



LG2851 Slim Right Antenna Specification

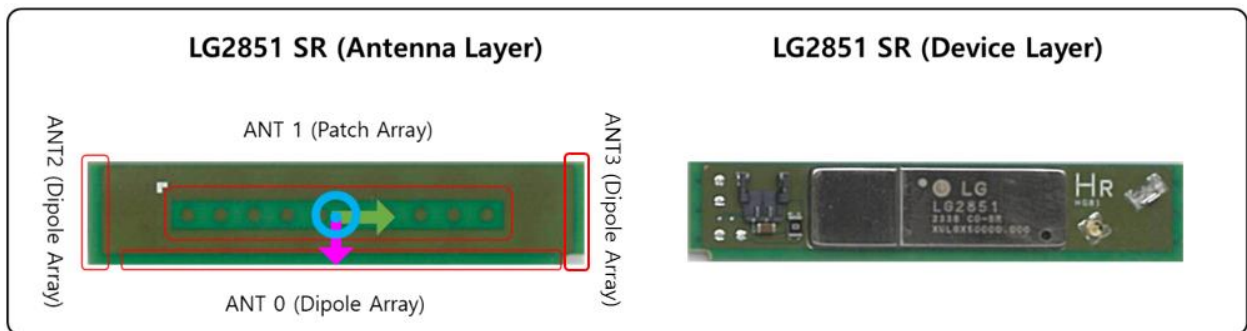
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LG2851 Slim Right Antenna Specification

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LG Electronics, Inc.

1 Antenna Definition

LG2851 slim right module operates with array antenna sets for different polarization and beam direction in their package substrate, so called Antenna in Package (AiP). Each antenna set has own antenna element design and array configuration.



2 Antenna Specification

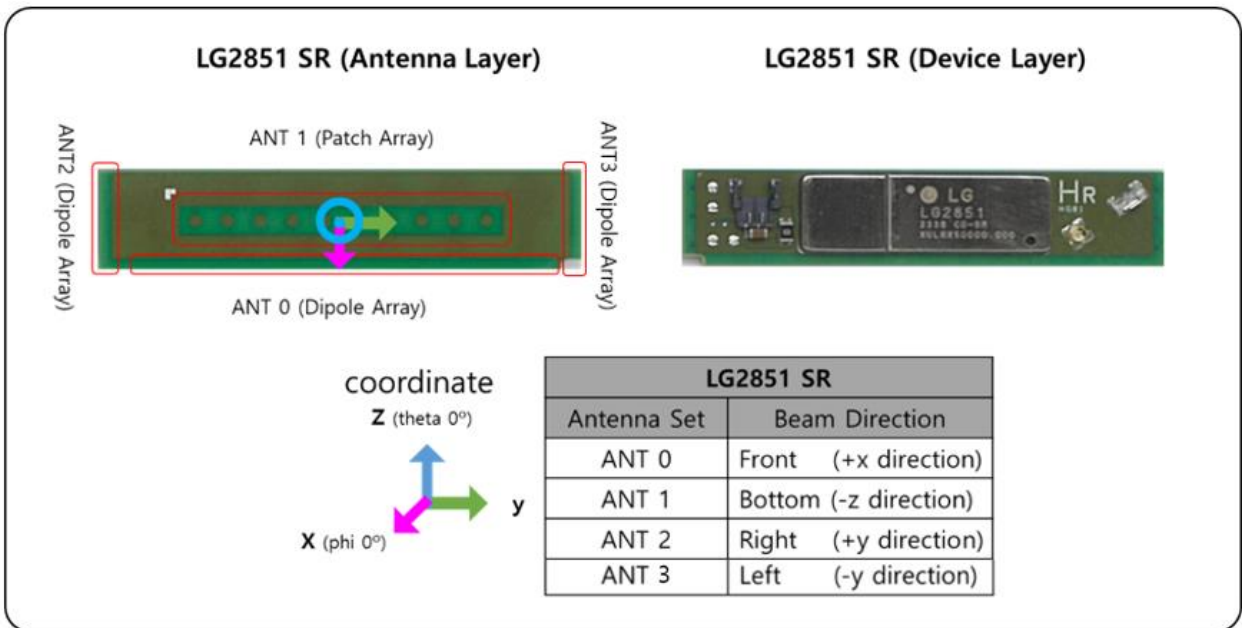
This chapter describes the array antenna specifications of LG2851 slim right module, including operating frequency, radiation characteristics, return loss and antenna impedance of each array antenna sets.

Parameters			Min.	Typ.	Max.	Units	
LG2851 SR							
ANT 0	Antenna Type		Dipole Array Antenna				
	Polarization		Horizontal Polarization				
	Operating Frequency		57.24		65.88	GHz	
	Transmit mode	Number of Antenna Elements			14		
		Peak Realized Gain		14.3		14.6	dBi
		Peak Beam Direction (Phi/Theta)			0 / 100		Degree
		HPBW (Phi/Theta)			6 / 126		Degree
	Receive mode	Number of Antenna Elements			14		
		Peak Realized Gain		14.3		14.6	dBi
		Peak Beam Direction (Phi/Theta)			0 / 100		Degree
		HPBW (Phi/Theta)			6 / 126		Degree
	Return Loss				-10	dB	
	Impedance			50		Ohm	
ANT 1	Antenna Type		Patch Array Antenna				
	Polarization		Vertical Polarization				
	Operating Frequency		57.24		65.88	GHz	
	Transmit mode	Number of Antenna Elements			10		
		Peak Realized Gain		13.4		15.2	dBi
		Peak Beam Direction (Phi/Theta)			0 / 163		Degree
		HPBW (Phi/Theta)			8 / 97		Degree
	Receive mode	Number of Antenna Elements			10		
		Peak Realized Gain		13.4		15.2	dBi
		Peak Beam Direction (Phi/Theta)			0 / 163		Degree
		HPBW (Phi/Theta)			8 / 97		Degree
	Return Loss				-10	dB	
	Impedance			50		Ohm	

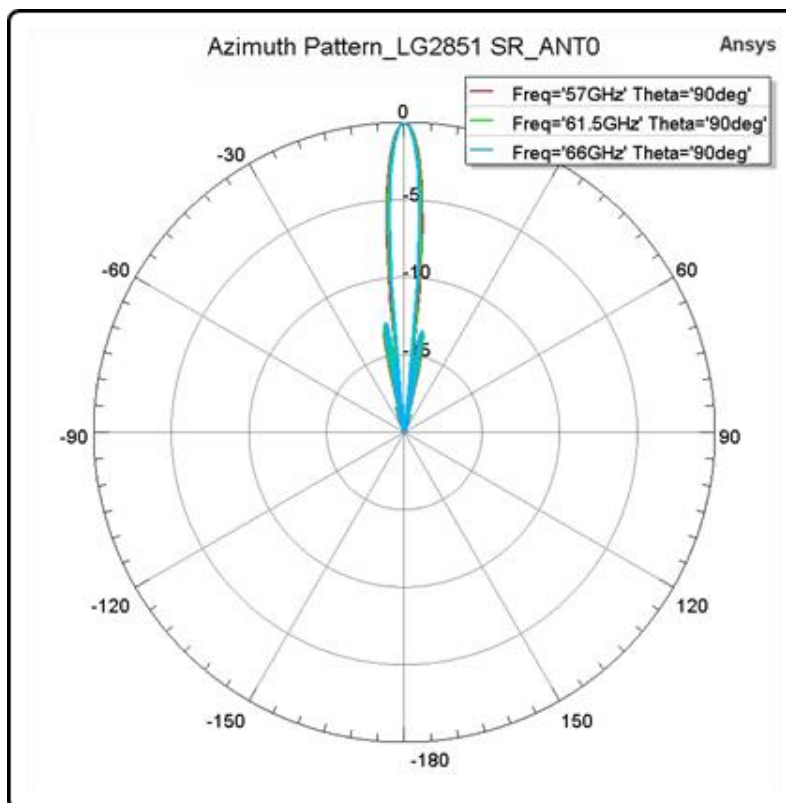
ANT 2	Antenna Type		Dipole Array Antenna			
	Polarization		Horizontal Polarization			
	Operating Frequency		57.24		65.88	GHz
	Transmit mode	Number of Antenna Elements		3		
		Peak Realized Gain	7.3		7.5	dBi
		Peak Beam Direction (Phi/Theta)		-92 / 90		Degree
		HPBW (Phi/Theta)		30 / 133		Degree
	Receive mode	Number of Antenna Elements		3		
		Peak Realized Gain	7.3		7.5	dBi
		Peak Beam Direction (Phi/Theta)		-92 / 90		Degree
		HPBW (Phi/Theta)		30 / 133		Degree
	Return Loss				-10	dB
	Impedance			50		Ohm
ANT 3	Antenna Type		Dipole Array Antenna			
	Polarization		Horizontal Polarization			
	Operating Frequency		57.24		65.88	GHz
	Transmit mode	Number of Antenna Elements		3		
		Peak Realized Gain	7.3		7.5	dBi
		Peak Beam Direction (Phi/Theta)		-92 / 90		Degree
		HPBW (Phi/Theta)		30 / 133		Degree
	Receive mode	Number of Antenna Elements		3		
		Peak Realized Gain	7.3		7.5	dBi
		Peak Beam Direction (Phi/Theta)		-92 / 90		Degree
		HPBW (Phi/Theta)		30 / 133		Degree
	Return Loss				-10	dB
	Impedance			50		Ohm

3 Radiation Pattern

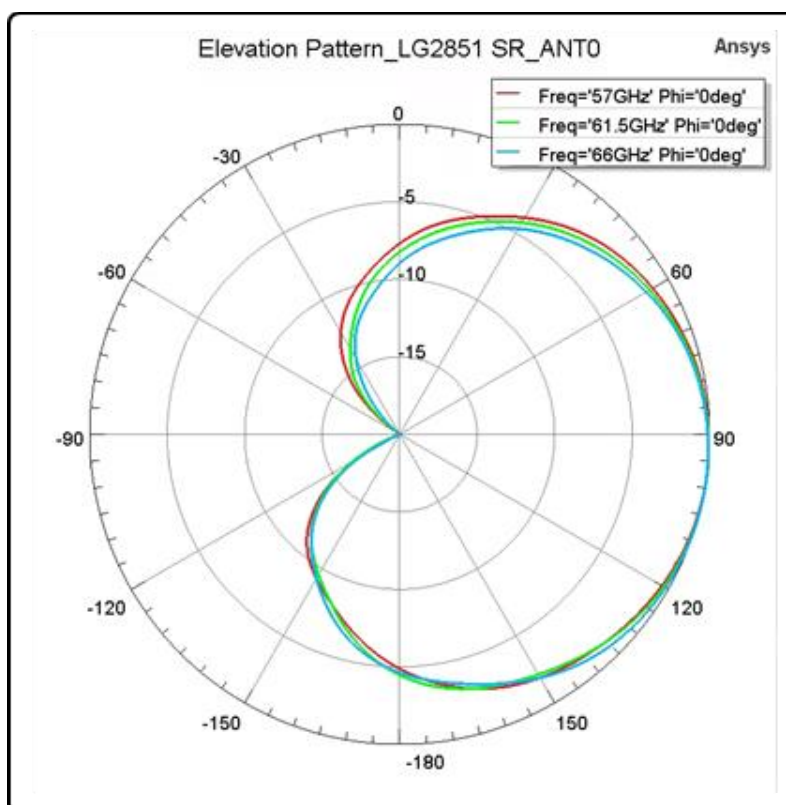
This chapter describes simulated beam patterns of each array antenna set. Normalized beam patterns are represented for transmit and receive mode with uniform phase control. The coordinate of beam pattern and main beam direction of each antenna set is summarized below.



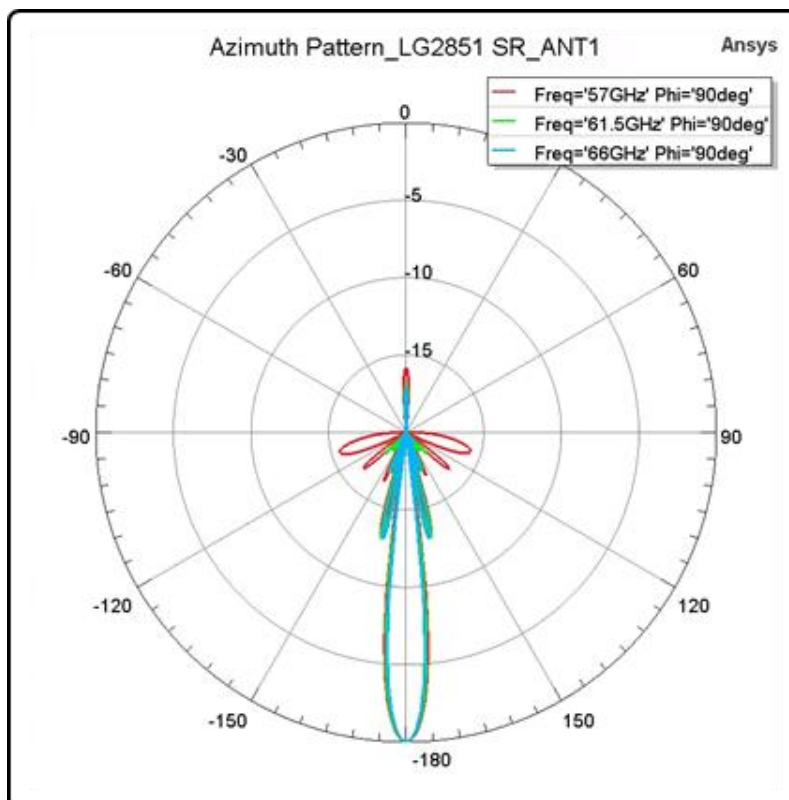
3.1 LG2851 Slim Right (Transmit Mode)



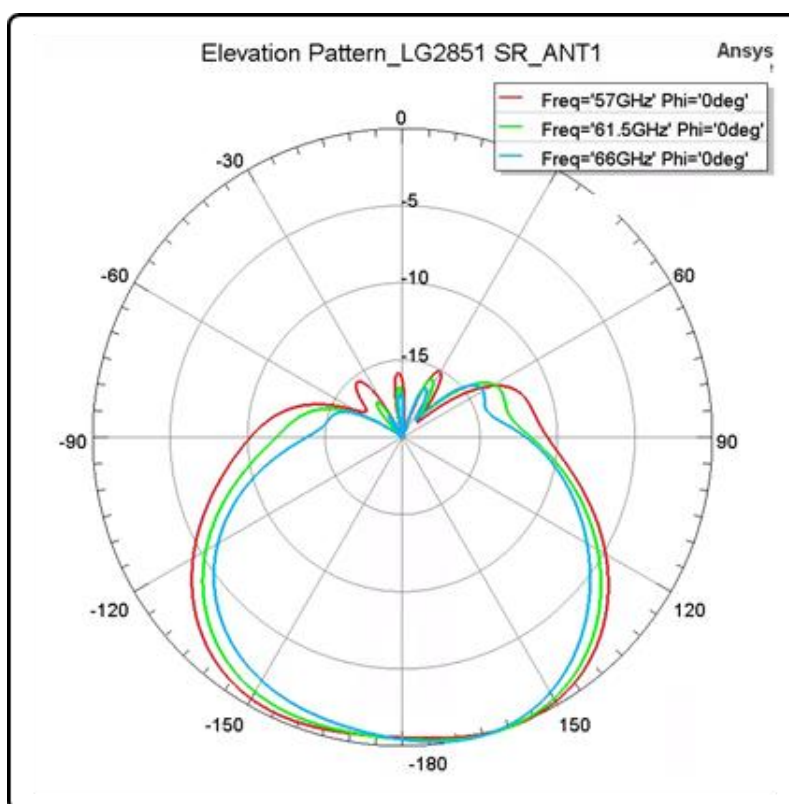
ANT 0 : Azimuth (X-Y plane) beam pattern



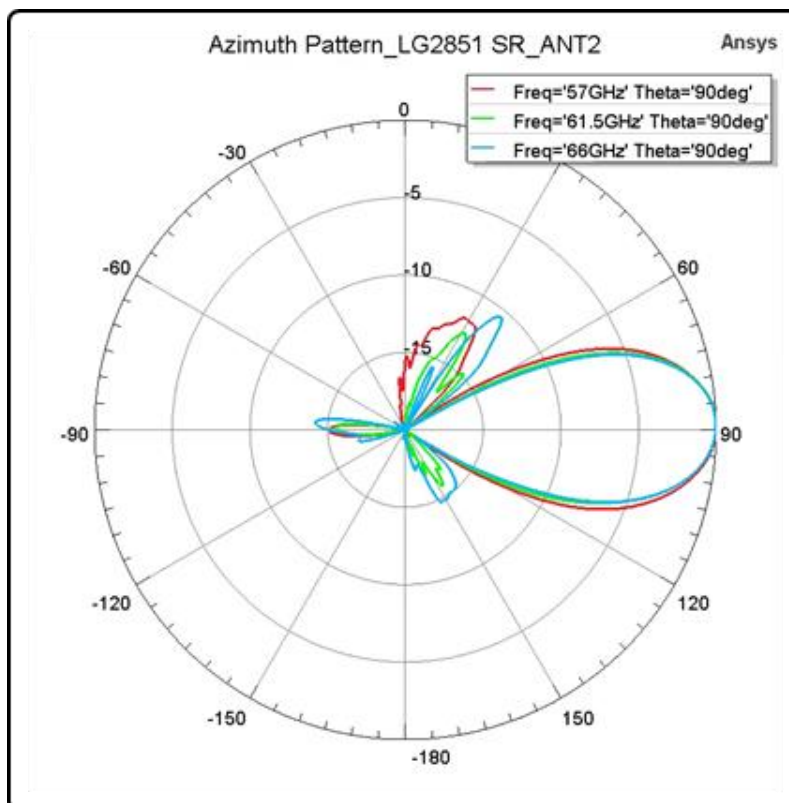
ANT 0 : Elevation (X-Z plane) beam pattern



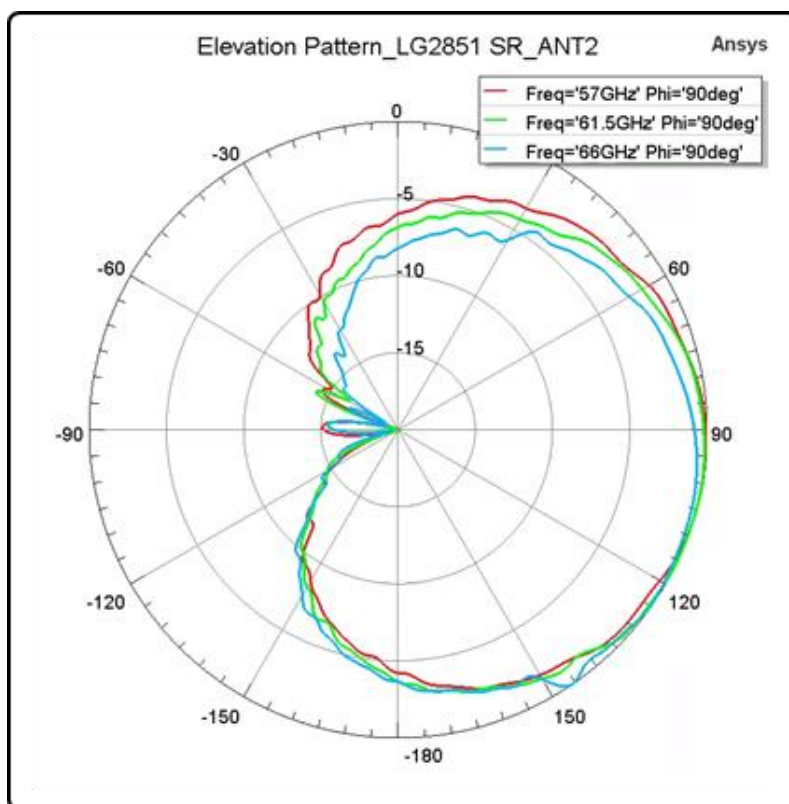
ANT 1 : Azimuth (Y-Z plane) beam pattern



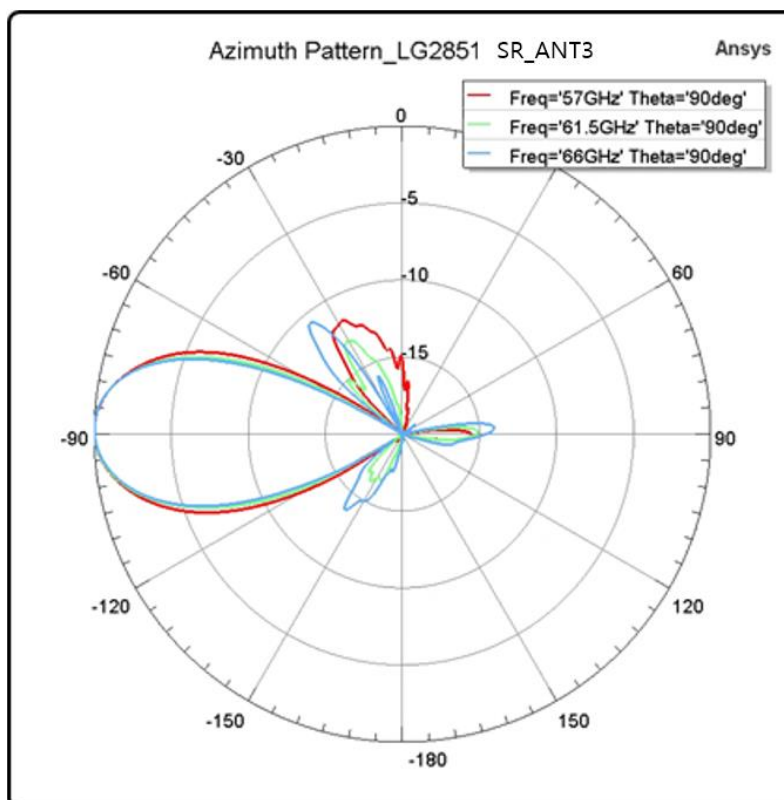
ANT 1 : Elevation (X-Z plane) beam pattern



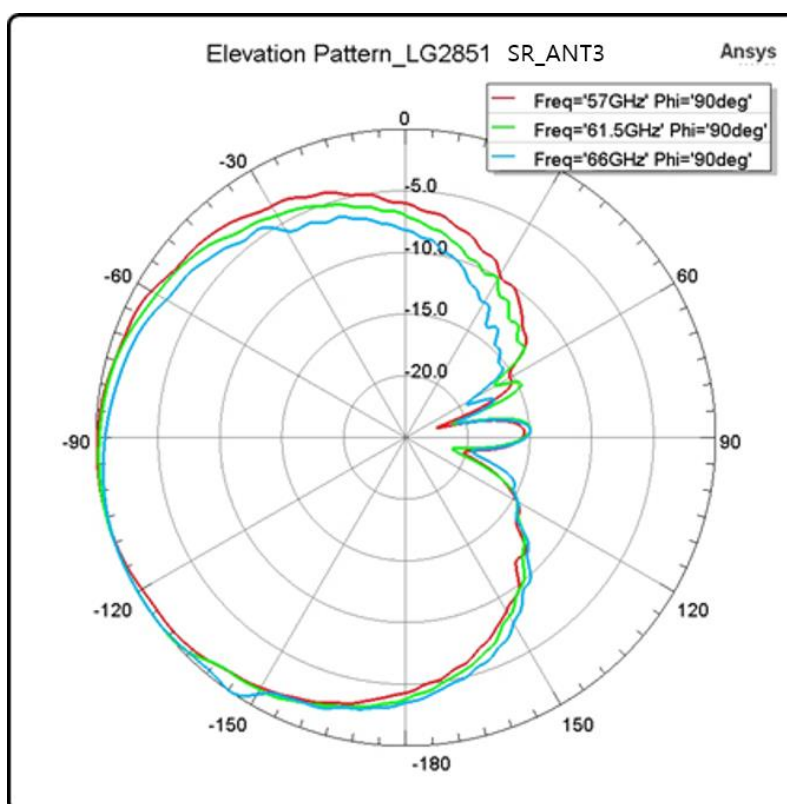
ANT 2 : Azimuth (X-Y plane) beam pattern



ANT 2 : Elevation (X-Z plane) beam pattern

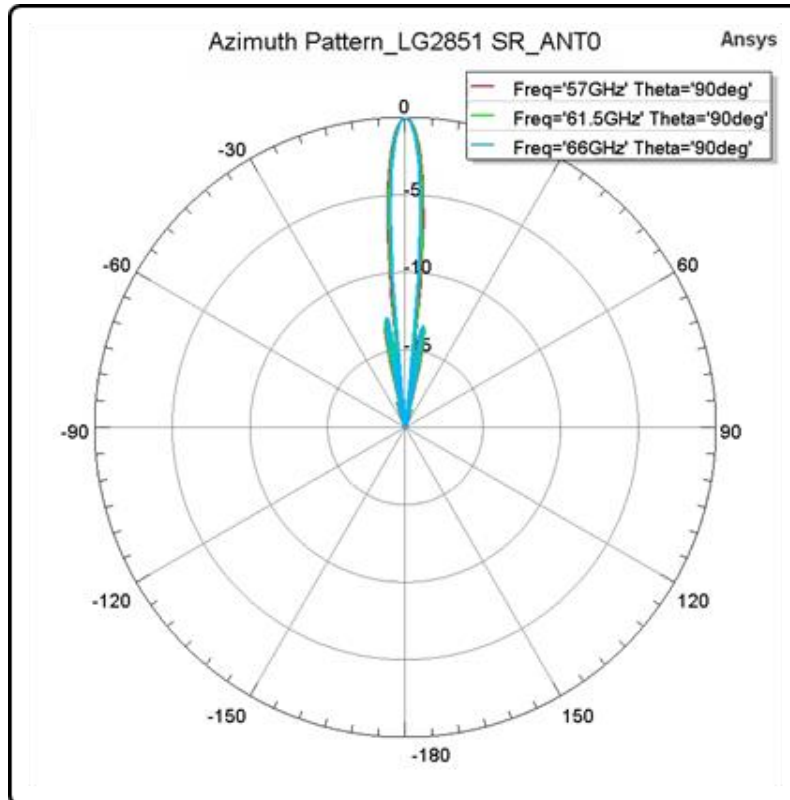


ANT 3 : Azimuth (X-Y plane) beam pattern

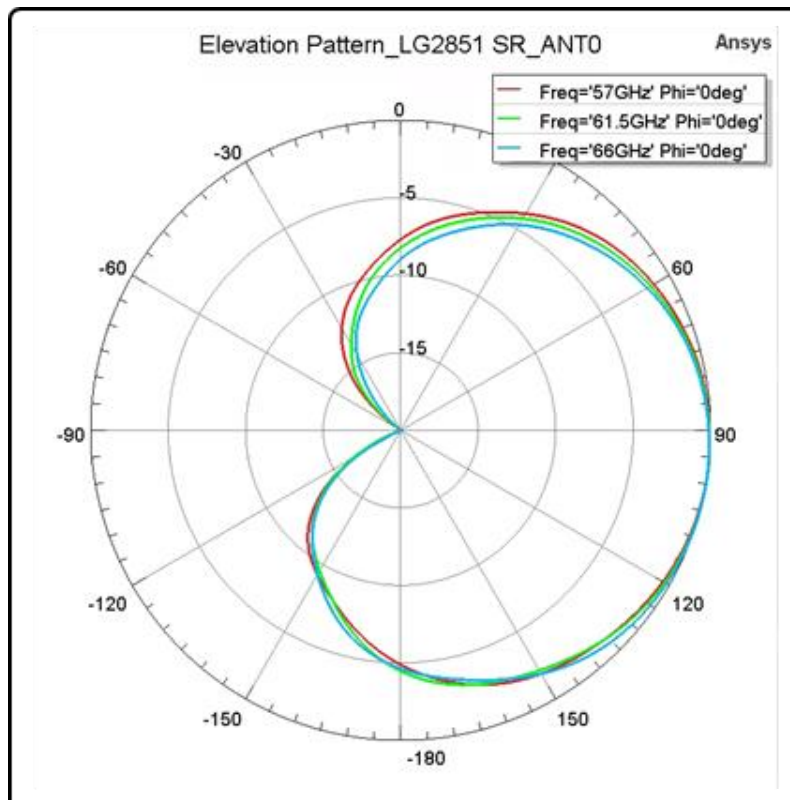


ANT 3 : Elevation (X-Z plane) beam pattern

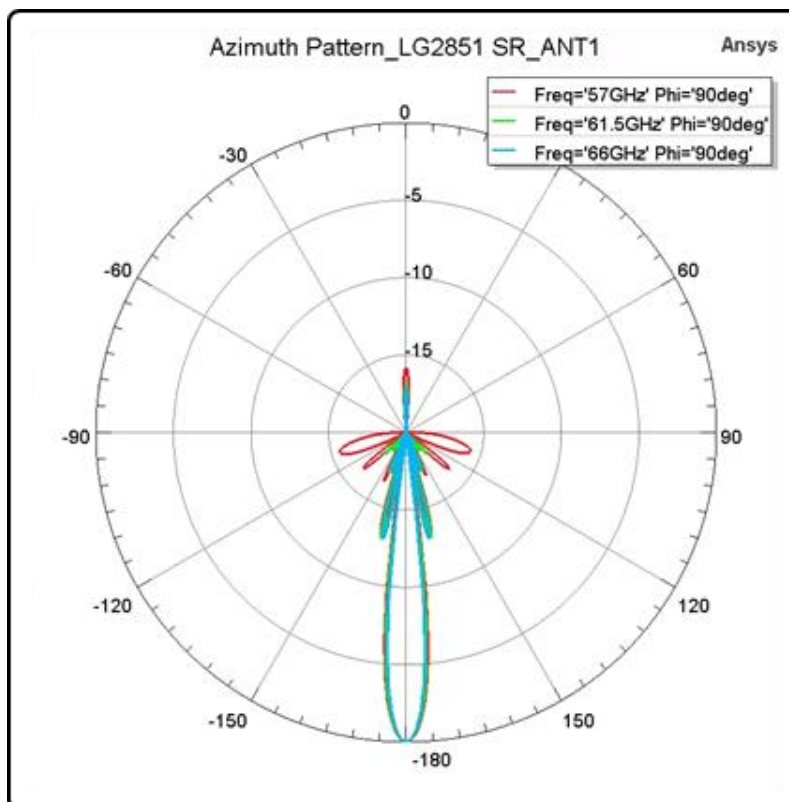
3.2 LG2851 Slim Right (Receive Mode)



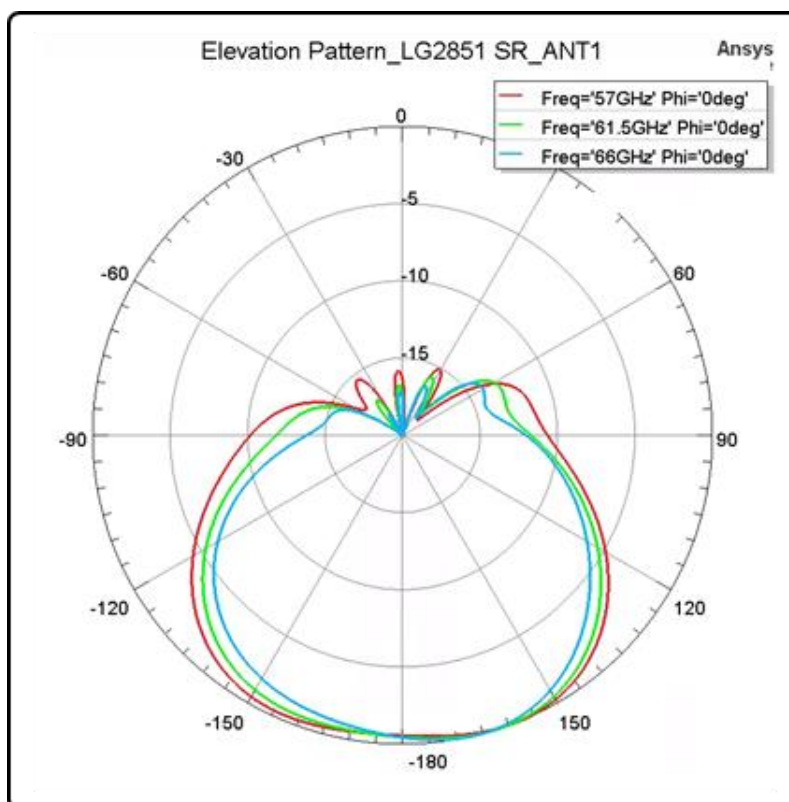
ANT 0 : Azimuth (X-Y plane) beam pattern



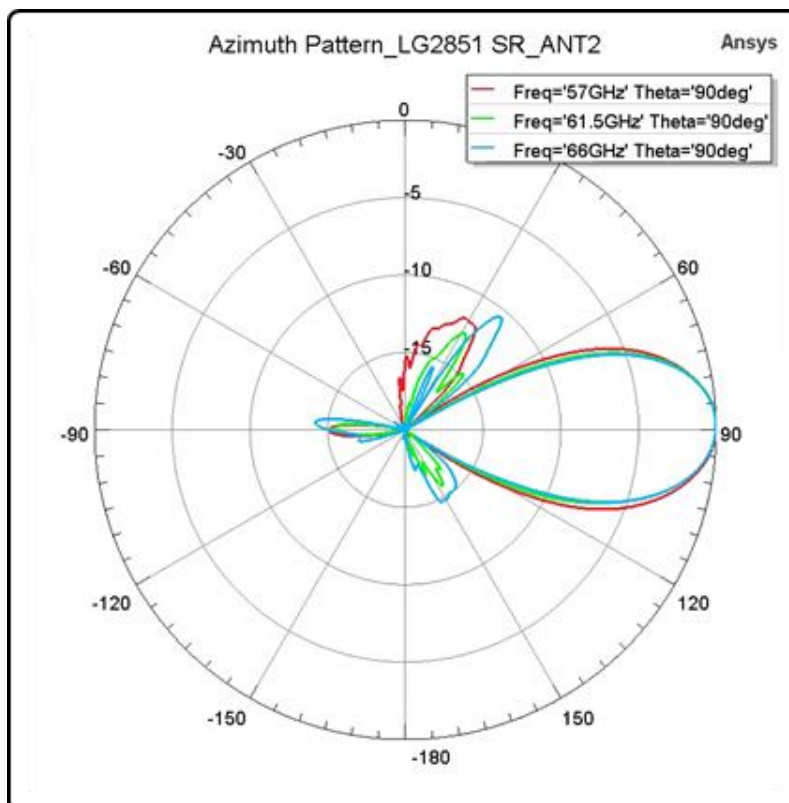
ANT 0 : Elevation (X-Z plane) beam pattern



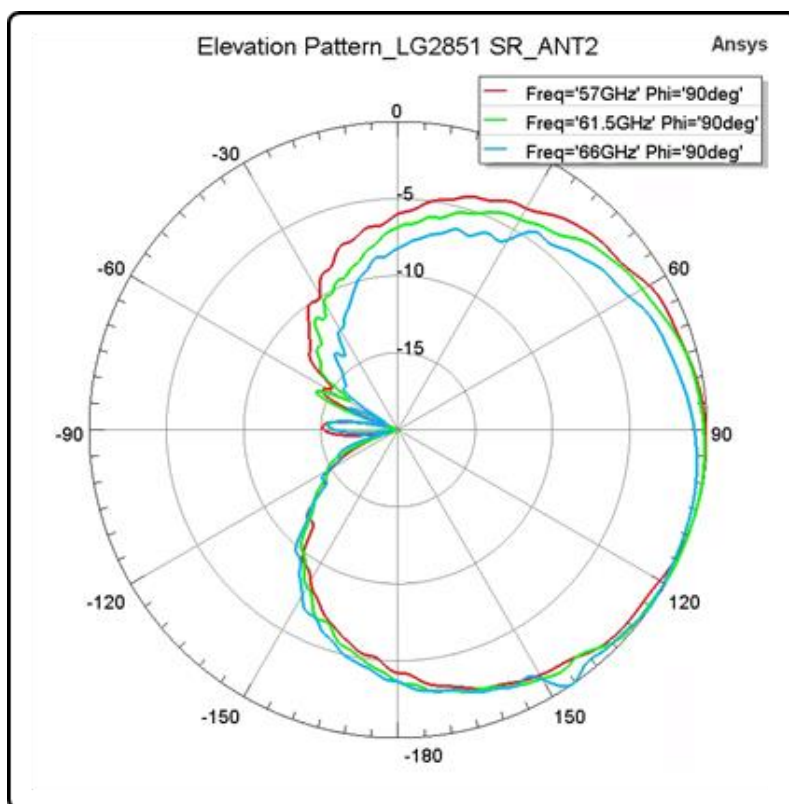
ANT 1 : Azimuth (Y-Z plane) beam pattern



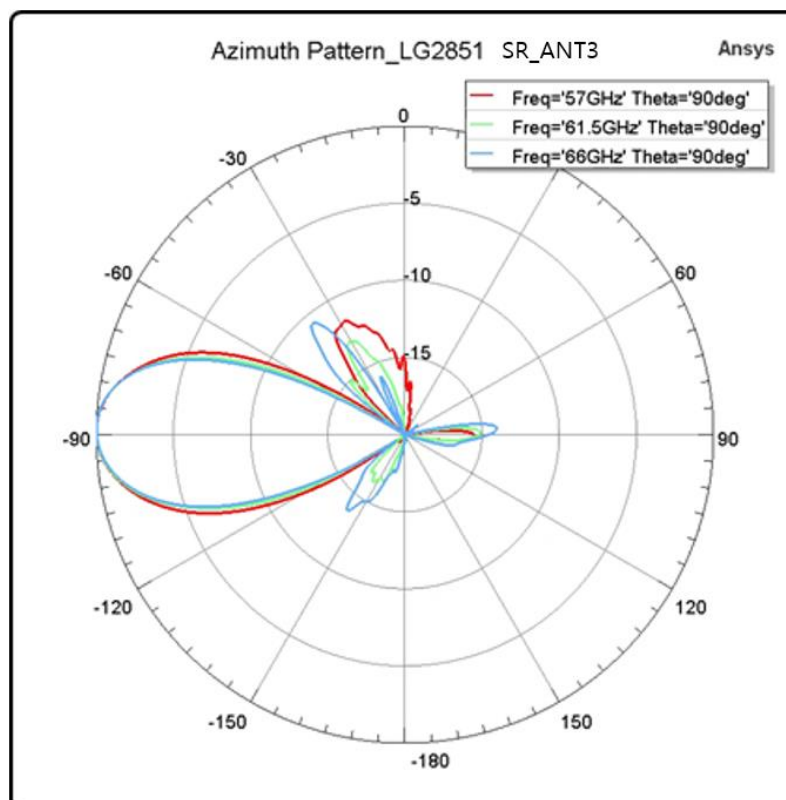
ANT 1 : Elevation (X-Z plane) beam pattern



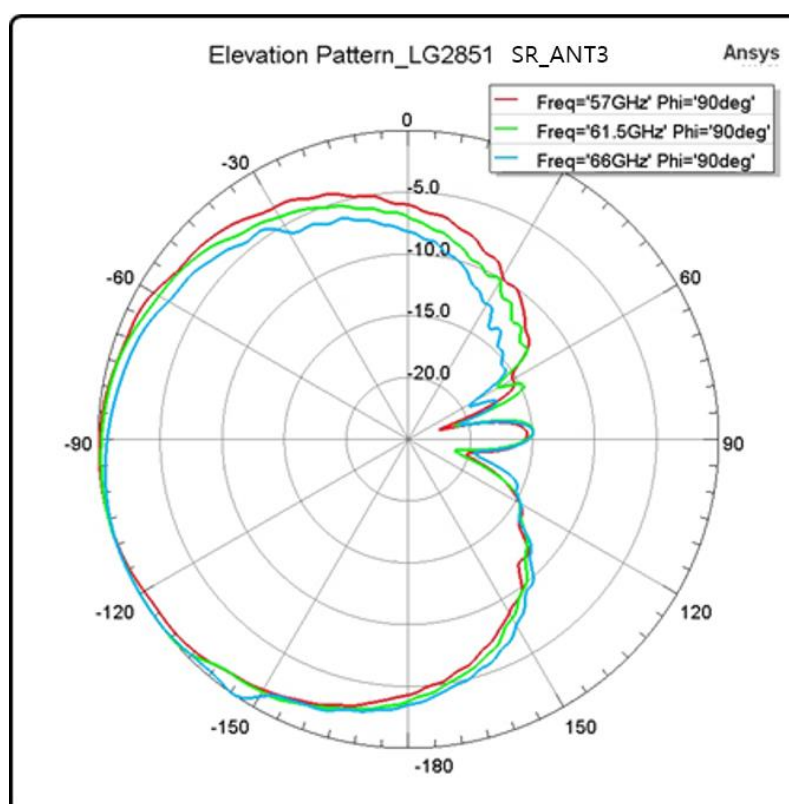
ANT 2 : Azimuth (X-Y plane) beam pattern



ANT 2 : Elevation (X-Z plane) beam pattern



ANT 3 : Azimuth (X-Y plane) beam pattern



ANT 3 : Elevation (X-Z plane) beam pattern

4 Simulation Setup

The 60 GHz antenna performances of LG2851 SLIM module specified in the table were simulated using ANSYS Electromagnetics suite 2023R2. ANSYS Electromagnetics suite 2023R2 is implemented based on Finite Element Method (FEM), which operates in the frequency domain.

In the simulation model of LG2851 SLIM module, the PCB consists of the antenna array elements, layers, vias and traces with electrical parameters of metal conductivities, dielectric constants and tangent losses. Metal shield can component is included in simulation model. The number of antenna ports of LG2851 SLIM module is equal to 32. These 32 ports are operating in a group of 4 antenna sets as ANT0, ANT1, ANT2 and ANT3 in which only one antenna set is activated at a time. ANT0 which is front side antenna set containing 1x14 elements array of dipole antennas. ANT1 which is bottom side antenna set containing 1x10 elements array of patch antennas. ANT2 and ANT3 which is right/left side antenna set containing 1x3 elements array of dipole antennas. ANT0, ANT1, ANT2 and ANT3 all have the same operating frequency range, from 57.24GHz to 65.88GHz.

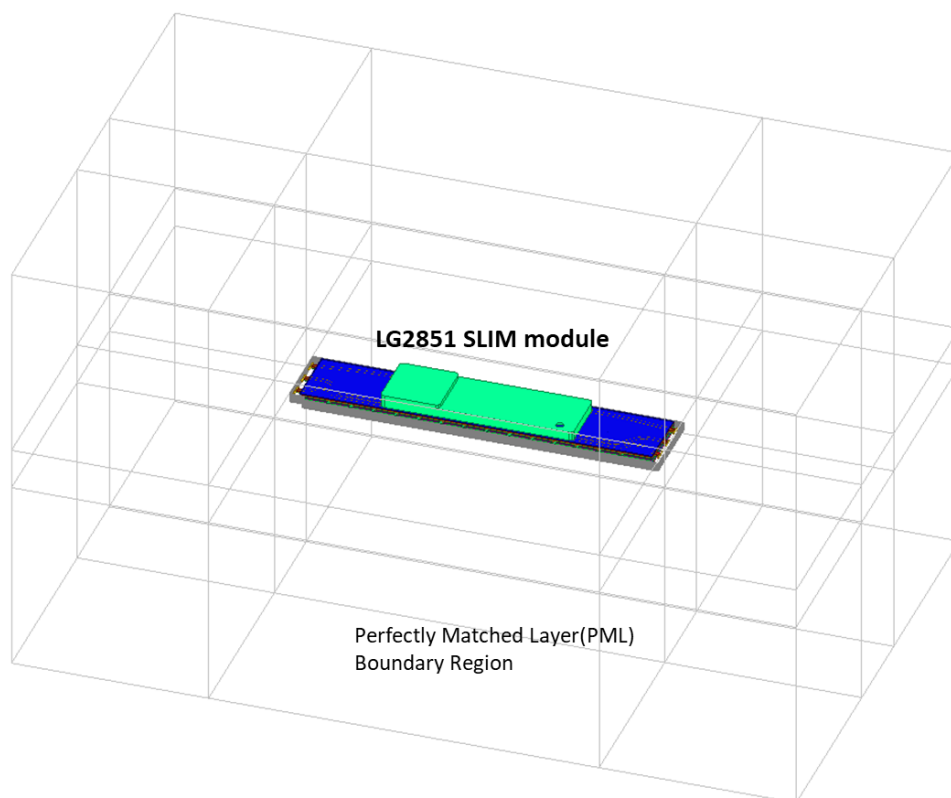


Figure 1. Simulation Model of LG2851 SLIM Module

In the simulation setup, lambda refinement in which Ansys Electromagnetics suite 2023R2 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 2023R2 computes the error, and the iterative process (solve – error analysis – adaptive refinement) repeats until the convergence criteria are satisfied. In Ansys Electromagnetics suite 2023R2, 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.

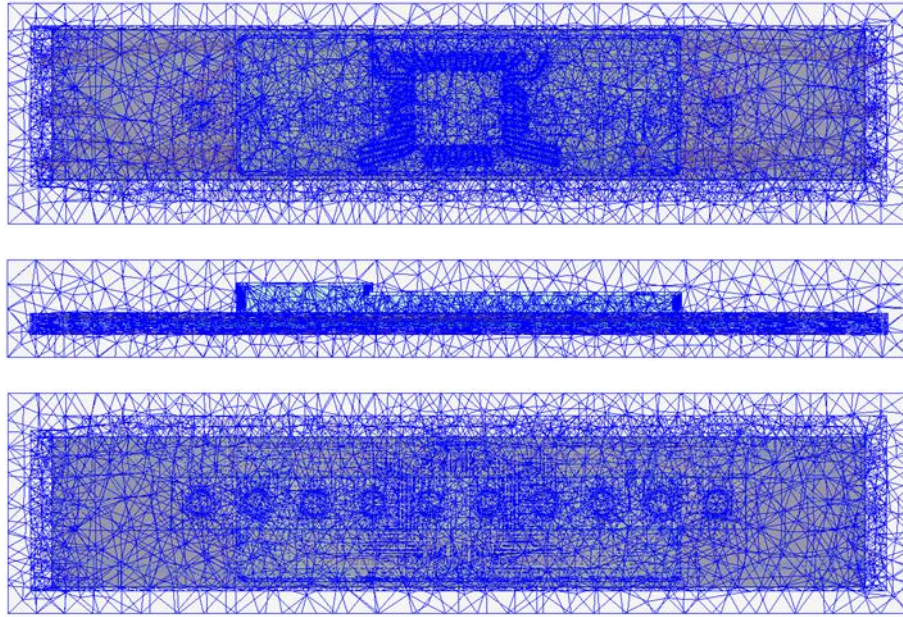


Figure 2. Simulation Mesh Setup Used in LG2851 SLIM Module

In Ansys Electromagnetics suite 2023R2, 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