

ABSTRACT

Low voltage vertical recording preamplifier for hard disk drives

(August 2004)

Mellachervu Ramachandra Murthy

Chair of Advisory Committee: Jose Silva-Martinez

Higher data rate hard disk drives (HDD) and improved read channel electronics are demanding preamplifier performance be extended well beyond 1 Gb/s. Historically, preamplifier power requirements were of low priority; however, with increased demand for battery powered devices such as laptops, MP3 players, personal video recorders, and many other wireless hand-held devices, power consumption has become an important design parameter. Furthermore, in order to continue to increase drive capacities, new read-write head technologies (vertical recording and TGMR heads) are demanding innovative preamplifier circuit solutions. Today's production preamplifiers possess a wide band response of 2.5 MHz-600 MHz; however next generation preamplifiers will require response greater than 250 KHz-1 GHz. Low corner frequencies below 250 KHz present read recovery (sleep-to-read, write-to-read, etc.) challenges which can limit drive capacity. This project targets a > 2 Gb/s TGMR (tunneling giant magneto-resistive) read path for vertical recording HDDs. A high performance BiCMOS process (IBM's $0.5\mu\text{m}$ 5HP process) is essential due to the large transconductances, low noise and high speed requirements of the read path's first stage. System frequency limitations at the input are a result of the large TGMR read sensor and preamplifier input capacitance. Due to read head and preamplifier manufacturing variations, resistive feedback around the first stage is used to set a controlled input impedance targeted to match the interconnect transmission line. Head resistance variations lead to gain variations; however, the TGMR element becomes more sensitive with larger resistance. This, to a first order approximation, acts like an automatic gain control and reduces variations in gain due to the head.