Antenna radiation patterns of module STM32WB5MMG

Introduction

This technical note presents the results of radiated emission tests of the STM32WB5MMG device made with the STM32WB5MM-DK Discovery Kit.

It gives a detailed description of the equipment used, the test setup, and the results. The purpose is to demonstrate the capabilities of the STM32WB5MMG module.

1 General information

This document applies to STM32 Arm®-based general-purpose microcontrollers or microprocessors.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Description of the test

2.1 Description of the device under test

The table below provides the characteristics of the device under test (DUT).

Table 1. Description of the DUT

Item	Description
Product	STM32WB5MM-DK
Product identification	DK32WB5MM$GU2
Power supply	5 V USB
Running mode	Transmission of Bluetooth® Low Energy carrier frequency on low, middle, and high frequency channels
Test program	STM32CubeMonitor-RF
Description of the module features	• Frequency band: 2400 to 2483.5 MHz (Tx and Rx, wideband data transmission systems) • Bluetooth® Low Energy power setting: power is set at 6 dBm • Duty cycle: none • Modulation: none, CW configuration • Antenna type: integrated in module • Powered by 5 V dc from USB power supply • Equipment intended for use as a mobile device • Equipment designed for continuous operation
Dimensions of the PCB	65×105×1.6 mm

2.2 Test setup for radiated emissions

The following figures present the anechoic chamber setup diagram, and a picture of the setup mounted on STMicroelectronics laboratory to perform the test.

Figure 1. Anechoic chamber setup

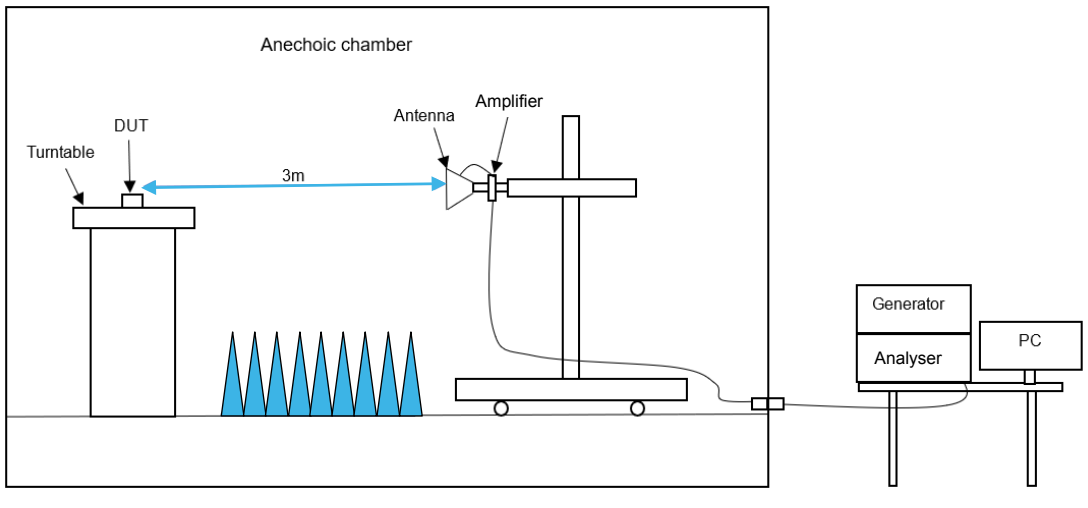


Figure 2. **Anechoic chamber picture**

2.3 Test equipment used for radiated emissions

The following table describes the test equipment used to perform the tests.

Table 2. **Test equipment used for radiate emission**

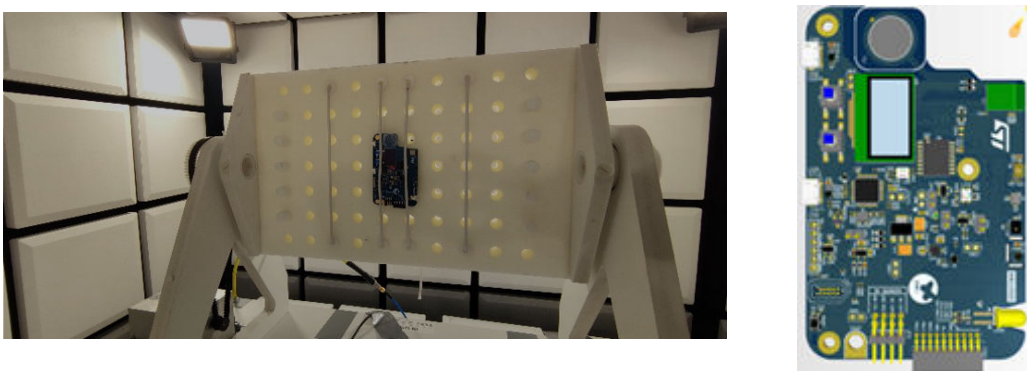
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
Horn antenna	SCHWARZBERCK	BBHA 9120D	EMC_002	2023/06	2024/06
RF cable	-	-	Cable antenna	2023/06	-
RF cable	-	-	Cable_FilterAmpli_2	2023/06	-
Semianechoic room	COMTEST	1766-1221 Ma	-	-	-
Antenna mast	Innco- Systems	MA2000-XP-ET	-	-	-
Turntable	Innco- Systems	-	MISC_0012A	-	-
Controller	Innco- Systems	CO3000	MISC_0012	-	-
Spectrum analyzer	Rohde&Schwarz	FSV3030	SPAN_0049	2023/06	2024/06
Pre-amplifier	SCHWARZBERCK	BBV 9718C 1-18 GHz	EMC_001	2022/11	2024/11
Radiated TEST BENCH SUITE	STMicroelectronics	-	-	-	-

3 Board positions and antenna polarization

3.1 Board positions

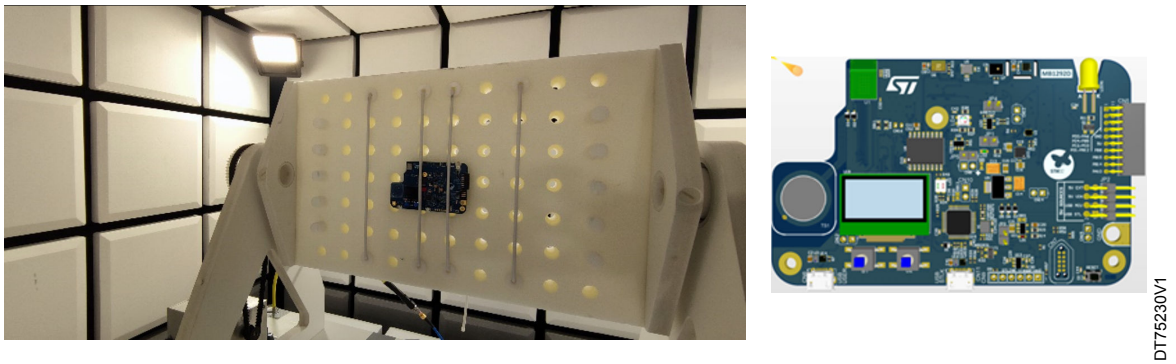
The board was tested in three different positions (X, Y, and Z). These setups are depicted in the following figures.

Figure 3. X board position



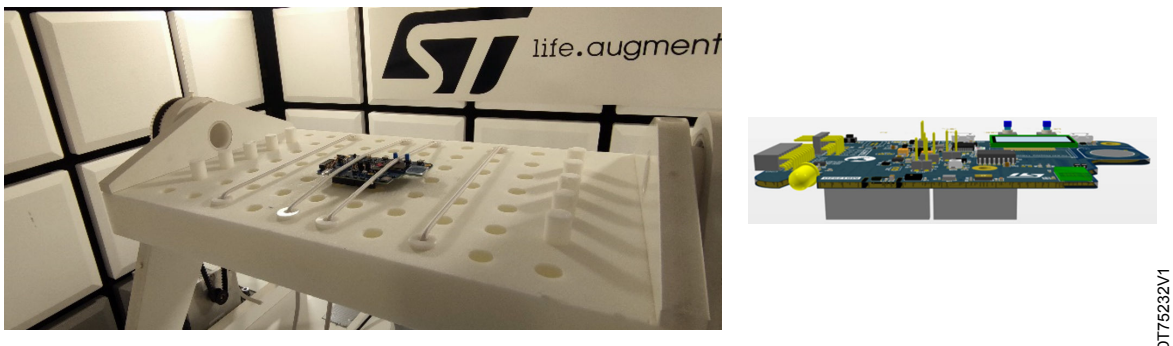
DT75229V1

Figure 4. Y board position



DT75230V1

Figure 5. Z board position



DT75232V1

3.2 Antenna polarization

The receiver antenna is fixed, and the board is turning from 0 to 359°.

Figure 6. Antenna polarization - horizontal

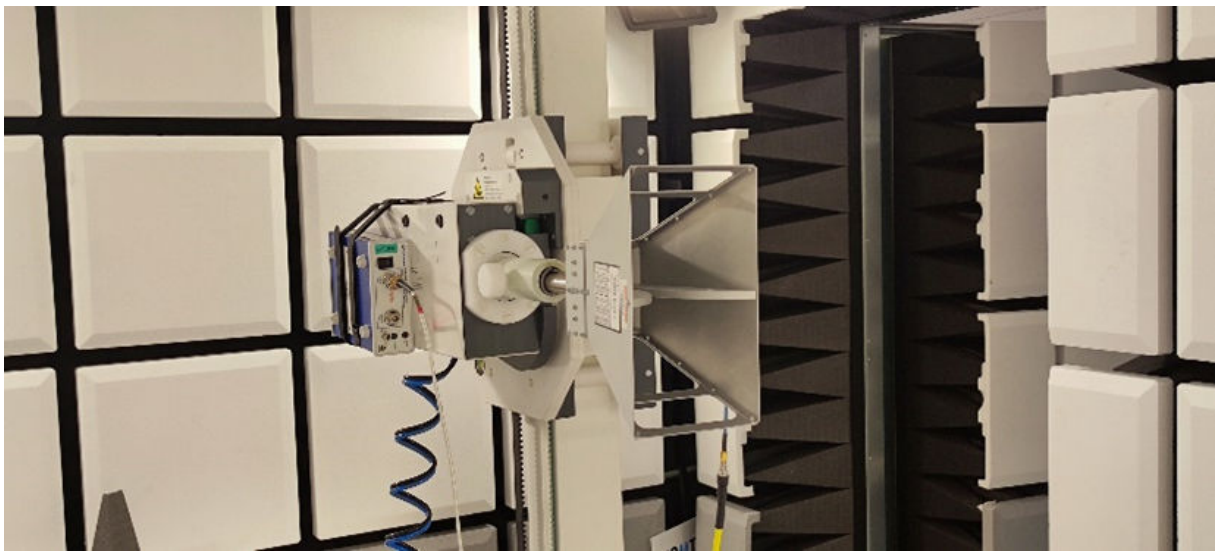
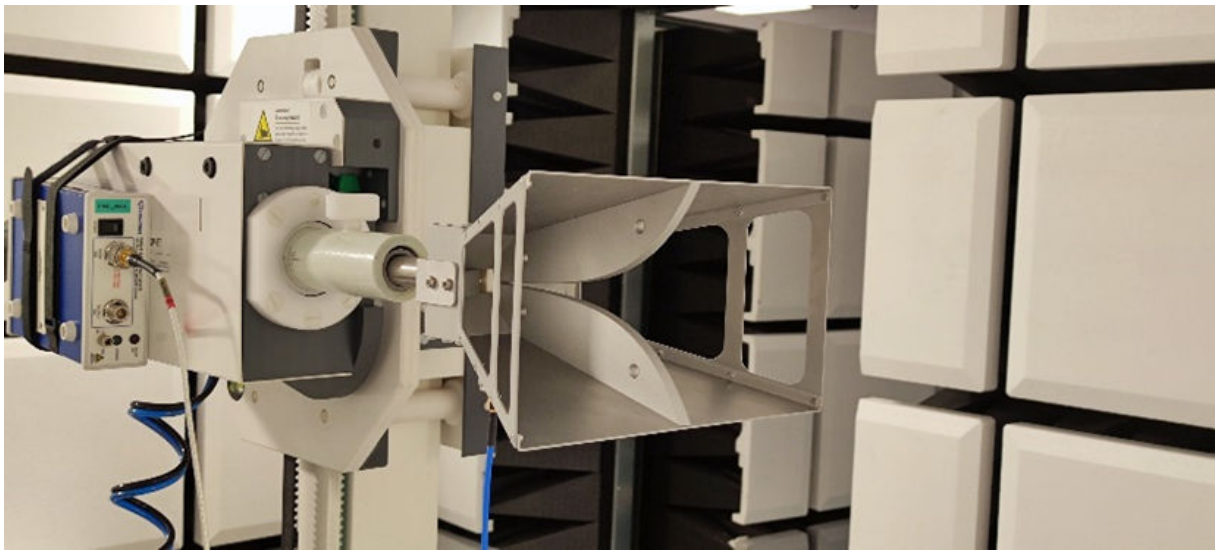


Figure 7. Antenna polarization - vertical



4 Test results

4.1 Radiation diagrams

The following radiation diagrams show the results for three different frequencies (low, medium, and high), three directions (X, Y and Z), and two polarizations (horizontal and vertical).

Output power radiated at 2.402 GHz

Figure 8. **Output power radiated @ 2.402 GHz horizontal X (dBm)**

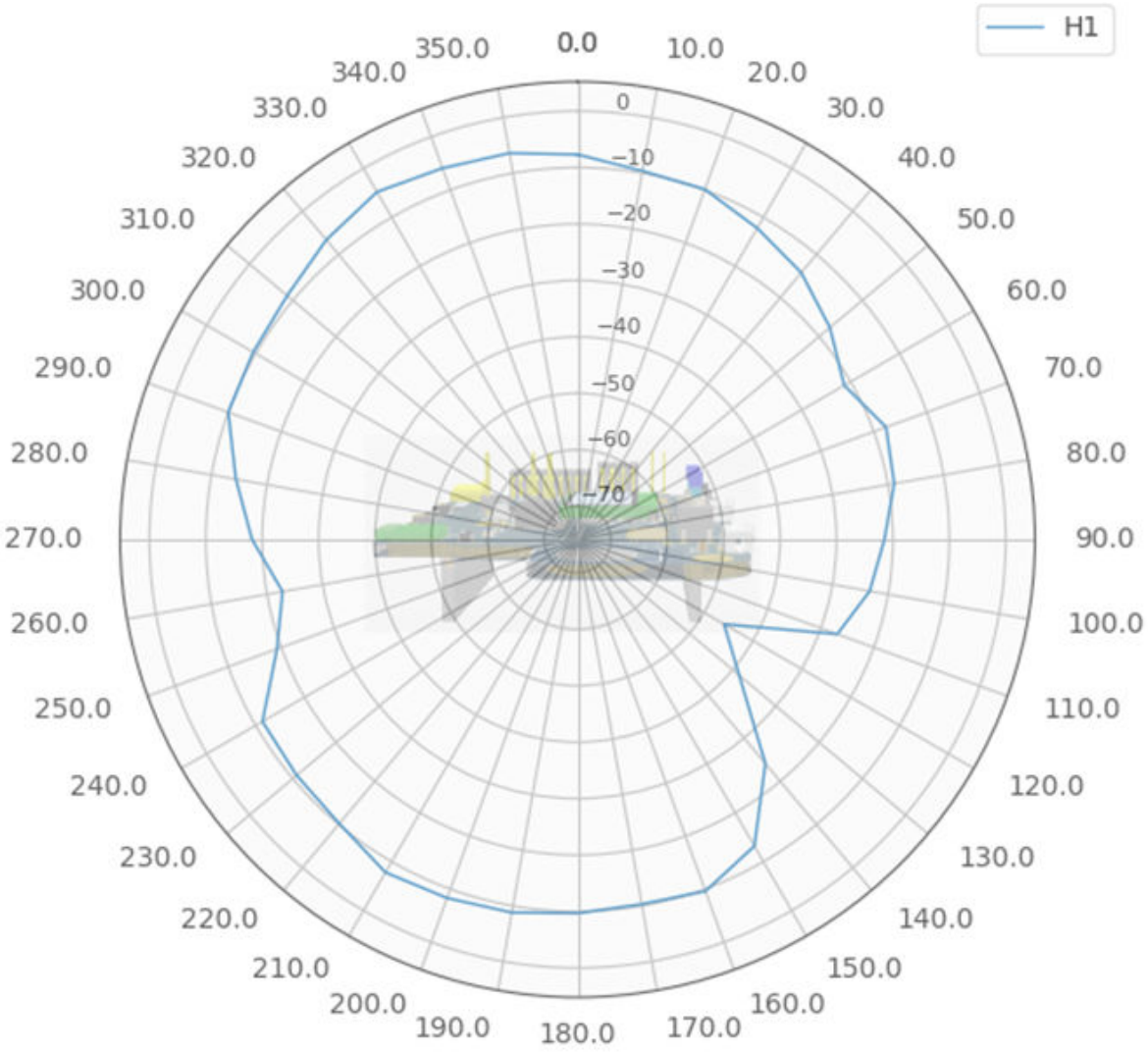


Figure 9. **Output power radiated @ 2.402 GHz vertical X (dBm)**

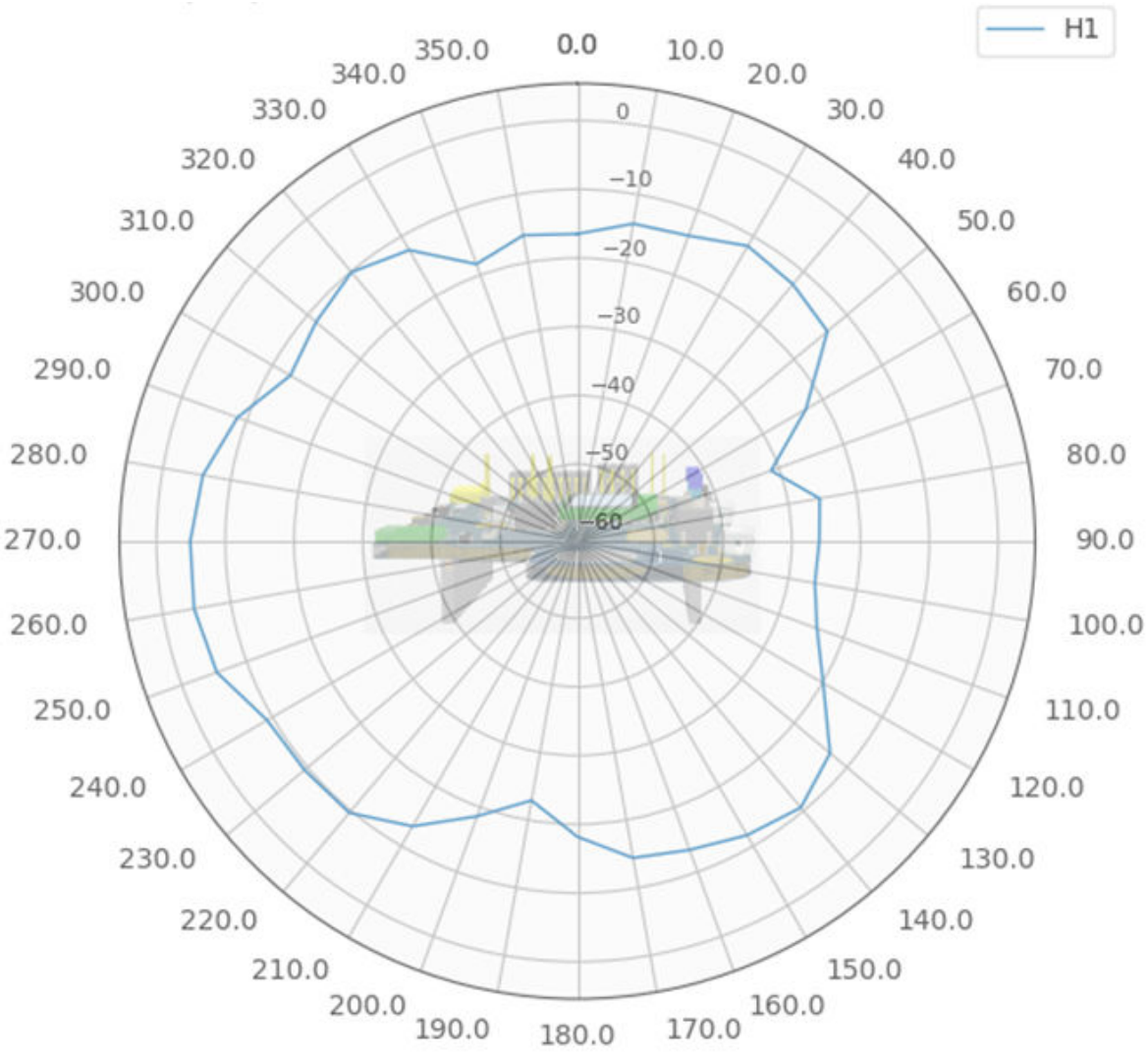


Figure 10. **Output power radiated @ 2.402 GHz horizontal Y (dBm)**

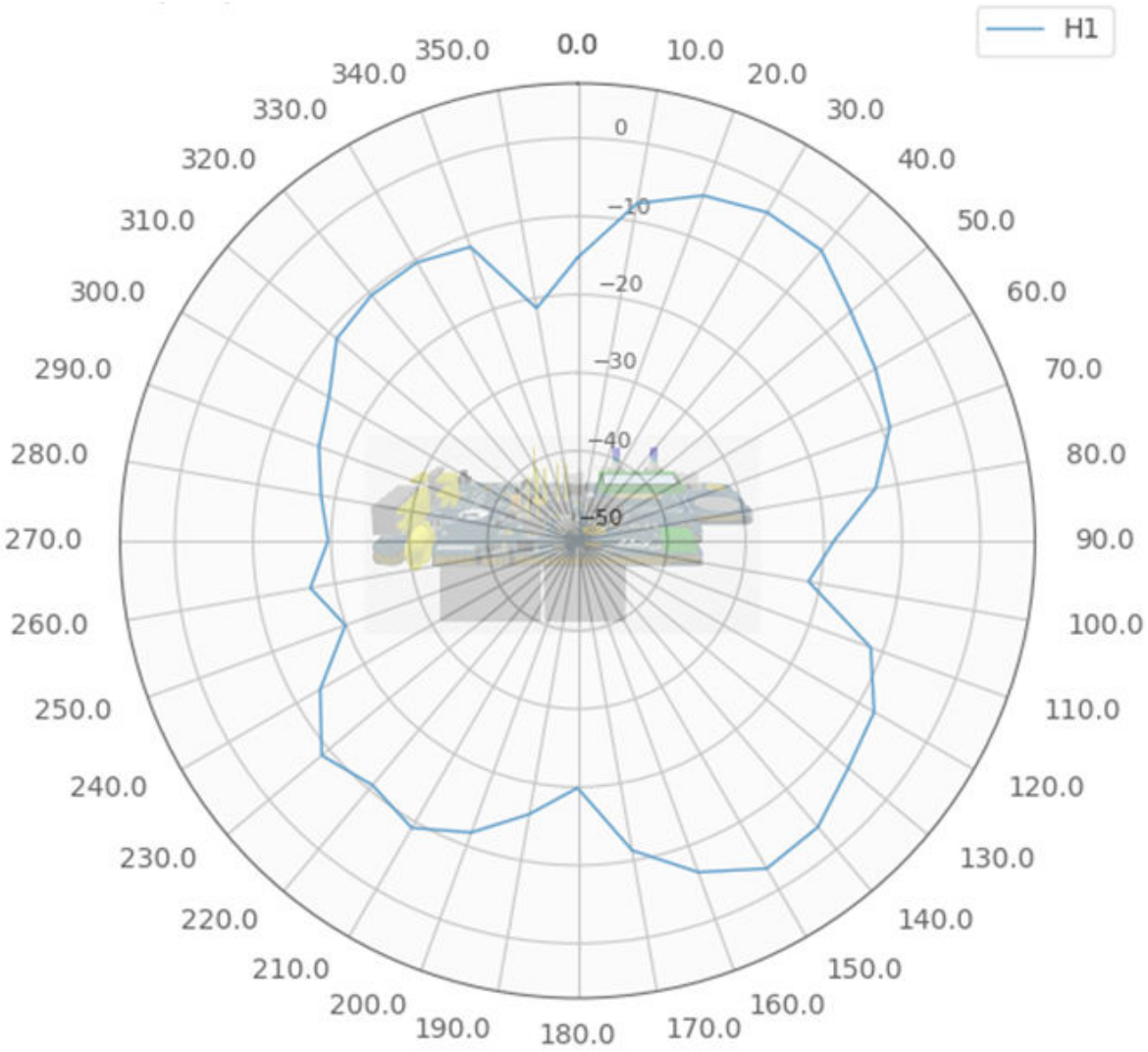


Figure 11. **Output power radiated @ 2.402 GHz vertical Y (dBm)**

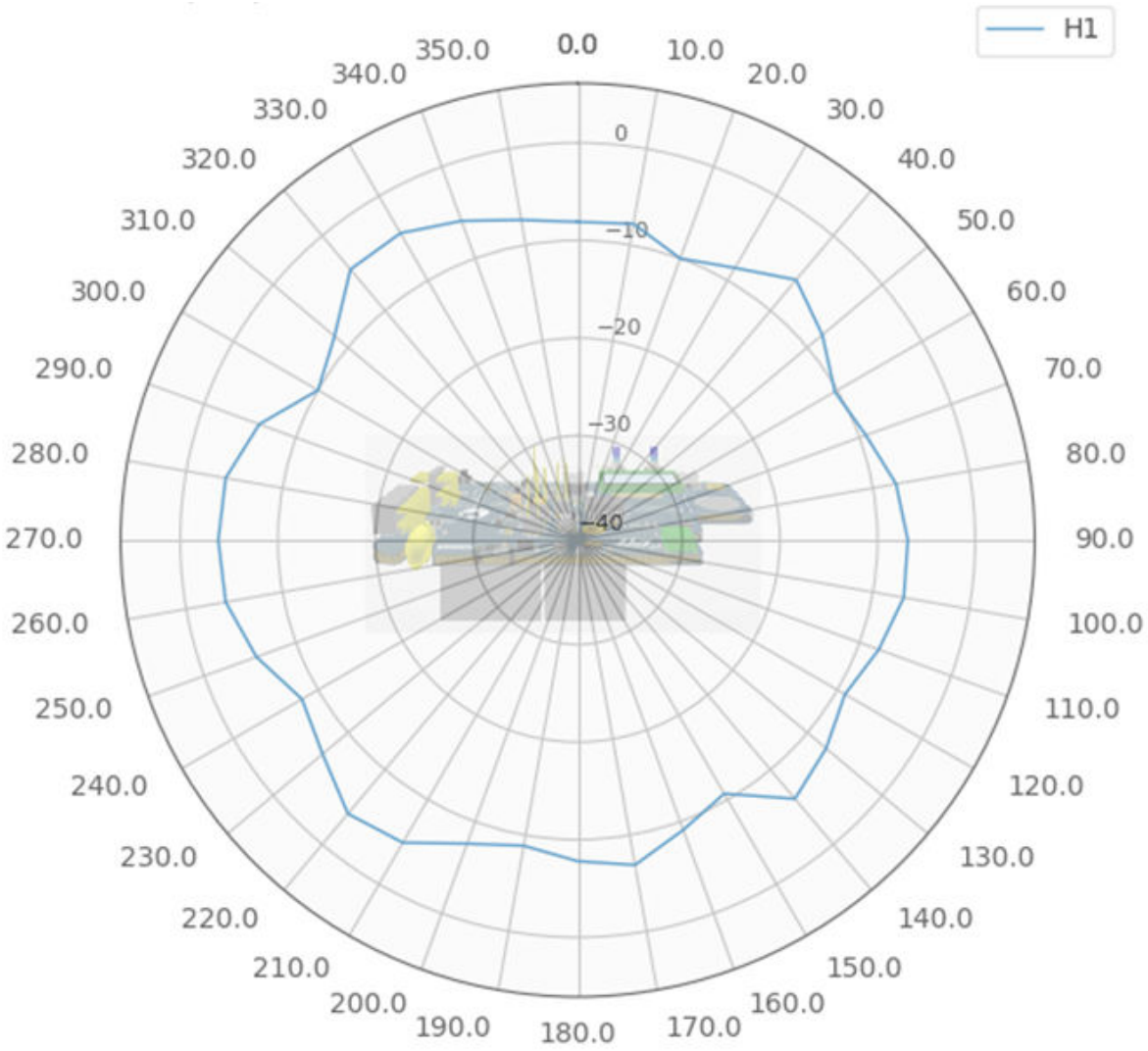


Figure 12. **Output power radiated @ 2.402 GHz horizontal Z (dBm)**

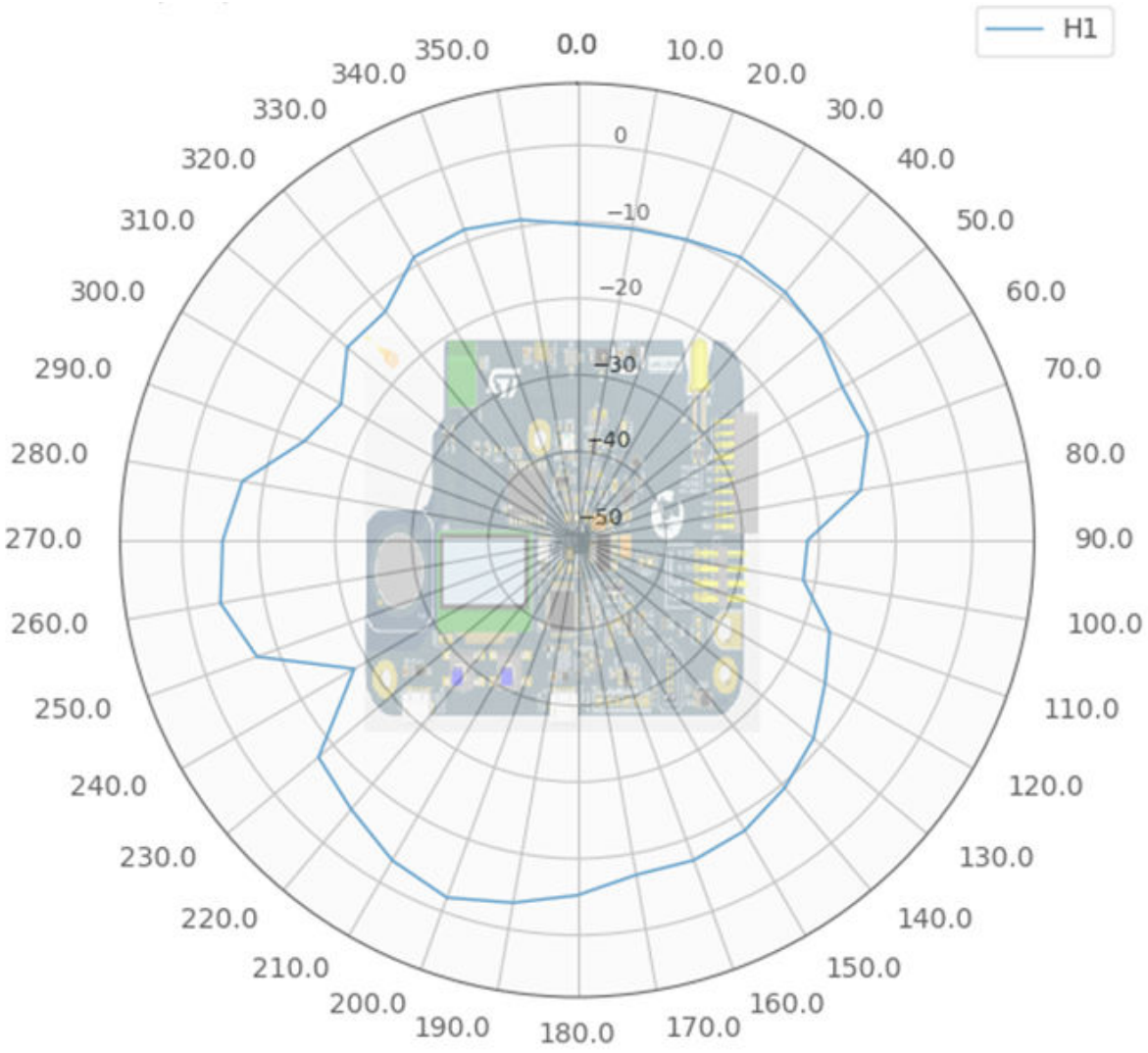
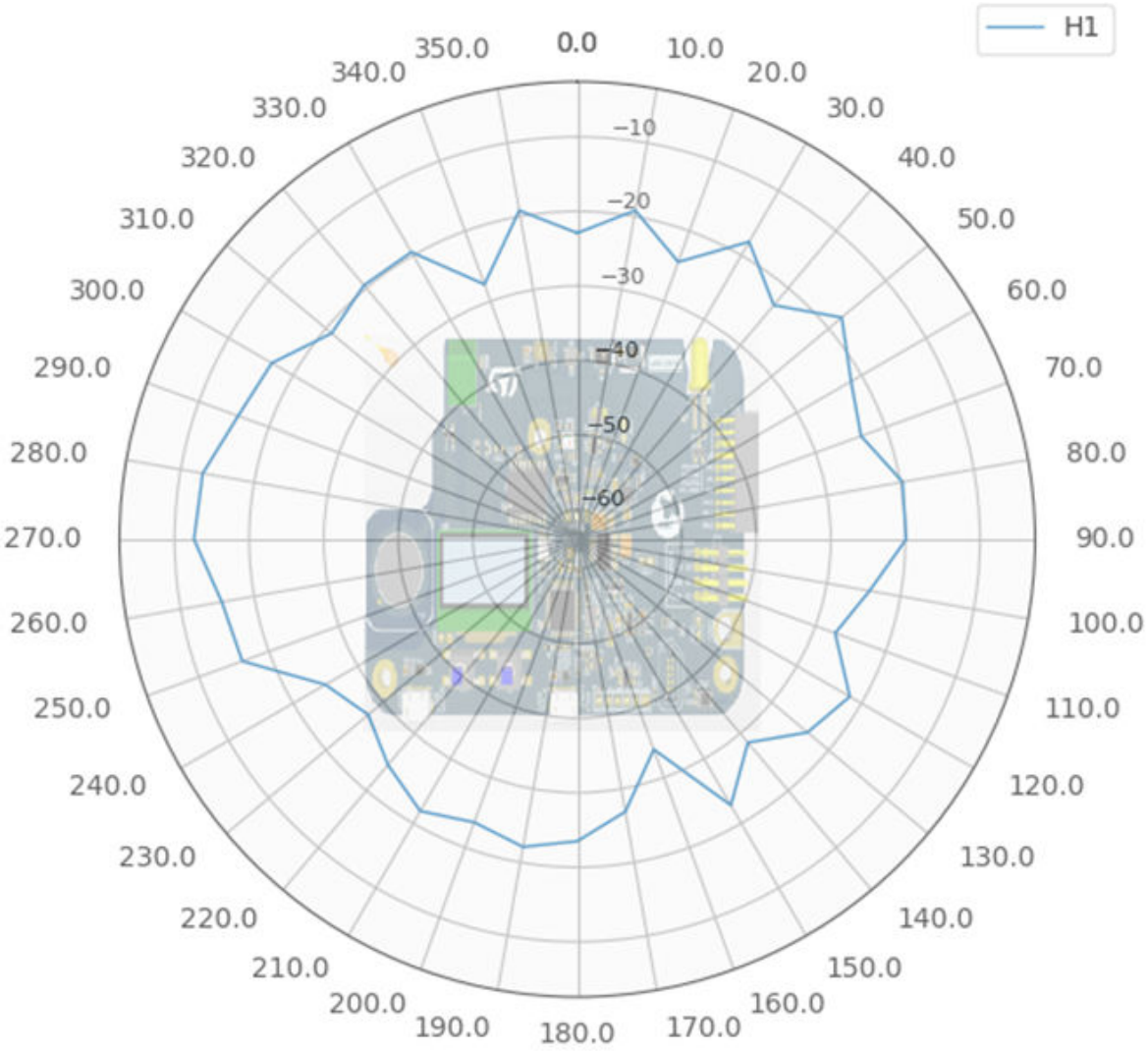


Figure 13. **Output power radiated @ 2.402 GHz vertical Z (dBm)**



Output power radiated at 2.44 GHz

Figure 14. **Output power radiated @ 2.44 GHz horizontal X (dBm)**

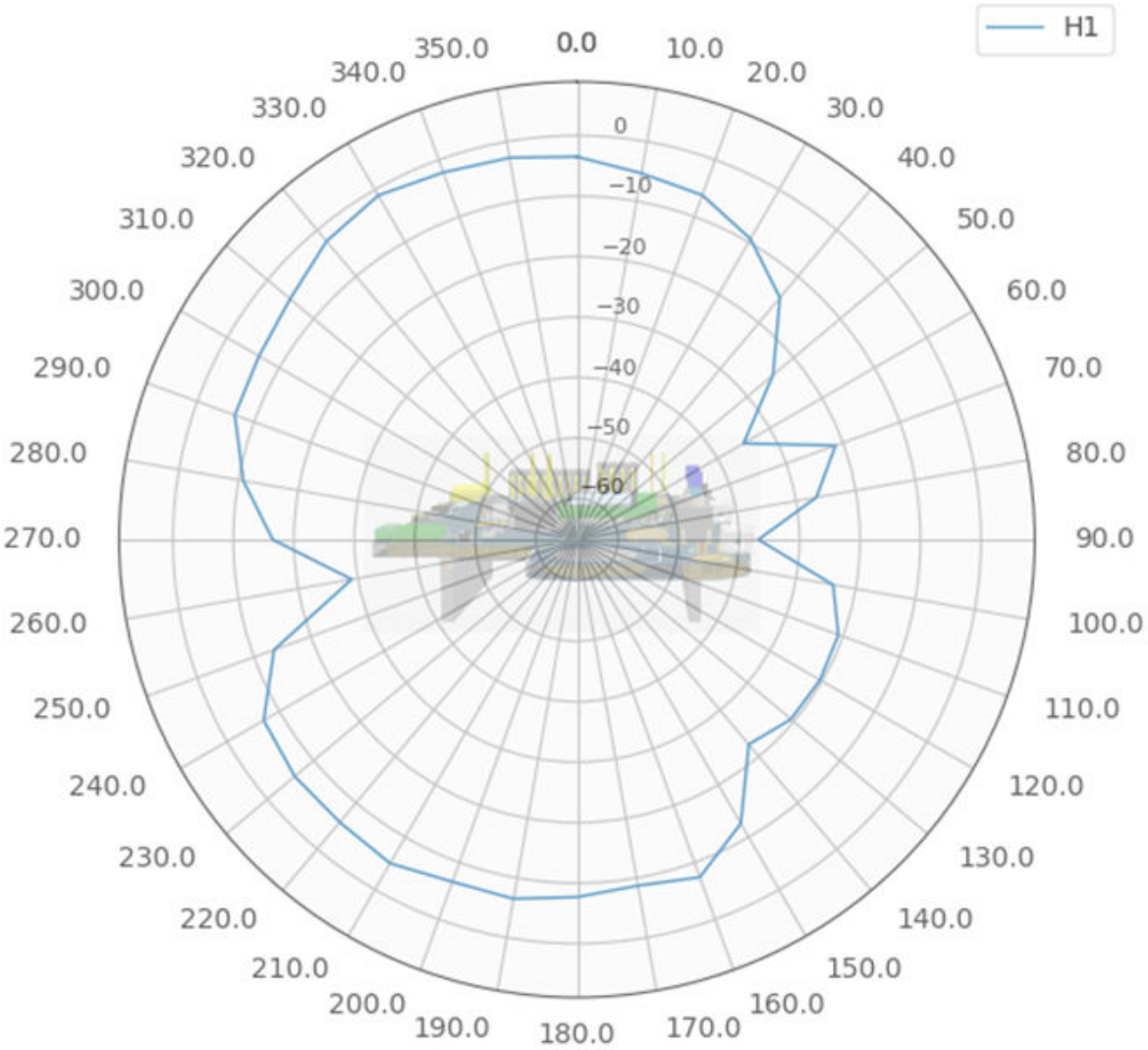


Figure 15. **Output power radiated @ 2.44 GHz vertical X (dBm)**

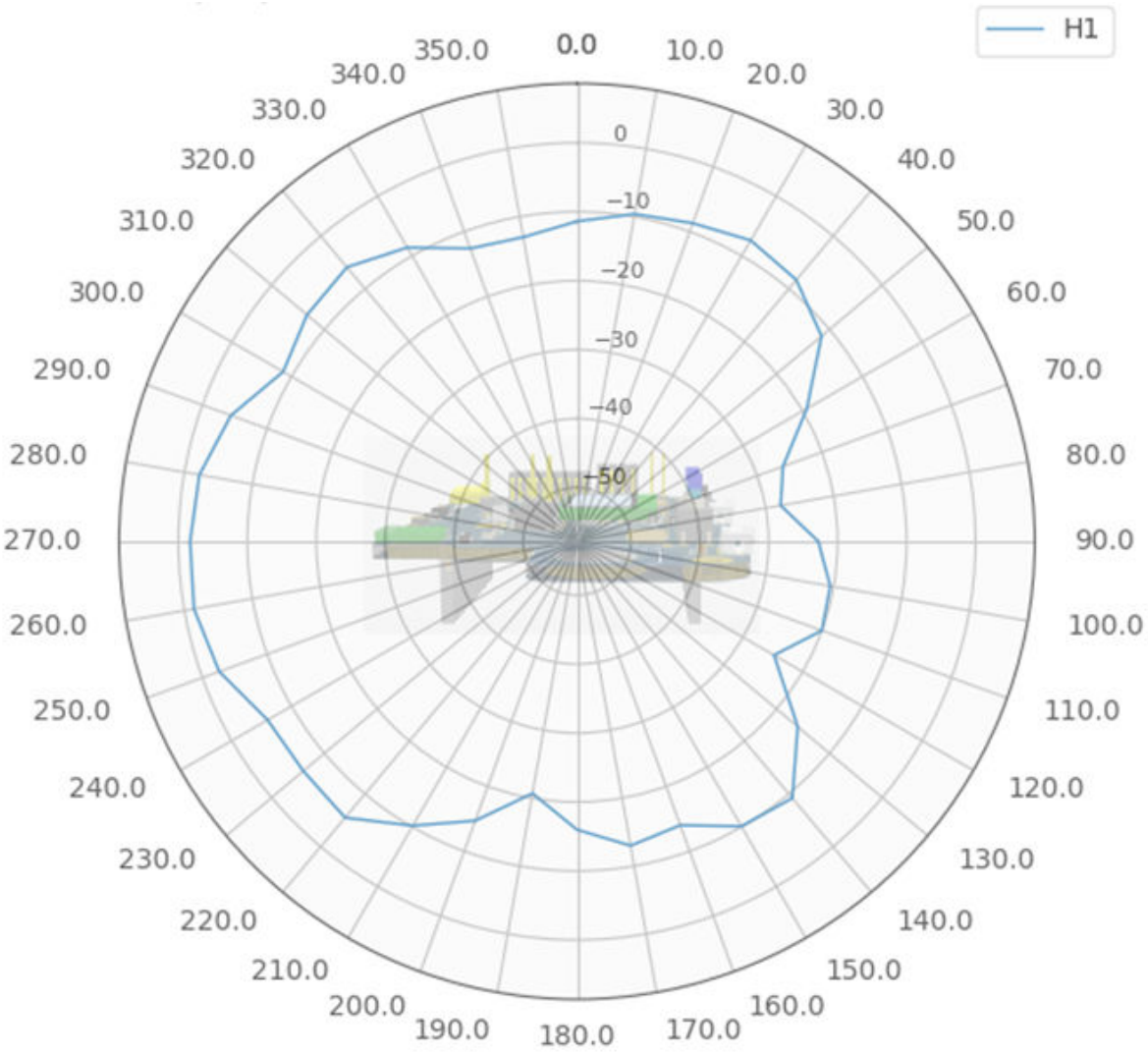


Figure 16. **Output power radiated @ 2.44 GHz horizontal Y (dBm)**

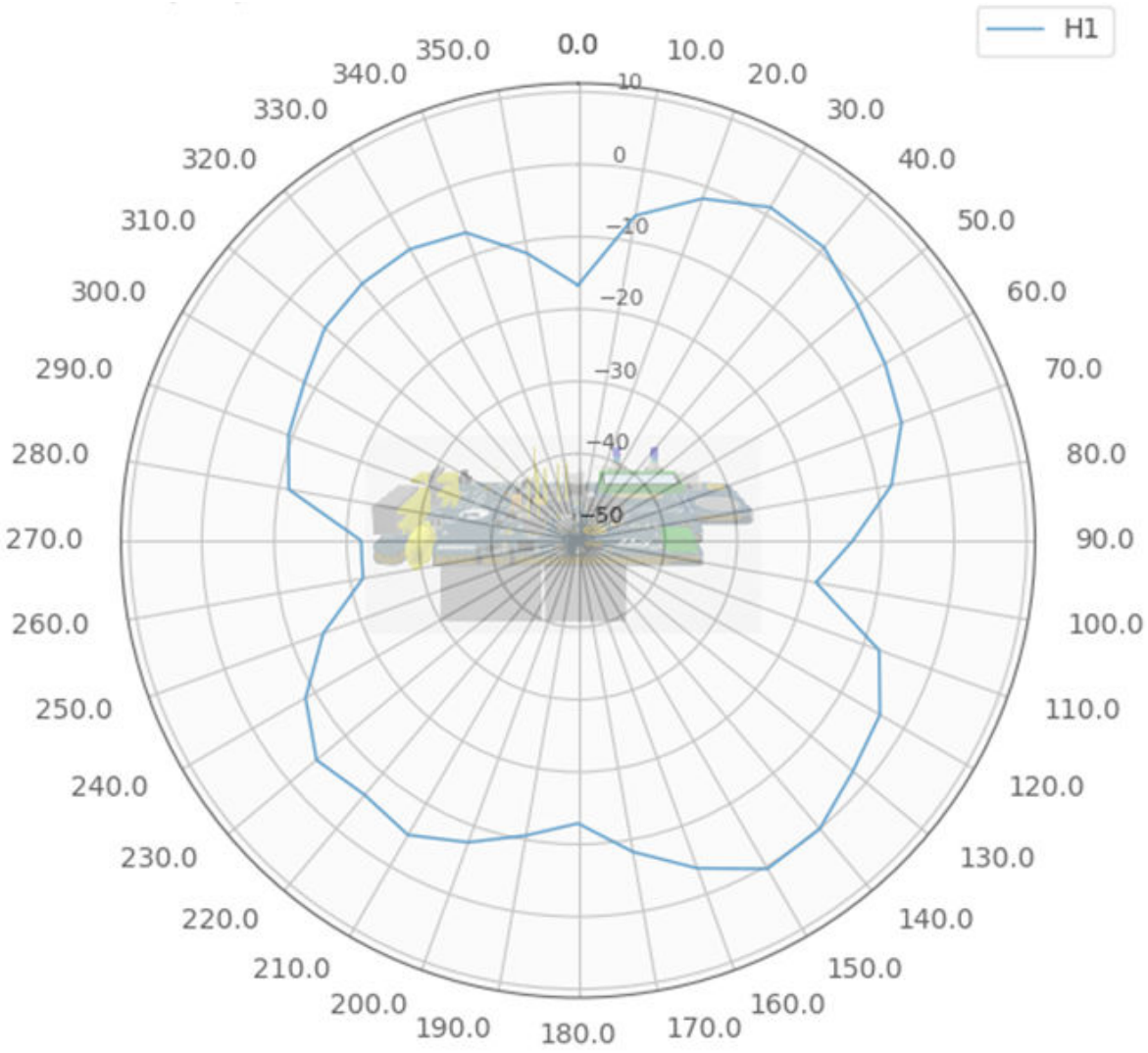


Figure 17. **Output power radiated @ 2.44 GHz vertical Y (dBm)**

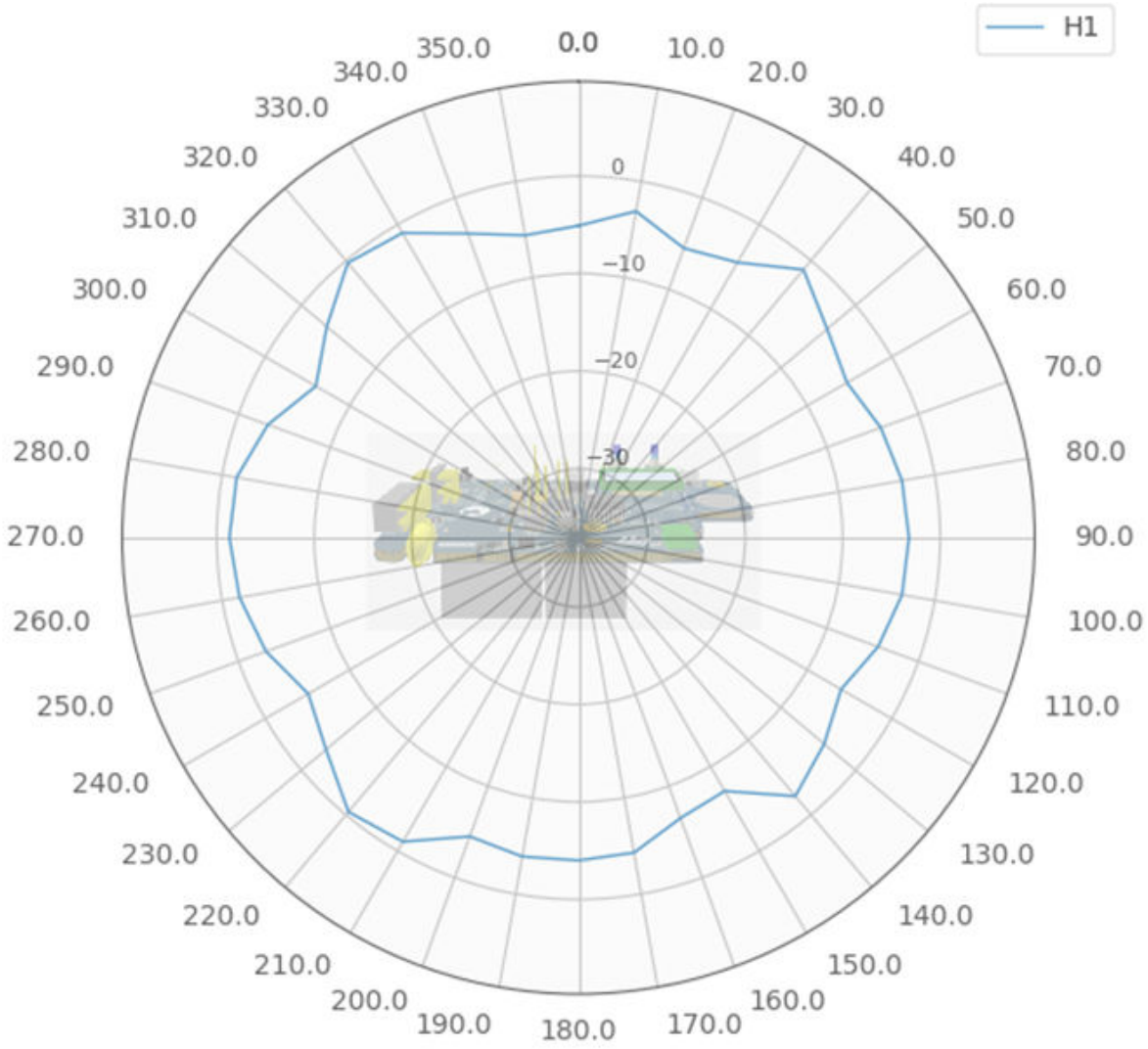


Figure 18. **Output power radiated @ 2.44 GHz horizontal Z (dBm)**

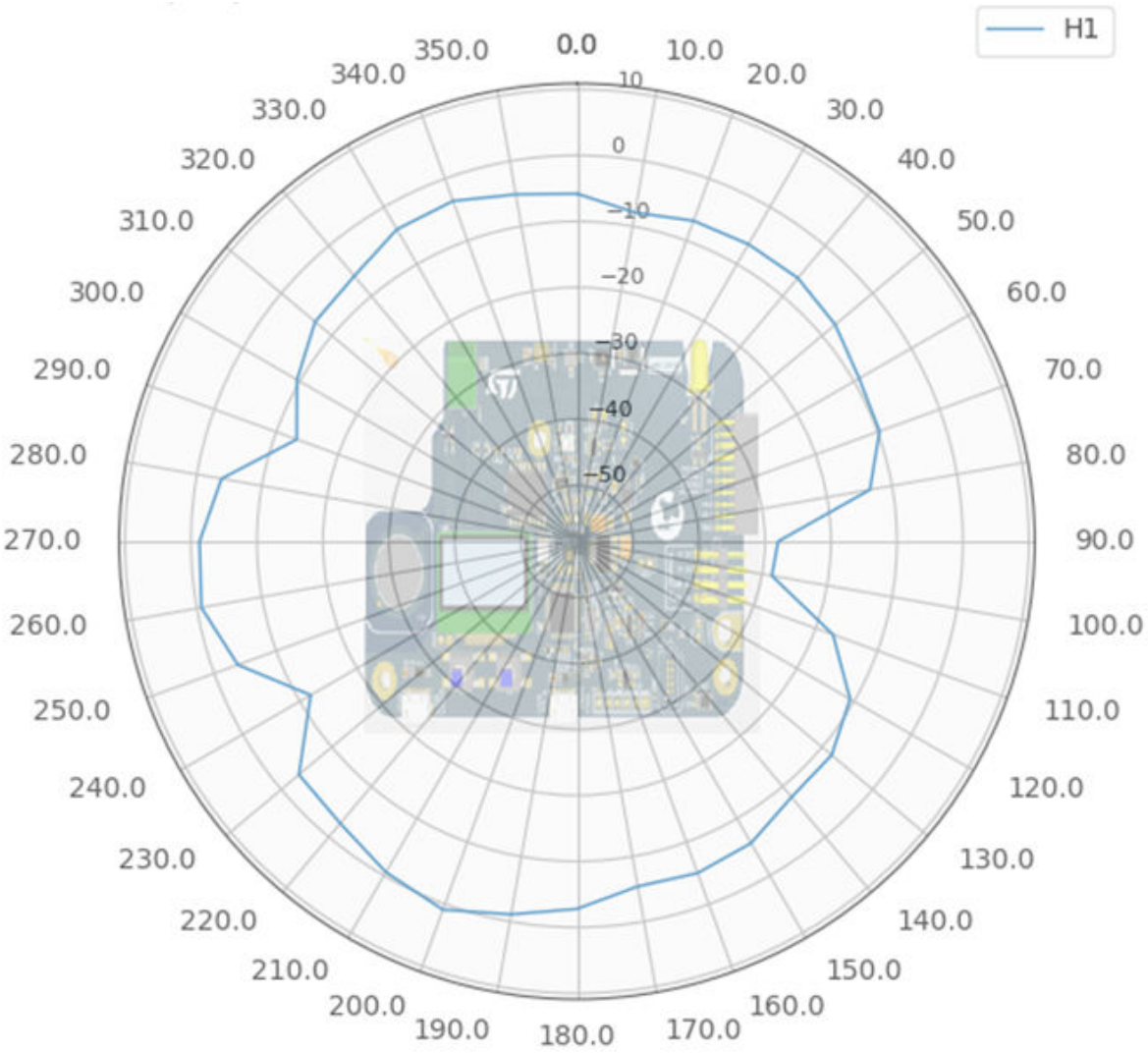
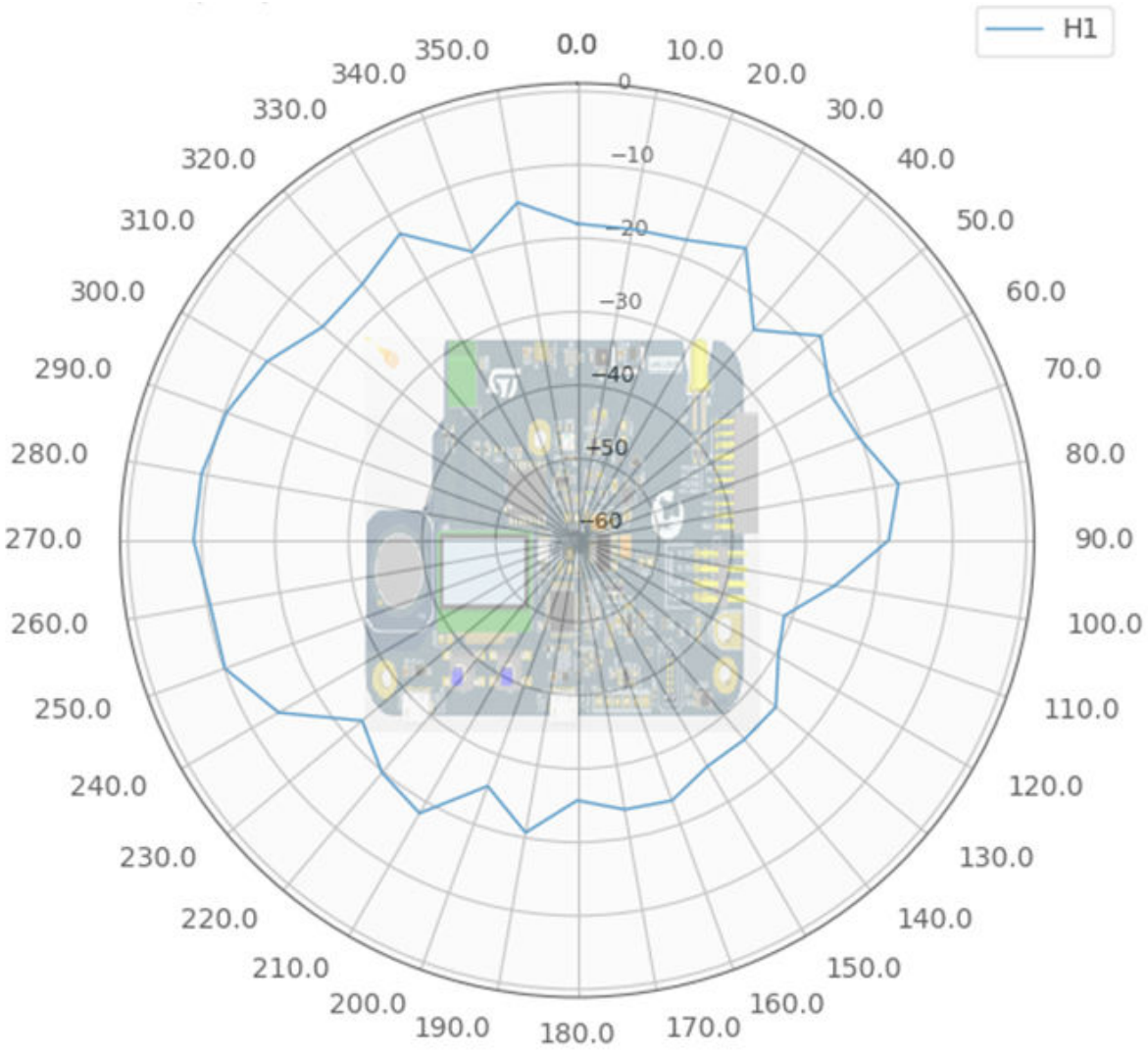


Figure 19. **Output power radiated @ 2.44 GHz vertical Z (dBm)**



Output power radiated at 2.48 GHz

Figure 20. **Output power radiated @ 2.48 GHz horizontal X (dBm)**

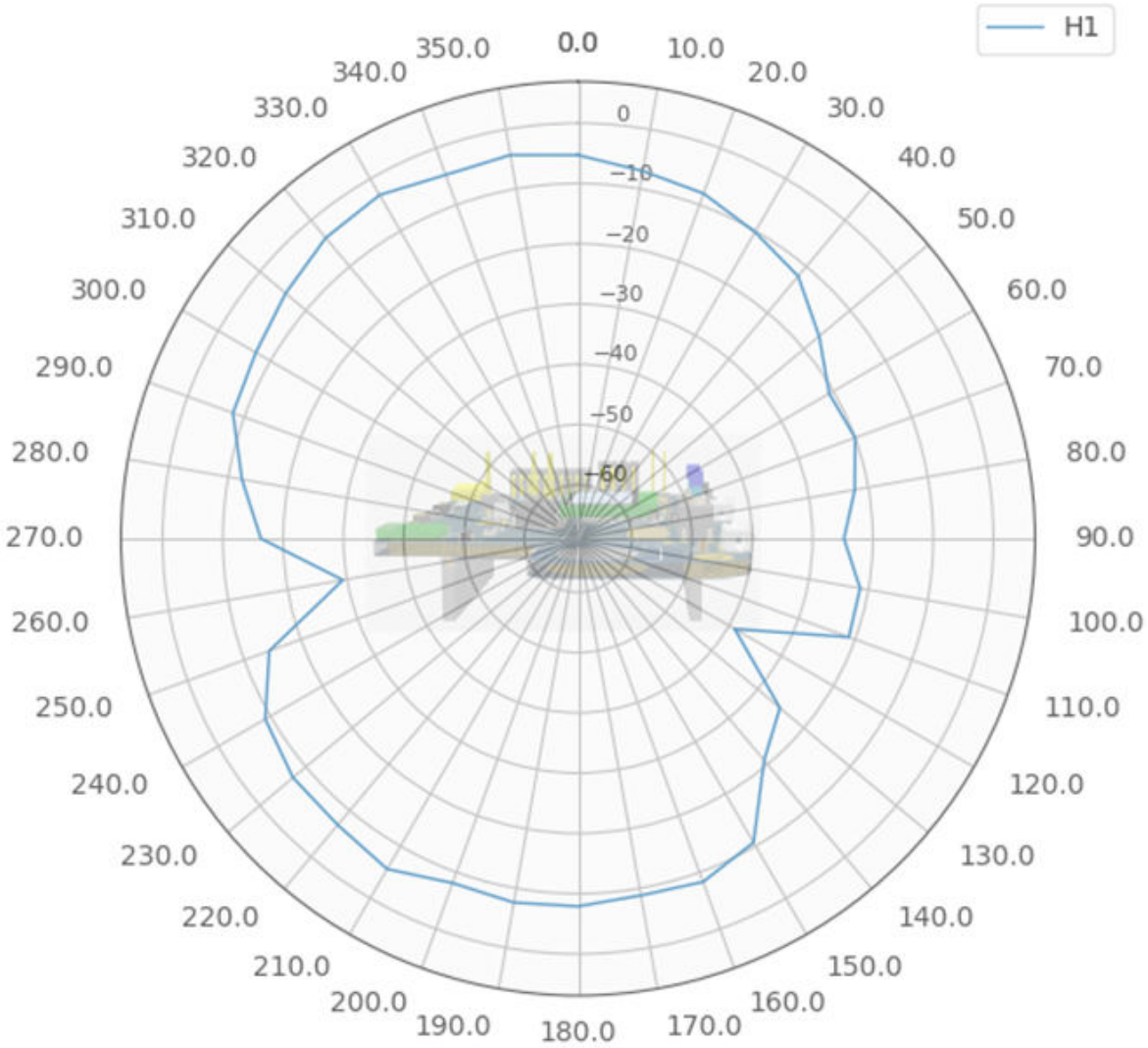


Figure 21. **Output power radiated @ 2.48 GHz vertical X (dBm)**

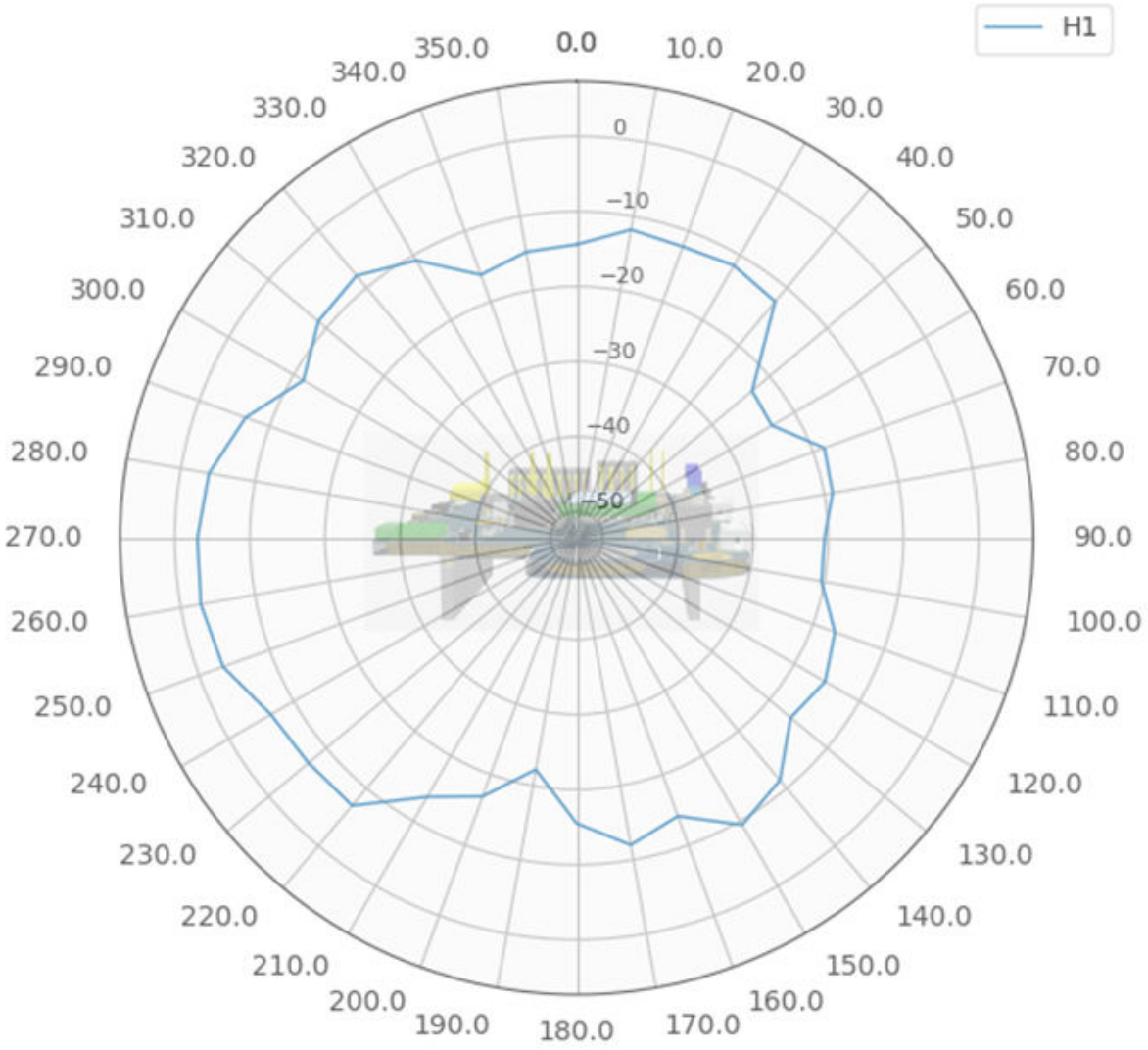


Figure 22. **Output power radiated @ 2.48 GHz horizontal Y (dBm)**

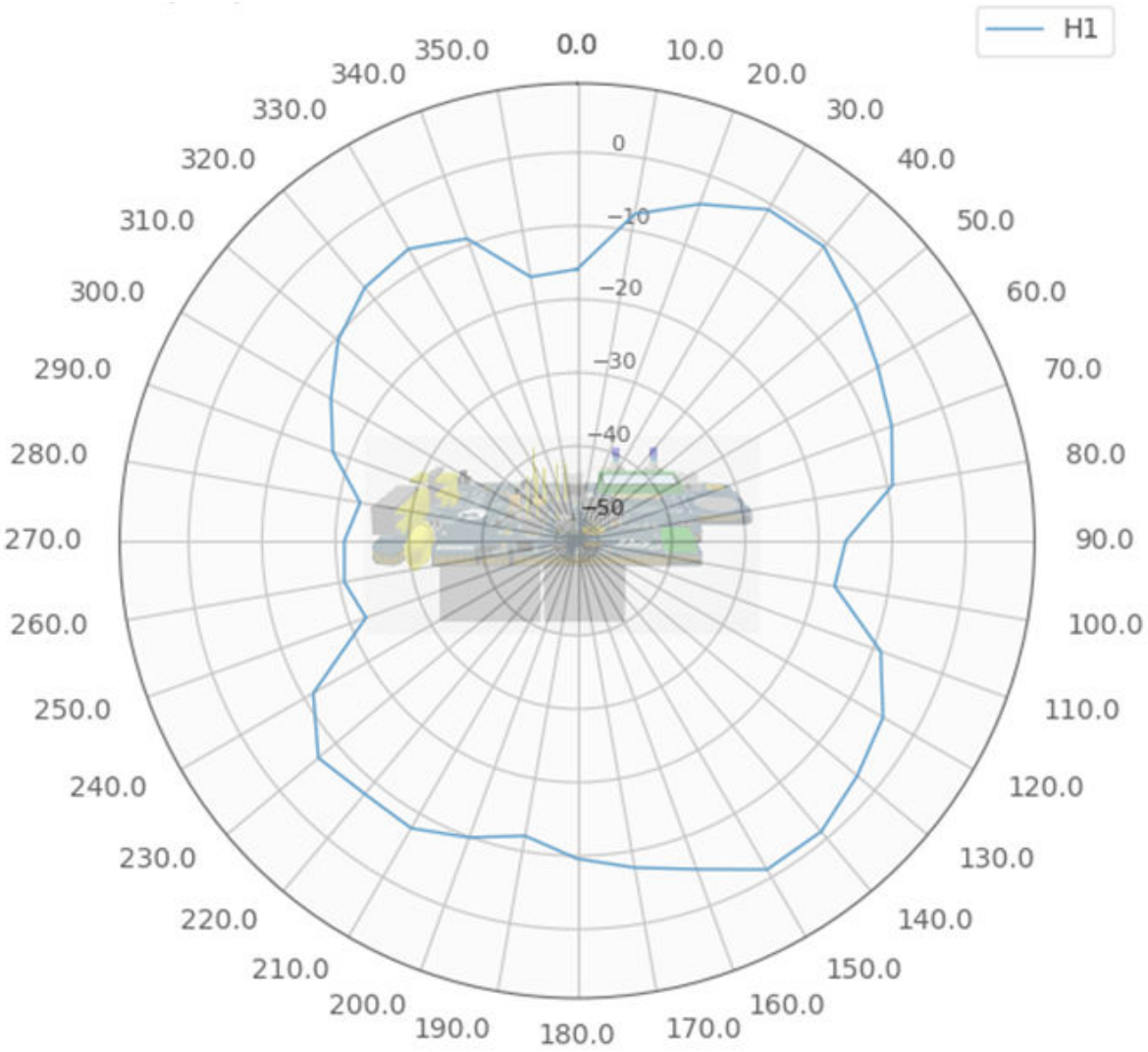


Figure 23. **Output power radiated @ 2.48 GHz vertical Y (dBm)**

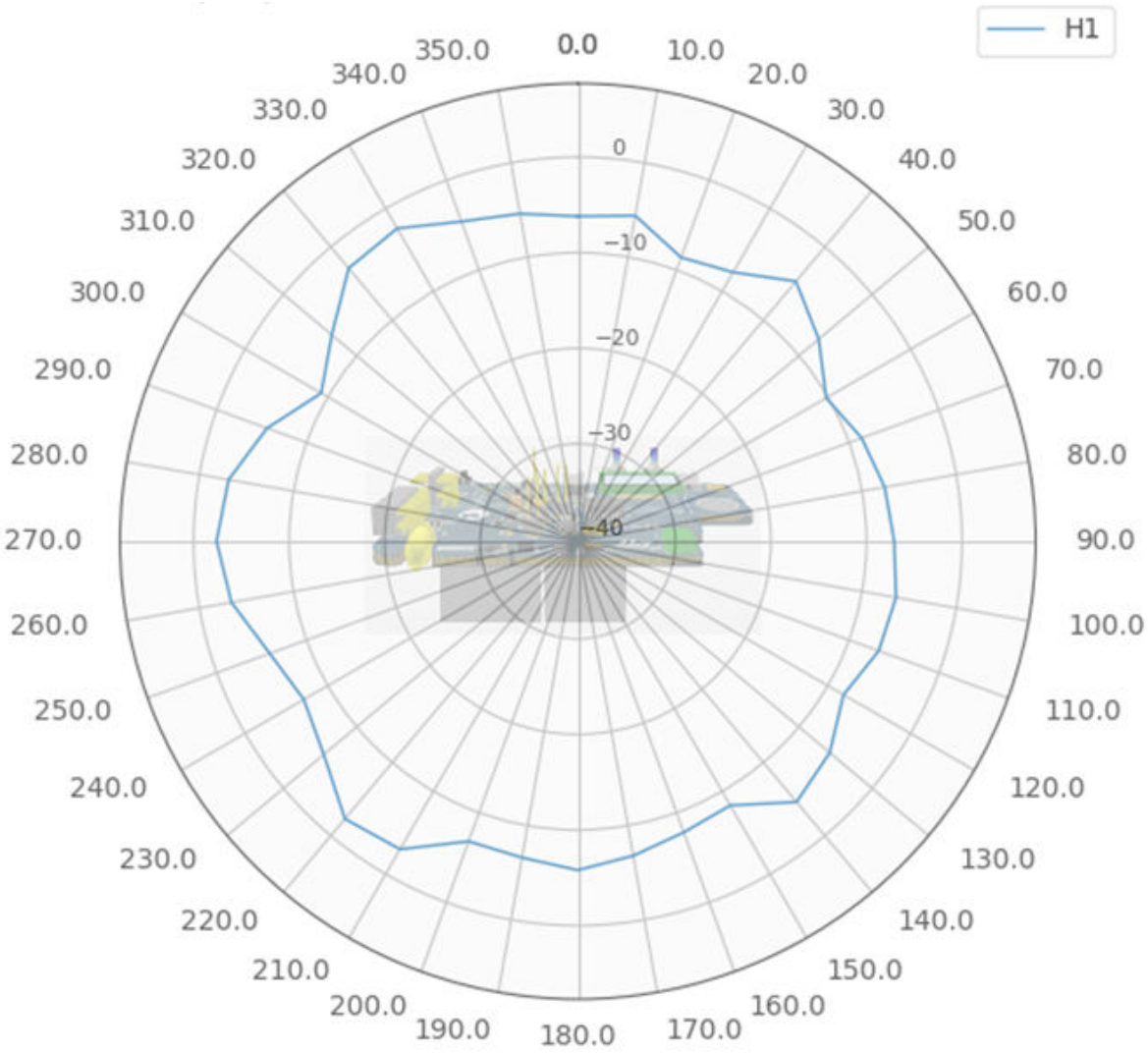


Figure 24. **Output power radiated @ 2.48 GHz horizontal Z (dBm)**

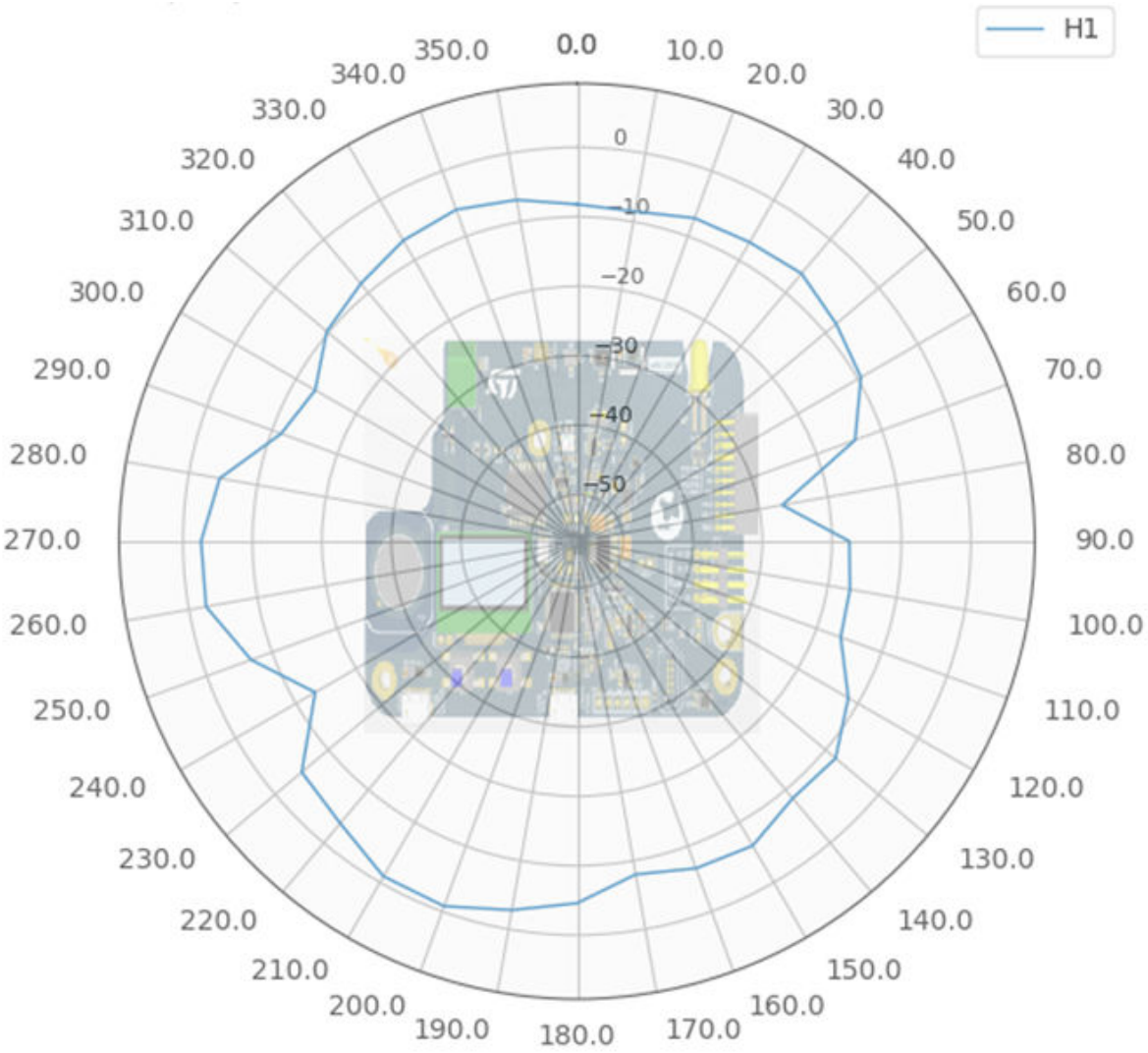
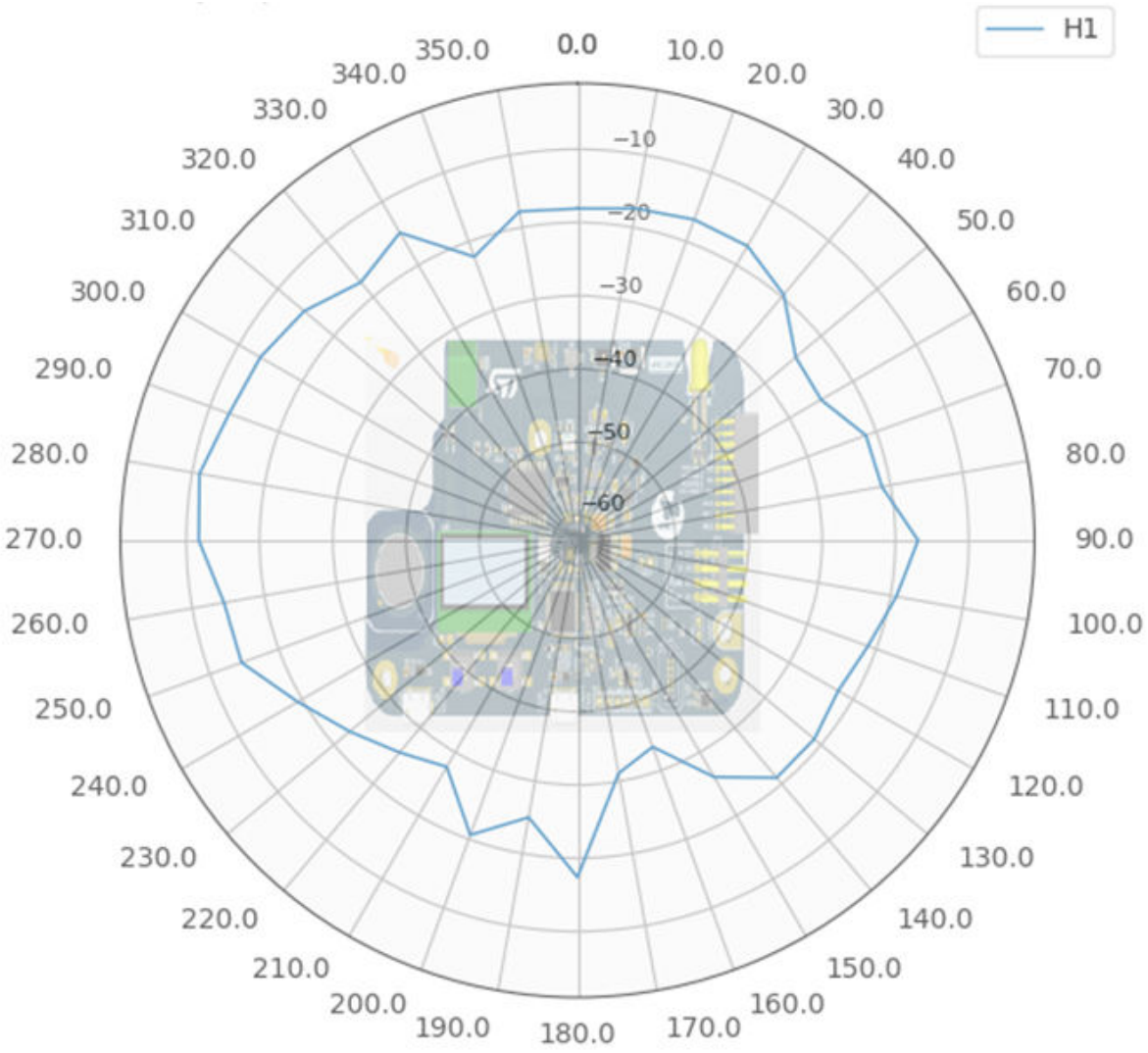


Figure 25. **Output power radiated @ 2.48 GHz vertical Z (dBm)**



4.2 Summary of test results

The tables below summarize the results of the tests performed at different frequencies.

Table 3. Test results at 2402.0 MHz

Board position	Polarization	P max	Angle P max (°)
X	Horizontal	-4.8	330
X	Vertical	-4.6	260
Y	Horizontal	-3.0	30
Y	Vertical	-3.9	270
Z	Horizontal	-1.9	200
Z	Vertical	-12.6	270

Table 4. Test results at 2440.0 MHz

Board position	Polarization	P max	Angle P max (°)
X	Horizontal	-1.1	330
X	Vertical	-1.4	260
Y	Horizontal	1.2	30
Y	Vertical	-0.3	320
Z	Horizontal	0.9	200
Z	Vertical	-8.9	270

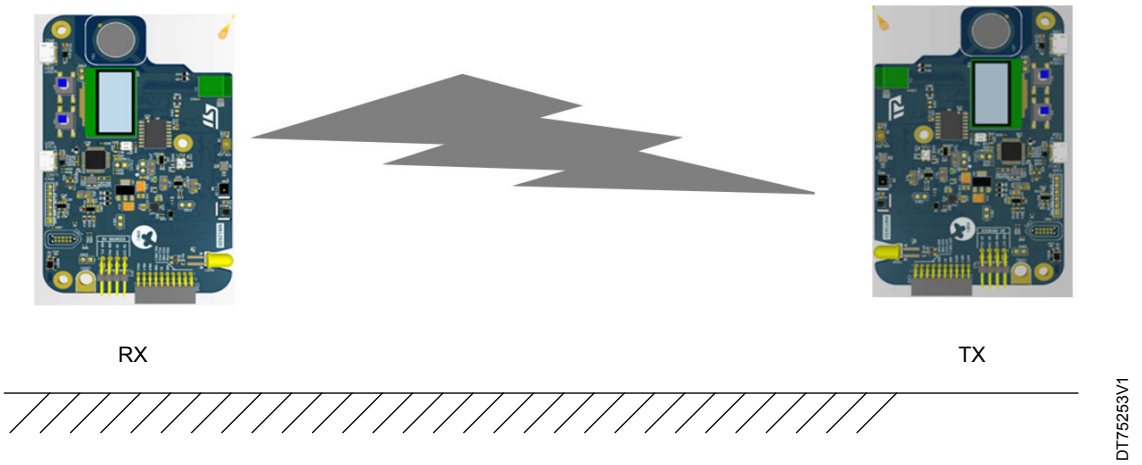
Table 5. Test results at 2480.0 MHz

Board position	Polarization	P max	Angle P max (°)
X	Horizontal	-3.1	330
X	Vertical	-2.7	260
Y	Horizontal	-0.6	40
Y	Vertical	-2.3	220
Z	Horizontal	-0.8	200
Z	Vertical	-11.0	280

5 Conclusion

The figure below shows the relative position of two boards for the best transmission quality.

Figure 26. Relative position of two boards for Tx and Rx



Revision history

Table 6. **Document revision history**

Date	Version	Changes
26-Aug-2024	1	Initial release.

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