S-BAND PATCH ANTENNA DESIGN

1. ***Patch Antennas shifted from Left- and Right-side to Top- and Bottom-side of CubeSat structure:*** S-Band square/rectangular patch antenna, for operation at 2.4GHz, shifted from Left- and Right-side to Top- and Bottom-side of CubeSat structure (Same side as Panels). Design stage performed with 2.4 m Wire Antennas, which are not yet energized. Simulations performed with CST Studio Suite 2017 ©.

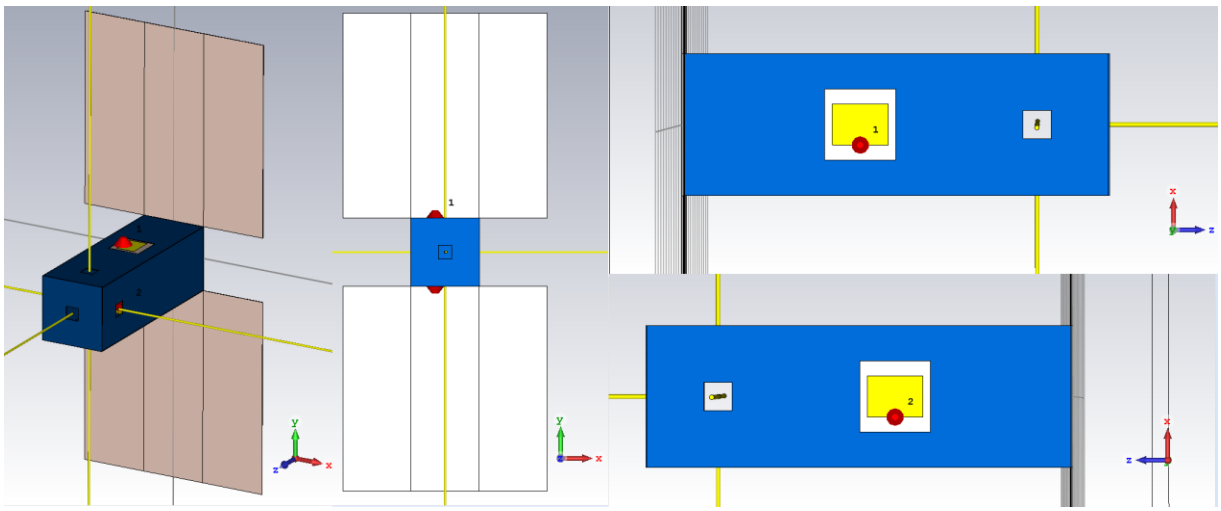

Figure 1.1. Cube-Sat structure. Perspective, Front, Top-side and Bottom-side Views

Name	Expression	Value	Description	Type
f	2.4	2.4	Frequency [GHz]	Frequency
Gpatch	10	10	Distance From Box Edge to Patch [cm]	Length
Hbox	10	10	Box Height (Y Axis) [cm]	Length
Hpan	10	10	Panel Height/Width (X Axis) [cm]	Length
Lambda	12.5	12.5	Wavelength [cm]	Length
LambdaG	6.1808	6.1808	Guided Wavelength [cm]	Length
Lbox	30	30	Box Length (Z Axis) [cm]	Length
Lpan	30	30	Panel Length (Y Axis) [cm]	Length
Lpatch	2.8973	2.8973	Patch Length (Y Axis) [cm]	Length
Lsubs	5	5	Substrate Length (Y Axis) [cm]	Length
MPHole	2	2	Wire Antenna Box Hole	Length
Tbox	0.1	0.1	Box Thickness [cm]	Length
Tpan	0.08	0.08	Panel Thickness [cm]	Length
Tpatch	0.005	0.005	Patch Thickness (X Axis) [cm]	Length
Tsubs	Tbox	0.1	Substrate Thickness (X Axis) [cm]	Length
Wpatch	3.9393	3.9393	Patch Width (Z Axis) [cm]	Length
Wposc	Hbox/2	5	Wire Antena Central Position [cm]	Length
Wsubs	Lsubs	5	Substrate Width (Z Axis) [cm]	Length
Lwire	240	240	Wire Antenna Length [cm]	Length
Rwire	0.16	0.16	Wire Antenna Radius [cm]	Length

Figure 1.2. Parameter List for Structure design

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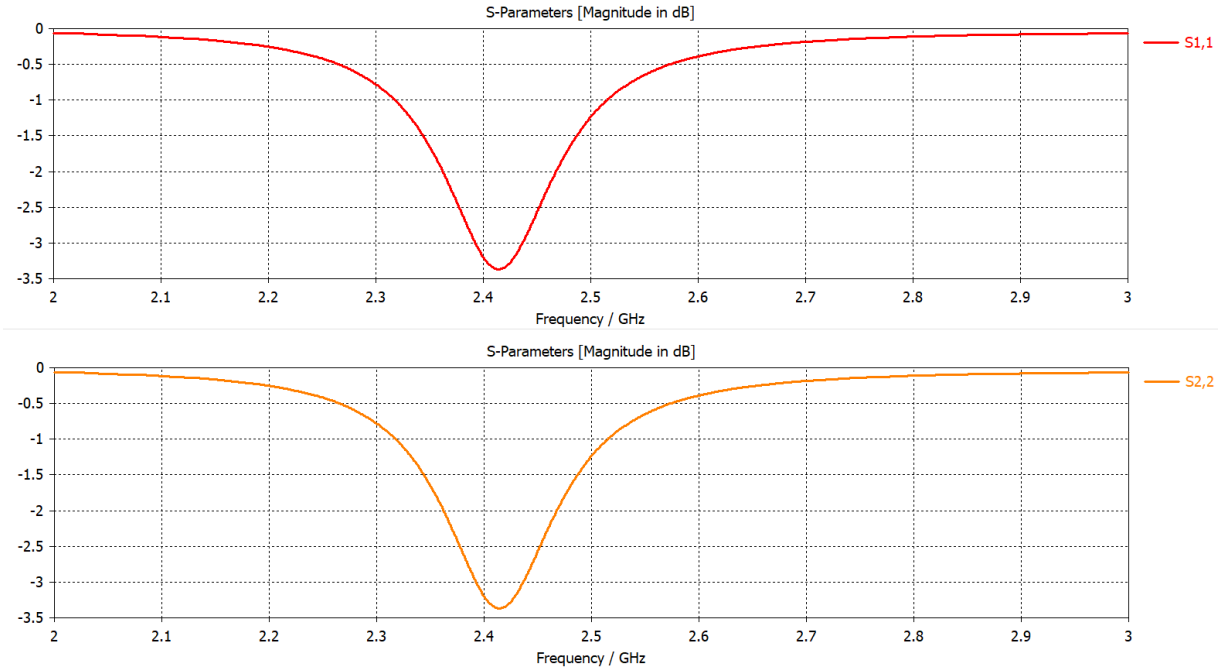

Figure 1.3. Input reflection coefficients (S11 and S22 Parameters) for both S-Band Patch Antennas

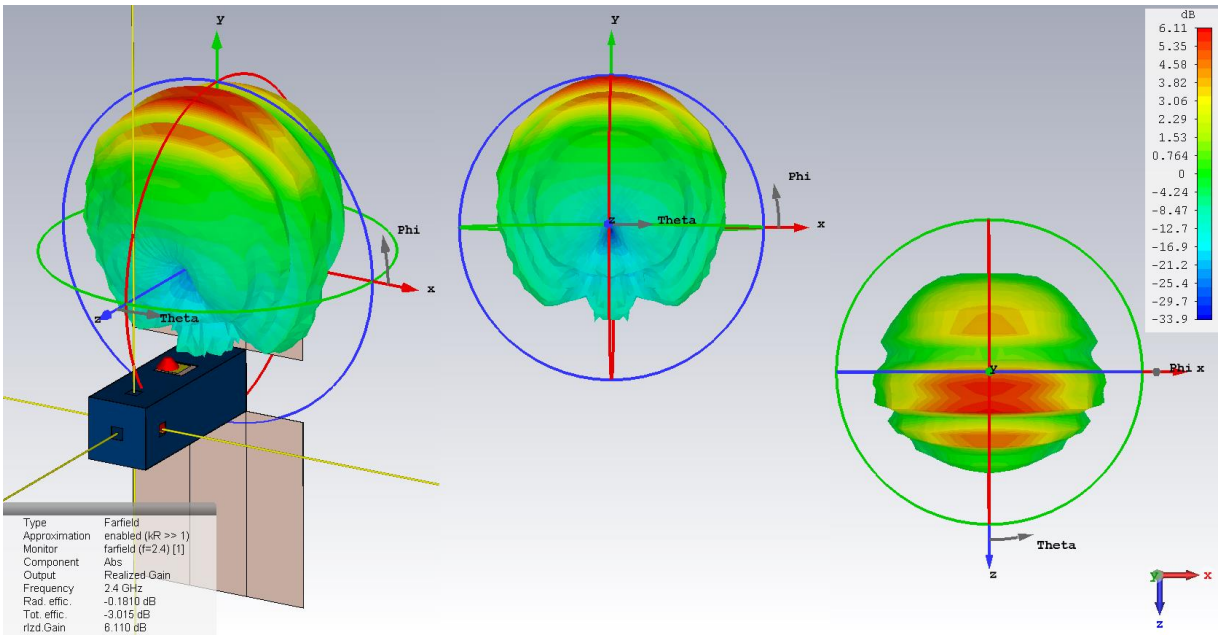

Figure 1.4. Far-field Radiation Pattern for Top-Side Patch Antenna Design. Realized Gain.

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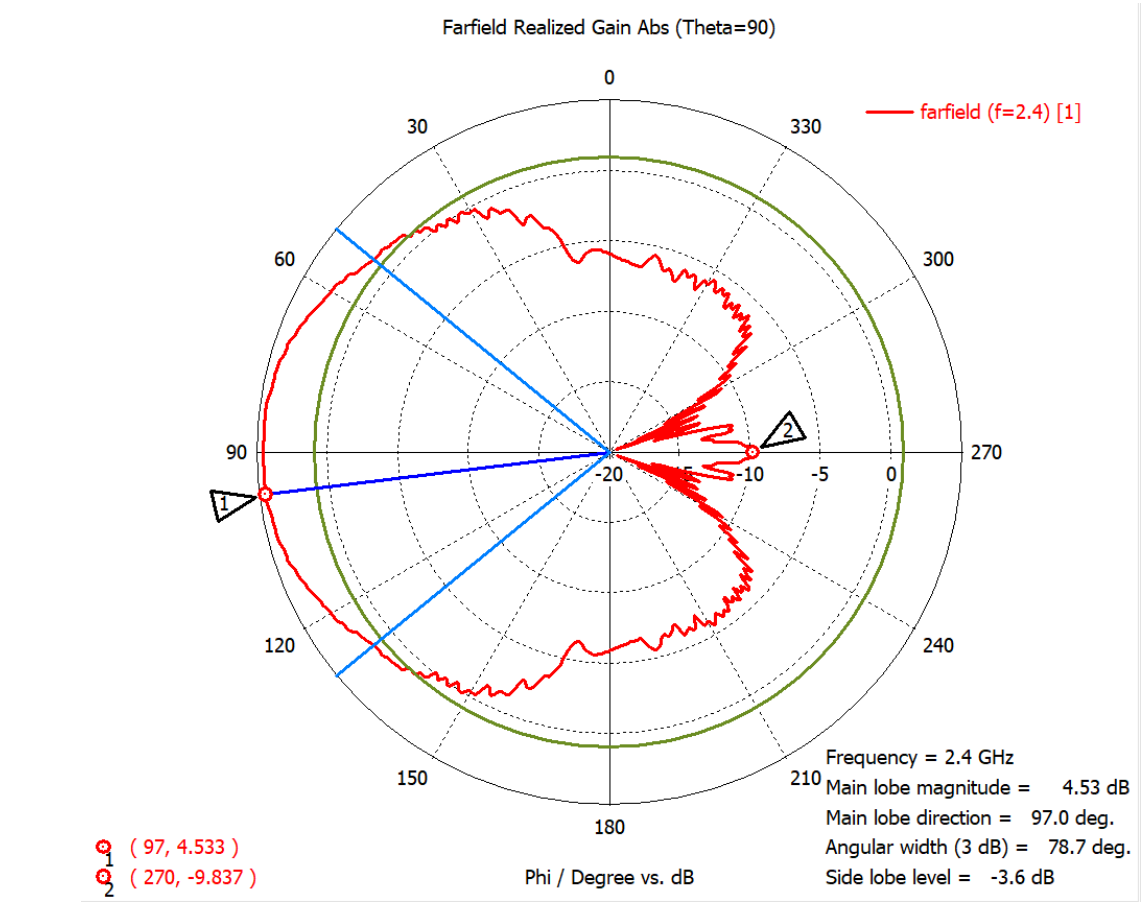

Figure 1.5. Far-field Radiation Pattern for Top-Side Patch Antenna Design. Realized Gain. (Polar View)

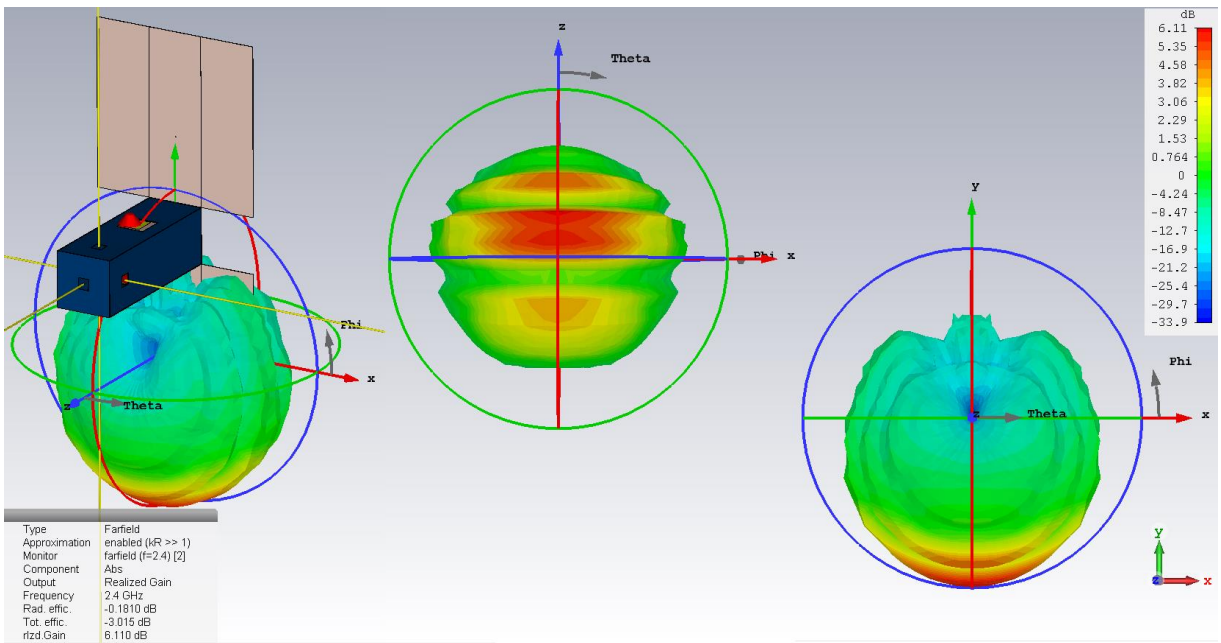

Figure 1.6. Far-field Radiation Pattern for Bottom-Side Patch Antenna Design. Realized Gain.

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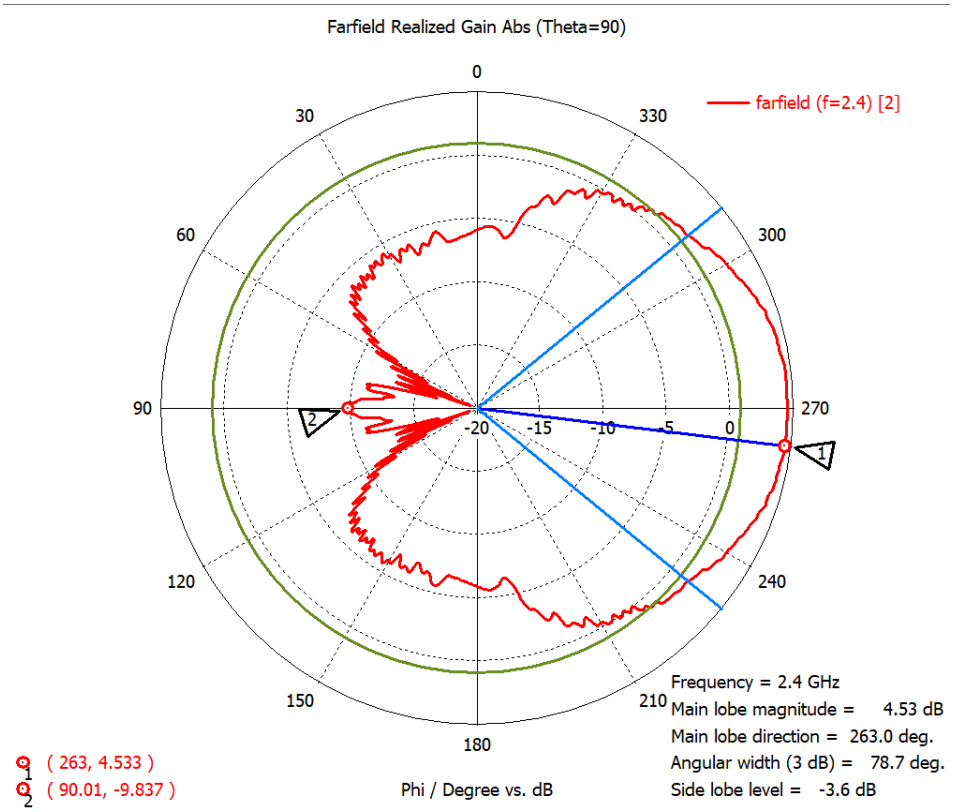

Figure 1.7. Far-field Radiation Pattern for Bottom-Side Patch Antenna Design. Realized Gain. (Polar View)

PARAMETER	Top-Side Patch	Right-Side Patch
Input Reflection Coefficient (S11 Parameter)	-3.3703(at 2.415 GHz)	-3.3703(at 2.415 GHz)
Directivity	9.126 dBi	9.126 dBi
Gain (IEEE)	8.945 dB	8.945 dB
Realized Gain	6.110 dB	6.110 dB
Front-to-Back Ratio	14.137	14.137

Table 1.1. Results Summary.

S-band patch behavior doesn't present a significant change in comparison with the previous location on the CubeSat structure. Also, Panel (simulated as a FR-4 board) without cells, still presents no interference effect. Comparing with the results presented in previous reports, is clear that the 2.4m Wire Antennas produce the interference on the farfield patterns for S-Band Patches, as well as an effect on Antenna Input Reflection Coefficient (and hence, in the Return Loss as well).

Is highly desirable to have a lower reflection coefficient (Higher in absolute magnitude). As reference, without wires, reflection coefficient for patch antenna is -14.79 dB and Return Loss is -23.399 dB; and with wire antennas, reflection coefficient is now 3.3703 dB and Return Loss is - 10.553 dB.

***Pending: Simulation results energizing all 3 wire antennas, and simulation shifting position of patch antenna with its corresponding 2.4m Wire.**