SWARG SW-Block-15 Measurement Report

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1 Introduction

Radiation pattern measurements were carried out on an SW-Block-15 antenna by SWARG antenski sustavi d.o.o., which is a dual-polarized horn antenna designed to operate in the frequency band between 4.9 GHz and 6.1 GHz. The aim of this document is to present information about the measurement configuration and an overview of obtained results. In addition to radiation patterns, typical antenna parameters were also evaluated, specifically: the VSWR, front-to-back ratio, port coupling, and the realized gain of the antenna.

2 Measurements

The near-field antenna radiation patterns were measured in the anechoic chamber at TU Wien, which consists of a theta/phi positioner capable of measuring θ-angles up to 160° and the whole range of ϕ-angles from 0° to 360°. For each of the two polarizations (vertical V and horizontal H), the patterns were measured in the orientation shown in Figure 1, where the spherical coordinate system is also drawn. Arrows representing θ and ϕ both start at angle 0° and point at angle 90°, respectively. For calibrated gain measurements, the measured patterns were scaled with a scaling factors obtained from comparative measurements of known reference standard gain horn antennas. As stated earlier, the measurement chamber only allows for measurements up to θ=160° and the accuracy for large theta angles is further reduced when patterns are transformed to far-field. Thus, additional measurements were required in order to obtain the front-to-back ratio. For these measurements, the antenna was rotated by -90 in θ so that the antenna aperture was pointing away from the θ-arm seen behind the antenna in Figure 1.

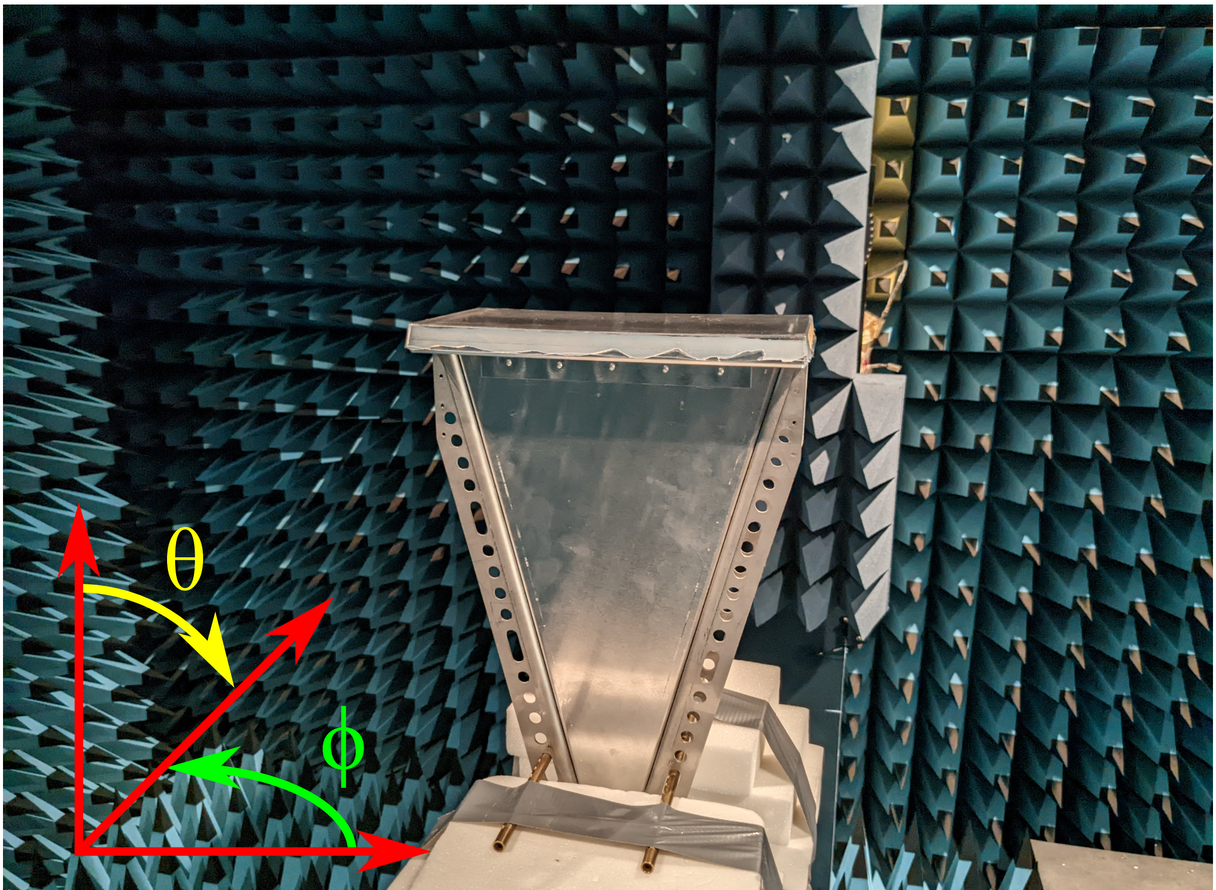


Figure 1: Antenna measurement orientation along with the θ-ϕ coordinate system

3 Results

The following subsections present radial cuts of the resulting far-field radiation patterns and remaining anntenna parameters, as obtained by the near-to-far-field transformation algorithm.

3.1 VSWR

The VSWR measurement results over frequency can be seen in Figure 2, shown for both H and V polarizations. VSWR remains below 1.55 over the whole frequency range for the horizontal polarization, while the VSWR for vertical polarization was found to be below 1.4 over the whole range of operation.

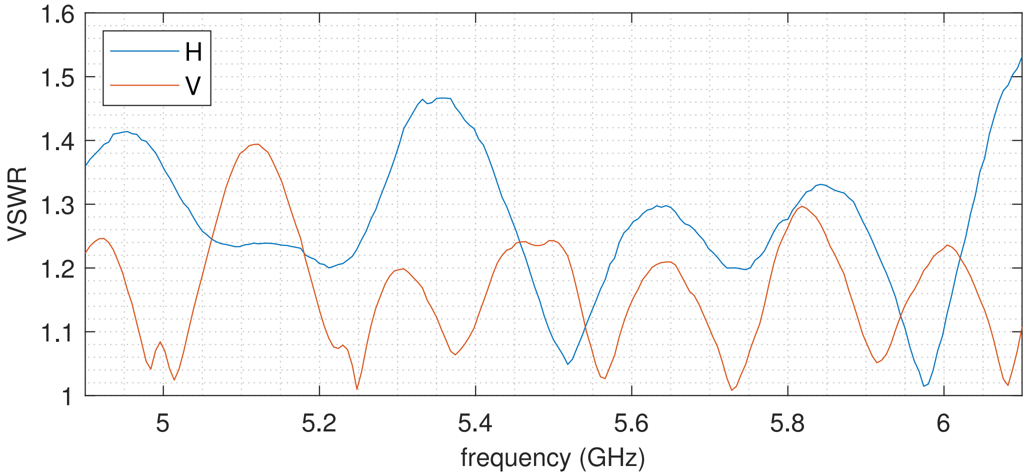


Figure 2: VSWR over frequency for horizontal polarization (blue) and vertical polarization (red)

3.2 Port Coupling

Measurement results of coupling between the two orthognal polarization ports over frequency can be seen in Figure 3. The maximum measured value, −40.0 dB, is located at 5.182 GHz.

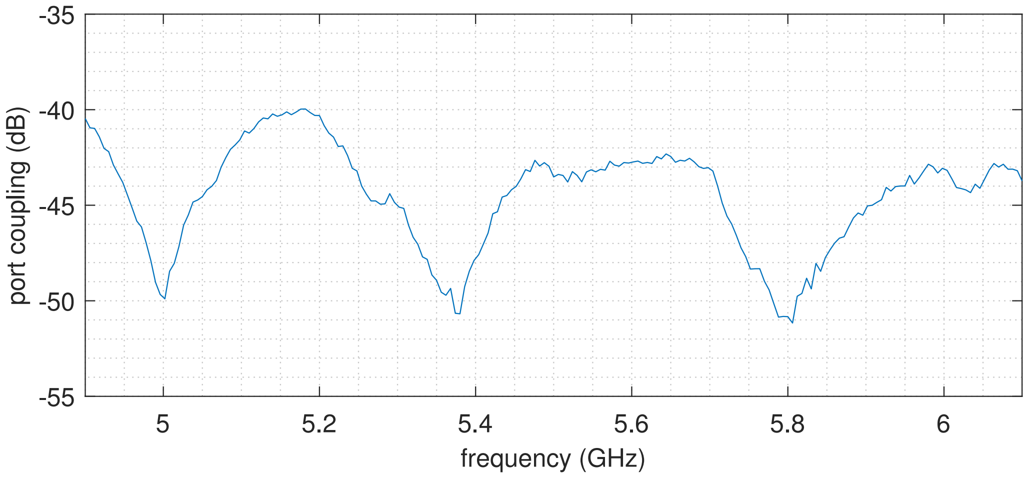
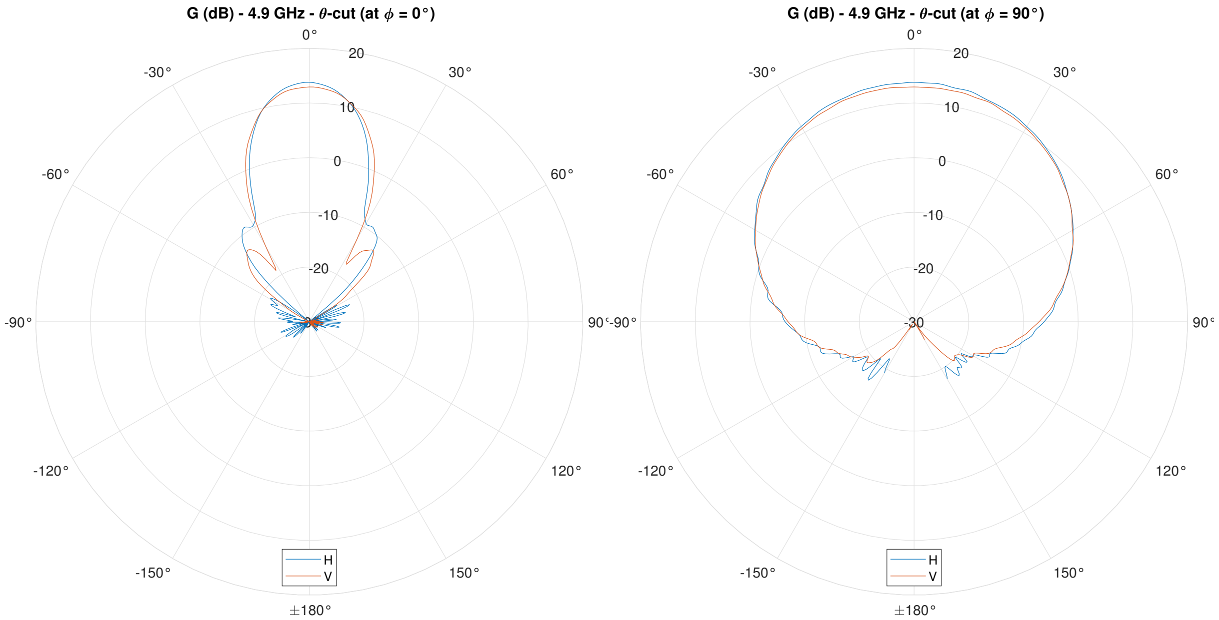


Figure 3: Port coupling over frequency

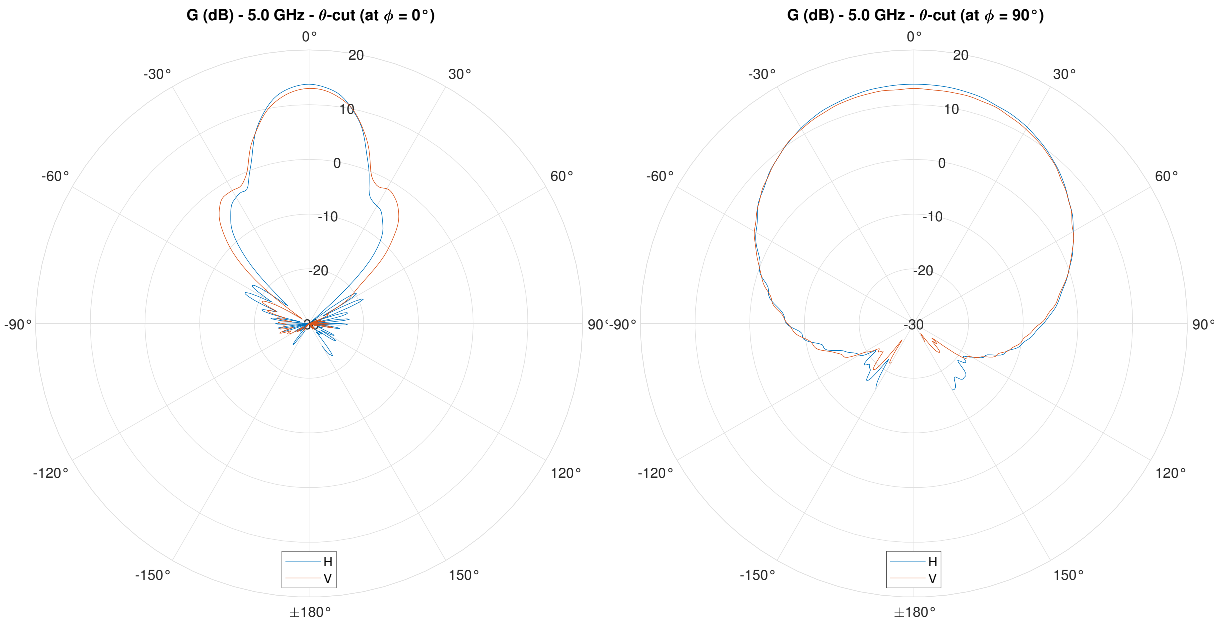
3.3 Radiation Patterns

Radiation patterns, represented in terms of realized gain, are shown in Figures 4 to 16. The θ and ϕ coordinates correspond to θ and ϕ positions, as presented in Figure 1. It should be noted that the patterns were truncated at $\theta = \pm 150°$ to exclude results deemed inaccurate due to the near-to-far-field transformation algorithm.



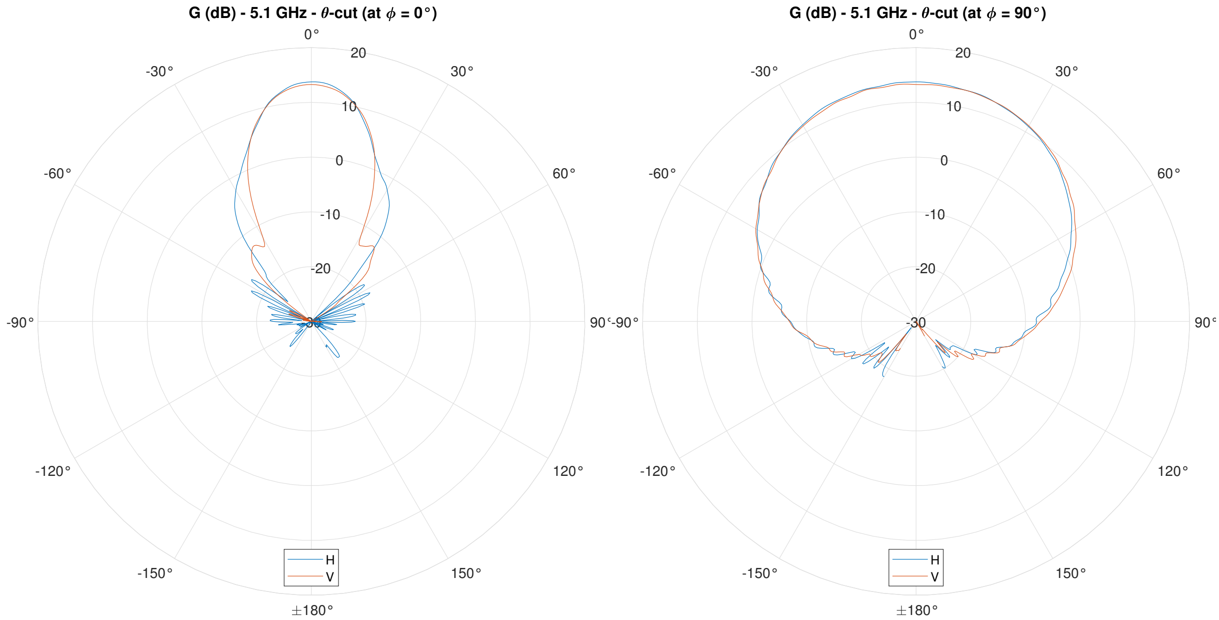
(a) (b)

Figure 4: Gain pattern cuts at 4.9 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



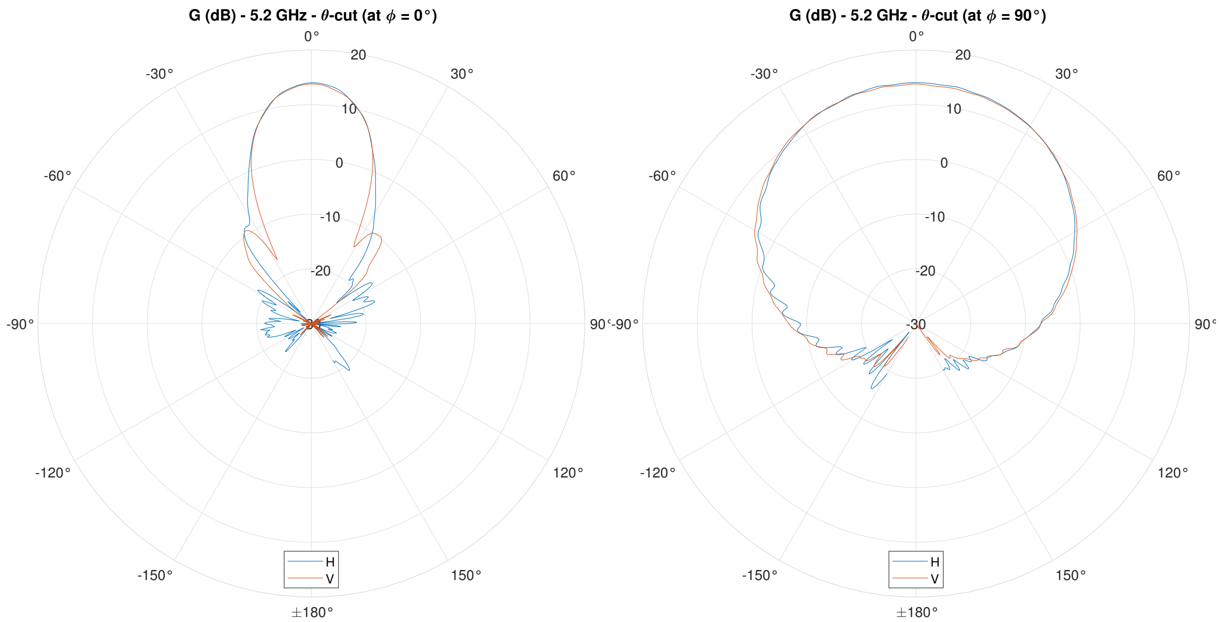
(a) (b)

Figure 5: Gain pattern cuts at 5.0 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



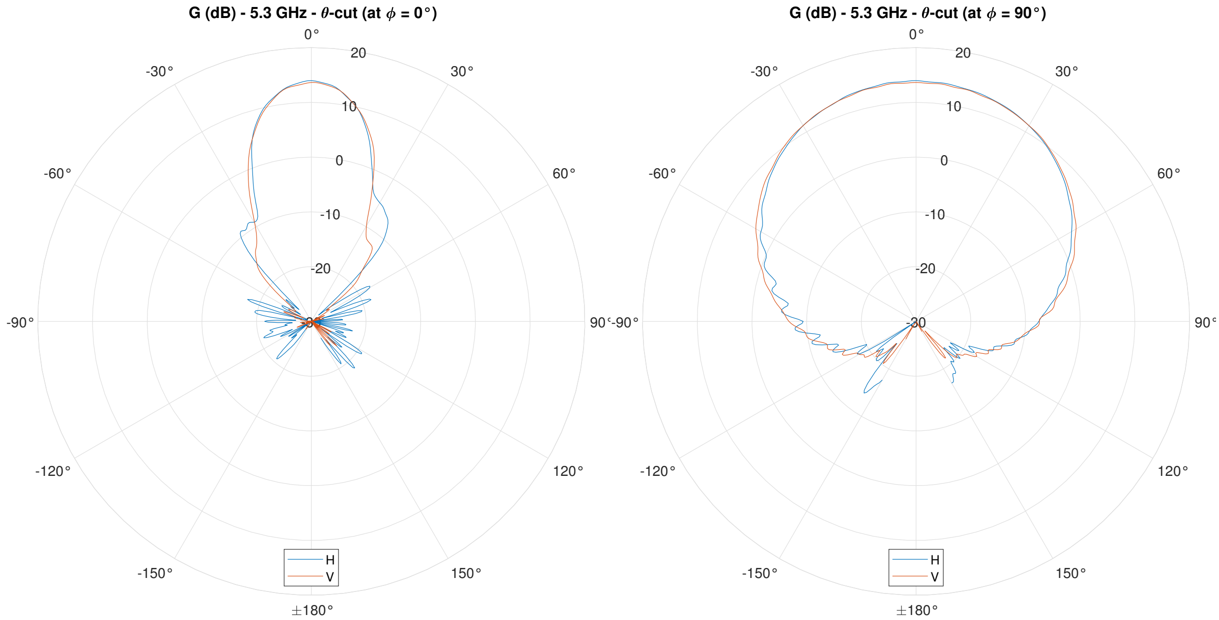
(a) (b)

Figure 6: Gain pattern cuts at 5.1 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



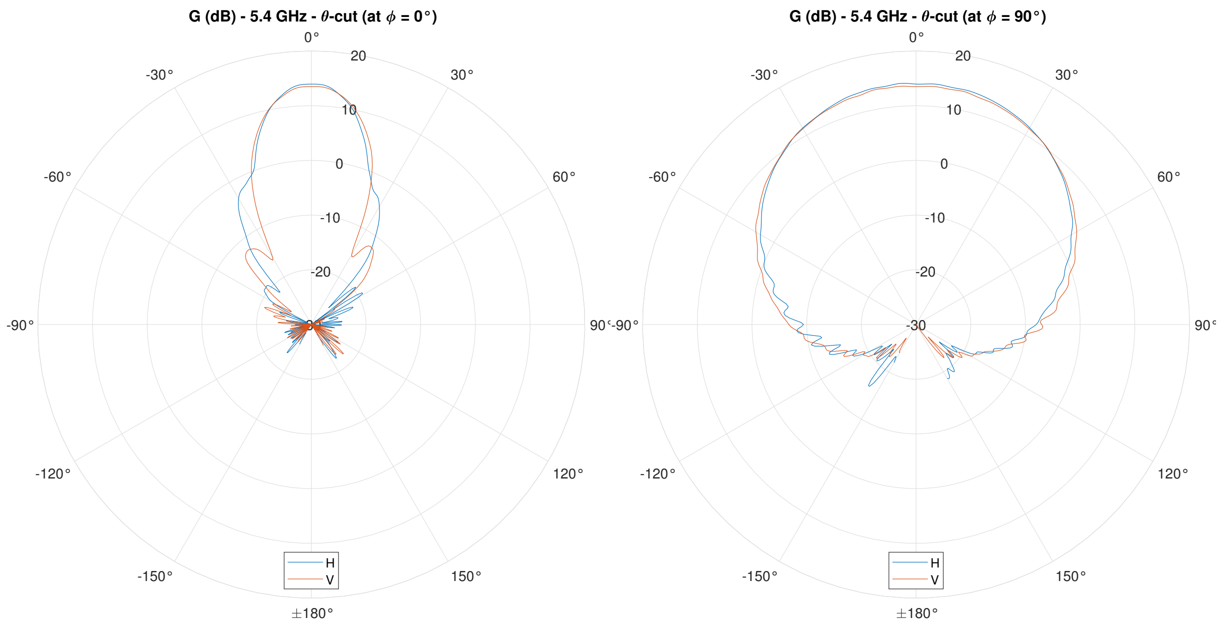
(a) (b)

Figure 7: Gain pattern cuts at 5.2 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



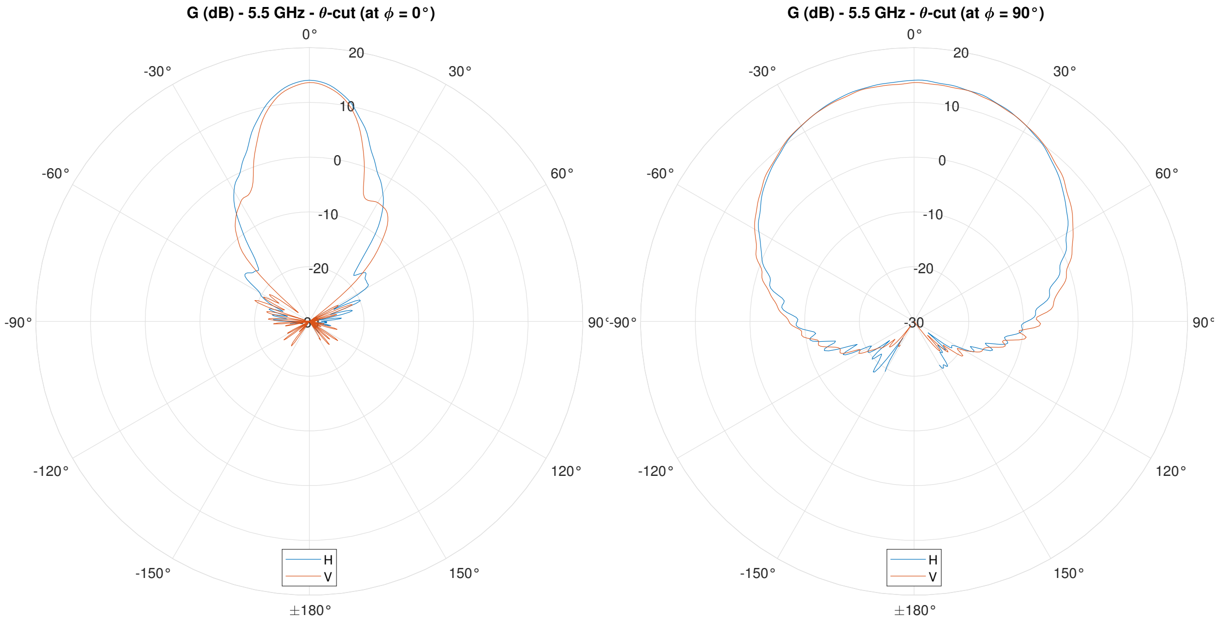
(a) (b)

Figure 8: Gain pattern cuts at 5.3 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



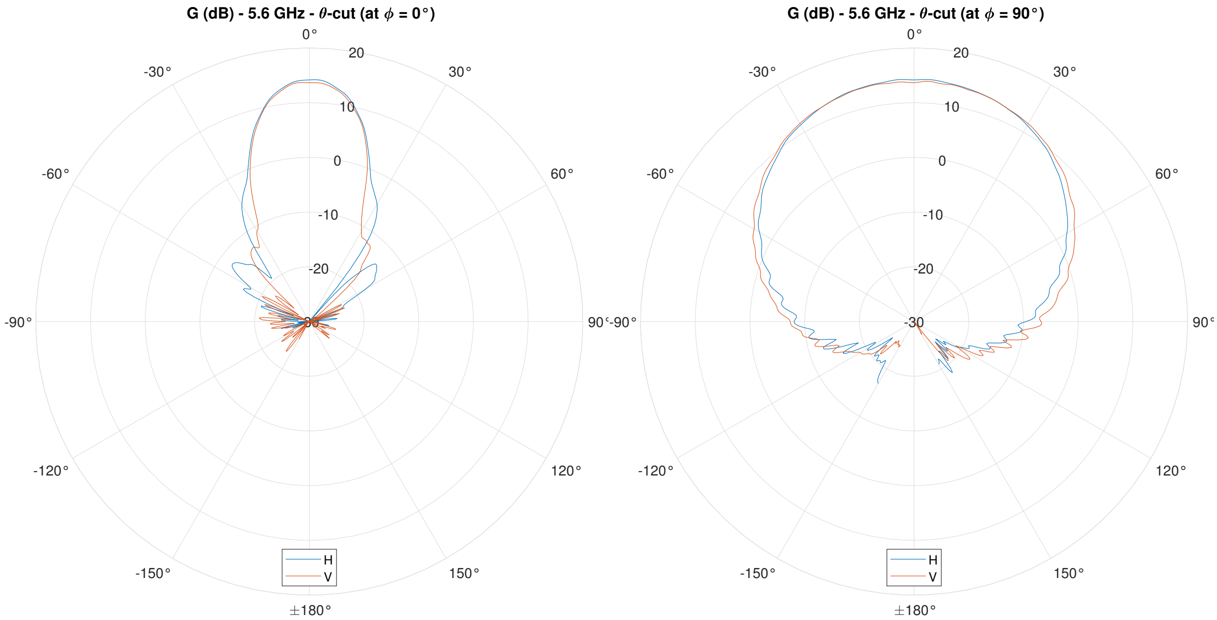
(a) (b)

Figure 9: Gain pattern cuts at 5.4 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



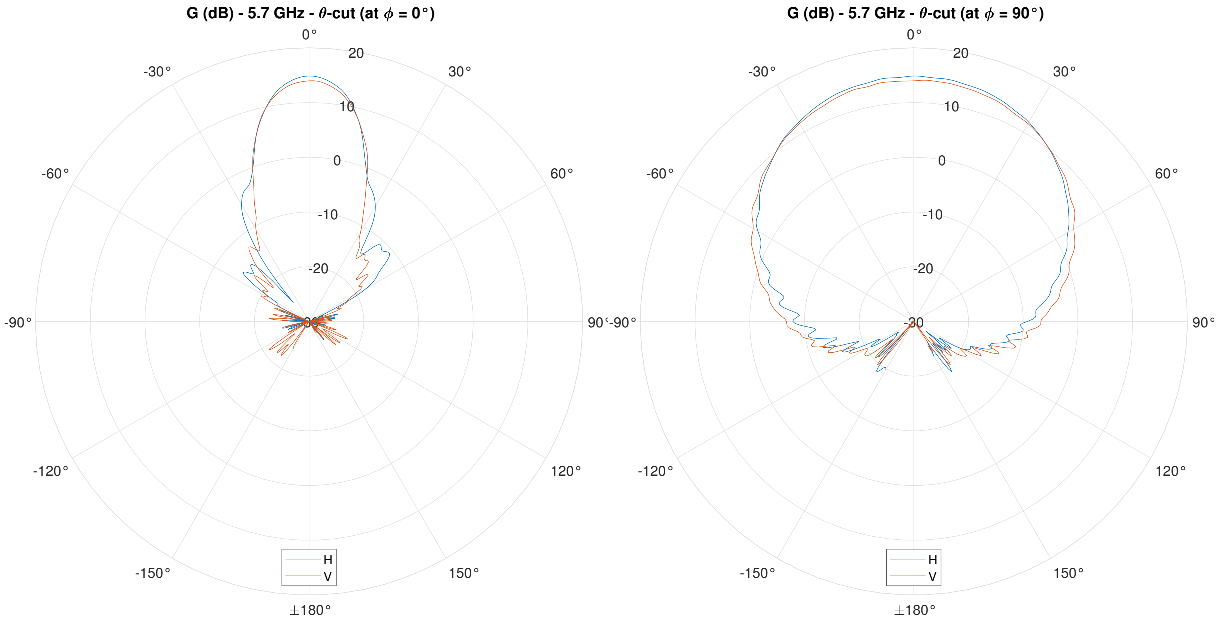
(a) (b)

Figure 10: Gain pattern cuts at 5.5 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



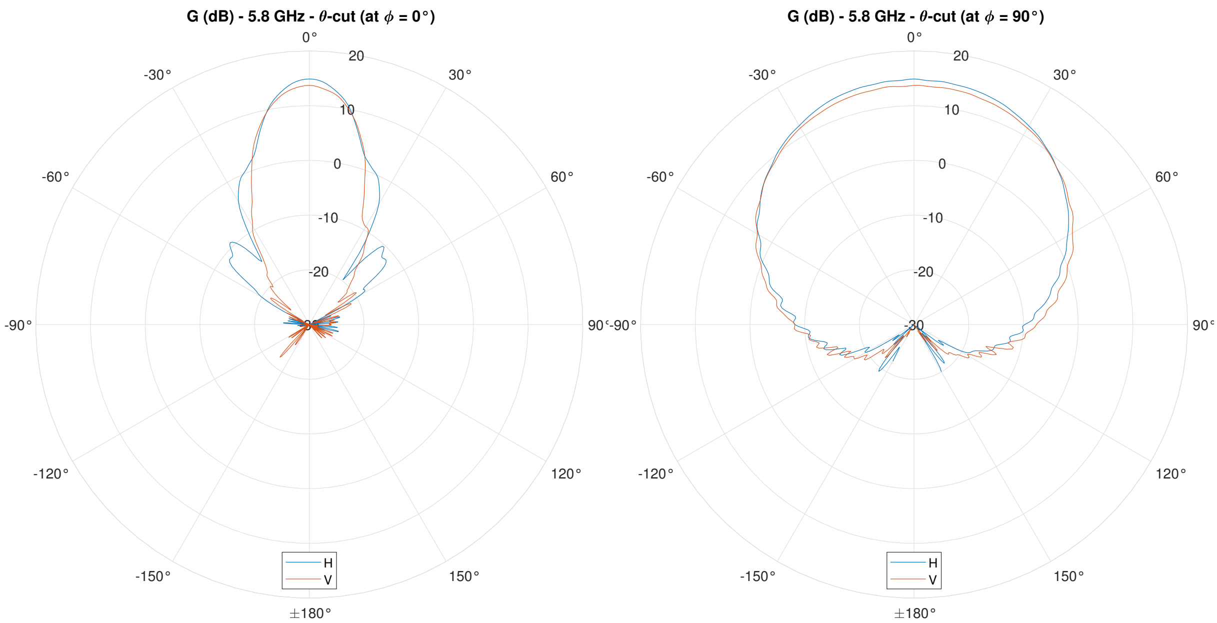
(a) (b)

Figure 11: Gain pattern cuts at 5.6 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



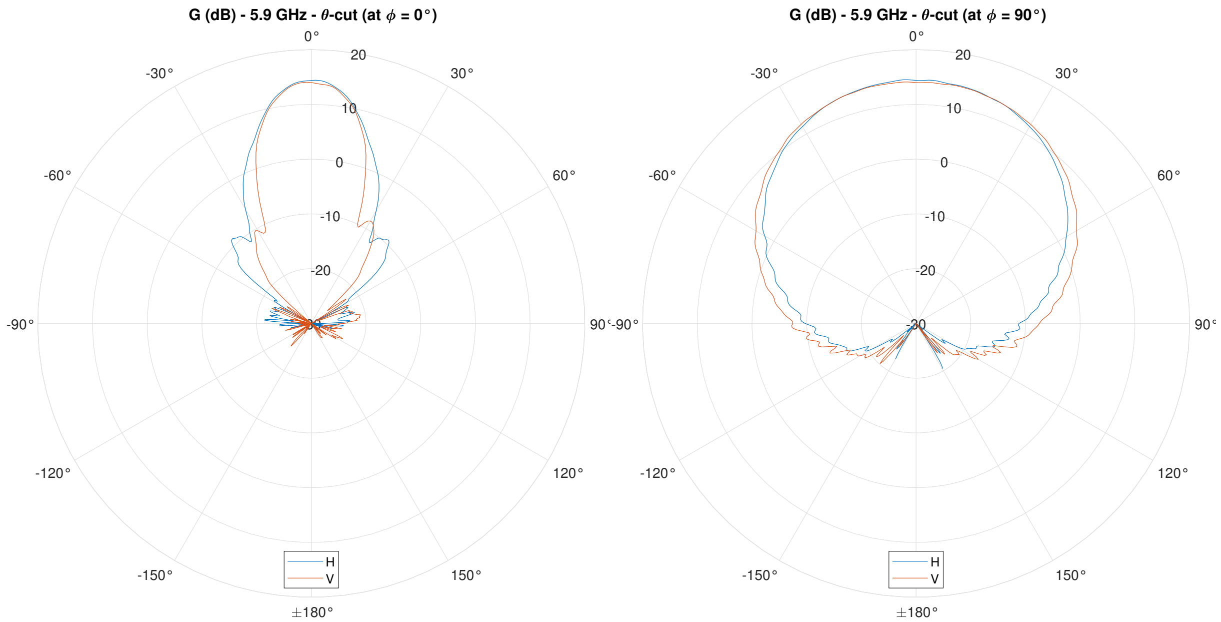
(a) (b)

Figure 12: Gain pattern cuts at 5.7 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



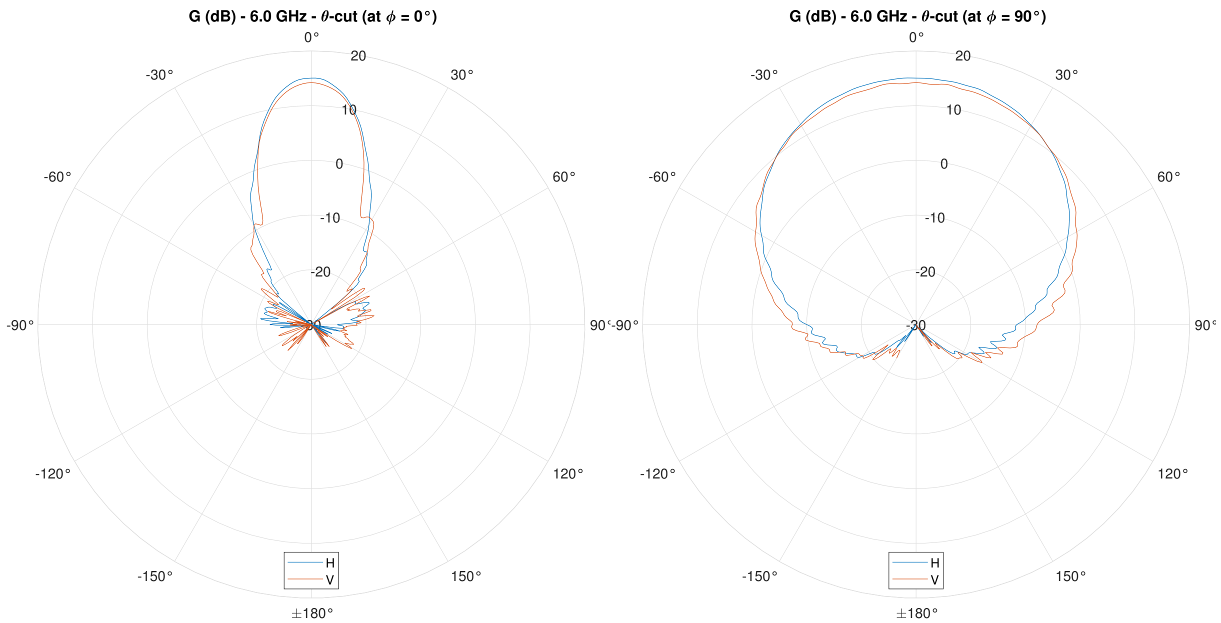
(a) (b)

Figure 13: Gain pattern cuts at 5.8 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



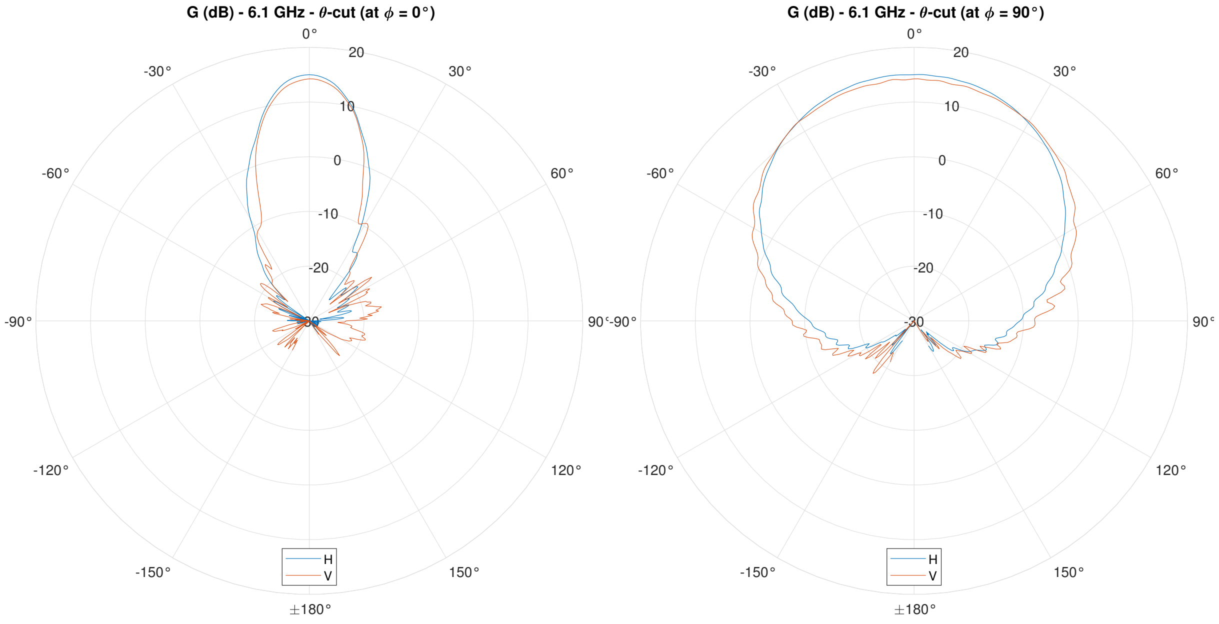
(a) (b)

Figure 14: Gain pattern cuts at 5.9 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



(a) (b)

Figure 15: Gain pattern cuts at 6.0 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$



(a) (b)

Figure 16: Gain pattern cuts at 6.1 GHz: (a) θ-cut at $\phi = 0°$ and (b) θ-cut at $\phi = 90°$

3.4 Gain

The realized antenna gain over frequency can be seen in Figure 17 for both polarizations. The realized gain for horizontal polarization was found to be in the range between 13.7 and 15.1 dB over all measured frequencies, while the realized gain for vertical polarization is in the range between 12.9 and 14.3 dB.

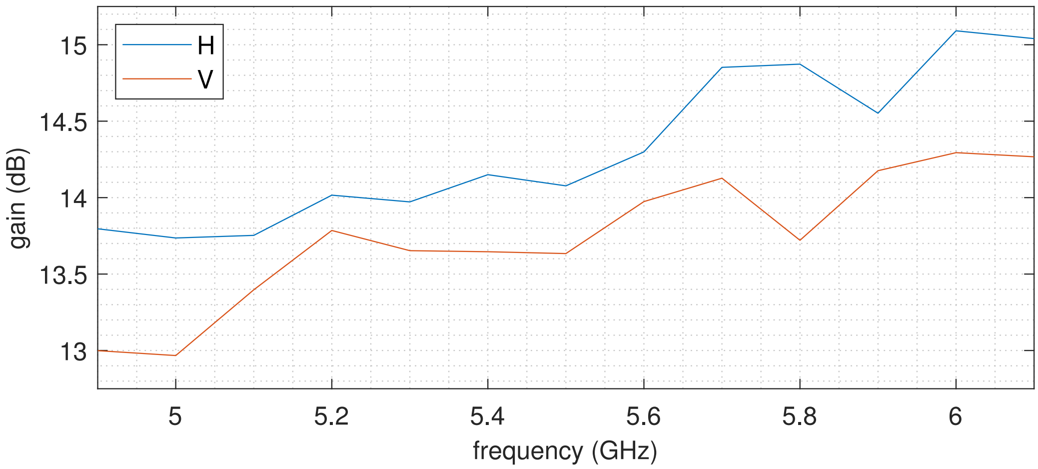


Figure 17: Gain over frequency for horizontal polarization (blue) and vertical polarization (red)

3.5 Front-to-Back Ratio

As mentioned previously, additional measurements were carried out to obtain the front-to-back ratio of the antenna. The ratio was evaluated by comparing the values when the antenna was pointing directly to the probe antenna with the values when antenna was pointing in the opposite direction (representing a ϕ-rotation of 180°). This was done for the combined power of co- and cross-polarized components, as well as for the co-polarization contribution. The minimum values are listed in Table 1.

front-to-back ratio	**H**	**V**
co-polarized	31.2 dB	32.2 dB
combined	29.2 dB	31.0 dB

Table 1: Minimum measured front-to-back ratio for co-polarized and combined-power patterns