

STEERABLE ARRAY ANTENNAS WITH DIELECTRIC PHASE SHIFTERS FOR 77 GHZ AUTOMOTIVE RADAR APPLICATIONS

Junho Cha, Yasuo Kuga

Department of Electrical Engineering, University of Washington

The 77 GHz collision avoidance radar in an automobile requires a beam scanning mechanism. In this paper, a new design is proposed for a mechanically controllable millimeterwave phase shifter and array antennas. Numerical simulations using Ansoft HFSS and Designer have been conducted. We have demonstrated that a movable dielectric slab placed on a coplanar waveguide (CPW) could be used as a phase shifter for automotive radar applications at 77 GHz. The effective dielectric constant and the characteristic impedance are calculated as a function of the movable dielectric slab position on the CPW transmission line. One of the advantages of this newly proposed phase shifter design is that the whole antenna can be designed without using solid state phase shifters or MEMS devices. The length of the dielectric material placed on a CPW is 1.82 mm, 3.64 mm, and 5.46 mm which corresponds to  $180^\circ$ ,  $360^\circ$ , and  $540^\circ$ , respectively. The required dielectric constant of  $\epsilon_r=5.60$  can be designed using a common ceramic material. The microstrip transmission line to WR-12 waveguide transition for an initial feeding point has been studied. Seven element patch array antennas were investigated for this application. The array antenna was designed to scan with a phase difference of  $-90^\circ$  to  $+90^\circ$  with an expected beam scan angle of  $-20^\circ$  to  $+20^\circ$ . The element separation was set to  $2.922$  mm which corresponds to  $0.75\lambda$ . The left and right dielectric slabs were alternatively and repeatedly inserted into the CPW. In addition, preset delays lines are added to minimize the number of dielectric slabs. We have designed the proposed antenna on a Duroid 5880 substrate ( $\epsilon_r=2.2$ ) with a thickness of 10 mil (0.254 mm).

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: cha7744

Date Received: September 22, 2005

1. (a)

JUNHO CHA

Department of Electrical Engine

University of Washington

Campus Box 352500

Seattle, WA

98195 United States

junho2@u.washington.ec

(b) 206-616-4374

(c) 206-543-3842

2. B - Fields and Waves

3. (a)

4. C - Contributed Paper

5. No special instructions