Design and Analysis of Slotted Ring Wideband Bandpass Filter for Microwave Sensor

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***Abstract*—Aiming to operate in wideband frequency range as a microwave sensor to measure the rice quality, two new design of slotted ring wideband bandpass filter design are presented in this paper. Broadside-coupled microstrip-slot technique has been implied into both designs to produce tight coupling filter with a wideband frequency range performance. Rogers RO4003C substrate with a thickness of 0.508 mm is used for the designs to maintain the low manufacturing cost. Both designs have different slotted ring widths. Therefore, investigations on the effect of difference slotted ring's widths towards the scattering parameter performance will also be presented in this paper. The simulation results show that the slotted ring wideband bandpass filter with thicker width shows better results compare to the one with thinner width. The overall results show that the designed wideband BPF possess good performance and suitable to be used as a microwave sensor to measure the rice quality.**

***Index Terms*—Bandpass Filter; Broadside Coupling; Microstrip-Slot; Wideband**

I. INTRODUCTION

The applications of microwave sensors are wide. Microwave sensors, or known as radar or radio frequency (RF) operate at frequencies ranging from 300 MHz to terahertz. They are commonly used in industry due to their effectiveness in sensing and not sensitive to the environment. One of their great advantages is their ability in sensing task in wide capacity [1]. This great advantage leads the communication between the sensor and the Material Under Test (MUT) to become non-invasive, non-ionizing and contact-less manner, which by then allows the information of the MUT to be extracted further [1]. Thus, the test subject information could be extracted without affecting the quality and material's condition of the test subject. Microwave sensors can be divided into several types such as radiometer sensors, transmission sensors and last but not least the most popular among all, resonator sensor. The easiest way to develop the resonator sensors is by applying the principle of microstrip filter. The microstrip filter response greatly on the frequency shift and broaden the curve compared to free space when filled with a test subject.

Microstrip wideband bandpass filter (BPF) is one of the most used devices as the microwave sensors. In recent years, the development of the wideband BPF has shown rapid increment and variety of different wideband BPF has been reported in the literature [2-11,14-15]. As reported in [4], cascading both low pass filters and high pass filter in one circuitry will produce the wideband bandpass filter. By using this technique, very simple BPF can be produced. However, it leads to large size of BPF, which is not suitable for current trends. Other techniques that have been proposed to produce wideband bandpass filter is by using short-circuited stubs, stub-loaded ring resonators, multi-mode stepped-impedance resonators (SIRs) and other multi-mode resonators [4].

Therefore, in this paper, two slotted ring wideband bandpass filter design with difference ring's width will be presented. Broadside-coupled microstrip-slot technique has been implied into both designs. This technique can produce tight coupling filter with a wideband frequency range performance where the slotline in the bottom layer will be coupled to the two open-circuited stubs on the upper layer of the patch. Meanwhile, Rogers RO4003C substrate with thickness of 0.508 mm is used for the designs to maintain the low manufacturing cost. The investigations on the effect of difference slotted ring's widths will also be presented. The results show that the designed wideband BPF possess good performance and suitable to be used as a microwave sensor to measure the rice quality.

II. DESIGN THEORIES AND ANALYSIS

Figure 1 through Figure 4 shows the configurations of the two slotted ring wideband bandpass filter designs (Type 1 and Type 2) with different ring's width. Both designs consist of top patch and ground. For Type 1 slotted ring wideband bandpass filter design, both top patch and ground are shown in Figure 1 and Figure 2, respectively. Meanwhile, for Type 2 slotted ring wideband bandpass filter design, both top patch and ground are shown in Figure 3 and Figure 4, respectively. Both Port 1 and Port 2 are located on the top patch.

As seen in Figure 1 to Figure 4, the top patch and the ground of both slotted ring wideband bandpass filter consists of elliptical ring broadside design and radial slot, respectively. The width of the elliptical ring have different dimension from each other.

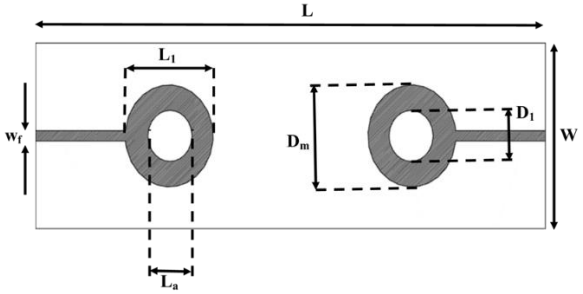

Figure 1: Type 1 slotted ring wideband bandpass filter design (top patch)