

LG2851 Box Antenna Specification

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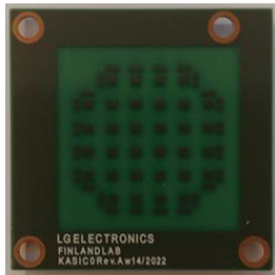
LG2851 Box Antenna Specification

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1 Antenna Definition

LG2851 box module operates with array antenna with horizontal polarization in package substrate, so called Antenna in Package (AiP). With rotating antenna module 90 degrees, vertical polarization can be implemented.

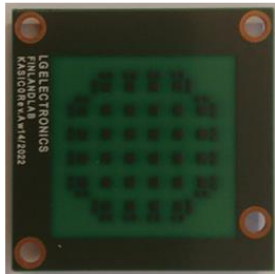
LG2851 C0 (Antenna layer)
Horizontal polarization



LG2851 C0 (Device layer)



LG2851 C0 (Antenna layer)
Vertical polarization



LG2851 C0 (Device layer)



2 Antenna Specification

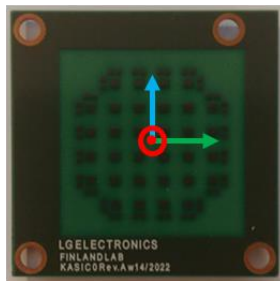
This chapter describes the array antenna specifications of LG2851 box module, including operating frequency, radiation characteristics, return loss and antenna impedance.

Parameters			Min.	Typ.	Max.	Units
LG2851 Box						
	Antenna Type		Patch Array Antenna			
	Polarization		Horizontal Polarization			
	Operating Frequency		57.24		65.88	GHz
	Transmit and receive mode	Number of Antenna Elements		32		
		Peak Realized Gain	18.6		20	dBi
		Peak Beam Direction (Phi/Theta)		0 / +90		Degree
		HPBW	14.5		18.1	Degree
		Side lobe level	-15.5		-14.5	dB
	Return Loss				-10	dB
	Impedance			50		Ohm

3 Radiation Pattern

This chapter describes simulated beam patterns. Normalized beam patterns are represented for transmit and receive mode with uniform phase control. The coordinate of beam pattern and main beam direction is summarized below.

LG2851 C0 (Antenna layer)
Horizontal polarization



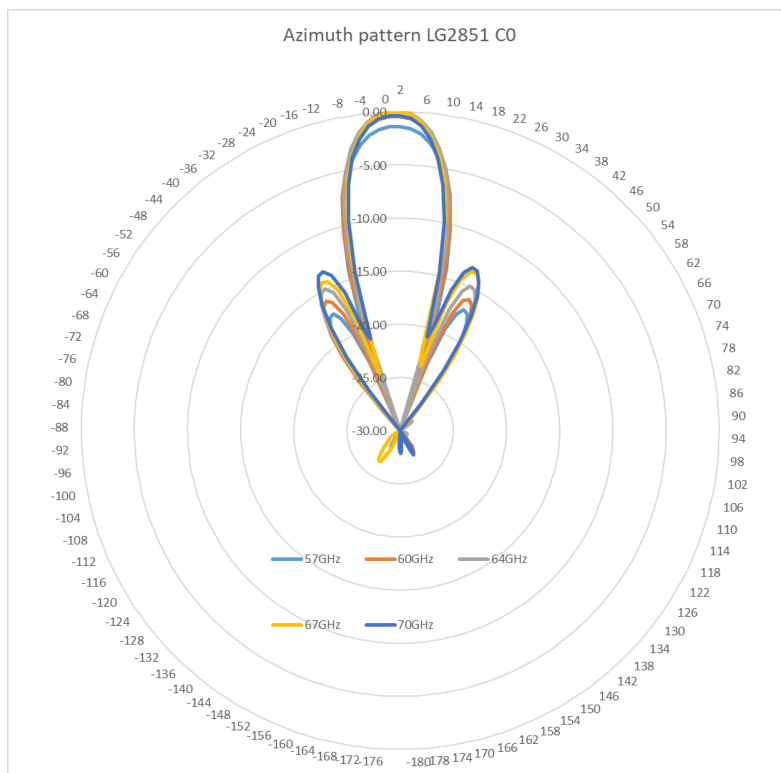
LG2851 C0 (Device layer)



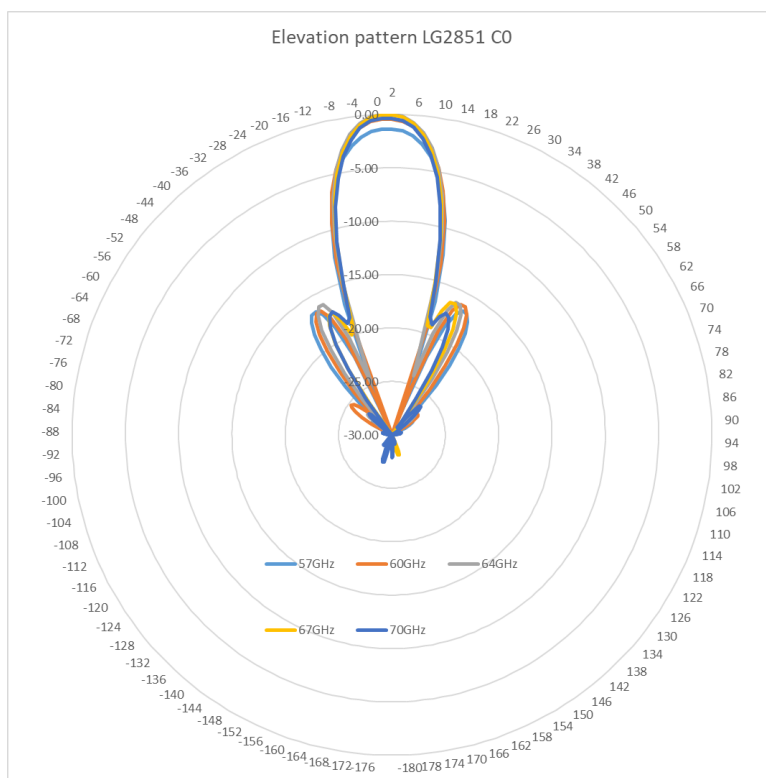
coordinate
Z (Theta 0°)

Y
X (Phi 0°)

Beam direction:
Front (+x direction)



Azimuth (X-Y plane) beam pattern



Elevation (X-Z plane) beam pattern

4 Simulation Setup

The 60GHz antenna performances of LG2851 box module specified in the table were simulated using ANSYS Electromagnetics suite 2023R1.1. ANSYS Electromagnetics suite 2023R1.1 is implemented based on Finite Element Method (FEM), which operates in the frequency domain.

In the simulation model of LG2851 box module, the PCB consists of the antenna array elements, layers, vias and traces with electrical parameters of metal conductivities, dielectric constants and tangent losses. The number of antenna ports of LG2851 box module is equal to 32. These 32 ports are operating bottom side antenna set containing 32 elements array of patch antennas. Operating frequency range is from 57.24 GHz to 70.20 GHz.

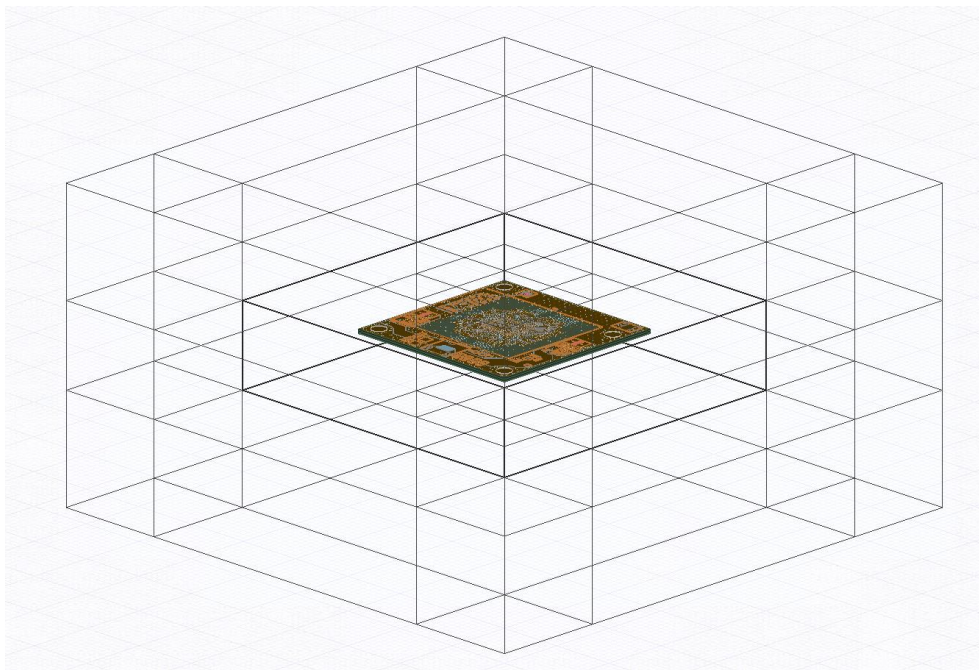


Figure 1. Simulation Model of LG2851 Box Module

In the simulation setup, lambda refinement in which Ansys Electromagnetics suite 2023R1.1 refines the initial mesh based on the material dependent wavelength was selected as initial mesh option and 30% of maximum refinement per pass was used as adaptive option. Ansys Electromagnetics suite 2023R1.1 computes the error, and the iterative process (solve – error analysis – adaptive refinement) repeats until the convergence criteria are satisfied. In Ansys Electromagnetics suite 2023R1.1, as long as the convergence is reached, the converged results are accurate. The convergence error (i.e., maximum magnitude delta S) in all our simulation was 0.02.

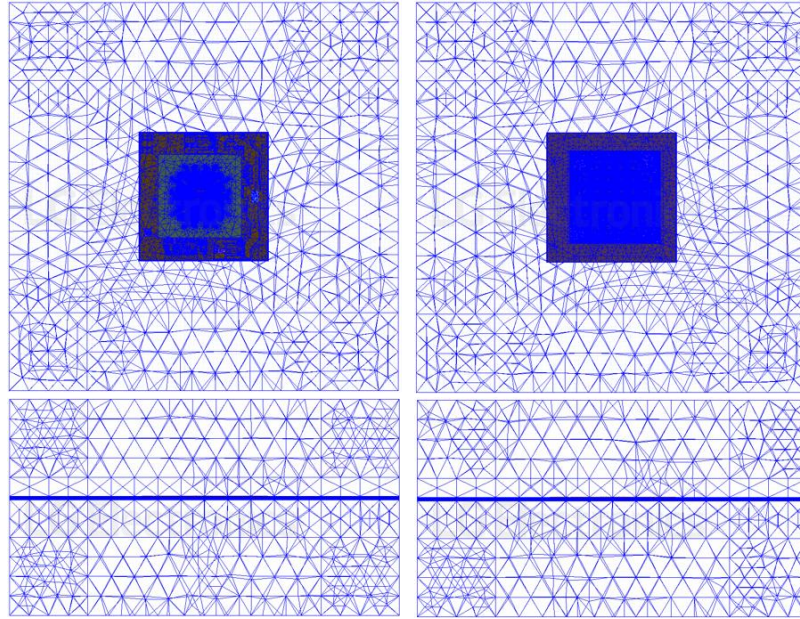


Figure 2. Simulation Mesh Setup Used in LG2851 Box Module

In Ansys Electromagnetics suite 2023R1.1, the realized gain formula is defined in terms of incident power as,

$$Realized\ Gain = 4\pi \times \frac{U}{P_{inc}}$$

where U is the radiation intensity and P_{inc} is the incident power.

It can also be expressed as the product of gain and mismatch factor as

$$Realized\ Gain = Gain \times (1 - |S_{11}|^2)$$

where Gain is the antenna's gain which does not account for impedance mismatch and $|S_{11}|^2$ is the reflection coefficient, representing the power that is reflected from the antenna port