



Test report for

Antenna_2G4_Type00

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Summary	2.4 GHz antenna
Operator	Flemming Nørskov Larsen

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2 TEST REPORT OVERVIEW

The test is performed in a 3 m FAR Fully Anechoic Room, the device under test is put onto a turntable in a 3 m distance from the measuring antenna. The MSR module is put into a fixed position.

The antenna is integrated into a carrying PCB with a FR4 base material with tracks made from copper.

2.1 SPECIFICATION

Frequency range	2.4 – 2.5 GHz
Impedance	50 ohm
Return loss	>10 dB
Radiation	Omni directional
Gain (Peak)	2.3 dBi
Polarization	Linear
Size	24.2 x 8.1 mm

2.2 OPERATOR

Date (Y-M-D)	2022-19-10
Operator	Flemming Nørskov Larsen
Location	DK-Bjerringbro
Temperature	23.8 °C
R.H.	46%

2.3 TERMS & ABBREVIATIONS

This table lists special terms and abbreviations, which are used throughout this document.

Term / Abbreviation	Explanation
PCB	Printed Circuit Board
HW	Hardware
SW	Soft ware
dBm	Power referenced to 1 mW in 50 Ohms
dBi	Gain relative to an Equivalent Isotropic antenna
FAR	Fully Anechoic Room

Table 1 Terms & Abbreviations

2.4 SETTLING ANTENNA GAIN

2.4.1 Measurements from anechoic room.

In the FAR the emitted power is measured with the DUT oriented in the X, Y and Z direction. The maximum levels are recorded in table 3

Orientation	dBi
000 2402 MHz Measure ant. horisontal Max	-1,07
000 2402 MHz Measure ant. vertical Max	-1,26
000 2440 MHz Measure ant. horisontal Max	-0,39
000 2440 MHz Measure ant. vertical Max	-1,07
000 2480 MHz Measure ant. horisontal Max	-1,81
000 2480 MHz Measure ant. vertical Max	-2,76
030 2402 MHz Measure ant. horisontal Max	-1,69
030 2402 MHz Measure ant. vertical Max	-3,28
030 2440 MHz Measure ant. horisontal Max	-0,15
030 2440 MHz Measure ant. vertical Max	-0,04
030 2480 MHz Measure ant. horisontal Max	-2,78
030 2480 MHz Measure ant. vertical Max	-4,67
060 2402 MHz Measure ant. horisontal Max	-2,81
060 2402 MHz Measure ant. vertical Max	1,4
060 2440 MHz Measure ant. horisontal Max	-0,53
060 2440 MHz Measure ant. vertical Max	0,56
060 2480 MHz Measure ant. horisontal Max	-5,08
060 2480 MHz Measure ant. vertical Max	0,68
090 2402 MHz Measure ant. horisontal Max	-1,75
090 2402 MHz Measure ant. vertical Max	2,3
090 2440 MHz Measure ant. horisontal Max	-0,63
090 2440 MHz Measure ant. vertical Max	1
090 2480 MHz Measure ant. horisontal Max	-1,89
090 2480 MHz Measure ant. vertical Max	0,2
120 2402 MHz Measure ant. horisontal Max	0,63
120 2402 MHz Measure ant. vertical Max	1,51
120 2440 MHz Measure ant. horisontal Max	-3,12
120 2440 MHz Measure ant. vertical Max	0,95
120 2480 MHz Measure ant. horisontal Max	-0,93
120 2480 MHz Measure ant. vertical Max	-0,52
150 2402 MHz Measure ant. horisontal Max	-0,71
150 2402 MHz Measure ant. vertical Max	0,52
150 2440 MHz Measure ant. horisontal Max	-2,12
150 2440 MHz Measure ant. vertical Max	-2,52
150 2480 MHz Measure ant. horisontal Max	-1,66
150 2480 MHz Measure ant. vertical Max	-1,39
180 2402 MHz Measure ant. horisontal Max	-0,44
180 2402 MHz Measure ant. vertical Max	-1,29
180 2440 MHz Measure ant. horisontal Max	-0,75

180 2440 MHz Measure ant. vertical Max	-1,39
180 2480 MHz Measure ant. horizontal Max	-1,81
180 2480 MHz Measure ant. vertical Max	-3,79

Table 2 Maximum dBi

2.4.2 Antenna gain

The antenna gain is the maximum EIRP – TX power conducted. Maximum is 2,3 dBi @2402 MHz.

2.5 INSTRUMENTATION

Device	Manufacturer	Asset no	Cal Expires
R&S FPL1026 Spectrum Analyzer	Rohde&Schwarz	800600	2026-24-11
Coax Cable SucoFlex 100	Huber-Suhner	S69	2026-11-11
Coax Cable SucoFlex 100	Huber-Suhner	S71	2026-11-11
Coax Cable SucoFlex 100	Huber-Suhner	S72	2026-11-11
EMCO 3115	ETS-Lindgreen	514231	2026-11-11
ANT_Test – meas. SW	Grundfos Holding		
FAR-3	Euroshield/ETS-Lindgren	271667	2026-16-11

Table 3 Terms & Abbreviations

2.6 FAR SITE

Fully Anechoic Room 7.04m x 4.8m x 3.06 m (l x w x h)

2.7 ANTENNA CONFIGURATION

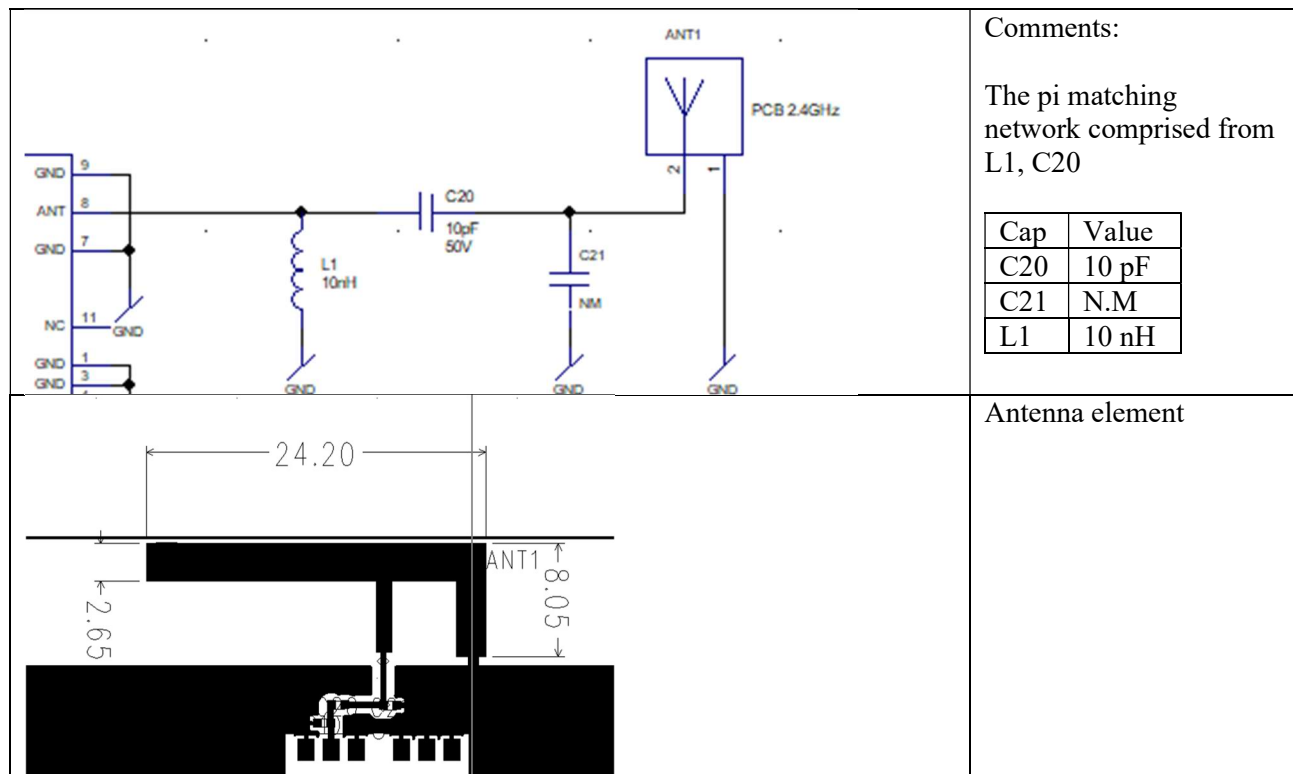


Figure 1 Antenna circuit

2.8 MEASUREMENT PROCEDURE

The antenna is put onto a turntable on a RF passive pole.

During measurement the module transmitter is used as signal source in continuous transmit mode. The measurements are performed at three channels, low, middle, and high channel. The receiving Spectrum analyser is set to the corresponding frequency.

During rotation of the turntable the emitted power is recorded.

The measurement is repeated in 7 positions, the DUT is rotated from 0 – 180° in 30° increments, each frequency with the measurement antenna in a vertical and a horizontal orientation.

The spectrum analyser is set to:

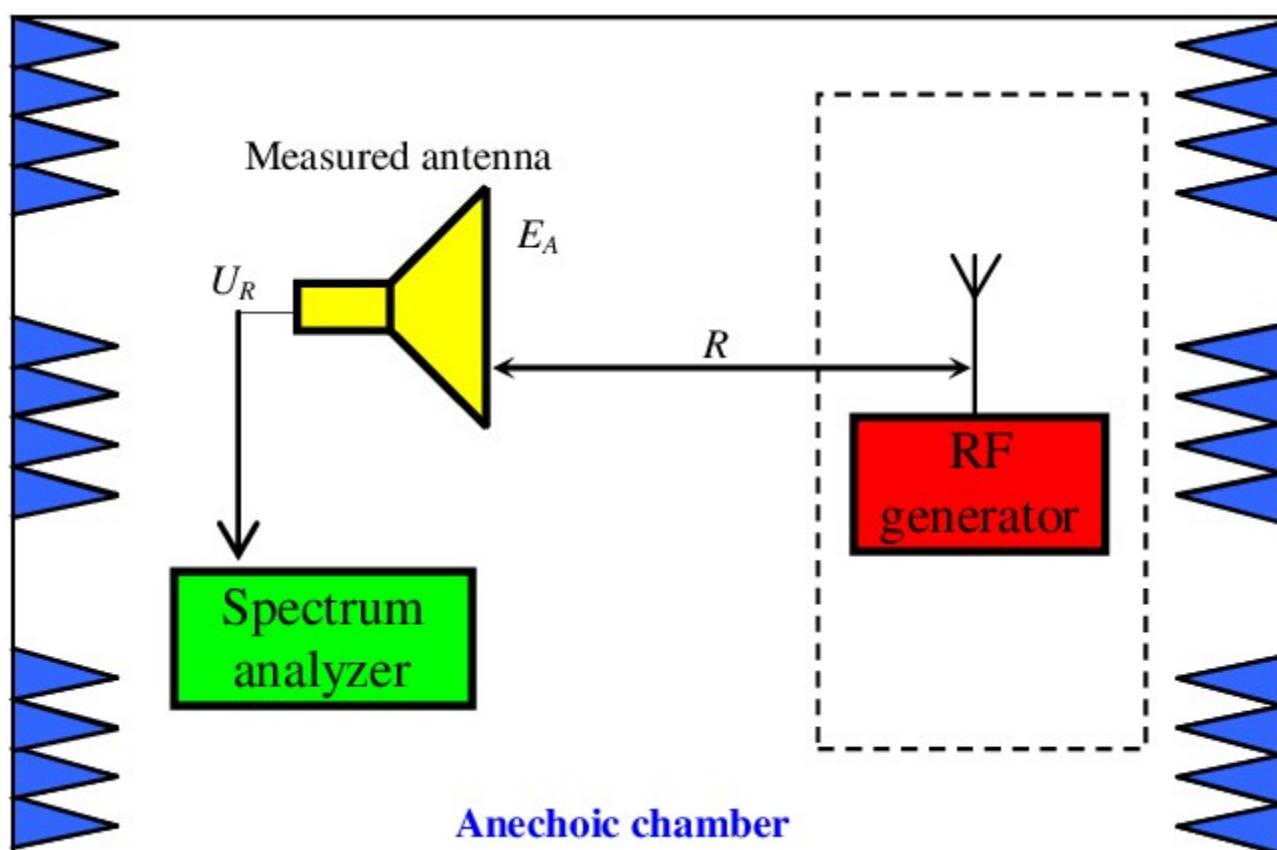
- to 0 span
- 3 MHz BW /3 MHz video BW
- Sweep time 10 mS

Turntable

- 40 sec revolution time

Software

Peak reading of marker every 250 mS giving a 3° resolution.



2.9 MEASUREMENT SETUP FULLY ANECHOIC ROOM

Device under test is placed on passive fixture. a passive pole. Below pictures showing the actual setup, in figure 2 a picture of the FAR room.

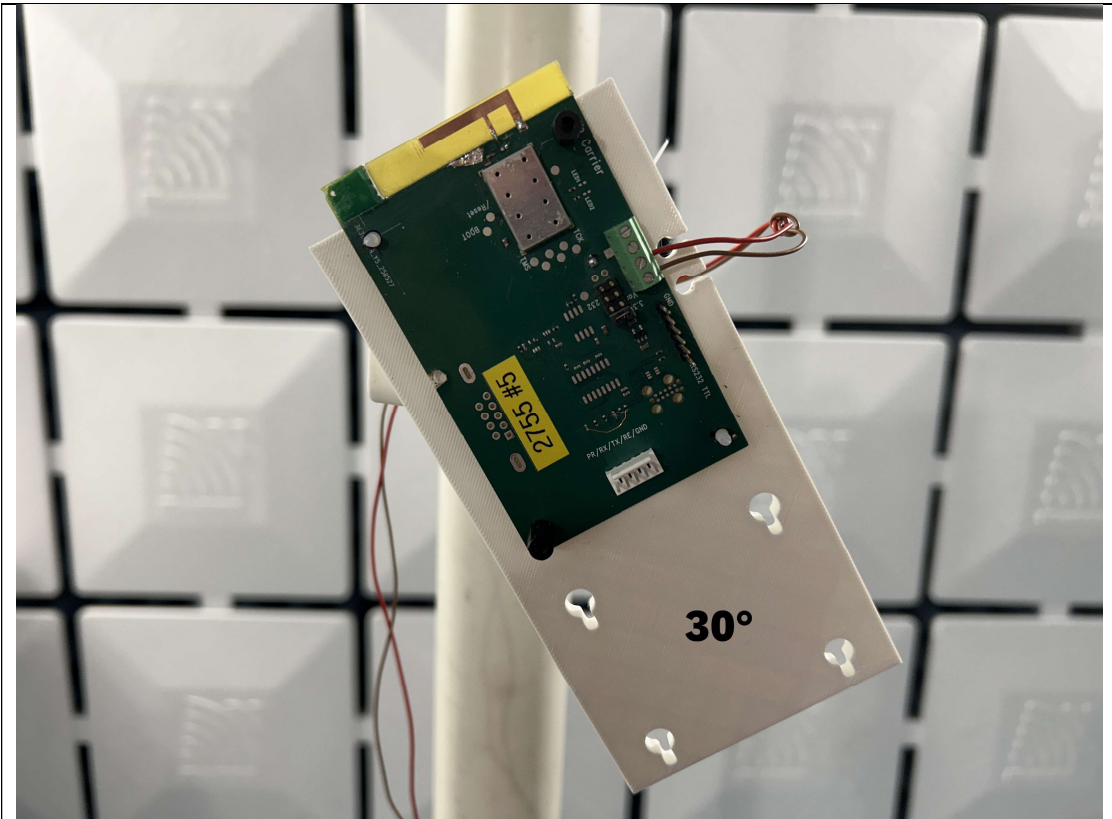
	Device under test is placed on RF passive fixture, the measurements are executed in 30° intervals here at 30°. Each position is measured with measurement antenna in both vertical and horizontal polarisation.	
DUT in 30° plane		

Figure 2 Pictures from FAR

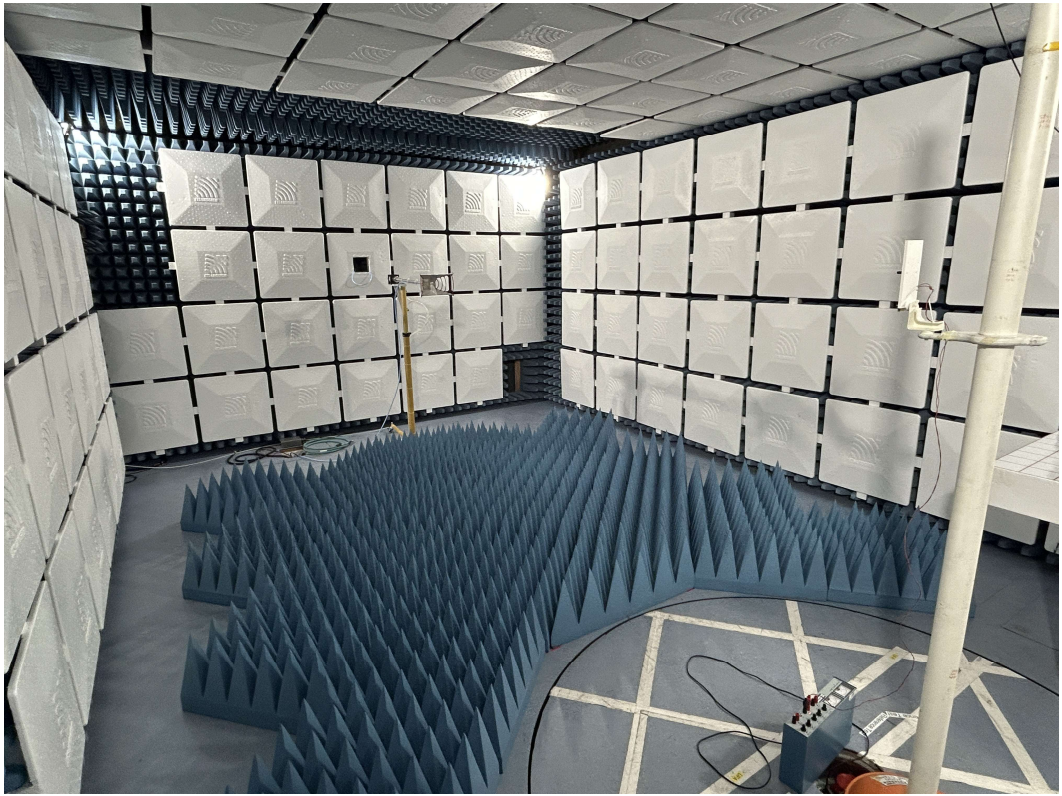
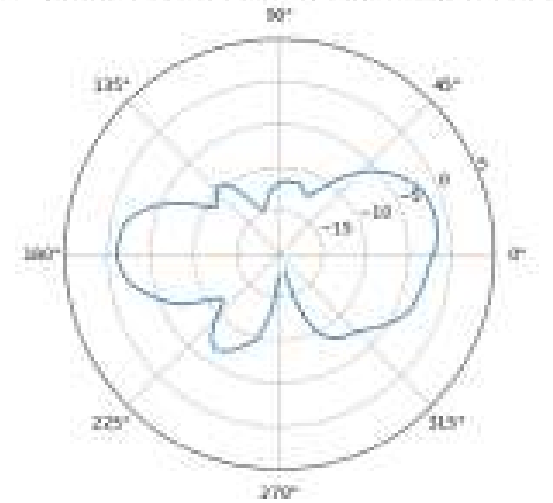


Figure 3 Test site

2.10 POLAR PLOTS OF THE PLANES

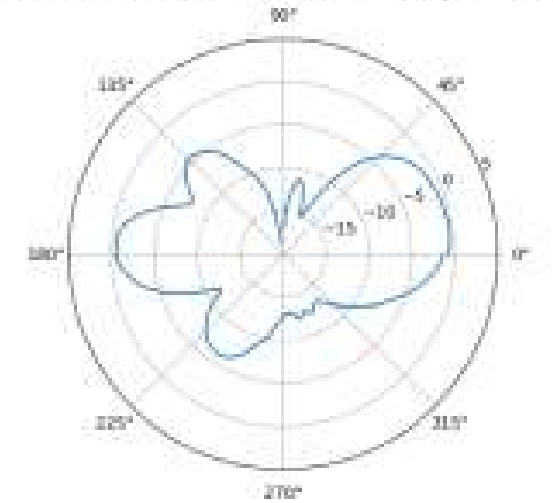
000 2402 MHz: Measure ant. horizontal Max power -1.07



000 2402 MHz: Measure ant. vertical Max power -1.26



000 2440 MHz: Measure ant. horizontal Max power -0.39



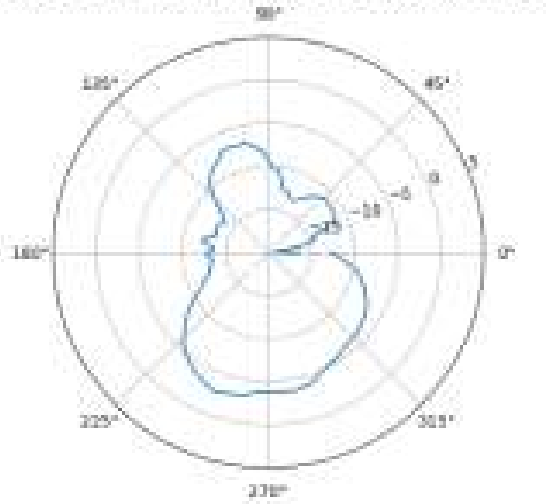
000 2440 MHz: Measure ant. vertical Max power -1.75



000 2480 MHz: Measure ant. horizontal Max power -1.81



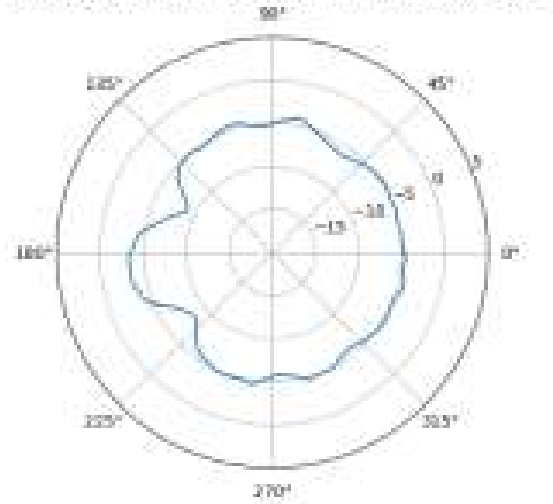
000 2480 MHz: Measure ant. vertical Max power -2.76



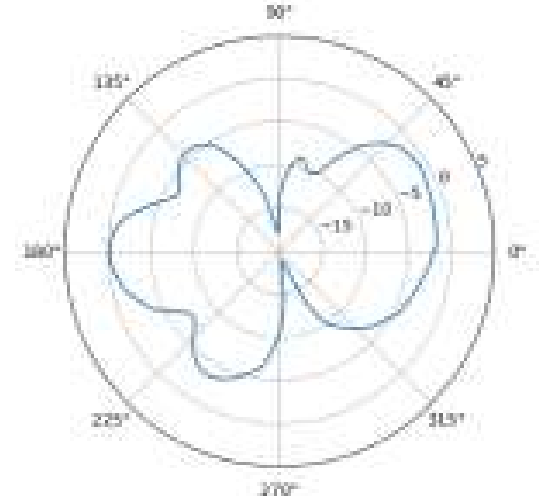
030 2402 MHz: Measure ant. horizontal Max power -1.69



030 2402 MHz: Measure ant. vertical Max power -3.28



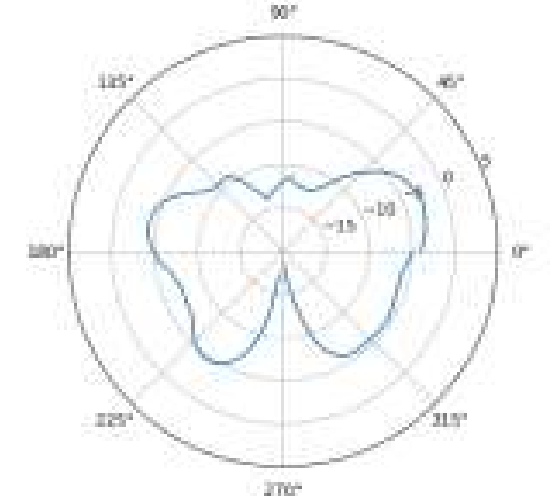
030 2440 MHz: Measure ant. horizontal Max power -0.15



030 2440 MHz: Measure ant. vertical Max power -0.04



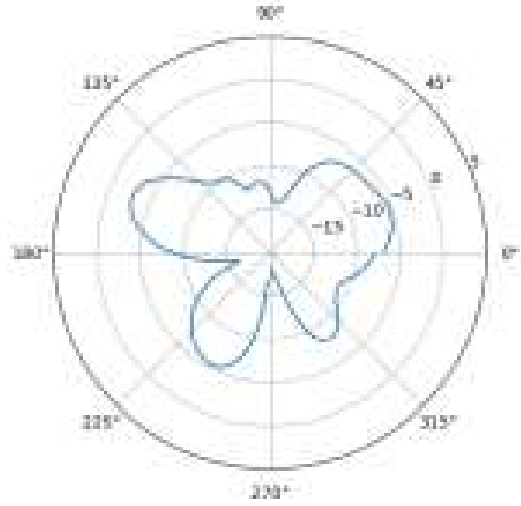
030 2480 MHz: Measure ant. horizontal Max power -2.78



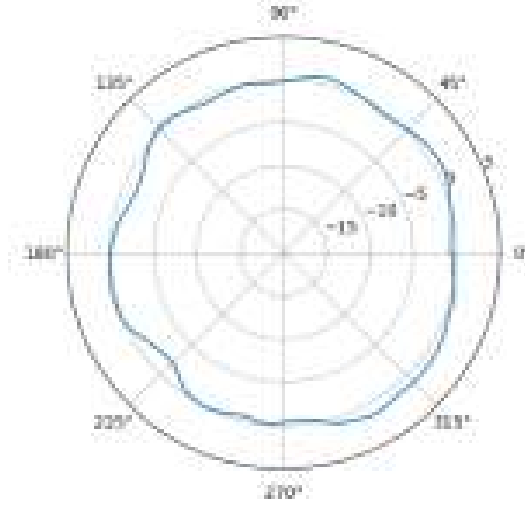
030 2480 MHz: Measure ant. vertical Max power -4.67



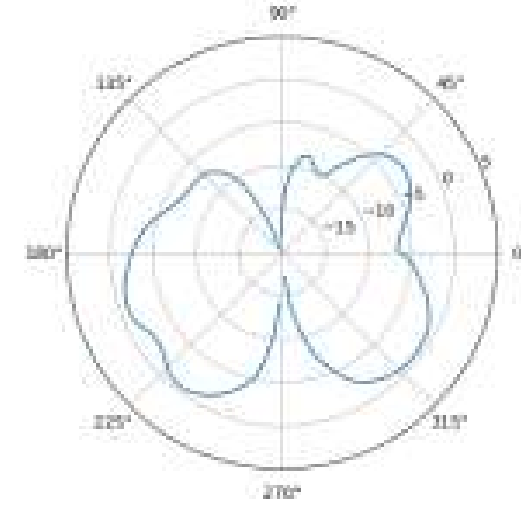
060 2402 MHz: Measure ant. horizontal Max power -2.81



060 2402 MHz: Measure ant. vertical Max power 1.40



090 2440 MHz: Measure ant. horizontal Max power -0.53



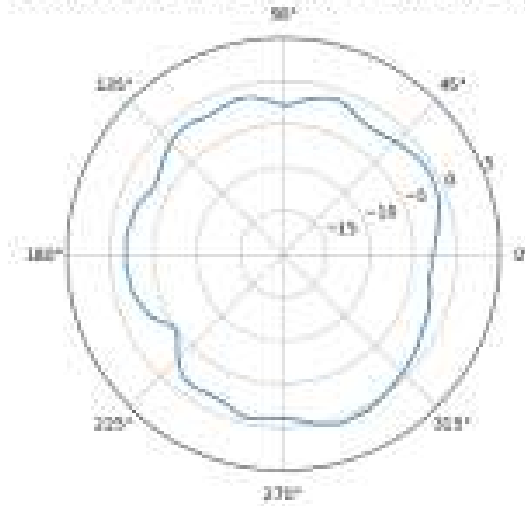
090 2440 MHz: Measure ant. vertical Max power 0.56



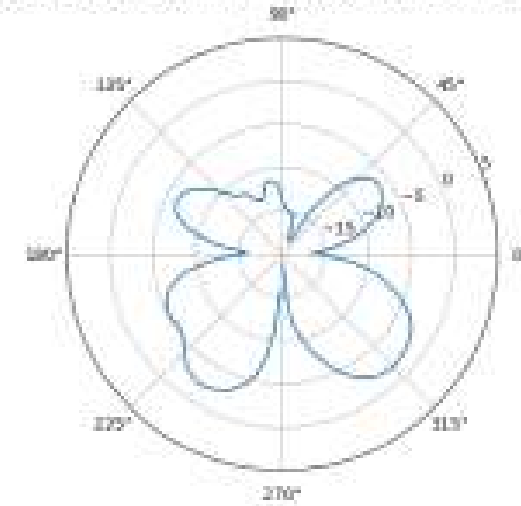
060 2480 MHz: Measure ant. horizontal Max power -5.08



060 2480 MHz: Measure ant. vertical Max power 0.68



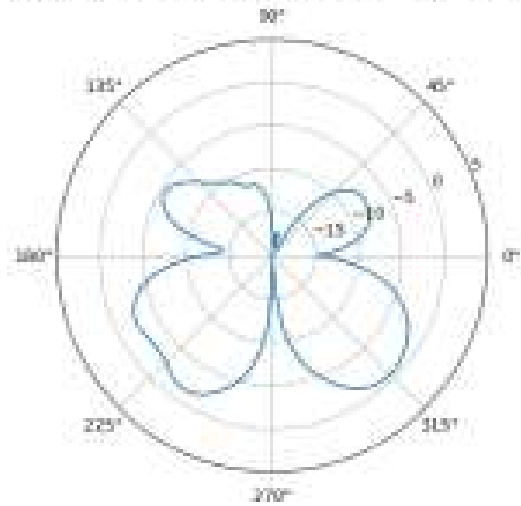
090 2402 MHz: Measure ant. horizontal Max power -1.75



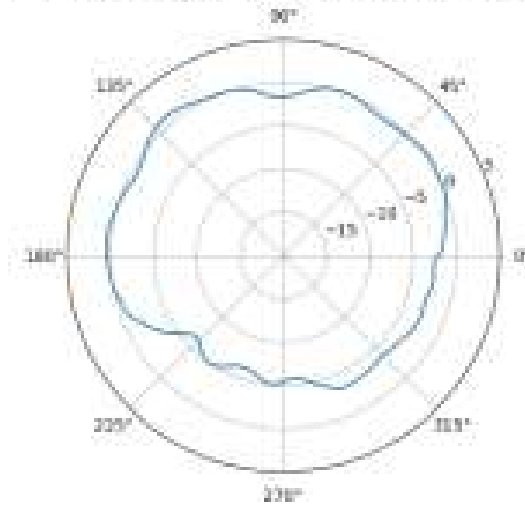
090 2402 MHz: Measure ant. vertical Max power 2.13



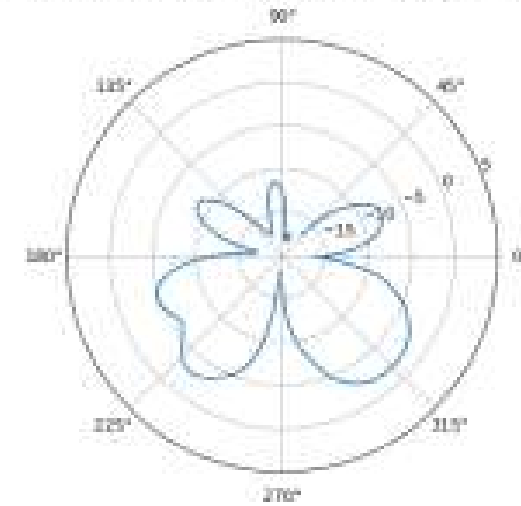
090 2440 MHz: Measure ant. horizontal Max power -0.63



090 2440 MHz: Measure ant. vertical Max power 1.00



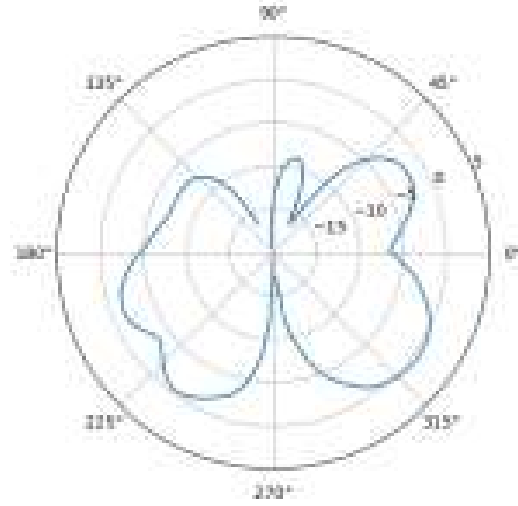
090 2480 MHz: Measure ant. horizontal Max power -1.89



090 2480 MHz: Measure ant. vertical Max power 0.20



120 2402 MHz: Measure ant. horizontal Max power 0.63



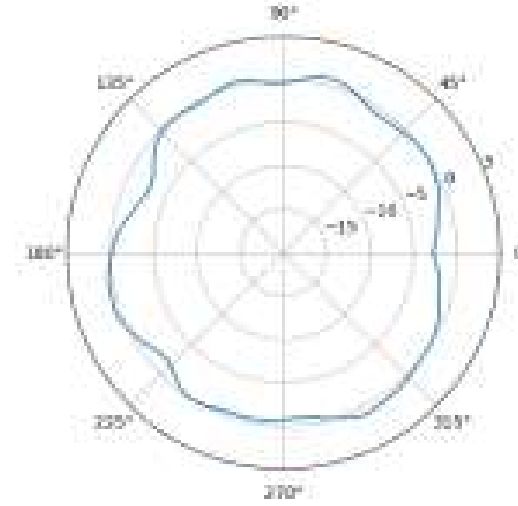
120 2402 MHz: Measure ant. vertical Max power 1.51



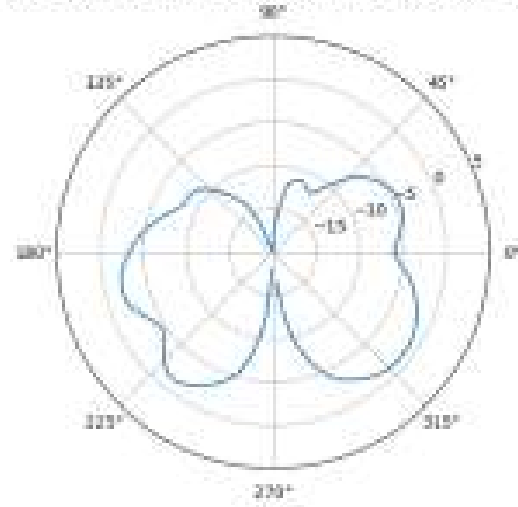
120 2440 MHz: Measure ant. horizontal Max power -3.12



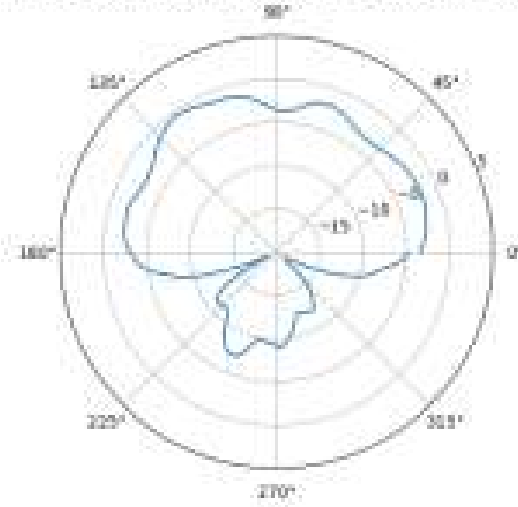
120 2440 MHz: Measure ant. vertical Max power 0.95



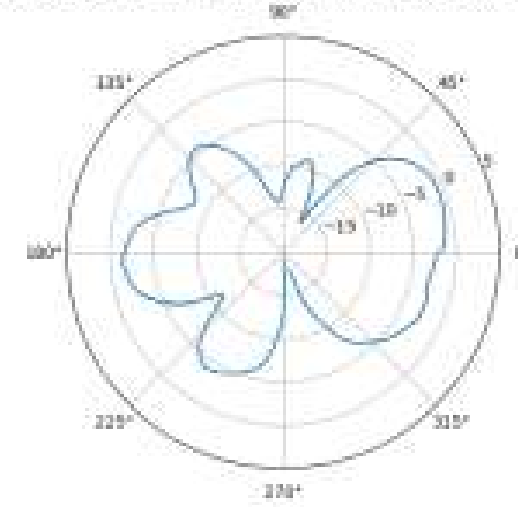
120 2480 MHz: Measure ant. horizontal Max power -0.93



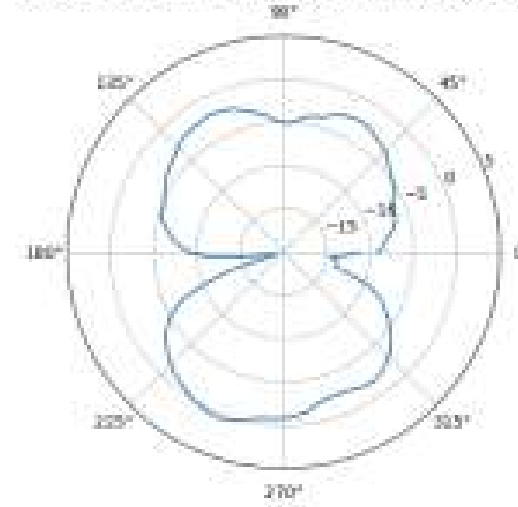
120 2480 MHz: Measure ant. vertical Max power -0.52



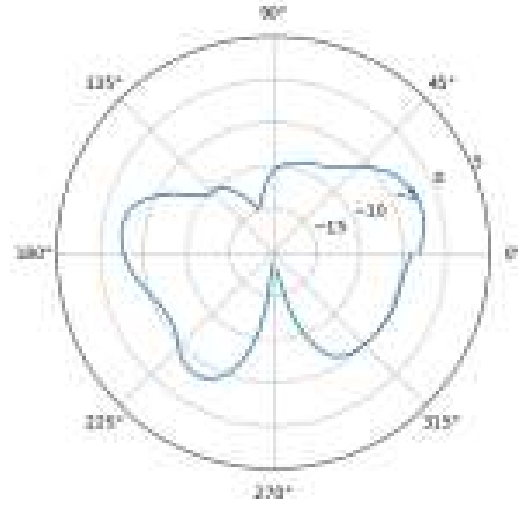
150 2402 MHz: Measure ant. horizontal Max power -0.71



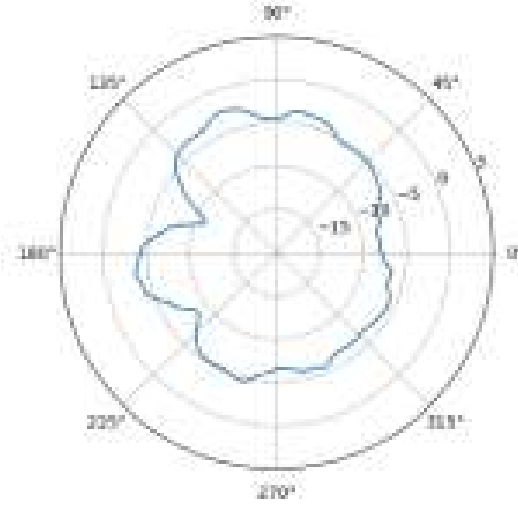
150 2402 MHz: Measure ant. vertical Max power 0.52



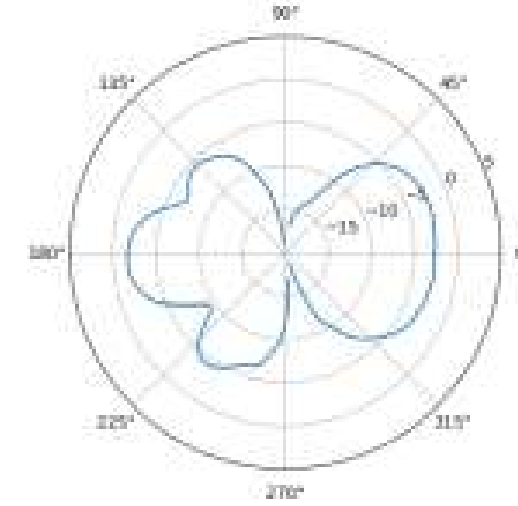
150 2440 MHz: Measure ant. horizontal Max power -2.12



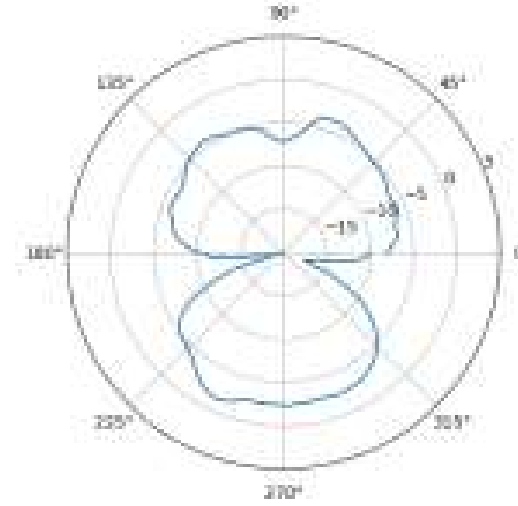
150 2440 MHz: Measure ant. vertical Max power -3.52



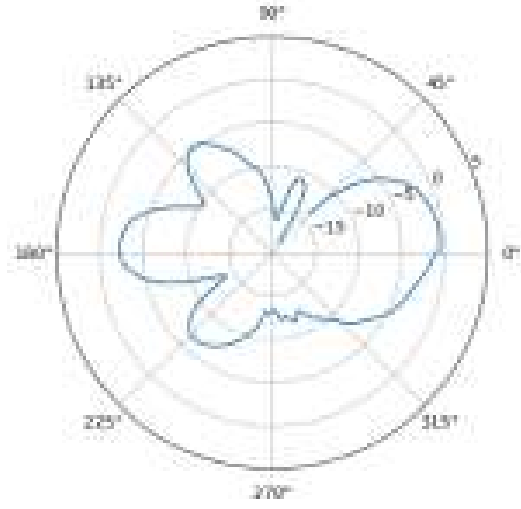
150 2480 MHz: Measure ant. horizontal Max power -1.66



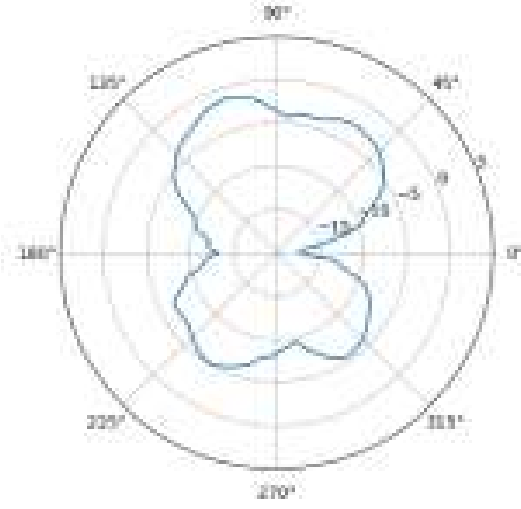
150 2480 MHz: Measure ant. vertical Max power -1.39



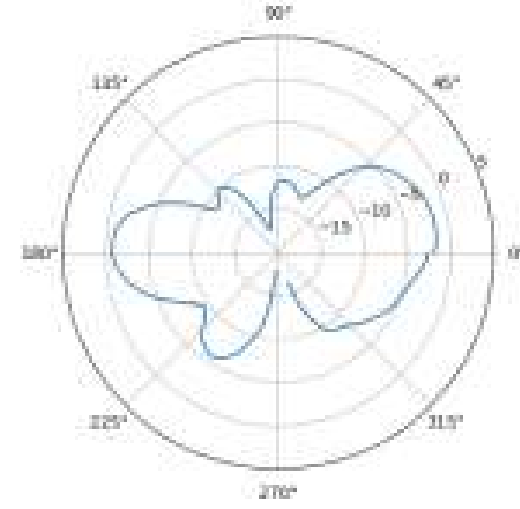
180 2402 MHz: Measure ant. horizontal Max power -0.44



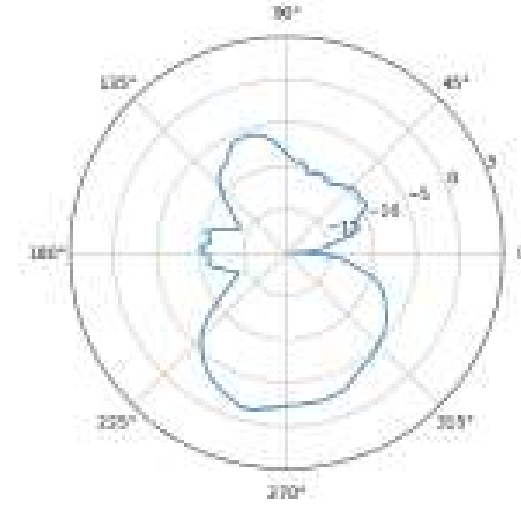
180 2402 MHz: Measure ant. vertical Max power -1.29



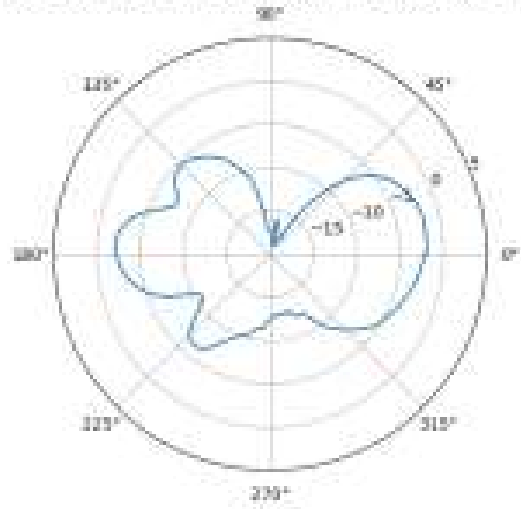
180 2440 MHz: Measure ant. horizontal Max power -0.75



180 2440 MHz: Measure ant. vertical Max power -1.39



180 2480 MHz: Measure ant. horizontal Max power -1.81



180 2480 MHz: Measure ant. vertical Max power -3.79

