A Low Profile Multi-bit Chipless RFID Tag

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Recently radio frequency identification (RFID) has been drawn considerable attention because of its wide range of commercial applications. A typical RFID system comprises a reader or interrogator and some tags. Tags can be attached or incorporated in any product for identification purposes. RFID tags may be classified as active which require an internal power source, and passive tags which powered up by interrogating signal. In recent years, Chipless RFID tags have been introduced for low power applications.

This paper proposes a low profile chipless RFID tag for large ID coding densities. Here, incorporating twenty slots on the chipless RFID tag, the data is encoded as complex natural resonances of the structure. The designed RFID tags operate in 2-4 GHz frequency band. When a short duration pulse illuminates the tag, time domain backscattered signal is affected by two distinct phenomena. Early-time part of the signal emanates from the specular reflections from localized scattering centers of the tag and depends strongly on the incident angle. On the other hand, based on singularity expansion method (SEM), late-time or source-free region includes global resonances of the tag which establishes after interrogation pulse has passed the tag completely. In this paper, a simple method called short-time-matrix-pencil-method (STMPM) is introduced to obtain natural poles of the tag in addition to the turn-on time of each pole. In this approach, a sliding time-window is introduced and the matrix-pencil-method (MPM) is applied to extract poles from the sliding time-window at each snapshot of time. Turn-on times can be fund when the extracted poles converge consistently to stable natural resonances of the scatterer. Two tags with different singularity poles are designed, simulated and measured. The measured data agree well with our simulations.