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ESTABLISHMENT OF STEADY-STATE OSCILLATION CONDITIONS OF FREQUENCY-STABILIZED MICROWAVE SELF-OSCILLATORS IN SEMICONDUCTOR DIODES

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The author defines methods for designing and adjustment of frequency-stabilized diode-type microwave generators providing for soft self-oscillation conditions in a range of frequency variation and in a wide range of temperatures.

One of the problems to cope with when designing diode self-oscillators, is to provide for a smooth rise of amplitude of their output microwave signal at the moment of switching-on the diode supply. Such starting conditions of the oscillator (soft self-oscillation conditions) must exist at all perturbations during an oscillator's maintenance, particularly, within a wide range of environmental temperatures. Realization of soft starting conditions for the frequency-stabilized oscillation mode implies a certain mutual position, at the impedance complex plane with coordinates R, jX, of the amplitude-frequency responses of the diode impedance and of frequency responses of the microwave circuit over the whole range of operating frequencies and temperatures. In the work below the problem of establishment of self-oscillation soft conditions is being treated for self-oscillators in IMPATT- and Gunn diodes, whose high-frequency circuit contains a high-quality stabilizing resonator. These frequency-stabilized self-oscillators, distinguished with their small dimensions, high reliability and frequency stability, have found a wide application.

However, the establishment of self-oscillation soft conditions can be achieved, as a rule, by a trial-and-error method, which hardly can provide for an optimal decision and complicates the process of adjustment. The purpose of this paper consists in using theoretical analysis to define the methods of designing and adjustment rules of frequency-stabilized diode microwave self-oscillators showing soft self-oscillation conditions in the range of variable frequencies and in a wide range of temperatures.

Conditions for soft and hard modes of self-oscillation operation. The self-oscillators under consideration, whose microwave circuit contains a high-quality stabilizing resonator, fall in the class of so-called stabilotrons [1], with their oscillation frequency confined in the resonant domain of the stabilizing resonator. Outside the resonator frequency band the spurious oscillations are suppressed by introducing an antispurious load. The semiconductor diode structure is placed into a case serving not only as a sealing assembly but also a transformer providing for matching the diode impedance to that of the load with minimum energy loss.

The network shown in Fig. 1 is optimal for the frequency-stabilized generators in IMPATT-diodes. It maps a structure with a high-quality resonator in the reactive waveguide network of the generator assembly. Here r_a is antispurious resistance for suppressing self-oscillation at frequencies outside the resonator frequency band [2].

The network shown in Fig. 2 is optimal for creation of frequency-stabilized generators based on the Gunn diodes. It corresponds to the structure with a transmissive stabilizing resonator in the event of placing the diode and antispurious load in a coaxial line [3]. By the optimal generator design is meant a structure ensuring the maximum stability of the frequency

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