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NASA TECH BRIEF

100 MHz Voltage-Controlled Oscillator

A voltage controlled crystal oscillator (VCXO), which has been developed, generates a center frequency of 100 MHz at a power level of 11 dBm into a 50 ohm load. It has a sensitivity of 100 Hz/volt and a phase noise of 0.09 degree rms in a 5 Hz loop bandwidth at 100 MHz. Its other characteristics are as follows:

1) B+voltage: +15 volts dc
2) Stability: one part in 10^{-8} for a 12-hour period
3) Error voltage: ± 3 volts (corresponds to changing frequency of oscillator ± 300 Hz).

Prior-art VCXO's operated in the range of intermediate frequencies and low rf frequencies. The new oscillator is the first VCXO design for 100 MHz operation with low phase noise (i.e., change in oscillator phase due to noise). The main application of VCXO's at this frequency and lower frequencies is phase-lock-loop detection systems used in tracking receivers and telemetry systems. The high frequency VCXO will be used in conjunction with apparatus for measuring the frequency stability of a hydrogen maser frequency standard. The importance of developing a high frequency, low phase-noise VCXO can be readily appreciated from the consideration that multiplication of the frequency of the VCXO to L band (as in this application) results in multiplication of the noise by the same factor. The higher the frequency of the VCXO, the less multiplication that is needed, and the lower the noise at L band.

In this oscillator, capacitor tuning is used instead of inductive tuning because of the microphonic effects of an inductance coil. Also the input is injected into a low-impedance point (base of the transistor) for better oscillator stability. A field effect transistor is used as a buffer amplifier to minimize the power drain on the oscillator and to give good isolation from the load. A source follower was chosen to minimize variations of its input capacity due to the Miller effect; i.e., since input capacity is no longer a function of voltage gain, it remains constant, thereby causing minimum detuning of the oscillator circuit. These expedients and prior design practices, such as utilization of a crystal oven for the oscillator and buffer circuit, account for the favorable characteristics of this high frequency VCXO.

Notes:

1. This circuit should be useful in communications systems and electronic test instruments, particularly those incorporating phase lock loops.
2. Documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10133

Patent status:

No patent action is contemplated by NASA.

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Category 01