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NASA TECH BRIEF

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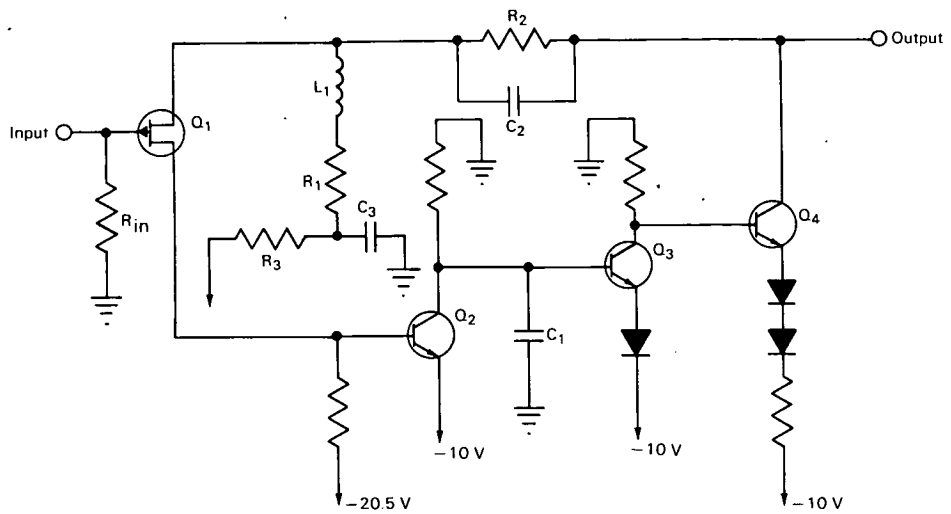
Field Effect Transistor Presents High Input Impedance in AC Amplifier



The problem: To design an ac amplifier that will present a high, stable input impedance and operate efficiently at low intrinsic noise levels.

The solution: A four-stage transistorized amplifier employing a field effect transistor in the first stage to provide a high input impedance and low intrinsic noise levels.

How it's done: The input signal is applied to the gate of the field effect transistor, Q_1, which is a majority-carrier device and hence is free of the noise associated with minority-carrier current flow. The gate presents an impedance on the order of 10^9 ohms; therefore the actual impedance presented to the signal is determined by the magnitude of R_{in} (10^7 ohms). The first stage provides a voltage gain of 20. Direct-coupled transistors Q_2, Q_3, and Q_4 provide three additional stages of amplification. The total open-loop voltage gain of all four transistors is 3×10^6.

The low-frequency cutoff, determined by R_1 and C_3, occurs at 159 cps. The high-frequency response is determined by the time constants of the four transistors and the feedback network (R_1, L_1, R_2, C_2). A closed-loop midband voltage gain of 1000 is attained with a feedback factor of 3000. A low closed-loop gain for dc prevents input drifts from producing excessive shifts in output operating points. Temperature variations from −55°C to +125°C produce a closed-loop midband gain variation of approximately $\pm 0.1\%$. The

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circuit has a 3-microsecond rise time and an 8% overshoot and consumes a small amount of power compared to conventional bootstrap amplifiers.

Notes:

1. The amplifier is suited to carrier or narrow-band sine wave applications since the bandpass and gain may be easily controlled. Its large intrinsic bandwidth and good transient response would also make it useful in pulse systems.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Jet Propulsion Laboratory
   4800 Oak Grove Drive
   Pasadena, California, 91103
   Reference: B65-10232

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: J. H. Marshall
(JPL-500)