



HL Antenna Proposal for CIG WF1881

Passive Measurement Report

Date: 11 June 2020

Prepared By: Bell Zheng

Introduction

- Brief Project Description
 - Project Name:WF1881
 - Category: AP
- The receiver supports IEEE 802.11 a/b/g/n/ac/ax and BLE wireless standards
- HL Technologies developed an antenna system proposal for CIG WF1881
- Antenna Configuration:
 - 2x dual-band WLAN antennas
 - 1x BLE antenna
- WLAN antennas in HL proposal are
 - off-board
 - Stamped metal type
 - cable-fed
- BLE antenna in HL proposal is
 - On-board
 - PCB type
 - Trace-fed
- This document shows passive measurement results for HL antenna solution which received the mockup housing from CIG



Requirements Review

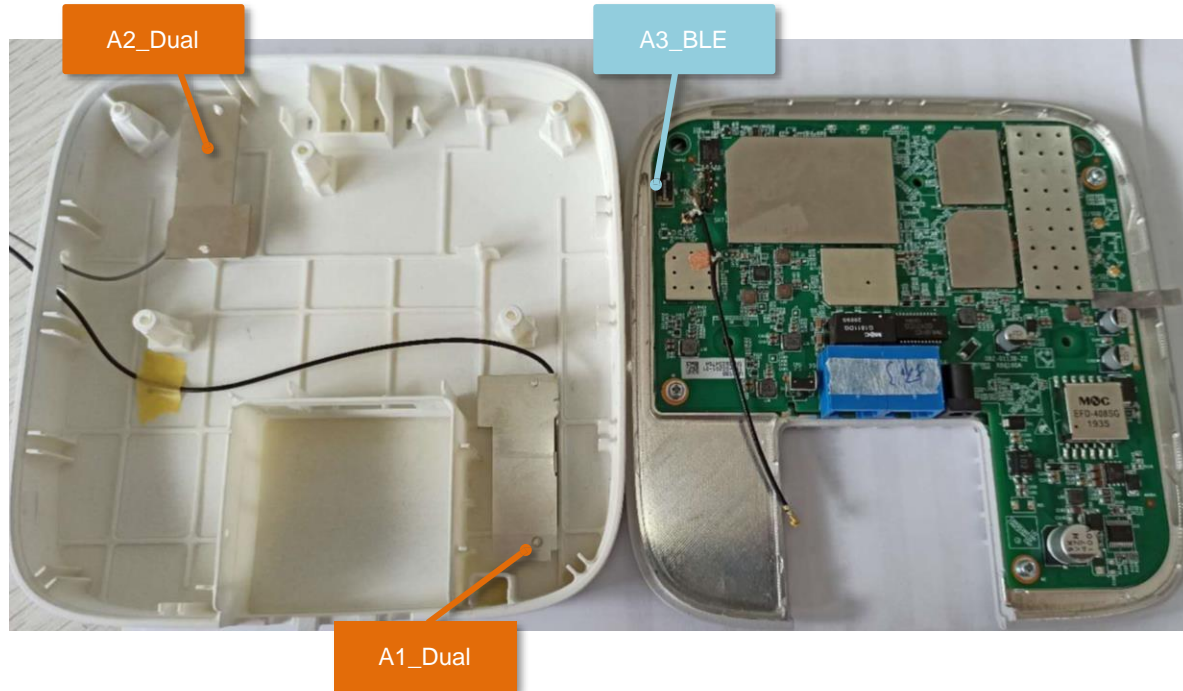
- Antenna Configuration of WF1881
 - 2x2 @ 2.4GHz & 5GHz (2 dual-band, off-board antennas)
 - 1x1 @ BLE (1 BLE, on-board antenna)
- Frequency bands
 - 2.4GHz to 2.49GHz
 - 5.15GHz to 5.85GHz
- Basic Passive Requirements
 - RL for each antennas > 10dB
 - Realized Efficiency >60%



HL Antenna System Proposal



HL Antenna System



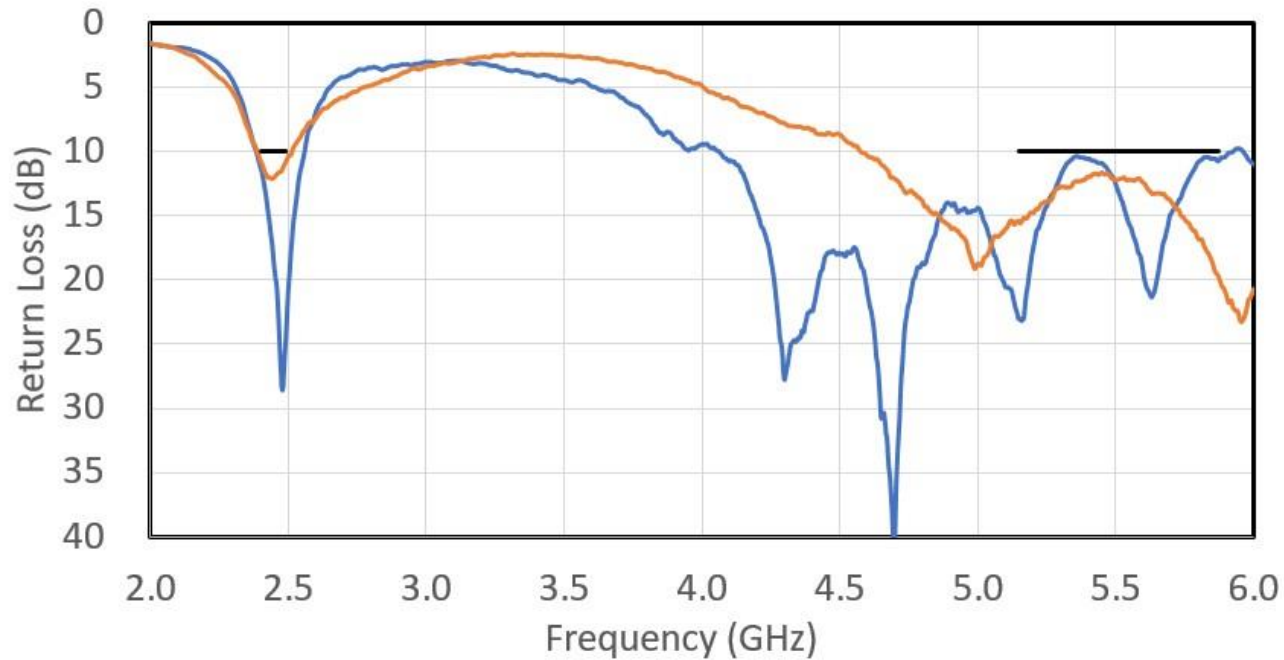
HL Antenna Designator	HL Antenna Part Number	Cable Length / mm
A1-Dual	SM2450WOC02CG-L1B210F	210
A2-Dual	SM2450WOC03CG-G70F	70
A3-BLE	PC24EST01CG	NA



S-parameters



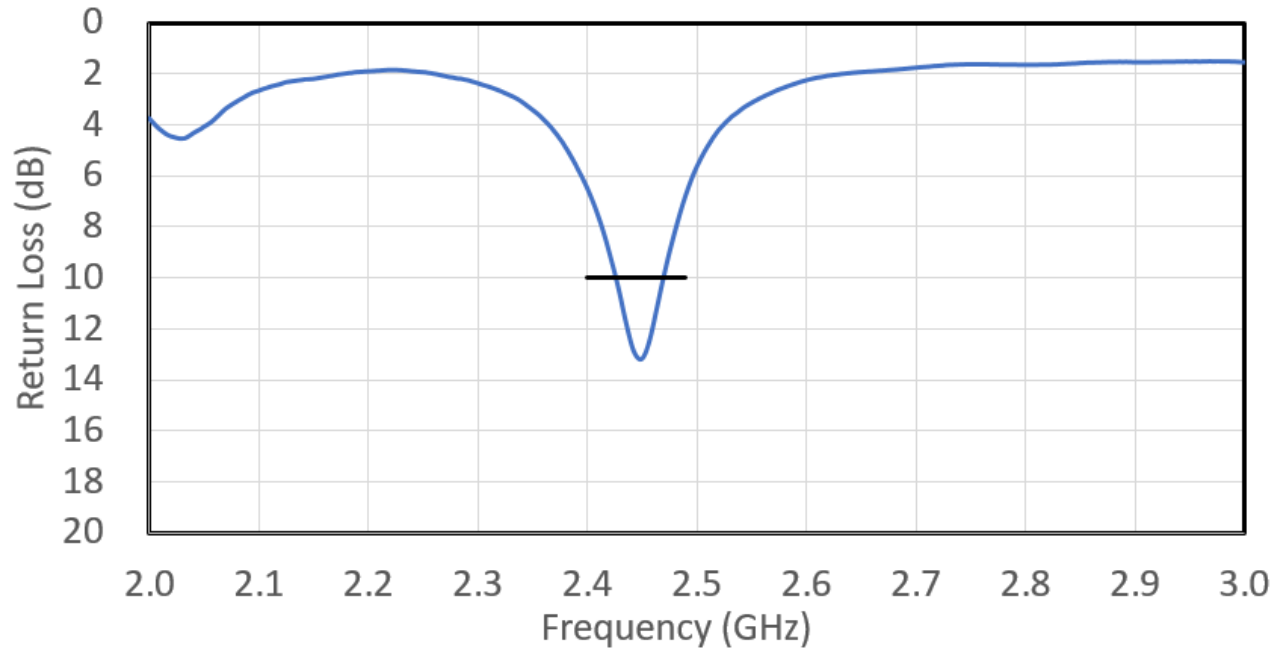
Return Loss of dual-band WLAN Antennas



Return loss (dB)	A1_Dual	A2_Dual
2400MHz	11.2	10.7
2490MHz	25.4	10.9
5150MHz	23.0	15.5
5850MHz	10.6	18.6



Return Loss of BLE Antenna

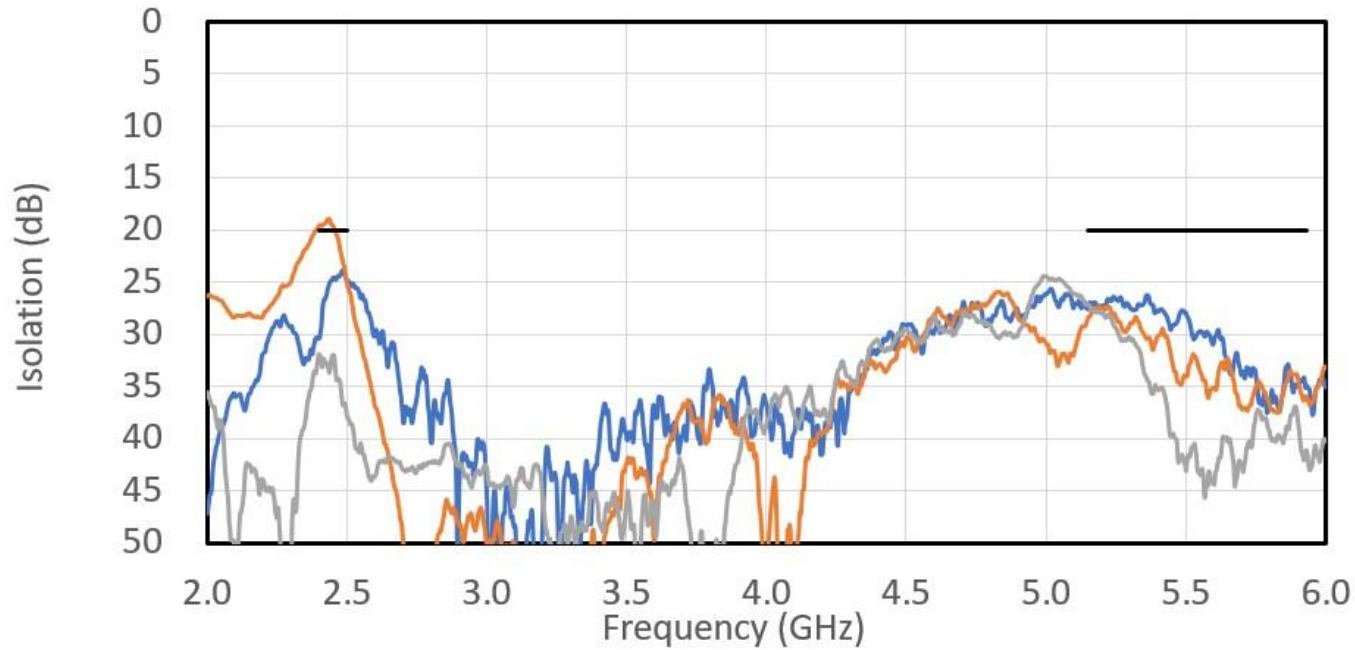


— A3-BLE

Return loss (dB)	A3_BLE
2400MHz	6.5
2490MHz	6.8



Isolation Between all antennas



— A1-A2
— A1-A3
— A2-A3

Isolation (dB)	A1-A2	A1-A3	A2-A3
2400MHz	30.4	19.6	32.0
2490MHz	24.4	23.8	36.6
5150MHz	27.6	28.5	27.2
5500MHz	28.0	34.1	43.1
5850MHz	34.9	35.5	40.1



Radiated Performance

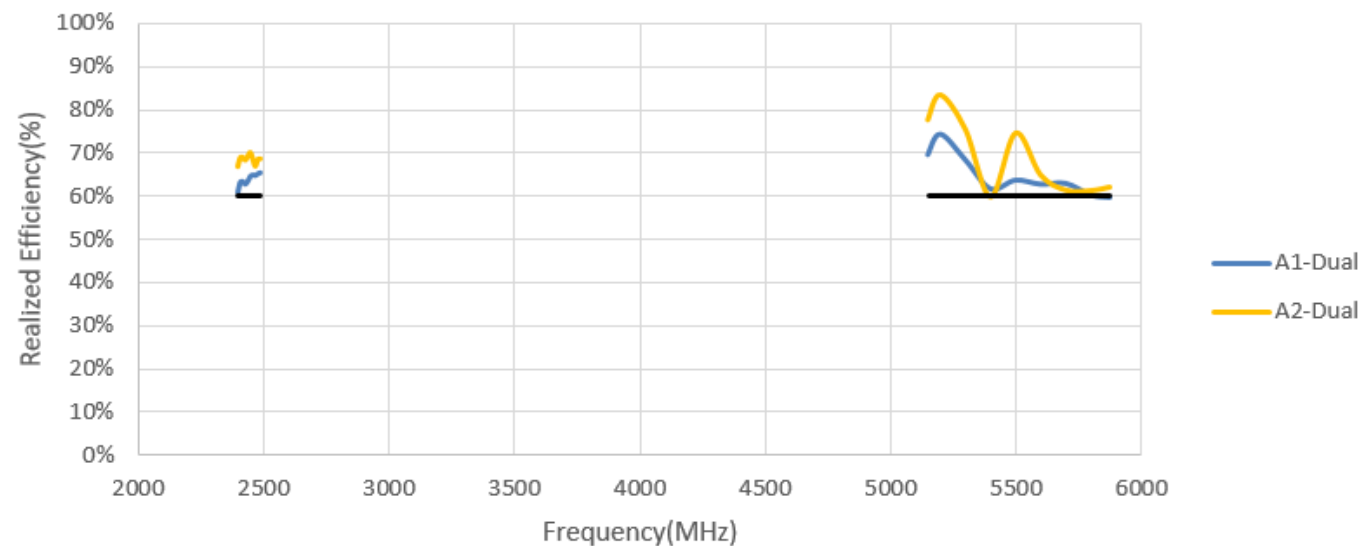
- Realized Efficiency
- Peak Realized Gain



Realized Efficiency – Dual Band WLAN Antennas

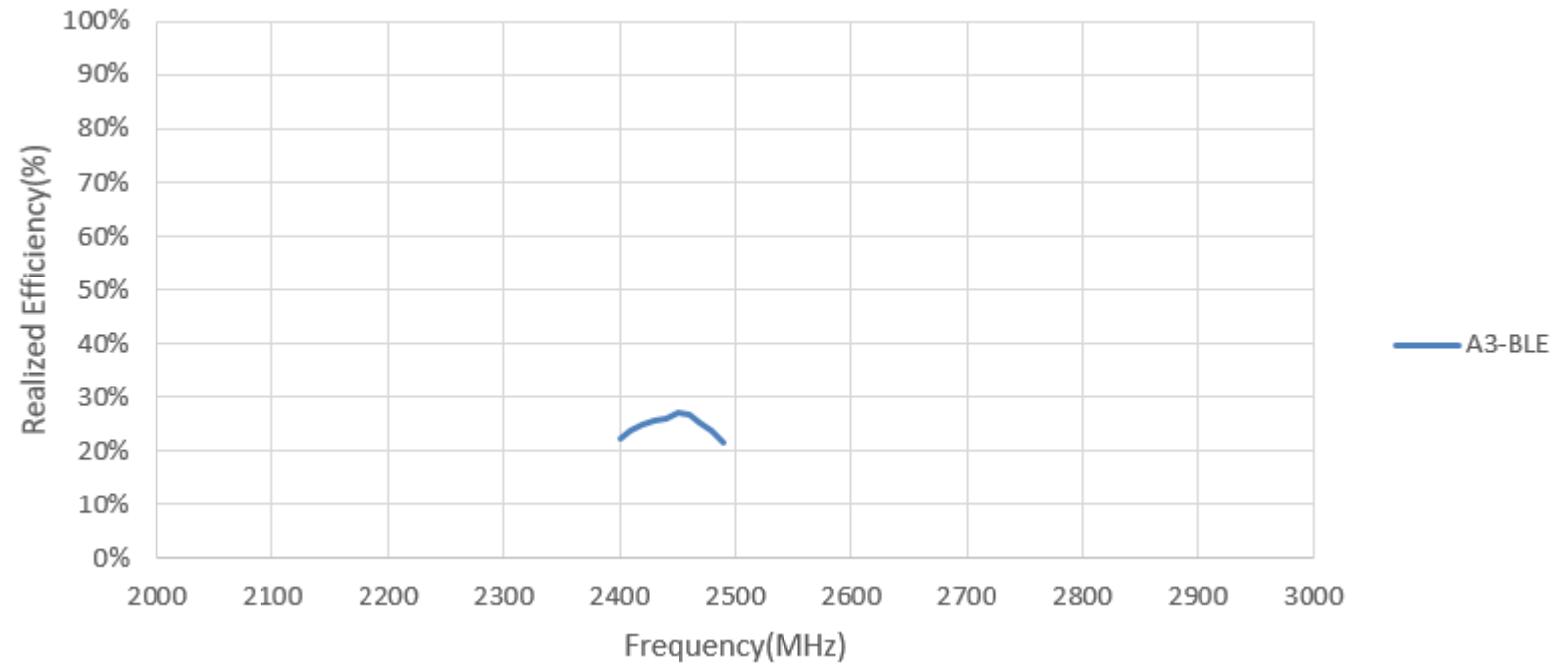
Frequency / MHz	A1_Dual (%)	A2_Dual (%)
2400	61%	67%
2410	63%	69%
2420	63%	69%
2430	63%	68%
2440	64%	69%
2450	65%	70%
2460	65%	69%
2470	65%	67%
2480	65%	68%
2490	65%	69%
Average	64%	68%

Frequency / MHz	A1_Dual (%)	A2_Dual (%)
5150	70%	78%
5200	75%	83%
5300	68%	75%
5400	62%	60%
5500	64%	75%
5600	63%	65%
5700	63%	61%
5800	60%	61%
5850	60%	62%
Average	65%	69%



Realized Efficiency – BLE Antenna

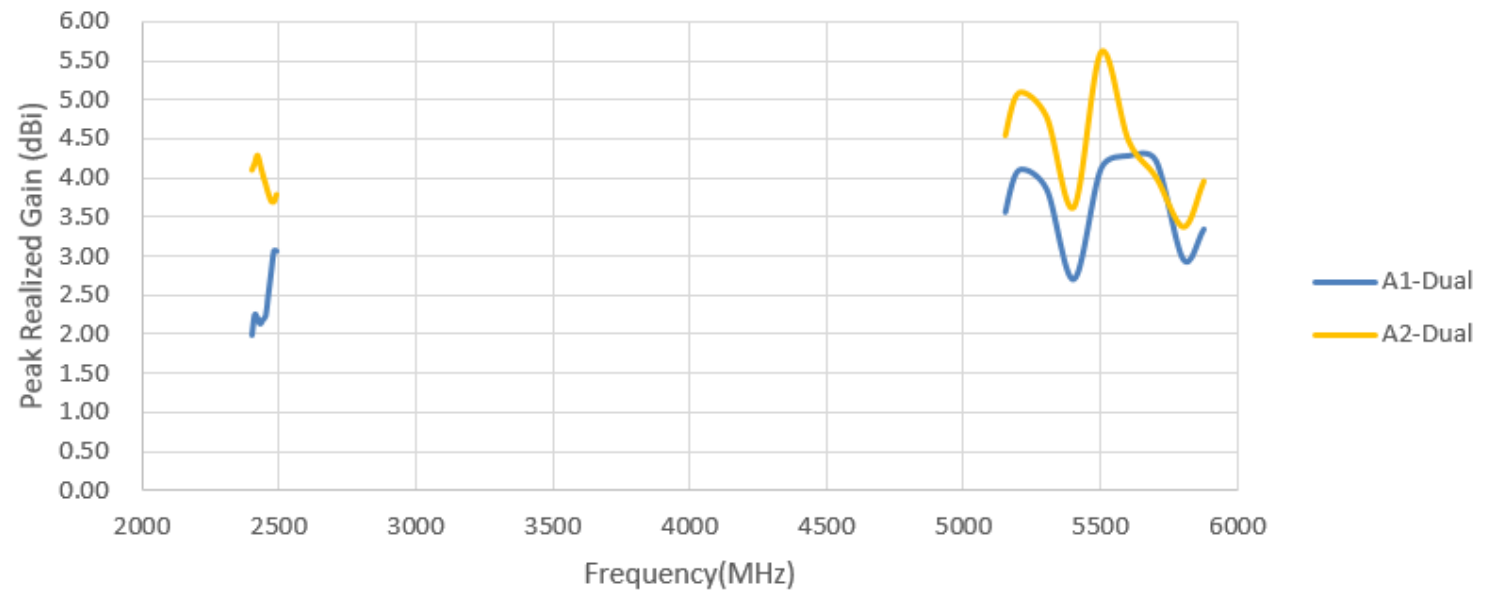
Frequency / MHz	A3_BLE (%)
2400	22%
2410	24%
2420	25%
2430	26%
2440	26%
2450	27%
2460	27%
2470	25%
2480	24%
2490	22%
Average	25%



Peak Realized Gain – Dual Band WLAN Antennas

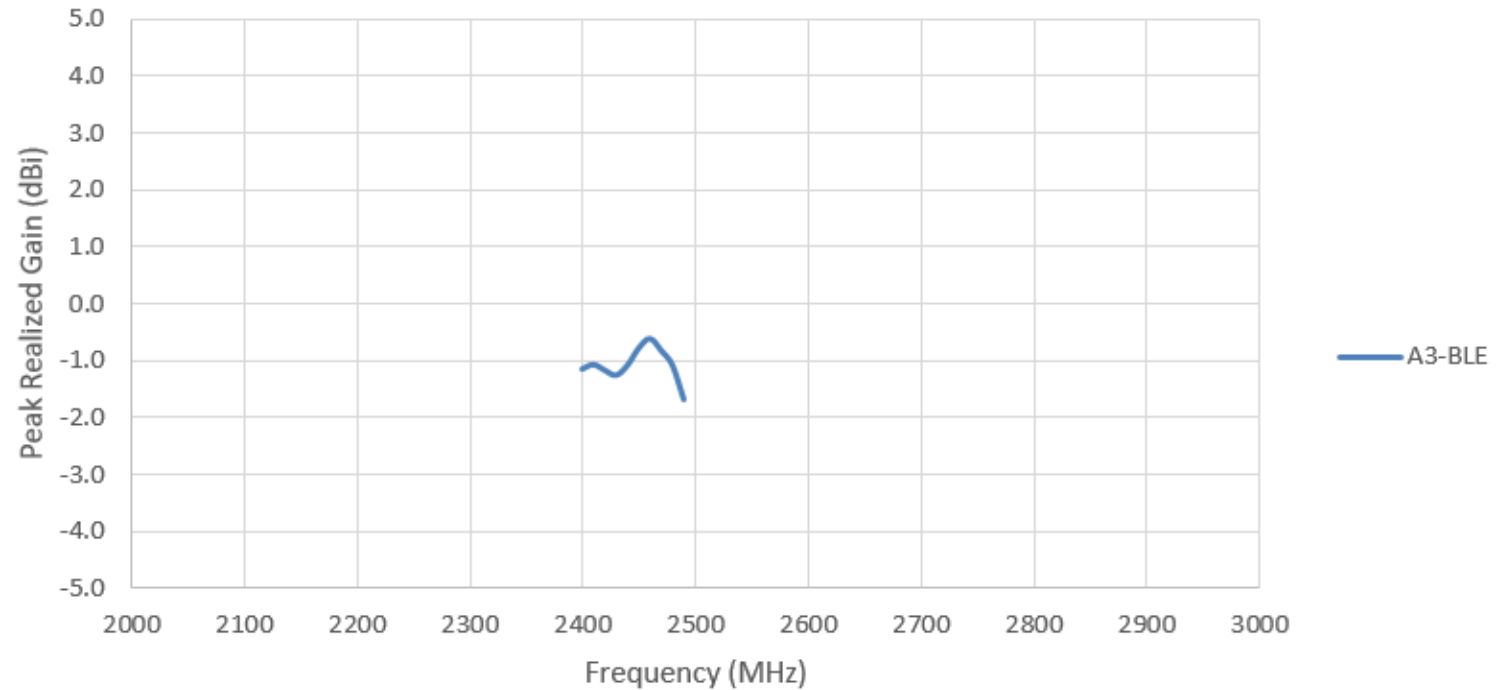
Frequency / MHz	A1_Dual (dBi)	A2_Dual (dBi)
2400	2.0	4.1
2410	2.2	4.2
2420	2.2	4.3
2430	2.1	4.2
2440	2.2	4.0
2450	2.2	3.9
2460	2.5	3.8
2470	2.8	3.7
2480	3.1	3.7
2490	3.1	3.8

Frequency / MHz	A1_Dual (dBi)	A2_Dual (dBi)
5150	3.6	4.6
5200	4.1	5.1
5300	3.9	4.8
5400	2.7	3.6
5500	4.1	5.6
5600	4.3	4.5
5700	4.2	4.0
5800	2.9	3.4
5850	3.3	4.0



Peak Realized Gain – BLE Antenna

Frequency / MHz	A3_BLE (dBi)
2400	-1.1
2410	-1.1
2420	-1.2
2430	-1.3
2440	-1.1
2450	-0.8
2460	-0.6
2470	-0.8
2480	-1.1
2490	-1.7

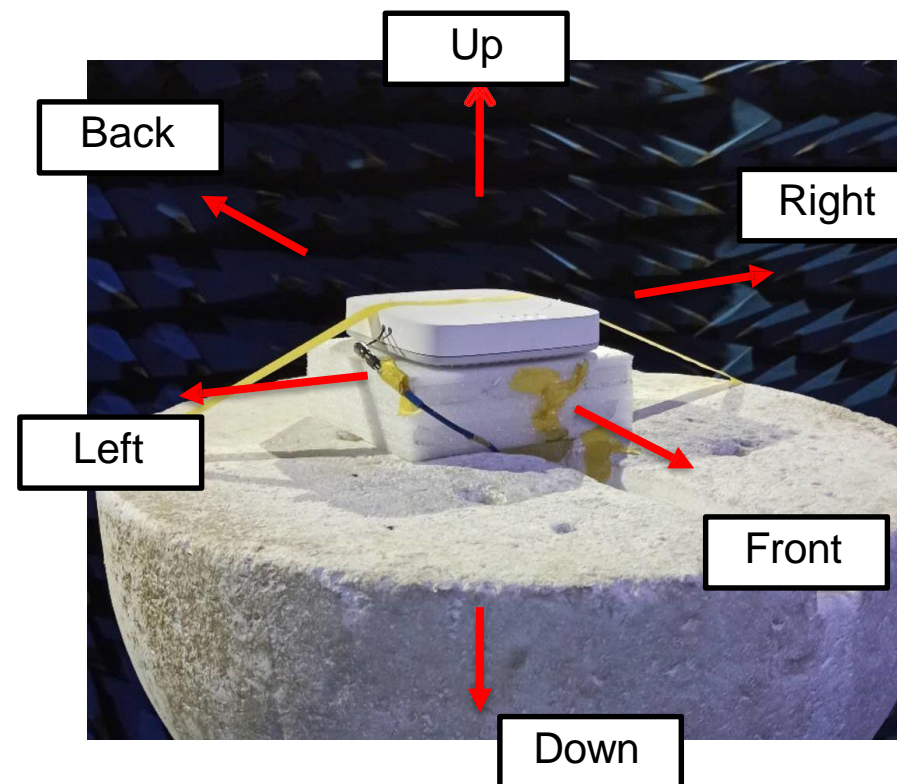
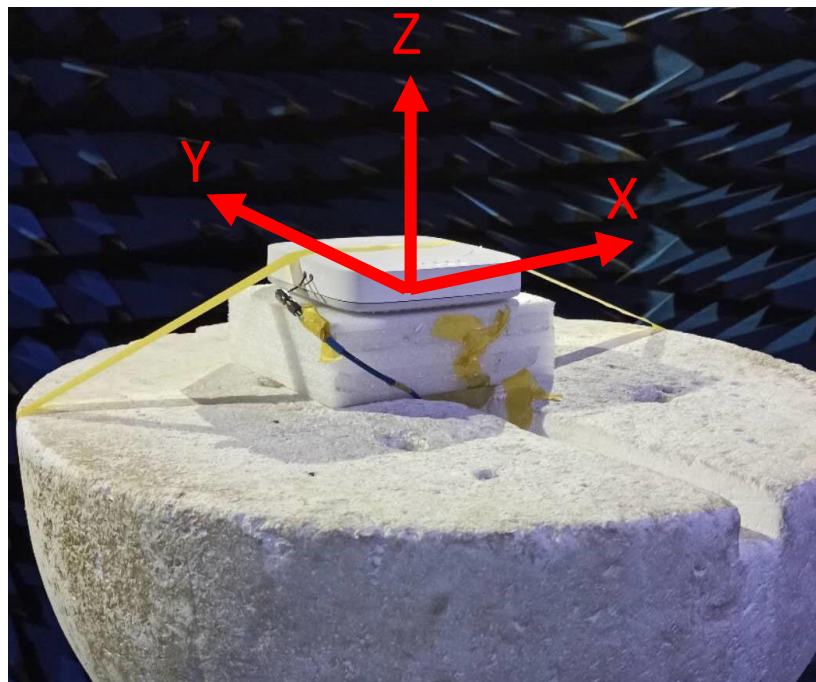


Radiation Patterns

- Total Gain 2D Pattern
- Total Gain 3D Pattern



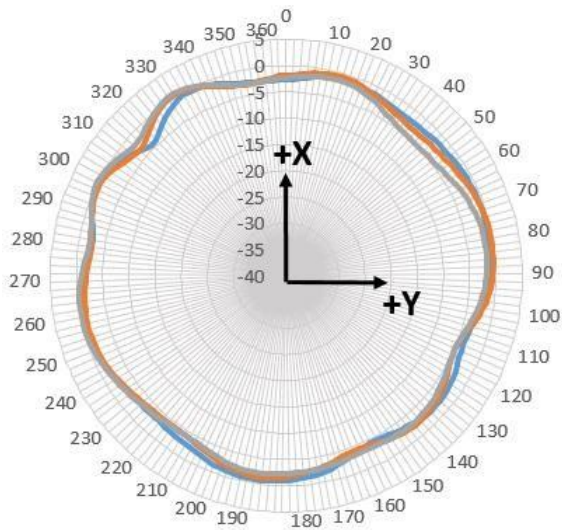
Orientation of DUT for Radiation Pattern Visualization



	XZ	YZ	XY
0	Up	UP	Right
90	Right	Back	Back
180	Down	Down	Left
270	Left	Front	Front

Total Gain Patterns in Principal Planes: A1-Dua at 2.4G

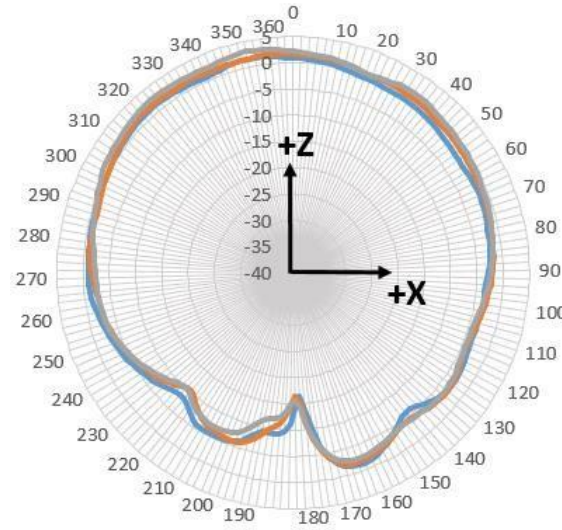
A1_Dual Azimuth (XY)



— 2400MHz — 2450MHz — 2490MHz

Azimuth (XY)

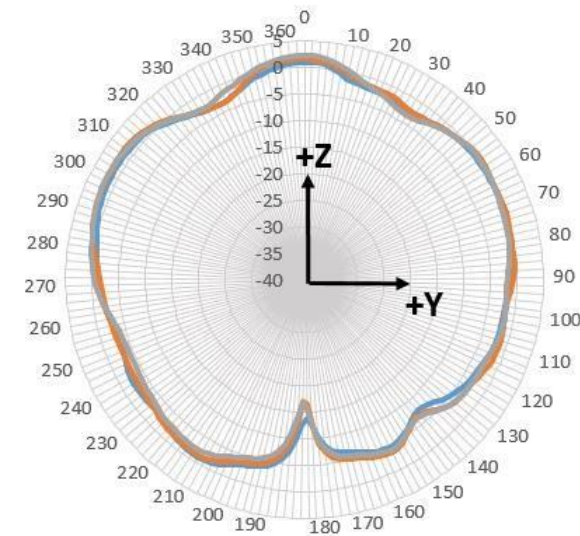
A1_Dual Side to Side (XZ)



— 2400MHz — 2450MHz — 2490MHz

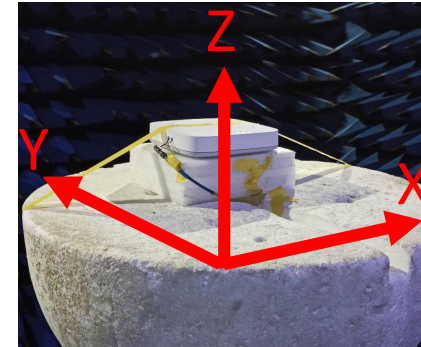
Elevation (XZ)

A1_Dual Front to Back (YZ)



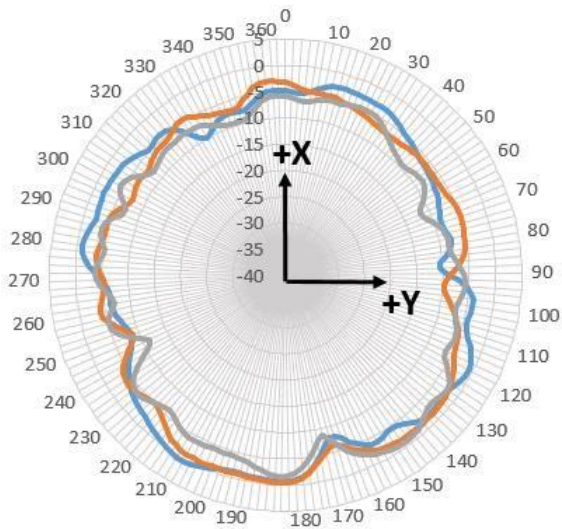
— 2400MHz — 2450MHz — 2490MHz

Elevation (YZ)



Total Gain Patterns in Principal Planes: A1-DB at 5GHz

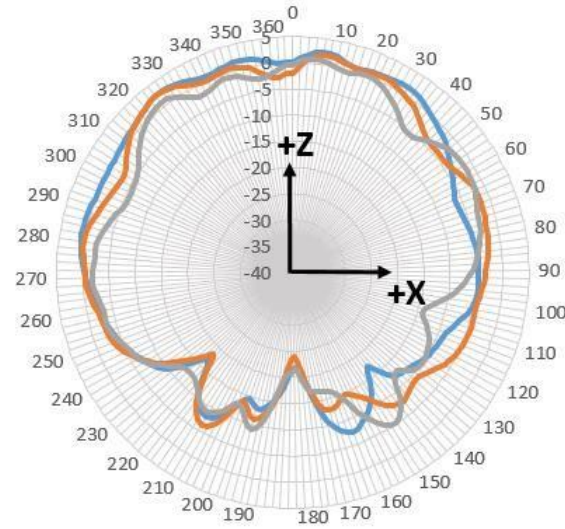
A1_Dual Azimuth (XY)



— 5200MHz — 5500MHz — 5800MHz

Azimuth (XY)

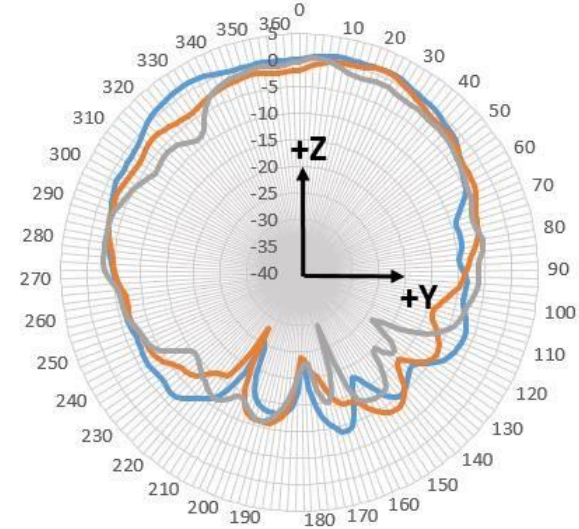
A1_Dual Side to Side (XZ)



— 5200MHz — 5500MHz — 5800MHz

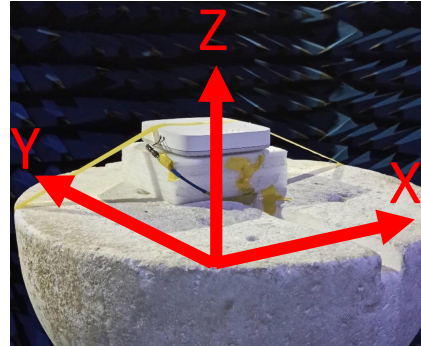
Elevation (XZ)

A1_Dual Front to Back (YZ)



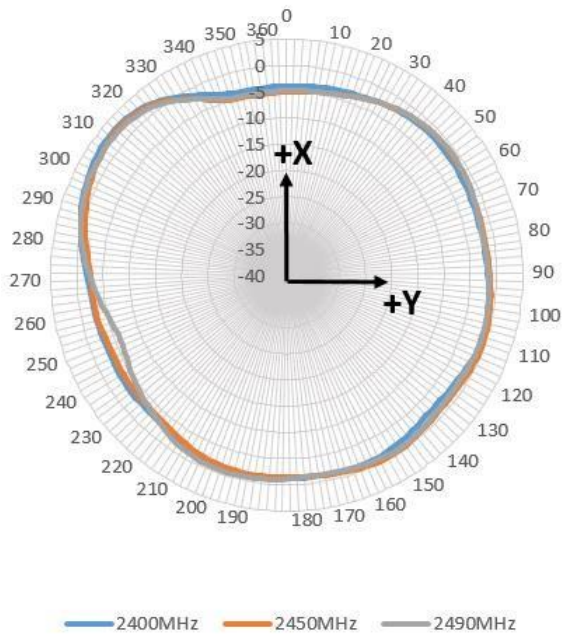
— 5200MHz — 5500MHz — 5800MHz

Elevation (YZ)



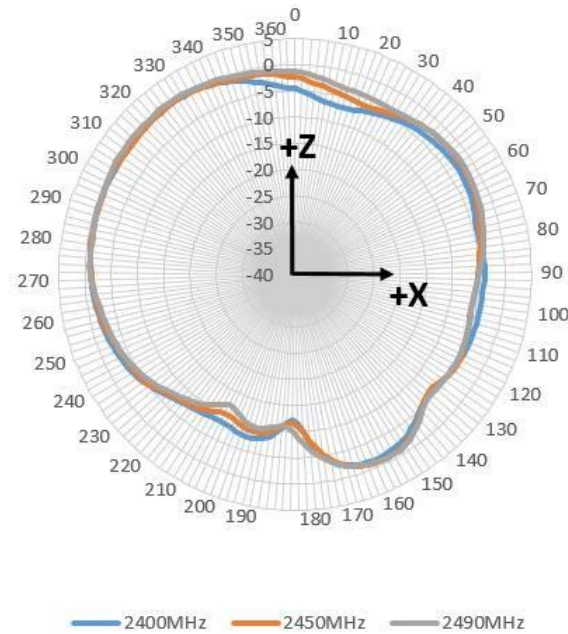
Total Gain Patterns in Principal Planes: A2-DB at 2.4GHz

A2_Dual Azimuth (XY)



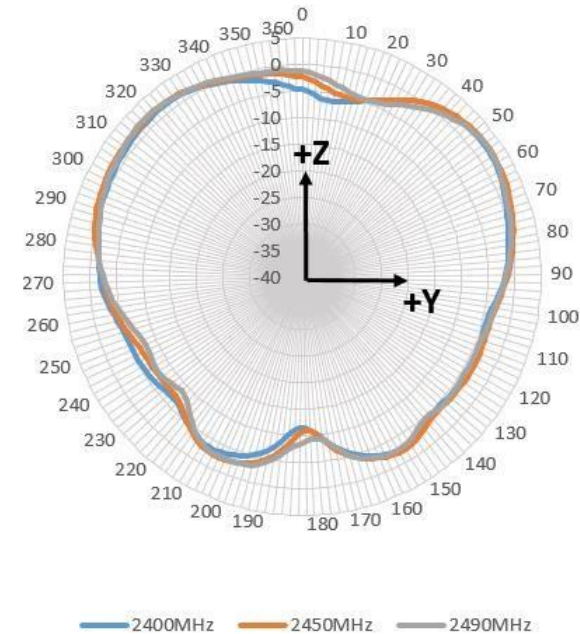
Azimuth (XY)

A2_Dual Side to Side (XZ)

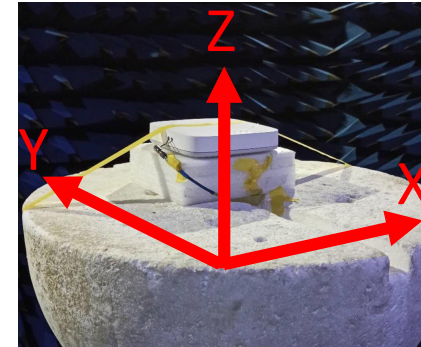


Elevation (XZ)

A2_Dual Front to Back (YZ)

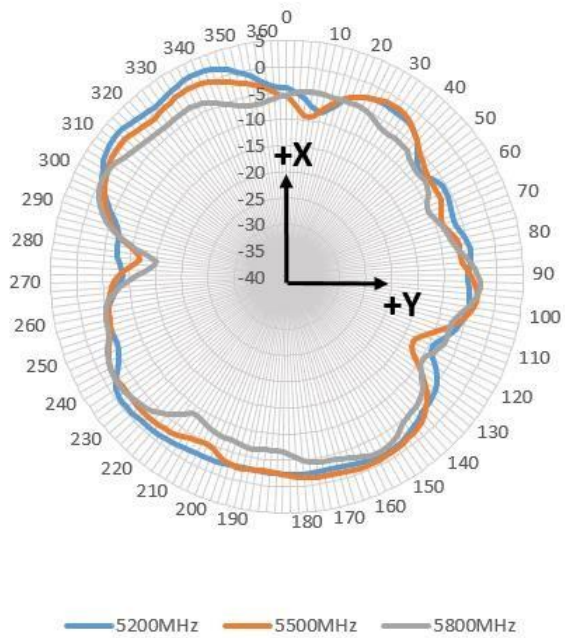


Elevation (YZ)



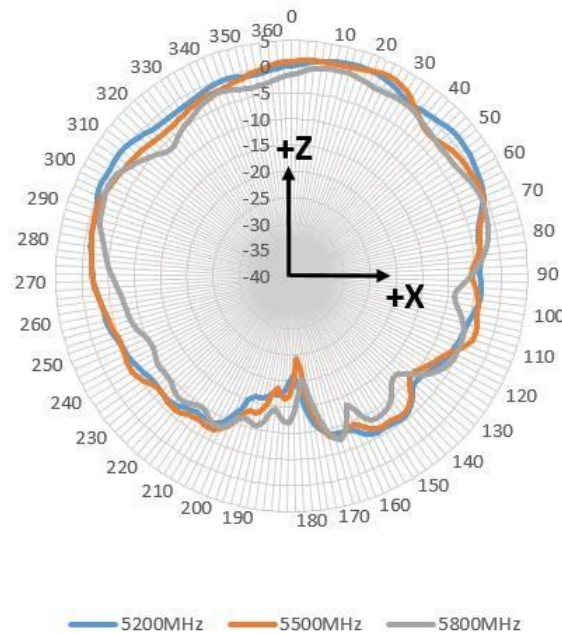
Total Gain Patterns in Principal Planes: A2-DB at 5GHz

A2_Dual Azimuth (XY)



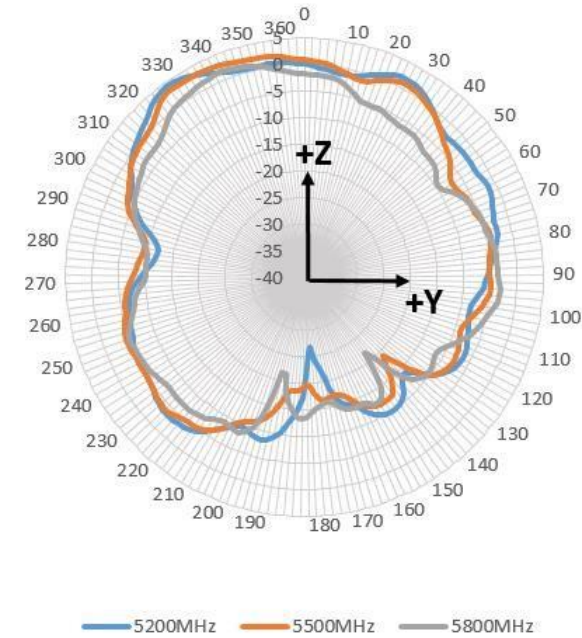
Azimuth (XY)

A2_Dual Side to Side (XZ)

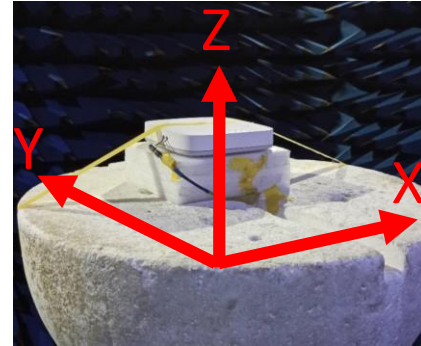


Elevation (XZ)

A2_Dual Front to Back (YZ)

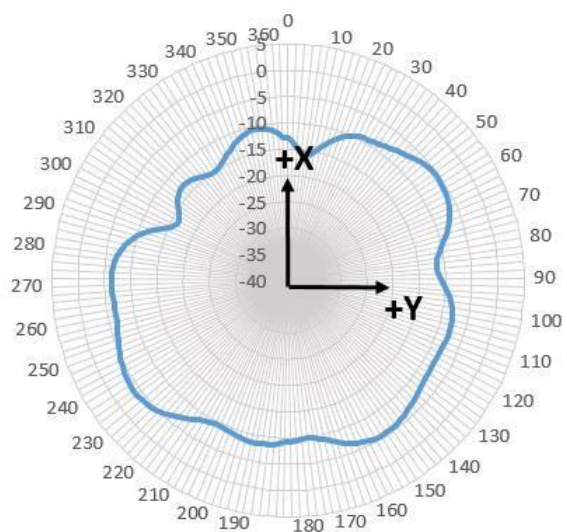


Elevation (YZ)



Total Gain Patterns in Principal Planes: A3-BLE

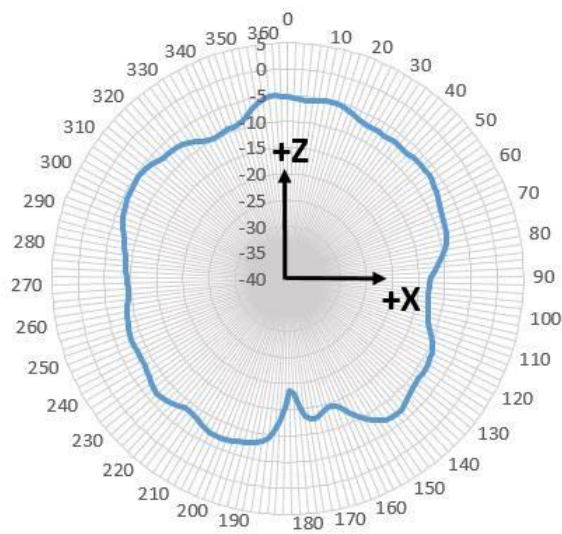
A3B-BLE Azimuth (XY)



— 2450MHz

Azimuth (XY)

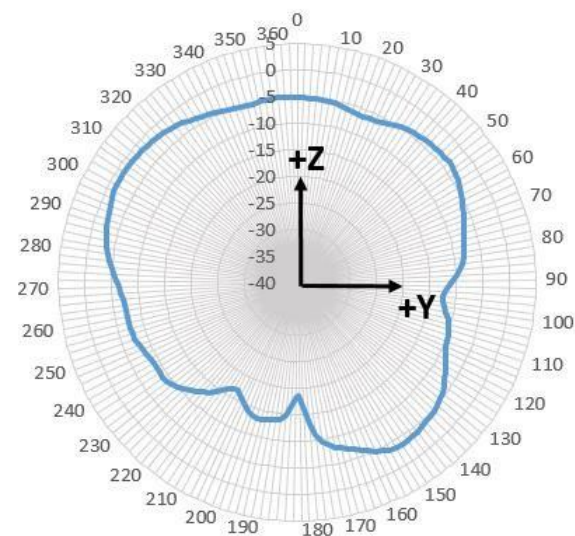
A3B-BLE Side to Side (XZ)



— 2450MHz

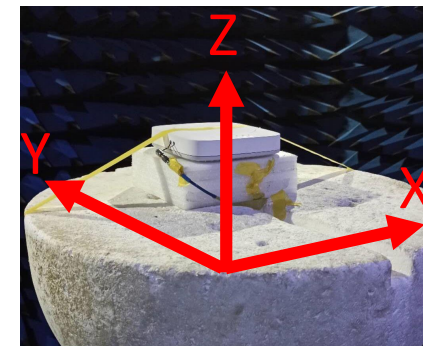
Elevation (XZ)

A3B-BLE Front to Back (YZ)



— 2450MHz

Elevation (YZ)



Conclusion and Recommendations

- Passive Measurement results for a preliminary HL Technologies antenna system for CIG WF1881 were presented
- HL Technologies antenna system exhibits
 - Return Loss > 10dB for all antennas
 - High realized efficiency



Directional Gain

Correlated Directional Gain:

$$\text{Directional Gain (each frequency)} = 10 \log[(10^{G^1/20} + 10^{G^2/20} + \dots + 10^{G^N/20})^2 / N_{\text{ANT}}]$$

Uncorrelated Directional Gain:

$$\text{Directional Gain (each frequency)} = 10 \log[(10^{G^1/10} + 10^{G^2/10} + \dots + 10^{G^N/10}) / N_{\text{ANT}}]$$

Frequency (MHz)	A1_Dual (dBi)	A2_Dual (dBi)	Direction Gain (dBi)	
			Correlated	Uncorrelated
2400	2	4.1	6.12	3.18
2410	2.2	4.2	6.27	3.31
2420	2.2	4.3	6.32	3.38
2430	2.1	4.2	6.22	3.28
2440	2.2	4.0	6.16	3.19
2450	2.2	3.9	6.10	3.13
2460	2.5	3.8	6.18	3.20
2470	2.8	3.7	6.27	3.27
2480	3.1	3.7	6.42	3.41
2490	3.1	3.8	6.47	3.46

Frequency (MHz)	A1_Dual (dBi)	A2_Dual (dBi)	Direction Gain (dBi)	
			Correlated	Uncorrelated
5150	3.6	4.6	7.12	4.13
5200	4.1	5.1	7.62	4.63
5300	3.9	4.8	7.37	4.37
5400	2.7	3.6	6.17	3.17
5500	4.1	5.6	7.89	4.91
5600	4.3	4.5	7.41	4.40
5700	4.2	4.0	7.11	4.10
5800	2.9	3.4	6.16	3.16
5850	3.3	4.0	6.67	3.66



THANK YOU



HL TECHNOLOGIES