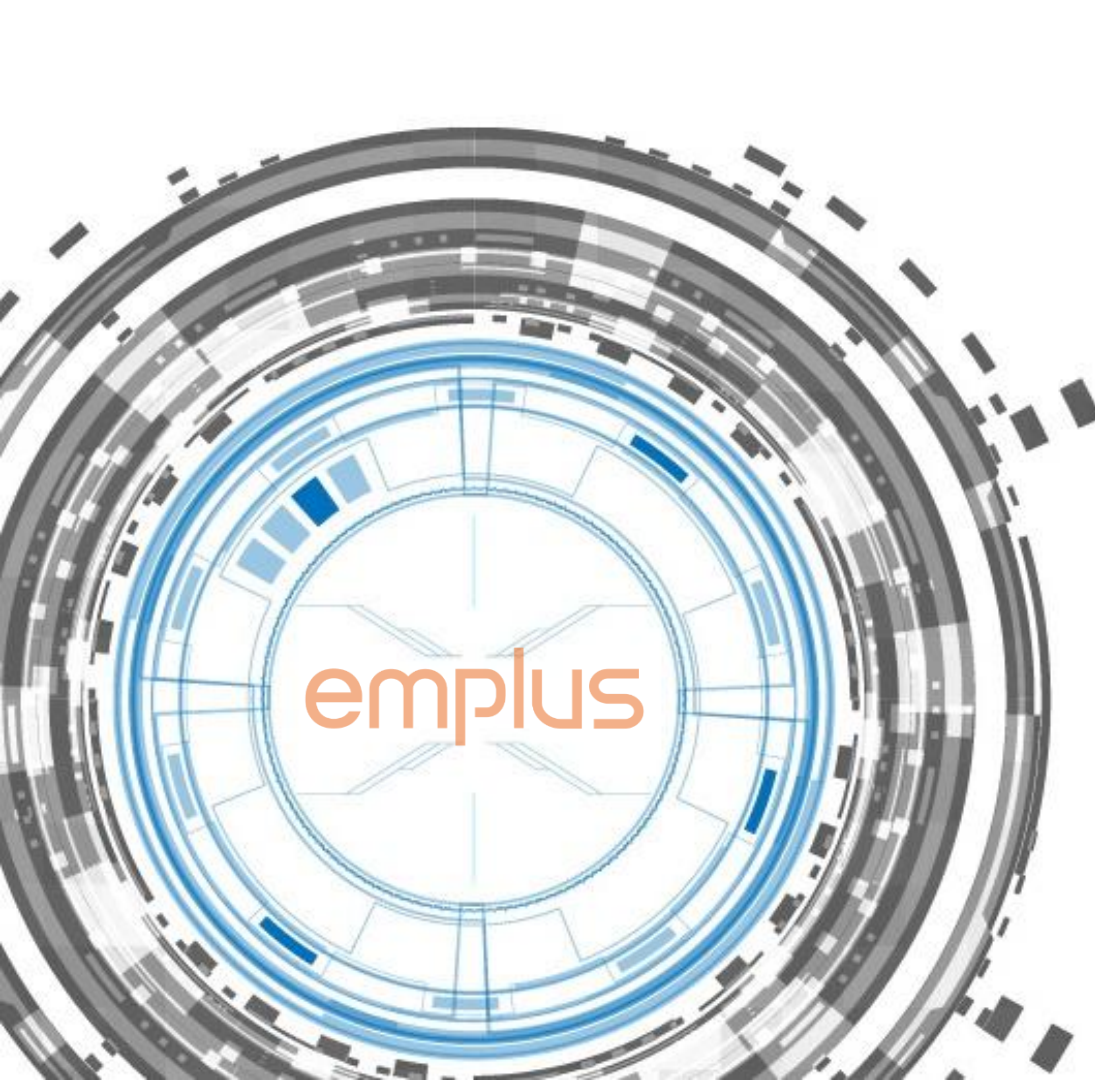




emplus

WAP7522

Antenna test report

V1.0
Tim Chao
2026/03/23

Agenda

- Antenna Placement
- Test Configuration
- Test Equipment
- Reference Calibration
- Test Method
- Test Location
- Test Frequency
- 3D Gain table
- 2D Radiation Pattern
- Combine Pattern
- 3D Raw data

Antenna placement

- WAP7522 have total four antennas as figure :
- 2.4GHz * 2
- 5GHz * 2

	Size(mm)	Material	PN	Type
2-1	29*7*10	Metal	7102A1320000	PIFA
2-2	29*7*10	Metal	7102A1322000	PIFA
5-1	12.5*9.2*5.5	Metal	7102A1321000	PIFA
5-2	12.5*9.2*5.5	Metal	7102A1323000	PIFA

Manufactory : Advanced wireless & antenna inc.

Add. : B2-F,No.207-1,Sec.3,Beixin Rd.,Xindian
Dist.,New Taipei City,231,Taiwan

Test Configuration

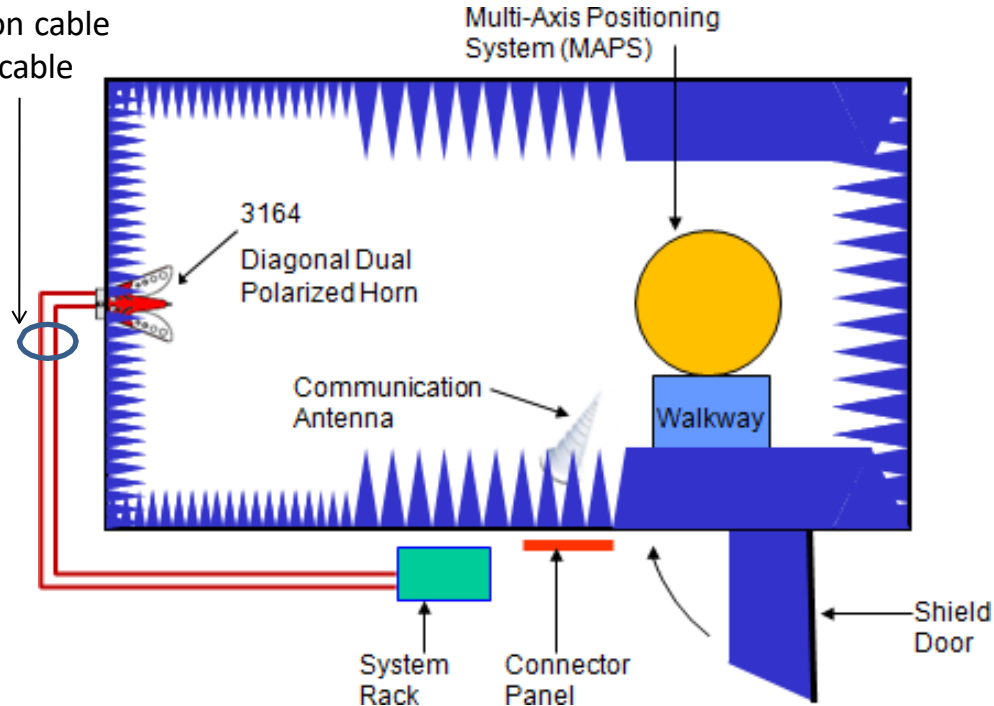
- 📶 Chamber Size: 24ft L x 12ft W x 12ft H
7.32m x 3.66m x 3.66m
- 📶 Test Distance: 4.9 meter
- 📶 Frequency: 700MHz – 8.5GHz
- 📶 Fully anechoic covered
with EHP-12, 24inch absorbers
- 📶 Quiet Zone Diameter:
 - 30cm
 - 50cm
 - per CTIA 2.x / 3.x versions



Test Configuration

 Bird view – look down from ceiling.

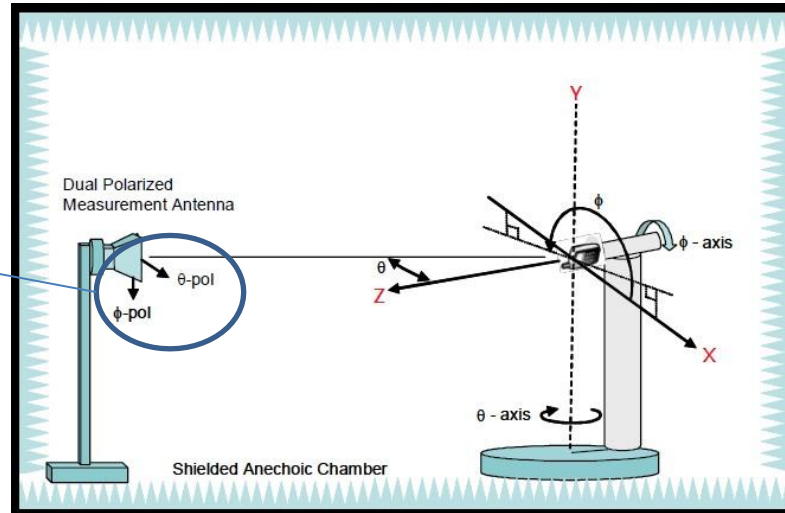
Theta-polarization cable
Phi-polarization cable



Test Configuration

- Both Theta- and Phi-axis rotate clockwise.
- From center of Quiet Zone
 - To 90-degree Phi $\rightarrow$ X axis
 - To ceiling $\rightarrow$ Y axis
 - To 3164 measurement antenna $\rightarrow$ Z axis

Theta Polarization $\rightarrow$ Horizontal
Phi Polarization $\rightarrow$ Vertical



Test Equipment

MAPS – Multi-Axis Positioning System

Two axes

- Phi axis: Mast
- Theta axis: Turntable

Mast is removable

Two mast models

- Medium duty: 2115(CR)
- Light duty: 2110(CR)

CR: continuous rotation



Model 2115CR Medium Duty MAPS

Test Equipment

2090 Controller

- One 2090 can control two devices.
- Two sets of fiber optic interfaces.
- Device one: theta-axis (Turntable)
- Device two: phi-axis (Mast)
- Four RF switches with option1 installed.



Test Equipment

E5071C ENA vector network analyzer

- Frequency Range : 9 kHz to 20GHz.
- Enhanced TDR measurement option.
- High Throughput and Yield.
- Time Domain Analysis.
- Frequency Offset Mode.



Simtek Calibration

Mod : KEYSIGHT E5071C

Report No : ST250414-2001

Cal Date : 2025.04.15

Test Equipment

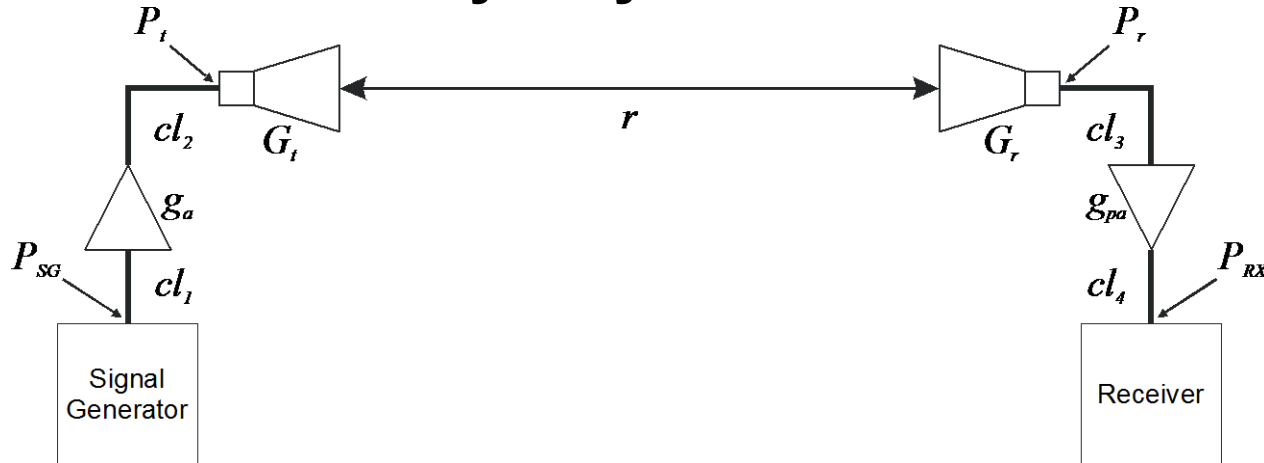
3164-08 Open Boundary Quad-Ridged Horn

- 700 MHz to 10 GHz Frequency Range
- Linear or Circular Polarization (With Hybrid)
- Low VSWR with Improved Gain
- Compact Design
- Flexible Mounting Schemes



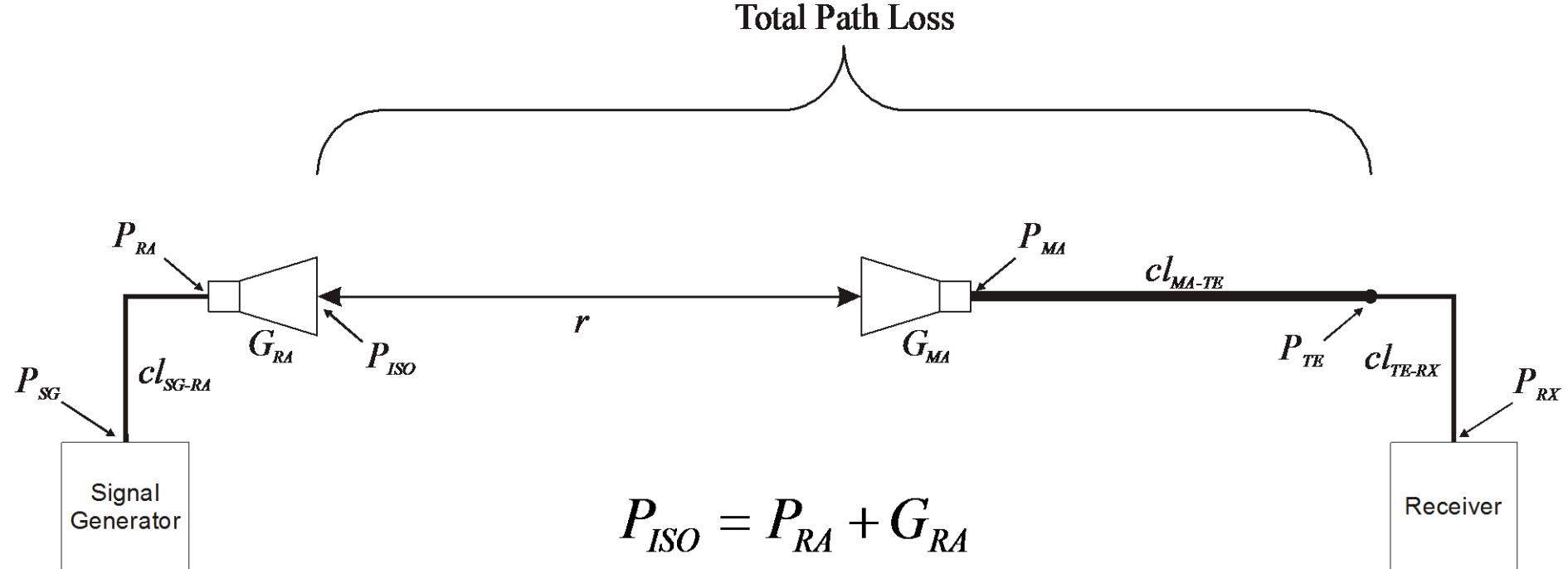
Cal Date : 2018.10.05

Range calibration is required to do much more than capture pretty pictures. Without it, only relative values like Directivity may be ascertained.



Precision reference antennas are required in order to obtain suitable results.

Reference Calibration



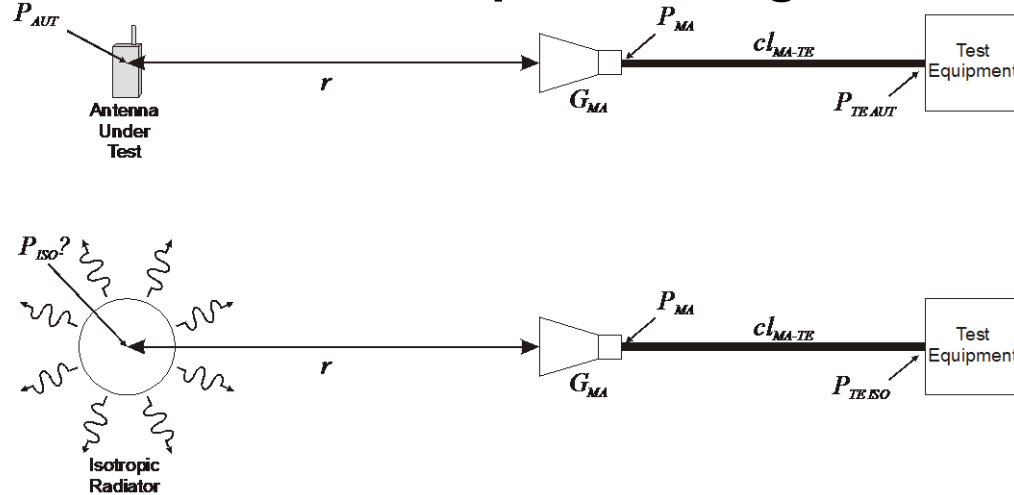
$$P_{ISO} = P_{RA} + G_{RA}$$

SO

$$PL = P_{RA} + G_{RA} - P_{TE}$$

Test Method

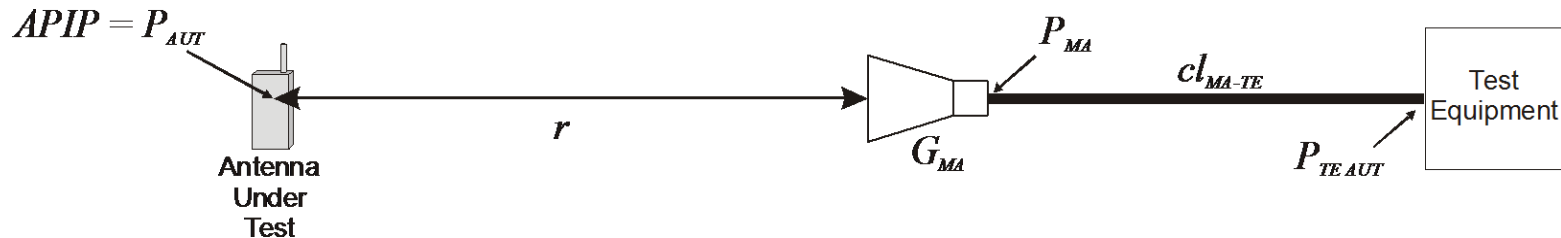
Power that would be radiated by an isotropic radiator to measure the same received power in a given direction.



$$EIRP = P_{ISO} \quad \text{when} \quad P_{TEISO} = P_{TEAUT}$$

Each measured power data point becomes EIRP when range calibration is applied.

- Antenna Port Input Power (APIP)
 - Power input to the transmit antenna port.
 - Normally assumes VSWR is part of antenna gain/efficiency terms.
 - APIP is forward power, not net power into antenna.



Gain

Product of Directivity and Efficiency (sum in dB).

Equivalent to ratio of EIRP to APIP (EIRP – APIP in dB).

Common term representing apparent amplification (gain) seen in bore sight (peak EIRP) direction over that from an equivalent lossless isotropic radiator.

Test Location

Testing Location			
HB	Add: No. 143, Xinhua 1st Rd., Neihu Dist., Taipei City 114758, Taiwan (R.O.C.)		
Test condition	Test Engineer	Test Environment (°C/%)	Test Date
Radiated	Henry	20-24 / 45-55	11.21.2025

Test Frequency

Band (MHz)	Test Frequency (MHz)
2400-2483.5	2450
5150-5250	5150
5250-5470	5350
5470-5725	5500
5725-5850	5850

3D Gain table

Antenna		2.45GHz	5.15GHz	5.35GHz	5.5GHz	5.85GHz
2-1	Peak Gain (dBi)	3.58				
	Effi.(%)	63				
2-2	Peak Gain (dBi)	3.64				
	Effi.(%)	60				
5-1	Peak Gain (dBi)		4.46	4.22	3.96	4.12
	Effi.(%)		71	67	69	67
5-2	Peak Gain (dBi)		6.56	6.96	6.49	6.47
	Effi.(%)		70	72	73	72

3D Gain table – Composite gain

DG_1SS max value position

Frequency	2.45GHz	5.15GHz	5.35GHz	5.5GHz	5.85GHz
Ant 2-1 (dBi)	2.31				
Ant 2-2 (dBi)	3.08				
Ant 5-1 (dBi)		2.24	1.25	0.5	4.11
Ant 5-2 (dBi)		5.07	6.96	6.49	3.84
DG 1ss(dBi)	5.71	6.78	7.58	7.01	6.99
$\phi(^{\circ})$	90	150	150	150	135
$\theta(^{\circ})$	45	90	60	60	105

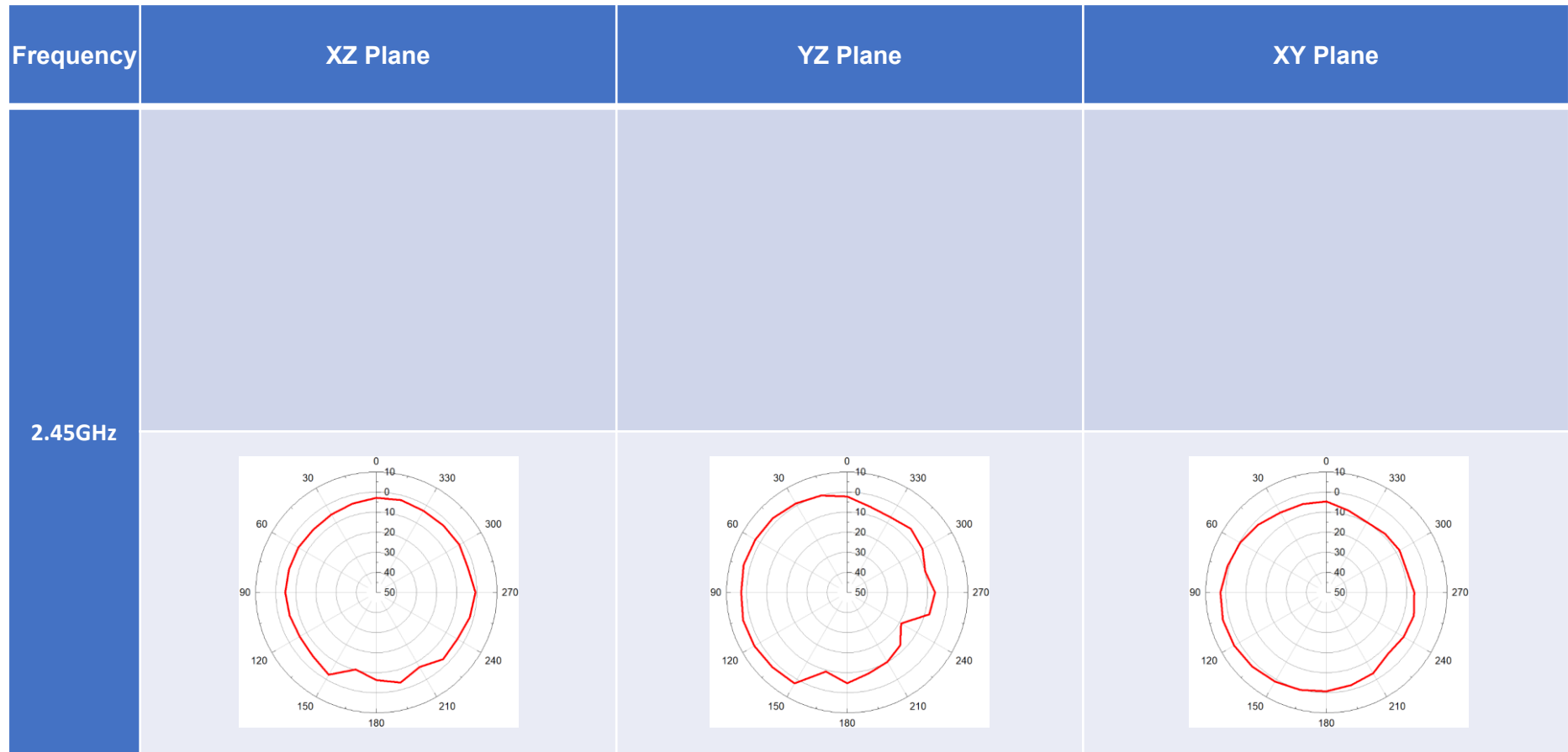
$$\text{Directional gain (1SS)} = 10 \cdot \log(10^{G_{\text{ant1}}/20} + 10^{G_{\text{ant2}}/20} + 10^{G_{\text{ant3}}/20} + 10^{G_{\text{ant4}}/20} + \dots)^{2/N_{\text{ant}}}$$

3D Gain table – Composite gain

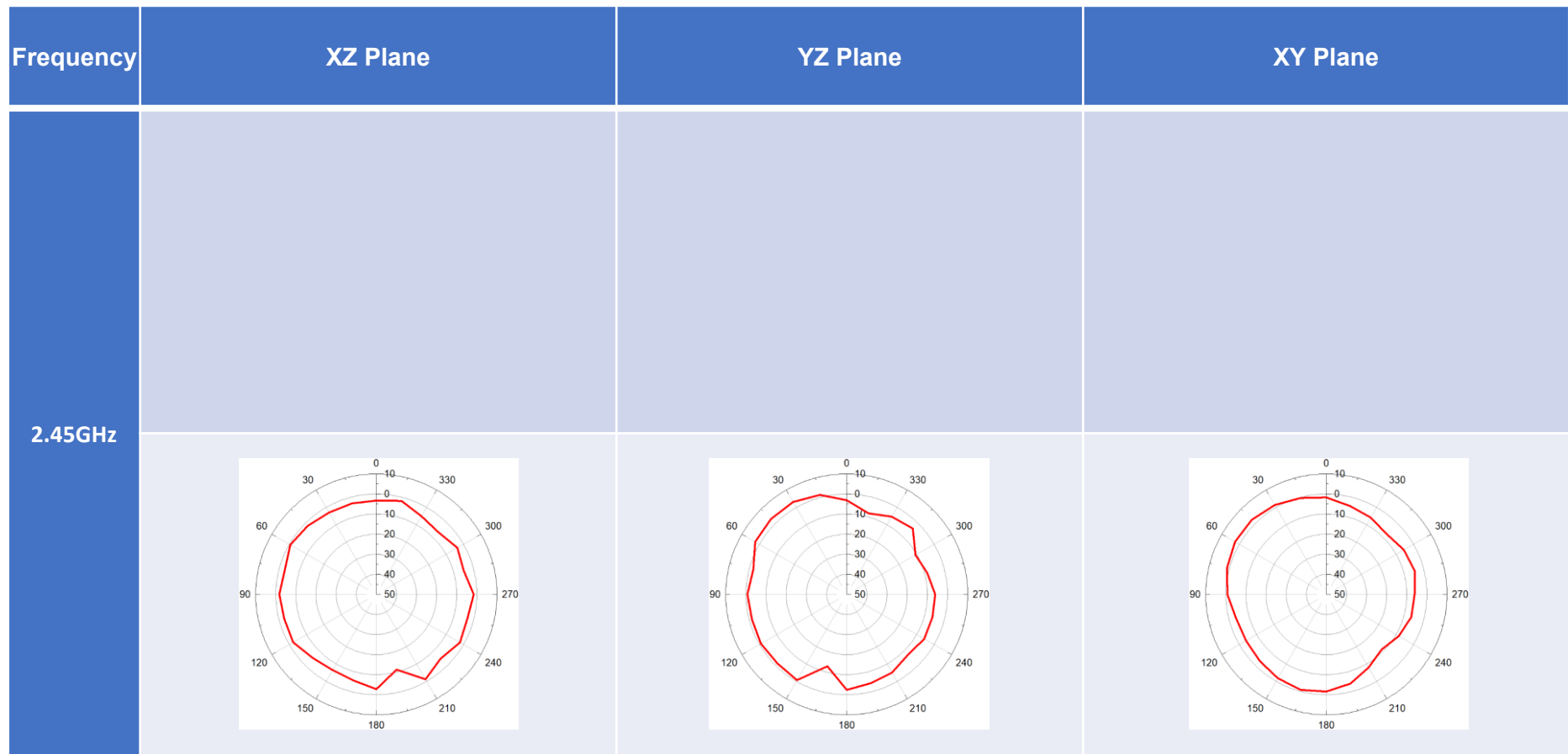
Summary

Frequency	2.45GHz	5.15GHz	5.35GHz	5.5GHz	5.85GHz
Ant 2-1 Max Gain (dBi)	3.58				
Ant 2-2 Max Gain (dBi)	3.64				
Ant 5-1 Max Gain (dBi)		4.46	4.22	3.96	4.12
Ant 5-2 Max Gain (dBi)		6.56	6.96	6.49	6.47
Ant -1 Max $\phi, \theta(^{\circ})$	90,105	120,150	105,105	105,150	30,135
Ant -2 Max $\phi, \theta(^{\circ})$	75,45	150,60	150,60	150,60	150,60
Max Gain (dBi)	3.64	6.56	6.96	6.49	6.47
DG 1ss (dBi)	5.71	6.78	7.58	7.01	6.99

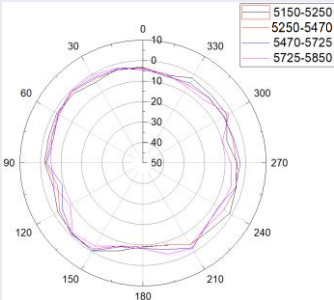
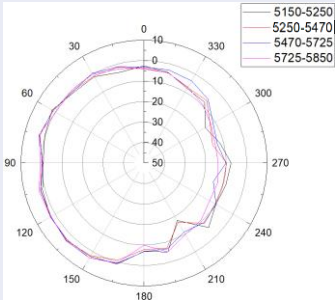
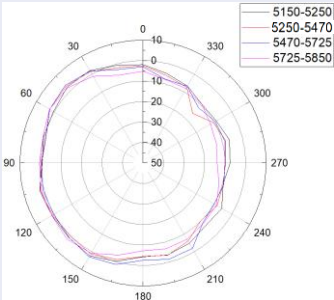
2D pattern : 2-1



2D pattern : 2-2



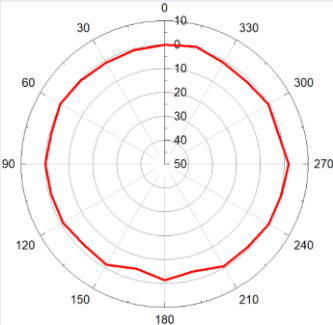
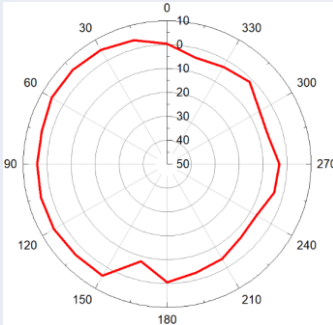
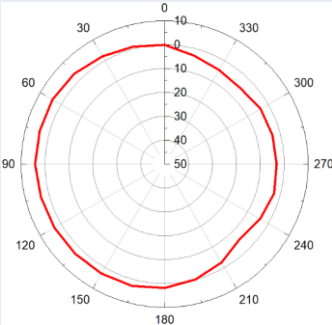
2D pattern : 5-1

Frequency	XZ Plane	YZ Plane	XY Plane
			

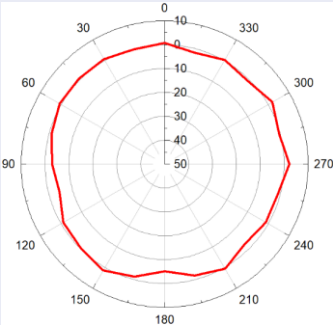
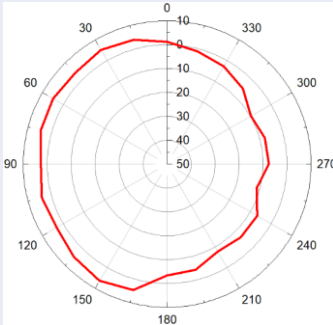
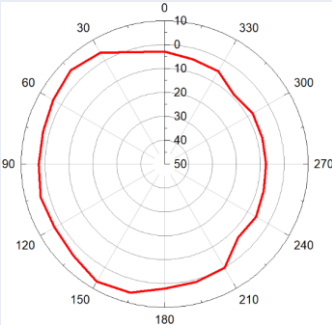
2D pattern : 5-2



Combine pattern : 2.4GHz

Frequency	XZ Plane	YZ Plane	XY Plane
2.45GHz			
			

Combine pattern : 5GHz

Frequency	XZ Plane	YZ Plane	XY Plane
5.5GHz			
			

3D Raw data: 2-1

2450 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180	
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	(dB)
0	-2.88	-4.2	-5.22	-5.71	-5.24	-5.07	-4.7	-5.37	-6	-5.23	-2.64	-10.25	-6.33	
15	-2.78	-3.68	-4.55	-4.04	-4.14	-4.18	-4.45	-4.36	-5.31	-3.74	-1.62	-8.35	-6.13	
30	-2.64	-2.79	-3.51	-2.08	-2.17	-2.95	-4.1	-3.73	-4.4	-2.2	-0.12	-6.72	-5.78	
45	-2.41	-1.75	-2.36	-0.82	-0.51	-0.43	-2.2	-2.44	-3.06	-0.66	1.1	-5.95	-5.37	
60	-2.39	-1.02	-1.31	-0.09	0.88	1.25	-0.49	-0.18	-0.94	0.81	1.6	-6.02	-5.06	
75	-2.12	-0.41	0.12	0.99	1.54	1.91	0.88	2.02	1.33	2.08	1.86	-7.25	-4.52	
90	-2.21	-0.02	1.13	2.31	2.71	3.29	2.69	3.58	3.33	2.61	2.33	-9.18	-4.74	
105	-2.27	-0.14	1.24	2.14	3.04	3.14	3.28	3.38	3.55	2.53	2.39	-11.82	-4.78	
120	-2.29	-0.72	0.11	0.85	1.87	1.88	2.98	2.38	2.44	1.15	1.41	-12.82	-4.82	
135	-2.14	-1.33	-1.32	-0.04	0.26	0.79	2.22	1.55	0.8	-0.79	-0.52	-10.1	-5.35	
150	-2.03	-1.65	-2.4	-0.99	-0.74	-0.7	1.26	0.28	-1.41	-2.5	-2.95	-6.78	-5.37	
165	-2.02	-2.1	-2.97	-2.08	-1.67	-2.17	0.3	-0.45	-3.1	-3.13	-5.12	-4.66	-5.81	
180	-2.17	-2.42	-3.09	-2.85	-2.38	-2.84	-0.72	-1.91	-3.51	-3.02	-7.08	-3.51	-5.96	
195	-2.16	-2.75	-3.47	-3.23	-3.55	-3.67	-2.19	-3.99	-3.52	-3.78	-7.45	-3.05	-6.54	
210	-2.06	-3.17	-3.54	-3.03	-4.75	-6.47	-3.51	-5.65	-5.49	-5.4	-6.48	-3.12	-6.66	
225	-2.13	-3.89	-3.74	-2.46	-5.53	-8.53	-6.68	-9.02	-9.03	-5.22	-5.26	-4.18	-6.89	
240	-1.92	-4.89	-4.11	-2.27	-5.7	-9.89	-5.66	-6.46	-15.09	-4.62	-6.02	-5.49	-6.57	
255	-1.86	-5.65	-4.86	-3.42	-5.02	-9.06	-4.99	-5.58	-9.96	-6.99	-9.89	-7.1	-6.52	
270	-1.96	-5.82	-6.81	-5.19	-6.77	-9.79	-6.3	-7.72	-19.06	-12.71	-10.04	-8.28	-6	
285	-2.13	-5.37	-8.32	-6.1	-11.69	-11.75	-8.62	-9.66	-16.72	-8.72	-5.94	-9.81	-6.05	
300	-2.43	-4.82	-7.48	-6.79	-8.25	-10.2	-8.02	-9.15	-10.54	-7.77	-4.15	-11.37	-6.08	
315	-2.41	-4.57	-7.02	-8.39	-7.08	-11.21	-8.76	-7.02	-9.49	-9.74	-3.75	-12.85	-6.16	
330	-2.47	-4.59	-7.23	-9.39	-8.73	-9.29	-9.62	-8.37	-7.91	-9.27	-3.92	-14.38	-6.21	
345	-2.45	-4.49	-7.37	-7.34	-8.26	-6.73	-7.76	-7.17	-7.41	-6.97	-3.71	-13.76	-6.11	
360	-2.32	-4.41	-5.87	-6.07	-5.75	-5.35	-4.82	-5.55	-6.34	-5.64	-2.84	-11.3	-6.18	

3D Raw data: 2-2

2450 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-3.29	-3.13	-2.98	-1.77	-0.62	-2.89	-1.77	-2.6	-2.23	-5.24	-6.46	-5.63	-2.78
15	-3.19	-2.26	-1.97	-0.91	0.09	-0.13	-0.34	-0.68	-1.33	4.21	-6.28	-7.53	-2.81
30	-3.39	-1.27	-0.07	0.61	1.2	2.85	1.37	1.56	-0.63	-2.52	-5.17	-10.01	-2.75
45	-3.56	-0.6	1.51	2.17	1.76	3.6	2.48	2.51	0.11	-1.66	-3.94	-12.73	-2.68
60	-3.46	0.33	2.63	3.18	2.09	2.22	2.42	1.54	0.06	-2.23	-2.89	-14.86	-2.62
75	-3.34	0.9	3.12	3.64	2.5	-0.22	1.15	-0.18	-0.86	-2.73	-2.19	-15	-2.54
90	-3.15	1.26	3.12	3.08	2.38	-2.06	-0.72	-1.38	-0.89	-1.38	-0.67	-12.95	-2.43
105	-2.71	1.33	2.55	1.62	1.1	-2.57	-3.54	-1.93	-0.38	-0.35	0.84	-11.33	-2.19
120	-2.39	1.02	1.39	0.24	0.01	-2.27	-3.86	-1.04	-0.39	-0.64	1.43	-10.38	-1.88
135	-2.16	0.47	0.08	-0.92	-0.48	-2.36	-3.08	-1.74	-0.82	-1.83	1.13	-9.39	-1.85
150	-2.01	-0.24	-1.63	-2.27	-0.97	-2.43	-1.74	-2.07	-1.51	-3.1	0.43	-9.61	-2.1
165	-1.64	-0.97	-3.46	-3.84	-1.75	-3.26	-0.78	-2.12	-1.75	4.03	-0.43	-9.96	-2.34
180	-1.36	-1.83	-5.1	-6.32	-3.54	4.97	-1.58	-3.16	-2.03	4.8	-1.16	-11.16	-2.55
195	-1.28	-2.67	-6.89	-8.82	-7.78	-7.29	-3.99	-6.11	-3.2	-5.42	-1.54	-12.74	-2.5
210	-1.43	-3.71	-7.45	-8.06	-14.16	-9.63	-7.98	-9.3	-5.26	-5.72	-2.16	-12.79	-2.53
225	-1.7	4.84	-6.48	-5.62	-11.98	-8.23	-11.17	-9.85	-6.8	-5.17	-3.1	-10.87	-2.2
240	-1.89	-6.13	-5.61	4.5	-10.1	-9.09	-8.45	-8.45	-5.23	-5.37	4.26	-7.87	-1.95
255	-2.22	-7.24	-5.1	4.58	-14.43	-9.72	-6.31	-7.79	4.36	-6.67	4.99	-5.46	-1.82
270	-2.36	-8.24	-5.34	-3.68	-10.69	-8.71	-6.14	-6.01	-5.65	-7.27	-5.05	4.17	-1.77
285	-2.38	-8.66	4.76	-3.46	-6.99	-12.73	4.55	-6.51	-6.27	-5.97	-6.54	-3.33	-1.92
300	-2.63	-8.13	4.37	4.96	-10.78	-11.48	-5.6	-7.27	-5.5	-3.68	-7.87	-2.74	-1.93
315	-2.77	-7.09	4.21	-6.32	-12.58	-6.35	-7.58	-6.68	4.85	-2.99	-8.05	-2.87	-2.3
330	-2.83	-5.66	4.39	-5.33	-6.65	4.1	-5.84	-5.6	4.8	-3.36	-7.39	-3.33	-2.6
345	-3.23	4.27	4.4	-3.35	-3.48	-3.47	4.48	4.03	4.45	4.17	-6.93	4.2	-2.77
360	-3.29	-3.24	-3.32	-2.09	-0.98	-3.23	-2.29	-2.9	-2.62	-5.03	-6.49	-5.17	-2.77

3D Raw data: 5-1

5150 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-3.32	-2.12	-4.34	-2.11	-1.38	-2.32	-1.96	-4.73	-2.01	-1.25	-0.58	-5.65	-9.18
15	-2.82	-2.15	-4.7	-1.55	-0.44	0.83	-0.65	-2.1	-0.91	-0.67	-0.13	-4.46	-9.24
30	-2.78	-2.13	-3.94	-0.54	0.9	2.17	2.02	0.31	3.09	2.54	1.43	-3.52	-8.52
45	-2.55	-2.57	-1.66	-0.2	1.09	1.19	2.38	1.55	3.57	2.66	3.27	-2.8	-8.4
60	-2.28	-3	0.24	0.37	1.76	-1.13	0.39	1.98	3.73	1.32	3.41	-1.69	-8.07
75	-2.47	-3.71	0.23	0.62	2.46	1.06	0.17	2.36	2.35	0.42	2.26	-0.05	-6.91
90	-2.59	-4.18	-1.39	-1.38	1.75	0.17	-0.82	1.29	2.75	3.18	2.59	1.03	-6.87
105	-2.43	-4.19	-2.88	-2.03	0.94	0.71	2.19	3.69	3.02	3.48	4.39	0.75	-7.08
120	-2.33	-3.82	-2.1	-1.07	-0.04	0.27	1.31	3.09	1.19	1.46	4.46	-0.38	-7.08
135	-2.46	-3.61	-1.05	-0.84	-0.53	-2.66	1.3	1.77	0.74	2.5	3.65	-2.29	-6.82
150	-2.16	-3.99	-1.06	-0.84	-0.41	-2.21	2.24	1.88	1.63	1.64	1.67	-4.36	-6.23
165	-2.71	-4.48	-1.27	-1.36	-0.53	-4.43	-0.28	-2	-0.8	-3.54	-1.47	-6.7	-6.1
180	-2.74	-5.67	-2.12	-3.01	-2.78	-7.77	-4.18	-3.05	-1.1	-3.83	-3.97	-8.51	-5.95
195	-2.43	-6.79	-3.61	-5.48	-6.9	-6.01	-3.57	-3.18	-1.43	-0.65	-4.94	-8.69	-5.96
210	-2.57	-6.88	-5.19	-7.03	-7.97	-6.28	-4.78	-14.87	-4.52	-0.98	-5.52	-7.77	-5.75
225	-2.2	-7	-7.51	-8.41	-8.75	-5.04	-6.78	-10.55	-11.95	-4.08	-4.35	-6.17	-6.11
240	-2.39	-6	-7.73	-9.37	-9.72	-9.93	-5.65	-9.56	-14.93	-6.64	-3.95	-5.14	-6.15
255	-2.76	-4.66	-7.93	-10.47	-10.92	-11.01	-9.59	-5.92	-6.36	-9.5	-9.35	-4.44	-7.28
270	-2.69	-4.29	-7.95	-8.14	-15.54	-11.79	-7.56	-8.68	-9.56	-5.48	-17.6	-5.06	-8.83
285	-2.66	-3.43	-8.31	-8.8	-15.36	-16.87	-6.41	-10.31	-15.47	-10.04	-10.68	-5.18	-8.3
300	-2.65	-2.7	-8.49	-9.2	-11.68	-8.02	-8.77	-8.67	-6.08	-7.4	-6.13	-6.03	-8.98
315	-2.9	-2.13	-6.53	-8.36	-8.41	-11.18	-9.44	-7.92	-7.64	-6.29	-3.97	-8.04	-9.48
330	-3.05	-2.07	-4.69	-5.25	-6.8	-5.4	-6.65	-8.97	-6.92	-3.14	-4.01	-9.56	-9.28
345	-2.83	-2.18	-3.53	-3.66	-4.7	-3.07	-4.87	-5.99	-5.38	-0.88	-2.88	-7.95	-9.41
360	-3.14	-2.24	-4.14	-2.47	-2.9	-2.72	-2.65	-4.31	-2.57	-0.97	-1.06	-6.47	-9.06

3D Raw data: 5-1

5350 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-3.45	-3.01	-2.62	-0.95	-2.87	-3.74	-2.53	-6.88	-3.14	-0.55	-1.61	-8.09	-8.92
15	-3.6	-3.48	-1.9	-0.4	-2.05	-0.59	-1.85	-7.62	-1.41	0.13	-1.23	-6.39	-9.22
30	-4.05	-3.93	-1.17	-0.17	-0.49	1.26	1.49	-2.55	2.92	2.75	0.2	-5.04	-8.38
45	-3.66	-3.7	-0.63	-0.46	1.36	1.13	3.08	1.25	2.71	2.65	1.86	-3.88	-8.14
60	-3.59	-3.2	-1.4	0	2.23	-0.63	2.55	2.11	3.18	1.24	1.73	-3.01	-7.75
75	-3.5	-2.23	-1.92	0.44	1.16	1.92	-0.86	2.21	1.75	1.61	1.1	-1.57	-7.77
90	-4.1	-1.55	-0.99	-0.55	1.39	2.46	-0.24	2.28	2.54	3.55	2.19	-0.93	-7.76
105	-3.65	-1.45	-0.36	0.09	0.6	2.95	1.86	4.22	2.4	2.52	3.18	-0.78	-7.56
120	-3.58	-1.73	-0.41	1.19	0.32	0.11	0.89	3.14	1.66	0.23	2.76	-1.85	-7.19
135	-3.79	-2.87	-1.46	1.02	1.6	0.39	0.4	2.94	1.86	1.2	1.59	-3.11	-6.87
150	-4.12	-4.49	-2.5	-0.75	1.25	1.2	1.18	3.03	0.81	1.11	0.05	-5.4	-6.3
165	-4.53	-5.1	-3.98	-3.26	-0.9	-1.19	-1.23	-1.68	-2.99	-3.79	-2.57	-7.03	-5.27
180	-4.34	-5.77	-5.98	-4.98	-4.31	-4.71	-4.36	-3.13	-4.42	-6.06	-3.87	-8.55	-5.54
195	-3.85	-5.76	-6.66	-4.74	-9.23	-7.04	-3.43	-3.8	-2.65	-3.82	-5.03	-9.89	-6.11
210	-3.97	-5.98	-6.4	-5.55	-10.98	-6.83	-6.08	-8.52	-4.7	-2.5	-6.44	-9.98	-6.17
225	-4.18	-5.82	-7.44	-9.12	-9.42	-8.14	-10.14	-14.66	-12.01	-4.19	-6.84	-9.51	-5.91
240	-4	-5.7	-9.78	-11.28	-12.24	-8.24	-8.31	-13.62	-16.32	-7.23	-6.38	-7.77	-6.36
255	-3.4	-5.12	-8.49	-11.15	-13.04	-11.16	-9.53	-9.15	-8.7	-13.54	-9.18	-7.65	-7.33
270	-3.28	-4.41	-7.47	-6.82	-12.68	-15.4	-9.75	-10.18	-9.84	-8.34	-16.64	-7.02	-7.89
285	-3.45	-4.18	-6.94	-6.6	-11.78	-14.44	-8.21	-10.35	-16.8	-12.62	-11.98	-6.9	-9.09
300	-3.73	-3.7	-5.98	-7.57	-7.76	-10.53	-10.43	-12.69	-12.27	-9.91	-8.71	-8.52	-9.51
315	-3.75	-3.09	-4.51	-7	-5.88	-10.23	-15.79	-13.39	-11.7	-6.18	-6.28	-11.57	-9.54
330	-3.6	-2.62	-3.85	-3.62	-6.42	-5.57	-7.3	-15.19	-7.12	-3.73	-4.95	-12.88	-9.74
345	-4.07	-2.89	-3.44	-2.1	-4.71	-5.67	-5.84	-7.45	-4.55	-0.9	-3.53	-9.95	-9.47
360	-3.68	-3.15	-2.98	-1.27	-3.87	-4.83	-2.92	-6.26	-3.44	-0.53	-1.9	-8.71	-9.48

3D Raw data: 5-1

5500 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-3.85	-2.68	-1.85	-0.5	-2.29	-4.7	-3.06	-9.17	-4.68	-0.98	-0.56	-7.65	-8.29
15	-3.23	-2.52	-1.41	-0.34	-1.78	-2.25	-2.79	-7.07	-3.56	0.23	-0.51	-6.31	-8.06
30	-3.33	-2.09	-1.14	-0.58	-0.51	-0.02	1.75	-1.64	1.97	2.6	0.4	-5.49	-8.32
45	-3.19	-2.03	-1	-0.96	1.45	-0.14	3.67	1.63	2	2.58	1.17	-4.3	-7.54
60	-3.15	-1.2	-0.86	-0.11	2.4	-0.59	2.52	1.3	3.38	0.67	0.54	-2.25	-7.28
75	-3.11	-1.12	0.12	0.11	2.1	2.66	-0.98	2.06	1.22	1.48	1.25	-0.7	-6.74
90	-3.22	-1.36	0.54	-0.89	1.13	2.87	-0.58	2.17	2.32	3.74	3.38	0.68	-6.77
105	-3.46	-2.75	-0.47	-0.46	-1.72	3.35	0.61	3.72	2.23	2.46	3.96	0.88	-6.6
120	-3.64	-3.96	-2.34	0.81	1.36	1.92	0.29	2.52	2.61	0.42	3.28	-0.39	-6.87
135	-3.46	-5.48	-4.12	1.04	2.47	1.75	1.16	2.45	2.94	1.42	1.49	-2.17	-6.8
150	-3.29	-6.85	-3.99	-0.64	0.5	1.29	2.82	3.03	1.17	1.3	-1.01	-4.16	-6.32
165	-3.46	-6.17	-4.28	-2.81	-2.06	-2.02	1.27	-1.9	-2.42	-2.3	-2.21	-5.77	-5.55
180	-3.31	-6.29	-4.82	-4.64	-4.63	-4.22	-2.56	-3.31	-7.44	-6.37	-2.13	-6.3	-5.25
195	-2.93	-6	-6.38	-6.84	-6.3	-8.32	-1.36	-2.54	-5.27	-8.47	-2.54	-6.35	-5.02
210	-3.23	-5.52	-6.58	-7.23	-10.37	-8.08	-1.87	-5.91	-5.17	-4.77	-3.83	-7.38	-4.7
225	-2.87	-3.86	-7.04	-8.02	-10.25	-10.29	-8.72	-11.59	-6.7	-3.94	-7	-8.23	-5.34
240	-2.86	-3.34	-8.55	-8.61	-10.77	-9.96	-9.91	-15.79	-15.55	-4.73	-6.79	-6.94	-6.07
255	-3.54	-3.48	-6.5	-7.41	-12.77	-12.55	-9.31	-13.55	-12.59	-8.63	-8.25	-5.89	-6.96
270	-3.16	-3.02	-3.69	-5.9	-11.11	-13.11	-10.07	-15.03	-9.47	-8.81	-11.06	-6.6	-8.26
285	-3.37	-2.84	-3.38	-5.48	-9.74	-14.09	-8.7	-14.56	-13.07	-13.18	-9.32	-8.44	-9.4
300	-3.58	-2.41	-4.03	-5.93	-9.29	-11.51	-9.35	-12.47	-15.01	-8.06	-8.38	-11.91	-10.39
315	-3.34	-2.19	-4.85	-5.48	-6.61	-7.88	-11.87	-7.92	-10.44	-6.39	-6.68	-15.8	-9.79
330	-3.74	-2.57	-4.56	-3.15	-5.86	-6.22	-6.75	-9.09	-5.22	-4.86	-5.54	-12.43	-9.68
345	-3.92	-2.47	-3.39	-0.92	-4.71	-6.4	-7.7	-5.7	-4.88	-2.4	-3.28	-10.05	-8.7
360	-3.37	-2.57	-2.29	-0.47	-2.66	-5.8	-3.21	-7.58	-4.65	-1.11	-0.89	-8.04	-8.26

3D Raw data: 5-1

5850 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180	
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	(dB)
0	-4.66	-2	-0.45	-0.43	-2.03	-3.7	-5.2	-5.11	-9.03	-1.48	-3.27	-7.91	-8.1	
15	-4.54	-0.68	0.2	0.82	-0.51	-1.54	-5.62	-3.58	-3.02	1.42	-2.58	-6.24	-7.78	
30	-4.08	-0.23	1.12	1.2	1.68	-0.14	-1.13	-0.57	1.68	4.12	0.02	-4.41	-8.71	
45	-3.9	0.28	1.09	2.26	2.11	0.16	1.91	-0.96	3.04	3.25	1.27	-2.73	-8.24	
60	-3.51	0.64	0.86	1.83	0.79	1.31	2.64	-0.1	3.03	1.57	1.17	-1.2	-8.47	
75	-3.96	-0.44	1.02	0.73	0.81	2.88	0.49	2.7	1	2.45	2.78	-0.06	-9.87	
90	-3.62	-2.46	0.08	0.04	-0.38	3.06	0.49	3.01	2.67	2.95	3.38	0.55	-9.89	
105	-3.5	-3.67	-1.89	1.07	-0.14	3.5	1.41	2.38	1.71	1.2	2.33	-0.14	-8.36	
120	-3.77	4.09	-2.06	-0.53	0.8	1.75	1.39	2.15	3.9	2.21	1.73	-0.94	-7.87	
135	-4.1	4.24	-2.47	-5.14	0.09	1.03	2.49	4.11	2.72	2.28	2.57	-2.09	-7.16	
150	-4.73	4.39	4.41	-5.82	-0.05	-2.26	0.8	2.55	-0.24	1.07	1.05	-2.78	-7.05	
165	-4.51	4.57	-6.15	-5.44	-1.23	-6.94	-3.47	-5.93	-1.58	-2.41	-1.41	4.29	-6.62	
180	-4.73	4.94	-7.17	-7.07	-1.67	-9.92	-7.11	-5.41	-6.93	-6.69	-1.77	-3.94	-7	
195	-4.59	-5	-7.2	-8.14	-3.07	-10.93	-6.68	-3.11	-10.77	-10.56	-2.1	-5.2	-6.3	
210	-4.56	-5.38	-6.83	-8.65	-5.22	-9.54	-7.03	-6.83	-8.9	-7.21	-3.73	-7.85	-5.66	
225	-4.3	-5.15	-6.03	-9.1	-8.89	-9.09	-8.42	-17.56	-10.93	-5.06	-5.26	-12.06	-5.5	
240	-4.04	-4.87	-6.36	-9.1	-10.11	-8.93	-8.69	-14.24	-16.51	4.52	-6.55	-10.09	-5.83	
255	-4.14	-4.82	-5.89	-10.01	-13.41	-16.07	-11.67	-11.3	-12.47	-8.54	-7.3	-5.69	-6.63	
270	-3.85	-4.53	-7.21	-9.63	-12.26	-14.09	-13.85	-12.82	-13.09	-10.64	-9.75	-5.07	-7.91	
285	-3.66	-4.06	-7.09	-10.56	-13.26	-15.36	-13.01	-17.01	-17.16	-17.76	-10.58	-9.43	-8.31	
300	-3.67	-3.97	-6.76	-7.49	-12.12	-15.97	-12	-10.86	-9.43	-7.73	-10.3	-17.39	-9.97	
315	-4.07	-3.49	-6.11	-6.11	-7.91	-9.03	-9.47	-8.42	-8.62	-5.94	-7.07	-17.92	-8.61	
330	-3.84	-3	-4.89	-4.09	-5.39	-5.7	-8.05	-9.83	-6.31	-3.19	-6.2	-10.85	-7.91	
345	-3.85	-2.7	-2.8	-2.37	-4.44	-6.23	-7.84	-5.59	-6.09	-2.03	-4.44	-10.46	-7.57	
360	-3.65	-1.91	-0.76	-0.83	-3.42	-4.5	-5.74	-5.3	-8.58	-1.64	-3.91	-8.17	-7.91	

3D Raw data: 5-2

5150 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-2.14	-2.24	-4.54	-5.43	-1.06	-2.29	-4.17	-3.13	-4.7	-4.77	-9.18	-4.79	-10.35
15	-2.63	-1.47	-4.06	-2.93	-1.72	0.05	-3.18	-0.13	-4.99	-8.92	-9.87	-4.15	-9.65
30	-2.42	-0.34	-1.89	-2.44	-1.47	3.22	-0.87	-0.64	-2.01	-5.79	-6.42	-3.81	-9.69
45	-2.22	0.79	0.53	-5.8	-2.75	-1.27	-3.86	-4.22	-0.23	-2.74	-3.12	-3.55	-8.94
60	-2.23	1.32	3.07	-2.62	-0.57	1.23	-0.68	0.34	0.38	-1.68	-1.61	-2.63	-7.98
75	-1.86	0.86	4.58	2.39	0.82	1.07	1.16	-1.14	-1.03	-2.16	-1.16	-1.7	-7.58
90	-1.99	-0.12	4.46	1.47	-1.66	1.05	-1.91	0.34	0.63	-0.28	-2.79	-1.62	-7.11
105	-2.37	-0.52	2.07	0.35	0.54	3.4	0.75	-0.58	1.41	-0.22	-1.69	-3.65	-6.92
120	-2.2	-0.91	1.87	3.15	2.31	3.45	-3.53	-0.63	-1.85	-0.62	-0.81	-6.41	-6.5
135	-2.51	-0.21	3.54	3.41	3.45	5.94	2.51	-0.22	0.88	-0.69	-0.8	-7.15	-5.96
150	-2.88	0.34	4.07	3.23	6.56	5.6	5.07	2.01	2.38	-0.62	-3.15	-6.06	-6.03
165	-3.24	0.07	3.01	0.94	4.79	1.72	3.37	-4.85	-1.73	-2.66	-5.86	-4.58	-6.39
180	-3.25	-0.84	1.21	-1.32	0.88	-1.35	-0.54	-2.89	-5.59	-6.67	-5.7	-3.87	-7.62
195	-3.32	-2.21	-2.18	-5.19	-0.19	-3.56	-3.85	-1.87	-5.29	-9.93	-4.08	-3.24	-7.19
210	-3.17	-3.82	-5.66	-7.81	-2.11	-10.39	-3.67	-5.66	-4.62	-10.86	-4.48	-3.11	-8.25
225	-2.35	-5.68	-5.27	-7.02	-5.13	-7.98	-8.86	-7.26	-8.1	-11.07	-4.57	-3.94	-8.56
240	-2.19	-6.64	-5.4	-13.54	-6.71	-8.78	-10.39	-11.04	-8.14	-12.14	-4.64	-5.72	-7.11
255	-2.15	-6.24	-6.56	-7.16	-9.3	-13.7	-13.37	-12.72	-8.62	-10.31	-7.14	-10.38	-7.2
270	-2.28	-5.45	-8.26	-7.77	-6.64	-12.93	-15.01	-9.79	-12.48	-8.46	-13.18	-11.36	-6.01
285	-2.42	-5	-9.79	4.76	-9.2	-12.68	-10.03	-10.89	-9.24	-11.87	-14.28	-8.1	-6.21
300	-1.9	-5.11	-9.53	-7.41	-10.51	-9.55	-11.53	-7.04	-7.47	-7.67	-8.7	-7.49	-6.25
315	-2.65	4.34	-9.77	-5.81	-8.92	-6.38	-12.61	-11.67	-10.3	-7.74	-8.95	-8.16	-8.37
330	-2.38	-3.88	-8.19	-7.1	-6.25	-3.75	-11.38	-6.49	-5.45	4.08	-10.95	-7.11	-8.62
345	-2.92	-3.5	-5.02	-9.53	-2.16	-3.39	-5.93	4.09	-2.66	-2.12	-11.28	-6.14	-9.73
360	-3.03	-2.6	-4.78	-5.9	-1.15	-2.73	-4.71	-3.9	-3.93	-3.5	-10.01	-5.2	-10.57

3D Raw data: 5-2

5350 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180	
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	(dB)
0	-0.77	-1.42	-4.23	-5.13	-2.24	-2.75	-5.32	-3.28	-5.47	-8.6	-7.46	-2.7	-7.83	
15	-0.91	-0.82	-3.37	-3.22	-2.28	0.34	-3.45	-0.88	-6.36	-10.03	-6.69	-2.77	-7.68	
30	-0.77	-0.01	-2.66	-1.23	-0.02	3.65	0.96	0.82	-4.82	-5.34	-5.55	-2.26	-7.53	
45	-0.64	1.16	-1.76	-1.61	-1.67	0.59	0.51	-1.5	-2.59	-2.17	-3.02	-1.64	-7.72	
60	-0.55	2.19	0.97	-3.79	-0.08	-0.19	-1.75	-0.17	0.06	-1.3	0.34	-0.2	-6.69	
75	-0.88	2.83	3.53	1.12	1.84	1.79	0.95	0.05	-0.71	4.31	2.18	1.27	-6.15	
90	-1.01	2.78	4.66	1.98	1.74	1.66	0.23	0.69	-0.81	-0.78	1.58	1.34	-5.12	
105	-1.21	2.33	3.79	0.63	0.79	3.67	0.73	0.76	1.72	1.16	1.17	0.36	-4.99	
120	-1.14	0.85	2.82	2.4	1.89	3.36	-1.06	-0.34	-2.05	-0.61	2.17	-3.31	-4.35	
135	-0.96	-0.76	3.02	2.45	3.95	6.3	0.77	0.24	0.57	-1.08	2.19	-8.08	-3.75	
150	-0.79	-3.02	2.1	1.98	6.96	5.62	4.86	1.15	3.69	-0.15	0	-7.63	-4.04	
165	-0.78	4.29	0.27	-0.95	5.37	0.56	3.94	-5.46	0.57	-1.82	-2.75	4.13	-4.45	
180	-0.77	-5.55	-1.61	-3.76	2.01	-2.24	0.26	4.67	-2.66	-5.53	4.66	-2.33	-4.84	
195	-1.08	-6.46	-4.24	-6.11	0.61	-3.79	-3.74	-3.63	-3.5	-8.33	4.35	-1.63	-5.22	
210	-1.26	-7.8	-7.53	-8.98	-0.96	-8.42	-4.31	-5.27	-4.44	-11.89	4.96	-1.57	-6.21	
225	-1.33	-8.46	-9.34	-7.77	-5.41	-11.38	-8.31	-5.76	-8.22	-8.42	-5.36	-2.52	-6.4	
240	-1.18	-7.5	-7.84	-14.96	-8.75	-10.45	-6.66	-9.97	-9.93	-7.47	-3.64	4	-6.23	
255	-1.19	-5.87	-8.64	-7.61	-10.45	-11.54	-16.07	-23.24	-10.96	-9	-5.73	-7.56	-5.42	
270	-1.02	4.04	-8.8	-12.92	-8.96	-11.53	-13.51	-11.96	-9.18	-10.31	-12.25	-9.48	-4.46	
285	-0.76	-3.31	-8.19	-8.32	-8.36	-13.29	-11.71	-8.1	-12.71	-10	-12.34	-5.5	-3.94	
300	-0.97	-3.14	-8.35	-8.85	-14.13	-8.2	-14.31	-9.19	-11.52	-9.18	-13.11	-5.36	-4.45	
315	-1.01	-3	-10.95	-7.84	-7.79	-7.83	-15.8	-12.25	-10.15	-5.09	-15.4	-4.9	-5.24	
330	-0.93	-2.8	-7.19	-9.59	-5.28	-5.79	-11.61	-8.54	-5.45	-3.69	-15.67	-3.59	-5.66	
345	-1.14	-2.31	-5.05	-6.61	-3.08	4.76	-6.66	-7.14	-5.01	4.71	-9.21	-3.02	-6.79	
360	-0.94	-1.66	-4.49	-5.68	-2.18	-3.2	-5.27	-3.84	-6.17	-7.52	-7.83	-2.83	-7.77	

3D Raw data: 5-2

5500 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-1.04	-3.98	-2.72	-4.77	-2.41	-3.5	-10.29	-6.18	-3.57	-6.63	-2.9	-1.75	-7.97
15	-0.95	-3.11	-1.8	-2.68	-1.47	-1.13	-6.65	-2.92	-5.19	-7.6	-1.89	-2.15	-7.98
30	-0.96	-1.46	-2.28	-0.5	-0.05	3.8	-0.32	0.33	-2.41	-2.02	-0.91	-2.58	-7.72
45	-0.67	-0.12	-1.63	0.64	-1.19	2.48	1.18	-0.38	-1.67	0.53	0.13	-1.91	-8.33
60	-0.72	1.39	0.11	-0.8	-1.82	-2.33	-1.43	-1.73	-0.38	0.17	1.77	0.17	-7.9
75	-0.54	2.44	2.35	1.28	1.85	0.22	0.15	0.21	-1.02	-2.37	3.35	1.65	-6.72
90	-0.62	2.61	3.52	2.62	2.52	-0.06	-0.2	-0.2	-2.71	-0.35	3.37	2.37	-6.05
105	-0.92	2.21	2.62	0.76	1.89	2.45	0.69	1.5	1.23	2.36	2.15	1.37	-5.71
120	-1.16	1.23	0.74	1.59	2.99	2.5	-0.04	0.4	-2.08	2.12	2.82	-1.94	-4.52
135	-1.45	0.34	1.71	1.88	3.09	5.28	0.96	0.66	-1.2	1.04	2.96	-6.59	-4.2
150	-1.69	-0.72	1.85	1.7	6.49	6.06	4.62	1.28	3	-0.2	1.6	-7.86	-4.05
165	-1.48	-1.9	0.3	-0.7	5.09	1.43	3.97	4.54	0.46	-1.46	-1.28	-4.85	-4.82
180	-1.04	-3.4	-1.02	-3.05	1.53	-2.88	0.54	4.86	-1.83	4.96	-2.74	-3.37	-4.89
195	-1.02	-5.09	-3.32	-5.54	-0.54	-3.62	-2.53	-3.83	-2.3	-6.99	-2.16	-2.33	-5.68
210	-0.94	-6.23	-5.79	-7.04	-1.29	-5.88	-4.06	-5.98	-2.43	-9.17	-3.57	-2.61	-6.31
225	-0.87	-7.49	-9.19	-7.33	-4.14	-10.99	-10.54	-8.32	-8.74	-7.58	-5.37	-3.09	-6.75
240	-0.76	-6.83	-9.48	-12.28	-5.25	-14.77	-7.92	-12.92	-10.54	-5.83	-4.45	-3.81	-6.6
255	-0.71	-5.7	-8.78	-10.28	-10.19	-11.29	-11.05	-15.59	-9.11	-8.06	-7.08	-6.17	-5.74
270	-0.71	-5.45	-8.51	-11.79	-14.7	-9.03	-11.15	-13.8	-9.86	-10.6	-10.45	-7.82	-5.18
285	-1.14	-5.18	-9.47	-6.53	-9.22	-11.62	-13.44	-7.45	-21.06	-10.26	-12.3	-5.38	-4.73
300	-1.42	4.02	-9.17	-8.57	-11.62	-10.2	-11.93	-8.04	-12.85	-7.55	-14.25	-4.25	-4.88
315	-1.63	-3.23	-10.06	-7.13	-6.8	-9.84	-12.1	-10.85	-9.15	-3.38	-13.35	-2.47	-5.48
330	-1.2	4.05	-5.94	-8.37	-5.36	-6.84	-9.89	-7.61	-5.85	-3.5	-8.28	-1.02	-5.71
345	-1.24	-3.76	-5.28	-6.65	-3.49	-3.91	-7.51	-4.64	-4.33	-5.37	-4.53	-1.06	-6.48
360	-1.22	-3.87	-2.75	-4.84	-1.97	-3.81	-8.89	-5.16	-3.52	-6.44	-3.13	-1.58	-7.45

3D Raw data: 5-2

5850 Theta Ang	0	15	30	45	60	75	90	105	120	135	150	165	180
Phi Angle	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response	Response (dB)
0	-2.28	-2.13	-3.72	-4.65	-7.47	-7.33	-6.31	-2.46	-5.58	-4.25	-1.54	-5.53	-10.47
15	-1.86	-0.88	-3.45	-2.75	-6.72	-5.17	-6.03	-2.62	-3.8	-4.66	-1.75	-5.57	-9.39
30	-1.75	0.35	-0.92	-0.13	-3.01	0.5	-2.1	-0.53	1.57	-1.02	-0.68	-5.13	-10.94
45	-1.44	1.44	0.93	0.93	-1.26	1.43	-0.4	-0.04	-0.74	0.28	1.26	-4.68	-12.3
60	-1.45	2.18	1.89	1.07	-0.24	-1.38	-0.38	-2.43	-3.28	0.29	2.51	-2.48	-12.66
75	-1.73	2.35	3.22	1.91	1.77	-0.65	-0.21	-1.3	-1.35	-0.44	2.85	-0.72	-12.26
90	-1.69	2.09	4.02	3.84	2.8	-0.36	2.84	-0.87	-2.4	0.48	2.5	0.33	-10.03
105	-1.6	1.58	3.59	3.45	1.89	2.77	2.62	-0.89	-0.48	0.89	2.18	1.06	-9.01
120	-1.8	0.81	2.01	3.34	3.6	0	3.29	0.93	-0.78	1.26	1.92	-0.89	-8.93
135	-2.29	-0.59	1.05	4.02	4.34	5.56	1.46	3.84	-1.55	2.73	0.88	-5.5	-8.77
150	-2.43	-2.05	1.05	3.85	6.47	5.96	2.86	1.36	1.5	0.73	-0.57	-10.94	-8.85
165	-2.4	-3.36	-0.82	-0.4	3.34	3.05	1.64	-2.06	-1.15	-0.99	-2.92	-9.76	-8.95
180	-1.98	-5.98	-2.81	-4	-0.68	-3.95	-0.7	-8.83	-3.57	-2.36	-4.99	-7	-10.23
195	-1.86	-7.93	-4.25	-5.01	-3.25	-6.32	-3.01	-3.32	-2.9	-4.24	-4.49	-5.64	-10.67
210	-1.53	-10.23	-6.11	-7.9	-4.96	-6.43	-4.8	-9.89	-3.17	-5.78	-5.04	-4.88	-10.48
225	-1.79	-11.41	-8.27	-8.57	-9.63	-12.84	-10.6	-8.35	-8.84	-7.58	-8.26	-4.53	-9.97
240	-1.64	-10.07	-11.43	-11.88	-7.26	-15.89	-11.38	-14.03	-12.97	-7.26	-10.5	-5.21	-9.05
255	-1.67	-8.7	-10.04	-10.48	-11.25	-10.39	-9.27	-16.45	-12.39	-5.84	-11.83	-7.26	-8.44
270	-2.37	-7.97	-7.07	-8.53	-10	-9.98	-11.67	-10.48	-13.41	-6.58	-10.68	-11.8	-8.71
285	-2.35	-6.1	-5.99	-9.55	-8.47	-11.13	-9.39	-6.55	-9.59	-6.82	-9.07	-9.05	-9.47
300	-1.84	-6.13	-5.94	-10.21	-12.39	-12.64	-12.7	-8.98	-11.08	-6.65	-7.74	-5.69	-8.97
315	-2.36	-5.59	-4.75	-9.6	-12.08	-12.5	-8.62	-9.67	-9.32	-3.8	-7.6	-4.15	-8.2
330	-2.17	-4.8	-5.07	-9.6	-8.72	-7.14	-9.36	-5.76	-4.09	-1.98	-4.28	-4.87	-7.5
345	-2.23	-3.49	-4.83	-5.43	-7.46	-3.91	-9.07	-2.43	-2.57	-1.49	-2.11	-5.75	-7.68
360	-2.05	-2.46	-3.93	-4.37	-7.6	-5.97	-6.61	-2.45	-3.95	-2.85	-1.52	-5.51	-9.49



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