

UHF PATCH ANTENNA DESIGN

UHF Rectangular Patch Antenna with Inset Feeding Strip added to CubeSat Structure: Rectangular patch design, with an inset feeding strip at one edge of the patch, on a 1.6mm standard FR-4 substrate with double copper layer of 50 μ m each. Patch dimensions are 6cm (length) by 7.825cm (width), and full substrate dimensions are 8.5cm (length) by 9cm (width), as previously reported. Simulation stage performed with patch antenna added to only one side of the CubeSat structure, without S-Band patch array, back panels or 2.5m wire antennas. Simulations performed with CST Studio Suite 2017 ©.

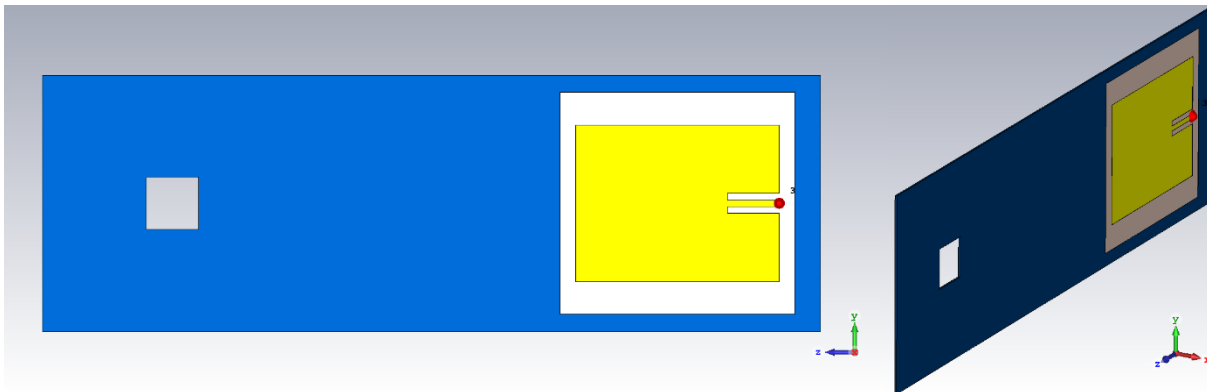


Figure 1.1. UHF Rectangular Patch Antenna on Side of CubeSat structure. Cube Side and Perspective Views.

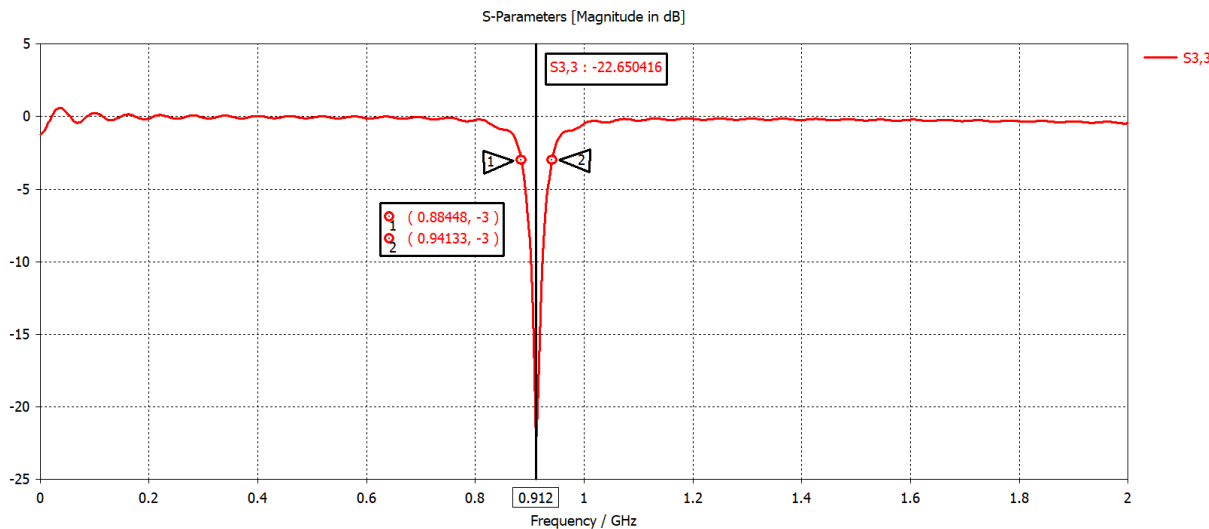


Figure 1.2. Input reflection coefficient (S11 Parameter) for UHF Rectangular Patch Antenna on Side of CubeSat structure.

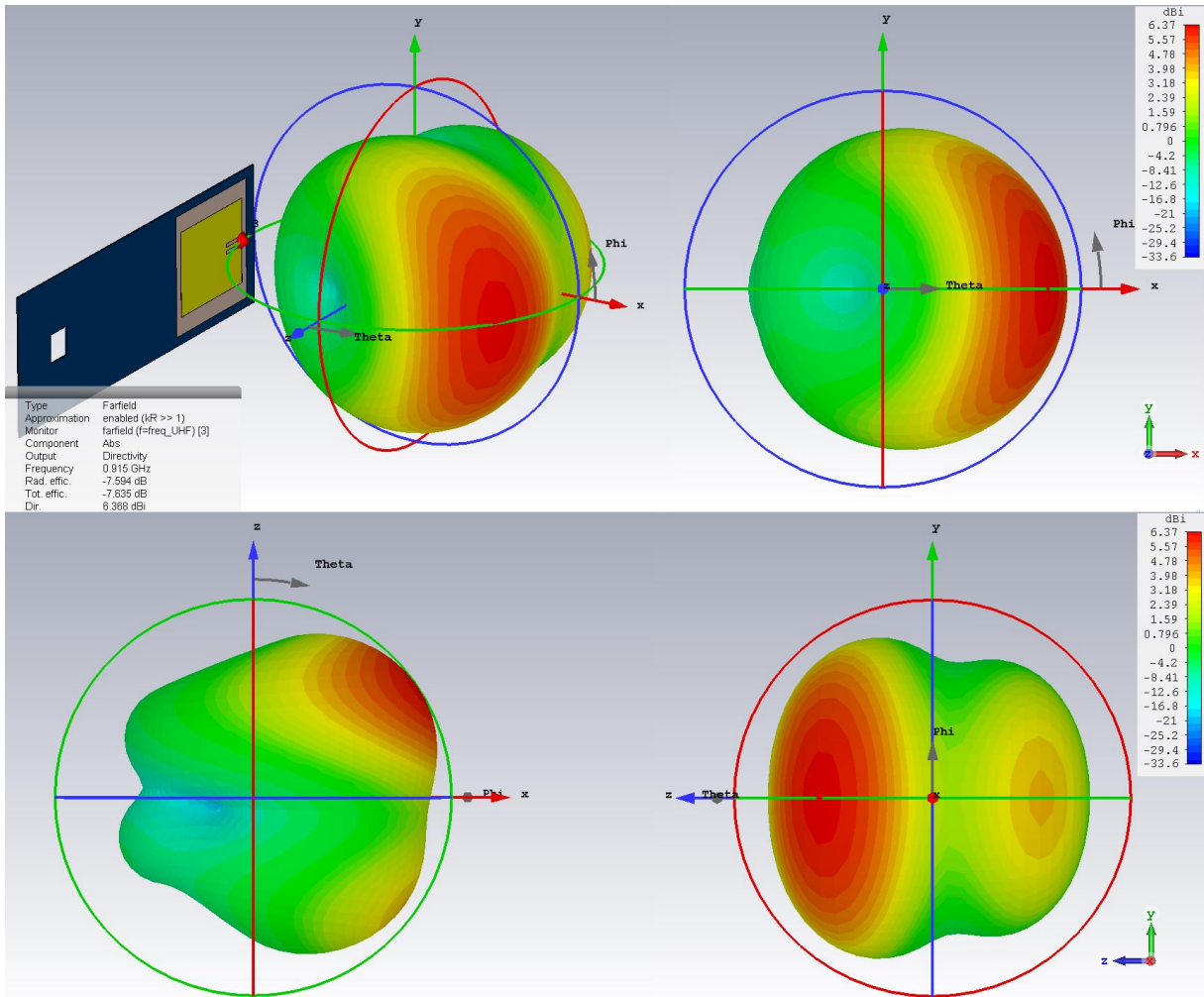


Figure 1.3. Far-field Radiation Pattern for UHF Rectangular Patch Antenna on Side of CubeSat structure. **Directivity.**

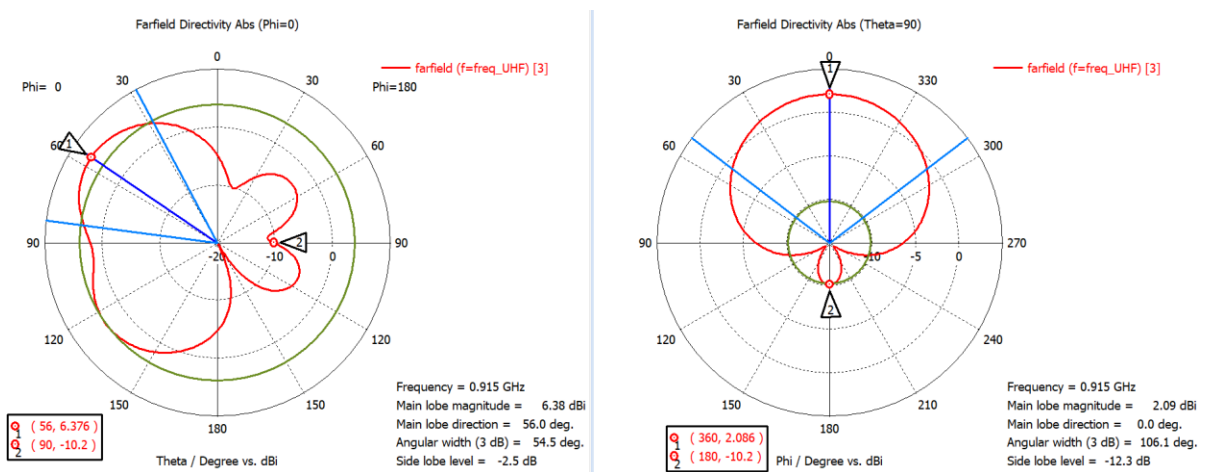


Figure 1.4. Far-field Radiation Pattern for UHF Rectangular Patch Antenna on Side of CubeSat structure. **Directivity (Polar View)**

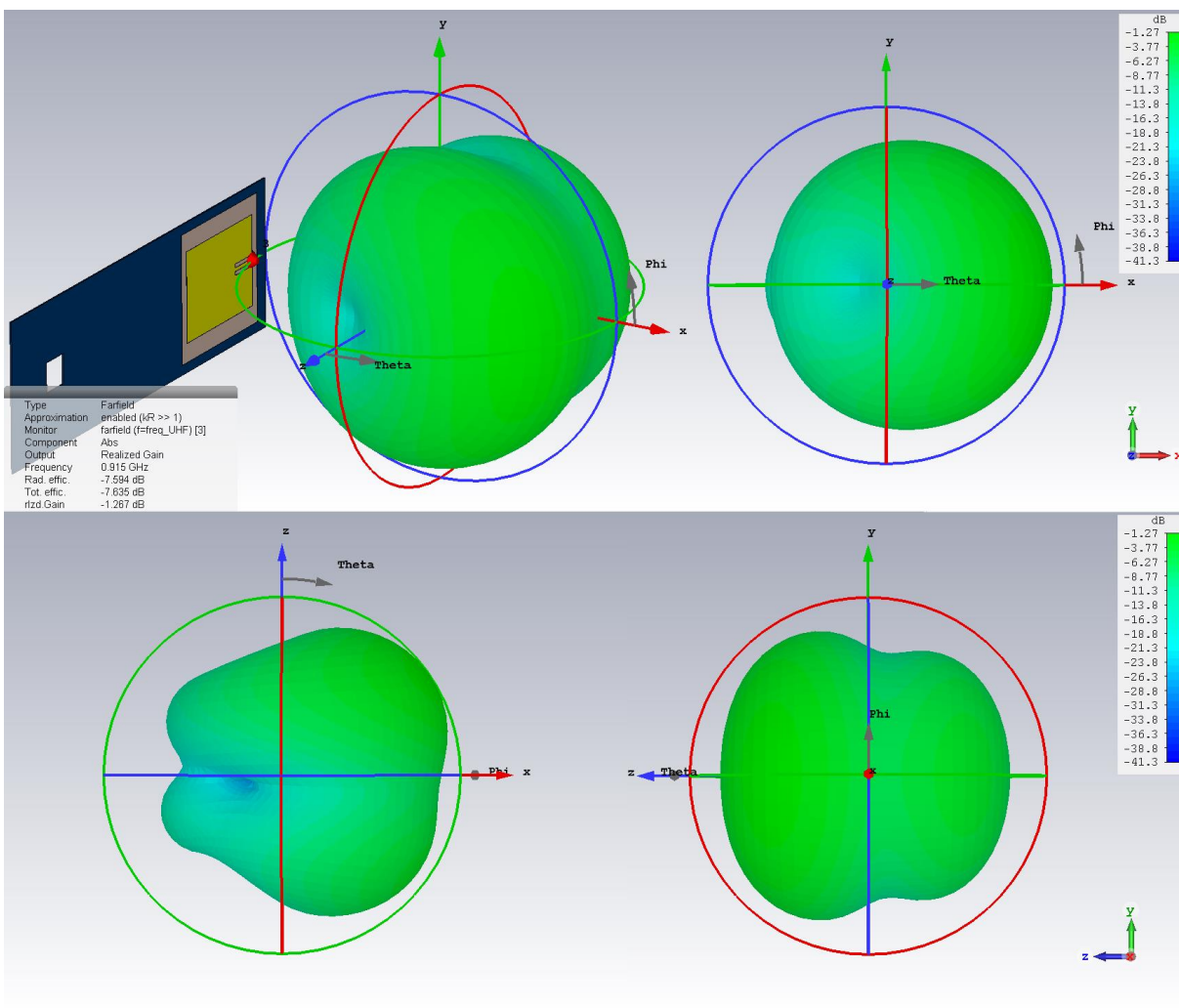


Figure 1. 5. Far-field Radiation Pattern for UHF Rectangular Patch Antenna on Side of CubeSat structure. **Realized Gain.**

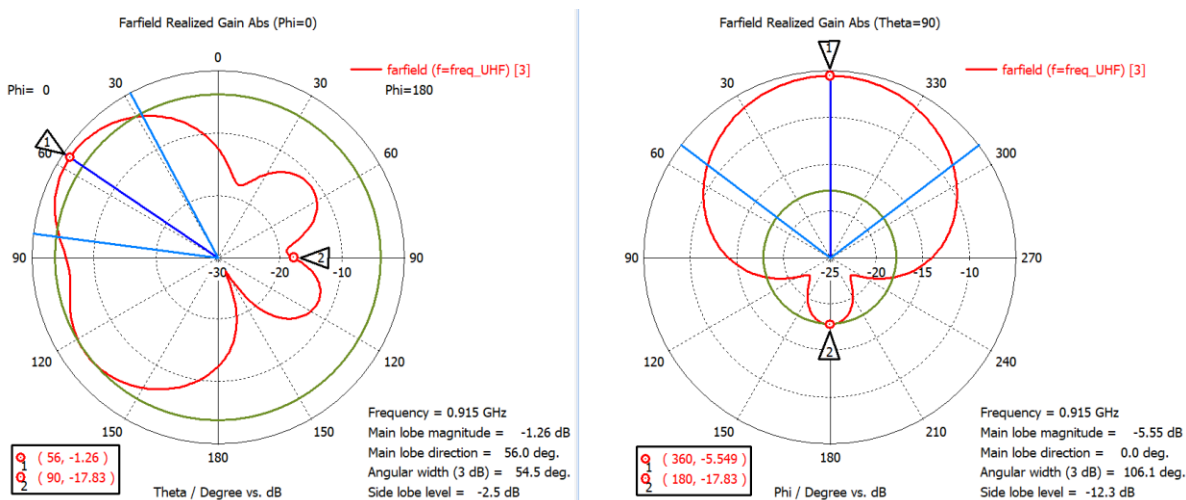


Figure 1. 6. Far-field Radiation Pattern for UHF Rectangular Patch Antenna on Side of CubeSat structure. **Realized Gain (Polar View).**

UHF Patch added to Structure – Including S-Band Patch Antenna array: S-Band patch array added to the side of CubeSat structure, and slightly shifted towards the front side of the Cube. Simulations performed with CST Studio Suite 2017 ©.

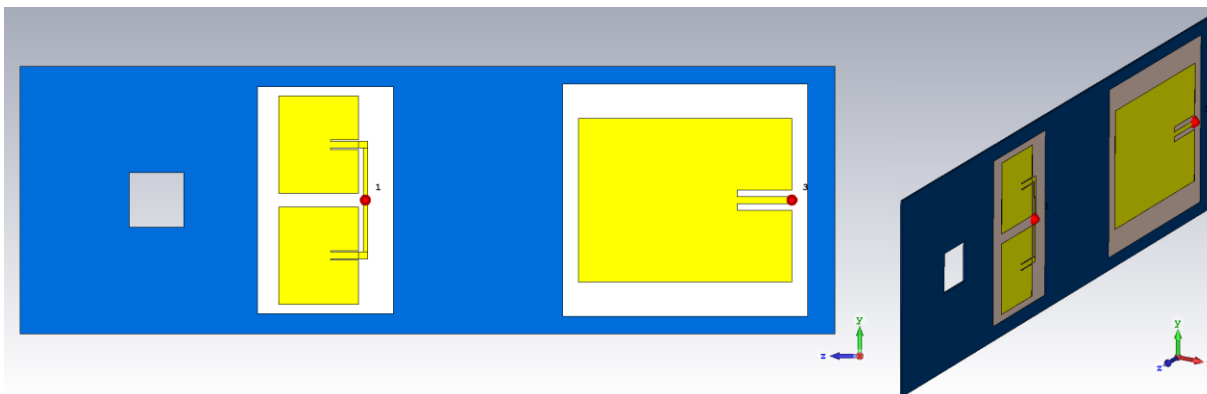


Figure 2.1. UHF Patch Antenna and 2x1 S-Band Patch Antenna Array added to side of CubeSat structure. Cube Side and Perspective Views.

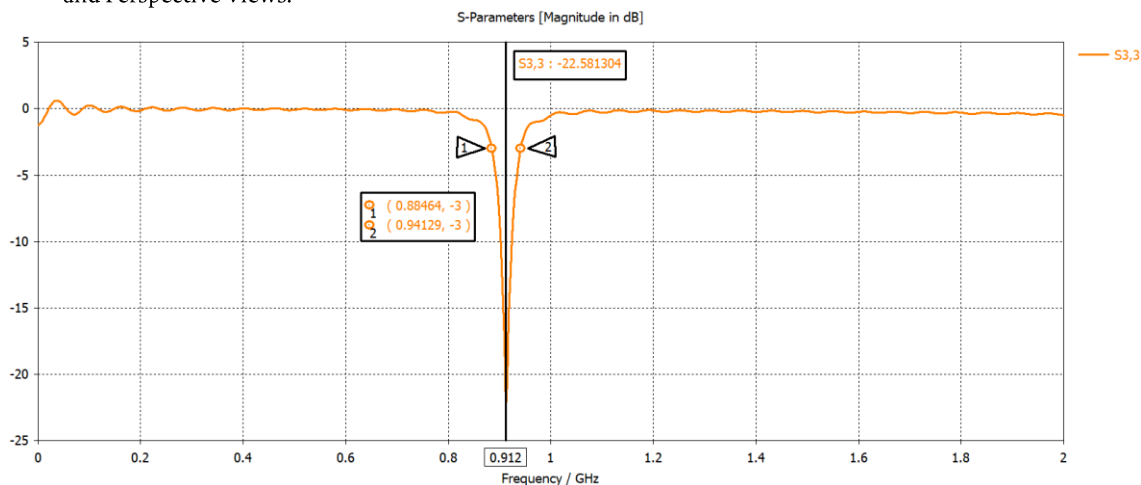


Figure 2.2. Input reflection coefficient (S11 Parameter) for UHF Patch Antenna added to side of CubeSat structure

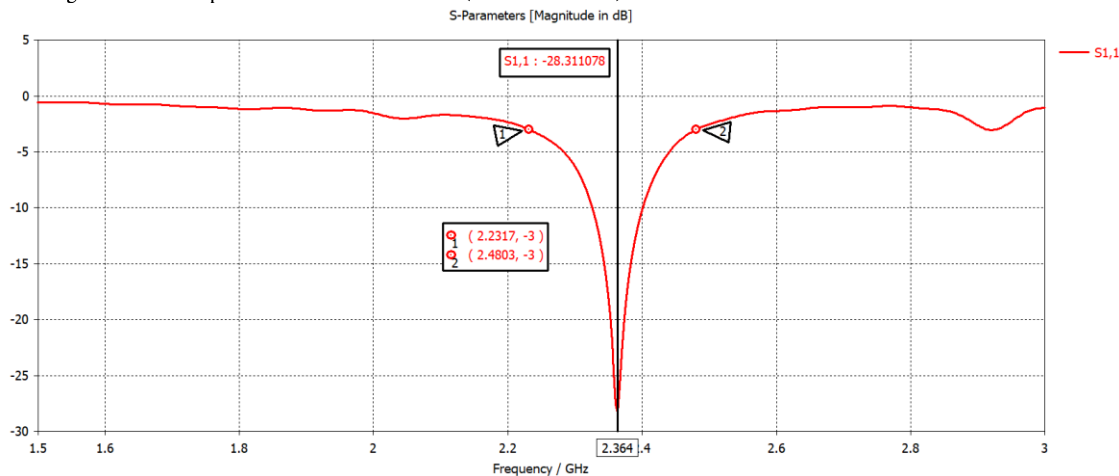


Figure 2.3. Input reflection coefficient (S11 Parameter) for S-Band Patch Array Antenna added to side of CubeSat structure

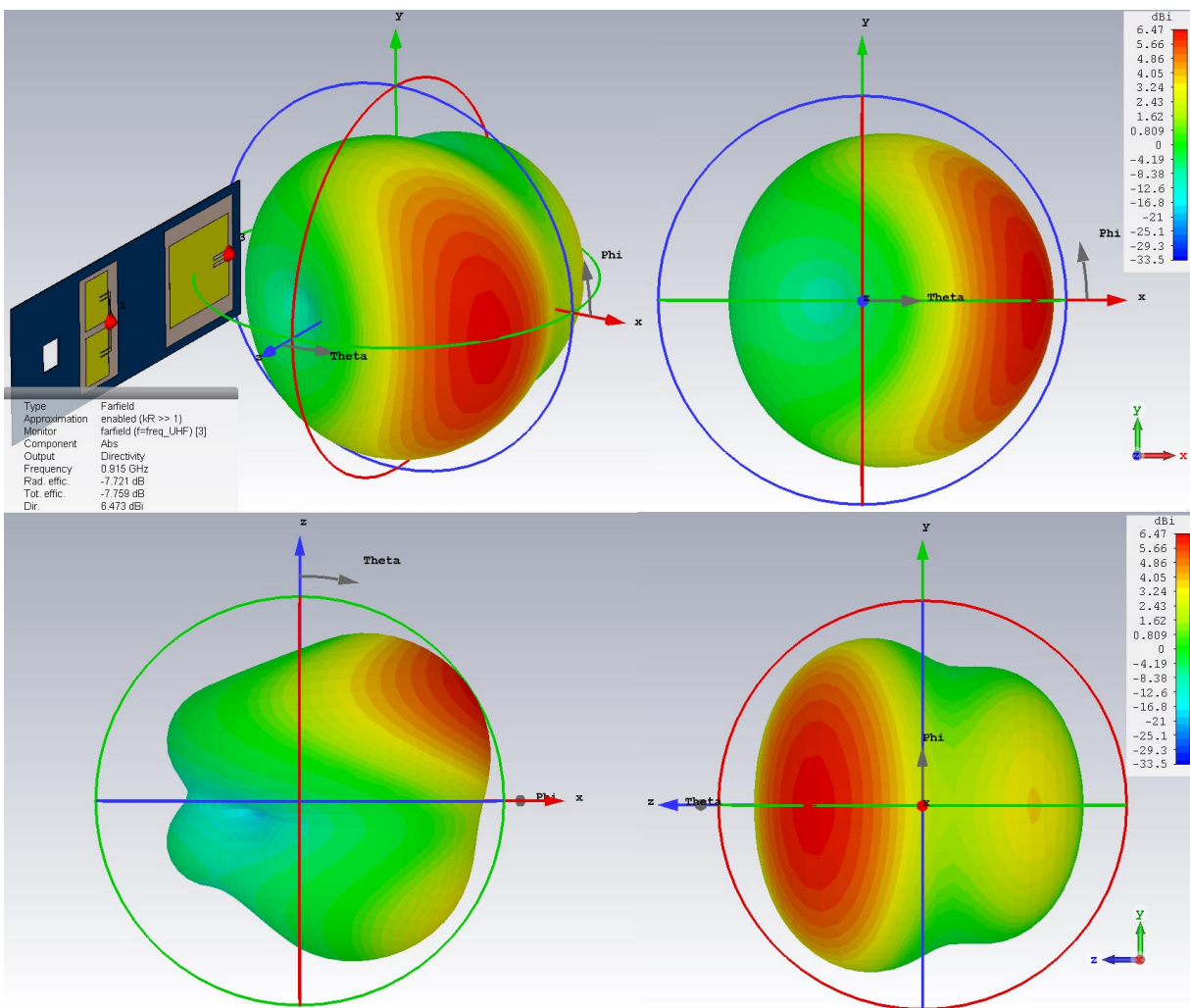


Figure 2. 4. Far-field Radiation Pattern for UHF Patch Antenna added to side of CubeSat structure. **Directivity**.

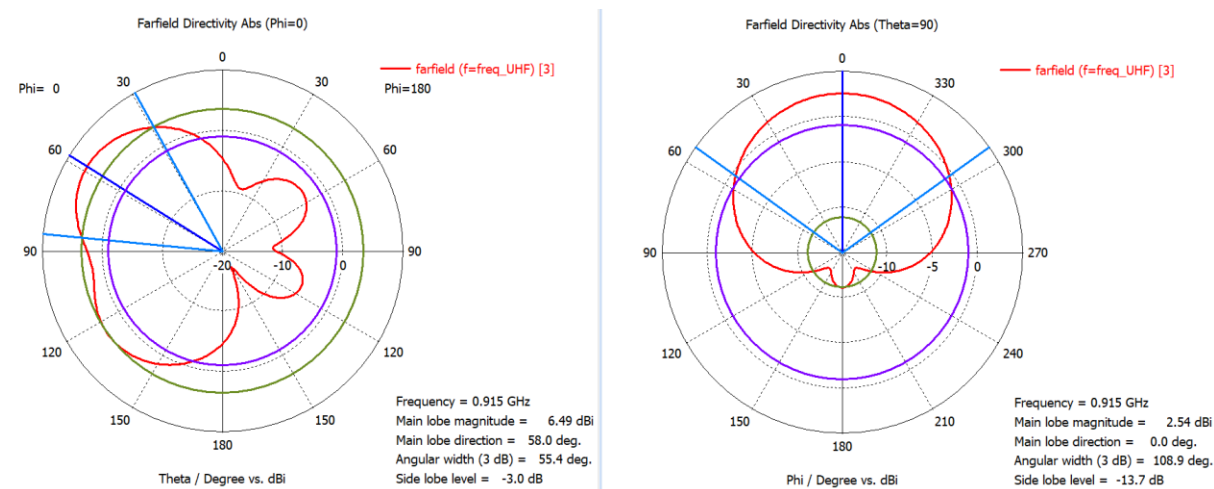


Figure 2. 5. Far-field Radiation Pattern for UHF Patch Antenna added to side of CubeSat structure. **Directivity (Polar View)**.

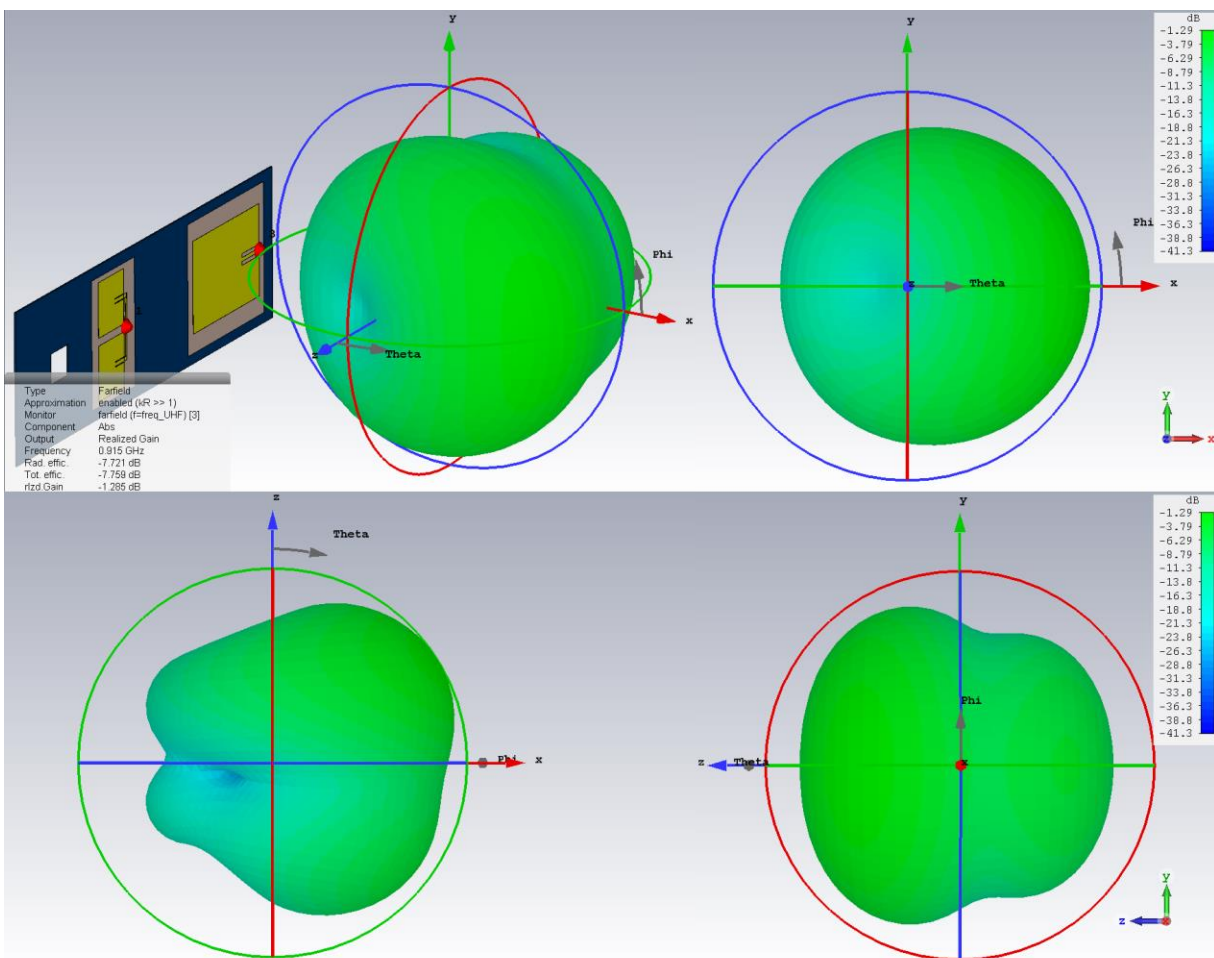


Figure 2.6. Far-field Radiation Pattern for UHF Patch Antenna added to side of CubeSat structure. **Realized Gain.**

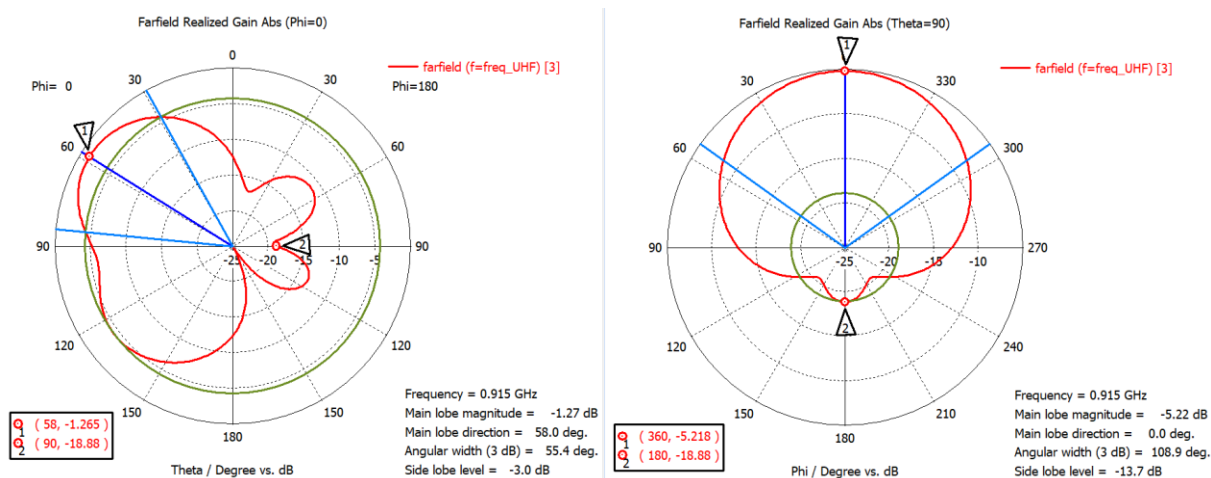


Figure 2.7. Far-field Radiation Pattern for UHF Patch Antenna added to side of CubeSat structure. **Realized Gain (Polar View).**

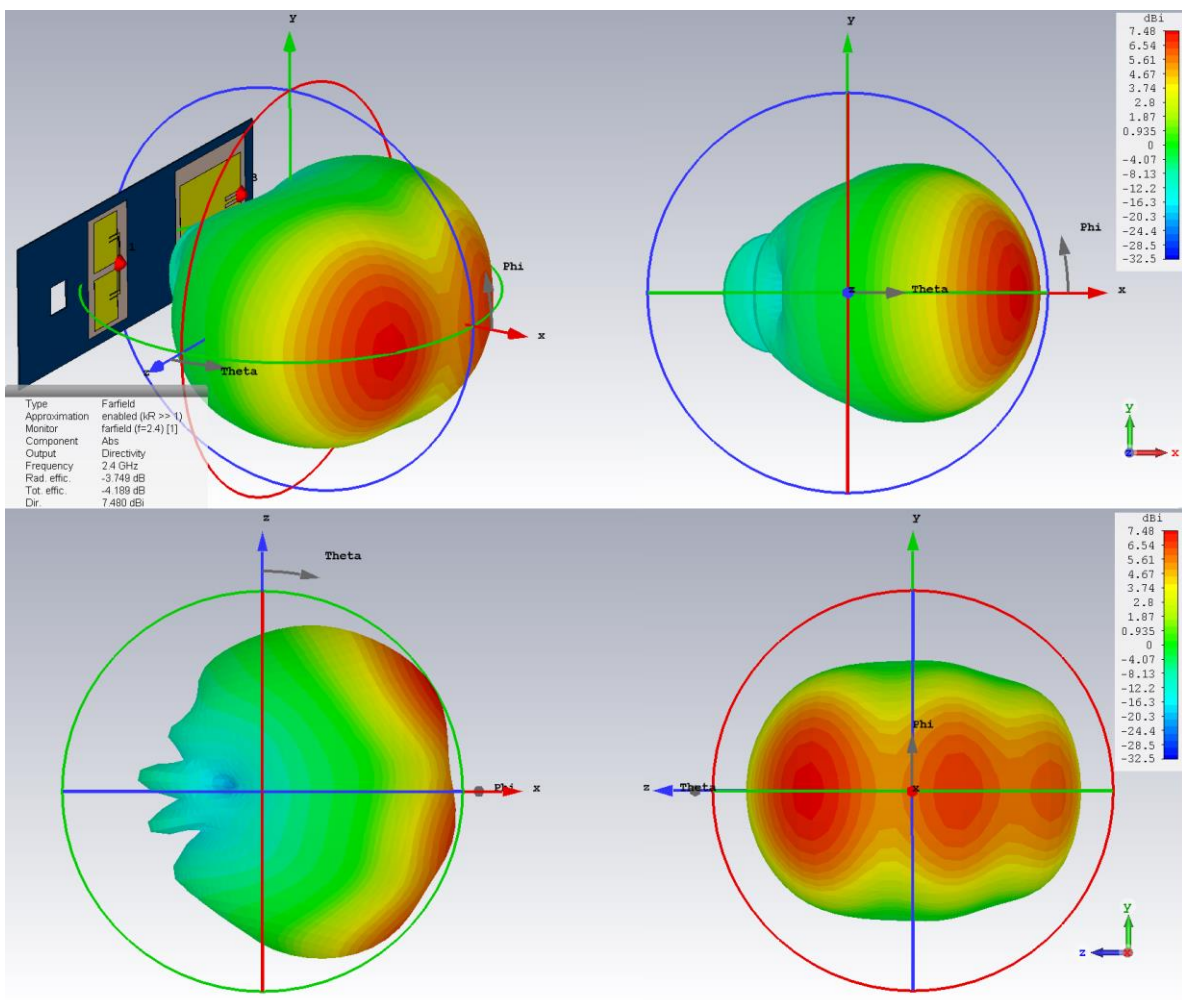


Figure 2.8. Far-field Radiation Pattern for S-Band Patch Array Antenna added to side of CubeSat structure. **Directivity.**

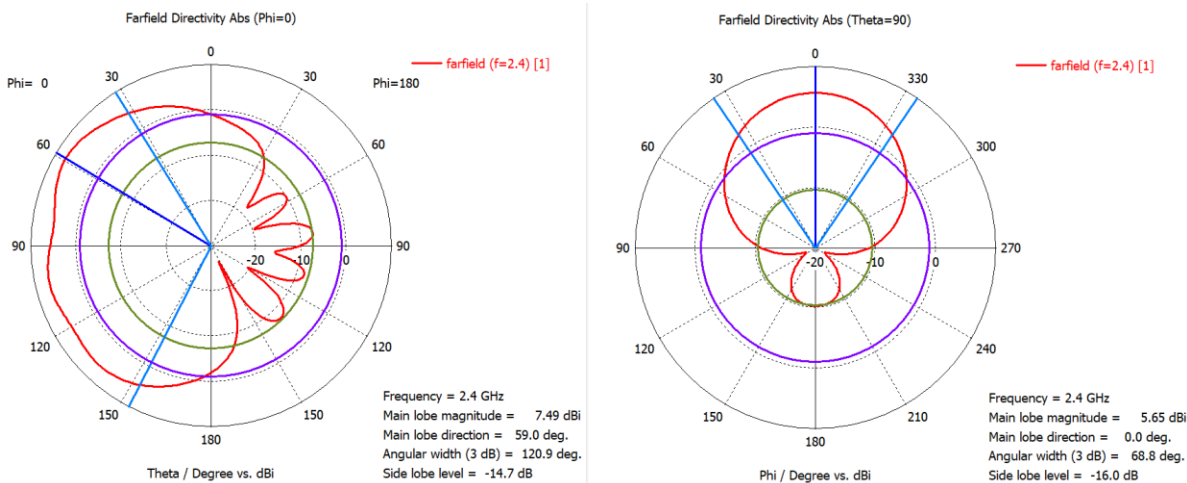


Figure 2.9. Far-field Radiation Pattern S-Band Patch Array Antenna added to side of CubeSat structure. **Directivity (Polar View).**

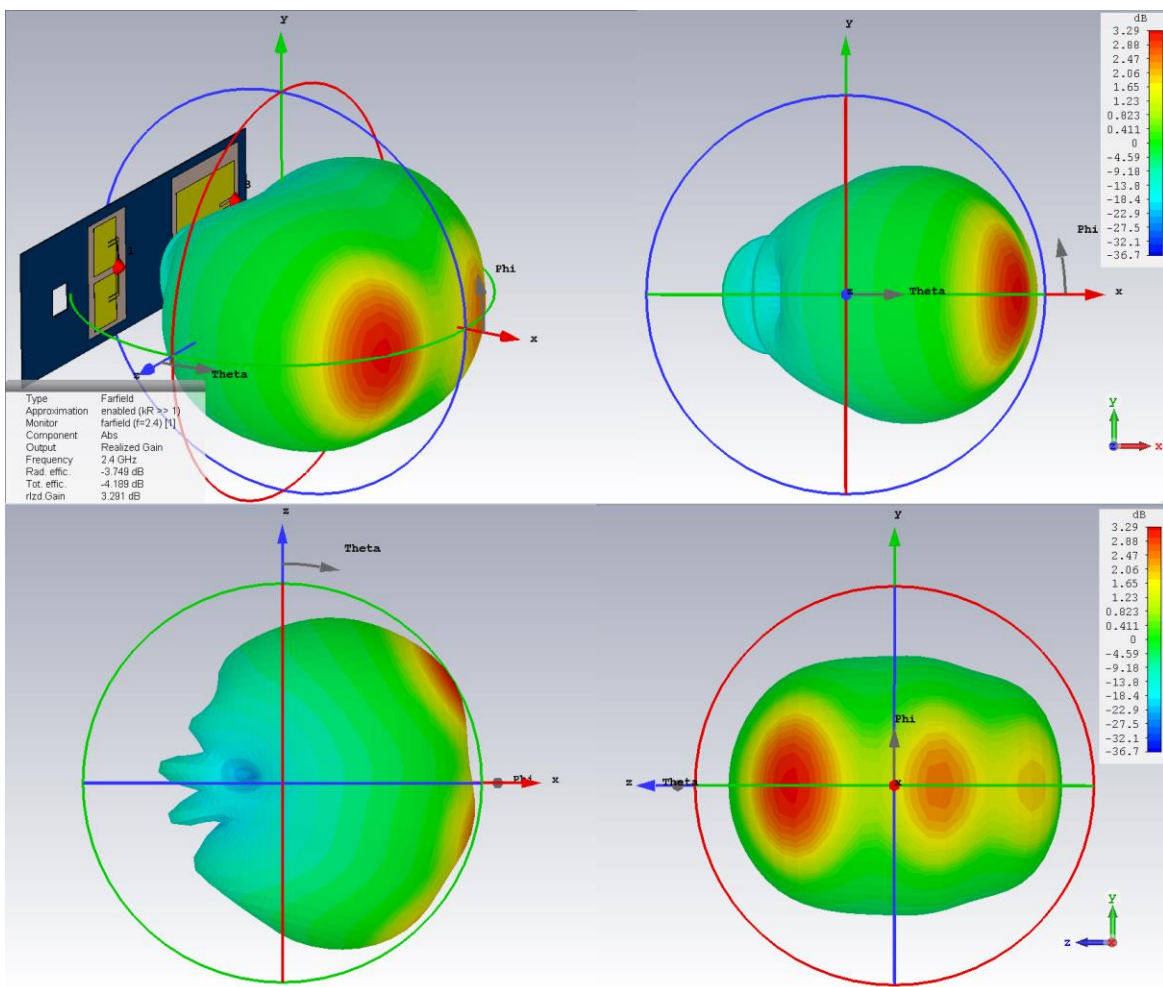


Figure 2. 10. Far-field Radiation Pattern for S-Band Patch Array Antenna added to side of CubeSat structure. **Realized Gain.**

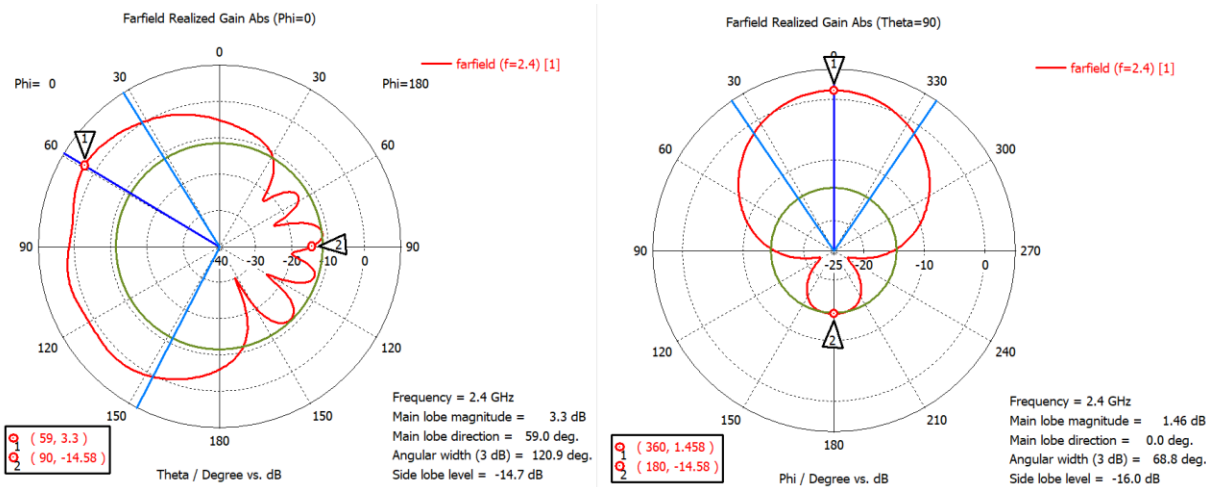


Figure 2. 11. Far-field Radiation Pattern for S-Band Patch Array Antenna added to side of CubeSat structure. **Realized Gain (Polar View)**

Adding the UHF patch antenna to the CubeSat structure side, shows a small enhancement in terms of UHF realized gain, with a operation frequency of 912MHz (shift down of 3MHz), however, the radiation pattern shows a small interference with the Cube metallic structure, shifting the direction of maximum radiation almost 30 degrees from the normal position of the patch antenna (See figures 1.3 to 1.6).

As previously reported, the UHF antenna has a small interference effect on the S-Band patch behavior and Radiation Pattern, possibly due to the current location of both communication antenna systems. With respect to the previous report, there's a small compromise in gain, due to both enlargement of substrate and interference with UHF antenna. (Pending verifications and a new simulation including 2.4m Wire antennas).

| PARAMETER | UHF Rectangular Patch Antenna | UHF Patch added to CubeSat Structure (Only One Side) | UHF and S-Band Patch added to CubeSat Structure (Only One Side) | |
|--|--------------------------------|--|---|----------------------------------|
| | | | UHF Antenna | S-Band Antenna |
| Input Reflection Coefficient (S11 Parameter) | -31.696 dB (at 915 MHz) | -22.650 dB (at 912 MHz) | --22.581 dB (at 912 MHz) | -28.311 dB (at 2.364 GHz) |
| Half-Power (-3 dB Bandwidth) | 50.14 MHz | 56.85 MHz | 56.65 MHz | 248.6 MHz |
| Directivity | 4.550 dBi | 6.368 dBi | 6.473 dBi | 7.480 dBi |
| Gain (IEEE) | -5.879 dB | -1.226 dB | -1.248 dB | |
| Realized Gain | -5.882 dB | -1.267 dB | -1.285 dB | 3.291 dB |
| Half-Power Beamwidth (HPBW) | 95.3 deg | 54.5 deg | 55.4 deg | 120.9 deg |
| Front-to-Back Ratio | 3.056 dB | 16.57 dB | 17.615 dB | 17.88 dB |

Table 1.1. Results Summary for UHF Patch and S-Band Patch Antennas.