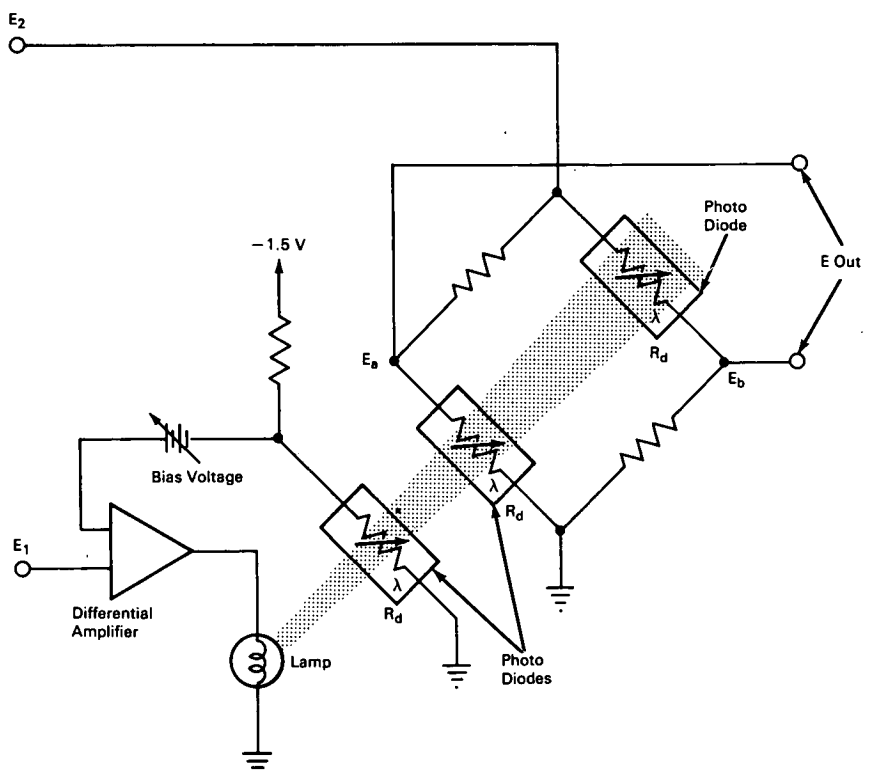
September 1965 Brief 65-10287

NASA TECH BRIEF

Photoresistance Analog Multiplier Has Wide Range



The problem: Analog multiplication involving two or more variables of either polarity performed over a wide frequency range. To achieve equal performance with previous multipliers would require extremely complex, expensive electronics requiring major adjustments.

The solution: Solid-state photodiodes are placed in the arms of a simple Wheatstone bridge and exposed to a light source whose intensity is proportional to the input signal voltage. The voltage potential across the bridge is proportional to the product of the voltage applied to the light source and the voltage applied to the bridge.

How it's done: The photoresistance analog multiplier has two basic units, the light source and the Wheatstone bridge. If E_2 is held constant, the resistances of the photodiodes R_d vary inversely with the potential of E_1. If E_1 increases, R_d decreases, causing

(continued overleaf)

E_a to fall and E_b to rise, in turn causing a linear increase in E_{out}, which is $E_b - E_a$. If E_1 decreases, then, by the inverse process, a linear decrease in E_{out} occurs.

If E_1 is held constant, then an increase in E_2 causes an increase in E_{out} and a decrease in E_2 causes a decrease in E_{out}. Thus the voltage E_{out} is a linear function of the light source and the voltage applied to the bridge, or E_{out}, is proportional to E_1 times E_2.

The differential amplifier in the closed loop of the light source compares the output of a photodiode, identical to those employed in the bridge circuit, to the input E_1. The output of the photodiode and potential of E_1 are made essentially equal (discounting the bias offset).

Notes:

1. A series of multiplications can be carried out or variables may be taken to any desired power by the addition of other photoactivated bridges.
2. The multiplier operates from direct current to an upper frequency limited by either the light source or the closed-loop difference amplifier.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10287

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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