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Research Article

Dual-Band Operation of a Microstrip Patch Antenna on a Duroid 5870 Substrate for Ku- and K-Bands

M. M. Islam, M. T. Islam, and M. R. I. Faruque

Institute of Space Science (ANGKASA), Universiti Kebangsaan Malaysia UKM, 43600 Bangi, Selangor D. E., Malaysia

Correspondence should be addressed to M. R. I. Faruque; rashedgen@yahoo.com

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The dual-band operation of a microstrip patch antenna on a Duroid 5870 substrate for Ku- and K-bands is presented. The fabrication of the proposed antenna is performed with slots and a Duroid 5870 dielectric substrate and is excited by a 50 Ω microstrip transmission line. A high-frequency structural simulator (HFSS) is used which is based on the finite element method (FEM) in this research. The measured impedance bandwidth (2 : 1 VSWR) achieved is 1.07 GHz (15.93 GHz–14.86 GHz) on the lower band and 0.94 GHz (20.67–19.73 GHz) on the upper band. A stable omnidirectional radiation pattern is observed in the operating frequency band. The proposed prototype antenna behavior is discussed in terms of the comparisons of the measured and simulated results.

1. Introduction

The implementation of the microstrip patch antenna is a milestone in wireless communication systems and is continuing to fulfill the changing demands of the new generation of antenna technology. Microstrip patch antennas are widely used in wireless communication systems because they are low profile, of light weight, of low cost, of conformal design, and easy to fabricate and integrate. Many researchers have heavy interest in designing Ku- and K-band antennas and still face a major challenge to implement these applications. The patch is the dominant figure of a microstrip antenna; the other components are the substrate and ground, which are the two sides of the patch [1]. Many dual-band antennas have been improved to face the rising demands of a modern portable wireless communication device that is capable of integrating more than one communication standard into a single system. For this reason, different types of antenna designs have been proposed [2–14].

A dual polarized microstrip patch antenna has been proposed for Ku-band applications with dimensions of 15 mm×15 mm, and such an antenna has achieved a 950 MHz bandwidth with a maximum gain of 7.6 dB, as noted in [15]. In [16], a multiband patch antenna was designed for Ku- and K-band applications with dimensions of 8 mm × 10 mm, a bandwidth of 760 MHz, and a peak gain of 4.5 dB. In [17], a Ku-band patch antenna using notches and slit was proposed, whose dimensions are 7.6 mm × 10 mm, with a substrate thickness of 0.8 mm; Teflon is used as the dielectric substrate material, and the antenna obtained a maximum bandwidth of 600 MHz. In [18], a dual-band compact microstrip antenna was proposed for Ku-band applications using three pairs of thin slits from the sides of a rectangular patch, whose dimensions are 9.5 mm × 10 mm; Rogers RT/Duroid 5880 is used as the dielectric substrate material, with a substrate thickness of 0.254 mm; the antenna obtained a maximum bandwidth of 90 MHz. In [19], a dual-frequency triangular slotted microstrip patch antenna was proposed for Ku-band applications, where the patch dimensions are 8.5 mm × 7.96 mm × 1.905 mm; the substrate thickness is 1.905 mm (Rogers RT/Duroid 6010 is used as the dielectric substrate material), and the maximum bandwidth is 576 MHz. In all of the previous proposed antenna designs, narrow bandwidth was achieved for Ku-band applications.

A printed double-T monopole antenna was proposed in [20]. In [21], a compact dual-band microstrip antenna for Ku-band applications was proposed, whose dimensions are 9.50 mm × 10 mm × 0.254 mm and which achieved a return loss of −23.83 dB at 12.54 GHz and −14.04 at 14.15 GHz, with a gain greater than 4 dBi. Comparatively, the proposed antenna has a limited return loss. A surface mount dual-loop antenna was proposed in [22]. A dual-band reduced-size PIFA