



# Rincon ZonePlayer Measurement

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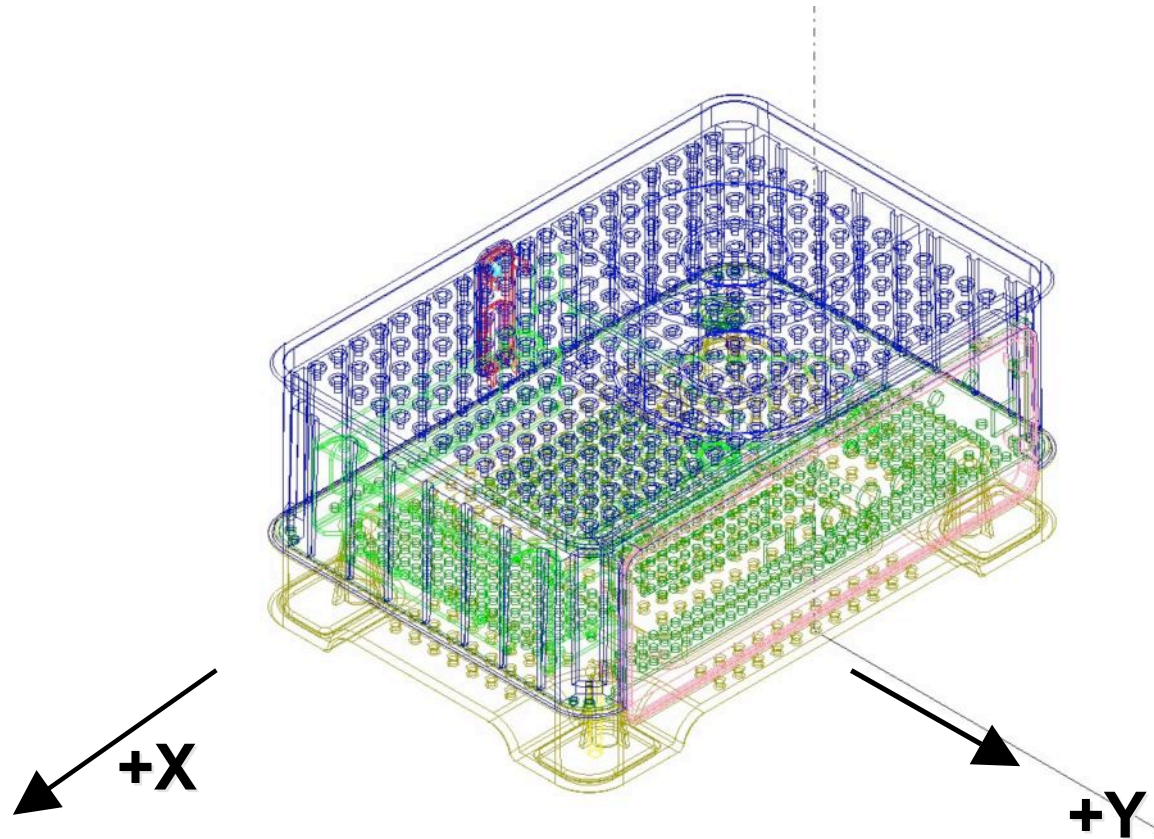
**Sonos PROPRIETARY**

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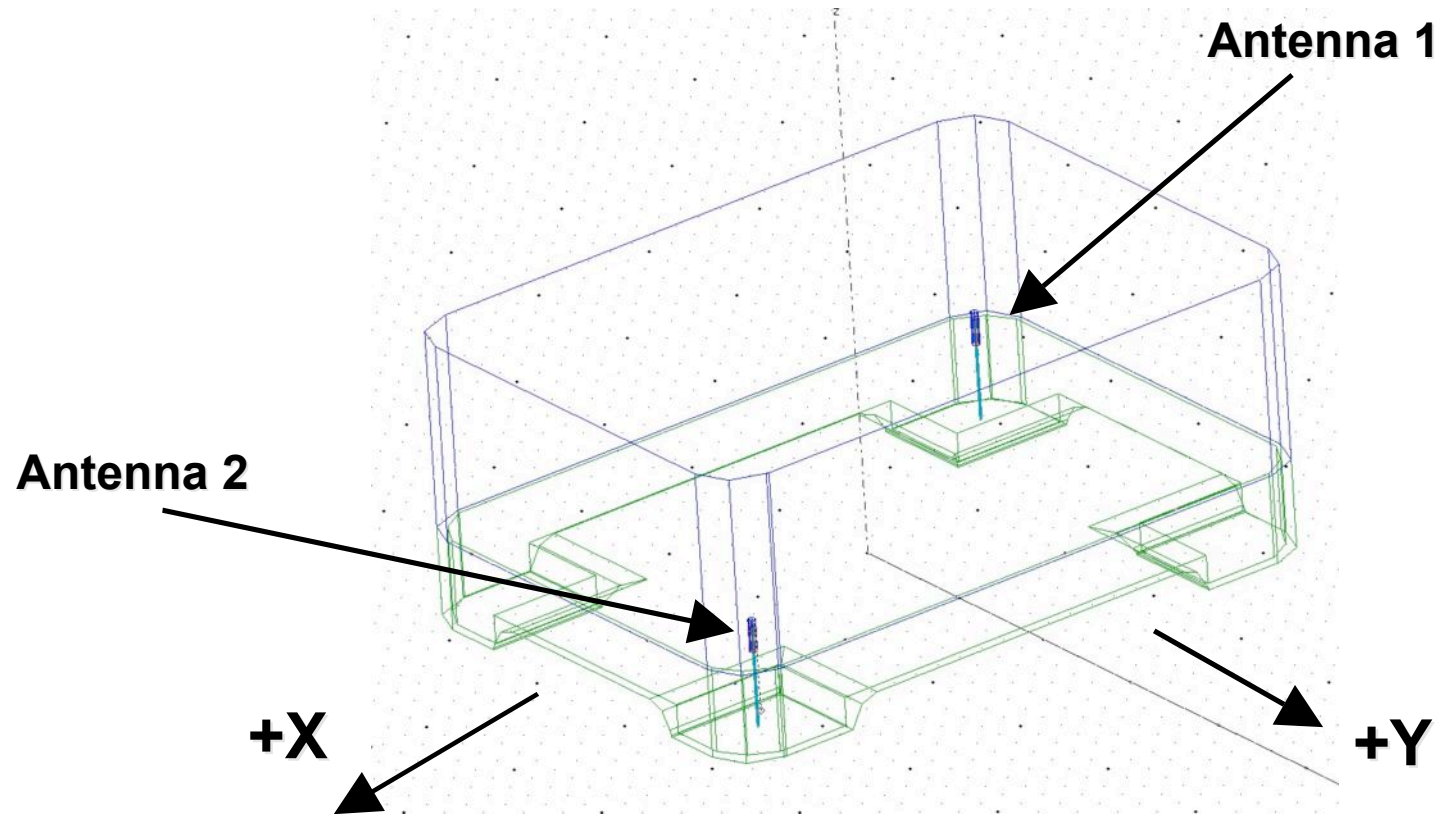
# Model Orientation



- Model as originally imported



# Model Orientation



- Model as simplified for FEA modeling
- Chassis top is modeled as solid metal
- Chassis bottom is ABS/PC Blend



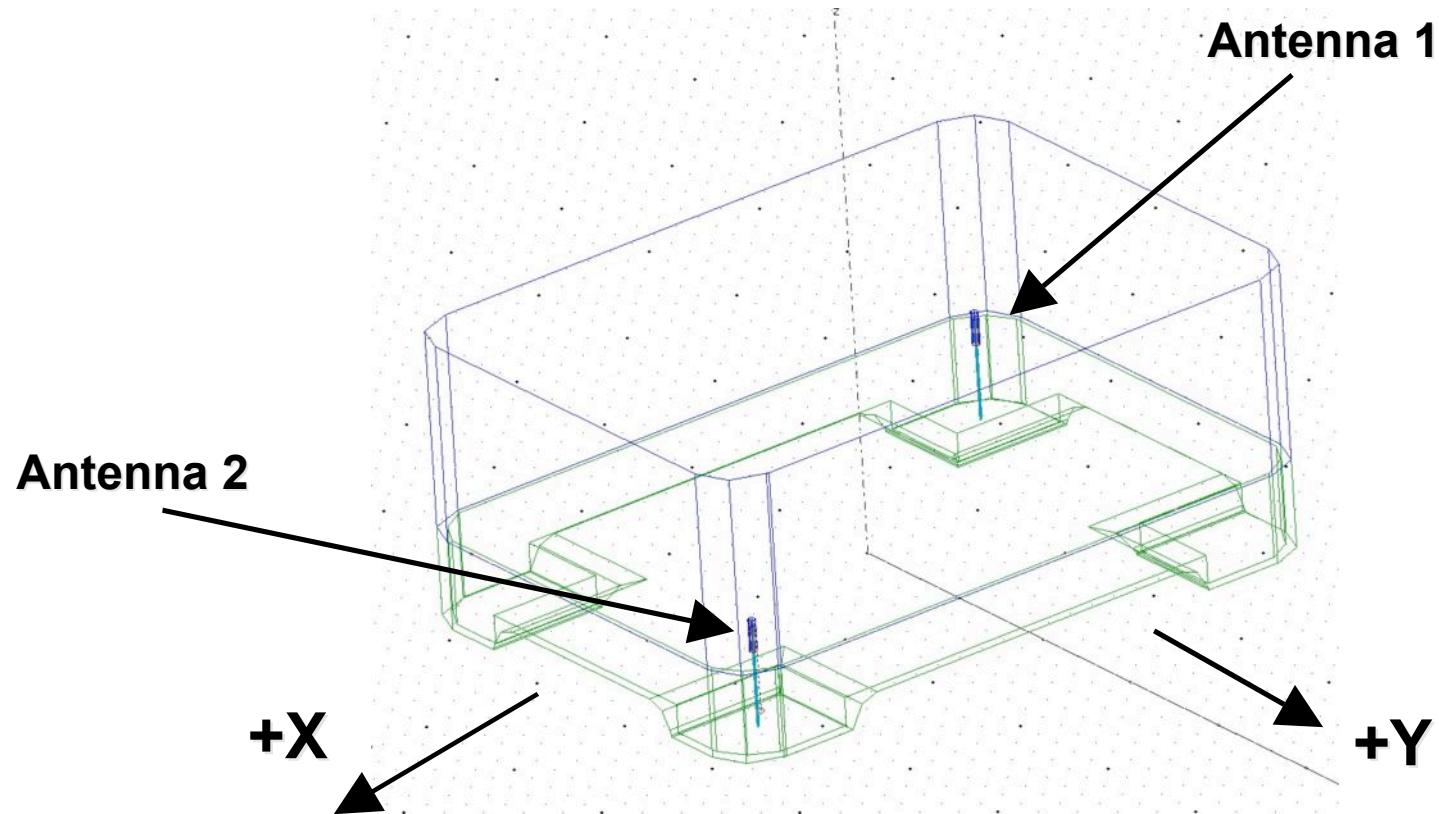
## Antenna Description

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- **Monopole antennas extend 29.75 mm below the bottom of the metal part of the chassis.**
- **Antennas are placed at the front left (below the toroid) and back right of the ZonePlayer**
- **Wire diameter corresponds to the center conductor of RG-402 (.141 inch outer diameter) cable.**



# Antenna Patterns - Orientation



- **+Y is back of ZonePlayer, +X is right of ZonePlayer**



## Measurements in Toyon's Anechoic Chamber

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- We measured return loss for both ZonePlayer antennas as well as patterns over the three principal planes (XY, XZ, and YZ)
- Pattern measurements are realized gain measured at the receiver, including the losses due to the cable and connector of roughly 1-1.25 dB.
- As in the computer modeling, Antenna 1 is at the front left of the ZonePlayer and Antenna 2 is at the back right.
- Both horizontal and vertical polarizations are plotted.
- Polarization convention is in the reference frame of the ZonePlayer, not the chamber.
  - If the ZonePlayer is resting on its side, then vertical polarization in the ZonePlayer reference frame is horizontal in the chamber reference frame.



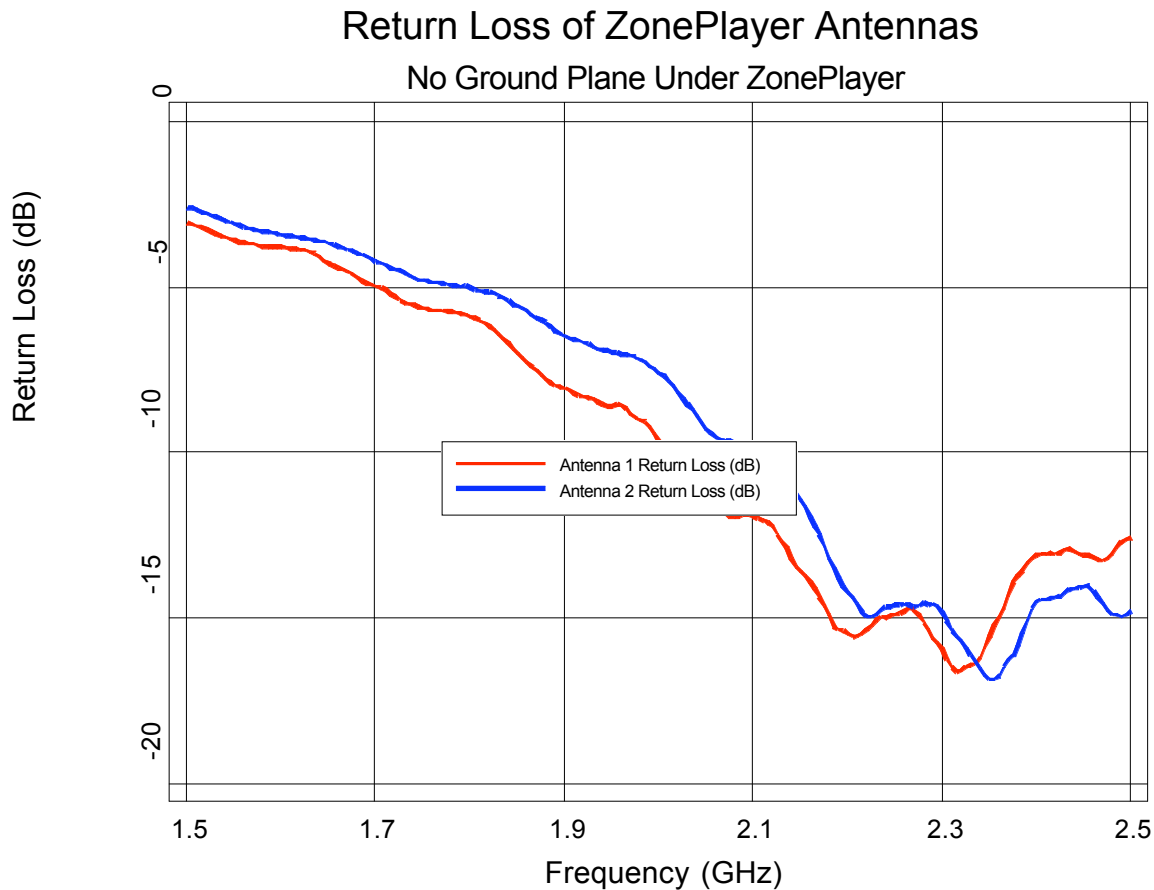
# Pattern Orientation

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- **The first four patterns are measured with the ZonePlayer sitting on its feet on a rotating pedestal.**
  - **Both Antenna 1 and Antenna 2 are measured, and both standard linear polarizations are shown for each.**
- **The second four patterns are measured with the ZonePlayer on its back (not on its top).**
- **The last four patterns are measured with the ZonePlayer on its side.**



# Measured Return Loss



- **Antennas are well matched (better than -10 dB return loss) through the 2.4 – 2.48 GHz band.**

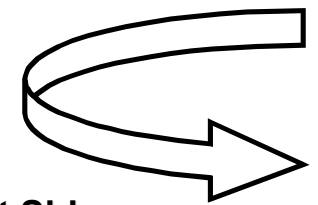
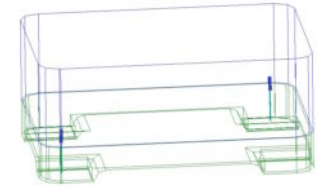
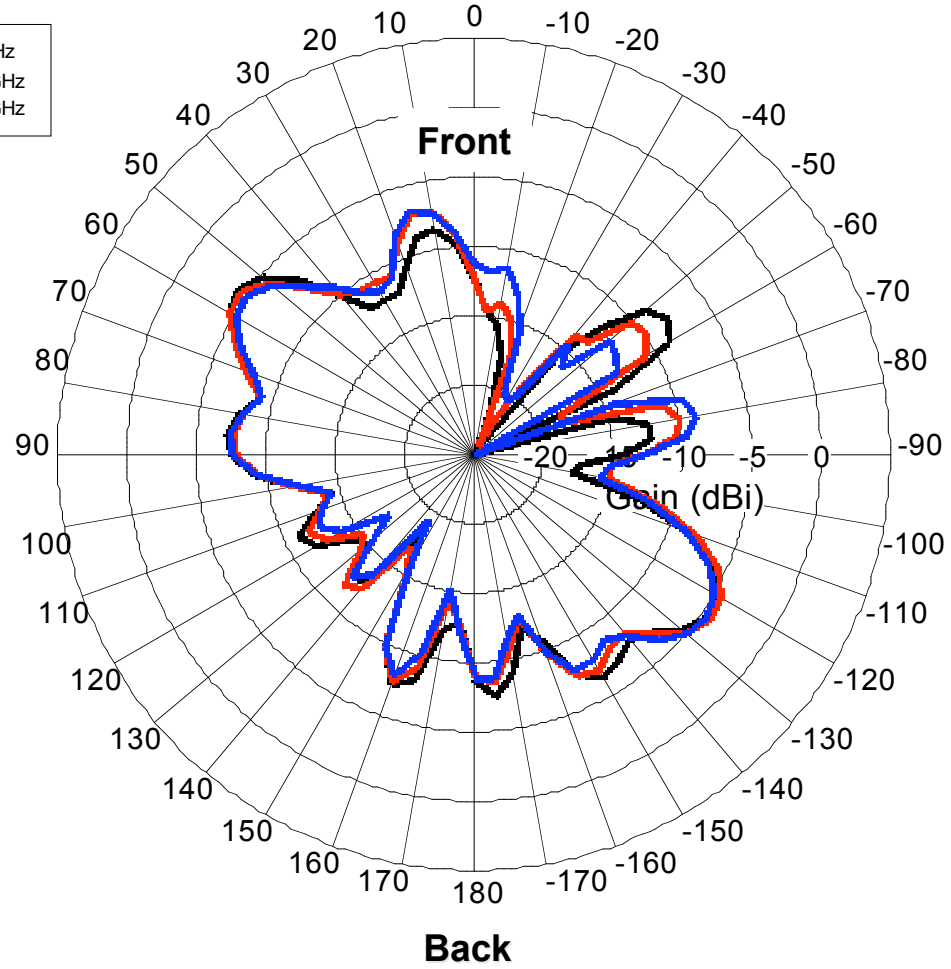
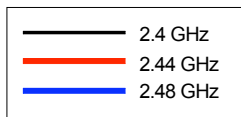




# Azimuth Cut (XY Plane)

Realized Gain (dBiL) - Antenna 1 - Horizontal Polarization

Azimuth Cut Through Theta = 0



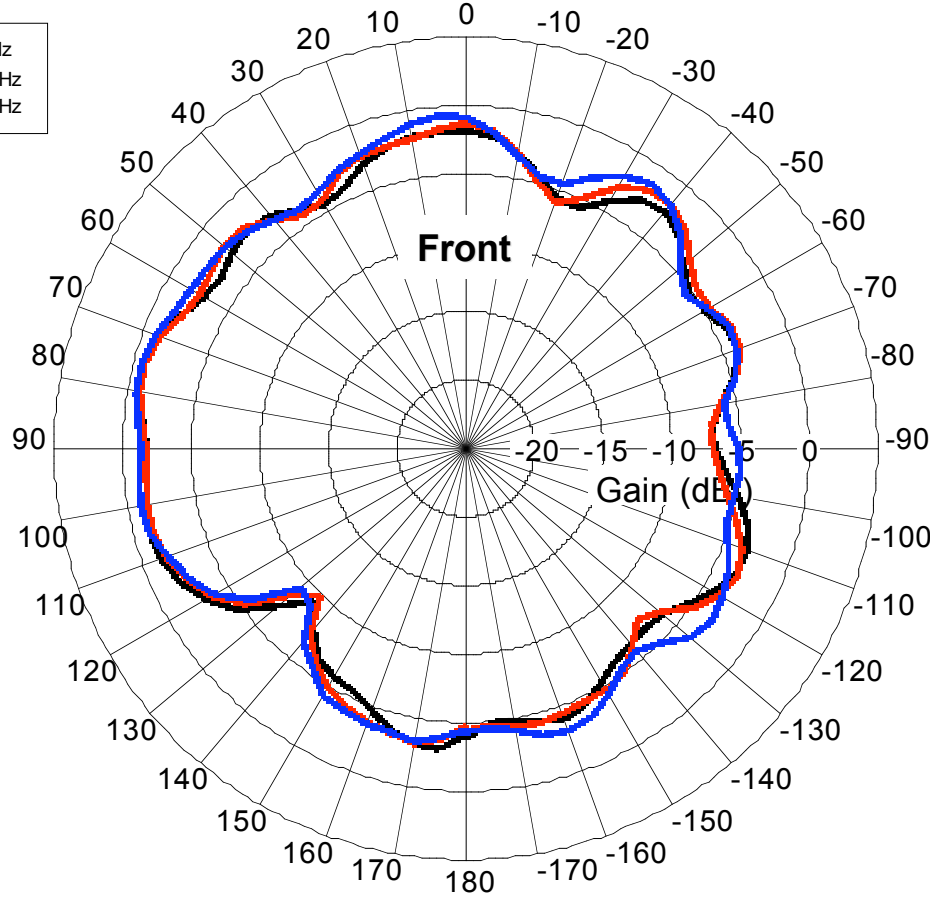
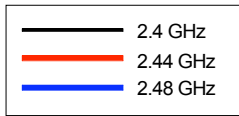
Theta is the elevation angle above the XY Plane



# Azimuth Cut (XY Plane)

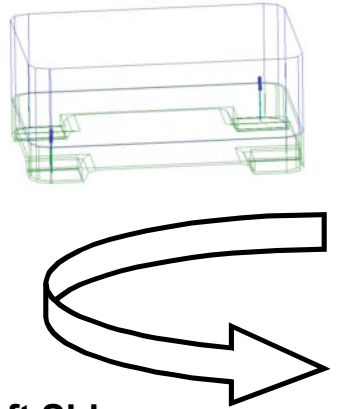
Realized Gain (dBiL) - Antenna 1 - Vertical Polarization

Azimuth Cut Through Theta = 0



Right Side

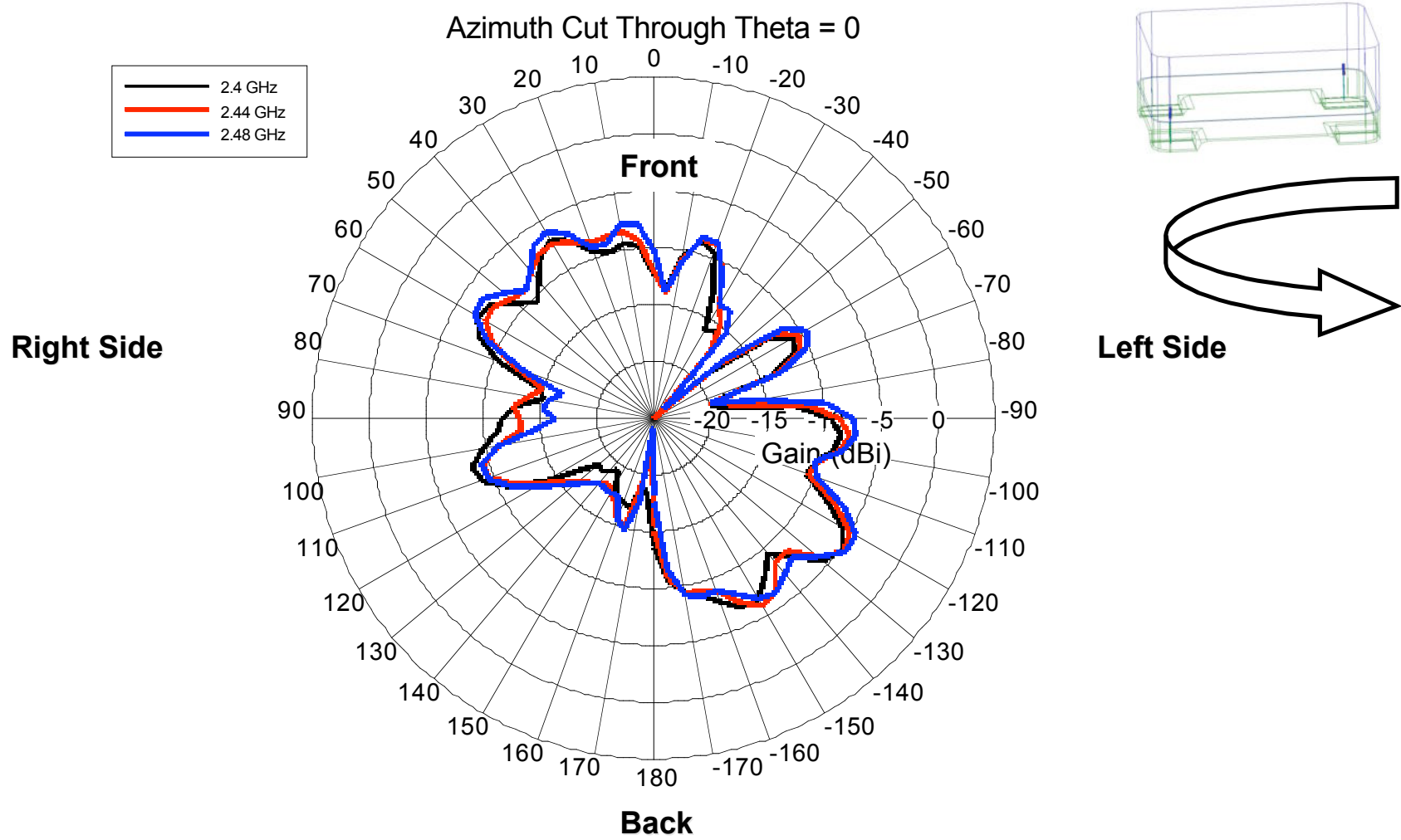
Left Side





# Azimuth Cut (XY Plane)

Realized Gain (dBiL) - Antenna 2 - Horizontal Polarization

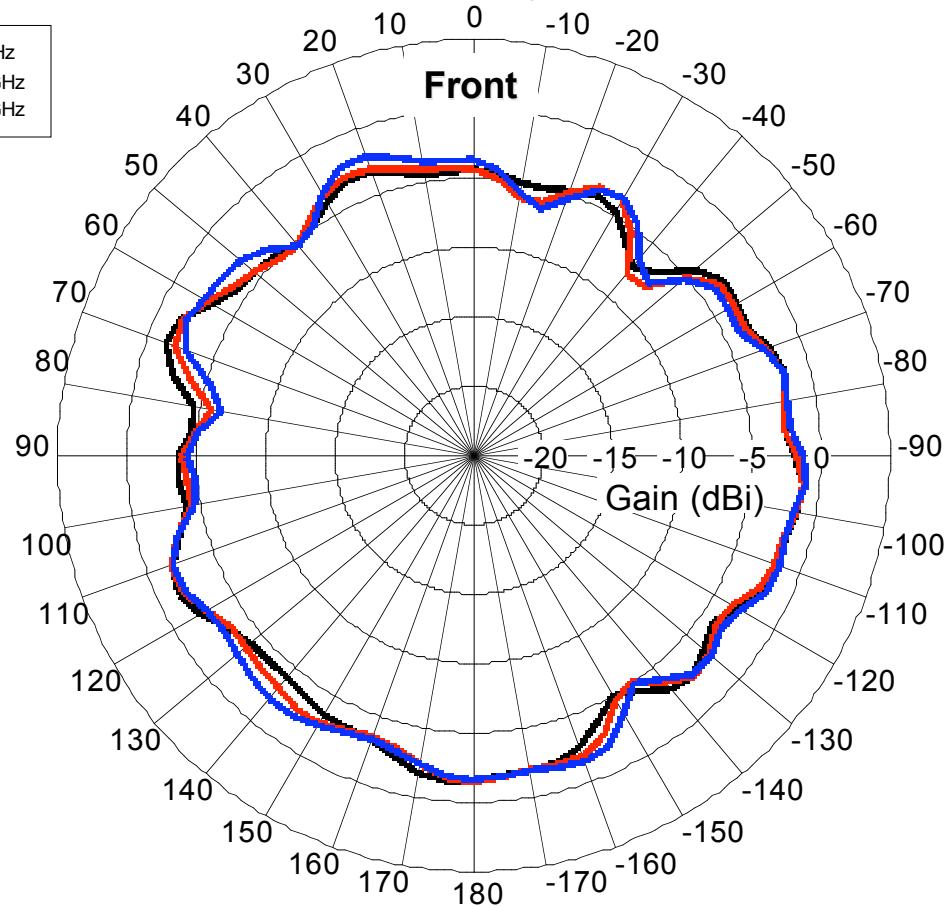
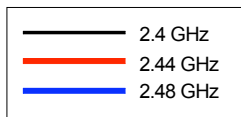




# Azimuth Cut (XY Plane)

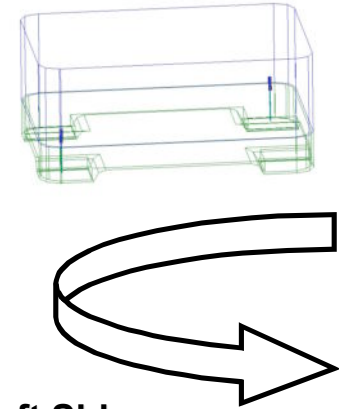
Realized Gain (dBiL) - Antenna 2 - Vertical Polarization

Azimuth Cut Through Theta = 0



Right Side

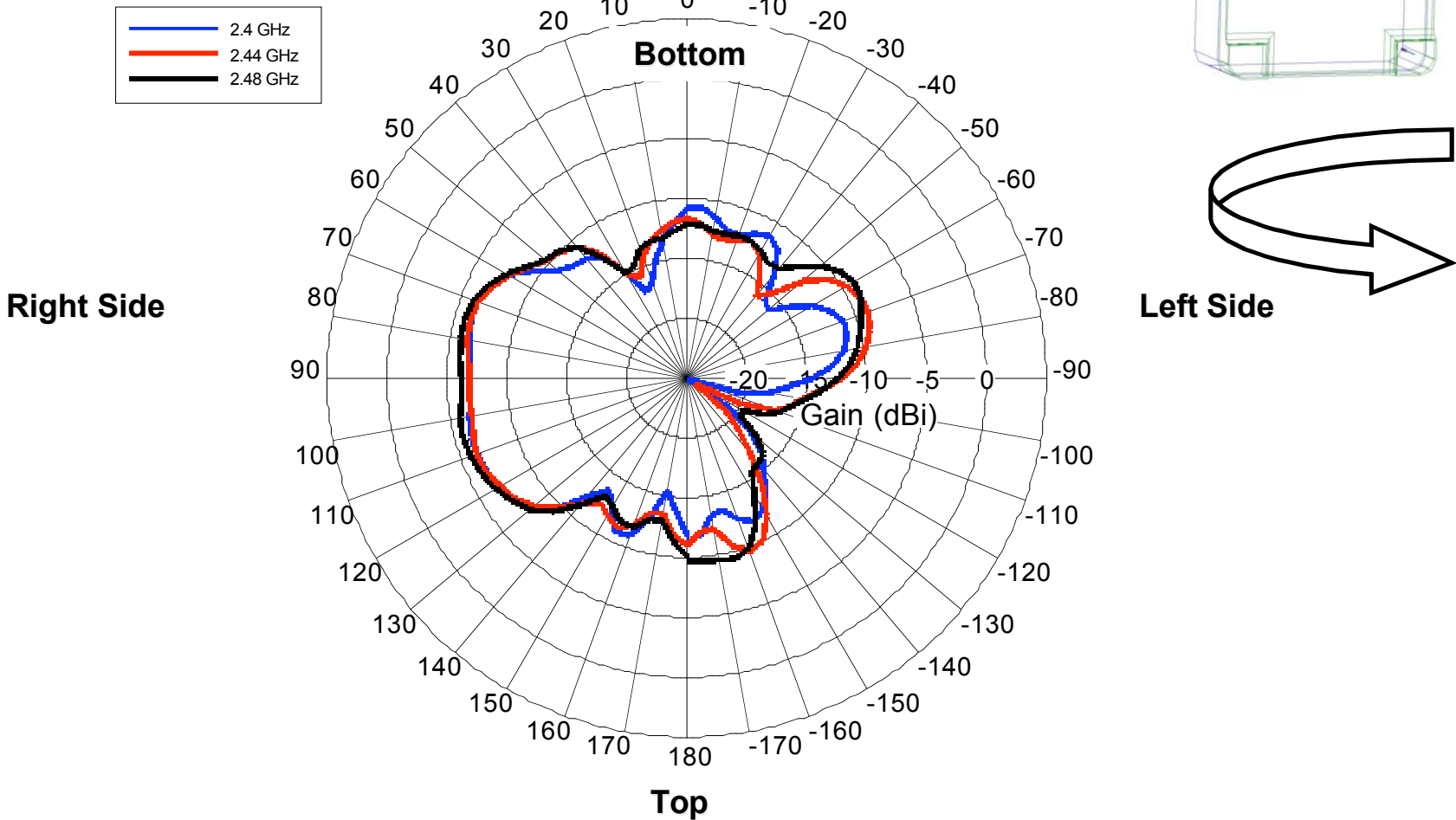
Left Side





# Elevation Cut (XZ Plane)

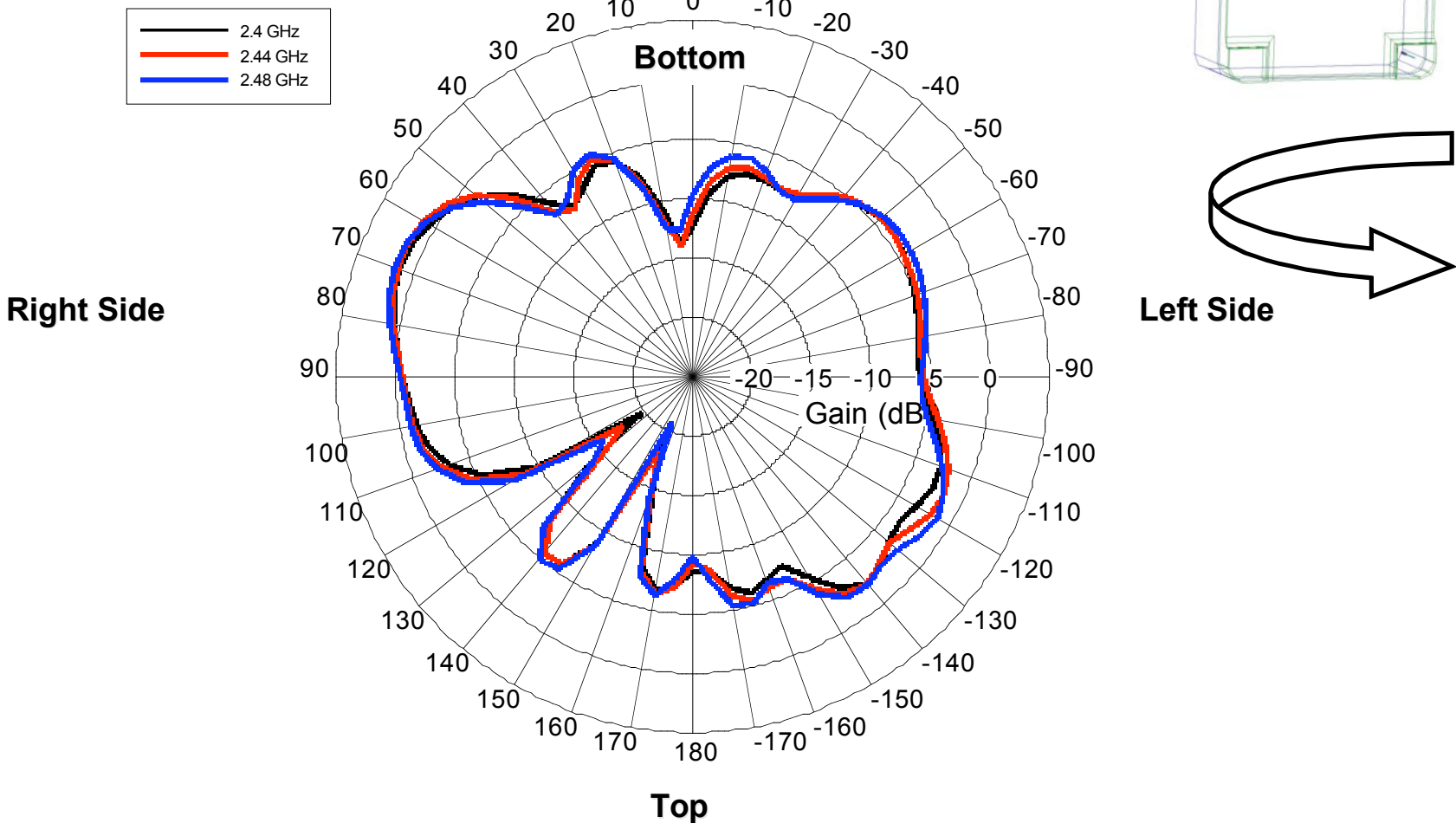
Realized Gain (dBiL) - Antenna 1 - Horizontal Polarization  
Elevation Cut Through Sides of ZonePlayer





# Elevation Cut (XZ Plane)

Realized Gain (dBiL) - Antenna 1 - Vertical Polarization  
Elevation Cut Through Sides of ZonePlayer

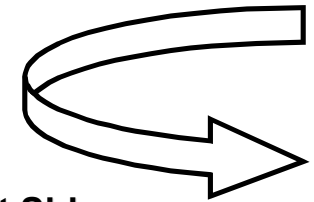
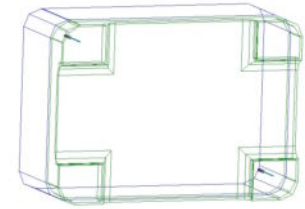
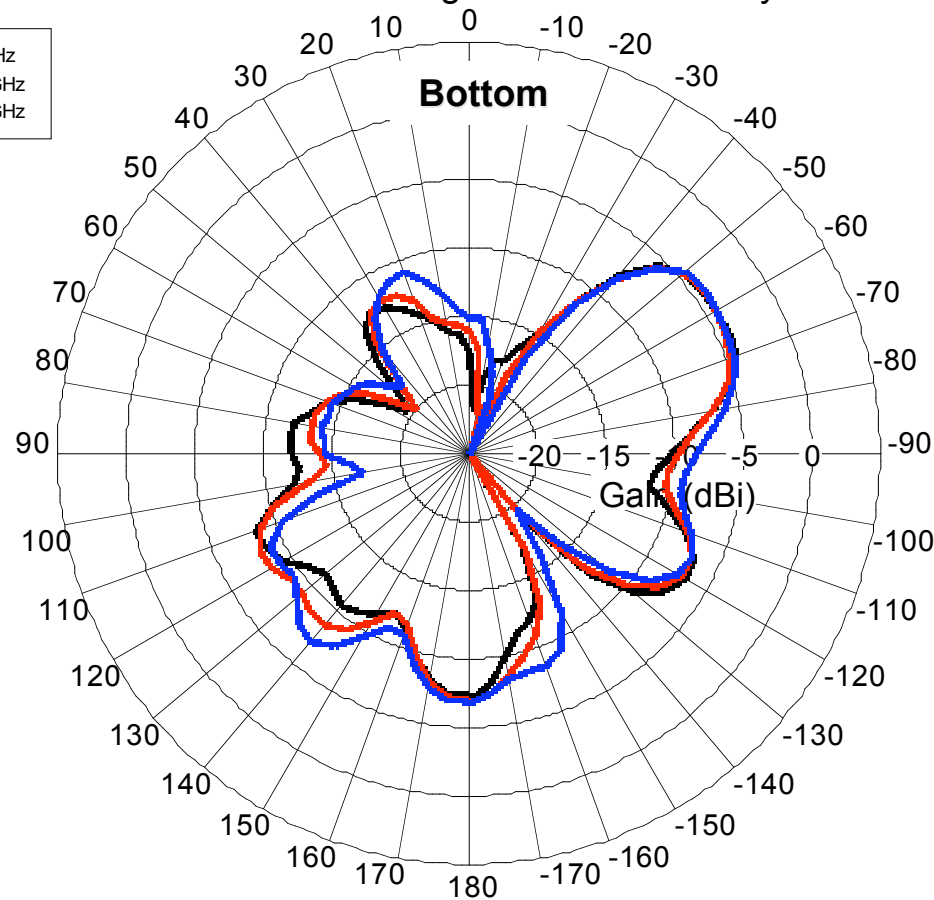
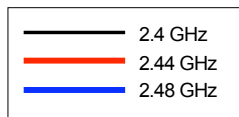




# Elevation Cut (XZ Plane)

Realized Gain (dBiL) - Antenna 2 - Horizontal Polarization

Elevation Cut Through Sides of ZonePlayer

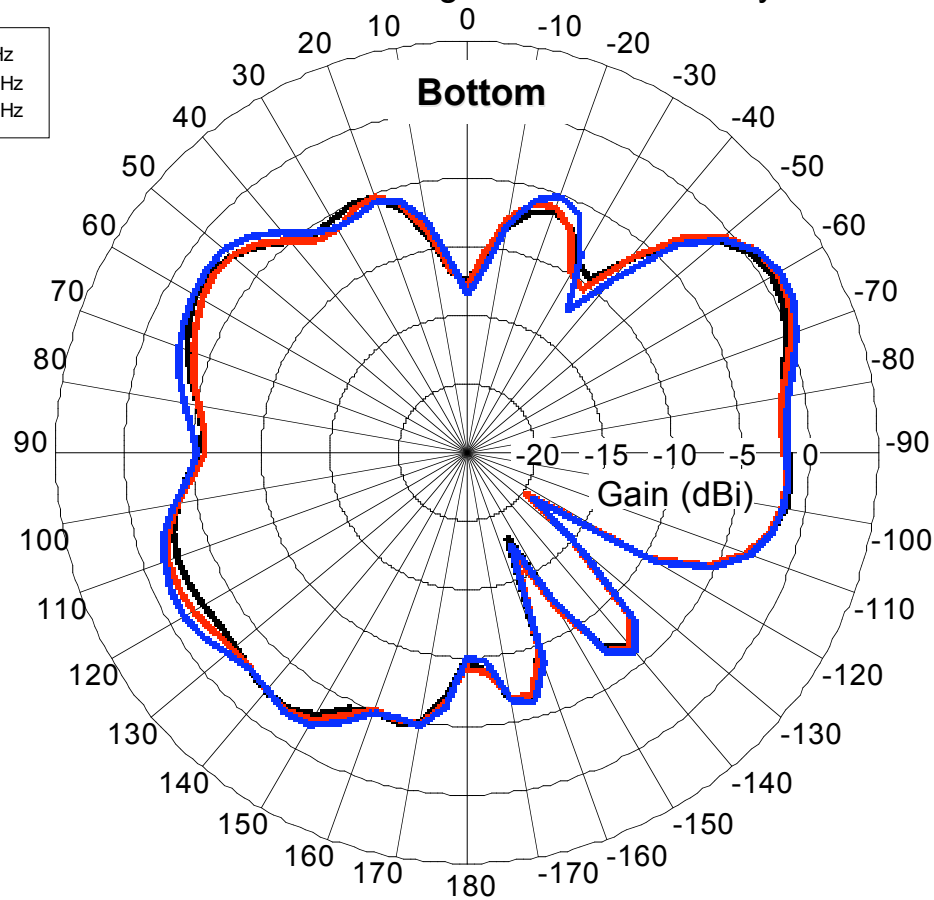
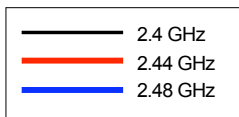




# Elevation Cut (XZ Plane)

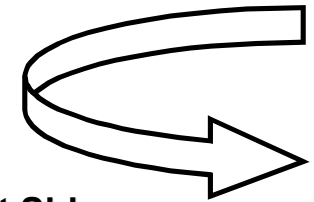
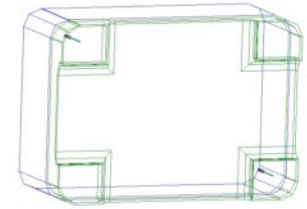
Realized Gain (dBiL) - Antenna 2 - Vertical Polarization

Elevation Cut Through Sides of ZonePlayer



Right Side

Left Side

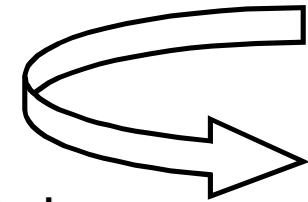
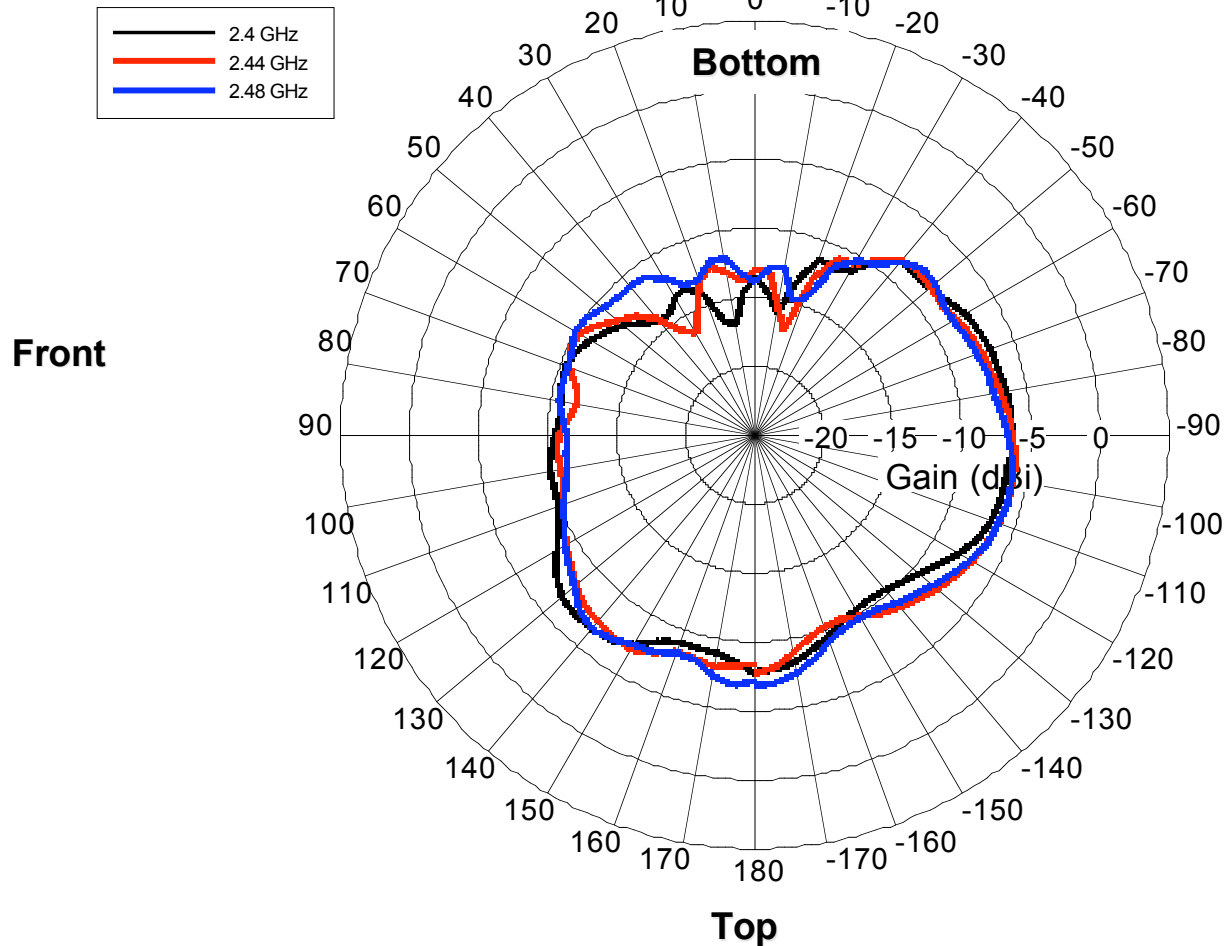






# Elevation Cut (YZ Plane)

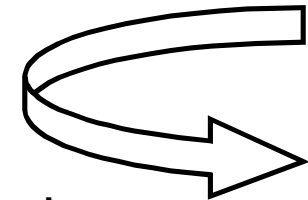
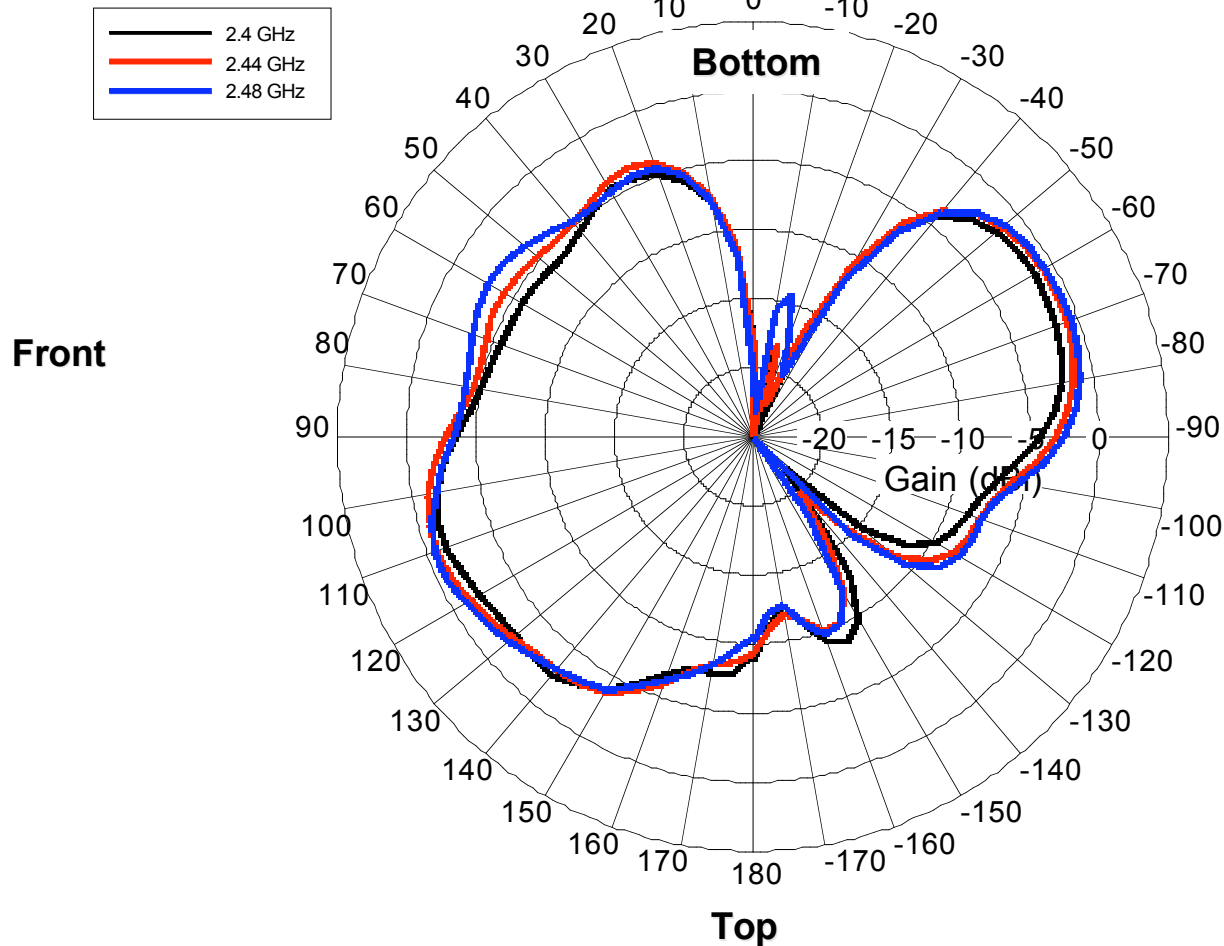
Realized Gain (dBiL) - Antenna 1 - Horizontal Polarization  
Elevation Cut Through Top and Bottom of ZonePlayer





# Elevation Cut (YZ Plane)

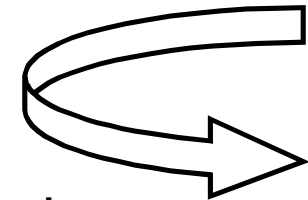
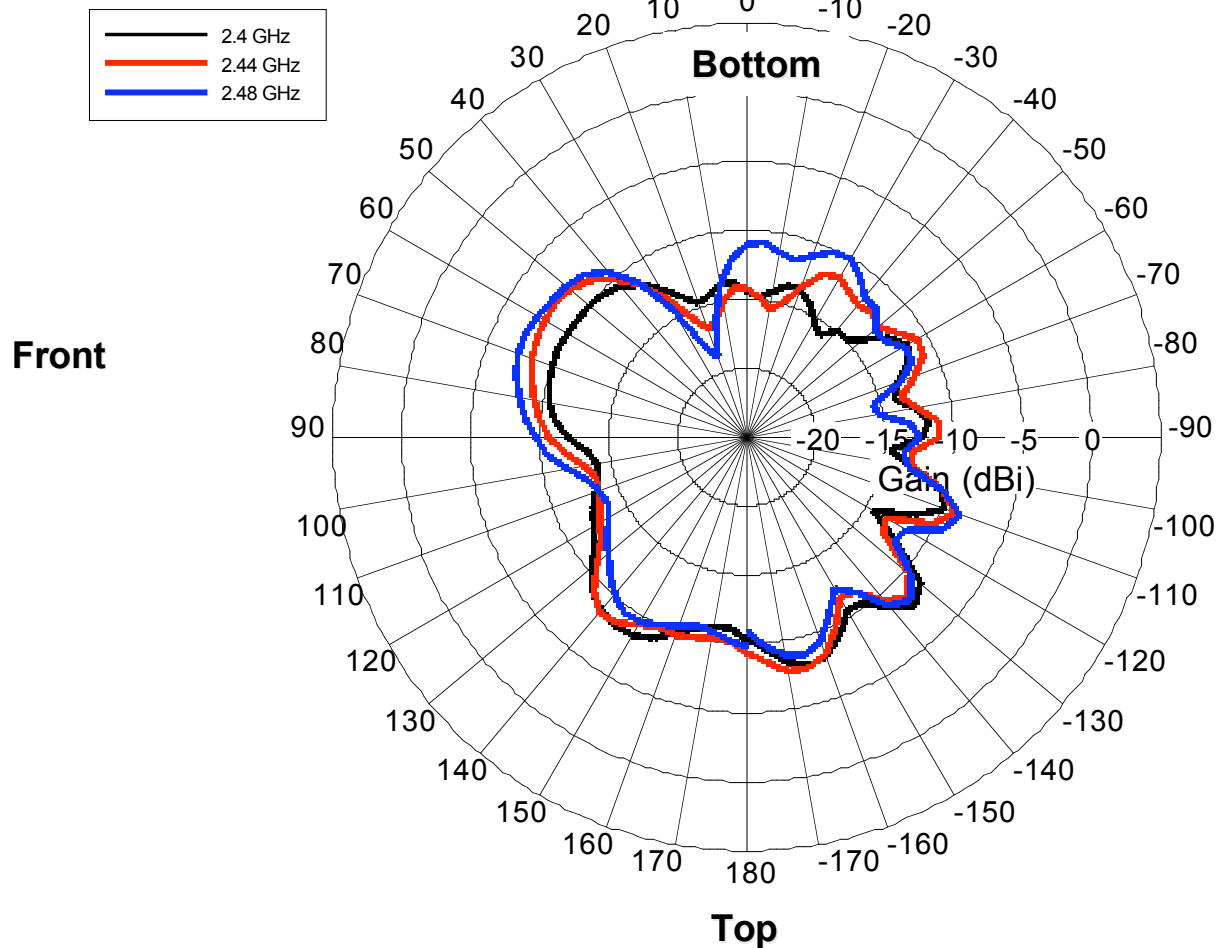
Realized Gain (dBiL) - Antenna 1 - Vertical Polarization  
Elevation Cut Through Top and Bottom of ZonePlayer





# Elevation Cut (YZ Plane)

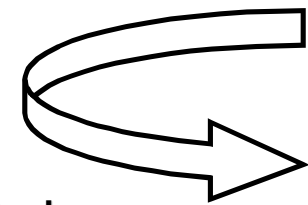
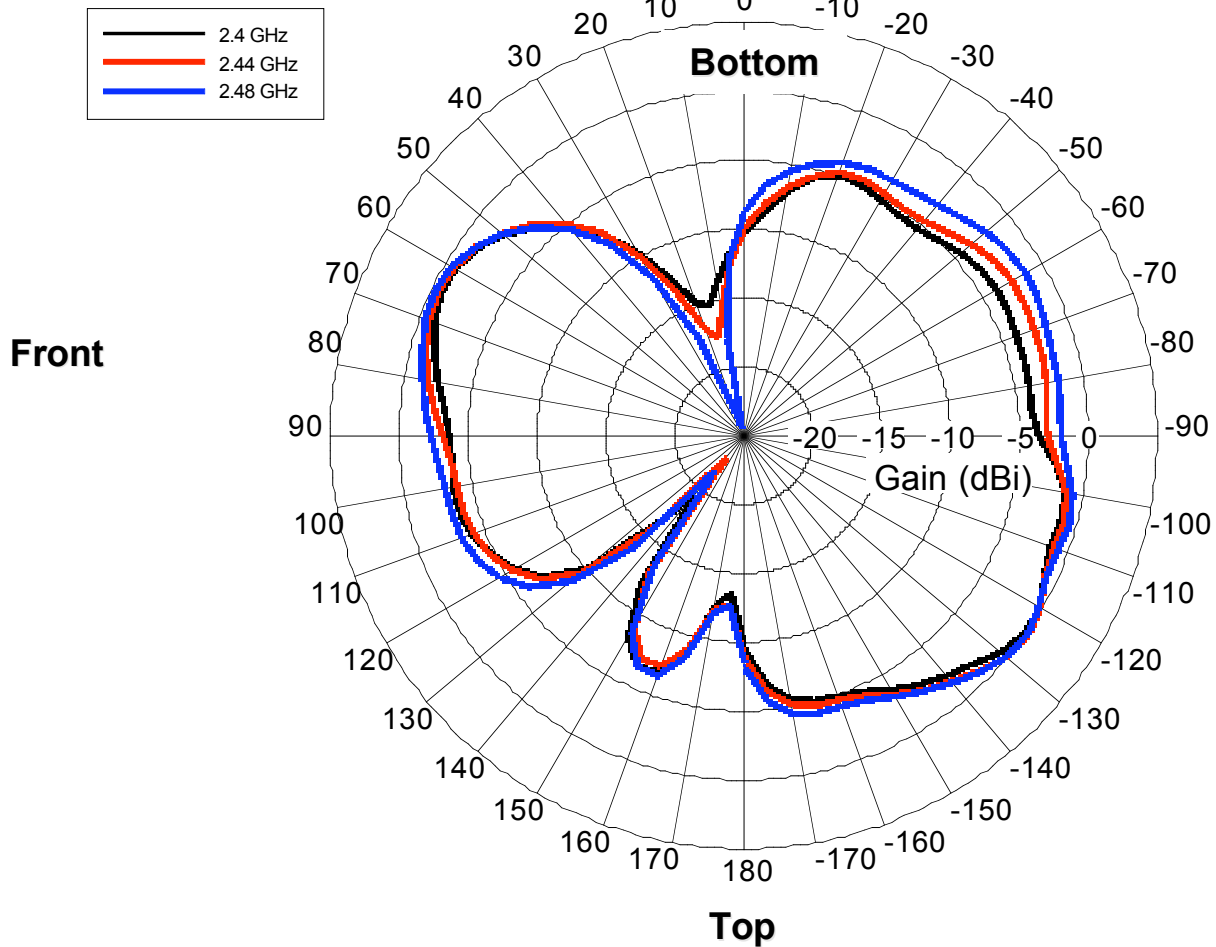
Realized Gain (dBi) - Antenna 2 - Horizontal Polarization  
Elevation Cut Through Top and Bottom of ZonePlayer





# Elevation Cut (YZ Plane)

Realized Gain (dBiL) - Antenna 2 - Vertical Polarization  
Elevation Cut Through Top and Bottom of ZonePlayer





## Results

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- **Radiation is mainly vertically polarized as expected.**
  - **Horizontal polarization is lower by 5-10 dB.**
- **Pattern coverage shows some masking due to the ZonePlayer chassis but is generally broad.**
  - **This is about as close to ideal as you can get without putting the antennas outside and on top of the chassis.**
  
- **The second set of patterns shows that the highest gain for each antenna is actually out the side opposite the antenna.**
  - **This is not intuitive, but it matches the simulation results.**