



Antenna Composite Gain Test Report

Equipment	WiFi Extender
Brand Name	technicolor
Model Name	OWM0131TCH
Applicant	Technicolor Delivery Technologies Belgium Prins Boudewijnlaan 47 Edegem B-2650 Belgium
Manufacturer	Technicolor Delivery Technologies Belgium Prins Boudewijnlaan 47 Edegem B-2650 Belgium
Sample Received	Jun. 23, 2022
Start Test Date	Jun. 27, 2022
Final Test Date	Jul. 07, 2022



Approved by: Jackson Tsai

SPORTON INTERNATIONAL INC. Hsinhua Laboratory

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Table of Contents

History of this test report.....	3
1. Operation Mode and Antenna Information	4
2. Test Frequency	5
3. Testing Location.....	5
4. Test Facility and Configuration.....	6
5. Reference Calibration	7
6. Test Method	8
7. Measured Values and Calculation of Maximum Gain Positions.....	9
8. Summary of Test Result	11
9. Test Setup	12
10. Test Equipment and Calibration Data	13
11. Test Results	14



History of this test report

Report No.	Version	Description	Issued Date
AP262320	01	Initial issue of report	Oct. 19, 2022



2. Test Frequency

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

Band [MHz]	Test Frequency [MHz]
2400-2483.5	2400
2400-2483.5	2450
2400-2483.5	2483.5
5150-5250	5200
5250-5350	5300
5470-5725	5600
5725-5850	5785

3. Testing Location

Test Lab. : Sporton International Inc. Hsinhua Laboratory				
<input checked="" type="checkbox"/> Wen 33rd.St.	ADD:	No.14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)		
		TEL: 886-3-318-0787	FAX: 886-3-318-0287	
Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
Radiated	05CH03-HY	Rex Liao	23~24°C / 40~50%	27/Jun/2022~07/Jul/2022

Note:

Testing Site Information

Brand Name: TDK

Dimension: 11m*6m*6m

Characteristic: Fully Anechoic Chamber

4. Test Facility and Configuration

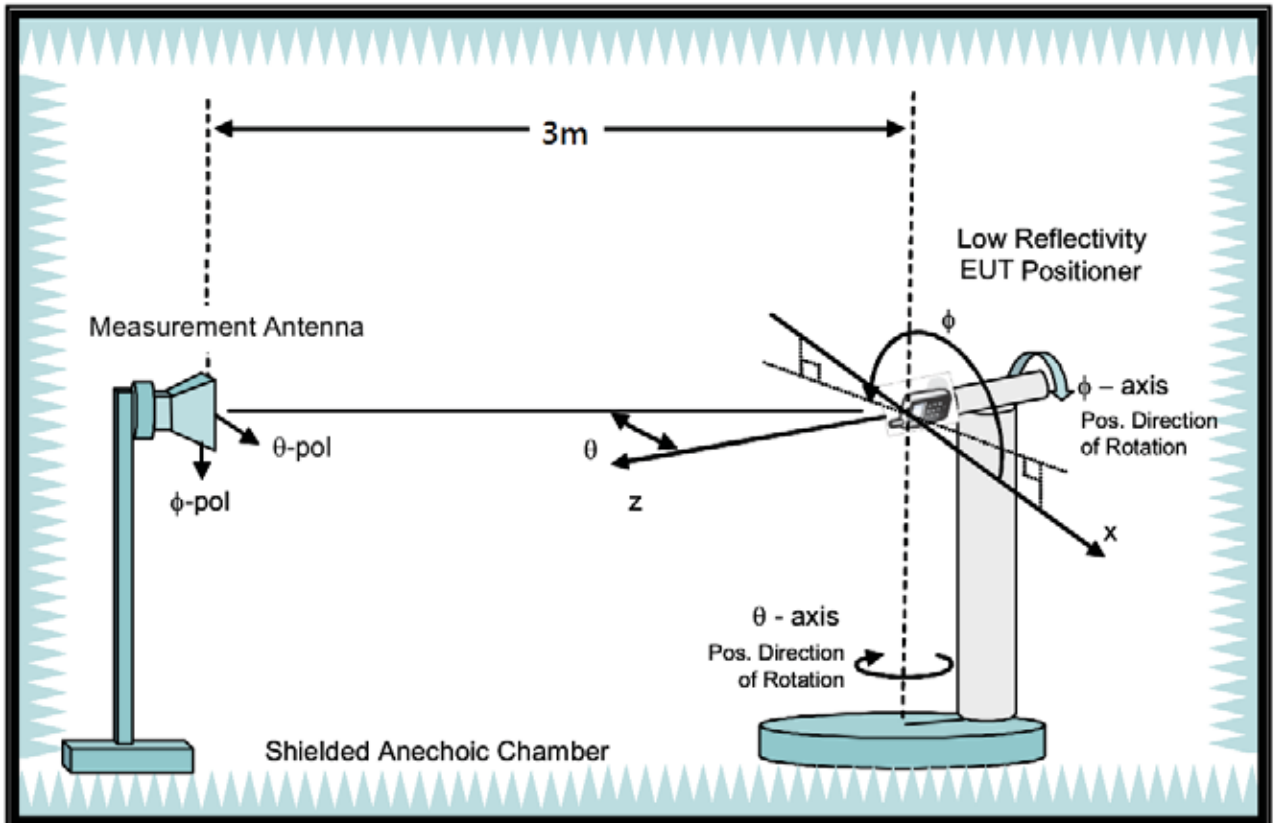
Test configuration: Reference to CITA OTA distributed-axes system configuration.

Chamber: Fully Anechoic Chamber.

Measurement antenna: Dual Polarization Horn antenna

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

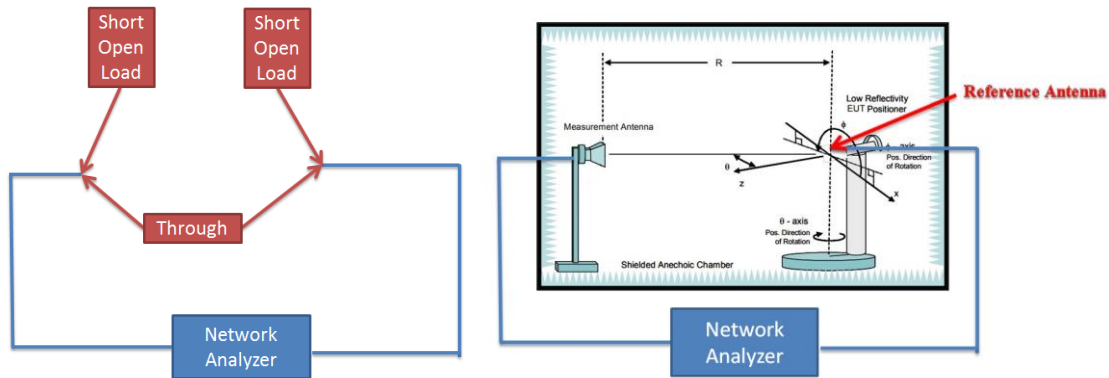
#Reference to CTIA "ctia-test-plan-for-wireless-device-over-the-air-performance-ver-3-7-1"



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	7500
G reading (dB)	-31.4	-31.4	-31.3	-31.3	-31	-30.7	-30.1	-30.5	-30.5	-30.8	-31.3	-32.8	-34.4	-35.4
Reference gain (dBi)	10.2	10.4	10.6	12.4	12.8	13.4	13.4	13.3	13.3	13.1	13.2	12.3	11.7	11.1
Factor (dB)	41.34	41.55	41.68	43.24	43.56	43.68	43.79	43.91	43.99	44.43	44.49	45.24	46.12	46.31

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 10 degree from 0 to 350 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)	2.4G	2.45G	2.4835G
Ant. 1 (dBi)	-2.02	-3.38	-4.36
Ant. 2 (dBi)	1.97	2.05	3.2
DG [1SS] (dBi)	3.21	2.76	3.23
Polarization	Theta	Theta	Theta
Θ(°)	90	90	90
Φ(°)	10	10	10

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)	2.4G	2.45G	2.4835G
Ant. 1 [10^(G/20)]	10^(-2.02/20)	10^(-3.38/20)	10^(-4.36/20)
Ant. 2 [10^(G/20)]	10^(1.97/20)	10^(2.05/20)	10^(3.2/20)
Ant. 1 [10^(G/20)] value	0.793	0.678	0.605
Ant. 2 [10^(G/20)] value	1.255	1.266	1.445
Sum All Antenna [Amax]	2.047	1.944	2.051
DG [10*log(Amax^2/Nant)]	3.21	2.76	3.23

Note:

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

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



DG_1SS max value position

Frequency (Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 (dBi)	4.09	2.71	-4.32	-1.47
Ant. 2 (dBi)	-2.45	-1.01	0.85	2.59
Ant. 3 (dBi)	-3.48	-3.31	1.14	1.74
Ant. 4 (dBi)	-4.06	-3.41	-3.12	-9.99
DG [1SS] (dBi)	5.23	5.14	4.98	5.41
Polarization	Theta	Theta	Theta	Theta
$\Theta(^{\circ})$	50	50	60	80
$\Phi(^{\circ})$	90	80	340	350

DG_1SS max value position calculation

Frequency (Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 [10^(G/20)]	10^(4.09/20)	10^(2.71/20)	10^(-4.32/20)	10^(-1.47/20)
Ant. 2 [10^(G/20)]	10^(-2.45/20)	10^(-1.01/20)	10^(0.85/20)	10^(2.59/20)
Ant. 3 [10^(G/20)]	10^(-3.48/20)	10^(-3.31/20)	10^(1.14/20)	10^(1.74/20)
Ant. 4 [10^(G/20)]	10^(-4.06/20)	10^(-3.41/20)	10^(-3.12/20)	10^(-9.99/20)
Ant. 1 [10^(G/20)] value	1.601	1.366	0.608	0.844
Ant. 2 [10^(G/20)] value	0.754	0.89	1.103	1.347
Ant. 3 [10^(G/20)] value	0.67	0.683	1.14	1.222
Ant. 4 [10^(G/20)] value	0.627	0.675	0.698	0.317
Sum All Antenna [Amax]	3.652	3.615	3.549	3.73
DG [10*log(Amax^2/Nant)]	5.23	5.14	4.98	5.41

Note:

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

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



8. Summary of Test Result

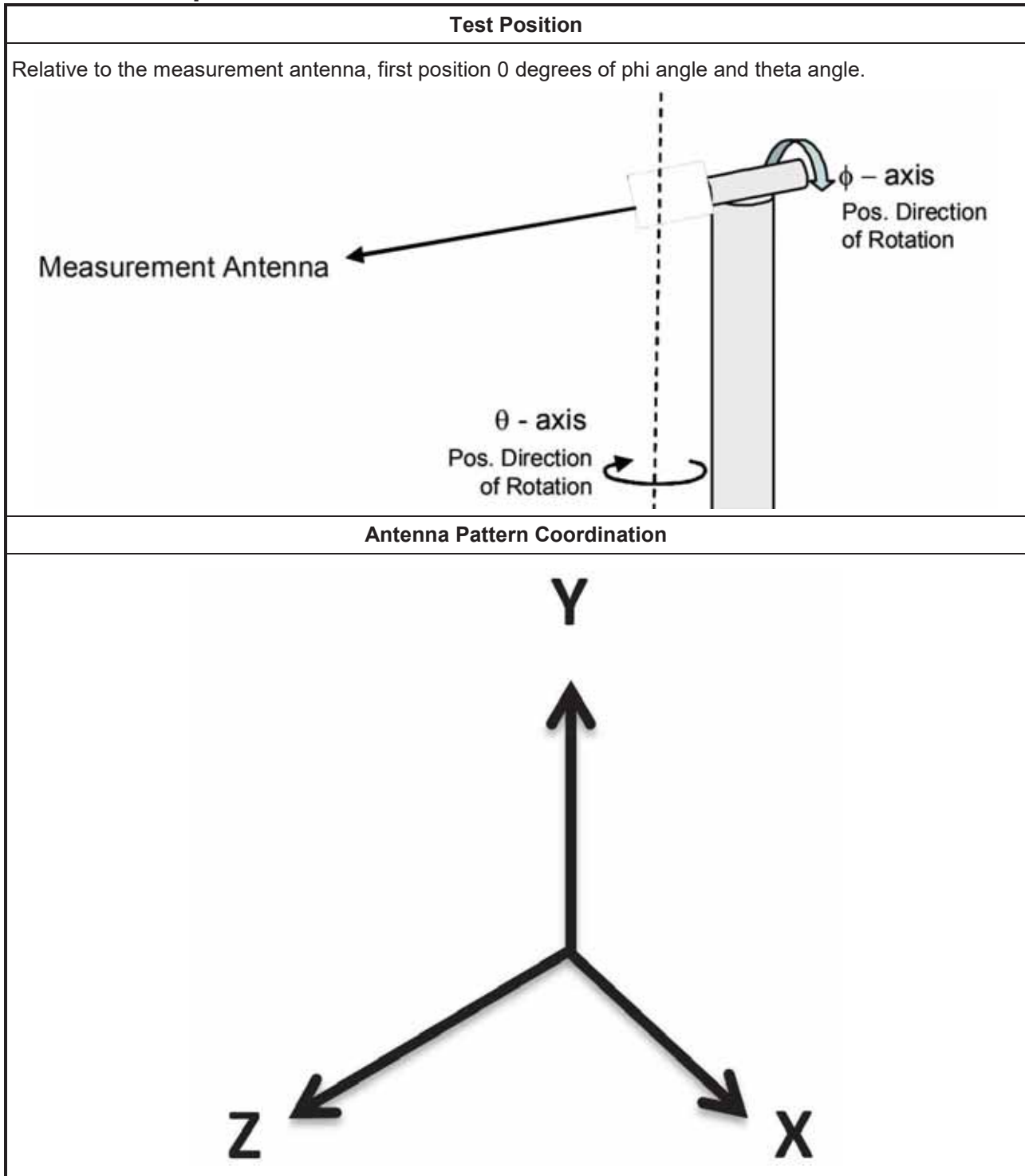
Frequency (Hz)	2.4G	2.45G	2.4835G
Ant. 1 Max Gain (dBi)	0.68	2.17	2.28
Ant. 2 Max Gain (dBi)	2.47	2.05	3.2
Ant. 1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Phi/10/320	Phi/100/150	Phi/100/150
Ant. 2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/100/40	Theta/90/10	Theta/90/10
Max Gain (dBi)	2.47	2.17	3.2
DG [1SS] (dBi)	3.21	2.76	3.23
DG [2SS] (dBi)	2.47	2.17	3.2

Frequency (Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 Max Gain (dBi)	4.09	3.63	3.13	3.29
Ant. 2 Max Gain (dBi)	2.57	2.67	2.32	2.7
Ant. 3 Max Gain (dBi)	2.33	2.8	3.81	2.51
Ant. 4 Max Gain (dBi)	3.75	3.81	2.76	2.65
Ant. 1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/50/90	Theta/60/90	Theta/110/90	Theta/110/110
Ant. 2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/80/340	Theta/80/340	Theta/80/350	Theta/70/350
Ant. 3 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/70/350	Theta/80/350	Theta/80/350	Phi/60/120
Ant. 4 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/10/300	Theta/20/290	Theta/40/100	Theta/40/110
Max Gain (dBi)	4.09	3.81	3.81	3.29
DG [1SS] (dBi)	5.23	5.14	4.98	5.41
DG [2SS] (dBi)	4.09	3.81	3.81	3.29
DG [3SS] (dBi)	4.09	3.81	3.81	3.29
DG [4SS] (dBi)	4.09	3.81	3.81	3.29

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 (3SS) = Directional Gain (1SS) – 4.77dB. If directional gain is less than max gain, use max gain as directional gain.
5. 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-1292	1GHz~18GHz	Aug. 04, 2021	Aug. 03, 2022
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	V1.0.6	-	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 2.4 GHz.....	Page 15
Appendix B – Radiated Composite Gain of 5GHz.....	Page 21
Appendix C – Antenna Pattern of 2.4GHz.....	Page 30
Appendix D – Antenna Pattern of 5GHz.....	Page 33
Appendix E – Test Photos.....	Page 37

————THE END————



Radiated Composite Gain Data

Appendix A

Freq(Hz)	2.4G	2.45G	2.4835G
Ant. 1 Max Gain (dBi)	0.68	2.17	2.28
Ant. 2 Max Gain (dBi)	2.47	2.05	3.2
Ant. 1 Polarization/ $\theta(^{\circ})/\phi(^{\circ})$	Phi/10/320	Phi/100/150	Phi/100/150
Ant. 2 Polarization/ $\theta(^{\circ})/\phi(^{\circ})$	Theta/100/40	Theta/90/10	Theta/90/10
Max Gain (dBi)	2.47	2.17	3.2
DG [1SS] (dBi)	3.21	2.76	3.23
DG [2SS] (dBi)	2.47	2.17	3.2



Radiated Composite Gain Data

Appendix A

θ(70°)	-1.49/0.75	-0.56/0.91	-1.29/1.67	-1.69/1.89	-1.39/1.03	-1.21/1.65	-1.88/2.08	-3.4/5.23	-6.2/6.52	-7.22/8.18	-8.78/8.54	-8.84/5.21	-4.55/4.42	-4.77/4.1	-2.4/1.13	-0.36/0.25	-0.59/1.1	-1.85/1.54
θ(80°)	0.89/1.49	1.34/0.95	0.67/0.19	-1.5/3.59	-4.45/4.12	-3.85/4.09	-4.02/3.81	-5.16/7.99	-8.97/8.51	-9.31/9.59	-9.42/11.07	-12.43/12.82	-11.18/9.93	-5.81/3.38	-1.83/1.21	-0.99/1.06	-1.38/1.43	-0.74/0.13
θ(90°)	2.54/3.23	2.53/1.68	1.05/0.16	-1.96/2.77	-4.13/4.72	-4.1/3.18	-2.51/2.59	-3.89/5.33	6.52/6.99	-7.47/8.1	-9.27/11.01	-11.13/9.71	-6.59/4.6	-3.31/2.09	-1.52/1.68	-1.71/1.39	-0.43/0.84	1.35/1.85
θ(100°)	0.42/0.35	-0.59/0.77	0.71/1.04	-2.09/3.22	3.46/3.41	3.32/2.7	1.91/1.47	2.99/5.89	-7.59/7.42	-8.03/10.05	-8.77/8.21	-7.84/5.16	3.5/2.8	2.14/1.49	-1.16/1.9	-2.23/1.83	-1.22/0.85	0.32/0.38
θ(110°)	0.65/0.04	-1.36/1.49	-0.43/0.25	-1.28/2.52	2.95/2.96	-4.14/4.63	-3.67/3.12	-4.29/6.65	7.81/8.71	-13.02/12.35	-8.71/10.02	-8.11/6.61	-4.79/3.67	-2.67/2	-0.64/0.23	0.5/0.7	0.2/0.32	0.26/0.2
θ(120°)	-1.13/0.79	-1.85/2.35	0.71/0.34	0.26/0.19	0.61/1.1	-2.19/3.48	-4.32/5.96	-10.01/15.2	-13.28/12.42	-12.51/11.3	-11.04/8.54	-5.22/3.97	2.71/1.71	-1.8/1.99	-0.81/0.22	0.41/0.48	4.16/2.36	-4.29/3.09
θ(130°)	-1.6/1.19	-1.99/2.53	2.29/0.93	-0.3/0.32	0.96/1.9	-2.95/4.07	5.39/7.2	-10.28/12.88	-13.66/12.57	-12.37/10.53	-7.42/5.19	4.2/3.21	-1.82/1.56	-1.93/1.31	0.24/1.43	2.02/2.11	1.87/0.06	2.1/2.46
θ(140°)	2.31/1.18	-0.08/0.11	0.5/0.85	-0.69/0.71	-1.13/2.3	-3.66/4.97	6.23/7.1	8.01/12.52	-13.33/12.19	-11.11/8.96	6.47/4.33	-3.04/1.69	0.83/0.74	-1.45/1.88	-1.57/0.9	-0.68/1.14	2.08/2.94	-3.19/2.89
θ(150°)	0.08/0.29	0.21/0.5	-1.69/3.1	4.58/4.23	-4.29/4.36	-4.45/4.39	-4.59/5.68	-7.52/11.96	-15.48/15.07	-11.22/8.57	-5.85/3.62	-1.95/0.91	-0.59/0.86	-1.48/1.82	-1.54/1.02	-0.56/0.36	4.27/0.15	-0.04
θ(160°)	-3.94/4.43	-5.95/6.89	-7.2/7.95	-9.23/10.39	-10.35/8.71	-8.52/5.55	-4.87/5.04	-6.25/8.3	-11.71/12.83	-14.13/11.42	-8.03/6.89	-5.76/5.35	-5.79/6.67	-7.59/8.13	-8.15/7.52	-7.98/6.86	-5.9/5.21	-4.59/4.06
θ(170°)	-12.11/11.52	-8.35/7.11	-5.79/4.74	-4.07/4.57	-4.94/5.35	-5.79/6.16	-6.51/6.72	-8.07/7.88	7.48/9.07	-8.89/8.23	9.46/9.36	-9.29/9.23	9.37/9.55	9.37/9.85	10.59/11.46	12.59/13.78	-13.27/13.08	-14.01/13.45
θ(180°)	-5.87/5.07	-4.51/4.27	-4.2/4.25	-4.65/5.35	-6.19/7.08	-7.59/8.35	-8.42/10.59	-11.28/10.2	-8.95/7.84	-6.59/5.98	-5.44/5.12	-4.98/5.03	-5.32/5.54	6.01/6.84	-7.8/8.84	-9.31/10.29	-8.48/8.24	-7.79/8.61



Radiated Composite Gain Data

Appendix A

	-14.22/14.66	-14.39/13.08	-11.85/10.39	-9.11/8.21	-7.62/7.39	-7.14/6.83	-7.28/8.3	-9.69/11.39	-14.04/16.79	-19.05/17.67	-18/18.77	-18.98/18.03	-17.01/15.55	-14.44/14.09	-14.29/14.95	-14.49/14.09	-13.16/12.25	-11.78/12.49
Freq(Hz)	2.48355GHz	ThetaAz=0.2	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ
Gain	Φ(0°)/Φ(10°)	Φ(20°)/Φ(30°)	Φ(40°)/Φ(50°)	Φ(60°)/Φ(70°)	Φ(80°)/Φ(90°)	Φ(100°)/Φ(110°)	Φ(120°)/Φ(130°)	Φ(140°)/Φ(150°)	Φ(160°)/Φ(170°)	Φ(180°)/Φ(190°)	Φ(200°)/Φ(210°)	Φ(220°)/Φ(230°)	Φ(240°)/Φ(250°)	Φ(260°)/Φ(270°)	Φ(280°)/Φ(290°)	Φ(300°)/Φ(310°)	Φ(320°)/Φ(330°)	Φ(340°)/Φ(350°)
Θ(0°)	-8.99/8.37	-7.97/7.77	-7.76/7.83	-8.67/8.61	-10.76/12.75	-14.03/15.06	-16.06/15.56	-14.02/13.08	-12.54/12.67	-13.01/13.25	-13.8/14.93	-16.9/18.22	-17.98/19.06	-17.35/15.64	-13.89/12.44	-11.22/10.47	-10.3/9.87	-8.98/9.29
Θ(20°)	-4.59/4.31	-4.24/4.2	-4.2/4.59	-5.37/6.23	-7.39/8.96	-10.73/12.76	-15.26/17.33	-17.85/18.27	-14.52/13.27	-13.03/13.46	-14.59/15.9	-18.91/19.04	-18.48/19.27	-18.62/13.51	-11.31/9.4	-8.27/7.22	-6.41/5.96	-5.52/5.03
Θ(40°)	-3.22/3.01	-3.99/3.14	-3.19/3.34	-3.71/4.62	-5.31/6.3	-7.76/9.43	-11.98/14.31	-19.18/19.69	-17.19/15.89	-13.99/13.28	-14.41/16.84	-18.79/18.95	-19.16/42	-13.96/11.94	-9.79/8.65	-6.54/5.53	-4.73/4.3	-3.95/3.58
Θ(60°)	-4.52/4.17	-3.71/3.16	-2.47/1.97	-1.62/1.99	-2.38/3.16	-4.26/5.55	-8.73/7.98	-10.28/16.87	-16.65/16.44	-13.99/13.29	-14.98/15.79	-15.6/13.82	-11.92/10.82	-10.12/10.29	-10.01/11.17	-10.11/13.32	-7.96/7.27	-5.88/4.98
Θ(80°)	-1.37/1.22	-1.19/1.04	-0.38/0.06	-0.22/0.34	-1.78/2.83	-4.39/5.87	-7.69/6.71	-13.11/19.2	-15.71/11.77	-11.39/12.79	-14.91/14.68	-11.49/8.24	-6.04/5.03	-4.71/4.6	-4.71/5.23	-4.71/5.23	-5.86/5.66	-4.47/3.4
Θ(100°)	0.23/0.09	-0.53/1.11	-0.95/0.72	-0.98/1.7	-2.28/2.63	-3.3/3.85	-4.01/4.71	-7.2/9.85	-8/1.79	-8.98/10.81	-13.12/13.52	-8.98/4.44	-4.42/3.39	-2.97/2.6	-2.44/2.54	-2.93/2.65	-1.99/1.26	-1.0/0.41
Θ(120°)	0.63/0.56	0.01/0.41	-0.07/0.48	0.41/0.35	-1.02/1.56	-2.24/3.65	-4.02/3.94	-6.42/7.54	-8.02/8.88	-11.13/13.99	-15.68/15.17	-12.36/9.33	-6.45/4.42	-3.27/2.76	-2.37/1.8	-1.29/1.17	-0.77/0.15	-0.07/0.14
Θ(140°)	2.02/2.2	1.49/0.98	1.24/1.11	-0.02/1.66	-2.72/3.02	-3.94/4.91	-4.94/4.41	-5.23/5.26	-8.91/9.79	-11.17/11.86	-13.03/16.83	-18.51/15.9	-11.07/8.35	-6.5/5.02	-3.99/2.7	-1.42/0.61	-0.18/0.34	0.81/2.5
Θ(160°)	2.77/3.2	2.54/1.5	1.25/0.83	-0.68/2.38	-3.14/3.06	-2.86/2.95	-2.64/2.34	-3.23/5.78	-8.01/8.06	-9.41/11.34	-11.95/12.02	-11.13/9.22	-6.99/5.65	-4.97/3.74	-2.71/2.26	-1.26/0.02	0.92/0.61	1.97/2.18
Θ(180°)	0.77/0.45	-0.05/0.37	-0.35/0.61	-1.79/2.89	-2.81/2.2	-1.77/1.94	-2.04/1.65	-3.07/7.2	-10.02/9.22	-11.94/11.76	-8.27/7.37	-7.59/6.7	-6.68/5.76	-5.62/4.27	-2.75/2.97	-2.91/3	-1.39/0.42	0.75/1.03
Θ(200°)	1.85/1.06	-0.28/0.07	1.03/1.02	-0.43/2.36	0.99/2.41	-2.34/2.84	-2.72/2.43	-3.9/4.43	-18.16/16.39	-13.31/11.11	-10.42/10.11	-6.65/5.69	-4.4/4.98	-4.98/2.97	-1.16/0.74	-0.89/0.32	-0.78/1.53	-0.17/1.37
Θ(220°)	0.72/0.64	-1.68/4.14	-2.64/1.65	-2.47/4.15	-4.58/4.14	-4.99/4.47	-4.94/5.88	-8.82/17.78	-18.16/16.39	-13.31/11.11	-10.42/10.11	-6.65/5.69	-4.4/4.98	-4.98/2.97	-1.16/0.74	-0.89/0.32	-0.78/1.53	-0.17/1.37
Θ(240°)	0.17/0.8	-0.27/2.79	-3.96/2.51	-1.84/2.29	-3.48/4.78	-6.62/5.86	-4.22/7.32	-10.12/14.51	-17.37/15.62	-14.13/14.36	-14.12/11.43	-9.47/9.48	-10.52/12.86	-11.22/6.7	-2.98/1.36	-1.32/1.31	-0.47/0.38	-1.31/1.27
Θ(260°)	-1.59/0.66	-0.57/1.92	-4.34/5.97	-5.97/6.27	-7.16/9.24	-11.96/13.92	-14.45/13.67	-14.01/16.89	-17.65/18.29	-18.62/18.81	-16.49/12.01	-10.11/10.03	-10.67/10.19	-9.62/7.84	-5.23/3.17	-2.69/3.21	-3.36/2.59	-2.14/2.13
Θ(280°)	1/1.8	0.85/0.3	2.15/4.47	-6.59/7.91	-9.33/10.47	-11.07/10.81	-10.61/11.54	-14.09/17.84	-18.58/18.03	-18.01/18.19	-14.72/12.09	-11.01/11.08	-11.48/11.38	-9.95/7.25	-4.37/2.14	-1.02/0.73	-0.74/0.51	0.01/0.56
Θ(300°)	-3.12/3.03	-3.47/4.63	6.36/8.7	-11.24/12.47	-11.89/10.15	-8.9/7.78	-7.35/7.83	-9.15/10.71	-12.11/13.9	-15.78/16.24	-15.82/14.59	-14.91/15.06	-16.62/16.74	-15.4/12.45	-9.63/7.55	-6.55/6.24	-4.03/3.79	-4.96/3.88
Θ(320°)	-13.48/12.54	-11.36/10.49	-10.55/9.41	-9.35/9.2	-9.05/8.66	-8.23/7.86	-7.71/7.79	-8.09/8.44	-8.64/9.29	-10.15/10.8	-11.55/12.37	-13.66/14.76	-16.59/18.1	-18.59/18.5	-18.36/18	-17.48/16.96	-14.98/15.02	-15.35/14.75
Θ(340°)	-6.81/6.83	-6.96/7.33	7.88/8.7	-9.91/11.34	-12.86/13.92	-13.62/13.02	-12.68/12.27	-11.03/9.92	-9.4/8.62	-8.42/8.5	-8.63/8.9	-8.67/10.67	-12.31/13.62	-14.6/15.7	-15.42/13.91	-11.85/10.15	-8.79/7.54	-6.93/6.83



Freq(Hz)	5.2G	5.3G	5.6G	5.785G
Ant. 1 Max Gain (dBi)	4.09	3.63	3.13	3.29
Ant. 2 Max Gain (dBi)	2.57	2.67	2.32	2.7
Ant. 3 Max Gain (dBi)	2.33	2.8	3.81	2.51
Ant. 4 Max Gain (dBi)	3.75	3.81	2.76	2.65
Ant. 1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/50/90	Theta/60/90	Theta/110/90	Theta/110/110
Ant. 2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/80/340	Theta/80/340	Theta/80/350	Theta/70/350
Ant. 3 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/70/350	Theta/80/350	Theta/80/350	Phi/60/120
Ant. 4 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	Theta/10/300	Theta/20/290	Theta/40/100	Theta/40/110
Max Gain (dBi)	4.09	3.81	3.81	3.29
DG [1SS] (dBi)	5.23	5.14	4.98	5.41
DG [2SS] (dBi)	4.09	3.81	3.81	3.29
DG [3SS] (dBi)	4.09	3.81	3.81	3.29
DG [4SS] (dBi)	4.09	3.81	3.81	3.29



Radiated Composite Gain Data

Appendix B

Table with columns for frequency (MHz), gain (dBS), and various antenna configurations (Theta, Phi, and Gain). The table contains multiple rows of data for different frequencies and configurations.



Radiated Composite Gain Data

Appendix B

Theta	-14.28/10.78	-10.51/10.42	9.14/8.26	-10.11/11.87	-12.54/11.06	9.62/8.57	8.41/11.89	-13.85/12.68	-8.78/8.67	8.88/14	-16.81/14.98	-12.32/8.81	7.15/7.74	8.21/9.92	-10.61/10.33	-10.26/10.02	9.78/8.18	8.75/11.86		
Phi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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	
Theta	-14.28/10.78	-10.51/10.42	9.14/8.26	-10.11/11.87	-12.54/11.06	9.62/8.57	8.41/11.89	-13.85/12.68	-8.78/8.67	8.88/14	-16.81/14.98	-12.32/8.81	7.15/7.74	8.21/9.92	-10.61/10.33	-10.26/10.02	9.78/8.18	8.75/11.86		
Phi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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
Theta	-14.28/10.78	-10.51/10.42	9.14/8.26	-10.11/11.87	-12.54/11.06	9.62/8.57	8.41/11.89	-13.85/12.68	-8.78/8.67	8.88/14	-16.81/14.98	-12.32/8.81	7.15/7.74	8.21/9.92	-10.61/10.33	-10.26/10.02	9.78/8.18	8.75/11.86		
Phi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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



Radiated Composite Gain Data

Appendix B

Table with columns for Az, El, AzEl, Gain, and various AzEl Gain values. It includes sub-sections for 5.25GPa and 5.625GPa, each with a PhatAz 3 and PhatAz 4 section. Each section contains a grid of Gain values for combinations of Az and El.



Antenna Pattern

Appendix C

θ(60°)	0.29015	-0.46102	0.85059	-0.78148	2.03217	-2.40245	2.39287	-4.71490	-7.58738	-8.23872	-8.30456	-4.811378	3.26294	-2.59204	-1.89211	-2.56254	-1.79119	0.93035
φ(70°)	0.69805	0.19029	0.09801	0.51025	-0.86123	-1.83237	-2.56283	-4.48456	-7.81826	-8.34817	-7.08440	-4.69480	-4.54373	-2.78218	-1.87148	-0.98078	-0.42002	-0.01020
θ(80°)	2.07028	1.61117	1.43121	0.04157	-2.31239	-3.05394	-4.23418	-5.09454	-7.62726	-7.09680	-5.73449	-6.33700	-6.73667	-6.06477	-3.45214	-0.86016	0.17053	0.88030
φ(90°)	2.82323	2.59180	1.36896	-0.52221	-2.96292	-2.72383	-2.51223	-3.06000	-5.83479	-4.29387	-3.61400	-4.52143	5.10479	-4.22172	-1.53112	-0.43050	1.16174	2.06226
θ(100°)	1.07074	0.19015	-0.17053	-1.66289	-2.59186	-1.38146	-1.58132	-2.57552	-6.37443	-4.01428	-3.58286	-2.90308	-3.68520	-5.56406	-2.49266	-2.50149	-1.05026	0.84122
φ(110°)	2.06151	0.37048	1.52183	0.42130	-1.85135	-1.16142	-1.52153	-2.71597	-6.94583	-6.64714	-5.59491	-4.02123	-1.98339	-4.06235	-0.74026	-0.28030	-0.10084	0.10148
θ(120°)	1.16151	0.03021	-1.71077	-1.31294	-4.52491	-4.29387	-3.41413	-6.461018	-8.81684	-5.93491	-4.21315	-1.21038	-1.28278	-3.11028	-0.23049	0.17025	0.41070	-1.74049
φ(130°)	0.42105	0.49129	2.55198	-1.40151	-1.90199	-1.75150	-1.83211	-3.74698	-8.30714	-6.82754	-6.62331	-1.20118	-2.62396	-3.88236	-0.74007	0.10020	0.20011	-0.62064
θ(140°)	-0.25067	1.25088	0.43202	-2.68281	-2.89333	-3.89438	-4.58497	-6.50963	-14.28167	-15.12930	-5.34247	-1.41204	-3.33392	-4.18387	-2.78177	-1.62199	-2.10170	-1.16075
φ(150°)	1.41180	1.80115	0.24233	-4.63818	-7.29838	-8.57881	-9.27886	-12.241544	-14.461197	-9.36446	-3.90235	-1.771214	-2.76300	-2.65179	-0.76015	0.59082	0.51037	6.49887
θ(160°)	2.97238	3.18438	5.46783	10.231120	-8.95826	-8.87385	-5.68438	-7.84978	-11.241220	-12.35186	8.01794	3.51777	8.28821	7.47629	5.29444	4.65391	3.82401	3.55154
φ(170°)	-10.821048	8.81838	7.85888	4.23157	-3.271497	-4.64430	-4.48103	5.73686	-7.68488	-8.83198	-10.681147	-12.541138	-13.781943	-13.021215	-12.261320	-12.751191	-10.871641	-10.201848
θ(180°)	-5.31635	-5.28639	-5.401545	-5.81658	-6.67128	-7.65780	-7.68789	-7.98403	-8.25426	-8.00402	-8.11811	-8.25843	-8.72867	-8.62876	-8.70811	-7.42482	-6.27649	-4.99655

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



Antenna Pattern

Appendix D

Total Gain Data

Table with columns: Frequency, dBS, TotalGain, and d. It contains multiple sub-tables for different antenna configurations and frequency bands (e.g., 5.2GHz, 5.3GHz).



Antenna Pattern

Appendix D

Theta	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Theta	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Gain	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90



Antenna Pattern

Appendix D

Table with columns for elevation (0° to 180°) and azimuth (0° to 360°), containing numerical values for antenna gain. The table is organized into four main sections, each with a 'Gain' header and a 'TotalGain' header.

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

