STABILIZATION OF FUNDAMENTAL-FREQUENCY MICROWAVE OSCILLATORS FOR RADIO-RELAY SYSTEMS

Haruo Yokouchi
Fujitsu Limited
kawasaki, Japan

The cavity stabilized microwave fundamental oscillator shown in Fig. 1 is conveniently used in IF heterodyne repeater systems for the receiver local oscillator. The frequency stability of the transmitter local oscillator is nearly the same as the receiver local oscillator, and shift oscillator stability determines the overall frequency stability of the transmitter. Harmonics of the shift oscillator do not affect either local signal.

The main point in improving frequency stability of fundamental oscillators is to design a high-Q cavity with a suitable temperature coefficient.

A K-band IMPATT oscillator was reported[1], but this technique is not good at lower microwave frequencies because of its size.

Material with a small expansion coefficient is used in temperature stable cavities, and the higher order resonance mode is preferred for high-Q cavities. At lower microwave frequencies, however, it is more practical to use a quarter-wave coaxial cavity, sealed to keep out humidity because the resonant frequency depends more on humidity than on temperature.

Figure 2 shows an example of a 2GHz fundamental oscillator for the receiver local oscillator. A quarter-wave coaxial cavity is transistor-coupled inductively through a hermetically sealed terminal. The output signal is picked up through a sealed terminal capacitively coupled to the cavity. The combination of inductive and capacitive coupling decreases the degradation of external Q due to parasitic coupling between the input and output terminal. This two-port cavity also suppresses the off-carrier noise.

The cavity housing and the quarter-wave resonator are made from super-invar material, annealed at suitable temperature and plated with pure silver.

To obtain a high stability oscillator, however, the temperature coefficient of the oscillator frequency must be compensated because of the matching circuits and the transistor itself.

In Fig. 2, this compensation is accomplished by the inductive post near the resonator.[2] The microwave magnetic field at the post is much larger than the electric field, and the increase in post volume pushes up the resonant frequency.

As a result, a small post of iron or brass can be easily fabricated to determine the temperature coefficient of the cavity at any value.

With this compensated cavity, the frequency stability of the fundamental oscillator is improved to ±20-30ppm from 0°C to 50°C.

The frequency multiplier is cascaded for higher frequencies, or the harmonics can be picked up by modifying the fundamental oscillator.

Although the cavity stabilized fundamental oscillators are larger than dielectric resonator stabilized oscillatos, there is considerable experince in producing them, and they will continue to be widely used in radio repeater system.

(1) "K-band High Power Single Tuned IMPATT Oscillator Stabilized by Hybrid-coupled Cavities", Y. Ito, H. Komizo et. al. IEE Transaction MTT Dec. 1972, pp 799 - 805

(2) "Temperature Stabilization Method in a Reentrant cavity", T Saito, Y. Arai et. al FSJJ vol 12 No.3 pp 27 - 55, 1976

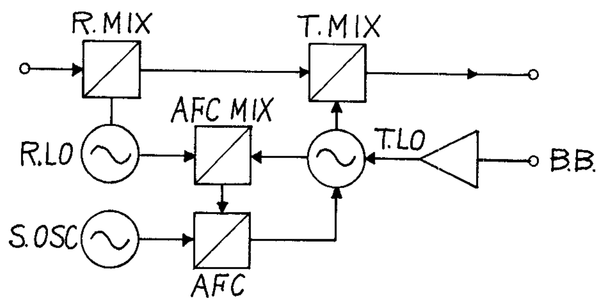

Fig. 1. IF heterodyne repeater

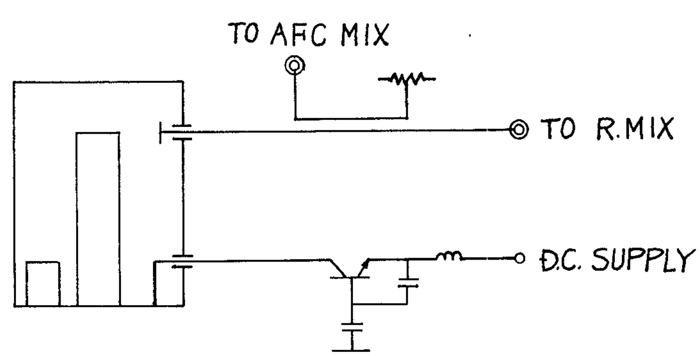

Fig. 2. 2GHz fundamental oscillator