

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

- Introduction
- Test Details
- Equipment List
- Measurement System Details
- Airgain Solution
 - Unit Details
- Return Loss and Isolation
- Efficiency and Peak Gain
- Radiation Patterns
 - System Coverage
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- 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

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- 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.

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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

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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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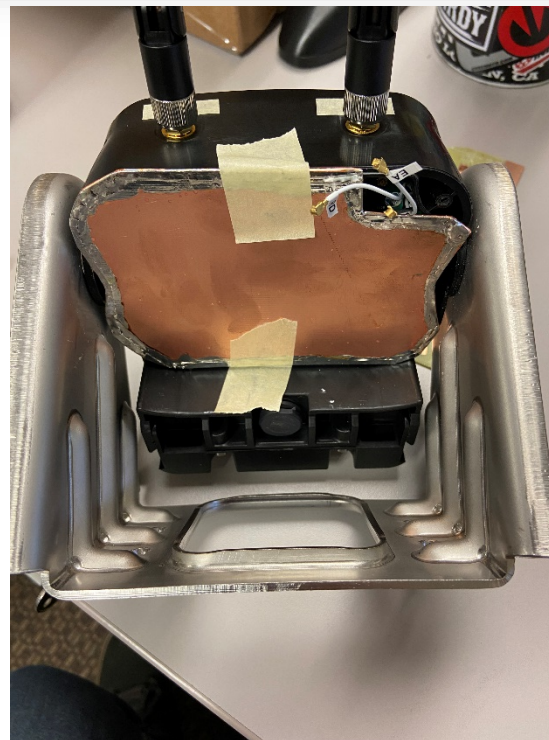
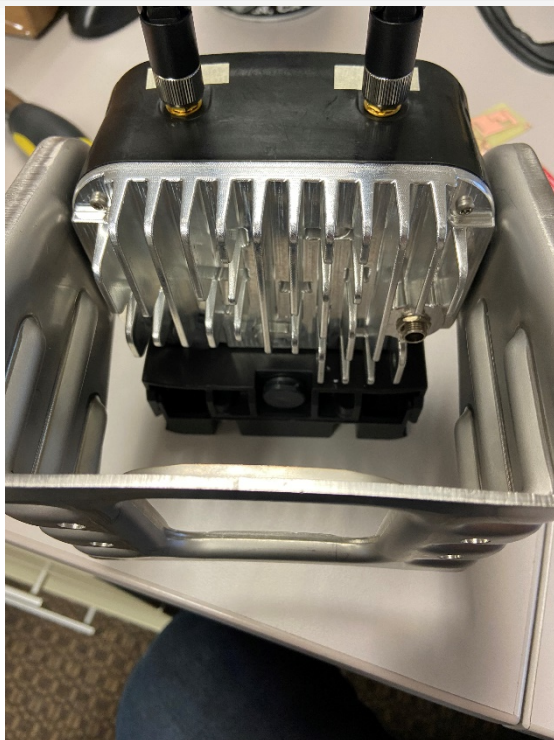
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Airgain Antenna System Proposal

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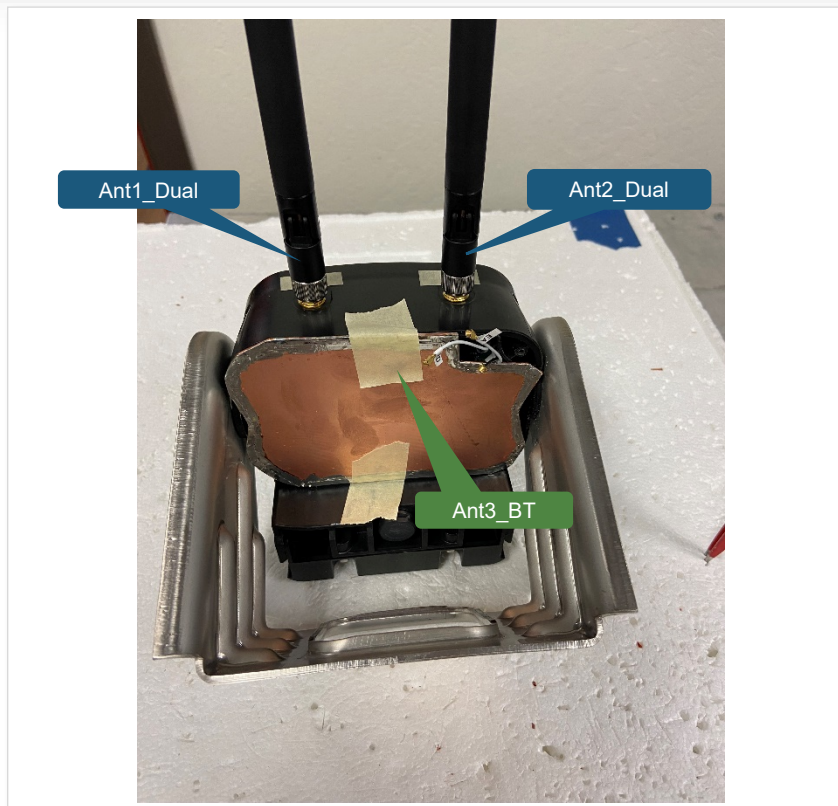


Metal backplate added to maintain similarity when removing heatsink to test antennas

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Antenna System Proposal

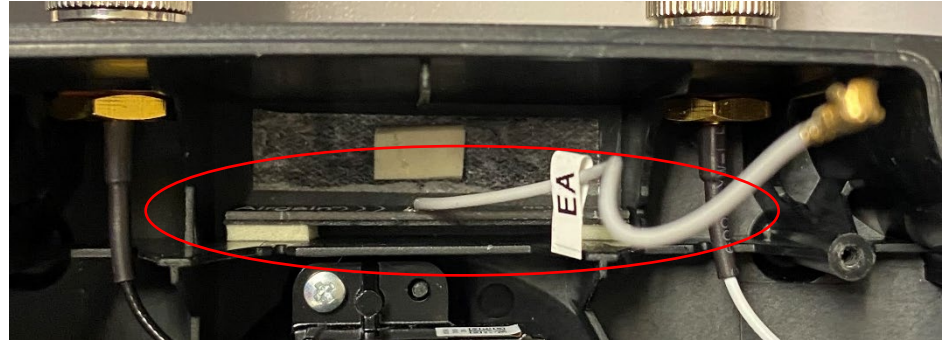


Antenna #	Part Number	Type	Cable Length
Ant1_Dual	ET03PCACA	External Dipole	N/A
Ant2_Dual	ET03PCACA	External Dipole	NA
Ant3_BT	N01PCAAB	FR4, Cable Fed	75mm

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Bluetooth Antenna



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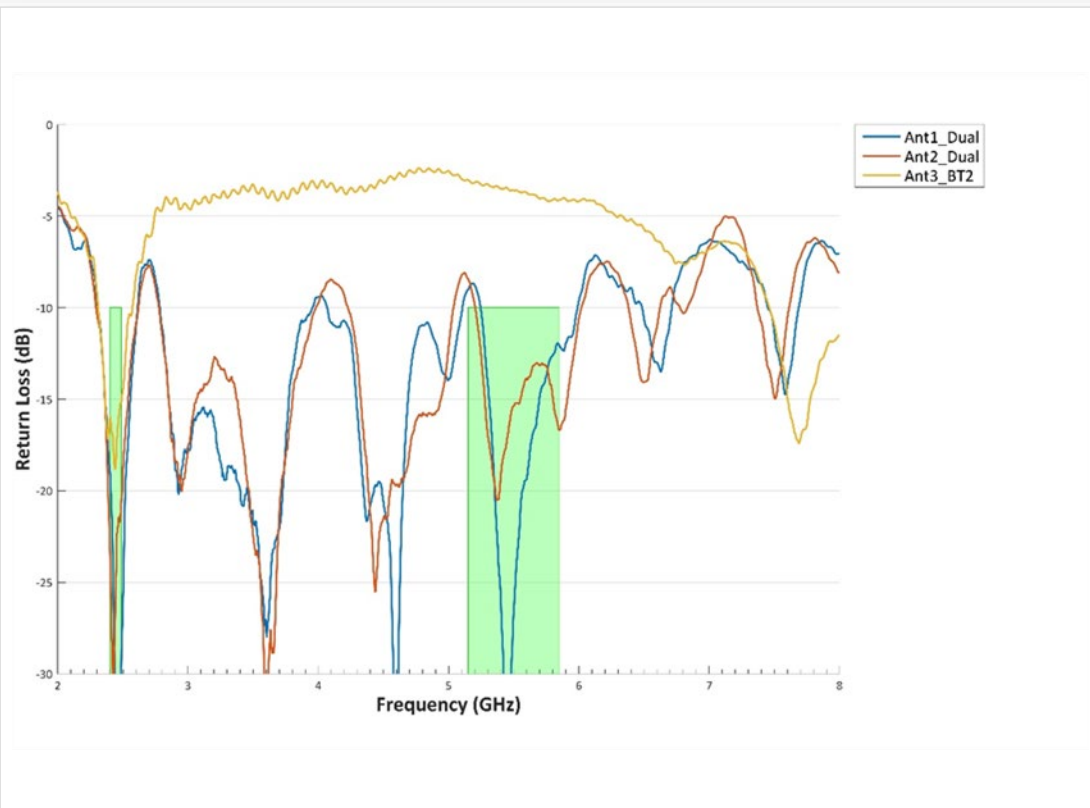
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S-Parameters

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Return Loss

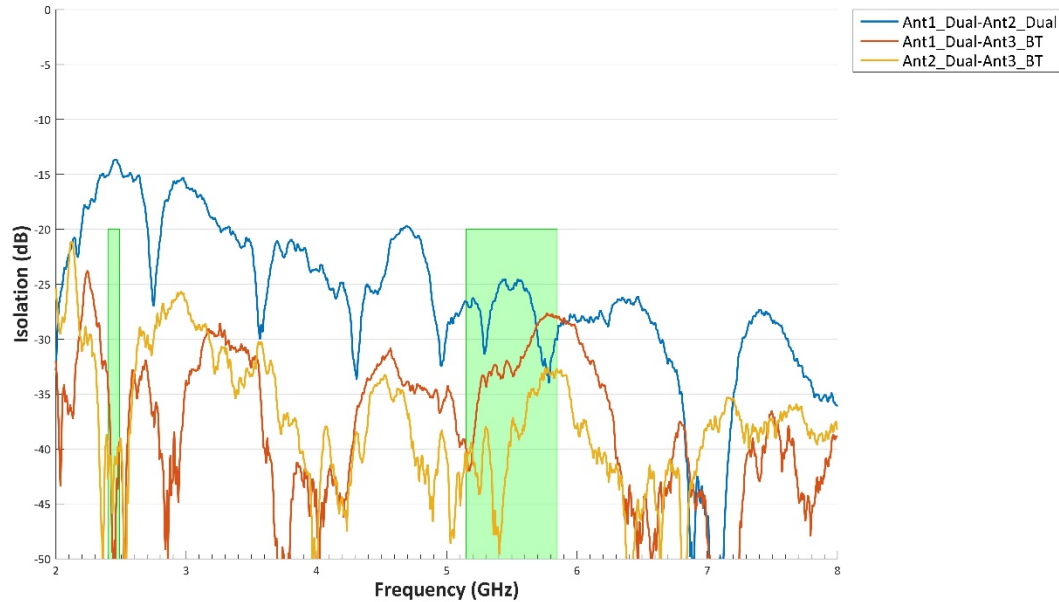


Antenna	Return Loss (dB)			
	2.4 GHz	2.49 GHz	5.15 GHz	5.85 GHz
Ant1_Dual	-17.2	-21.3	-10	-8.5
Ant2_Dual	-22.7	-19.8	-8.0	-8.3
Ant3_BT	-16.1	-15.2	-	-

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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

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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°

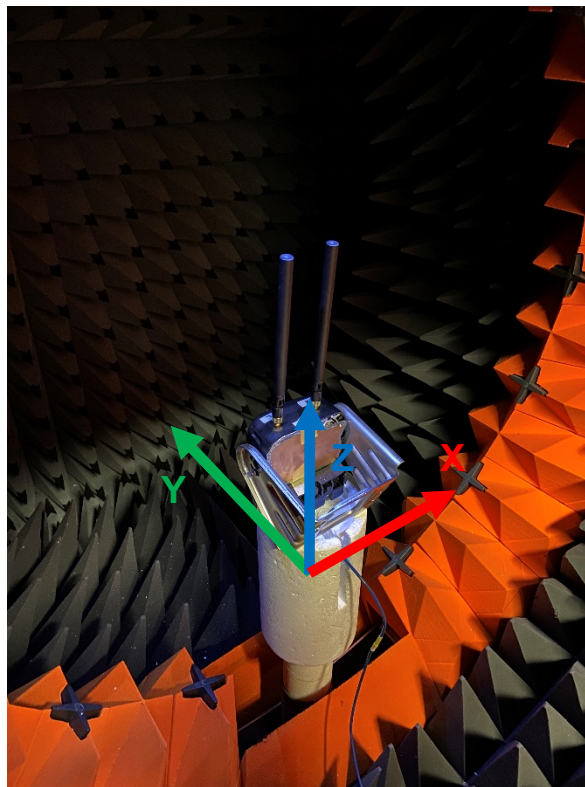
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Radiation Patterns

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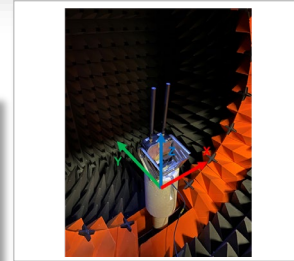
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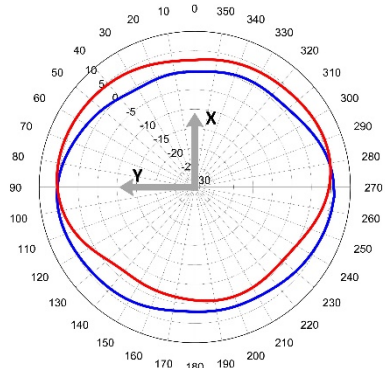
Gain Patterns: System Coverage – 2.4GHz



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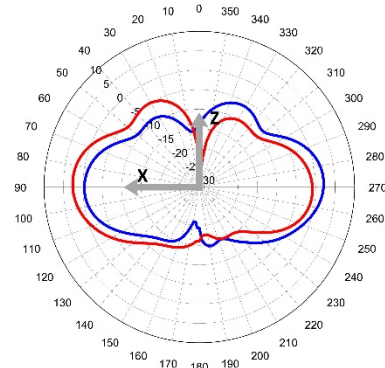
Azimuth XY 2440 MHz



— Ant1_Dual: Max = 5.9 Avg = 2.9
— Ant2_Dual: Max = 5.6 Avg = 2.8

Azimuth (XY)

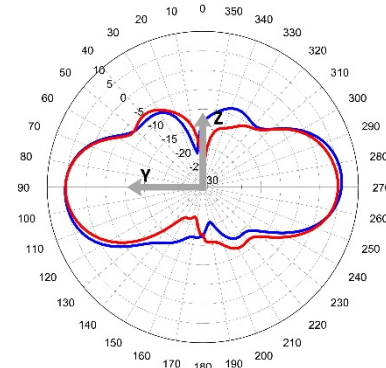
Side to Side XZ 2440 MHz



— Ant1_Dual: Max = 2.1 Avg = -6.2
— Ant2_Dual: Max = 2.6 Avg = -6.1

Front to Back (XZ)

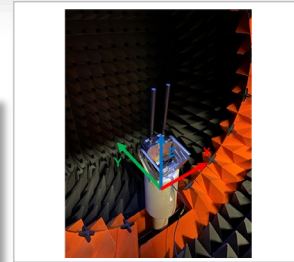
Front to Back YZ 2440 MHz



— Ant1_Dual: Max = 5.8 Avg = -3.3
— Ant2_Dual: Max = 5.3 Avg = -3.9

Side to Side (YZ)

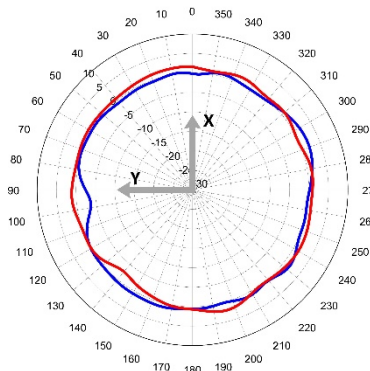
Gain Patterns: System Coverage – 5GHz



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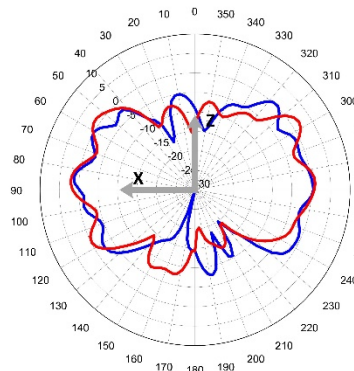
Azimuth XY 5500 MHz



Ant1_Dual: Max = 2.1 Avg = 0.2
Ant2_Dual: Max = 2.2 Avg = 0.7

Azimuth (XY)

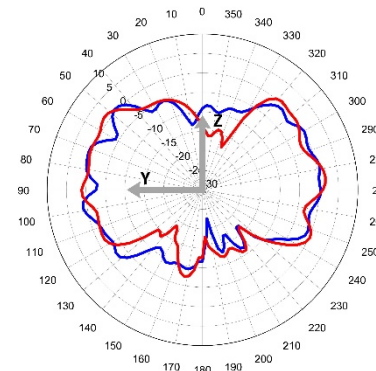
Side to Side XZ 5500 MHz



Ant1_Dual: Max = 1.4 Avg = -4.8
Ant2_Dual: Max = 2.1 Avg = -4.6

Front to Back (XZ)

Front to Back YZ 5500 MHz

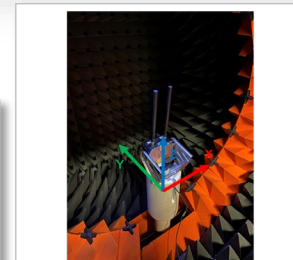


Ant1_Dual: Max = 1.1 Avg = -4.3
Ant2_Dual: Max = 1.8 Avg = -4.3

Side to Side (YZ)

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.

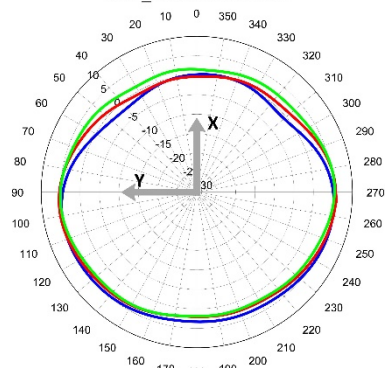
Gain Patterns: Ant1_Dual – 2.4GHz



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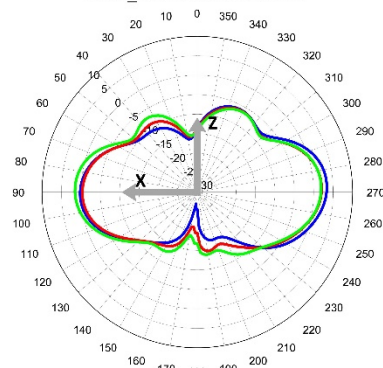
Ant1_Dual Azimuth XY



2400 MHz:	Max = 5.6	Avg = 2.8
2440 MHz:	Max = 5.9	Avg = 2.9
2490 MHz:	Max = 5.4	Avg = 3.2

Azimuth (XY)

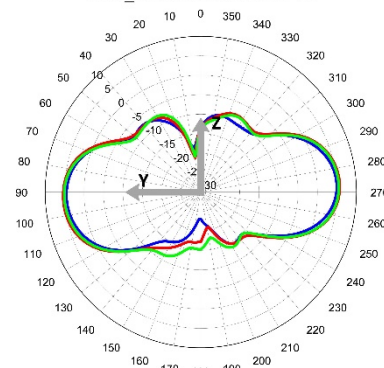
Ant1_Dual Side to Side XZ



2400 MHz:	Max = 3.4	Avg = -5.8
2440 MHz:	Max = 2.1	Avg = -6.2
2490 MHz:	Max = 2	Avg = -5.5

Front to Back (XZ)

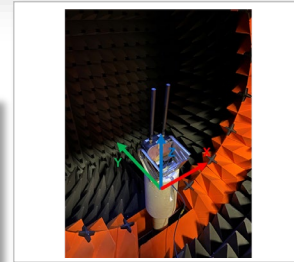
Ant1_Dual Front to Back YZ



2400 MHz:	Max = 5	Avg = -4.2
2440 MHz:	Max = 5.8	Avg = -3.3
2490 MHz:	Max = 5.5	Avg = -3.5

Side to Side (YZ)

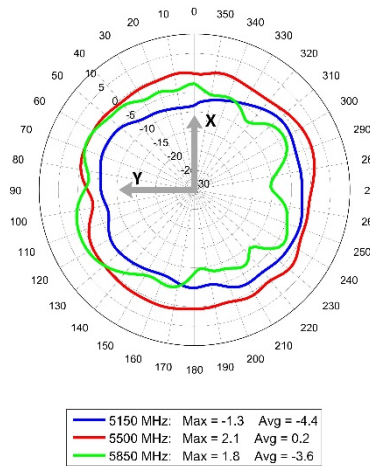
Gain Patterns: Ant1_Dual – 5GHz



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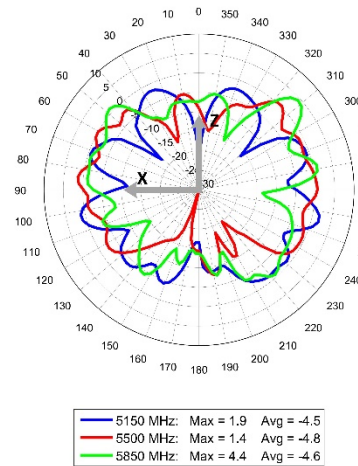
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Ant1_Dual Azimuth XY



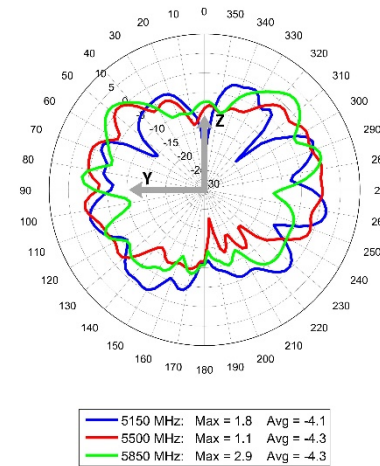
Azimuth (XY)

Ant1_Dual Side to Side XZ



Front to Back (XZ)

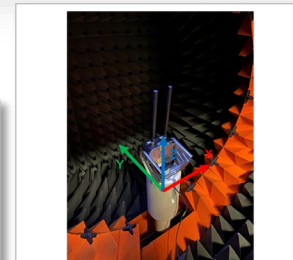
Ant1_Dual Front to Back YZ



Side to Side (YZ)

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.

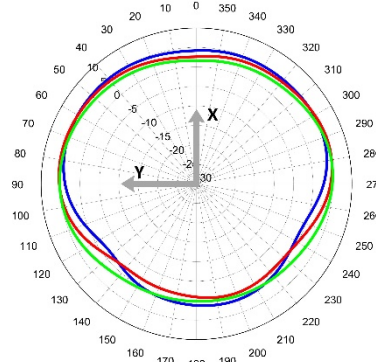
Gain Patterns: Ant2_Dual – 2.4GHz



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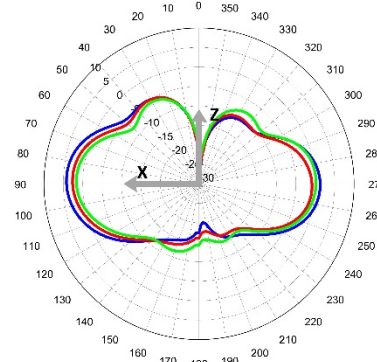
Ant2_Dual Azimuth XY



2400 MHz:	Max = 5.3	Avg = 2.9
2440 MHz:	Max = 5.6	Avg = 2.8
2490 MHz:	Max = 5.3	Avg = 3

Azimuth (XY)

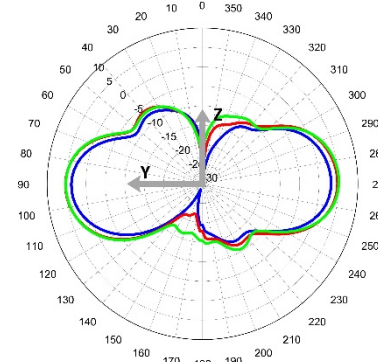
Ant2_Dual Side to Side XZ



2400 MHz:	Max = 4.2	Avg = -4.9
2440 MHz:	Max = 2.6	Avg = -6.1
2490 MHz:	Max = 1.7	Avg = -6.1

Front to Back (XZ)

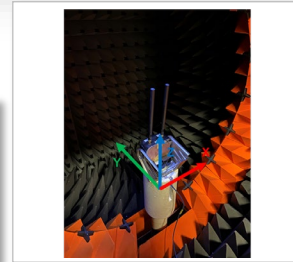
Ant2_Dual Front to Back YZ



2400 MHz:	Max = 3.8	Avg = -5.5
2440 MHz:	Max = 5.3	Avg = -3.9
2490 MHz:	Max = 5.2	Avg = -3.7

Side to Side (YZ)

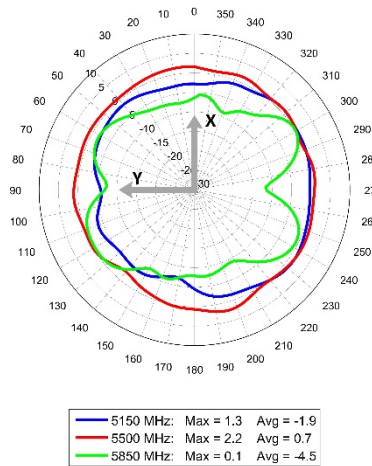
Gain Patterns: Ant2_Dual – 5GHz



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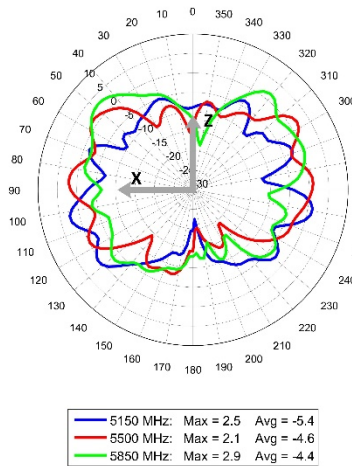
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Ant2_Dual Azimuth XY



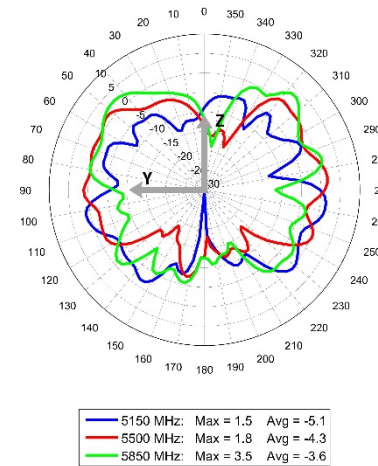
Azimuth (XY)

Ant2_Dual Side to Side XZ



Front to Back (XZ)

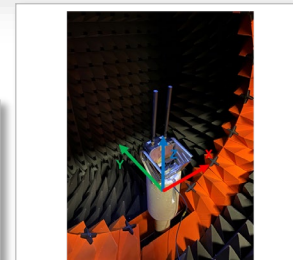
Ant2_Dual Front to Back YZ



Side to Side (YZ)

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Please refer to the 3D Plot and the heatmap.

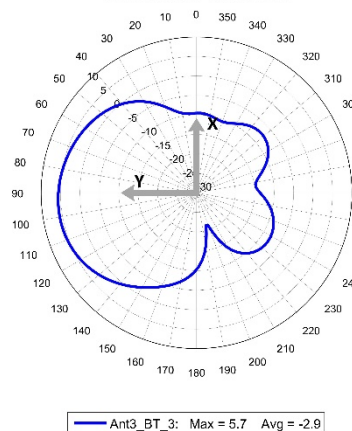
Gain Patterns: Ant3_BT



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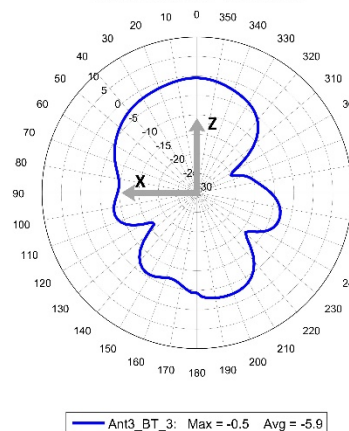
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Azimuth XY 2440 MHz



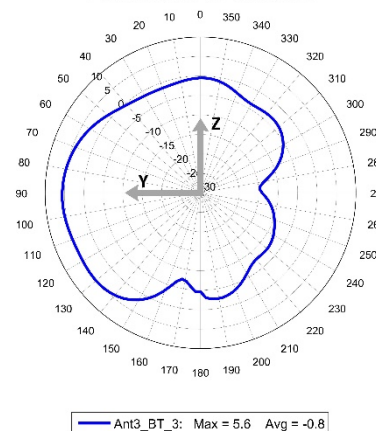
Azimuth (XY)

Side to Side XZ 2440 MHz



Front to Back (XZ)

Front to Back YZ 2440 MHz

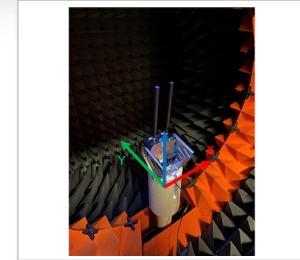
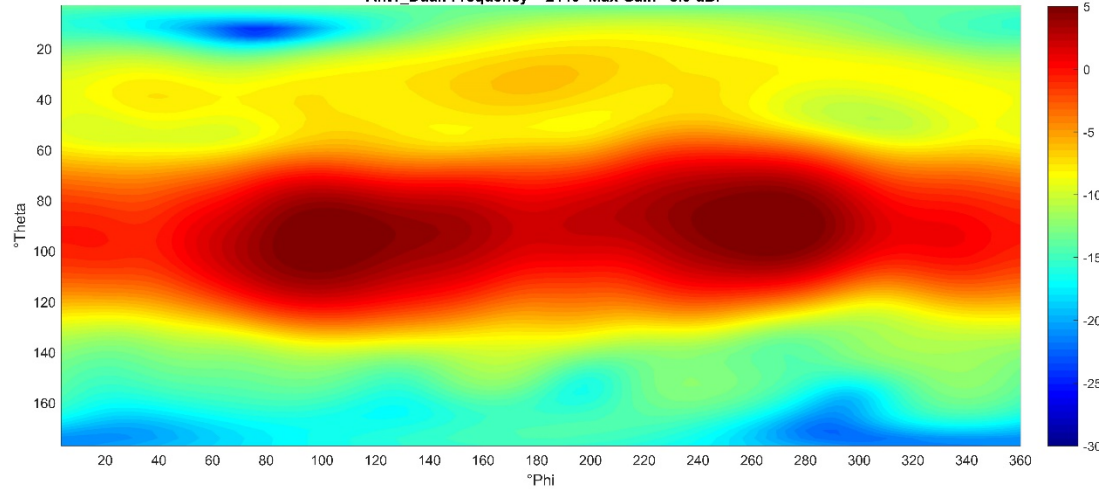


Side to Side (YZ)

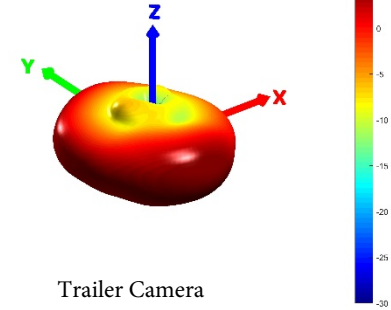
3D Gain Pattern and Heatmap: Ant1_Dual at 2440MHz



Ant1_Dual: Frequency = 2440 Max Gain= 5.9 dBi



Ant1_Dual: Frequency = 2440 MHz Peak Gain = 5.9 dBi

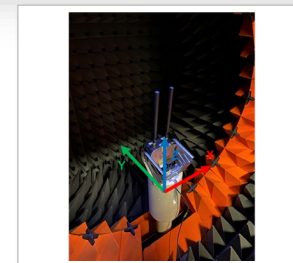
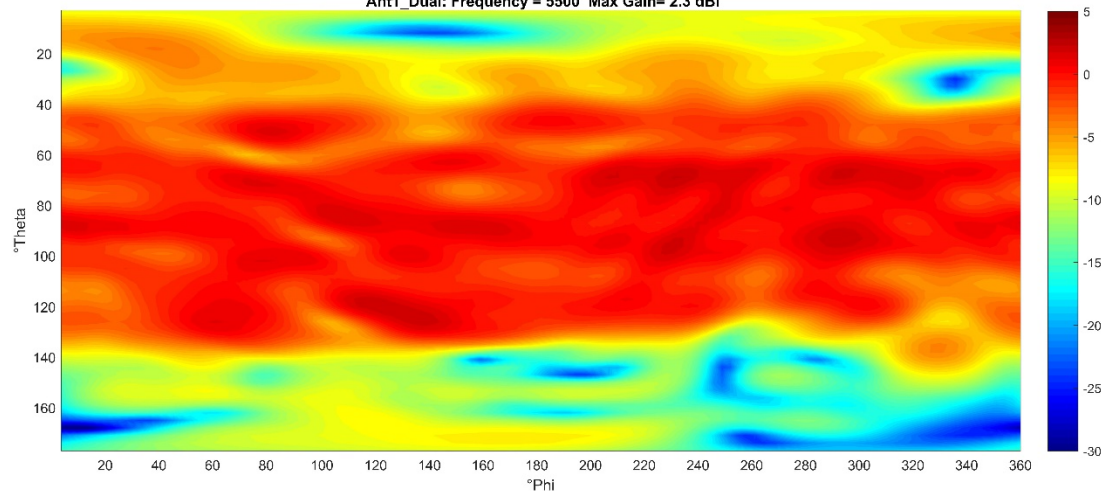


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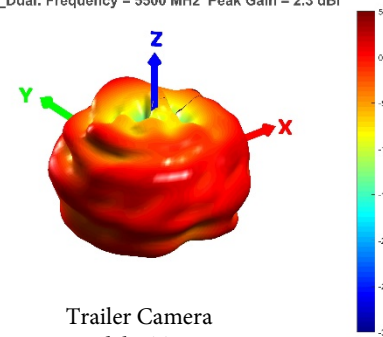
3D Gain Pattern and Heatmap: Ant1_Dual at 5500MHz



Ant1_Dual: Frequency = 5500 Max Gain= 2.3 dBi



Ant1_Dual: Frequency = 5500 MHz Peak Gain = 2.3 dBi

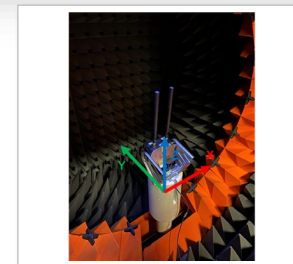
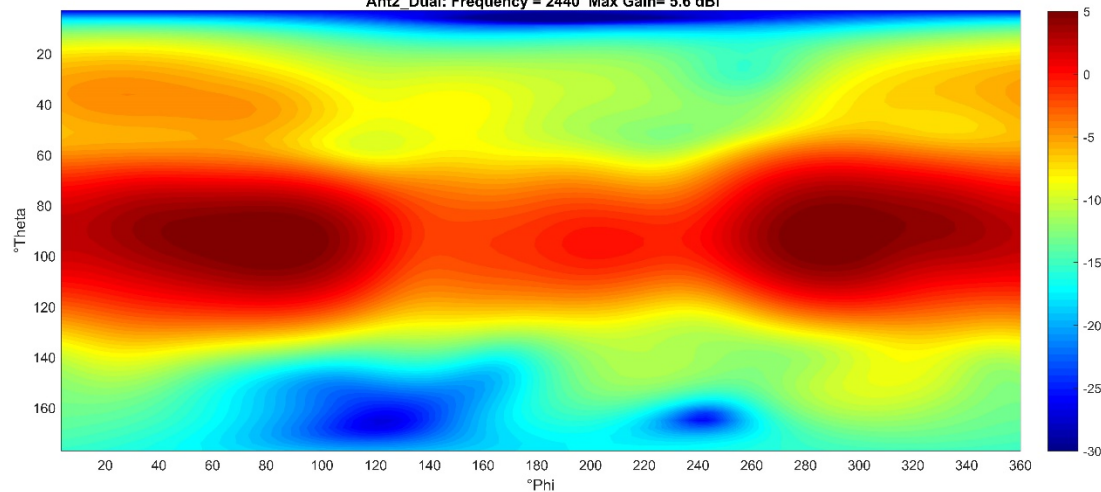


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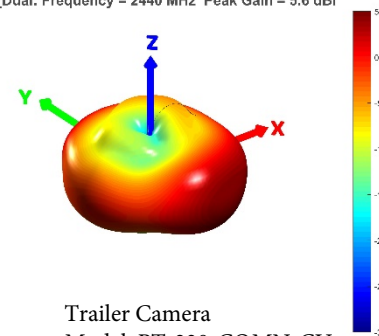
3D Gain Pattern and Heatmap: Ant2_Dual at 2440MHz



Ant2_Dual: Frequency = 2440 Max Gain= 5.6 dBi



Ant2_Dual: Frequency = 2440 MHz Peak Gain = 5.6 dBi

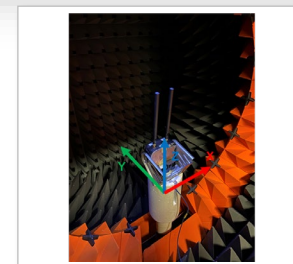
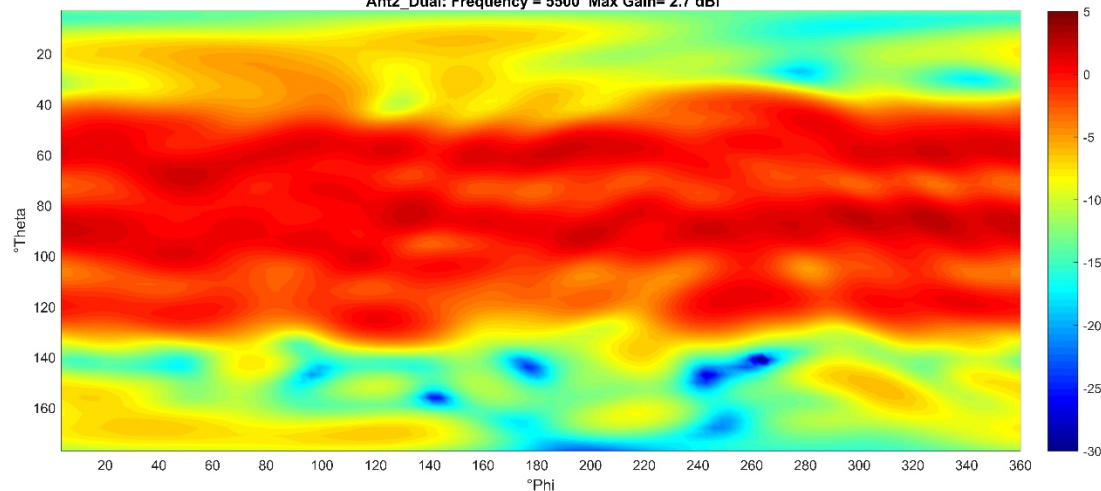


Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

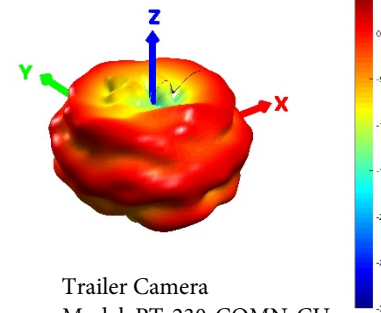
3D Gain Pattern and Heatmap: Ant2_Dual at 5500MHz



Ant2_Dual: Frequency = 5500 Max Gain= 2.7 dBi

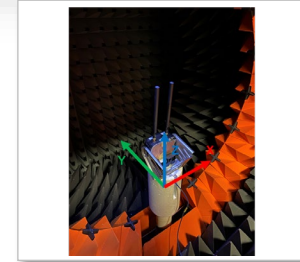
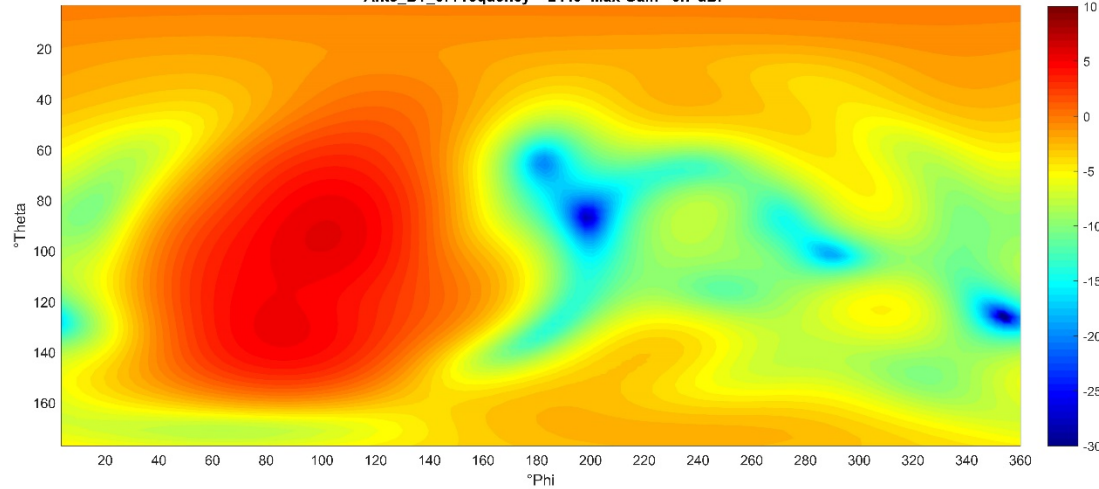


Ant2_Dual: Frequency = 5500 MHz Peak Gain = 2.7 dBi

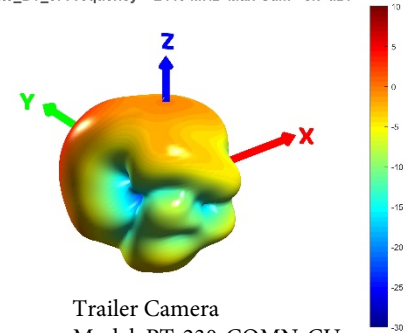


Trailer Camera
Model: PT-230-COMN-CU
FCC ID: ACJ932A-PT230
IC: 216A-PT230

Ant3_BT_3: Frequency = 2440 Max Gain= 5.7 dBi



Ant3_BT_3: Frequency = 2440 MHz Max Gain= 5.7 dBi



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