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A MICROSTRIP VERSION OF CLASS-*E* MICROWAVE AMPLIFIER

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The paper is devoted to design and experimental investigation of a microwave class-*E* amplifier built in MESFET, type CLY5, and intended for operation at frequency 820 MHz. The simulation results show a good agreement with the experiment.

Improvement of efficiency of microwave amplifiers is useful in many aspects: it helps reduce the power of supply sources, soften thermal conditions of the constituent active devices and amplifiers as a whole, diminish the energy spent on cooling, and raise the equipment reliability. High efficiency of conversion of dc energy into ac one can be attained in amplifiers operating under current-flow cutoff conditions, with the control of impedance at upper modes' frequencies. The same properties are inherent in the switching amplifiers whose active element operates with currents and voltages of special shape. These conditions are called polyreactive, polyharmonic, or harmonic-keying [1]. The most investigated modes of operation are those corresponding to the classes *E* [2–5] and *F* [6]. Today such amplifiers are being intensively developed for microwave applications [7–11].

The purpose of this work is design and experimental investigation of a new class-*E* transistorized amplifier of microwave power implemented in microstrip lines (MSL). The classical network of a class-*E* amplifier assumes the presence of the output capacitance of the active device in the output circuit. This capacitance helps create the waveforms of current and voltage at the device output electrode ensuring a minimum of energy loss in the transistor. Moreover, the output circuit must ensure transformation of the external load resistance (50 Ω) into transistor's load resistance, which is dictated by a prescribed power value at a fixed supply voltage [2–5]. The advancement to the microwave range requires that the output circuit be built in the lines with distributed parameters.

The results of designing of early class-*E* microstrip amplifiers showed promise of this approach, which made possible creation of amplifiers with good energy characteristics. However, the simulation gave no way of predicting the amplifiers' characteristics, the microstrip circuits required experimental adjustment, and the publications contained only the simplest experimental relationships, not giving the full-scale picture of high-frequency properties of the amplifier. All this permits us to consider this work useful enough.

For operation in the class-*E* conditions, the transistor must possess good switching properties. The most important requirements for obtaining high efficiency include a low resistance R_{ON} in the open state, and a small output capacitance of the transistor in the microwave range. These requirements are somewhat contradictory, and selection of suitable transistor for high-efficiency operation is not an easy matter. We picked out a GaAs MESFET, type CLY5, production of the "Siemens" company, which had shown good results at creating several experimental class-*E* amplifiers [7–8]. For simulation of our amplifier we used the Materka-Kasprchak model of this transistor, whose parameters were updated in [11]. The amplifier modeling was performed with the aid of Serenade SV 8.5 programming complex.

To realize the class-*E* mode of operation, introduce some conditions meeting the best efficiency and permitting to establish simple relations between the network elements [2–5, 8]: cutoff angle 90°; the transistor operates as an ideal switch, i.e., has zero resistance in the open state and infinite resistance in the cutoff mode; linear output capacitance; ideal

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