NASA TECH BRIEF

Marshall Space Flight Center

Temperature-Stable Gunn-Diode Oscillator

The problem:

Many solid-state oscillators are subject to frequency shifts in response to temperature changes. This problem can be overcome with automatic-frequency-control (AFC) crystal oscillators. However, the crystal-controlled devices are relatively expensive.

The solution:

An oscillator consisting of a Gunn diode embedded in a coaxial circuit has excellent temperature stability and low fabrication costs.

How it's done:

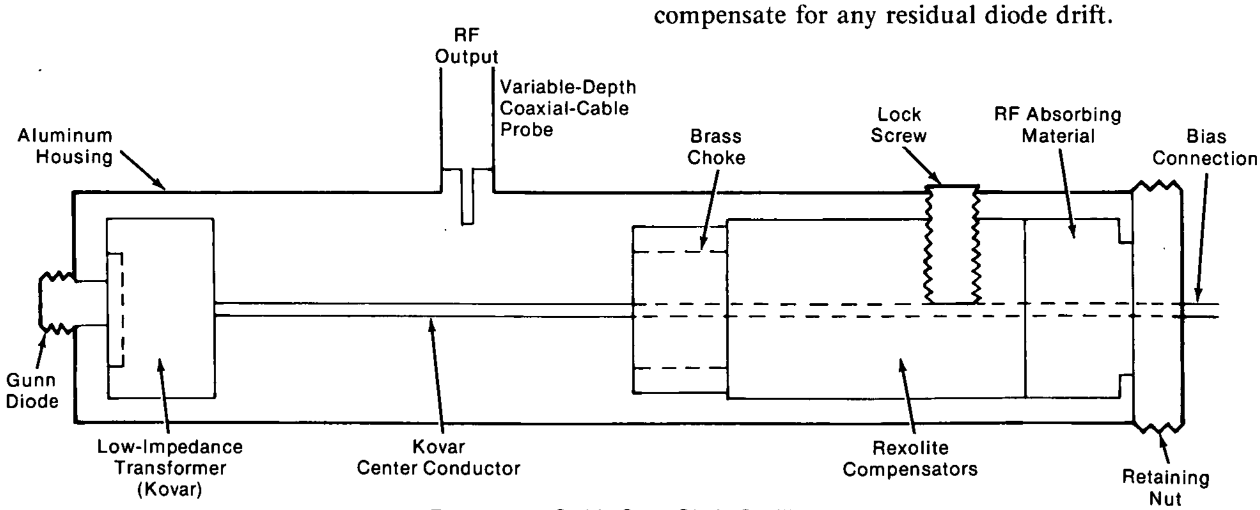
In the illustrated oscillator the low impedance of a Gunn diode is transformed through a section of radial line and low-impedance coaxial cable. This results in an even lower impedance and raises the oscillator loaded Q factor to 150. A section of high-impedance coaxial cable runs the length of the device.

Only the transformer and center conductor need to be made from a low-thermal-expansion material, thus reducing manufacturing costs. Initial results indicate that the oscillator has a stability of 1 part in 10^4 over a range of 30° C at 9.5 GHz.

An RF cavity, which includes the transformer and a section of the coaxial cable, is terminated by a choke short. The cavity length is one-half the oscillator wavelength ($\lambda/2$), and a variable-depth coaxial-cable probe at the cavity midpoint serves as the RF output.

The choke is a hollow brass piece with an exterior length equal to $\lambda/4$ in air and an interior length equal to $\lambda/4$ in rexolite. The choke is followed by a block of rexolite that is firmly attached to the center conductor cable at a single point. A section of RF absorbing material further reduces any leakage out of the bias port.

As the temperature rises the transformer and the conductor cable expand. However, the section of rexolite, although smaller than the cavity length, also expands an equal amount. The thickness of rexolite (a material with a high coefficient of thermal expansion = 90×10^{-6}/°C) expands in a direction opposite to the cable-and-transformer expansion and maintains a constant cavity length. It may also be designed to compensate for any residual diode drift.



Temperature-Stable Gunn-Diode Oscillator

(continued overleaf)

Note:

Requests for further information may be made in writing to:

Technology Utilization Officer
Marshall Space Flight Center
Code AT01
Marshall Space Flight Center, Alabama 35812
Reference: B75-10306

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Marshall Space Flight Center
Code CC01
Marshall Space Flight Center, Alabama 35812

Source: J. E. Dengenford, L. E. Dickens, D. W. Maki, and B. A. Newman of Westinghouse Electric Corp.
(MFS-23242)

Category: 01 (Electronics - Components and Circuitry)