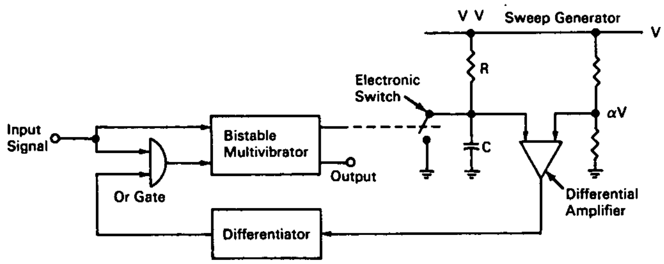
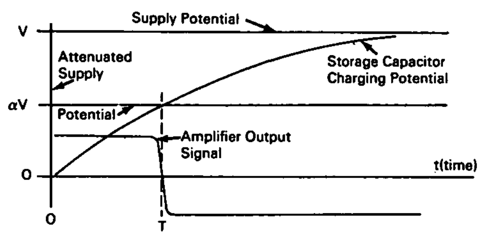
NASA TECH BRIEF

Electronic Circuit Delivers Pulse of High Interval Stability





The problem:

In a number of electronic instrumentation systems, accurate counting of events per unit time requires a pulse of specified and highly stable interval. Such systems have been designed in the past but, generally, at a very high complexity level.

The solution:

A circuit that fundamentally depends, for its stability, on the regularity of an energy storage–energy dissipative time constant. This circuit generates a pulse of high interval stability with a complexity level considerably below systems of comparable stability.

How it's done:

An input pulse of either random or predetermined period triggers the bistable multivibrator. With the multivibrator in the reset state, this pulse drives it to the set state and its true output drives the switch to the open or nonconducting state. This causes the capacitor terminal potential to increase toward the supply potential (V). The high gain and wide bandwidth differential amplifier now generates a single-ended output voltage in response to the capacitor instantaneous potential as well as to the fixed potential V, the algebraic difference between the two representing the amplifier input signal.

Assuming that the capacitor is allowed to charge indefinitely, the differential amplifier output signal would appear as shown in the figure on the right. At the instant denoted T, the differential input signal changes relative polarity, that is, the attenuated potential V is greater than the capacitor potential before time T, whereas after time T the converse is true. This in turn causes the amplifier output potential to rapidly reverse potential at T in a period dependent on the gain and bandwidth of the amplifier.

The interval T is solely dependent on the supply potential V if the capacitor is initially charged $V_c(0)$ so that proper circuit operation depends on the capacitor being fully discharged before each triggering event. This requirement effectively sets an upper limit to the frequency of operation, being related to the choice of capacitance of the RC time constant for a given application.

Output of the differentiator resets the bistable multivibrator at a precise preselected instant and the output of the multivibrator drives the switch to the closed or conducting state to discharge the capacitor, which in time returns to its quiescent state. The circuit remains in the discharged state until the next input triggers the bistable multivibrator to repeat the events described above.

(continued overleaf)

Notes:

1. This circuit is being used as a linear frequency discriminator in the signal conditioner of the Apollo comand module.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B66-10501

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Benjamin Fisher
of North American Aviation, Inc.
under contract to
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(MSC-673)