Comparison of Multi-Beam Pillbox Antennas using Leaky-Wave and Slotted Waveguide Radiating Parts for Automotive Radars at Millimeter-Waves

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***Abstract*— This work deals with a comparison between multi-beam leaky-wave and slotted waveguide pillbox antennas. The antenna systems present the same pillbox architecture: feeding part, quasi-optical system and radiating part. Two different radiating parts are considered: a leaky-wave solution and an array of slotted waveguides. In particular, an array of slots etched on the uppermost metal layer of the pillbox structure and 23 waveguides with 8 radiating slots are adopted for the leaky-wave and slotted waveguide solution, respectively. The quasi-optical system and feeding part used in both antennas are the same. The quasi-optical system is made by a pin-made integrated parabola and several coupling slots, and is used to shape and focus the energy coming from the input part to the radiating part. Seven pin-made integrated horns are placed in the focal plane of the integrated parabola to radiate seven beams in the far field. The antenna performances in terms of efficiency, bandwidth and scanning capabilities are compared. Both the proposed antennas are low-cost, low profile, compact, efficient and very promising solutions for applications in the millimeter-wave range, especially for long range automotive radars.**

I. INTRODUCTION

During the last years, automotive radars have been indicated as possible solutions to reduce fatal road accidents as demanded by EU authorities. To respond to this new needs, automotive radars should evolve from nowadays expensive comfort system [1]-[3] to low cost active equipments able to detect and respond to the different scenarios close (short range) and far away (long range) from the car.

A recently proposed pillbox antenna [4] seems to be a really promising solution for next generation of automotive radars. The attractive characteristics of such antenna are high-performance, low-cost, compactness, low-cost and small-size.

In particular, the proposed pillbox antenna is based on a SIW (Substrate Integrated Waveguide) double layer structure (Fig. 1) where the feeding and radiating parts are located in two different substrates connected by a quasi-optical system made by an integrated parabolic reflector and several coupling slots. More precisely the feeding part (an integrated horn in Fig. 1-(c)) is placed in the focal plane of the parabolic surface and launches the energy in the first substrate in the form of a quasi-Transverse Electromagnetic Mode (TEM) presenting a cylindrical wave front.

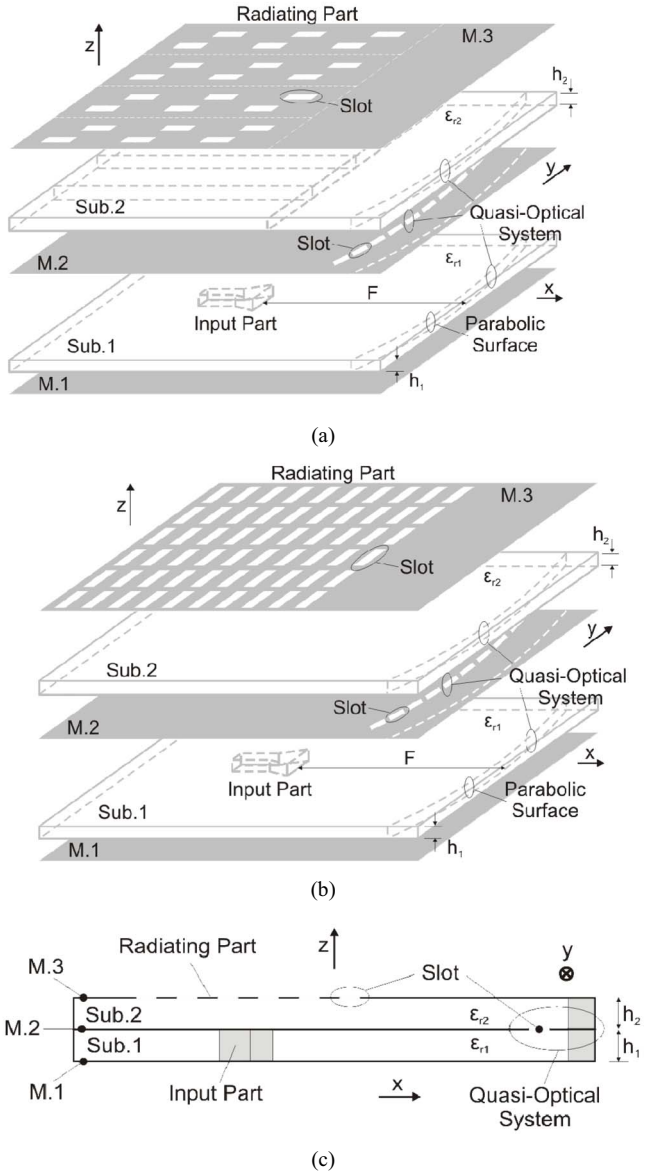

Fig. 1 Multi-beam pillbox antennas. (a) 3-D view of the slotted waveguide solution; (b) 3-D view of the leaky-wave solution; (c) 2-D view of both antennas in the *xz*-plane. 'Sub.' and 'M.' stand for substrate and metal layer, respectively. Sub.1 and Sub.2 are double grounded substrates.