ON THE USE OF RADIAL GUIDES FOR MOBILE RADIO-FINDERS

P. del Castillo, M. Hernanz, C. Martín
T.D.C.-C.S.I.C.- Serrano 144, 28006 MADRID

Introduction

The origin of this work is the study of the radiation properties of a set of monopoles placed on the roof of a van containing a mobile laboratory for the detection of radio sources working on vertical polarization on the frequency range comprised between 10 and 1000 MHz. The obtained results in its study showed that this structures emitted in oblique polarization not only because of the ground plane influence (the roof) but also of the body of the van that works as a short monopole at low frequencies. Under these circumstances the azimuth discrimination was impossible since the horizontal component was highest and it masked the vertical one which is useful to determine the direction. So, new structures must be studied to solve this problem.

Among them, we think that the radial guide is the simplest. This guide is constituted, in our case, by two parallel metallic planes and between them a monopole is placed. The considered metallic and parallel sheets were rectangular (2m x 1m), and we studied two cases for the sheets separation, the first one was 0.145m and the second one was 0.240m.

The monopole is assumed placed perpendicularly to the sheets, in an asymmetric position and the distance from the monopole input to both edges of the sheets was 0.20m.

Numerical study

The structure treatment has been done by Moment Methods by means of the Richmond algorithm. Firstly, if the obtained radiation patterns with the two distances between sheets are compared, it can be observed that they have similar shape but the level of the signal is very different for each one. This behaviour can be clearly seen in figure 1 where there are two cuts one for $\Phi = 0^{\circ}$ and another one for $\Phi = 90^{\circ}$ and both at $f = 10$ GHz (for $\Phi = 90^{\circ}$, the signal level for E_{Φ} is at -40 dB aproximately).

Taking into account his result, it was decided to continue this study only for one value of the sheet separation (0.240m).

Azimuth radiation patterns

The obtained radiation patterns show that the vertical polarization (E_{θ}) is constant for one determined frequency and its value is higher than the horizontal one. As far as the phases are concerned, the variation of vertical component is sinusoidal, therefore the wanted discrimination seems possible whereas that of horizontal one corresponds with the typical change of sign between adjacent lobes.

The figure 2 shows the maximum variation of the phase of E_{θ} (for each frequency) versus the frequency. It can be seen that this variation is almost

linear and it becomes greater than 2 x (2π) for frequencies higher than 400 MHz.

Elevation radiation pattern

The study of different elevation radiation patterns for different frequencies leads to the conclusion that this structure is similar to that of a patch with the same surface dimensions that our structure.

Amongst the most representative frequencies only four of them have been chosen: two of them define the behaviour at low and high frequencies (10 MHz and 400 MHz) and the other ones become the resonant frequencies of the associated patch for the (1,0) and (0,1) modes. These frequencies are respectively 75 and 150 MHz.

The corresponding radiation patterns (in power) can be seen in figure 3.

If we observe these figures we can conclude that near the horizon the behaviour of both components is similar: E_θ is higher than E_ϕ (at high frequency, E_ϕ increases very much because superior modes are excited).

Input impedance

In figure 4 the variation of the input impedance of the monopole in the radial guide versus the frequency is represented.

The numbers correspond to the calculated frequencies, therefore the line that links these points shows a continuous estimation of the evolution, that seems in general, very reliable. Only it is possible the existence of small loops which have not been detected in that representation for high frequencies where resonances corresponding to consecutive modes appear.

Conclusions

Through the study it is observed that the obtained results for the considered radial guide are similar to a patch behaviour with the same dimensions that the guide. Like a consequence it seems advisable to design the future antenna like a patch whose characteristics are enough reported in the literature.

As far as the sub-band division is concerned, there are a lot of reasons which point to not overcome excessively the highest of the fundamental resonant frequency, some of them being:

- Very fast variation of impedance.
- Very hand ripple in the elevation radiation patterns.
- The need for removing the azimuth ambiguity which shows up when the variation of E_θ phase is higher than 2π, this value is reached (see fig. 2) for 187 MHz.

Acknowledgements

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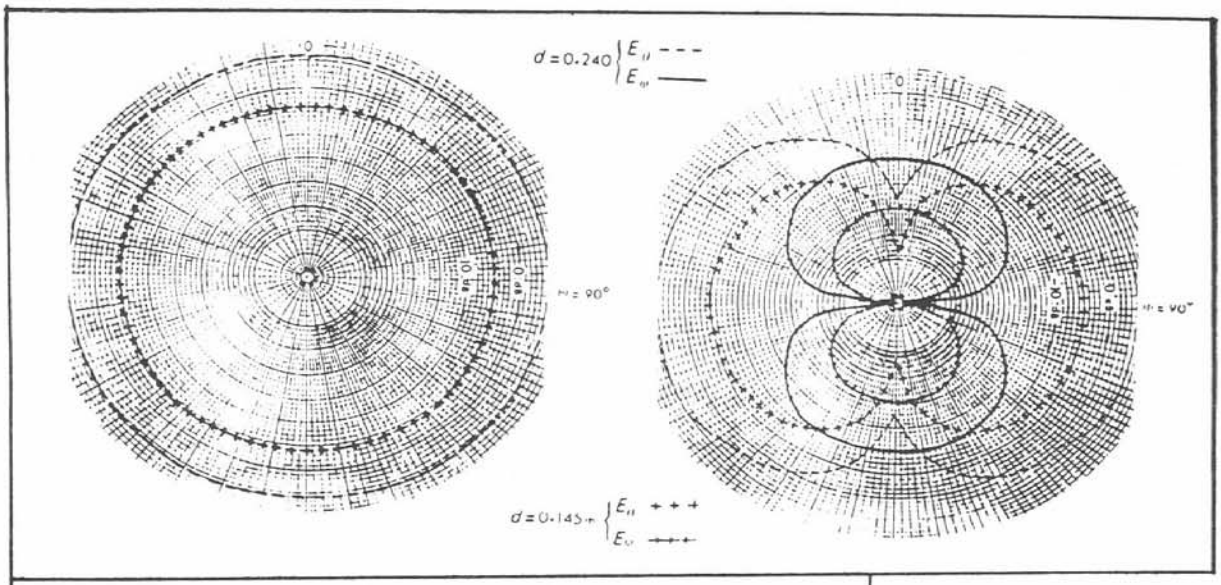

Fig. 1

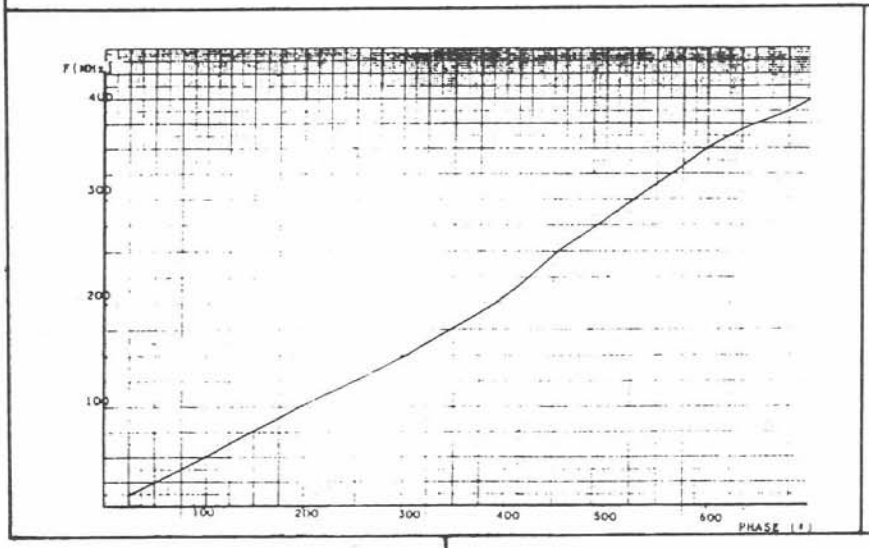

Fig. 2

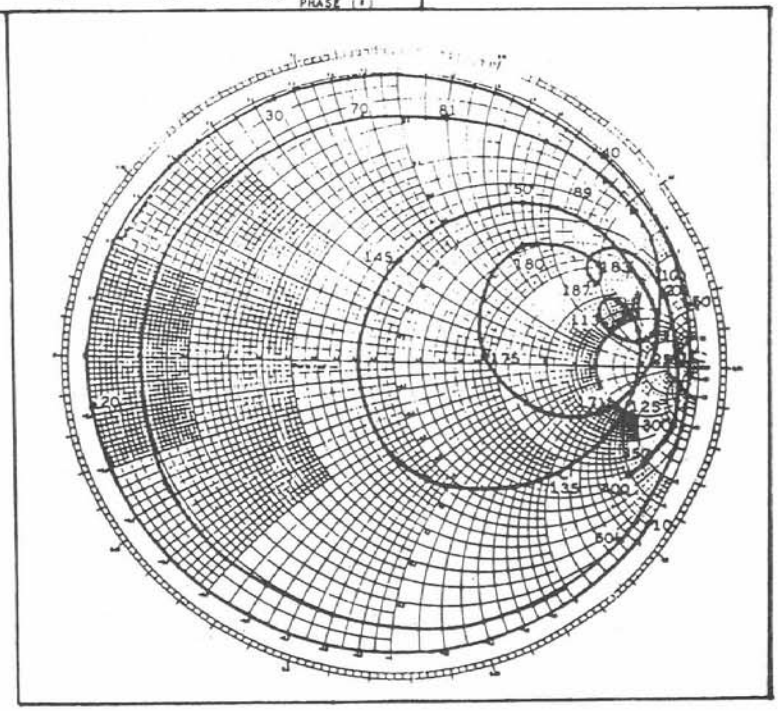

Fig. 4

Fig.3