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Zero ground clearance dual antenna pair for metal-cased fifth-generation multiple input multiple output smartphone

Key words: Smartphone antenna; MIMO antenna; Orthogonal polarization; Zero ground clearance; Dual antenna pair

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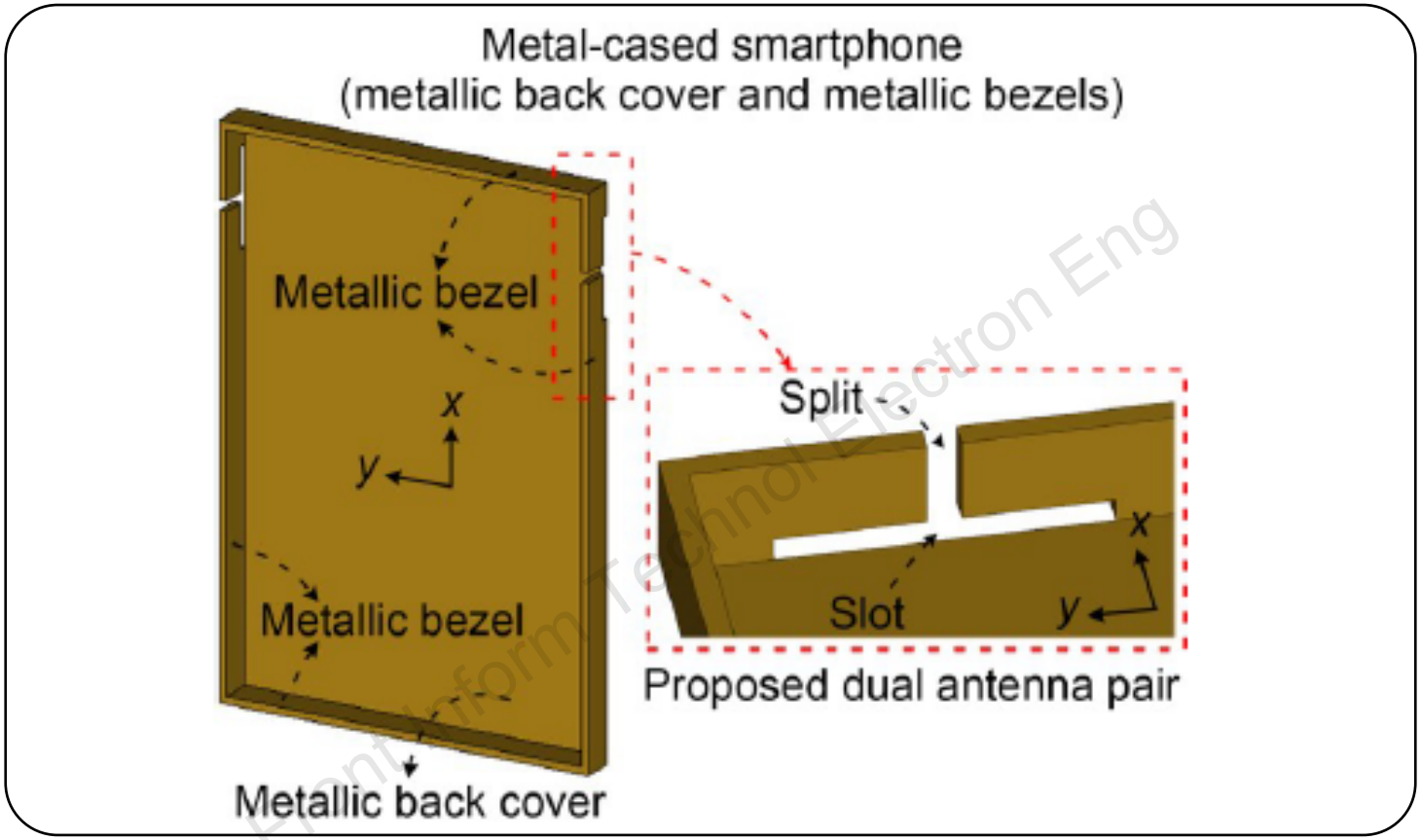
Motivation

- For a fifth-generation (5G) device, the most challenging task for antenna engineers is to accommodate the numerous 5G multi-port antennas while **avoiding mutual coupling problems**.

- **A metallic back cover** can deteriorate impedance matching and reduce radiation efficiency for antennas deployed in ground clearance.

- This article addresses the issue of **zero clearance** dual antenna pair suitable for **metal-cased smart terminals**.

Metal-cased smartphone model



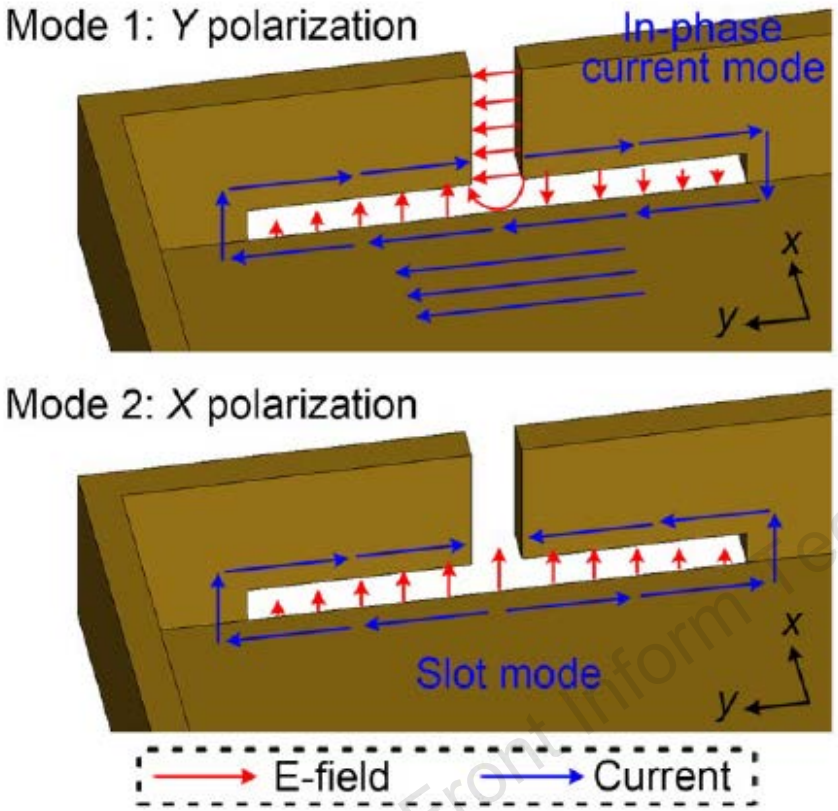
Metal-cased model:

- **Metallic back cover**
- **Zero ground clearance**

Dual antenna pair:

- **Ant1: excite the split**
- **Ant2: excite the slot**

Working principle



Orthogonal polarization

Mode1: *Y* polarization:
The potential difference is built across the split to excite the in-phase current mode.

Mode2: *X* polarization:
The potential difference is built across the slot to excite the classic slot mode.

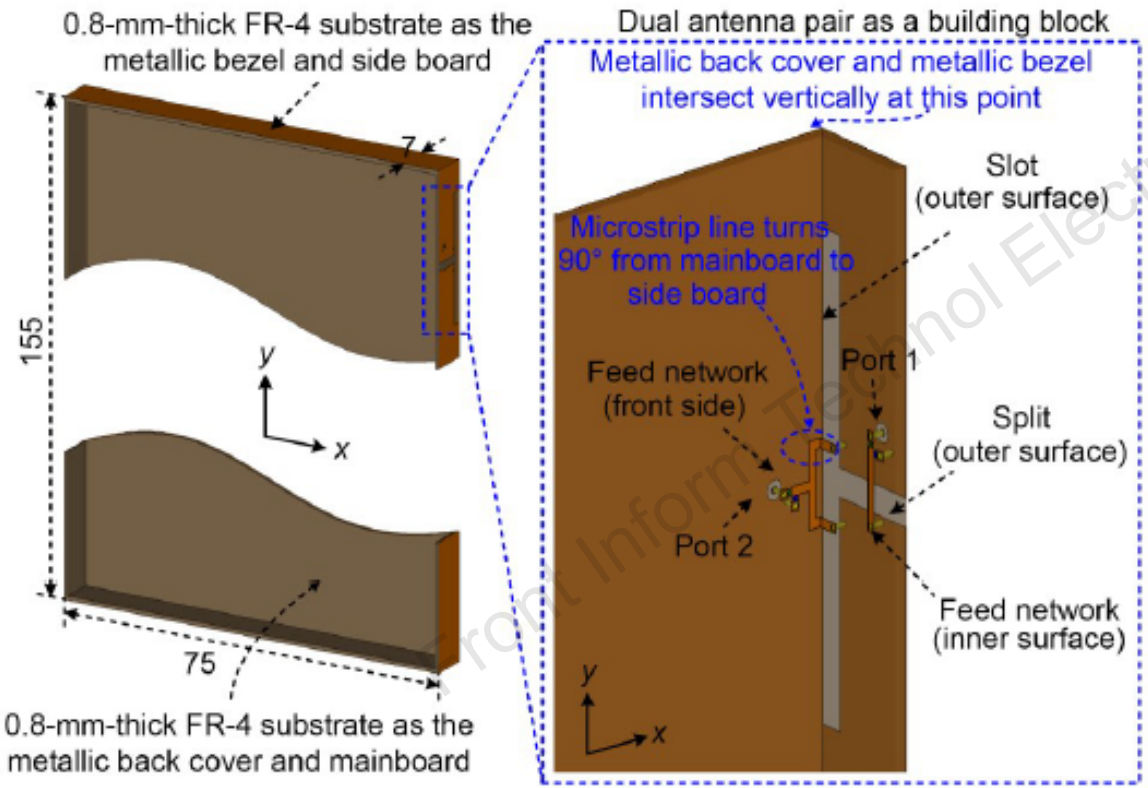
Manipulate two modes:

- ✓ **Make $f_{mode\ 1} = f_{mode\ 2}$**
- ✓ **Excited them properly**

Merits:

- ✓ **Suitable for zero clearance**
- ✓ **High isolation**

Realization



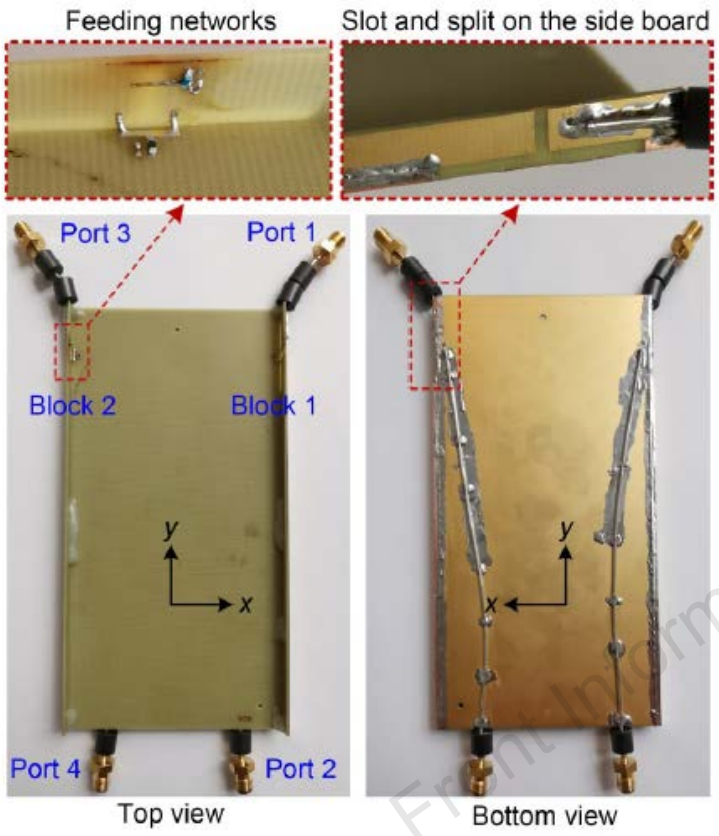
Size: 25 × 1.5 mm^2
Bands: 3.4~3.6 GHz

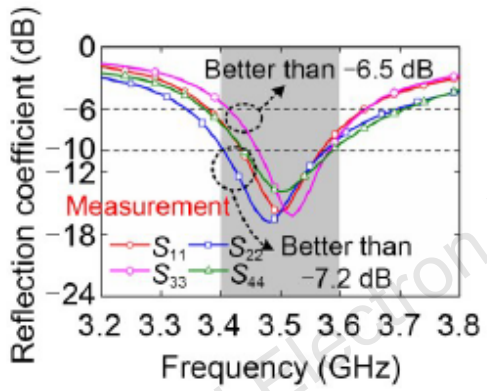
Manipulate two modes:

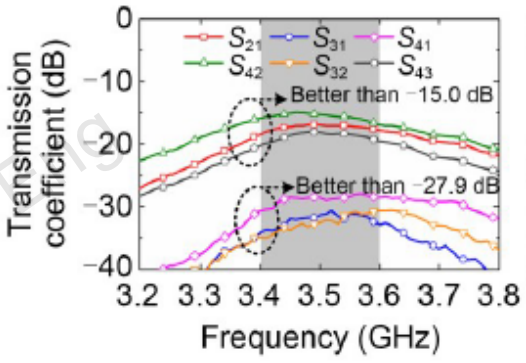
✓ **Make $f_{mode\ 1} = f_{mode\ 2}$**
Both: Using LC

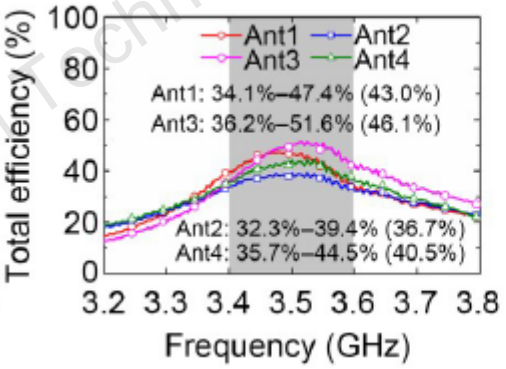
✓ **Excited them properly**
Odd slot: Microstrip line
Even slot: *Y*-shaped network

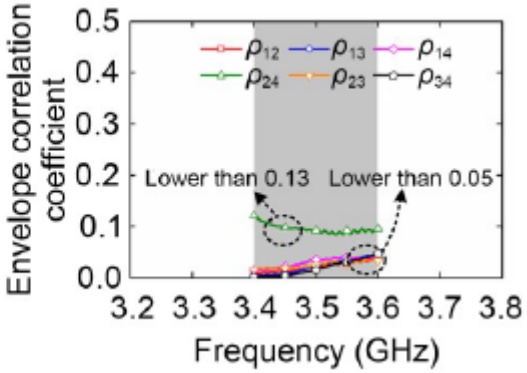
Fabrication prototype and measured performance











- ✓ **Isolation is better than 15 dB**
- ✓ **Envelope correlation coefficient (ECC) is lower than 0.13**

Conclusions

- A dual antenna pair with orthogonal polarization and zero ground clearance property suitable for metal-cased 5G MIMO smartphone was proposed.

- Two orthogonal degenerate characteristic modes, including the in-phase current and slot modes, were excited on the single antenna structure.

- A four-antenna MIMO system was fabricated, and the measured results demonstrated the feasibility of the device.

Le CHANG received the BS degree in electronics and information engineering from Xidian University, Xi'an, China, in 2012, and the PhD degree in electrical engineering from Tsinghua University, Beijing, China, in 2017. From 2017 to 2020, he worked at the Antenna and RF Group, Huawei Device Ltd., Beijing, China, where he was a senior engineer. Since 2021, he has been a Special Appointed Researcher with Xi'an Jiaotong University, Xi'an, China. His current research interests include 5G mobile antennas, millimeter-wave antennas, and phased arrays.

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