

# MR Head Manufacturing:

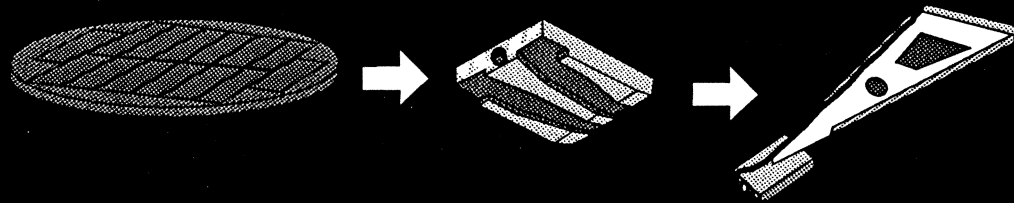
## A High Yield, Reproducible, Low Cost Process

Dr. Robert A. Scranton

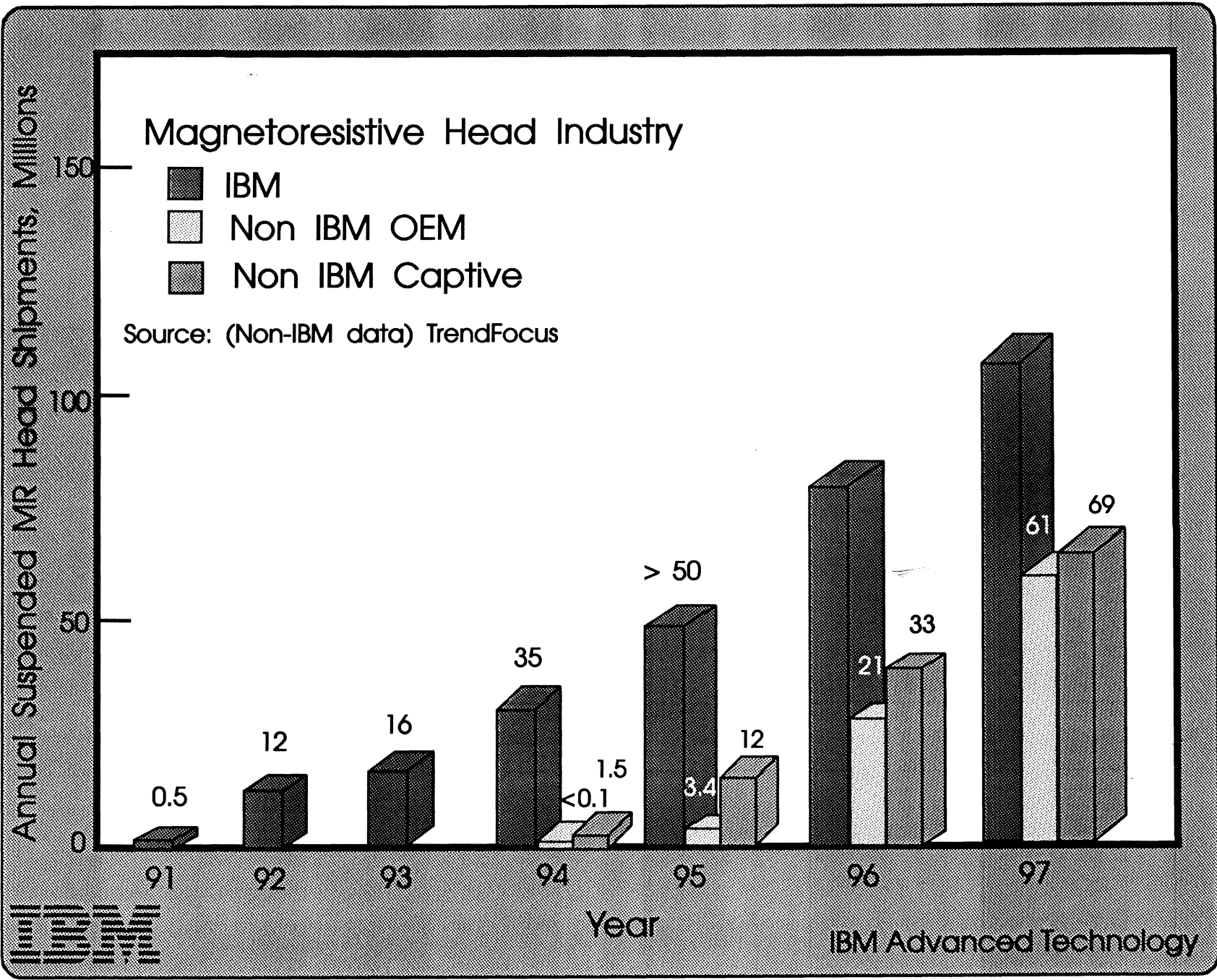
Director of Magnetic Head Development and Manufacturing

IBM Storage Systems Division

5600 Cottle Road, San Jose CA 95193

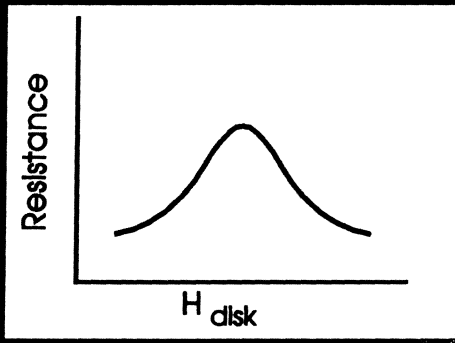
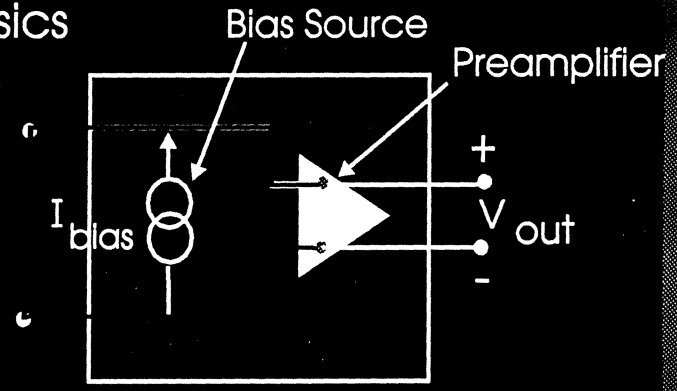
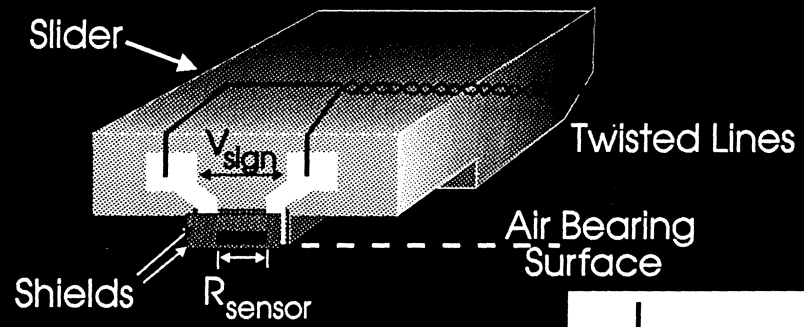


DISKCON'95 USA  
September 6-7, 1995  
San Jose Convention Center  
San Jose, CA

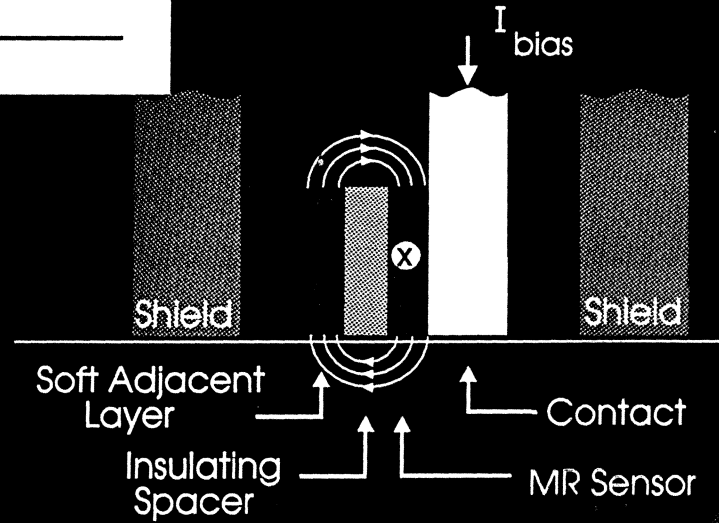
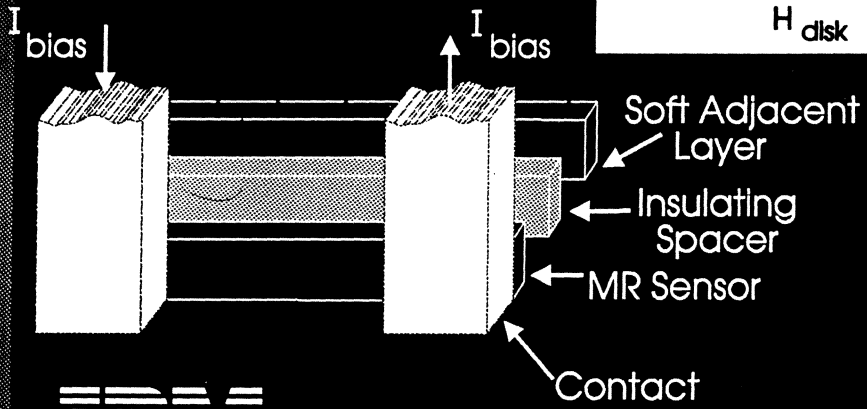


# MR Head Basics

$$V_{\text{sign}} = I_{\text{bias}} \times \Delta R_{\text{sensor}}$$

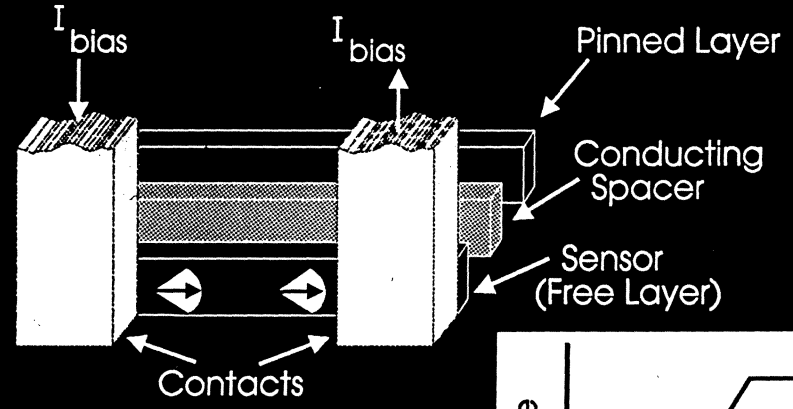


## Arm Electronics Module

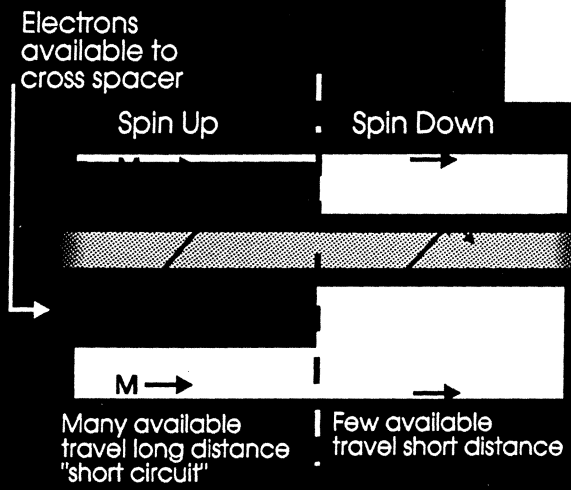
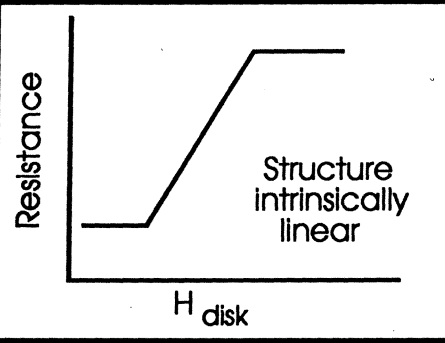


IBM Advanced Technology

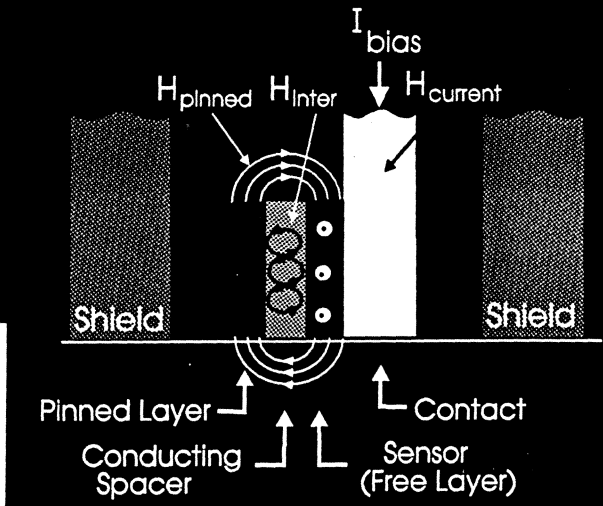
# Spin Valve Head (Giant MR) Basics



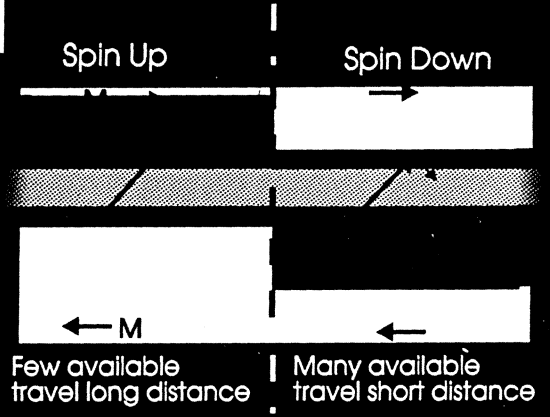
Key: Electrons shared between layers



Low resistance



$$H_{pinned} + H_{inter} + H_{current} = 0$$



High resistance

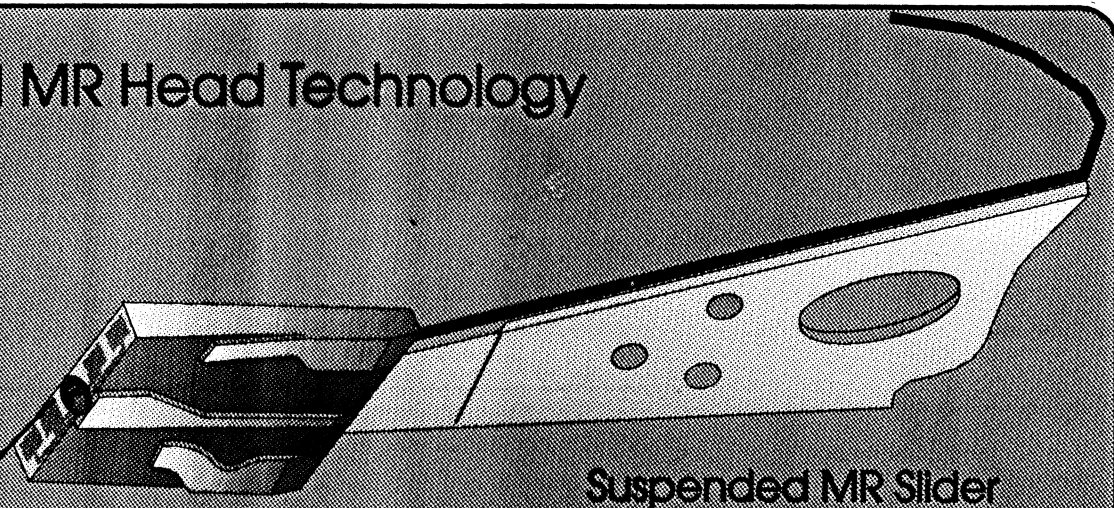
IBM Advanced Technology



Current direction



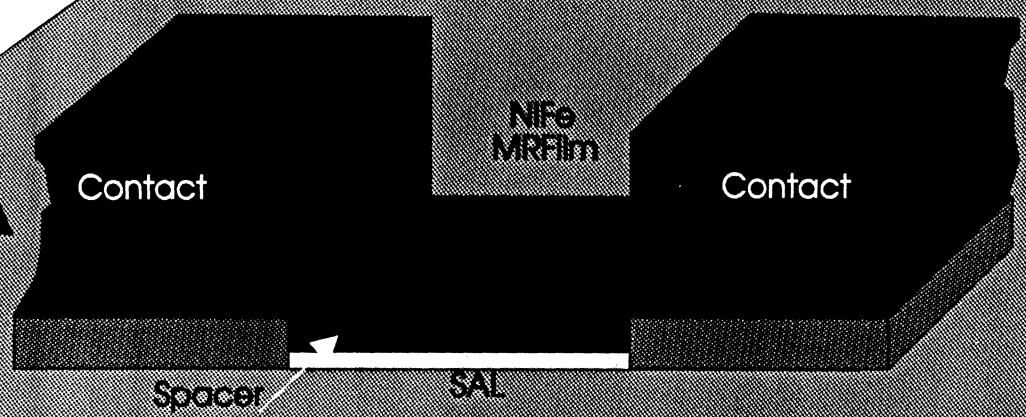
# IBM MR Head Technology



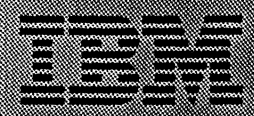
Suspended MR Slider



Merged MR Head



SAL MR Sensor



IBM Advanced Technology

## Inductive/MR Process Complexity

	3 Coil Inductive	SAL MR/Read Inductive/Write
Alumina Recess	$Ph + Pa = 2$	
Bottom Yoke or Shield	$2Ph + PI + 2Dp + 1Pa = 6$	$2Ph + PI + 2Dp + 1Pa = 6$
Yoke shaping layer	$Ph + PI + 2Dp = 4$	
Gap(s)	$Ph + Dp + Pa = 3$	$Ph + 3Dp + Pa = 5$
Top Shield		$2Ph + PI + 2Dp + 1Pa = 6$
SAL/MR Sensor		$2Ph + 5Dp + 2Pa = 9$
Coil(s) + Insulators	$10Ph + 3PI + 6Dp = 19$	$4Ph + PI + 2Dp = 7$
Top Yoke	$2Ph + PI + 2Dp + 1Pa = 6$	$2Ph + PI + 2Dp + 1Pa = 6$
Yoke Shaping Layer	$Ph + PI + 2Dp = 4$	
Contacts, Studs, Pads	$3Ph + 3PI + 6Dp = 12$	$3Ph + 3PI + 6Dp = 12$
Overcoat	$1Dp + Pa = 2$	$1Dp + Pa = 2$
Total Processes	58*	53

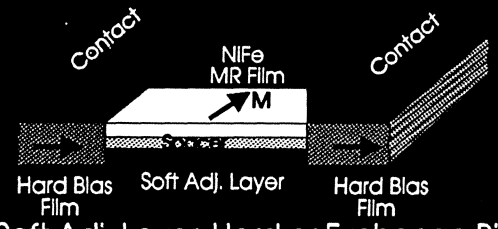
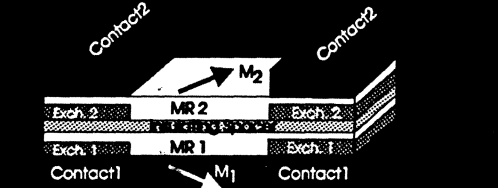
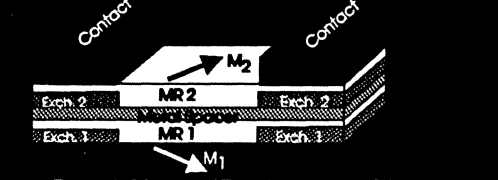

Ph = Photo  
 PI = Plating  
 Dp = Deposition  
 Pa = Patterning

\* 64 for 4 coil structure



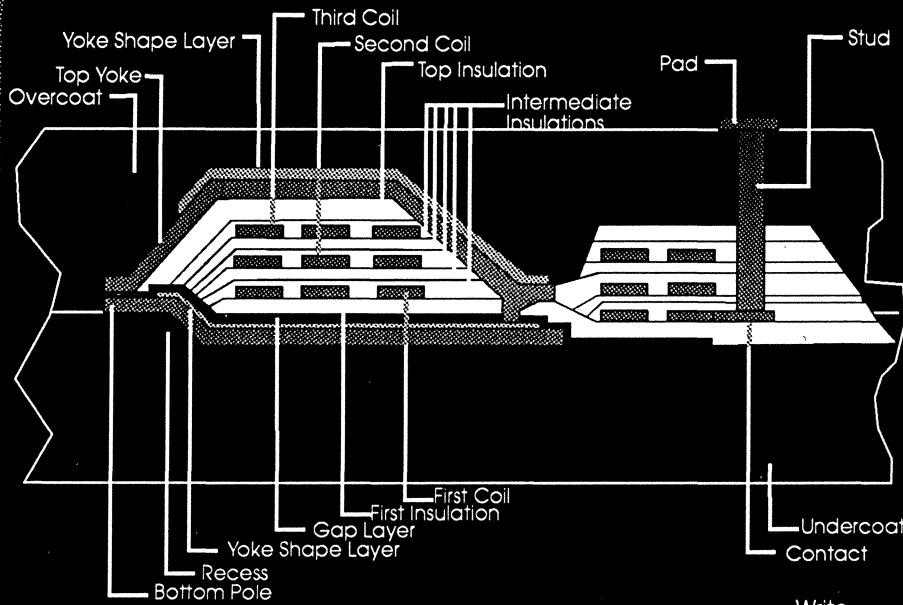
IBM Advanced Technology

## Magnetoresistive Head Biasing Alternatives

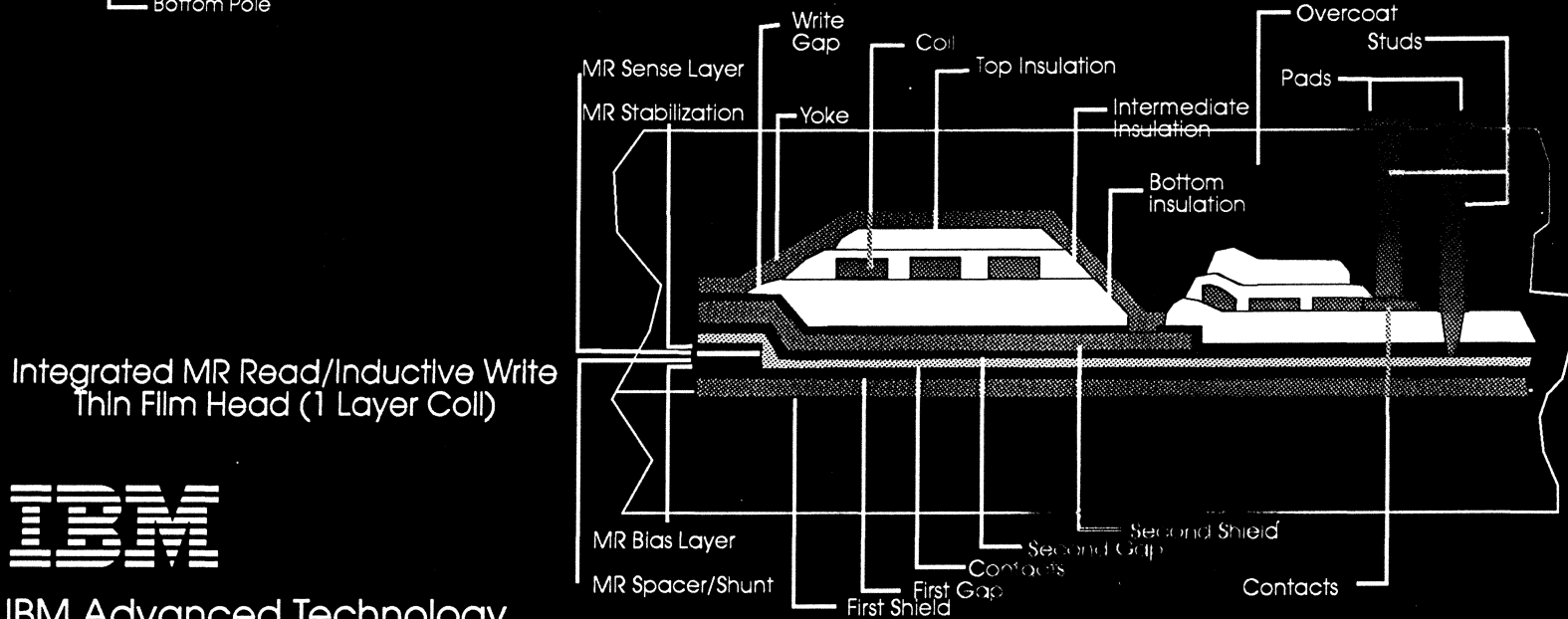
Technology	Advocate	Advantages
 <p>NiFe MR Film M Soft Adj. Layer Hard Bias Film Contact Contact</p> <p>Soft Adj. Layer, Hard or Exchange Bias</p>	<p>IBM Quantum Seagate Hitachi Read Rite Fujitsu TDK AMC</p>	<p>Over 60M heads in operation 3 Gbit/sq.in. demo Simple, high yield process</p>
 <p>Contact2 Contact2 Exch. 2 MR 2 Exch. 2 Exch. 1 MR 1 Exch. 1 Contact1 Contact1 M2 M1</p> <p>Differential-Dual Stripe/Exchange Bias</p>	<p>Headway</p>	<p>Large output Thermal spike protection</p>
 <p>Contact Contact Exch. 2 MR 2 Exch. 2 Exch. 1 MR 1 Exch. 1 Contact1 Contact2 M2 M1</p> <p>Dual Stripe/Exchange Bias</p>	<p>Kodak (Tape Drives)</p>	<p>Unshielded structure Resolution by Spacer</p>
 <p>Contact Contact NiFe MR Film M Barberpole</p> <p>Barberpole</p>	<p>Phillips (Tape Drives)</p>	<p>Simple structure Single level MR film</p>



IBM Advanced Technology



Inductive Thin Film Head (3 Layer Coil)



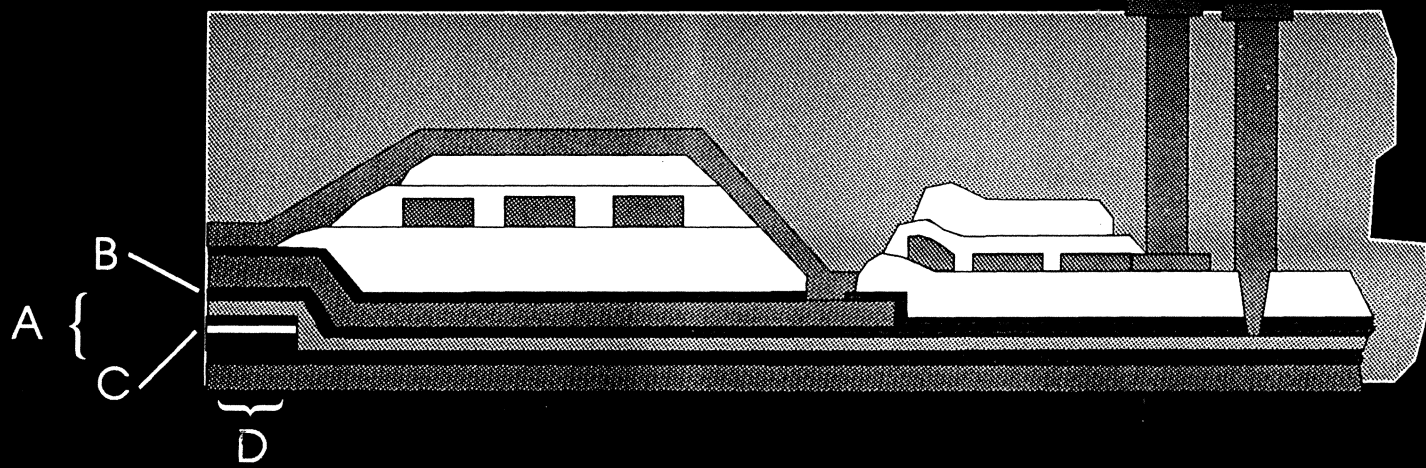
Integrated MR Read/Inductive Write Thin Film Head (1 Layer Coil)



IBM Advanced Technology



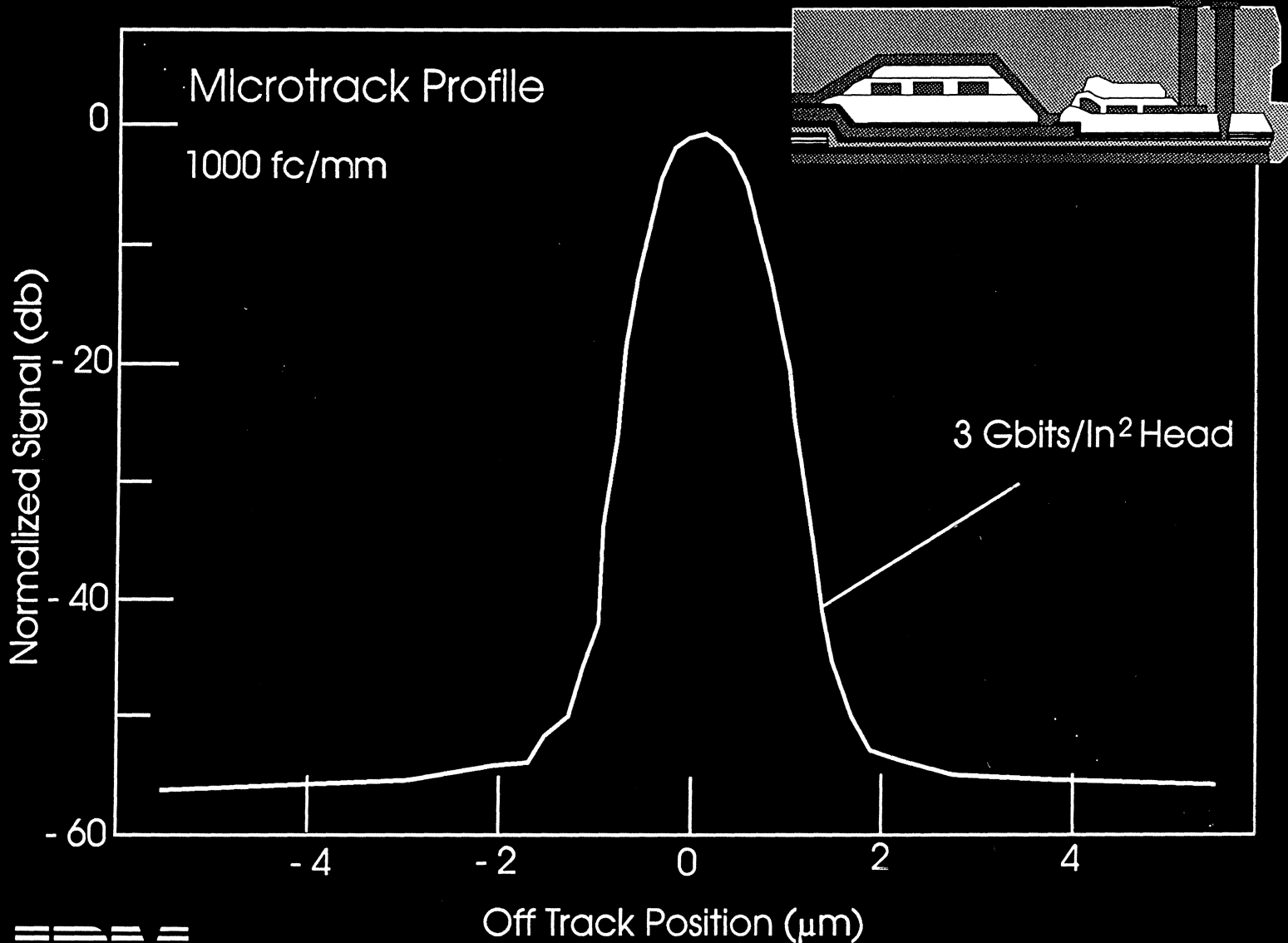
## Advanced MR Head Designs



	1 Gbit/in <sup>2</sup> Head	3 Gbits/in <sup>2</sup> Head	
A	Total Read Gap	0.25 $\mu\text{m}$	0.20 $\mu\text{m}$
B	Sensor/Shield Spacing	< 1200 $\text{\AA}$	< 1000 $\text{\AA}$
	Read Trackwidth	2 $\mu\text{m}$	1.1 $\mu\text{m}$
C	MR Layer	150 $\text{\AA}$	120 $\text{\AA}$
D	Sensor Height	1.0 $\mu\text{m}$	0.5 $\mu\text{m}$
	Flying Height	1.5 $\mu\text{-in}$	1.5 $\mu\text{-in}$



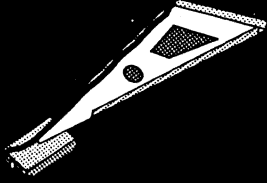
IBM Advanced Technology



IBM Advanced Technology

## MR Head Manufacturing

### Conclusion



- SAL Structure-Industry Accepted
- Process is Stable, High Yield, Low Cost
- Manufacturing Volumes Are Expanding
  
- MR Heads Are Not Components
  - Part of an Integrated System



IBM Advanced Technology