# Antenna Test Report

| | | |
|---|---|---|
| **Equipment** | **:** | **CME350RFID2** |
| **Brand Name** | **:** | **CME350RFID2** |
| **Model Name** | **:** | **CME350RFID2-RevA** |
| **Applicant** | **:** | **CME Manufacturing and Logistics AB**<br>**Teknikvagen 11, Odsmal 44494, SWEDEN.** |
| **Manufacturer** | **:** | **CME Manufacturing and Logistics AB**<br>**Teknikvagen 11, Odsmal 44494, SWEDEN.** |
| **Standard** | **:** | **ANSI C63.5: 2017** |

**The product was received on Jan. 04, 2024, and testing was started from Jan. 19, 2024 and completed on Jan. 20, 2024. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.5: 2017 and shown compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Hsinhua Laboratory, the test report shall not be reproduced except in full.**

Jackson Tsai

**Approved by: Jackson Tsai**

***SPORTON INTERNATIONAL INC. Hsinhua Laboratory***

*No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)*

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# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| AP3D1528 | 01 | Initial issue of report | Feb. 20, 2024 |
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# Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 2 | - | Antenna test result | PASS | - |

| **Declaration of Conformity:** |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| **Comments and Explanations:** |
| None. |

**Reviewed by: Barry Hsiao**

**Report Producer: Amber Chiu**

# 1 General Description

## 1.1 Antenna Information

| Antenna Category | | |
|---|---|---|
| ☐ | Equipment placed on the market without antennas | |
| ☒ | Integral antenna (antenna permanently attached) | |
| | ☐ | Temporary RF connector provided |
| | ☒ | No temporary RF connector provided<br>Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path. |
| ☐ | External antenna (dedicated antennas) | |

## 1.2 Testing Applied Standards

According to the specifications of the manufacturer, the AUT must comply with the requirements of the following standards:

- ANSI C63.5: 2017

## 1.3 Testing Location

| Test Lab.：Sporton International Inc. Hsinhua Laboratory | | | | |
|---|---|---|---|---|
| ☒ Hsinhua | **ADD:** No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.) | | | |
| **(TAF:** 3785**)** | **TEL:** 886-3-327-3456 | | **FAX:** 886-3-327-0973 | |
| **Test Condition** | **Test Site No.** | **Test Engineer** | **Test Environment** | **Test Date** |
| Radiated | 05CH01-HY | Wayne Chiu | 23.5~24.6°C / 52~57% | 19/Jan/2024 ~ 20/Jan/2024 |
| ☐ Wen 33rd.St. | **ADD:** No.14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) | | | |
| **(TAF:** 3785**)** | **TEL:** 886-3-318-0787 | | **FAX:** 886-3-318-0287 | |

## 1.4 Test Channel Frequencies Configuration

| Antenna Test Suites | | | |
|---|---|---|---|
| **Description** | **Polarization** | | **Test Channel** |
| | **Azimuth plane** | **Elevation plane** | |
| Antenna Gain | ✔ | ✔ | BMT |

| **EUT Channel** | **B** | **M** | **T** |
|---|---|---|---|
| **Frequency** | 903.24MHz | 914.76MHz | 926.76MHz |

# 2 Antenna Test Result

## 2.1 Test Procedures

### 2.1.1 Standard Antenna Method

Sporton implement Standard Antenna Method in electromagnetic fully anechoic chambers to measure the unknown antenna gain of AUT. To measure the gain of an antenna, three antennas are required:
a) The antenna under test (AUT)
b) An antenna of known gain, that we will call Reference Gain
c) A third antenna which can be of unknown gain

The far-field calculations are accurate when the distance, r, from an antenna of length D to a point of investigation is greater than:

| Dimension *D* of radiating structure | Far-field criterion $rR_{ff}$ |
|---|---|
| Small: low-gain antenna in free space D<λ | $R_{ff}\lambda / 2\pi$ |
| Large: low-gain antenna installed on or near a large conducting ground plane with dimension D>>λ | $R_{ff} 8 \lambda$ |
| Large (high-gain antenna) with aperture diameter D>>λ | $R_{ff} 2D^2/ \lambda$ Rayleigh distance |

Two measurements are required to determine the gain of the antenna under test (AUT). In each measurement, one antenna is connected to a transmitter, which can be a Signal Generator, and the other one is connected to a receiver, which can be a Spectrum Analyzer or a Power Meter. In our case, the receiver will be a Spectrum Analyzer. The antennas are mounted over tripods at fixed positions. The distance between the tripods should be more than a couple of meters to measure the far field. It is assumed that the three antennas have been carefully matched to the appropriate impedance and accurately calibrated and matched devices are being used. The antenna with known gain may be any type of antenna, which has been calibrated either by direct measurement or in special cases by accurate construction according to computed dimensions.

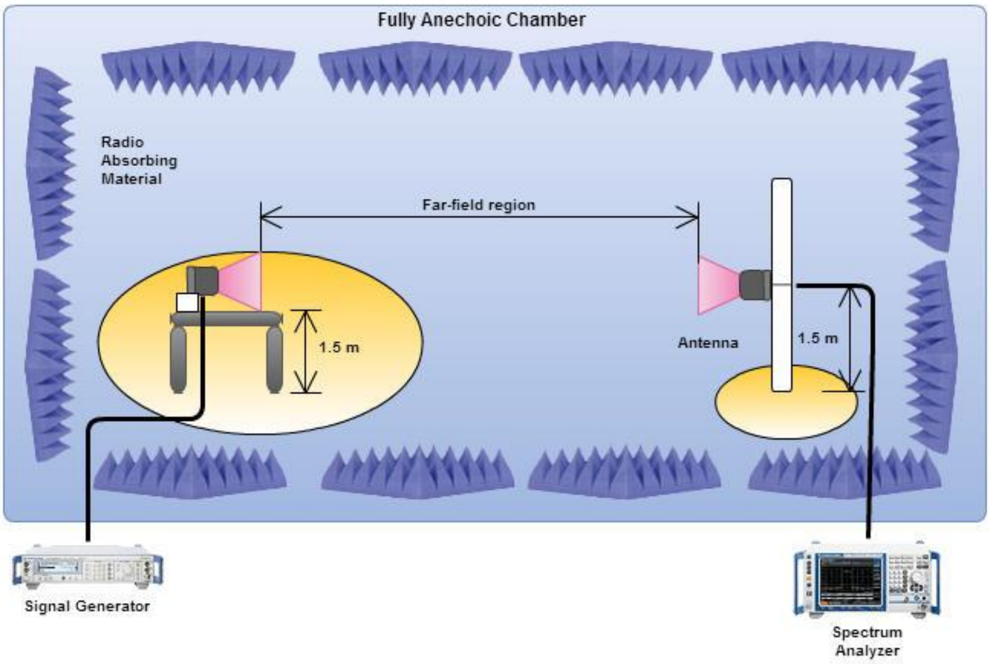
To prepare the measurement, switch on the Signal Generator and the Spectrum Analyzer well in advance and let them stabilize. Set the frequency of the Signal Generator to measurement frequency, with no modulation and disable the RF output until you connect the antenna. Set also the Spectrum Analyzer for a center frequency of measurement frequency and a frequency span of 1 MHz.

In the first measurement, the antenna of known gain is connected to the transmitter and the third antenna is connected to the receiver. Switch on the RF output of the Signal Generator and set its level high enough so that on the Spectrum Analyzer you can see the peak of the signal well over the noise floor. After arranging the two antennas to read the maximum value for the received signal, record this value on paper. This will be your Reference Level.

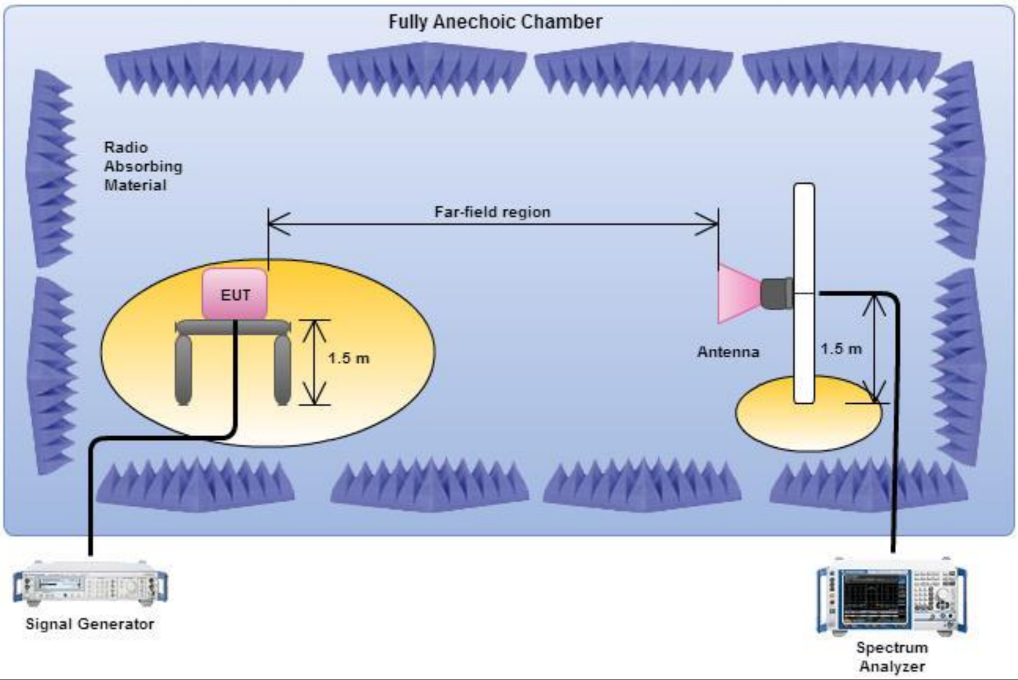
Without changing the position of the tripods nor the cables or connector/adapters, you should now exchange the antenna of known gain with the antenna under test. The value of the received signal must be read and recorded on paper as Measured Level. The gain of the antenna under test is then given by:
Gain (dBi)= Reference Gain+(Measured Level - Reference Level)
The gains are expressed in dBi and the levels are expressed in dBm.

## 2.1.2 Test Setup

**Standard Know Gain Antenna – Read Reference Level in Spectrum**




**AUT Unknown Gain Antenna – Read Measured Level in Spectrum**



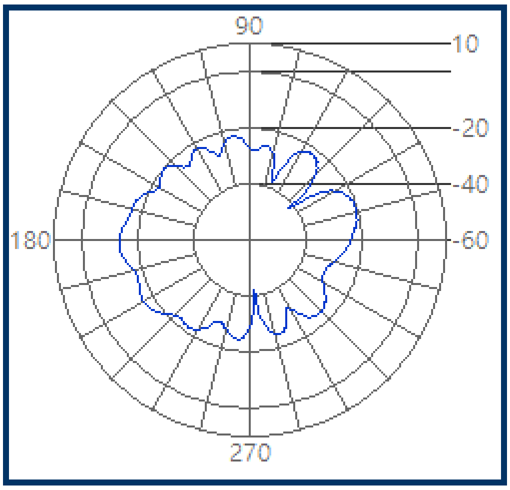
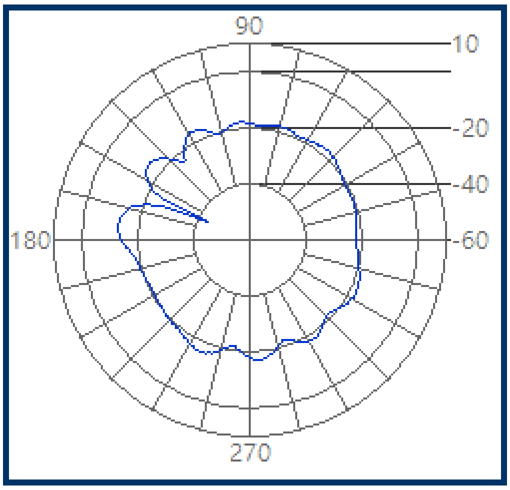
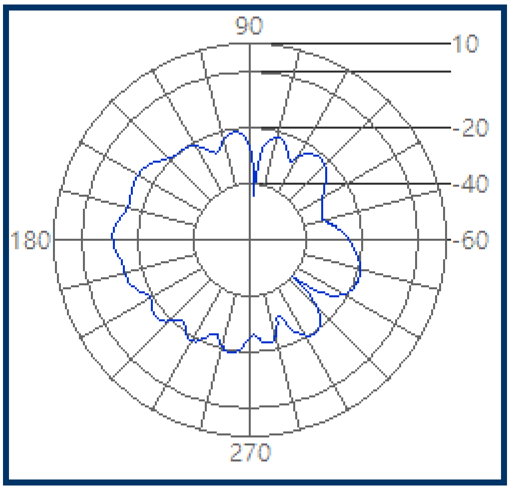
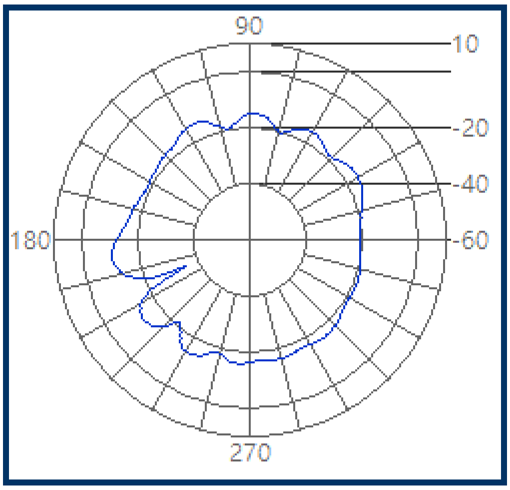
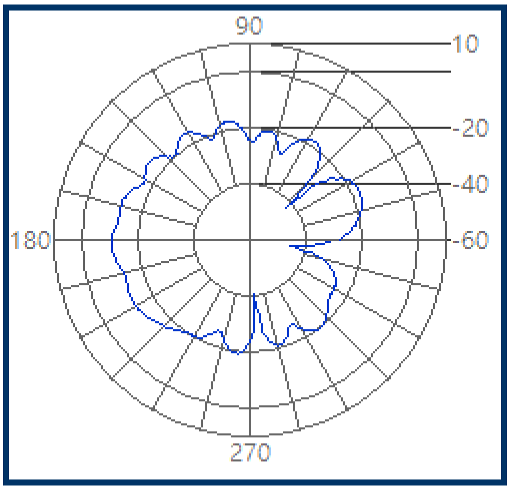
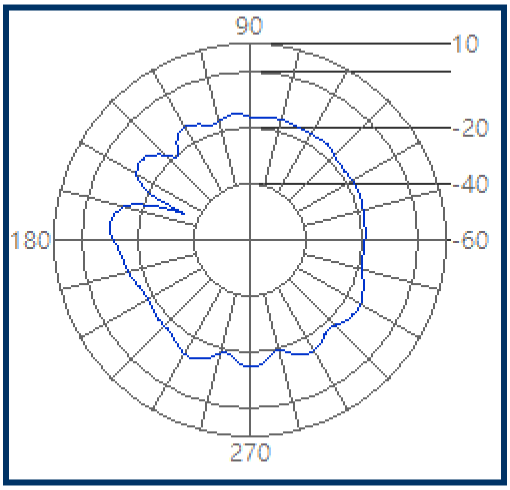
### 2.1.3 Test Result of Antenna Gain

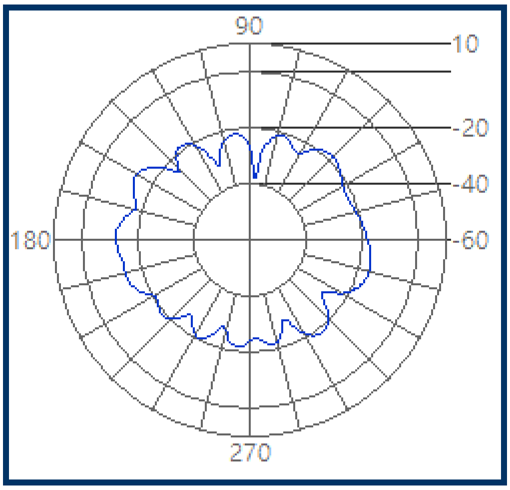
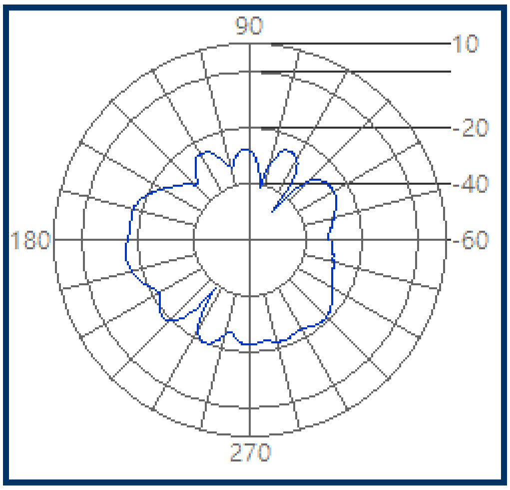
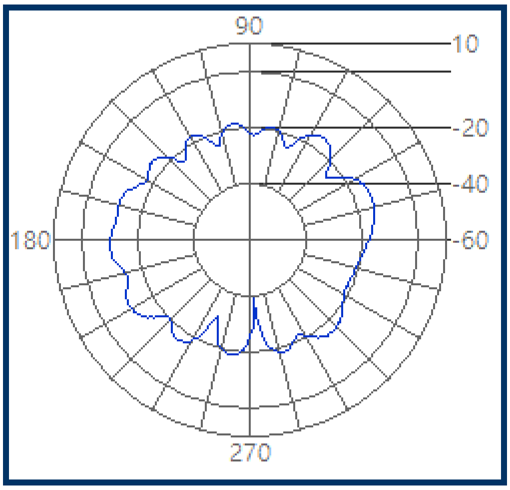
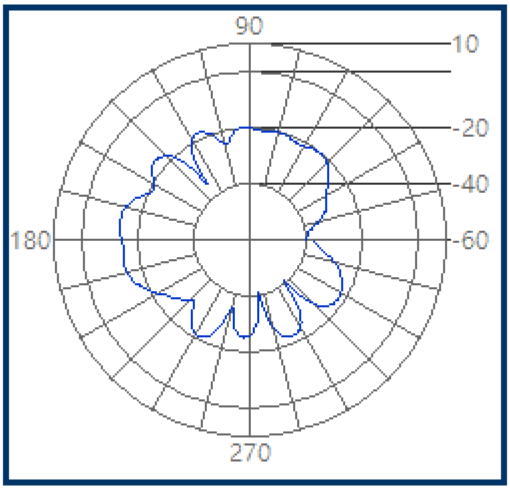
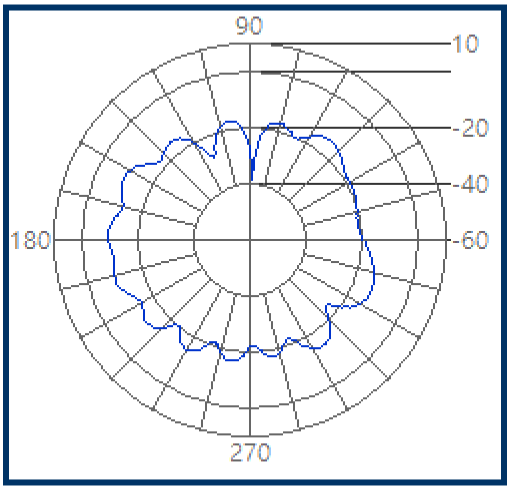
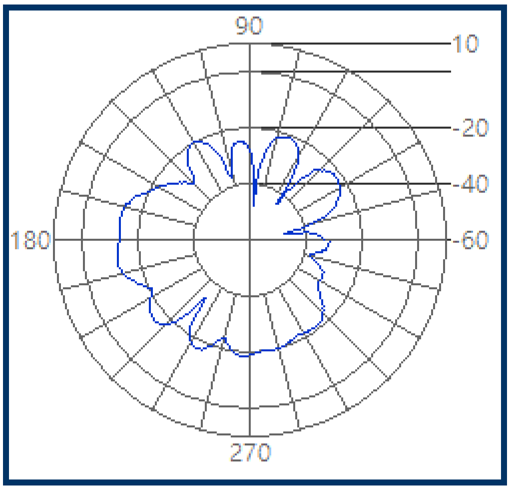
| Test Freq | Peak Gain (dBi) | Average Gain (dBi) | Beamwidth (˚) | Plane |
|---|---|---|---|---|
| 903.24MHz | PK -13.23 dBi | AV -21.21 dBi | Beam 23 ° | Azimuth_Co_X_B |
| 914.76MHz | PK -11.01 dBi | AV -18.73 dBi | Beam 47 ° | Azimuth_Co_X_M |
| 926.76MHz | PK -10.46 dBi | AV -17.43 dBi | Beam 53 ° | Azimuth_Co_X_T |
| 903.24MHz | PK -12.67 dBi | AV -18.49 dBi | Beam 43 ° | Elevation_Co_X_B |
| 914.76MHz | PK -10.52 dBi | AV -16.39 dBi | Beam 42 ° | Elevation_Co_X_M |
| 926.76MHz | PK -9.87 dBi | AV -15.59 dBi | Beam 42 ° | Elevation_Co_X_T |

| Test Freq | Peak Gain (dBi) | Average Gain (dBi) | Beamwidth (˚) | Plane |
|---|---|---|---|---|
| 903.24MHz | PK -12.07 dBi | AV -18.73 dBi | Beam 55 ° | Azimuth_Co_Y_B |
| 914.76MHz | PK -9.85 dBi | AV -16.33 dBi | Beam 54 ° | Azimuth_Co_Y_M |
| 926.76MHz | PK -9.23 dBi | AV -15.16 dBi | Beam 57 ° | Azimuth_Co_Y_T |
| 903.24MHz | PK -15.38 dBi | AV -22.47 dBi | Beam 39 ° | Elevation_Co_Y_B |
| 914.76MHz | PK -13.09 dBi | AV -20.43 dBi | Beam 60 ° | Elevation_Co_Y_M |
| 926.76MHz | PK -12.1 dBi | AV -19.84 dBi | Beam 35 ° | Elevation_Co_Y_T |

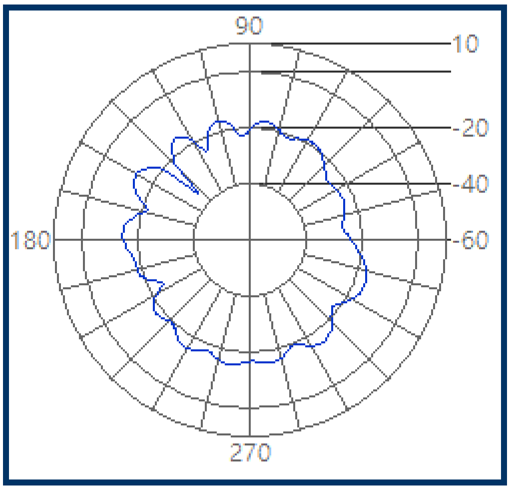
| Test Freq | Peak Gain (dBi) | Average Gain (dBi) | Beamwidth (˚) | Plane |
|---|---|---|---|---|
| 903.24MHz | PK -13.35 dBi | AV -18.08 dBi | Beam 334 ° | Azimuth_Co_Z_B |
| 914.76MHz | PK -10.79 dBi | AV -15.75 dBi | Beam 335 ° | Azimuth_Co_Z_M |
| 926.76MHz | PK -9.58 dBi | AV -14.44 dBi | Beam 360 ° | Azimuth_Co_Z_T |
| 903.24MHz | PK -17.75 dBi | AV -25.48 dBi | Beam 49 ° | Elevation_Co_Z_B |
| 914.76MHz | PK -15.31 dBi | AV -23.2 dBi | Beam 46 ° | Elevation_Co_Z_M |
| 926.76MHz | PK -14.2 dBi | AV -22.16 dBi | Beam 44 ° | Elevation_Co_Z_T |

## 2.1.4 Test Result of Antenna Gain Pattern

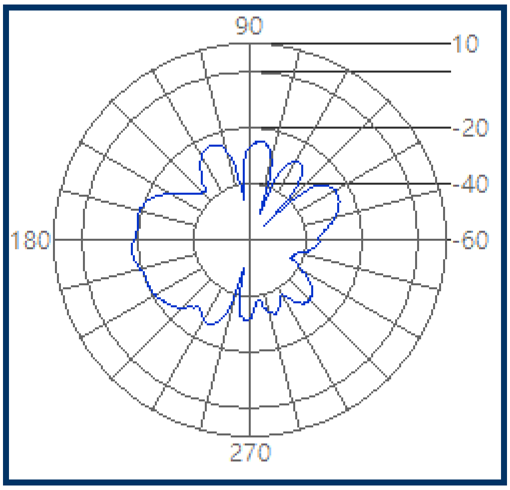
| B – Azimuth Plane – X | B – Elevation Plane – X |
|---|---|
|  |  |
| **M – Azimuth Plane – X** | **M – Elevation Plane – X** |
|  |  |
| **T – Azimuth Plane – X** | **T – Elevation Plane – X** |
|  |  |

| B – Azimuth Plane – Y | B – Elevation Plane – Y |
|---|---|
|  |  |
| **M – Azimuth Plane – Y** | **M – Elevation Plane – Y** |
|  |  |
| **T – Azimuth Plane – Y** | **T – Elevation Plane – Y** |
|  |  |

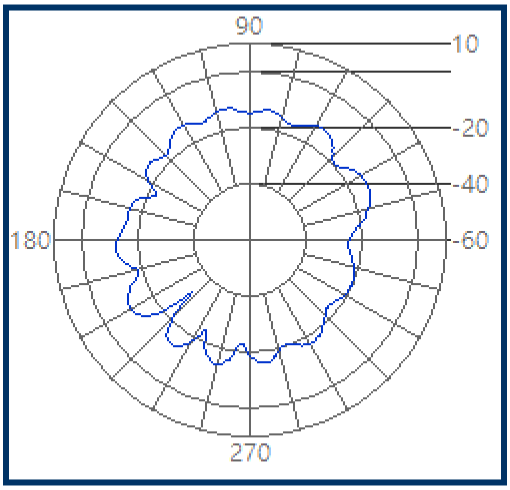
**B – Azimuth Plane – Z**



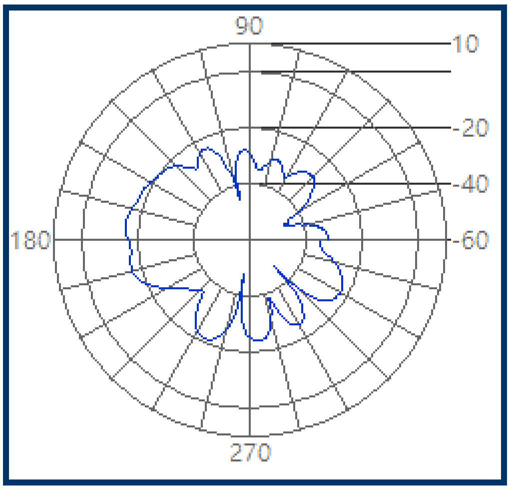

**B – Elevation Plane – Z**



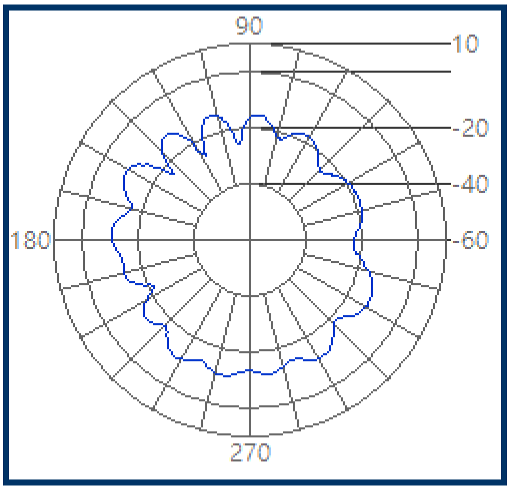

**M – Azimuth Plane – Z**



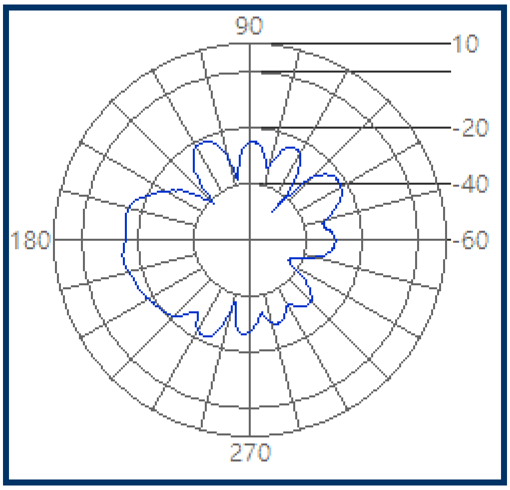

**M – Elevation Plane – Z**




**T – Azimuth Plane – Z**




**T – Elevation Plane – Z**



# 3 Test Equipment and Calibration Data

| Instrument | Manufacturer /Brand | Model No. | Serial No. | Characteristics | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV40 | 101514 | 9kHz - 40GHz | 26/Apr/2023 | 25/Apr/2024 |
| Signal Generator | R&S | SMB100A | 181147 | 100kHz~40GHz | 20/Oct/2023 | 19/Oct/2024 |
| Bilog Antenna & 6dB Attenuator | SCHAFFNER | CBL6111C & N-6-06 | 2737 & AT-N0603 | 25MHz~1GHz | 13/Sep/2023 | 12/Sep/2024 |
| Bilog Antenna & 6dB Attenuator | SCHAFFNER | CBL6112B / N-6-05 | 22237 / AT-N-0603 | 30MHz~1GHz | 15/Oct/2023 | 14/Oct/2024 |

# 4 Uncertainty of Evaluation

| Essential Antenna Test Suites | | |
|---|---|---|
| **Description** | **Measuring Uncertainty (confidence of 95%)** | **Standard Required Measuring Uncertainty** |
| Radiation Pattern Envelope (RPE) | ± 2.6 dB | N/A |
| Antenna Gain | ± 3.1 dB | N/A |