High Gain Microstrip Patch Antenna using Frequency Selective Surface for 5G Energy Harvesting Applications

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Abstract

This study introduces a novel microwave power transmission method designed to wirelessly power electronic devices, addressing the issues associated with energy storage and wired power sources. The antenna, fabricated using Roger's RT/5880 substrate measuring 50 × 50 × 1.575 mm, functions within the 3.4 – 3.6 GHz C-band frequency range. The design has been tuned for a broad response and improved axial ratio, resonating throughout a bandwidth of 3.2 – 6.2 GHz, appropriate for WLAN, WiMAX, and 5G applications, with an average gain of 5 dBi. A technique for enhancing the gain of the monopole antenna was employed, utilizing a single-layer 4 × 4 metallic Frequency Selective Surface (FSS) reflector, which produced a band-stop filter response throughout a frequency range of 0.5 – 7 GHz and attained an antenna gain of 10 dB. Additionally, a rectifier circuit was

incorporated to enhance power conversion efficiency and output voltage, employing SMD-Schottky diode type HSMS-2850-TR1 components that optimize the design and minimize its size. The rectifier circuit demonstrates an efficiency of 64.5% at an input power of 12 dBm with a 2 kΩ resistive load, producing a maximum voltage of 3.5 V with an input power of 13 dBm and a 10 kΩ load. This design enables the rectenna to operate efficiently in diverse contexts, providing a Power Dynamic Range (PDR) of (–30 to 30) dBm, ensuring a reliable power supply for devices even in low-power conditions. This technique is ideally suited for energizing a range of wireless sensors and other IoT applications.

Author keywords

5G Communications; Energy harvesting; FSS reflector; MP antenna; Rectifier circuit

Indexed keywords

GEOBASE Subject Index

antenna; communication; energy efficiency; energy storage; frequency analysis; instrumentation; optimization; sensor

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