Separated Microstrip Antenna for Satellite Simulators

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Abstract

Microstrip patch antenna have been designed for satellite simulator system for transceiver antenna. The transmitter antenna is designed for the uplink at 14.25 GHz and receiver antenna is designed for the downlink at 11.45 GHz. The transmitter and receiver antennas are designed on a single substrate with microstrip transmission feedline on two sides for each frequency band. Quarter-wavelength structure is used for matching. Simulation results reveal a broadband structure for reflection, with a gain of 7 dB and high efficiency.

1. Introduction

The features of satellite communications such as propagation delay and limited bandwidth, reveals the importance of testing equipment in SATCOM Communication. Satellite simulators are vital tools in SATCOM for assessing the performance of satellite earth stations. It is important to be able to test the ground station before launching the satellite into orbit. It can be used for analysis, alignment and testing the earth station without the cost of launching.

UK-based SATCOM test company, Atlantic Microwave, has pioneered the development of such instruments for several years with their Satellite Simulator product range. The product family includes Loop Test Translator, Satellite simulators and Drone Satellite simulators to meet the mobility requirement of the SATCOM[1].

In this work, in order to improve the payload of the drone satellite simulators, to reduce the weight and size of the payload, microstrip planar antennas have been designed to replace the horn antenna on the payload. In order to make the transceiver antenna compact, transmitter and receiver are designed on one substrate.

2. ANTENNA STRUCTURE

The antenna design is on Roger RO4350 substrate with 1.524 millimetre thickness. The Dielectric constant is 3.66. The operating frequency for the designs are 14.25 GHz for receiver in the uplink and 11.45 GHz for transmitter in the downlink. For the single patch antenna designs, the dimensions have been calculated using the well-known equation from Ballanis [2]. And they have been integrated into a single substrate with the dimensions calculated as 20*18 mm for a single patch as shown in Fig 1.

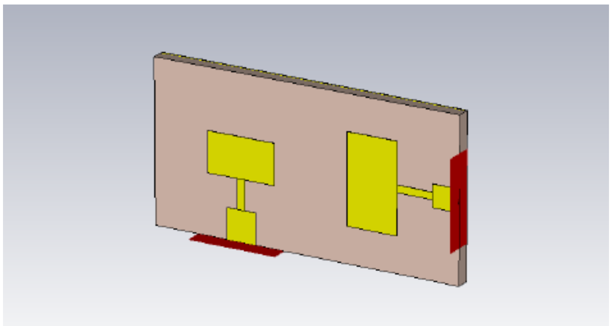

Fig. 1. Transceiver antenna configuration

3. SIMULATION AND RESULTS

The designed microstrip patch has been modelled and simulated in CST software. Quarter-wavelength transformer is added for matching purposes. The antenna has a return loss better than -10 dB over a broad frequency band as can be seen in Fig. 2. The bandwidth for uplink, at 11.45 GHz, is 756 MHz and for downlink, at 14.25 GHz, is 1080 MHz. As can be seen in the Fig. 2, the isolation between the antennas is better than 28dB. Gain of the single patch is calculated as 8.5 dB.

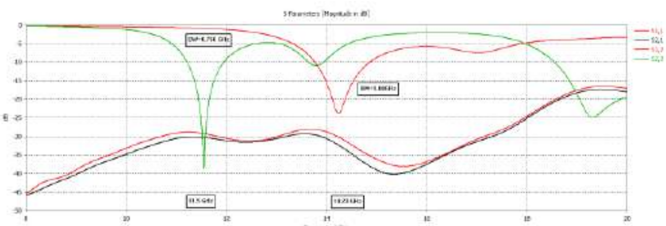

Fig. 2. Reflection coefficient of antenna

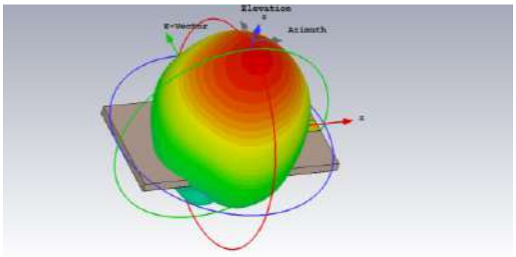

Fig. 3. Three dimensional radiation pattern at 14.25 GHz

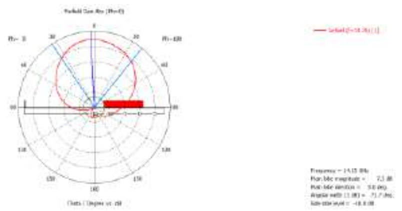
Fig. 4. Polar radiation pattern at 14.25 GHz

4. Conclusions

Microstrip patch antenna have been designed for satellite simulator system for transceiver antenna. The transmitter antenna is designed for the uplink at 14.25 GHz and receiver antenna is designed for the downlink at 11.45 GHz. The transmitter and receiver antennas are designed in a substrate with microstrip transmission feedline on two sides for each frequency band. Quarter-wavelength structure is used for matching. Simulation results reveal a broadband structure for reflection, with a gain of 7 dB and high efficiency.

Acknowledgements

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