# A FOUR-TRANSISTOR PEAK DETECTOR READ-OUT SYSTEM FOR DIGITAL MAGNETIC SURFACE RECORDING SYSTEMS

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Received January 20, 1965

(Communicated by Dr. B. V. Thosar, F.A.SC.)

## ABSTRACT

Straightforward amplitude threshold read-out systems fail at low packing densities in non-return-to-zero recording systems. Several elaborate systems have been designed as a remedy. The present circuit is a very much simplified version which operates satisfactorily, using the regenerative action within a flip-flop to detect the change in current polarity occurring at the peak in a voltage differentiator.

## INTRODUCTION

THE finite resolution attainable with magnetic surface recording[1] techniques imposes an upper limit on bit packing density. In other words, a step function change in the input current waveform, applied to the magnetic recording head, results in a corresponding flux pattern which is less than perfect. The read waveform obtained in playback again, is not an ideal derivative of this waveform, due to limitations of the frequency response of the playback head system. Ideally, an upper limit to the packing density should be so chosen that the distance between two consecutive flux changes is at least equal to the base width of the output spike for a single flux change. There is, then, no cancellation due to overlapping of adjacent output spikes of opposite polarity. Actually, however, the packing densities chosen are such that there is partial overlapping and cancellation with the result that:

(*a*) The output amplitude decreases with increasing packing density, and

(*b*) an isolated flux change (as in NRZ recording) causes an output which is much broader and bigger than otherwise.

The remedy in the first case involves choosing an amplitude threshold small enough to recognise a flux change at the maximum packing density.

Such a level, however, might be impossible to find, for a worst case analysis of minimum signal to noise ratio, cross-talk and amplitude modulation in the output. Moreover, such a method could result in an indication of an isolated flux change much earlier than actually, due to this broadening. If this time error is greater than one bit period, a read-out error results.

Several methods[2, 3] have been proposed to remedy this, but the most reliable is to use a peak detector[4, 5] (Fig. 1) which indicates flux change at the peak of the output waveform, irrespective of output amplitude fluctuations. These employ between 20 and 30 transistors each.

A new four-transistor peak detector (Fig. 2) has been designed, which incorporates the above features and is appreciably simpler. It requires push-pull inputs and uses the principle of detecting the change of current polarity in a CR differentiator at the peak of an applied waveform.

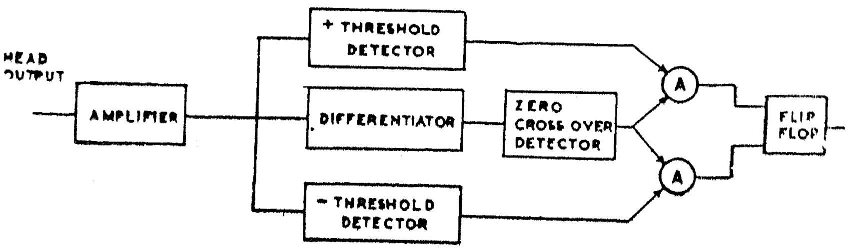


FIG. 1

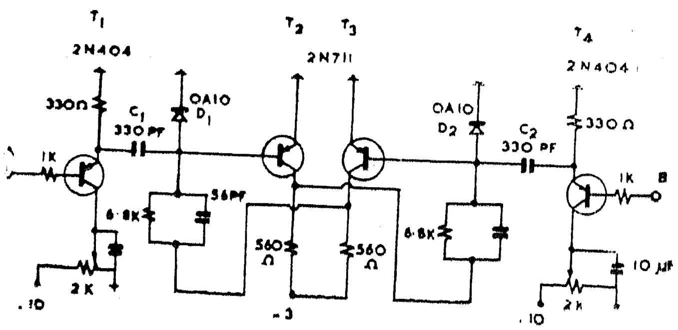


FIG. 2. Peak detector.

Amplitude discrimination is effected by saturable emitter followers ($T_1$ and $T_4$). Positive peaks beyond the threshold imposed by the collector, are faithfully reproduced in the output, but all negative parts are clipped off due to saturation.

During the positive part in the waveform at $T_1$, the capacitor $C_1$ charges to the peak value through the very small forward resistance $R_f$ of the diode $D_1$. At the peak of the input waveform, the emitter-base diode of the transistor $T_1$ becomes forward biased, as $C_1$ discharges drawing base current.

Because of the regenerative action in $T_2$ and $T_3$, $T_2$ if originally cut-off goes into saturation, changing the state of the flip-flop constituted by $T_2$ and $T_3$. A similar action takes place in transistor $T_3$ during the negative peak of the original input waveform. The low impedance output obtained from the collectors of $T_3$ and $T_4$, is a faithful reproduction of the recorded waveform.

The circuit was tested from about 50–250 Kc./s. and was found to operate satisfactorily for minimum input voltage of about 1·5 volts. A slight lag is observed between the change over and the peak of the input waveform, due to the switching delay in the saturated transistor.

## Acknowledgements

Thanks are due to several colleagues in the Computer Group, especially Mr. S. Ramani, for useful discussions.

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