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BROADBAND ANTENNAS

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This article shows the different types of broadband antennas, their main characteristics and disadvantages are also shown.

An antenna design is selected that most satisfies the broadband condition. Any radio engineering installation intended for radiation or reception of radio waves contains an antenna. The transmitting antenna can be defined as a device designed to emit electromagnetic waves. The receiving antenna is a device used to receive electromagnetic waves to use the information transmitted by these waves. The requirements for the antenna are different depending on the destination of the radio station [1]. Currently, there is a need for antennas for mobile communication, for navigation GLONASS Navstar, for communication with satellites, for communication with aircraft and other mobile objects. This requires the development of broadband antennas in the frequency range from the middle of the decimeter range (800 MHz) to the middle of the centimeter range (9 GHz).

In Fig. 1 shows one of the simplest broadband antennas – a broadband vibrator.

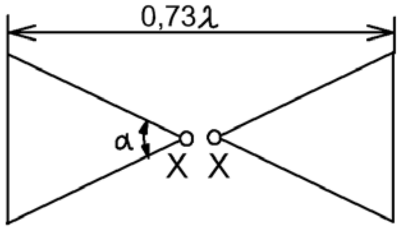

Fig. 1. Broadband vibrator

In this case we are talking about a wave vibrator which, due to the fact that its elements expand at the ends, has an extremely high bandwidth. Due to the increased influence of the edge capacitive effect the total length of the antenna is only 0,73λ. The input resistance depends on the angle α. Sometimes broadband vibrators are placed one above the other or in front of the reflex grating, which provides additional focus radiation in the vertical and horizontal planes [3]. Lack of vibrator antennas – low efficiency.

Spiral broadband antennas are more effective Fig. 2. The spiral antenna differs from other antennas possessing directional radiation, primarily in that its radiation field has a circular polarization. In the case of using such antennas, it is necessary that both the transmitting and receiving antennas have a circular polarization of the radiation.

Circular polarization takes place when the conductor is wound in the direction of radiation in the form of a spiral, and it is necessary that the total length of the conductor in one turn equals 1 λ, which corresponds to the coefficient of shortening of the diameter of the turn D equal to approximately 0.31 λ. It is assumed that at least three turns are used to obtain circular polarization, since the more turns the antenna has, the closer the polarization will be to the circular. A simple spiral antenna radiates in both directions in the direction of its axis. To obtain one-sided radiation and increase the antenna gain, a disk reflector is used.

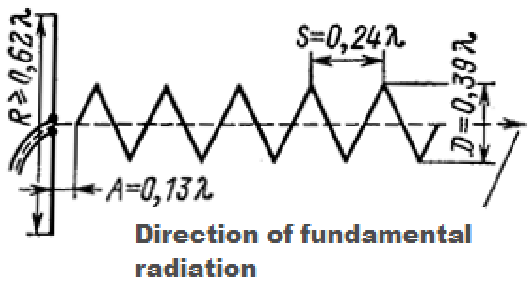

Fig. 2. Schematic representation of a spiral antenna

The spiral antenna has a wide bandwidth. With a distance between turns S 0.24 λ and the assumption of the maximum standing wave ratio in the power line (VSWR = 1.35) the ratio of frequencies within which the antenna operates satisfactorily is 1: 1.6 [3].

Logarithmic periodic antennas work best in a wide range of waves. Logarithmic periodic antennas are a relatively new design of broadband directed antennas. The greater bandwidth of the antenna combined with the significant gain is achieved due to the large consumption of structural materials, therefore the use of a logarithmic antenna only for radio amateur bands is usually impractical, but it is used as an all-wave antenna for television reception, including both amateur bands of 2 m and 70 cm. A characteristic of a logarithmically periodic antenna is that it consists of a plurality of elements connected in parallel [3].

The number of construction materials can be reduced using flat logarithmic spiral antennas. A flat logarithmic helical antenna is an electrodynamic system consisting of two flat curvilinear metal plates excited by a high frequency generator. The plates are called the shoulders of the antenna. The edges of each arm are defined by two identical logarithmic spirals, one of which rotates relative to the other by some fixed angle δ. This turn allows you to get a shoulder of finite width.

The equations of spirals for one arm in polar coordinates have the form:

$$\rho_1 = \rho_0 \exp(\alpha\phi);$$
$$\rho_2 = \rho_0 \exp[\alpha(\phi - \delta)]$$

where ρ_1, ρ_2 and ϕ – current polar coordinates; ρ_0, α and are δ positive constants.

The second arm of the antenna is identical to the first and rotated relative to it by 180°. The ratios of the radius vectors defining the edges of the shoulders are constant. Flat logarithmic spiral antennas belong to the class of frequency-independent antennas. To clarify this property, consider the curve that determines the shape of one of the edges of the antenna arm. We first note some features of the logarithmic spiral. The angle α formed by the radius vector ρ and tangent to any point of the helix is a constant value. Therefore, such spirals are also called conformal. As the angle ϕ is increased by one complete revolution, the radius vector ρ increases by a factor of. Thus, the dimensions of each subsequent turn of the logarithmic spiral differ from the previous only by a constant factor. The characteristics of the antenna remain unchanged if, with a change in the wavelength, all the dimensions of the antenna are proportionally changed. Influence of the shape and materials of which the antenna is made on its characteristics is shown in [4, 5]. The lower frequency of the working range of a logarithmic spiral is limited by the length of the helix arm, the upper frequency by the design in the region of the antenna feed points. In real antennas the ratio of these frequencies reaches 20. The large range of such antennas is explained by the following. The electromagnetic field along the antenna arms due to effective radiation rapidly decreases (by about 20 dB at a distance of one wavelength). As a result, with an increase in frequency, the active length of the shoulder decreases, a kind of automatic "cutoff" of the acting length of the shoulder occurs. This cutoff ensures the constancy of the relative dimensions of the radiating part of the spiral at different wavelengths and, consequently, the greater antenna range [1].

Conclusion. The characteristics of antennas operating in a wide frequency range are compared. The results of the comparison are as follows: vibrator antennas are low-efficient; spiral antennas are better, have an overlap factor = 2; Logarithmic periodic antennas require a large flow of structural materials; the most effective and economical are flat logarithmic spiral antennas with one-sided radiation, the overlap factor of which reaches up to 20.

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