



Test report for

2.4 GHz antenna

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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 WiFi module is put into a fixed position in 3 planes X, Y, Z.

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)	2.15 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.	52%

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 maxima levels are recorded in table 3

Emitted Power	dBm
X 2412 MHz Measure ant. horisontal Max	17,07
X 2412 MHz Measure ant. vertical Max	13,99
X 2442 MHz Measure ant. horisontal Max	18,2
X 2442 MHz Measure ant. vertical Max	14,5
X 2472 MHz Measure ant. horisontal Max	17,77
X 2472 MHz Measure ant. vertical Max	14,13
Y 2412 MHz Measure ant. horisontal Max	15,49
Y 2412 MHz Measure ant. vertical Max	16,99
Y 2442 MHz Measure ant. horisontal Max	15,44
Y 2442 MHz Measure ant. vertical Max	17,87
Y 2472 MHz Measure ant. horisontal Max	15,53
Y 2472 MHz Measure ant. vertical Max	17,34
Z 2412 MHz Measure ant. horisontal Max	14,89
Z 2412 MHz Measure ant. vertical Max	16,19
Z 2442 MHz Measure ant. horisontal Max	15,57
Z 2442 MHz Measure ant. vertical Max	15,98
Z 2472 MHz Measure ant. horisontal Max	15,43
Z 2472 MHz Measure ant. vertical Max	15,89

Table 2 Maximum EIRP

2.4.2 Wifi Module TX power

Conducted power measured at the RF port.

Frequency	2412	2442	2472
TX power	15,89	16,05	16,1

Table 3 Module TX power

2.4.3 Antenna gain

The antenna gain is the maximum EIRP – TX power conducted. Maximum is the centre channel in the X-plane @ 2442 MHz. the gain is 2.15 dBi

2.5 INSTRUMENTATION

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

Device	Manufacturer	Asset no	Cal Expires
N9020 MXA Spectrum Analyzer	Keysight	529528	2022-24-11
Coax Cable SucoFlex 100	Huber-Suhner	S69	2022-11-11
Coax Cable SucoFlex 100	Huber-Suhner	S71	2022-11-11
Coax Cable SucoFlex 100	Huber-Suhner	S72	2022-11-11
EMCO 3115	ETS-Lindgreen	514231	2022-11-11
ANT_Test – meas. SW	Grundfos Holding		

FAR-3	Euroshield/ETS-Lindgren	271667	2022-16-11
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Table 4 Terms & Abbreviations

2.6 FAR SITE

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

excel

2.6.1 Radiated power 2412 MHz

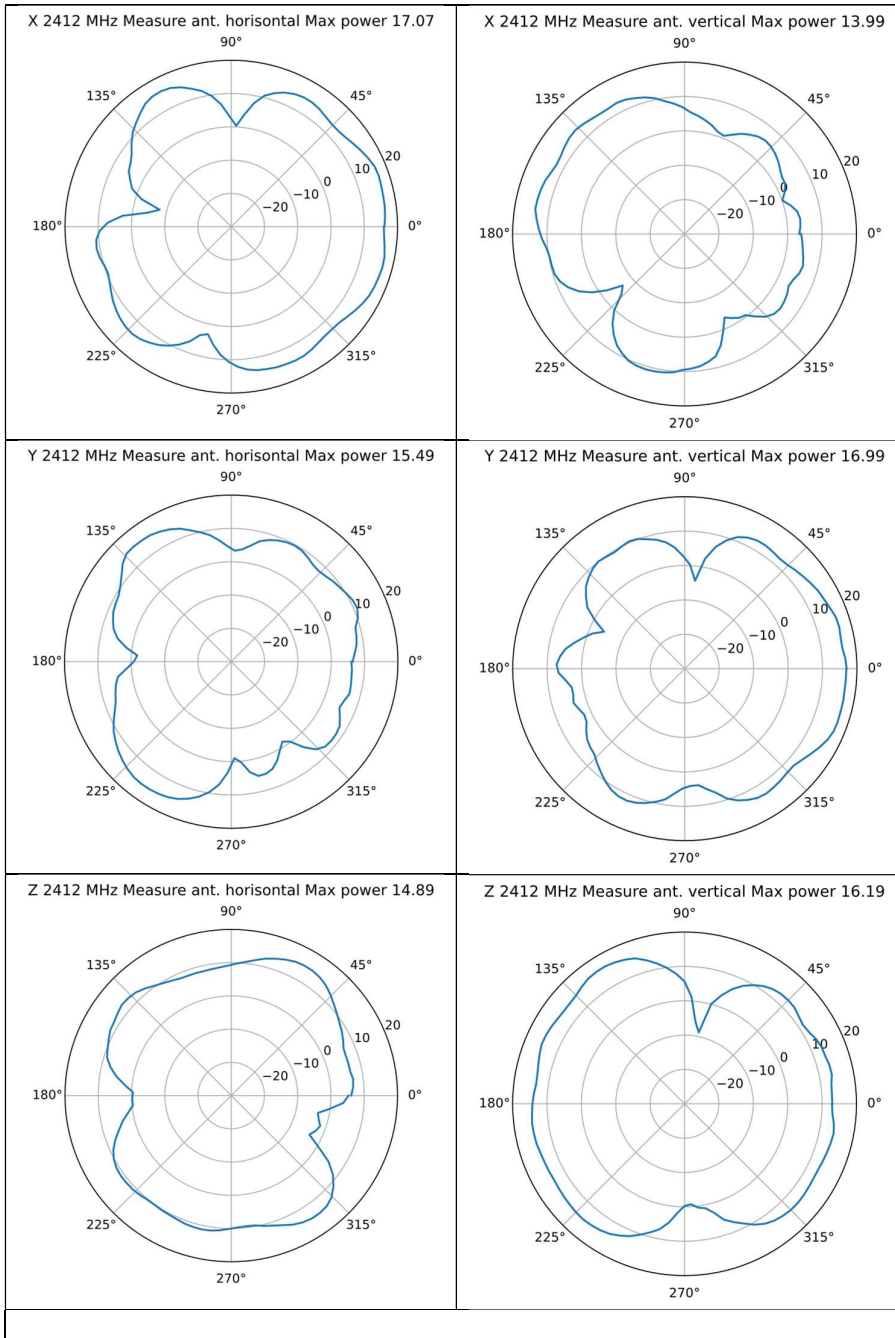


Figure 1: Polar plot 2412 MHz

2.6.2 Radiated power 2442 MHz

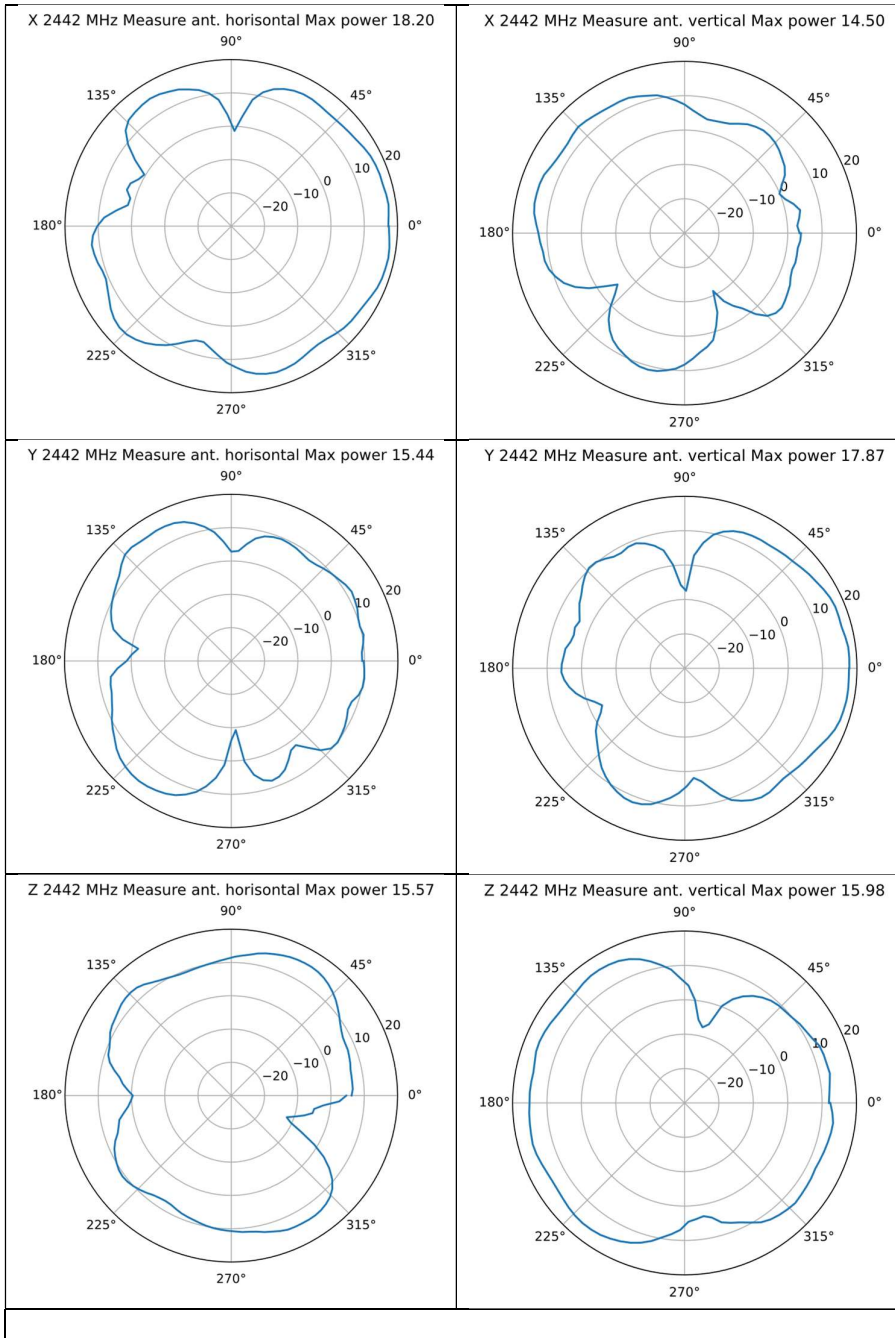


Figure 2: Polar plot 2442 MHz

2.6.3 Radiated power 2472 MHz

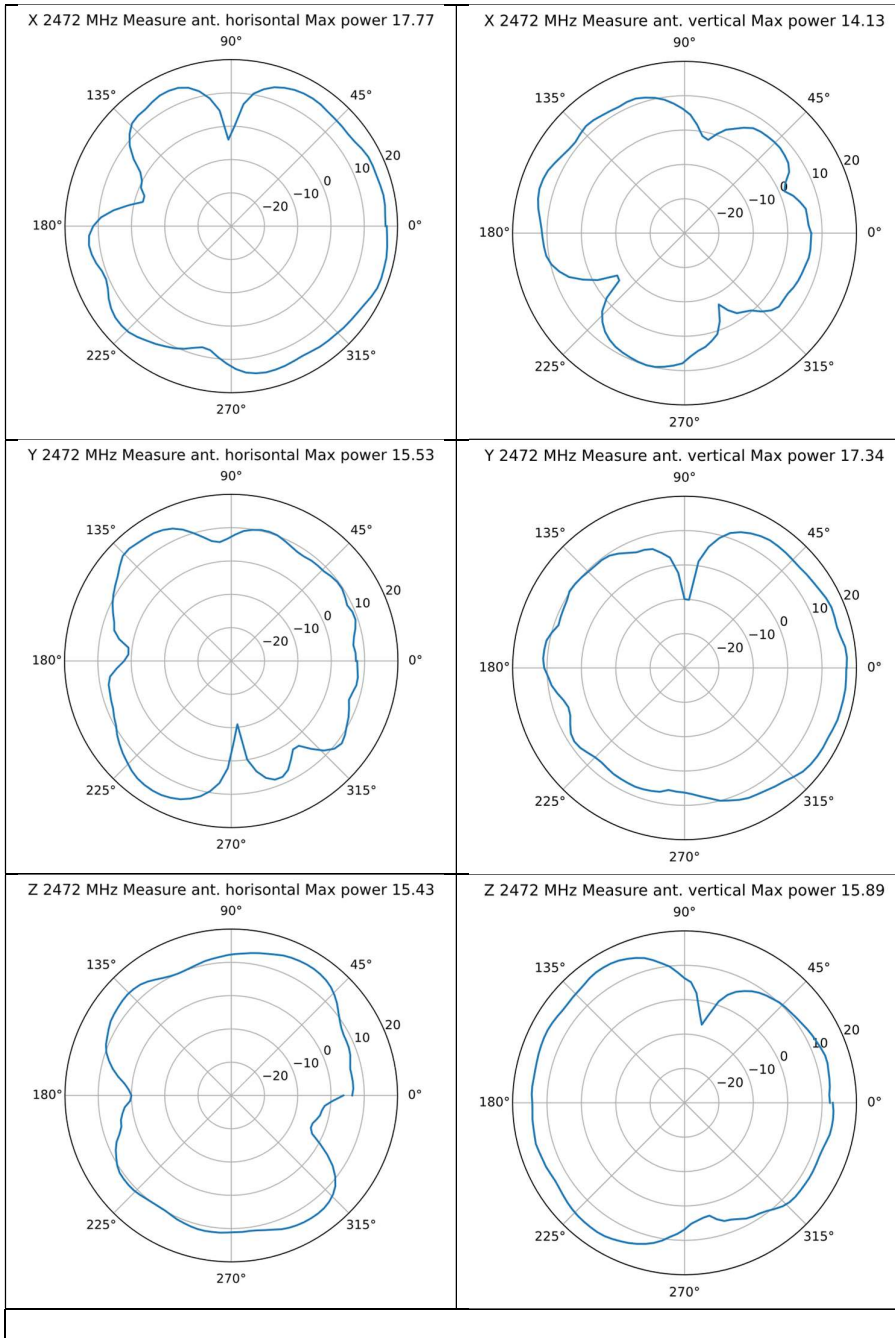


Figure 3: Polar plot 2472 MHz

2.7 ANTENNA CONFIGURATION

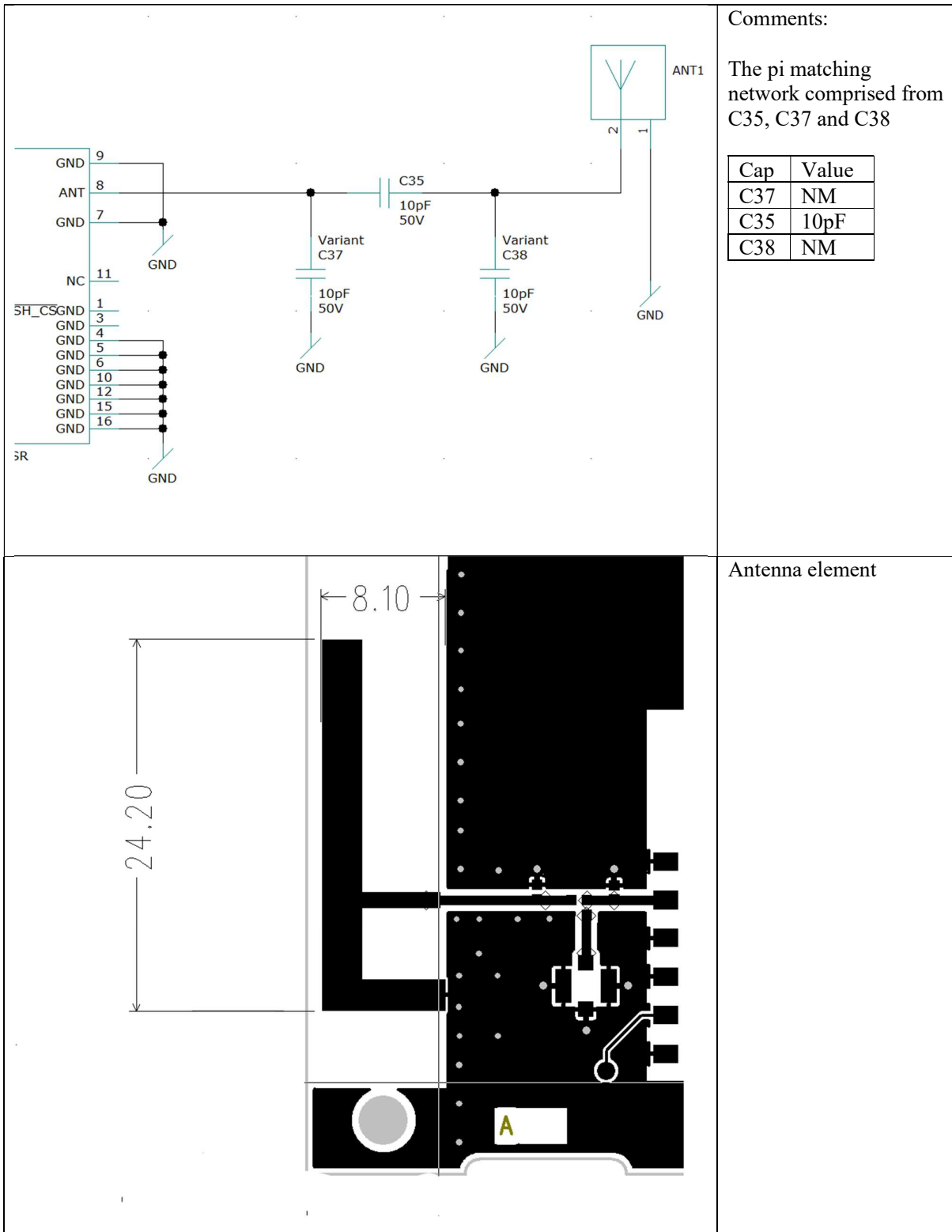


Figure 4 Antenna circuit

2.8 MEASUREMENT PROCEDURE

The antenna is put onto a turntable on a Styrofoam table.

During measurement the WiFi 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 3 positions X, Y, and Z for each frequency with the measurement antenna in a vertical and a horizontal orientation.

The spectrum analyser is set to:

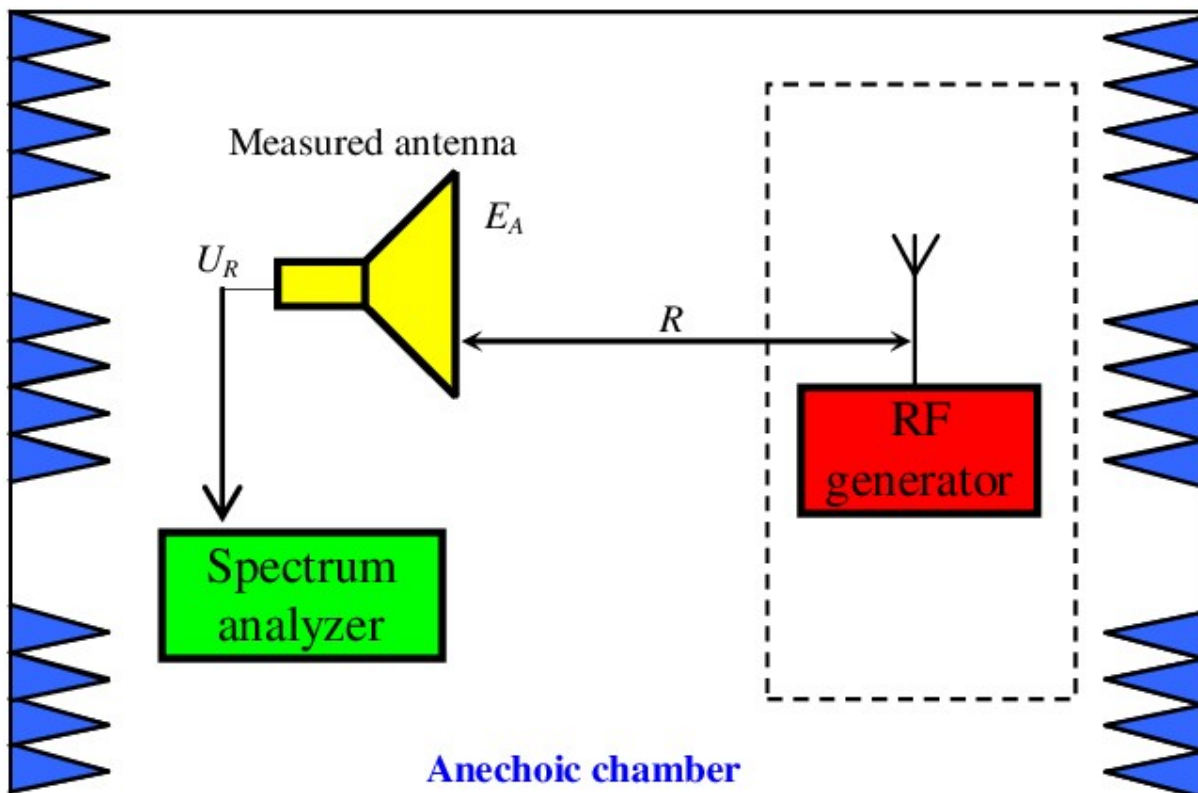
- to 0 span
- 3 MHz BW /3 MHz video Bw
- Sweep time 10 mS

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 a Styrofoam table the DUT is placed in a wooden fixture for the X, Y and Z orientation. Below pictures showing the actual setup, in figure 6 a picture of the FAR room.

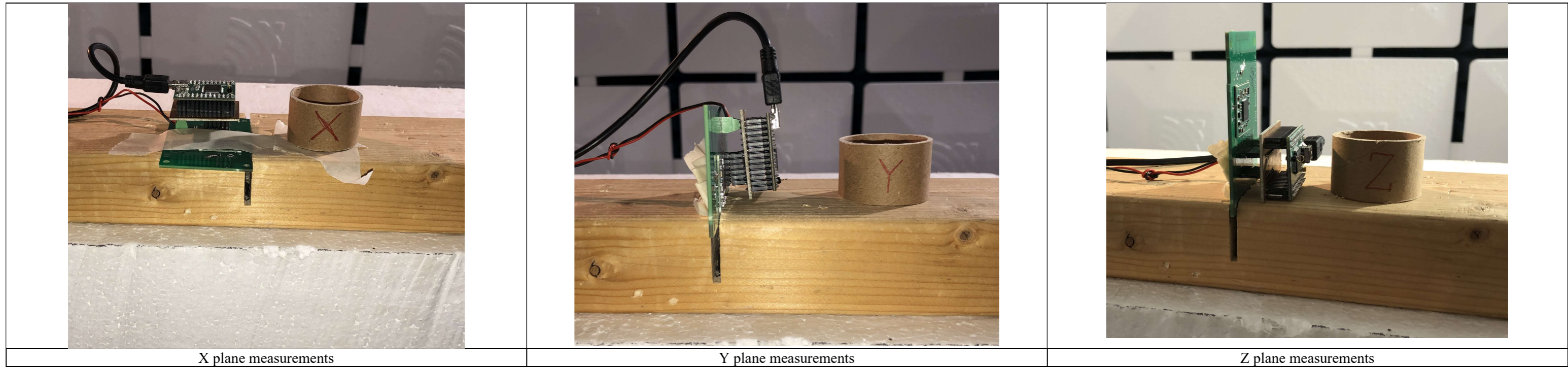


Figure 5 Pictures from FAR

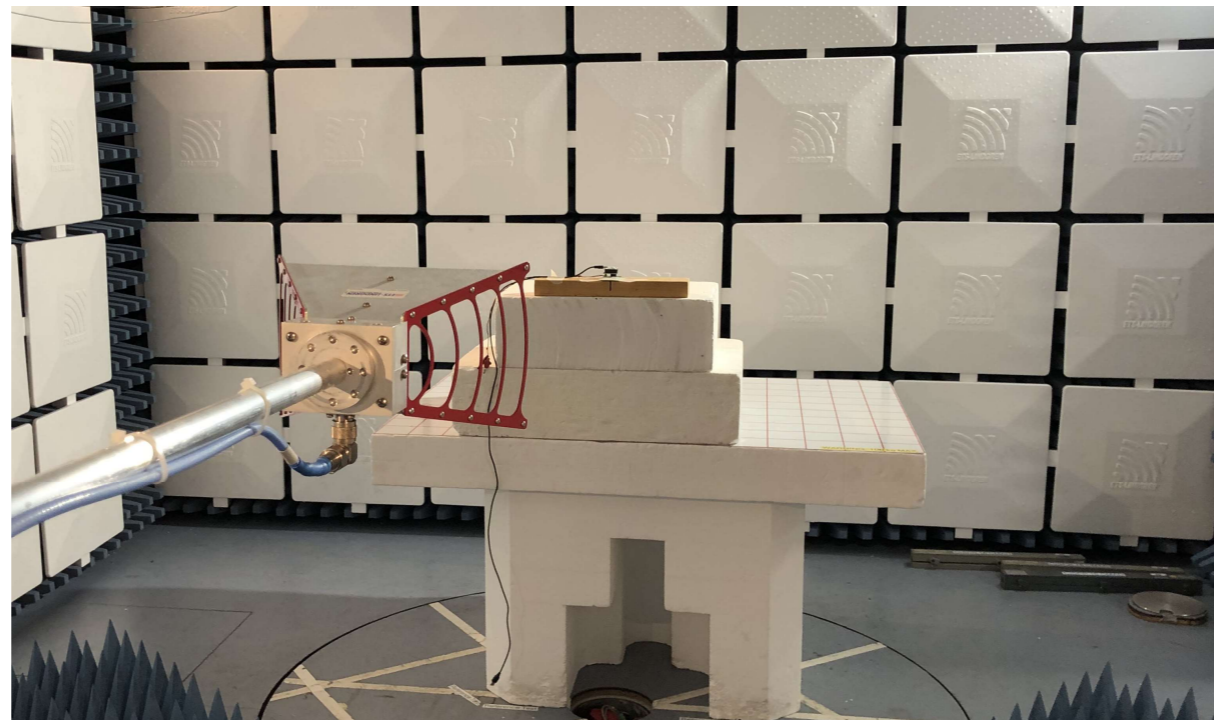


Figure 6 Test site