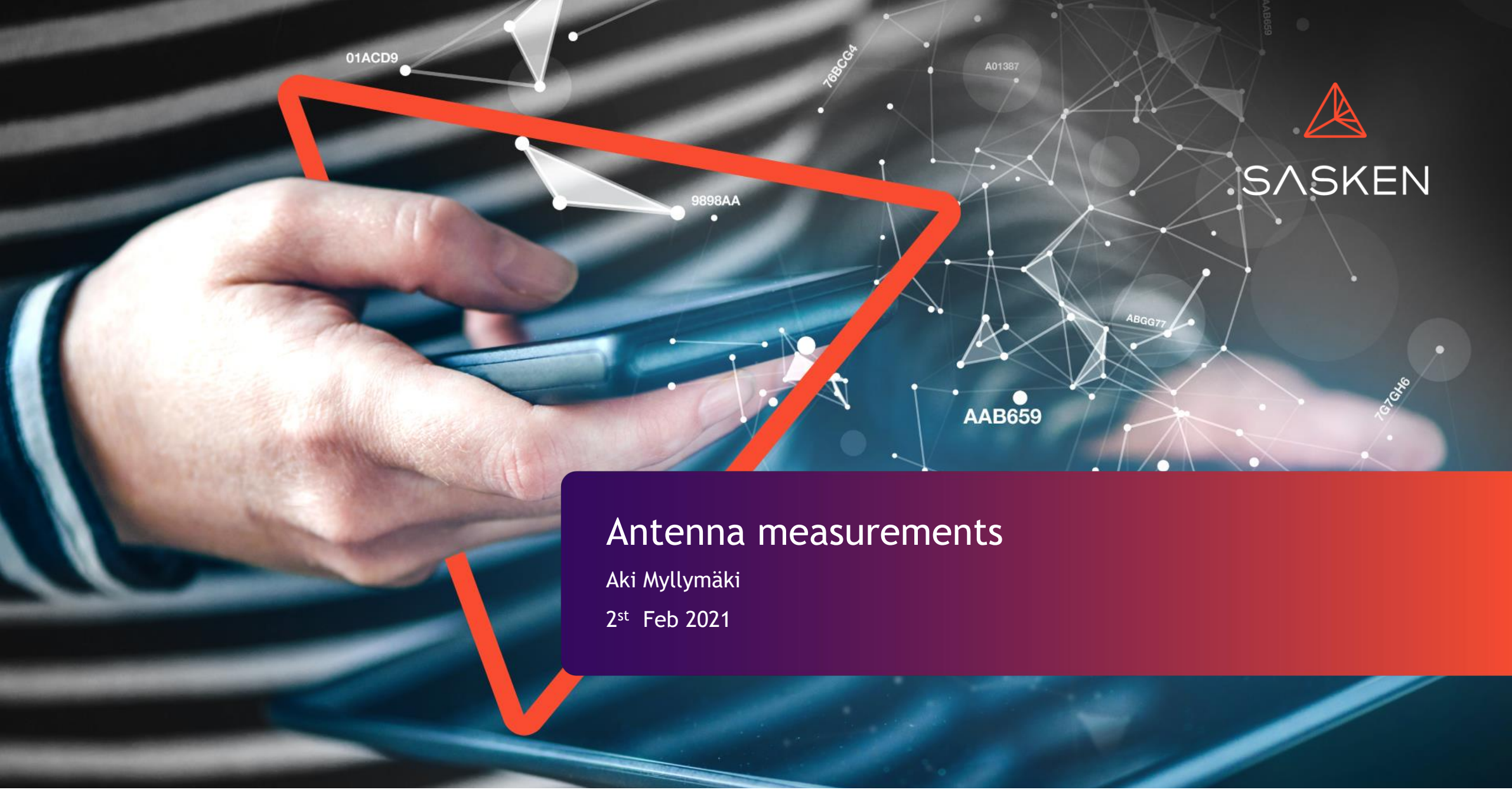


SASKEN

Antenna measurements

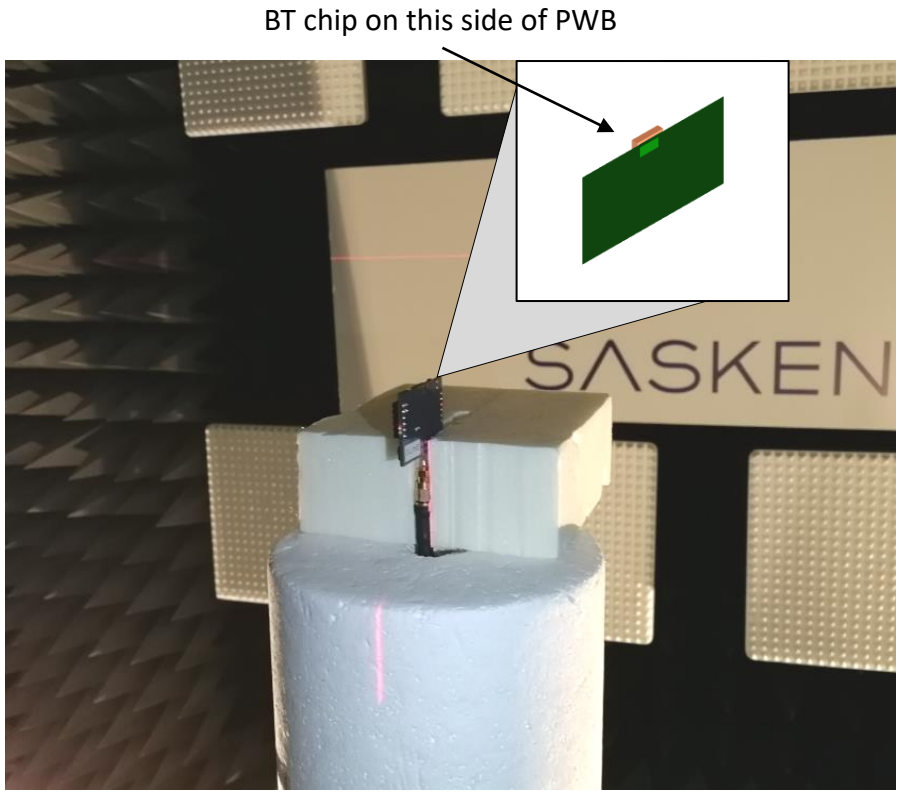
Aki Myllymäki

2st Feb 2021

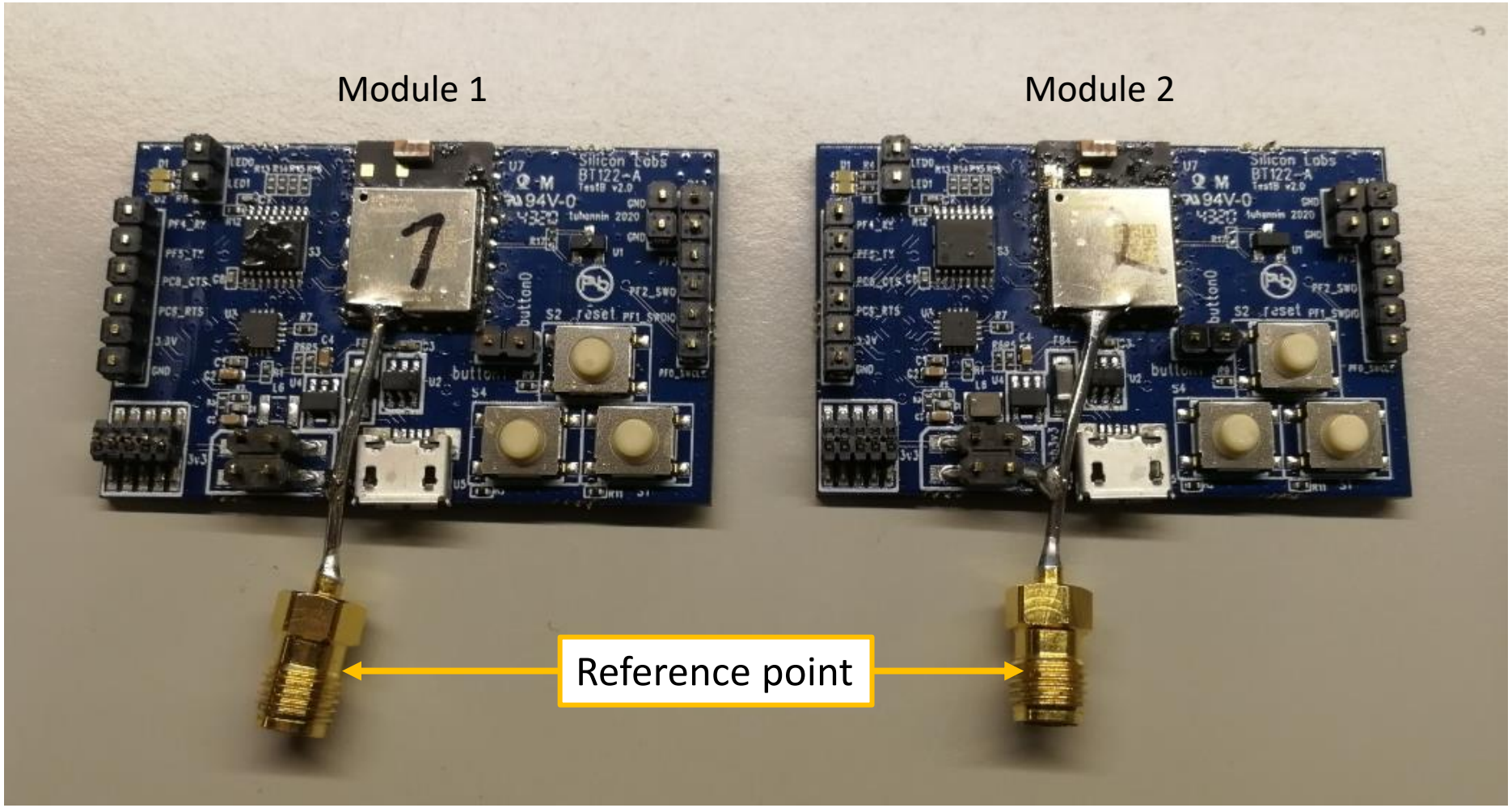
Introduction

- In this document are presented measurement results for two module boards received from Silicon Labs:
  - Module 1
  - Module 2

- Parameters measured
  - Efficiency (dB)
  - Peak gain (dB)
  - 3D radiation pattern
  - 1D radiation pattern (dB), Polar Mode, Phi 0, Phi 90 and Theta 90 cuts
- Measurement frequencies:
  - Gain patterns: 2402, 2440, 2480MHz
  - Gain/Efficiency over frequency 2390 – 2490 MHZ, 5MHz steps
- In all measurements module was placed in the same position and orientation as shown in the picture on right side.



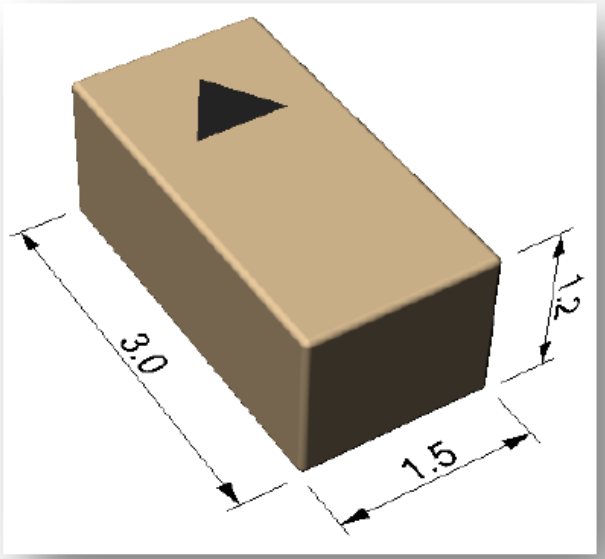
Modules



Chip antenna information from antenna manufacturer

AMOTECH Co., Ltd.

Type	Dielectric Chip Antenna
Application	2.4GHz
Part No.	AMAN301512ST01



Application

Bluetooth
Zigbee
WLAN (IEEE 802.11 b/g)
ISM 2.4GHz Wireless Devices

Features

PIFA Structure
Small Size (3.0*1.5*1.2mm³)
Easy Optimizing
with external lumped matching components
SMT Available under Pb-free Condition
RoHS Compliant

Chip antenna information from antenna manufacturer (details)

Electrical Specifications

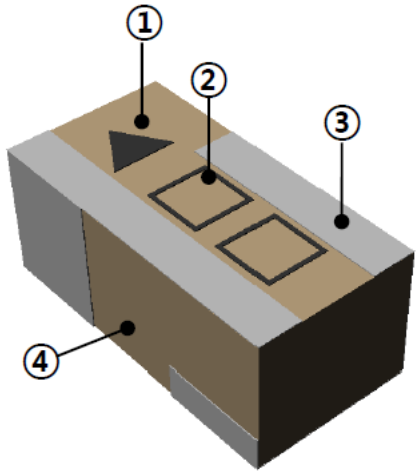
Item	Spec.
Frequency Range [GHz]	2.4 ~2.485
VSWR	Max 3.0:1
Polarization	Linear
Impedance [Ω]	Nominal 50

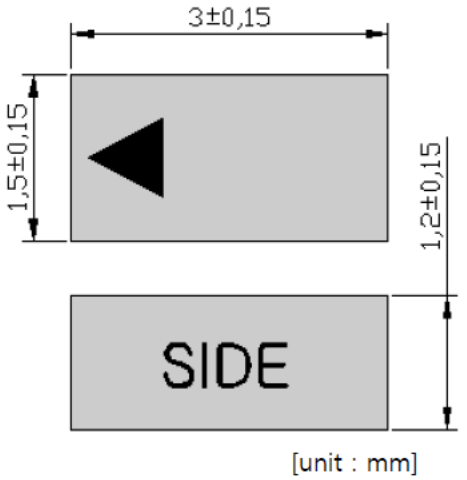
Mechanical Specifications

Item	Spec.
Dimensions (LxWxH)	3.0x1.5x1.2 mm^3
Unit Weight	typ. 20 mg
Operating Temperature	-35 ~ +85 ℃

Appearance & Material

No	Item	Function	Material
①	Marking	Feeding Index	Ink
②	Marking	Week number	Ink
③	Electrode	Radiation Element	Ag
④	Ceramic Body	-	Ceramic





[unit : mm]

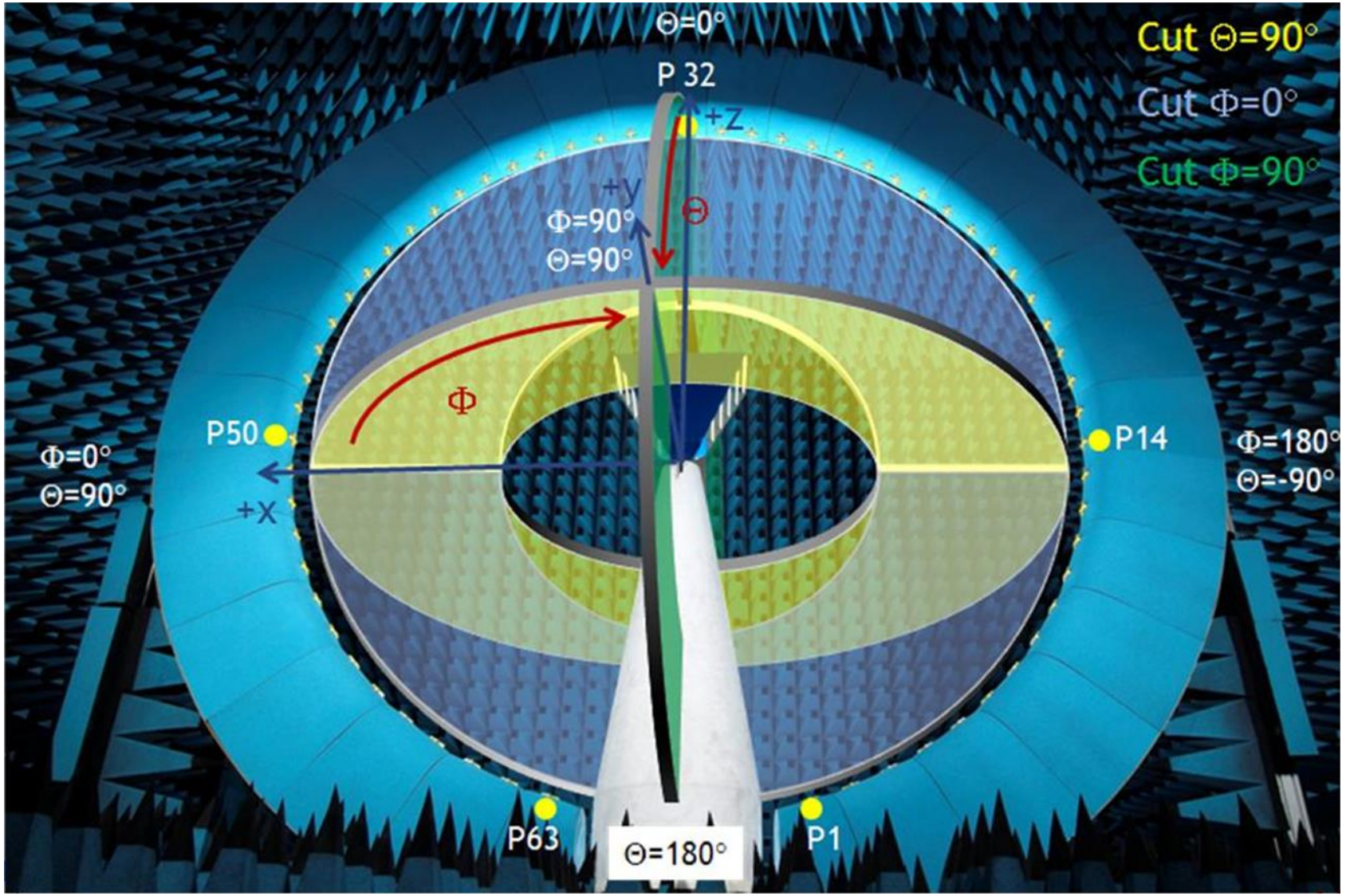
AMOTECH Co., Ltd.

5BL-1Lot, 617, Namchon-Dong, Namdong-Gu, Incheon, Korea

Dielectric Chip Antenna

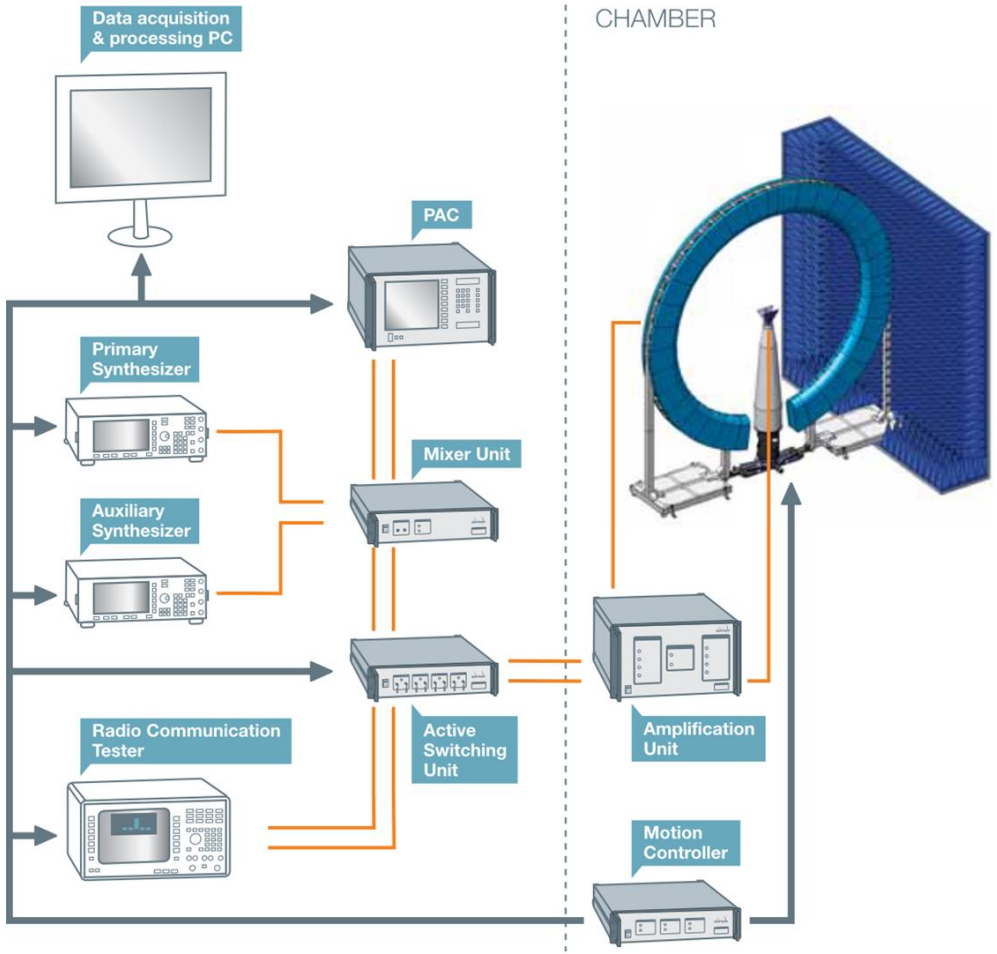
P/N : AMAN301512ST01

Sasken coordinate system



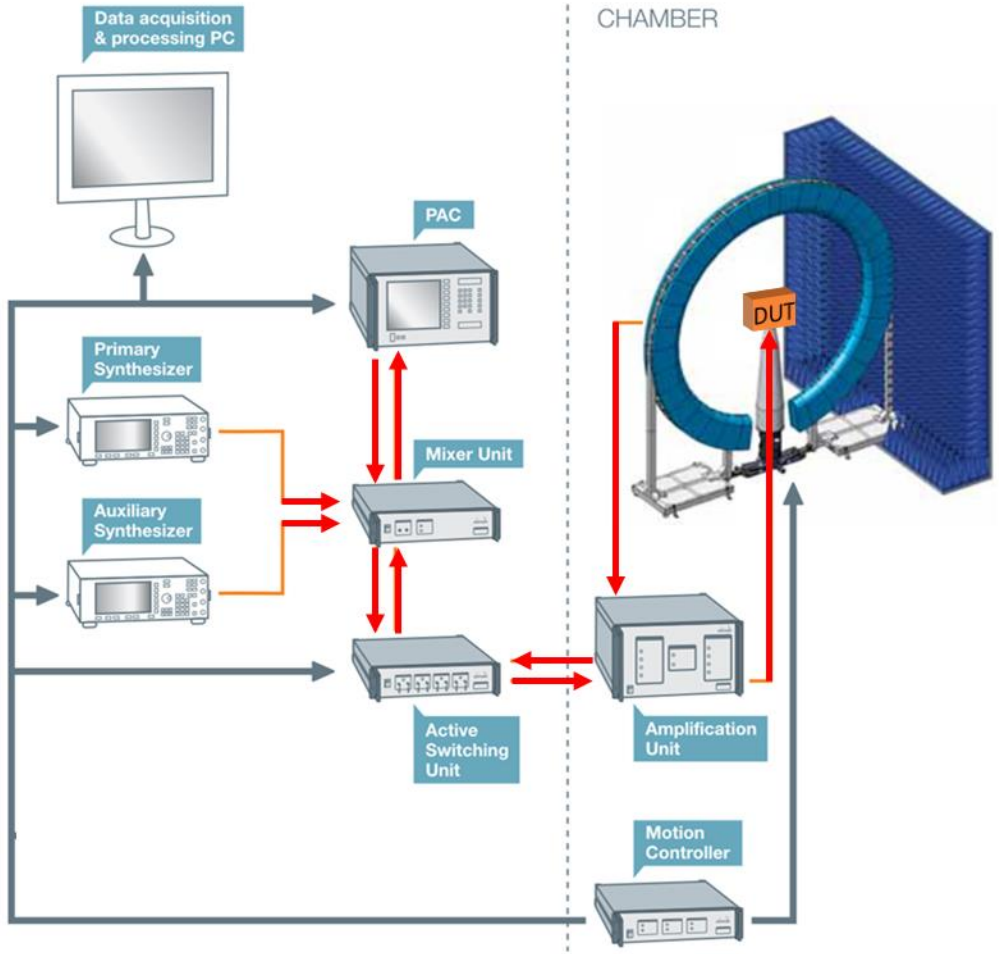
Satimo SG64 Setup

- SG64 has been developed to measure stand alone antennas or antennas integrated in subsystem. It is also ideal for CTIA certifiable measurement facilities.
- SG system can switch between the Probe Array Controller (PAC) for passive measurements and the Radio Communication Tester for active measurements.
  - For passive measurements it uses Analog RF Signal Generators for emitting from the probe array to the Antenna Under Test or from the Antenna Under Test to the probe array. The PAC is also a RF receiver for antenna measurements. The PAC controls as well the electronic scanning of the probe array. The Amplification Unit has RF amplifiers for both RX and TX channels.
  - For active measurements, the test is performed with a Multi-protocol Radio Communication Tester. It is used to communicate with the DUT and to measure the Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS).



Passive Measurement Setup

- All antenna measurements were done using Satimo SG64 Passive Measurement Setup.
- Setup:
  - DUT is prepared with coaxial probe cable to be connected with antenna feed cable coming from the antenna mast on the turntable.
  - Satimo test system feeds the signal on specified frequencies through the antenna feed cable to DUT
  - The DUT is then rotated with turntable and the Satimo probe array will measure the signal from all directions for all rotation steps to get a 3D radiation pattern.
  - Near-field to far-field transformation will be then done to the measurement data.
- Calibration
  - System is calibrated to the reference point that is in the end of antenna feed cable on the antenna mast.
  - System calibration is done yearly by Satimo
    - last system calibration was done on week 37/2020
  - Measurement calibration is done with reference antennas.
    - Dual-Ridge Horn antenna SH400/S#0040 (0.4 – 6GHz)



Module 1

Measurement results

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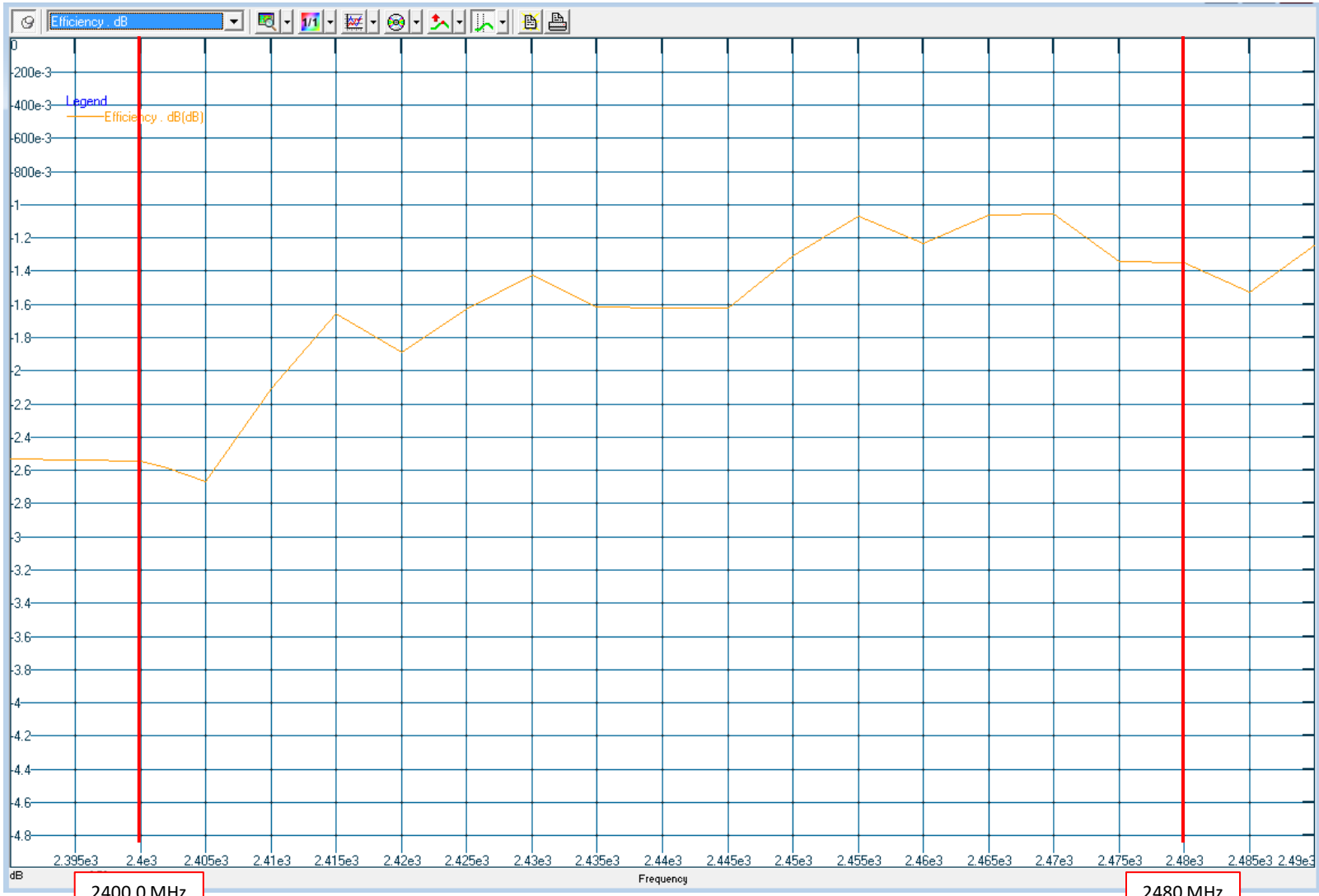
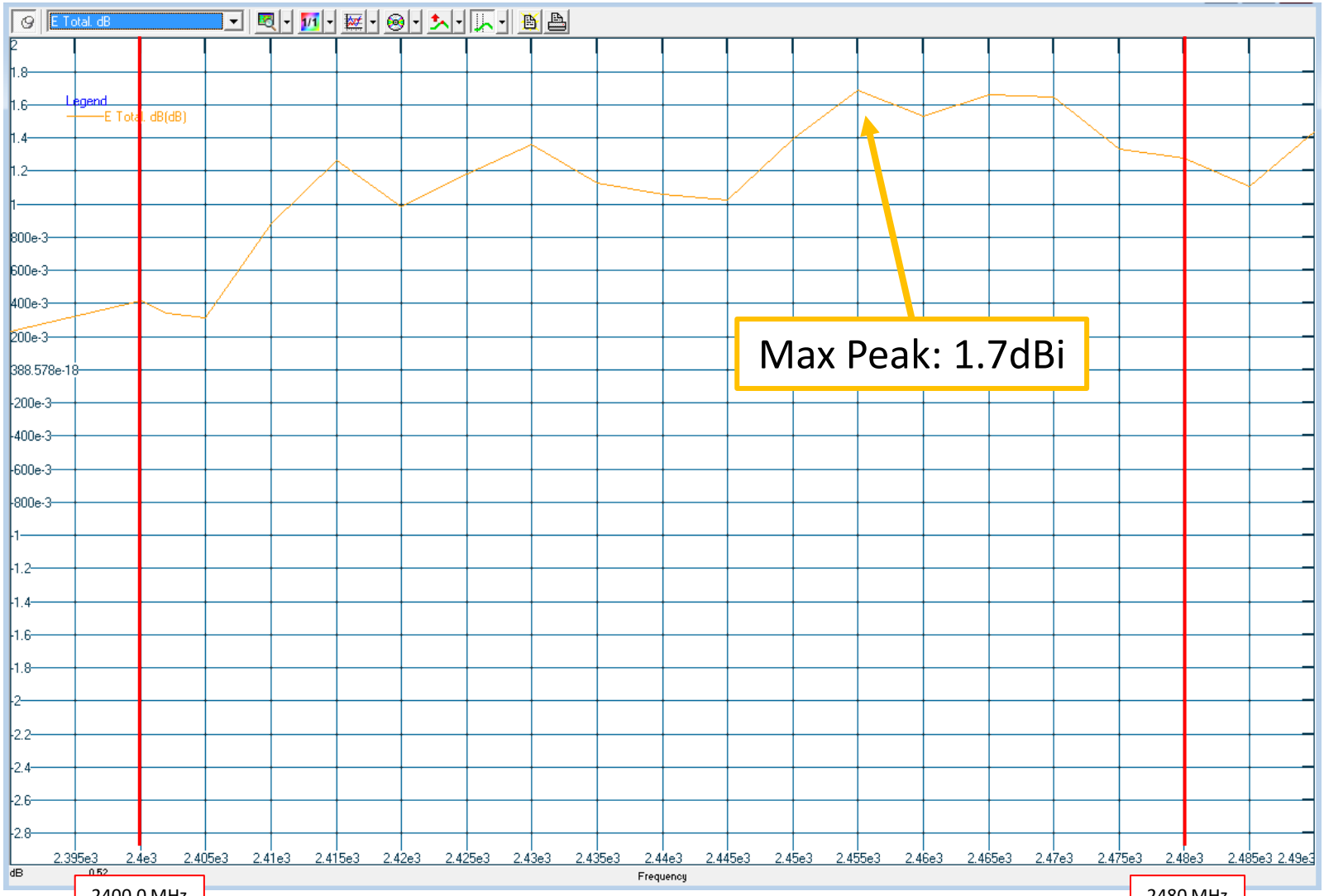
Efficiency (dB)

Module 1



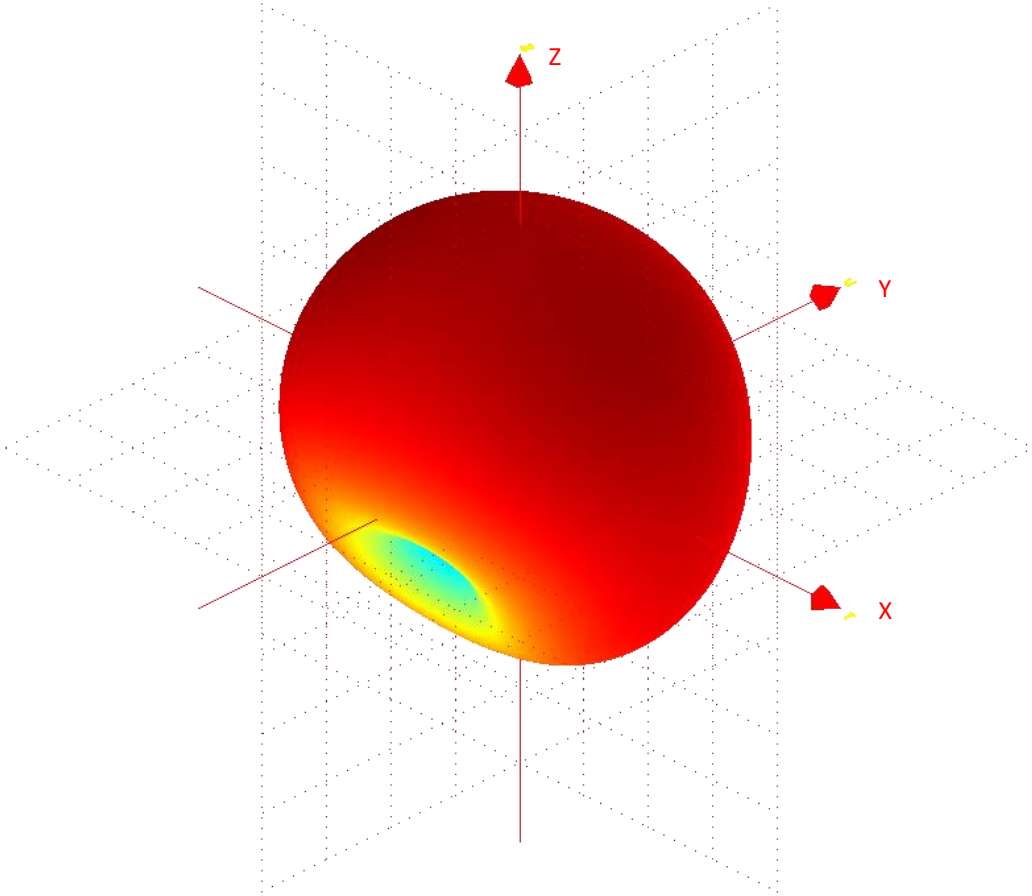
Peak Gain (dBi)

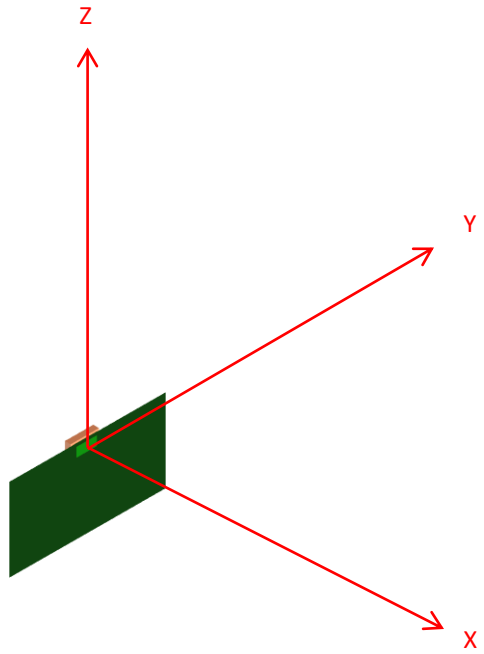
Module 1



3D gain pattern @ 2402MHz, View 1

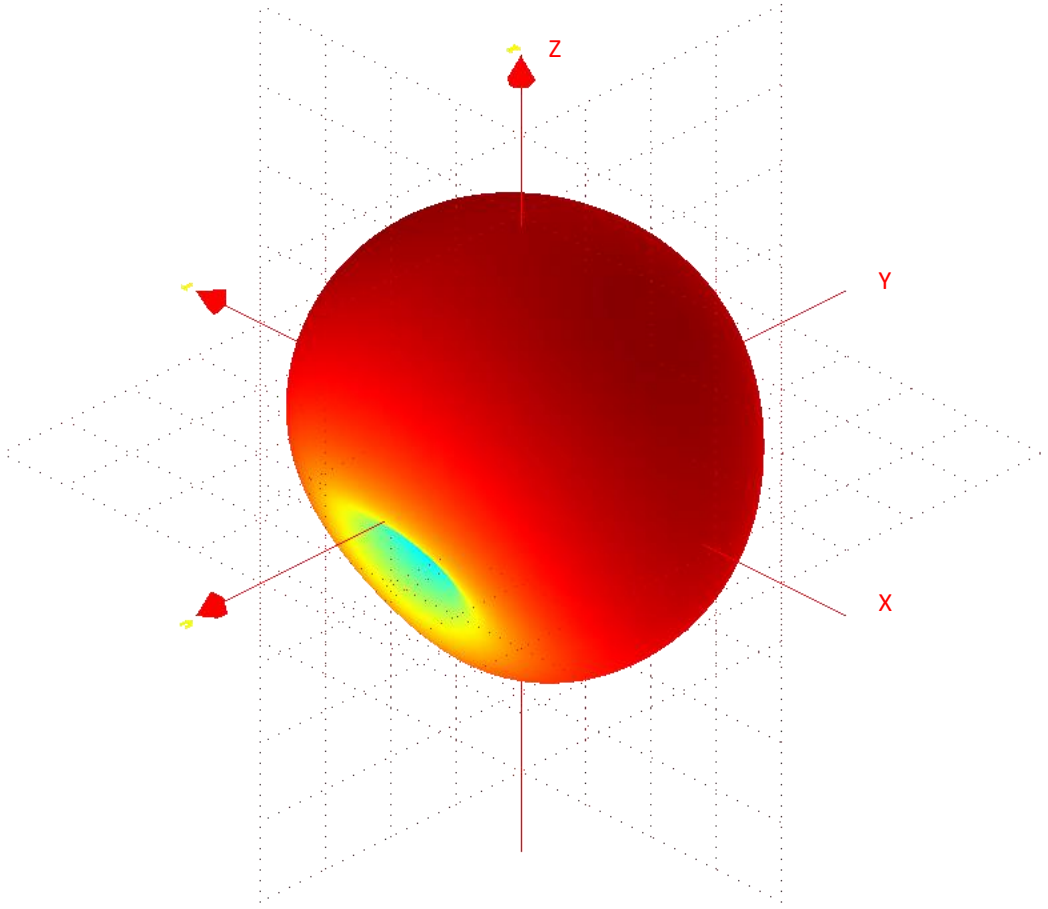
Module 1

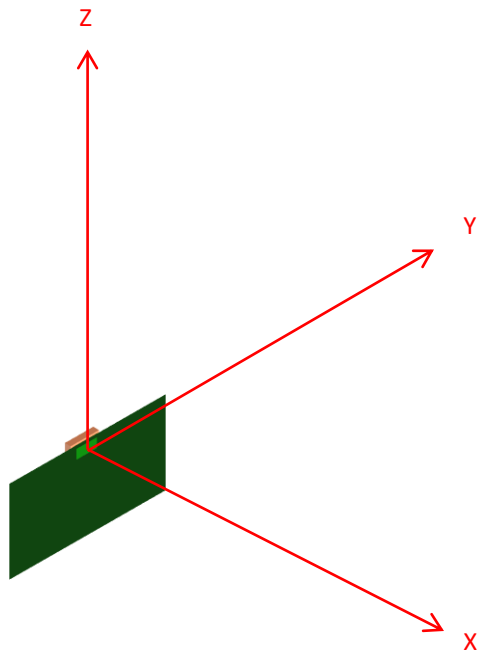




3D gain pattern @ 2402MHz, View 2

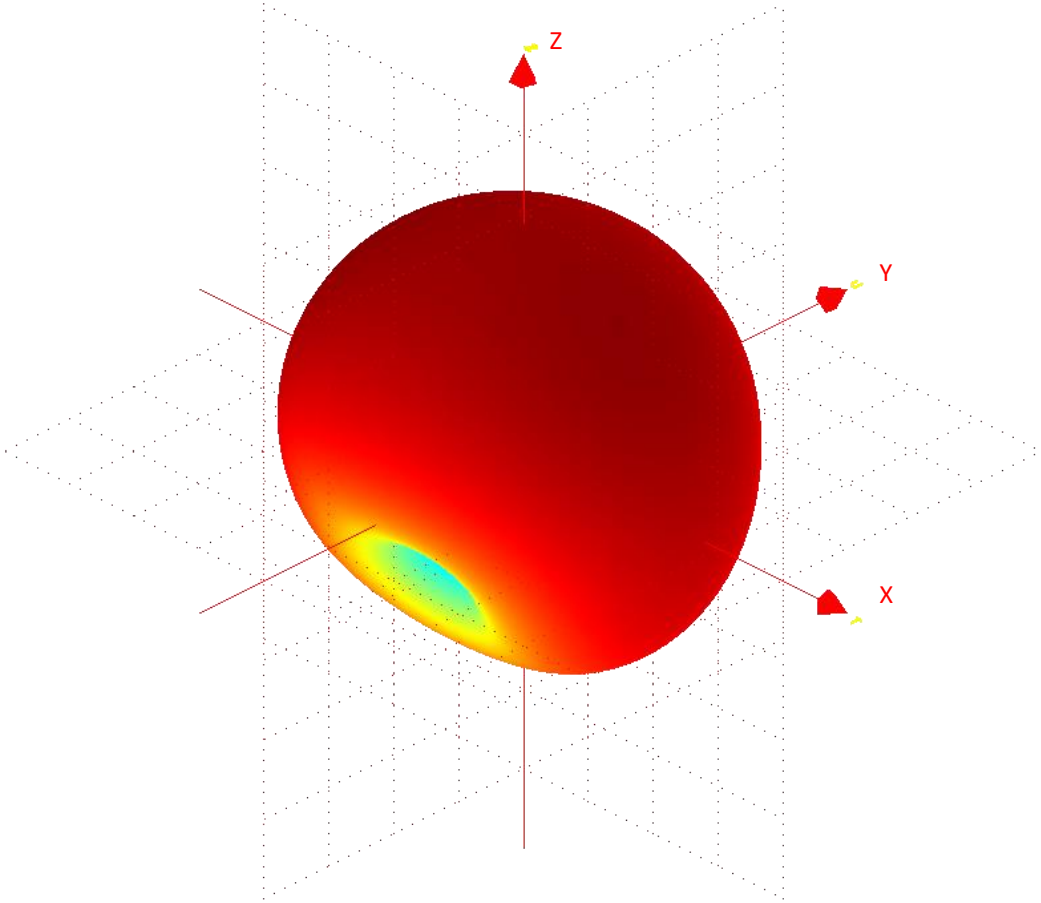
Module 1

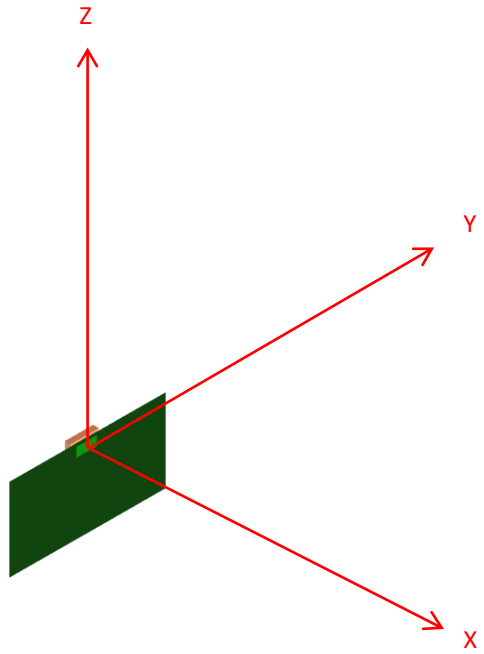




3D gain pattern @ 2440MHz, View 1

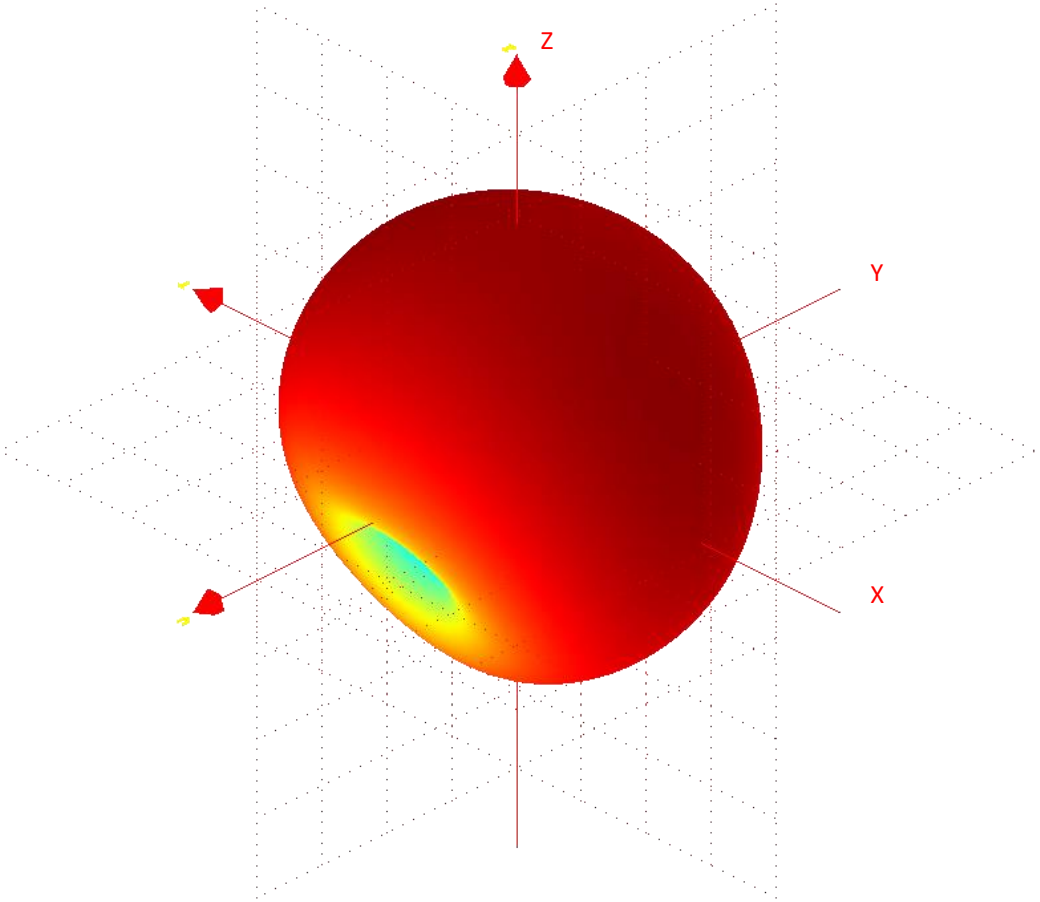
Module 1

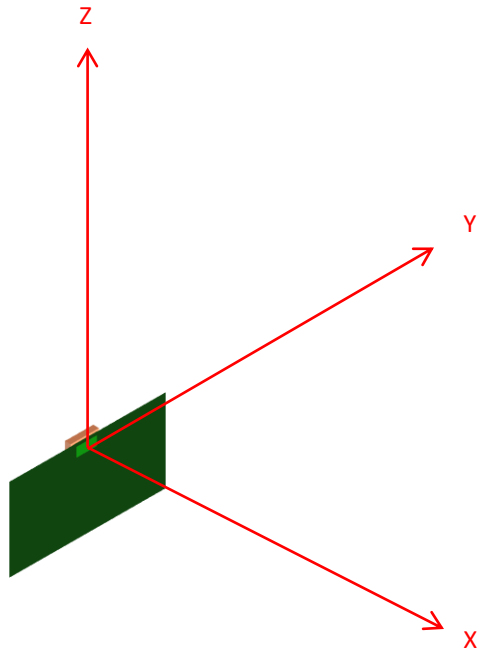




3D gain pattern @ 2440MHz, View 2

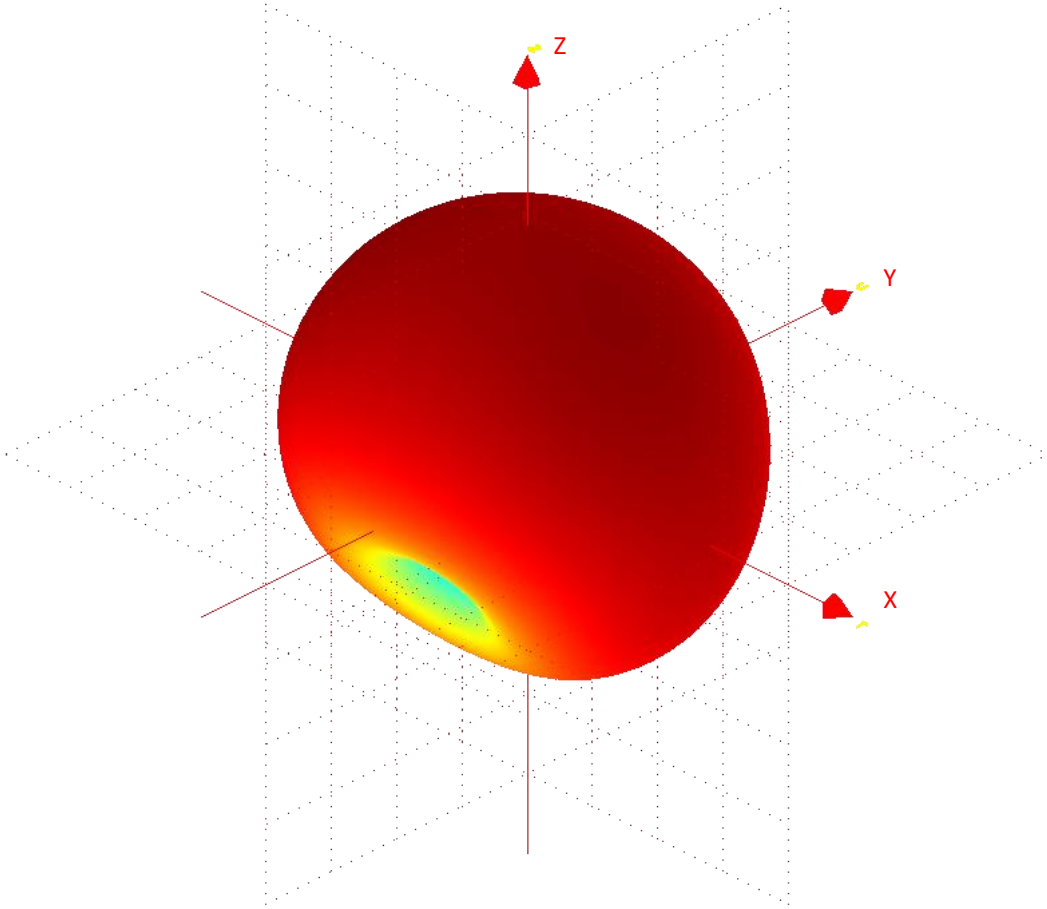
Module 1

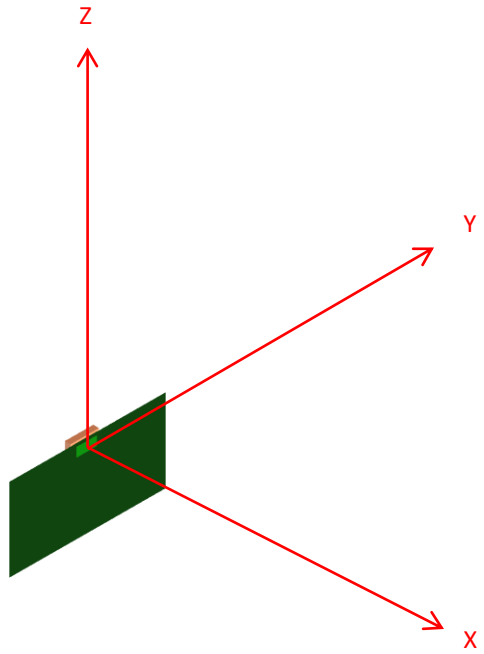




3D gain pattern @ 2480MHz, View 1

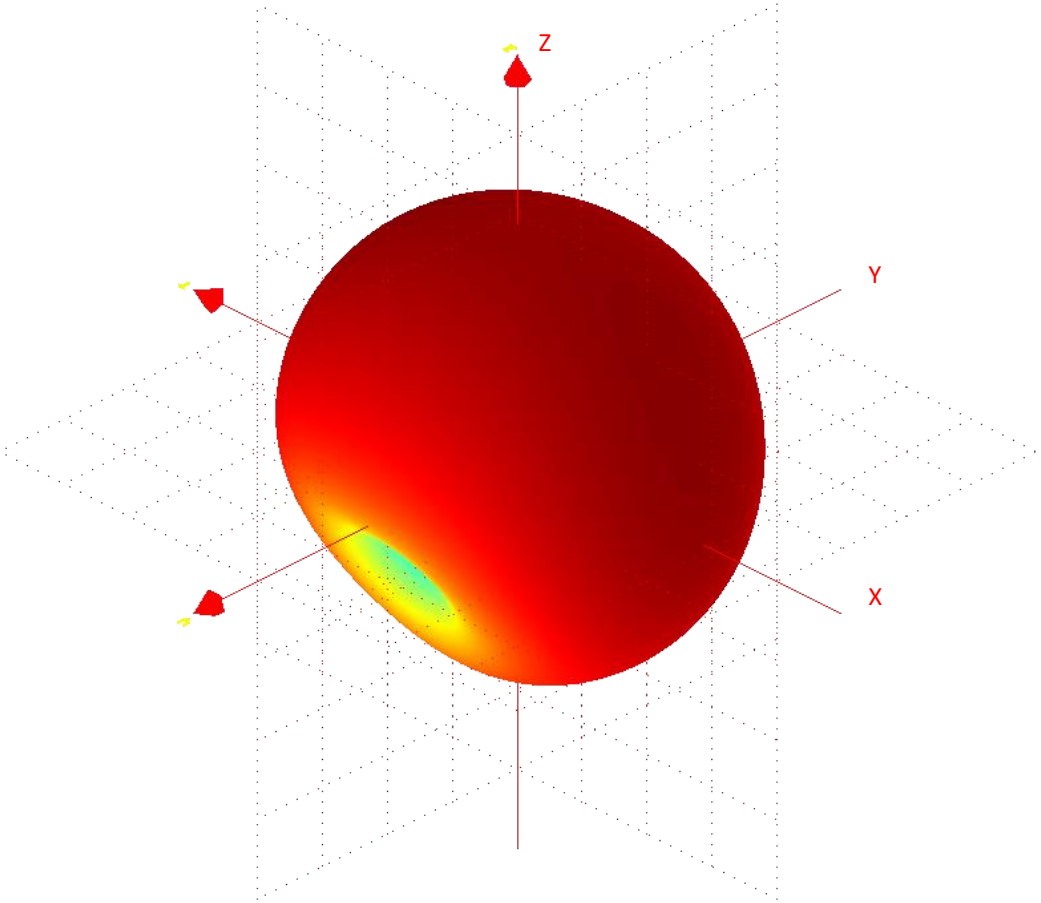
Module 1

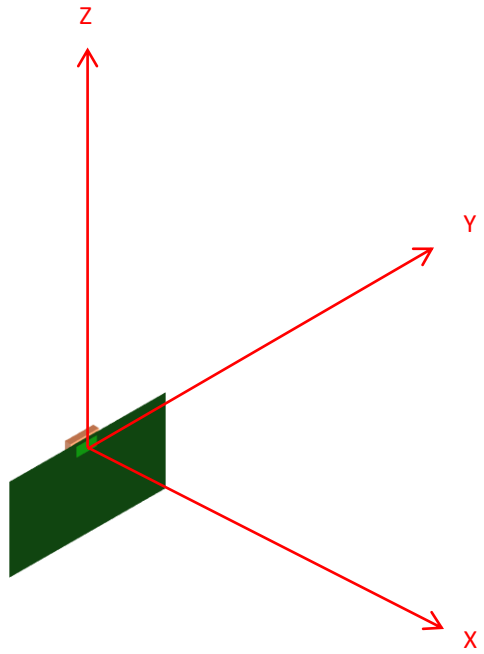




3D gain pattern @ 2480MHz, View 2

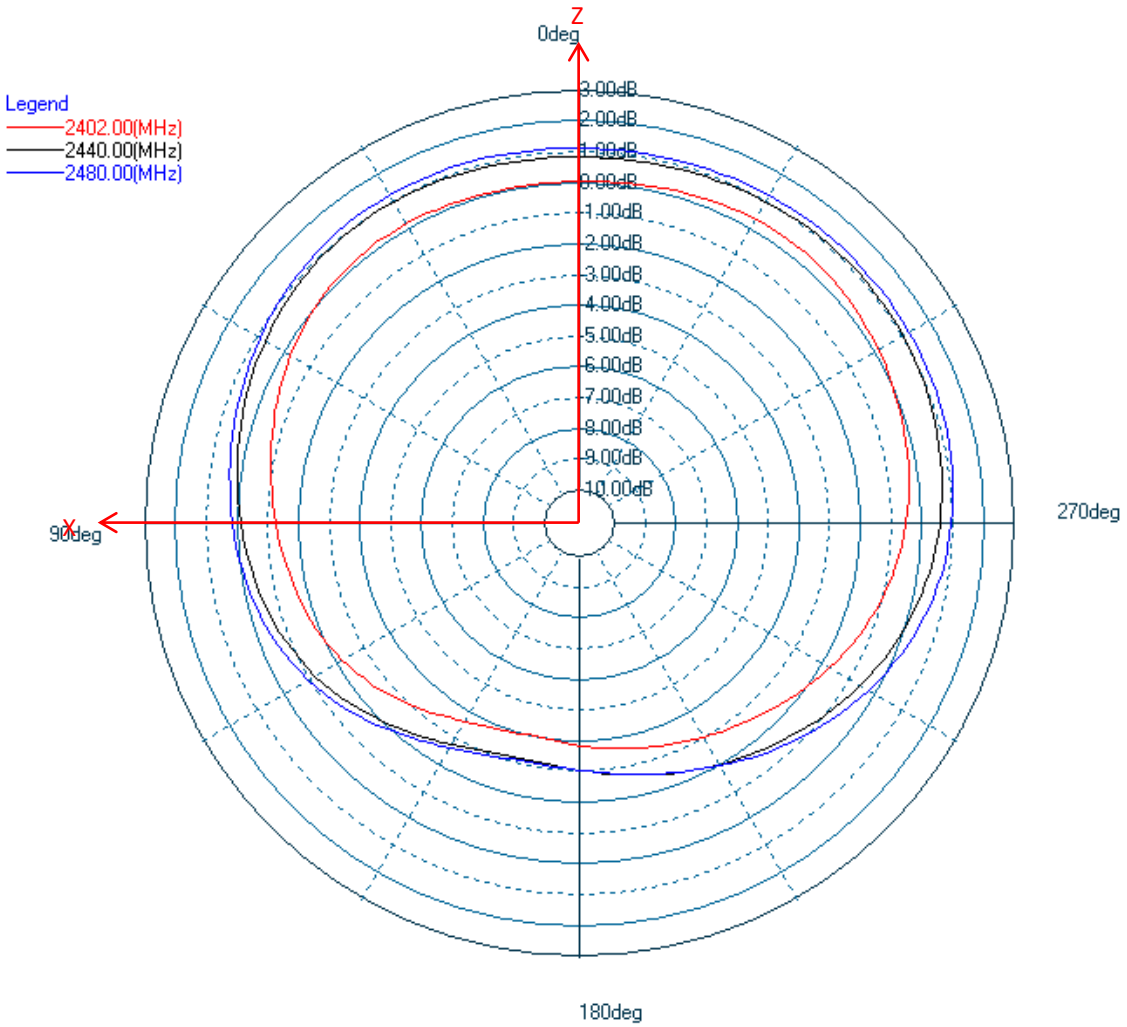
Module 1

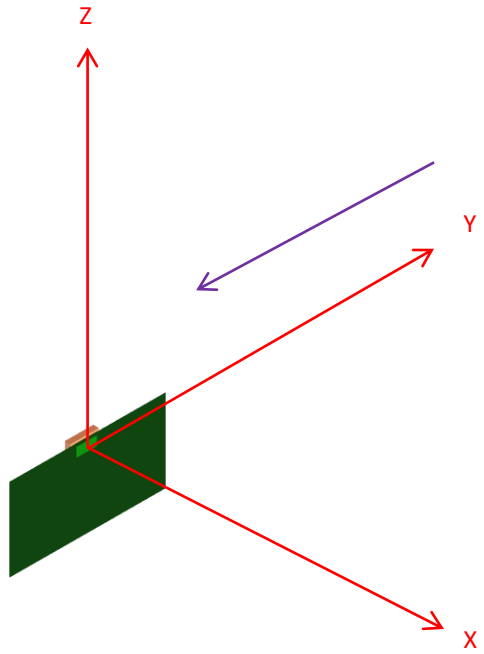




Phi0 Gain cut (dBi)

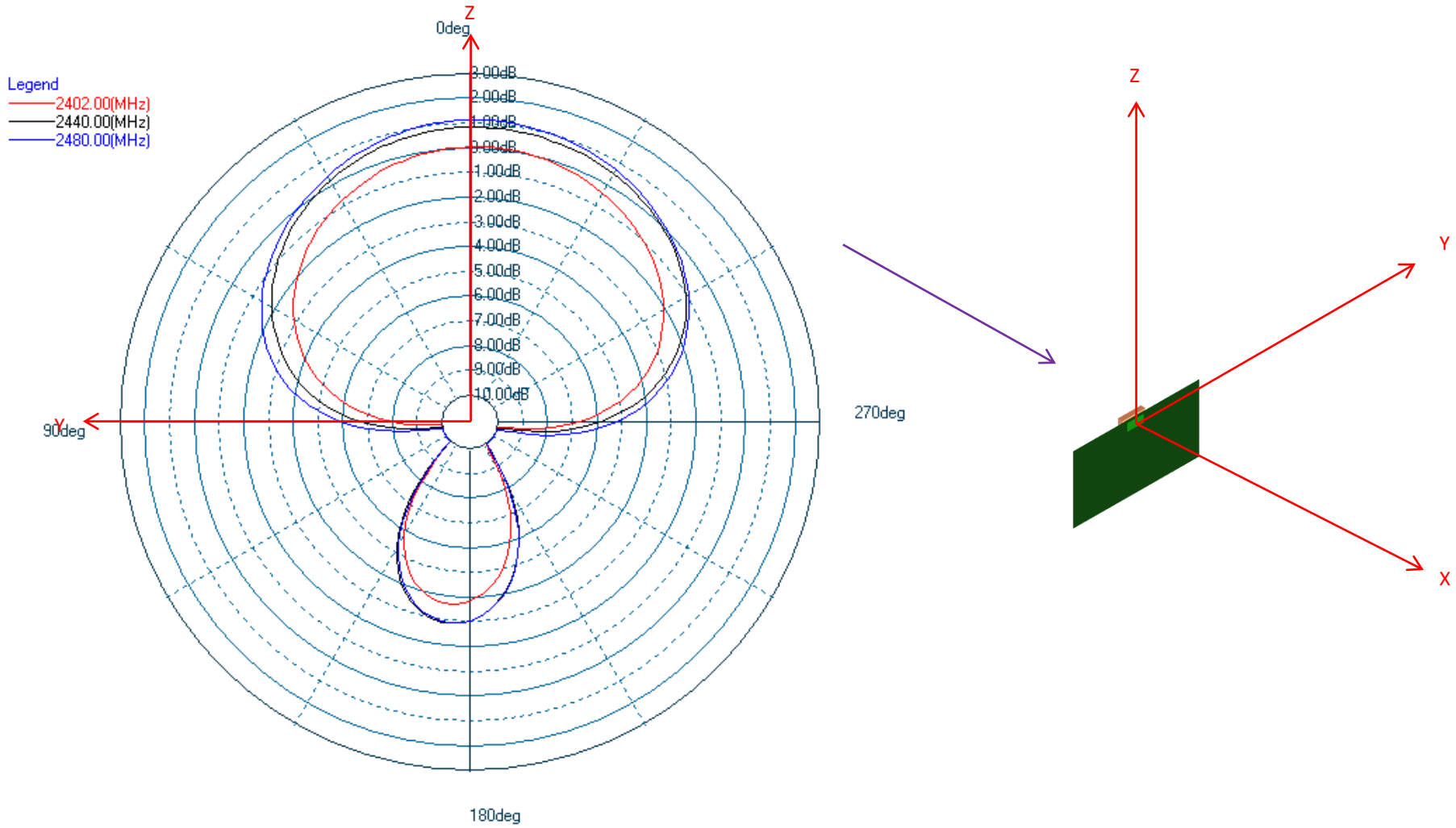
Module 1





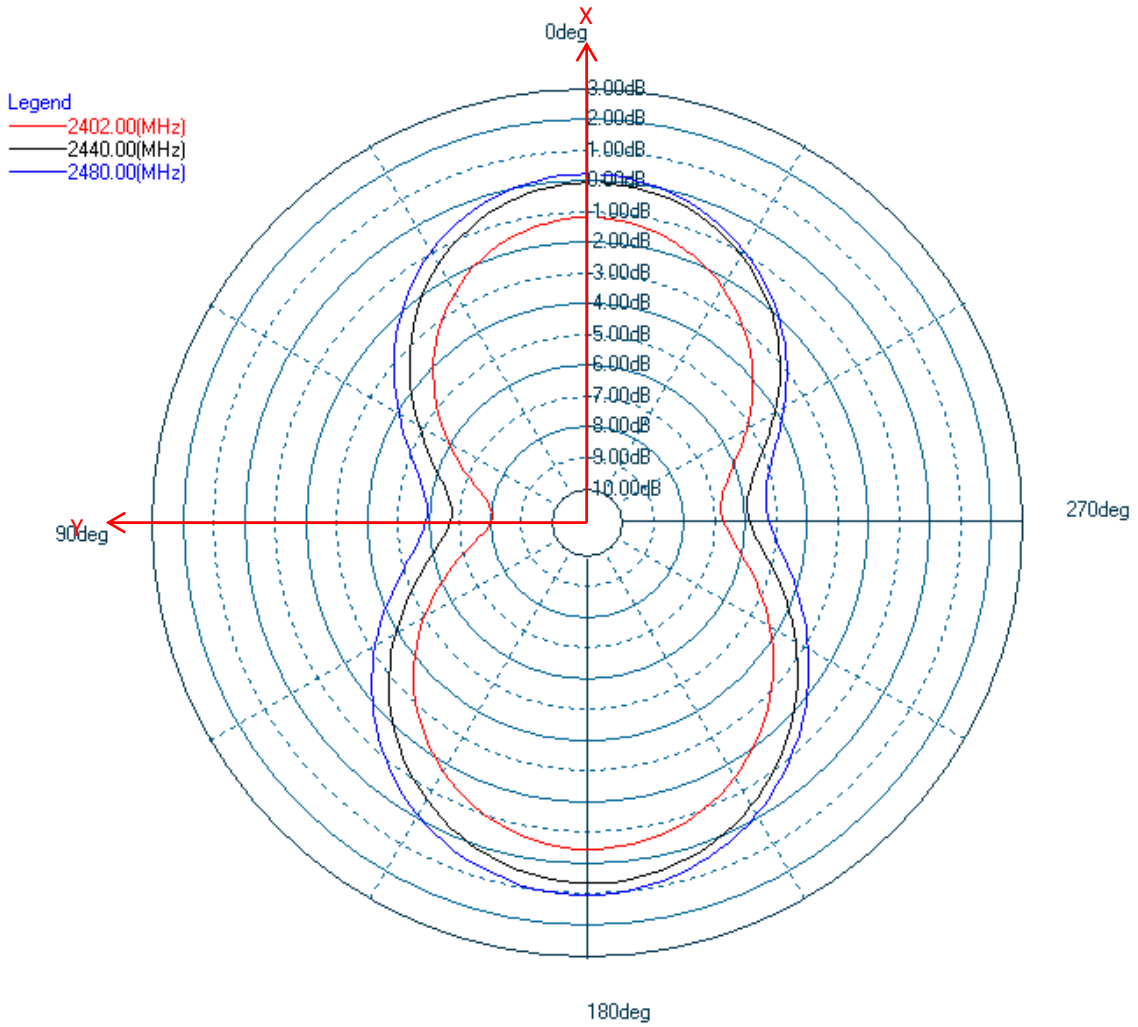
Phi90 Gain cut

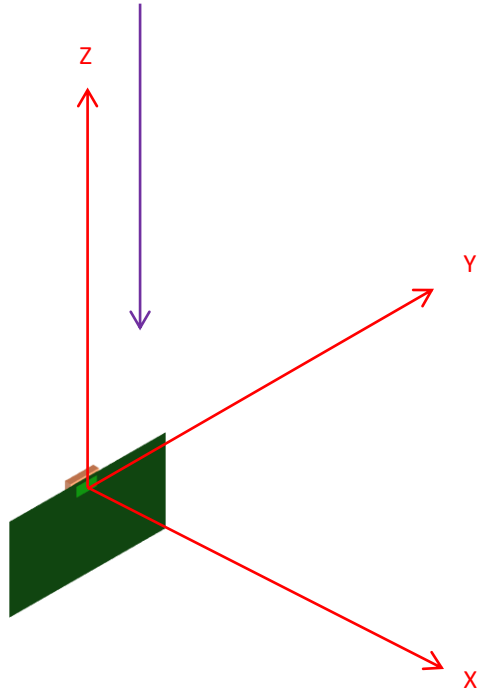
Module 1



Theta90 Gain cut

Module 1





Module 2

Measurement results

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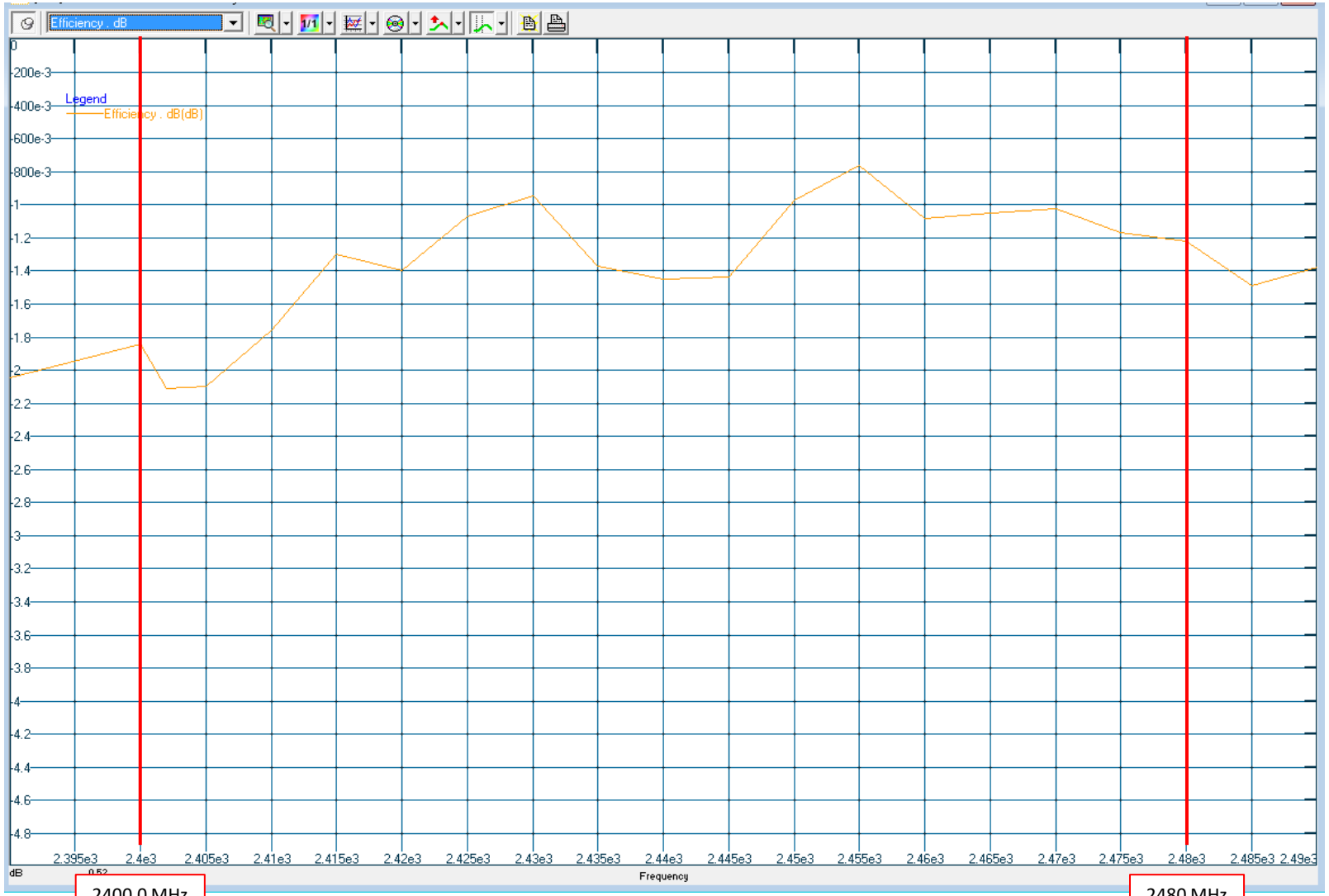
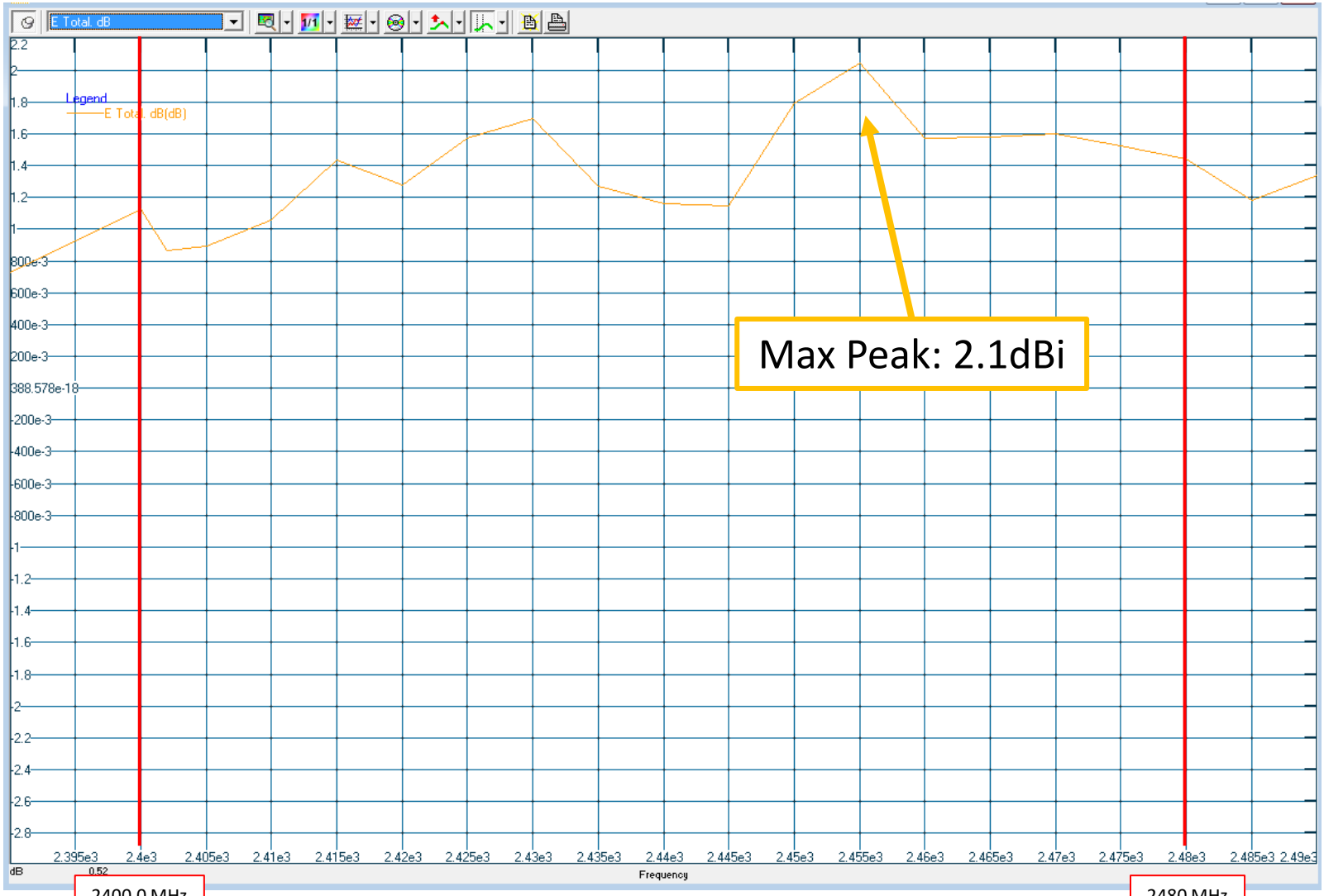
Efficiency (dB)

Module 2



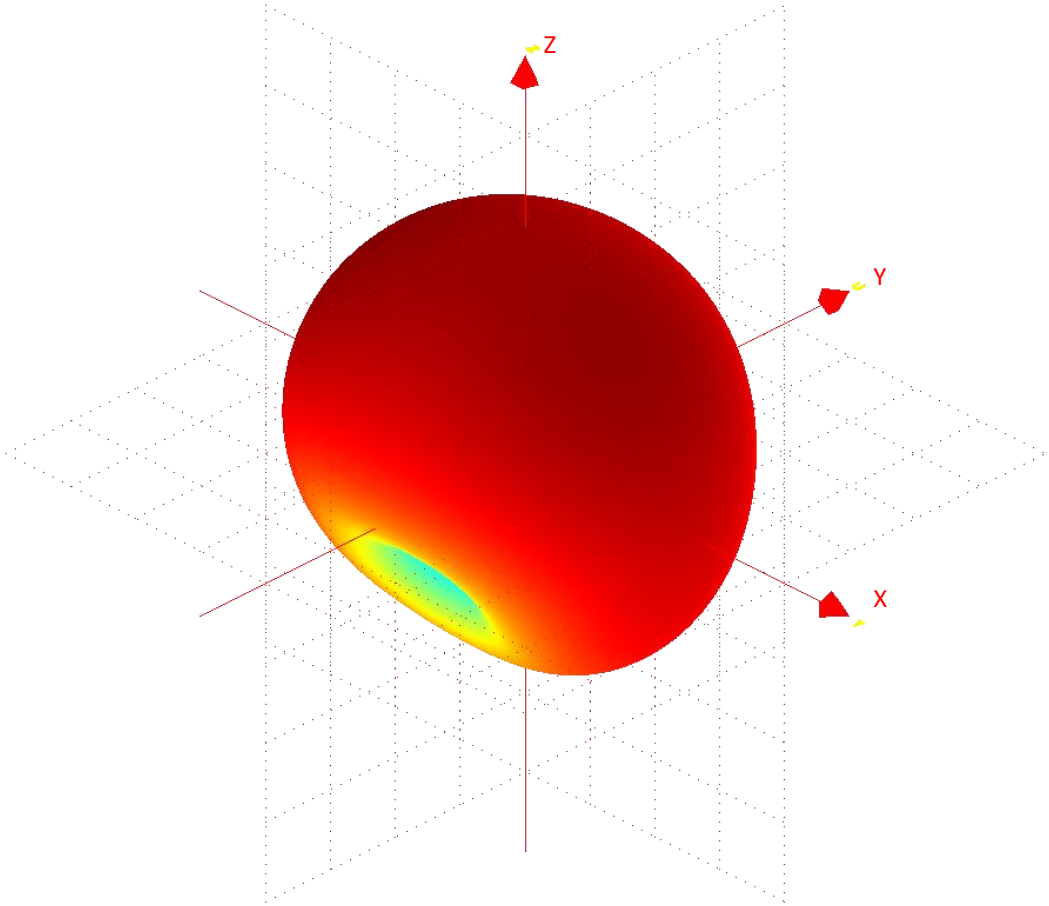
Peak Gain (dBi)

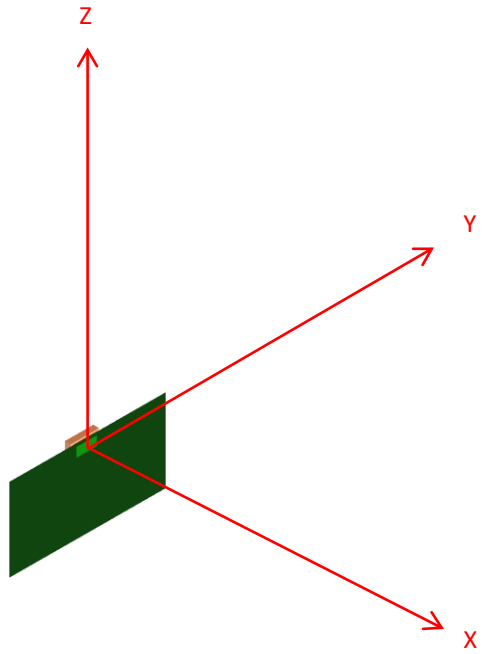
Module 2



3D gain pattern @ 2402MHz, View 1

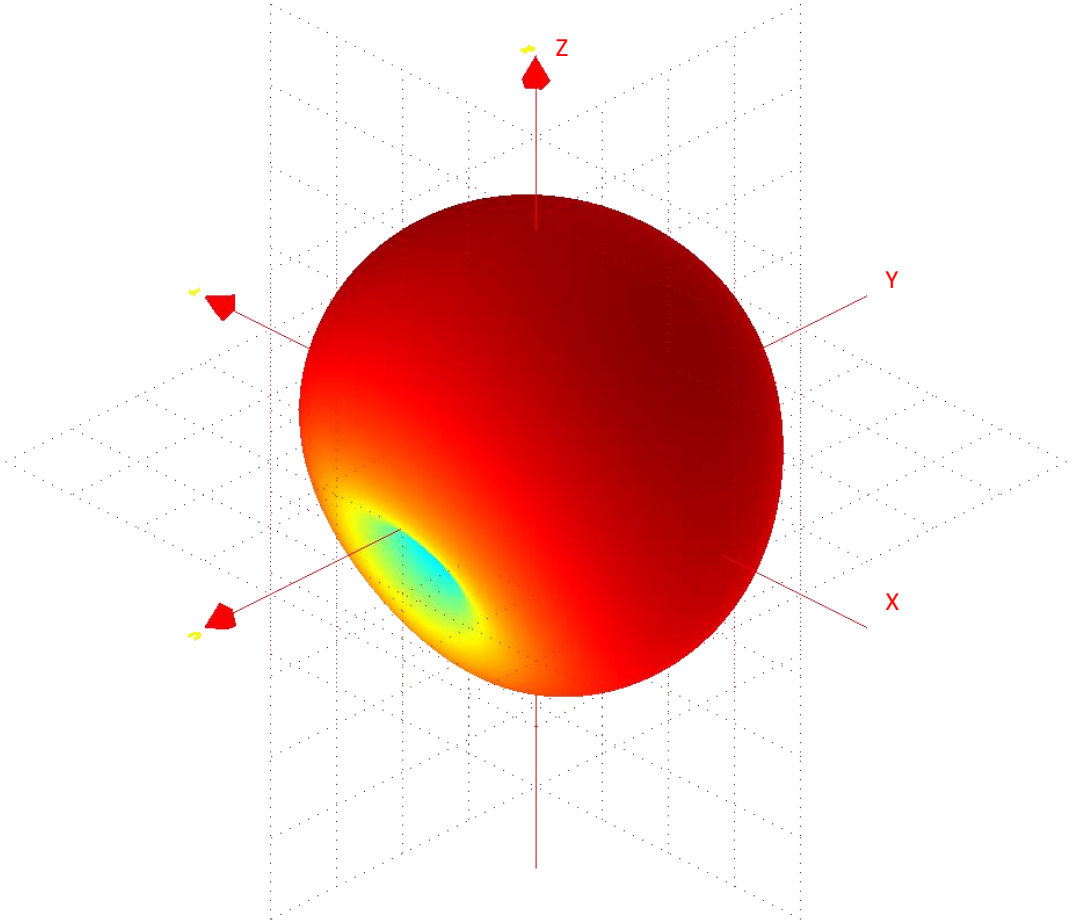
Module 2

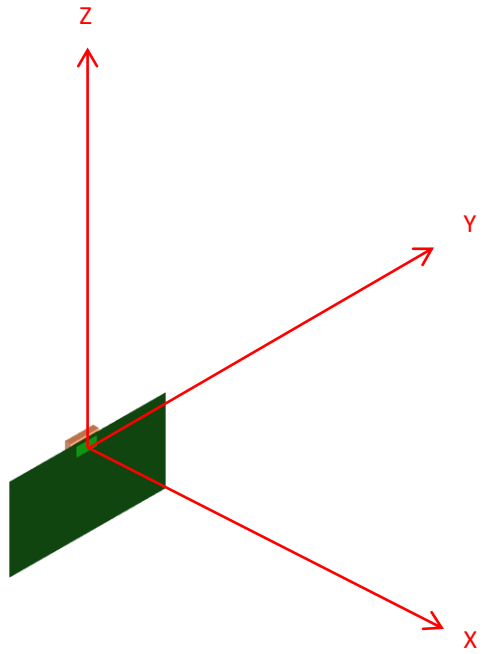




3D gain pattern @ 2402MHz, View 2

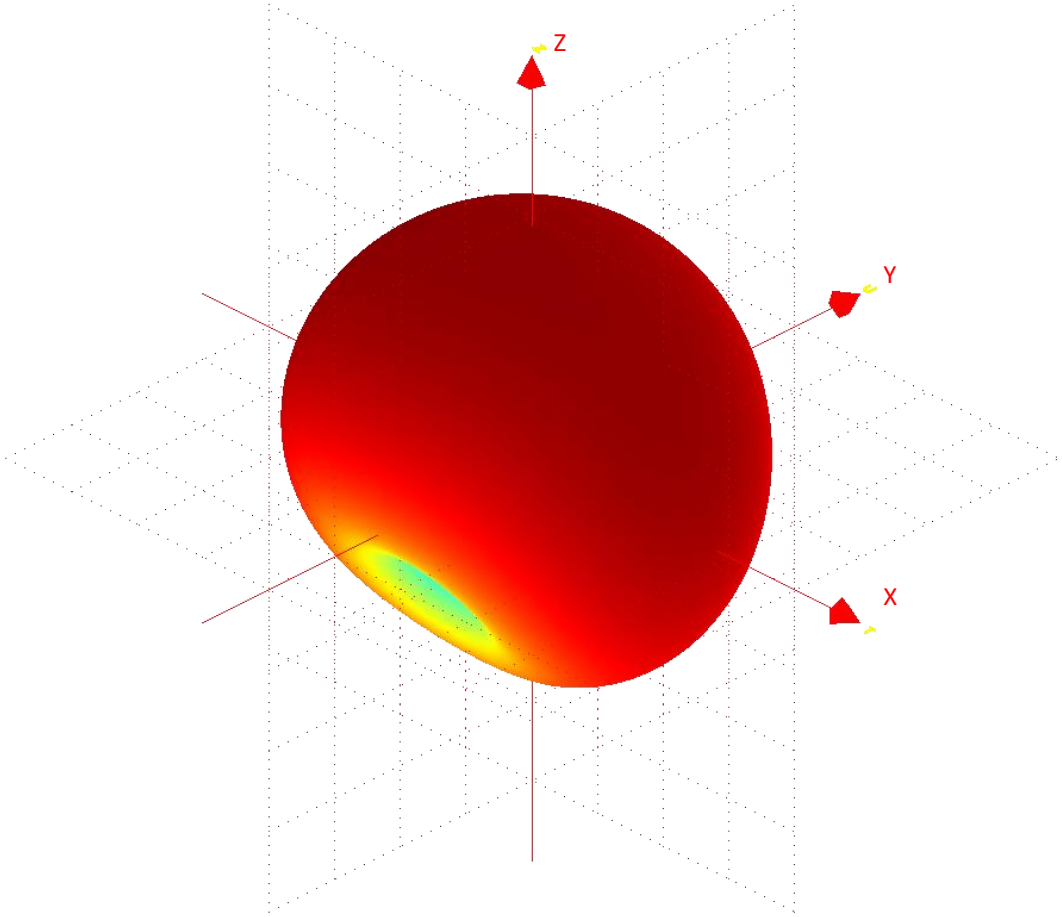
Module 2

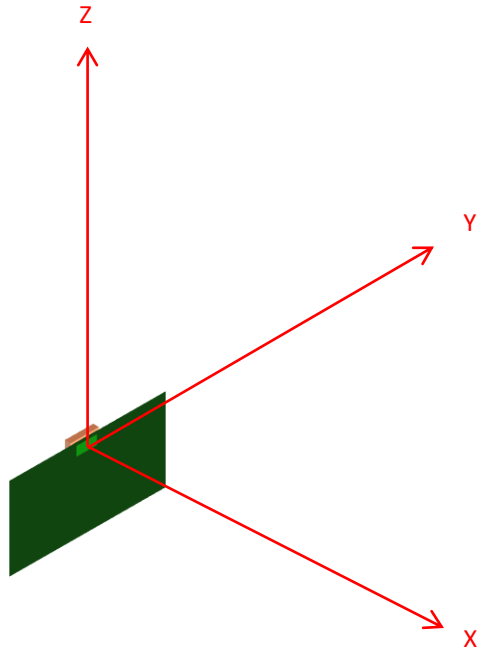




3D gain pattern @ 2440MHz, View 1

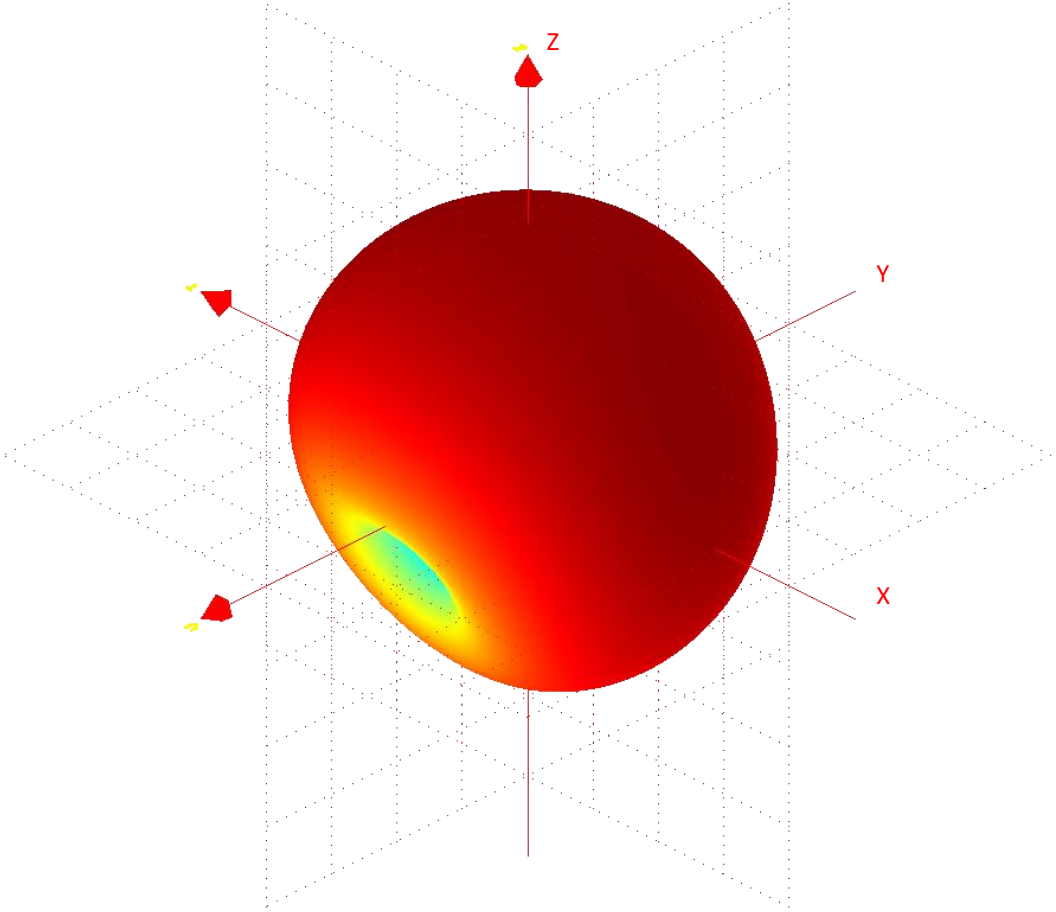
Module 2

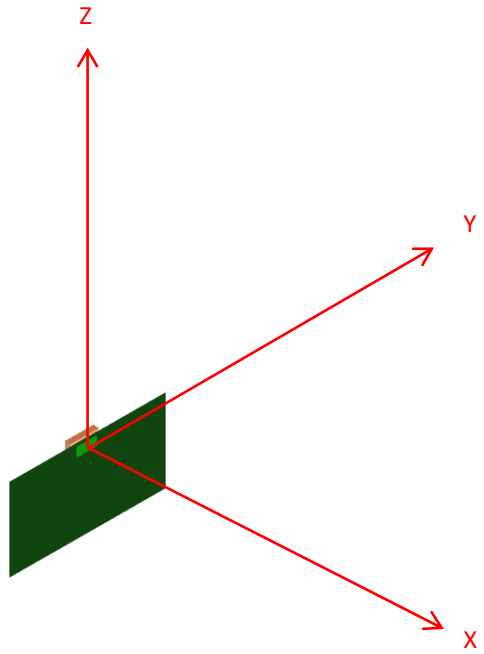




3D gain pattern @ 2440MHz, View 2

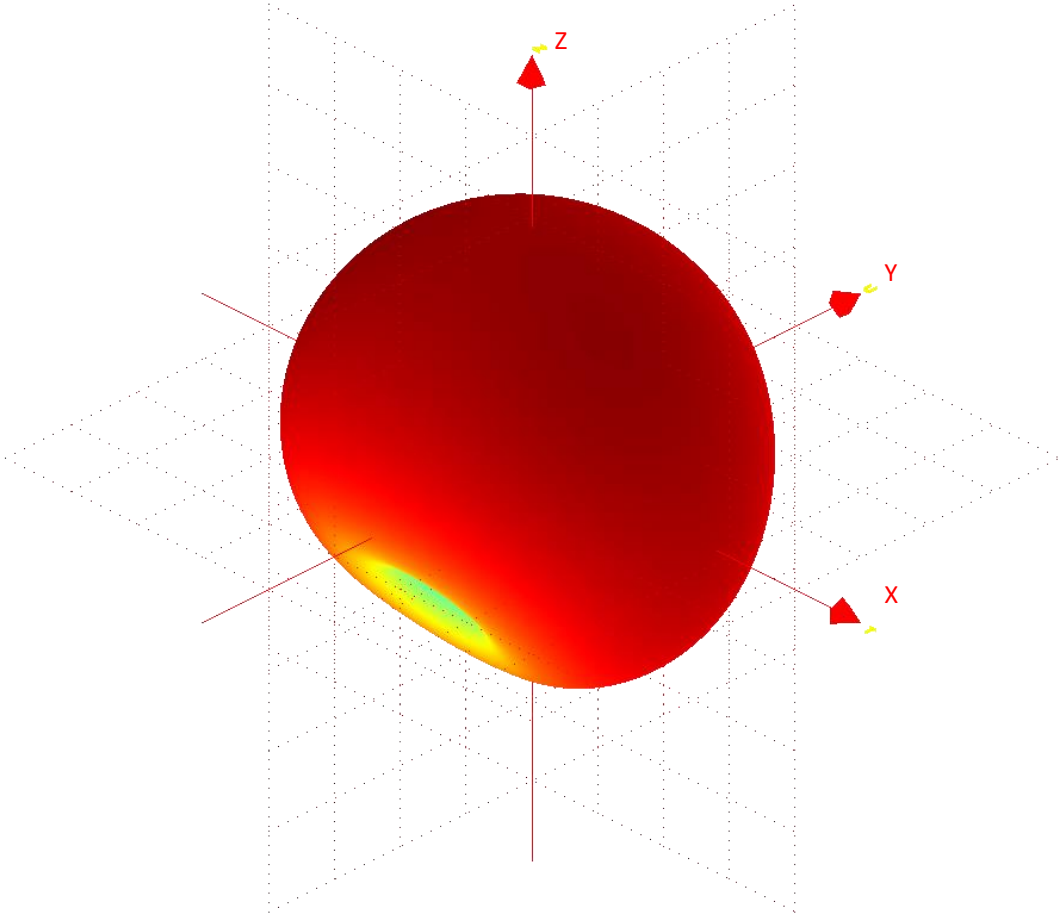
Module 2

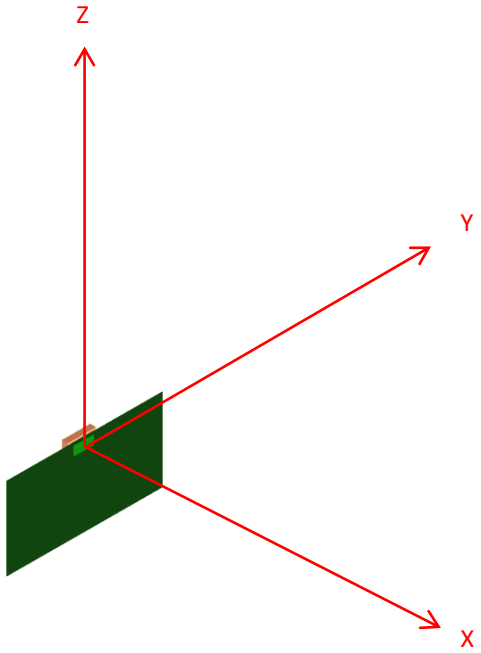




3D gain pattern @ 2480MHz, View 1

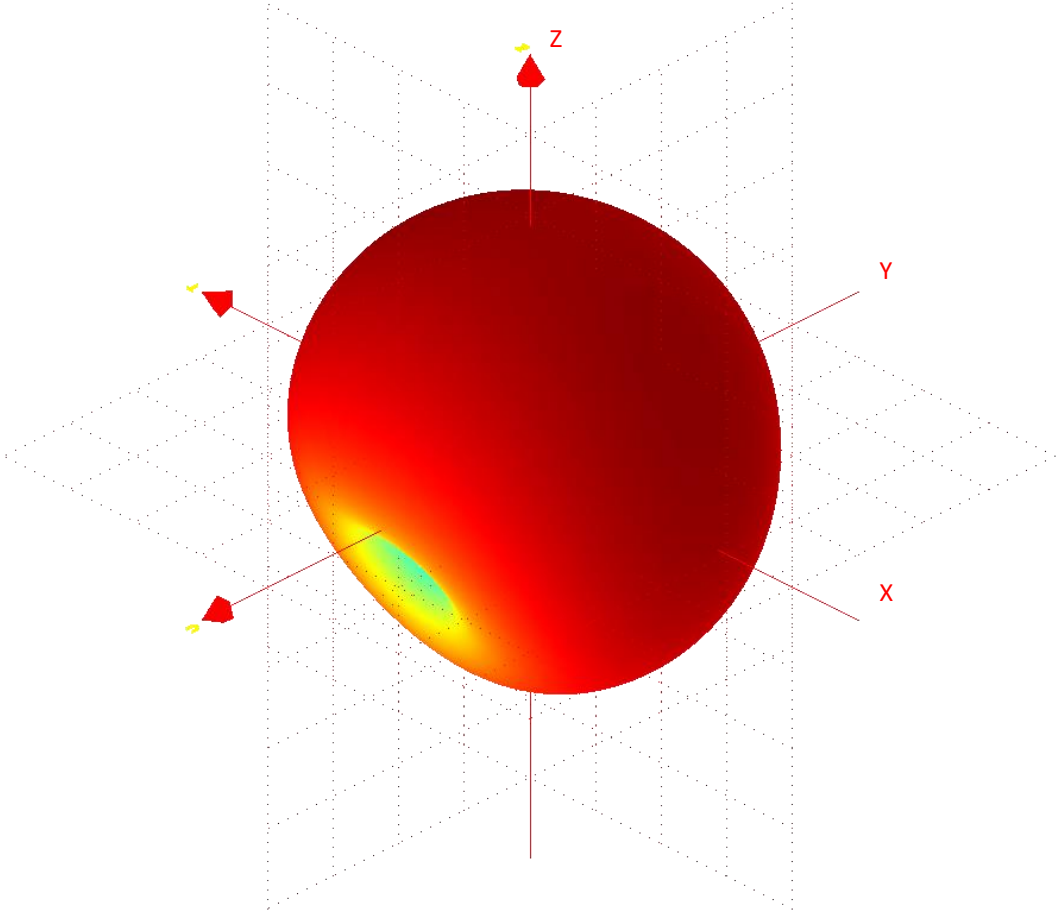
Module 2

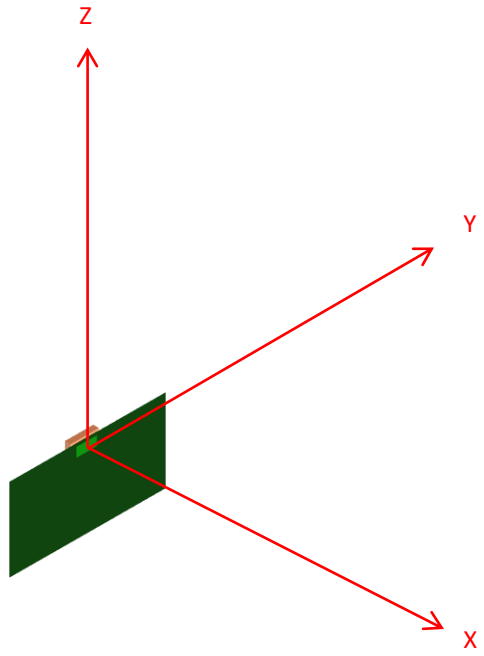




3D gain pattern @ 2480MHz, View 2

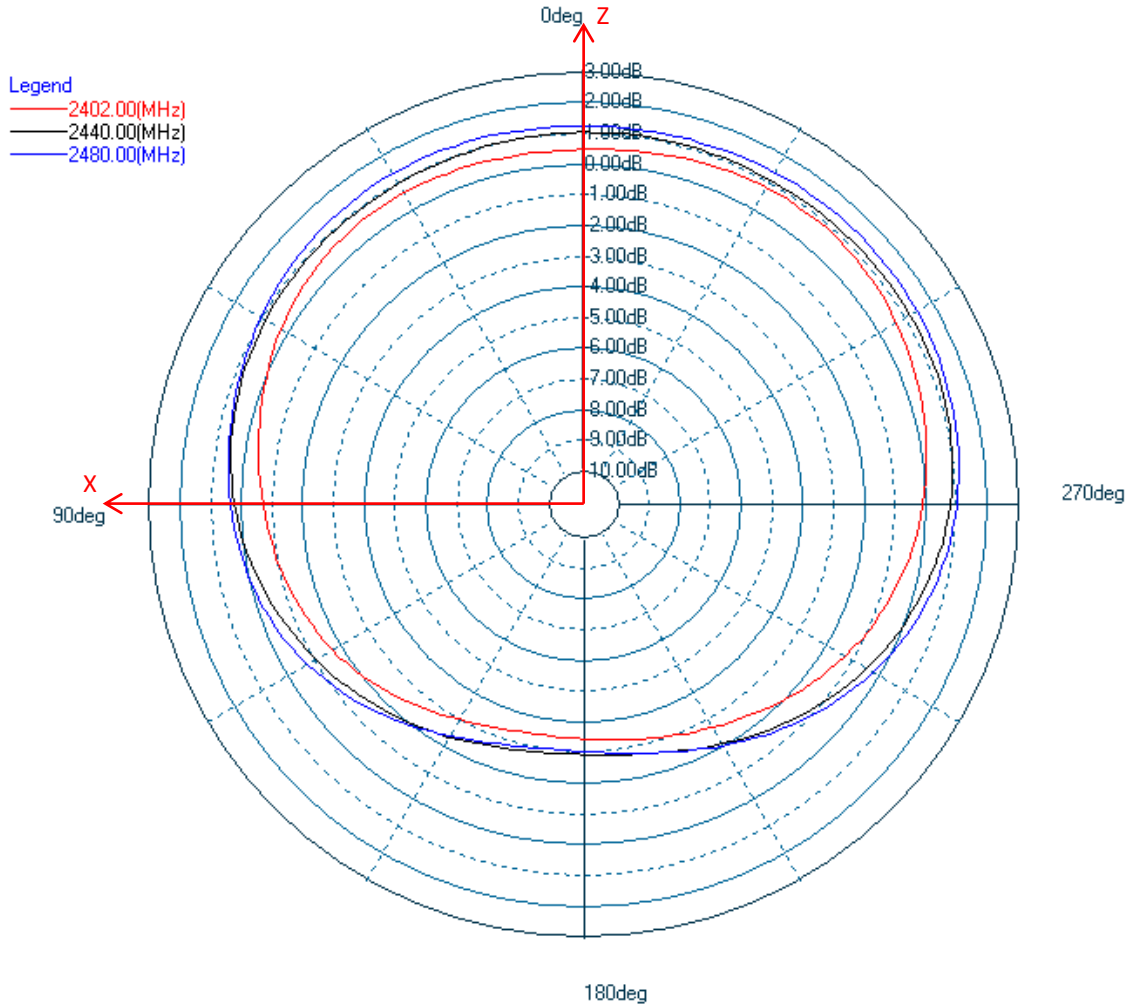
Module 2

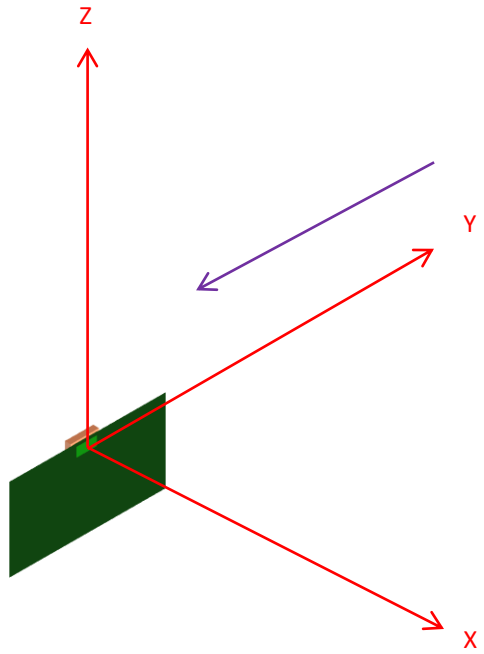




Phi0 Gain cut (dBi)

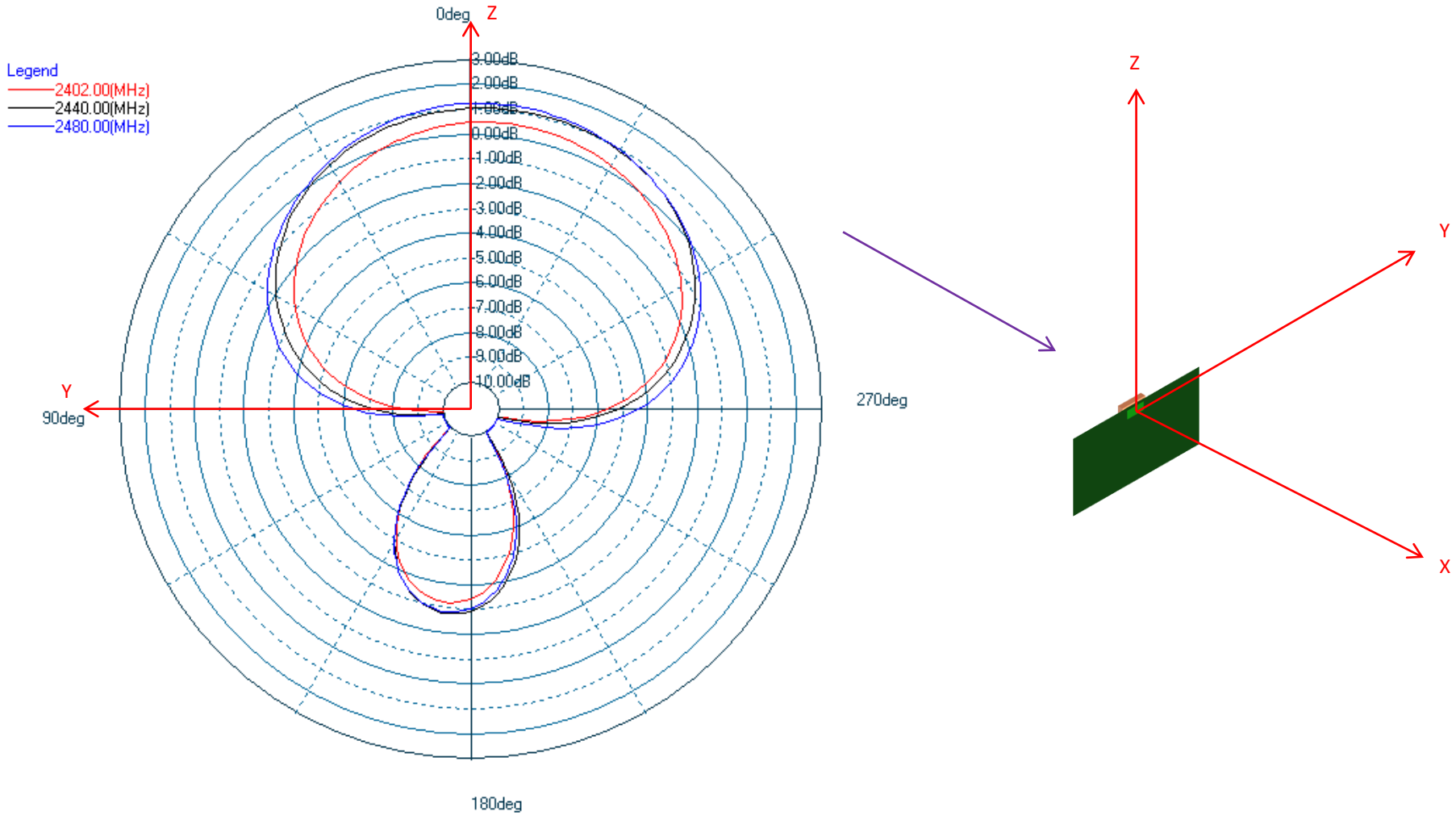
Module 2





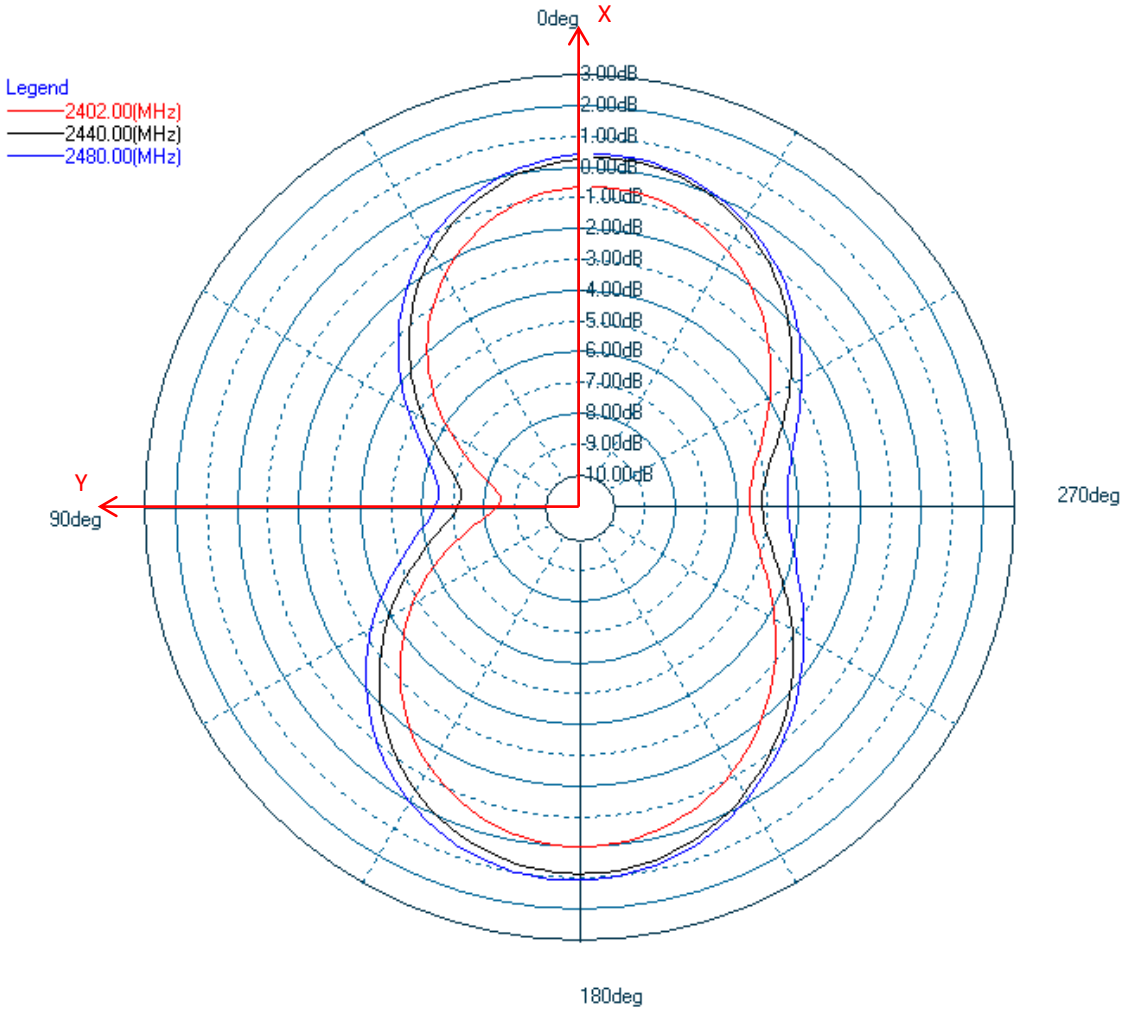
Phi90 Gain cut

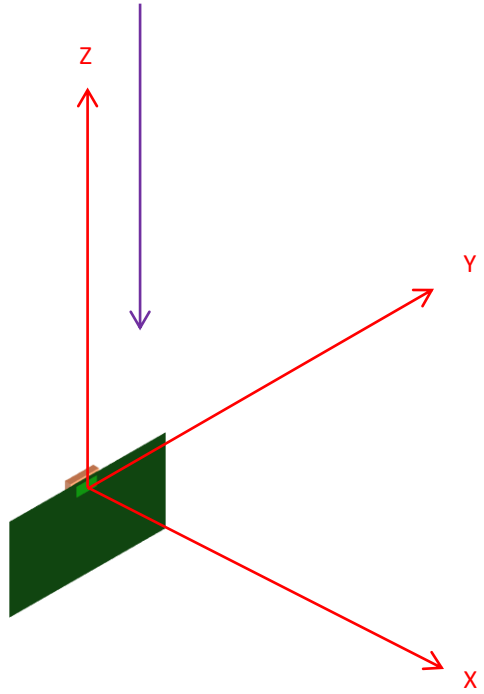
Module 2



Theta90 Gain cut

Module 2





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Thank You