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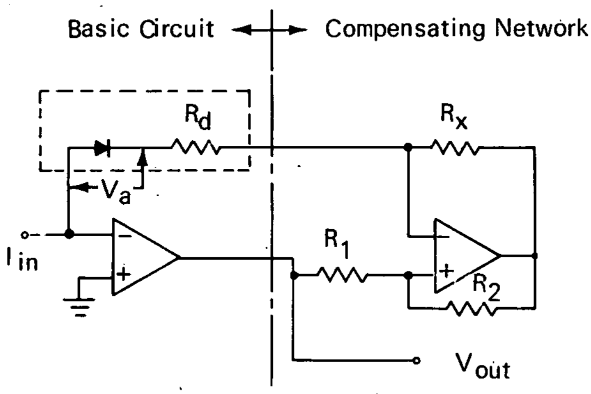
AEC-NASA TECH BRIEF

Space Nuclear Systems Office

High Current Compensation Network for DC Logarithmic Amplifiers

The problem:

At currents of from 1 to 20 mA, the volt-ampere characteristic of semiconductors used in logarithmic amplifiers is not logarithmic. In practical semiconductors, this is caused by resistances that do not change logarithmically with changes in current. These resistances are the external metallic connections to the semiconductors, the external circuit wiring resistance, and the ohmic resistance through the body of the semiconductor. Though the resistances are always present, the IR drops across them at low currents are small enough to be neglected. At higher currents (1-20 mA), however, the IR drops across these resistances cause the output voltage of the log amplifier to be higher than it would be if a perfect diode were used.



The solution:

Construct a circuit whose voltage output is reduced by a voltage equivalent to the IR drop of the non-logarithmic resistances found in a practical diode. Its output will therefore be the same as a circuit using an ideal diode.

How it's done:

The basic circuit shows a simplified logarithmic amplifier made up of an operational amplifier with a non-perfect diode (inside dotted line) around it. The non-perfect diode is represented by a perfect diode D plus a resistor R_d, which is the non-logarithmic resistance associated with practical diodes. In the ideal amplifier, the output voltage (V_{out}) is the same as V_a. But R_d creates an undesirable voltage component ($I_{in}R_d$) which adds to V_a. The function of the compensating network is to subtract $I_{in}R_d$ from the output voltage. This requires the matching of only two sets of values. First, R_x must be selected experimentally to equal R_d. Second, R_1 must equal R_2.

The network-compensated circuit has been in use for several years. It has yielded a logarithmic performance improvement over the basic circuit by a factor of 3 to 5 at 1 to 10 mils. At 10^{-8} amps, the circuit response is 10 milliseconds.

This circuit is applicable to meter and electronic recorder movements. In addition, it can improve the performance of radiation detectors and a variety of sensitive microbiological monitoring devices. In order to obtain suitable response at 10^{-8} amps, the circuit must perform adequately up to 20 mA. Hence, the term "high current compensation."

Note:

Requests for further information may be directed to:

Technology Utilization Officer
AEC-NASA Space Nuclear Systems Office
U.S. Atomic Energy Commission
Washington, D.C. 20545
Reference: B71-10128

(continued overleaf)

Patent status:

No patent action is contemplated by AEC or NASA.

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