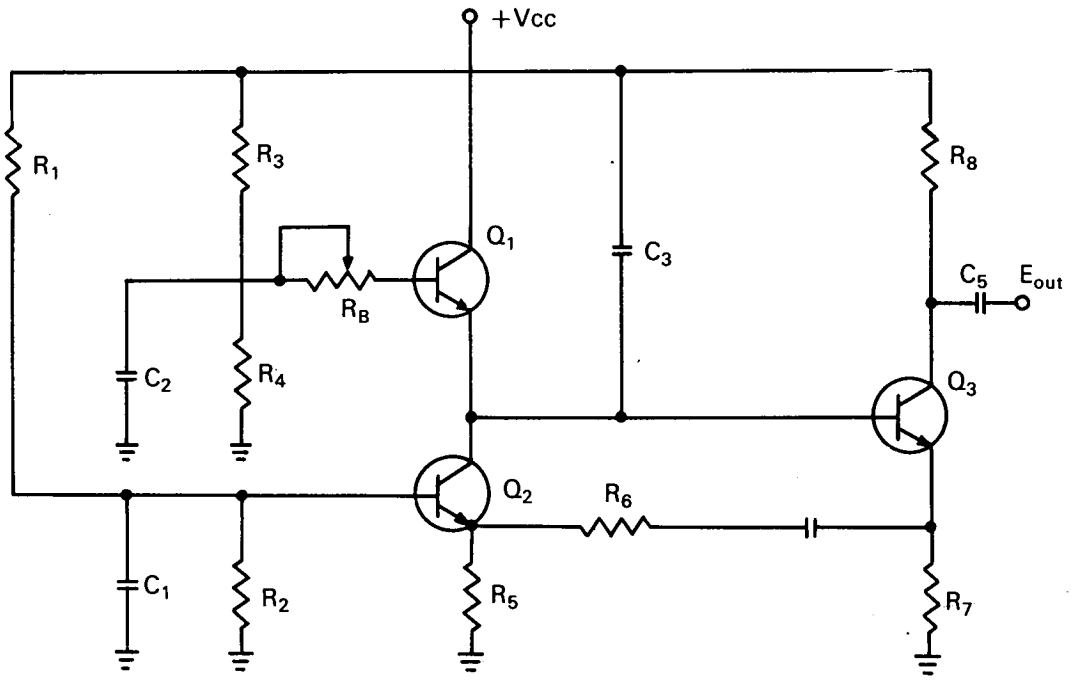
NASA TECH BRIEF

Microelectronic Oscillator II



The inability of microminiature component technology to fabricate suitable inductors, particularly for the lower frequencies 5–20mc, places a serious limitation upon the design engineer. Circuits employing inductors, such as tuned amplifiers and oscillators, are difficult to achieve by conventional techniques. Thin film inductors are limited to small values of inductance owing to the large areas required for larger values of inductance. Monolithic technology has yet to produce suitable inductors.

To circumvent the inductor problem a bipolar transistor is operated in the grounded base configuration. If a base resistor R_B is present, the value of inductive reactance is given by:

$$jX_L = \frac{jR_B F_T}{F}\left[\frac{1}{1+\left(\frac{F_T}{F}\right)^2}\right]$$

Where F_T is the transistor's transitional frequency, and F is the operating frequency. In series with the inductor is a resistor whose value is given by:

$$R_L = \frac{R_B}{1+\left(\frac{F_1}{F}\right)^2}$$

(continued overleaf)

The basic oscillator configuration is shown in the schematic. The oscillator is a modified Butler oscillator, in which the tuning inductor is replaced by the inductive transistor. Resistors R_1, R_2 R_3 and R_4 are biasing resistors for Q_1 Q_2; C_1 is the base bypass capacitor for Q_2; and C_2 is the base bypass capacitor for Q_1. Capacitor C_1 may be replaced by a crystal for a crystal controlled oscillator. Transistor Q_1 is the inductive transistor, the value of which is determined by R_B, and, in conjunction with C_3 forms the basic frequency determining network. Positive feedback is obtained by coupling the collector of Q_2 to the base of Q_3, which in turn drives the emitter of Q_2. The output signal is taken from the collector of Q_3.

The oscillator may be fabricated by hybrid thin film techniques or by monolithic construction. Discrete microminiature components may also be employed.

Notes:

1. No further documentation is available.
2. A related innovation is described in NASA Tech Brief B69-10064, March 1969. Inquiries may also be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B69-10063

Patent status:

No patent action is contemplated by NASA.

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