



# Antenna Composite Gain Test Report

FCC ID	Z8H-89FT0067
Equipment	XE3-4 Wi-Fi 6e Indoor Access Point
Brand Name	Cambium Networks
Model Name	XE3-4
Applicant	Cambium Networks Inc. 3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA
Manufacturer	Cambium Networks, Ltd. Ashburton, TQ13 7UP, UK
Sample Received	Aug. 11, 2022
Start Test Date	Aug. 16, 2022
Final Test Date	Aug. 16, 2022

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	Remark
	WLAN 5GHz	WLAN 6GHz						
Ant1	4	4	Accton	EAP9219A-6E-1120-CAM	PIFA	I-PEX	5GHz UNII1~4 and 6GHz	Radio 2
Ant2	2	2	Accton	EAP9219A-6E-1120-CAM	PIFA	I-PEX	5GHz UNII1~4 and 6GHz	Radio 2
Ant3	3	3	Accton	EAP9219A-6E-1120-CAM	PIFA	I-PEX	5GHz UNII1~4 and 6GHz	Radio 2
Ant4	1	1	Accton	EAP9219A-6E-1120-CAM	PIFA	I-PEX	5GHz UNII1~4 and 6GHz	Radio 2

Note:

5GHz and 6GHz Operation Mode (4TX/4RX)

Ant1~4 can be used as transmitting/receiving antenna.

Ant1~4 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]
5725-5895	5850
5725-5895	5885
5725-5895	5895

### 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	Rex Liao	23.5-24.5 / 40-50	Aug. 16, 2022

Note:

Testing Site Information

Brand Name: TDK

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

Characteristic: Fully Anechoic Chamber

#### 4. Test Facility and Configuration

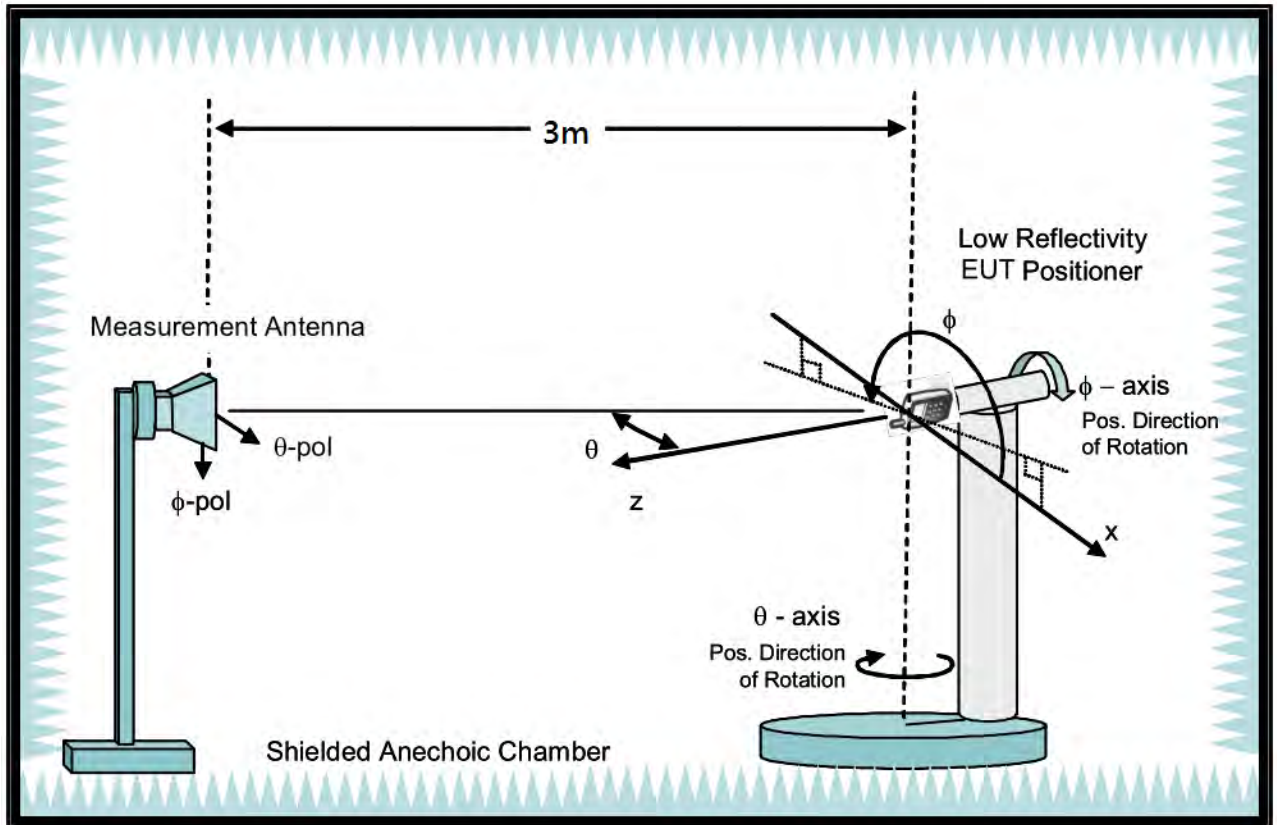
Test configuration: Reference to CITA OTA distributed-axes system configuration.

Chamber: Fully Anechoic Chamber.

Measurement antenna: Dual Polarization Horn antenna

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

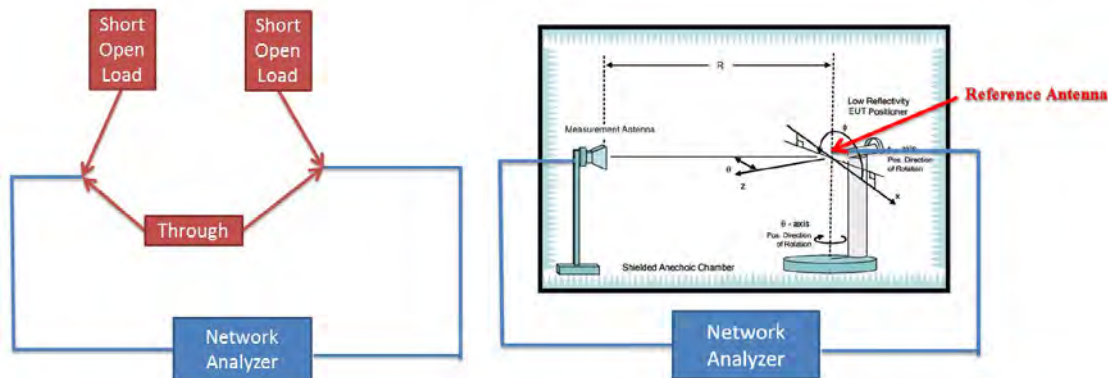
#Reference to CTIA "ctia-test-plan-for-wireless-device-over-the-air-performance-ver-3-7-1"



### 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)	-33.55	-33.27	-32.92	-32.91	-32.73	-32.02	-32.67	-32.82	-32.98	-33.18	-32.8	-33.92	-34.62	-35.57
G(phi) reading (dB)	-33.15	-32.7	-32.41	-32.61	-32.43	-31.72	-32.37	-32.51	-32.52	-32.66	-32.5	-33.62	-34.32	-35.48
Reference gain (dBi)	10.1	10.4	10.7	12.5	12.7	13.5	13.4	13.3	13.3	13.2	13.4	12.5	12.1	11.4
Factor(theta) (dB)	43.65	43.67	43.62	45.41	45.43	45.52	46.07	46.12	46.28	46.38	46.2	46.42	46.72	46.97
Factor(phi) (dB)	43.25	43.1	43.11	45.11	45.13	45.22	45.77	45.81	45.82	45.86	45.9	46.12	46.42	46.88

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)	5.85G	5.885G	5.895G
Ant. 1 (dBi)	3.22	3.16	3.18
Ant. 2 (dBi)	-2.04	-1.33	-0.99
Ant. 3 (dBi)	-2.25	-1.38	-1.03
Ant. 4 (dBi)	2.83	2.71	3.21
DG [1SS] (dBi)	6.84	7.07	7.37
Polarization	Theta	Theta	Theta
$\Theta(^{\circ})$	45	45	45
$\Phi(^{\circ})$	202.5	202.5	202.5

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)	5.85G	5.885G	5.895G
Ant. 1 [ $10^{(G/20)}$ ]	$10^{(3.22/20)}$	$10^{(3.16/20)}$	$10^{(3.18/20)}$
Ant. 2 [ $10^{(G/20)}$ ]	$10^{(-2.04/20)}$	$10^{(-1.33/20)}$	$10^{(-0.99/20)}$
Ant. 3 [ $10^{(G/20)}$ ]	$10^{(-2.25/20)}$	$10^{(-1.38/20)}$	$10^{(-1.03/20)}$
Ant. 4 [ $10^{(G/20)}$ ]	$10^{(2.83/20)}$	$10^{(2.71/20)}$	$10^{(3.21/20)}$
Ant. 1 [ $10^{(G/20)}$ ] value	1.449	1.439	1.442
Ant. 2 [ $10^{(G/20)}$ ] value	0.791	0.858	0.892
Ant. 3 [ $10^{(G/20)}$ ] value	0.772	0.853	0.888
Ant. 4 [ $10^{(G/20)}$ ] value	1.385	1.366	1.447
Sum All Antenna [Amax]	4.396	4.516	4.67
DG [ $10 \cdot \log(A_{max}^2/N_{ant})$ ]	6.84	7.07	7.37

Note:

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

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





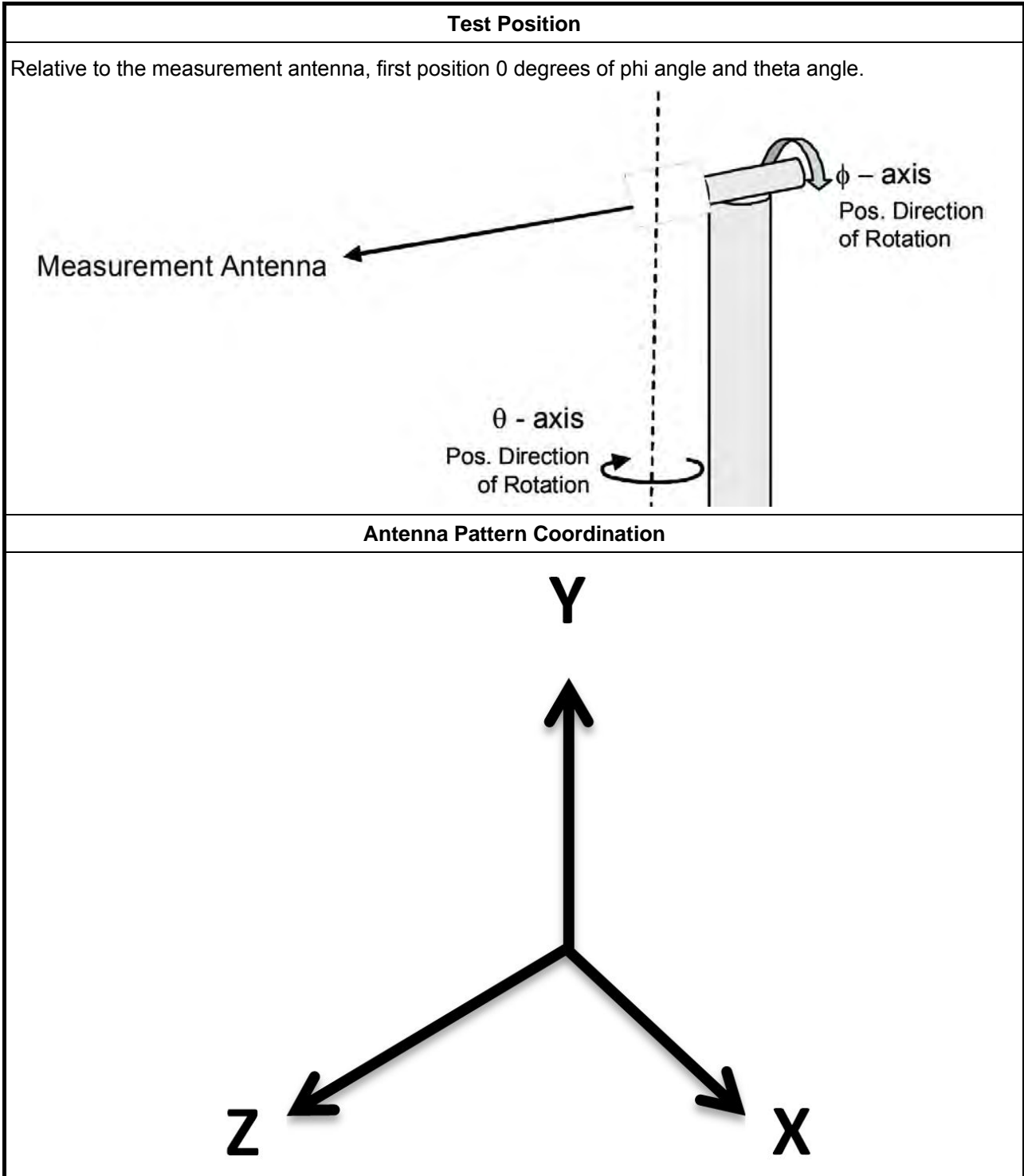
### 8. Summary of Test Result

Frequency (Hz)	5.85G	5.885G	5.895G
Ant. 1 Max Gain (dBi)	5.49	5.29	5.44
Ant. 2 Max Gain (dBi)	5.08	4.77	4.82
Ant. 3 Max Gain (dBi)	3.85	3.73	3.9
Ant. 4 Max Gain (dBi)	4.6	4.69	4.77
Ant. 1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/37.5/180	Theta/37.5/180	Theta/37.5/180
Ant. 2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/15/262.5	Theta/15/262.5	Theta/15/262.5
Ant. 3 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/30/285	Theta/30/277.5	Theta/30/277.5
Ant. 4 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/52.5/210	Theta/52.5/202.5	Theta/52.5/202.5
Max Gain (dBi)	5.49	5.29	5.44
DG [1SS] (dBi)	6.84	7.07	7.37
DG [2SS] (dBi)	5.49	5.29	5.44
DG [4SS] (dBi)	5.49	5.29	5.44

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.
4. Directional Gain (4SS) = Directional Gain (1SS) – 6dB. If directional gain is less than max gain, use max gain as directional gain.

### 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. 31, 2022	May. 30, 2023
Dual Polarization Horn Antenna	Sporton	S0209DP	S0209DP-001	2GHz~9GHz	N.C.R.	N.C.R.
ENA Series Network Analyzer	AGILENT	E5071C	MY46419201	100kHz~8.5GHz	Feb. 21, 2022	Feb. 20, 2023
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.

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Freq(Hz)	5.85G	5.885G	5.895G
Ant. 1 Max Gain (dBi)	5.49	5.29	5.44
Ant. 2 Max Gain (dBi)	5.08	4.77	4.82
Ant. 3 Max Gain (dBi)	3.85	3.73	3.9
Ant. 4 Max Gain (dBi)	4.6	4.69	4.77
Ant. 1 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Theta/37.5/180	Theta/37.5/180	Theta/37.5/180
Ant. 2 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Theta/15/262.5	Theta/15/262.5	Theta/15/262.5
Ant. 3 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Theta/30/285	Theta/30/277.5	Theta/30/277.5
Ant. 4 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Theta/52.5/210	Theta/52.5/202.5	Theta/52.5/202.5
Max Gain (dBi)	5.49	5.29	5.44
DG [1SS] (dBi)	6.84	7.07	7.37
DG [2SS] (dBi)	5.49	5.29	5.44
DG [4SS] (dBi)	5.49	5.29	5.44



# Radiated Composite Gain Data

# Appendix A

## DG 1SS Result

Freq(Hz)	5.85GPol.	PhiL	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(°)	1.25/1.74	1.53/1.66	2.26/2.54	2.46/1.88	1.45/1.51	0.89/0	-0.61/-1.79	-2.66/-2.38	-1.59/-0.89	0.05/11	0.43/0.86	1.56/2.53	2.88/3.1	3.5/3.76	3.56/3.46	3.14/2.72	2.35/1.68	1.30/88	-0.27/-0.52	-1.11/-0.63	-0.45/0.36	0.37/1.36	0.60/77	0.64/51
Theta(7.5°)	4.54/4.88	4.54/4.88	4.87/4.61	3.99/4.42	2.74/1.98	1.33/0.59	0.27/0.52	0.83/0.84	0.84/0.81	1.02/0.89	0.96/0.57	0.25/0.35	1.25/1.86	2.05/2.53	3.17/3.1	2.95/2.4	2.06/2.17	-0.11/-0.78	-1.04/-0.25	-1.25/0.37	1.28/1.88	2.6/23	3.53/42	
Theta(15°)	2.98/3.69	4.11/3.96	4.18/4.11	3.84/3.44	2.94/2.14	1.37/0.47	-0.13/0.45	0.79/1.28	1.65/2.04	2.46/3.02	3.27/2.94	2.35/1.7	1.33/1.61	2.44/3.64	4.61/4.82	4.48/3.82	2.89/2.02	0.51/-1.6	-2.98/-2.19	-0.20/84	1.26/1.89	2.52/27	1.95/1.71	1.86/2.25
Theta(22.5°)	3.24/0.8	4.04/3.67	2.93/2.49	2.07/2.27	2.49/2.64	2.96/3.83	2.15/0.92	0.05/0.17	1.66/2.89	3.65/4.25	4.15/3.95	3.32/1.93	0.79/0.21	1.72/3.05	3.76/3.8	3.27/2.24	2.01/1.85	0.88/0.57	-1.89/-1.43	-0.13/0.97	1.72/2.4	2.29/2.02	0.42/-0.59	-0.39/-1.19
Theta(30°)	3.68/4.28	4.04/3.67	3.27/3.09	3.25/3.56	3.64/0.6	<b>4.97/5.66</b>	4.62/2.93	1.45/1.94	3.19/4.44	4.82/4.65	4.23/4.4	4.62/3.94	3.12/2.75	2.32/2.77	3.31/3.24	2.46/1.53	1.42/2.3	2.51/5.9	-0.12/-1.17	-1.71/0.43	0.93/1.7	1.80/76	-0.39/-0.34	0.62/2.22
Theta(37.5°)	3.19/3.04	2.69/2.57	2.18/1.78	3.24/4.38	4.87/4.81	4.52/4.27	3.71/2.19	2.08/3.18	3.91/3.55	2.48/2.74	3.61/4.32	4.55/3.93	2.8/3	3.65/3.11	2.72/6.4	2.06/1.91	2.28/2.41	1.66/1.43	1.14/0.63	-1.34/-1.35	-0.30/36	0.05/-0.15	0.91/1.28	1.66/2.15
Theta(45°)	2.89/2.73	2.62/2.37	1.96/2.50	1.87/3.65	4.03/2	2.77/1.29	-0.15/-1.45	-0.23/1.8	2.52/37	2.48/3.58	3.58/2.93	3.28/3.02	3.14/2.73	4.02/3.71	3.79/3.23	2.16/1.82	2.01/1.12	0.71/1.56	1.55/1.65	-0.52/-3.55	-1.48/1	1.76/23	3.61/2.71	1.61/2.14
Theta(52.5°)	3.33/4.6	3.09/2.28	1.4/0.12	1.23/2.2	3.39/2.82	0.74/0.51	-0.95/-2	-0.37/0.65	1.72/2.62	3.22/3.29	2.13/1.01	1.11/2.18	2.86/2.98	3.89/3.24	2.72/1.93	2.31/85	2.31/0.28	-0.29/1.77	0.70/08	-2.38/-2.63	-0.97/0.91	1.94/33	4.96/4.53	2.68/2.43
Theta(60°)	3.15/3.13	2.70/91	-1.32/-1.35	0.15/2.06	2.34/1.73	-0.84/-1.98	-2.13/-1.03	-0.18/0.19	0.18/1.62	2.38/2.27	2.41/73	1.96/2.75	2.94/3.58	5/3	2.32/2.05	1.47/0.61	1.01/-1.11	-1.72/0.8	-0.25/-1.69	-3.9/-2.35	0.08/0.86	2.62/27	4.53/4.92	32/14
Theta(67.5°)	2.55/2.54	2.02/0.97	-0.86/-1.6	-0.42/0.52	1.29/1.3	-1.21/-2.96	-2.37/-1.33	0.15/0.34	-0.96/0.3	1.39/1.63	3.05/2.09	1.27/1.63	2.49/3.67	4.92/3.63	2.86/2.21	2.43/0.77	-0.21/-0.21	-0.47/1.28	-0.13/-1.39	-3.12/-1.85	0.18/0.36	1.45/0.01	2.65/4.39	2.82/0.21
Theta(75°)	0.93/0.62	0.72/0.39	-0.27/-0.98	-0.84/-0.31	-0.25/0.21	-2.13/-5.59	-5.45/-1.87	-0.95/-2.17	-0.98/-0.98	0.71/45	3.03/1.57	-0.65/0.13	1.03/2.44	4.2/2.69	2.67/2.25	2.32/1.56	0.23/1.28	0.62/1.26	-0.69/-2.32	-2.12/-1.14	0.54/0.45	-0.05/-1.23	1.03/2.6	1.86/0.08
Theta(82.5°)	-0.59/-0.62	0.05/0.5	-0.93/-1.3	-2.22/-1.83	-1.81/1.83	-3.36/-6.96	-5.83/-3.21	-1.95/-2.53	-0.92/1	1.25/-0.76	-3.17/-2.36	-0.61/0.61	2.46/0.92	1.37/1.46	1.88/2.61	0.25/0.34	-0.31/-2.55	-1.71/-2.21	-0.08/-1.28	-1.12/-2.62	-0.78/0.88	-0.92/-2.12	-0.78/0.88	-0.92/-2.12
Theta(90°)	-2.16/-3.47	-1.91/-1.44	-1.86/-2.94	-3.57/-3.59	-3.09/-2.72	-3.35/-6.95	-5.76/-6.63	-4.54/-3.88	-4.23/-4.78	-3.79/-1.45	-0.19/-1.86	-4.47/-3.16	-2.17/-0.95	0.85/-0.96	-0.33/2.18	0.28/-0.44	1.83/0.43	-1.17/-3.17	-2.08/-4.41	-2.35/-4.4	-1.41/-3.78	-3.84/-3.82	-2.29/-0.65	-2.63/-0.48
Theta(97.5°)	-2.97/4.33	-3.18/-1.69	-2.76/-4.68	-5.43/-6.33	-5.13/-4.55	-6.13/-9.79	-6.88/-7.53	-6.55/-4.53	-6.56/-7.61	-7.63/-5	-2.09/-3.2	-5.41/-9.77	-3.81/-2.68	-0.15/-1.86	-1.46/0.35	-2.3/-1.6	0.91/-4.94	-3.37/-0.51	-3.34/-4.14	-4.67/-5.39	-3.85/-5.42	-3.9/-4.94	-3.58/-2.52	-4.59/-5.52
Theta(105°)	-5.94/-5.78	-4.49/-2.73	-3.43/-5.97	-7.11/-7.06	-6.05/-5.2	-6.51/-10.99	-9.97/-9.99	-8.81/-6.79	-7.41/-7.6	-8.35/-9.24	-6.18/-4.15	-7.5/-6.76	-3.84/-4.68	-2.79/-1.88	-2.54/-3.5	-2.73/-4.11	-0.53/-10.96	-4.88/-5.2	-2.89/-4.34	-4.94/-6.54	-6.44/-5.69	-4.92/-5.4	-3.78/-3.22	-5.84/-6.94
Theta(112.5°)	-6.91/-7.21	-4.91/-2.98	-3.14/7.73	-9.07/-8.22	-7.25/-4.98	-7.18/-11.55	-10.47/-10.83	-7.54/-8.28	-6.54/-8.71	-8.04/-10.39	-8.35/-6.43	-9.05/-8.78	-7.45/-7.45	-4.46/-3.49	-4.04/-5.76	-5.58/-1.75	-2.92/0.75	-6.08/-3.57	-3.37/-3.71	-3.98/-6.05	-7.57/-6.44	-5.56/-6.4	-4.63/-3.43	-6.36/-7.47
Theta(120°)	-6.81/-5.71	-5.31/4.2	-4.81/-9.41	-9.45/-9.59	-11.71/-6.45	-7.43/-9.51	-10.19/-10.98	-8.42/-9.95	-7.93/-6.7	-8.33/-9.09	-10.45/-7.62	-9.17/-11.09	-9.35/-8.44	-7.74/-3.96	-8.73/-11.5	-8.73/-3.15	-6.86/-9.47	-7.04/-6.37	-3.26/-4.42	-6.09/-8.14	-7.94/-8.07	-5.64/-7.44	-8.21/-5.18	-7.58/-6.34
Theta(127.5°)	-7.75/-7.34	-6.57/-5.58	-7.27/9.47	-9.07/-10.74	-9.58/-8.13	-8.87/-9.68	-6.41/-9.08	-7.27/9.48	-8.95/-9.75	-6.87/-6.64	-8.01/-7.58	-6.99/-10.28	-8.25/-9.78	-10.27/-9.17	-12.65/-3.94	-7.65/-11.09	-9.27/7.15	-4.45/-5.76	-6.35/-10.21	-7.25/-5.7	-7.79/-8.4	-9.25/-7.2	-6.9/-7.28	
Theta(135°)	-6.73/-7.72	-7.74/-6.03	-6.33/7.42	-10.33/-9.64	-8.08/-8.52	-8.1/6.52	-8.14/-8.48	-8.51/-11.5	-9.06/-9.51	-9.56/-11.7	-6.38/-7.88	-7.6/-7.8	-9.93/-9.09	-9.41/-10.7	-9.04/-6.6	-11.56/-7.9	-7.42/9.34	-10.09/-8.17	-7.38/-7.81	-7.21/-11.72	-10.02/9.47	-7.72/-9.36	-10.04/-8.43	-7.26/-6.77
Theta(142.5°)	-9.78/-8.13	-8.1/8.24	-9.22/-9.87	-11.51/-11.76	-9.62/-9.12	-7.76/-8.22	-10.65/-8.18	-8.84/-10.44	-10.8/-10.45	-10.01/-9.64	-7.73/-8.47	-9.86/-7.71	-8.58/-9.27	-10.41/-10.66	-12.63/-12.25	-12.05/-10.58	-9.84/-11.14	-12.01/-10.39	-6.65/-8.08	-11.85/-12.88	-11.54/-10.82	-10.62/-10.8	-10.14/-9.56	-9.9/-8.96
Theta(150°)	-9.74/-10.42	-9.56/-9.24	-9.53/9.92	-9.78/-8.46	-9.2/-11.34	-9.25/9.3	-11.55/-12.23	-10.19/-10.55	-11.45/-11.32	-9.99/11.6	-11.16/-9.46	-8.67/-8.86	-8.13/-10.64	-11.21/-12.54	-11.29/-10.66	-11.84/10.8	-12.55/-12.32	-9.81/9.54	-9.57/8.88	-11.87/9.84	-10.71/9.54	-8.93/9.7	-9.69/8.62	
Theta(157.5°)	-10.01/-12.55	-10.97/9.21	-9.33/10.89	-10.26/-11.24	-11.01/9.36	-8.81/9.21	-10.89/11.37	-7.67/8.3	-12.36/-12.24	-10.51/11.11	-12.21/11.92	-9.67/10.04	-10.71/11.86	-12.86/10.82	-9.54/8.09	-8.26/8.31	-9.69/11.17	-10.76/-8.39	-7.37/7.99	-8.95/8.06	-9.11/9.99	-10.22/-10.58	-9.95/9.73	-9.24/9.2
Theta(165°)	-10.3/-8.97	-8.28/-8.74	-8.84/8.57	-9.08/-8.66	-7.51/-9.07	-7.81/-8.53	-9.34/-11.07	-11.69/-11.58	-11.24/-11.07	-10.07/-11.1	-11.01/-12.11	-12.32/-10.88	-10.72/-11.19	-11.47/-11.19	-9.6/-8.8	-7.87/-8.66	-10.08/-10.7	-10.18/-4.44	-9.65/-10.43	-10.5/-9.47	-8.52/-8.52	-8.77/-10.22	-11.63/-11.81	-11.69/10.81
Theta(172.5°)	-8.74/-8.66	-10.72/-11.08	-10.07/10.81	-11.11/10.28	-9.28/-9.85	-10.68/-11.89	-11.34/11.96	-11.66/-11.43	-12.06/-12.47	-12.34/12.77	-11.69/-12.11	-11.69/-12.14	-12.31/11.97	-12.73/12.36	-12.12/12.43	-11.84/11.8	-11.72/11.57	-12.07/11.99	-11.11/11.46	-11.62/10.31	-11.72/10.82	-9.81/-8.4	-8.78/-8.69	
Theta(180°)	-12.34/-12.16	-12.11/11.75	-11.26/-11.29	-9.82/-9.38	-10.43/9.97	-11.07/10.77	-10.57/10.84	-11.15/10.15	-9.38/9.61	-10.96/10.01	-10.35/11.61	-10.59/10.78	-10.63/11.57	-12.35/12.31	-12.61/11.97	-12.21/11.41	-10.36/10.31	-10.54/9.94	-9.55/8.9	-10.18/11.16	-11.14/10.91	-10.61/10.86	-11.17/11.38	-12.11/11.79
Theta(187.5°)	-12.34/-12.16	-12.11/11.75	-11.26/-11.29	-9.82/-9.38	-10.43/9.97	-11.07/10.77	-10.57/10.84	-11.15/10.15	-9.38/9.61	-10.96/10.01	-10.35/11.61	-10.59/10.78	-10.63/11.57	-12.35/12.31	-12.61/11.97	-12.21/11.41	-10.36/10.31	-10.54/9.94	-9.55/8.9	-10.18/11.16	-11.14/10.91	-10.61/10.86	-11.17/11.38	-12.11/11.79

















# Radiated Composite Gain Data

# Appendix A

Theta	120°	127.5°	135°	142.5°	150°	157.5°	165°	172.5°	180°	187.5°	195°	202.5°	210°	217.5°	225°	232.5°	240°	247.5°	255°	262.5°	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5°																
Gain	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000																
Theta	0°	7.5°	15°	22.5°	30°	37.5°	45°	52.5°	60°	67.5°	75°	82.5°	90°	97.5°	105°	112.5°	120°	127.5°	135°	142.5°	150°	157.5°	165°	172.5°	180°	187.5°	195°	202.5°	210°	217.5°	225°	232.5°	240°	247.5°	255°	262.5°	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5°
Gain	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000









Total Gain Data

Table with columns for Frequency (MHz), Total Ant. 1, and various antenna gain patterns (Theta and Phi) ranging from 0 to 180 degrees. The table contains multiple rows of numerical data for each frequency and angle combination.







Antenna Pattern

Appendix B

Table with columns for elevation angle (Theta), frequency (Freq), and gain for various antenna configurations. The table contains multiple rows of numerical data representing gain values across different frequencies and angles.



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  $\Theta(0-180)\Phi(270)$

