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Enhance the impact of the magneto-dielectric materials to miniaturize a planar monopole antenna

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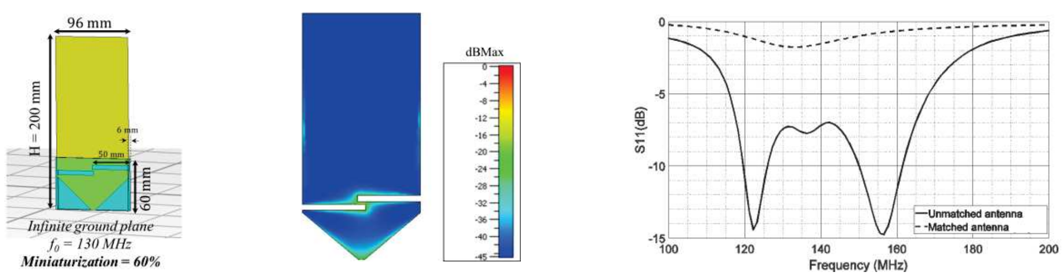
The use of Magneto-Dielectrics Materials (MDM) is becoming increasingly popular in the development of low-profile antennas [1]–[3] as well as achieving a high miniaturized size, these Materials allows avoiding highly concentrated field confinement when using high-permittivity substrates, which results in low antenna efficiency and narrow-band operation. This document presents the miniaturization impact of different geometries of the low-loss Magneto-Dielectric Materials (MDM) [4] on the planar monopole antenna covering the VHF band.

A wide-band planar monopole antenna covers the VHF band (118-156) MHz in the size of 51 cm was miniaturized, by inserting the antenna between two MDM plates, which covers partially the antenna only in the region near of the source where the intensity of the magnetic field is maximum, which allowed to miniaturize the antenna size to 43 cm by an optimum miniaturization rate of 15% using MDM of dimensions 9.6 × 6 cm [5]. The MDM used has a $\mu_r = 20$ and $\varepsilon_r = 14$ in the band of interest.

To enhance the effective permeability of such material we propose to insert two slots in the antenna structure, which serve to concentrate the surface currents in the area of intersection between the two slots (Figure 1), that leads to an increase in the magnetic field intensity in the MDM and therefore the effective medium. An optimization process has been elaborated of the MDM dimensions as well as its position on the planar monopole antenna. The objective is to reduce the quantity of MDM necessary to obtain a high antenna miniaturization rate as much as we can. We have finally shown that by covering only the region of the intersection between the two slots where the intensity of the surface currents and the magnetic field is maximum; it reduces the amount needed of MDM by 80% while maintaining a size reduction of 60% of the antenna's height.



(a) (b) (c)

Figure 1. (a) Antenna geometry, (b) surface currents and (c) reflection coefficient versus frequency.

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