E24 MULTI-CHANNEL TIME-RECORDER (DIGITRON)

In experiments where many time-measurements are required, the application of conventional scalers is often complex and expensive. The instrument described below is capable of recording up to 200 time-measurements with a precision of ± 5 nS using 4 scalers and a buffer memory. It has been developed for the new "g-2" experiment but has other applications. (Tradition in "g-2" experiments dictates that this instrument be called a "Digitron".)

Precision

Timing precision is given primarily by the crystal-controlled 100 MHz clock. In addition, the input signals to be measured pass via Time-Quantizers (sometimes called Derandomisers or Synchronisers) which place them in the nearest 10 nS time-bin. This is a necessary procedure in order to avoid errors (see later). The crystal-clock in the "g-2" application is always running - in other applications the clock could be started in synchronism with a Start pulse.

The 4 scalers have each 16 bits (4 x 95H16). They are controlled by a recirculating shift-register (95H00) which contains a single 1 bit and three zeros - thus only one scaler counts at a time. Having started the system such that the first scaler is counting the 100 MHz clock pulses, the arrival of a signal to be measured causes the shift register to move on one position, stopping the first scaler and starting the next. To avoid losing a count it is arranged that this shift takes place between two clock-pulses - hence the need for the Time-Quantizer.

Organisation

As soon as a scaler stops counting, its content is transferred to the M.O.S. buffer and it is then cleared to zero. It takes 500 nS to do this transfer. If, during this 500 nS, two more input signals arrive, the next two scalers also stop counting and the fourth begins. A fourth input stops the fourth scaler and starts the first again (which has been cleared after data transfer to buffer). Should the fourth signal arrive before the first scaler has been cleared, this signal is lost. These losses we call the "Queuing Losses", somewhat analogous to Dead-Time losses; they can be predicted and in most applications will be small. The 500 nS transfer

time is a property of the particular MOS memory chosen. Faster buffers would mean even lower queuing losses.

This procedure continues until the buffer of 200 words is full or the measurement is complete.

Reference NP Internal Report 73-14 August 1973 - I. Pizer.

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