QUALITATIVE INDICES OF BROADCAST TRANSMITTERS IN A SINGLE-SIDEBAND MODE

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Izvestiya VUZ. Radioelektronika,
Vol. 35, No. 11, pp. 31-37, 1992

UDC 621.375:621.396.61

It is suggested to characterize the quality of a signal at the output of high-frequency broadcast transmitters in a single-sideband mode with an attenuated carrier R3E by the same indices as are used in the usual amplitude modulation mode A3E. The indicated indices are calculated for a radio transmitter with separate amplification of the components of a single-sideband signal with consideration of the characteristics of the output filter of the switch anode modulator. The requirements imposed on the filter are formulated.

According to the recommendations of the World Administrative Radio Conference [1], newly developed broadcast transmitters of the short-wave range should, along with the usual amplitude modulation mode A3E, have the ability to operate in a single-sideband (SSB) mode R3E with suppression of the carrier relative to the peak power of the envelop by respectively 6 and 12 dB (we will denote these modes at 6 dB SSB and 12 dB SSB). Many well-known firms are already producing such transmitters, and, as a rule, the method of separate amplification of the components of the SSB signal is used for realizing the SSB modes [2]. In that case, one of the main sources of distortions is the low-pass filter (LPF) at the output of the switch anode modulator necessary for suppressing components of the switching frequency of the switches, since it limits the theoretically infinite spectrum of the envelope of the SSB signal and introduces a delay into the signal of the envelope.

An investigation of combination distortions occurring for the indicated reason when using the method of two tones equal in amplitude was carried out in a number of works [3-5]. According to the generally accepted norms [6], the two-tone method is used for determining the level of nonlinear distortions of connected SSB transmitters in the J3E mode with complete carrier suppression. However, the existing norms [1, 7] at present simply do not specify criteria characterizing the quality of the output signal of broadcast transmitters in SSB modes. The use of the method of two equal tones here (the role of one of the tones is played by the carrier signal) [8] enables obtaining an estimate of nonlinear distortions only for one depth of modulation m, whereas for other values of m the distortions can be substantially greater.

The purpose of the present work was to investigate nonlinear distortions caused by the output filter of the modulator with consideration of the specifics of broadcast SSB transmitters.

It is most natural to use for characterizing the quality of the output signal of broadcast SSB transmitters the same indices that are used for the usual amplitude modulation mode. Then as the test signal it is necessary to take a harmonic modulating signal with frequency f_m and arbitrary amplitude determining the depth of modulation m of the output signal of the transmitter F(t), which in a normalized form in the absence of distortions is described by the formula

$$F(t) = (\beta'/2)(\cos\omega_1 t + \beta'' m \cos\omega_2 t), \quad (1)$$

where

$$\beta' = 2, \beta'' = 1 \text{ — for 6 dB SSB; } \beta' = 1, \beta'' = 3 \text{ — for 12 dB SSB;}$$
$$0 < m \le 1, \omega_1 = 2\pi f_c, \omega_2 = \omega_1 + \Omega, \Omega = 2\pi f_m,$$

f_c is the carrier frequency, and $f_m \ll f_c$.

With consideration of the distortions occurring in the transmitter, the output signal F*(t) can be

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20 April 1992