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# Two-bit dual-polarized reconfigurable intelligent surface with low power consumption for 6G near-field communication

**Key words:** Reconfigurable intelligent surface (RIS); Dual polarization; Near-field communication; 6G communication

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# Motivation

- The hardware of reconfigurable intelligent surface (RIS) is applicable for both near-field and far-field communications. However, the array scale of RIS is much larger in near-field communication to expand the near-field coverage region, and the cost and power consumption of RIS are crucial factors that determine the massive application in the future 6G near-field communication.



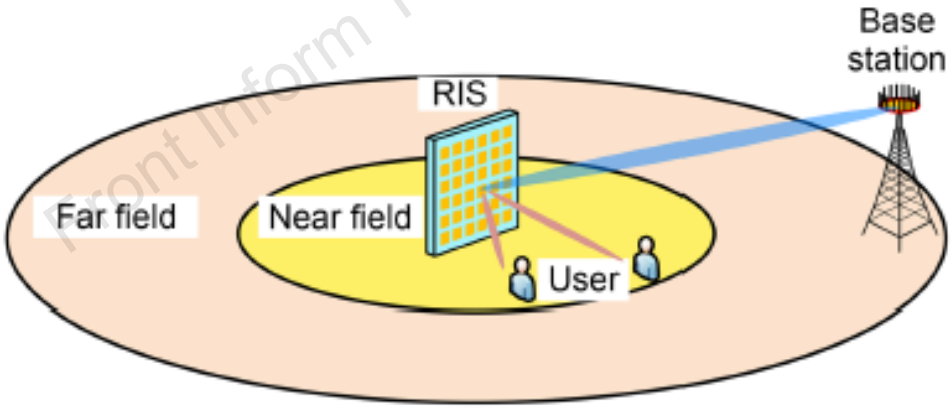


**Fig. 1 Typical reconfigurable intelligent surface (RIS) aided scenario for near-field and far-field hybrid communication**

# Main idea

- In this paper, a novel 2-bit dual-polarized RIS operating at 3.6 GHz band is presented which has low power consumption. Instead of using the p-i-n diodes, a single-pole-four-throw (SP4T) switch is adopted to build the 2-bit phase shifter. The complementary metal oxide semiconductor (CMOS) fabrication process makes the switch have very low biasing current.
- Dual polarization is generated by placing two orthogonal slots with two 2-bit phase shifters. The total power consumption of the 15×15 RIS is about 100 mW. To the best of authors' knowledge, it is the first dual-polarized RIS that uses merely one tunable component to achieve 2-bit phase shift.

# Method

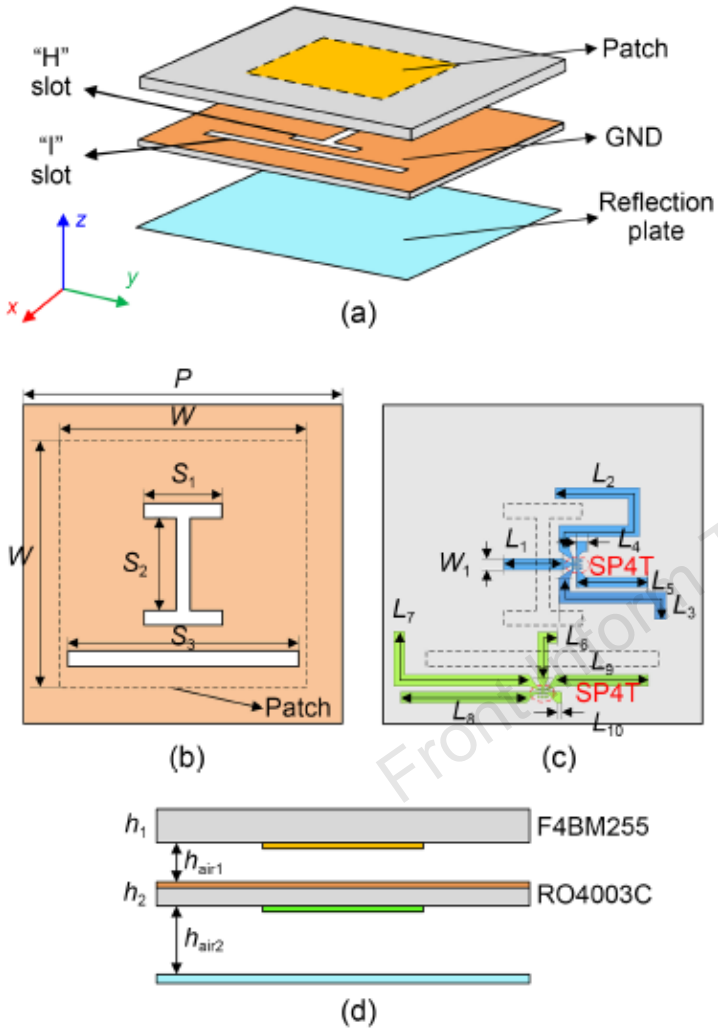


Fig. 2 Structure of the proposed 2-bit dual-polarized element: (a) 3D exploded view; (b) ground (GND) layer; (c) transmission line layer; (d) side view of the element

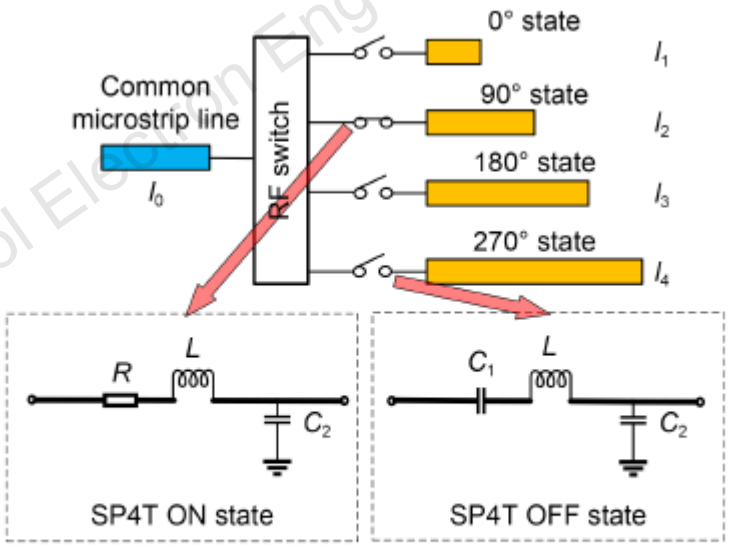


Fig. 3 Equivalent circuit of the single-pole-four-throw (SP4T) switch

# Method

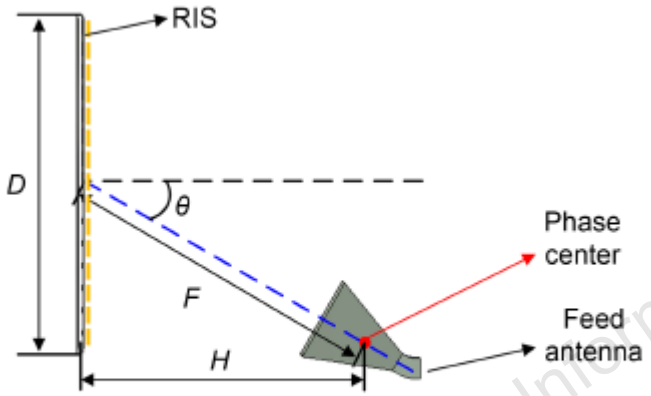


Fig. 17 Simulation model of the 15×15 RIS fed by a horn antenna

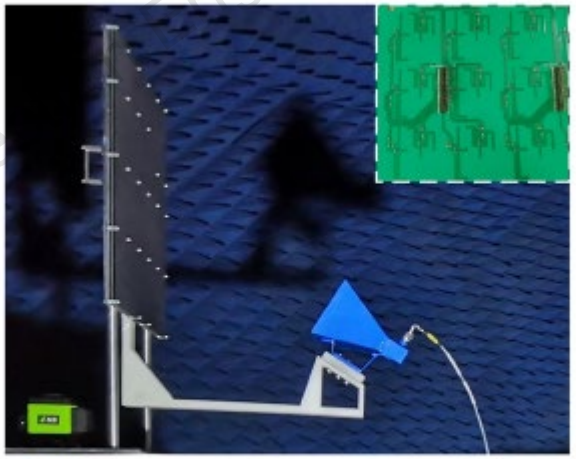

Fig. 20 Photograph of the fabricated RIS prototype in the far-field anechoic chamber

# Results

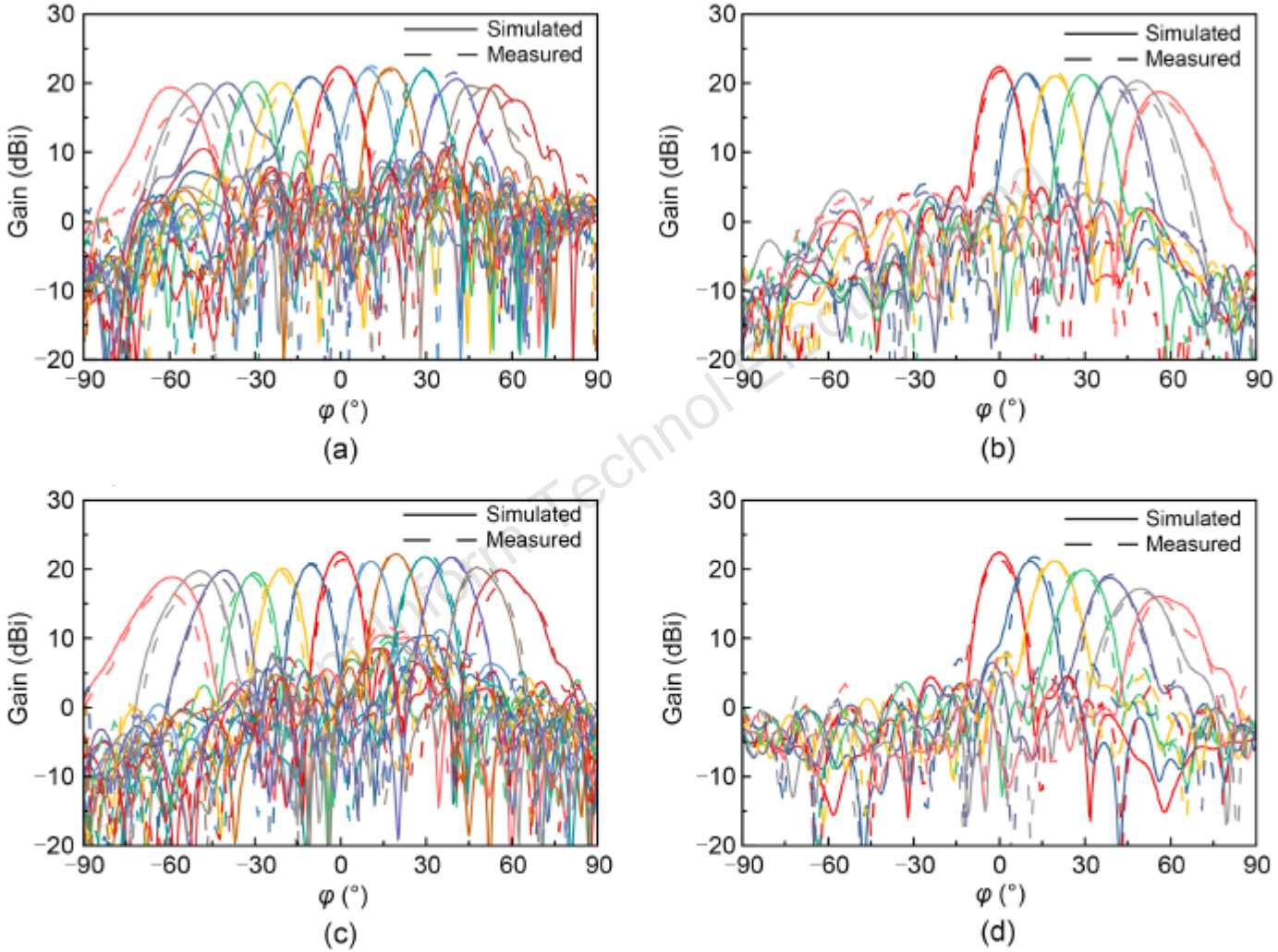


**Fig. 21 Simulated and measured radiation patterns of the 2-bit dual-polarized RIS with vertical polarization in the *xoz* plane (a), vertical polarization in the *yoz* plane (b), horizontal polarization in the *xoz* plane (c), and horizontal polarization in the *yoz* plane (d)**

# Conclusions

In this article, a 2-bit dual-polarized electronically beam scanning RIS is proposed for 6G near field applications. The element is based on a dual-polarized slot-coupled patch antenna. Each polarization needs only one SP4T switch to generate 2-bit phase quantization. The two orthogonal polarizations are capable of being controlled independently. A 225-element RIS is fabricated and measured. The measured peak aperture efficiencies for the two polarizations are 40.1% and 38.3%, separately.

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