

A SIMPLE DEVICE FOR RECORDING SEVERAL CHANNELS OF BINARY DATA ON PAPER TAPE

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Recently we have had occasion to record several channels of binary data over the course of experiments lasting for substantial periods of time. One class of experiment involved testing four people simultaneously on a four category ratings task of signal detection, and the second class of experiment involved monitoring several indices of coding activity, such as the occurrence of fidgeting, blinking, staring, etc., simultaneously. In both classes of experiment, the binary data are produced at a substantial rate and for quite a long period of time. Lacking an on-line computer terminal of any sort we cast around for a cheap and efficient way of coding the data in a way amenable to later off-line computer analysis. Clearly, a criterion would be an output on paper tape, preferably 8 hole tape.

At this time, we were fortunate enough to find that Burroughs Ltd. were disposing of some usable but out of date 8 hole tape punching machines. This discovery effectively excluded other solutions.

The general approach to building the device was to use each punch driver independently to record the presence of one in-punch state or the other, on each of the 8 possible in-punch channels, at a predetermined rate.

The first stage of the circuitry, therefore, was eight buffered input stages each signalling whether the input was present or not on that channel. These input stages were sampled for a brief time (20 msec.) during each duty cycle, or some multiple thereof of the motor driving the punches. If any of the input stages registered an input present then the appropriate punches were operated during the duty cycle. The general arrangement of the circuitry is shown in Figure 1.

As mentioned above the duty cycle of the motor was used to provide the clock pulse to sample the input states. Therefore the fastest sampling rate was governed by the period of the duty cycle. However, slower sampling rates of twice, four times, eight times the period of the motor were arranged, by sampling on every second, fourth and eighth rotation of the motor and so on. This gave the device sampling intervals of 40 msec. to 20 sec.

In principle the eight hole tape is capable of signalling the binary state of only eight inputs. The present device was extended to sample 16 input channels, by sampling first one set of eight inputs and

punching out the state of those inputs and then 40 msec later sampling the other set of eight inputs and punching out the state of those inputs. Consequently, 16 channels could be recorded at a minimum sampling rate of once every 80 msec.

The device was arranged so that the interval between successive samples of all 16 channels was variable as when the device operated in only the 8 channel mode.

It is of course possible to govern the sampling rate of the device by using an external clock pulse. The only constraint on this procedure which obviously allows a limitless range of sampling intervals, is that the device only punches out the state of the inputs at one point in the 40 msec. duty cycle of the motor. Consequently the accuracy of an externally clocked sampling interval is ± 20 msec. of the external clock interval.

The device has been used for a minimum period of 100 hours of continuous operation without any apparent fault emerging up to now. Programmes have been developed to deal with reading and compiling the data on the University's PDP 11 computer. This data is transcribed onto magnetic tape for processing in the Burroughs 6700 machine.

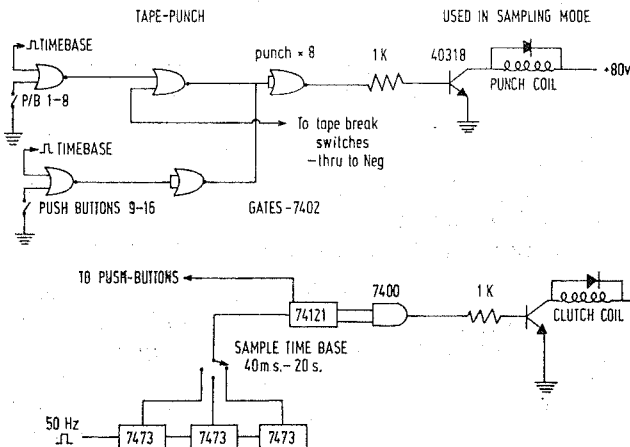


Figure 1 shows one channel of the input circuitry to the punch coil, and the time base circuitry determining the sampling rate. The other input channels were identical to the one shown.

As mentioned above the device has been used in two different classes of experiment and it is sufficiently flexible to be used to code a wide range of binary data such as the occurrence of particular sleep stages, major components of the EEG spectrum, changes in activity patterns of animals, the results of some decision tasks and various other experimental situations. At the present, the input stages are designed to record whether electrical contacts are open or closed, but they can be easily extended to recording other forms of signalling binary events. And of course a further coding stage can be easily added to make use of the 2^8 possible alternatives that the device can signal on each punching operation.

We can supply complete circuit diagrams of the construction of the device and also copies of the programme used to compile the data on to magnetic tape for further processing by the Burroughs 6700 machine. We understand that basic paper-tape punches identical or closely similar to the present one become available from Burroughs Ltd. from time to time.