# Compact Quad-band Slot Antenna for GPS L1, WiMAX, and WLAN Applications

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***Abstract* – In this paper, a compact four-band slot antenna in a small ground plane is proposed for global positioning system (GPS L1), worldwide interoperability for microwave access (WiMAX), and wireless area network (WLAN) applications. The proposed antenna is comprised of a slotted ground plane on the top and an asymmetric cross parasitic strip on the bottom. By properly designing the slots on the ground plane, four resonant frequency bands are achieved in the small area. The proposed antenna attains multiband characteristic with compact size. In addition, the proposed antenna has a gain greater than 2.5 dBi in free space.**

***Index Terms* — Slot antenna, Multiband, GPS, WiMAX, WLAN.**

## 1. Introduction

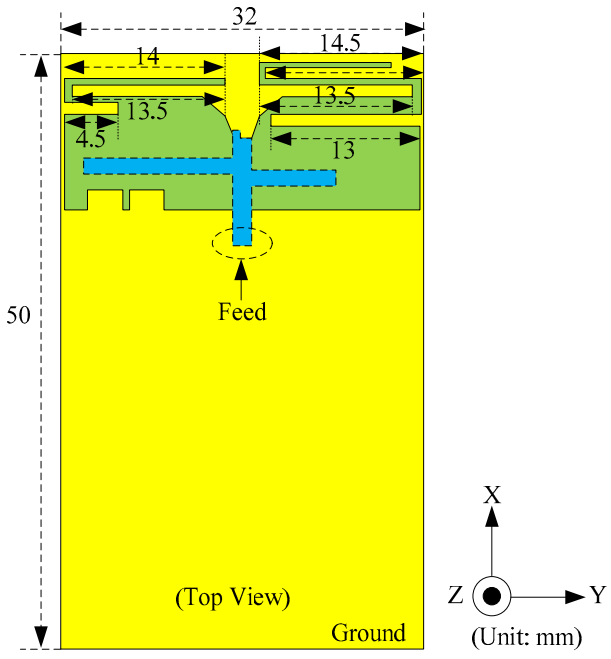
With the rapid development of the wireless communication standards, such as global positioning system (GPS), worldwide interoperability for microwave access (WiMAX), and wireless area network (WLAN), multi-band operation is highly demanded in a single wireless communication device. However, it is a big challenge for a single wireless device to achieve multi-band operation and to maintain good radiation gains due to the size limitation of the compact main circuit board. Thus, it is desirable to minimize the antenna size while keeping a good radiation characteristic.

Recently, many researches on multi-band antennas have been reported. In [1]-[2], the printed inverted-F antenna (PIFA) was proposed to realize the multi-band characteristic. In [3]-[6], multi-band characteristic was achieved by etching multi-slots on the ground plane. However, the antennas mentioned in [1]-[6] have a large size.

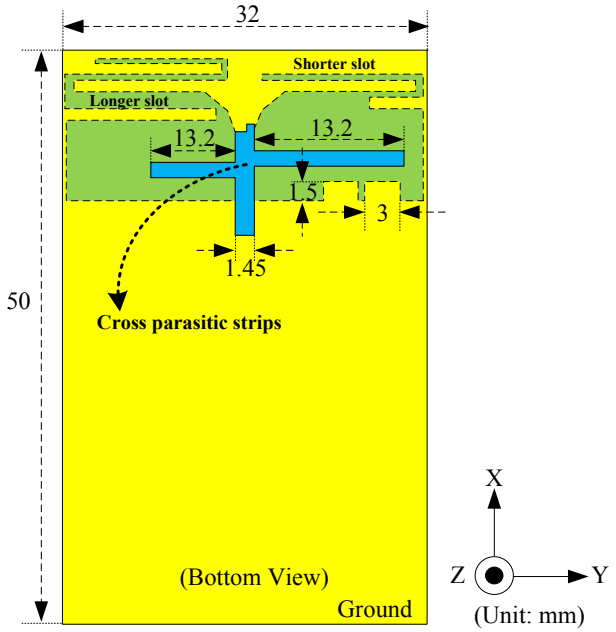
In this paper, we propose a compact slot antenna which covers GPS L1 (1.52 GHz – 1.62 GHz), WiMAX (3.3 GHz – 3.6 GHz), and WLAN (2.4/5.2/5.8 GHz) bands. The proposed antenna consists of a slotted ground plane on the top and an asymmetric cross parasitic strip on the bottom. The cross parasitic strip mainly operates as a tuning stub. The antenna attains good radiation gains greater than 2.5 dBi in operating bands, with a compact size (13 mm × 32 mm × 0.8 mm). The proposed antenna is simulated by ANSYS High Frequency Structure Simulator (HFSS) and CST Microwave Studio (MWS) in this work.

## 2. Antenna Design and Results

Fig. 1 depicts the geometry of the proposed antenna. The proposed antenna is designed on a FR-4 ($\varepsilon_r$ = 4.4, tanδ = 0.02) substrate with a thickness of 0.8 mm. The proposed antenna has a compact size of 13 mm × 32 mm × 0.8mm, being minimized for 51.9% compared to [7]. The total dimension of the proposed antenna including the ground plane is 50 mm × 32 mm × 0.8 mm, which is reduced for 35.1% than [7]. Two narrow slots are etched on the top of the substrate, in which the longer one in the right side is mainly performed to resonate at the GPS L1 frequency band, and the shorter one in the left side resonates at the WLAN (2.4/5.2/5.8 GHz) band. In addition, the asymmetric cross parasitic strip on the bottom side of the substrate improves the impedance matching for WiMAX band. The antenna is fed by a 50 Ω SMA connector which is located at the center of the antenna.




(a)




(b)

Fig. 1. Geometry of the proposed antenna (a) top view (b) bottom view.

Fig. 2 shows the simulated reflection coefficient of the proposed antenna. The -10 dB reflection coefficient bandwidth is satisfied in GPS L1 (1.54 GHz – 1.59 GHz), WLAN 2.4 GHz (2.19 GHz – 2.59 GHz), WiMAX (3.31 GHz – 3.69 GHz), and WLAN 5.2/5.8 GHz (4.99 GHz – 5.82 GHz) bands.

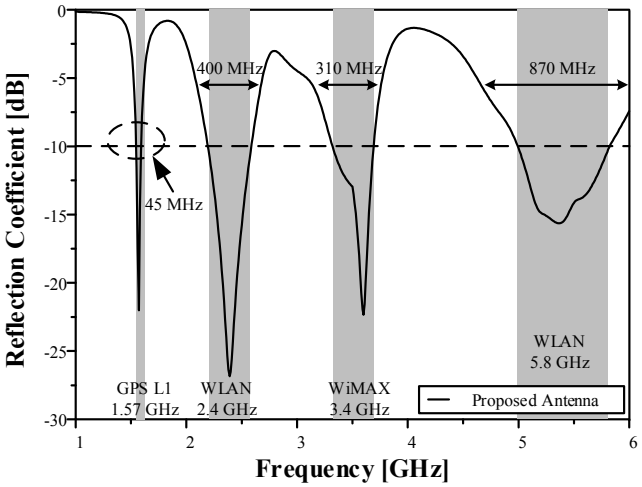



Fig. 2. Simulated reflection coefficient of the proposed antenna.

Fig. 3 illustrates the simulated realized gains of the proposed antenna. The proposed antenna attains good radiation gains of 2.5 dBi in GPS L1 band, 2.9 dBi in WLAN 2.4 GHz band, 4.72 dBi in WiMAX band, and 4.78 dBi in WLAN 5.2/5.8 GHz bands, respectively.

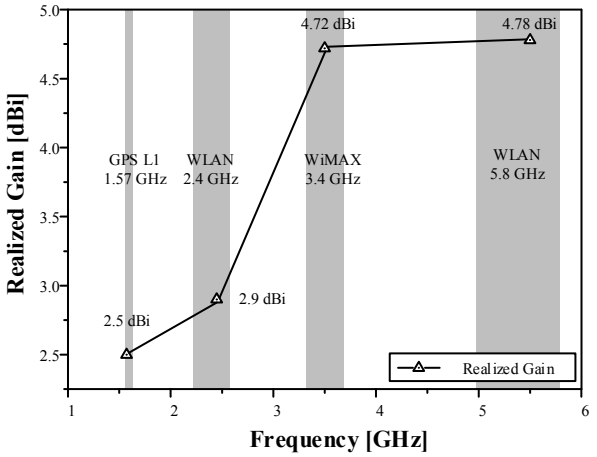



Fig. 3. Simulated realized gains of the proposed antenna.

## 3. Conclusion

In this paper, a compact four-band slot antenna for GPS L1 (1.57 GHz), WLAN (2.4/5.2/5.8 GHz), and WiMAX (3.4 GHz) applications is proposed. The proposed antenna has a compact size of 32 mm × 13 mm × 0.8 mm. This antenna has wide bandwidths of 45 MHz in GPS L1, 400 MHz in WLAN 2.4 GHz, 310 MHz in WiMAX, and 870 MHz in WLAN 5.2/5.8 GHz bands, respectively. In addition, the proposed antenna has good radiation gains greater than 2.5 dBi. Therefore, this antenna is an excellent candidate for the GPS L1, WiMAX, and WLAN (2.4/5.2/5.8 GHz) applications.

## Acknowledgment

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