

Antenna Test Report

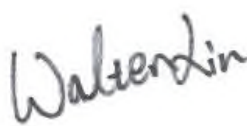

Report No.: TEOT2401000045EO

Applicant Name: SIGNAL ELECTRONIC CO., LTD.
Manufacturer Name: SIGNAL ELECTRONIC CO., LTD.

Product Name: BLE Module
Model No.: SMD2860-P093

Measurements performed at
SGS Taiwan Ltd.
NeiHu District, Taiwan

Issued Date: January 15, 2024

	Name	Date & Signature	Distribution
Prepared by:	Walter Lin Engineer	 January 15, 2024	
Approved by:	Eason Chou Supervisor	 January 15, 2024	

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Revision Version

Report Number	Revision	Date	Memo
TEOT2401000045EO	00	2024/01/15	Initial creation of test report. Please be noted that the report TEOT2401000045EO will replace the previous TEOT2312000833EO as the new version. Also be pay attention that TEOT2312000833EO is ineffective anymore from now on.

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

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Measurement System Information

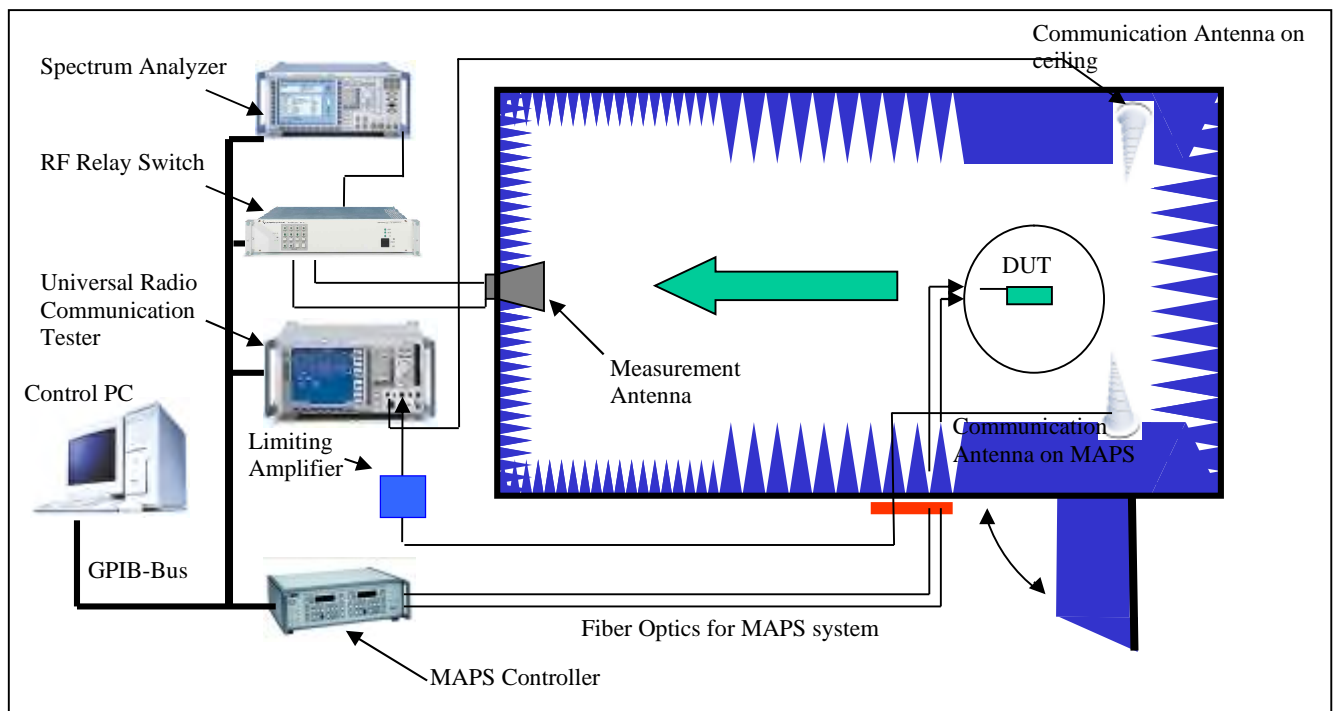
General Information

Testing Condition:

- Temperature: $25 \pm 3^\circ\text{C}$
- Humidity: $< 80\%$

Measurement Facility:

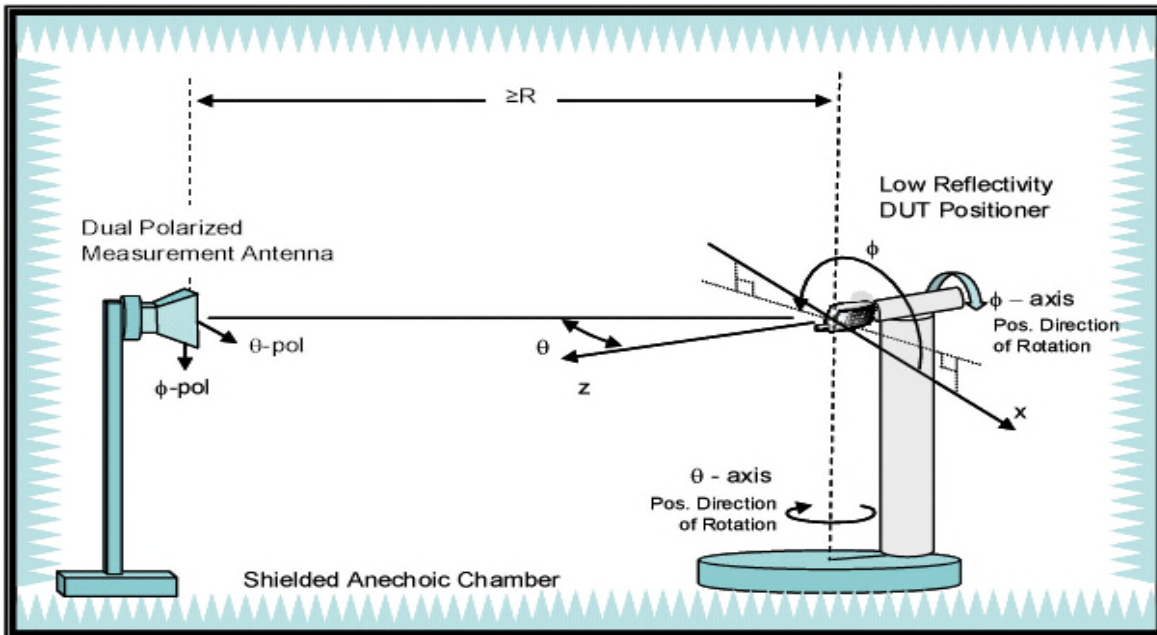
- Measurement Chamber: ETS-Lindgren 3D fully anechoic chamber and its measuring system (AMS-8500)
- Base Station Simulator: Agilent E5515C
- ETS-Lindgren EMCO-2090 Auxiliary Ports RF Relay Switches
- Spectrum Analyzer: Agilent N9010A
- Network Analyzer: Agilent E5071C



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Measurements are performed in an ETS-Lindgren **AMS-8500** 3D fully anechoic test system. The test system includes a high-performance RF-shielded, rectangular anechoic chamber, a Multi-Axis Positioning System (MAPS), and *EMQuest™* **EMQ-100** data acquisition and analysis software. The geometry of the setup is specified below for reference.

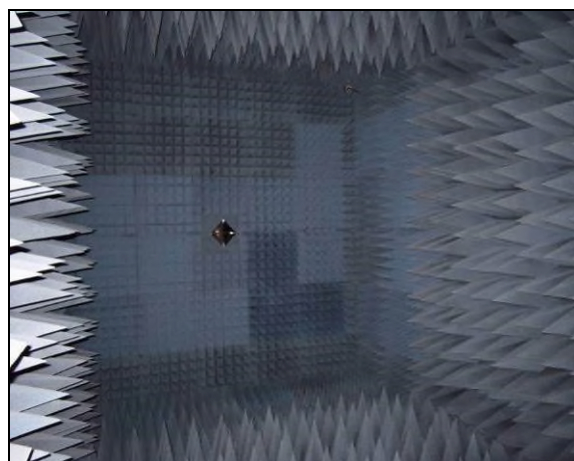
Typical Setup for ETS-Lindgren AMS-8500:



Instruments View



Inside 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:**
 1F, No. 8, Alley 15, Lane 120, Sec. 1, NeiHu Road, NeiHu District, Taipei City 114, Taiwan 11446.

Details of Applicant:

Applicant's name:	SIGNAL ELECTRONIC CO., LTD.
Applicant's address:	4F-2, No.3, Park St. Nankang Software Park Taiwan, R. O. C.
Contact person:	Jon Liao
Telephone:	(02)2655-7577 ext : 259
Fax:	(02)2655-7578
E-mail:	jon@e-signal.com.tw

Details of Manufacturer:

Manufacturer's name:	SIGNAL ELECTRONIC CO., LTD.
Manufacturer's address:	4F-2, No.3, Park St. Nankang Software Park Taiwan, R. O. C.
Contact person:	Jon Liao
Telephone:	(02)2655-7577 ext : 259
Fax:	(02)2655-7578
E-mail:	jon@e-signal.com.tw

Details of EUT:

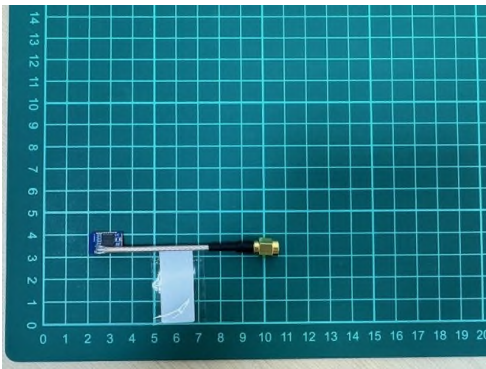
Device Description:	BLE Module
Device Manufacturer:	SIGNAL ELECTRONIC CO., LTD.
Device Model:	SMD2860-P093
Hardware Version:	N/A
Software Version:	N/A
Frequency Range:	2400 MHz ~ 2483 MHz
Antenna Type:	PCB Antenna

Duration of Tests:

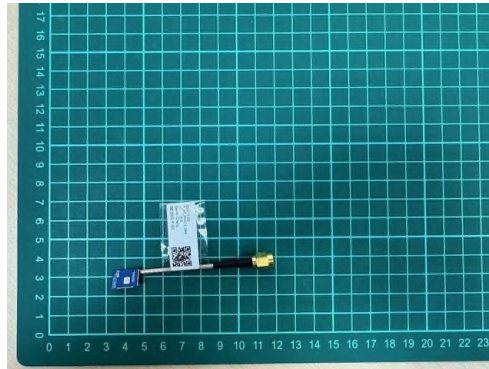
Sample Receive Date:	2023-12-20
Test Starting Date:	2023-12-22
Test Ending Date:	2023-12-22
Report Issued Date:	2024-01-15

Photographs of EUT:

Front View



Back View



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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	2023/05/10	2024/05/09
Measurement software	ETS-Lindgren	EMQuest 1.14	N/A	N/A
Multi axis positioning system(MAPSTM)	ETS-Lindgren	EMCO 2115	N/A	N/A
Multi axis positioning system(MAPSTM)	ETS-Lindgren	EMCO 2110	N/A	N/A
MAPSTM controller	ETS-Lindgren	EMCO 2090	N/A	N/A
Fully anechoic test system	ETS-Lindgren	AMS-8500	2023/03/03	2024/03/02
Horn antenna	ETS-Lindgren	3164-10	2023/03/03	2024/03/02

Reference Measurement Procedure

The reference measurement procedure is described in SGS Working Instruction WI-TESP-EO-101 to 108 for OTA services. EIRP measurement is based on the industry-standard method described in CTIA OTA Test Plan v3.9.5. 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

Test Result										
Frequency (MHz)	2400	2402	2404	2406	2408	2410	2412	2414	2416	2418
Point Values										
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-2.61	-2.54	-2.51	-2.57	-2.58	-2.51	-2.43	-2.44	-2.51	-2.51
Peak EIRP (dBm)	2.90	2.99	2.99	2.90	2.88	2.91	2.99	2.95	2.85	2.81
Directivity (dBi)	5.51	5.53	5.50	5.47	5.46	5.43	5.43	5.39	5.36	5.33
Efficiency (dB)	-2.61	-2.54	-2.51	-2.57	-2.58	-2.51	-2.43	-2.44	-2.51	-2.51
Efficiency (%)	54.88	55.71	56.11	55.37	55.24	56.05	57.12	57.02	56.12	56.05
Gain (dBi)	2.90	2.99	2.99	2.90	2.88	2.91	2.99	2.95	2.85	2.81
NHPRP ±Pi/4 (dBm)	-4.58	-4.51	-4.48	-4.54	-4.55	-4.50	-4.41	-4.42	-4.49	-4.50
NHPRP ±Pi/6 (dBm)	-6.45	-6.38	-6.35	-6.40	-6.42	-6.36	-6.27	-6.27	-6.35	-6.35
NHPRP ±Pi/8 (dBm)	-7.52	-7.45	-7.42	-7.47	-7.48	-7.42	-7.34	-7.34	-7.41	-7.41
Upper Hem. PRP (dBm)	-7.36	-7.31	-7.28	-7.34	-7.35	-7.29	-7.21	-7.22	-7.29	-7.30
Lower Hem. PRP (dBm)	-4.37	-4.30	-4.27	-4.33	-4.34	-4.27	-4.19	-4.20	-4.27	-4.27

Test Result											
Frequency (MHz)	2420	2422	2424	2426	2428	2430	2432	2434	2436	2438	2440
Point Values											
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-2.49	-2.47	-2.50	-2.52	-2.50	-2.57	-2.63	-2.65	-2.62	-2.61	-2.72
Peak EIRP (dBm)	2.80	2.82	2.76	2.73	2.70	2.59	2.52	2.48	2.47	2.45	2.31
Directivity (dBi)	5.29	5.29	5.27	5.25	5.21	5.16	5.15	5.13	5.09	5.06	5.03
Efficiency (dB)	-2.49	-2.47	-2.50	-2.52	-2.50	-2.57	-2.63	-2.65	-2.62	-2.61	-2.72
Efficiency (%)	56.40	56.64	56.17	55.98	56.17	55.33	54.57	54.26	54.71	54.86	53.50
Gain (dBi)	2.80	2.82	2.76	2.73	2.70	2.59	2.52	2.48	2.47	2.45	2.31
NHPRP ±Pi/4 (dBm)	-4.47	-4.46	-4.49	-4.51	-4.50	-4.56	-4.62	-4.65	-4.61	-4.60	-4.71
NHPRP ±Pi/6 (dBm)	-6.32	-6.30	-6.34	-6.36	-6.34	-6.40	-6.45	-6.47	-6.43	-6.41	-6.51
NHPRP ±Pi/8 (dBm)	-7.38	-7.37	-7.40	-7.42	-7.40	-7.46	-7.51	-7.53	-7.49	-7.47	-7.56
Upper Hem. PRP (dBm)	-7.28	-7.27	-7.31	-7.33	-7.31	-7.38	-7.44	-7.47	-7.44	-7.42	-7.52
Lower Hem. PRP (dBm)	-4.24	-4.21	-4.25	-4.26	-4.25	-4.31	-4.37	-4.39	-4.36	-4.35	-4.46

Test Result											
Frequency (MHz)	2442	2444	2446	2448	2450	2452	2454	2456	2458	2460	2462
Point Values											
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-2.84	-2.86	-2.84	-2.89	-3.03	-3.18	-3.24	-3.22	-3.36	-3.45	-3.56
Peak EIRP (dBm)	2.11	2.10	2.13	2.10	1.99	1.86	1.79	1.84	1.68	1.61	1.54
Directivity (dBi)	4.96	4.96	4.96	4.99	5.01	5.04	5.03	5.06	5.03	5.06	5.10
Efficiency (dB)	-2.84	-2.86	-2.84	-2.89	-3.03	-3.18	-3.24	-3.22	-3.36	-3.45	-3.56
Efficiency (%)	51.94	51.77	52.05	51.39	49.82	48.06	47.41	47.63	46.18	45.15	44.06
Gain (dBi)	2.11	2.10	2.13	2.10	1.99	1.86	1.79	1.84	1.68	1.61	1.54
NHPRP ±Pi/4 (dBm)	-4.84	-4.85	-4.83	-4.88	-5.03	-5.18	-5.25	-5.22	-5.35	-5.46	-5.57
NHPRP ±Pi/6 (dBm)	-6.64	-6.64	-6.62	-6.66	-6.81	-6.96	-7.02	-6.99	-7.12	-7.22	-7.33
NHPRP ±Pi/8 (dBm)	-7.69	-7.70	-7.67	-7.72	-7.87	-8.02	-8.08	-8.05	-8.18	-8.29	-8.39
Upper Hem. PRP (dBm)	-7.65	-7.66	-7.63	-7.69	-7.82	-7.97	-8.02	-8.00	-8.12	-8.22	-8.32
Lower Hem. PRP (dBm)	-4.59	-4.60	-4.58	-4.64	-4.77	-4.94	-5.00	-4.98	-5.12	-5.22	-5.33

Test Result											
Frequency (MHz)	2464	2466	2468	2470	2472	2474	2476	2478	2480	2482	2483
Point Values											
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-3.63	-3.76	-3.90	-3.96	-4.04	-4.15	-4.34	-4.46	-4.52	-4.58	-4.62
Peak EIRP (dBm)	1.49	1.36	1.21	1.16	1.14	1.01	0.81	0.70	0.65	0.59	0.59
Directivity (dBi)	5.12	5.12	5.11	5.12	5.17	5.16	5.15	5.16	5.17	5.18	5.21
Efficiency (dB)	-3.63	-3.76	-3.90	-3.96	-4.04	-4.15	-4.34	-4.46	-4.52	-4.58	-4.62
Efficiency (%)	43.38	42.05	40.76	40.23	39.49	38.49	36.84	35.78	35.32	34.80	34.50
Gain (dBi)	1.49	1.36	1.21	1.16	1.14	1.01	0.81	0.70	0.65	0.59	0.59
NHPRP ±Pi/4 (dBm)	-5.64	-5.77	-5.91	-5.97	-6.05	-6.16	-6.36	-6.48	-6.54	-6.61	-6.65
NHPRP ±Pi/6 (dBm)	-7.40	-7.53	-7.66	-7.72	-7.80	-7.91	-8.10	-8.22	-8.28	-8.35	-8.39
NHPRP ±Pi/8 (dBm)	-8.46	-8.59	-8.73	-8.78	-8.86	-8.98	-9.17	-9.30	-9.36	-9.43	-9.47
Upper Hem. PRP (dBm)	-8.38	-8.51	-8.63	-8.68	-8.75	-8.85	-9.02	-9.15	-9.20	-9.26	-9.30
Lower Hem. PRP (dBm)	-5.40	-5.54	-5.68	-5.74	-5.83	-5.94	-6.14	-6.27	-6.32	-6.39	-6.43

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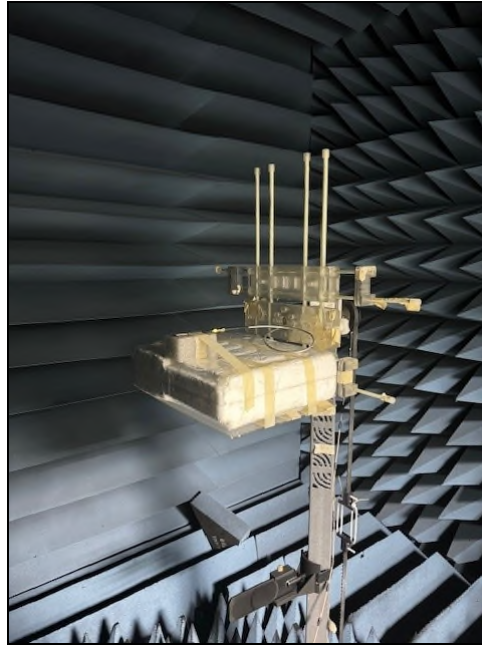
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Test Setup

Free Space - Front View



Free Space - Side View

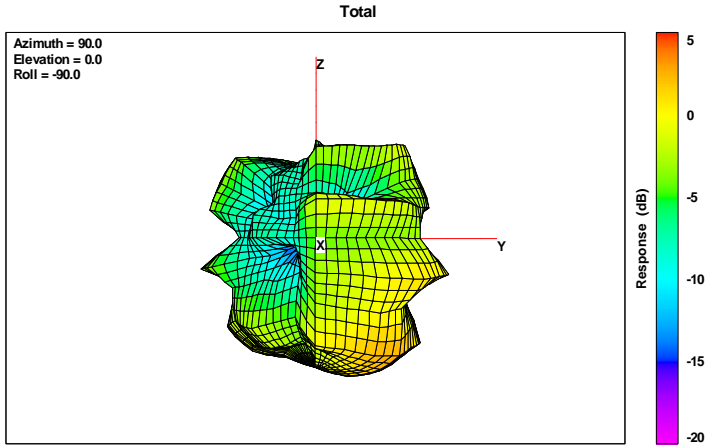


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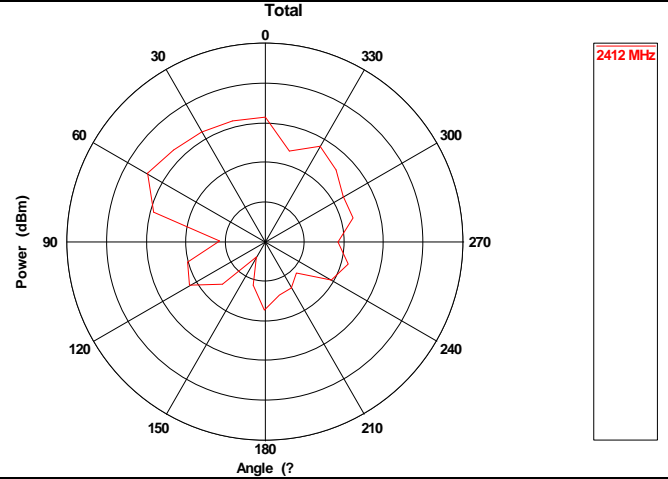
Antenna 3D Plot Matrix

All plots in this section show the total EIRP ($EIRP_{\theta} + EIRP_{\phi}$) with the +x-axis pointing out of the page, +y-axis pointing top of the page, and +z-axis pointing left of the page.

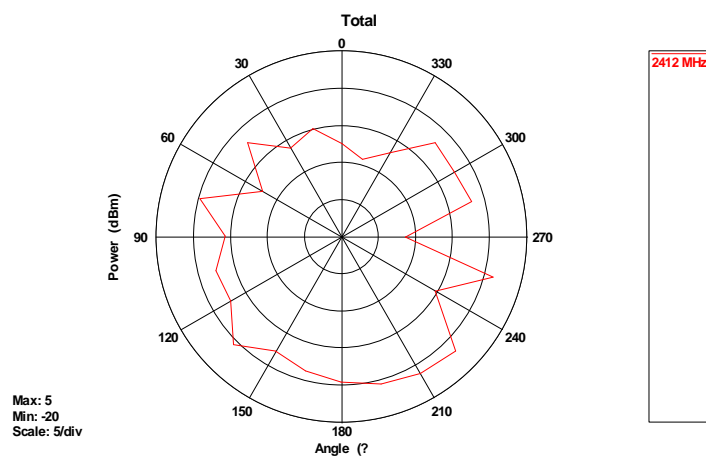
**Free Space
EIRP (2412 MHz) - 3D**



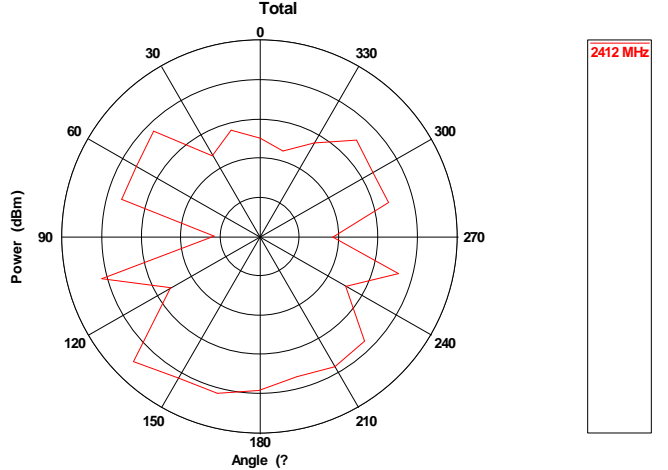
**Free Space
EIRP (2412 MHz) - XY cut**



**Free Space
EIRP (2412 MHz) - XZ cut**



**Free Space
EIRP (2412 MHz) - YZ cut**



End of Report

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