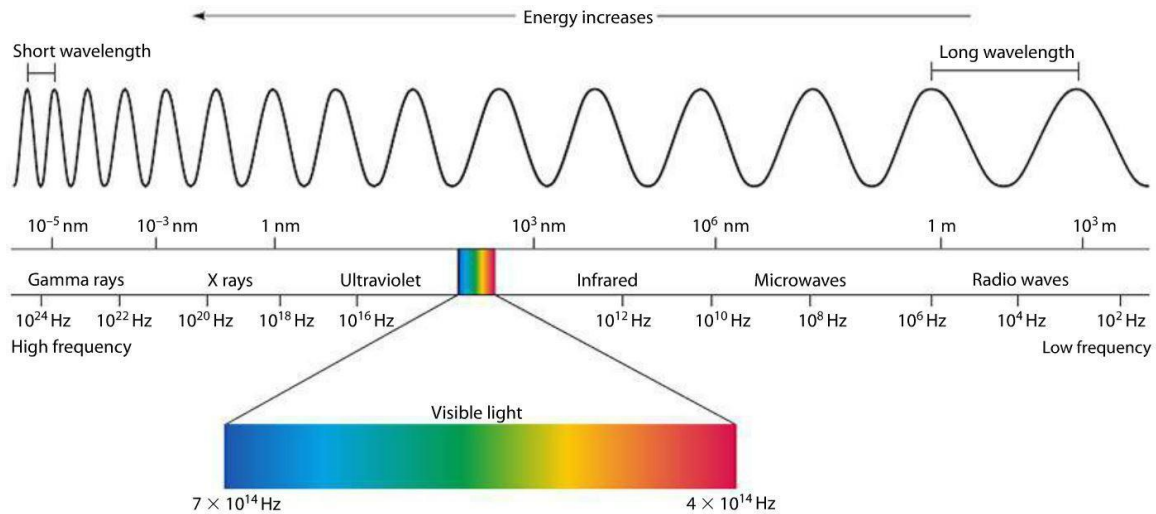


Rectangular Waveguide & Dipole Antenna Design Simulation in CST



INTRODUCTION TO ENGINEERING APPLICATIONS

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Calculations of Rectangular Waveguide Dimensions

X-Band Rectangular Waveguide Dimensions

X-Band Frequency Range $\rightarrow 8.2 \text{ GHz} - 12.4 \text{ GHz}$

Cutoff frequency is $f_c = 6.557 \text{ GHz}$

$$\lambda_{\max} = \frac{c}{f_{\min}} = \frac{3 \cdot 10^8}{8.2 \cdot 10^9} = \cancel{0.000} = 0.03658 \text{ m} = 3.658 \text{ cm}$$

$$3 \lambda_{\max} = l = 3 \cdot 3.658 = 10.974 \text{ cm}$$

$$\lambda_c = \frac{c}{f_c} = \frac{3 \cdot 10^8}{6.557 \cdot 10^9} = \frac{3}{65.57} = 0.0458 \text{ m} = 4.58 \text{ cm}$$

$$\lambda_c = 2a$$

$$\rightarrow 2a = 4.58 \Rightarrow a \approx \frac{4.58}{2} \approx 2.29 \text{ cm}$$

$$a \approx 2b \Rightarrow b \approx \frac{2.29}{2} \approx 1.145 \text{ cm}$$

$$0.5 > t > 0.2 \begin{matrix} \text{for lower freq.} \\ \text{for high freq.} \end{matrix} \Rightarrow t = 0.4 \text{ cm}$$

As in the lecture t value is taken within boundaries.

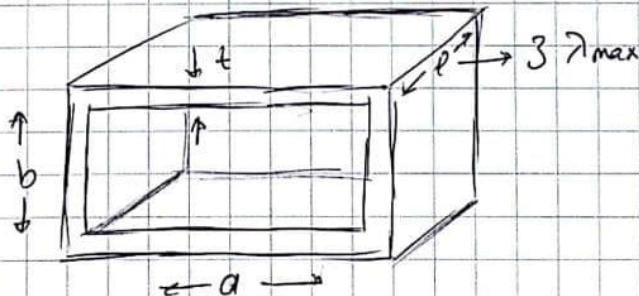
$$a \times b \times t \times l = 2.29 \text{ cm} \times 1.145 \text{ cm} \times 0.4 \text{ cm} \times 10.974 \text{ cm}$$

$$a \approx 2.29 \text{ cm}$$

$$b \approx 1.145 \text{ cm}$$

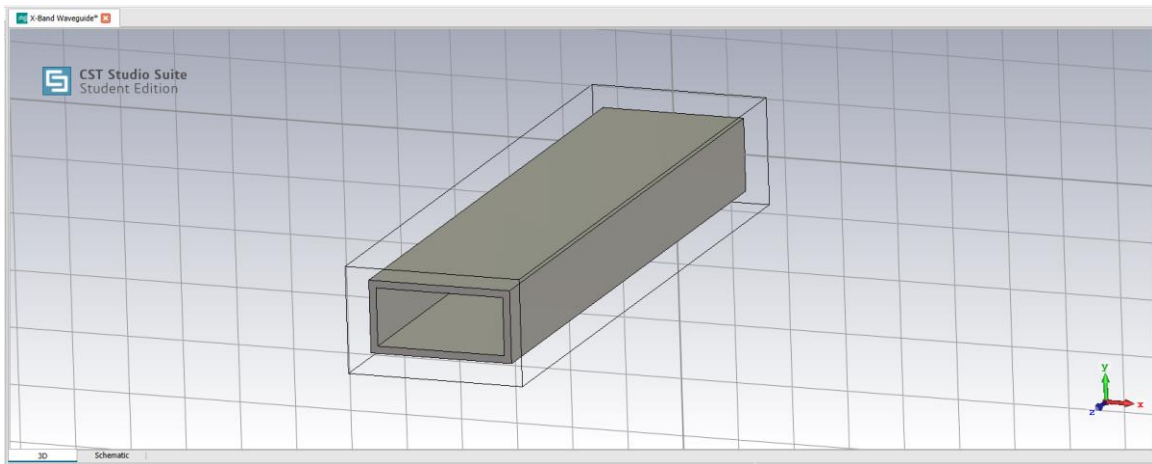
$$t \approx 0.4 \text{ cm}$$

$$l = 10.974 \text{ cm}$$

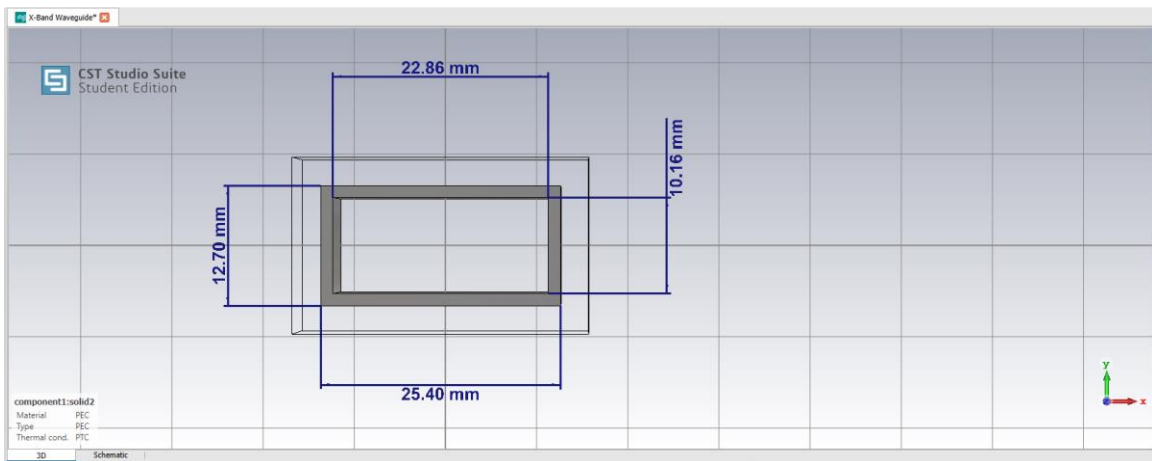


2. fiktiv dyder

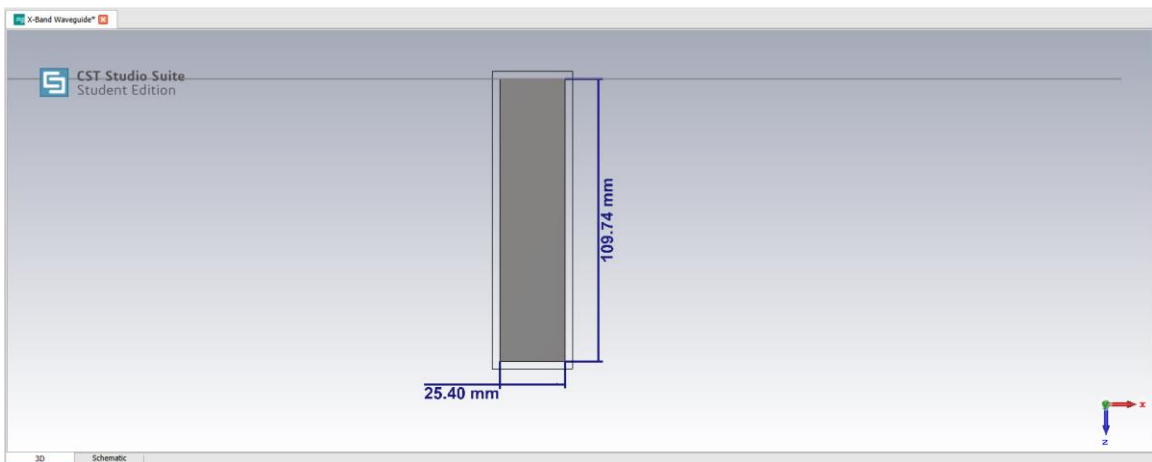
Rectangular Waveguide Dimensions



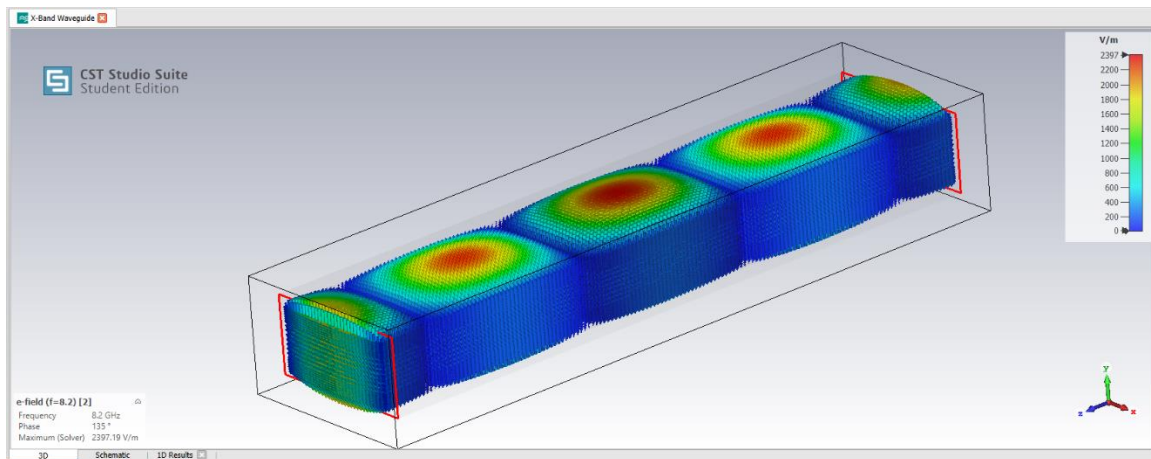
Perspective View



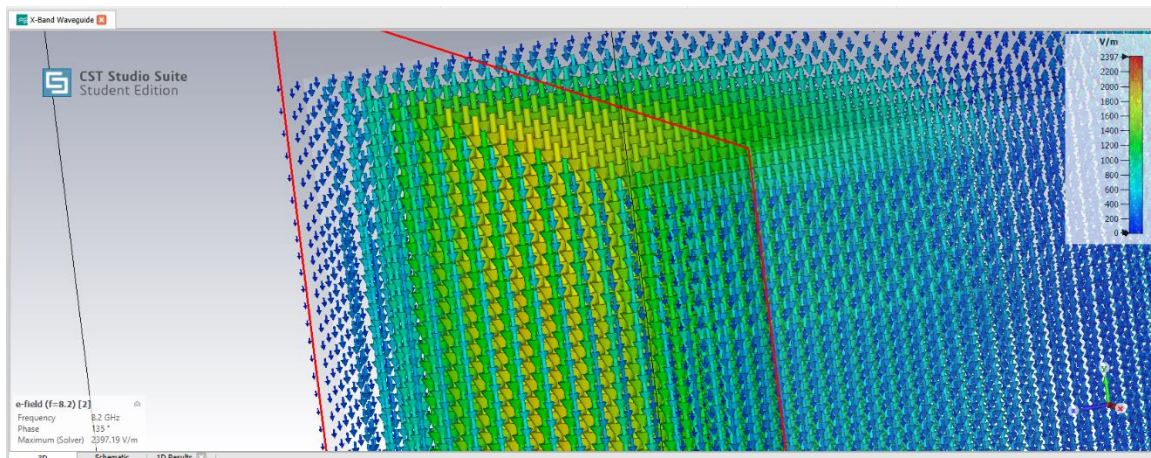
Front View



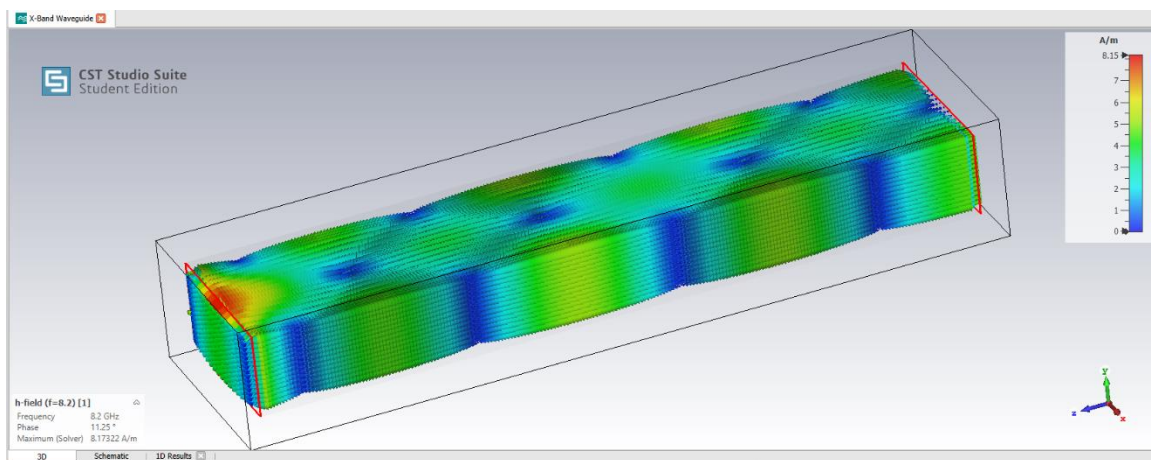
Top View



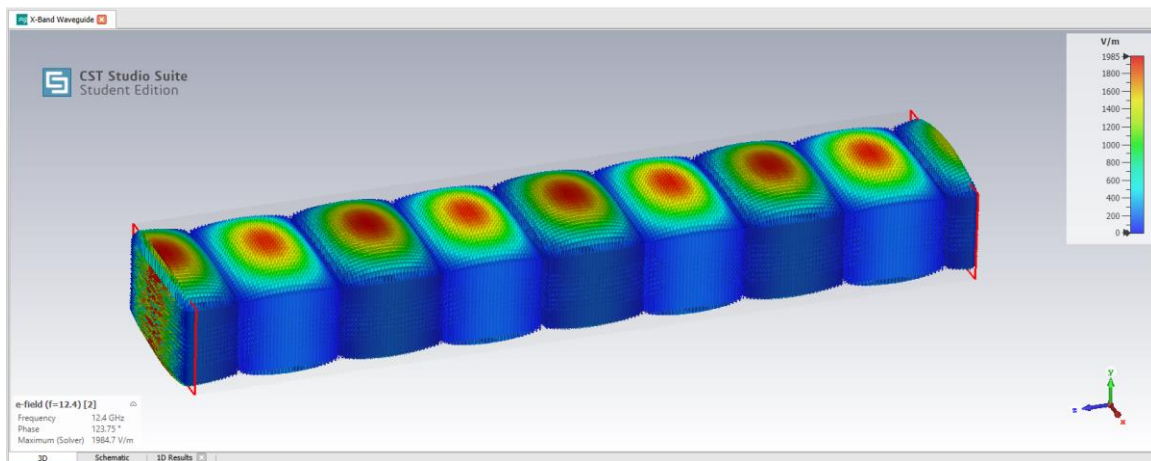
Electric Field at 8.2 GHz



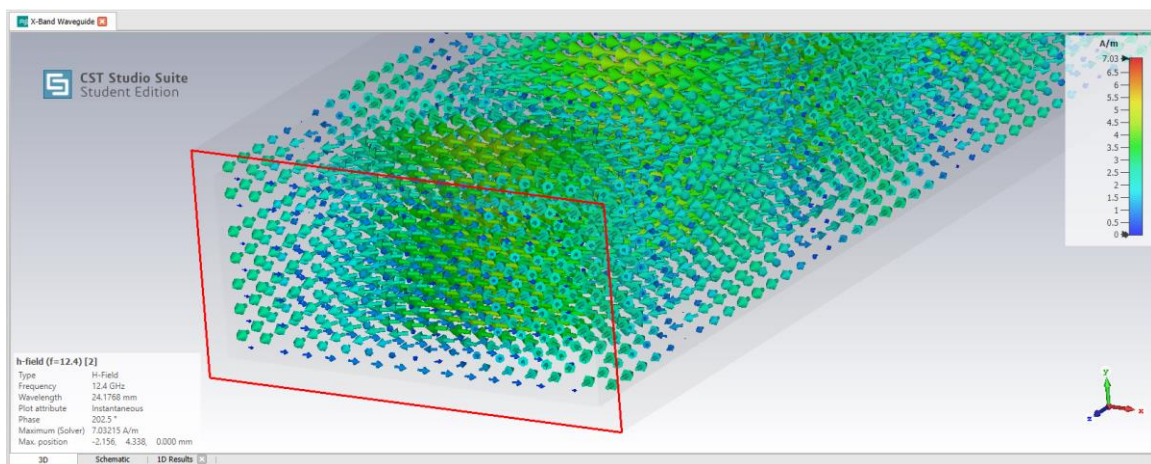
Electric Field Arrows at 8.2 GHz



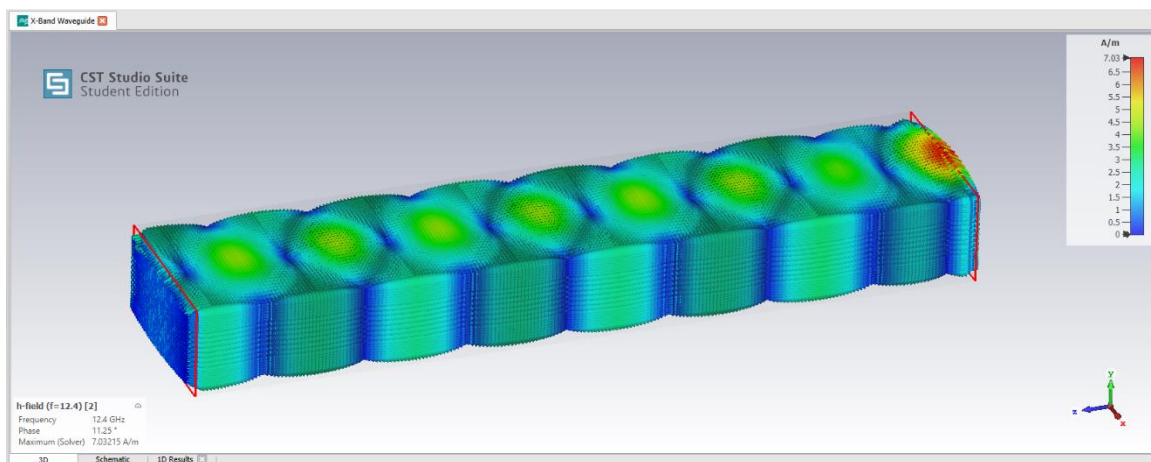
Magnetic Field at 8.2 GHz



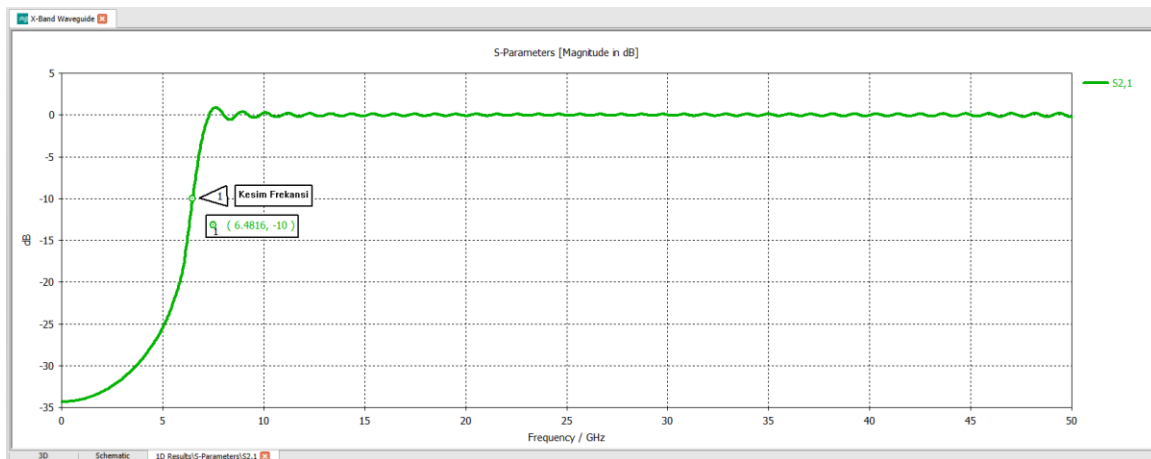
Electric Field at 12.4 GHz



Magnetic Field Arrows at 12.4 GHz



Magnetic Field at 12.4 GHz



Cutoff Frequency

Calculations of Dipole Antenna Dimensions

$\frac{\lambda_r}{2}$ Dipole Antenna Design ($f_r = 16 \text{ Hz}$)

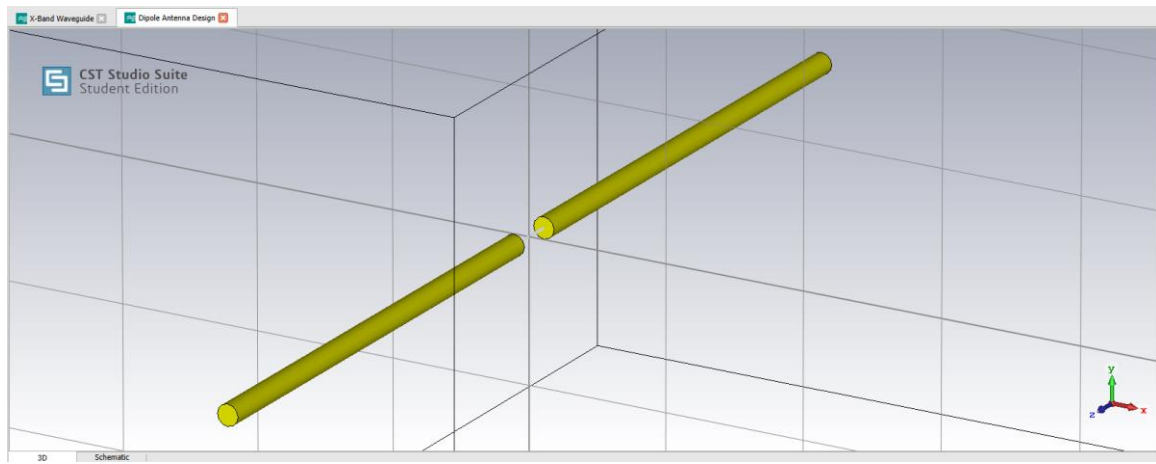
$$\boxed{\lambda_r} = \frac{c}{f_r} = \frac{3 \cdot 10^8}{1 \cdot 10^9} = 0,3 \text{ m} = 30 \text{ cm} = 300 \text{ mm}$$

$$l = \frac{\lambda_r}{2} = \frac{30 \text{ cm}}{2} = 15 \text{ cm} = 150 \text{ mm}$$

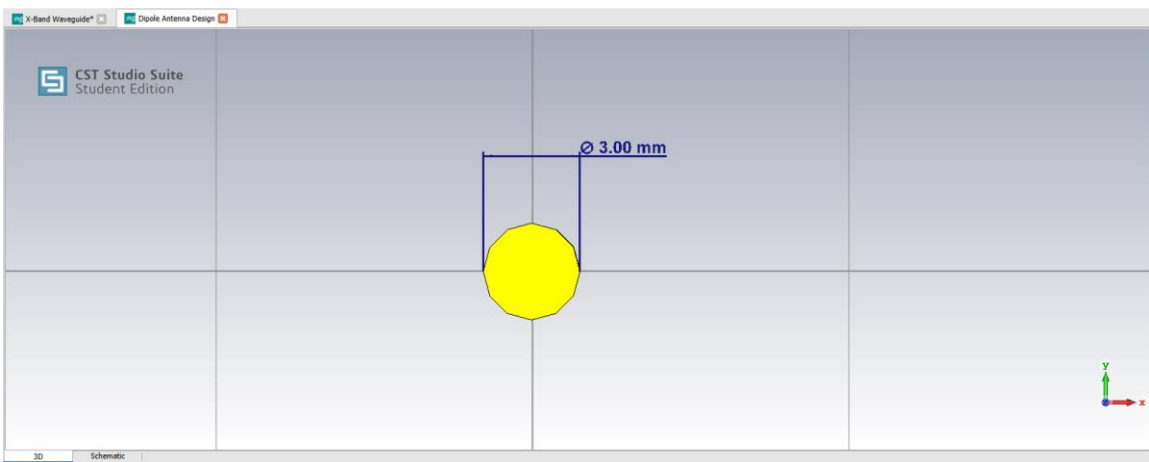
$$\text{Thickness} = \frac{\lambda_r}{100} = \frac{300}{100} = 3 \text{ mm}$$

$$\text{Gap} = \lambda_r \cdot 0,025 = 300 \cdot 0,025 = 7,5 \text{ mm}$$

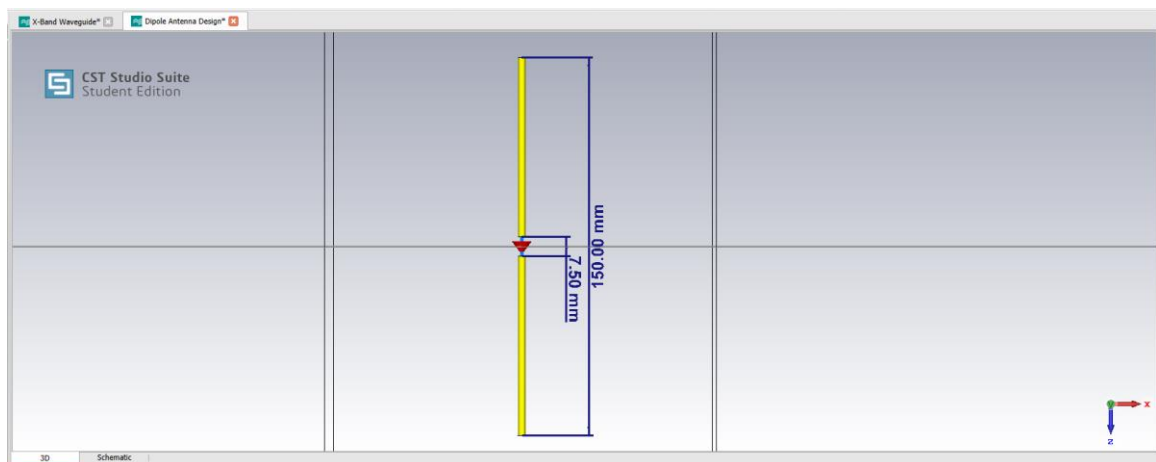
Dipole Antenna Dimensions



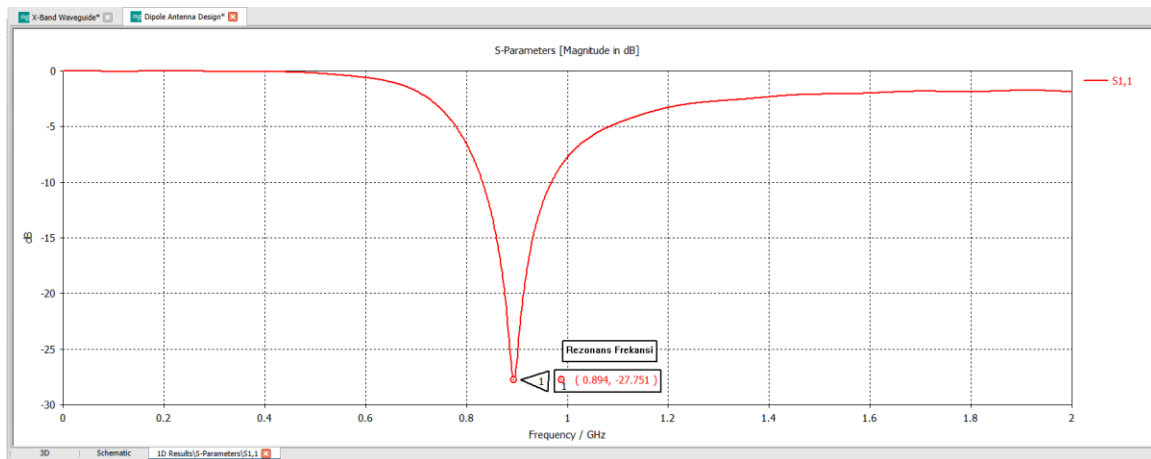
Perspective View



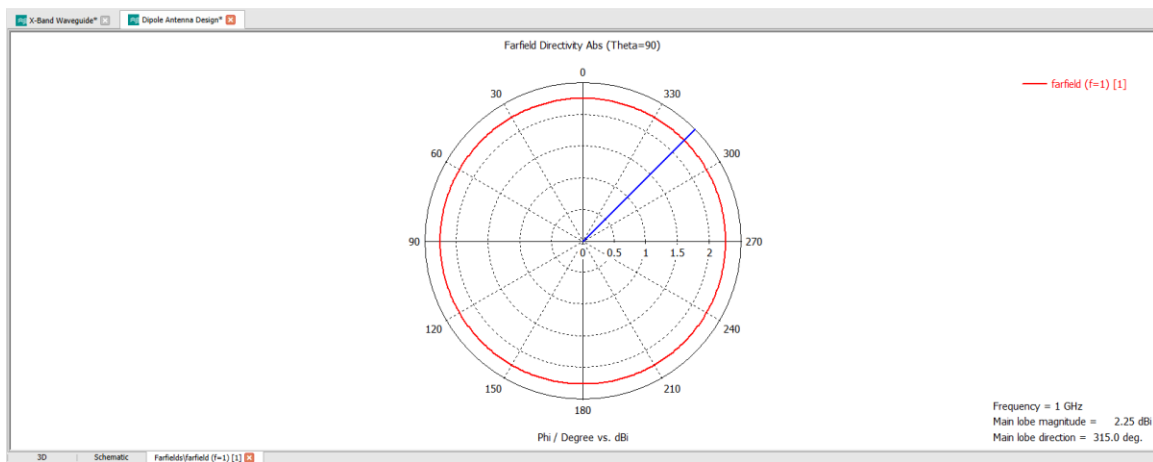
Front View



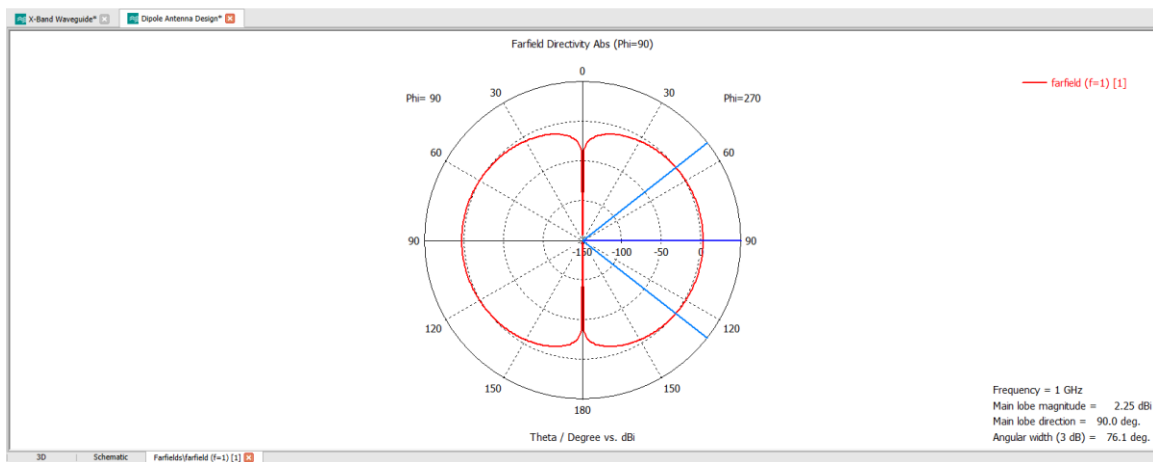
Top View



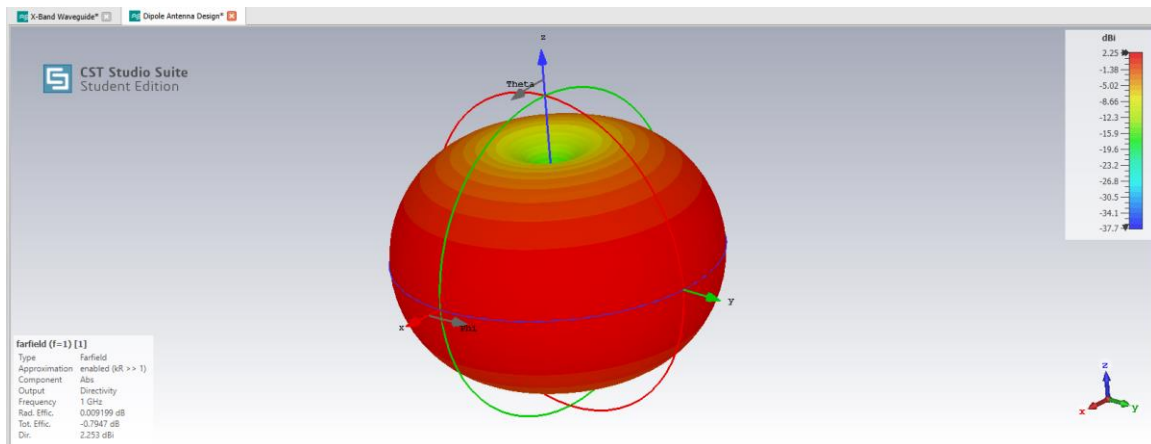
Resonance Frequency



Theta = 90 Degrees



Phi = 90 Degrees



3D Farfield View