

Manufacturing and study of oscillator modules for microwave ICs

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An oscillator module of microstrip design with a silicon double-drift IMPATT diode has been developed, manufactured, and tested. The output power of 10 to 50 mW has been attained in the 30 to 38.5 GHz frequency range. The IMPATT diode design involves TiB_x and Mo antidiffusion layers providing high quality and heat tolerance of ohmic contacts.

Разработан, изготовлен и апробирован в эксперименте генераторный модуль в микрополосковом исполнении на кремниевом двухпролетном диоде. Выходная мощность генераторного модуля составляет 10–50 мВт в диапазоне частот 30–38,5 ГГц. В технологии IMPATT диода использованы антидиффузионные слои TiB_x и Mo, обеспечивающие высокое качество и термостойкость омических контактов.

An essential requirement to electrically tunable oscillators is to provide a broad frequency band at relatively small power change therein. To meet this requirement, the varicaps should exhibit a high $C_{\text{max}}/C_{\text{min}}$ ratio, the electrodynamic system should store a relatively low energy and the diode (involving its components) should have an even negative conductance over a broad frequency band. These requirements are contradictory to some extent, since the IMPATT diode conductance differs substantially from the characteristic impedance of the transmission line. So, components are to be used which increase the total energy stored by the system. In this case, a contradiction appears between the frequency characteristic uniformity and tuning range. Besides, some additional components should be introduced to provide the phase balance in the system.

To simplify the matching conditions for microstrip unit, we have developed, manufactured and tested an oscillator module

package. It contains a taper between the microstrip line (characteristic impedance of 50 Ω) and standard waveguide section ($7.2 \pm 3.4 \text{ mm}^2$). The matching device involves sections of microstrip line-non-symmetric line and non-symmetric line-one-sided symmetric slot line (with a smooth growth of characteristic impedance) placed at the central part of the waveguide parallel to its narrow wall. The measured taper losses in the 30 to 38 GHz frequency range do not exceed 0.2 dB.

The oscillator module and matching device were made as an integrated unit. The amplitude modulation was performed using the IMPATT diode feed current from a pulse supply unit. A miniature metal-corundum package was used in the oscillator module. A dielectric corundum bush could be considered as a miniature resonator where the IMPATT diode chip was mounted.

The output power of such oscillator modules amounts 10 to 50 mW in the 30 to