

TWO CHANNEL AMPLITUDE ANALYSER FOR MULTI-UNIT DISCHARGES ANALYSIS

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In neurophysiological experiments, neuronal discharges are often recorded from several units simultaneously with the use of a single micro-electrode. Since it is sometimes desirable to separate the recorded spike potentials with regard to their sources, a number of different types of devices has been designed for that purpose.

The apparatus described by Bradley et al. (1) was provided for selection of units of specific amplitudes from a background of units of various amplitudes and from the noise level. However, Schmitt triggers are the input circuits of the device and this appeared to be a disadvantage of this apparatus. Because of the hysteresis effect in Schmitt triggers, some limitations were imposed on the minimum separation distance.

The input discriminator (differential amplifier) in Landot's instrument (3) has no hysteresis; by means of this device, however, only the spikes of the highest amplitude could be analysed.

It is, of course, also possible to carry out the spike trains selection with the aid of a computer. Dill, Lockemann and Naka (2) have reported about such a possibility, but their method turned out to be expensive.

The device described in this paper separates two spike trains recorded simultaneously. One of them may be analysed on line, the second may be stored on a magnetic tape for the future use. Block diagram of the device is shown in Fig. 1, and the complete circuit diagram in Fig. 2. The description of circuit operation follows.

The input gate (Q_3) leads to two amplitude discriminators. The gate is controlled by the Gate Control Unit 1 (transistors Q_1 and Q_2 and their

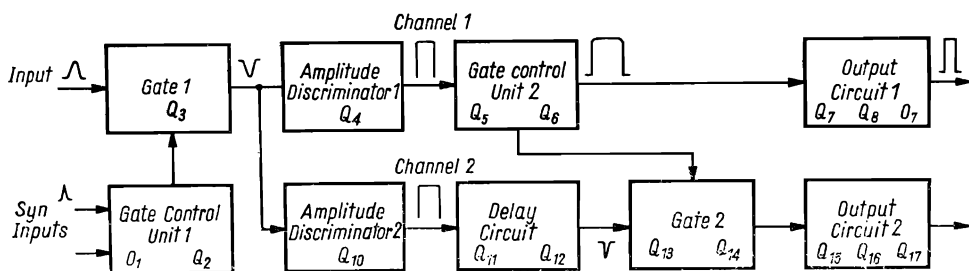


Fig. 1. Block diagram of the device.

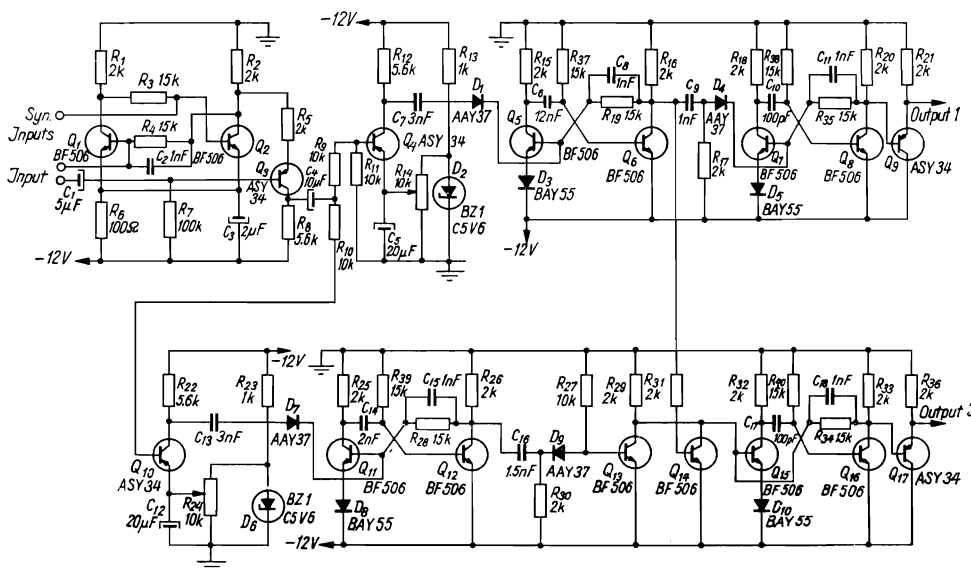


Fig. 2. Circuit diagram of the device.

associated circuitry), which is triggered by synchronizing pulses of either a stimulator or computer. Both discriminators enable the experimenter to make adjustments of discrimination levels from 0.5 to 5 v. Each of them may be monitored by comparing the input and output signals on the dual-beam oscilloscope display. The discriminator is a common emitter amplifier with adjustable threshold and high voltage gain. It has no hysteresis characteristic for Schmitt triggers.

Let us assume, that input spike amplitude exceeds discrimination level of the discriminator in Channel 1. It is evident that the discriminator in Channel 2 will also be excited, because its threshold should always be lower. One shot (Q_5, Q_6), triggered by amplitude discriminator, forms 1 msec pulse. Output of this circuit is fed to the Gate 2 (Q_{13}, Q_{14}) in Chan-

nel 2 and to the monostable multivibrator (Q_7 , Q_8) providing output standard pulses. Emitter follower Q_9 reduces output resistance of the device. Pulse of 0.6 msec duration generated by monostable multivibrator made up of Q_{11} and Q_{12} is differentiated, so that its negative part is always placed in time before the end of a pulse from Q_8 collector, independently of discrimination level adjustments and input spike parameters. Should the Gate 2 not be opened, no signal would pass to the output circuits of the Channel 2 and no signal would appear on the Output 2. Output standard pulses are provided by monostable multivibrator (Q_{15} , Q_{16}) and emitter follower Q_{17} for every spike which falls between the two levels. Pulses on the Output 2 correspond to low amplitude spikes, and pulses on the Output 1 to high amplitude spikes. Parameters of output circuits vary in accordance with the cooperating devices, in this case they are adapted to the special purpose computer ANOPS 2.

The most important technical data of the device are:

supply voltage, 12 v;

input spike amplitude, 0–5 v;

input spike frequency 20–1000 cycles/sec;

output pulses amplitude, 12 v.

The two channel amplitude analyser may be used in all cases, where separation of two spike series occurring simultaneously is desired. The separation is provided corresponding to the amplitude of spikes. The output pulse shape is constant, and independent of the shape of the input spike. It is obviously possible to use the analyser for separating single spike series from noises or background.

Low cost, single power supply and independence of the discrimination levels of battery voltage are the advantages of the device.

Summary. Simple two channel amplitude analyser is described and its circuit diagram is presented. The device is designed for selecting two simultaneous spike trains.

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