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A Compact Printed Antenna with Switchable Broadside and Conical Radiation Patterns for V2X Applications integrated into Vehicle Lateral Mirrors

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In the last decades, the number of mobile and wireless applications has rapidly increased and some specific applications have experienced a significant evolution. For example, the demand of wideband cellular antennas for Long Term Evolution (LTE) and 5G communication systems is continuously increasing in smartphones and vehicular applications. In particular, with the aim of making a vehicle as "smart" and autonomous as possible, in automotive industry the number of wireless services is significantly increasing, that consequently leads to a higher number of embedded radiating elements [1]. Even though the size of a vehicle is expected to allow for an easy integration of a multitude of antennas, it is well known that one of the best positions for antennas is above the vehicle roof, since the radiating elements are not affected by surrounding mechanical components and a better radiation toward the cellular base-stations is guaranteed. Antennas are typically integrated together under plastic covers, named shark-fin. However, the increase of wireless functionalities in automotive industry results in complex electronic systems, networks, and architectures. Thus, the integration of antennas is challenging in those cases where multiple antennas are present because antenna compactness and isolation requirements are complicated to be fulfilled. Moreover, some applications such as the Vehicle-to-Infrastructure (V2X) service require antennas with omnidirectional patterns so that an omnidirectional coverage is guaranteed to communicate with vehicles and infrastructure. However, the presence of multiple antennas under the same coverage deteriorates the omnidirectionality of the antenna radiation pattern on the azimuthal plane, due to the shielding effect of surrounding elements. This effect is particularly notable at higher frequency as for example at the V2X band (i.e 5.85 – 5.925 GHz). Consequently, several studies are focused on distributing multiple V2X antennas around the car, for example in the lateral mirrors, to obtain an omnidirectional coverage by combining multiple radiating elements.

In this paper, a V2X antenna is designed to be integrated into the vehicle lateral mirrors. A picture of the fabricated prototype is depicted in Figure 1. Thanks to its low profile and compactness, it can be easily integrated without modifying the existing mechanical structures. Also, by means of PIN diodes, its radiation pattern can be switched from broadside to conical, thus obtaining a further degree-of-freedom to get an omnidirectional service coverage.

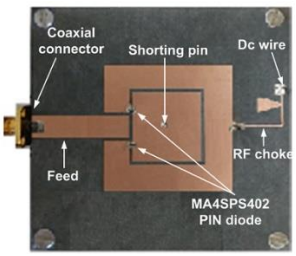

Figure 1. A picture of the fabricated prototype of the V2X printed antenna with switchable broadside and conical radiation patterns.

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