

Built-in Slot Antenna Utilizing Through-Hinge FPCB Holes in Folded Smartphone

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Recently, foldable smartphones (as shown in Fig. 1(a)) have been leading market trends by enabling a large-screen display experience while maintaining portability. However, from the perspective of mobile antennas, these devices present several growing challenges. Key issues include the need to enhance durability against repeated folding, the reduced distance between the antenna and the display/black matrix due to thinner and lighter designs, the limited physical space available for antenna implementation, and the requirement to meet various mobile carrier specifications (e.g., bandwidth, TRP, TIS, throughput). These challenges have become increasingly demanding year by year.

Traditional methods for designing mobile antennas to address these challenges often focus on optimizing metal frame antenna structures to physically maximize separation from the display. However, as the available physical area for antennas continues to shrink, performance degradation due to hand effects during usage has become a significant concern. Furthermore, implementing multiple antenna segments to support multi-band coverage is reaching its limitations.

This paper introduces a novel class of smartphone antennas that utilize built-in slot antennas through hinge FPCB (flexible printed circuit board) holes in foldable smartphones. For foldable devices, FPCBs and hinges are essential components that electrically connect the main PCB and sub-PCB while enabling folding operations (as illustrated in Fig. 1(b)). By designing a built-in slot antenna that passes through a hinge and reaches the opposite metal, these previously unused slots and hinges can now contribute to antenna performance in addition to their original mechanical functions.

The proposed approach demonstrates that utilizing these typically unused regions as antennas significantly enhances mobile antenna performance. By maximizing antenna diversity, this design mitigates multipath fading, improves transmission rates, and addresses prior limitations. Additionally, under real-world conditions, users can fully benefit from improved antenna performance, even in areas typically obscured by their hands.

Details about the proposed antenna topology, design procedure, and simulated/measured results will be presented.

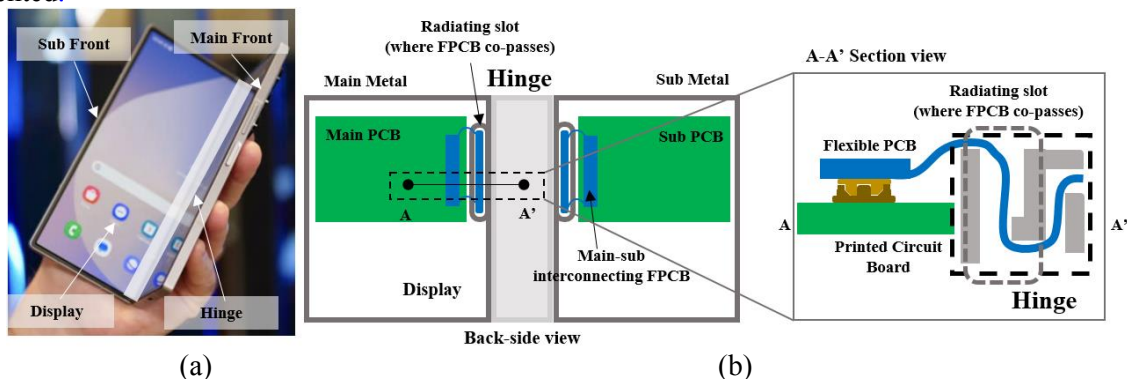


Figure 1. (a) Foldable Smartphone and (b) Proposed Antenna Concept and Topology