



# Antenna Composite Gain Test Report

FCC ID	O6ZHS17R2
Equipment	Digital Satellite Receiver(Headless DVR Server)
Brand Name	DIRECTV
Model Name	HS17-500
Applicant	HUMAX Co., Ltd. HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu , Yongin-si, Gyeonggi-do, South Korea 17040
Manufacturer	HUMAX Co., Ltd. HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu , Yongin-si, Gyeonggi-do, South Korea 17040
Standard	KDB662911 D03 v01
Sample Received	Jan. 16, 2024
Start Test Date	Jan. 18, 2024
Final Test Date	Jan. 18, 2024

Approved by: **Sam Chen**

**Sporton International Inc. Hsinchu Laboratory**

No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)



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### 1. Operation Mode and Antenna Information

Antenna Position	RF Port	Brand Name	Model Name	Ant. Type	Connector	Modes of Operation
5G Ant 1	2	Airgain	N5X35B2YN-E57U	PIFA	U.FL	5GHz UNII 1~3
5G Ant 2	1	Airgain	N5X35B2YN-R137U	PIFA	U.FL	5GHz UNII 1~3
5G Ant 3	3	Airgain	N5X35B2YW-G80U	PIFA	U.FL	5GHz UNII 1~3
5G Ant 4	4	Airgain	N5X35BYN-A100U	PIFA	U.FL	5GHz UNII 1~3

Note:

5GHz Operation Mode (4TX/4RX)

5G Ant 1~4 can be used as transmitting/receiving antenna.

5G Ant 1~4 could transmit/receive simultaneously.



## 2. Test Frequency

The listed frequency of each bands are selected to represent each frequency bands

Band [MHz]	Test Frequency [MHz]
5150-5250	5200
5250-5350	5300
5470-5725	5600
5725-5850	5785

## 3. Testing Location

Testing Location		
Sporton International Inc. Hsinhua Laboratory		
<input checked="" type="checkbox"/>	HWA YA	ADD : No.13-1 & 14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333, Taiwan R.O.C.

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
Radiated	05CH03-HY	Rofy Chen	23.5-24.5 / 45-55	Jan. 18, 2024

Note:

Testing Site Information

Brand Name: TDK

Dimension: 11m\*6m\*6m

Characteristic: Fully Anechoic Chamber

#### 4. Test Facility and Configuration

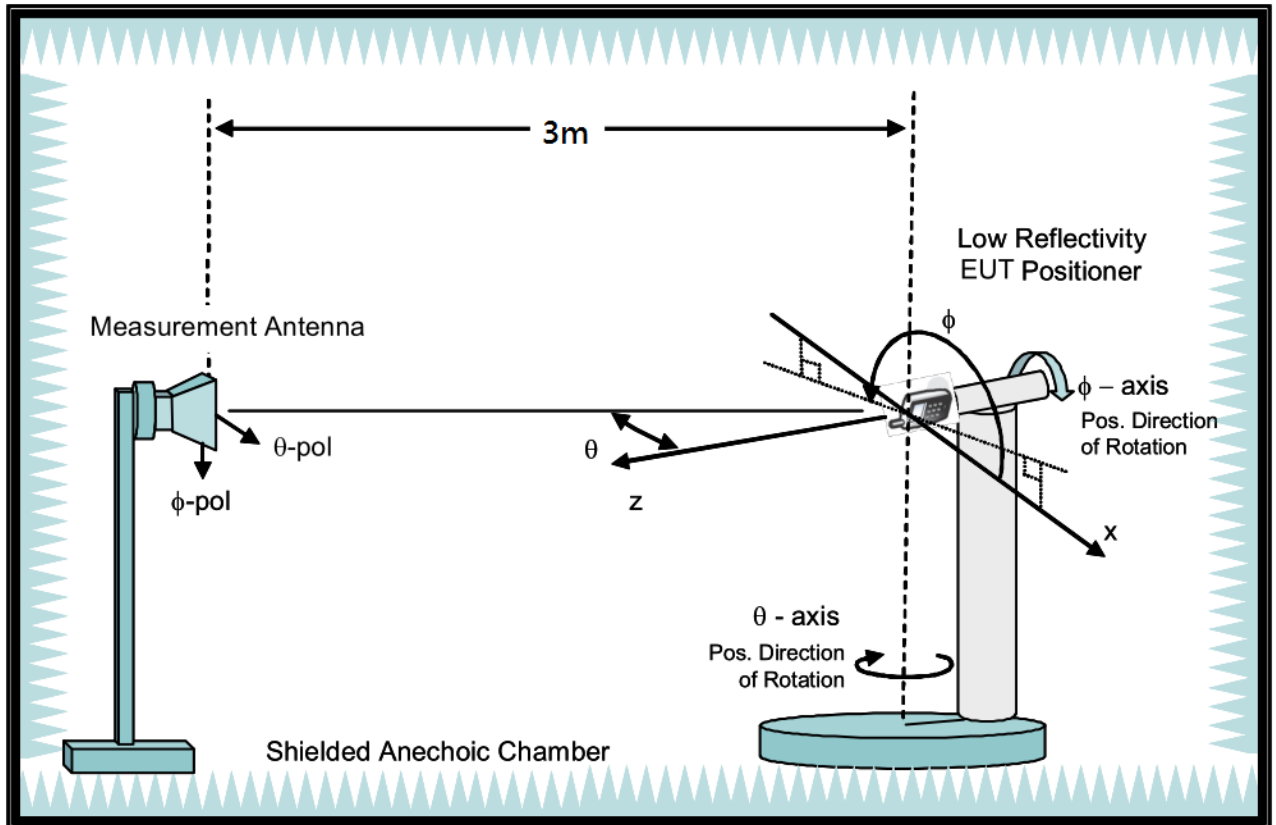
Test configuration: Reference to CITA OTA distributed-axes system configuration.

Chamber: Fully Anechoic Chamber.

Measurement antenna: Dual Polarization Horn antenna

Turntable: Multi-axis positioner (Theta and Phi angle).

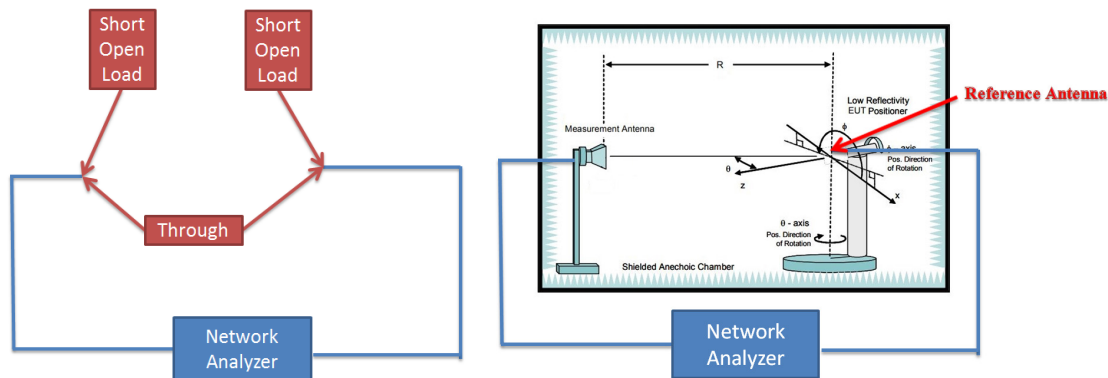
#Reference to CTIA "ctia-test-plan-for-wireless-device-over-the-air-performance-ver-3-7-1"



### 5. Reference Calibration

Connected cables to VNA calibration kit and use network analyzer internal function to do calibration. Do short, open and load to each side. Then connect through to both side and calibrate G values. The cable loss is calibrated and set inside the network analyzer.

Measurement Antenna is connected to port1 of Network analyzer and reference antenna connected to port 2 of Network Analyzer. Record G values and used with reference antenna gain to calculate gain factor.



Frequency (MHz)	2400	2450	2500	5150	5200	5300	5600	5750	5800	5900	6000	6500	7000	7200
G(theta) reading (dB)	-33.75	-33.64	-32.91	-32.21	-32.45	-32.33	-32.57	-32.94	-32.78	-33.35	-32.91	-33.81	-34.54	-35.64
G(phi) reading (dB)	-33.19	-32.12	-32.48	-32.51	-32.64	-31.68	-32.24	-32.45	-32.45	-32.85	-32.45	-33.62	-34.48	-35.24
Reference gain (dBi)	10	10.4	10.6	12.3	12.5	13.3	13.3	13.2	13.1	13	13.2	12.4	11.8	11.1
Factor(theta) (dB)	43.75	44.04	43.51	44.51	44.95	45.63	45.87	46.14	45.88	46.35	46.11	46.21	46.34	46.74
Factor(phi) (dB)	43.19	42.52	43.08	44.81	45.14	44.98	45.54	45.65	45.55	45.85	45.65	46.02	46.28	46.34

Note:

$$G \text{ reading (dB)} = 20 \cdot \log(V2/V1) = 10 \cdot \log(P2/P1)$$

V2 is the voltage of VNA port2 is measured, V1 is the voltage of VNA port1 is the reference source.

P2 is the power of VNA port2 is measured, P1 is the power of VNA port1 is the reference source.

$$\text{Factor} = \text{gain factor} + \text{power gain conversion} = (\text{Reference antenna gain}) - (G \text{ reading})$$

## 6. Test Method

EUT set on multi-axis positioner and adjust EUT's physical center to measurement reference center. Measurement antenna set at phi polarization and 1.5 meter height. Port 1 of Network analyzer connect to antenna 1 of EUT. Record G value every 7.5 degree from 0 to 352.5 degree on Phi angle and 0 to 180 on theta angle of multi-axis positioner. Then set measurement antenna to theta polarization and repeat process. Repeat process to each antenna of EUT.

DG steps:

1. Each Phi and Theta polarization antenna gain are measured for all test angles.
2. Composite Phi and Theta antenna gain are computed, using formula in KDB662911 D01 d) (i) and e) (ii), for all angles.
3. Composite antenna gain are examined for all angles to determine max gain and Phi/Theta position. Max gain and phi/theta position are listed in section 7 tables.

Note: Antenna gain = G reading + factor, The factor of chapter five includes reference antenna gain factor and power gain conversion.



## 7. Measured Values and Calculation of Maximum Gain Positions

### DG\_1SS max value position

Frequency (Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 (dBi)	-1.12	-1.55	-2.28	0.07
Ant. 2 (dBi)	1.44	-0.19	0.05	0.12
Ant. 3 (dBi)	-2.12	-0.28	4.42	4.59
Ant. 4 (dBi))	-1.55	-2.88	-4.62	-12.94
DG [1SS] (dBi)	5.29	4.86	6.08	5.9
Polarization	Theta	Theta	Theta	Theta
$\Theta(^{\circ})$	67.5	67.5	105	105
$\Phi(^{\circ})$	330	337.5	292.5	285

Note: The DG 1SS max value position is the maximum value of section 11 table DG 1SS Result.

### DG\_1SS max value position calculation

Frequency (Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 [ $10^{(G/20)}$ ]	$10^{(-1.12/20)}$	$10^{(-1.55/20)}$	$10^{(-2.28/20)}$	$10^{(0.07/20)}$
Ant. 2 [ $10^{(G/20)}$ ]	$10^{(1.44/20)}$	$10^{(-0.19/20)}$	$10^{(0.05/20)}$	$10^{(0.12/20)}$
Ant. 3 [ $10^{(G/20)}$ ]	$10^{(-2.12/20)}$	$10^{(-0.28/20)}$	$10^{(4.42/20)}$	$10^{(4.59/20)}$
Ant. 4 [ $10^{(G/20)}$ ]	$10^{(-1.55/20)}$	$10^{(-2.88/20)}$	$10^{(-4.62/20)}$	$10^{(-12.94/20)}$
Ant. 1 [ $10^{(G/20)}$ ] value	0.879	0.837	0.769	1.008
Ant. 2 [ $10^{(G/20)}$ ] value	1.18	0.978	1.006	1.014
Ant. 3 [ $10^{(G/20)}$ ] value	0.783	0.968	1.663	1.696
Ant. 4 [ $10^{(G/20)}$ ] value	0.837	0.718	0.587	0.225
Sum All Antenna [Amax]	3.679	3.501	4.026	3.944
DG [ $10 \cdot \log(A_{max}^2/N_{ant})$ ]	5.29	4.86	6.08	5.9

Note:

Directional Gain (1SS) is the max value of every look angle. Each position value is calculated by KDB662911 D01 d) (i).

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

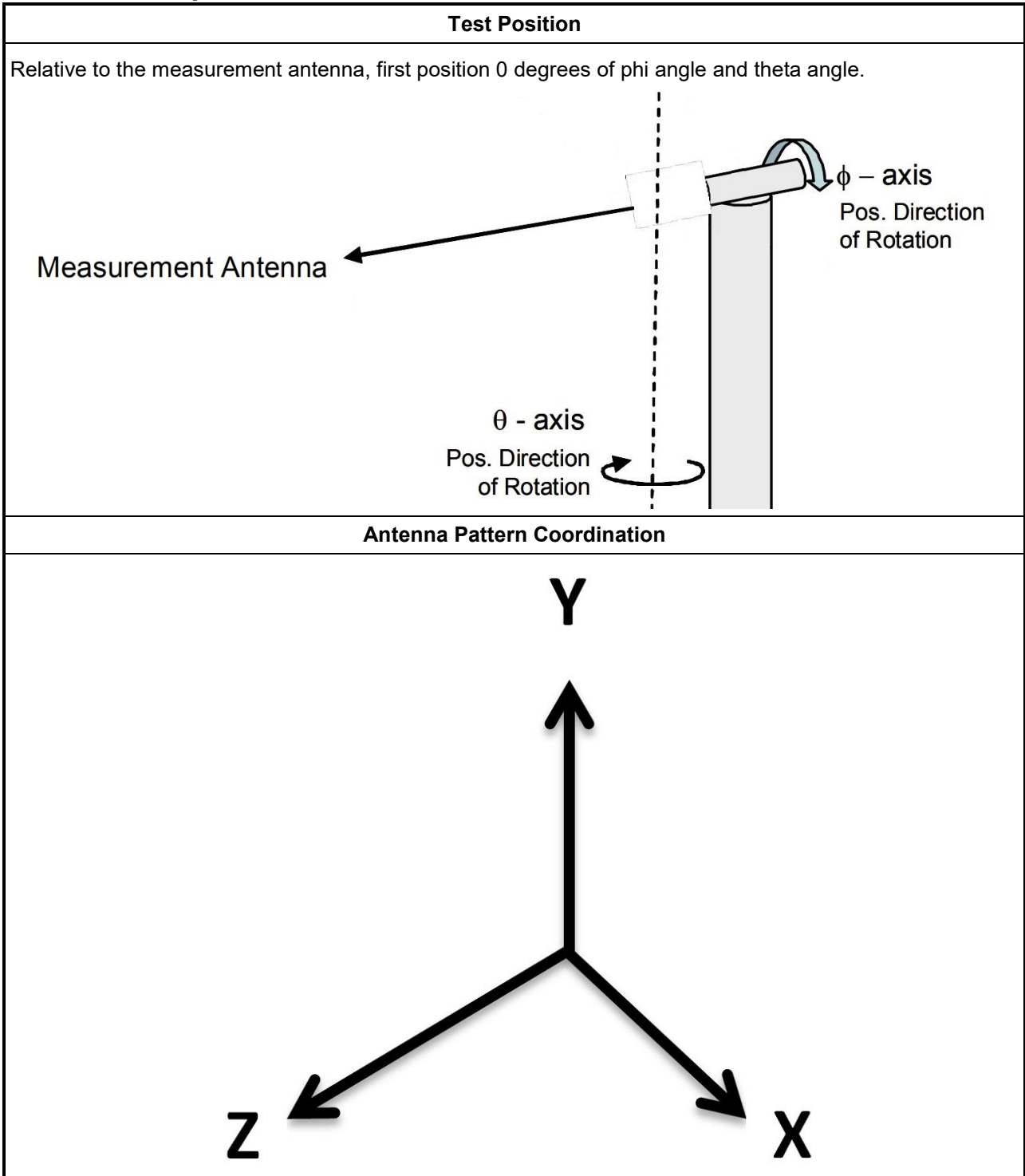
## 8. Summary of Test Result

Freq(Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 Max Gain (dBi)	2.46	2.59	3.58	3.38
Ant. 2 Max Gain (dBi)	2.93	3.23	4.55	3.68
Ant. 3 Max Gain (dBi)	3.5	3.28	4.42	4.59
Ant. 4 Max Gain (dBi)	4.57	4.23	5.18	5.06
Ant. 1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/52.5/277.5	Theta/60/262.5	Theta/45/255	Theta/37.5/255
Ant. 2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/82.5/300	Theta/127.5/0	Theta/82.5/322.5	Theta/127.5/15
Ant. 3 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/105/277.5	Theta/112.5/285	Theta/105/292.5	Theta/105/285
Ant. 4 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Phi/45/82.5	Phi/82.5/135	Phi/90/135	Phi/90/232.5
Max Gain (dBi)	4.57	4.23	5.18	5.06
DG [1SS] (dBi)	5.29	4.86	6.08	5.9
DG [2SS] (dBi)	4.57	4.23	5.18	5.06
DG [4SS] (dBi)	4.57	4.23	5.18	5.06

Note:

1. Antenna max gain is the max value of each individual antenna through all measurement angles.
2. The max gain is the max value of all antennas.
3. Directional Gain (2SS) = Directional Gain (1SS) – 3dB. If directional gain is less than max gain, use max gain as directional gain. Refer to KDB662911D01 (F) (2) (e) (ii)
4. Directional Gain (4SS) = Directional Gain (1SS) – 6dB. If directional gain is less than max gain, use max gain as directional gain. Refer to KDB662911D01 (F) (2) (e) (ii)

### 9. Test Setup



Note:

Photos of Test Position: Please refer to the test photos in the appendix.



### 10. Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date
Horn Antenna	SCHWARZBECK	BBHA9120D	BBHA 9120D-1543	1GHz~18GHz	May 11, 2023	May 10, 2024
Dual Polarization Horn Antenna	Sporton	S0209DP	S0209DP-001	2GHz~9GHz	N.C.R.	N.C.R.
ENA Series Network Analyzer	AGILENT	E5071C	MY46419477	100kHz~8.5GHz	Jul. 28, 2023	Jul. 27, 2024
VNA Calibration Kit	TS RF	TS85033E-F	-	DC~9GHz	N.C.R.	N.C.R.
Multi-axis positioner	Sporton	MAPS01	MAPS01-001	Theta / Phi axis	N.C.R.	N.C.R.
Test Software	SPORTON	SENSE-RDG	V1.0.8	-	N.C.R.	N.C.R.

Note: Calibration Interval of instruments listed above is one year.

NCR means Non-Calibration required.



## **11. Test Results**

Please refer to the appendix.

Appendix A – Radiated Composite Gain of 5GHz.....Page 14  
Appendix B – Antenna Pattern of 5GHz.....Page 25  
Appendix C – Test Photos..... Page 31



Freq(Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 Max Gain (dBi)	2.46	2.59	3.58	3.38
Ant. 2 Max Gain (dBi)	2.93	3.23	4.55	3.68
Ant. 3 Max Gain (dBi)	3.5	3.28	4.42	4.59
Ant. 4 Max Gain (dBi)	4.57	4.23	5.18	5.06
Ant. 1 Polarization/ $\theta$ (°)/ $\Phi$ (°)	Theta/52.5/277.5	Theta/60/262.5	Theta/45/255	Theta/37.5/255
Ant. 2 Polarization/ $\theta$ (°)/ $\Phi$ (°)	Theta/82.5/300	Theta/127.5/0	Theta/82.5/322.5	Theta/127.5/15
Ant. 3 Polarization/ $\theta$ (°)/ $\Phi$ (°)	Theta/105/277.5	Theta/112.5/285	Theta/105/292.5	Theta/105/285
Ant. 4 Polarization/ $\theta$ (°)/ $\Phi$ (°)	Phi/45/82.5	Phi/82.5/135	Phi/90/135	Phi/90/232.5
Max Gain (dBi)	4.57	4.23	5.18	5.06
DG [1SS] (dBi)	5.29	4.86	6.08	5.9
DG [2SS] (dBi)	4.57	4.23	5.18	5.06
DG [4SS] (dBi)	4.57	4.23	5.18	5.06



# Radiated Composite Gain Data

# Appendix A

## DG 1SS Result

Freq(Hz)	5.2GPol	Phi	Phi(15°)	Phi(30°)	Phi(45°)	Phi(60°)	Phi(75°)	Phi(90°)	Phi(105°)	Phi(120°)	Phi(135°)	Phi(150°)	Phi(165°)	Phi(180°)	Phi(195°)	Phi(210°)	Phi(225°)	Phi(240°)	Phi(255°)	Phi(270°)	Phi(285°)	Phi(300°)	Phi(315°)	Phi(330°)	Phi(345°)
DG(dB)	Phi(7.5°)	Phi(15°)	Phi(30°)	Phi(45°)	Phi(60°)	Phi(75°)	Phi(90°)	Phi(105°)	Phi(120°)	Phi(135°)	Phi(150°)	Phi(165°)	Phi(180°)	Phi(195°)	Phi(210°)	Phi(225°)	Phi(240°)	Phi(255°)	Phi(270°)	Phi(285°)	Phi(300°)	Phi(315°)	Phi(330°)	Phi(345°)	
Theta(°)	0.0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	
Theta(7.5°)	1.06/69	0.62/39	-0.22/0.91	-1.55/2.02	2.39/2.8	-3.59/4.35	-4.38/4.24	-3.53/3.22	-2.54/2.11	-1.75/1.38	-1.02/0.88	-0.92/0.43	0.28/0.85	1.32/1.37	1.35/1.21	1.10/75	0.08/0.68	-1.42/2.17	-2.63/3.21	-3.33/3	-2.92/2.22	-1.39/0.66	0.01/0.88	1.31/21	
Theta(15°)	1.11/0.05	-0.69/1.3	-1.93/3.27	-3.03/2.92	-2.21/1.37	-1.12/1.44	-1.93/2.68	-2.83/2.75	-2.79/2.2	-1.67/1.55	-1.3/1.49	-2.11/2.12	-1.23/0.15	1.12/1.78	2.32/4.7	2.41/36	0.78/26	-0.26/0.53	-0.99/1.84	-2.18/2.09	-1.6/0.79	-0.24/0.23	0.57/1.3	1.87/1.89	
Theta(22.5°)	1.23/0.18	-1.42/2.41	-3.29/3.33	-3.27/2.99	-2.03/1.22	-0.32/0.34	-1.54/3.32	-2.34/0.74	-0.3/0.32	-0.69/1.14	-1.91/3.02	-2.28/0.52	0.69/1.8	1.03/0.7	0.90/0.8	0.90/0.8	0.90/0.8	-0.9/2.5	-2.71/2.79	-2.71/3.19	-3.19/2.11	-1.25/0.01	1.13/1.97	2.23/1.98	
Theta(30°)	-3.17/2.59	-2.82/2.92	-3.12/2.55	-2.33/2.79	-2.58/2.58	-2.57/2.62	-2.79/3.28	-4.57/4.41	-3.48/1.81	-0.25/0.32	0.04/0.86	-2.18/3.45	-2.33/0.83	0.14/0.5	0.47/0.02	-0.19/0.37	0.41/0.26	0.16/0.69	0.58/0.3	-1.48/2.12	-2.16/2.27	-2.88/2.69	-3.18/3.34	-2.98/2.84	
Theta(37.5°)	-1.51/0.76	-0.4/0.85	-1.38/2.62	-3.25/3.57	-3.18/3.19	-1.91/0.58	0.52/0.1	-2.38/5.56	-4.91/2.42	-1.09/0.56	-0.37/0.37	-0.67/1.66	-2.08/0.67	-0.02/0.01	-1.15/0.94	0.07/0.97	1.39/1.33	1.46/1	0.69/1.02	1.08/0.71	0.78/0.41	-0.27/0.54	-0.86/1.45	-2.61/2.58	
Theta(45°)	-2.99/2.35	-1.56/1.88	-3.79/3.87	-2.73/1.59	-0.43/0.56	2.23/3.06	2.43/1.78	1.37/0.21	-2.43/4.57	-3.7/2.68	-2.48/4.44	1.59/0.84	-2.64/2.98	-1.84/1.94	-1.95/1.55	0.31/1.03	0.65/1.21	1.18/1.44	0.91/0.66	-0.67/0.87	1.71/34	0.71/0.52	-2.29/3.63	-3.52/3.65	
Theta(52.5°)	-1.93/0.32	-0.71/1.11	-2.14/3.87	-2.56/0.27	0.75/1.08	0.77/0.05	0.71/0.62	1.97/1.03	-0.42/0.84	-1.62/1.25	-1.43/0.02	1.72/0.65	-1.69/3.24	-2.52/2.67	-3.38/3.2	-2.55/2.33	-0.97/0.02	0.72/0.29	-1.03/1.23	-1.2/1.27	-1.59/1.08	-0.43/0.14	1.26/1.15	-1.24/2.72	
Theta(60°)	-2.65/1.76	-2.37/2.22	-1.16/1.02	-1.51/2.02	-2.84/2.21	-1.82/1.83	-0.78/0.58	0.49/0.58	-0.6/1.87	-1.41/1.33	0.83/0.4	-2.05/4.46	-1.48/1.16	-4.23/3.49	-0.94/0.66	-0.48/0.09	0.95/0.93	1.52/1.16	-1.06/1.83	-1.22/0.64	-0.76/0.33	0.64/0.9	-4.32/6.04	-3.22/4.28	
Theta(67.5°)	-2.68/3.94	-1.78/1.22	-1.96/3.11	-4.85/5.62	-5.01/3.46	-1.76/1.25	-1.82/3.1	-3.9/2.35	-0.69/0.86	-0.49/0.09	-0.93/1.54	-0.49/0.64	-2.74/5.87	-6.92/6.98	-5.57/3.22	-1.92/3.17	-2.5/2.04	-1.81/2.19	-2.59/5.16	-5.05/3.33	-1.55/1.39	-1.85/3.19	-3.43/4.24	-4.93/5.59	
Theta(75°)	-1.7/0.78	0.35/0.69	-0.62/2.77	-4.72/4.74	-3.38/2.76	-2.51/2.02	-0.98/1.04	-2.82/5.64	-2.77/0.25	-0.39/0.87	-1.3/1.61	-1.47/1.33	-1.43/1.79	-1.94/3.19	-3.85/5.08	-6.02/4.93	-4.76/4.44	-3.03/3.95	-7.7/7.12	-3.65/2.83	-3.3/4.01	-4.29/4.68	-4.06/4.03	-7.33/5.53	
Theta(82.5°)	-9.4/1.8	-3.12/2.14	-1.36/2.26	-5.43/5.44	-1.26/0.74	0.98/0.24	0.39/0.31	-1.3/3.65	-4.32/1.4	-1.33/1.37	-1.59/2.25	-2.43/2.28	-2.68/3.5	-3.94/5.79	-7.03/7.86	-5.24/4.46	-4.99/5.4	-4.78/4.76	-5.8/3.64	-2.33/0.8	-1.98/5.27	-7.86/5.66	-4.32/6.04	-9.53/6.37	
Theta(90°)	-6.71/4.73	-2.32/2.17	-3.32/4.84	-4.14/1.93	0.13/0.58	0.19/0.38	0.15/0.21	0.59/1.7	-6.28/4.76	-2.3/2.26	-3.01/2.16	-2.93/3.6	-4.6/5.08	-3.04/3.94	-5.71/7.34	-7.42/7.43	-5.25/2.75	-0.96/0.9	-1.67/2.54	-1.19/0.92	-2.05/3.8	-7.15/3.63	-3.99/5.64	-5.42/5.89	
Theta(97.5°)	-8.35/8.12	-4.42/5	-2.19/3.21	-3.07/1.16	0.25/0.91	1.16/0.02	0.13/1.15	0.84/1.17	-3.96/7.19	-5.32/4.79	-4.91/5.86	-6.11/2.84	-4/2.69	-4.15/3.46	-4.09/5.12	-6.18/1.73	-1.07/1.34	-0.72/0.17	-1.94/0.71	-0.86/0.84	-3.44/3.57	-3.14/3.17	-3.3/6.09	-6.31/5.42	
Theta(105°)	-7.74/6.39	-5.37/3.85	-3.19/3.93	-5.75/1.49	0.69/1.67	0.70/0.58	-0.46/0.43	-0.93/0.56	-2.71/6.92	-4.66/4.86	-6.63/5.15	-4/4.05	-3.85/4.76	-5.94/6.15	-4.84/3.53	-4.14/2.5	-1.81/2.39	-4/0.797	1.30/49	-2.04/1.89	-3.99/4.98	-1.88/2.34	-7.57/4.85	-4.22/7.07	
Theta(112.5°)	-7.91/6.61	-3.23/4.23	-4.14/1.59	-2.81/1.88	-0.65/0.02	0.12/0.07	-0.02/0.37	-0.39/1.57	-3.03/6.68	-7.97/4.88	-6.21/2.72	-3.64/1.88	-2.61/5.48	-4.55/3.72	-3.86/4.98	-5.71/3.94	0.09/0.89	-1.68/0.93	-2.35/2.9	-1.29/3.43	-1.81/2.24	-3.22/4.24	-2.58/4.39	-2.53/5.29	
Theta(120°)	-9.26/5.29	-5.23/7.69	-5.4/3.85	-2.41/2.34	-0.25/0.7	1.16/0.97	0.48/0.06	-0.11/0.56	-0.25/0.96	-0.52/3.44	-5.38/7.97	-6.38/7.48	-4.35/1.51	-4.67/2.04	-1.34/2.76	-1.74/0.47	0.09/0.74	-0.18/4.09	-2.57/1.07	-2.19/1.86	-6.73/6.57	-6.02/7.27	-8.6/5.61	-4.05/7.96	
Theta(127.5°)	-7.72/5.44	-3.38/2.93	-2.1/2.7	-2.52/2.46	-1.71/1.78	-3.2/2.24	-0.89/1.45	-2.33/2.02	-1.92/0.48	0.37/0.78	-2.79/2.72	-4.23/1.08	-1.57/1.37	-5.23/5.45	-0.19/3.6	-3.81/2.02	-2.29/1.35	-0.16/2.99	-8.12/11.1	-3.13/3.56	-3.9/7.19	-8.12/6.57	-6.48/5.52	-5.49/6.64	
Theta(135°)	-2.47/0.84	-1.26/1.4	-0.63/0.71	-1.17/0.85	-0.37/0.06	-4.11/2.82	-3.47/3.24	-1.23/0.58	0.22/0.09	-3.03/5.65	-6.88/4.52	-3.91/0.15	-2.63/3.35	-2.24/1.69	0.51/0.51	-2.9/1.49	-4.3/6.82	-4.63/2.56	-2.60/2.87	-1.07/2.06	-1.07/2.06	-1.07/2.06	-1.07/2.06	-1.07/2.06	
Theta(142.5°)	-6.56/3.08	1.46/1.97	0.91/0.78	-1.69/2.02	-1.9/1.95	-2.29/2.26	-3.14/4.77	-5.48/6.41	-6.82/5.32	-5.06/7.44	-4.76/4.69	-2.88/0.91	-2.03/3.35	-3.75/4.02	-0.23/3.4	-4.28/0.09	0.68/0.94	-3.98/2.66	-3.54/3.21	-2.64/1.8	-2.1/3.76	-2.01/4.79	-5.62/4.97	-2.78/4.02	
Theta(150°)	-2.66/4.57	-4.19/3.97	-3.99/3.95	-3.13/1.73	-0.6/0.59	-1.06/1.36	-1.26/1.16	-1.14/1.54	-2.39/3.37	-3.25/2.99	-4.73/6.03	-3.43/1.04	-3.35/5.79	-3.77/3.83	-6.09/6.23	-2.58/2.66	-1.54/1.4	-0.38/0.06	-0.65/2.64	-5.59/4.94	-2.61/1.87	-1.42/1.27	-4.07/5.57	-1.93/0.88	
Theta(157.5°)	-2.84/1.3	-0.55/0.91	-1.89/1.82	-1.16/0.05	0.28/0.15	-1.23/1.79	-1.6/1.17	-1.26/1.77	-1.89/1.87	-2.66/5.02	-8.72/7.56	-4.82/3.03	-2.52/2.63	-3.78/6.57	-7.03/4.17	-3.45/6.04	-8.97/8.17	-5.51/3.3	-2.95/4.56	-6.81/7.54	-3.66/2.37	-2.88/3.93	-4.85/4.47	-4.45/4.07	
Theta(165°)	0.05/0.15	-0.37/1.19	-1.59/2.23	-3.04/3.76	-3.88/2.99	-2.39/2.05	-2.01/1.63	-1.44/1.8	-1.87/2.45	-5.74/6.47	-5.59/4.01	-2.74/1.93	-2.62/3.56	-4.11/5.09	-6.77/8.61	-9.42/6.36	-3.65/2.18	-1.92/2.63	-3.21/2.26	-2.11/2.81	-2.53/1.55	-0.57/0.44	-0.57/0.44		
Theta(172.5°)	-4.57/4.43	-3.86/2.56	-1.57/1.26	-0.99/0.88	-1.12/1.69	-2.39/3.07	-3.74/0.41	-4.4/4.51	-4.44/5.57	-4.42/3.41	-3.59/2.79	-2.43/2.53	-2.68/2.4	-2.27/2.4	-2.86/3.91	-4.19/4.12	-3.69/3.55	-3.27/3.14	-3.47/4.22	-5.34/7.11	-7.63/6.34	-5.37/4.8	-4.37/4.13	-3.65/4.04	
Theta(180°)	-3.67/3.92	-3.13/1.87	-1.13/1.51	-2.57/3.4	-4.13/0.45	-4.05/4.34	-5.61/6.5	-6.4/6.32	-5.99/5.75	-5.31/4.39	-3.71/3.48	-3.56/3.62	-3.57/2.82	-2.18/2.03	-2.08/2.15	-2.11/2.57	-3.93/5.7	-7.15/8.26	-8.47/8.84	-9.68/10.95	-10.94/10.54	-8.7/6.51	-5.31/4.66	-4.15/3.95	





# Radiated Composite Gain Data

# Appendix A

Theta	1220.16	0.41/-0.18	-0.25/-1.89	-4.17/-3.58	-1.71/-0.41	0.47/0.73	0.34/-0.17	-0.67/-0.78	-0.95/-1.37	-1.79/-1.08	-1.05/-1.53	-2.23/-2.49	-2.24/-2.38	-2.15/-0.84	0.20/0.41	0.63/1.28	2.06/2.19	1.95/1.88	1.95/1.92	1.51/1	0.35/0.49	1.09/1.49	1.68/1.6	1.41/1.61																							
Theta(30°)	-0.49/-0.62	-1.25/-0.85	-0.59/-0.04	-0.13/-0.54	-0.26/0.2	0.39/0.1	0.33/1.96	3.2/1	2.71/2.26	1.61/1.28	0.52/-1.04	-2.88/-3.48	-2.45/-1.3	-1.02/-0.3	1/1.2	1.08/1.56	1.42/0.94	-0.11/-1.56	-2.27/-1.6	-1.38/-1.65	-2.33/-2.88	-1.85/-0.88	-0.64/-0.34	-0.16/-0.17																							
Theta(37.5°)	-1.11/-0.66	-0.08/1.97	2.79/2.12	0.05/2.67	-3.29/-3.52	-3.01/-2.16	-0.43/1.37	2.25/1.61	0.67/2.06	3.08/2.89	1.71/-0.23	-2.12/-3.79	-1.66/-1.05	-1.87/0.14	0.7/-0.6	-2.79/-2.49	-1.12/-1.28	-2.07/-1.48	-1.48/-1.32	-1.53/-1.76	-2.56/-2.61	-2.08/-1.34	-0.24/-0.74																								
Theta(45°)	-3.57/6.34	-5.58/1.76	-0.47/-1.97	-3.71/4.38	-2.29/-0.39	1.55/2.26	2.22/1.76	0.73/1.66	-3.2/-1.71	0.58/2.23	2.40/9.3	-0.93/-3.95	-4.06/-2.72	-0.91/-1.1	-2.24/-4.08	-5.42/-3.94	-0.60/7.1	1.04/0.13	0.18/1.15	1.34/0.49	0.01/1.35	-1.31/-2.99	-4.97/-3.93	-2.55/-1.57																							
Theta(52.5°)	-2.51/4.79	-2.63/-2.46	-2.28/-3.02	-4.57/-3.6	-1.40/9	2.57/3.07	3.88/3.81	2.60/98	-0.96/-3.77	-2.88/-0.41	0.59/0.85	-0.22/-1.6	-1.74/-0.62	-0.94/-3.03	-4.96/-3.48	-1.05/1.23	1.12/1.08	0.73/1.59	1.64/1	1.19/1.78	2.35/2.17	1.54/0.13	-2.33/-1.63	-0.39/-0.88																							
Theta(60°)	-3.19/4.45	-1.99/1.98	-0.32/-1.3	-3.75/-3.75	-4.89/4.79	-3.16/-1.51	-1.28/1.46	-0.83/0.05	-0.75/-1.87	-1.44/-0.87	-0.33/0.96	-2.24/1.88	-2.07/4.71	-3.46/4.17	-5.98/-3.43	-1.85/-1.04	0.31/2	2.23/1.52	1.70/36	-0.52/0.25	1.16/1.11	0.58/0.53	-0.60/0.53	1.52/0.32																							
Theta(67.5°)	-3.05/6.88	-5.27/-1.56	0.36/0.58	-4.08/-3.95	-2.08/-2.03	-2.56/-2.32	-3.52/-2.4	0.16/1.4	2.16/1.24	0.29/-0.91	-1.64/-1.59	-0.16/-0.31	-1.11/-1.98	-1.56/-2.6	-3/2.82	-3.85/-0.96	0.36/0.23	-0.04/0.48	-0.99/-0.94	-1.74/-3.35	-0.72/0.81	1.03/0.57	-1.98/-2.25	-0.02/-0.42																							
Theta(75°)	-6.56/5.3	-4.48/-2.97	-3.07/0.61	-8.58/-9.86	-5.68/-4.52	-3.36/-1.92	-2.15/-3.01	-3.88/-1.12	1.72/1.39	0.23/-0.54	-0.92/-1.49	-0.79/-0.49	-1.87/-2.64	-2.5/-2.13	-3.29/-3.21	-1.38/1.39	0.5/-1.56	-0.37/-2.41	-3.15/-2.24	-3.5/-7.34	-3.59/-1.44	-1.37/-2.42	-2.24/-2.42	-3.44/-5.47																							
Theta(82.5°)	-3.35/-5.2	-5.59/-3.14	-3.32/-5.73	-4.44/-1.16	-0.67/-2.24	-1.68/-2.51	-2.55/-2.72	-3.95/-2.04	1.22/1.8	1.4/-1.49	-2.18/-1.89	-0.50/4	-0.34/-1.48	-2.19/-1.86	-1.44/-2.39	-1.32/-0.28	0.17/1.44	-0.74/-1.97	-4.71/-2.87	-3.27/-7.7	-5.34/-2.55	-1.61/-3.14	-5.95/-2.02	-0.5/-0.74																							
Theta(90°)	-7.88/7.28	-4.11/-1.5	-2.71/4.45	-5.37/1.72	-0.53/-1.05	-1.9/-0.51	0.17/-0.21	-2.05/-5.89	-1.71/1.7	2.13/0.93	-1.51/-2.27	-1.99/-1.96	-0.76/-1.02	-1.44/-1.72	-5.65/4.45	-2.66/0.41	0.51/3.61	-2.99/-1.9	-4.95/-5.43	-5.05/-2.84	-3/1.3	-2.38/4.03	-1.63/-0.78	-3.23/4.75																							
Theta(97.5°)	-5.99/8.38	-5.25/-1.63	-3.38/5.38	-4.16/-2.49	-1.1/-1.23	-1.26/-0.31	0.64/1.16	0.55/-1.15	-3.45/1.7	1.64/0.15	-0.22/-1.47	-3.03/-1.98	-0.32/-0.8	-1.18/-3.56	-6.19/-4.32	-3.21/-1.2	-3.6/-3.02	-0.9/-0.55	-2.56/-1.14	-2.31/-5.23	-4.62/-2.69	-3.77/-2.34	-2.23/-1.64	0.25/-2.33																							
Theta(105°)	-3.54/4.43	-1.69/-2.98	-3.89/4.64	-3.51/-0.6	0.42/-0.72	-0.08/0.47	1.47/2.92	2.62/-0.59	-6.59/-7.74	-2.54/-3.25	-3.55/-2.98	-4.56/-2.6	-2.38/-2.45	-3.85/-3.36	-4.56/-6.89	-7.02/-6.94	-3.81/-1.35	0.28/0.35	-0.13/-0.11	-0.51/0.7	-0.93/-1.91	-2.43/-7.9	-6.76/-3.94	-2.31/-5.9																							
Theta(112.5°)	-2.28/6.35	-5.76/4.74	-2.71/3.61	-3.83/1.31	-1.15/-1.33	-0.18/1.3	2.37/1.68	-0.15/-2.81	-4.32/-1.84	-1.34/-1.95	-2.62/-2.43	-4.29/-3.51	-3.65/-3.51	-2.43/-5.01	-4.29/-4.03	-3.73/-4.32	-2.74/-1.13	-1.18/0.63	-1.99/-0.75	-0.21/-0.92	-0.53/-0.68	-3.29/-2.22	-3.05/-3.27	-0.71/0.55																							
Theta(120°)	-4.29/-5.2	-1.17/-3.29	-2.9/-4.98	-4.04/-1.07	0.20/0.5	1.57/2.29	1.95/1.61	0.17/-2.45	-3.23/-2.59	-2.66/-2.73	-3.76/-3.14	-2.29/-2.08	-4.07/-1.99	-1.97/0.19	-0.27/-3	-0.69/-3.74	-1.53/-0.91	2.46/-0.72	-2.3/-6.43	-6.13/-7.8	-8.12/-6.7	-5.51/-2.49	-8.12/-6.7	-5.51/-2.49																							
Theta(127.5°)	-4.4/-1.76	-1.51/-1.65	-2.01/2.99	-4.91/3.28	-3.55/-2.41	-2.22/-0.47	0.33/0.25	-0.91/-2.38	-0.58/-1.01	0.78/1.44	-2.46/-3.36	-2.21/-1.06	1.03/0.61	-3.73/-2.21	-2.22/-3.27	-1.88/-1.26	-0.68/0.4	1.09/-1.69	-6.34/0.86	-3.66/-1.58	-6.03/-8.78	-6.57/-8.62	-9.17/-7.53	-7.66/-6.24																							
Theta(135°)	-3.31/5.4	2.03/1.9	0.89/-1.12	-1.56/-1.81	-2.7/-6.91	-5.74/-3.92	-1.96/-1.46	-1.98/-3.55	-2.49/-0.95	-0.92/-1.48	-2.94/-2.6	-3.07/-2.21	-0.29/-1.3	-5.89/-1.16	0.98/-1.28	-2.32/3.45	2.44/1.66	-2.41/-1.6	-5.22/-4.92	-3.14/-3.46	-1.79/-1.06	-1.22/-0.57	-0.25/-1.73	-5.5/-2.73																							
Theta(142.5°)	-3.88/1.58	0.71/-0.03	-0.25/-2.13	-3.2/-2.01	-0.87/-0.98	-1.04/-1.6	-3.33/4	-5.7/-6.81	-6.76/-4.76	-2.23/-3.59	-1.66/-0.1	-2.27/-2.26	-0.66/0.36	1.02/0.54	-2.16/0.98	-4.69/-3.26	-3.32/-1.32	-3.1/-1.81	-2.74/-1.57	-2.44/-9.31	-4/-2.72	-2.44/-9.31	-4/-2.72	-1.72/-4.52																							
Theta(150°)	-3.84/2.03	-1.86/-4.05	-5.56/-2.7	-0.39/0.86	0.29/-1.22	-1.41/-0.76	-0.87/1.51	-2.84/4.24	-3.72/-3.65	-4.4/-3.78	-4.09/5.33	-4.08/-3.34	-3.89/4.3	-4.39/-2.6	-1.37/4.45	-1.55/0.44	0.48/1.05	-2.28/-0.77	-0.97/-1.87	-3.59/-2.49	-0.61/1.14	-2.37/2.54	-7.53/-4.38	-1.8/-3.2																							
Theta(157.5°)	-1.12/0.29	0.68/0.17	-0.46/0.42	1.67/2.16	2.22/1.94	1.36/0.2	-1.24/-2.41	-3.19/-3.72	-4.5/-4.85	-4.83/-5.36	-6.54/-4.09	-1.91/-0.88	-0.68/-2.02	-4.99/-7.95	-4.29/-0.29	0.1/-1.83	-1.63/-2.14	-3.08/-2.2	-2.54/5	-4.74/-1.85	-1.12/-1.43	-1.82/-2.14	-3.54/-3.81	-3.88/-3.2																							
Theta(165°)	0.1/0.33	-0.15/-0.33	-0.27/-1.21	-1.94/-2.6	-3.19/-3.77	-4.29/-4.53	-4.25/-3.93	-3.87/-4.38	-4.98/-5.58	-6.5/-6.66	-4.08/-1.52	-0.01/1.1	1.42/1.21	0.61/0.62	-3.22/-6.17	-8.81/-4.92	-8.18/-5.72	-3.47/-2.92	-4.22/-5.17	-5.54/-3.17	-1.77/-2.14	-3.48/-3.85	-2.42/-7.05	-0.07/0.11																							
Theta(172.5°)	-1.33/0.11	0.64/0.06	0.3/0.03	-0.21/-0.21	-0.5/-0.96	-1.08/-1.13	-1.93/-2.13	-2.45/-3.48	-4.77/-6.35	-7.02/-7.05	-6.18/-6.25	-3.35/-1.68	-1.59/-2.7	-2.87/-3.3	-3.84/-4.07	-4.1/4.54	-4.94/-4.84	-4.27/-1.49	-3.87/4.46	-4.46/-4.46	-4.87/-4.2	-4.87/-4.2	-3.21/-3.68																								
Theta(180°)	-2.75/-1.97	-1.22/-1.13	-0.78/-0.39	-0.69/-1.3	-1.81/-2.07	-2.12/-2.79	-3.98/-4.42	-5.5/-5.38	-5.56/-5.12	-4.47/-3.71	-3.54/-3.24	-2.68/-1.92	-1.29/-0.9	-0.98/-1.5	-1.78/-1.74	-1.95/-2.82	-4.66/-6.21	-7.61/-7.94	-7.41/-6.68	-6.29/-7.4	-8.73/-8.89	-7.91/-6.08	-3.99/-3.28	-3.07/-2.98																							
Freq(Hz)	5.66/Pol	Theta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
DG(dB)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)	Phi(187.5°)	Phi(195°)	Phi(202.5°)	Phi(210°)	Phi(217.5°)	Phi(225°)	Phi(232.5°)	Phi(240°)	Phi(247.5°)	Phi(255°)	Phi(262.5°)	Phi(270°)	Phi(277.5°)	Phi(285°)	Phi(292.5°)	Phi(300°)	Phi(307.5°)	Phi(315°)	Phi(322.5°)	Phi(330°)	Phi(337.5°)	Phi(345°)	Phi(352.5°)
Theta(0°)	0.84/0.77	0.81/1	1.27/1.2	1.37/0.87	0.35/0.29	-0.06/-0.18	-0.20/2.2	0.71/1.1	1.34/1.56	1.44/1.38	1.25/1.1	1.15/1.15	0.99/0.8	0.49/0.44	0.25/0.12	0.05/-0.25	-0.74/-1.13	-1.45/-1.13	-0.82/-0.66	-0.39/3.9	0.58/0.71	0.91/0.9	1.31/26	1.14/1																							
Theta(7.5°)	0.64/0.16	0.24/0.53	0.42/0.49	0.36/0.19	-0.68/-1.36	-1.96/-2.23	-1.77/-1.37	-0.79/-0.2	0.55/0.65	0.85/1	1.81/3.7	1.45/1.8	1.94/1.97	1.82/1.74	1.64/1.72	1.61/1.52	1.48/1.23	0.88/0.45	0.54/1.08	1.44/1.47	1.95/2.22	2.11/1.97	1.71/28																								
Theta(15°)	0.31/0.4	0.91/1.7	1.33/1.27	1.01/0.69	0.22/-0.25	-0.57/-1.1	1.80/1.71	1.21/5.4	2.01/2.22	2.09/1.64	0.95/0.69	0.82/1.35	1.94/2.38	2.44/1.99	1.28/0.77	0.76/1.05	1.51/1.57	1.22/0.63	0.23/0.23	0.67/1.04	1.61/2.03	2.07/2.03	1.62/1.07																								
Theta(22.5°)	-0.3/-0.82	-0.23/0.58	1.08/1.02	0.68/-0.05	0.71/-1.27	-1.48/-1.13	-0.95/-0.5	0.31/1.4	1.94/2.61	3.26/3.68	3.69/3.2	2.11/0.66	0.31/3.25	2.53/3.7	3.73/4.4	2.88/1.65	0.70/3.37	0.61/0.95	1.11/0.87	0.64/0.78	1.10/4.3	1.96/2.2	2.43/2.33	1.45/0.91																							
Theta(30°)	0.78/0.41	0.22/0.36	0.09/1.04	0.14/0.48	-2.17/-3.6	-2.94/-3.33	-4.59/-4.61	-2.91/-1.19	0.14/1.31	2.44/2.23	3.58/2.29	2.43/1.16	0.78/0.95	1.54/2.68	3.57/3.49	2.50/7.9	0.41/1.58	2.35/2.64	2.42/1.4	1.94/1.51	2.25/3.16	1.33/2.44	1.76/1.69	1.61/1.37																							
Theta(37.5°)	1.53/1	0.47/0.46	-0.72/-0.73	-0.81/-0.27	0.95/1.56	1.55/1.25	0.14/-1.8	-3.97/-3.28	-2.04/-1.06	1.09/2.85	3.15/2.6	1.1/0.4	-0.26/0.38	1.63/2.69	3.57/3.9	2.55/1.36	2.02/2.4	2.92/3.9	4.1/3.39	2.86/2.85	3.06/3.48	3.51/3.52	3.2/2.6	2.38/2.2																							
Theta(45°)	2.65/2.45	1.91/1.7	1.84/1.72	2.11/1.83	1.64/1.53	0.91/0.3	-3.02/-0.9	1.05/0.22	-0.78/1.31	2.31/2.4	1.46/0.4	0.99/2.16	2.97/2.96	3.64/4	3.09/1.99	2.69/3.5	3.92/6.1	0.98/0.98	2.07/2.14	2.91/3.5	3.42/3.37	3.57/3.12	2.91/2.91																								
Theta(52.5°)	2.74/2.79	2.48/2.16	2.72/3.9	2.39/1.99	2/1.82	1.38/1.2	0.66/0.76	1.2/4.4	2.89/2.45	0.89/1.13	1.54/1.48	0.32/-0.52	0.09/1.83	2.71/2.63	2.45/2.43	1.56/1.39	1.44/1.79	2.57/2.22	1.4/0.15	0.76/1.24	1.42/1.94	3.94/4.6	4.36/4.13	3.63/2.85																							
Theta(60°)	3.93/5.4	3.36/4.03	4.84/4.5	2.51/1.88	2.38/3.51	3.78/3.44	2.29/7.9	-0.23/0.58	2.32/2.79	2.84/2.22	0.76/0.84	0.31/1.03	-0.63/1.6	2.46/2.85	4.11/3.7	3.83/83	4.06/3.47	1.66/2.18	2.89/2.16	0.95/2.58	4.49/5.5	5.99/5.17	3.74/3.5																								







# Radiated Composite Gain Data

# Appendix A

Theta (°)	3-43/5.54	6-62/7.02	7-5/8.8	13-46/13.51	16-49/11.53	8-33/6.62	5-65/5.18	6-12/7.06	-7-55/7.45	-7-22/8.02	-9-19/9.55	-8-58/6.71	-5-34/4.37	-3-79/3.73	-4-47/5.92	-8-07/11.21	-14-72/14.41	-10-79/6.67	-5-11/3.54	-2-78/2.14	-1-76/1.82	-2-07/2.79	-3-15/3.32	-3-32/4.31
Theta (22.5°)	-5.79/-7.23	-4.51/-6.08	-5.57/-7.52	-12.76/-16.09	-11.08/-11.53	-5.47/-4.98	-6.23/-8.34	-12.46/-16.19	-19.41/-17.99	-17.95/-14.43	-14.22/-14.53	-13.25/-9.77	-6.62/-4.27	-3.12/-3.03	-4.07/-6.39	-10.68/-16.28	-13.02/-9.31	-7.21/-5.16	-3.75/-3.25	-3.22/-3.59	-3.93/-3.68	-3.35/-3.15	-3.66/-4.12	-4.76/-5.31
Theta (30°)	-12.84/-8.89	-7.84/-6.88	-3.04/-3.17	-8.34/-10.37	-9.47/-10.5	-5.81/-5.43	-4.35/-4.96	-9.67/-16.74	-17.41/-15.71	-12.83/-8.88	-2.67/-4.72	-5.74/-3.07	-1.82/-1.67	-8.21/-6.3	-11.78/-9.83	-6.73/-5.41	-6.23/-8.36	-11.08/-10.57	-10.09/-10.67	-6.89/-9.13	-7.88/-7.27	-7.45/-9.08	-10.23/-11.82	
Theta (37.5°)	-6.24/-7.41	-6.02/-4.58	-2.42/-1.57	-3.17/6.2	-8.98/-6.18	-4.76/-3.65	-1.94/-1.22	-1.82/-3.63	-5.64/-7.82	-10.88/-11.62	-8.57/-6.78	-5.91/-6.86	-6.61/-4.56	-4.38/-4.26	-5.17/8.25	-12.11/-10.91	-7.57/7.11	-11.93/-18.69	-17.44/-11.07	-8.47/-8.83	-11.51/-13.68	-17.12/-16.12	-11.08/-8.21	-5.14/-6.6
Theta (45°)	-12.71/-17.6	-13.72/-4.59	-3.99/-2.57	-7.68/-10	-7.66/-7.17	-6.6/-6.16	-5.09/-5.02	-4.9/-6.63	-9.35/-11.51	-12.93/-14.1	-9.64/-6.26	-1.72/-4.04	-6.58/-6.26	-3.74/-6.56	-7.18/-10.03	-11.85/-9.32	-6.75/-6.75	-8.76/-12.06	-14.94/-12.83	-10.93/-10.03	-11.63/-13.7	-19.09/-18.14	-18.58/-17.38	-11.19/-13
Theta (52.5°)	-8.43/-13.24	-5.11/-2.39	-1.41/-3.23	-8.34/-10.37	-9.47/-10.5	-5.81/-5.43	-4.35/-4.96	-9.67/-16.74	-17.41/-15.71	-12.83/-8.88	-2.67/-4.72	-5.74/-3.07	-1.82/-1.67	-8.21/-6.3	-11.78/-9.83	-6.73/-5.41	-6.23/-8.36	-11.08/-10.57	-10.09/-10.67	-6.89/-9.13	-7.88/-7.27	-7.45/-9.08	-10.23/-11.82	
Theta (60°)	-8.38/-11.29	-2.6/-0.67	-0.6/-4.69	-12.69/-9.98	-10.82/-13.21	-15.47/-12.7	-10.55/-10	-9.46/-10.21	-12.98/-12.95	-9.38/-8.87	-13.78/-8.34	-2.67/-1.07	-5.73/-7.38	-4/-6.38	-10.93/-7.86	-10.17/-16.56	-6.36/-3.43	-3.63/-5.53	-8.41/-11.07	-13.14/-10.62	-7.71/-8.04	-7.08/-8.7	-14.45/-8.38	-3.12/-3.26
Theta (67.5°)	-10.12/-5.24	-7.16/-5.38	-4.8/-6.69	-8.5/-6.98	-6.66/-7.94	-10.12/-10.11	-11.53/-13.75	-12.42/-10.05	-10.55/-18	-13.28/-8.55	-9.89/-16.39	-5.23/-4.3	-6.41/-7.57	-4.09/-4.51	-6.59/-7.78	-17.83/-11.51	-8.16/-8.34	-6.12/-4.88	-7.86/-14.48	-13.79/-11.4	-8.99/-7.19	-5.13/-4.15	-6.92/-8.4	-5.9/-5.99
Theta (75°)	-17.83/-17.61	-11.32/-8.43	-9.59/-15.34	-17.77/-18.24	-18.47/-18.03	-18.41/-15.65	-14.41/-12.46	-8.96/-7.18	-8.56/-10.47	-10.55/-16	-8.27/-3.93	-7.58/-7.96	-6.59/-7.43	-8.78/-13.98	-14.49/-9.49	-10.84/-10.88	-8.55/-8.01	-8.28/-9.91	-11.75/-10.89	-9.59/-9.17	-5.42/-4.19	-6.55/-11.06	-5.91/-5.93	
Theta (82.5°)	-7.48/-9.19	-6.52/-4.92	-8.25/-10.38	-12.04/-13.3	-15.44/-19.25	-18.27/-17.79	-18.72/-17.44	-13.27/-7.76	-4.93/-7.01	-12.91/-16.62	-8.35/-10.8	-5.98/-2.58	-4.37/-7.98	-9.82/-8.46	-7.99/-11.98	-18.05/-13.72	-9.14/-8.6	-9.24/-5.92	-9.33/-10.23	-11.07/-15.92	-11.84/-12.27	-10.06/-6.43	-7.25/-9.37	-6.95/-5.09
Theta (90°)	-17.05/-12.71	-8.29/-7.5	-13.4/-16.59	-10.79/-9.83	-11.81/-14.44	-17.77/-19.12	-16.5/-15.4	-15.33/-12.81	-8.54/-6.74	-6.79/-8.18	-8.01/-6.25	-8.11/-3.47	-3.31/-5.08	-15/-7.22	-10.83/-18.95	-17.78/-14.4	-10.85/-17.2	-16.29/-10.02	-7.88/-12.51	-12.16/-8.91	-8.92/-6.48	-8.19/-6.4	-5.54/-6.62	-11.23/-13.3
Theta (97.5°)	-12.81/-12.67	-8.54/-4.39	-7.92/-16.03	-18.95/-15.34	-18.55/-19.1	-17.64/-18.57	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1	-17.71/-19.1
Theta (105°)	-15.39/-18.62	-9.02/-7.96	-13.29/-11.24	-10.04/-9.47	-7.61/-8.29	-11.32/-17.54	-15.33/-10.68	-12.37/-17.45	-13.87/-15.9	-16.85/-19.27	-8.97/-6.3	-11.58/-7.51	-10.06/-15.08	-18.79/-18.35	-9.54/-16.9	-18.75/-14.45	-19.34/-16.81	-18.88/-15.16	-13.87/-11.28	-6.53/-8.04	-9.68/-10.49	-12.71/-18.34	-15.3/-7.82	-9.19/-12.04
Theta (112.5°)	-8.12/-8.07	-10.23/-6.89	-7.22/-15.05	-18.39/-18.31	-19.31/-16.32	-13.96/-12.16	-10.96/-16	-17.91/-16.97	-12.21/-16.59	-10.49/-15.47	-13.16/-10.92	-13.84/-18.5	-19.54/-18.76	-16.6/-12.64	-14.63/-16.13	-13.91/-12.02	-15.43/-14.52	-17.69/-17.66	-18.52/-12.47	-7.07/-9.11	-9.78/-13.05	-8.05/-10.26	-17.32/-14.15	-7.75/-7.23
Theta (120°)	-10.05/-14.8	-10.72/-13.59	-8.7/-12.1	-10.89/-9.97	-12.41/-11.39	-12.09/-14.08	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1	-17.93/-18.1
Theta (127.5°)	-11.22/-6.33	-5.67/-11.68	-9.65/-9.43	-4.96/-7.82	-12.75/-13.62	-13.95/-12.81	-15.69/-14.69	-18.36/-13.43	-9.47/-10.33	-5.83/-5.31	-12.44/-7.44	-5.97/-12.63	-4.2/-2.66	-14.68/-18.14	-17.39/-16.07	-11.65/-11.9	-8.75/-10.02	-9.28/-10.32	-7.72/-10.38	-11.31/-11.85	-18.69/-18.06	-14.61/-15.97	-9.14/-13.57	-10.04/-17.87
Theta (135°)	-3.07/-2.01	-1.28/-1.2	-3.53/-9.94	-13.17/-18.45	-16.41/-16.99	-10.47/-18.42	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99	-16.41/-16.99
Theta (142.5°)	-11.62/-4.96	-2.34/-6.68	-5.31/-9.95	-18.94/-15.95	-11.77/-10.73	-9.76/-12.37	-15.56/-17.04	-16.83/-13.48	-17.33/-9.13	-4.45/-5.83	-18.5/-19.81	-8.28/-4.59	-10.34/-10.46	-10.39/-9.88	-11.94/-6.6	-17.75/-5.6	-18.26/-9.59	-18.69/-9.28	-6.79/-3.82	-6.54/-7.47	-9.91/-7.07	-13.43/-15.72	-4.77/-3.58	-5.27/-10.7
Theta (150°)	-10.02/-7.09	-5.13/-9.64	-14.03/-10.39	-8.15/-5.63	-5.99/-7.68	-9.62/-11.44	-11.91/-11.72	-14.83/-19.07	-15.71/-10.66	-9.11/-10.21	-10.88/-18.21	-10.26/-5.04	-4.44/-7.21	-11/-8.1	-9.49/-12.83	-13.56/-15.32	-11.23/-19.14	-17.21/-14.57	-11.38/-8.98	-7.1/-3.81	-3.03/-5.95	-6.37/-7.49	-15.88/-8.35	-6.42/-6.27
Theta (157.5°)	-2.06/-3.09	-4.77/-6.01	-6.56/-5.32	-5.4/8.4	-3.98/-3.94	-4.6/-6.36	-10.34/-13.49	-17.59/-17.97	-18.71/-18.18	-17.59/-16.33	-16.27/-13.92	-13.24/-16.69	-16.98/-16.44	-16.44/-12.2	-8.14/-6.42	-7.94/-17.88	-11.61/-15.94	-9.4/-6.51	-7.76/-7.19	-4.98/-7.24	-5.89/-5.74	-6.66/-7.06	-4.72/-3.01	
Theta (165°)	1.23/0.9	-0.59/-2.18	-1.67/-2.62	-5.41/-8.84	-11.44/-13.82	-16.31/-17.82	-18.88/-19.27	-17.86/-17.46	-15.91/-14.35	-13.11/-11.25	-8.27/-6.81	-5.89/-4.94	-5.04/-5.69	-6.04/-5.83	-6.34/-7.35	-8.66/-10.12	-10.12/-9.57	-9.78/-10.15	-10.62/-12.51	-14.91/-11.3	-8.25/-6.59	-5.95/-6.4	-3.4/-1.26	-0.59/0.82
Theta (172.5°)	-2.62/-3.56	-5.21/-4.21	-5.23/-6.11	-6.58/-6.7	-7.44/-9.37	-10.47/-12.43	-14.09/-13.6	-13.15/-12.65	-14.97/-16.96	-17.29/-18.99	-12.92/-9.84	-5.77/-4.58	-3.87/-3.77	-4.19/-5.03	-6.23/-7.85	-9.48/-11.03	-11.93/-11.87	-11.76/-11.67	-9.85/-10.08	-11.18/-11.26	-9.25/-7.65	-7.15/-5.42	-3.19/-3.17	
Theta (180°)	-9.48/-5.66	-4.16/-3.88	-3.43/-3.5	-4.55/-5.97	-7.06/-8.52	-10.36/-13.34	-17.77/-17.17	-18.27/-18.01	-17.94/-14.95	-12.95/-11.69	-11.55/-10.1	-8.78/-8.04	-7.54/-7.77	-8.39/-9.19	-9.52/-10.05	-10.28/-10.84	-11.31/-12.18	-12.62/-12.86	-12.77/-12.69	-14.94/-18.56	-14.66/-12.01	-11.41/-11.02	-9.19/-2.22	-9.19/-10.48
Freq (Hz)	5.65GPa	ThetaAnt. 1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gain	Phi(0°)Phi(7.5°)	Phi(15°)Phi(22.5°)	Phi(30°)Phi(37.5°)	Phi(45°)Phi(52.5°)	Phi(60°)Phi(67.5°)	Phi(75°)Phi(82.5°)	Phi(90°)Phi(97.5°)	Phi(105°)Phi(112.5°)	Phi(120°)Phi(127.5°)	Phi(135°)Phi(142.5°)	Phi(150°)Phi(157.5°)	Phi(165°)Phi(172.5°)	Phi(180°)Phi(187.5°)	Phi(195°)Phi(202.5°)	Phi(210°)Phi(217.5°)	Phi(225°)Phi(232.5°)	Phi(240°)Phi(247.5°)	Phi(255°)Phi(262.5°)	Phi(270°)Phi(277.5°)	Phi(285°)Phi(292.5°)	Phi(300°)Phi(307.5°)	Phi(315°)Phi(322.5°)	Phi(330°)Phi(337.5°)	Phi(345°)Phi(352.5°)
Theta (0°)	-7.05/-6.6	-5.41/-4.96	-4.06/-3.68	-2.6/2.14	-1.68/-1.46	-1.64/-1.77	-1.9/2.25	-2.85/-3.57	-4.28/-5.06	-6.42/-7.78	-9.19/18	-8.24/-7.38	-6.89/-6.36	-6.05/-5.65	-5.18/-4.88	-4.51/-4.21	-4.41/-4.61	-4.44/-4.04	-4.31/-4.67	-4.94/-5.37	-5.73/-6.05	-6.64/-7.63	-8.04/-8.17	-7.72/-5.72
Theta (7.5°)	-5.47/-5.03	-4.44/-4.4	-4.55/-3.87	-3.42/-3.44	-3.71/-3.47	-4.93/-5.7	-5.94/-6.74	-8.43/-8.92	-11.49/-9.49	-9.91/-9.77	-9.72/-9.44	-8.88/-8.41	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2	-8.43/-8.2
Theta (15°)	-5.89/-4.96	-3.78/-3.27	-2.45/-1.81	-1.82/-2.23	-3.08/-4.43	-6.37/-8.79	-8.84/-8.81	-8.99/-10.11	-11.29/-13.18	-14.44/-15.43	-18.88/-16.92	-17.46/-14.54	-10.45/-7.31	-4.69/-0.95	-1.41/-0.17	-0.08/-0.67	-1.37/-2.06	-2.27/-2.9	-3.01/-3.55	-3.61/-3.99	-4.21/-4.65	-5.28/-5.11	-6.73/-6.28	
Theta (22.5°)	-6.72/-5.76	-3.88/-2.39	-1.31/-1.08	-1.06/-1.83	-3.05/-6.43	-5.86/-5.12	-4.39/-4.31	-4.53/-4.55	-7.01/-8.71	-10.22/-11.15	-11.22/-11.07	-12.77/-16.68	-16.24/-10.49	-6.17/-3.3	-1.54/-0.66	-0.21/-0.35	-0.82/-1.24	-1.26/-0.87	-0.54/-0.19	-0.24/-0.48	-0.75/-1.15	-1.64/-2.65	-3.84/-4.04	-5.05/-5.93
Theta (30°)	-6.22/-6.17	-5.68/-4.11	-3.62/-3.74	-4.11/-6.62	-11.11/-17.17	-18.11/-18.69	-19.18/-13.37	-9.05/-6.49	-5.43/-5.1	-5.54/-6.99	-8.48/-10.13	-11.38/-12.08	-12.02/-11.59	-8.71/-5.04	-2.24/-1.05	-1.59/-3.03	-2.33/0.69	2.43/3.11	2.61/1.65	0.72/0.43	0.15/-1.09	2.54/-1.94	-5.24/-5.94	-6.05/-6.2
Theta (37.5°)	-6.22/-4.94	-4.01/-4.11	-5.13/-9.23	-17.67/-17.08	-9.44/-5.58	-3.75/-3.08	-4.27/-2.1	-12.87/-16.63	-16.35/-16.04	-12.75/-10.92	-11.44/-14.41	-15.09/-13.88	-14.54/-13.66	-2.13/-1.1	-2.12/-3.19	-0.79/1.3	2.74/2.22	2.85/1.82	0.88/0.7	0.37/-1.83	-4.53/-5.33	-4.57/-4.47	-5.34/-6.74	
Theta (45°)	-2.27/-1.74	-1.67/-1.77	-2.92/-4.83	-6.41/-6.82	-4.02/-1.71	-1.95/-4.44	-7.99/-11.43	-17.48/-13.27	-10.02/-10.97	-18.52/-16.94	-14.8/-17.2													





# Radiated Composite Gain Data

# Appendix A

Theta (°)	-11.33-18.18	-8.16-6.72	-8.94-7.48	-11.69-17.65	-12.24-8.5	-7.03-6.95	-9.42-11.23	-9.31-7.88	-7.21-7.68	-8.24-12.94	-16.69-15.21	-11.47-8.23	-7.35-9.57	-14.03-15.45	-13.22-18.34	-14.65-16.32	-17.26-11.53	-8.2-9.48	-10.41-16.25	-13.04-8.84	-5.35-3.35	-2.16-5	-7.39-7.55	-6.17-7.26
Theta (75°)	-6.67-4.91	-4.78-4.75	-5.32-5.98	-5.2-6.48	-9.71-12.08	-13.58-17.34	-17.44-15.01	-14.37-16.55	-12.64-10.01	-9.61-8.89	-10.77-15.18	-18.18-18.29	-8.48-4.59	-4.39-10.38	-10.77-11.54	-17.69-8.92	-8.54-11.21	-8.48-8.88	-18.86-16.96	-10.17-16.71	-5.86-7.77	-5.96-4.72	-6.67-6.62	-14.35-13.61
Theta (82.5°)	-18.58-15.47	-13.59-14.68	-5.87-3.55	-7.61-11.52	-6.63-6.73	-8.61-10.97	-12.39-15.53	-18.26-18.03	-18.11-14.89	-15.61-8.43	-15.56-17.52	-12.65-10.38	-13.02-12.04	-11.07-9.69	-12.51-15.77	-9.37-7.65	-11.22-18.72	-11.81-10.83	-13.16-6.9	-5.19-4.13	-2.94-7.01	-12.14-14.63	-9.05-14.53	-18.57-12.56
Theta (90°)	-7.41-7.29	-6.12-3.94	-4.05-6.5	-7.76-5.11	-4.47-9.22	-8.85-17.6	-18.46-17.97	-18.32-18.81	-18.32-18.31	-17.11-14.49	-13.16-13.77	-14.8-18.52	-18.58-11.33	-6.94-12.24	-17.07-14.64	-17.53-9.23	-7.41-10.35	-6.66-5	-5.97-10.15	-7.51-4.59	-7.17-7.8	-18.21-4.25	-6.33-10.82	-8.83-6.99
Theta (97.5°)	-10.21-11.68	-14.91-17.48	-6.73-4.09	-6.63-4.61	-3.15-4.28	-6.93-9.17	-11.84-15.49	-15.15-19.31	-14.23-12.25	-18.23-18.53	-18.89-18.5	-17.97-13.44	-18.82-9.08	-8.23-17.7	-8.14-9.23	-9.33-2.27	-3.04-10.63	-8.28-5.79	-19.2-13.71	-11.24-12.05	-17.36-8.48	-8.53-9.8	-7.81-14.47	-11.76-9.17
Theta (105°)	-17.05-18.36	-18.75-10.34	-5.99-7.16	-18.54-5.88	-1.84-0.88	-1.87-4.08	-7.39-11.75	-14.45-10.2	-9.53-16.08	-17.65-15.7	-16.34-18.47	-16.48-18.42	-11.48-7.17	-12.48-18.63	-15.22-12.52	-17.33-8.05	-6.33-12.16	-6.31-4.41	-3.94-6.58	-13.91-8.05	-11.73-10.08	-7.64-7.8	-16.43-11.76	-7.56-9.37
Theta (112.5°)	-14.47-14.85	-11.95-10.75	-4.89-4	-4.71-5.82	-5.65-4.95	-4.85-6.84	-8.61-7.64	-7.17-6.32	-6.43-8.02	-12.75-10.87	-10.24-15.56	-18.32-8.81	-8.87-14.04	-12.17-15.29	-17.07-15.91	-12.24-19.01	-3.81-8.46	-19.31-5.5	-7.33-9.91	-3.19-13.61	-8.73-5.77	-7.09-6.72	-6.53-9.23	-9.53-11.48
Theta (120°)	-18.61-12.83	-14.33-14.74	-8.45-5.59	-6.65-9.36	-3.77-2.21	-1.19-0.59	-1.89-4.64	-5.73-5.86	-5.46-6.1	-5.36-7.73	-15.21-10.93	-14.17-19.04	-6.24-5.14	-13.1-12.22	-12.87-18.48	-9.48-7.04	-9.51-18.05	-7.51-14.14	-3.52-2.23	-5.36-1.51	-14.37-12.49	-12.21-10.33	-17.81-15.51	-9.32-15.56
Theta (127.5°)	-17.96-8.16	-3.26-1.74	-1.99-3.06	-3.71-5.13	-1.71-8.66	-7.27-5.99	-4.87-5.03	-5.95-5.48	-5.78-5.94	-7.26-6.89	-8.47-12.47	-14.57-5.58	-2.67-6.58	-11.53-14.52	-10.99-4.12	-6.06-6.08	-13.77-12.94	-7.69-9.24	-10.99-4.12	-10.99-4.12	-5.81-11.59	-15.88-13.42	-19.03-9.92	-6.89-11.56
Theta (135°)	-18.4-12.93	-5.43-2.37	-0.95-1.54	-1.87-1.9	-1.93-1.67	-2.59-5.03	-7.51-8.21	-7.95-8.67	-8.43-7.99	-6.19-6.9	-7.86-14.07	-15.23-14.53	-7.89-12.54	-7.81-8.14	-12.22-15.05	-4.22-2.5	-11.67-9.04	-1.97-2.96	-6.76-13.28	-5.39-11.56	-7.63-6.23	-6.19-5.89	-7.81-10.5	-10.64-13.63
Theta (142.5°)	-18.05-15.76	-6.72-2.58	-0.87-0.47	-1.25-1.12	-1.98-1.58	-1.31-3.39	-9.25-13.1	-13.71-12.87	-10.17-8.45	-8.53-8.02	-9.48-14.04	-17.73-10.68	-10.39-15.32	-18.55-8.4	-6.45-11.62	-10.79-5.44	-3.77-7.68	-8.73-4.44	-4.14-3.96	-3.07-9.88	-18.47-10.63	-5.77-3.95	-6.32-10.13	-10.84-11.69
Theta (150°)	-8.36-12.11	-17.71-8.38	-4.26-2.69	-1.56-1.12	-1.16-1.28	-2.55-4.19	-6.09-7.39	-8.45-10.03	-12.7-15.81	-13.86-13.93	-18.71-17.71	-11.91-9.77	-11.93-9.35	-3.97-4.25	-9.25-18.66	-8.76-7.11	-17.66-6.38	-1.41-0.39	-1.18-4.75	-12.98-8.21	-5.62-7.01	-9.31-8.53	-11.18-18.4	-12.24-9.53
Theta (157.5°)	-8.62-6.43	-5.91-5.22	-3.75-2.56	-1.15-0.05	0.11-0.82	-2.26-3.18	-3.06-3.02	-3.34-4.59	-5.43-4.81	-5.11-6.97	-10.97-15.36	-14.94-13.29	-10.91-9.17	-11-18.58	-19.33-14.63	-12.34-14.52	-12.25-7.82	-7.19-6.21	-3.69-3.48	-7.94-18.19	-11.49-11.19	-16.43-14.11	-11.97-15.5	-18.24-13.18
Theta (165°)	-6.84-7.31	-8.52-9.14	-9.66-9.84	-9.11-7.63	-3.81-3.45	-2.1-1.44	-1.88-2.55	-3.35-5.14	-7.41-10.35	-12.55-14.39	-14.81-15.6	-17.69-19.94	-18.17-18.94	-13.51-16.44	-19.2-9.22	-4.15-15.1	-0.58-1.23	-4.19-10.06	-11.91-8.99	-10.71-14.56	-15.91-12.67	-10.71-14.56	-15.91-12.67	-9.57-7.7
Theta (172.5°)	-14.05-12.42	-10.5-8.39	-6.38-4.88	-3.88-3.35	-2.96-2.49	-3.06-3.65	-4.63-5.41	-6.51-8.27	-9.65-11.39	-12.82-13.35	-13.21-13.07	-13.12-13.43	-14.08-14.37	-14.71-15.13	-14.56-12.84	-11.01-9.14	-6.62-4.45	-3.01-2.35	-2.56-4.07	-7.08-12.03	-13.65-12.34	-12.23-12.86	-11.82-11.26	-12-13-13.82
Theta (180°)	-6.44-6.26	-6.26-6.57	-7.67-9.97	-11.85-13.53	-13.29-11.94	-10.91-10.32	-11.53-12.43	-12.52-11.91	-11.08-10.73	-10.41-9.95	-10.05-10.34	-10-9.05	-8.38-7.57	-6.97-6.29	-5.79-5.4	-5.6-6.41	-7.71-9.09	-10.41-11.95	-12.98-15.35	-18.37-18.12	-16.3-16.81	-18.33-17.6	-16.44-11.82	-8.77-7.44
Theta (75°)	Phi(15°)Phi(22.5°)	Phi(30°)Phi(37.5°)	Phi(45°)Phi(52.5°)	Phi(60°)Phi(67.5°)	Phi(75°)Phi(82.5°)	Phi(90°)Phi(97.5°)	Phi(105°)Phi(112.5°)	Phi(120°)Phi(127.5°)	Phi(135°)Phi(142.5°)	Phi(150°)Phi(157.5°)	Phi(165°)Phi(172.5°)	Phi(180°)Phi(187.5°)	Phi(195°)Phi(202.5°)	Phi(210°)Phi(217.5°)	Phi(225°)Phi(232.5°)	Phi(240°)Phi(247.5°)	Phi(255°)Phi(262.5°)	Phi(270°)Phi(277.5°)	Phi(285°)Phi(292.5°)	Phi(300°)Phi(307.5°)	Phi(315°)Phi(322.5°)	Phi(330°)Phi(337.5°)	Phi(345°)Phi(352.5°)	
Theta (0°)	-12.48-15.4	-17.31-18.72	-17.79-16.22	-13.33-10.56	-9.83-8.62	-6.74-5.26	4.49-3.91	-3.73-3.54	-3.23-3.19	-3.43-3.67	-4.34-5.02	-5.92-7.44	-9.89-13.51	-18.85-18.8	-16.37-13.52	-11.07-8.65	-6.36-4.9	-4.01-3.62	-3.47-3.28	-3.31-3.42	-3.71-4.21	-5.03-5.49	-5.96-7.37	-8.96-10.83
Theta (7.5°)	-14.14-15.29	-13.71-11.31	-9.81-9.28	-7.58-7.1	-7.32-6.66	-6.27-5.9	-6.21-6.47	-5.9-5.61	-5.65-6.3	-7.49-8.69	-9.81-10.5	-11.16-12.13	-14.17-16.03	-17.24-17.78	-18.57-18.77	-19.14-18.38	-17.23-12.82	-9.99-7.83	-6.28-5	-4.2-3.52	-3.21-3.41	-3.76-3.83	-4.31-5.51	-7.23-10.15
Theta (15°)	-11.81-10.07	-8.81-7.72	-7.31-7.68	-6.13-6.89	-5.16-5.05	-4.44-3.18	-3.14-2.88	-3.68-5.09	-7.57-10.49	-13.33-15.3	-16.11-15.31	-17.10-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21	-10.11-10.21
Theta (22.5°)	-5.46-5.5	-5.92-6.65	-7.11-9.99	-5.19-4.1	-3.62-3.79	-3.61-3.59	-3.58-3.68	-3.67-4.02	-4.81-6.21	-7.22-7.06	-7.81-8.1	-12.56-15.31	-14.93-13.12	-11.95-12.37	-14.07-14.47	-12.05-9.33	-7.15-5.41	-4.11-3.53	-3.48-4.03	-5.31-7.15	-8.49-9.07	-10.61-12.84	-17.08-16.5	-9.88-6.48
Theta (30°)	-4.97-3.86	-3.35-4.05	-6.19-9.72	-3.82-5.22	-3.74-3.01	-2.49-2.29	-2.31-2.95	-4.26-7.48	-4.09-4.1	-4.32-4.04	-4.68-6.1	-5.96-6.69	-8.19-7.3	-6.1-6.98	-13.08-8.38	-6.53-6.42	-6.86-7.56	-7.91-8.7	-17.17-6.4	-7.15-9.38	-9.91-10.29	-13.99-11.72	-13.48-8.05	
Theta (37.5°)	-5.08-4.42	-3.00-2.64	-5.11-10.25	-1.12-7.19	-3.91-3.99	-3.01-2.54	-2.51-3.41	-4.38-4.2	-2.84-2.89	-3.91-3.57	-3.53-3.03	-14.21-14.71	-10.78-10.09	-16.03-17.47	-6.91-4.69	-4.83-6.89	-10.46-10.98	-9.01-9.31	-10.88-11.13	-7.21-7.59	-4.25-5.24	-4.25-5.24	-5.91-5.61	
Theta (45°)	-2.78-3.26	-4.85-5.44	-6.14-8.6	-10.52-9.72	-8.17-6.51	-5.42-5.2	-4.99-4.92	-4.74-4.41	-3.98-4.3	-6.11-6.33	-6.13-5.39	-5.81-7.4	-7.81-6.81	-6.11-6.67	-9.91-17.45	-12.26-6.4	-5.91-10.23	-15.27-9.58	-10.72-11.83	-15.11-15.7	-7.83-5.72	-2.93-3.71	-5.25-6.54	-5.31-4.04
Theta (52.5°)	-0.87-10.18	-1.57-7.12	-1.19-9.07	-7.49-9.07	-10.88-9.83	-8.14-6.45	-5.54-5.13	-5.62-5.54	-4.6-5.59	-5.03-4.47	-4.8-5.59	-5.03-4.47	-5.85-15.08	-14.8-17.94	-16.35-11.21	-15.52-6.68	-4.01-3.46	-3.31-6.83	-12.49-9.19	-10.74-17.41	-2.35-1.97	-2.24-1.47	-5.47-3.88	
Theta (60°)	-8.53-5.57	-4.36-7.69	-15.19-6.46	-4.49-3.6	-3.16-3.21	-1.69-0.98	-1.23-1.81	-2.18-1.76	-1.75-1.29	-2.27-3.21	-4.93-9.24	-11.56-11.35	-10.24-11.88	-13.04-17.05	-11.05-11.21	-11.56-5.64	-5.61-9.58	-4.93-5.14	-2.79-2.19	-2.79-2.19	-2.79-2.19	-2.79-2.19	-2.79-2.19	-2.79-2.19
Theta (67.5°)	-1.27-0.38	-2.26-3.27	-4.71-8.24	-11.83-10.69	-7.86-6.07	-5.01-3.95	-3.38-3.13	-3.69-4.84	-2.61-1.99	-2.55-3.93	-3.81-6.27	-8.37-7.97	-7.78-8.12	-8.11-10.17	-12.36-17.88	-18.09-16.03	-17.87-10.44	-4.53-4.25	-6.36-6.53	-3.43-0.93	0.41-0.86	1.86-1.41	1.44-0.62	-3.25-2.87
Theta (75°)	-5.07-11.2	-2.64-5.22	-4.51-2.25	-2.31-4.67	-4.78-7.31	-3.61-3.36	-2.64-2.04	-1.72-1.48	-1.94-1.8	-3.11-4.16	-6.41-7.05	-5.86-7.07	-5.84-6.45	-4.46-7.82	-14.2-18.4	-15.97-12.1	-10.14-11.2	-14.54-12.79	-17.83-10.92	-8.32-3.17	-0.90-7.7	-0.60-45	1.782-18	-0.15-7.27
Theta (82.5°)	-0.29-0.89	-2.18-3.58	-4.15-6.54	-9.61-10.82	-9.23-6.17	-4.42-2.18	-2.11-2.88	-1.38-4.24	-4.35-4.44	-7.01-9.31	-1.66-3.14	-1.07-9.55	-5.35-4.22	-6.43-6.28	-6.37-9.59	-18.79-18.57	-19.04-18.96	-8.76-14.22	-11.49-11.27	-1.45-6.63	2.93-1.7	2.482-248	1.910-85	-1.61-1.46
Theta (90°)	-0.63-0.53	-3.08-2.56	-0.88-1.1	-2.17-4.63	-5.14-4.89	-4.39-3.42	-2.02-0.8	-0.82-2.13	-3.98-7.33	-6.71-5.6	-5.67-5.27	-5.97-8.55	-5.43-3.24	-4.32-5.84	-10.48-16.57	-14.75-15.61	-17.86-18	-14.99-9.71	-10.45-13.4	-12.77-3.37	-0.77-0.5	-0.45-1.37	2.691-46	-4.21-5.56
Theta (97.5°)	-1.04-1.48	-1.26-2.11	-2.93-3.69	-6.19-2	-6.93-5.29	-5.03-4.6	-2.98-2.31	-2.52-2.59	-3.78-5.25	-4.29-4.78	-6.2-5.06	-4.1-6.84	-9.67-7.21	-8.8-11.11	-10.37-10.22	-11.16-18.24	-14.81-5.85	-4.95-6.33	-3.71-13.3	-2.75-5.66	2.540-57	0.252-71	0.910-67	0.51-99







# Radiated Composite Gain Data

# Appendix A

Theta (°)	5.09/6.64	-10.37/17.98	-18.25/17.96	-18.28/16.81	-15.46/17.28	-18.4/17.5	-12.9/10.98	-10.09/9.59	-9.67/11.81	-10.46/6.24	-5.6/5.41	-3.16/2.58	-5.63/11.12	-12.11/13.67	-16.73/10.84	-7/5.87	-4.69/6.05	-11.33/18.6	-12.5/8.66	-9.39/14.02	-14.15/9.02	-5.5/4.59	-10.1/9.1	-5.25/4.26	
Theta (157.5°)	-17.63/10.58	-8.2/5.89	-10.33/13.59	-18.72/17.97	-18.1/16.35	-15.21/13.86	-12.93/12.58	-14.58/17.7	-19.24/18.82	-14.72/12.56	-14.83/19.03	-16.92/10.98	-7.89/6.25	-6.42/10.23	-17.83/13.98	-12.35/13.42	-13.92/17.62	-18.72/17.29	-18.91/18.35	-12.35/8.58	-7.54/6.83	-5.92/7.63	-12.21/11.2	-10.38/15.48	
Theta (165°)	-14.6/9.9	-7.73/8.68	-9.37/8.96	-10.39/12.43	-18.96/18.65	-18.12/18.65	-19.3/12.5	-19.77/17.3	-15/13.83	-16.16/19.9	-18.41/12.8	-8.79/6.43	-5.44/5.56	-7.42/11.67	-16.91/16.74	-15.48/16.45	-16.75/16.66	-17.16/17.26	-13.45/9.84	-8.1/6.59	-5.95/6.83	-8.3/7.73	-9/17.89		
Theta (172.5°)	-16.74/17.42	-18.51/14.1	-8.19/6.68	-7.24/7.97	-8.87/9.12	-10.04/12.53	-16.01/17.57	-18.53/18.96	-18.16/18	-13.99/11.58	-9.12/7.39	-6.02/4.74	-3.63/2.97	-2.7/2.61	-3.25/4.74	-6.01/7.39	-9.52/12.14	-13.5/15.22	-18.06/15.59	-12.67/11.6	-10.68/9.49	-9.3/10.54	-14.19/16.85	-17/19.17	
Theta (180°)	-11.9/19.33	-19.09/11.55	-7.39/6.64	-7.34/8.25	-8.2/8.35	-9.19/11.28	-15.3/18.47	-17.67/18.45	-19.1/18.38	-16.34/12.6	-10.19/9.17	-8.61/8.25	-7.72/6.53	-5.9/6.23	-6.96/7.67	-7.73/8.51	-10.92/14.41	-17.8/18.99	-16.42/15.91	-17.6/17.1	-19.49/18.23	-16.32/12.82	-11.26/11.01	-11.19/10.63	
Freq(Hz)	5.2GPol	ThetaAnt. 3																							
Gain	Phi(0°)/Phi(7.5°)	Phi(15°)/Phi(22.5°)	Phi(30°)/Phi(37.5°)	Phi(45°)/Phi(52.5°)	Phi(60°)/Phi(67.5°)	Phi(75°)/Phi(82.5°)	Phi(90°)/Phi(97.5°)	Phi(105°)/Phi(112.5°)	Phi(120°)/Phi(127.5°)	Phi(135°)/Phi(142.5°)	Phi(150°)/Phi(157.5°)	Phi(165°)/Phi(172.5°)	Phi(180°)/Phi(187.5°)	Phi(195°)/Phi(202.5°)	Phi(210°)/Phi(217.5°)	Phi(225°)/Phi(232.5°)	Phi(240°)/Phi(247.5°)	Phi(255°)/Phi(262.5°)	Phi(270°)/Phi(277.5°)	Phi(285°)/Phi(292.5°)	Phi(300°)/Phi(307.5°)	Phi(315°)/Phi(322.5°)	Phi(330°)/Phi(337.5°)	Phi(345°)/Phi(352.5°)	
Theta (0°)	-19.14/17.69	-19.38/14.38	-11.42/9.89	-8.8/7.44	-6.39/5.09	-4.26/4	-3.89/3.69	-3.96/3.98	-4.45/5.09	-5.73/6.31	-7.22/8.74	-11.07/14.99	-18.34/17.65	-18.23/14.29	-10.9/8.57	-7.25/6.73	-6.19/4.75	-4.17/3.92	-3.76/4.45	-4.84/5.46	-5.71/6.27	-6.76/7.39	-8.48/10.56	-13.06/17.19	
Theta (7.5°)	-18.7/18.75	-14.48/11.05	-8.83/6.97	-6.5/7.17	-4.61/4.29	-4.16/4.31	-4.64/5.04	-5.36/5.17	-5.63/6.57	-7.49/8.05	-8.51/9.16	-10.34/13.06	-17.68/18.07	-15.93/13.66	-12.12/9.48	-6.97/6.09	-5.93/4.85	-3.4/2.75	-2.54/2.74	-2.86/3.15	-3.69/4.09	-4.58/5.62	-7.26/9.6	-13/17.99	
Theta (15°)	-17.33/12.72	-10.29/9.36	-9.3/8.46	-7.86/7.6	-8.33/8.78	-8.31/7.06	-6.07/6.4	-6.69/6.28	-5.47/5.62	-6.01/6.41	-6.65/7.51	-9.21/11.43	-14.11/18.23	-17.67/14.85	-12.03/11.08	-9.5/7.83	-6.75/5.5	-4.69/3.75	-2.88/2.68	-2.32/2.61	-3.02/3.53	-4.35/5.62	-7.72/10.76	-13.93/17.08	
Theta (22.5°)	-12.83/14.52	-13.25/13.27	-13.98/17.34	-18.99/17.62	-16.21/13.93	-13.48/12.02	-9.22/8.54	-9.47/9.55	-7.17/5.99	-5.95/6.41	-6.64/7.77	-9.41/10.92	-10.89/10.2	-9.38/8.7	-8.53/7.86	-7.56/7.73	-6.66/4.41	-3.19/2.77	-2.72/2.24	-1.81/1.96	-2.33/2.82	-3.25/3.84	-4.32/5.01	-6.91/9.38	
Theta (30°)	-9.68/10.73	-10.28/11.07	-13.14/17.56	-15.51/14.49	-16.75/14.33	-10.69/9.78	-10.51/11.08	-11.63/11.81	-10.17/7.73	-5.96/5.64	-5.2/4.82	-4.92/5.06	-5.02/4.54	-3.47/2.34	-1.68/1.22	-1.45/2.79	-4.39/3.61	-3.3/4.08	-3.87/1.94	-0.91/0.55	-0.5/1.07	-2.53/3.81	-4.01/4.29	-5.68/7.46	
Theta (37.5°)	-10.74/9.52	-9.18/10.09	-10.66/11.15	-11.57/10.04	-10.32/12.06	-12.51/11.98	-12.47/11.95	-9.25/6.96	-5.17/3.36	-2.21/1.76	-1.79/2.36	-3.46/4.49	-4.8/4.22	-2.87/1.48	-0.55/0.35	-1.11/1.57	-2.08/3.88	-4.64/2.23	-0.78/0.95	-1.21/1.42	-2.3/3.53	-3.44/2.62	-2.82/5.06	-8.53/10.79	
Theta (45°)	-9.88/9.67	-7.97/8.8	-10.58/9.68	-11.08/13.54	-10.72/13.95	-11.68/14.44	-17.74/18.1	-15.92/8.94	-4.68/2.95	-1.73/0.73	-0.75/1.72	-2.67/4.04	-4.92/4.15	-2.27/3.08	0.68/0.26	-0.55/0.47	-1.99/4.74	-4.97/3.09	-2.16/2.2	-2.96/2.6	-1.99/3.41	-4.89/4.34	-4.02/3.95	-4.99/8.01	
Theta (52.5°)	-4.03/3.88	-4.73/7.5	-9.69/8.75	-8.39/10.44	-10.72/8.73	-7.1/5.7	-6.08/7.85	-12.9/15.11	-8.17/4.66	-2.19/0.54	-0.56/0.73	-1.88/4.04	-4.18/2.18	-0.57/0.69	1.35/2.21	0.83/0.05	-1.5/3.75	-5.1/4.82	-3.1/1.69	-1.68/0.53	-1.18/2.06	-2.53/3.52	-3.15/2.85	-3.34/3.9	
Theta (60°)	-2.17/3.91	-5.9/6.36	-8.12/8.32	-8.99/8.96	-8.83/7.3	-6.55/5.43	-6.74/7.8	-9.92/16.14	-18.98/7.9	-2.23/0.7	1.08/1.18	0.38/2.18	-5.75/7.57	-3.91/1.7	-0.96/0.91	-1.53/2.03	-5.46/10.38	-7.35/1.53	0.4/0.2	-0.29/2.52	-2.22/1.13	-1.43/2.22	-3.07/3.89	-4.2/3.1	
Theta (67.5°)	-3.21/2.86	-6.03/7.79	-9.26/8.47	-8.43/9.73	-8.63/5.8	-4.62/2.58	-4.96/4.7	-5.08/8.7	-18.7/8.25	-2.64/0.15	0.42/0.25	-1.3/2.76	-3.95/4.36	-3.09/0.81	0.47/0.12	-0.56/1.81	-4.97/8.85	-8.73/3.33	-1.18/0.94	-1.53/1.61	-2.17/1.56	-1.51/1.53	-2.12/2.72	-3.31/3.5	
Theta (75°)	-3.87/3.48	-7.28/12.19	-17.91/16.26	-17.91/16.26	-3.53/3.9	-2.95/2.61	-3.63/6.81	-7.4/6.52	-11.18/10.44	-4.23/1.47	-0.47/0.33	-4.32/5.92	-4.14/2.75	-0.48/0.56	0.91/2.85	-5.46/7.52	-16.99/10.6	-0.45/1.38	-0.55/3.39	-3.06/1.28	-4.07/2.06	-4.13/3.33	-2.87/3.46		
Theta (82.5°)	-3.57/4.98	-11.31/18.93	-18.18/18.27	-8.52/6.75	-4.85/2.92	-2.88/2.93	-3.31/5.57	-8.11/7.33	-9.24/5.11	-0.48/0.08	-1.74/1.46	-3.17/3.72	-4.32/6.19	-3.23/0.36	0.92/0.79	-0.17/1.25	-0.37/3.45	-9/6.44	-1.63/0.37	0.66/0.57	-3.31/3.7	-2.03/3.7	-5.1/4.15	-4.06/3.31	
Theta (90°)	-2.32/4.12	-4.8/9.49	-10.96/13.86	-9.17/5.05	-4.57/3.04	-2.35/3.36	-4.1/4.63	-6.62/8.16	-7.08/5.05	-1.46/0.09	-0.23/0.52	-1.35/2.18	-6.44/6.65	-1.87/0.26	-0.08/0.64	-0.61/3	-2.09/5.91	-9.87/3.74	0.66/2.62	2.24/1.06	-4.11/1.4	-1.77/2.53	-3.9/5.04	-8.22/13.9	
Theta (97.5°)	-1.15/6.35	-9.37/9.51	-11.33/11.97	-8.76/4.56	-6.02/5.45	-4.15/4.74	-3.95/4	-6.13/12.12	-10.38/3.41	0.1/41	1.31/0.67	-1.68/2.35	-4.23/4.67	-2.23/0.04	1.53/1.77	0.86/0.79	-0.75/2.39	-3.85/1.82	1.37/1.95	2.21/0.79	-1.92/1.46	-1.12/4.54	-8.06/8.21	-8.42/6.46	
Theta (105°)	-1.01/4.62	-9.64/4.82	-8.08/15.74	-10.33/4.38	-6.88/6.31	-6.65/7.68	-4.61/4.4	-6.22/7.65	-9.68/6.99	-0.82/1.53	1.86/1.84	0.11/0.18	-1.02/5.02	-3.36/0.35	0.37/0.43	-0.82/2.27	-1.42/2.97	-3.01/0.66	2.72/3.5	3.26/0.16	-2.06/1.37	-1.11/5.02	-7.45/6.84	-8.95/4.55	
Theta (112.5°)	-3.56/7.02	-9.2/4.16	-8.29/7.79	-8.2/5.57	-9.19/15.71	-12.24/9.53	-6.65/4.94	-11.67/11.16	-9.38/2.68	-0.85/0.44	0.81/1.23	-0.54/0.09	-1.6/2.94	-0.99/2.18	1.27/0.9	0.71/1.37	1.19/2.17	-0.99/2.18	2.97/2.38	2.98/1.87	-1.39/0.62	-2.73/6.53	-8.12/10.14	-9.2/4.54	
Theta (120°)	-4.72/9.57	-12.33/7.6	-4.37/11.78	-15.64/18.1	-14.53/18.36	-14.88/9.03	-6.82/6.78	-7.71/10.46	-9.43/5.98	-4.3/2.46	0.76/0.87	0.72/1.7	-1.08/1.62	-2.94/2.24	-1.04/1.39	-0.54/1.06	-1.81/2.26	2.02/3	-2.23/4.14	1.81/2.26	2.02/3	-2.23/4.14	-6.1/12.63	-16.33/17.88	-12.12/19.47
Theta (127.5°)	-7.3/11.87	-17.91/14.04	-7.5/16.86	-10.15/8.48	-11.78/19.06	-18.93/17.53	-17.95/18.38	-17.42/8.72	-5.34/5.56	-5.58/3.09	-0.98/1	-0.19/1.29	-3.4/2.27	0.18/1.28	1.31/0.9	-3.07/5.32	-2.77/1.92	-0.82/0.1	0.06/0.61	-1.09/3.56	-3.1/3.31	-4.45/6.06	-11.44/11	-18.64/12.21	
Theta (135°)	-15.9/14.63	-18.97/18.59	-13.08/11.6	-14.34/18.64	-18.82/18.49	-15.15/18.91	-11.12/12.55	-11.25/9.02	-6.74/5.01	-2.99/1.96	-2.76/3.12	-2.46/1.21	-1.65/2.21	-3.8/2.17	-0.42/0.26	-3.86/1.85	-8.12/7.12	-0.99/1.44	-1.6/1.97	-2.5/2.8	-6.19/8.31	-12.5/8.98	-8.72/18.06	-11.25/13.59	
Theta (142.5°)	-9.11/11.31	-14.43/9.09	-7.53/11.59	-18.49/17.86	-19.47/18.69	-16.63/16.05	-11.94/12.51	-8.48/5.55	-6.23/2.31	-4.11/4.3	-4.63/5.6	-4.14/1.78	-2.07/3.38	-1.95/0.87	-0.91/1.25	-6.5/1.25	-7.54/3.48	-0.97/1.68	-1.86/4.58	-5.22/3.54	-1.26/3.67	-1.68/18.73	-12.64/9.52	-15.07/8.85	
Theta (150°)	-16.6/13.71	-14.98/11.48	-9.72/12.35	-13.02/10.96	-11.8/17.54	-18.19/13.45	-10.77/9.74	-9.15/7.28	-5.65/5.27	-6.29/8.55	-8.88/5.48	-3.43/3.01	-2.9/2.88	-3.66/5.55	-7.6/10.6	-18.29/18.29	-15.72/7.44	-5.37/5.5	-4.67/5.39	-6.77/4.73	-5.17/11.38	-9.95/12.15	-18.35/10.62	-12.53/19.21	
Theta (157.5°)	-18.22/17.7	-17.27/16.64	-17.78/13.84	-10.25/7.73	-6.07/8.47	-4.85/5.48	-5.49/4.64	-3.79/3.89	-4.9/6.45	-6.69/6.06	-4.73/4.37	-2.94/3.08	-3.98/4.85	-5.84/7.63	-1.05/15.22	-19.31/16.46	-11.91/11.55	-15.91/12.27	-7.61/6.44	-7.73/8.86	-7.18/5.5	-6.77/11.65	-16.63/12.27	-13.16/16.62	
Theta (165°)	-14.42/12.83	-14.39/15.45	-14.05/12.42	-12.09/12.71	-11.49/9.11	-7.25/7.28	-7.52/6.87	-5.89/4.92	-4.54/5.08	-6.24/7.3	-7.52/6.61	-8.55/9.41	-10.11/11.56	-13.03/13.44	-13.43/11.01	-9.1/8.48	-8.75/7.22	-5.03/3.15	-2.33/2.01	-1.79/2.22	-3.1/4.65	-7.78/12.12	-16.49/14.77	-13.26/15.51	
Theta (172.5°)	-17.89/18.33	-18.69/18.31	-15.45/13.46	-10.71/8.33	-6.74/5.82	-5.91/5.98	-6.84/7.32	-7.32/7.21	-6.91/6.82	-7.02/7.69	-8.35/9.62	-10.94/12.05	-12.48/12	-10.54/8.39	-6.03/4.48	-3.91/3.59	-3.93/3.94	-4.21/4.37	-5.11/5.87	-7.24/8.79	-10.07/12.7	-14.16/14.95	-17.81/18.45	-18.85/18.92	
Theta (180°)	-17.95/17.04	-17.97/17.76	-15.44/15.13	-14.85/13.69	-12.19/10.32	-9.69/9.13	-9.03/9.46	-9.28/7.85	-8.67/8.7	-9.07/9.51	-10.14/11.85	-13.86/15.01	-16.6/15.1	-15.93/14.2	-12.91/12.31	-12.88/13.59	-13.64/13.68	-14.35/14.93	-13.6/11.79	-9.29/7.59	-7.				



# Radiated Composite Gain Data

# Appendix A

Theta (°)	-17.81-14.76	-12.46-10.02	-8.15-6.49	-4.85-5.02	-5.49-5.23	-5.19-4.47	-4.38-4.42	-4.71-4.87	-5.46-5.59	-6.31-7.14	-8.39-10.4	-12.82-15.46	-18.43-17.97	-16.78-12.49	-10.71-8.7	-7.21-6.39	-5.74-5	-4.63-4.34	-4.26-4.34	-4.3-7.7	-5.41-7.24	-8.88-9.73	-10.06-12.97	-16.95-18.79
Theta (7.5°)	-14.54-16.96	-15.48-12.06	-9.46-7.97	-6.69-6.37	-5.98-5.4	-5.08-4.82	-4.55-4.41	-5.28-5.93	-6.85-8.07	-9.55-11.8	-15.67-18.63	-18.52-17.15	-16.7-12.72	-10.24-9.21	-8.78-7.55	-6.11-5.29	-5.34-4.64	-3.73-3.76	-3.78-4.04	-4-3.63	-3.67-4.41	-4.74-4.93	-5.61-6.87	-8.62-10.82
Theta (15°)	-18.71-18.86	-14.05-10.34	-8.29-7.37	-6.76-6.41	-6.19-5.62	-4.81-4.38	-4.01-3.86	-3.77-3.9	-4.18-4.71	-5.21-6.47	-8.61-11.69	-11.73-17.47	-18.32-14.04	-11.88-11.14	-10.71-12.63	-15.05-19.07	-18.43-13.36	-7.88-5.46	-4.54-4.21	-3.99-3.95	-3.62-3.84	-3.66-3.9	-4.65-5.79	-8.09-11.78
Theta (22.5°)	-16.71-18.85	-15-12.76	-11.12-10.82	-12.38-14.93	-17.54-19.4	-17.95-17.16	-13.54-10.21	-7.35-4.3	-3.71-2.11	-1.21-1.26	-2.16-4.09	-6.12-8.03	-7.95-6.29	-4.68-3.64	-3.31-3.46	-4.66-6.06	-6.34-5.15	-3.61-2.85	-2.82-3.65	-4-3.39	-3.48-3.3	-3.08-3.1	-3.61-4.24	-6.9-9.69
Theta (30°)	-14.14-13.68	-8.75-7.21	-8.25-9.78	-9.72-11.09	-13.58-16.42	-13.58-13.27	-16.45-18.62	-13.22-8.24	-5.44-3.27	-1.61-1.04	-1.55-2.94	-4.84-6.79	-6.75-5.3	-3.34-1.47	0.09-0.65	0.30-0.02	-0.13-0.02	-0.24-0.3	-0.41-1.38	-1.82-2.49	-2.41-1.02	-1.73-3.48	-5.12-8.53	-7.29-10.17
Theta (37.5°)	-9.88-10.89	-9.34-9.67	-11.36-10.12	-8.43-7.3	-6.6-6.61	-7.18-6.96	-8.53-11.15	-14.23-7.48	-3.75-2.28	-1.02-1.12	-1.1-3.43	-0.79-10.13	-8.78-5.8	-2.86-0.1	1.94-0.21	0.41-0.23	-0.02-2.23	-1.78-0.39	-0.59-0.23	-0.50-0.07	-0.34-0.06	-0.58-1.6	-2.08-2.68	-3.45-5.78
Theta (45°)	-11.16-8.08	-5.96-4.8	-5.36-8.94	-10.05-10.3	-10.63-11.77	-12.81-12.21	-12.84-13.06	-9.99-5.27	-1.10-4.7	0.25-0.18	-1.54-4.22	-8.12-13.51	-7.52-4.1	-1.68-0.22	0.98-1.14	0.56-0.16	0.58-0.75	-0.98-1.27	-0.65-0.44	0.53-0.28	-0.86-1.88	-4.37-4.3	-3.22-2.64	-3.62-7.91
Theta (52.5°)	-6.45-5.14	-3.11-3.55	-5.74-11.19	-15.67-13.07	-10.23-8.58	-8.59-10.43	-14.31-13.44	-6.99-3.69	-1.08-0.52	0.48-0.56	-1.3-2.25	-4.81-10.26	-10.49-5.61	-2.95-1.88	-1.96-1.82	-2.36-1.53	-2.16-2.89	-3.94-1.51	-1.84-2.03	-0.83-4.09	-0.91-2.83	-3.71-3.94	-3.14-1.41	-1.98-4.64
Theta (60°)	-1.65-1.47	-1.54-1.83	-3.52-5.37	-8.99-7.2	-5.39-4.44	-6.34-7.29	-8.89-11.15	-16.95-14.38	-5.67-1.64	1.39-1.83	0.4-3.14	-7.26-11.53	-7.69-4.19	-2.13-1.19	1.67-0.95	1.67-0.95	1.67-0.95	-0.07-1.54	-2.18-0.02	2.27-0.07	-0.33-3.46	-1.89-0.98	-1.1-1.68	-1.92-1.84
Theta (67.5°)	-3.02-2.77	4.17-2.46	3.66-4.02	-6.86-6.81	-4.97-4.03	-5-4.49	-5.61-9.47	-10.07-14.12	-7.44-1.98	0.09	-0.43-2.74	-6.74-14.45	-8.24-3.4	-2.38-0.8	0.60-4.6	0.14-1.79	2.48-0.07	0.15-3.05	-1.84-0.02	0.94-0.7	-0.5-3.58	-3.41-1.03	-1.27-1.67	-1.48-2.55
Theta (75°)	-2.01-2.55	-4.78-4.62	-5.36-4.44	-7.23-6.29	-4.13-1.28	-1.59-2.46	-3.79-12.33	-7.9-4.94	-7.1-2.59	0.24-0.06	-0.69-2.6	-6.41-12.32	-11.66-5.55	-4.49-1.13	-0.22-0.68	0.96-2.7	2.61-8.7	-2.03-4.52	-4.87-1.66	0.25-0.01	-2.21-7.16	-3.8-1.19	-1.91-1.29	-1.18-1.73
Theta (82.5°)	-2.87-1.11	-7.24-9.76	-6.41-6.53	-3.78-4.66	-1.40-0.8	-0.45-0.92	-2.92-9.55	-4.96-1.7	0.67-0.86	-2.92-3.93	-6.54-8.36	-6.87-3.72	-4.11-1.9	-1.54-1.14	-0.061-0.09	2.13-2.58	2.13-2.58	-0.67-6.57	-2.59-0.35	0.29-0.24	-2.95-3.92	-2.31-4.2	-3.6-1.63	1.31-0.71
Theta (90°)	-5.82-2.26	-6.78-15.72	-15.41-12.32	-3.44-3.23	-3.09-2.01	-2.14-0.64	-0.6-6.74	-10.03-3.65	-1.96-1.19	2.09-1.6	-1.48-3.15	-6.85-14.01	-9.18-5.13	-9.54-2.52	-0.32-0.22	1.59-0.87	3.08-2.46	-2.51-2.99	0.02-0.68	0.25-0.8	-0.65-1.12	-1.84-4.54	-10.43-3.74	0.05-4.2
Theta (97.5°)	-0.35-4.15	-3.12-11.46	-15.91-17.7	-5.62-4.44	-1.53-0.11	-0.24-6.47	-10.21-5.19	-3.31-7.4	2.78-0.9	-1.97-1.79	-6.88-18.07	-9.21-10.22	-8.36-3.54	-1.8-1.96	1.49-0.29	-3.15-2.43	0.27-0.05	3.01-0.96	0.57-1.01	0.75-0.6	-3.55-2.07	-2.45-2.37	-8.55-6.33	
Theta (105°)	-0.19-0.42	-3.03-6.41	-18.29-12.49	-1.27-4.39	-6.83-7.41	-8.09-3.62	-2.61-6.73	-6.4-6.99	-5.77-0.32	3.61-2.68	-1.35-2.84	-4.54-7.4	-7.95-6.16	-6.57-1.72	-0.68-0.67	-0.48-1.98	-1.38-0.25	-1.47-1.1	1.21-1.2	2.12-0.42	-2.95-3.92	-2.31-4.2	-3.6-1.63	1.31-0.71
Theta (112.5°)	-4.27-6.41	-17.31-7.64	-11.59-4.89	-9.46-4.84	-19.15-10.91	-9.06-6.34	-4.89-7.71	-9.81-5.37	-2.97-0.34	1.74-1.59	-0.70-4.6	-0.84-3.35	-1.73-4.11	-0.99-1.19	0.82-0.92	0.69-0.15	1.78-1.17	-1.09-0.41	2.37-2.63	2.87-2.52	1.78-1.19	-3.18-4.58	-9.33-19.19	-10.41-15.12
Theta (120°)	-1.73-1.39	-6.43-10.17	-14.07-12.48	-10.58-6.77	-11.99-18.79	-11.3-8.94	-8.59-13.63	-8.31-5.9	-7.08-9.97	1.35-0.38	-0.75-6.19	0.16-0.12	0.17-2.84	0.041-0.55	2.21-9.2	0.32-0.64	-1.32-0.48	-0.20-0.63	-0.84-0.99	3.01-3.6	0.86-2.01	-0.16-3.46	-11.69-11.54	-7.57-19.06
Theta (127.5°)	-10.31-5.32	-8.14-5.85	-5.7-8.48	-4.15-3.98	-7.76-10.23	-14.32-17.16	-18.97-13.21	-5.08-3.63	-4.06-3.17	-2.81-6.13	-1.63-0.27	-1.63-0.27	-3.78-3.24	0.78-1.58	2.09-1.2	0.61-1.6	1.32-0.23	1.73-2.27	1.73-2.27	0.36-1.49	0.18-0.54	-0.26-0.46	-0.33-1.41	-10.09-12.79
Theta (135°)	-8.62-18.86	-17.42-10.96	-10.42-8.19	-10.26-12.22	-10.97-9.64	-11.9-18.61	-15.67-9.8	-8.82-2.67	-0.68-1.07	-3.82-5.47	-3.31-0.27	2.17-1.37	0.38-0.08	-1.67-2.12	0.78-1.9	0.62-1.35	-1.98-3.88	-5.88-5.31	-3.27-1.52	-0.91-4.28	-5.32-5.53	-7.55-10.15	-8.33-5.8	
Theta (142.5°)	-3.57-4.43	-8.6-6.3	-9.13-18.87	-17.02-10.82	-12.8-17.94	-14.51-8.59	-7.67-3.45	-1.85-1.04	-1.29-2.8	-6.82-5.02	0.021-1.6	0.91-0.29	-1.73-2.86	-8.67-3.8	-2.62-3.35	-5.17-16.22	-3.95-1.34	1.65-0.51	-2.06-5.55	-5.42-3.82	-1.12-1.76	-11.07-6.93	-15.15-9.61	-11.05-4.32
Theta (150°)	-14.4-8.79	-10.39-13.32	-18.72-16.37	-13.75-18	-15.47-13.34	-7.49-4.16	-3.01-3.43	-4.71-6.29	-9.38-12.34	-19.53-11.36	-6.88-4.03	-2.13-2.79	-5.98-8.07	-9.76-10.45	-5.94-3.95	-8.48-18.54	-8.82-4.53	-3.13-5.73	-6.15-6.44	-5.01-1.1	-0.13-2.71	-8.63-18.79	-12.57-9.28	-13.67-11.74
Theta (157.5°)	-9.08-7.33	-6.67-5.57	-5.23-4.27	-4.84-4.41	-3.86-4.81	-6.99-7.15	-6.51-6.64	-7.36-5.83	-3.68-3.71	-4.51-4.2	-3.12-1.8	-1.22-1.31	-3.63-8.98	-18.91-16.25	-10.71-7.9	-9.77-8.94	-10.41-7.27	-5.44-7.74	-12.07-11.88	-17.86-12.67	-9.48-9.55	-9.48-12.88	-16.84-11.69	-8.75-8.9
Theta (165°)	-15.1-13.68	-11.52-8.33	-5.75-5.56	-6.15-7.2	-4.83-5.14	-5.33-5.59	-6.68-8.04	-10.94-11.97	-9.88-9.97	-6.95-5.31	-3.45-2.58	-2.99-4.25	-5.66-1.6	-4.15-9.7	-6.73-9.41	-12.87-15.06	-13.77-13.51	-17.26-14.05	-6.54-2.81	-1.23-4.43	-2.8-4.49	-8.76-11.54	-12.53-11.15	-11.34-14.45
Theta (172.5°)	-11.07-14.11	-16.72-17.89	-19-18.57	-16.91-13.9	-12.18-13.26	-16.84-17.76	-19.58-19.05	-13.89-10.04	-7.14-5.15	4.11-4.22	-4.75-4.58	-6.91-10.08	-11.65-19.33	-14.67-9.47	-4.66-4.78	-4.66-4.78	-3.63-3.89	-3.84-3.26	-2.95-3.41	-5.31-8.74	-11.65-12.59	-13.58-12.84	-13.26-14.12	-12.71-10.66
Theta (180°)	-7.09-6.83	-7.23-8.87	-10.70-10.68	-8.74-9.5	-10.14-9.12	-8.13-7.76	-7.98-6.82	-6.65-6.69	-6.86-6.32	-5.75-5.23	-5.56-6.61	-8.03-9.77	-11.60-10.95	-10.51-9.02	-7.75-7.46	-4.26-6.94	-6.95-8.26	-9.88-12.17	-15.12-19.03	-15.01-9.6	-17.81-5.3	-8.4-8.19	-9.46-8.86	-7.38-7.26
Gain (0°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (0°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (7.5°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (15°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (22.5°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (30°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (37.5°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (45°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)
Gain (52.5°)	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)																







# Radiated Composite Gain Data

# Appendix A

Theta (°)	-2.48/-4.76	-9.77/-11.89	-18.61/-5.74	-1.26/-2.24	-7.47/-17.71	-10.68/-3.99	-2.21/-1.49	-1.12/-1.42	-4.93/-14.15	-10.25/-5.61	-6.4/-9.85	-13.91/-6.71	-3.28/-3.48	-6.12/-5.52	-5.09/-6.37	-18.15/-17.96	-18.46/-10.52	-7.01/-7.92	-8.85/-8.49	-7.37/-6.66	-11.78/-17.45	-17.79/-17.96	-5.03/-3.7	-8.19/-5.59	
Theta (90°)	-5.08/-8.27	-18.01/-19.25	-10.71/-4.29	-1.93/-2.86	-5.45/-13.04	-14.23/-9.84	-9/-7.04	-3.84/-2.64	-5.13/-12.1	-18.41/-17.55	-10.92/-9.6	-12.92/-8.7	-9.89/-10.12	-12.21/-10.52	-11.71/-10.67	-17.89/-16.41	-10.07/-6.09	-4.15/-5.83	-7.74/-7.31	-7.87/-5.43	-10.17/-17.69	-17.77/-17.68	-6.27/-4.52	-5.63/-5.75	
Theta (105°)	-6.51/-12.33	-12.95/-14.44	-11.52/-3.99	-2.56/-4.8	-9.39/-9.19	-6.82/-5.94	-6.59/-5.88	-4.31/-4.81	-6.15/-9.8	-18.57/-19.06	-17.35/-16.53	-12.43/-17.47	-10.49/-8.32	-10.27/-7.4	-9.22/-9.17	-11.07/-14.31	-11.51/-9.66	-6.02/-5.08	-7.14/-7.36	-4.96/-4.62	-8.18/-15.81	-15.99/-7.57	-6.51/-7.17	-7.54/-4.64	
Theta (120°)	-7.19/-12.05	-17.56/-18.02	-17.31/-6.57	-8/-6.68	-6.35/-7.84	-7.86/-7.23	-7.09/-7.5	-9.41/-13.53	-18.41/-16.37	-14.92/-11.89	-6.24/-3.89	-9.16/-11.48	-8.34/-3.96	-2.13/-4.19	-6.02/-7.8	-10.68/-13.22	-10.48/-7.49	-4.82/-6.23	-6.02/-3.55	-6.29/-6.78	-8.46/-18.87	-10.4/-5.64	-5.65/-6.18	-5.99/-4.24	
Theta (135°)	-10.03/-16.14	-10.33/-12.37	-12.58/-8.36	-5.09/-7.75	-8.04/-8.03	-8.4/-9.83	-9.8/-7.57	-5.22/-3.03	-3.99/-8.88	-11.42/-12.6	-19.09/-7.09	-4.54/-6.33	-3.52/-3.29	-0.69/-1.86	-0.81/-4.53	-6.48/-8.93	-12.29/-18.57	-18.98/-9.23	-7.36/-8.54	-6.93/-8.75	-13.08/-10.06	-13.12/-12.09	-10.26/-6.91	-5.61/-5.99	
Theta (150°)	-10.95/-17.48	-16.52/-12.74	-17.86/-18.59	-12.73/-12.34	-14.11/-11.76	-9.03/-7.63	-6.87/-6.53	-3.56/-1.8	-3.91/-8.14	-11.57/-15.65	-16.84/-10.59	-8.7/-3.94	-6.61/-3.67	-2.21/-4.54	-3.1/-2.24	-4.77/-8.29	-8.42/-15.75	-16.8/-6.65	-6.97/-9.1	-8.67/-11.32	-19.38/-12.46	-5.64/-8.75	-10.02/-14.18	-9.58/-6.69	
Theta (165°)	-15.06/-13.37	-18.85/-15.22	-18.84/-18.87	-17.26/-10.82	-6.25/-3.9	-3.23/-2.6	-1.64/-1.93	-2.93/-3.62	-3.91/-7.42	-14.13/-19.27	-11.47/-12.26	-8.68/-5.17	-4.6/-3.9	-1.41/-1.39	2.26/0.11	-6.25/-10.18	-8.71/-10.25	-12.54/-17.59	-13.53/-9.23	-9.77/-5.95	-7.99/-15.34	-17.55/-12.99	-19.19/-11.32	-13.05/-18.74	
Theta (180°)	-10.54/-12.08	-11.46/-12.16	-8.68/-7.69	-8.89/-6.04	-2.24/-0.94	-0.44/-0.35	-0.57/-0.58	-0.88/-2.01	-3.6/-5.61	-9.86/-17.21	-14.86/-8.6	-9.95/-10.31	-5.87/-5.65	-7.33/-4.7	-1.38/-2.99	-7.4/-9.22	-6.23/-4.56	-6.47/-11.19	-17.79/-19.18	-15.35/-10.13	-11.99/-6.67	-9.05/-14.06	-16.88/-10.5	-12.07/-10.97	
Theta (90°)	-14.03/-18.1	-17.58/-11.96	-10.27/-9.65	-7.4/-5.39	-3.98/-1.88	-1.11/-0.83	-0.81/-1.56	-3.05/-4.88	-7.24/-10.67	-12.93/-11.65	-8.49/-7.62	-8.91/-8.99	-9.76/-7.98	-6.35/-4.71	-3.48/-3.65	-6.51/-8.74	-7.31/-9.27	-7.88/-9.39	-14.67/-18.46	-18.86/-12.96	-14.74/-16.17	-18.81/-15.73	-16.04/-15.51	-13.49/-18.21	
Theta (90°)	-16.24/-17.14	-15.43/-12.35	-10.99/-8.76	-8.09/-7.53	-7.81/-7.89	-7.41/-8.28	-10.87/-13.9	-16.31/-17.93	-18.77/-19.24	-12.22/-8.9	-7.28/-7.52	-8.81/-12.75	-19/-19.02	-17.71/-13.02	-6.91/-5.32	-6.51/-6.51	-6.35/-5.72	-4.95/-5.71	-7.22/-9.38	-10.52/-14.83	-17.59/-16.69	-18.49/-19.24	-16.75/-18.19	-14.34/-10.11	
Theta (90°)	-9.71/-11.57	-13/-13.59	-8.5/-6.2	-5.46/-5.58	-5.71/-5.81	-6.07/-6	-6.17/-7.01	-8.38/-9.29	-8.16/-5.72	-3.63/-2.42	-2.21/-3.19	-5.04/-7.76	-9.95/-11.09	-12.39/-13.55	-16.27/-18.54	-14.75/-12.3	-13.97/-19.1	-19.67/-14.4	-11.59/-11.02	-11.84/-14.35	-17.95/-18.52	-19.07/-19.27	-18.33/-16.49	-12.31/-9.92	
Theta (90°)	-14.71/-12.15	-9.42/-8.65	-6.8/-5.36	-4.42/-4.37	-4.78/-5.45	-4.94/-5.45	-5.61/-6.18	-6.82/-7.16	-7.1/-7.27	-7.67/-8.42	-9.64/-10.68	-11.83/-12.59	-12.33/-12.43	-11.45/-9.09	-7.06/-6	-5.49/-5.06	-4.34/-3.98	-4.04/-4.47	-5.22/-6.53	-8.23/-10.42	-12.28/-14.64	-17.67/-18.37	-18.17/-17.47		
Theta (90°)	-13.52/-13.75	-14/-14.39	-14.22/-14.22	-12.75/-10.23	-8.5/-6.89	-5.56/-5.12	-5.07/-5.07	-4.99/-5.14	-5.06/-4.94	-4.93/-5.19	-5.62/-5.73	-6.38/-7.24	-8.59/-10.16	-11.72/-13.41	-15.02/-17.26	-18.34/-16.53	-11.95/-9.18	-8.34/-7.77	-7.94/-8.3	-8.58/-8.09	-6.72/-5.62	-4.96/-4.83	-5.74/-7.51	-9.83/-12.22	
Gain	5.785GPol	PhiAnt. 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Gain	Phi(0°)Phi(7.5°)	Phi(15°)Phi(22.5°)	Phi(30°)Phi(37.5°)	Phi(45°)Phi(52.5°)	Phi(60°)Phi(67.5°)	Phi(75°)Phi(82.5°)	Phi(90°)Phi(97.5°)	Phi(105°)Phi(112.5°)	Phi(120°)Phi(127.5°)	Phi(135°)Phi(142.5°)	Phi(150°)Phi(157.5°)	Phi(165°)Phi(172.5°)	Phi(180°)Phi(187.5°)	Phi(195°)Phi(202.5°)	Phi(210°)Phi(217.5°)	Phi(225°)Phi(232.5°)	Phi(240°)Phi(247.5°)	Phi(255°)Phi(262.5°)	Phi(270°)Phi(277.5°)	Phi(285°)Phi(292.5°)	Phi(300°)Phi(307.5°)	Phi(315°)Phi(322.5°)	Phi(330°)Phi(337.5°)	Phi(345°)Phi(352.5°)	
Theta (0°)	-13.09/-7.69	-4.98/-3.2	-1.40/-1.6	1.19/2.01	2.54/2.86	3.16/3.31	3.44/3.23	3.12/2.82	2.32/1.52	0.31/0.94	-3.28/-6.06	-10.43/-17.78	-17.96/-10.24	-6.32/-3.68	-1.40/-2.6	1.31/2.12	2.63/3.09	3.39/3.46	3.32/2.89	2.31/1.75	0.97/0.21	-1.45/-3.18	-6.36/-8.73	-13.26/-19.2	
Theta (7.5°)	-15.04/-9.34	-6.34/-2.29	-2.41/-1.15	0.02/0.93	1.45/1.5	1.58/1.83	1.98/2.04	1.96/1.44	1.20/0.6	-0.25/-1.52	-3.27/-5.95	-10.85/-17.63	-15.72/-9.81	-6.32/-4.01	-2.2/-1	0.31/0.53	2.23/2.61	3.07/3.31	3.37/3.18	2.85/2.5	1.98/1.25	0/-1.6	-3.49/-6.71	-11.92/-16.76	
Theta (15°)	-15.16/-19.08	-15.07/-10.61	-7.79/-6.29	-4.67/-3.79	-3.24/-2.85	-2.47/-1.87	-1.51/-1.64	-1.97/-2.01	-1.96/-2.4	-3.5/-5.19	-6.94/-9.06	-10.34/-9.36	-7.63/-6.62	-5.54/-4.28	-2.68/-1.29	-0.29/0.42	0.63/0.4	0.41/0.47	0.47/0.57	0.60/0.81	0.71/0.15	-1.31/-2.92	-6.12/-10.19		
Theta (22.5°)	-10.43/-11.47	-12.77/-12.99	-12.9/6.6	-7.4/-4.91	-3.23/-1.92	-1.03/-0.69	-0.11/0.51	0.59/0.68	0.17/0.36	-1.14/-2.49	-4.49/-6.08	-6.23/-5.56	-4.77/4.39	-3.75/-2.82	-1.4/-0.23	0.23/0.4	0.51/0.6	0.22/-0.51	-0.88/-0.9	-1.11/-1.07	-0.78/-0.36	-0.18/-0.83	-2.25/-3.86	-6.61/-8.7	
Theta (30°)	-9.46/-10.92	-10.97/-10.3	-8.39/-6.42	-4.42/-2.78	-2.12/-2.03	-2.43/-2.27	-0.83/0.02	0.54/0.93	0.89/0.37	-0.18/-1.03	-2.93/-5.77	-7.98/-7.6	-6.65/-5.55	-3.74/-2.11	-0.94/-0.48	-0.73/-1.3	-0.54/-0.32	-1.41/-2.58	-2.72/-2.75	-3.28/-4.6	-5.34/-5.52	-5.34/-5.47	-4.05/-4.14	-6.07/-9.93	
Theta (37.5°)	-14.52/-13.72	-8.34/-6.65	-6.8/-5.43	-4.27/-4.9	-5.63/-5.54	-4.76/-4.37	-6.01/-4.09	-2.14/0.87	-0.04/0.07	-0.21/0.23	-0.79/-2.08	-3.79/-5.83	-6.64/-6.08	-1.88/-1.1	-1.23/0.3	-0.69/-1.26	-0.85/-1.26	-4.34/-5.21	-4.93/-3.97	-3.71/-4.53	-6.51/-6.29	-6.63/-6.39	-6.17/-7.5	-10.57/-16.28	
Theta (45°)	-10.45/-10.04	-7.33/-7.06	-10.22/-13.51	-17.61/-16.49	-11.21/-7.36	-5.14/-4.86	-5.91/-7.51	-10.24/-11.14	-6/-2.21	-0.74/-0.26	-1.16/-3.61	-6.33/-7.26	-7.62/-8.4	-10.59/-9.94	-8.29/-5.77	-4.32/-4.7	-5/-5.73	-7.37/-6.52	-3.92/-2.66	-2.99/-4.35	-6.37/-6.77	-6.77/-6.37	-6.93/-8.11	-9.61/-11.63	
Theta (52.5°)	-8.81/-11.17	-17.63/-17.68	-15.07/-18.64	-10.37/-3.14	-0.36/0.56	-10.37/-3.14	-3.76/-3.05	-4.53/-9.91	-1.09/-2.12	-2.95/-5.09	-0.24/-13.53	3.44/0.32	1.5/-1.91	-3.48/-2.05	-3.36/-5	-7.92/-9.96	-17.55/-18.48	-6.08/-0.41	2.98/3.72	3.54/2.96	2.63/1.65	-1.10/7.6	1.06/-3.28	-8.6/-9.22	-8.83/-18.68
Theta (60°)	-19/-14.59	-11.94/-17.71	-16.3/-10.25	-5.92/-2.98	-1.87/-1.36	-0.98/-0.33	0.20/3.7	0.62/0.9	-0.24/4.43	-15.83/-6.23	-13.07/4.4	-2.48/-4.33	-6.4/-8.8	-13.11/-13.31	-7.93/-9.1	0.88/1.1	2.21/2.82	2.22/0.3	0.14/1.82	1.34/-2.05	-3.07/-2.54	-2.61/-3.2	-5.26/-6.21	-5.61/-9.03	
Theta (67.5°)	-18.93/-10.47	-10.64/-18.75	-11.23/-6.58	-4.54/-3.91	-4.46/-7.58	-13.59/-19.06	-12.27/-5.63	-20/12	1.53/0.72	-3.36/-6.73	-2.54/-1.2	-2.94/-6.46	-7.66/-7.3	-9.38/-14.8	-12.13/-2.93	1.81/3.87	3.77/3.31	3.26/2.96	1.82/0.74	-0.01/-1.31	-7.22/-5.35	-2.37/-5.14	-9.27/-6.34	-6.43/-10.24	
Theta (75°)	-11.2/-8.75	-18.22/-7.12	-5.68/-2.31	-7.63/-11.26	-18.56/-7.37	-3.76/-3.05	-4.53/-9.91	-1.57/0.5	3.44/0.32	1.5/-1.91	-3.48/-2.05	-3.36/-5	-7.92/-9.96	-16.13/-12.36	-11.19/-9.89	-9.05/-5.99	-3.75/-2.24	-1.71/-1.79	-1.15/-0.22	-0.38/-2.22	-5.37/-5.68	-4.93/-6.26	-6.77/-8.94	-8.83/-18.68	
Theta (82.5°)	-17.73/-18.32	-11.62/-10.34	-8.59/-10.33	-7.77/-17.41	-11.37/-4.34	-0.75/0.51	-0.12/-1.62	-7.3/-10.63	0.37/2.66	1.4/-2.24	-2.91/-1.05	-2.28/-6.63	-15.05/-8.82	-4.64/-2.25	-2.28/0.75	3.38/4.1	4.17/2.88	2.63/3.66	-4.44/-2.5	-2.85/-6.3	-11.63/-6.41	-3.76/-12.4	-14.27/-8.96	-9.74/-12.15	
Theta (90°)	-9.06/-18.81	-10.26/-7.31	-9.71/-13.69	-18.91/-14.99	-7.32/-4.01	-0.99/0.69	1.11/0.5	-3.21/-12.47	-2.95/2.23	3.61/9.3	-2.26/-3.92	-6.69/-9.24	-13.08/-10.79	-8.81/-6.98	-2.91/0.08	2.93/0.6	4.5/0.57	-1.6/-4.23	-3.99/-4.2	-4.65/-12.7	-14.04/-5.65	-4.93/-6.92	-7.41/-6.22	-7.56/-9.42	
Theta (97.5°)	-8.35/-11.47	-14.71/-8.5	-7.6/-8.96	-13.84/-12.94	-7.99/-4.23	-0.26/1.64	1.70/5.9	-2.74/-16.02	-4.43/1.62	3.02/2.13	0.94/0.08	-2.13/-11.39	-17.89/-14.77	-17.47/-10.32	-7.11/-3.83	-1.49/-0.49	-2.15/-2.36	-0.89/-0.67	-1.61/-2.96	-5.16/-12.15	-4.57/-1.94	-4.17/-5.11	-11.08/-11.16	-10.79/-10.89	
Theta (105°)	-16.51/-13.76	-5.79/-6.62	-11.07/-11.05	-10.12/-7.3	-3.31/-2.36	-3.92/-3.57	-1.67/-1.28	-1.61/-4.11	-14.56/-4.95	-0.05/0.25	-1.24/-2.38	-4.5/-6.88	-11.28/-8.64	-9.17/-15.2	-7.57/-4.28	-1.44/-0.12	1.75/1.54	-0.54/-0.85	-2.5/-9.73	-7.55/-7.53	-11.32/-14.33	-18.15/-18.8	-14.66/-12.05		
Theta (112.5°)	-15.47/-17.96	-11.21/-6.63	-8.95/-16.39	-12.26/-6.3	-3.58/-2.12	-1.43/-1.08	-1.25/-0.64	-1.07/-2.72	-6.08/-11.33	-7.63/-5.42	-8.38/-7.68	-9.33/-8.83	-12.12/-19.01	-18.79/-18.18	-17.76/-18.69	-9.58/-4.15	-1.06/0.54	2.21/1.43	-1.94/-0.5	-6.94/-6.77	-6.9/-4.94	-11.51/-15.4	-18.03/-13.26	-18.34/-18.13	
Theta (120°)	-18.9/-12.29	-5.47/-5.66	-16.24/-10	-8.61/-6.02	-3.66/-4.91	-5.22/-2.75	-1.54/-2.81	-5.14/-3.82	-1.44/-1.23	-5.51/-10.44	-8.76/-15.74	-8.76/-9.7	-13.55/-11.79	-10/-5.93	-9.16/-8.78	-5.96/-1.4	-4.03/-9.4	-1.04/-1.38	-4.42/-3	-4.09/-6.63	-4.77/-7.65	-13.9/-16.25	-1		





Total Gain Data

Table with columns for Freq(Hz), 5.2GPol, TotalAnt.1, and various antenna gain patterns (Theta, Phi) for frequencies from 0 to 180 degrees.







# Antenna Pattern

# Appendix B

θ (75°)	-2.03/-2.72	-6.30/-8.27	-8.50/-9.64	-6.66/-4.19	-2.60/-2.88	-2.49/-2.25	-2.78/-3.50	-6.80/-6.02	-9.05/-4.75	-4.06/-1.27	-0.21/-0.77	0.11/-1.55	-2.51/-3.12	-1.77/-0.27	0.92/0.75	0.26/-2.75	-5.25/-7.15	-13.61/-6.74	-0.32/-1.60	-0.12/-0.32	-2.78/-0.91	-0.29/-1.91	-3.99/-3.08	-2.67/-2.46	
θ (82.5°)	-3.40/-4.80	-9.16/-8.27	-6.12/-7.00	-6.12/-6.50	-4.26/-1.95	-1.92/-2.57	-2.66/-3.54	-5.13/-5.94	-6.87/-4.75	-0.42/-0.22	-1.20/-0.71	-2.41/-3.19	-3.01/-3.12	-1.95/-1.80	1.24/0.98	0.32/-0.51	0.00/-3.05	-8.62/-6.22	-1.30/0.71	0.97/0.06	-3.17/-3.57	-1.93/-3.26	-4.54/-3.85	-3.92/-3.00	
θ (90°)	-1.97/-3.99	-4.23/-7.10	-6.32/-7.47	-6.32/-7.47	-3.54/-1.95	-1.81/-2.78	-3.05/-3.22	-4.46/-6.43	-6.71/-4.87	-1.39/0.16	-0.60/-1.17	-1.81/-1.62	-4.49/-5.22	-0.66/0.88	0.73/0.98	0.25/-2.88	-1.83/-5.07	-8.61/-3.25	0.76/2.68	2.28/-0.97	-3.55/-1.17	-1.31/-2.41	-3.71/-4.15	-2.36/-1.26	
θ (97.5°)	-1.08/-6.03	-7.24/-7.43	-7.58/-9.27	-5.77/-3.12	-4.94/-5.17	-3.52/-4.31	-3.42/-3.13	-2.78/-6.04	-8.38/-3.27	0.07/1.46	1.36/0.46	-1.23/-1.53	-2.50/-1.96	-0.91/0.49	1.68/1.82	0.91/1.00	-0.39/-1.84	-3.56/-1.72	1.47/2.14	2.46/0.94	-1.43/-1.20	-1.41/-3.79	-6.13/-6.06	-5.60/-3.11	
θ (105°)	-0.33/-4.24	-9.02/-4.43	-6.22/-6.58	-6.80/-2.83	-5.58/-5.52	-6.28/-6.15	-3.22/-3.29	-5.11/-5.93	-8.10/-6.70	-0.74/1.57	1.91/1.99	0.53/0.56	0.01/-2.96	-1.55/0.32	0.67/0.72	-0.60/-2.16	-1.32/-2.87	-2.72/-0.18	<b>2.92/3.55</b>	3.30/0.28	-1.96/-1.11	-0.73/-4.59	-7.03/-6.01	-8.52/-5.29	
θ (112.5°)	-3.42/-6.72	-7.66/-3.99	-8.08/-5.91	-7.43/-4.94	-7.79/-11.06	-4.47/-3.97	-8.42/-10.44	-8.87/-6.05	-0.78/0.50	1.05/1.63	0.39/1.09	-0.63/-1.53	0.58/1.67	1.61/1.07	0.76/1.41	-1.28/-1.76	-0.66/2.22	3.00/2.41	3.01/1.95	-0.85/-0.31	-2.29/4.68	-5.96/-6.81	-6.21/-4.78		
θ (120°)	-4.09/-7.60	-10.36/-6.54	-3.81/-12.59	-8.79/-9.10	-9.37/-12.35	-13.47/-8.45	-5.88/-5.15	-6.18/-8.84	-7.44/-5.37	-3.47/-2.26	0.93/1.00	0.95/1.89	-0.44/0.02	1.27/0.98	0.47/-0.57	-2.74/-1.97	-2.25/-1.63	-1.13/1.50	1.87/2.40	2.14/0.29	-1.84/-3.98	-5.82/-9.57	-10.81/-12.76	-10.00/-12.78	
θ (127.5°)	-6.43/-10.99	-15.16/-8.83	-6.01/-14.63	-9.59/-7.89	-10.04/-13.17	-15.97/-11.68	-9.01/9.90	-8.82/-9.40	-3.46/-3.86	-3.42/-2.82	-0.89/-0.76	0.76/-0.58	-2.14/-0.56	0.88/1.37	1.78/1.06	-2.97/-4.58	-2.29/-1.48	-0.35/0.25	0.13/0.76	-0.47/-1.25	-2.43/-3.19	-4.29/-6.57	-7.07/-7.75	-12.29/-7.42	
θ (135°)	-8.11/-8.81	-15.86/-14.06	-11.77/-10.88	-13.07/-15.30	-12.77/-12.24	-12.00/-10.90	-10.33/-8.11	-6.41/-6.28	-5.22/-3.84	-2.55/-1.83	-2.41/-1.99	-1.81/-1.49	-0.71/-1.86	-2.16/1.18	2.19/3.01	-2.60/-2.51	-1.29/-3.12	-0.88/-1.36	-1.51/-1.86	-2.37/-2.44	-4.58/-3.89	-4.97/-3.95	-3.02/-8.05	-10.45/-9.95	
θ (142.5°)	-7.15/-8.11	-5.24/-2.96	4.02/-6.75	-8.59/-11.65	-15.33/-14.48	-14.18/-11.93	-8.60/-7.89	-6.98/-5.01	-3.09/-3.09	-3.94/-3.91	-3.11/-3.09	-1.37/0.72	0.01/-1.54	-0.53/0.21	0.24/-0.77	-4.87/-2.69	-2.28/-1.83	-0.89/-1.11	-1.39/-3.84	-6.00/-3.14	-1.20/-3.08	-9.43/-15.67	-11.10/-7.89	-9.15/-7.06	
θ (150°)	-4.79/-5.86	-9.08/-10.60	-9.15/-11.30	-11.89/-9.96	-10.25/-14.40	-15.28/-12.01	-8.70/-3.71	-6.58/-2.57	-4.20/-4.40	-4.88/-4.23	-3.93/-2.43	-0.28/0.22	-1.04/-2.27	-3.08/-4.93	-6.69/-6.63	-4.36/-3.68	-4.39/-5.29	-4.01/-3.71	-4.88/-4.25	-4.65/-7.03	-4.17/-4.64	-9.49/-6.78	-4.51/-4.12		
θ (157.5°)	-14.90/-9.81	-7.69/-9.96	-9.61/-10.70	-7.67/-9.34	-5.81/-4.57	-4.47/-4.89	-4.77/-3.96	-3.44/-3.71	-4.70/-6.21	-6.06/-5.18	-4.33/-3.35	-2.77/-2.48	-1.53/-0.97	-10.22/-11.55	-11.55/-11.67	-9.79/-10.60	-14.08/-11.08	-7.30/-6.17	-6.44/-5.71	-6.30/-1.70	-3.31/-6.18	-10.87/-8.69	-8.54/-3.76		
θ (165°)	-11.50/-8.11	-6.88/-7.85	-8.10/-8.01	-8.15/-9.56	-10.77/-8.65	-6.91/-6.97	-7.24/-6.58	-5.72/-4.70	-4.17/-4.54	-5.59/-6.86	-8.07/-8.80	-8.97/-7.77	-6.39/-5.27	-4.74/-4.90	-6.45/-8.32	-8.43/-7.88	-7.91/-6.73	-4.75/-2.96	-2.19/-1.88	-1.50/-1.53	-1.91/-2.50	-3.68/-5.70	-7.69/-6.93	-7.62/-13.40	
θ (172.5°)	-14.27/-14.84	-15.59/-12.70	-7.44/-6.55	-5.63/-5.14	-4.67/-4.15	-4.49/-5.11	-6.34/-6.93	-7.00/-6.93	-6.60/-5.60	-6.22/-6.20	-5.71/-5.35	-4.81/-4.00	-3.10/-2.46	-2.04/-1.59	-1.42/-1.60	-1.84/-2.08	-2.87/-3.33	-3.73/-4.03	-4.90/-5.43	-6.15/-6.96	-7.35/-7.79	-8.07/-9.20	-12.62/-14.57	-14.82/-16.03	
θ (180°)	-10.94/-15.03	-15.48/-10.62	-6.76/-6.06	-6.63/-7.16	-6.74/-6.21	-6.42/-7.06	-8.11/-8.95	-8.69/-8.31	-8.29/-8.26	-8.32/-7.78	-7.15/-7.30	-7.36/-7.42	-7.12/-6.11	-5.49/-5.59	-5.98/-6.39	-6.57/-7.34	-9.06/-11.02	-12.73/-13.49	-11.77/-10.37	-8.57/-7.22	-7.01/-6.57	-6.47/-6.66	-7.25/-8.29	-9.48/-9.36	
Freq(Hz)	5.62Pol	TotalAnt.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gain	Φ(0°)Φ(7.5°)	Φ(15°)Φ(22.5°)	Φ(30°)Φ(37.5°)	Φ(45°)Φ(52.5°)	Φ(60°)Φ(67.5°)	Φ(75°)Φ(82.5°)	Φ(90°)Φ(97.5°)	Φ(105°)Φ(112.5°)	Φ(120°)Φ(127.5°)	Φ(135°)Φ(142.5°)	Φ(150°)Φ(157.5°)	Φ(165°)Φ(172.5°)	Φ(180°)Φ(187.5°)	Φ(195°)Φ(202.5°)	Φ(210°)Φ(217.5°)	Φ(225°)Φ(232.5°)	Φ(240°)Φ(247.5°)	Φ(255°)Φ(262.5°)	Φ(270°)Φ(277.5°)	Φ(285°)Φ(292.5°)	Φ(300°)Φ(307.5°)	Φ(315°)Φ(322.5°)	Φ(330°)Φ(337.5°)	Φ(345°)Φ(352.5°)	
θ (0°)	-1.91/-2.66	-2.46/-2.50	-2.76/-2.54	-2.27/-2.42	-2.88/-3.23	-3.18/-2.86	-2.64/-2.25	-2.24/-1.94	-1.62/-1.54	-1.26/-0.85	-0.63/-0.69	-0.69/-0.58	-0.79/-1.22	-1.50/-1.73	-1.58/-1.78	-2.28/-2.41	-2.16/-2.43	-2.70/-2.14	-1.41/-1.20	-1.02/-1.20	-1.60/-1.44	-1.00/-0.74	-1.32/-1.50		
θ (7.5°)	-0.29/-0.35	-0.79/-1.17	-1.64/-1.85	-2.12/-2.18	-2.16/-2.17	-2.16/-1.78	-1.44/-1.47	-1.45/-1.24	-1.10/-0.96	-0.88/-0.68	-0.63/-0.88	-1.06/-1.22	-1.09/-0.93	-1.16/-2.00	-2.25/-1.81	-1.88/-2.68	-3.05/-2.78	-2.99/-3.39	-3.53/-3.13	-2.77/-2.82	-2.21/-1.83	-1.29/-1.24	-1.30/-0.80	-0.43/-0.75	
θ (15°)	-0.54/-0.23	-0.09/-1.43	-2.96/-3.78	-4.75/-4.54	-6.13/-3.76	-7.50/-7.75	-6.33/-5.52	-4.88/-6.06	-4.24/-2.37	-2.69/-2.52	-2.53/-2.36	-2.20/-2.31	-2.04/-1.51	-1.03/-1.02	-1.26/-1.55	-1.61/-1.99	-2.55/-2.69	-2.81/-2.83	-3.12/-3.93	-2.98/-2.99	-2.01/-1.24	-0.84/-0.96	-1.15/-0.84	-0.41/-1.09	
θ (22.5°)	-4.51/-7.09	-7.42/-9.74	-7.40/-8.03	-8.29/-6.82	-6.05/-6.98	-8.64/-10.79	-12.95/-12.97	-10.15/-8.50	-8.07/-5.78	-3.95/-3.55	-3.16/-2.50	-1.29/-1.92	-1.80/-1.85	-1.53/-0.97	-1.46/-1.12	-0.95/-0.90	-1.23/-1.70	-1.02/-1.46	-0.34/-2.16	-1.23/-1.56	-2.83/-3.46	-1.84/-1.30	-0.78/-0.76	-1.57/-2.76	
θ (30°)	-1.78/-3.08	-5.29/-5.21	-3.97/-2.85	-3.29/-5.61	-8.01/-8.00	-9.52/-9.84	-8.70/-8.98	-10.29/-8.21	-5.95/-3.96	-2.32/-1.31	-1.63/-2.09	-2.11/-2.23	-2.80/-3.13	-2.65/-1.47	-0.14/0.53	0.31/-0.33	-0.83/-0.61	-0.66/-0.68	-0.80/-0.59	-0.18/-0.09	-0.55/-0.93	-1.62/-1.19	-0.43/-0.14	-0.52/-1.34	
θ (37.5°)	-3.01/-2.95	-2.83/-2.70	-3.39/-3.81	-3.41/-4.98	-7.70/-7.83	-8.59/-10.26	-8.87/-7.65	-8.36/-7.86	-5.05/-4.24	-0.38/0.59	0.26/0.50	-0.96/-1.35	-1.97/-1.80	-0.78/0.65	1.67/1.78	1.26/0.73	0.47/0.08	-0.61/-2.14	-1.74/-4.00	-0.32/-0.62	-0.65/-1.85	-2.17/-1.36	-0.79/-1.18	-1.93/-2.02	
θ (45°)	-6.59/-6.20	-3.68/-4.18	-5.98/-8.15	-9.76/-10.40	-9.06/-9.19	-9.58/-9.40	-8.90/-7.22	-6.00/-5.49	-4.27/-1.76	-0.31/-1.12	-1.97/-1.09	-0.05/-1.05	-1.97/-1.98	-0.69/0.86	1.90/1.87	0.90/-0.47	-1.40/-2.23	-2.60/-3.14	-1.17/-1.30	-1.43/-1.69	-2.04/-2.20	-1.19/-4.09	-0.86/-4.16		
θ (52.5°)	-5.20/-6.25	-5.31/-5.44	-6.80/-9.25	-12.50/-12.47	-9.37/-6.87	-6.31/-6.14	-6.20/-7.38	-8.78/-9.40	-4.98/-1.32	0.89/1.81	1.54/0.19	-1.57/-2.41	-1.97/-0.62	1.06/1.89	1.81/1.38	0.56/0.72	-0.22/-1.46	-2.30/-4.18	-2.03/-0.67	0.47/0.54	-0.64/-3.38	-2.96/-1.30	-0.05/0.11	-1.44/-3.46	
θ (60°)	-2.61/-3.31	-5.42/-6.24	-8.26/-9.13	-10.28/-11.88	-10.76/-6.62	-3.72/-4.26	-5.53/-7.17	-9.56/-12.12	-9.14/-4.24	-0.69/0.94	1.19/1.25	0.39/-2.55	-3.59/-2.61	-1.04/0.30	0.86/0.20	-1.66/-3.15	-4.53/-4.80	-6.83/-3.99	-1.38/0.11	-0.53/-0.22	-0.23/0.86	-0.60/-1.71	-0.80/-0.80	-2.15/-2.90	
θ (67.5°)	-3.15/-3.13	-5.23/-6.80	-7.67/-5.34	-6.26/-6.76	-5.29/-2.70	-6.20/-2.86	-4.40/-5.65	-8.70/-5.26	-8.07/-2.86	-1.58/0.37	0.52/0.24	-0.28/-2.61	-3.25/-1.64	-3.09/0.77	0.68/0.33	-0.59/-1.66	-4.23/-5.61	-6.93/-3.88	-2.41/-0.89	-0.81/-2.15	-3.05/0.91	0.10/0.11	-0.41/-0.09	-0.89/-3.52	
θ (75°)	-3.78/-4.53	-11.08/-10.18	-8.59/-8.78	-6.96/-6.62	-4.67/-2.43	-1.03/-1.35	-2.09/-4.61	-9.93/-9.36	-7.76/-5.46	-2.77/-1.24	-0.64/0.09	-0.43/-3.05	-4.83/-6.84	-5.23/-1.90	-0.42/-1.08	-1.52/-3.55	-5.70/-7.55	-7.60/-7.21	-2.93/-0.05	0.28/0.49	-1.55/-1.10	-1.36/-2.38	-2.05/0.02	-0.46/-3.60	
θ (82.5°)	-2.72/-3.31	-8.82/-9.14	-5.68/-3.81	-8.73/-9.63	-6.35/-2.52	-0.89/-1.43	-2.59/-2.76	-4.84/-6.58	-3.16/-2.34	-0.85/-0.63	-1.52/-3.37	-4.07/-3.68	-3.25/-0.78	-0.07/0.02	0.36/-1.84	-4.86/-5.42	-1.57/-0.15	-4.84/-1.71	-2.06/-1.70	-1.91/-3.36	-2.04/-0.65	-0.47/-0.28	-2.04/-0.65	-0.47/-0.28	
θ (90°)	-2.61/4.86	-6.27/-7.24	-5.79/-9.50	-8.13/-5.93	-4.36/-2.33	-1.51/-1.05	-1.20/-3.58	-5.81/-7.38	-5.14/-2.77	-0.75/0.16	-1.02/0.65	-1.62/-1.54	-2.46/-4.17	-3.47/2.54	-2.44/-1.75	-2.77/5.59	-3.96/-6.85	-4.72/-3.34	0.27/0.29	1.50/4.44	-0.13/-0.04	-0.81/-3.87	-1.91/-1.27	-2.05/-2.93	
θ (97.5°)	-1.31/-4.83	-7.08/-3.57	-6.24/-9.41	-8.86/-4.38	-7.84/-4.74	-3.43/-1.72	-0.34/-1.83	-5.73/-6.54	-4.21/-1.57	-0.18/-0.05	-0.05/-0.57	-0.96/-1.74	-4.53/-5.10	-2.21/0.55	1.06/0.64	-1.32/-2.21	-3.39/-2.78	-2.36/-0.66	0.70/0.09	1.10/2.61	-1.08/-1.65	-5.33/-6.06	-2.50/-1.33	-5.97/-3.78	
θ (105°)	0.11/-2.77	-6.72/-6.43	-6.47/-8.11	-7.68/-4.18	-7.66/-6.25	-4.22/-3.79	-1.80/-2.26	-7.14/-7.77	-6.36/-6.11	-0.61/1.65	1.47/1.33	-0.24/-0.43	-0.60/-3.24	-2.08/0.12	0.09/-0.44	-1.97/-1.99	-1.25/-2.84	-1.16/-0.32	1.91/2.23	3.12/2.66	0.33/0.45	-0.39/-3.97	-3.83/-4.41	-8.81/-3.95	
θ (112.5°)	-3.36/-7.17	-10.70/-5.48	-8.11/-5.88	-9.51/-3.88	-7.79/-12.91	-9.46/-7.51	-6.67/-5.13	-6.26/-8.79	-6.78/-5.66	-0.85/0.89	0.72/1.33	-0.27/0.30	-0.10/-2.11	0.57/1.86	1.53/0.92	-0.52/-0.26	1.18/0.57	-0.24/-1.33	2.89/2.58	<b>3.44/2.56</b>	0.62/0.58	-2.22/-2.72	-7.71/9.44	-8.00/-4.97	
θ (120°)	-1.22/-6.94	-12.44/-7.54	-3.72/-10.83	-11.71/-11.54	-10.03/-11.00	-10.70/-7.19	-3.71/-4.13	-7.40/-8.70	-8.27/-5.31	-1.58/-0.83	1.59/1.30	0.36/2.17	0.11/0.08	2.39/1.15	1.50/0.21	-1.36/-1.91	-2.46/-1.05	-0.24/0.92	1.68/2.61	3.41/1.89	-0.91/-3.51	-4.22/-7.42	-7.95/-10.37	-9.14/9.86	
θ (127.5°)	-7.62/-9.14	-11.47/-8.60	-6.76/-12.67	-6.16/-5.72	-10.18/-11.29	-10.14/-6.69	-7.33/-2.97	-7.92/-4.32	-3.28/-4.35	-3.90/-5.06	-1.87/-1.95	0.89/1.59	0.40/1.37	1.87/1.38	0.76/0.33	-2.19/-1.85	-0.83/0.97	1.51/0.94							



# Antenna Pattern

# Appendix B

Theta (°)	5.46/5.49	-7.10/9.41	-8.03/5.30	-5.61/4.57	-1.88/2.30	-4.38/4.62	-3.35/2.99	-5.12/7.86	-4.89/1.53	-0.54/0.13	-0.67/5.97	-7.69/3.24	-5.83/4.78	-4.86/2.43	0.12/1.89	-4.31/1.64	-0.45/0.41	-2.11/6.69	-15.22/12.01	-12.32/10.83	-9.54/8.29	-5.72/7.52	-9.90/8.21	-7.94/5.51																							
Theta (127.5°)	-5.46/5.49	-7.10/9.41	-8.03/5.30	-5.61/4.57	-1.88/2.30	-4.38/4.62	-3.35/2.99	-5.12/7.86	-4.89/1.53	-0.54/0.13	-0.67/5.97	-7.69/3.24	-5.83/4.78	-4.86/2.43	0.12/1.89	-4.31/1.64	-0.45/0.41	-2.11/6.69	-15.22/12.01	-12.32/10.83	-9.54/8.29	-5.72/7.52	-9.90/8.21	-7.94/5.51																							
Theta (135°)	-7.68/8.80	-5.53/6.81	-3.48/2.12	-2.95/5.33	-6.10/5.15	-5.19/6.41	-5.41/3.91	-4.23/3.89	-2.58/2.21	-2.03/2.98	-5.53/5.74	-8.11/4.58	-5.44/8.33	-7.30/2.25	0.00/2.86	-4.90/1.53	-0.84/0.10	-1.91/4.19	-10.80/10.59	-10.10/6.92	-8.77/10.81	-7.01/11.79	-12.85/10.51	-7.99/10.33																							
Theta (142.5°)	-7.09/10.71	-5.60/4.82	-6.49/7.60	-10.09/9.63	-5.58/4.19	-3.16/1.84	-1.24/1.38	-2.05/2.60	-3.02/4.37	-5.41/7.31	-6.92/6.73	-6.75/6.99	-5.13/3.85	-4.72/4.69	-4.20/5.27	-5.59/5.02	-1.56/1.37	-4.18/5.65	-8.57/11.58	-14.86/9.75	-8.04/7.95	-6.74/8.77	-9.71/9.37	-5.38/5.42																							
Theta (150°)	-15.01/13.79	-10.31/8.49	-9.16/9.10	-8.63/7.15	-4.92/3.75	-3.06/2.25	-1.59/1.32	-1.51/2.09	-2.92/3.55	-4.67/7.50	-12.24/10.46	-6.13/4.76	-7.13/9.75	-7.36/5.69	-5.93/7.26	-7.25/4.35	-2.20/2.65	-3.76/4.51	-8.19/13.97	-14.21/15.20	-11.63/9.67	-9.09/9.63	-11.40/13.04	-11.78/15.96																							
Theta (157.5°)	-15.22/12.63	-9.34/9.87	-13.31/11.40	-8.36/6.08	-5.11/5.26	-5.87/4.96	-4.13/3.48	-2.95/2.05	-1.45/1.68	-2.90/4.39	-4.81/6.41	-4.13/4.07	-5.62/7.64	-8.23/8.89	-9.74/10.20	-10.25/10.88	-13.22/10.97	-8.43/8.84	-11.05/13.38	-14.93/13.64	-9.14/7.59	-8.60/11.54	-13.53/12.53	-14.88/15.42																							
Theta (165°)	-10.12/10.38	-10.27/10.12	-11.30/11.53	-9.88/8.44	-7.26/5.98	-5.57/5.24	-4.51/3.83	-3.66/3.66	-3.59/3.81	-4.86/5.91	-6.09/6.95	-5.66/6.06	-7.66/8.60	-7.90/7.15	-6.82/7.34	-8.20/9.12	-9.74/9.27	-8.54/8.41	-8.06/7.97	-8.71/8.17	-7.36/8.28	-10.65/12.95	-12.34/12.46	-13.37/11.48																							
Theta (172.5°)	-7.37/7.82	-7.85/7.42	-8.35/7.87	-7.02/6.44	-6.38/6.85	-6.63/6.42	-6.04/5.76	-5.66/5.57	-5.53/5.22	-5.08/4.78	-4.47/4.16	-3.93/4.15	-4.73/5.29	-5.85/5.97	-6.53/4.93	-4.99/5.82	-6.61/7.74	-8.27/8.37	-8.55/9.43	-10.26/11.01	-12.90/13.77	-14.05/12.25	-8.86/8.95	-8.39/7.66																							
Theta (180°)	-10.40/10.71	-10.14/9.40	-9.06/7.75	-6.87/6.57	-6.17/6.31	-6.24/5.83	-5.68/5.26	-5.13/5.17	-5.16/5.14	-4.96/4.80	-4.63/4.68	-5.07/6.07	-7.93/9.73	-10.67/10.82	-10.94/11.31	-10.85/9.93	-9.52/9.35	-9.47/10.45	-12.04/12.07	-12.18/12.12	-12.56/13.22	-12.53/11.58	-11.03/10.55	-9.29/9.12																							
Freq(Hz)	5.3GPol	TotalAnt.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
Gain	Phi(7.5°)	Phi(15°)	Phi(22.5°)	Phi(30°)	Phi(37.5°)	Phi(45°)	Phi(52.5°)	Phi(60°)	Phi(67.5°)	Phi(75°)	Phi(82.5°)	Phi(90°)	Phi(97.5°)	Phi(105°)	Phi(112.5°)	Phi(120°)	Phi(127.5°)	Phi(135°)	Phi(142.5°)	Phi(150°)	Phi(157.5°)	Phi(165°)	Phi(172.5°)	Phi(180°)	Phi(187.5°)	Phi(195°)	Phi(202.5°)	Phi(210°)	Phi(217.5°)	Phi(225°)	Phi(232.5°)	Phi(240°)	Phi(247.5°)	Phi(255°)	Phi(262.5°)	Phi(270°)	Phi(277.5°)	Phi(285°)	Phi(292.5°)	Phi(300°)	Phi(307.5°)	Phi(315°)	Phi(322.5°)	Phi(330°)	Phi(337.5°)	Phi(345°)	Phi(352.5°)
Theta (0°)	-2.50/1.90	-1.54/1.18	-0.77/0.66	-0.56/0.28	-0.02/0.03	0.05/0.28	0.18/0.43	-0.82/1.33	-1.66/1.76	-1.90/2.29	-1.96/2.18	-2.05/1.83	-1.34/1.45	-1.43/1.39	-1.36/1.21	-1.01/0.91	-0.87/1.02	-1.44/1.76	-1.94/1.65	-1.66/2.00	-2.07/2.30	-2.60/2.63	-2.62/2.73	-2.79/2.46																							
Theta (7.5°)	-2.62/2.62	-2.66/2.58	-2.69/2.87	-2.84/2.43	-1.72/1.60	-1.70/1.94	-1.94/1.74	-1.58/2.13	-1.88/2.03	-2.25/2.62	-2.58/2.29	-1.81/1.43	-1.20/1.24	-1.30/1.28	-1.22/1.37	-1.36/1.28	-1.19/0.86	-0.91/1.37	-1.72/1.67	-1.65/1.83	-1.86/2.08	-2.36/2.48	-2.52/2.64	-2.70/2.70																							
Theta (15°)	-3.26/4.67	-5.91/6.18	-4.80/3.36	-2.48/2.29	-2.04/1.67	-0.97/0.75	-0.83/1.15	-1.01/0.94	-0.97/0.96	-0.79/0.80	-0.71/0.50	-0.51/0.83	-1.75/2.59	-3.10/2.94	-2.65/2.71	-3.31/4.04	-4.46/3.88	-3.92/3.60	-4.11/4.36	-4.23/3.83	-3.23/2.94	-2.87/2.83	-2.68/2.45	-2.27/2.63																							
Theta (22.5°)	-5.37/4.00	-2.68/1.71	-1.72/1.24	-2.94/3.32	-3.61/4.40	-3.77/3.23	-2.97/2.32	-1.40/0.59	0.14/0.87	1.41/1.70	1.76/1.23	-0.07/2.08	-3.68/4.16	-3.87/3.72	-4.26/5.17	-6.54/7.55	-8.16/8.91	-9.71/10.08	-9.63/7.58	-5.67/3.99	-3.18/3.03	-3.17/3.55	-4.16/5.48	-5.91/6.12																							
Theta (30°)	-4.47/3.01	-1.93/2.04	-2.43/3.11	-3.44/3.30	-4.25/4.95	-4.20/3.86	-3.97/3.62	-1.00/8.36	-9.88/8.50	0.60/1.29	1.40/1.30	0.55/0.86	-2.19/3.33	-4.73/6.74	-8.59/9.89	-11.22/12.11	-10.67/7.39	-4.79/3.33	-3.34/4.08	-4.40/4.03	-3.10/2.87	-1.46/2.01	-3.86/4.52																								
Theta (37.5°)	-3.33/3.46	-3.59/4.68	-6.92/8.22	-6.64/3.80	-2.53/1.96	-2.26/2.80	-4.09/7.28	-10.32/9.54	-6.04/3.07	-1.08/0.08	0.22/0.02	-1.02/2.84	-4.57/7.09	-10.05/12.10	-11.20/9.05	-8.51/6.85	-3.67/1.29	-0.50/0.47	-0.38/0.40	-0.72/0.43	-0.18/0.65	-1.54/1.81	-2.30/2.98	-3.74/3.56																							
Theta (45°)	-1.94/2.40	-3.44/5.89	-5.55/3.89	-2.27/0.22	1.30/2.61	3.49/3.75	3.33/2.32	0.64/1.94	-5.96/10.68	-7.93/3.98	-1.40/0.72	-1.87/2.76	-2.91/3.64	-6.67/8.62	-7.22/5.11	-3.08/1.59	0.19/1.01	1.13/0.91	0.71/0.72	0.45/0.07	0.01/0.34	0.25/0.53	-1.52/2.70	-3.42/3.38																							
Theta (52.5°)	-4.96/5.97	-5.80/3.82	-2.40/1.14	0.35/1.99	2.51/2.35	2.08/2.28	2.57/1.67	0.70/0.23	-0.67/2.42	-3.77/2.08	-0.11/0.33	-0.36/0.38	-1.34/2.77	-3.67/2.83	-2.17/1.58	-0.19/1.55	2.51/2.88	3.43/3.88	3.13/1.49	0.64/0.55	0.30/0.94	-1.85/1.73	-1.46/2.01	-3.06/3.78																							
Theta (60°)	-5.07/5.44	-5.69/3.94	-1.84/1.35	-1.29/1.20	-0.93/1.33	-1.31/0.36	0.46/0.66	1.07/0.21	2.73/2.19	-0.32/3.45	-2.29/0.54	-0.89/1.92	-2.20/3.56	-4.53/4.27	-3.17/1.84	-0.18/0.43	0.39/0.97	1.86/2.40	2.00/0.62	-0.05/0.30	0.56/0.83	-2.25/1.83	-1.71/3.36	-5.10/4.78																							
Theta (67.5°)	-4.37/7.80	-5.10/1.50	-1.30/1.92	-2.21/0.22	-3.56/4.99	-4.11/2.45	-2.41/3.78	-6.00/2.77	1.77/3.82	3.28/1.43	0.51/0.84	0.59/0.94	-3.26/3.59	-4.16/3.68	-6.72/1.07	0.36/0.13	0.18/0.44	0.41/0.03	-1.28/3.29	-4.07/1.28	-0.07/0.33	-3.09/3.68	-1.51/1.53	-2.80/3.39																							
Theta (75°)	-5.28/4.61	-4.84/4.92	-5.75/5.71	-5.23/2.67	-0.74/0.13	-0.29/0.21	0.27/0.40	-5.68/11.25	-1.39/2.24	3.26/1.78	0.27/1.17	0.105/0.91	-3.56/4.21	-4.76/5.74	-6.03/5.17	-5.24/6.95	-5.03/5.74	-4.96/4.56	-6.60/2.86	-3.11/3.64	-4.60/4.61	-5.62/4.61	-5.29/4.59																								
Theta (82.5°)	-4.56/5.58	-4.71/3.82	-5.96/4.38	-0.95/0.64	0.69/1.06	1.42/2.80	3.82/3.35	0.74/6.15	-7.53/1.88	4.48/3.70	-0.10/3.26	-3.12/5.21	-8.14/10.32	-7.79/8.86	-10.01/6.51	-6.05/7.00	-8.80/7.40	-6.79/6.02	-7.53/9.11	-8.96/5.33	-3.66/4.69	-6.53/4.77	-2.52/3.29	-7.68/6.58																							
Theta (90°)	-4.42/5.25	-6.58/8.85	-7.15/3.25	-0.77/0.95	1.56/1.16	1.54/2.81	3.75/3.85	2.54/1.03	-7.41/1.18	2.10/2.36	0.63/1.09	-1.79/5.14	-9.34/10.40	-13.97/14.30	-15.91/13.82	-12.13/11.32	-7.51/5.29	-3.09/1.84	-1.61/3.09	-3.50/2.88	-2.97/6.14	-10.76/6.56	-4.63/4.61	-4.30/4.19																							
Theta (97.5°)	-4.02/5.23	-4.84/4.92	-5.77/3.00	-0.43/0.67	1.12/1.49	0.84/1.62	3.82/3.45	3.08/0.81	-5.24/4.89	-1.29/0.67	-3.44/5.44	-8.37/9.27	-10.79/8.08	-9.82/9.78	-7.86/6.85	-4.16/0.95	3.80/1.78	1.46/0.99	0.25/0.86	-0.99/3.34	-6.39/4.79	-5.03/6.74	-5.10/3.16																								
Theta (105°)	-6.97/9.23	-8.84/9.94	-8.23/3.90	-3.19/1.43	0.60/1.06	1.05/1.57	1.88/1.83	1.57/0.42	-3.35/7.98	-4.43/3.43	-4.84/4.16	-2.49/1.57	-2.62/3.56	-4.60/3.47	-3.19/4.58	-3.88/2.46	-1.57/0.33	0.88/1.41	0.53/1.17	0.82/0.22	-0.56/2.33	-3.04/4.97	-5.71/5.76	-4.31/4.36																							
Theta (112.5°)	-7.54/9.56	-7.85/9.04	-11.27/5.64	-2.43/1.09	0.78/0.99	0.66/1.39	2.30/1.92	0.57/0.69	-3.83/10.29	-4.81/2.18	-4.08/3.11	-1.77/0.70	-1.84/2.22	-0.08/0.46	-4.44/1.51	-1.78/1.07	0.96/1.22	0.77/0.95	-1.92/0.35	-1.14/2.21	-0.81/4.04	-4.32/1.79	-5.48/3.33	-5.20/2.77																							
Theta (120°)	-12.93/8.26	-14.81/7.40	-6.03/4.46	-1.93/0.21	-1.10/0.74	0.30/0.68	-0.10/0.81	-0.27/1.74	-3.54/3.31	-2.16/2.58	-4.95/0.64	-3.88/3.17	-2.21/0.31	-1.16/2.47	1.77/0.70	1.16/2.47	2.14/0.17	-4.19/3.83	-2.19/3.75	-2.19/3.75	-3.59/4.88	-5.94/6.90	-5.50/5.20																								
Theta (127.5°)	-7.45/7.35	-7.10/7.13	-7.81/5.62	-4.78/4.05	-2.92/4.13	-4.96/3.79	-2.26/2.37	-3.97/6.13	-5.07/0.87	0.61/0.64	-0.43/6.69	-6.51/2.19	-3.45/2.28	-2.88/2.58	0.23/0.75	-3.17/1.89	-1.00/0.02	-1.11/5.16	-9.31/7.46	-6.42/6.98	-9.56/12.22	-7.82/8.72	-7.75/5.05	-5.73/4.27																							
Theta (135°)	-6.88/7.02	-5.46/3.50	-2.82/1.96	-3.35/5.72	-6.97/5.46	-6.19/5.69	-3.96/2.69	-2.64/2.67	-1.48/1.37	-2.01/3.19	-5.31/5.69	-8.42/3.96	-3.04/4.50	-5.11/1.04	1.22/1.15	-4.21/0.55	0.88/0.98	-2.81/6.30	-11.62/10.36	-10.44/6.98	-8.34/10.14	-6.45/10.82	-10.59/8.63	-6.44/7.93																							
Theta (142.5°)	-7.25/10.37	-6.55/6.51	-9.63/10.35	-11.41/8.60	-4.10/2.53	-1.79/1.25	-0.45/0.19	-1.07/2.30	-3.20/3.69	-5.24/8.56	-8.28/6.82	-8.14/7.57	-6.67/6.70	-5.63/4.37	-4.11/6.21	-5.63/3.37	-0.15/0.26	-6.64/5.92	-8.41/10.08	-15.42/6.32	-4.70/7.05	-6.89/9.72	-13.30/10.61	-5.70/5.93																							
Theta (150°)	-15.70/12.17	-8.51/7.61	-7.60/6.39	-5.63/4.95	-3.79/3.00	-2.71/2.78	-2.65/2.05	-1.35/1.55	-2.88/3.86	-5.07/7.33	-10.07/8.73	-6.43/6.00	-8.21/9.35	-7.79/7.34	-6.82/7.49	-6.08/3.96	-2.07/1.97	-3.21/5.99	-11.63/14.75	-10.98/11.36	-12.83/9.21	-11.92/11.17	-10.44/13.32	-12.24/																							



E1(XY plane) –  $\Theta(90)\Phi(0-360)$   
 E2(XZ plane) –  $\Theta(0-180)\Phi(0)$  and  $\Theta(0-180)\Phi(180)$   
 E3(YZ plane) –  $\Theta(0-180)\Phi(90)$  and  $\Theta(0-180)\Phi(270)$

