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# NASA TECH BRIEF



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## Circuit Counts Pulses and Indicates Time of Occurrence of Slow Pulses

A circuit has been devised to (1) count pulses (such as those generated by an ion chamber or sensor in response to ionizing particles or radiation) received over a wide range of pulse repetition rates and (2) to indicate the time of occurrence of the slow pulses, i.e., for phenomena in which a pulse may occur at infrequent intervals. In the latter case, it is often desirable to determine the exact time of occurrence of the pulse. For example, if an ionizing particle sensor is rotating so that at different times during a sampling interval it is pointing in different directions, a determination of the instant when a pulse occurred also indicates the orientation of the sensor at that instant.

The counter includes one section which counts the first several pulses received from the detector or sensor and a second section which counts pulses from a clock during the period between the beginning of a sampling interval and the receipt of the first pulse by the circuit. The number of clock pulses counted indicates the time of receipt of the first pulse. If a larger number of pulses is received during an interval than the first section can contain, two things happen: a) the clock pulse count in the second section is dumped; i.e., the counter is reset to zero, b) that section begins counting the number of times the first section overflows. Thus, the second section of the circuit has two functions: at low pulse rates it counts clock pulses, and at high pulse rates it counts the number of times the first section overflows.

In one form of the circuit, two groups of binary memory elements, i.e., flipflops, are included. One group of three elements is in the first section of the circuit, and the other group, consisting of six elements, is in the second section of the circuit. With

this combination of nine elements, the circuit can count a maximum of  $2^9$  pulses. The first pulses to be received are registered in the first group of three elements, which can count up to seven pulses. Before the first pulse is received, however, the second group of six elements counts clock pulses. When the seventh pulse is received, the clock pulse count in the second group of elements is reset to zero; thereafter arithmetic carries from the overflowing first group of elements are delivered to the second group. Thus, at high pulse rates, the second group counts the most significant digits of the pulse count, while at low pulse rates (less than 7 per sampling interval) it indicates the time at which the first pulse was received since the last sampling. At each sampling, all nine elements are reset to zero. The circuit indicates the total number of count pulses received during the sampling interval in all cases, regardless of the number of these count pulses.

### Note:

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Reference: TSP69-10313

### Patent status:

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