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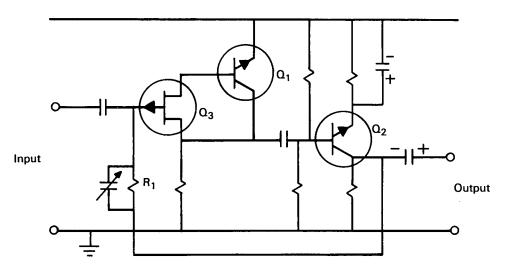
## Brief 64-10143

## NASA TECH BRIEF



This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

## Field-Effect Transistor Improves Electrometer Amplifier



**The problem:** Accurate measurement in a rigorous environment of small currents approaching the theoretical noise limit. Vacuum-tube electrometers employ a filament at high temperature thus producing an undesirable level of thermal noise and drawing appreciable power. The vacuum tube is also vulnerable in a harsh environment.

**The solution:** An electrometer amplifier using a field-effect transistor (FET) to measure currents as low as  $10^{-13}$  ampere at room temperature with a 1-cycle bandwidth.

**How it's done:** The circuit illustrated was developed as an ac amplifier to be used with an external filter which limits bandwidth to achieve optimum noise performance. A close-coupled feedback pair,  $Q_1$  and  $Q_2$ , is used in the input stage to achieve in-phase operation and cancellation of source-to-gate capacitance in the FET  $Q_3$ . By feedback,  $Q_2$  improves the gain of the input source-follower circuit from a

value of approximately +0.6 to very nearly +1.0. DC bias in the FET is accomplished through the feedback resistor  $R_1$ , thus eliminating the noise-producing biasing resistors ordinarily used. The amplifier draws only 4.5 miliwatts and is useful in the frequency range from 100 cps to several kilocycles.

## Notes:

- 1. Capability of this circuit depends on the FET characteristics of low noise and high leakage resistance. When FET's having higher leakage resistance become available, sensitivity will be increased.
- 2. Inquiries concerning this invention may be directed to:

Technology Utilization Officer Ames Research Center Moffett Field, California, 94035 Reference: B64-10143

(continued overleaf)

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