UHF RFID Reader Antenna with Spatial and Polarization Receive Diversity

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UHF RFID systems are exposed to multipath fading inherent to the wireless channel. Due to fading, the reliability of RFID systems is significantly reduced, which hampers their widespread introduction into the market. Recently, some researchers report that the RFID readers employing the receive diversity can deal with the multipath fading problem.

This paper presents a novel UHF RFID reader antenna composed of a 2 x 2 array of square microstrip patches for receive diversity. The patches are on air substrate and have two feed probes as shown in Fig. 1. The antenna transmits a right-hand circularly polarized signal, and at the same time receives four linearly polarized signals along two orthogonal axes (x, y). In transmit mode, the patches are fed by a 4-way power divider that provides 0°, 90°, 180°, and 270° signals from a transmit port (port T) to transmit probes. In receive mode, the patches receive signals independently to each other via receive probes connected directly to receive ports (ports R1–R4). The transmit and receive probes are positioned orthogonally in the patch. The array topology and probe positions provide both spatial and polarization receive diversity. A cross-shaped partition wall is installed between the patches in order to reduce mutual coupling and envelope correlation coefficient (ECC) between receive ports. The shape and dimension of the partition wall are optimized through systematic numerical simulations and experiments for improving the transmit-receive isolation as well as ECC.

A prototype has been designed, fabricated and measured in the Korea RFID band (917–923.5 MHz). The transmit gain is above 9.5 dBic, and the axial ratio is less than 0.8 dB in z-direction. The transmit-receive isolations are more than 30 dB for all the receive ports. The receive gains are above 6.4 dBil, and the ECCs are less than –40 dB. Results obtained in terms of gains, transmit-receive isolations, and ECCs show that the proposed antenna is well suited for the UHF RFID system with receive diversity scheme.

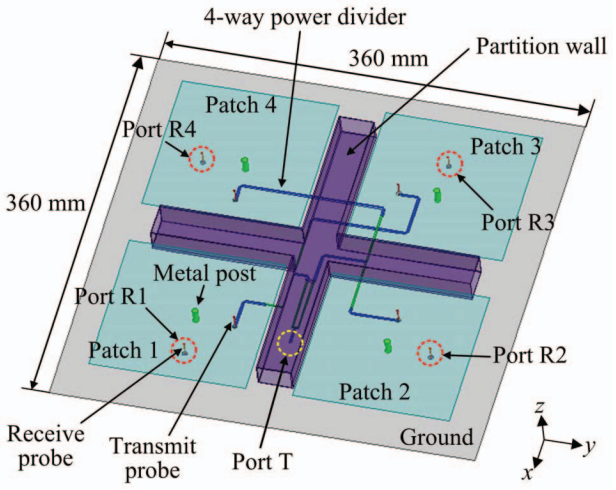

Figure 1. Antenna structure.