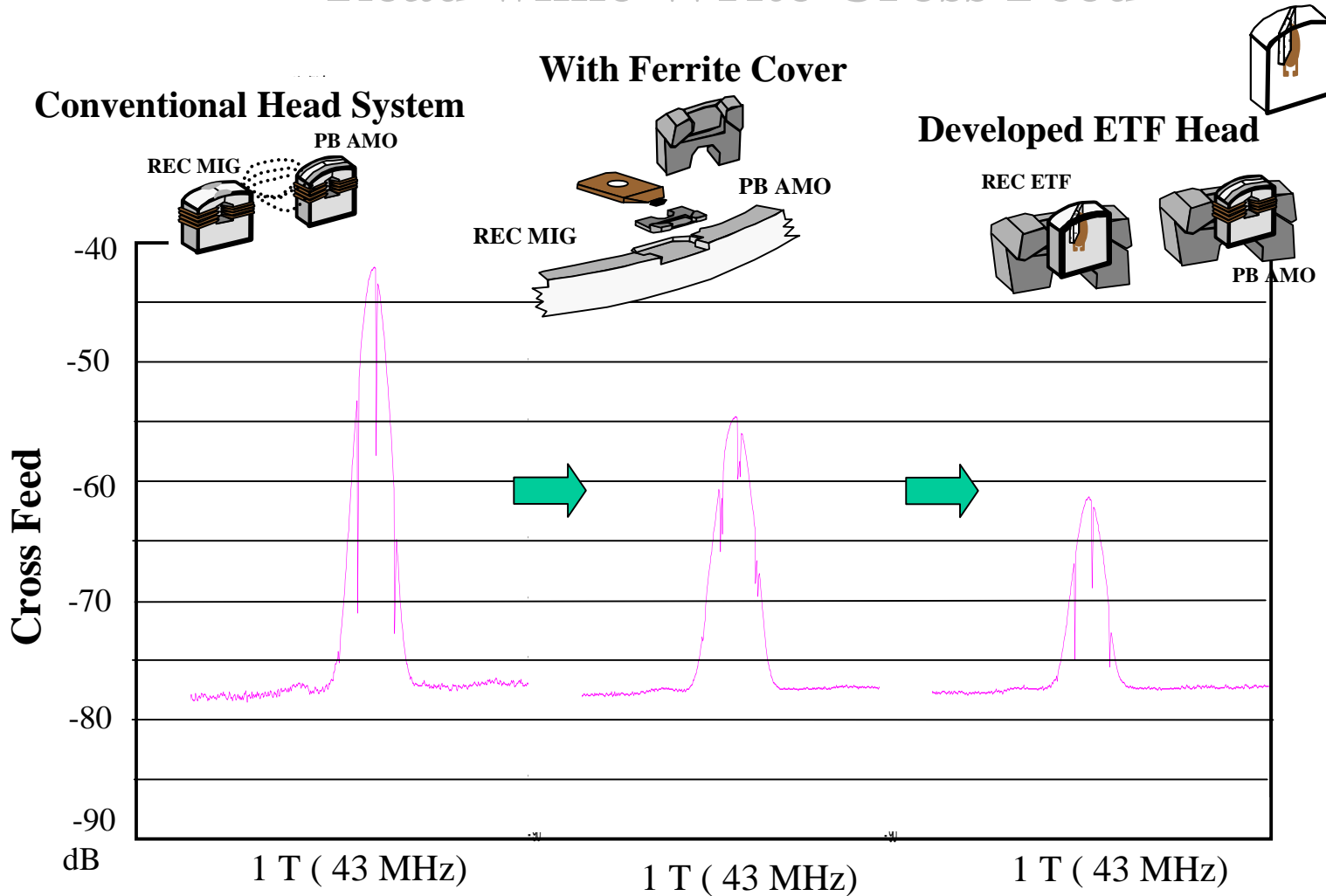
Top View



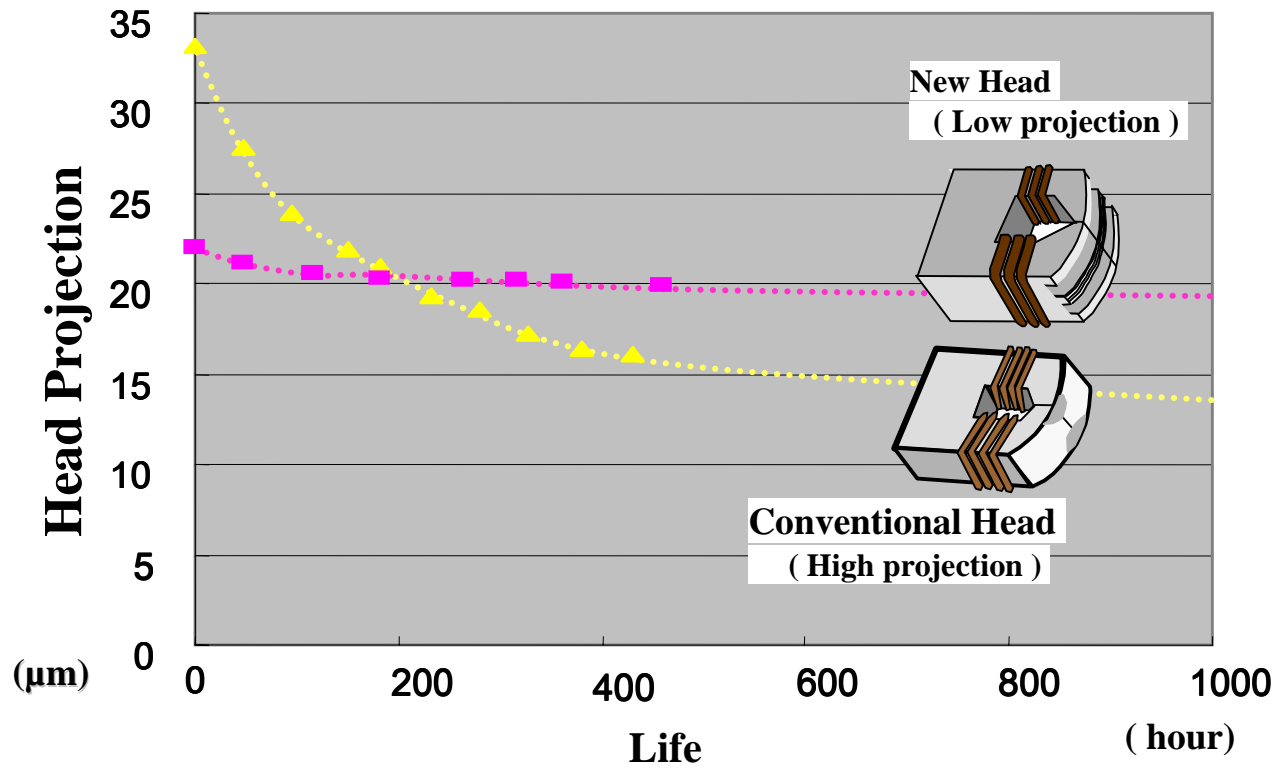
DIR-(1G) Prototype Head Wheel



Read while Write Cross Feed



Head Life



Development of New Metal tape

For High Density Recording

- **Dimensions**

	DIR -1G	DIR-240 (DTF-2)
Width	19.01 mm	12.65 mm
Thickness	10.8 μm	10.8 μm
Length	L= 1800 m	L = 890 m

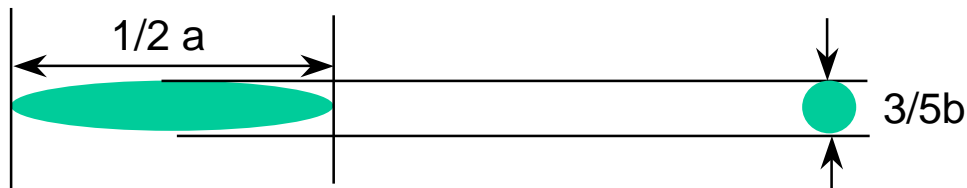
- **Magnetic Characteristics**

Coercive force (HC)	185 KA/ m (2300 Oe)
Squareness ratio	0.8

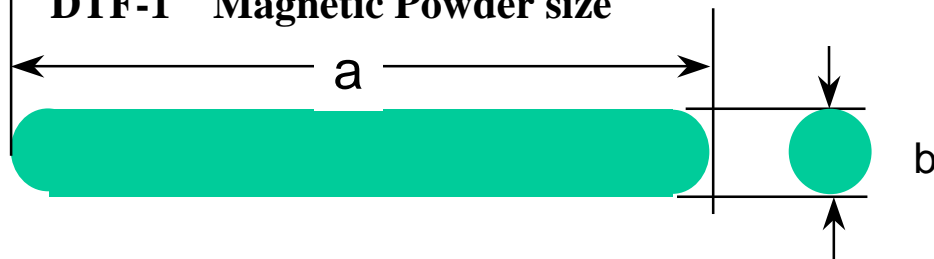
Fine Grain Magnetic Powder

For High Density Recording

DTF-2, DIR-240 Magnetic Powder size



DTF-1 Magnetic Powder size

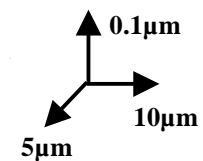
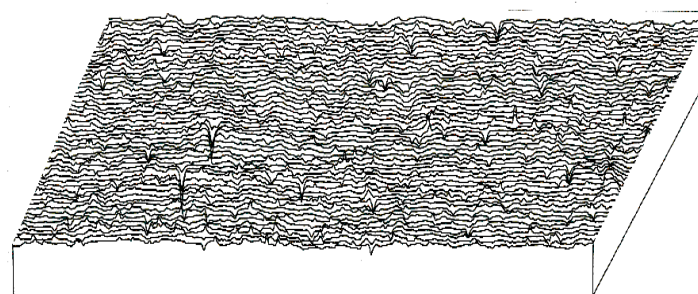
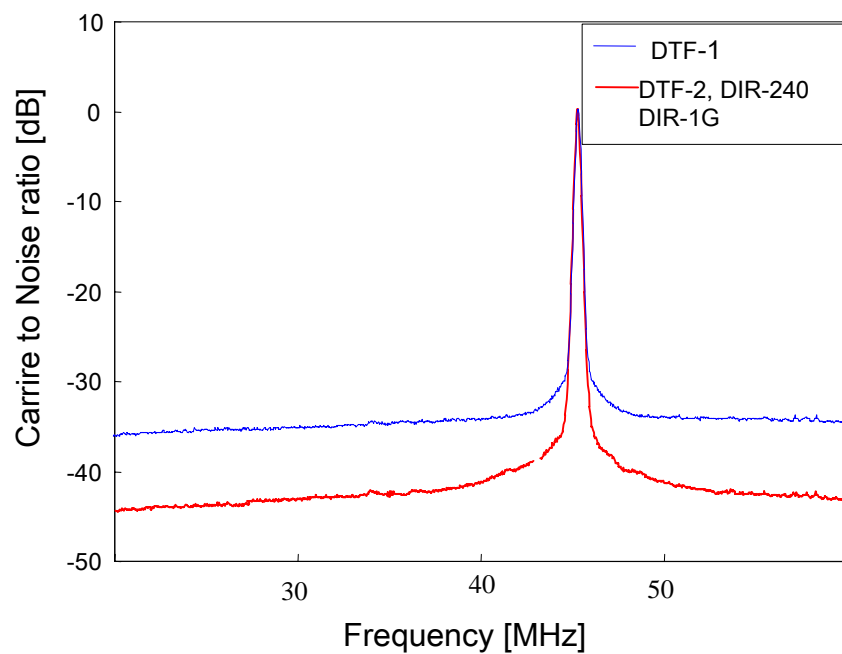


↔ 0.3 μ m



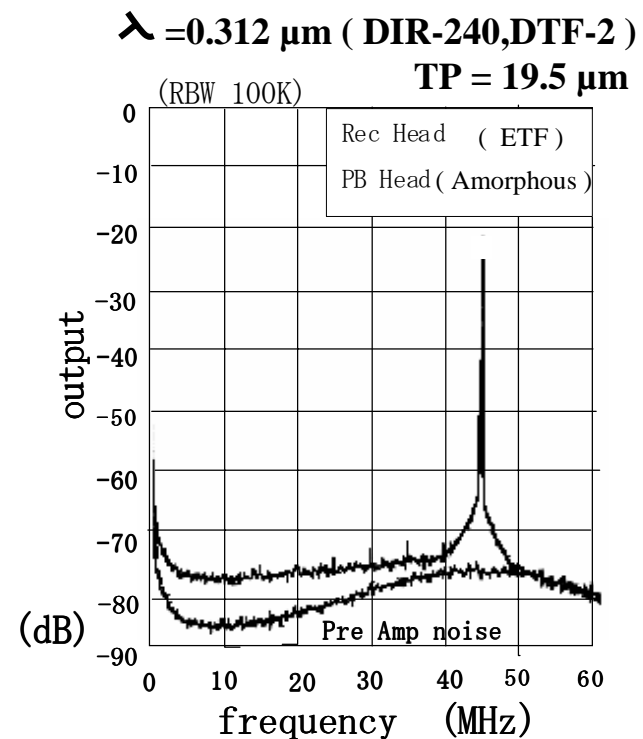
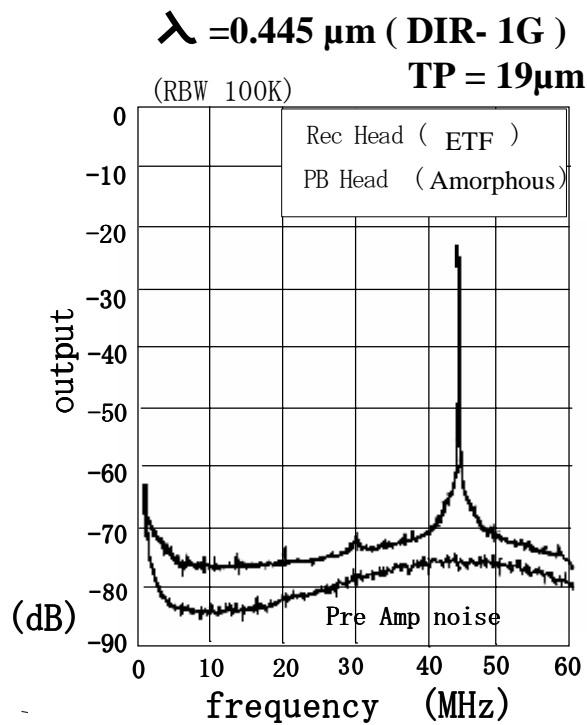
Characteristic of New Tape

Low Noise Characteristic



Noise Performance of New Metal tape

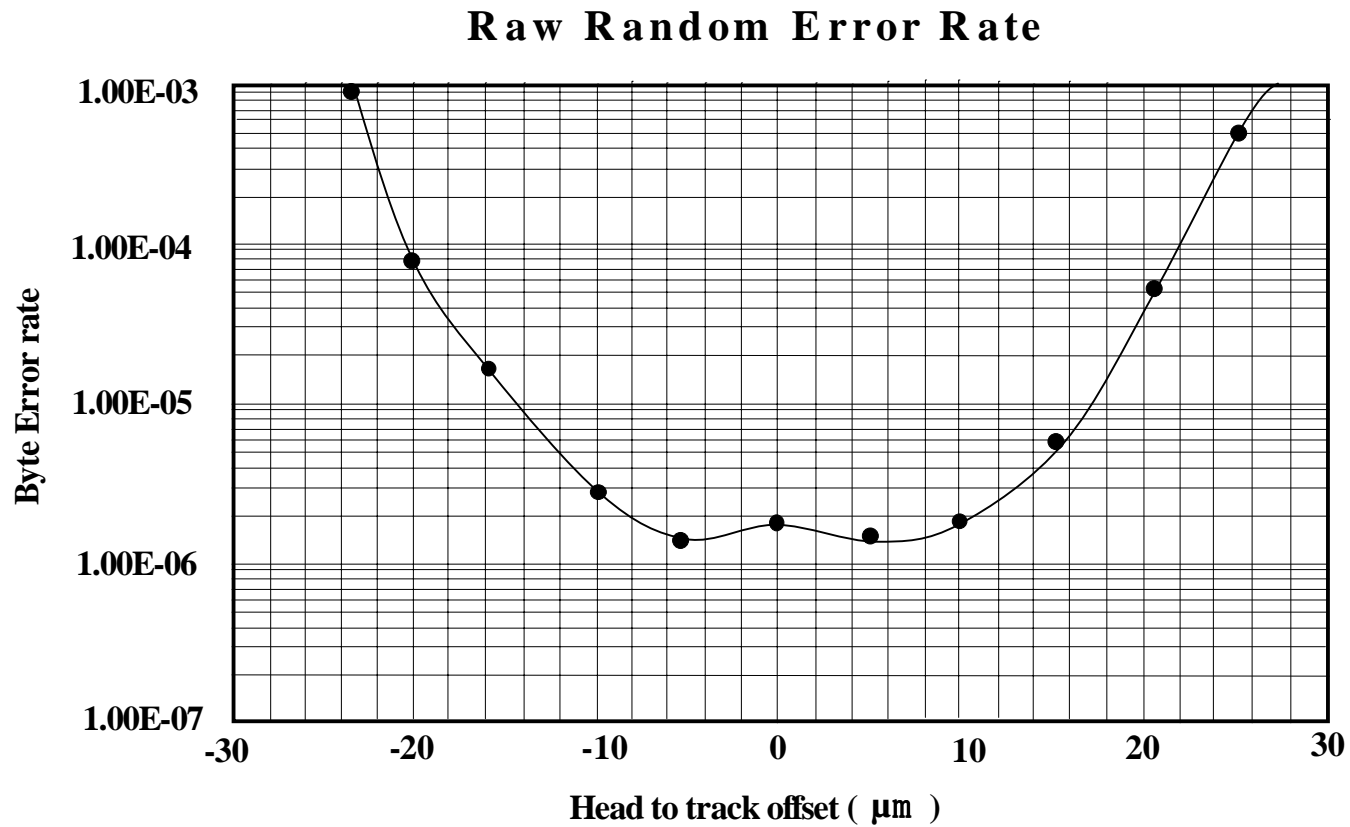
- Recording of shortest wavelength,
- Narrow track pitch





Byte Error Rate / Track Offset

(Measured by DIR-240)



DIR-(1G) Prototype Configuration

(DIR-2000UT) for VERA Project of National Astronomical Observatory, Japan



Both Unit
(Same size as DIR-1000 Series)

Recording 2 Gigabit / sec

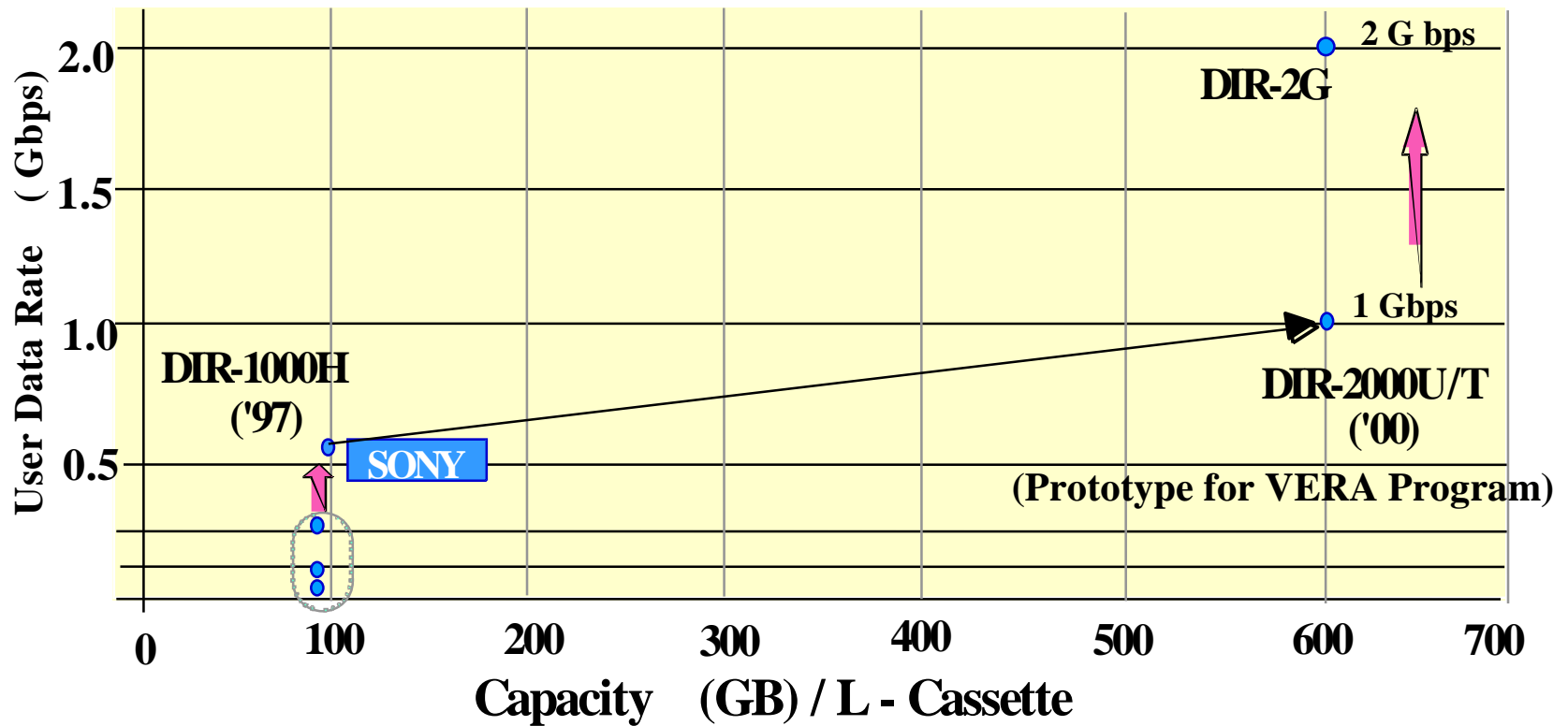
**DIR-(2G) is possible by doubling
the recording frequency :**

- **DIR-(1G) Prototype have already**
 - **doubled the number of channels**
 - **halved shortest wavelength**
 - **reduced the track pitch to 19 μ m**
 - **achieved the compatibility with ID-1 format**

DIR - Series Specification

	19 mm (3/4 inch)			12 mm (1/2 inch)
	DIR-1000H (ID-1)	DIR- X (1 G)	DIR- XX (2 G)	DIR-240 (DTF-2)
User Data Transfer Rate	512 Mbps	1024 Mbps	2048 Mbps	240 Mbps
Storage Capacity (L)	100GByte	600 GByte	600 GByte	250 GByte
Media	16 μ m Co-oxide	10.8 μ m New metal	10.8 μ m New Metal	10.8 μ m New metal
Rec Data Rate / ch	88 Mbps	88 Mbps	176 Mbps	86 Mbps
Rec Heads / Proc ch	16 / 8ch	32 / 16ch	32 / 16ch	8 / 4ch
Shortest wavelength	0.89 μ m	0.445 μ m	0.445 μ m	0.312 μ m
Track Pitch	45 μ m	19 μ m	19 μ m	19.5 μ m
Writing Speed	39.5 m/sec	19.74m/sec	39.5m/sec	13.43m/sec
Tape Speed	847.5mm/sec	356.6 mm/sec	713.2 mm/sec	84.75mm/sec
Scanner Rotation	110 rps	55 rps	110 rps	52.5 rps
Record Time / L-Cassette	26 min	80 min	40 min	138 min

DIR-XXXX Growth Path



DIR-240 Production Model Configuration



DIR-240 (12.65mm DIR)

Feature

- **Large Data Capacity**
 - High density recording format
 - 250 GB (L-Size), 74 GB (S-Size)
- **Long Recording Time**
 - 138 min. (L-Size), 41min. (S-Size) [240Mbps]
- **Variable Data Transfer Rate**
 - 0 to 240 Mbps
- **Compact Size & Light Weight**
 - W x H x D : 315 x 220 x 480 mm , 19 Kg

DIR-240 (12.65mm DIR)

Interface

- **High Speed Variable Rate 8 bits parallel I/O**
 - 0 to 240 Mbits / sec
- **IRIG A or B Time code I / O**
- **Remote control Interface**
 - RS422A or RS232C [remote]
- **Ultra SCSI (SCSI - 3) Interface**
 - 40 MB / sec (burst), 30 MB / sec (sustained)



DIR-240 (12.65mm DIR) Growth Path

