

A Novel Patch Antenna Integrated with Relative Humidity Sensor for Passive RFID Tag

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Abstract

A new type of a component, the relative humidity sensing antenna using a modified polyimide is proposed for passive RFID. The proposed structure can be applied for RFID sensor tag as a physically and functionally combined antenna with the RH sensor. For sensitivity to moisture, a polyimide film was synthesized from aromatic monomers where no hydrophobic element is included, to have variable permittivity. To obtain the better sensitivity, the modified polyimide film was formed on the microstrip patch antenna with high quality factor. Furthermore, to enhance the resolution, the patch antenna was designed to have a narrower bandwidth by meandering structure. Calibration of the microwave RF sensor was carried out in terms of sensitivity, hysteresis, and stability. These characteristics were analyzed through change in fundamental resonant frequency of the patch antenna against various RH levels. From the measured results, it is achieved that the sensitivity of the proposed structure was -181 kHz/%RH under 30%RH ~ 90%RH. This means that the proposed component provides the humidity sensing function as well as the radiation. Therefore, it is apparent that the proposed RH sensing antenna using a modified polyimide can be applicable and useful for the implementation of the compact RFID sensor tag.

ACKNOWLEDGMENT

This research was supported by the MIC (Ministry of Information and Communication), Korea, under the ITRC (Information Technology Research Center) support program supervised by the IITA (Institute of Information Technology Assessment) (IITA-2005-C1090-0502-0012)

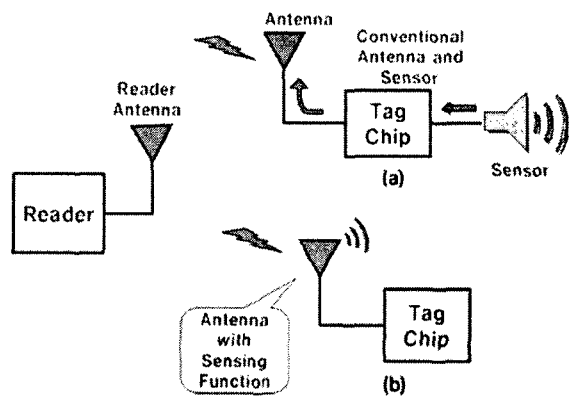
I. INTRODUCTION

Radio frequency identification (RFID) sensing has attracted considerable press attention in recent years, and also expected as one of important elements in order to realize ubiquitous environments, for the expected applications such as monitoring physical parameters, automatic product tamper detection, harmful agent detection, and noninvasive monitoring [1-3].

The RFID mechanisms can also be applied to collecting sensed data. The configurations of the RFID sensing system is illustrated in Fig. 1. As you can see in Fig. 1(a), for monitoring the environmental conditions, RFID tags with sensors are required so that tags can send sensor-derived data to the readers. However, the addition of the sensor component enlarges the tag size and cost, especially considering the signification of the small size and the low cost in RFID tag. However, as shown in Figure 1(b), the physical and functional integration of the antenna and the sensor component provides the compactness and the cost-

efficiency for the sensor tag. The tag chip can also be simplified since the tag chip need not process the sensed data.

Thus, this paper presents the antenna with the RH (Relative Humidity) sensing function, which simultaneously plays radiating and sensing roles. The novel patch antenna integrated with RH sensor using a modified polyimide is investigated and proposed for the passive RFID tag. Characteristics including sensitivity, hysteresis and stability in terms of the resonant frequency were analyzed.



(a) Conventional antenna and sensor
(b) Proposed antenna with sensing function
Figure 1. Configurations of the RFID sensing system