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# Reconfigurable Waveguide Using Glide-Symmetric Pins

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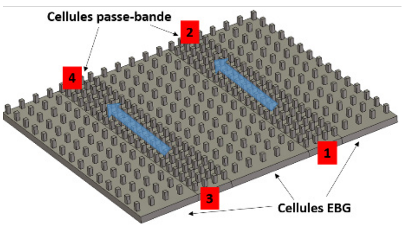
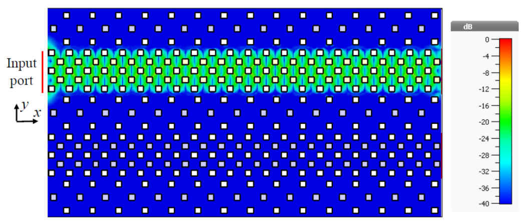
Millimeter waves are a pillar of next generation communications, since they offer large available bandwidths. At these frequencies, beamforming is typically considered to compensate for large free-space attenuations. Among good candidates for a physical implementation, multi-beam antennas such as multiple-input lens antennas can avoid expensive and lossy beamforming networks, since they can radiate different beams according to the selected input port, suitable for the grid-of-beams concept. However, the selection of the input port should be performed with a switch, a reconfigurable microwave component able to select the correct feeding port. Unfortunately, millimeter-wave switches are expensive and their power consumption is not negligible, due to the presence of active components, which are reconfigured to select the desired propagation path.

Here, we propose a metamaterial waveguide realized in parallel-plate technology designed for 60 GHz applications. The propagation characteristics of this waveguide are reconfigurable by modifying the distance between the plates. The structure is a parallel-plate waveguide (PPW) with a periodic array of vertical pins on both plates (the bottom plate is shown in Fig. 1(a), where two parallel waveguides are drilled in the same plate). Two different regions are drilled in the plates: EBG have large periodicities, so that no wave propagates in these regions. Waveguide regions have smaller periodicity, which corresponds to a pass-band at 60 GHz. The pins on the top plate are off-shifted with respect to the pins on the bottom plate by half a period in both periodicity directions. This configuration is called “glide symmetric” [1] since the structure is invariant under a translation of half a period and a mirror around the plane in the middle between the metallic plates. It has been shown that arrays of pins having glide symmetry usually exhibit a lack of frequency dispersion in their pass band, and have a much larger stopband frequency ranges with respect to structures with aligned pins [2].

It is important to notice that the two plates are contactless, so their distance can be easily reconfigured by means of piezoelectric actuators placed between the plates. Different distances between plates can modify the propagation features of the waveguide region. Closer plates prevent the propagation, while farther plates allow it. This mechanism enables therefore a switching behavior by simply acting on the distance between plates. The actuators only consume power when they are reconfigured, so the overall power consumption of the device is negligible. In Fig. 1(b) we show the simulation of the power flow of the structure in Fig. 1 at 60 GHz when the two waveguides are in the pass-band state and only one waveguide is fed. The isolation between the guides and the pass-band inside the waveguide are clearly proved.



(a)



(b)

**Figure 1.** (a) View of two reconfigurable waveguides; only the bottom plate is shown. (b) Power flow if only one waveguide is excited (top view; white and grey squares are metallic pins on the top and bottom plate, respectively.)

## References

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[2] M. Ebrahimpouri, E. Rajo-Iglesias, Z. Sipus, and O. Quevedo-Teruel,“Cost-effective gap waveguide technology based on glide-symmetric holey EBG structures,” *IEEE Trans. Microwave Theory Tech.*, vol. 66, no. 2, pp. 927–934, Feb 2018.