UDC 621.371.39

THE STUDY OF THE CHARACTERISTICS OF THE 3G ANTENNA FROM CHANGES IN THE MATERIAL OF THE CONDUCTOR

A. STANOVOY, V. YANUSHKEVICH
Polotsk State University, Belarus

The article presents the design results of a GSM antenna depending on the material of the conductor. In connection with the development of electronic devices and communication systems, there is a need for GSM antennae. The use of antennae in radio systems allows increasing the capabilities of radio communication systems, radar systems, since the amount of information that is transmitted per unit of time is directly proportional to the signal frequency band; it also allows for high noise immunity of communication channels and improves accuracy in assessing the relative orientation of moving objects.

Introduction. An antenna is a device for radiation and reception of radio waves. [1]

The shape, size and design of antennae vary depending on the length of the emitted or received waves and the antenna destination. Antennae are used in the form of a piece of wire, combinations of such segments, reflective metal mirrors of various configurations, cavities with metal walls in which slots are cut (a slot antenna), spirals of metal wires and others. [2]

A GSM antenna is the most common antenna with a fairly narrow radiation pattern in the horizontal and vertical planes. An antenna consists of a set of elements: an active vibrator and several passive vibrators, one of which is a reflector, and the others work in the mode of directors. Reflectors weaken the radiation in the rear direction, directors amplify the signal in the right direction. All vibrators are parallel and lie in the same plane, which determines the polarization of the antenna. Such an antenna is called a "wave channel" antenna or a "Uda-Yagi" antenna. [3]

Main part. The calculation of the antenna allows us to obtain only approximate results, since it is necessary to take into account many interrelated factors (the length and thickness of vibrators, the distance between them), and is associated with cumbersome calculations. Therefore, most often antenna design, selecting all their sizes experimentally, adhere to the following rules:

1) for a given operating wave λ, calculate and set the length of the active vibrator $2l$ taking into account the shortening Δl

2) set the length of the reflector $2\ l_p$ by 5 - 10% longer than the length of the active vibrator, and the distance between the vibrators is about $0.2\ \lambda$;

3) using the field indicator, measure the field strength E_O (towards the active vibrator) and E_{180} (towards the reflector), and adjusting the distance dp between the vibrators and the length of the reflector achieve the minimum ratio E_{180}/E_O. for a system of two vibrators;

4) add a director, the length of which $2l_q$ is set shorter by 10 - 15% of the active length, and the distance a_d to the last is about $0.2\ \lambda$, and the minimum ratio E_{180}/E_O is achieved by adjusting the specified dimensions. For a system of three vibrators (this may require a slight adjustment of the reflector);

5) add successively second, third, etc. directors and make similar adjustments.

The shape of the radiation pattern (DN), the standing wave ratio (CWS) and the reflection coefficient (S11) are calculated for the frequency from 1.92 GHz to 2.17 GHz, the material is copper. The antenna has a directional radiation in the direction of 0 °, in the direction of -180 ° there is a reverse low radiation of the radiation pattern as shown in Figure 1. The antenna has good matching properties in the frequency range from 1.99 GHz to 2.17 GHz (Figure 2). The reflection coefficient from the input decreases from 0 dB at 1.92 GHz to -10.4 dB at 2.17 GHz, at 2.045 GHz, the reflection coefficient is -6 dB.

The shape of the radiation pattern (DN), the standing wave ratio (CWS) and the reflection coefficient (S11) are calculated for the frequency from 1.92 GHz to 2.17 GHz, the material is aluminum. The antenna has directional radiation in the 0 ° direction and is more directional. In the direction of -180 °, the backward radiation of the beam is observed (Figure 4). In the frequency range from 1.98 GHz to 2.17 GHz, good matching properties are observed (Figure 5). The magnitude of the reflection coefficient from the input decreases from -3.9 dB at a frequency of 1.92 GHz to -4.58 dB at a frequency of 2.17 GHz. At a frequency of 2.045 GHz, the reflection coefficient is -4.3 dB (Figure 6).

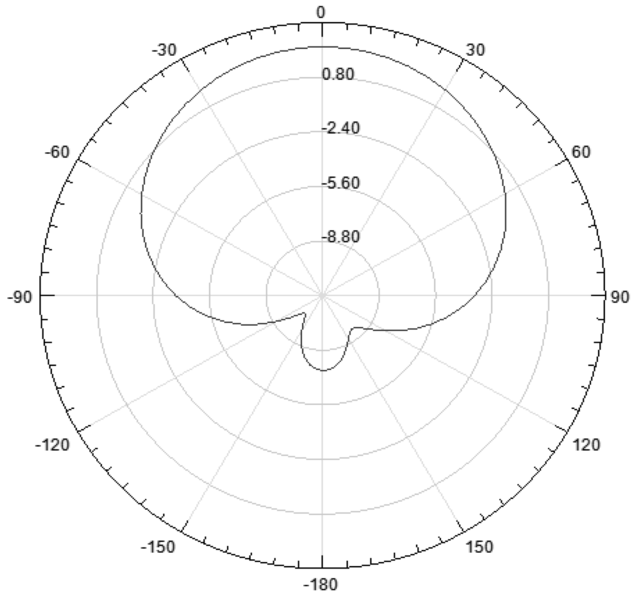

Figure 1. - Antenna pattern (copper)

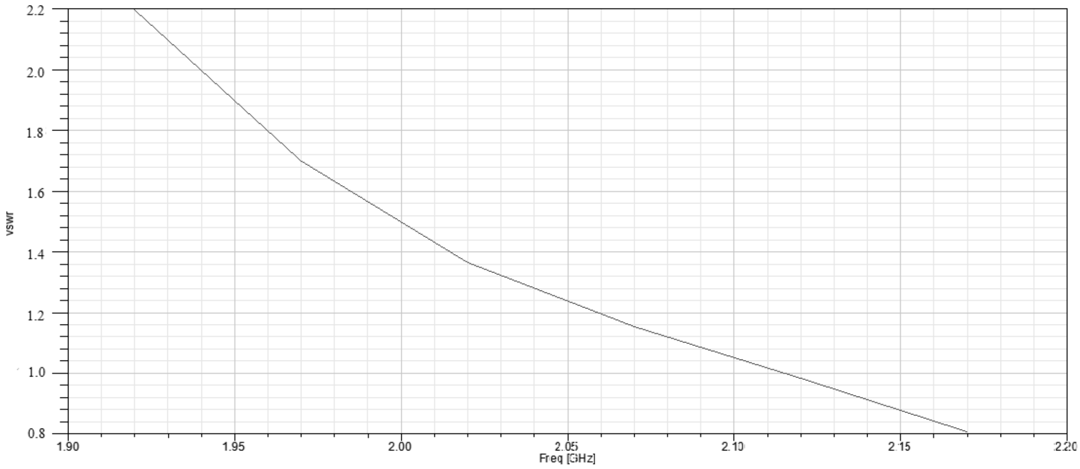

Figure 2. - Antenna standing wave ratio (copper)

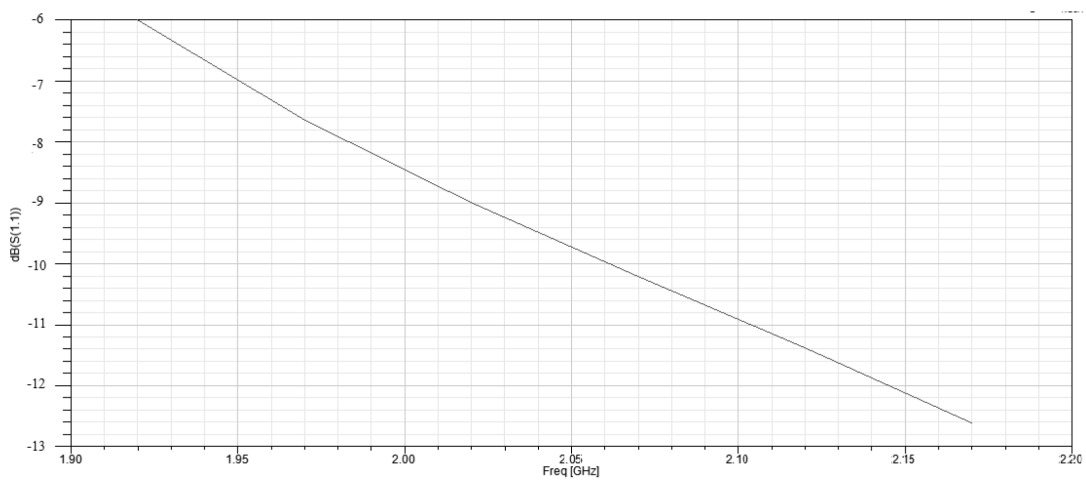

Figure 3. – S_{11} antenna parameter (copper)

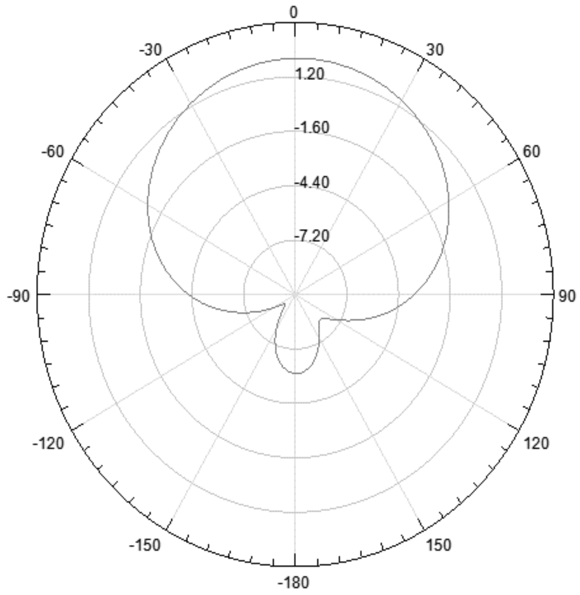

Figure 4. - Antenna pattern (aluminum)

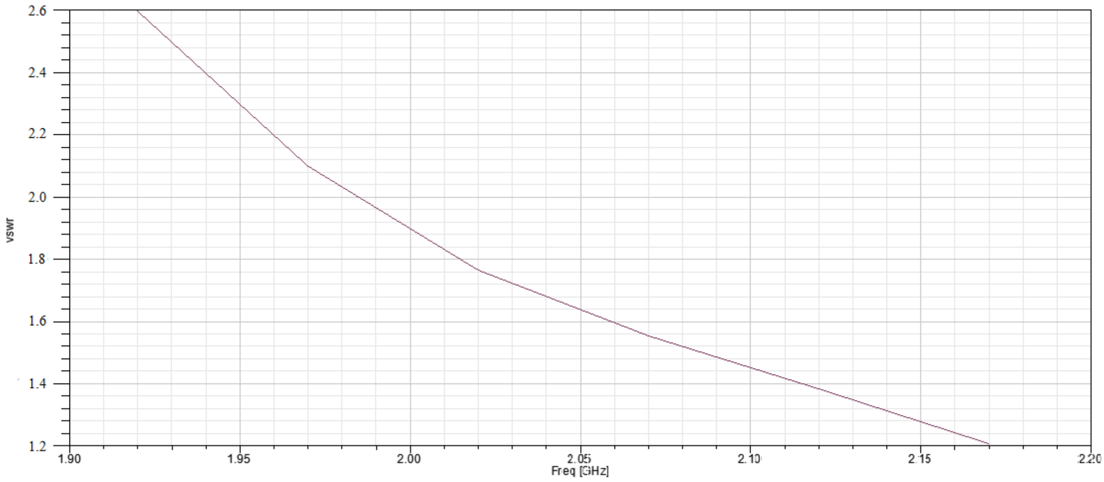

Figure 5. - Antenna standing wave ratio (aluminum)

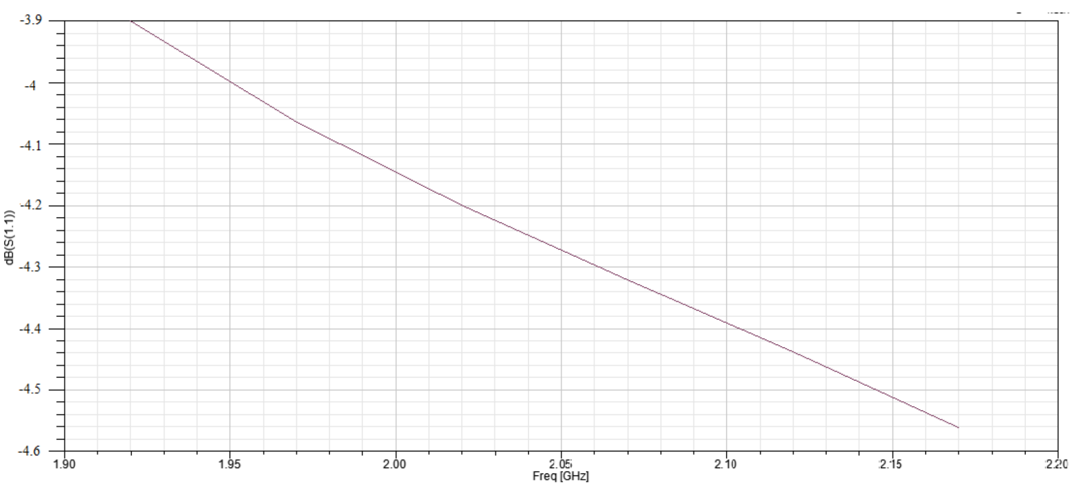

Figure 6. – S_{11} antenna parameter (aluminum)

Conclusion. In connection with the development of radio-electronic devices and communication systems, there is a need for GSM antennas. The use of antennae in radio systems allows you to increase the capabilities of radio communication systems, a radar, as the amount of information transmitted per unit of time is directly proportional to the frequency band of the signal; it also allows for high noise immunity of communication channels and improves accuracy when assessing the relative orientation of moving objects. A change in the material of the conductor affects the radiation pattern, its width and back radiation, as well as the SWR and reflection coefficient. From the data obtained, the optimal characteristics were shown, the material is cooper.

REFERENCES

1. GOST 24375-80. Radio communication. Terms and Definitions. 1986
2. Mob [Electronic resource]. - Electronic data. - Access mode: http: //mob.ua, access date: 21.02.2019
3. O.A., Yurtsev Yu 82 Traveling wave antennas, antenna arrays, short, medium and long wave antennas. At 3 pm - Part 3: Methodological manual for the course "Antennas and microwave devices" for students of the specialty "Radio Engineering". –Mn .: BSUIR, 2001. - 72 p., Ill. 60.