



Amplifying Reflectarray Unit Cell with Extended Bandwidth

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Reflectarray antennas are very good candidates for long distance wireless applications, including space communications, with known advantages over parabolic reflectors. The phase progression between the elements that construct the reflectarray antenna is responsible for redirecting the incident wave from a feeding source to a reflected beam at a desired angle. Recently, there has been interest in integrating amplifiers into the reflectarray unit cell design for applications including gain enhancement, loss compensation or spatial power combining [1].

A popular methodology for designing amplifying reflectarray unit cell uses cross-polarized elements, which receive power in one polarization and transmit power in the orthogonal polarization [2-4]. Amplifier stability over the entire operating frequency range is secured, in contrast to co-polarized reflectarray elements. Such cross-polarized elements can be orthogonal slots etched off a metallic plane. However, they suffer from narrow bandwidth, due to their single frequency resonance. This, subsequently, limits the bandwidth of the amplified transmitted wave.

In this work, we propose a unit cell with improved cross-polarized elements, that operate over a wider frequency range in microwaves. Starting from the general design topology of the unit cell in [4], we investigate and propose new geometries replacing the single coupling slot. The principle of operation of the proposed unit cell consists in a y-polarized wave incident on the microstrip patch, which next couples into the input terminals of the amplifier through the new slot structures along y. The amplified signal is coupled back to the microstrip patch through similar slots along x and radiates out as an x-polarized wave. The bandwidth of the amplified signal is therefore improved with this technique. A satisfactory impedance matching bandwidth is maintained over this frequency range with the optimization of the bottom microstrip line, which secures the lossless incorporation of the amplifier, as well as good isolation between the ports. The proposed cross-polarized unit cell is designed for operation in the C-frequency band.

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