ABSTRACT

Low voltage vertical recording preamplifier for hard disk drives

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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 0.5µm 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.