**AIN SHAMS UNIVERSITY**
**FACULTY OF ENGINEERING**
**CAIRO – EGYPT**
**Electronics and Communications Engineering Department**

# Self-Diplexed Integrated Microstrip Antenna Front-End Transceiver for Wireless Applications.

A Thesis
Submitted in partial fulfillment for the requirements of the degree of **Master of Science in Electrical Engineering**

Submitted by

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# STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author in the Department of Electronics and Communications Engineering, Ain Shams University.

No part of this Thesis has been submitted for a degree or a qualification at any other university or institute.

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**Abstract**

Due to the advent of the unlicensed wireless communication systems such as Bluetooth and WLAN, in many communication devices, the demand upon microwave and millimeter - wave communication system applications increases. The primitive communication systems which have the capability to transmit and receive at the same time, consists of two isolated circuits. One circuit is used for transmitting and consists of a transmitter and a radiating antenna. Another circuit is used for receiving and consists of a receiver and a receiving antenna. Such system has some problems such as increasing the overall number of components in the circuit and the transmitting and the receiving antennas must be placed far enough apart that the transmitter signals don't interfere with the receiver side. The concept of the transceiver systems is becoming the solution to decrease the cost, size, and weight. In transceiver systems the transmitting and the receiving circuits are integrated together by using a common shared antenna for transmitting and receiving at the same time. Although the transceiver system reduces the overall number of components in the circuit, it faces the problem of poor isolation between the transmitting and the receiving bands.

Conventionally, the transceiver system consists of a common shared antenna and a duplexer or a circulator placed between the radio transmitting and the radio receiving circuits, which is used to provide high isolation performance between them. The main function of duplexer in the transceiver circuits is to protect the receiver from damage if a high level RF signal, like those directly from a transmitter output is applied to the receiver antenna. Although the duplexer provides high isolation between the transmitter and the receiver, it increases the circuit size and cost. In addition, it needs a matching network.

This thesis presents high port isolation for dual-band of frequency, orthogonally polarized proximity coupled rectangular microstrip patch antenna operating at 2.5 GHz band signal at the transmitting port and 2.0 GHz band signal at the receiver port. The proposed system consists of a proximity coupled rectangular microstrip patch antenna with two orthogonal feeding lines. The two orthogonal feeding lines are used as filters. By this technique one can achieve high degree of port isolation between the transmitting and the receiving ports of the microstrip patch antenna. The later system can be achieved by placing a lowpass filter (LPF) at the transmitting port of antenna for suppressing the

higher order harmonic frequency components generated by the integrated power amplifier and a bandstop filter (BSF) at the receiving port of antenna for passing the desired receiving frequency band signal operating at 2.0 GHz and filter out/ suppression of unwanted transmitting frequency band signal operating at 2.5 GHz band at Rx port. The two filters were designed utilizing two different shapes of defected ground structure (DGS) units where, placed underneath the two microstrip feeding lines. A parametric study for both the DGS units is presented. Also, a design formula for getting the 3dB cut off frequency for both DGS units is obtained. The design and simulation of the aforementioned system (i.e. the antenna and the microstrip filters integrated with DGS units) was achieved by using electromagnetic simulation IE3D Zeland ver. 12. The fabrication of the proposed circuit was carried out on RT/Duroid 5880 dielectric substrate with dielectric constant $\varepsilon_r$=2.2 and substrate thickness of 31mil. The measured and simulated results of the proposed dual frequency proximity coupled patch antenna shows a high port isolation than the conventional dual frequency proximity coupled patch antenna by about 20dB.

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