

77 GHz UWB High Resolutions Automotive Radar Sensitivity, DR, and NF

The following assumptions are to calculate Sensitivity, Dynamic Range, and Noise Figure for 77GHz Ultra-Wideband resolution automotive radar.

Similar specifications can be calculated for other automotive radar metrics.

Any question and/or inquire should be addressed to; shafie@ieee.org

$$RCS = \sigma = 0.25m^2$$

$$\text{Maximum Range} = R = 30m$$

$$BW = 1GHz$$

$$EIRP = P_t G_t = 55dBm$$

$$P_t = 23.5dBm \Rightarrow G_t = 55dBm - 23.5dB = 31.5dBi$$

$$f_0 = 77GHz \Rightarrow \lambda_0 = \frac{c}{f_0} = \frac{3(10^8)m/s}{77(10^9)Hz} = 3.896mm \approx 4mm$$

Radar Equation

$$P_r = P_t \frac{G_t G_r \sigma \lambda^2}{(4\pi)^3 R^4}$$

The same antenna for Tx and Rx

$$G_t = G_r = 31.5dBi$$

$$P_r = 55dBm + 31.5dBi + 10 \log_{10}(0.25m^2) + 20 \log_{10}[4(10^{-3})m] - 30 \log_{10}(4\pi) - 40 \log_{10}(30m)$$

$$P_r = 55dBm + 31.5dBi - 6dB - 48dB - 33dB - 59dB = -59.5dBm \approx -60dBm$$

$$MDS \leq -60dBm - 90dBHz = -150dBm/Hz$$

$$DR \geq -20dBm - (-60dBm) = 40dB$$

$$NF \leq -150 \frac{dBm}{Hz} - \left(-174 \frac{dBm}{Hz} \right) = 24dB$$