1. TEST REPORT GENERAL INFORMATION

Date of the report:	04/06/2024
Client's Contact Information:	Mayte Penella
Test responsible:	Jordi Romeu
Testing laboratory:	UPC - Antenna lab, signal Theory and communications department
Tested devices:	Wireless parking sensor
Testing has been carried out in accordance with:	Antenna full 3D radiation pattern measurements per customer request
Documentation:	The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory.
Test results:	The test results relate only to devices specified in this document

Date and signatures:

04.06.2024

Professor Jordi Romeu,

Antenna lab, Signal Theory, and Communications Department,

Universitat Politècnica de Catalunya,
Barcelona, Spain

2. SUMMARY

1. TEST DETAILS

Devices under Test (DUT)

Product	Wireless parking sensor
Manufacturer info:	Barcelona Smart Technologies S.L.
SW Info:	
DUT number:	1234

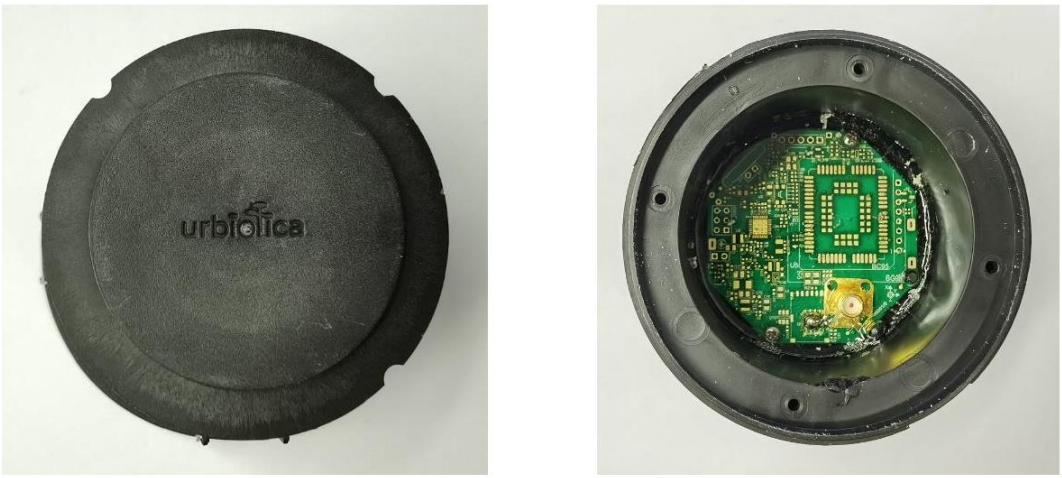

Figure 1. DUT top (left) and DUT bottom (rigth)

Testing information

Testing performed:	10.10.2021
Notes:	-
Document name:	Antenna_uspot_3.0
Temperature ºC / Humidity RH%	22±2 / 25%±10%
Measurement performed by:	Jordi Romeu
Document history:	

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3. TEST EQUIPMENT

Main used test equipment is listed below. For full equipment list and calibration intervals, please contact the testing laboratory.

Type of Equipment	Type	Manufacturer	Calibration date	Calibration period	Calibration due	Purpose
Broadband linear polarized ridge horn antenna Measurement Antenna	Custom made	UPC	Included in range calibration	Included in range calibration	Included in range calibration	Probe antenna
Positioning Controller		ORBIT	n/a	n/a	n/a	DUT alignment
3D Positioner	Custom made	ORBIT	n/a	n/a	n/a	DUT alignment
Anechoic Chamber	4	UPC	Included in range calibration	Included in range calibration	Included in range calibration	Test range
Network Analyzer	ZNB40	Rohde-Schwarz	27-11-2020	1 year	27-11-2021	Measurement transmitter / receiver
Broadband linear polarized ridge horn antenna	Custom made	UPC	Included in ranges calibration	n/a	n/a	Calibration horn probe antenna.

0.5

Chamber schematic

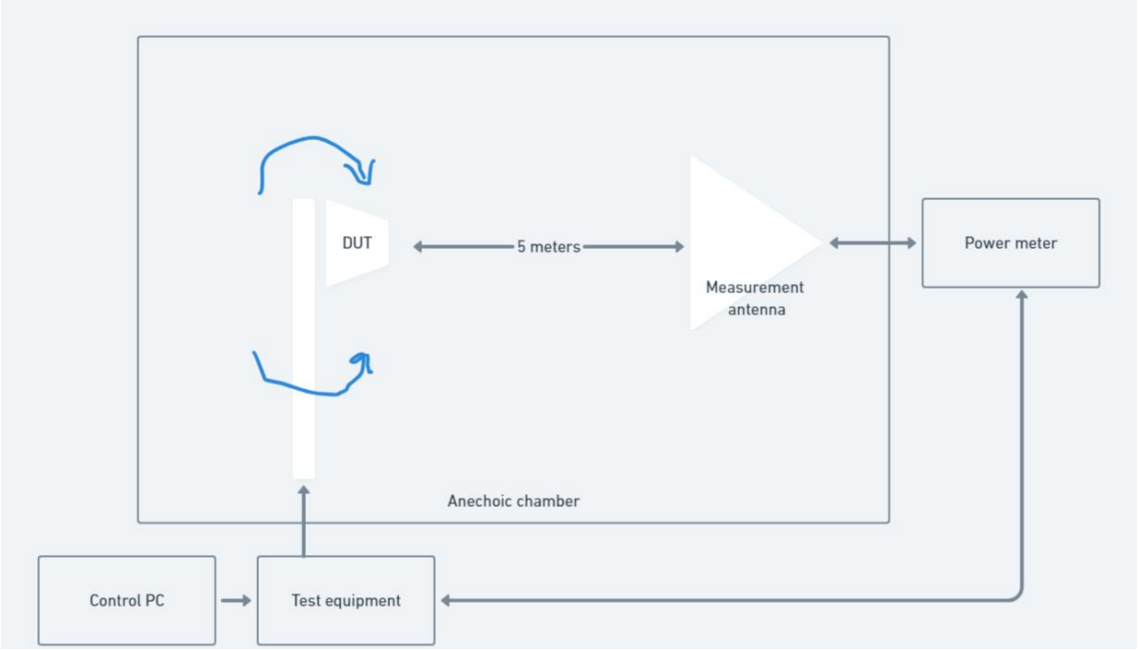


Figure 2. Chamber schematic

4. UNCERTAINTY ESTIMATES

Parameter	Expanded uncertainty (k=2)
Gain	± dB
efficiency	0.5

5. TEST SETUP

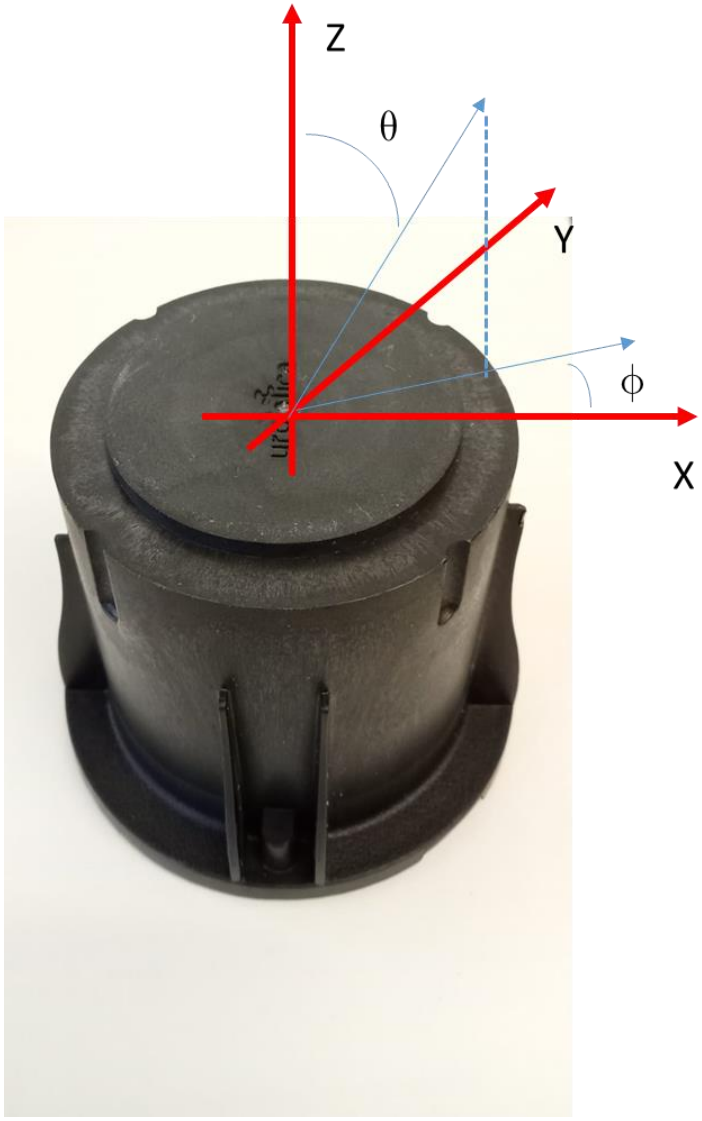


Figure 3. DUT coordinate system

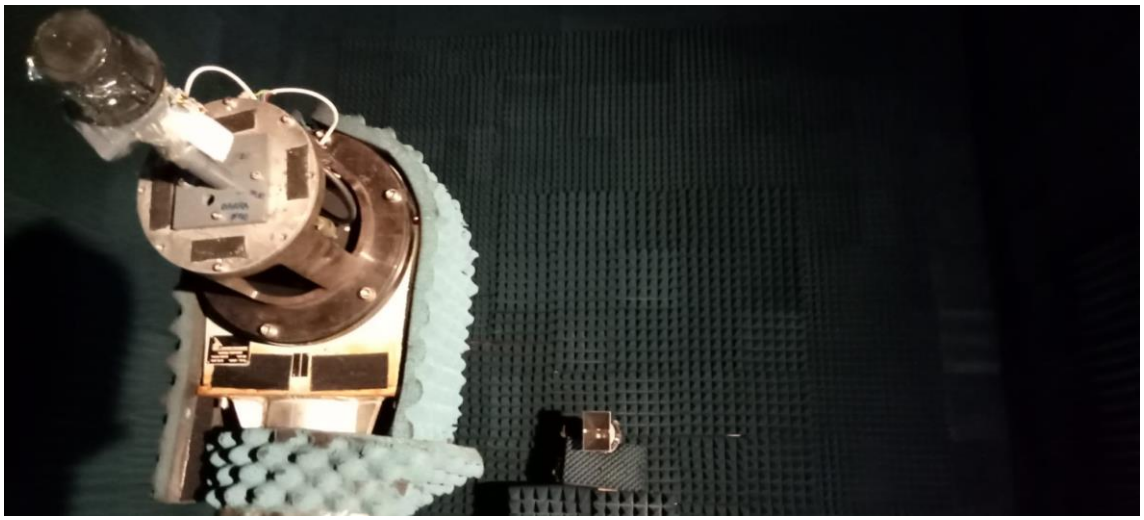
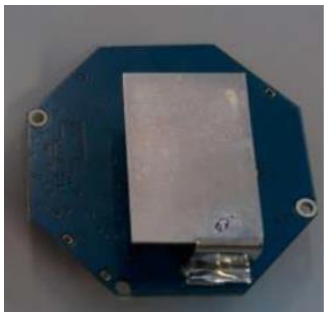
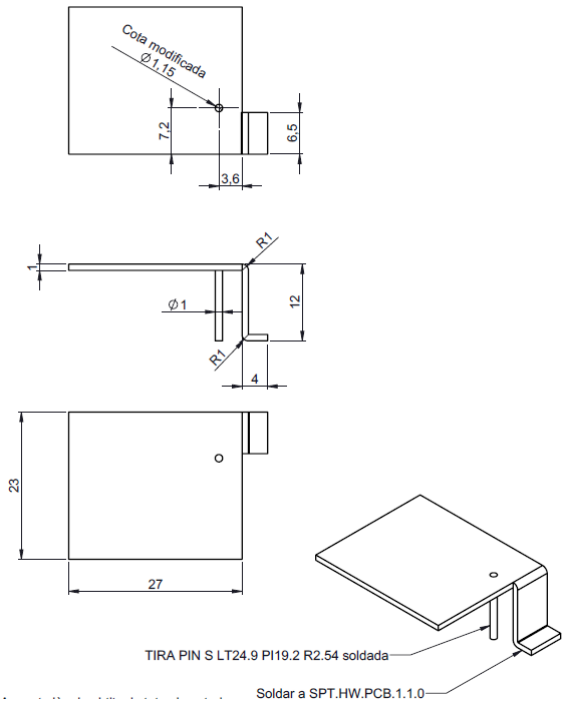


Figure 4. DUT in the anechoic chamber

6. ANTENNA DESCRIPTION

The antena is a PIFA with the following dimensions. The dielectric is a 2 component resin EL227.



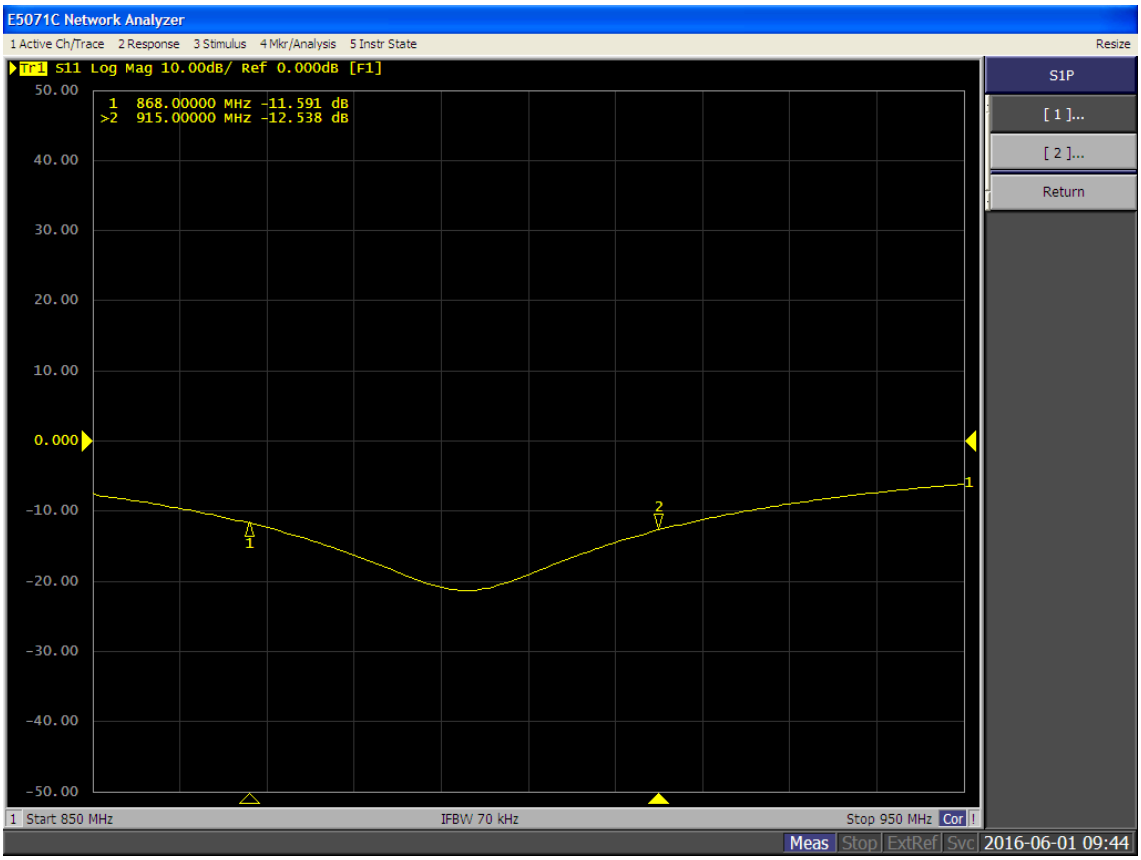


The full 3D far-field radiation pattern has been measured in anechoic chamber with a distance from the antenna to the measuring probe of 5 m.

The efficiency measurements have been obtained by comparison with a reference probe.

7. RESULTS

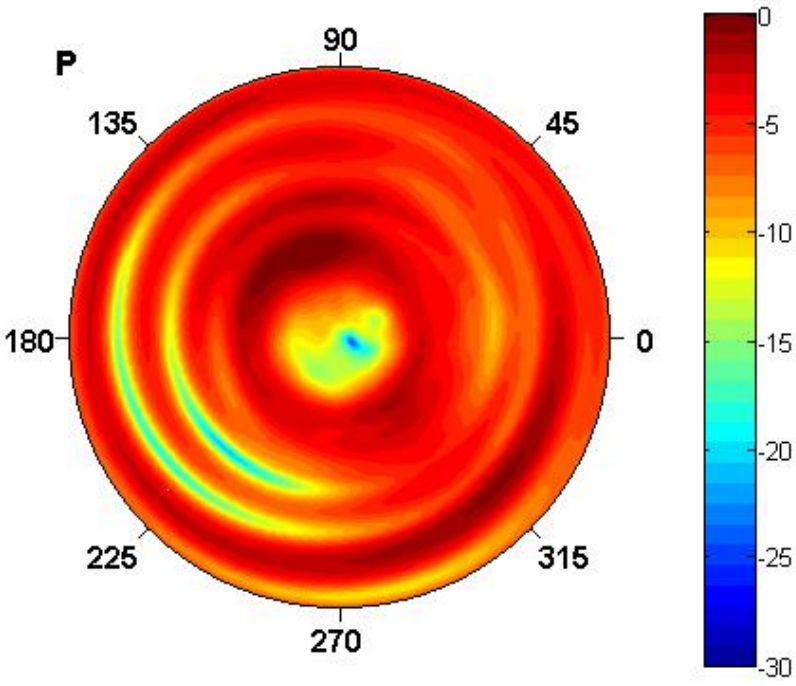
7.1 S11

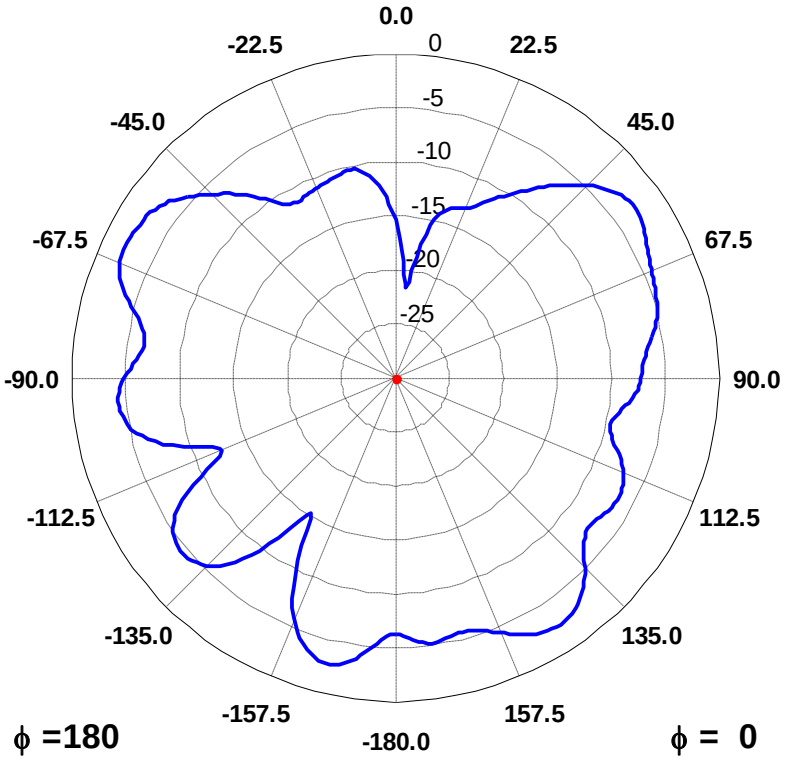

E5071C Network Analyzer
1 Active Ch/Trace
2 Response
3 Stimulus
4 Mkr/Analysis
5 Instr State
Resize
Tr1 S11 Log Mag 10.00dB/ Ref 0.000dB [F1]
1 868.00000 MHz -11.591 dB
>2 915.00000 MHz -12.538 dB
50.00
40.00
30.00
20.00
10.00
0.000
-10.00
-20.00
-30.00
-40.00
-50.00
1 Start 850 MHz
IFBW 70 kHz
Stop 950 MHz
Cor
S1P
[1]...
[2]...
Return
Meas
Stop
ExtRef
Svc
2016-06-01 09:44

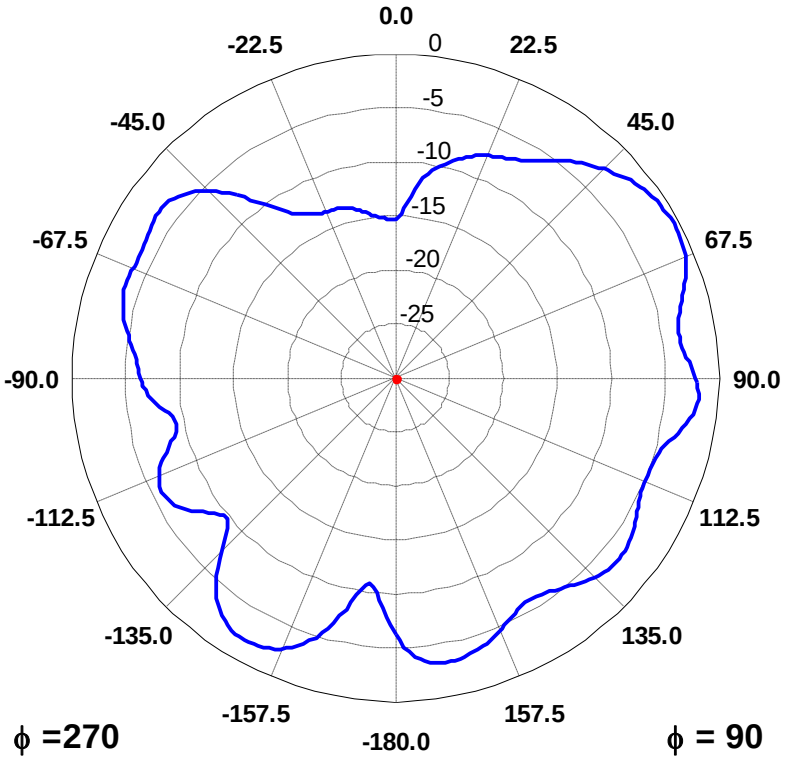
7.2 RADIATION PATTERN

Frequency = 868 MHz

Directivity = 4.76 dB

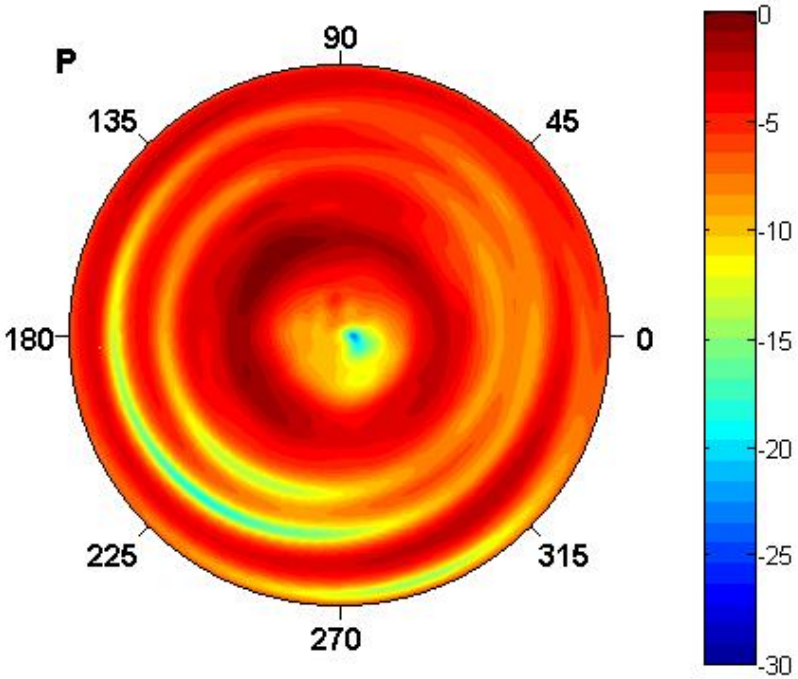


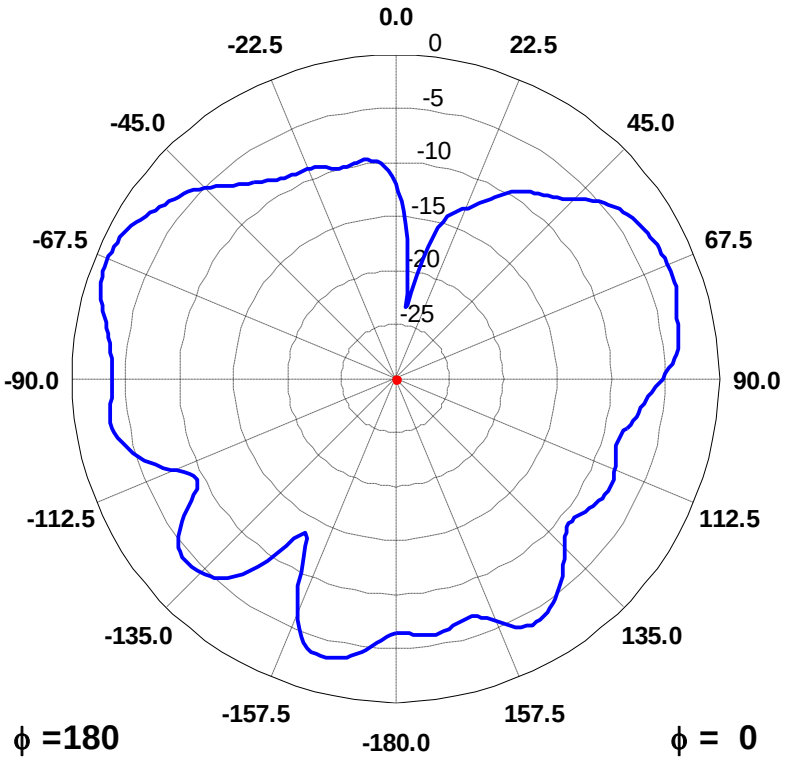

0.0
-22.5
22.5
-45.0
45.0
-67.5
67.5
-90.0
90.0
-112.5
112.5
-135.0
135.0
-157.5
157.5
-180.0
0
-5
-10
-15
-20
-25
ϕ =180
ϕ = 0

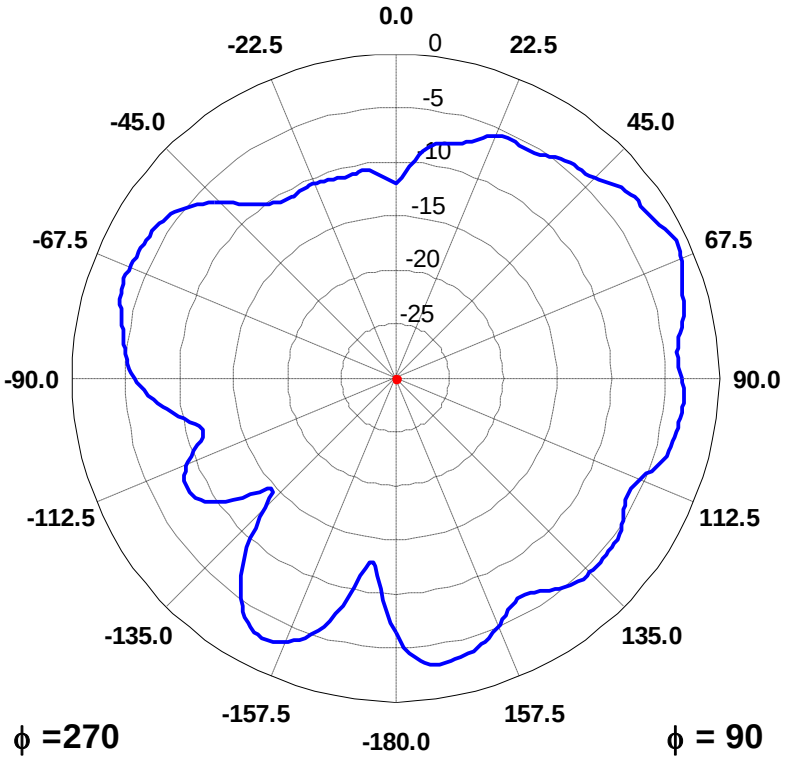

0.0
-22.5
22.5
-45.0
45.0
-67.5
67.5
-90.0
90.0
-112.5
112.5
-135.0
135.0
-157.5
157.5
-180.0
0
-5
-10
-15
-20
-25
ϕ =270
ϕ = 90

Frequency = 915 MHz

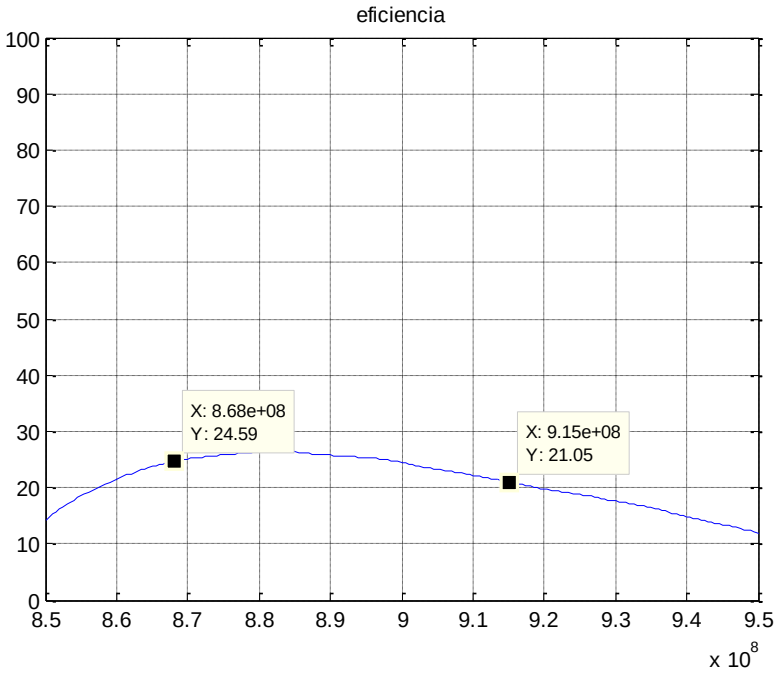
Directivity = 4.74 dB







7.3 EFFICIENCY



7.4 ANTENNA GAIN

Gain = efficiency * directivity

Frequency	Directivity (dBi)	Efficiency (%)	Gain (dBi)
868 MHz	4.76	24.59	-1.33
915 MHz	4.74	21.05	-2.02