Radioelectronics and Communications Systems
Vol. 48, No. 11, pp. 53–56, 2005

Izvestiya VUZ. Radioelektronika
Vol. 48, No. 11, pp. 72–77, 2005
UDC 621.396.2

NARROWING THE PASSBAND OF THE PHASE-KEYED SIGNAL RECEIVER

V. V. Gorshenin and A. V. Kiselyov

Novosibirsk State Technical University, Russia

The paper is devoted to narrowing the passband in a radio receiver of phase-keyed signals. The narrowing is attained due to diminishing the coefficient of signal spectrum round-off by the reception channel. It is shown that in this case we can reach a considerable improvement of selectivity with respect to the neighboring channel, when the sensitivity and the intersymbol interference level are within allowable limits.

One of the most pressing problems arising in design and maintenance of radio receivers of digital signals is to afford the required selectivity with respect to the neighboring channel. Traditional compression of receiver's passband in this case is intolerable, since it leads to intersymbol interference (ISI), which increases the probability of erroneous reception.

The ISI is known to be absent [1] if the phase spectrum of a signal is linear and the amplitude spectrum $Y(\omega)$ meets the condition of partial symmetry with respect to the Nyquist frequency (we denote it as $\omega_N = \pi / T_S$, where T_S is the symbol duration):

$$Y(\omega_N - |\omega|) = 1 - Y(\omega_N + |\omega|),\ 0 \le |\omega| \le \omega_N . \quad (1)$$

Non-fulfillment of this condition leads in occurrence of ISI, i.e., to overlapping the symbol signals in reference points. All this results to a decrease in probability of reliable reception and in actual sensitivity of the receiver.

When meeting (1), the signal spectrum width and, accordingly, the receiver bandwidth may vary in the range from 2 to $4\omega_N$. But the actual bandwidth, with regard for possible inaccuracy in setting the operation frequencies of the transmitter and receiver, is even more broad. Moreover, as we pass to a more "smooth" spectrum, the widening becomes more pronounced. Such a spectrum is undesirable from the viewpoint of efficiency of utilization of the frequency range, and of receiver's selectivity with respect to the neighboring channel. Nevertheless, we sometimes resort to smoothing in order to diminish ISI arising in the event of inaccurate operation of the system of symbol synchronization in the receiver.

Thus, we face a dilemma. An increase in sensitivity demands for widening the spectrum, so that (1) has to be satisfied, but this widening is intolerable, since it leads to lowering the sensitivity because of growing interference from the neighboring channel. One of the ways to resolve this contradiction is that in the event of interference in the neighboring channel we vary adaptively both the receiver passband and AFR in this band. In this case the symmetry condition (1) must be satisfied for any bandwidth. When the level of interference coming from the neighboring channel is low, it is expedient to work with a wide band of the receiver, and pass to processing of signals with the spectrum shaped by the transmitter. When an intensive interference appears, we have to narrow the passband, promoting the suppression of interference from the neighboring channel. And again, in order to neutralize ISI for any passband value, condition (1) must be met.

In essence, at a fixed spectrum of the transmitter output signal, the amplitude-frequency response of the channel part preceding the detector processing in the receiver (the transfer factor module $|K_P(j\omega)|$) must meet the following condition:

$$\left|K_P\left(j(\omega - \omega_0)\right)\right| \sim Y_P(\omega) / Y_0(\omega), \quad (2)$$

REFERENCES

1. K. Feyer, Wireless Digital Communication — Methods of Modulation and Spectrum Expansion [Russian translation, ed. by. V. I. Zhuravlyov], Radio i Svyaz', Moscow, 2000.
2. D. Prokis, Digital Communication [Russian translation, ed. by. D. D. Klovskii], Radio i Svyaz', Moscow, 2000.
3. V. V. Bykov, Digital Simulation in Statistical Radio Engineering [in Russian], Sov. Radio, Moscow, 1971.

15 April 2003