Radioelectronics and Communications Systems
Vol. 48, No. 1, pp. 15–21, 2005

Izvestiya VUZ. Radioelektronika
Vol. 48, No. 1, pp. 23–32, 2005
UDC 621.375.026

DESIGN OF BAND-PASS PUSH-PULL STAGES OF POWER AMPLIFIERS FOR UHF TRANSMITTERS OF FM AND TV BROADCASTING

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The paper considers principles of construction, peculiarities of design, and techniques of network element calculation of push-pull amplification stages in linear bipolar microwave transistors. An example of calculation and results of experimental tests of an amplifier for transmitters of FM and TV broadcasting are presented.

The required output power levels in amplifiers of radio-transmitting sets are beyond potentialities of the present-day circuitry. Because of this, designing of such devices is added by various methods of raising the output power. These methods are based on application of networks used for summation of power yielded by several transistors [1–5] and for setting optimal modes of operation of the active elements [2, 5–8].

One of the most efficient approaches to creation of amplifiers operating with large powers is the push-pull connection of transistors [1, 2, 5], which permits to simplify the amplifier structure and to suppress the even harmonic components in the output signal spectrum by 20–40 dB. The absence of practical methods for push-pull amplifier calculation complicates their designing.

The purpose of this paper is to describe an engineering method of calculation of band-pass push-pull amplification stages of UHF transmitters for FM and TV broadcasting.

The schematic circuit diagram of the band-pass push-pull amplification stage (Fig. 1) includes a divider, an adder, a stabilizer of base bias voltage, a correction circuit, and a transformer of impedance. As a rule, such systems are designed for operation in a standard 50- or 75-ohm channel, which facilitates the process of transmitter adjustment and maintenance [1, 5]. So let us assume that the resistance of the signal generator R_g and of the load R_{ld} of the stage is known.

The divider and the adder are implemented in quarter-wave coaxial segments of transmission lines used in designing the push-pull band-pass power amplifiers of the metric and decimetric range with passband up to 20–25% [1, 2, 4, 5]. In Fig. 1 they are denoted as Tr1— Tr4. The divider is intended for antiphase excitation of transistors VT2 and VT3. The amplified antiphase signals are added by the adder realized in transmission line segments Tr3 and Tr4. When selecting the quarter-wave coaxial segments of transmission lines of the divider (with its wave resistance R_g) and the adder (with its wave resistance R_{ld}), their input and output resistances will also be equal to R_g and R_{ld}, respectively. The segments Tr1 and Tr3 may be absent, but in this event the divider and adder yield different frequency responses at the inverted and non-inverted output, which results in a loss of 5 to 10% of the output power.

The stabilizer of the base bias voltage, implemented in transistors VT1, VT4, is used for stabilizing the cutoff angle of transistors VT2 and VT3 at variations of the amplified signal level and the temperature of the transistor-bearing radiator [9, 10]. The use of such stabilizer permits also to linearize the starting region of the amplitude response of the amplifier designed [1, 11].

In the known literature we could not find any methods of calculation of the elements of the base bias voltage stabilizer. In this connection, we suggest the following technique for their calculation.

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8 December 2003