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A FAST AND LOW-COST DISCRIMINATOR AND SHAPER

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A simple and low-cost discriminator has been realized with Emitter-Coupled Logic I. C. ; input threshold and output width can be varied continously; the maximum repetition rate is 55 MHz and the typical double pulse resolution is 18 nsec.

In modern high energy physics experiments very sophisticated and fast system of events selection, processing a very high number of informations, are used. It is therefore convenient to use low-cost, high density electronics with fast switching and very short propagation times.

In this paper we report a simple, low-cost, fast discriminator and shaper which has been studied and realized for an ISR experiment with ECL integrated comparator and monostable.

The characteristic features of the discriminator are:

1) high repetition rate;
2) short delay and transition times;
3) input threshold and output width continously variable in a wide range;
4) very small recovery time, independent from output width.

We have easily fitted four identical discriminator channels into a standard NIM module; but if ECL output levels are needed instead of NIM ones or if a number of

outputs for each channel less than six is needed, eight discriminator channels can be fitted into a single NIM module.

The complete circuit diagram of a single discriminator channel is shown in Fig. 1. It can be subdivided in three stages : the input and discrimination stage, the pulse shaping stage and the output one.

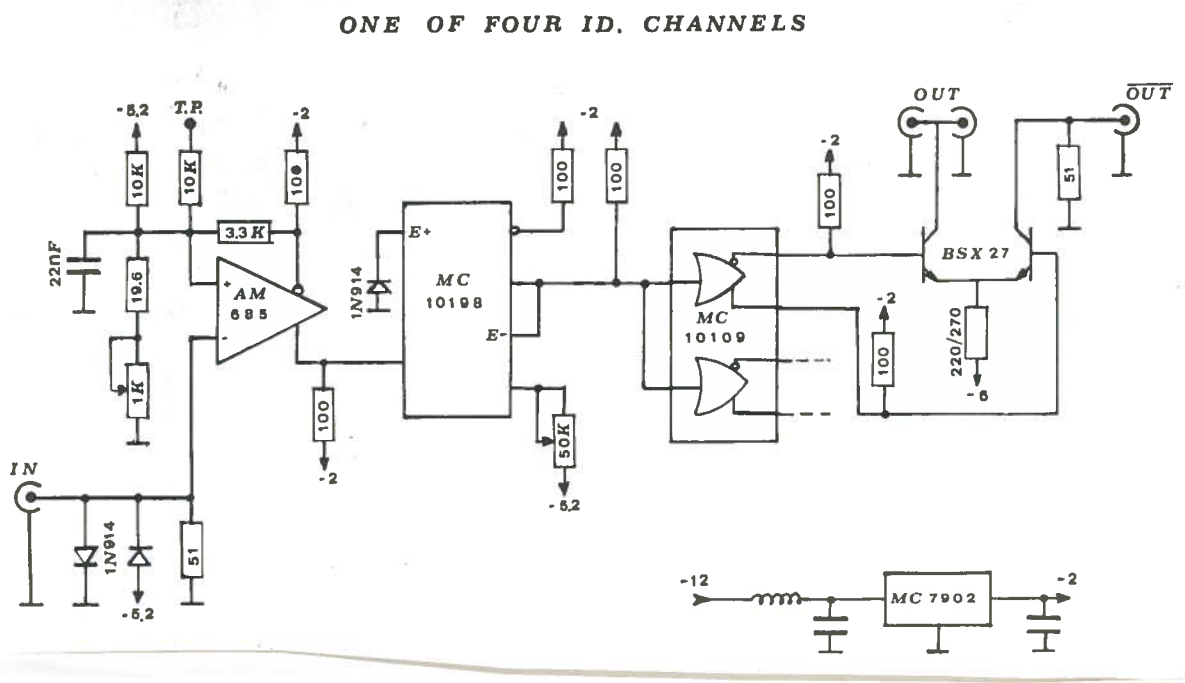

FIG. 1 - Complete circuit diagram.

In the first stage the input is protected for over-voltage and 50 Ω adapted with low reflections (< 3 %). The discrimination function is obtained by the use of the fast voltage comparator AM 685[1]. The input threshold can be continuously varied between - 20 mV and - 900 mV by changing the voltage bias at the comparator reference input, through a resistive partition.

Low input reflections and a 20 % of threshold level hysteresis, allow to work with very low threshold values without multiple pulsing. The threshold stability depends on DC power supply performances.

A MC 10198[2] Motorola ECL monostable performs the pulse shaping function. This I. C. has very interesting features. It is triggered by very short pulses (> 2 nsec); its output pulse width is practically independent from temperature and input pulse characteristics, and the recovery time is constant with respect to temperature and independent from the output pulse width.

Without any external capacitor, we have obtained a pulse width variable between 10 and 250 nsec and a recovery time of 8 nsec. The double pulse resolution is 18 nsec and the maximum repetition rate is above 55 MHz (Fig. 2).

The current at the 2+2 NIM standard and 1+1 complementary outputs is supplied by two BSX 27 emitter-coupled transistor pairs.

The final stage is driven in differential mode by two OR/NOR ECL gates which perform the fan-out function of the shaping stage. The rise and fall times are less than 2 nsec from 10% to 90% of the total pulse height when all outputs are correctely terminated (Fig. 3).

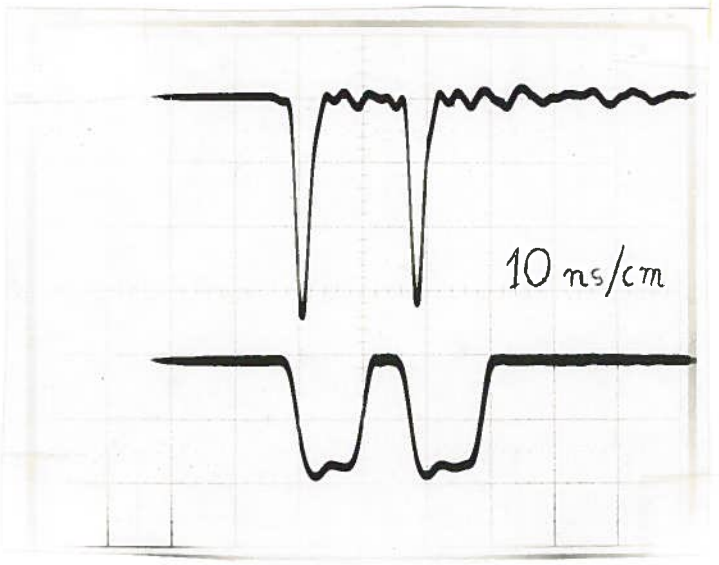

FIG. 2 - Double pulse resolution; input and output pulses.

The output pulse width variation with respect to the amplitude of the input signals is < 1% and the time walk of the output pulse amplitude variable from 100% of threshold level and above.

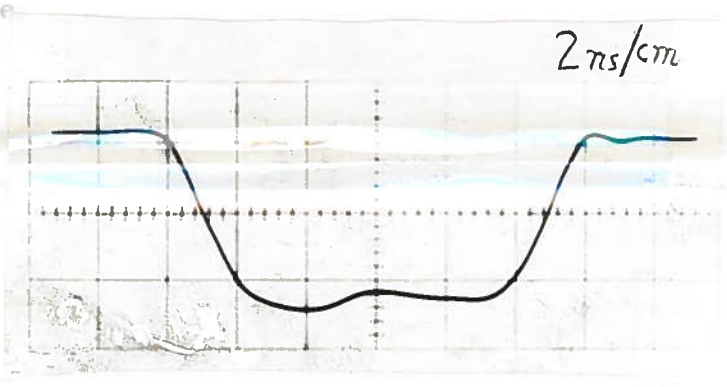

FIG. 3 - Rise and fall time of the output pulses.

The total delay time is 12 nsec from 50% of an input pulse of amplitude 100% greater than the threshold level to 50% of the output pulse.

In conclusion, a fast and compact discriminator has been built with standard NIM outputs, using three integrated circuits and few other low cost discrete components. With a very simple design, good performances and high reliability has been obtained. Some hundreds channels have been running for many months on the APPIA experimental apparatus at the ISR of CERN, having shown no failures.

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REFERENCES

(1) - Advanced Micro Devices Linear Data Book (A. M. D. Inc., 1974).

(2) - MECL High-Speed Integrated Circuits Data Book (Motorola Inc., 1978).