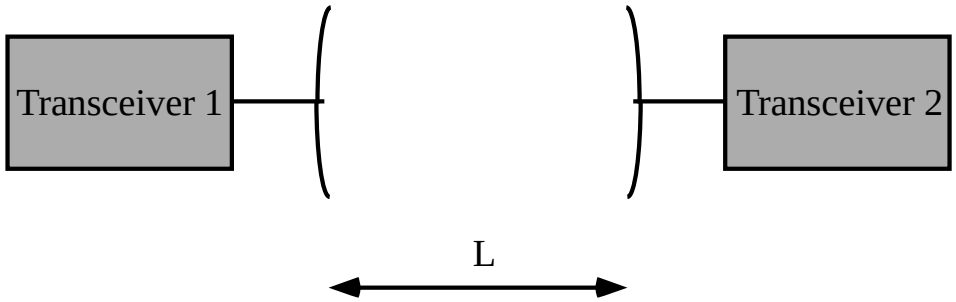
Analog Circuits for Biochip: exercises on antennas, antenna systems and RFID antennas

Exercise 1: Friis' formula and polarization mismatch

Consider the communication system in free space depicted on the figure.



if antenna 1 has a right hand circular polarization (polarization vector is $\boldsymbol{e}_1 = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ j \\ 0 \end{pmatrix}$ what is the depolarization factor when antenna 2 has a linear polarization ? What is this factor if antenna 2 has an elliptical polarization defined by $\boldsymbol{e}_2 = \frac{1}{\sqrt{3}}\begin{pmatrix} 1 \\ 1+j \\ 0 \end{pmatrix}$

Exercise 2

Consider again the link depicted in the figure above (in free space), where L= 5km and we consider and freq= 2.45 GHz. The receiver of transceiver 2 has a sensitivity of -100dBm, and the transmitter 1 emits a power of 10 mW. Antenna 1 has a gain of 3dBi. What should the gain of antenna 2 be if we consider both antennas matched? How much do we need to increase the power of the transmitter 1 if both antennas have a reflection coefficient of -6dB ? We consider a depolarization factor χ_{pol}=0.9 in both cases.