

Antenna Test Report

Report No.: TEOT2408000770E4

Applicant Name: Dyson Operations Pte Ltd
Manufacturer Name: Dyson Operations Pte Ltd

Product Name: Haircare Product
Model Number: X590

Measurements performed at
SGS Taiwan Ltd.
Hwaya District, Taiwan

Issued Date: September 06, 2024

	Name	Date & Signature
Prepared by:	Nandi Chen Sr. Engineer	<i>Nandi Chen</i> September 06, 2024
Approved by:	Shawn Yen Supervisor	<i>Shawn Yen</i> September 06, 2024

Distribution

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Revision Version

Report Number	Revision	Date	Memo
TEOT2408000770E4	00	2024/09/06	Initial creation of test report.

This test report contains a reference to the previous version test report that it replaces.

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Measurement System Information

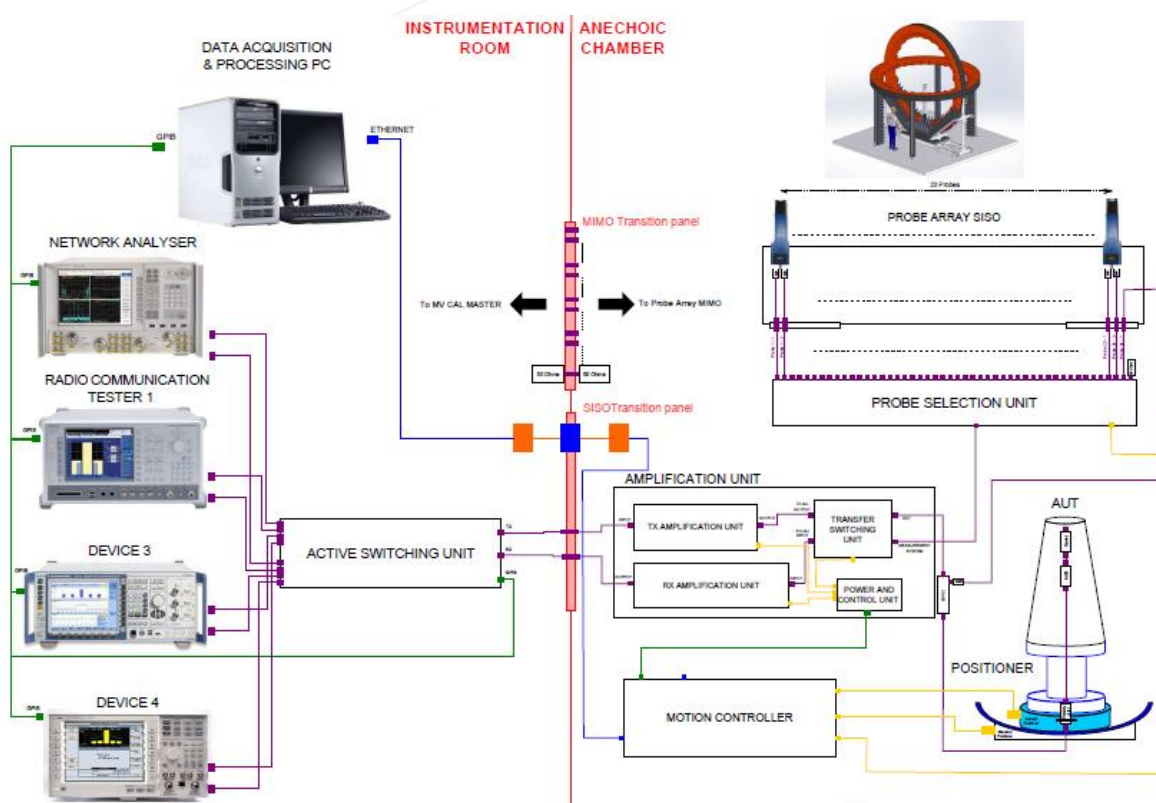
General Information

Testing Condition:

- Temperature: $22 \pm 3^{\circ}\text{C}$
- Humidity: $< 80\%$

Measurement Facility:

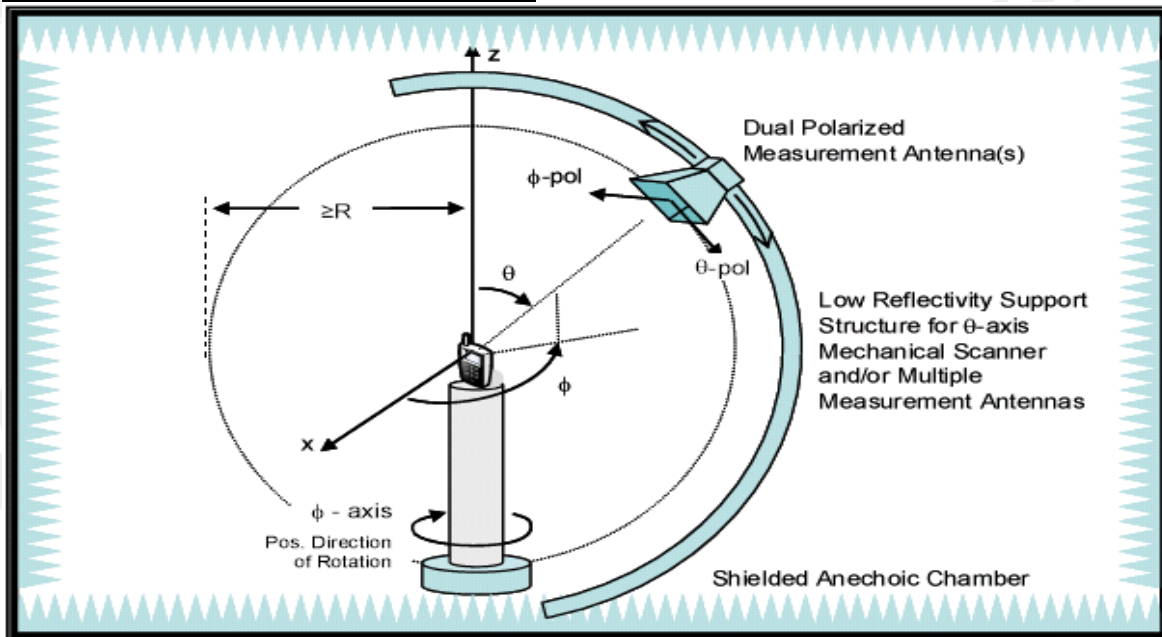
- Measurement Chamber: MVG 3D fully anechoic chamber and its measuring system (Stargate-24-L)
- Network Analyzer: Agilent E5071C



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Measurements are performed in a MVG **Stargate-24-L** with the StarAct interface for a base station simulator. The **Stargate-24-L** has 23 probe antennas mounted with equal spacing on a circular arch. Electronic switching of the probe antennas provides outstanding measurement speed. The geometry of the setup, with only a Styrofoam column within 1.6 meters of the EUT, ensures minimum interference and low ripple on the measured radiation patterns. The DUT is placed on top of the pedestal, in the center of the system.

Typical Setup for MVG Stargate-24-L:



Instruments View



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Testing Laboratory: Identification of the Responsible Test Laboratory.● **OTA Laboratory:****SGS Taiwan Ltd. Wireless Laboratory**

No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803.

Telephone: +886 2 2299 3279

Fax: +886 2 2298 0488

Internet: <http://www.tw.sgs.com>

● **Testing Location:**

No. 2, Keji 1st Rd., Hwaya Technology Park, Guishan District, Taoyuan City, Taiwan 33383.

Details of Applicant:

Applicant's name:	Dyson Operations Pte Ltd
Applicant's address:	Dyson Global Headquarters, 3 Sentosa Gateway, Singapore 098544
Contact person:	Bek Shiau Chin
Telephone:	+65 93730856
Fax:	N/A
E-mail:	Shiauchin.bek@dyson.com

Details of Manufacturer:

Applicant's name:	Dyson Operations Pte Ltd
Applicant's address:	Dyson Global Headquarters, 3 Sentosa Gateway, Singapore 098544
Contact person:	Bek Shiau Chin
Telephone:	+65 93730856
Fax:	N/A
E-mail:	Shiauchin.bek@dyson.com

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Details of EUT:

Device Description:	Haircare Product
Device Manufacturer:	Dyson Operations Pte Ltd
Device Model:	X590
Hardware Version:	EVT3/mini-build
Software Version:	EVT3/mini-build
Frequency Range:	2400MHz ~ 2500MHz (Step: 2MHz)
Antenna Type:	PCB Antenna

Duration of Tests:

Sample Receive Date:	2024-08-28
Test Starting Date:	2024-08-29
Test Ending Date:	2024-08-29
Report Issued Date:	2024-09-06

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List of Equipment

Equipment Summary Sheet

Equipment Description	Manufacturer	Identification no.	Current calibration date	Next calibration date
Network Analyzer	Agilent	E5071C	2023/12/20	2024/12/19
Sleeve Dipole	MVG	SD740	2022/01/07	2025/01/06
Dual Ridge Horn	MVG	SH800	2023/12/14	2024/12/13
Stargate-24-L probe array	MVG	Stargate-24-L	2024/08/14	2025/08/13
Measurement software	MVG	Wave Studio V22.5.6	N/A	N/A

Reference Measurement Procedure

The reference measurement procedure is described in SGS Working Instruction WI-TESP-EO-002 for OTA service, and MVG Support Document “SG24 active measurements user manual”. Measurements are made by placing the probe in contact with the sample and measuring the admittance or reflection coefficient with respect to the open-circuit end, using a network analyzer or equivalent instrumentation.

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Antenna Gain and Efficiency

Note: All data include cable loss of 0.3 dB for 2.4 GHz.

Without attachment

Frequency (MHz)	Peak Gain (dBi)	Min Antenna Gain (dBi)	Directivity Gain (dBi)	Efficiency (%)	Average Gain (dBi)
2400.00	2.19	-22.74	6.83	34.43%	-4.63
2402.00	2.09	-22.66	6.74	34.28%	-4.65
2404.00	1.94	-22.84	6.61	34.12%	-4.67
2406.00	1.78	-21.62	6.47	33.96%	-4.69
2408.00	1.79	-21.15	6.48	33.96%	-4.69
2410.00	1.86	-21.24	6.58	33.73%	-4.72
2412.00	1.90	-21.20	6.61	33.81%	-4.71
2414.00	1.88	-21.29	6.57	33.96%	-4.69
2416.00	1.71	-21.28	6.42	33.88%	-4.70
2418.00	1.84	-20.67	6.50	34.20%	-4.66
2420.00	1.91	-19.80	6.53	34.51%	-4.62
2422.00	1.88	-20.40	6.46	34.83%	-4.58
2424.00	1.91	-21.11	6.45	35.24%	-4.53
2426.00	1.96	-21.63	6.44	35.65%	-4.48
2428.00	2.01	-21.79	6.45	35.97%	-4.44
2430.00	2.03	-21.81	6.42	36.39%	-4.39
2432.00	2.04	-21.60	6.41	36.64%	-4.36
2434.00	2.13	-21.18	6.47	36.81%	-4.34
2436.00	2.41	-20.30	6.68	37.41%	-4.27
2438.00	2.34	-19.94	6.61	37.33%	-4.28
2440.00	2.28	-19.56	6.56	37.33%	-4.28
2442.00	2.23	-19.05	6.52	37.24%	-4.29
2444.00	2.15	-19.63	6.46	37.07%	-4.31
2446.00	2.05	-20.61	6.38	36.81%	-4.34
2448.00	1.96	-21.76	6.30	36.73%	-4.35
2450.00	1.90	-23.55	6.24	36.81%	-4.34
2452.00	1.82	-25.63	6.18	36.56%	-4.37
2454.00	1.71	-27.21	6.12	36.31%	-4.40
2456.00	1.46	-27.14	5.96	35.48%	-4.50
2458.00	1.50	-26.36	6.03	35.24%	-4.53
2460.00	1.43	-25.42	6.01	34.83%	-4.58
2462.00	1.38	-24.37	6.01	34.43%	-4.63
2464.00	1.45	-23.63	6.11	34.20%	-4.66
2466.00	1.44	-23.52	6.11	34.12%	-4.67
2468.00	1.40	-23.80	6.07	34.04%	-4.68
2470.00	1.33	-23.58	6.04	33.81%	-4.71
2472.00	1.34	-24.28	6.07	33.65%	-4.73
2474.00	1.35	-25.16	6.10	33.50%	-4.75
2476.00	1.20	-26.01	5.97	33.34%	-4.77
2478.00	1.10	-26.51	5.89	33.19%	-4.79
2480.00	1.10	-26.84	5.89	33.19%	-4.79
2482.00	1.16	-26.85	5.92	33.42%	-4.76
2484.00	1.13	-26.40	5.85	33.73%	-4.72
2486.00	0.92	-25.66	5.68	33.42%	-4.76
2488.00	0.92	-25.09	5.67	33.50%	-4.75
2490.00	0.94	-25.36	5.68	33.57%	-4.74
2492.00	0.84	-25.35	5.60	33.42%	-4.76
2494.00	0.70	-25.14	5.49	33.19%	-4.79
2496.00	0.79	-26.12	5.61	32.96%	-4.82
2498.00	0.74	-27.11	5.56	32.96%	-4.82
2500.00	0.64	-26.78	5.49	32.73%	-4.85

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With attachment

Frequency (MHz)	Peak Gain (dBi)	Min Antenna Gain (dBi)	Directivity Gain (dBi)	Efficiency (%)	Average Gain (dBi)
2400.00	2.10	-21.39	6.75	34.20%	-4.66
2402.00	2.08	-20.80	6.75	34.12%	-4.67
2404.00	2.01	-21.08	6.70	33.96%	-4.69
2406.00	1.93	-22.01	6.63	33.88%	-4.70
2408.00	1.93	-22.98	6.64	33.81%	-4.71
2410.00	1.98	-25.82	6.71	33.57%	-4.74
2412.00	2.02	-28.32	6.74	33.73%	-4.72
2414.00	1.99	-28.84	6.69	33.81%	-4.71
2416.00	1.81	-27.03	6.52	33.81%	-4.71
2418.00	1.92	-25.87	6.59	34.12%	-4.67
2420.00	1.99	-26.33	6.62	34.43%	-4.63
2422.00	1.94	-27.49	6.53	34.75%	-4.59
2424.00	1.91	-27.92	6.46	35.16%	-4.54
2426.00	1.84	-29.90	6.33	35.48%	-4.50
2428.00	1.90	-29.51	6.35	35.89%	-4.45
2430.00	1.90	-28.28	6.30	36.22%	-4.41
2432.00	1.83	-28.36	6.21	36.48%	-4.38
2434.00	1.79	-27.68	6.15	36.64%	-4.36
2436.00	2.07	-25.28	6.36	37.15%	-4.30
2438.00	1.95	-25.20	6.25	37.15%	-4.30
2440.00	1.79	-26.45	6.10	36.98%	-4.32
2442.00	1.72	-27.55	6.04	36.98%	-4.32
2444.00	1.68	-28.86	6.02	36.73%	-4.35
2446.00	1.61	-31.92	5.98	36.56%	-4.37
2448.00	1.44	-34.63	5.82	36.48%	-4.38
2450.00	1.43	-37.23	5.80	36.56%	-4.37
2452.00	1.38	-40.37	5.78	36.31%	-4.40
2454.00	1.38	-44.02	5.83	35.97%	-4.44
2456.00	1.35	-38.80	5.88	35.16%	-4.54
2458.00	1.37	-34.35	5.94	34.91%	-4.57
2460.00	1.29	-31.98	5.91	34.51%	-4.62
2462.00	1.22	-36.89	5.90	34.12%	-4.67
2464.00	1.27	-38.02	5.97	33.81%	-4.71
2466.00	1.24	-38.57	5.95	33.81%	-4.71
2468.00	1.19	-33.15	5.92	33.65%	-4.73
2470.00	1.12	-27.04	5.88	33.42%	-4.76
2472.00	1.14	-24.23	5.92	33.27%	-4.78
2474.00	1.15	-23.22	5.95	33.11%	-4.80
2476.00	1.00	-23.34	5.82	32.96%	-4.82
2478.00	0.90	-23.14	5.74	32.81%	-4.84
2480.00	0.91	-22.88	5.75	32.81%	-4.84
2482.00	0.94	-22.52	5.75	33.04%	-4.81
2484.00	0.90	-22.02	5.67	33.27%	-4.78
2486.00	0.73	-21.51	5.54	33.04%	-4.81
2488.00	0.73	-21.25	5.53	33.11%	-4.80
2490.00	0.75	-20.99	5.54	33.19%	-4.79
2492.00	0.66	-21.03	5.46	33.04%	-4.81
2494.00	0.53	-21.43	5.36	32.89%	-4.83
2496.00	0.54	-22.21	5.40	32.66%	-4.86
2498.00	0.54	-22.74	5.40	32.66%	-4.86
2500.00	0.45	-24.28	5.34	32.43%	-4.89

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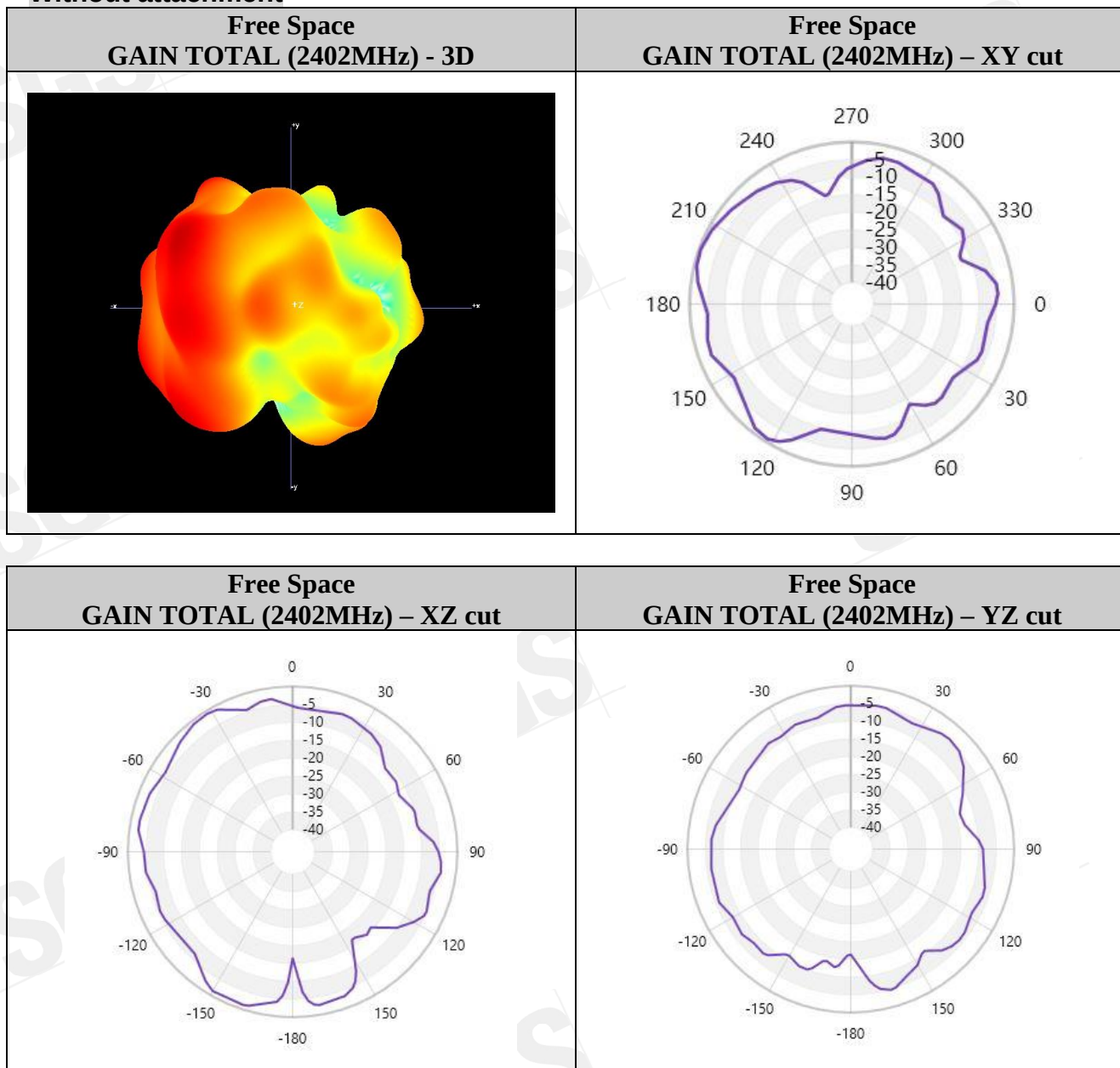
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Antenna 3D Plot Matrix

All plots in this section show the total GAIN TOTAL (GAIN TOTAL θ + GAIN TOTAL ϕ) with the +x-axis pointing right, +y-axis pointing up, and +z-axis pointing out of the page.

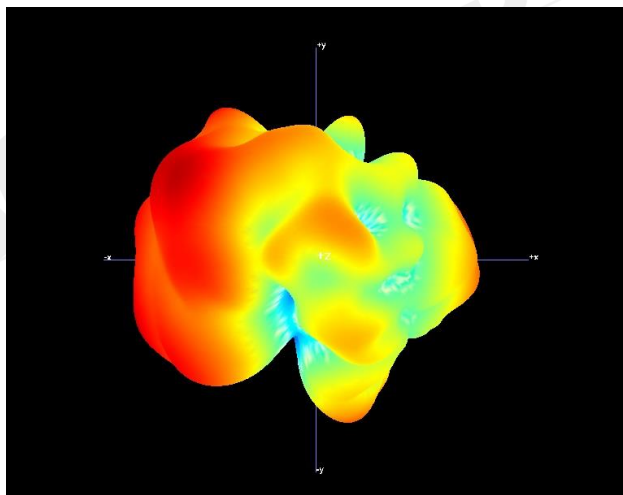
Without attachment



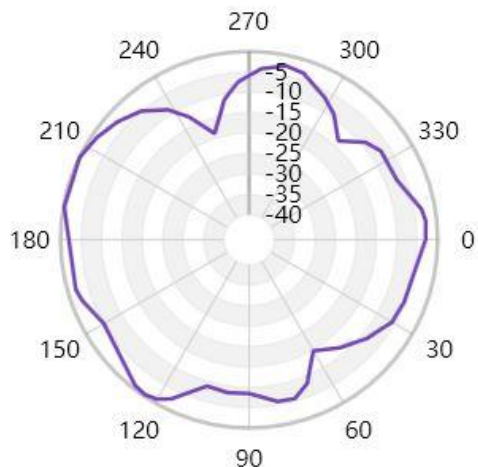
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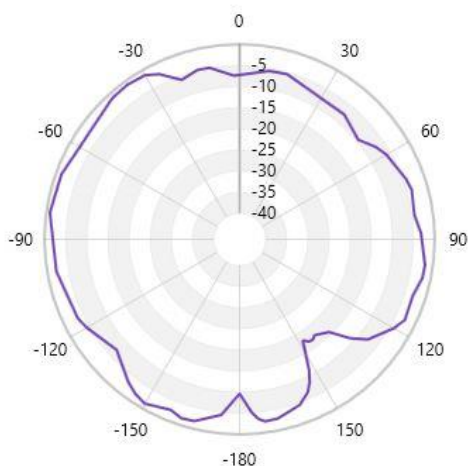
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GAIN TOTAL (2440MHz) - 3D**



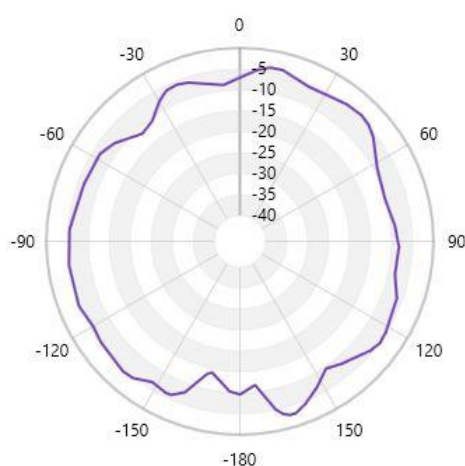
**Free Space
GAIN TOTAL (2440MHz) - XY cut**



**Free Space
GAIN TOTAL (2440MHz) - XZ cut**



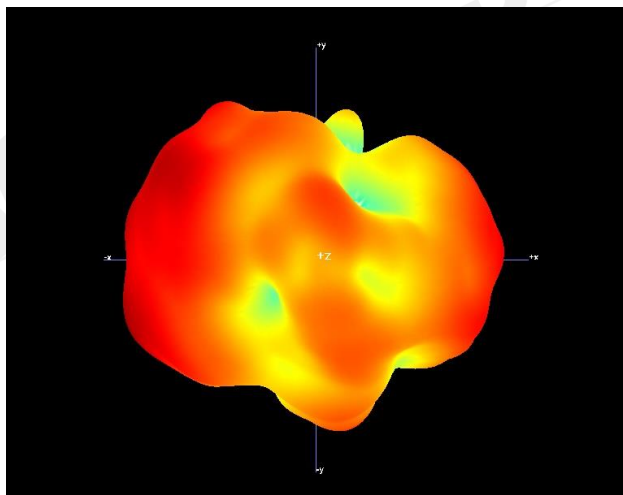
**Free Space
GAIN TOTAL (2440MHz) - YZ cut**



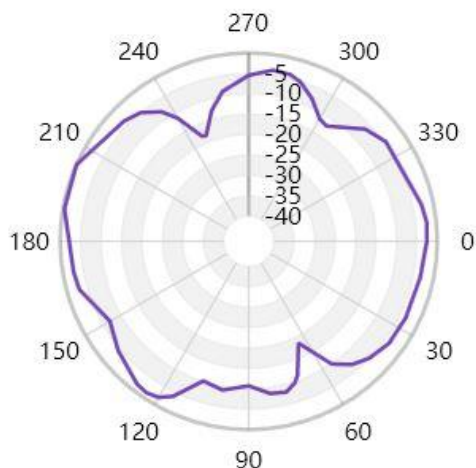
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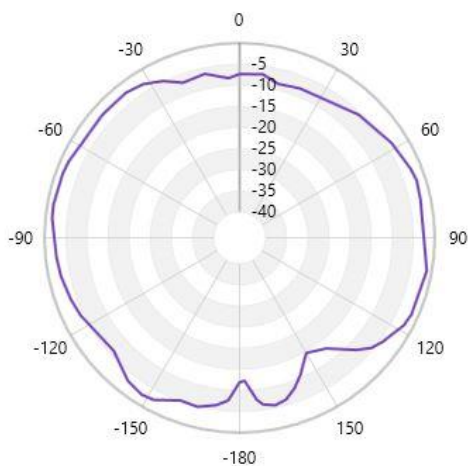
**Free Space
GAIN TOTAL (2480MHz) - 3D**



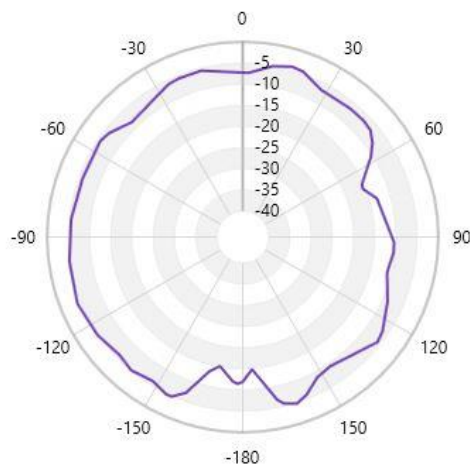
**Free Space
GAIN TOTAL (2480MHz) - XY cut**



**Free Space
GAIN TOTAL (2480MHz) - XZ cut**



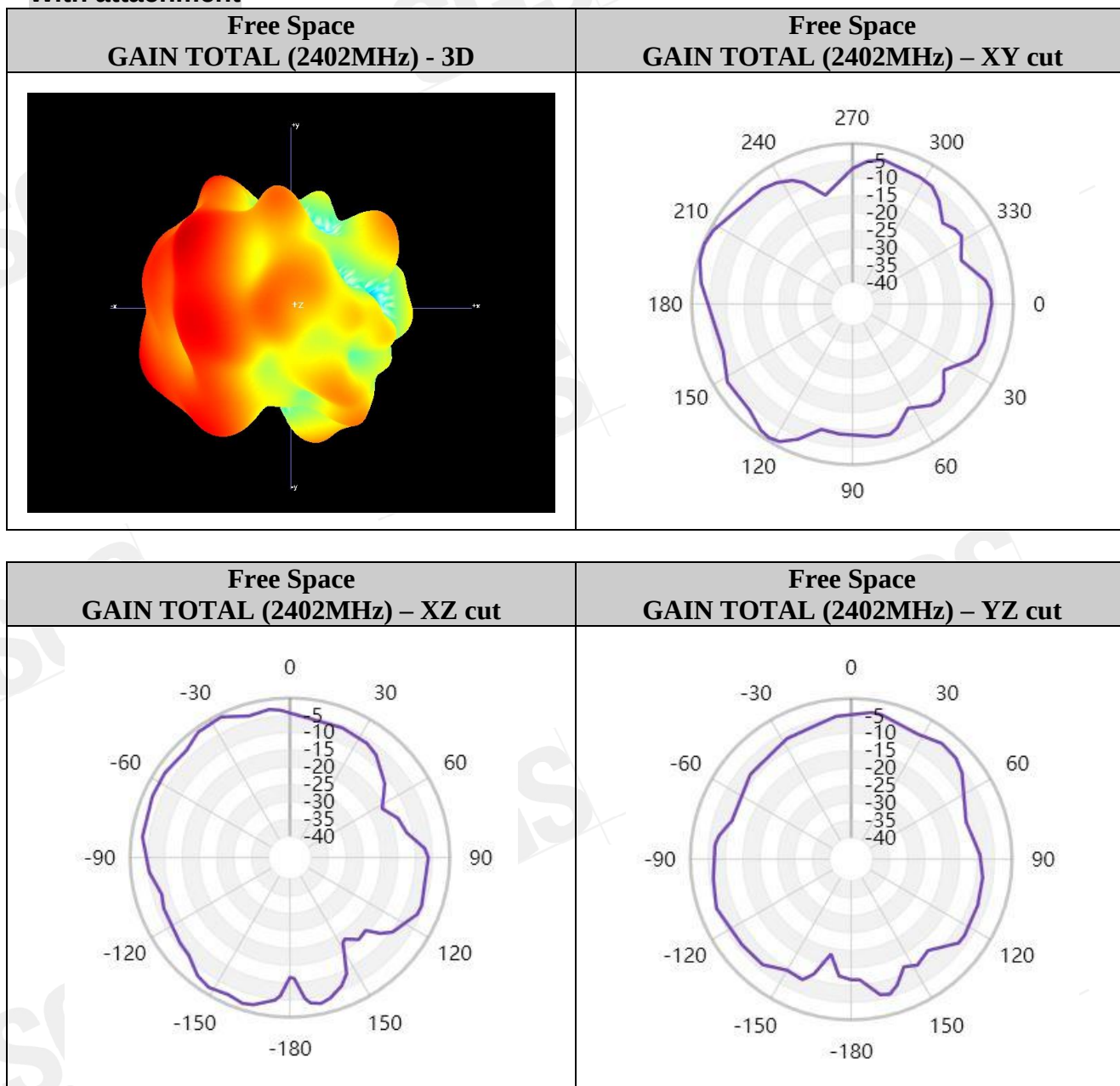
**Free Space
GAIN TOTAL (2480MHz) - YZ cut**



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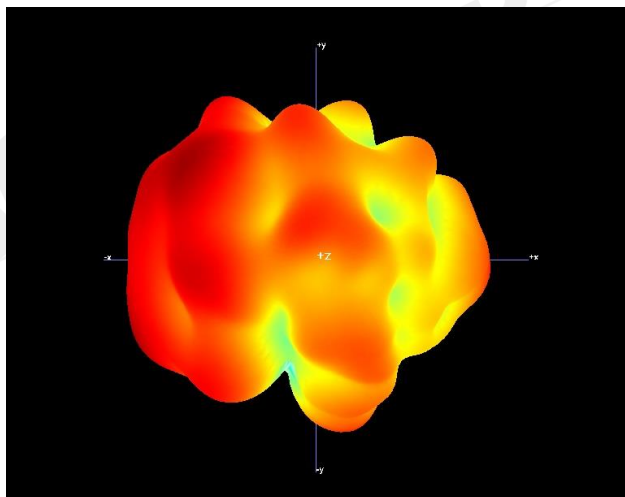
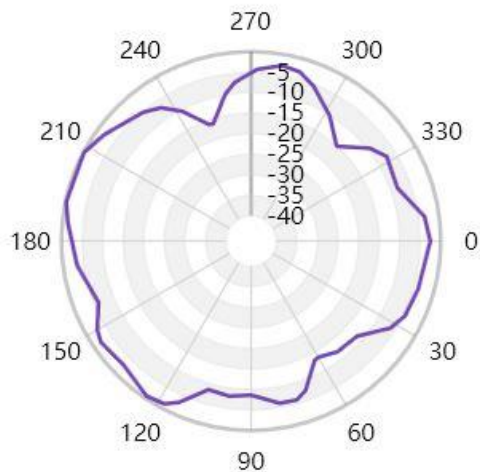
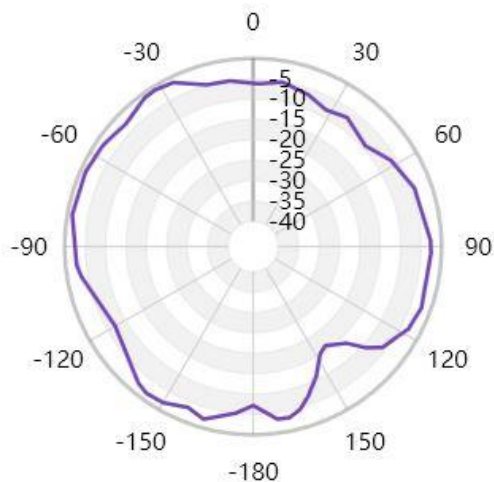
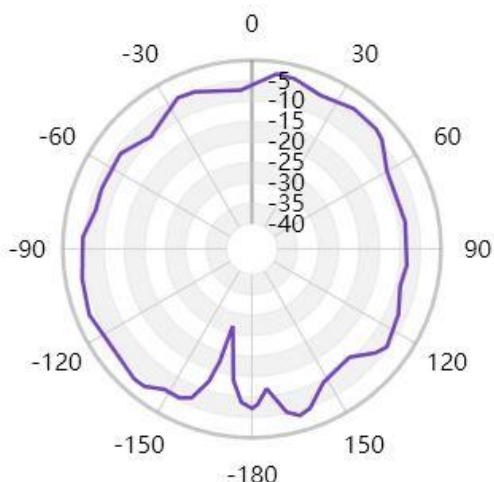
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With attachment



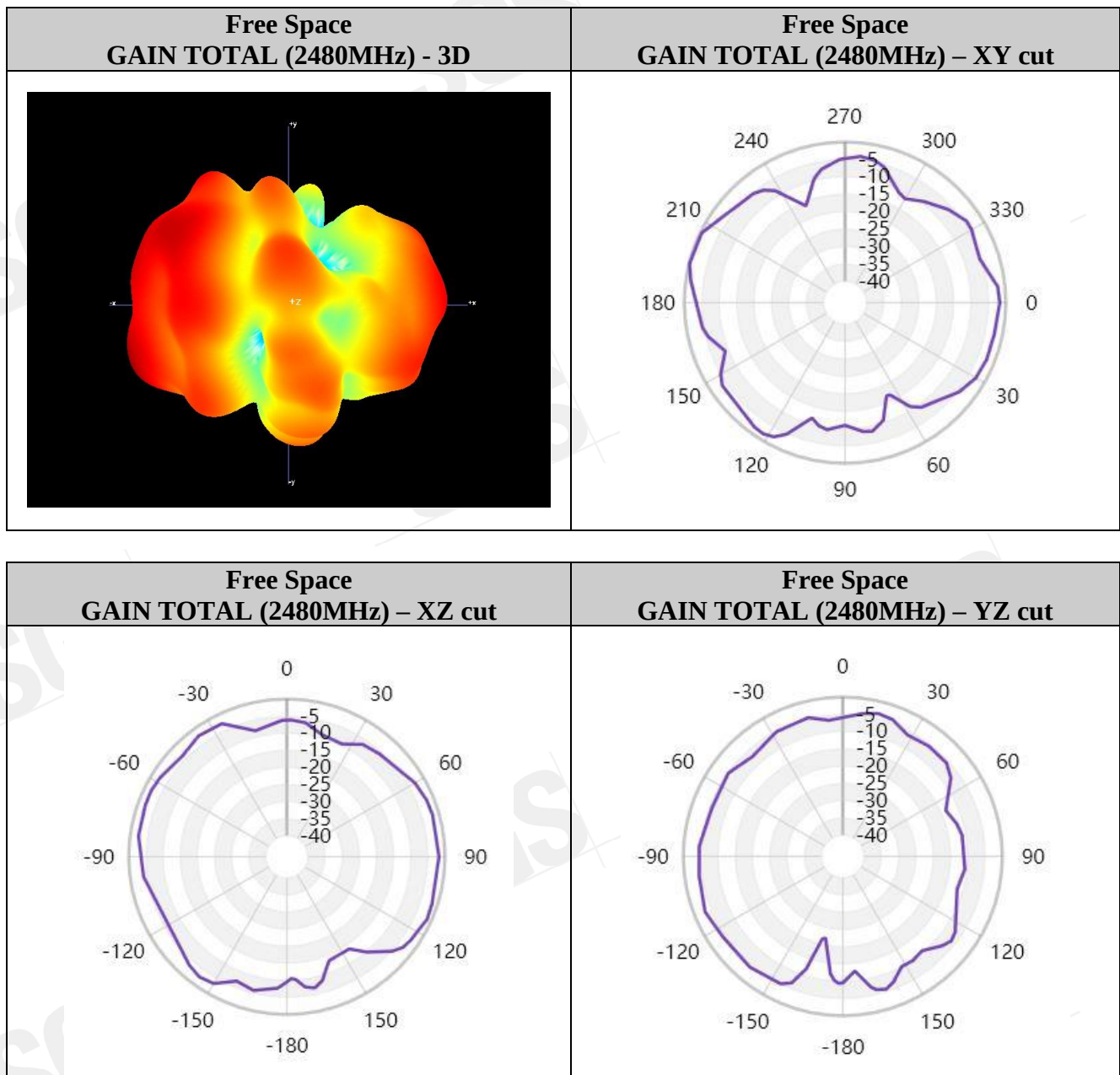
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**Free Space
GAIN TOTAL (2440MHz) - 3D****Free Space
GAIN TOTAL (2440MHz) - XY cut****Free Space
GAIN TOTAL (2440MHz) - XZ cut****Free Space
GAIN TOTAL (2440MHz) - YZ cut**

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End of Report

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