A Novel Reconfigurable Electromagnetic Bandgap Structure for Wide-Band Noise Suppression on Printed Circuit Boards

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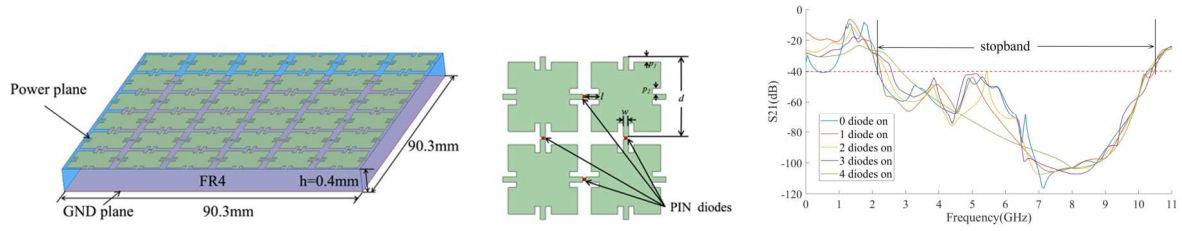
Simultaneous switching noise (SSN) is one of the important issues of the electronic devices, especially for medical devices that require a high degree of precision. SSN may be generated internally when the device is running, which affects the normal operation of the device [1]. In recent years, the electromagnetic bandgap (EBG) structure has been used to solve the SSN problem and has shown outstanding performance. Conventionally, it was required to design EBG structures of different sizes according to their respective desired frequency bandgaps. When the operating frequency is changed, the EBG dimensions have to be redesigned. However, this limits the application of EBG structures in many cases. A novel reconfigurable electromagnetic bandgap (REBG) structure is proposed in this paper to solve this problem. The 3D view of the whole structure is shown in **Figure 1.** (a). It is considered that a design of the two-layer FR4 printed circuit board (PCB) substrate with the total dimension 90.3×90.3×0.4mm^3 consisting of 3×3 large unit cells. As shown in **Figure 1.** (b), a large unit is made up of an array of 2×2 small unit cells and 4 PIN diodes, which is used to connect two adjacent small cells. The corresponding geometrical parameters of the small unit cell are denoted as (d, l, w, p_1, p_2), where d is the length of the side of small unit cell, l is the bridge length, w is the bridge width, p_1 is the half-gap between adjacent small unit cells, and p_2 is the gap between the metal pad and the bridge. The corresponding parameters for the design are (15, 2.5, 1, 1, 1 mm). The length and width of the diode are 0.1mm. The state of the PIN diodes in the same position in each large unit must be consistent, otherwise periodicity of the overall structure is not guaranteed. Several different cases of the reconfigurable EBG structure are simulated in HFSS with ideal conditions. The simulated results are shown in **Figure 1.** (c). The structure of unit cells will be changed by modifying the state of the PIN diodes, and then the bandwidth of the stop band can be tuned. The reconfigurable band gap width of the EBG board can be tuned from 2.15 GHz to 10.47 GHz, which is much larger than a lot of existing EBG structures. Compared with the conventional uniplanar compact electromagnetic bandgap (UC-EBG) structure in [2], the bandwidth of this paper is nearly doubled.



(a) (b) (c)

Figure 1. (a) 3D view of the proposed novel REBG structure. (b) Configuration of the array of 2×2 small unit cells. (c)Simulation results of the proposed novel REBG structure in different switching states.

References

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[2] Tzong-Lin Wu, Yen-Hui Lin, Ting-Kuang Wang, Chien-Chung Wang and Sin-Ting Chen, "Electromagnetic bandgap power/ground planes for wideband suppression of ground bounce noise and radiated emission in high-speed circuits," *IEEE Transactions on Microwave Theory and Techniques*, **53**, 9, Sept 2005, pp. 2935-2942, doi:10.1109/TMTT.2005.854248.