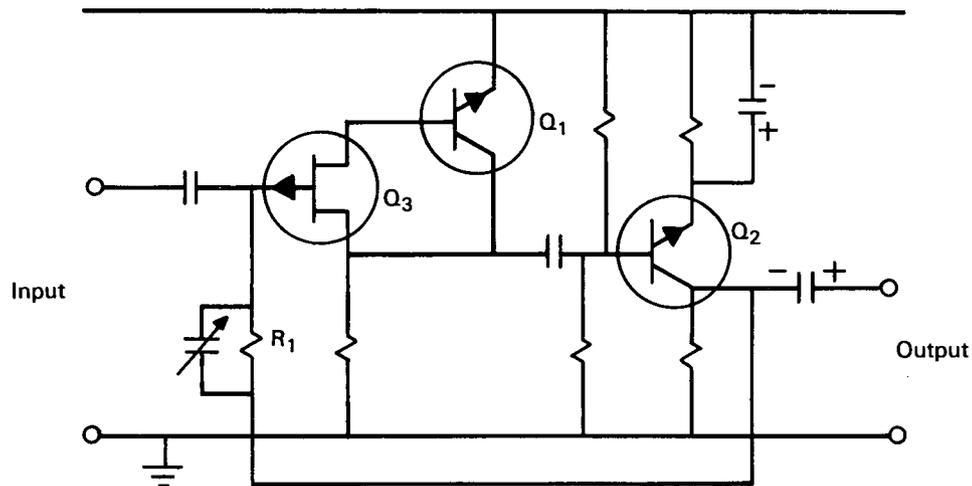


# NASA TECH BRIEF



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 milliwatts 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)

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

Source: Robert Munoz  
(ARC-36)