A Two-Element Modular Antenna for Near-Field UHF RFID Applications

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Near-Field (NF) Ultra-High Frequency (UHF) Radio Frequency IDentification (RFID) systems have been developed for those applications where reader antenna and tags are in the near-field region of each other. Specifically, they keep the typical advantages of UHF RFID systems, with an improved robustness with respect to the effects of metals and liquids nearby the tag, as in the High-Frequency (HF) RFID systems.

NF UHF RFID systems are typically used in pharmaceutical industry, retailing, printer encoders and smart points reader. Generally, the item material the tag is attached to and the mutual coupling among tags in a stacked configuration can compromise the tags readability and reduce the read range. For this reason, in the framework of NF UHF RFID desktop readers and smart point readers, it could be useful to design reader antennas that in unloaded condition exhibit a read range larger than that required in real operational conditions (A. Michel, R. Caso, A. Buffi, P. Nepa, G. Isola, *XXXIth URSI General Assembly and Scientific Symposium (URSI GASS)*, pp.1,4, 16-23 Aug. 2014). For particular applications, reconfigurable antennas can be also considered, which allow for a shaping of the interrogation field in the antenna near-field region, when a simple control of the reader output power is not enough to guarantee high reading percentages on the whole antenna surface and for any tagged item and tag topology/orientation (R. Caso, A. Michel, A. Buffi, P. Nepa, and G. Isola, *RFID Technology and Applications Conference (RFID-TA)*, pp.204,207, 8-9 Sept. 2014).

In this paper a modular antenna for NF-UHF RFID desktop readers is proposed. By employing two series-fed radiating elements , it is possible to maximize the electromagnetic (e.m.) field within the reactive and radiative near-field regions of the desktop reader antenna. Specifically, a microstrip transmission line is designed in the central area of a commercial desktop reader, where tags are more likely placed on. When the transmission line is ended on a matched load, a travelling wave is excited and a stationary non-constant current distribution is avoided. Thus, a spiral transmission line is able to generate a strong and uniform field just above the reader surface, but it decays very fast by increasing the distance from the antenna. The transmission line also feeds a circularly polarized slot antenna etched on the microstrip ground plane. The latter can be designed in order to extend the reader detection volume up to 50-60cm in free space, which is reduced to few centimeters in presence of items or multiple tags. Since the slot antenna is series-fed by the transmission line, it is fed with a low input power, and this allows for confining the detection volume and limiting the false-positive issue. The spiral transmission line can be arbitrarily extended beyond the slot antenna, covering a larger area and shaping the antenna on the basis of the reader size (i.e. it is an almost scalable solution). Finally, to reduce the back radiation and limit the effect of the desk where the reader is placed on, a metallic reflector plane could be considered. However, the optimum distance between the antenna and the reflector is more than 10cm, which is significantly larger than the thickness allowed for a commercial desktop reader. Thus, a trade-off between the reflector distance and the overall reader case thickness is needed, with a fair compromise on the overall antenna performance.