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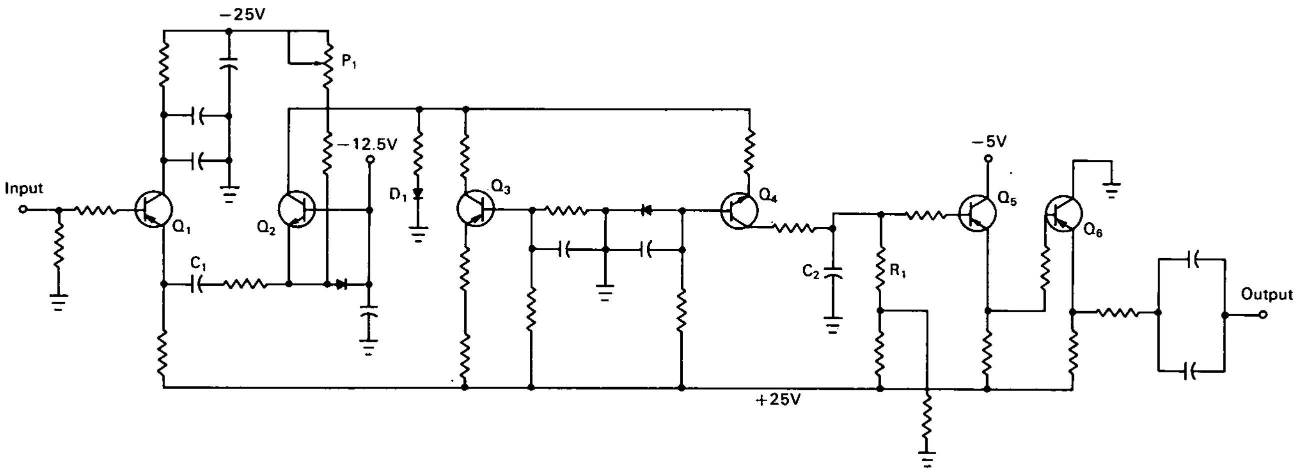
AEC-NASA TECH BRIEF

Pulse Stretcher Has Improved Dynamic Range and Linearity



The problem:

To lengthen nanosecond pulses so that their amplitude may be determined and to extend the dynamic range of the pulse stretcher. The most serious limitation of the commonly used diode–capacitor stretcher is the nonlinear attenuation of the diode for signals of less than a few hundred millivolts. Also, when operating in the nanosecond range the diode capacitance allows partial feedthrough of the signal to produce distortion.

The solution:

A current-switching pulse stretcher to overcome the diode nonlinearity and capacitive feedthrough of voltage switching diode–capacitor stretchers.

How it's done:

The figure shows the complete circuit of the current switching nanosecond pulse stretcher. When no input is present, the quiescent operating conditions are such that Q_2 and Q_3 are biased into the active region. The quiescent current in Q_2 is adjusted with P_1 so that D_1 conducts approximately 10 microamperes. Since D_1 draws little current, the emitter potential of Q_4 is nearly zero and Q_4 is held in cutoff.

An input pulse enters through the base of emitter follower Q_1. Q_1 drives the differentiating capacitor C_1. A current proportional to the derivative of the input voltage passes through Q_2 to the diode switching circuit, D_1 and Q_4. The signal current switches D_1 off and turns Q_4 on. The output from the collector of Q_4 rapidly charges C_2. As the differentiated pulse returns to zero, Q_4 turns off, leaving a charge on C_1. When Q_4 is turned off, C_2 discharges exponentially through R_1, with a time constant of approximately R_1C_2. R_1 is selected to give the desired decay time of the stretched pulse. The input impedance of emitter followers Q_5 and Q_6 is high compared to R_1 and therefore isolates C_2 from the output load.

(continued overleaf)

The voltage swing at the emitter of Q_4 is small so that the effect of capacitive feedthrough from emitter to collector of Q_4 during the trailing edge of the input is negligible. There is a slight threshold in the circuit due to the 10-microampere quiescent current in D_1, as well as the charge which is lost in charging the stray capacitance across D_1. This effect is made quite small by choosing C_1 large enough so that the full scale current pulse is large compared to 10 microamperes.

Notes:

1. The rise time of the output pulse in response to a step function is approximately 5 nanoseconds.
2. The differential linearity of the output is 1–2 percent over an output range of 50 millivolts to 10 volts.
3. Additional information is contained in *Rev. Sci. Instr.*, vol. 37, no. 4, p. 514-515, April 1966.
4. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 S. Cass Avenue
   Argonne, Illinois 60439
   Reference: B66-10509

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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