JOINT SELECTION OF THE PARAMETERS OF A MINIMUM-SHIFT FREQUENCY-KEYED COMPLEX SIGNAL AND A MATCHED SURFACE-ACOUSTIC-WAVE FILTER

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It is ever more frequently the practice to use frequency-keyed complex signals with minimum shift along with phase-keyed signals in order to increase the efficiency with which the frequency band assigned to a system for transmitting information in complex signals (CS) is utilized. For an identical cycling frequency f_c of the main lobe of the spectrum of a frequency keyed complex signal with minimum shift (FK-MS) is already 1.33 times greater than it is for a phase-keyed (PK) complex signal and contains 99.5% of the total energy (against 92% for a PK complex signal), while the level of the first sidelobe is -23 dB relative to the main lobe (compared to -13 dB for a PK complex signal).

The utilization of surface-acoustic-wave (SAW) devices in units which form FK-MS allows their weight-size and electrical characteristics to be improved. Possible versions of these devices have been described in [1,2] and are illustrated in Fig. 1a-1d; the nonideal nature of their characteristics leads to a distortion of the shape of the FK-MS, and this causes a reduction in the principal spike of the autocorrelation function during signal processing in a matched filter (MF); as a consequence of this, the signal/noise ratio q^ is diminished. The signal/noise ratio for an undistorted FK-MS is denoted by q. Versions of devices which shape FK-MS can be compared according to the relative magnitude of the signal/noise ratio reduction at the output of the MF:

$$\eta_s = | q - \hat{q} |/q = | 1 - \hat{q}/q |. \tag{1}$$

The purpose of the present work is to develop a procedure for comparative selection of a version of devices which shape FK-MS according to the attribute η_s while taking account of the operating conditions.

Figure 1 displays versions of devices which shape FK-MS having the keying frequencies f_1, f_2. Their distinguishing attributes are the shape of the exciting signal $s_{in}(t)$, the shape of the pulse response of the input counter-stub converter (CSC) $y_{in}(t)$, and the shape of the response produced by the output CSC $y_{out}(t)$.

The exciting signals for the devices (Fig. 1a, 1c, 1d) are short video pulses whose polarity is determined by the binary sequence in accordance with which the FK-MS is shaped. The video pulses are described by triangular functions having base lengths T_{tr} and amplitude-frequency spectra

$$F(f) \sim \mathrm{sinc}^2 (\pi f T_{tr}/2). \tag{2}$$

A complex PK signal having a carrier frequency f_1 is applied to the input of the device (Fig. 1b).

The versions of the device which forms the FK-MS (Fig. 1a, 1b, 1d) contain broad-band input CSC with a pulse response $y_{in}(t)$ having a length $T_{re} = N_{el}/f_0$, where N_{el} is the number of pairs of CSC electrodes, $f_0 = (f_1 + f_2)/2$ is the center frequency of the FK-MS. The device (Fig. 1c) has a nonapodized input CSC having $y_{in}(t)$ which coincides in shape with an elementary pulse of the FK-MS having a length T_e and a frequency f_1.

The output CSC of the device (Fig. 1a) is apodized according to the cosine law:

$$y_{out}(t) \sim \cos(\pi t/[2T_e]) \cos(2\pi f_0 t), \quad -T_e \leqslant t \leqslant T_e. \tag{3}$$

The devices (Fig. 1b and 1c) have nonapodized output CSC having $y_{out}(t)$ of length T_e and frequency f_2. The output CSC of the device (Fig. 1d) are nonapodized and have $y_{out}(t)$ with a length $2T_e$ and the frequencies f_1 and f_2.

The matched SAW filter for the FK-MS has an input CSC with the pulse response $y^{mf}_{in}(t)$ defined by

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