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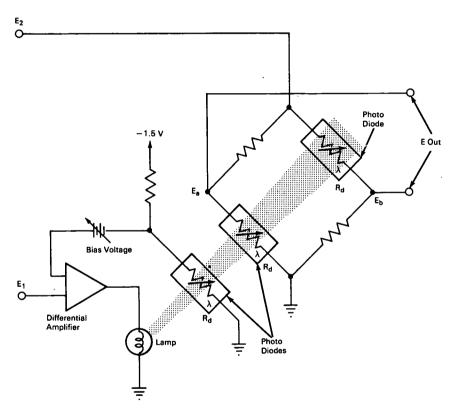
Brief 65-10287

## NASA TECH BRIEF



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## 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)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.  $E_a$  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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