Improving Noise Immunity of QPSK Demodulation of Signals in Digital Satellite Communication Systems

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Abstract – **this paper represents improving noise immunity of QPSK demodulation of signals in digital satellite communication systems.**

Keywords - **noise immunity, QPSK demodulation.**

I. Introduction

One of the basic parameters effecting the total noise immunity to receiving digital signals is quadrature signal QPSK demodulator stability [1]. Using digital methods forming special signals based on direct digital synthesis what allows improving characteristics of digital channels is the actual problem these days.

II. Forming high-stable quadrature signals at demodulation in digital communication systems

Decomposing input signal into quadrature components taking into account the noise results in:

$$S_{1t}(t)=\sqrt{\frac{2E_b}{2T_0}}\cdot\sin\theta_t+n_t\cdot\sin(\omega_0 t),\qquad(1)$$

$$S_{2t}(t)=\sqrt{\frac{2E_b}{2T_0}}\cdot\cos\theta_t+n_t\cdot\cos(\omega_0 t),\qquad(2)$$

where $\theta_t=\theta(t)$ - the signal phase represented as: $\theta_t=S_k\pi h/T_0\cdot[t-(k-1)\cdot T_0]+\pi h\sum S_j+\theta_0$ when $(k-1)T_0\le t\le kT_0$; where $h=2\Delta f_\partial T_0$ and Δf_∂ - frequency deviation, $S_k=\pm1$ - random informational signal values; θ_0 - random initial phase; T_0 - the bit duration, E_b - the average bit energy, n_t - Gaussian white noise with spectral density $N_0/2$ [1]. Statistically averaging expressions (1) and (2) considering effect of pre-selector of the receiver with impulse response and verifying integrations result in:

$$S_{1t}^{/}=\sin\theta_t+\sigma_{ш}\cdot S_{1t},\qquad(3)$$

$$S_{2t}^{/}=\cos\theta_t+\sigma_{ш}\cdot S_{2t},\qquad(4)$$

where $S_{1t}^{/}$ and $S_{2t}^{/}$ - correspondently the time correlated and mutually uncorrelated Gaussian processes with single dispersion; $\sigma_{ш}=\left(\beta T_0/4h_0^{\,2}\right)^{0,5}$, h_0^2 - signal/noise energy ratio.

Approximate assessment of noise immunity to receiving signal of multi-positional phase modulation (QPSK) is defined as (5):

$$P_{ош}=\frac{1}{2}\cdot e^{(-0,5\cdot h_0^2)}.\qquad(5)$$

Figure 1 represents the structure of satellite communication receiving tract with sequent transforming the signal U_{in} after low-noise amplifier (LNA) and high-stable quadrature frequency synthesizer (HQFS), which allows one – two orders reducing frequency instability comparing with existing schemes [2]. In HQFS structure the following designations are accepted: DQG – dual-frequency quartz generator, MFCC – multi-frequency correcting coder, DDS – Direct Digital Synthesis.

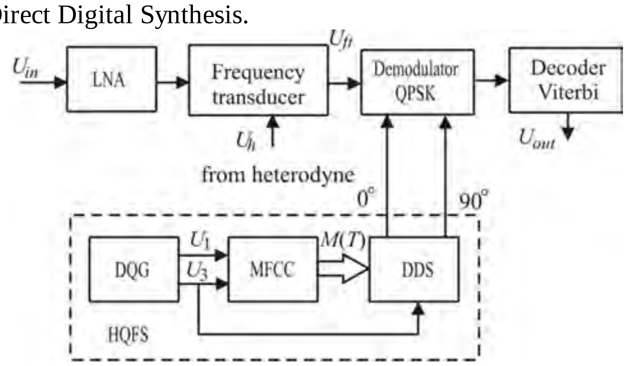

Fig.1 QPSK demodulator structure

Using dual-frequency mode for excitation of quartz generator allows conducting the online identification of thermal and vibration effect on quartz resonator and compensating these instabilities by correcting DDS with input code $M(T)$.

III. Conclusion

This paper represents the structure of QPSK – demodulator based on thermal and vibration compensated synthesizer, which allows improving stability of generating quadrature signals by at least one order in comparison to existing methods using quartz frequency stabilizing.

References

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