

# Mechanically Steerable Array Antennas Using Controllable Microwave Phase Shifters

## Abstract

Low-cost antenna systems are important issues of the recent and the future flexible wireless communication systems. The most flexible satellite to ground/airplane communication systems are based on the phased-array antenna technology. However, the cost of phased array antenna is related to the number of active elements, and the present systems are too expensive for many commercial/military applications. In this paper, a novel design is proposed for a low-cost mechanically steerable array antenna. First, we fabricated and measured that a movable dielectric slab placed close to a coplanar waveguide (CPW) with gap used as a phase shifter. The added dielectric slab on CPW changes the effective dielectric constant and the characteristic impedance of CPW. Second, the 4-element array patch antenna with feeding network is fabricated and measured. Finally, based on previous ideas the mechanically steerable antenna designed and fabricated. The antenna consists of 4 patch antennas, 3 phase shifters, delay lines, and feeding network at 5.8GHz. The total antenna is fed from a  $50\Omega$  microstrip transmission line and the array antenna is designed to have an input impedance of  $98\Omega$ . The phase shifter consists of an adjustable phase shifter which uses the movable dielectric slab placed on a CPW and a fixed delay line to preset the phase of each feed line. Unfortunately, when the dielectric slab is added to CPW, reflection can be increased. To minimize reflection due to a dielectric slab, we set the length of the modified section to be  $\lambda/2$  (or  $m\lambda/2$  where  $m$  is an integer). Therefore, impedance mismatch can be avoided by choosing the slab dielectric constant and length carefully.