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Brief 71-10286

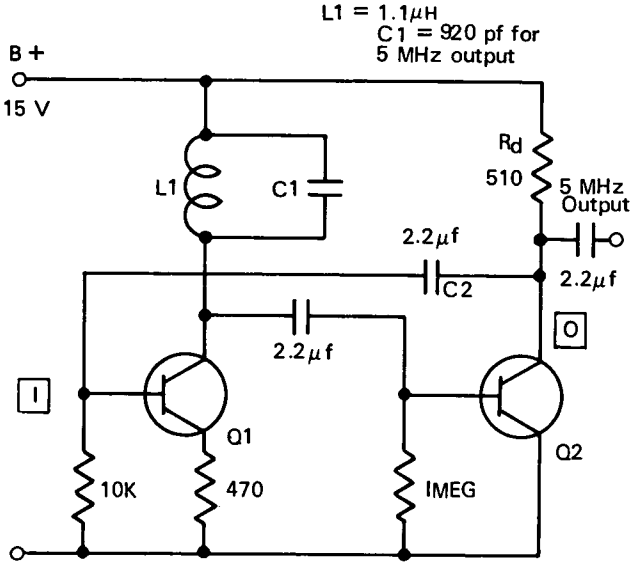
NASA TECH BRIEF

Goddard Space Flight Center

Oscillator with Wide Dynamic Tuning Range

The problem:

Tune an oscillator over a frequency range of six decades by changing only two circuit components. The oscillator may operate in a distributed mode for increased frequency stability.



Resonant Drain Oscillator

The solution:

Use two or more tandem amplifier stages, at least one of which is tuned. Remove the feedback voltage from the drain of the last stage and apply it to the gate of the first stage to eliminate the need for frequency sensitive impedance matching circuitry. Within practical limitations, the stability can be increased by increasing the number of tuned stages.

How it's done:

The basic oscillator circuit (see fig.) consists of a two-stage non-inverting amplifier with the output terminal connected to the input through C2. Q1 functions as a selective amplifier which controls the frequency and stability of the oscillator; Q2 is a wideband amplifier and phase inverter that provides positive feedback to Q1 at the resonant frequency of L1-C1. The circuit oscillates at the frequency for which the phase shift through the amplifier is zero, provided that the gain of the amplifier is equal to or greater than unity. This frequency can be tuned by varying the component values of L1-C1 in the drain circuit of Q1. Oscillations over a 15:1 range can be achieved by varying only C1, and a 10^6:1 range can be obtained by varying both L1 and C1. The wide frequency span which can be covered by varying only one component makes the circuit a logical choice as a voltage controlled oscillator. Hyperabrupt varactors are available with a capacity range as high as 20:1. Since the frequency of oscillation is inversely proportional to the square root of capacity, these devices should make it possible to construct voltage controlled oscillators with greater than a 4:1 frequency range.

For applications primarily concerned with obtaining maximum frequency stability, Q2 can also be operated as a selective amplifier by replacing R_d with an LC circuit identical to L1-C1. If n independent tuned stages are used, the oscillator will have a figure of merit F given by:

$$F = \frac{\left[\sum_{1}^{n} \Delta \theta_n^2\right]^{1/2}}{f_o \sum_{n-1}^{n} \tau_n}$$

where τ_n is the group delay of the n^{th} stage, θ_n is the RMS phase jitter of the n^{th} stage, and f_o

(continued overleaf)

is the frequency of oscillation. The smaller the F, the greater the stability.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
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(GSC-11086)