Antenna for radar “Radio Dozor-M”

R N Satarov, I S Tseplyaev, S E Shipilov, Y Buyanov
Researcher, Tomsk State University, Tomsk, Russia
E-mail: satarov.rail@gmail.com

Abstract. The article presents a new antenna for “Radio Dozor-M” device, which uses for a searching people behind the obstacles. The antenna is made with a printing on a foil PCB, mounted on a copper base. The antenna is part of an array with serial perquisition and it’s a combination of electrical and magnetic emitters. The calculated characteristics of the simulated antenna are presented. Also presents the results of the oscillogram obtained by probing a person behind the wall.

1. Introduction
The task of detecting people behind obstacles makes special demands on characteristics of searching devices. One of the main properties is weight and size. In the earlier article [1], the previous version of the device was demonstrated, which a lot larger. The authors developed a new antenna to modernize the Radiodozor-M radar and minimize size of the device. The new antenna array, which consist of two antennas, allows us to reduce device sizes to 45×15×15 cm and give it a functional shape.

It should be noted that all the methods of radiotomography were described earlier [1] and successfully implemented in the new version of device.

2. Antenna
The physical configuration of the print model of this antenna is shown in Figure 1. This design forms the total load of the wire antenna model which value is 50 Ω. A standard bipolar signal apply to this antenna. The frequency dependence of the VSWR antenna shows in the curve in a frequency range 0.7–3 GHz.

![Figure 1. Antenna: 1 – TEM horn, 2 – magnetic dipole, 3 – the input sma connector](image)
From the graph on Figure 2 you can see that in this frequency range, the VSWR of the modelling antenna (solid line) ≤ 2.5, which indicates good antenna matching. In addition, this figure have labels, which corresponding to frequencies. In addition, Figure 2 shows the VSWR of a real antenna (broken line), which was measured on a vector analyzer.

Can you see on the graph, matching of the real antenna is better than the calculated model. VSWR in the entire frequency range ≤ 2.0, with the exception of 2.4 GHz, where VSWR = 2.5.

![Figure 2. VSWR of antenna](image)

The antenna pattern was also calculated. From the graph on Figure 3 you can see that Peak power antenna patterns on 1.5 GHz. Angular width is 97 degrees at 3 dB at this frequency.

![Figure 3. Peak power antenna patterns](image)

At higher frequencies (3 GHz), the radiation pattern acquires an additional maximum, but at the same time, the amplification factor remains.

3. Results
Consider the use of developed antenna in a linear array. We selected the geometry of the antenna array in the linear array based on earlier studies of clocked antenna arrays excited by bipolar pulses [2]. As the basis chosen the distance between the elements 30 cm. We conducted the full-scale experiment to
probe a brick wall with the antenna array in a clocked mode, while data were collected in S11 and S12 modes. Behind the wall was a man at different ranges.

![Experiment demonstration](image)

**Figure 4.** Experiment demonstration

Figure 5 shows graphs of the intensity of S11 (a,b) and S12(c,d) radiation from a person in range, for a distance near of 5 m (a) and 10 m (b) from the wall. As you can see, the signal reflected from a person has a large amplitude due to the subtraction of the background signal.
Figure 5. Shows S11 signals reflected from a human for a distance of 5 and 10 m from the wall

4. Summary
The developed antenna is able to improve the functionality of the device radar “Radio Dozor-M”. With its help, the dimensions of the device will be reduced by half. As can you see from the graphs, the signals reflected from a human are distinguished from the signals reflected from other objects (walls, furniture, etc.). That means these signals can be processed by using methods of mathematical focusing and synthesis of aperture [2–4].

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