

1.0 ANTENNA INFORMATION

- 1.1 Operating Frequency: 915 MHz
- 1.2 Antenna Material: FR-4 PCB
- 1.3 Antenna Type: Printed monopole antenna
- 1.4 Antenna Dimension 30 x 23 mm
- 1.5 Input Impedance 50 Ω
- 1.6 Return Loss (S11): >-30dB
- 1.7 Standing Wave Ratio (SWR):1.12:1
- 1.8 Peak gain: -1.11 dBi on XZ, and -3.5dBi on XY plane
- 1.9 Polarization: Linear

2.0 TEST RELATED INFO:

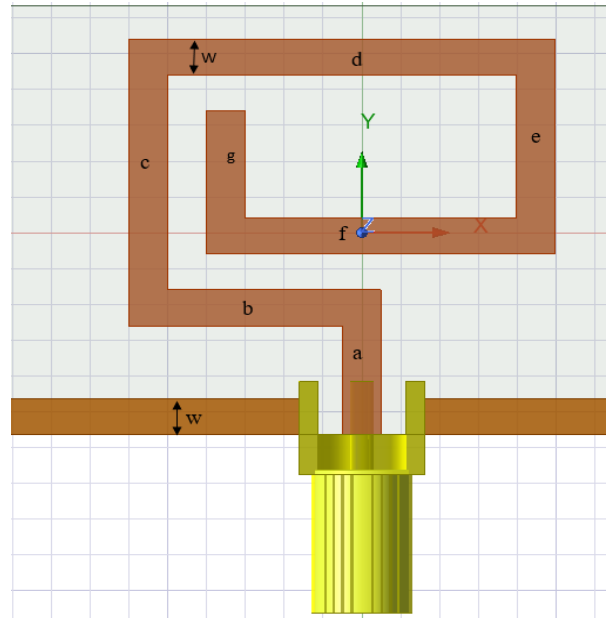
- 2.1 R&S ZNLE6 VNA, PN: 1323.0012K56. Cal date: 1/6/2023, Cal due: 1/6/2026
- 2.2 CBL-20FT-SMSM
- 2.3 CBL-15FT-SMSM
- 2.4 Rotator motor
- 2.5 Test date: 04/24/2025
- 2.6 RF Test Engineer: Milad Hmeda
- 2.7 Software for plotting: Excel
- 2.8 RF antennas under test were themselves being used as TX and RX antennas to get Gain.

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3.0 ANTENNA DIMENSION

Parameter	Dimensions (mm)
a	3
b	12
c	14
d	20
e	10
f	16
g	6
w	2
Dielectric thickness	1.524
Copper thickness	0.035
Board Width	30.7
Board length	24



4.0 RETURN LOSS AND SWR MEASUREMENTS

Figure 1 shows the measured antenna return loss using the VNA. The antenna connected to the VNA 50Ω port. Figure 1 shows the antenna return loss is > -33dB at 915 MHz.

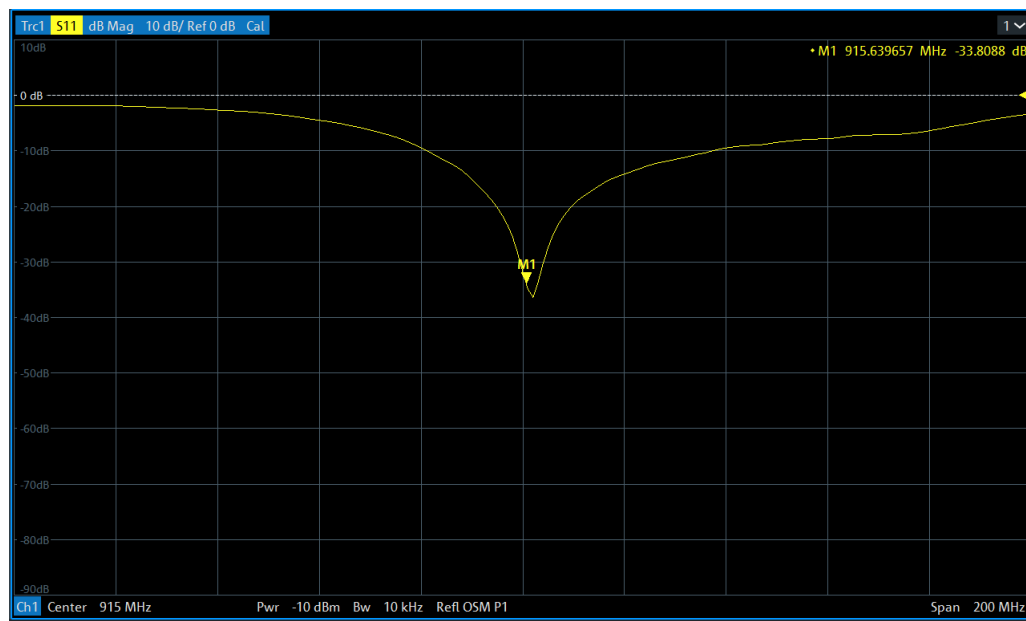


Figure 1. Antenna return loss (S11) vs. Frequency

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Figure 2 shows the voltage standing wave ratio (VSWR) measurement using the R&S VNA. The VSWR value is equal to 1.12 :1. The plot shows the antenna matched good to the 50Ω port.

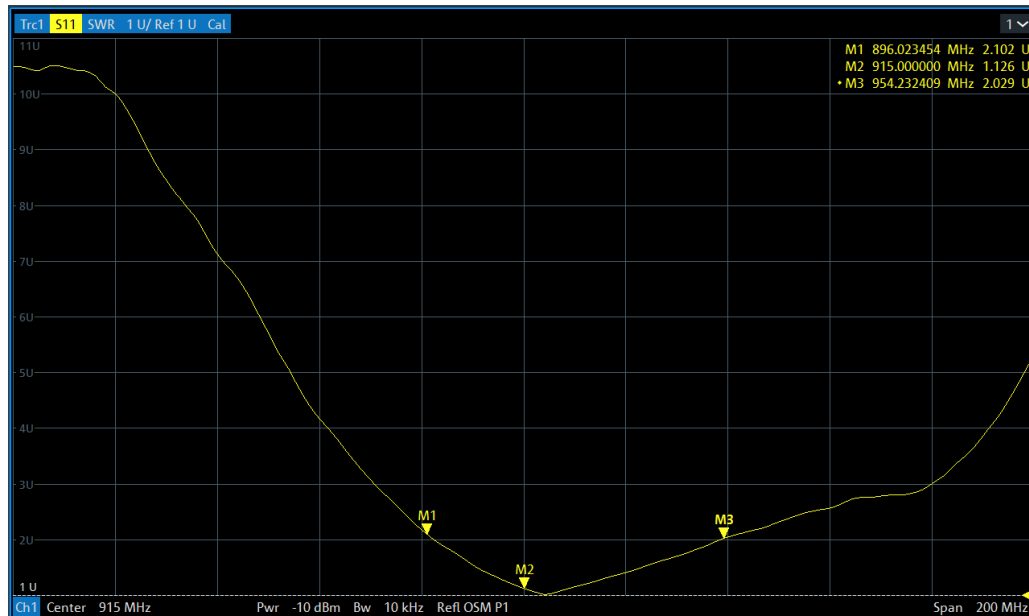


Figure 2. VSWR vs. Frequency

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5.0 RADIATION PATTERN MEASUREMENTS.

The antenna radiation pattern was measured inside the anechoic chamber. In this measurement the two identical 915 MHz antennas were used as TX and RX. The separation distance between the antennas is three (3) meters. The antennas were tested for XZ and XY plane radiation pattern measurement. Figure 3 shows the radiation pattern measurements. The TX antenna connected to the VNA port #1 by a 20 ft. RF cable and RX antenna to the VNA port # 2 by a 15 ft. RF cable. The RX antenna was mounted on the motor; the motor rotated incremental azimuth from 0° to 360°, 10 degrees incremental.

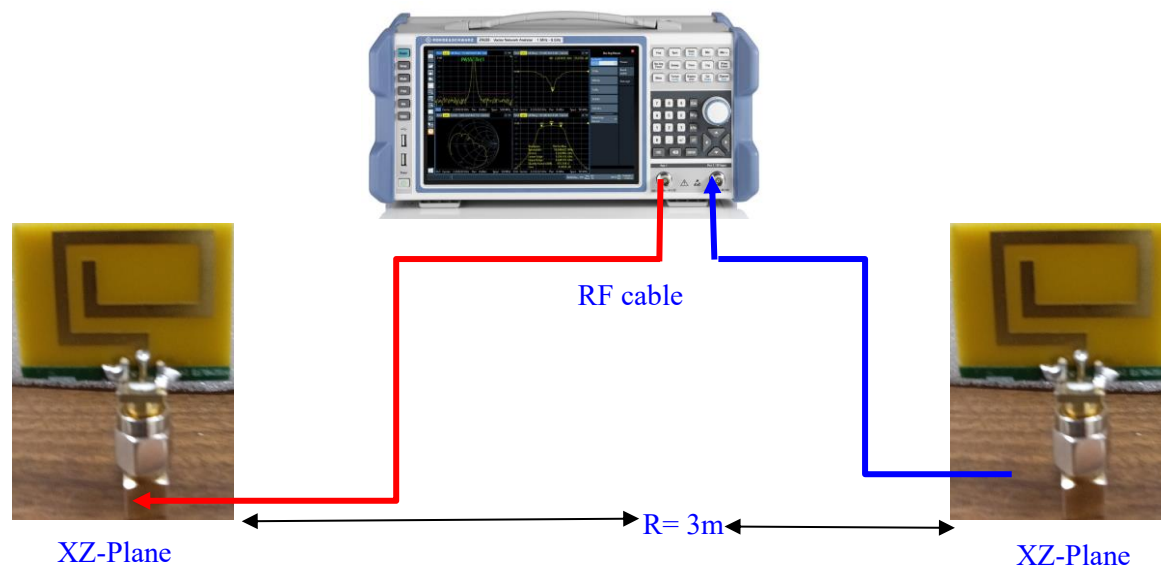


Figure 3. Antenna Measurement Diagram

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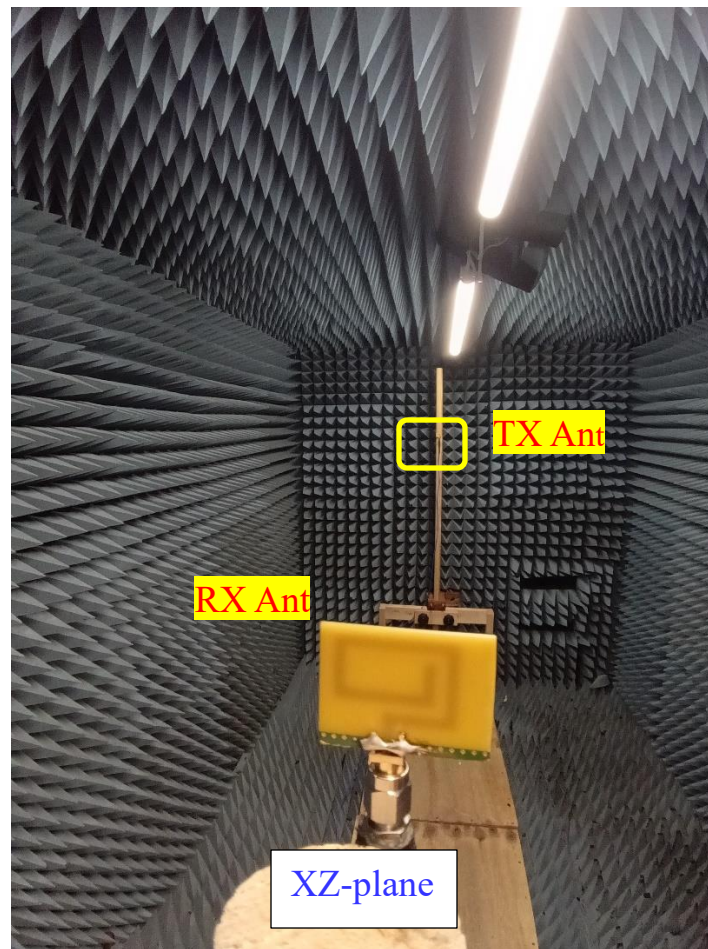


Figure 4. Antenna Measurement Inside the RF Chamber

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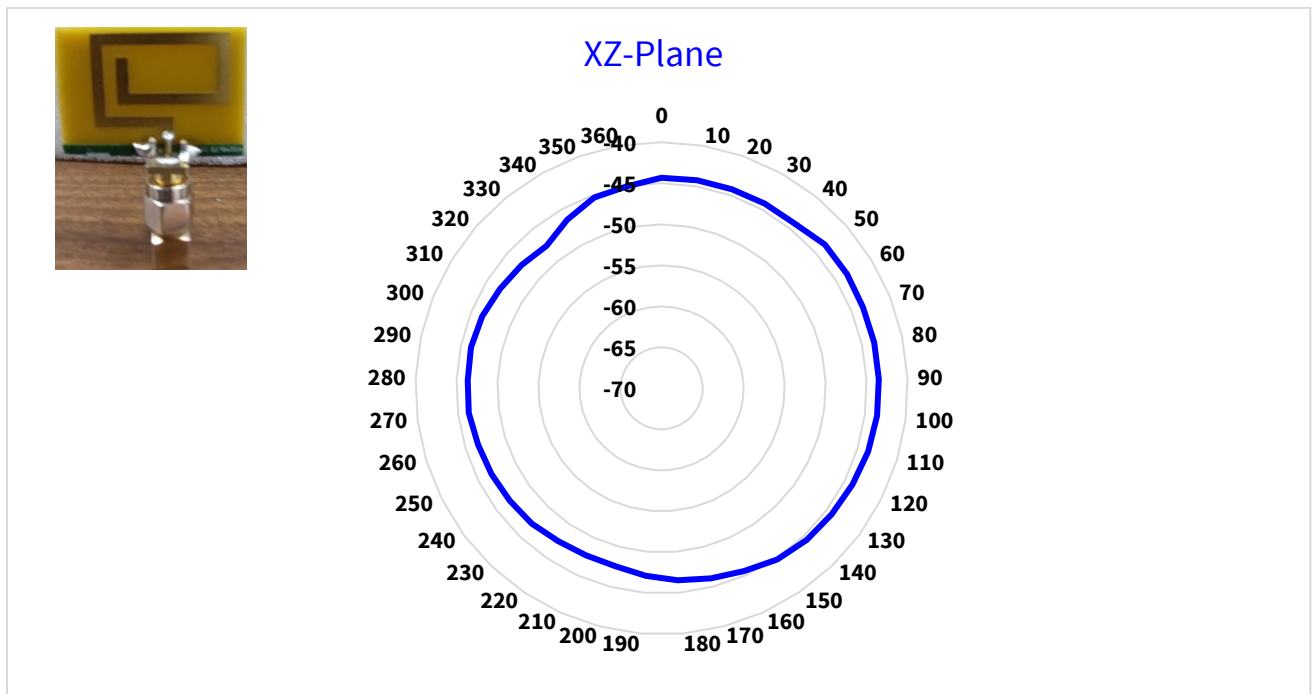


Figure 5. Antennas on XZ- plane omnidirectional radiation pattern in dB scale

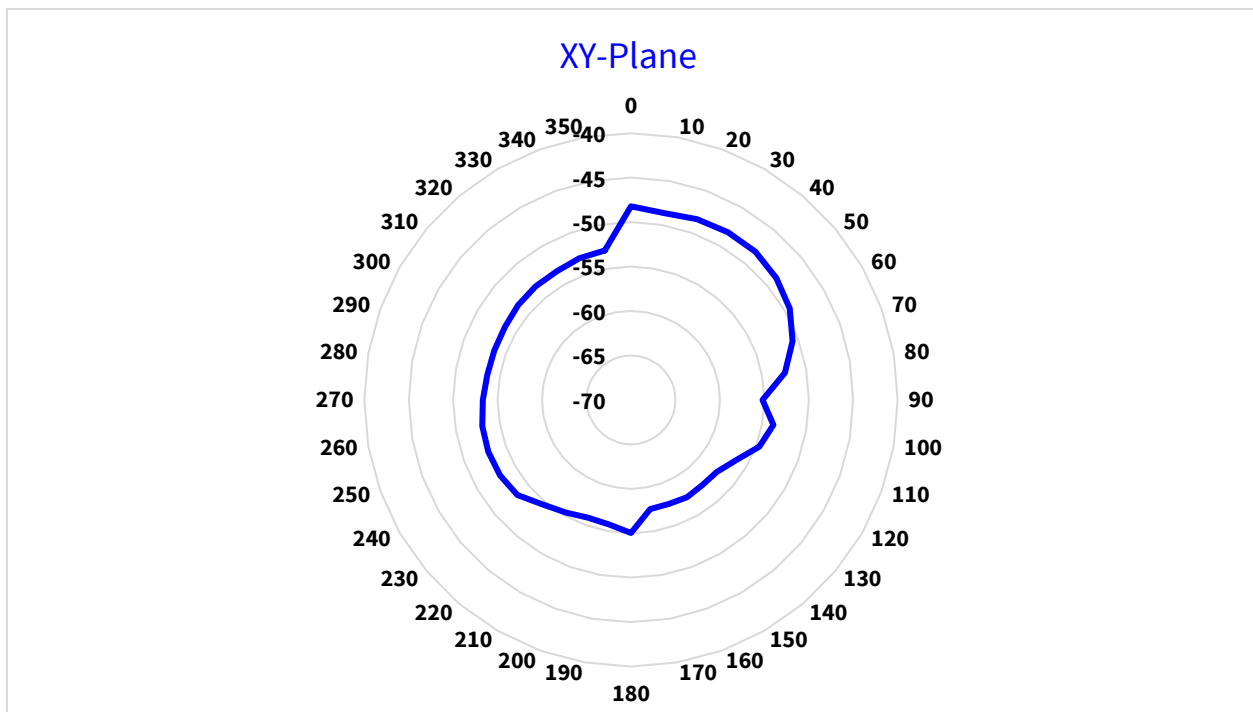


Figure 6. Antennas on XY- plane (flat) omnidirectional radiation pattern in dB scale

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6.0 ANTENNA GAIN

The antenna gain was calculated from the VNA S21 result using the two-antenna method and Friis transmission equation.

$$\frac{P_r}{P_t} = \left(\frac{\lambda}{4\pi R} \right)^2 G_t G_r, \text{ where } G_t = G_r = G,$$

or, in dB,

$$G_{dB} = \frac{1}{2} \left[20 \log_{10} \left(\frac{4\pi R}{\lambda} \right) + 10 \log_{10} \left(\frac{P_r}{P_t} \right) \right].$$

Where:

R: the distance between two antennae inside the chamber is 3 meters.

λ : the wavelength.

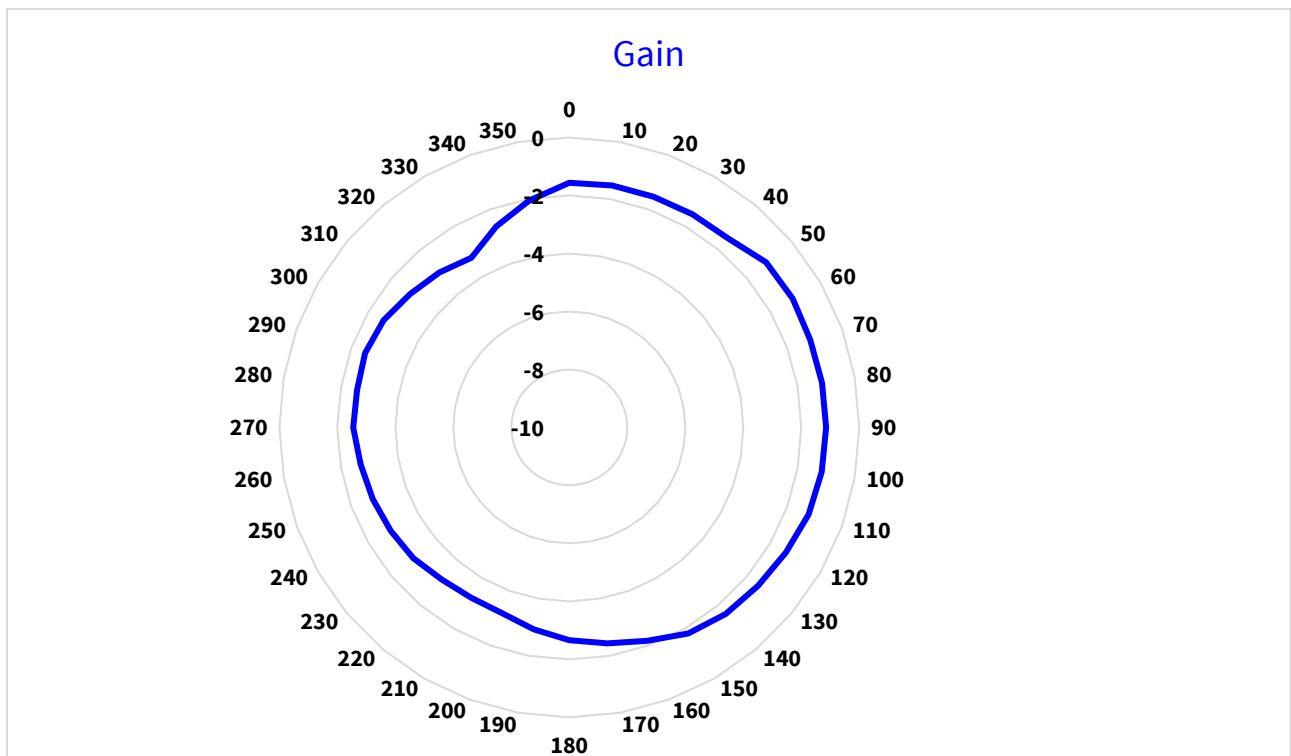


Figure 7. Antenna gain in (dBi) at XZ plane

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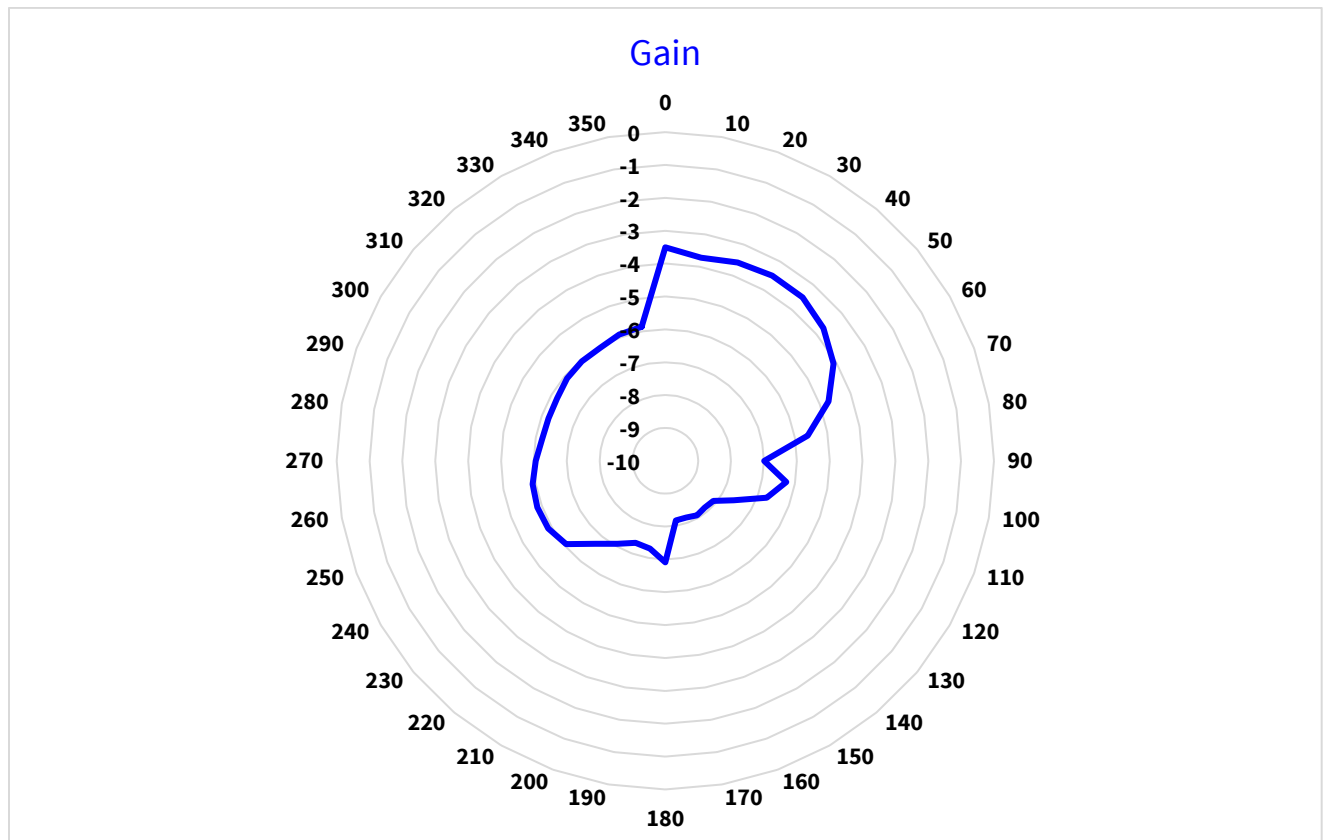


Figure 8. Antenna gain in (dBi) at XY plane (flat)

7.0 CONCLUSION

The 915MHz monopole antenna was tested for the return loss, VSWR, radiation pattern, and gain by ZNLE6 network analyzer. The antenna's measurement results show the antenna is omnidirectional and matched to the 50 Ω source. The return loss (S11) is higher than -30 dB, VSWR value is 1.12:1, and the peak gain is equal to -1.11dBi on XZ -plane and -3.5dBi on XY-plane.