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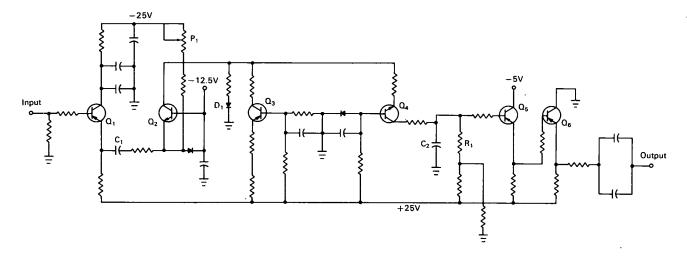
AEC-NASA TECH BRIEF



Brief 66-10509

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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 Q2 and Q3 are biased into the active region. The quiescent current in Q2 is adjusted with P1 so that D1 conducts approximately 10 microamperes. Since D₁ draws little current, the emitter potential of Q4 is nearly zero and Q₄ is held in cutoff.

An input pulse enters through the base of emitter follower Q₁. Q₁ drives the differentiating capacitor C₁. A current proportional to the derivative of the input voltage passes through Q2 to the diode switching circuit, D₁ and Q₄. The signal current switches D₁ off and turns Q4 on. The output from the collector of Q₄ rapidly charges C₂. As the differentiated pulse returns to zero, Q_4 turns off, leaving a charge on C_1 . When Q₄ is turned off, C₂ discharges exponentially through R₁, 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 Q₅ and Q₆ is high compared to R₁ and therefore isolates C_2 from the output load.

(continued overleaf)

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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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> Source: R. N. Larsen Electronics Division (ARG-82)