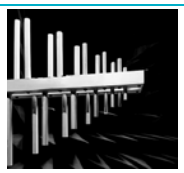
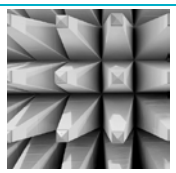

Abridged report

Test report no.: 1-4904_22-01-02-B

Report information			
Kind of test item:	Antenna		
Model name:	PSA AIO2		
Customer:	Robert Bosch GmbH		
Standard:	Antenna Tests regarding customer request		
Frequency:	2400 MHz to 2483.5 MHz, 5725 MHz to 5825 MHz		
Technology tested:	Bluetooth®, +EDR, WLAN		
Antenna:	Integrated BT antenna, Integrated Dualband WLAN antenna		
Verdict:	☐ Compliant	☐ Not compliant	☒ Information only
Additional comments:	-/-		

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signature, the public key can be requested at the testing laboratory.

Test performed:

cn=Rene Oelmann, o=CTC advanced GmbH, ou=OEL-221129, email=rene.oelmann@ctcadvanced.com, c=DE
2022.12.09 11:13:14 +01'00'

René Oelmann
Lab Manager
Radio Communications

1 Table of contents

1 Table of contents 2
2 Notes and disclaimer 3
3 Description of the test setup 4
3.1 Shielded fully anechoic chamber 5
4 Measurement uncertainty 6
5 Summary of measurement results 7
6 Additional comments 8
7 Additional EUT parameter 8
8 Measurement results - BT part 9
8.1 Antenna gain 9
8.2 Radiation Pattern Diagram 10
9 Measurement results - WLAN part 16
9.1 Antenna gain 16
9.2 Radiation Pattern Diagram – 2400 MHz to 2483.5 MHz 18
9.3 Radiation Pattern Diagram – 5725 MHz to 5850 MHz 24
10 Observations 32
11 Glossary 33
12 Document history 34

2 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report replaces the test report with the number 1-4904/22-01-02-A and dated 2022-11-29.

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3 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

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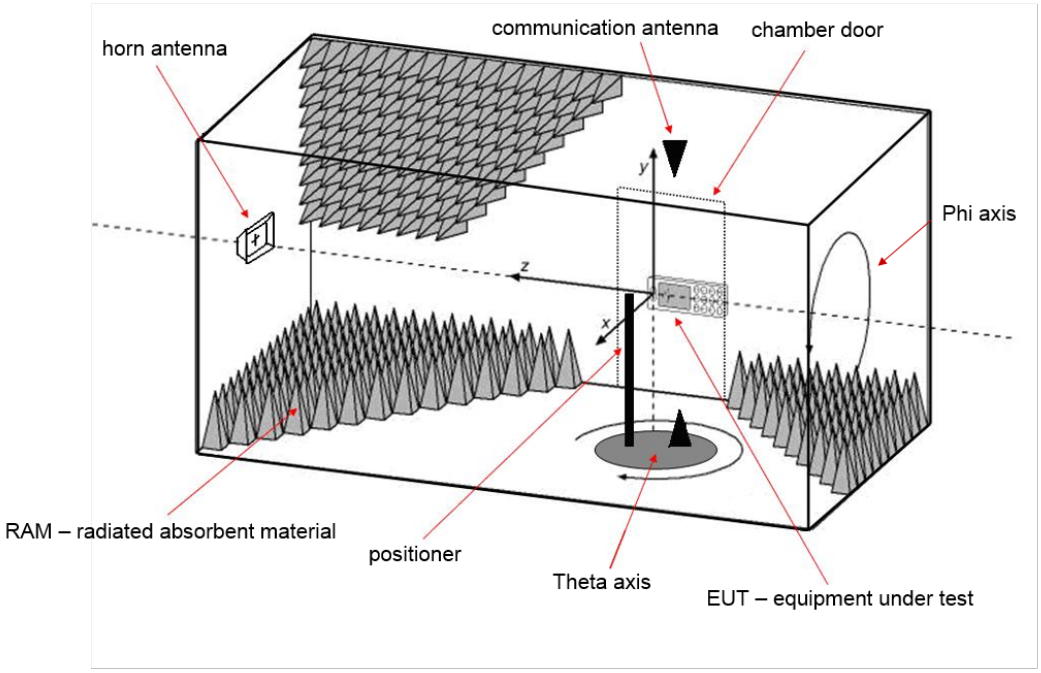
3.1 Shielded fully anechoic chamber

OTA – over the air performance



EM Quest software version: 1.0.7.0

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -40.0 [dBm] + 49.9 [dB] – 12.4 [dBi] + 9 [dB] = 6.5 [dBm] (4.47 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Spektrum Monitor	EZM	Rohde & Schwarz	883086/026	300001469	NK!	-/-	-/-
2	A	Power supply GPIB dc power supply, 0-50 Vdc, 0-2 A	6633A	HP	2851A01222	300001530	vIKI!	10.12.2019	09.12.2022
3	A	Switch Unit	TS-RSP	R&S	100155	300003281	ev	-/-	-/-
4	A	CTIA-Chamber	CTIA-Chamber AMS 8500	ETS-Lindgren Finnland	-/-	300003327	ne	-/-	-/-
5	A	CTIA-Chamber - Positioning Equipment	CTIA-Chamber - Positioning Equipment	EMCO/2	-/-	300003328	ne	-/-	-/-
6	A	CTIA-Chamber - Software	CTIA-Chamber - Software	EMCO/2	-/-	300003328	ne	-/-	-/-
7	A	Spectrum Analyzer 9kHz - 30 GHz	FSP30	R&S	100623	300003464	vIKI!	09.12.2020	08.12.2022

4 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	± 2.0 dB
RF Power conducted	± 0.4 dB
EIRP	± 1.6 dB
RF sensitivity conducted	± 0.5 dB
EIRS	± 1.7 dB

5 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	Over the Air Performance Test	See table!	2022-12-09	-/-

Test Case	temperature conditions	power source voltages	Mode	C	NC	NA	NP	IO	Remark
Antenna Gain	Nominal	Nominal	-/-	☐	☐	☐	☐	☒	-/-
TRP Total Radiated Power	Nominal	Nominal	-/-	☐	☐	☐	☐	☒	-/-
EIRP Equivalent Isotropic Radiated Power	Nominal	Nominal	-/-	☐	☐	☐	☐	☒	-/-
TRS Total Radiated Sensitivity	Nominal	Nominal	-/-	☐	☐	☐	☒	☐	-/-
EIRS Equivalent Isotropic Radiated Sensitivity	Nominal	Nominal	-/-	☐	☐	☐	☒	☐	-/-

Note:

C	Compliant	NC	Not compliant
NA	Not applicable	NP	Not performed
IO	Information Only		

6 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

7 Additional EUT parameter

Test mode:

☐ No test mode available
Iperf was used to transmit data to another device with the largest support packet size

☒ passive antenna supplied by signal generator

Modulation types:

☒ CW

☐ Frequency Hopping Spread Spectrum (FHSS)

Antennas and transmit operating modes:

☒ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

☐ Operating mode 2 (multiple antennas, no beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*

☐ Operating mode 3 (multiple antennas, with beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.*
  In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

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8 Measurement results - BT part

8.1 Antenna gain

Description:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	3 MHz
Resolution bandwidth:	3 MHz
Span:	Zero-Span
Trace-Mode:	Max Hold
Test setup	See sub clause 3.1
Measurement uncertainty	See sub clause 4

Limits:

No restriction!

Results:

T_{nom}	V_{nom}	Lowest channel 2403 MHz	Middle channel 2442 MHz	Highest channel 2480 MHz
Conducted power [dBm]		0.0	0.0	0.0
Radiated power [dBm]		-2.9	-0.7	-0.7
Gain [dBi] Calculated		-2.9	-0.7	-0.7

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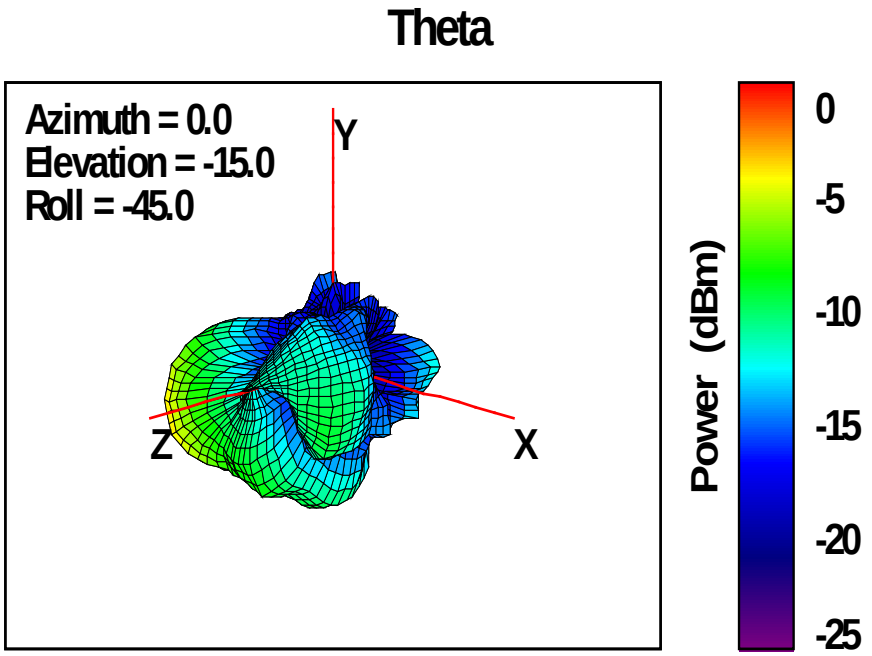
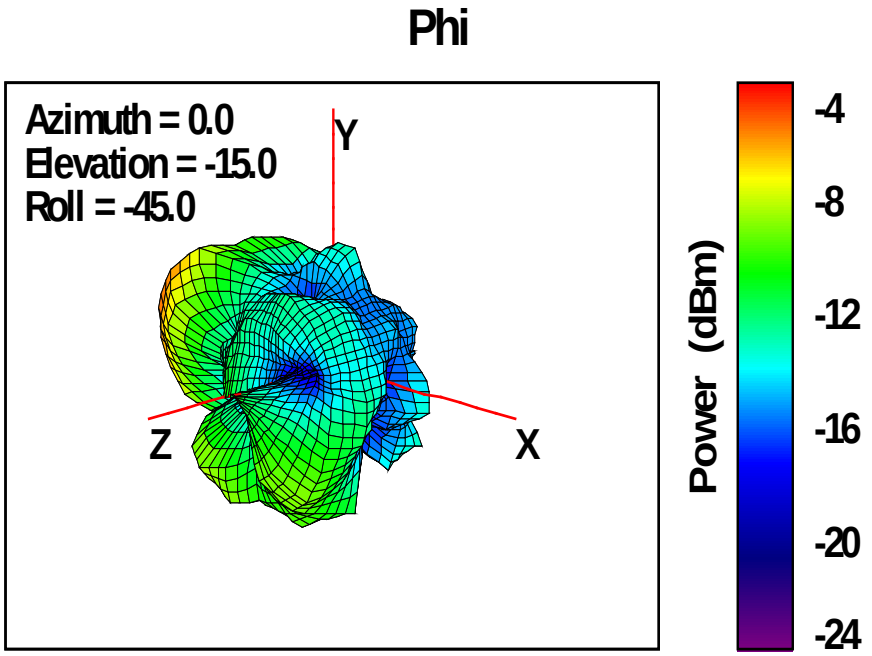
8.2 Radiation Pattern Diagram

Low channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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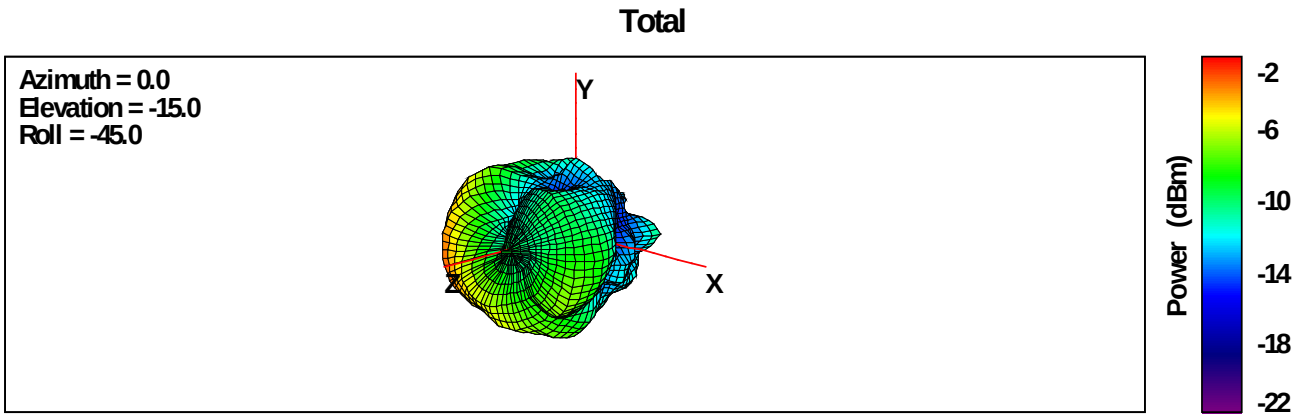
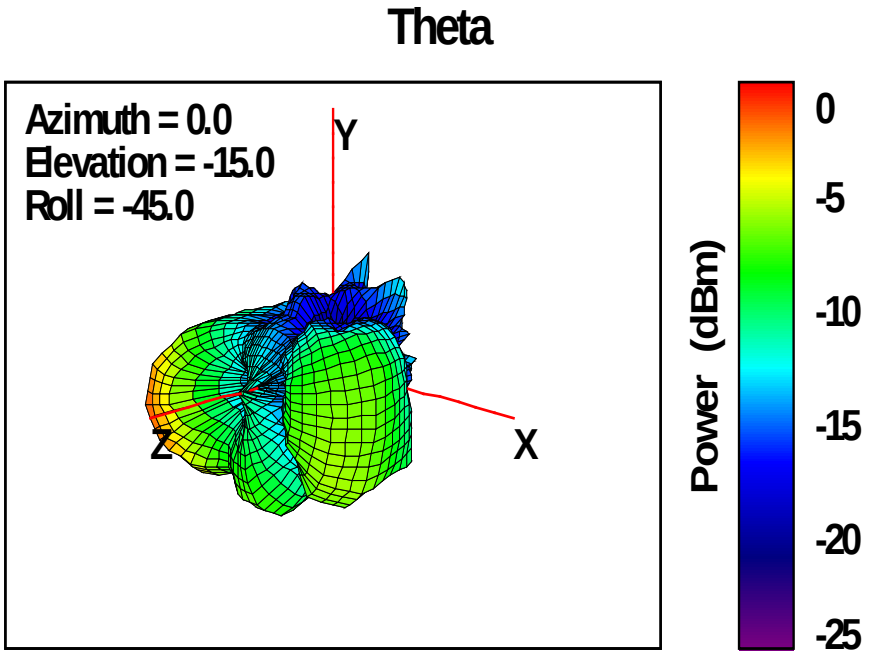
Plot 3 summary of both polarisations

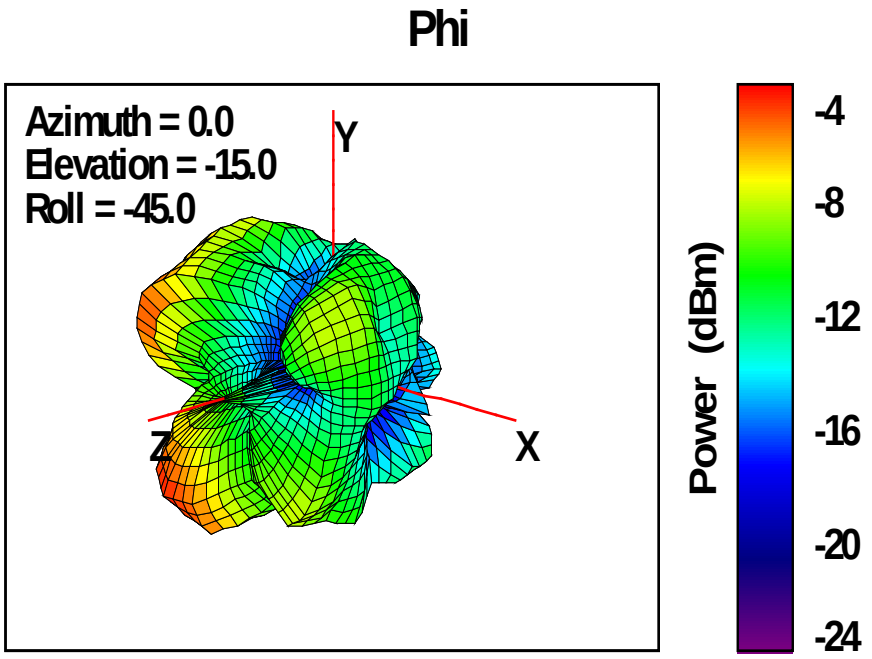


Mid channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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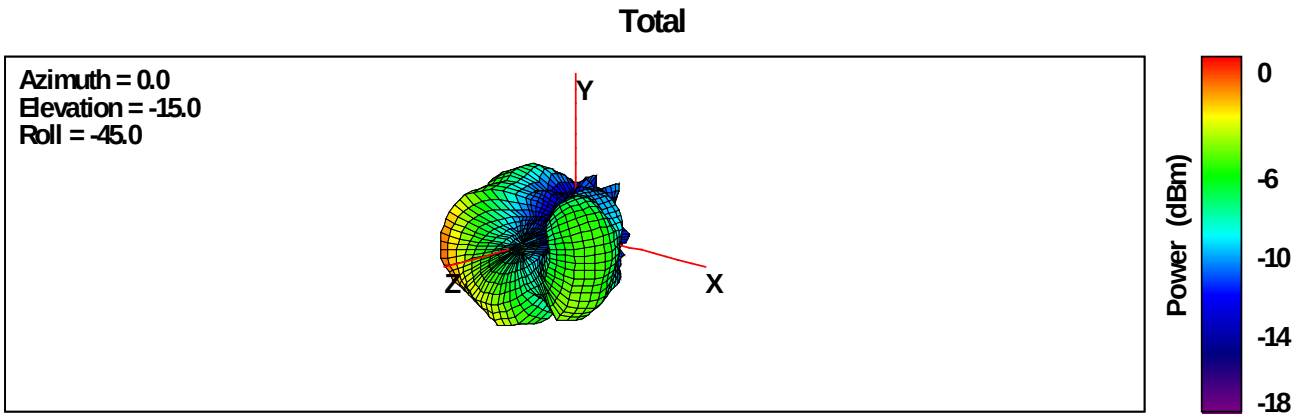
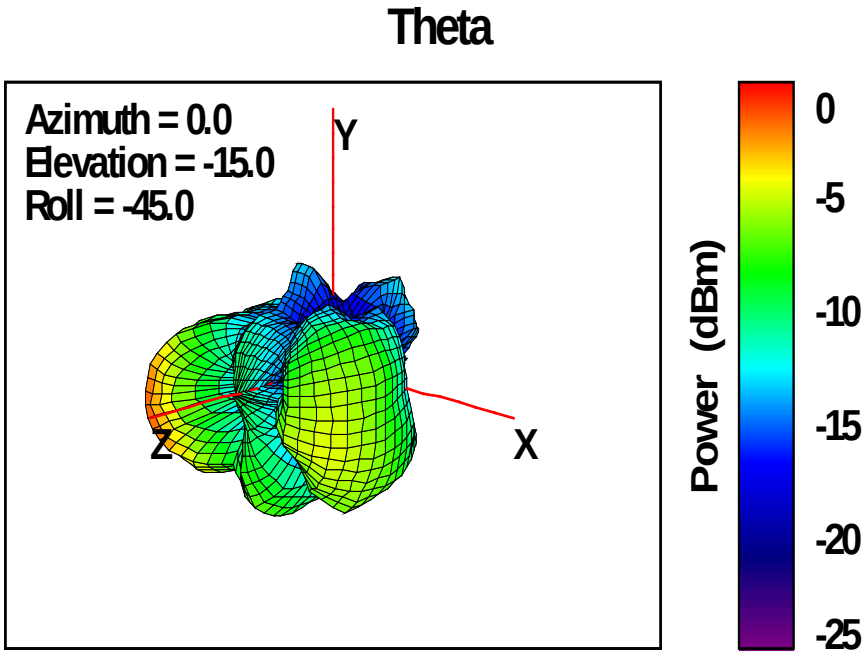
Plot 3 summary of both polarisations

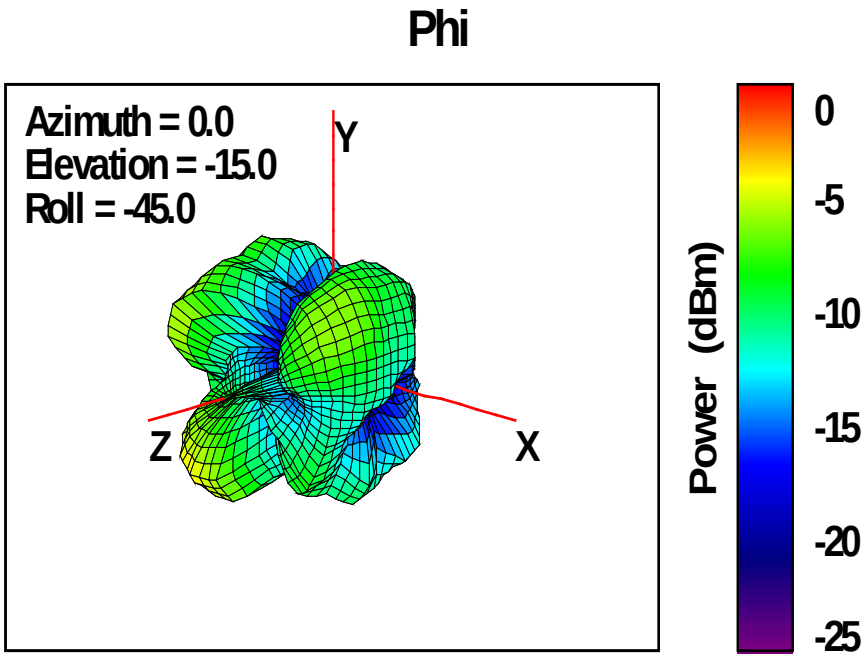


High channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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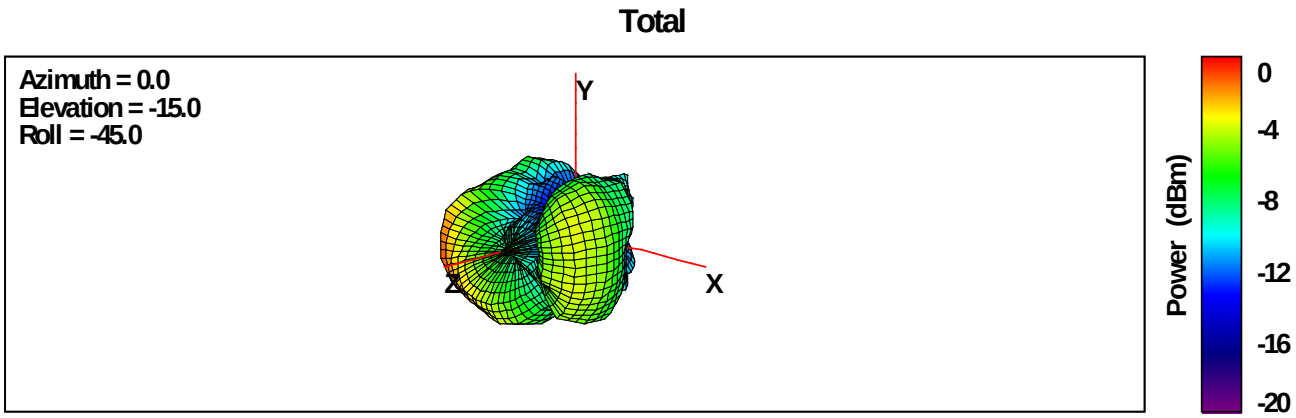
Plot 3 summary of both polarisations



9 Measurement results - WLAN part

9.1 Antenna gain

Description:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	3 MHz
Resolution bandwidth:	3 MHz
Span:	Zero-Span
Trace-Mode:	Max Hold
Test setup	See sub clause 3.1
Measurement uncertainty	See sub clause 4

Limits:

No restriction!

Results: Range 2400 MHz to 2483.5 MHz

T_{nom}	V_{nom}	Lowest channel 2412 MHz	Middle channel 2442 MHz	Highest channel 2472 MHz
Conducted power [dBm]		0.0	0.0	0.0
Radiated power [dBm]		-3.3	-1.4	-1.8
Gain [dBi] Calculated		-3.3	-1.4	-1.8

Results: Range 5725 MHz to 5850 MHz

T_{nom}	V_{nom}	Lowest channel 5755 MHz		Highest channel 5825 MHz
Conducted power [dBm]		0.0	-/-	0.0
Radiated power [dBm]		5.4		6.8
Gain [dBi] Calculated		5.4		6.8

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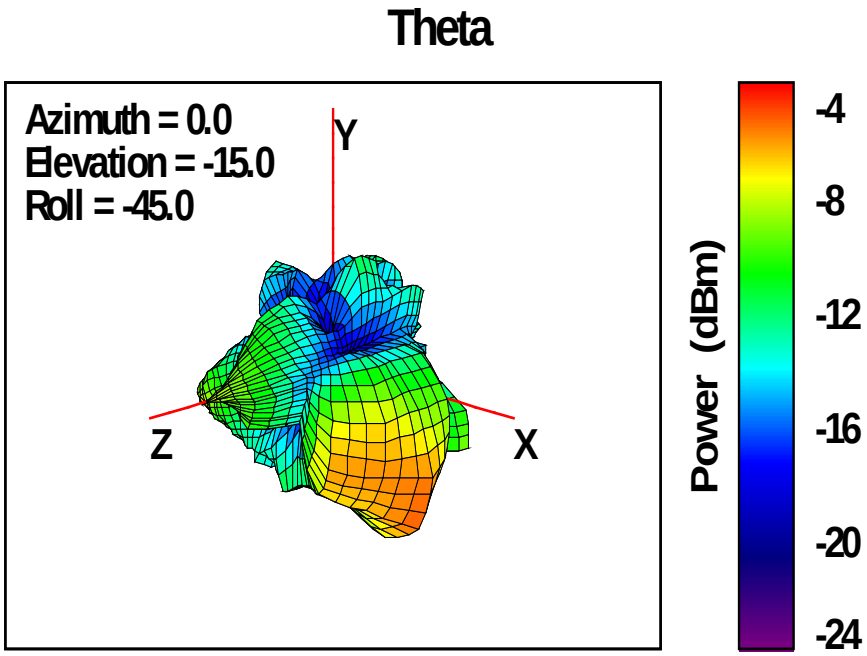
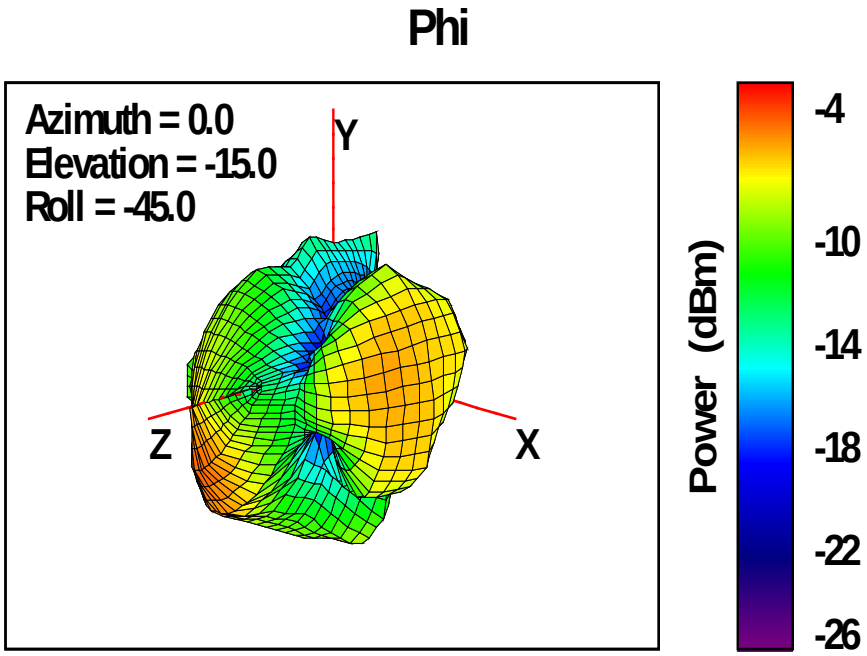
9.2 Radiation Pattern Diagram – 2400 MHz to 2483.5 MHz

Low channel

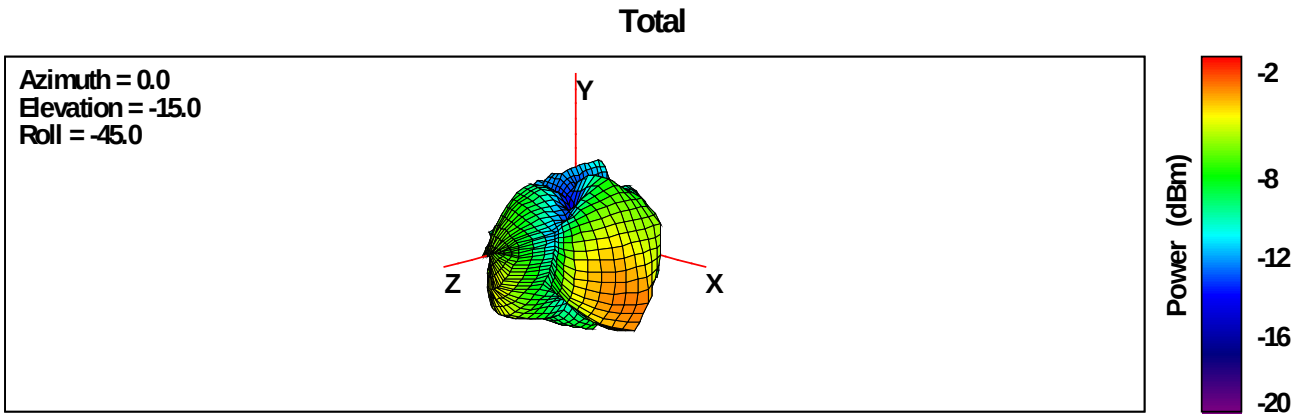
Plot 1 vertikal polarisation



Plot 2 horizontal polarisation

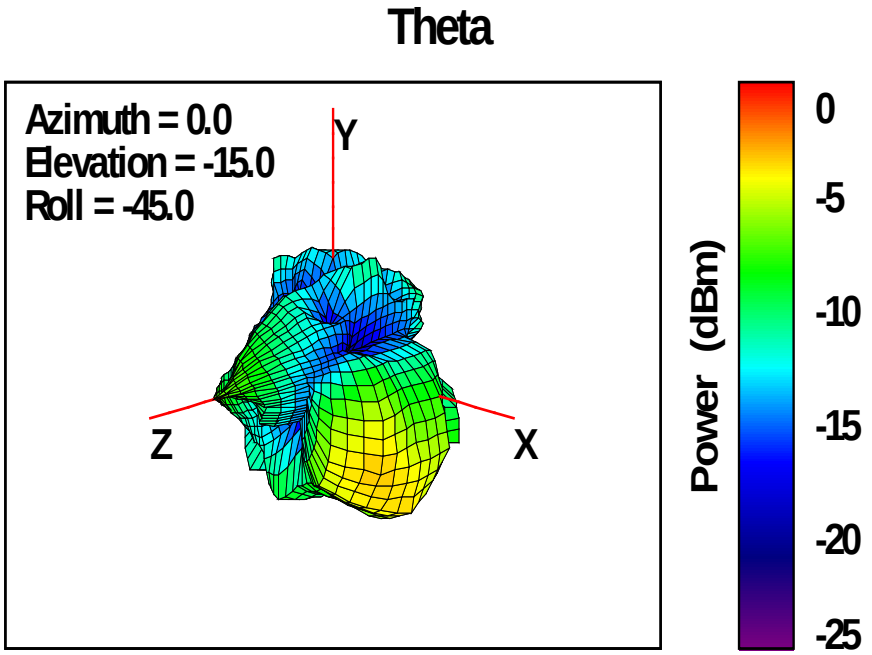


Plot 3 summary of both polarisations

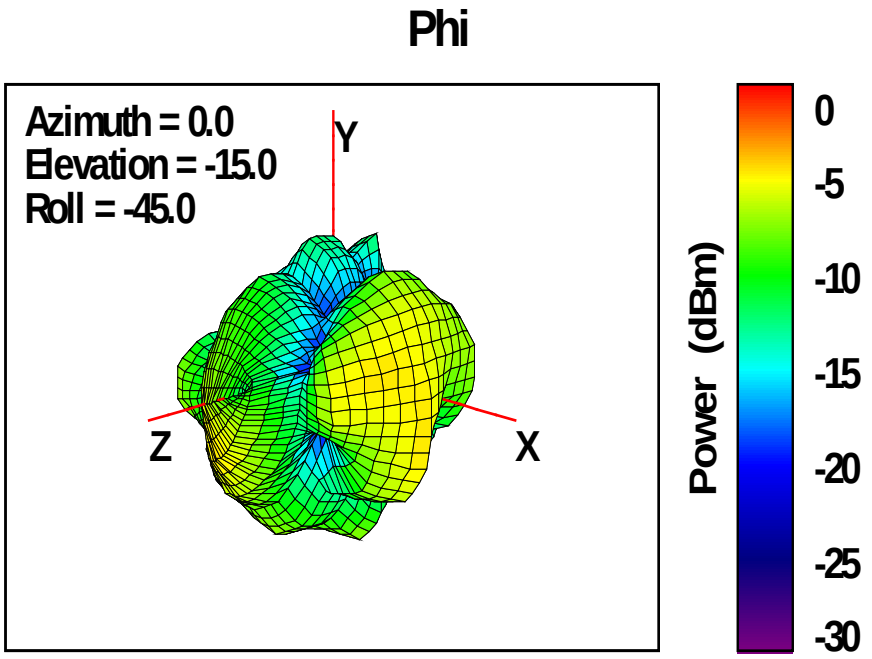


Mid channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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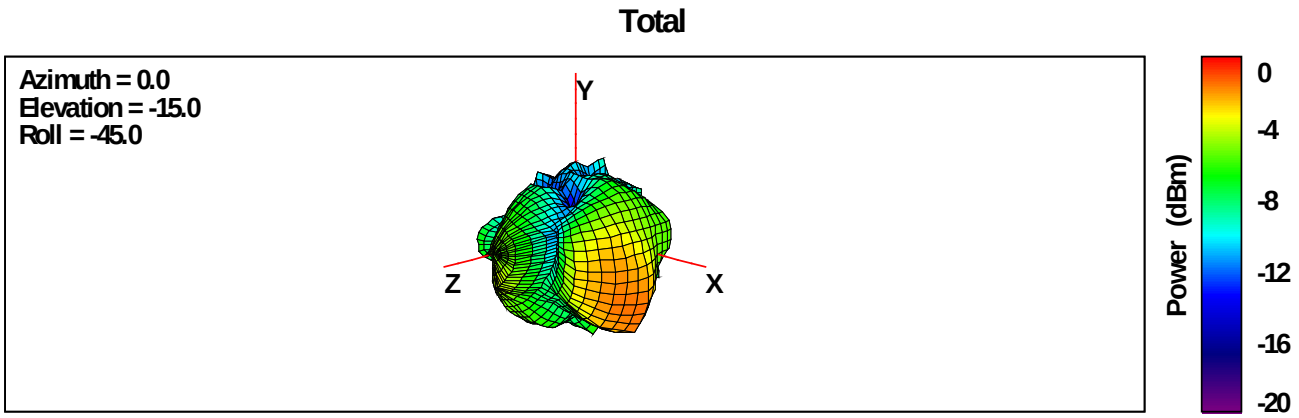
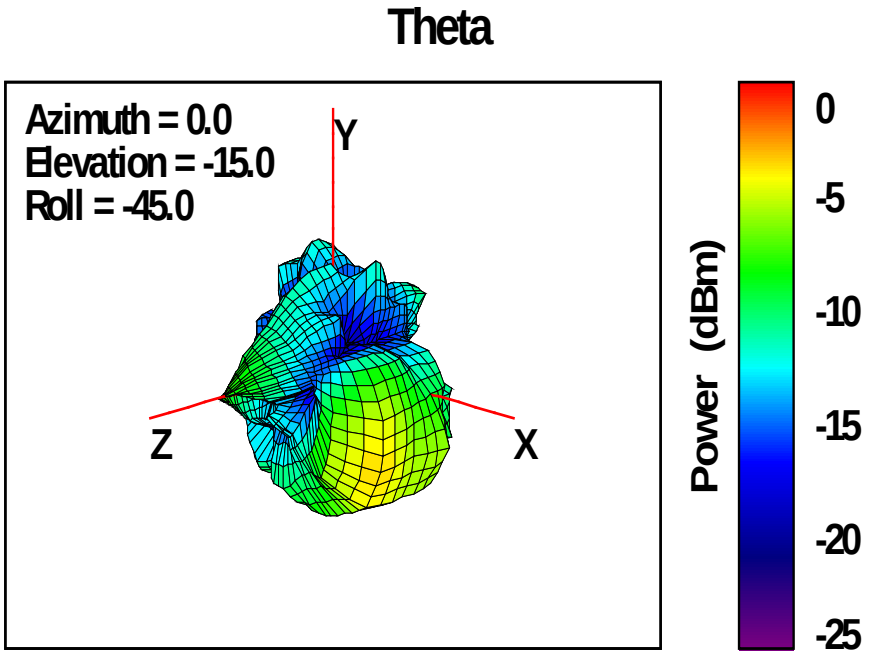
Plot 3 summary of both polarisations

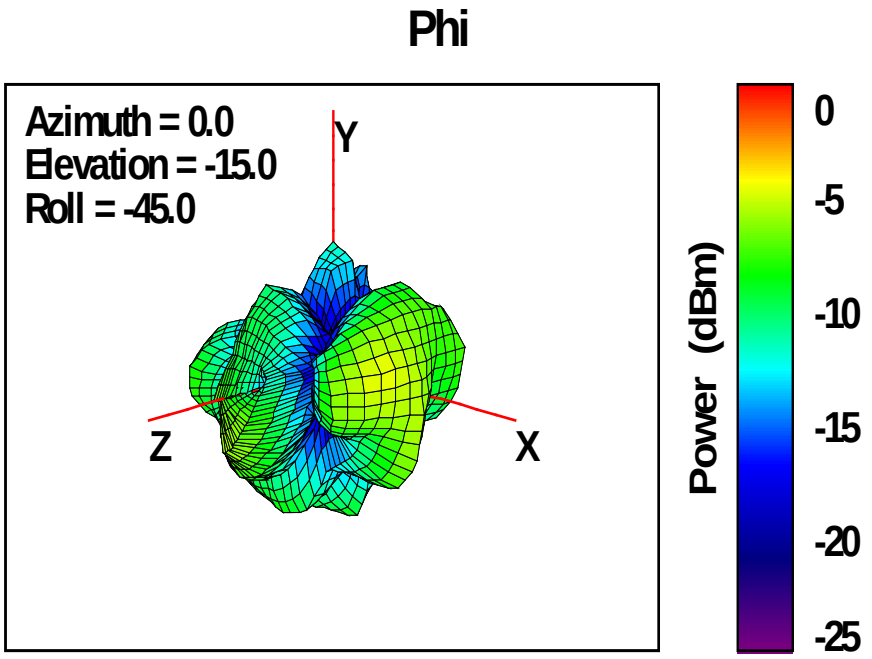


High channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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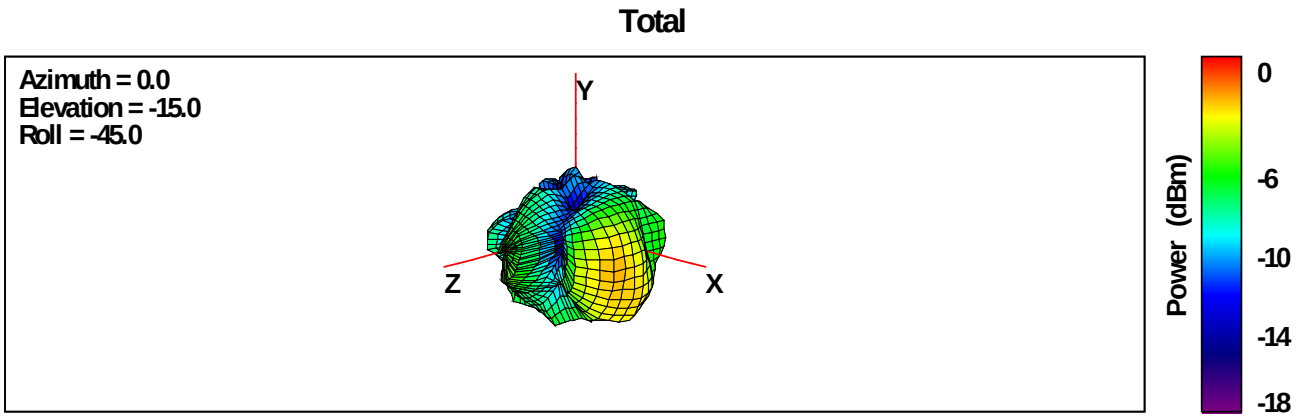
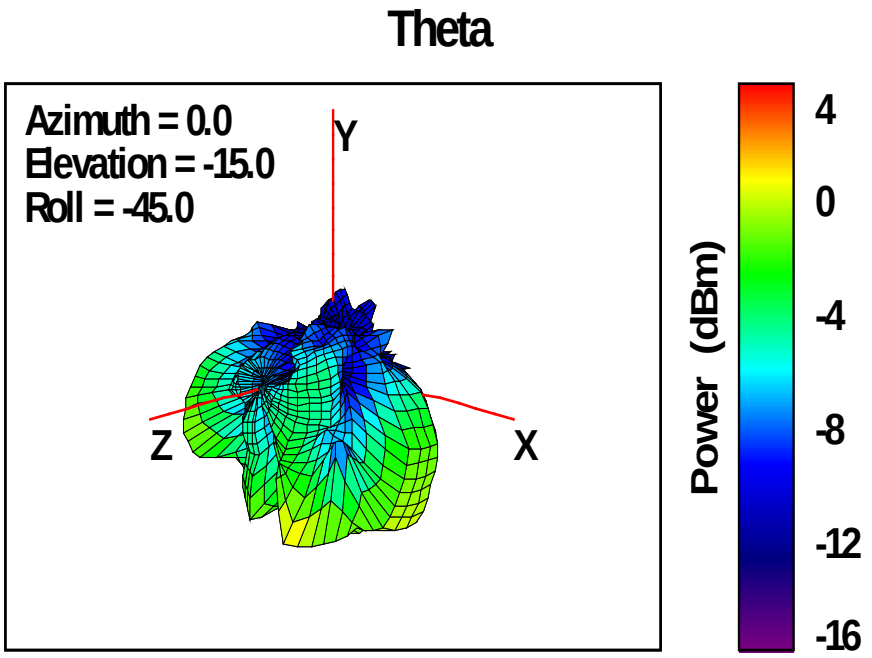
Plot 3 summary of both polarisations



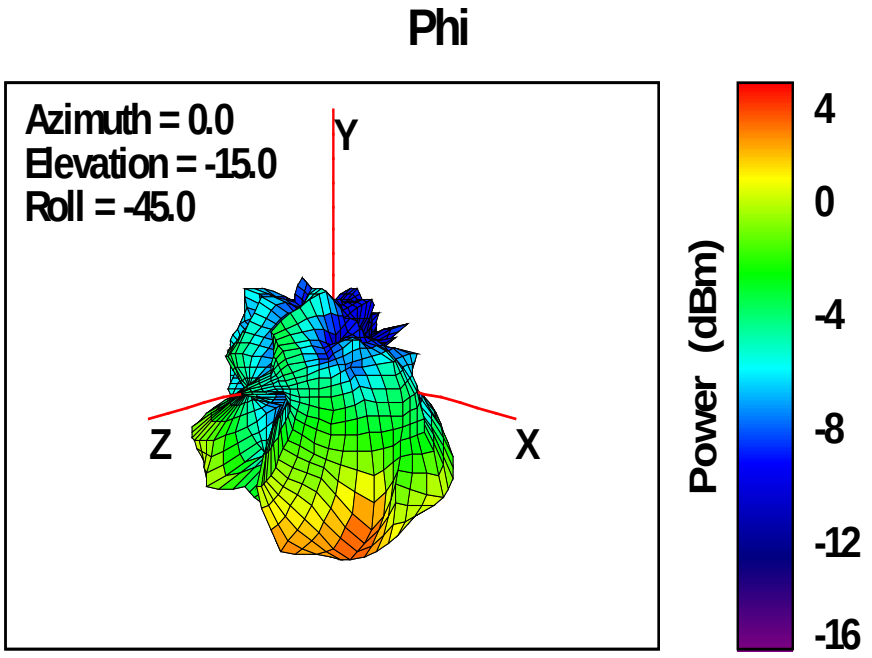
9.3 Radiation Pattern Diagram – 5725 MHz to 5850 MHz

Low channel

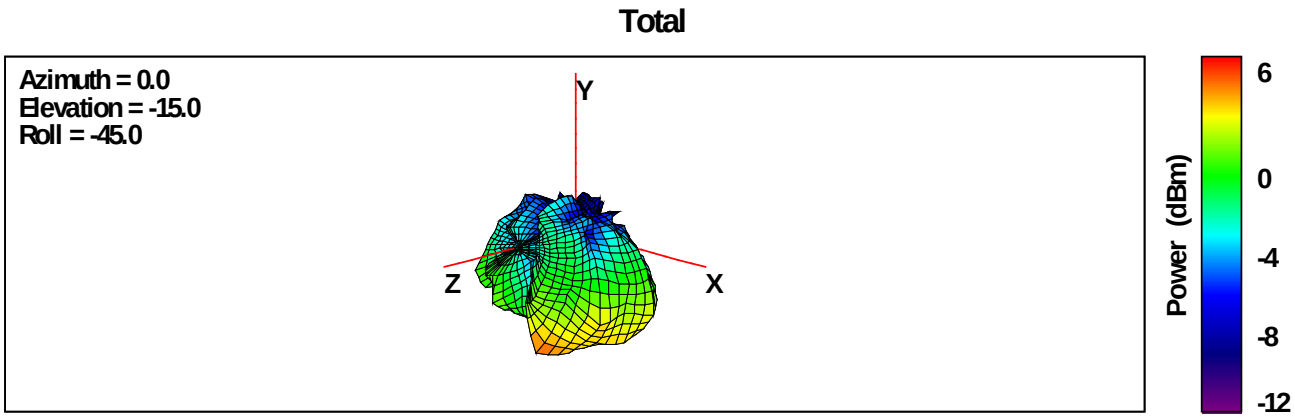
Plot 1 vertikal polarisation



Plot 2 horizontal polarisation

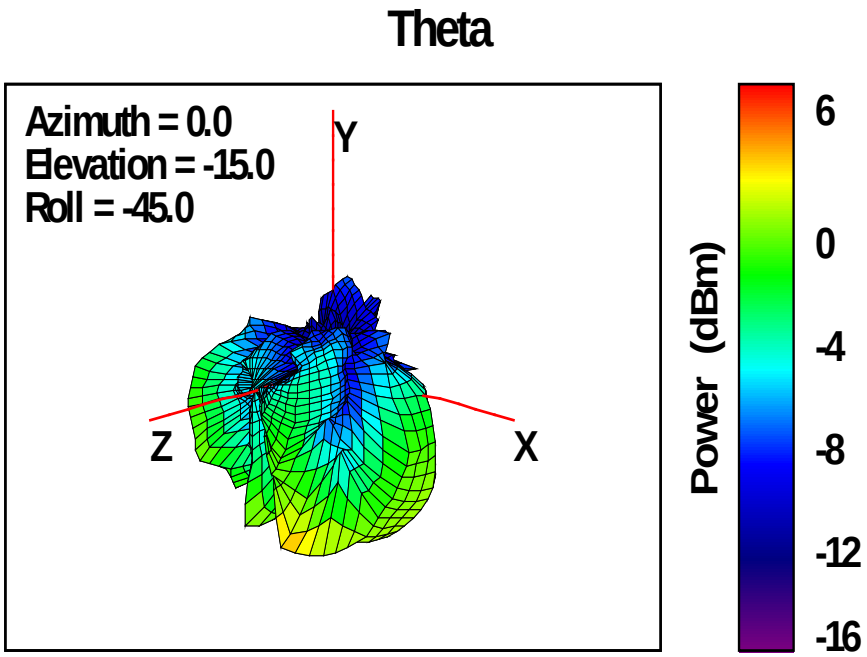


Plot 3 summary of both polarisations

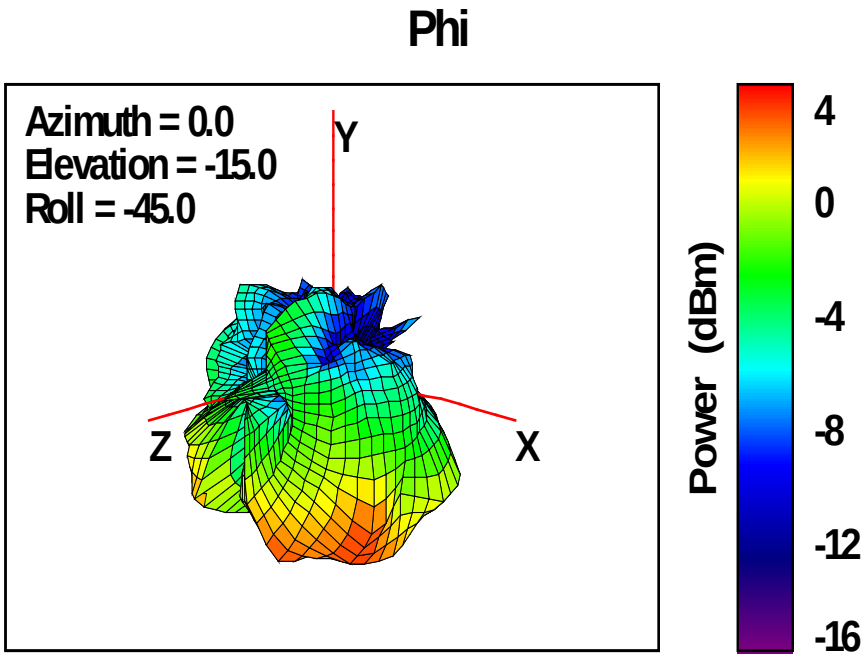


High channel

Plot 1 vertikal polarisation



Plot 2 horizontal polarisation



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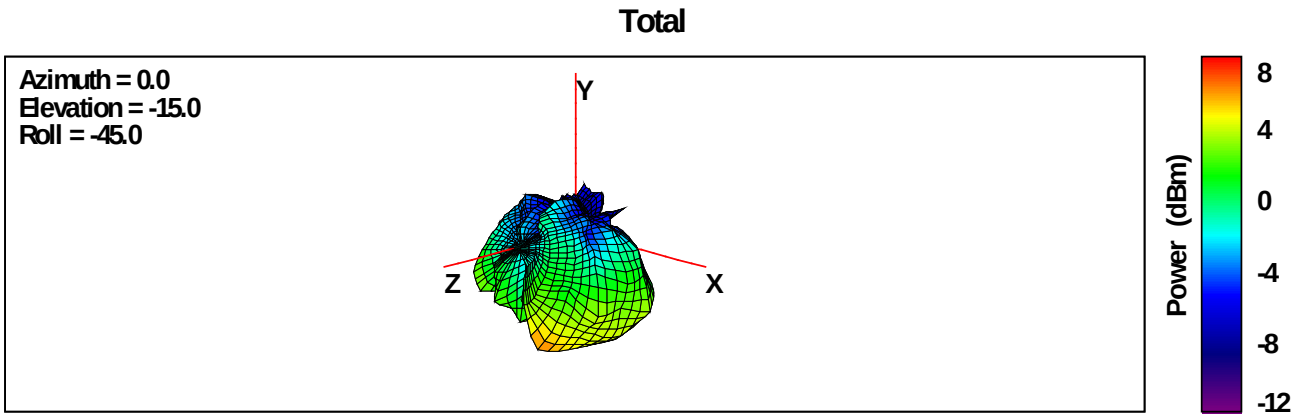
Plot 3 summary of both polarisations



10 Photos

Photo 1:

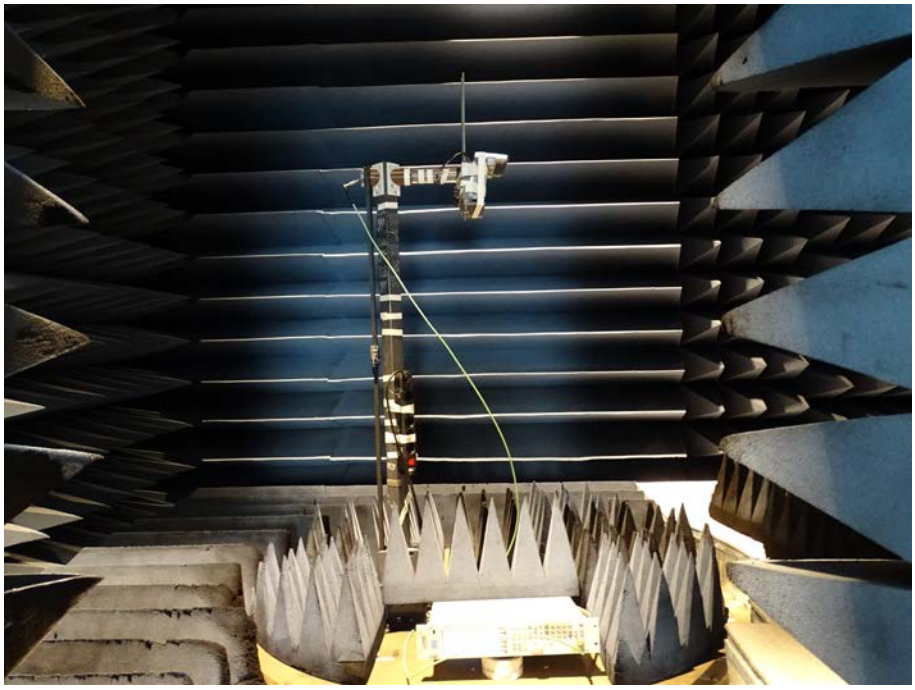


Photo 2:

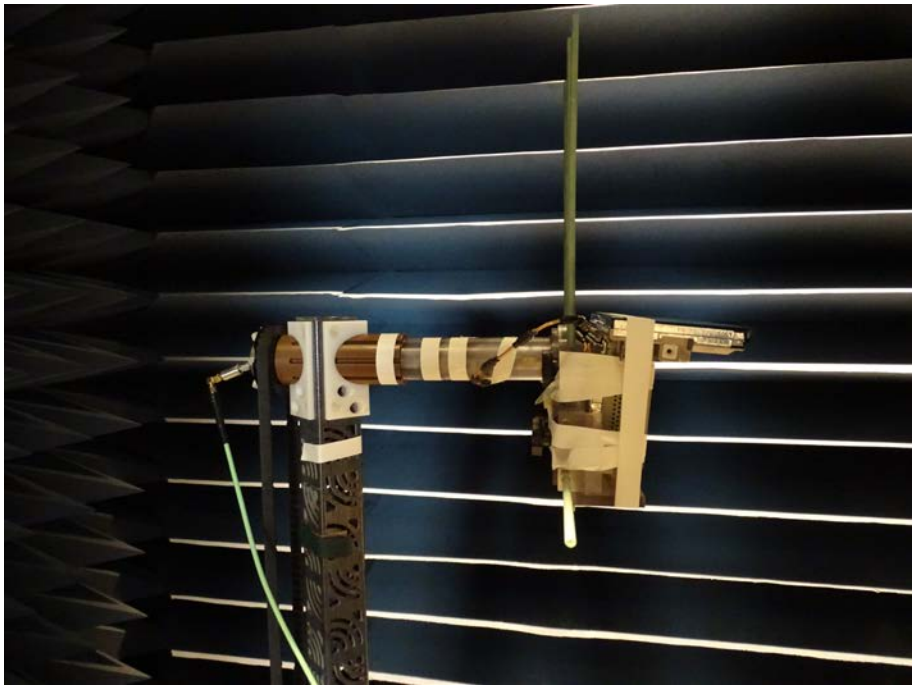


Photo 3:

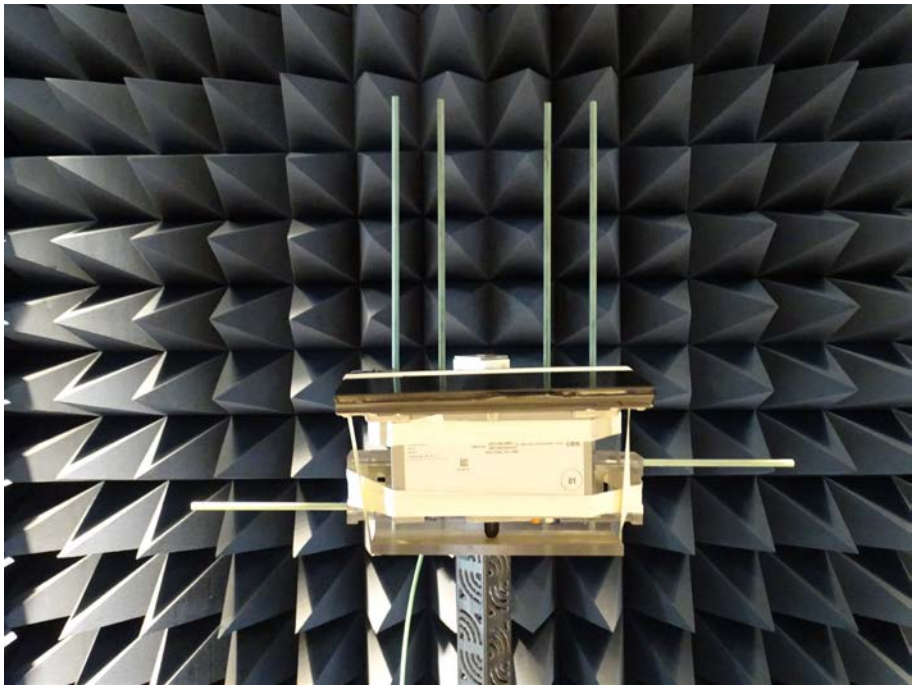


Photo 4:

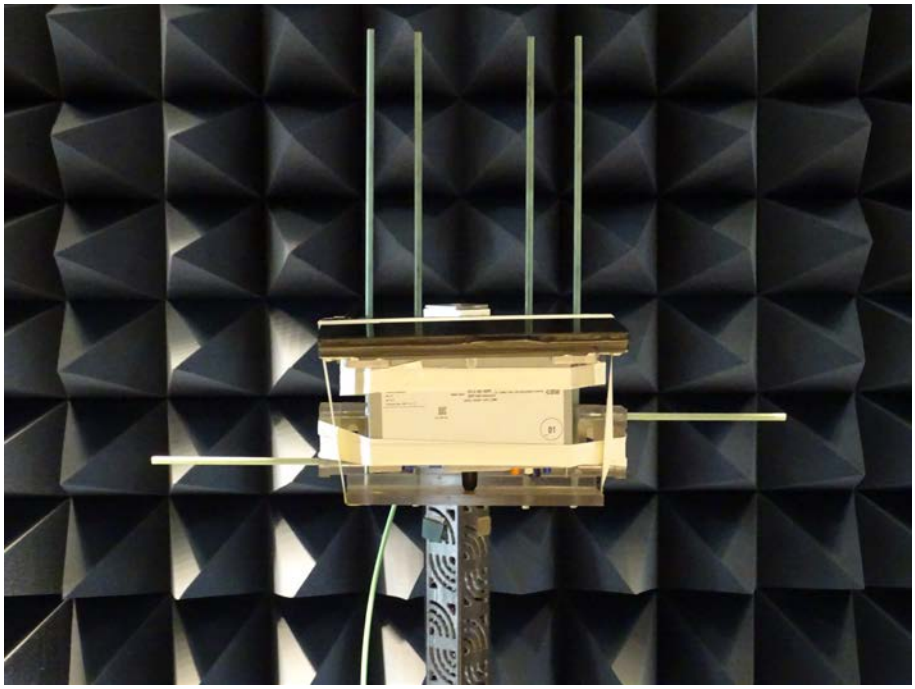


Photo 5:

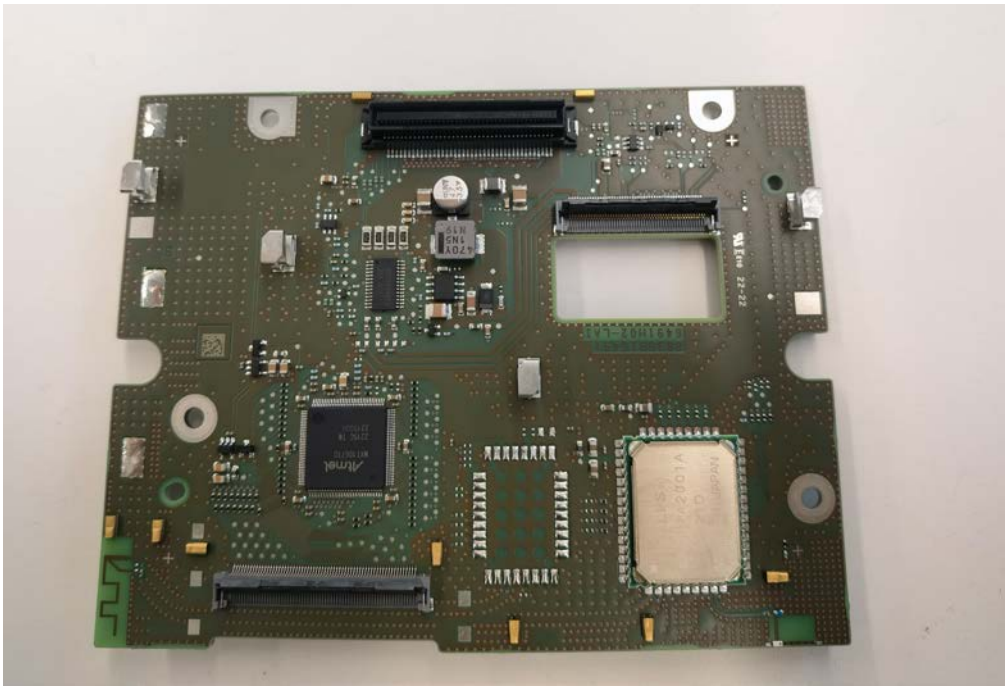
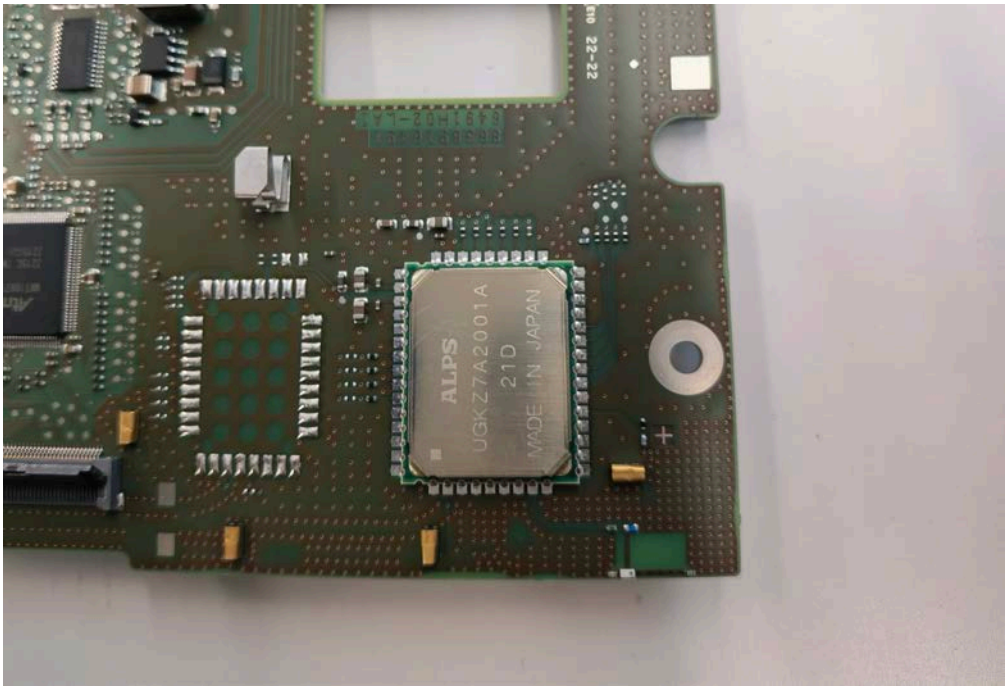


Photo 6:

Bluetooth antenna

Photo 7:



WiFi antenna

11 Observations

No observations except those reported with the single test cases have been made.

12 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

13 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-09-15
A	Editorial changes, Photos added	2022-11-29
B	Editorial changes, Photos added	2022-12-06

################################## END OF TEST REPORT ##################################