Materials of Conferences

AM WAVEFORM AN UNMODULATED CARRIER SIGNAL UNDERGOES THE PROCESS OF MODULATION

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Message signalare usually of a low-frequency. Generally, low frequency signals are not suitable for signal transmission. Thus, in communication systems require modulation for audio signals. Modulation is used to modulate a low frequency signal that carries the information signal with the appropriate frequency. Thus it is possible to solve the problems associated with the transmission and amplification of weak signals. Role modulation in radiocommunication systems is important. Modulation is used to modulate a low frequency signal source division multiplexing (FDM). If the signals are the same frequency band is transmitted on the same channel at the same time, they can easily interfere with each other and therefore so are first modulated on a different carrier so that multiple signals can be transmitted simultaneously. In the experimental part of this article uses the spectrum analyzer, which measures the characteristics of AM signals. These characteristics are of great importance to transmission FM and AM signals.

Introduction. Modulation is the process of moving a low-frequency signal to a high-frequency and then transmitted the high-frequency signal. Generally the low-frequency signal carrying the original information is called the modulating signal or baseband signal. The high-frequency is known as the carrier signal. After the carrier signal is modulated by the modulating signal, the resultant signal is called the modulated wave. There are three kinds of modulation methods that are used: AM (Amplitude Modulation), FM (Frequency Modulation) [1, 2] and PM (Phase Modulation) [3].

In this case we begins with AM to lean some modulation theory. AM uses the modulating signal to control the amplitude of the high-frequency carrier signal. The modulating signal is used to alter the amplitude of the carrier in proportion to the amplitude of the modulating signal. A high-frequency carrier signal that is amplitude modulated is called an AM waves. AM waves are divided into ordinary AM waves, double-sideband AM waves with suppressed carrier transmission and single-sideband AM waves with suppressed carrier transmission.

In order to pass any kind of information by transmitted, it is necessary to modulated wave. Each transmitted process can be imagined as a result of modulation of harmonic signal:

$$u(t) = U(t)\cos\left[\omega(t) + \varphi(t)\right].$$

In paper [3] was reviewed by the PM-oscillations in quasi-stationary conditions, when was considered that the amplitude and frequency of oscillation were slowly evolution processes. Modulating $s(t)$ signal – was stationary Gaussian process:

$$\overline{s} = 0;$$

$$\overline{ss_\tau} = B_0(\tau) \equiv \sigma_0^2 R_0(\tau) = \int_{-\infty}^{\infty} G_0(\omega) e^{-i\omega\tau} d\omega.$$

It has been shown that in the given case of PM-signal will not be stationary random signal, because its statistical characteristics are the periodic function of time. Usually, spectral and correlation characteristics of the signals in practical terms is more interesting to determine the average time values, since the time averaged statistical quantities of devices are registered.

In papers [4, 5] was studies temporal variation of the amplitude of high-frequency pulse shape modulated signal propagation in the dispersion plasma layer. It is shown that the shape of the amplitude depends not only on the carrier signal frequency, but also on the degree of the AM. For this important experimentally study of AM signal and their spectra, since the degree of modulation affects the transmission.

Basic part. Consider the quasi-monochromatic oscillations with constant phase and randomly fluctuated amplitude. During the AM, the value of amplitude is proportional to the modulating $s(t)$ signal amplitude:

$$u(t) = U_m(t)\cos\left[\Omega t + \varphi\right] = k \cdot s(t)\cos\left[\Omega t + \varphi\right];$$

$$\varphi = \text{const}, \tag{1}$$

where k – is a proportionality coefficient, which determines the degree of modulation, so it can be described as modulation coefficient, and $s(t)$ modulating signal. Assuming that modulating signal is a sine wave of a single frequency $\Omega = 2\pi f$. Then the carrier signal is

$$u_0(t) = U_{0m}(t)\cos\left[\omega_0 t + \varphi_0\right]. \tag{2}$$

Because the carrier frequency remains unchanged after amplitude modulation and the amplitude of an AM waves is proportional to the modulating signal, therefore, the modulated wave can be expressed as below:

$$u_{AM}(t) = U_{AM}(t)\cos(\omega_0 t + \varphi_0) = U_{0m}\left(1 + m \cdot \cos(\Omega t + \varphi)\right)\cos(\omega_0 t + \varphi_0). \tag{3}$$

To simplify the analysis, we set the initial phase angle of both waveforms to zero. In formula (3), m is known as the degree of AM modulation or the AM modulation index. Namely:

$$m = \frac{k \cdot s(t)}{U_{0m}}. \quad (4)$$

This equation indicates to what degree the carrier amplitude is controlled by modulating signal. The constant k is a proportional constant determined by the modulation circuit. The AM modulation index should be less than or equal to 1. When the AM modulation index is greater than 1, it is called over modulation and will distort the modulated signal.

We can see from this that the AM wave also oscillates at a high frequency. Its amplitude varies regularly (envelope changes) and is proportional to the modulated signal. Therefore, the information in a modulating signal carried in the amplitude of an amplitude modulated wave. The following figure shows how a signal changes from a carrier signal.

Expand formula (3) to get the following formula:

$$u_{AM}(t) = U_{0m}\cos(\omega_0 t) + \frac{1}{2} m \cdot U_{0m}\cos\left[(\omega_0 + \Omega)t\right] + \frac{1}{2} m \cdot U_{0m}\cos\left[(\omega_0 - \Omega)t\right]. \quad (5)$$

As can be seen here, a single modulated audio signal consists of three high frequency components. In addition to the carrier, two new frequency components ($\omega_0 + \Omega$) and ($\omega_0 - \Omega$) are included. One is higher than ω_0, known as the upper sideband, and the other is lower than ω_0, known as the lower sideband.

Experimental part. In the experimental part we have carried out the work for measure the spectrum of the AM wave with different carrier frequencies and with modulating signals with different amplitudes. Spectrum analyzer GSP-930 and synthesizer GAF-130 by GW Instek were used. The experimental results shown in the following Fig. 1-3.

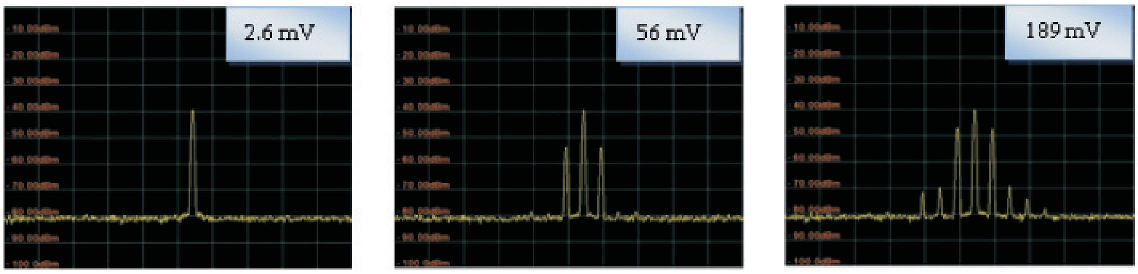

Fig. 1. Changing the modulating voltage. Frequency of modulating signal is 100 kHz, frequency of carrier signal 880 MHz

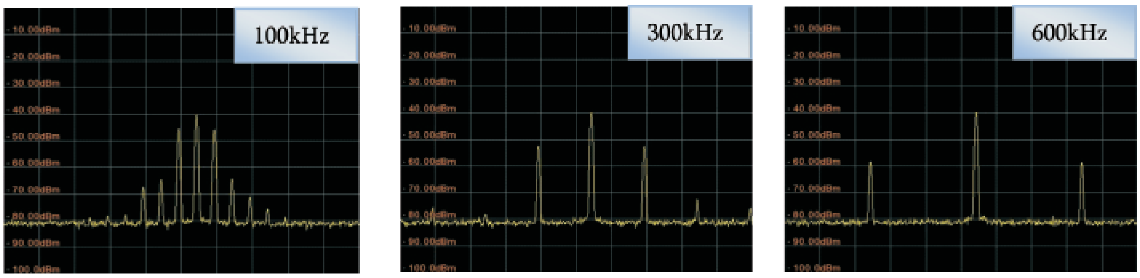

Fig. 2. Changing the modulating signal frequency. Modulating voltage is 250 mV, frequency of carrier signal 880 MHz

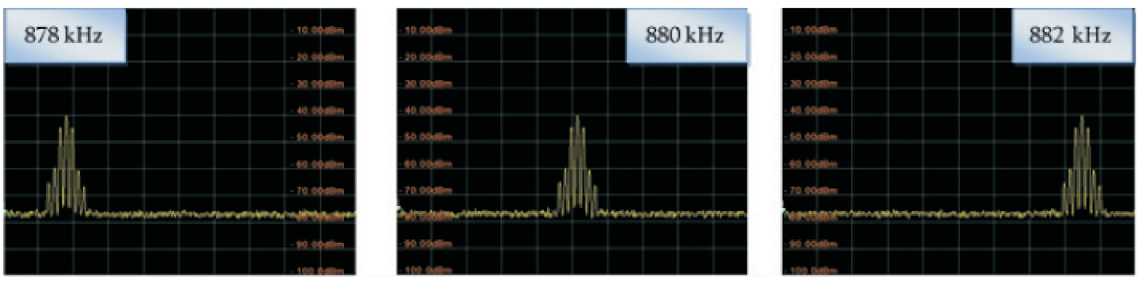

Fig. 3. Changing the carrier frequency. Frequency of modulating signal is 300 kHz, modulating voltage is 250 mV

Conclusion. From the above analysis, we can understand that amplitude modulation is a process of shifting a low frequency modulating signal into the sideband of a high frequency carrier. Obviously, in AM waves, the carrier does not contain any useful information. Information is only included in the sidebands.

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STUDY WETTING ACTIVITY SILICONES IN THE PRESENCE OF SURFACTANTS

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The influence of surfactant (technical product «Dispersant Telaz D») on the wetting of metal substrates with a silicon solution. It is shown that the surfactant improves the wetting of the metallic substrate wetting ability, and silicone fluids are closely correlated with their dispersant activity.

Silicone lacquer paint materials historically occupy a significant market share of coatings. Their quality of coatings depends largely on the degree of dispersion of their component pigments. Effective process for dispersing pigments, a great importance is the ability of the pigmented particles wetted components of the liquid dispersion medium. The purpose was to study the effect of surfactants (hereinafter SAS) wetting metallopigment. As the surfactant used technical condensation product of vegetable oils with diamines under the trademark «Dispersant Telaz D» (molecular weight – 2121 amu; amine number (HCI mg/g) – 32), the manufacturer of «Avtokoninvest», Russia.

It has been established that the layer was formed on an aluminum substrate with toluene at the boundary with the water is hydrophobic, the contact angle is equal to 116,3°. In contrast, the interfacial layer, which was formed in the presence of surfactants, had a completely different surface properties (possessed significantly lower hydrophobicity). Since the introduction of surfactant in toluene, water contact angles of metals decreased by 12–15°. With the introduction of surfactant in dilute solutions of resin content (10 % silicones), water contact angles decreased by 8–12°. Change in the interaction with the surface of the pigment wetting liquid, as a result of adsorption of surfactants, can be determined by changing the values of «relative work of wetting». In assessing this parameter is set, that the introduction of surfactant is increased wetting of metal substrates solutions silicones. Established patterns of change in the wetting activity are closely correlated with changes in patterns of dispersion metallopigment.

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CHARACTERES OF TWO COMPONENT CRYSTALOPTICAL SYSTEMS

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An analysis and synthesis of difficult optical elements from anisotropic crystals are of interest for the construction of laser measuring devices. Thus there is a task of development of methodology of calculation of such elements, that more precisely would describe their properties on passing and interference of hertzian waves. The co-version method of Ph. I (is known). Fyodor for the calculation of distribution of electro-magnetic waves in anisotropic environments. However this method results in difficult general expressions, and his use for ДКЭ is difficult. On the whole a task is not accessible to the strict analytical decision, thus basic difficulty is; in the necessity to take into account out-of-parallelism of wave vector to $k = 2\pi/\lambda$, describing transfer of phase of wave, and radial vector $\bar{s} = [\vec{E}, \vec{H}]$, describing transfer of energy of wave (λ – the length of wave, E, H – vectors of interesting of elliptic and magnetic fields.