Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

Panasonic Trailer Camera Passive Antenna Report

Tested By: Cody Friszell

Test Date: 18 October 2021

Table of Contents

- This passive report describes the performance of the Panasonic Trailer Camera WiFi antennas P/N ET03PCACA and the Bluetooth antenna P/N N01PCAAB-T2M59-PK1-G75U.
- The WiFi antennas are mounted to the top of the camera.
- The Bluetooth antenna is embedded inside the camera

- The camera heat sink is removed and the end of the coaxial cable that feeds the antenna is routed out the back side of the camera. A metal plate is installed in place of the heatsink.
- The antenna is tested with the camera mounted on a non-conductive surface centered in the quiet zone of the compact antenna chamber with the WiFi antennas pointed skyward.
- The antenna return loss and isolation is recorded.
- The antenna gain and efficiency is measured using MVG WaveStudio software.
- The results are presented in tabulated and graphical format.

Equipment List

Equipment	Description	Serial Number	Calibration Due Date
Keysight E5063A Network Analyzer	2-port Network Analyzer	MY54101021	22-Sep-22
MVG Starlab	Antenna Measurement System	ATL2108S	8-Mar-22

Measurement System Details

SYSTEM INFORMATION

System type : StarLab
Arch Radius :0.45 m
Mast Position Error : 0.025845 mm
Active mode option : Yes
Hard drive ID : 18233480387
Probe array(s) : 0.65 - 10 GHz :
– Polarization 1 angle : 90◦
– Polarization 2 angle : 0◦
– Measurement probe electrical length : m
– Reference probe electrical length : m

SOFTWARE LIST

Software Version
Acceptance Report Generator 4.15.4
Amplification Unit Configurator 22.1.1
Antenna Measurement Validation ToolSuite 2.1.13
Arch API 3.4.1
Calibration Tools 22.1.1
DemuxEthernetConfigurator 22.1.1
Device Configuration 22.1.1
FAT Tools 22.1.1
Hardware Configuration 22.1.1
Mac23 Controller 22.1.1.0
Mast Position Error 3.0.0
MATLAB Runtime 9.0
Measurement Configuration 22.1
MiKTeX 2.9
MVG Maintenance 21.2.6
PsuAcceptanceWzard 22.1
Satenv 3.0.3.0b23
System Acceptance Tool 2.0.0
Vna API 22.1.1

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Airgain Antenna System Proposal

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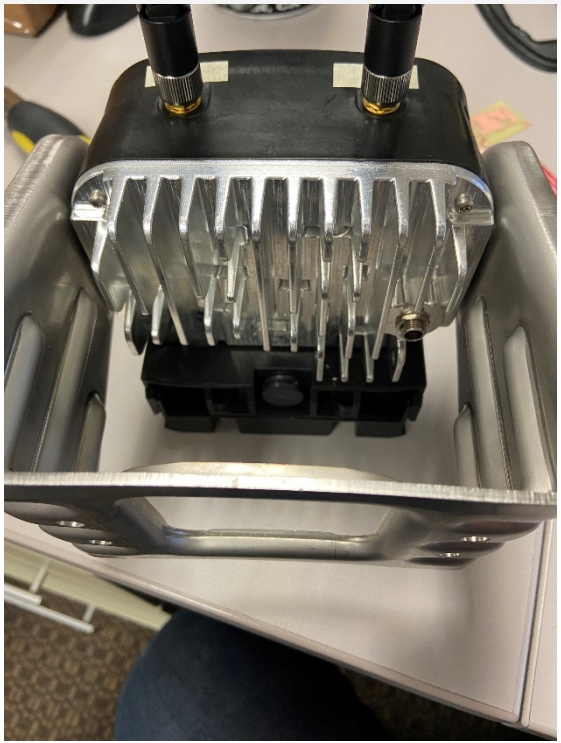
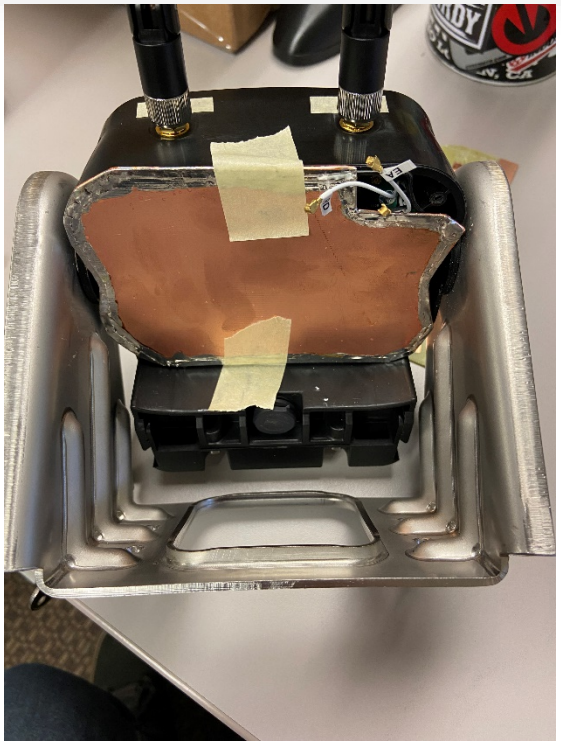
Unit Details





Metal backplate added to maintain similarity when removing heatsink to test antennas

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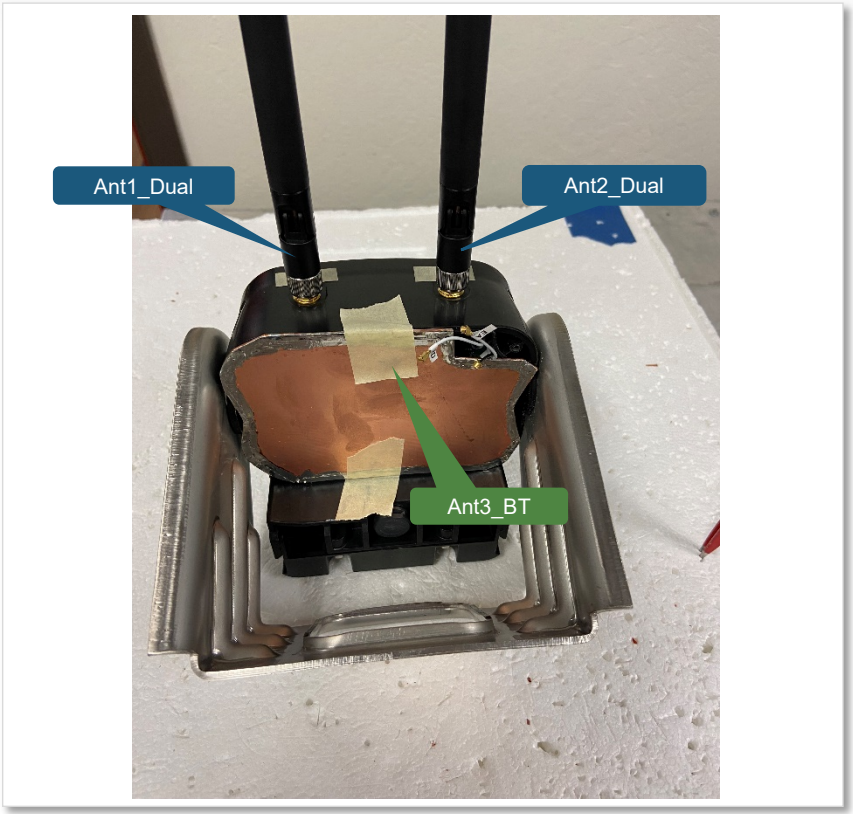
Antenna System Proposal



Antenna #	Part Number	Type	Cable Length
Ant1_Dual	ET03PCACA	External Dipole	N/A
Ant2_Dual	ET03PCACA	External Dipole	NA
Ant3_BT	N01PCAAB	FR4, Cable Fed	75mm

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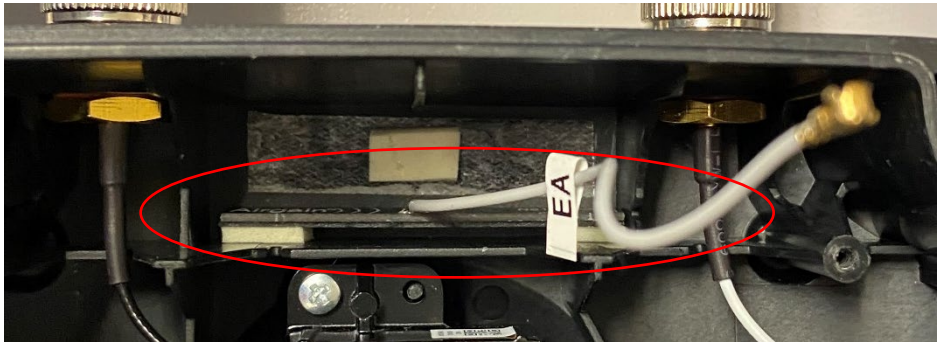

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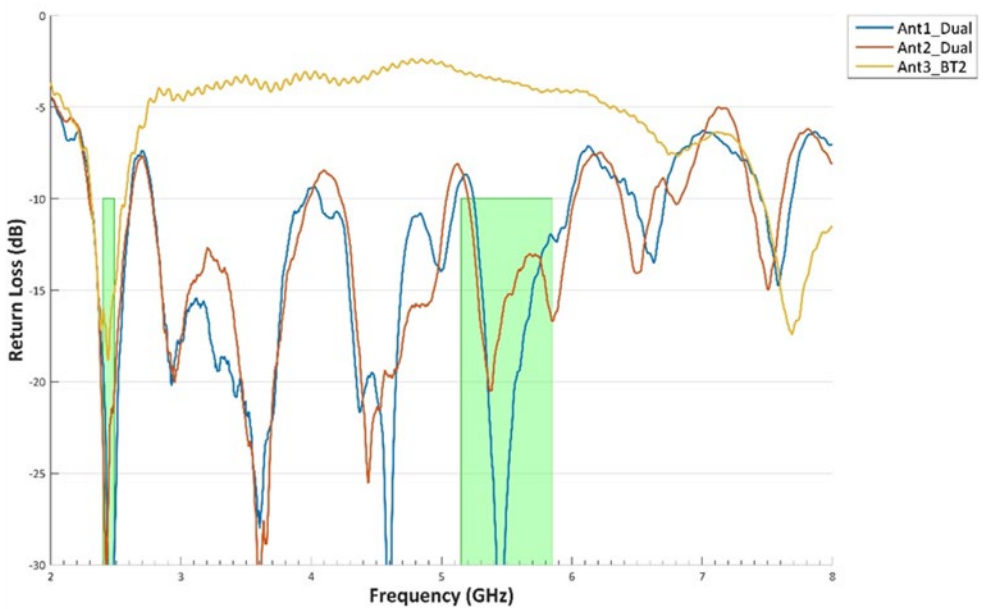
S-Parameters

Return Loss



Antenna	Return Loss (dB)			
	2.4 GHz	2.49 GHz	5.15 GHz	5.85 GHz
Ant1_Dual	-17.2	-21.3	-10	-8.5
Ant2_Dual	-22.7	-19.8	-8.0	-8.3
Ant3_BT	-16.1	-15.2	-	-

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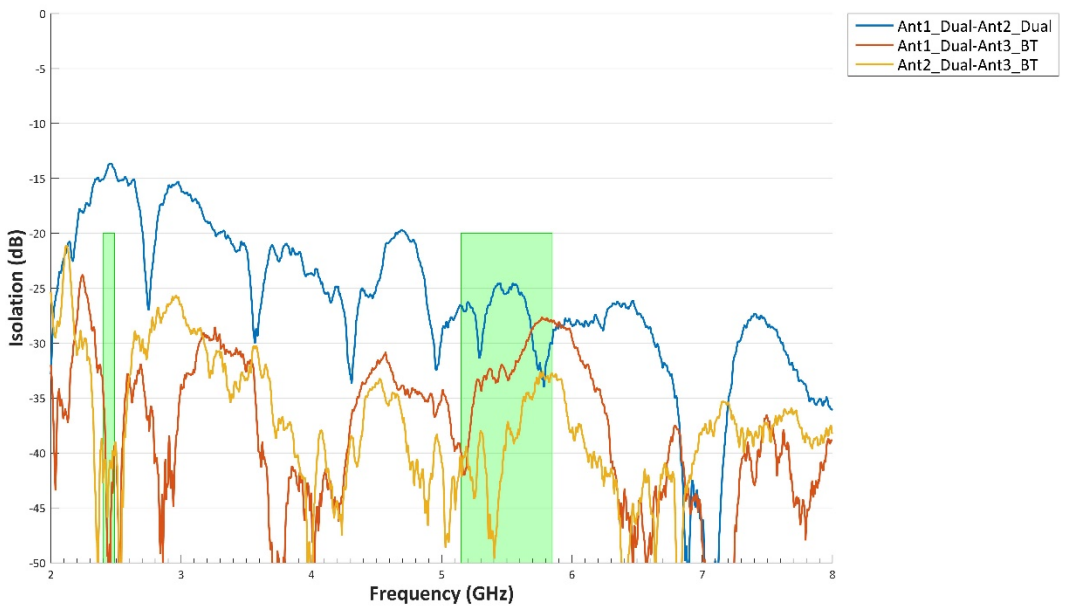
Isolation



Antenna Pair	Minimum Isolation (dB)	
	2.4-2.49 GHz	5.15-5.85 GHz
Ant1_Dual-Ant2_Dual	-13.7	-26.5
Ant1_Dual-Ant3_BT	-33.9	-39.1
Ant2_Dual-Ant3_BT	-39.7	-40.2

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Radiated Measurements

Realized Efficiency: (Table)

Frequency (MHz)	Ant1_Dual	Ant2_Dual
2400	74	75
2410	75	75
2420	74	74
2430	75	74
2440	75	74
2450	76	74
2460	77	75
2470	77	74
2480	77	75
2490	76	73
Average	76	74

Frequency (MHz)	Ant1_Dual	Ant2_Dual
5150	52	51
5200	53	56
5300	60	64
5400	63	66
5500	64	66
5600	63	64
5700	60	60
5800	58	61
5850	58	64
Average	59	61

Frequency (MHz)	Ant3_BT
2400	71
2410	70
2420	69
2430	70
2440	70
2450	71
2460	71
2470	70
2480	70
2490	68
Average	70

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Peak Realized Gain: (Table)

Frequency (MHz)	Ant1_Dual	Ant2_Dual
2400	5.6	5.3
2410	5.7	5.4
2420	5.8	5.4
2430	5.9	5.6
2440	5.9	5.6
2450	5.9	5.6
2460	5.9	5.7
2470	5.8	5.6
2480	5.7	5.5
2490	5.5	5.3

Frequency (MHz)	Ant3_BT
2400	5.7
2410	5.6
2420	5.6
2430	5.7
2440	5.7
2450	5.8
2460	5.8
2470	5.8
2480	5.8
2490	5.7

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Peak Realized Gain: (Table)

Frequency (MHz)	Ant1_Dual			Ant2_Dual		
	Gain (dBi)	Theta	Phi		Theta	Phi
5150	2.6	100°	291°	2.9	108°	328°
5200	3.1			3.1		
5300	3.6			3.2		
5400	3.3			3.0		
5500	2.3	63°	230°	2.7	82°	325°
5600	3.1			3.4		
5700	4.1			3.4		
5800	5.0			4.0		
5850	4.8	40°	200°	3.5	44°	274°

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Radiation Patterns

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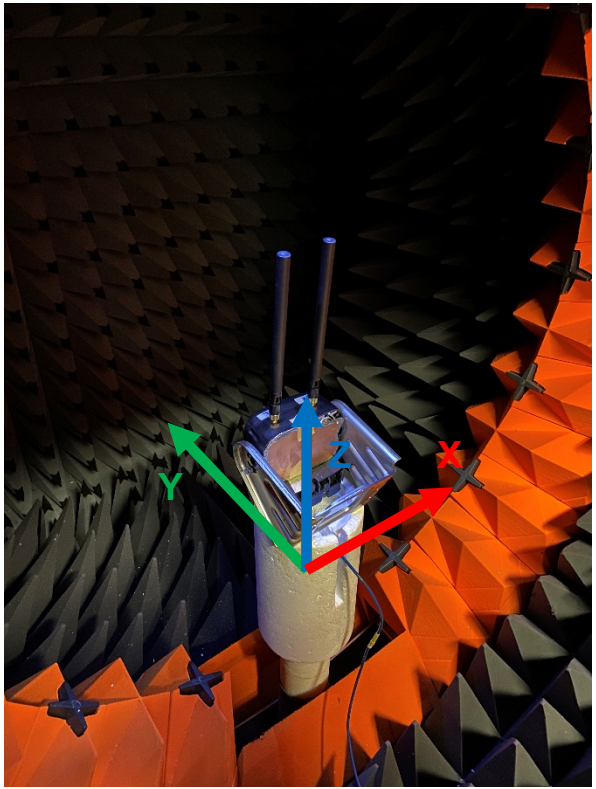
Coordinate System for Radiation Pattern Visualization



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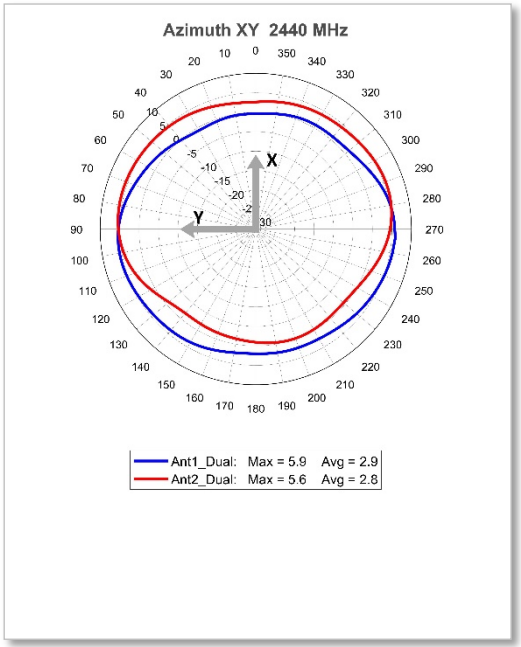
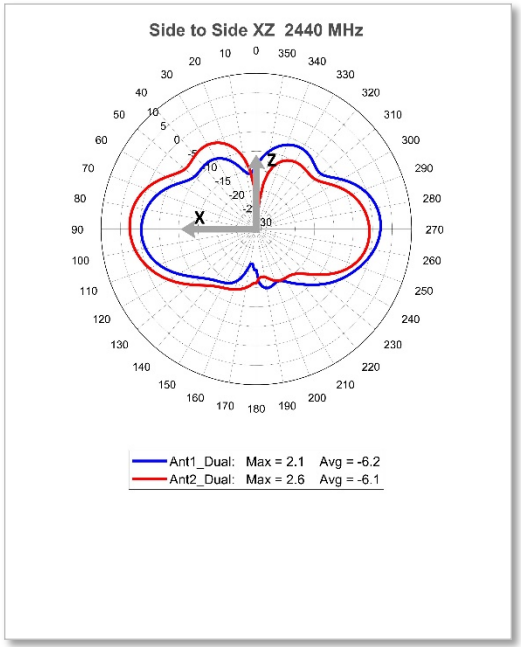
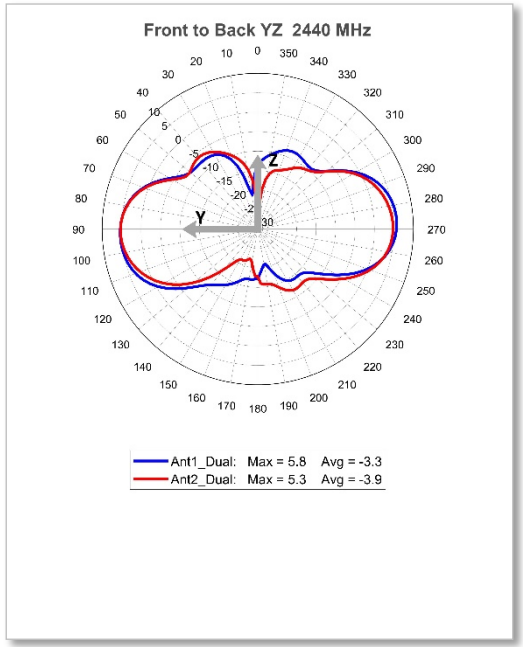
Gain Patterns: System Coverage – 2.4GHz



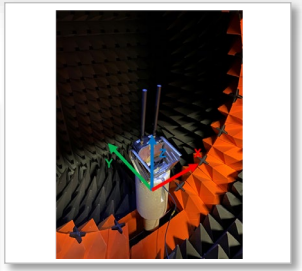
Azimuth (XY)



Front to Back (XZ)



Side to Side (YZ)



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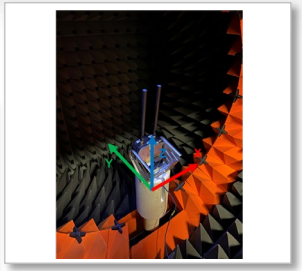
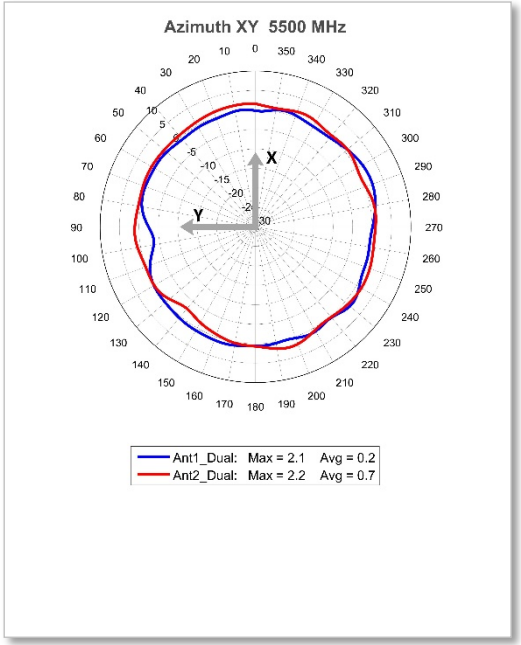
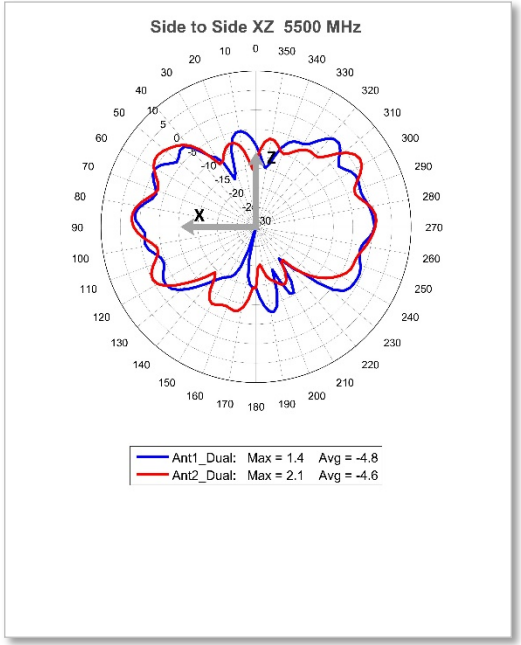
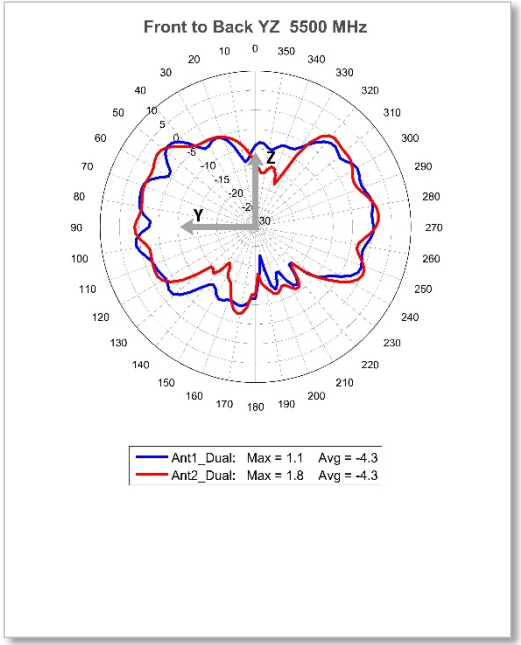
Gain Patterns: System Coverage – 5GHz









Azimuth (XY) Front to Back (XZ) Side to Side (YZ)

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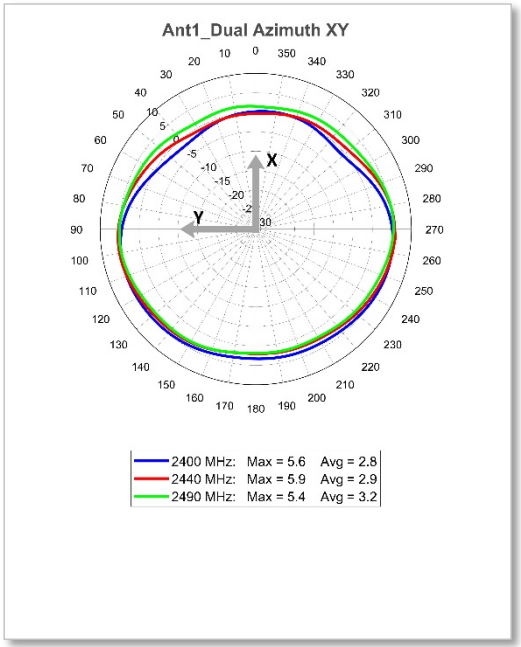
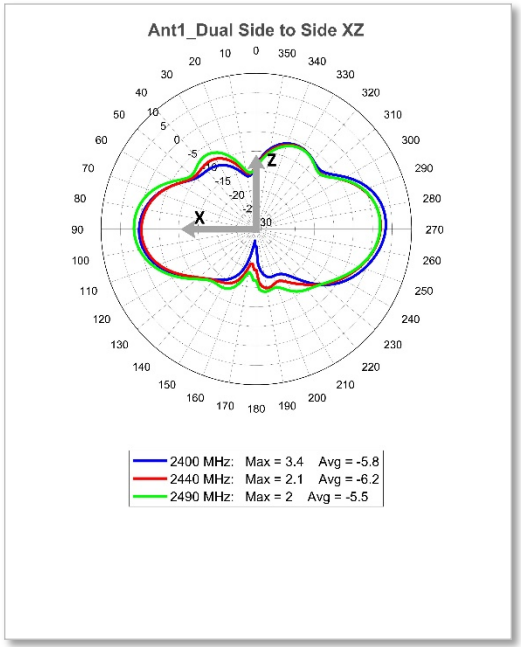
Note: Max Antenna gain may not reflect the peak gain on slide 17 as the theta and Phi of the peak gain may not exist in the principal cuts. Please refer to the 3D Plot and the heatmap.

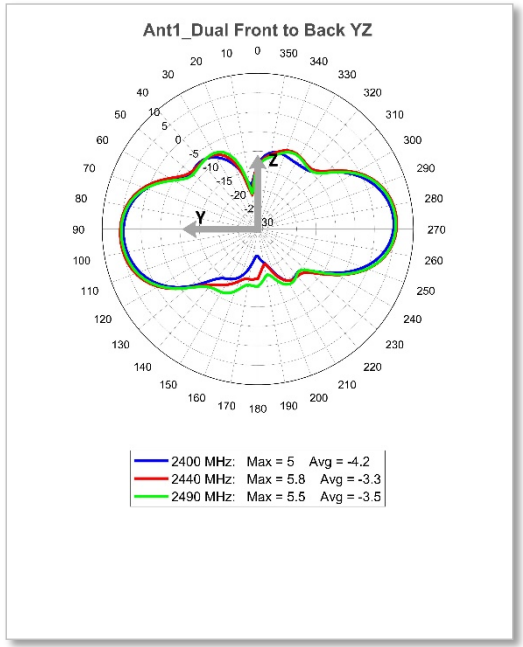
Gain Patterns: Ant1_Dual – 2.4GHz



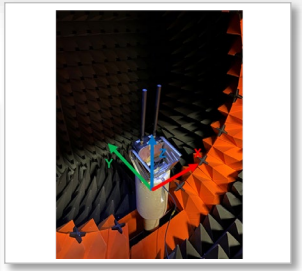
Azimuth (XY)



Front to Back (XZ)



Side to Side (YZ)



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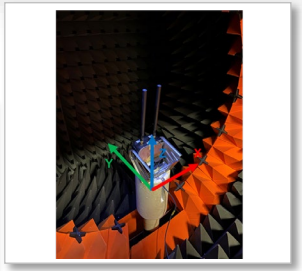
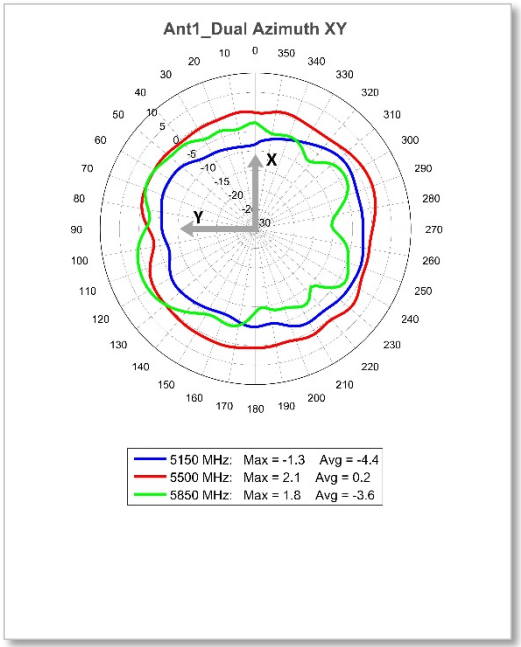
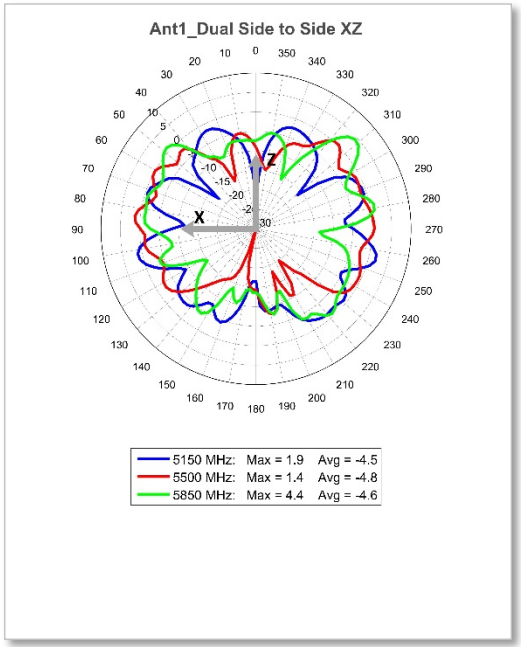
Gain Patterns: Ant1_Dual – 5GHz

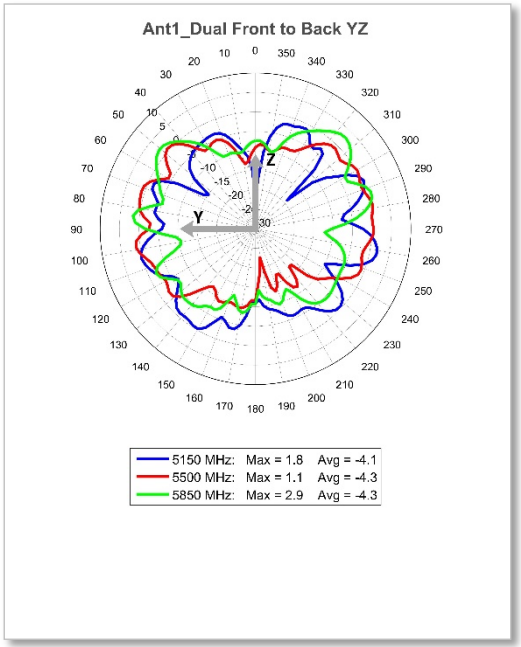




Azimuth (XY)



Front to Back (XZ)



Side to Side (YZ)

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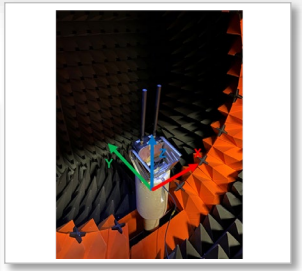
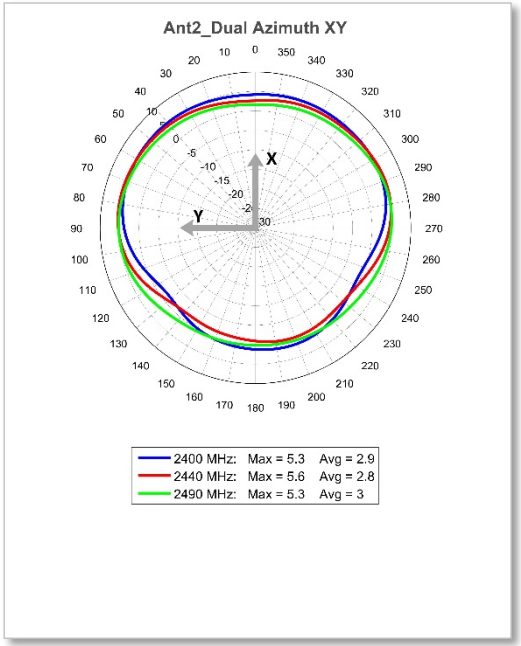
Gain Patterns: Ant2_Dual – 2.4GHz





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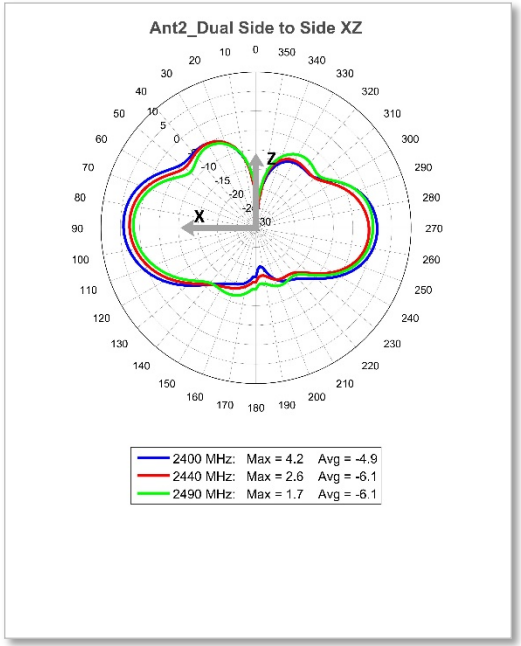
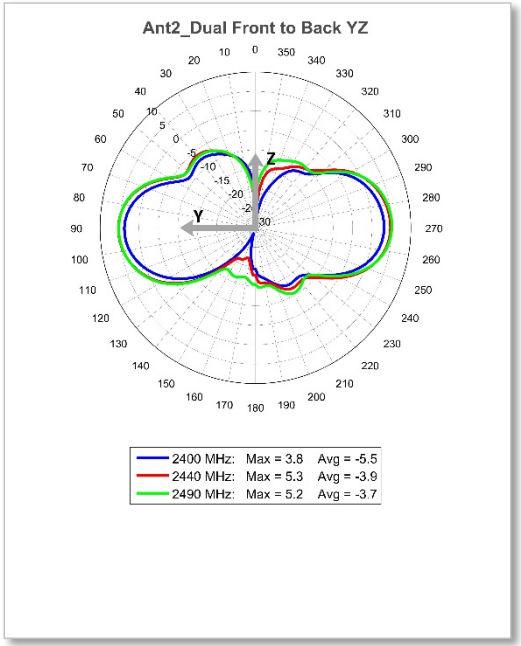


Front to Back (XZ)



Side to Side (YZ)

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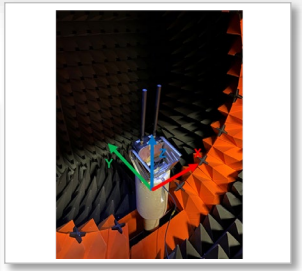
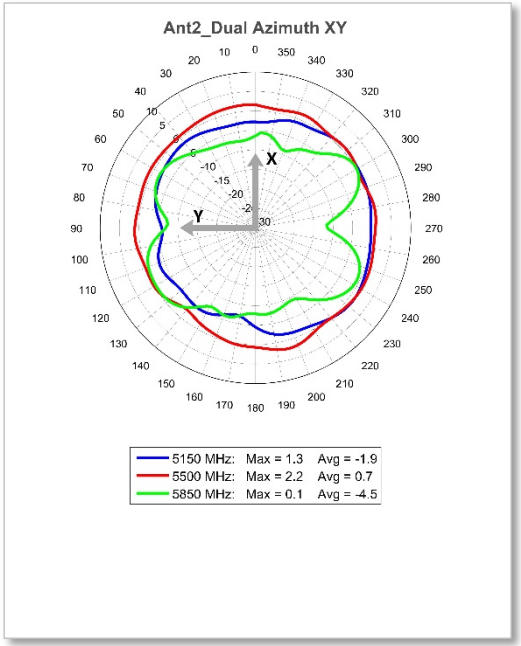
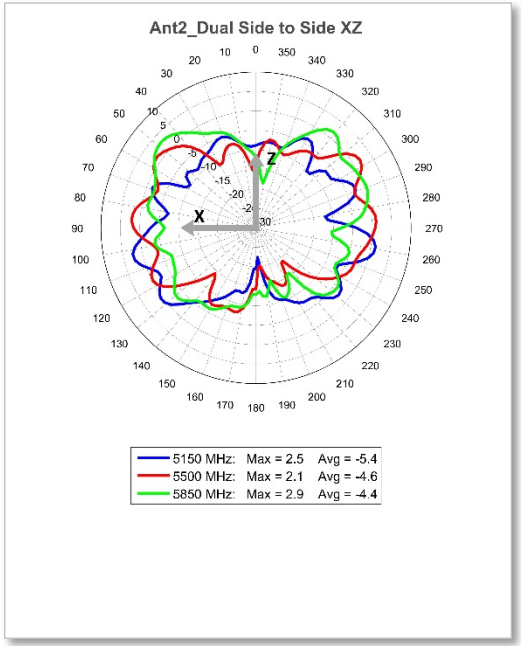
Gain Patterns: Ant2_Dual – 5GHz

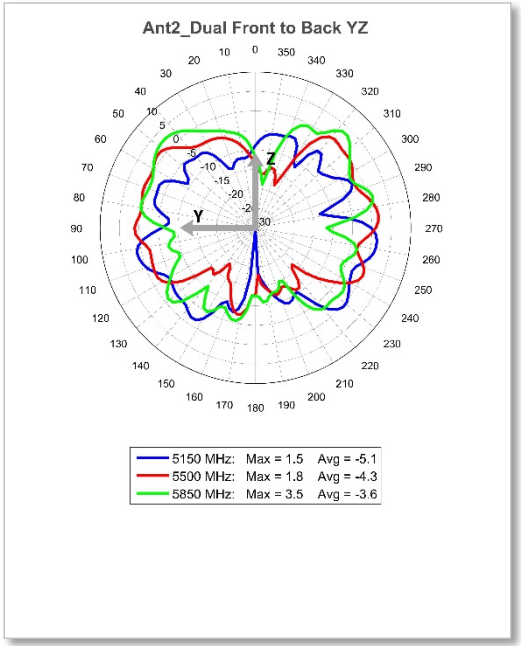




Azimuth (XY)



Front to Back (XZ)



Side to Side (YZ)

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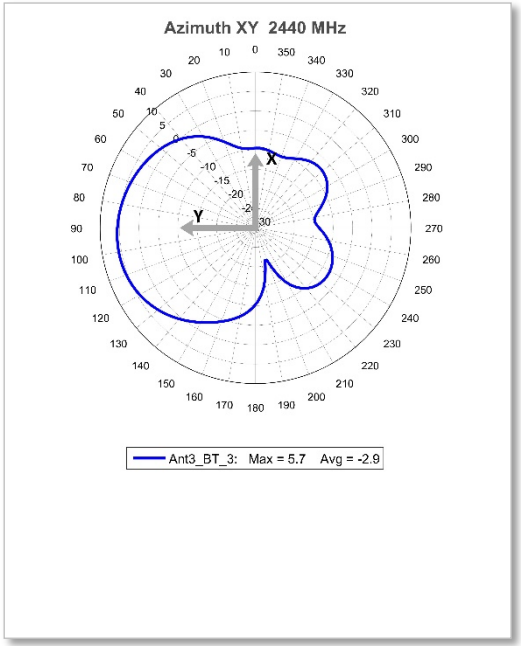
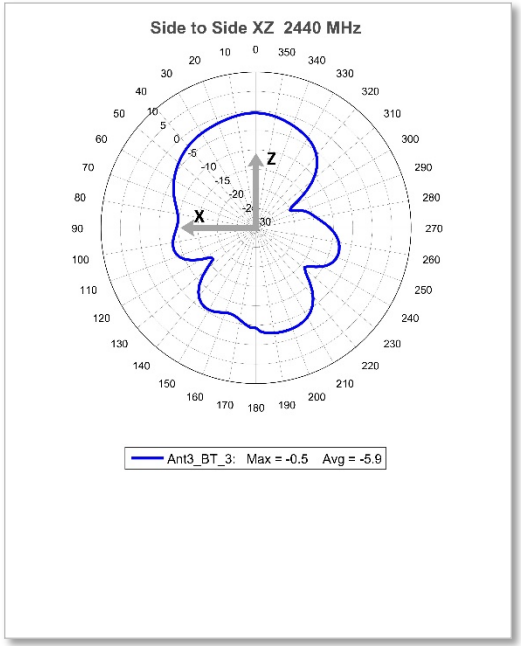
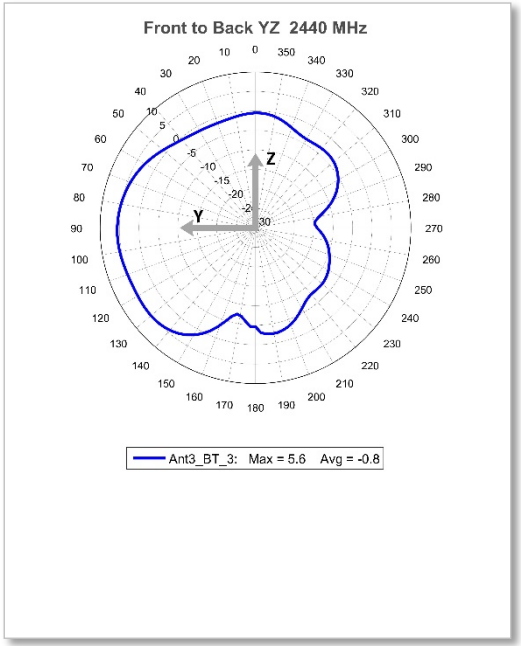
Gain Patterns: Ant3_BT



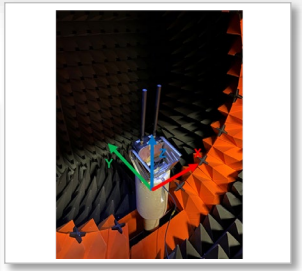
Azimuth (XY)



Front to Back (XZ)



Side to Side (YZ)



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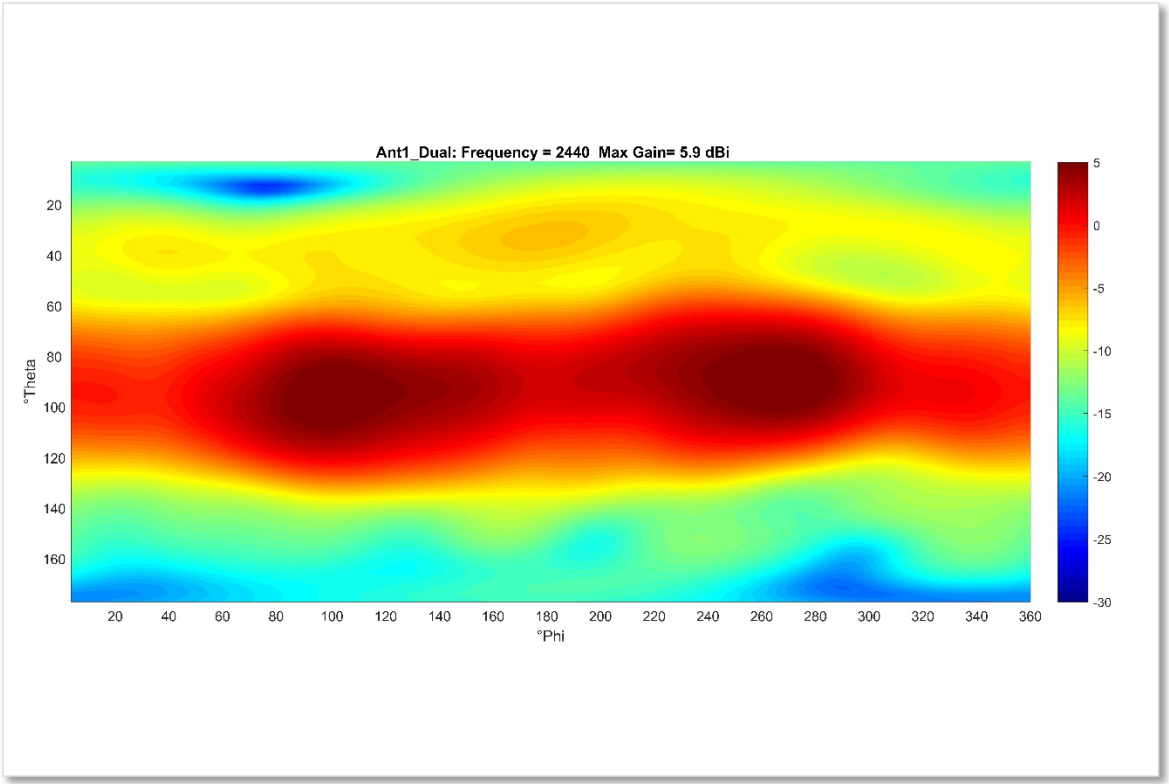
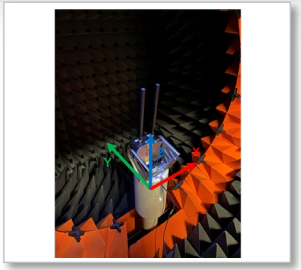
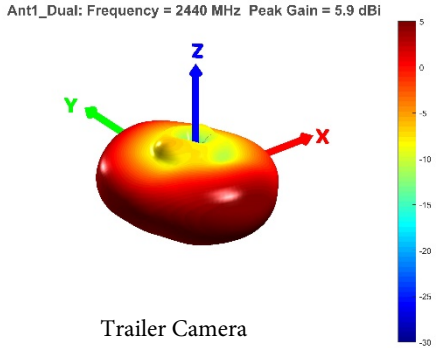
3D Gain Pattern and Heatmap: Ant1_Dual at 2440MHz







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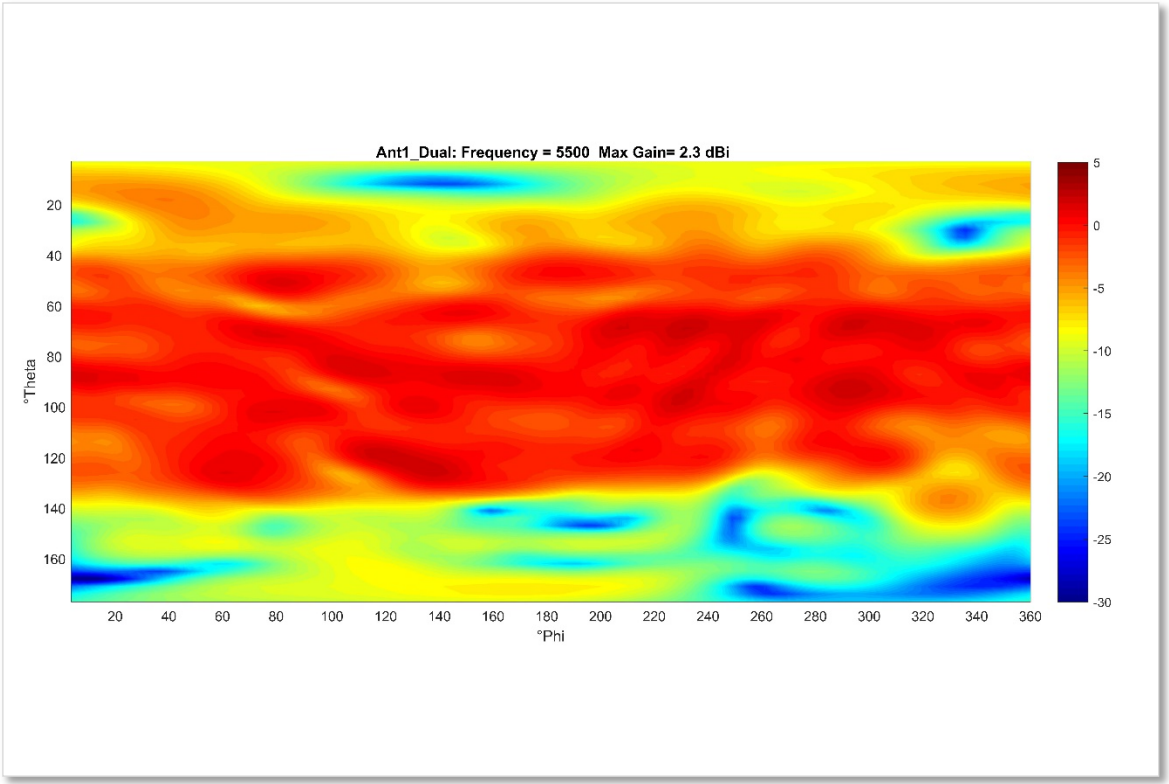
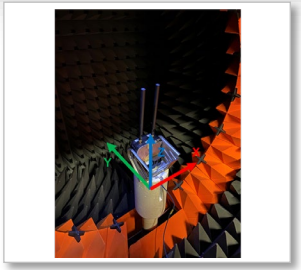
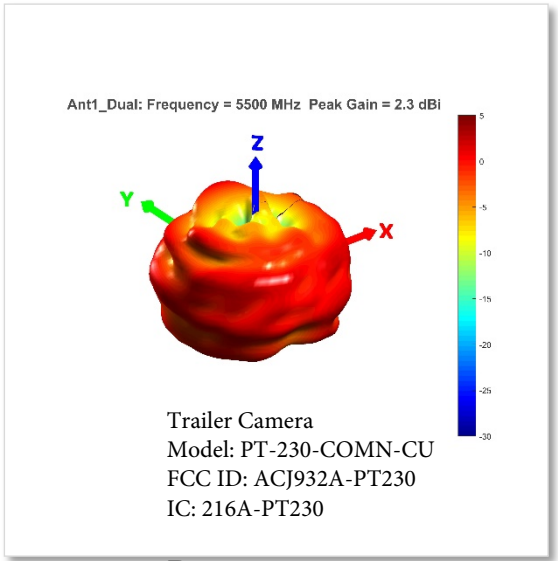
3D Gain Pattern and Heatmap: Ant1_Dual at 5500MHz

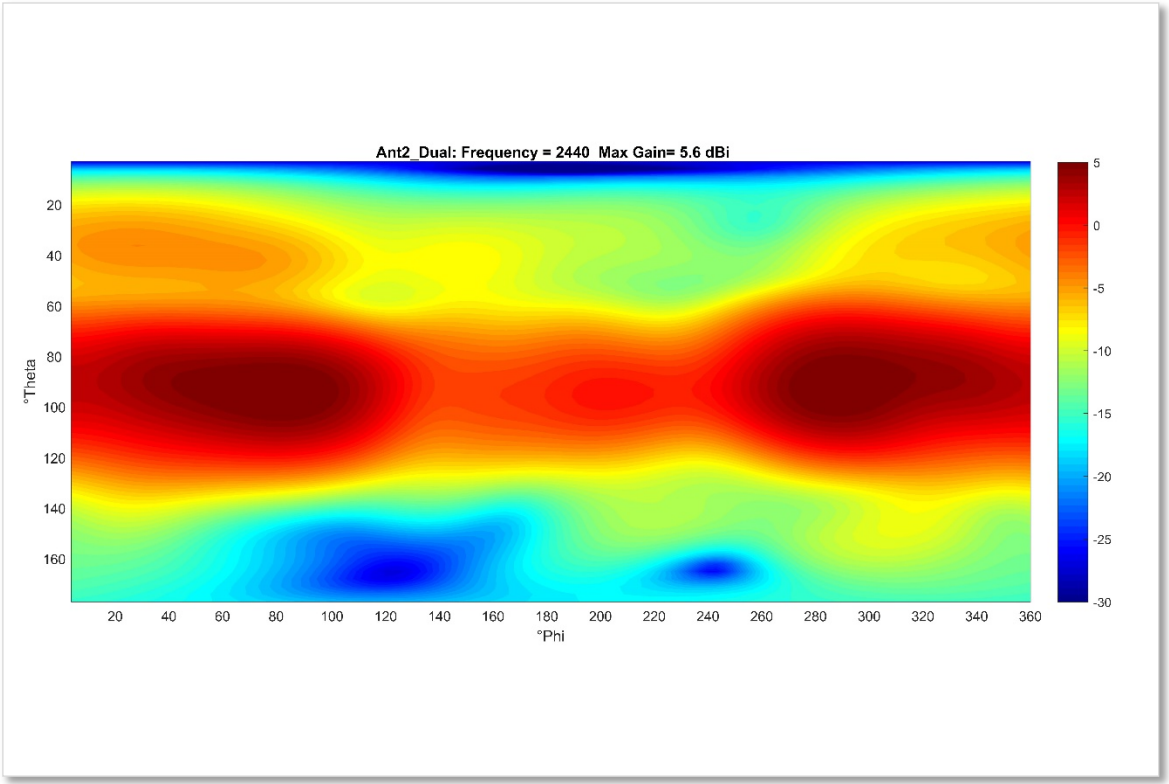


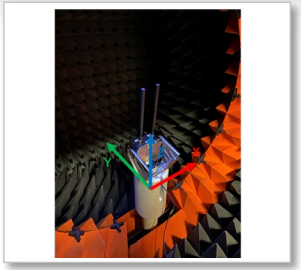


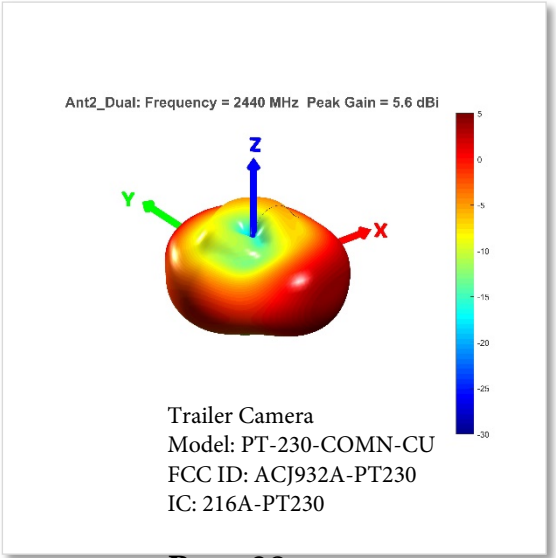


Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

3D Gain Pattern and Heatmap: Ant2_Dual at 2440MHz







Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

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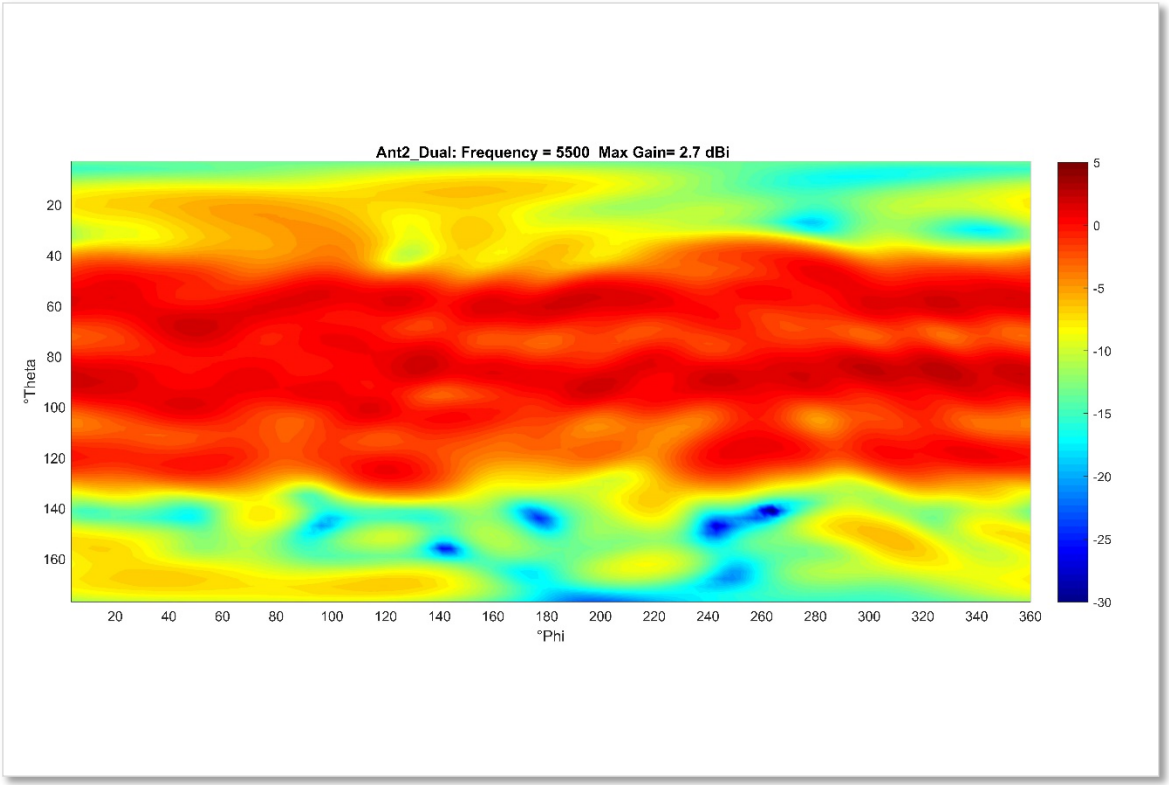
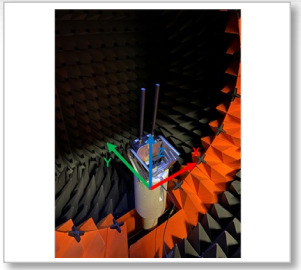
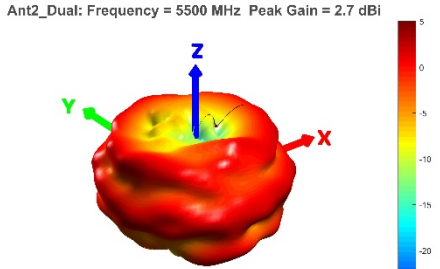
3D Gain Pattern and Heatmap: Ant2_Dual at 5500MHz







Trailer Camera
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FCC ID: ACJ932A-PT230
IC: 216A-PT230

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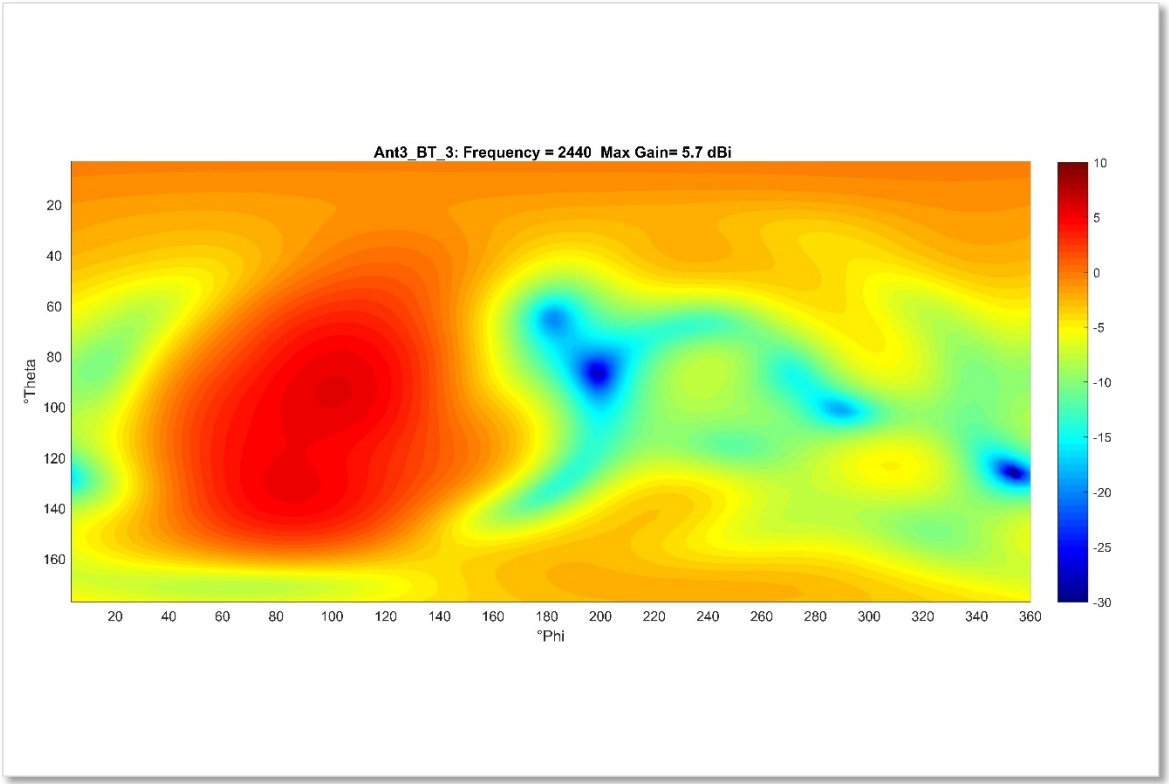
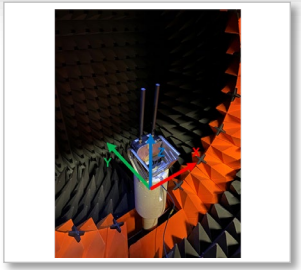
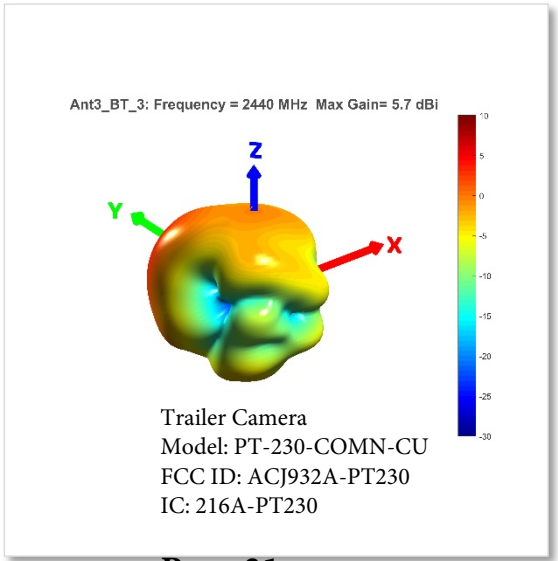
3D Gain Pattern and Heatmap: Ant3_BT at 2440MHz







Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

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