Analog Circuits for Biochip: exercises on antennas, antenna systems and RFID antennas

Exercise 1

The maximum allowed effective isotropic radiated power for RFID reading devices is 4W. Let us consider a RFID tag working at 2.45 GHz having an antenna with a gain of -0.5dBi, an antenna input impedance of 10 Ω and an IC chip having an impedance of 5-50j Ω. What is the sensitivity of this chip if we want to ensure a reading distance of 5 m ? We do assume first that there are no polarization mismatches, then that the reader has a circular polarization and the tag a linear polarization.

Exercise 2

We use an RFID reader to read a tag worn by people. The distance between the reader and the tag is comprised between 20 cm and 50 cm. The tag has an antenna gain of -20 dBi, taking into account the losses in the wearer. We assume a reflection coefficient of 0.1 and a perfect polarization match. The frequency used is 1 GHz

1. We want to ensure that the human wearer of the tag is never exposed to a field of more than 1 V/m. what is the maximum EIRP allowed at the reader?

2. What should in this case the minimum threshold power of the chip on the tag be?

Exercise 3

When antennas for implantable devices are designed, they are in a first step designed considering that they radiate into a lossless material having the same dielectric permittivity then the biological tissue they will be implanted into. An antenna designed in such a way has a directivity of 2.5 dB. Knowing than when it will be implanted in real biological tissue, 98.7 % of the power will be absorbed by the host tissue and that the radiation pattern will remained unchanged, what will be the gain of the antenna + real tissue be once the antenna is implanted ?