A mm-Wave RFID System based on the EPC-Gen2 Protocol

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The importance of radio frequency identification (RFID) is expressed by the vast amount of commercial applications using this approach. Worldwide, billions of the RFID systems are operated in the HF (13.56 MHz) and UHF (868 and 915 MHz) frequency range. These RFID implementations suffer from rather large antennas required for a reliable and efficient operation. Increasing the operating frequency overcomes this physical constraint.

To evaluate the performance and investigate the challenges of RFID systems in the mm-wave regime, we have designed and implemented a system operating at 74 GHz. The system supports the EPC Gen2 protocol. This approach provides a good comparison to common UHF RFID implementations and maintains compatibility to standard baseband interface units.

Our implementation of the mm-wave RFID base station is based on a commercial mm-wave transceiver chipset, which performs the up and down conversion between differential IQ baseband and the RF signals. An arbitrary signal generator and a sampling card generate and analyze the IQ baseband signals, respectively. This generic approach on the baseband unit allows flexible operation in terms of future protocols and applications. The mm-wave transponder utilizes a baseband chip from NXP Semiconductors that enables the EPC-Gen2 compatible communication. The core device of the RF frontend in the transponder is a mm-wave diode from Infineon Technologies operated in shunt configuration. This diode is used as an envelope detector in receive mode. During the transmit mode, a backscatter modulated signal is generated by changing the impedance of the antenna feeding port. Controlling the bias current of the diode causes the variation of the impedance. The antenna is implemented as a planar structure on a ceramic substrate.

In this paper we will present the design and the implementation of a mm-wave RFID system including first measurement results.