Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [The Effect of Human Body on UWB BAN Antenna]

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Abstract: [Discussions on the Effect of Human Body on UWB BAN ANTENNA]

Purpose: [To provide an introduction of the Effect of Human Body on UWB BAN ANTENNA]

THE EFFECT OF HUMAN BODY ON UWB BAN ANTENNA

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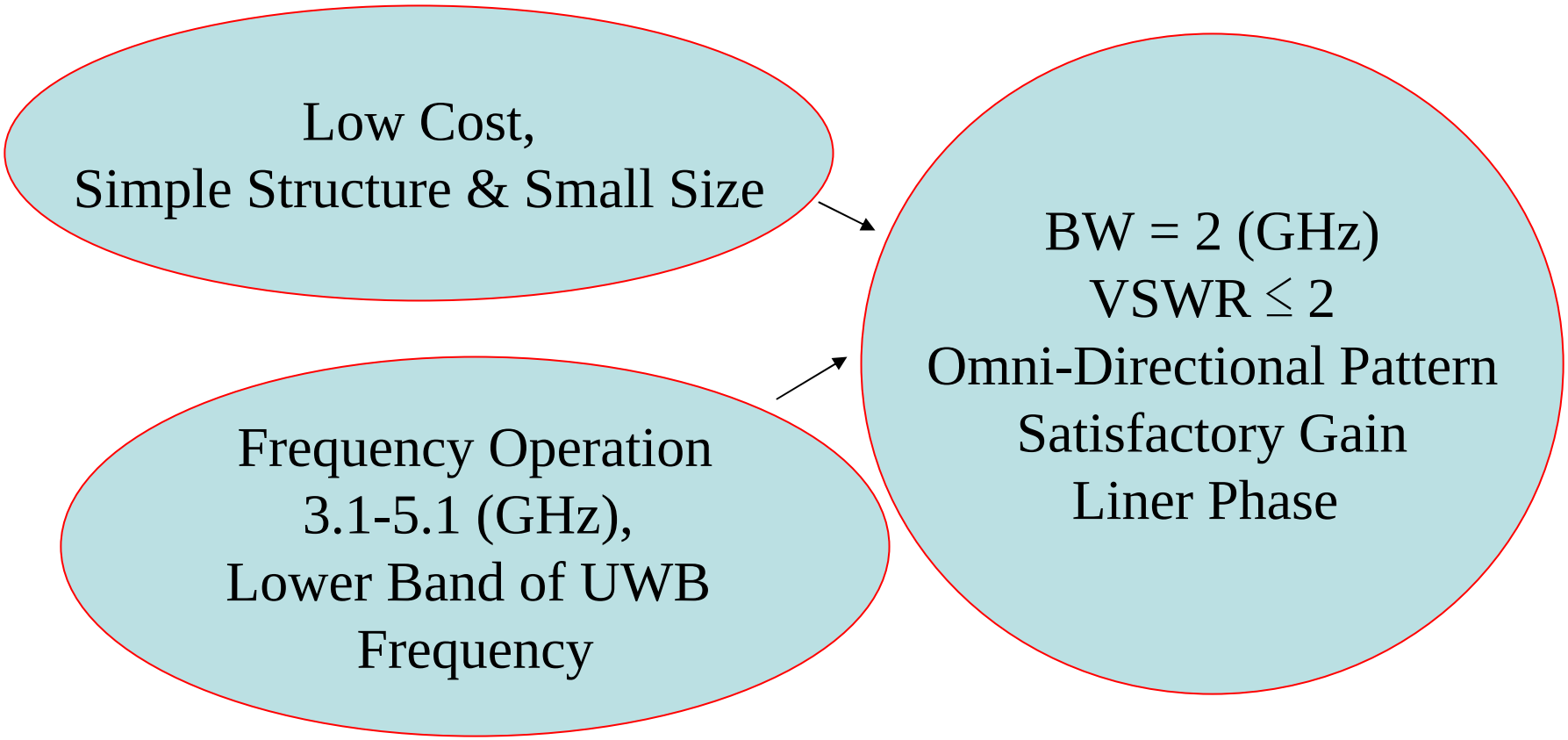
Outline

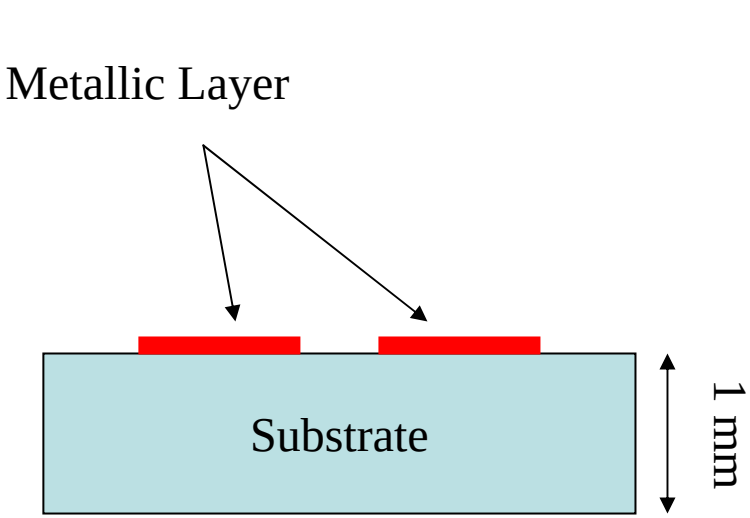
- UWB Antenna in Free Space
- UWB Antenna on Direct Contact with Human Body
- UWB Antenna on Direct Contact with Human Body with 2nd Substrate
- Conclusion

Antenna in Free Space

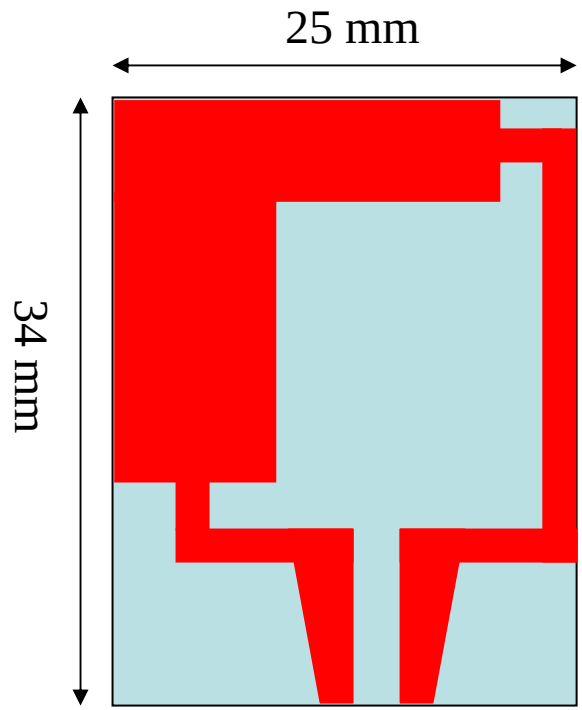
Aim of Design



Developed Antenna



Side view of the antenna Structure



Top view of the antenna structure

Substrate: FR4 (ε r = 4.4)
Metal: Copper (t = 18 um)

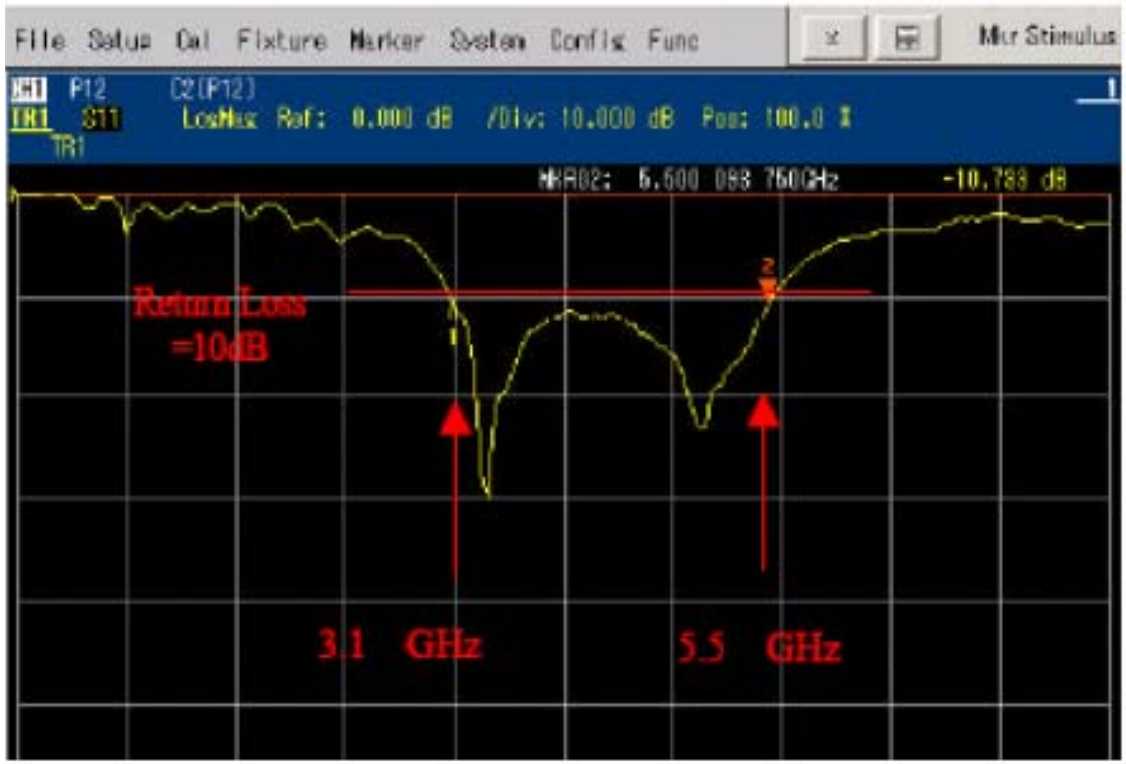
Feed Line

- The antenna is fed through a couple tapered transmission line.
- The tapered transmission lines have shown good impedance matching over a wide frequency range.
- The geometry of the taper is chosen to minimize the reflection and optimize impedance matching and bandwidth.

Prototype

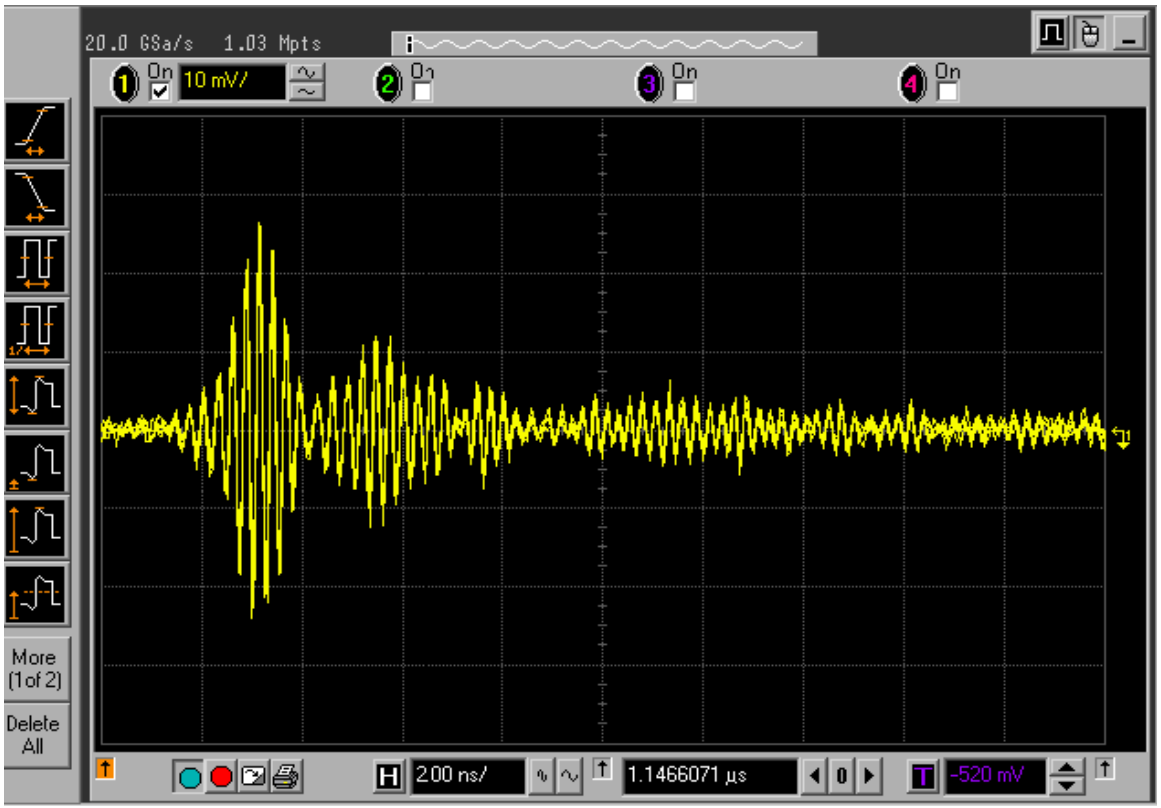
Results (Free Space)

Return Loss



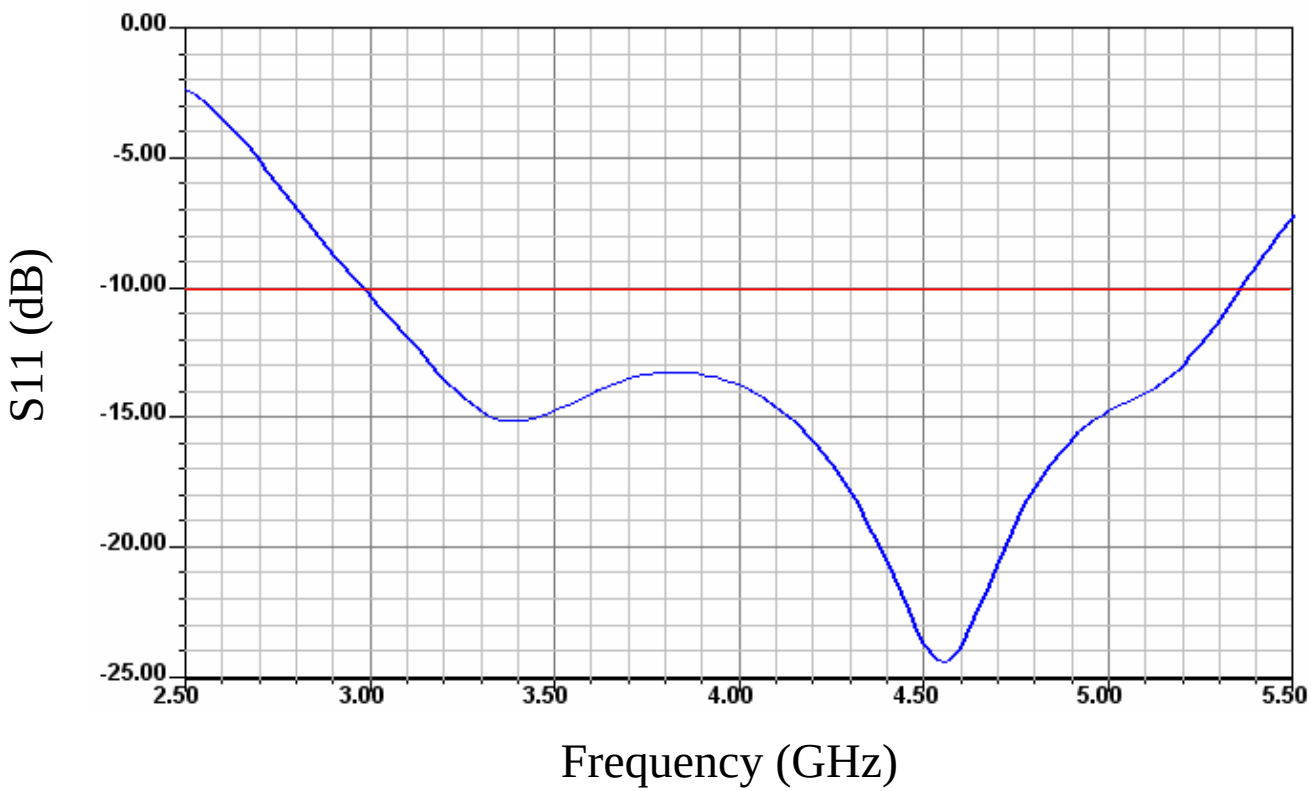
Results (Free Space)

Impulse Response (Receive Signal)



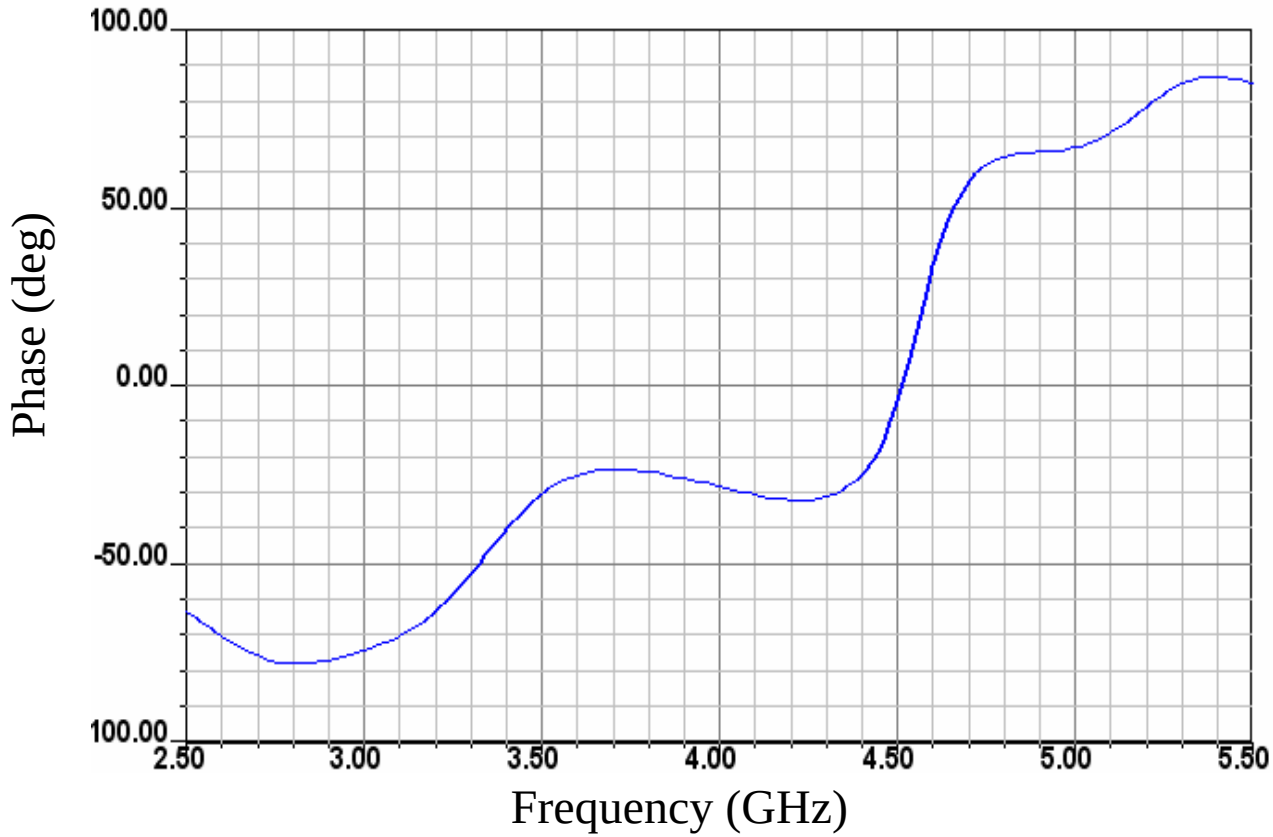
Results (Free Space)

Return Loss



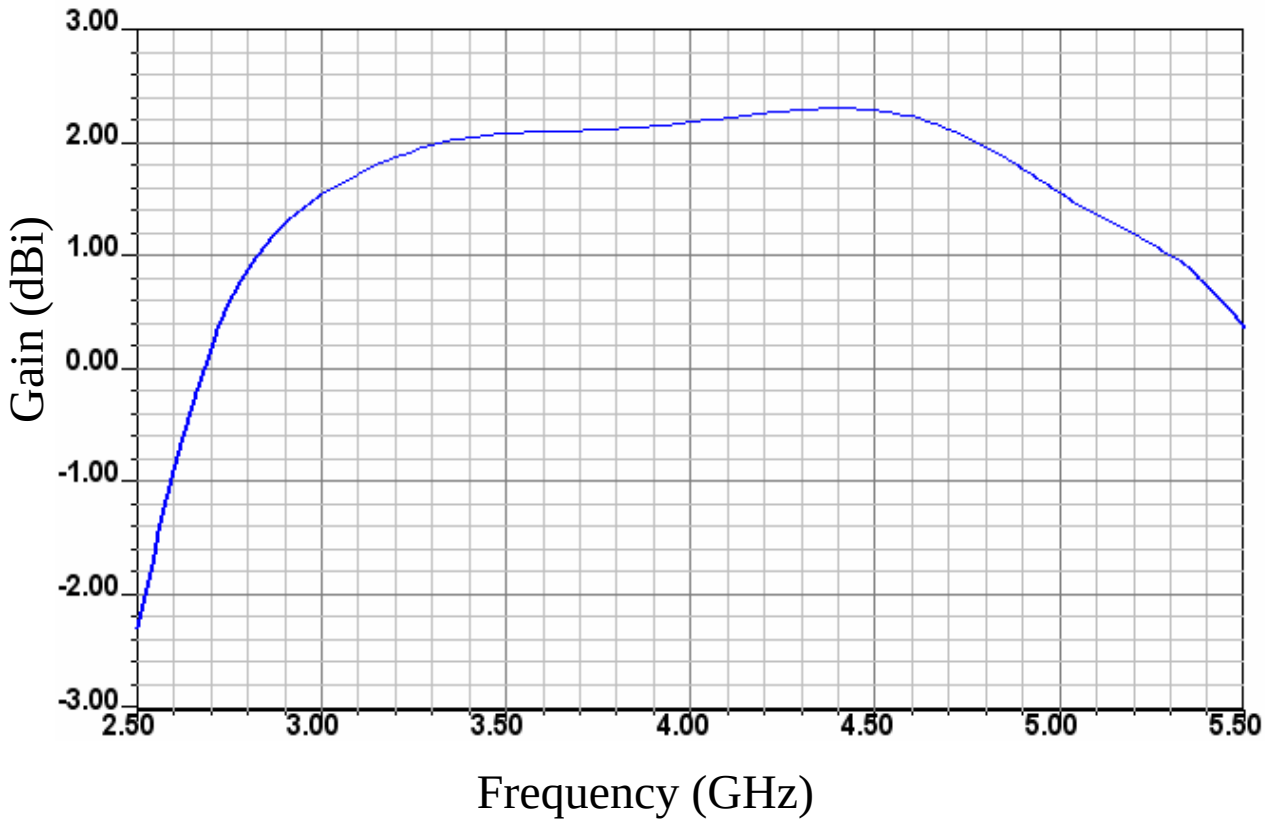
Results (Free Space)

Phase



Results (Free Space)

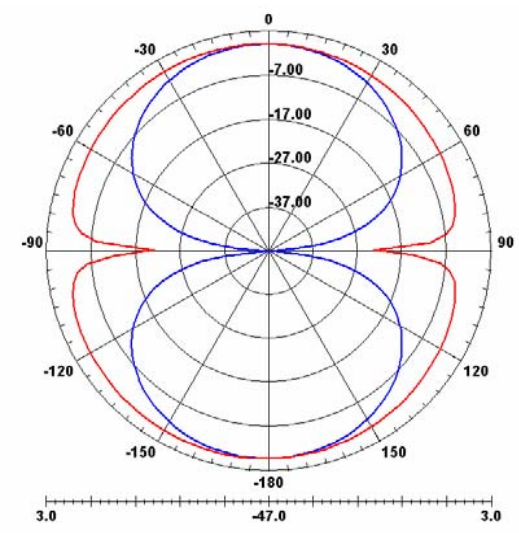
Gain



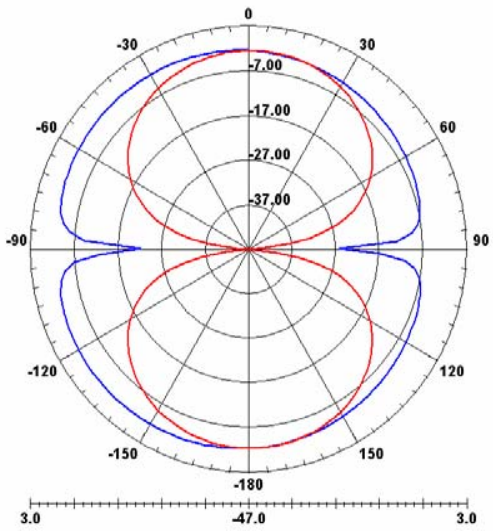
Results (Free Space)

Radiation Pattern (dBi) at 3.1 GHz

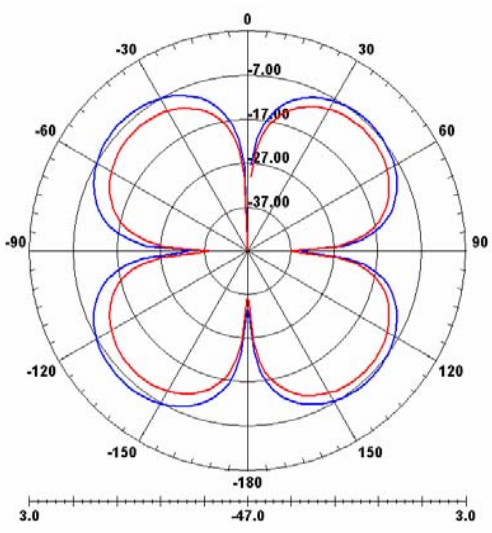
$\phi = 0$ $\phi = 90$



y-z plane



x-z plane

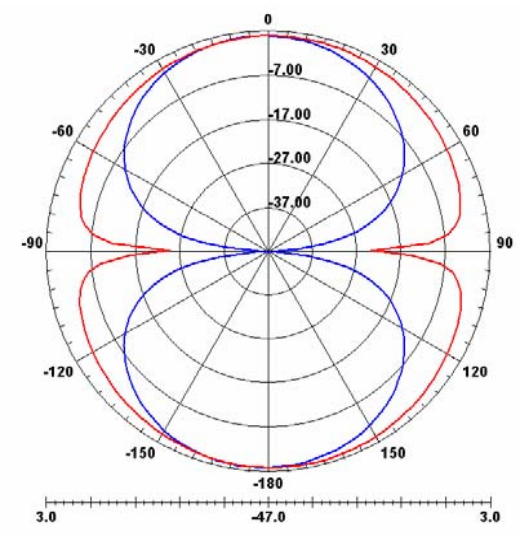


x-y plane

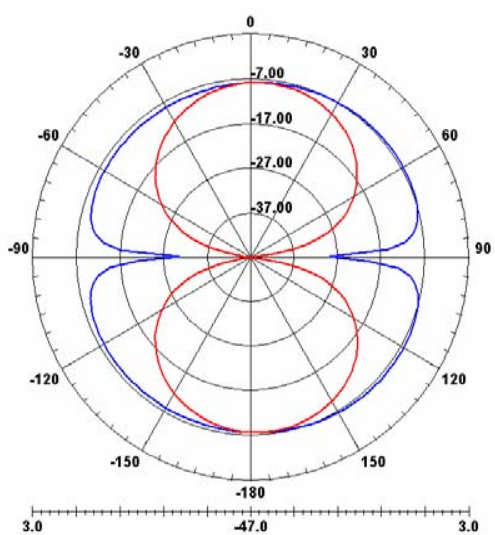
Results (Free Space)

Radiation Pattern (dBi) at 4.1 GHz

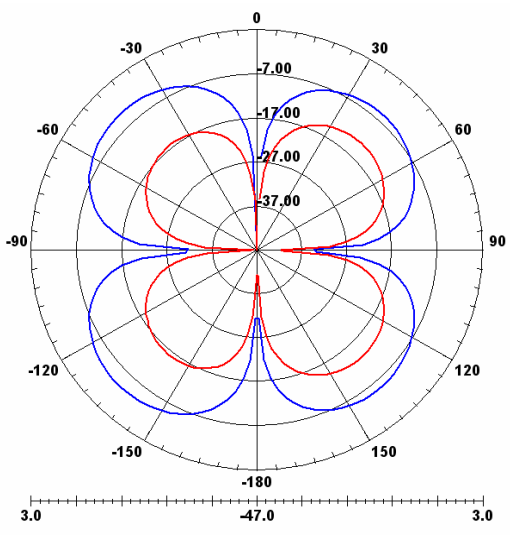
$\phi = 0$ $\phi = 90$



y-z plane



x-z plane

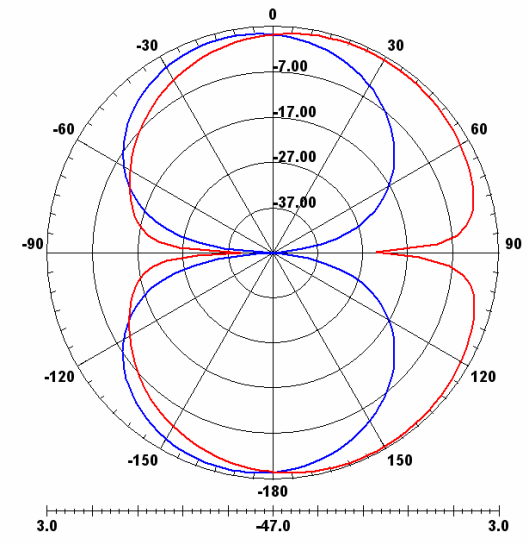


x-y plane

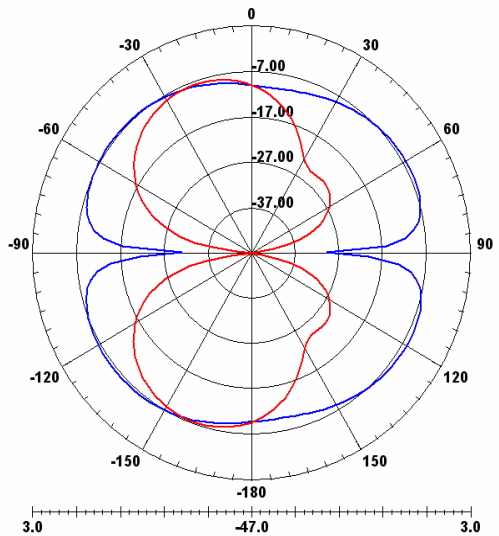
Results (Free Space)

Radiation Pattern (dBi) at 5.1 GHz

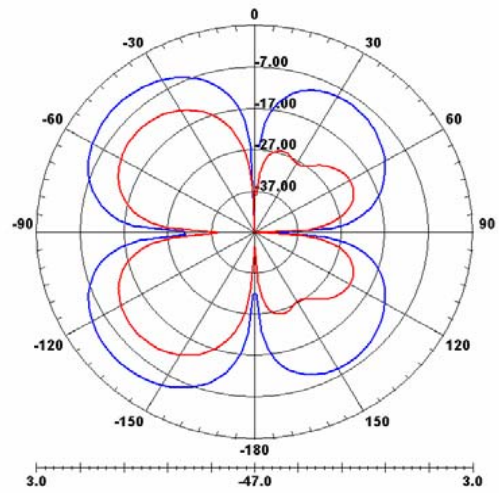
$\phi = 0$ $\phi = 90$



y-z plane



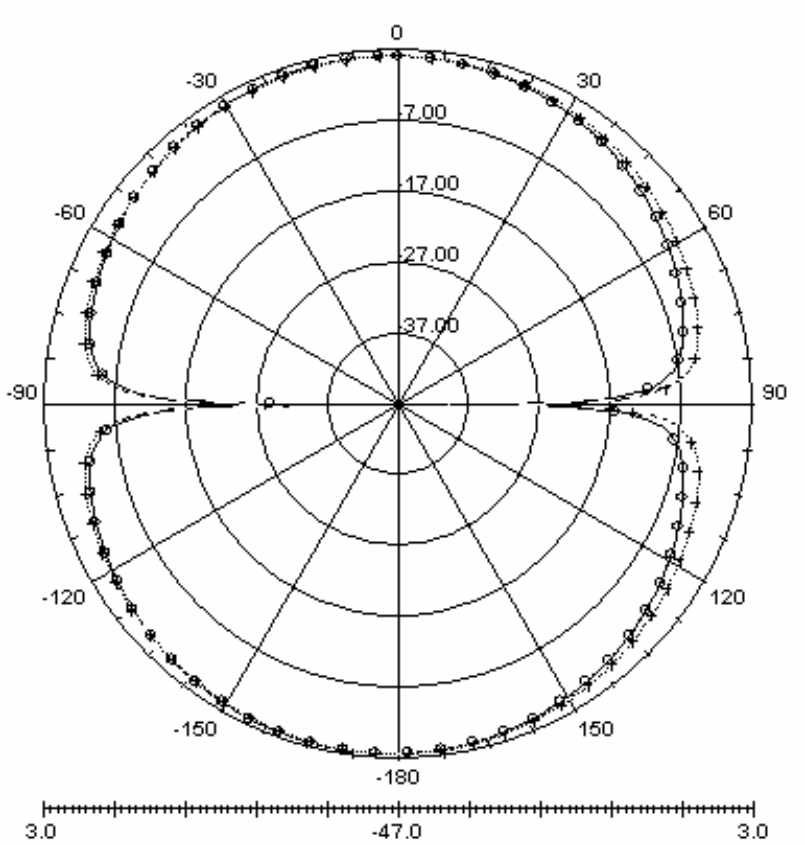
x-z plane

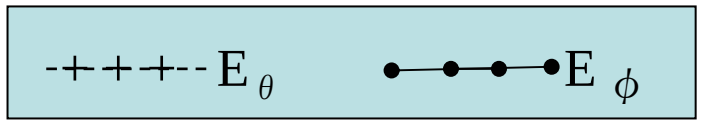


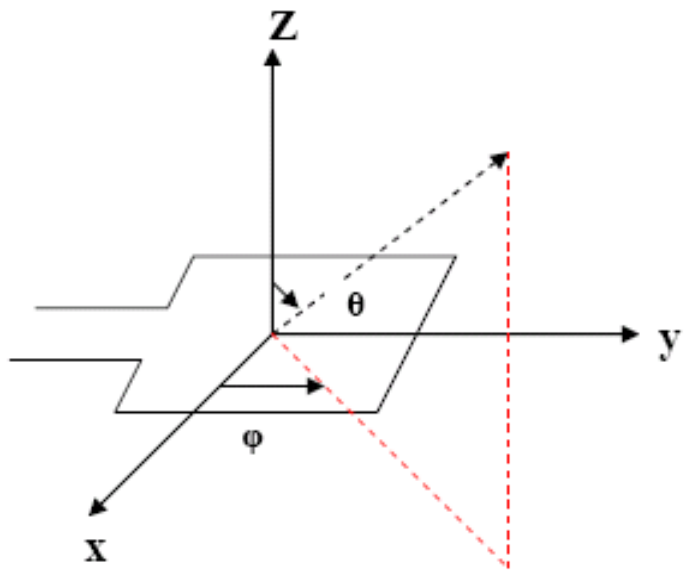
x-y plane

Results (Free Space)

Radiation Pattern (dBi) at 3.1 GHz

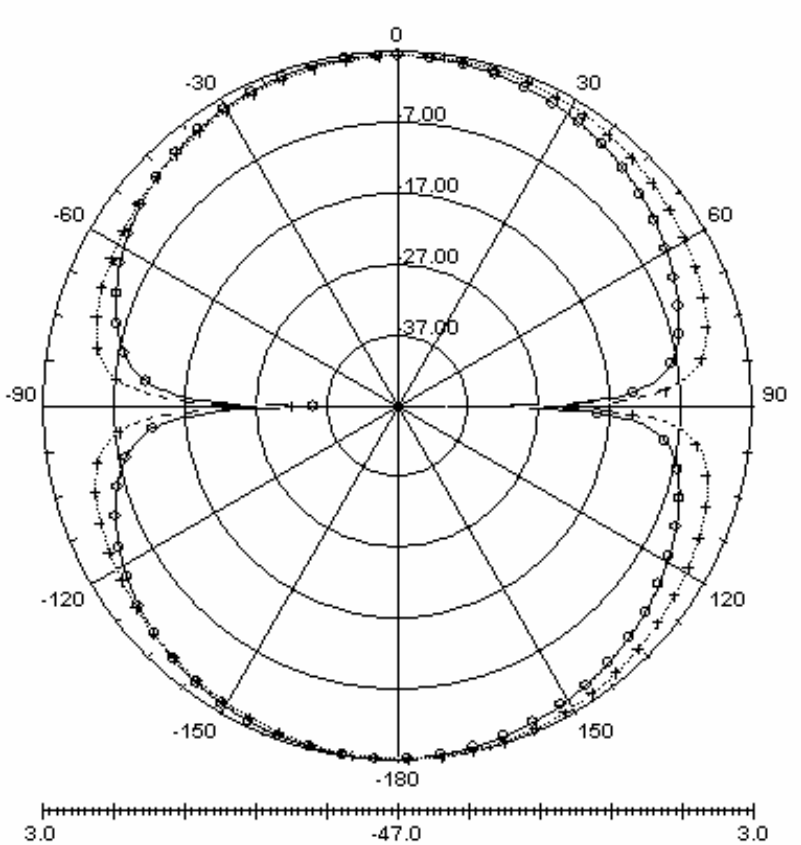


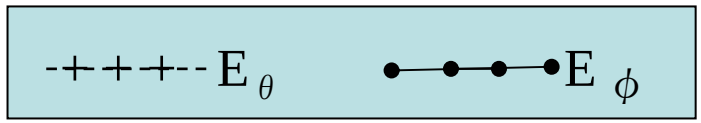


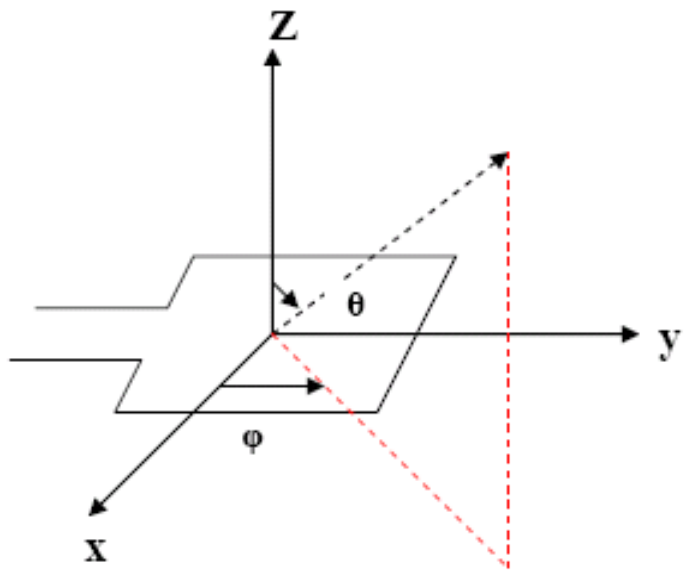


Results (Free Space)

Radiation Pattern (dBi) at 4.1 GHz

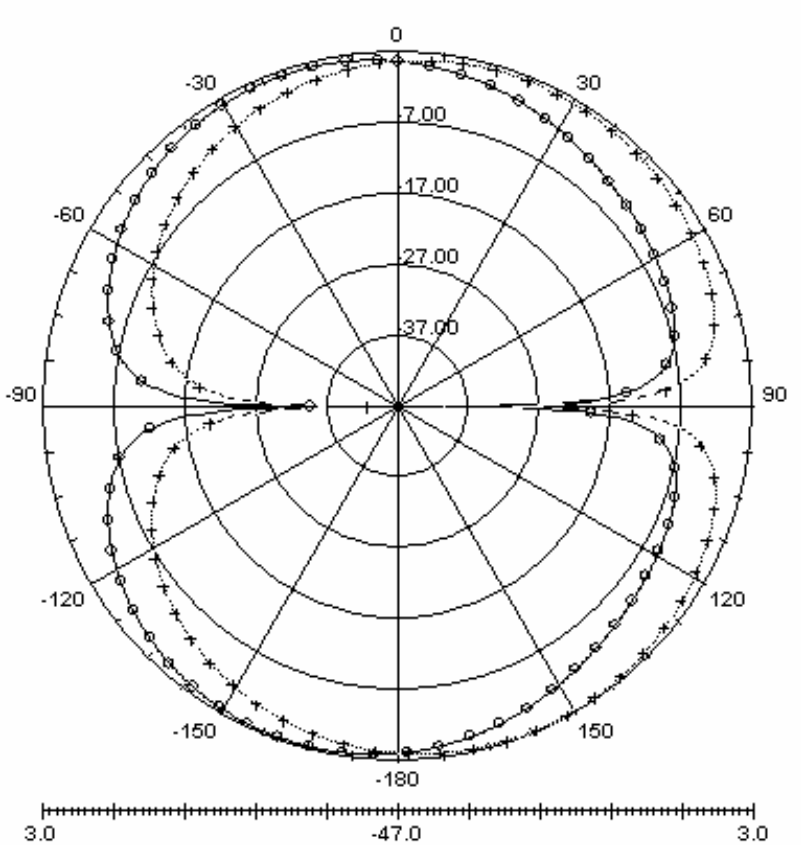


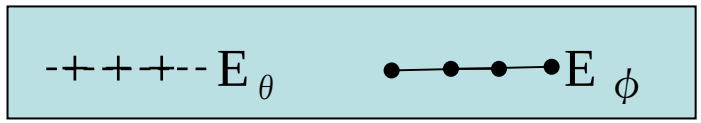


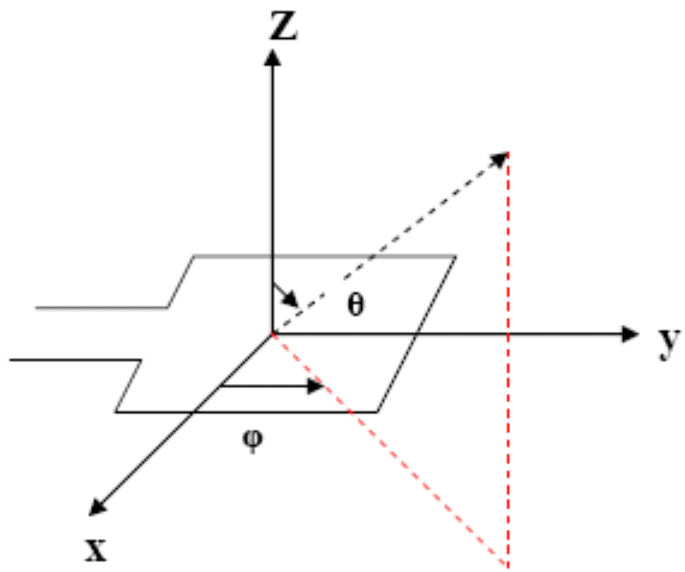


Results (Free Space)

Radiation Pattern (dBi) at 5.1 GHz

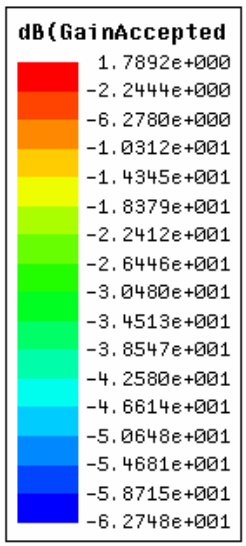


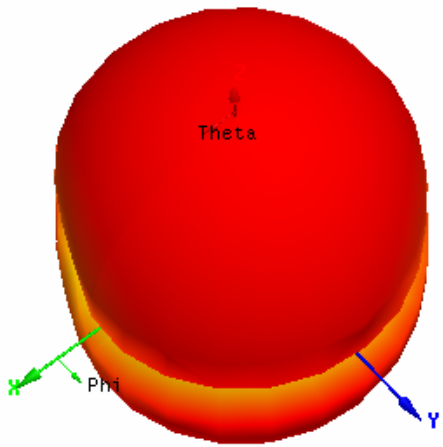


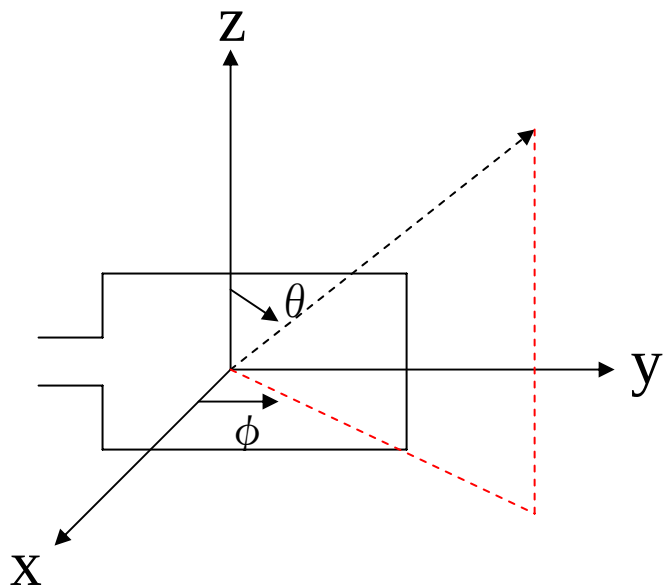


Results (Free Space)

3D Radiation Pattern

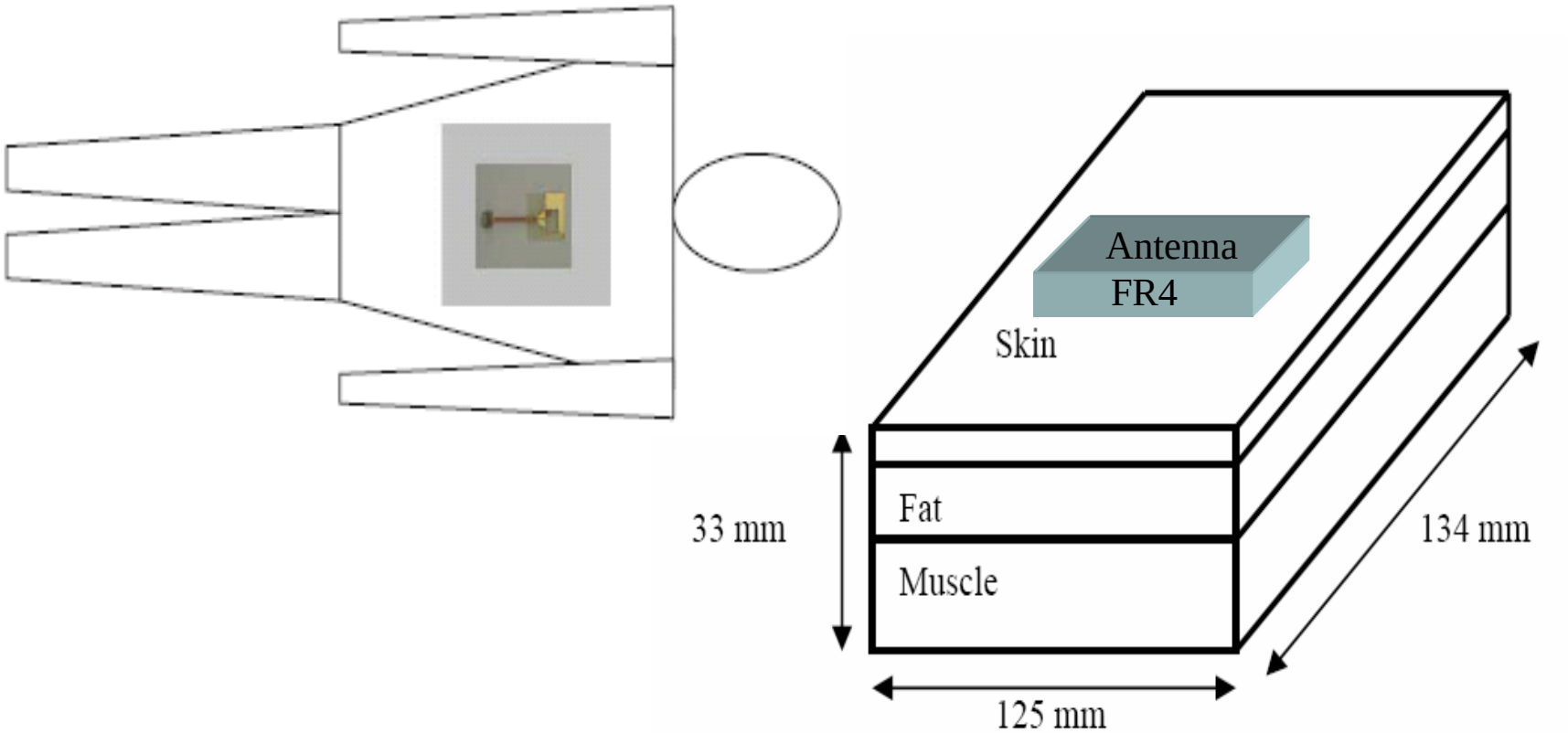






Antenna on Direct Contact with Human Body

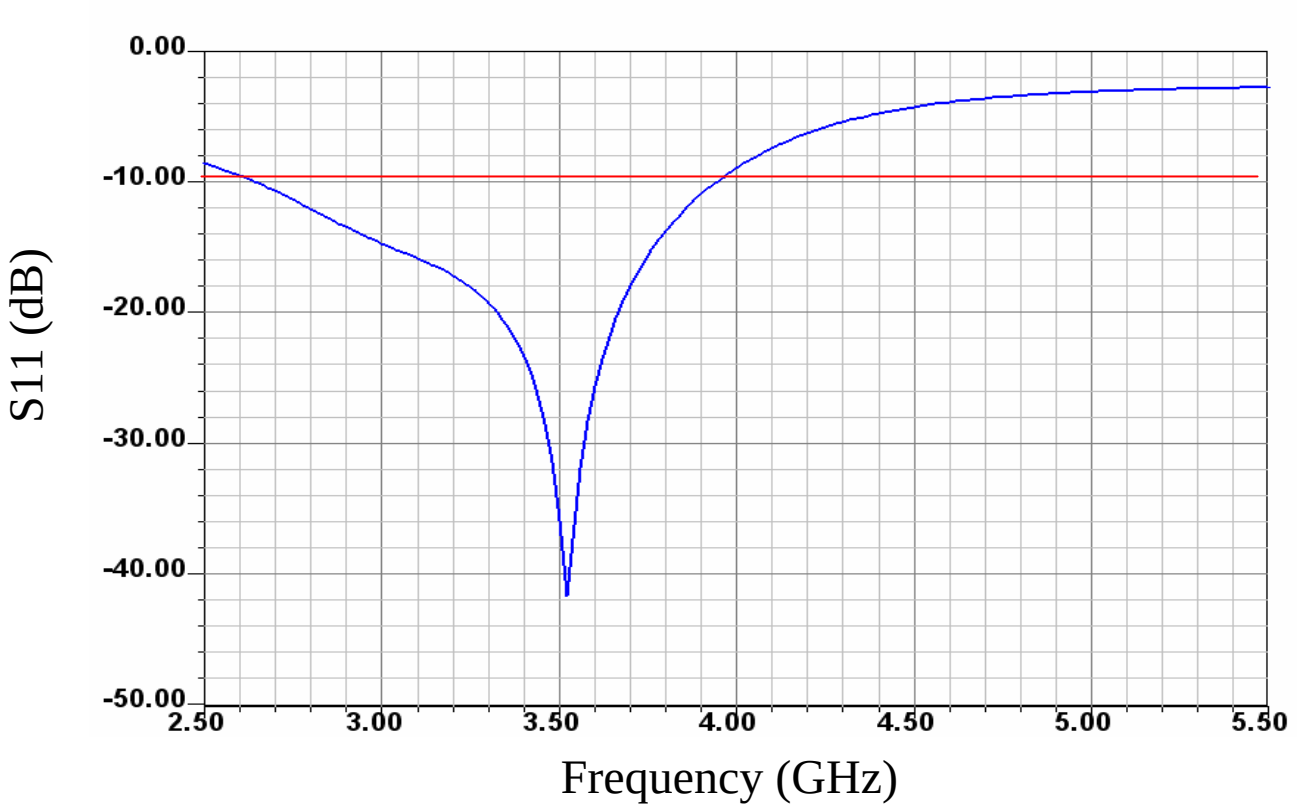
Direct Contact of the Antenna Substrate with Skin



A part of human chest wall used in electromagnetic simulation

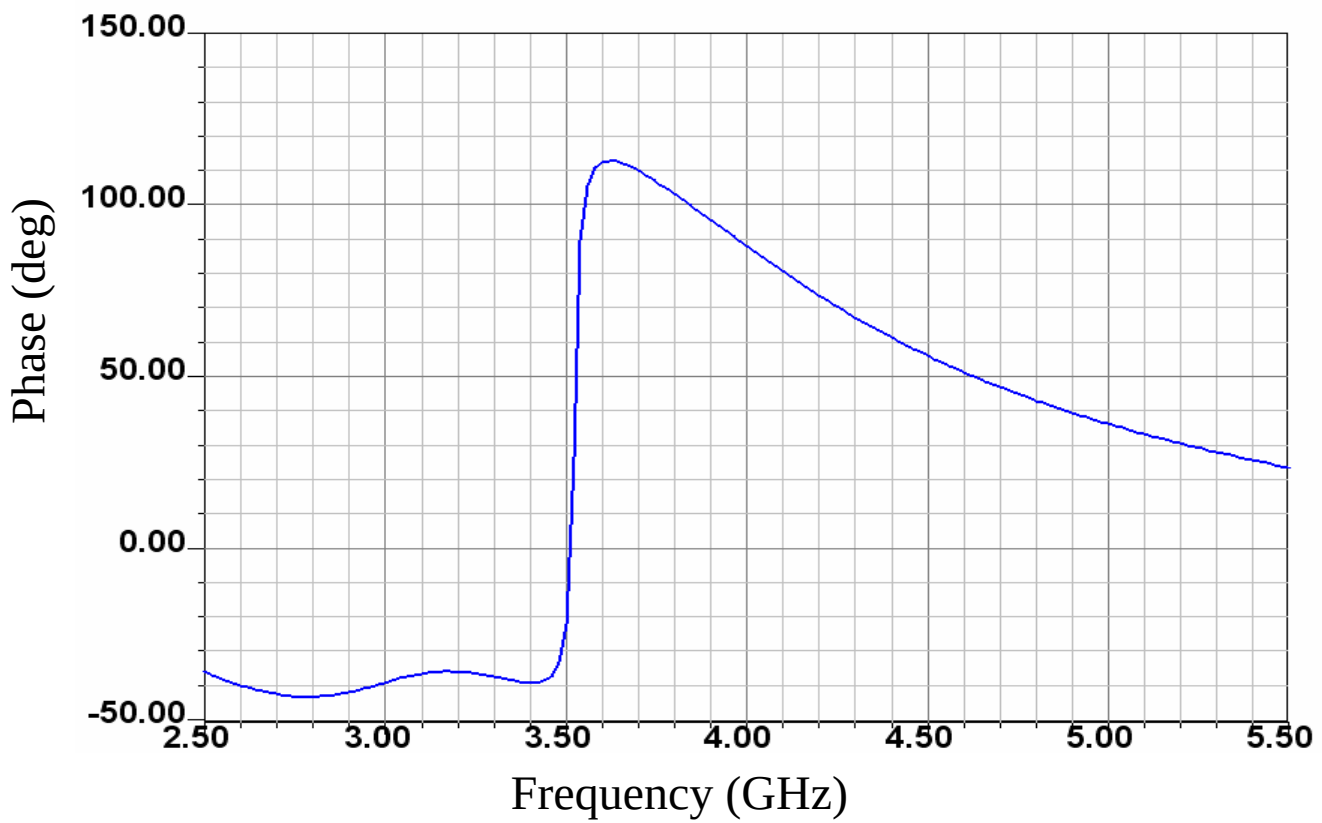
Results (On Body, Direct Contact)

Return Loss



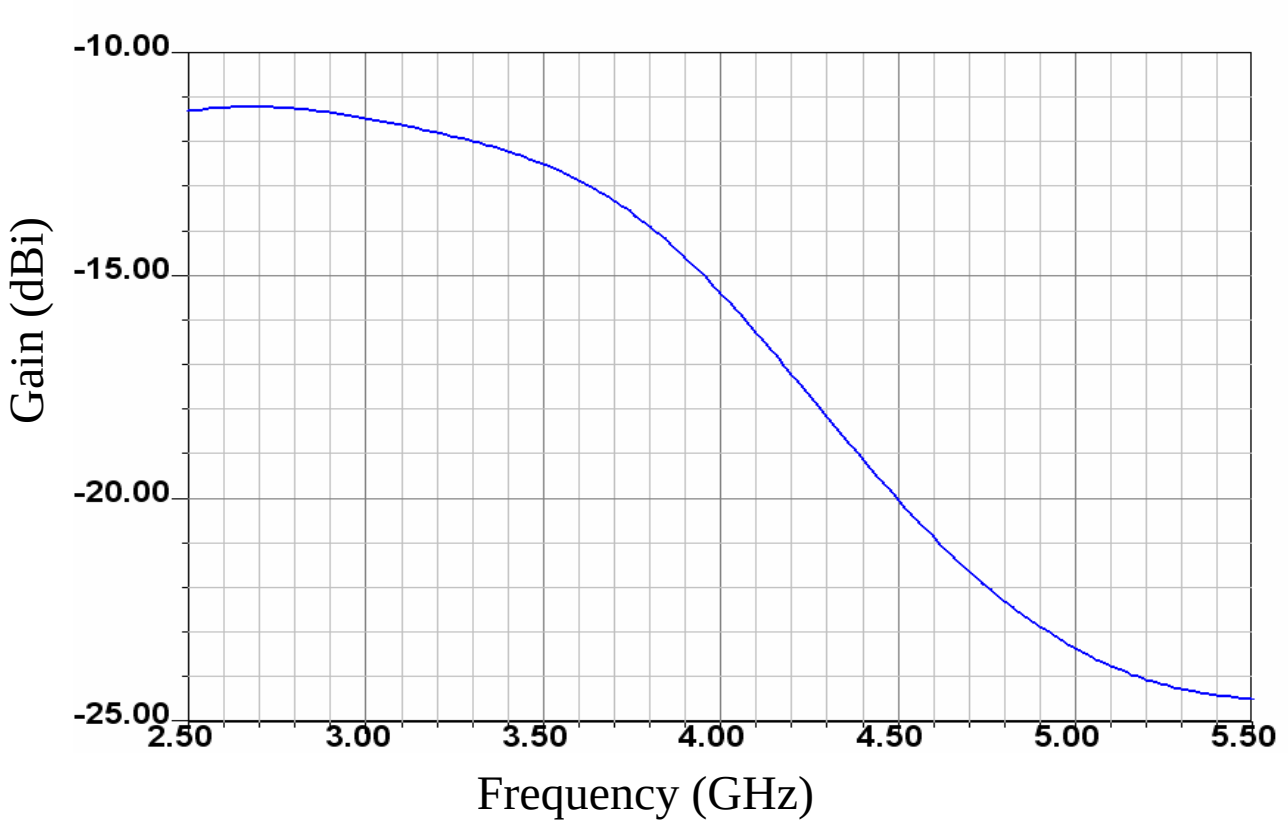
Results (On Body, Direct Contact)

Phase



Results (On Body Direct Contact)

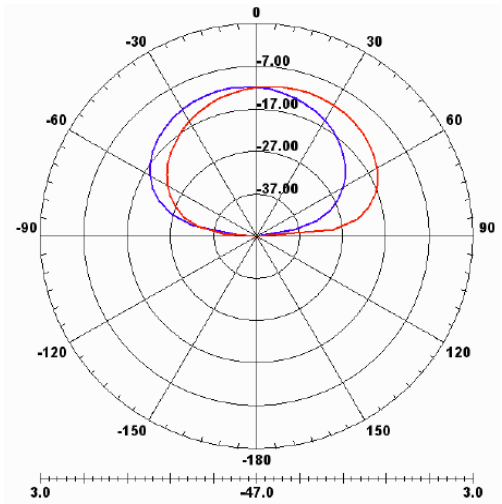
Gain



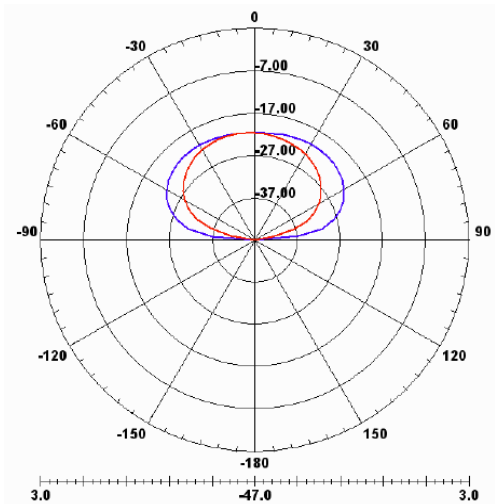
Results (On Body, Direct Contact)

Radiation Pattern (dBi) at 3.1 GHz

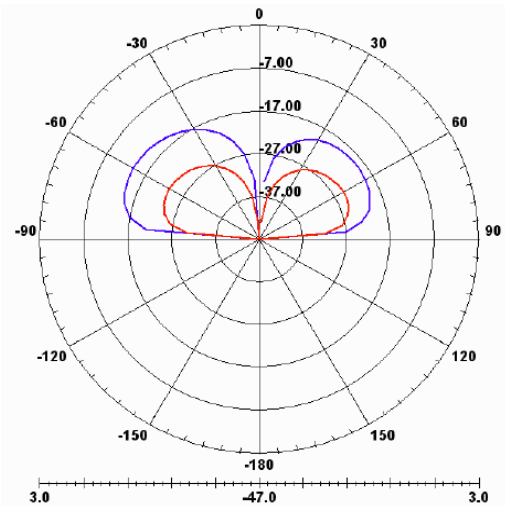
$\phi = 0$ $\phi = 90$



y-z plane



x-z plane

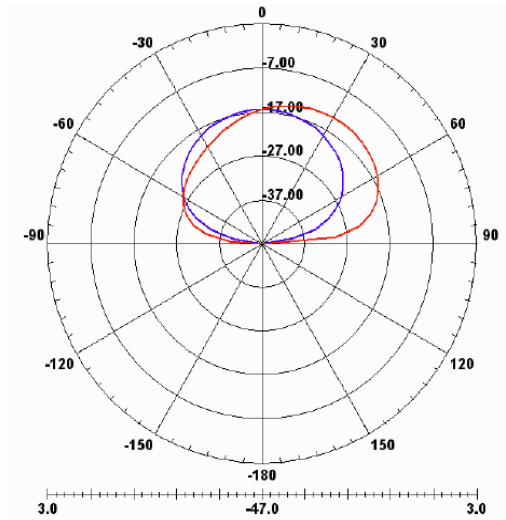


x-y plane

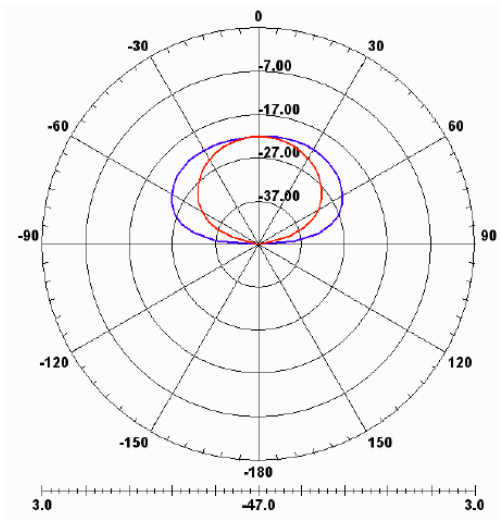
Results (On Body, Direct Contact)

Radiation Pattern (dBi) at 4.1 GHz

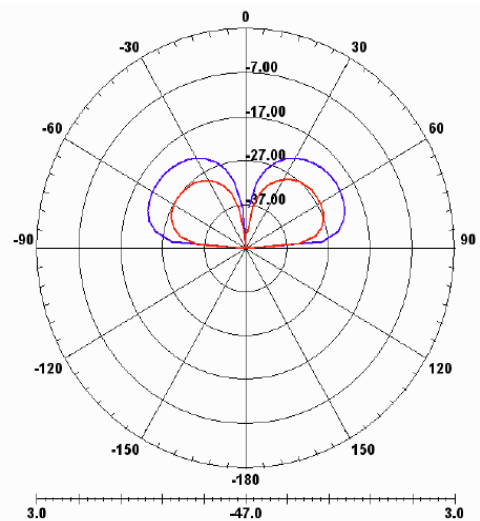
$\phi = 0$ $\phi = 90$



y-z plane



x-z plane

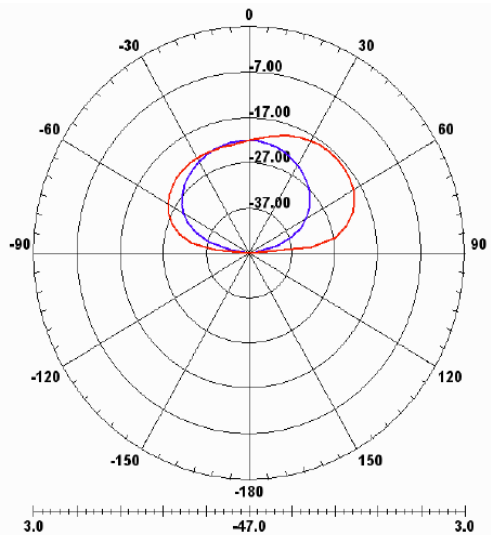


x-y plane

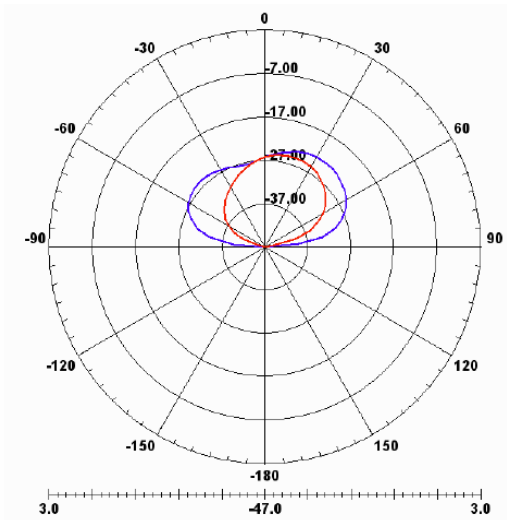
Results (On Body, Direct Contact)

Radiation Pattern (dBi) at 5.1 GHz

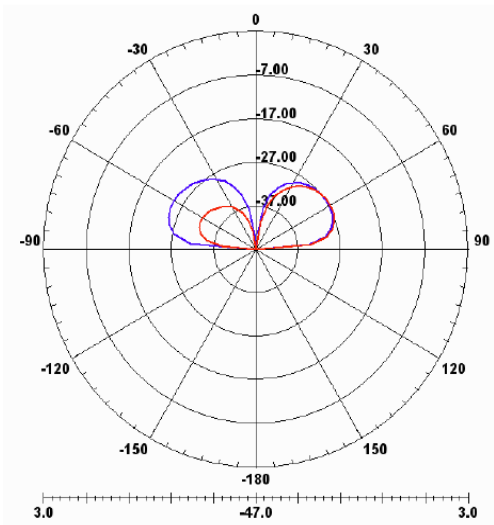
$\phi = 0$ $\phi = 90$



y-z plane



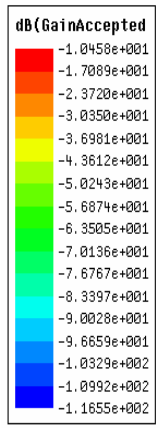
x-z plane

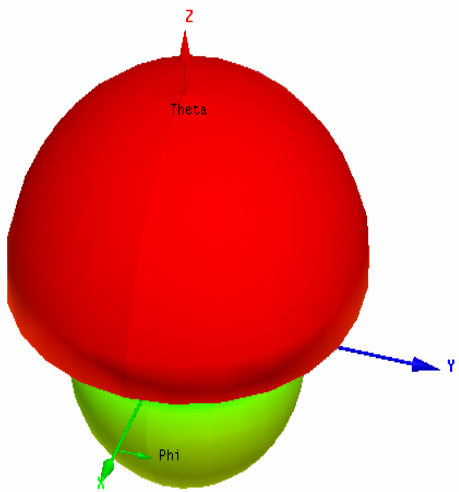


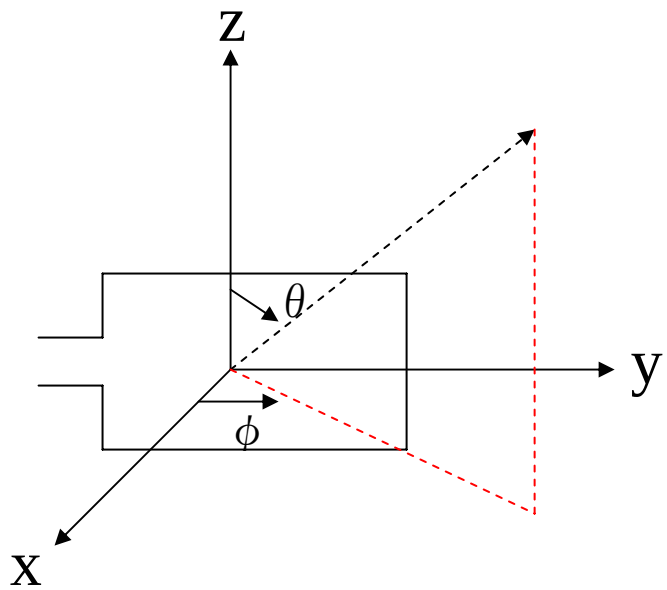
x-y plane

Results (On Body, Direct Contact)

3D Radiation Pattern







Antenna on Direct Contact with Human Body with 2nd Substrate

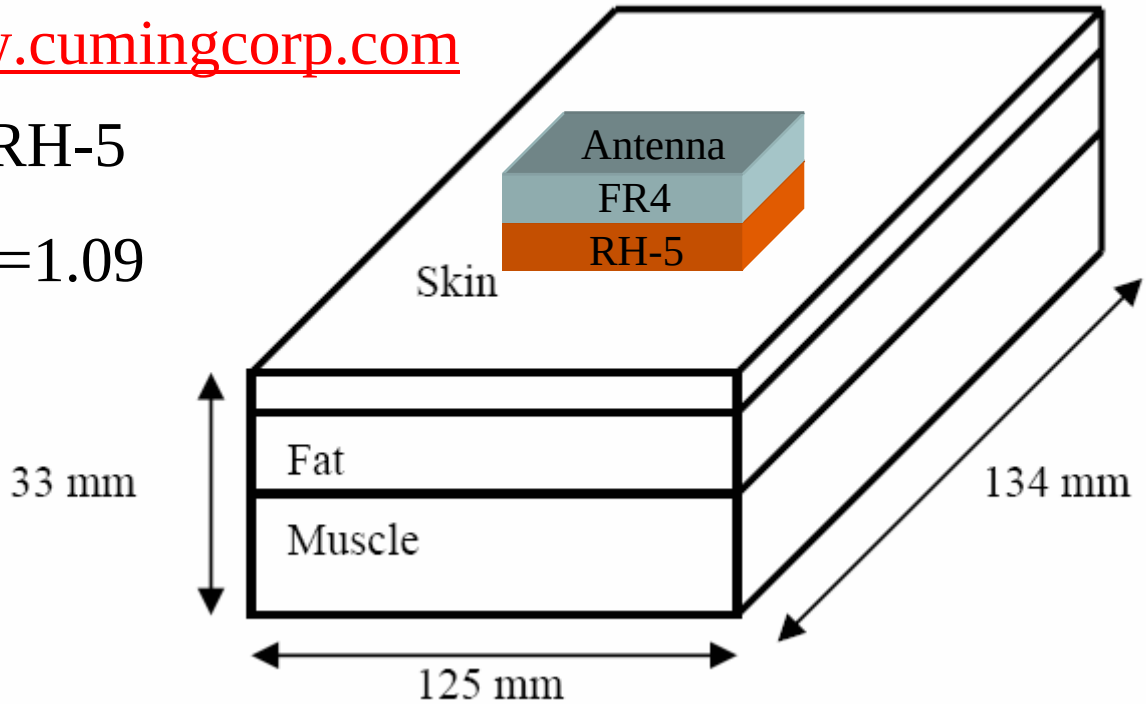
Direct Contact of the Antenna Substrate with Skin

http://www.cumingcorp.com

2nd Substrate: RH-5

t = 14 mm , ε_r=1.09

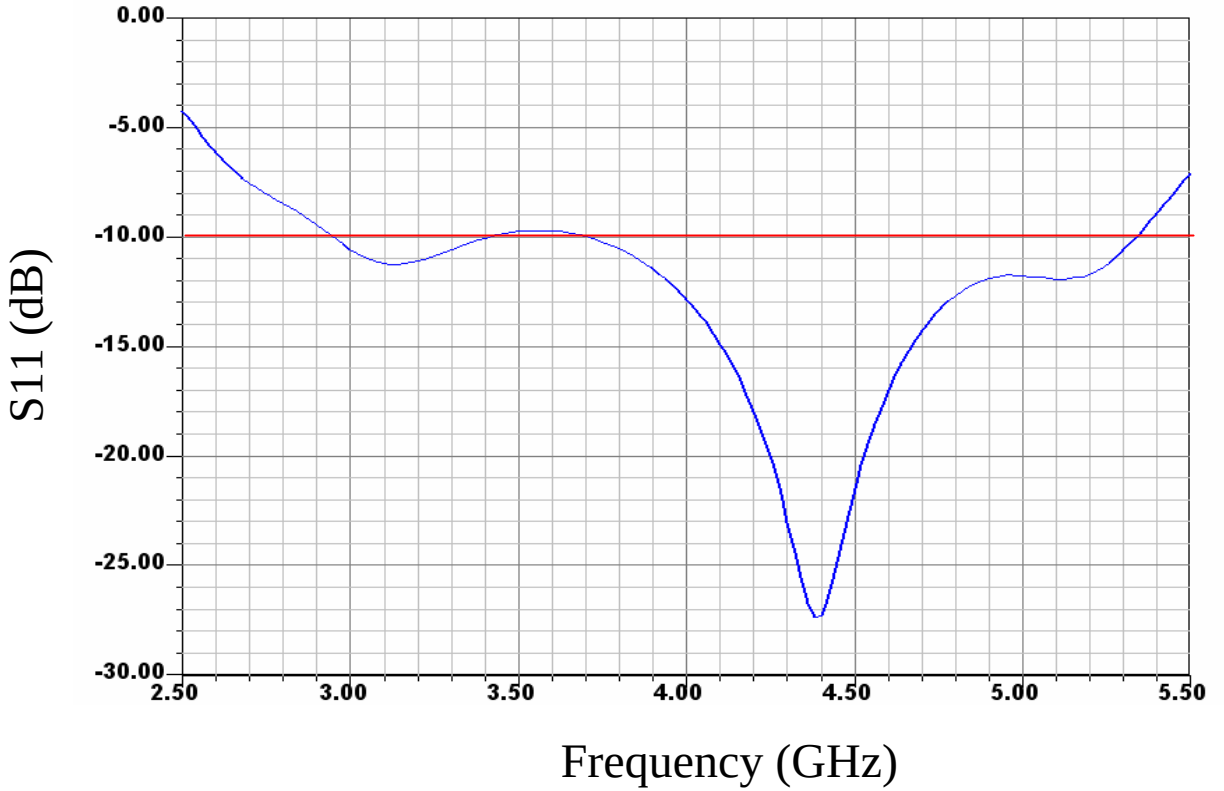
tan θ =0.0004



A part of human chest wall used in electromagnetic simulation

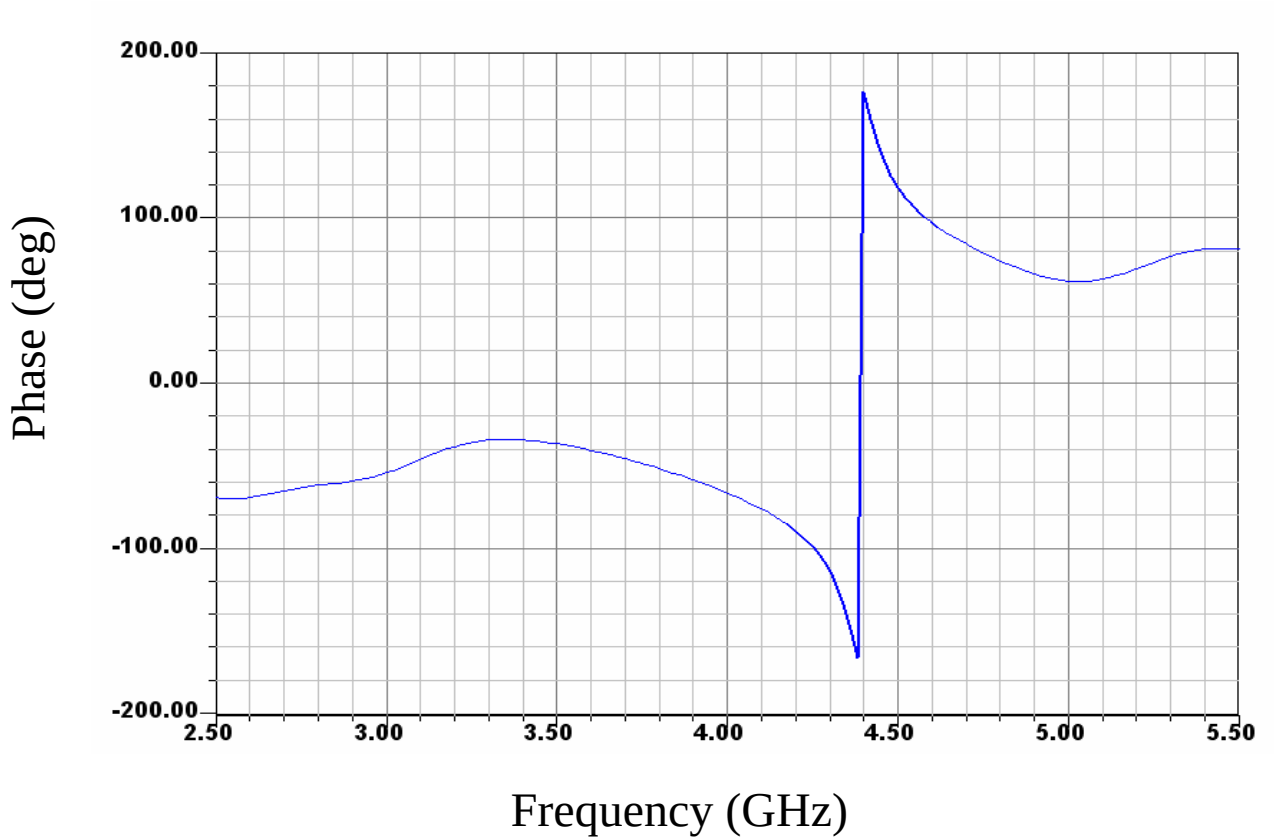
Results (Direct Contact, 2nd Substrate)

Return Loss



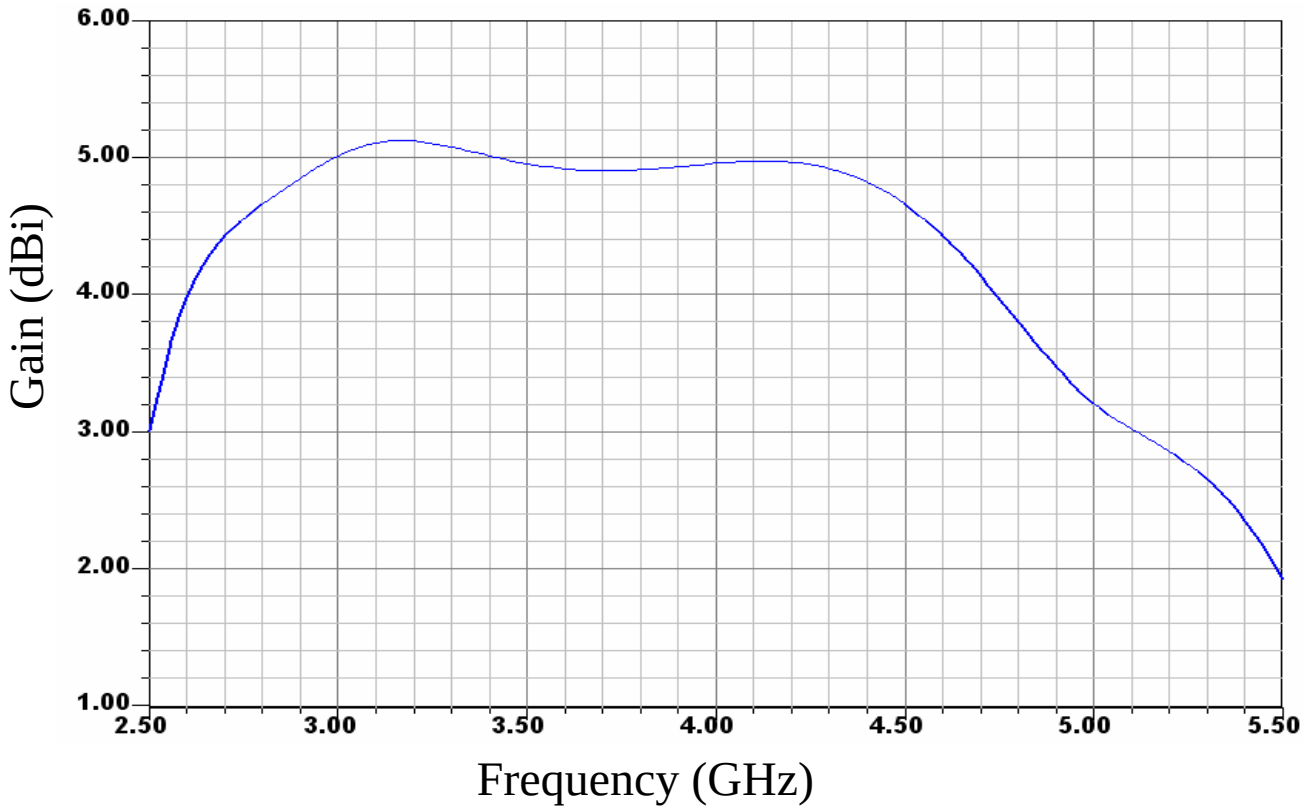
Results (Direct Contact, 2nd Substrate)

Phase



Results (Direct Contact, 2nd Substrate)

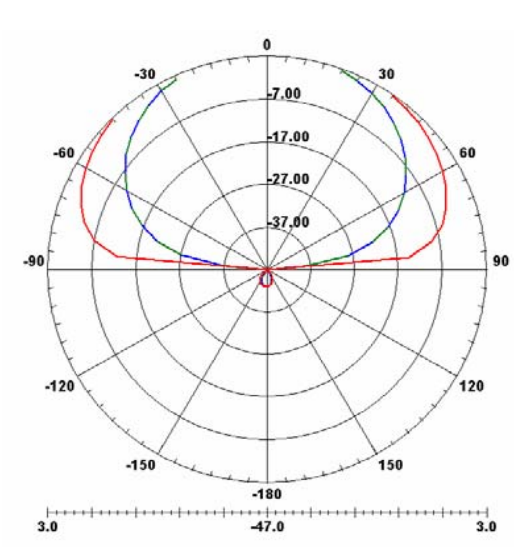
Gain



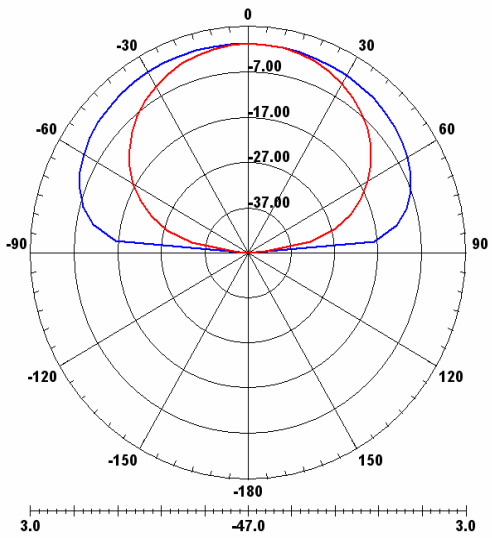
Results (Direct Contact, 2nd Substrate)

Radiation Pattern (dBi) at 3.1 GHz

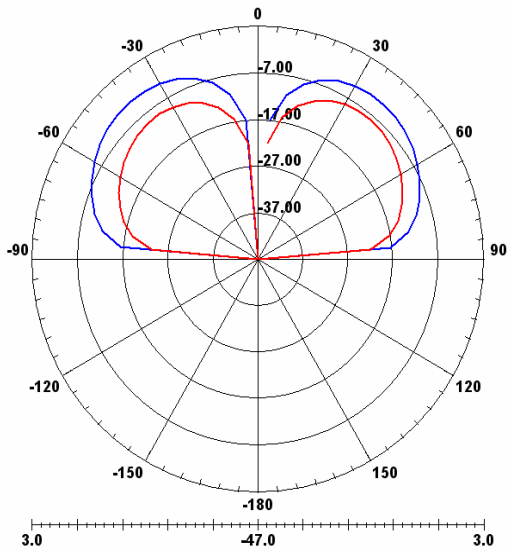
$\phi = 0$ $\phi = 90$



y-z plane



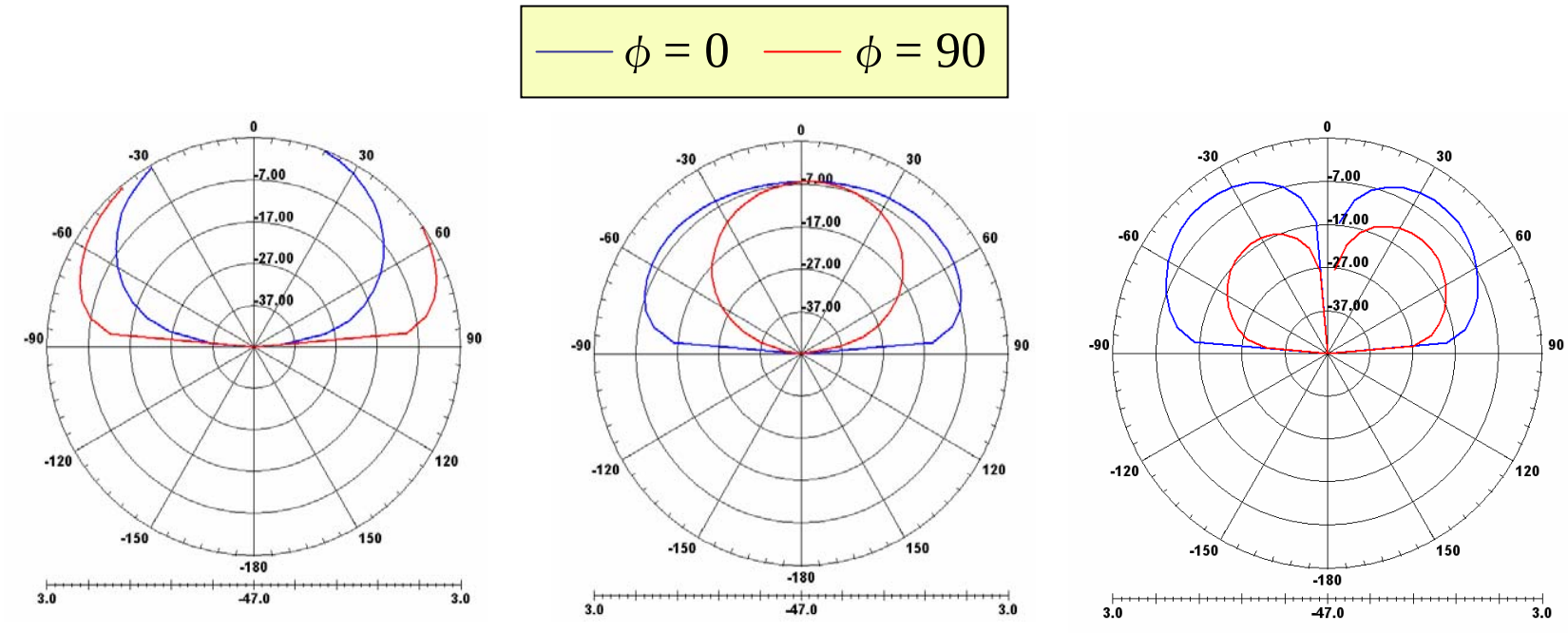
x-z plane



x-y plane

Results (Direct Contact, 2nd Substrate)

Radiation Pattern (dBi) at 4.1 GHz



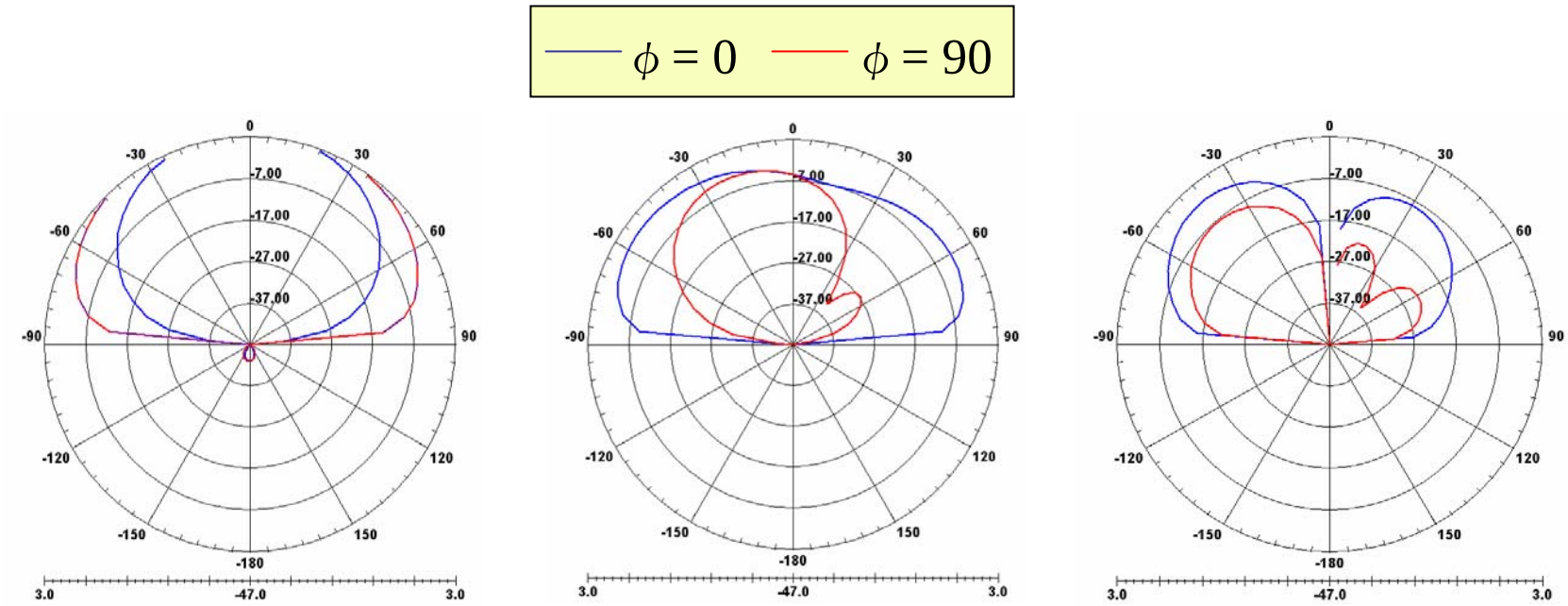
y-z plane

x-z plane

x-y plane

Results (Direct Contact, 2nd Substrate)

Radiation Pattern (dBi) at 5.1 GHz



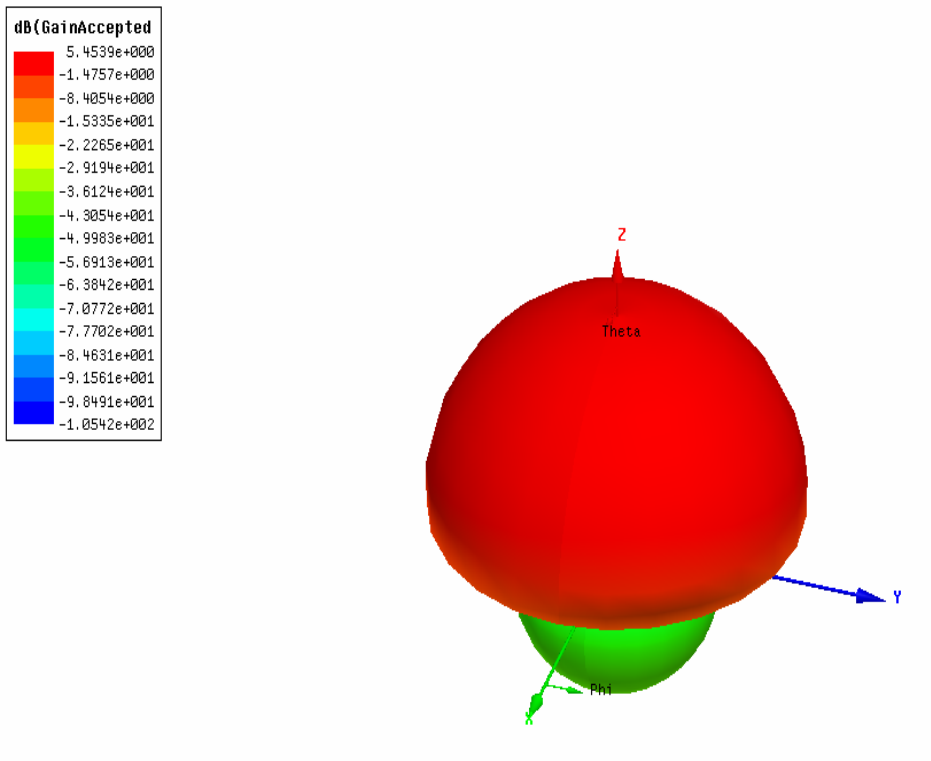
y-z plane

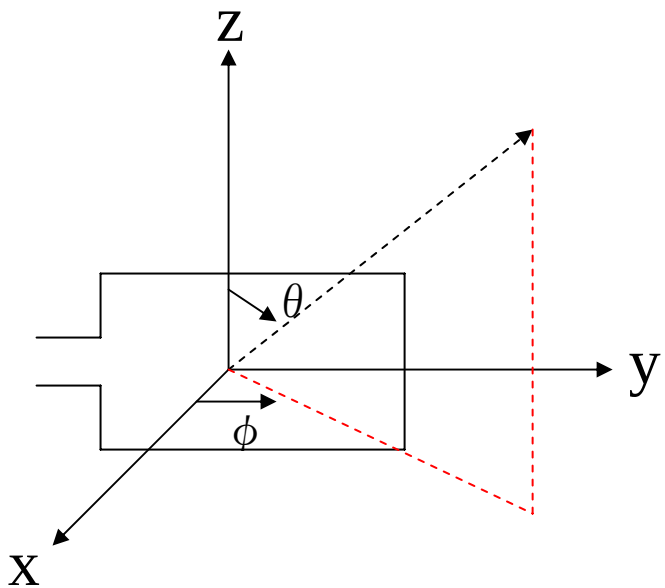
x-z plane

x-y plane

Results (Direct Contact, 2nd Substrate)

3D Radiation Pattern





Conclusion

✓A study on the affects of human body on wearable UWB antenna has been performed.

✓The antenna designed to operate in a lower band of UWB frequency from 3.1 to 5.1 GHz.

✓The antenna performance in a free space, close to the human body and same antenna with second substrate layer close to the human body presented.

✓We have shown that, the body absorbs a significant amount of the output power and changes the antenna characteristics, when an antenna placed on the surface of human body. Therefore destructively affects the performance of the system.

✓Particularly, the human body affected the radiation pattern of antenna and it has become directional.

✓Also, we presented that, adding second substrate layer can improve the antenna performance close to the body. However, the antenna radiation patterns remained directional.

Thank you For Your Attention