



JUNIPER AP47 ANTENNA REPORT

Brand: Juniper

Model: AP47



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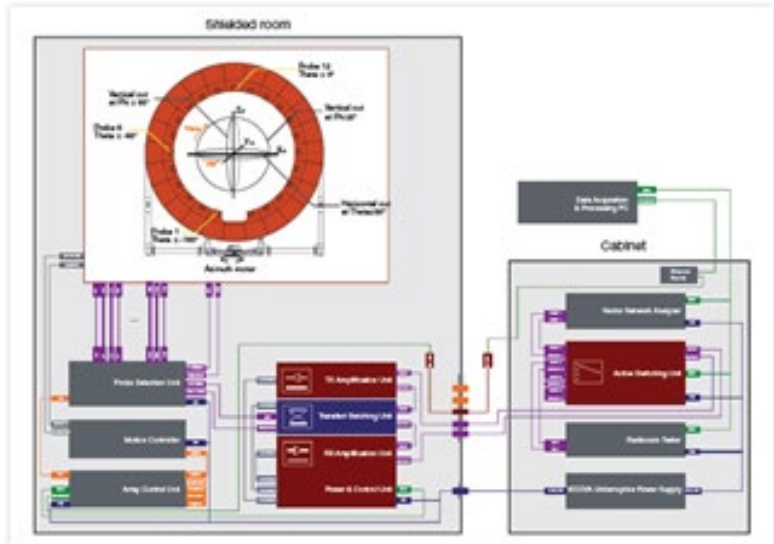
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Chamber Information

- Test Date : 20241004
- Test Engineer : LiKai Kuo
- Measurement System : SATIMO SG24-L
- Software Name : Wave Studio
- Software Version : 22.5.6



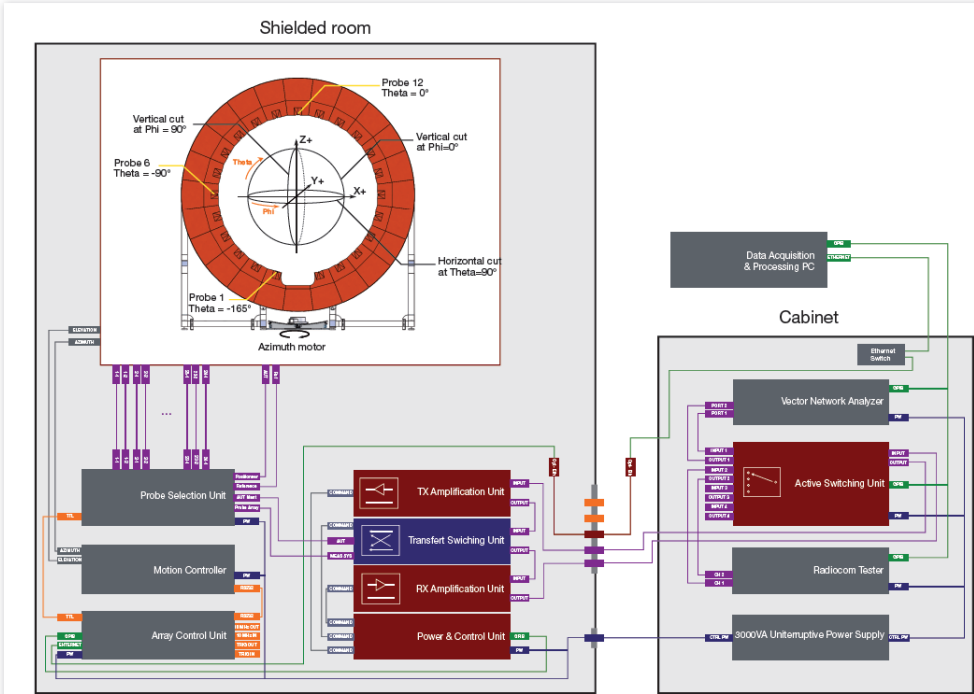
Test Equipment

■ Measurement System : SATIMO SG24-L Chamber

■ Measurement Setup

- pattern & gain measurement
 - SATIMO chamber (SG24-L)
 - SATIMO program (wave studio)
 - System overview
- Test item
 - antenna passive test 400MHz~9GHz

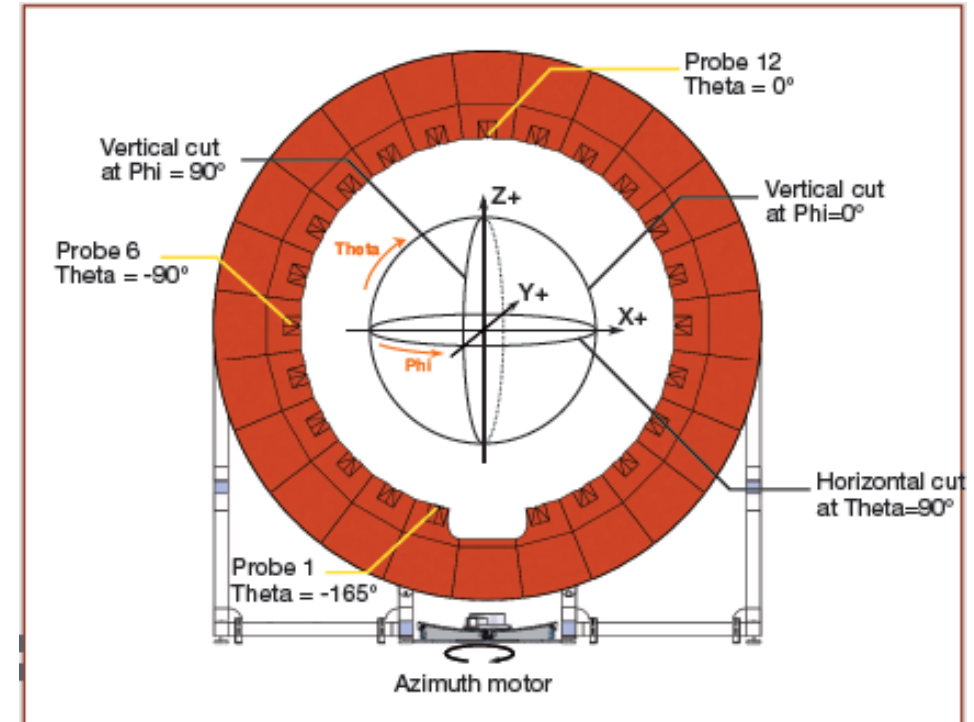
■ Calibration Information



Device	Type / Model	Serial #	Manufacture	Cal. Date	Cal. Until
Antenna Measurement System	SG24-L	HKG1669S	MVG-SATIMO	2024-06-05	2025-06-04
Network Analyzer	Keysight E5080B	MY59203136	Keysight	2024-06-05	2025-06-04

Test Procedure

1. Place the device to be tested on the fixture and align it with the center of the chamber.
2. Connect the antenna cable to the RF connector of the chamber.
3. Use the SW to configure parameters (antenna name, frequency points, measurement angles, antenna dimension), and then run the test SW (wave studio).
4. By phi from 0° to 360° and theta from 0° to 180° with a step size of 3 degrees, get the 3D data, including efficiency, peak gain, 2D and 3D radiation patterns.
5. This is far field test for antenna verification.
6. This is passive measurement, which means the device is off and not in any operating mode.



Summary

The summary of antenna performance are shown in below.

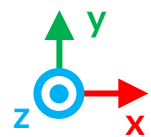
- Radiation efficiency
 - ~56% for 2.4GHz, ~67% for 5GHz, ~63% for 6GHz Wi-Fi Tri-band antennas [TB1, TB2, TB3, TB4]
 - ~59% for 5GHz Wi-Fi 5G antennas [5G1, 5G2, 5G3, 5G4]
 - ~63% for 6GHz Wi-Fi 6G antennas [6G1, 6G2, 6G3, 6G4]
 - ~60% for 2.4GHz ~65% for 5-7GHz Scanning antennas [SC1, SC2]
 - ~68% for 2.4GHz Zigbee(Thread) antenna [Zigbee(Thread)]
 - ~59% for L1, ~61% for L5 GPS antenna [GPS]
 - ~41% for Ch5, ~61% for Ch9 UWB TWR antenna [UWB-TWR] ;
 - ~4% for Ch5, ~19% for Ch9 UWB PDoA antennas [UWB2, UWB3, UWB4]
 - ~16% for 2.4GHz BLE array [Beam1~Beam8]; ~27% for 2.4GHz BLE slot_directional antenna [Beam9]
 - ~19% for 2.4GHz BLE array [Omni]
- Peak gain
 - 5.0dBi for 2.4GHz, 6.0dBi for 5GHz, 5.9dBi for 6GHz Wi-Fi Tri-band antennas [TB1, TB2, TB3, TB4]
 - 5.2dBi for 5GHz Wi-Fi 5G antennas [5G1, 5G2, 5G3, 5G4]
 - 6.0dBi for 6GHz Wi-Fi 6G antennas [6G1, 6G2, 6G3, 6G4]
 - 3.9dBi for 2.4GHz, 5.9dBi for 5-7GHz Scanning antennas [SC1, SC2]
 - 3.9dBi for 2.4GHz Zigbee(Thread) antenna [Zigbee(Thread)]
 - 2.6dBi for L1, 2.9dBi for L5 GPS antenna [GPS]
 - 4.2dBi for Ch5, 4.7dBi for Ch9 UWB TWR antenna [UWB-TWR] ;
 - -0.7dBi for Ch5, 1.8dBi for Ch9 UWB PDoA antennas [UWB2, UWB3, UWB4]
 - 4.2dBi for 2.4GHz BLE array [Beam1~Beam8]; 3.0dBi for 2.4GHz BLE slot_directional antenna [Beam9]
 - -0.4dBi for 2.4GHz BLE array [Omni]

Antenna Placement



Antenna Plate: 246x246mm

Radio	Antenna Type
TB(1-4)	PIFA
5G(1-4)	Alford Loop
6G(1-4)	PIFA
SC(1-2)	PIFA
GPS	PIFA
UWB-TWR	PIFA
UWB-PDoA	Patch
Zigbee(Thread)	PIFA
BLE [Beam1~Beam8/Omni]	PIFA
BLE [Beam9]	Slot



UWB_TWR	Peak Gain	Position of Peak Gain (θ , φ)
TWR	4.7 dBi	$\theta = 118^\circ$, $\varphi = 354^\circ$

Zigbee(Thread)	Peak Gain	Position of Peak Gain (θ , φ)
Zigbee(Thread)	3.9 dBi	$\theta = 126.5^\circ$, $\varphi = 90^\circ$

BLE Array	Peak Gain	Position of Peak Gain (θ , φ)
BLE Array (Beam6)	4.2 dBi	$\theta = 53^\circ$, $\varphi = 222^\circ$

Wi-Fi Tri-Band



■ Maximum VSWR

- 2.0:1 on 2.4GHz / 2.0:1 on 5-7GHz

■ Minimum Isolation

- 26.2dB on 2.4GHz / 28.8dB on 5GHz /

■ Average Efficiency

- ~56% on 2.4GHz / 67% on 5GHz / ~63% on 6GHz

■ Peak Gain

- 5.0dBi on 2.4GHz / 6.0dBi on 5GHz / 5.9dBi on 6GHz

■ Cable Length

TB1 : 147mm

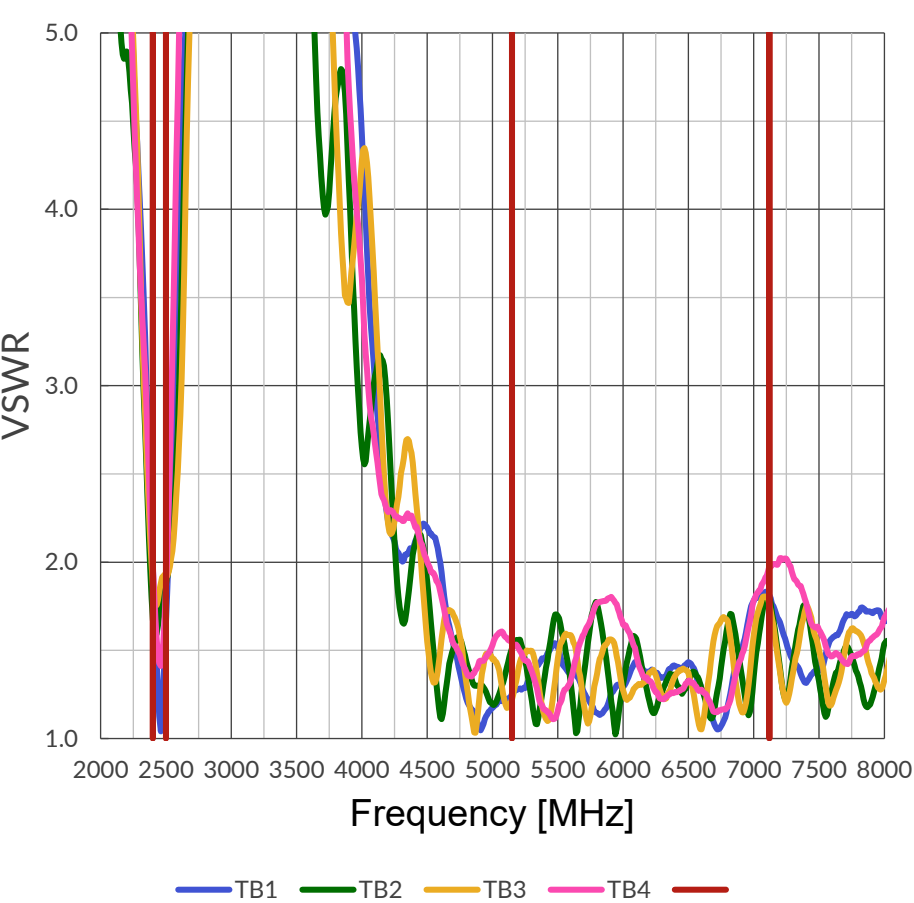
TB2 : 342mm

TB3 : 297mm

TB4 : 97mm

VSWR

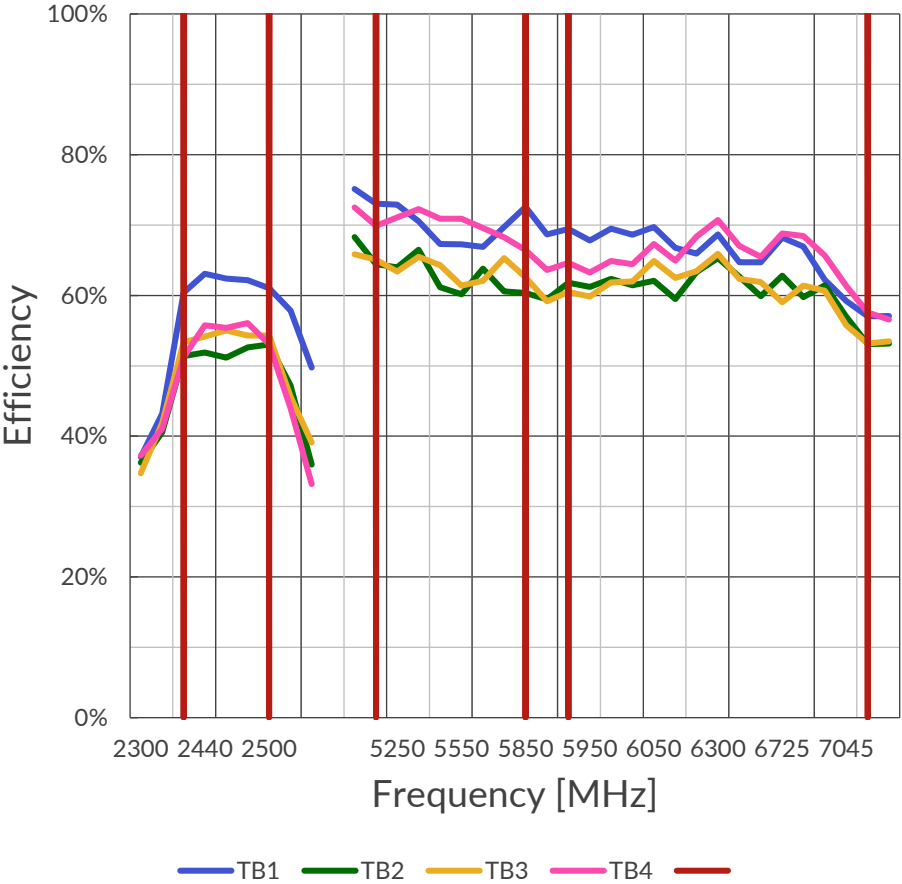
Wi-Fi Tri-Band



2.4GHz	Max	Mean	Min
TB1	2.0	1.4	1.0
TB2	1.9	1.7	1.6
TB3	1.9	1.9	1.8
TB4	2.0	1.6	1.4
Summary	2.0	1.7	1.0

5GHz	Max	Mean	Min
TB1	1.8	1.4	1.1
TB2	1.8	1.4	1.0
TB3	1.8	1.4	1.1
TB4	2.0	1.4	1.1
Summary	2.0	1.4	1.0

Efficiency Wi-Fi Tri-Band



2.4GHz	Max	Mean	Min
TB1	63 %	62 %	60 %
TB2	53 %	52 %	51 %
TB3	55 %	54 %	53 %
TB4	56 %	54 %	51 %
Summary	63 %	56 %	51 %

5GHz	Max	Mean	Min
TB1	73 %	70 %	67 %
TB2	66 %	63 %	60 %
TB3	65 %	64 %	61 %
TB4	72 %	70 %	66 %
Summary	73 %	67 %	60 %

6GHz	Max	Mean	Min
TB1	70 %	66 %	57 %
TB2	65 %	61 %	53 %
TB3	66 %	61 %	53 %
TB4	71 %	66 %	58 %
Summary	71 %	63 %	60 %

■ Cable Length

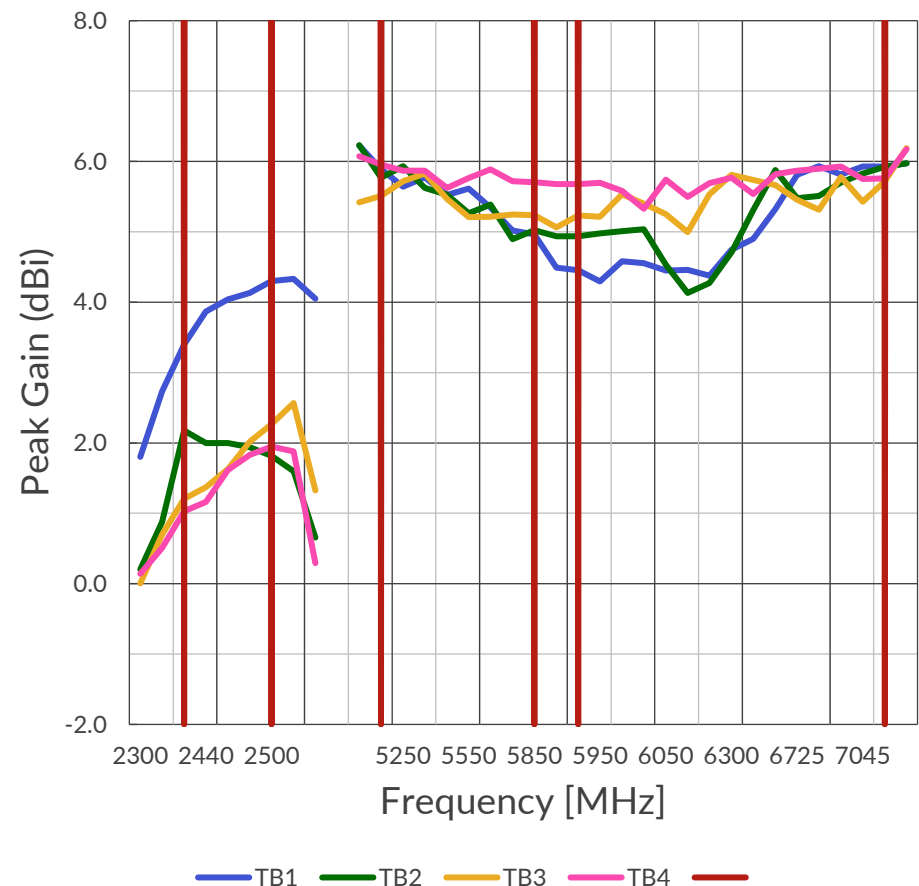
TB1 : 147mm

TB2 : 342mm

TB3 : 297mm

TB4 : 97mm

Peak Gain Wi-Fi Tri-Band



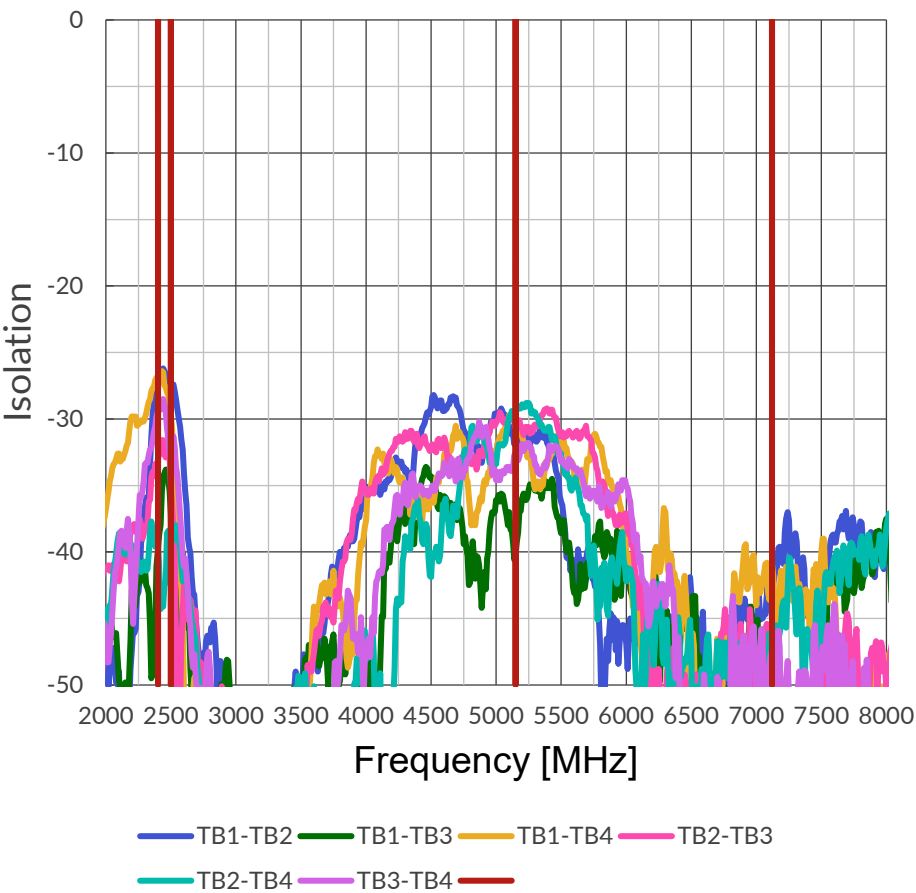
2.4GHz	Max	Mean	Min
TB1	4.3 dBi	3.9 dBi	3.4 dBi
TB2	2.2 dBi	2.0 dBi	1.8 dBi
TB3	2.3 dBi	1.7 dBi	1.2 dBi
TB4	1.9 dBi	1.5 dBi	1.0 dBi
Summary	4.3 dBi	2.2 dBi	1.0 dBi

5GHz	Max	Mean	Min
TB1	5.9 dBi	5.5 dBi	5.0 dBi
TB2	5.9 dBi	5.4 dBi	4.9 dBi
TB3	5.8 dBi	5.4 dBi	5.2 dBi
TB4	6.0 dBi	5.8 dBi	5.6 dBi
Summary	6.0 dBi	5.5 dBi	4.9 dBi

6GHz	Max	Mean	Min
TB1	5.9 dBi	5.0 dBi	4.3 dBi
TB2	5.9 dBi	5.1 dBi	4.1 dBi
TB3	5.8 dBi	5.5 dBi	5.0 dBi
TB4	5.9 dBi	5.7 dBi	5.3 dBi
Summary	5.9 dBi	5.3 dBi	4.1 dBi

- Cable Length
- TB1 : 147mm
- TB2 : 342mm
- TB3 : 297mm
- TB4 : 97mm

Isolation Wi-Fi Tri-Band

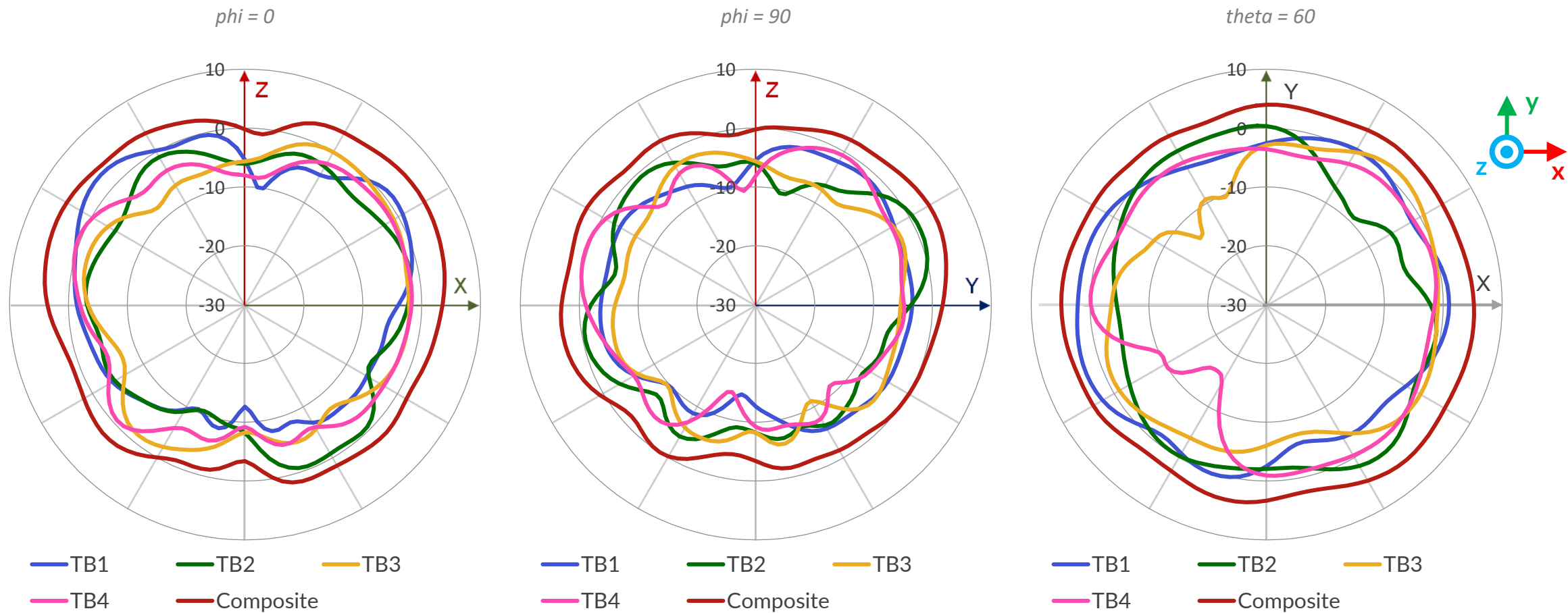


2.4GHz	Max	Mean	Min
TB1-TB2	-26.2	-26.9	-27.5
TB1-TB3	-33.8	-35.9	-39.7
TB1-TB4	-26.4	-27.6	-29.7
TB2-TB3	-31.6	-32.6	-35.1
TB2-TB4	-38.4	-41.2	-44.3
TB3-TB4	-28.5	-30.0	-32.7
Summary	-26.2	-32.4	-44.3

5GHz	Max	Mean	Min
TB1-TB2	-30.6	-43.3	-63.7
TB1-TB3	-34.5	-44.0	-65.4
TB1-TB4	-30.1	-40.3	-61.5
TB2-TB3	-29.2	-41.8	-70.8
TB2-TB4	-28.8	-43.4	-69.3
TB3-TB4	-31.8	-42.4	-65.0
Summary	-28.8	-42.5	-70.8

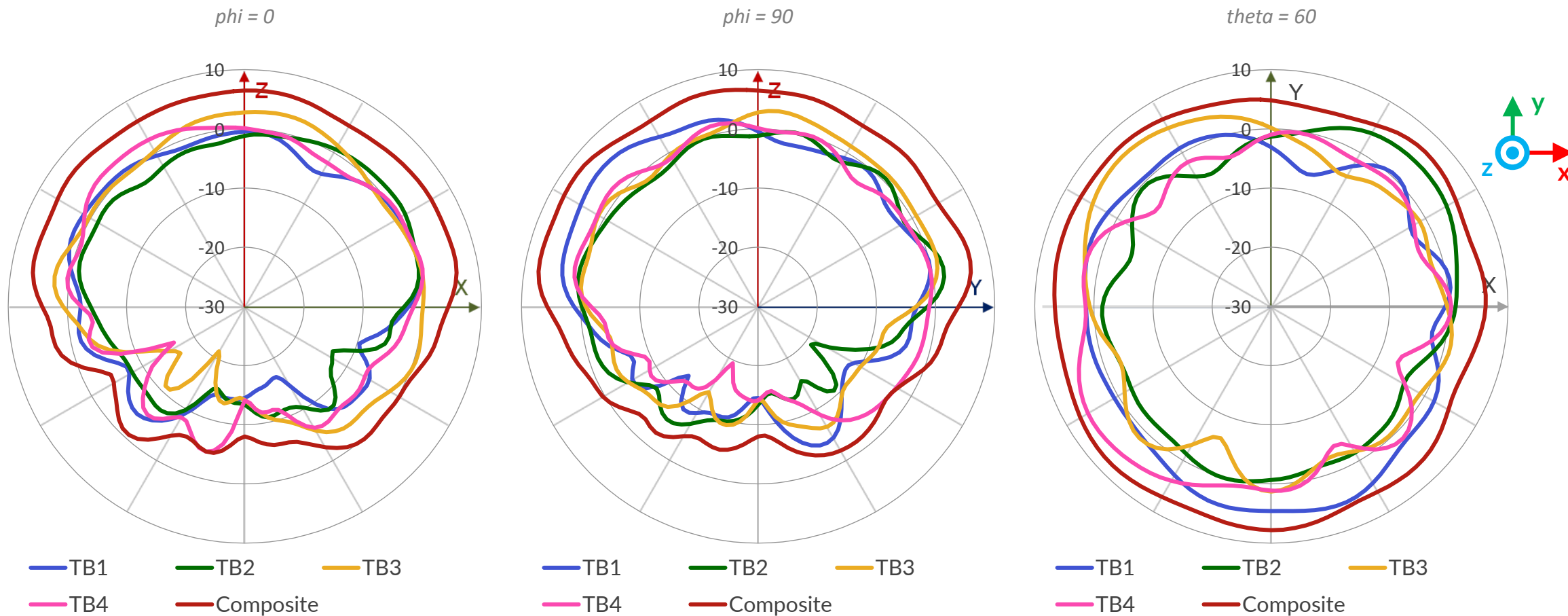
Realized Gain Pattern

Wi-Fi Tri-Band @2450MHz for Gtotal



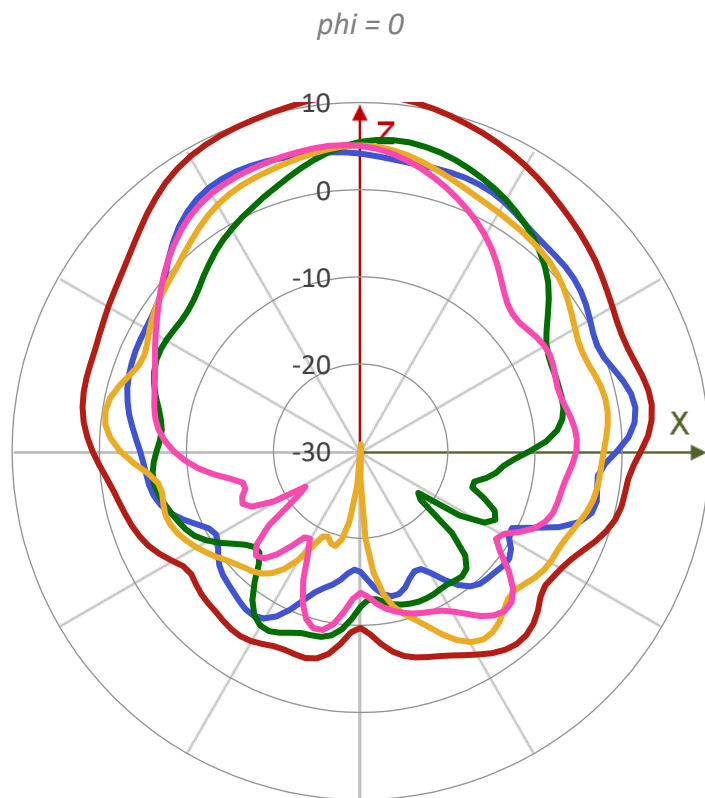
Realized Gain Pattern

Wi-Fi Tri-Band @5250MHz for Gtotal

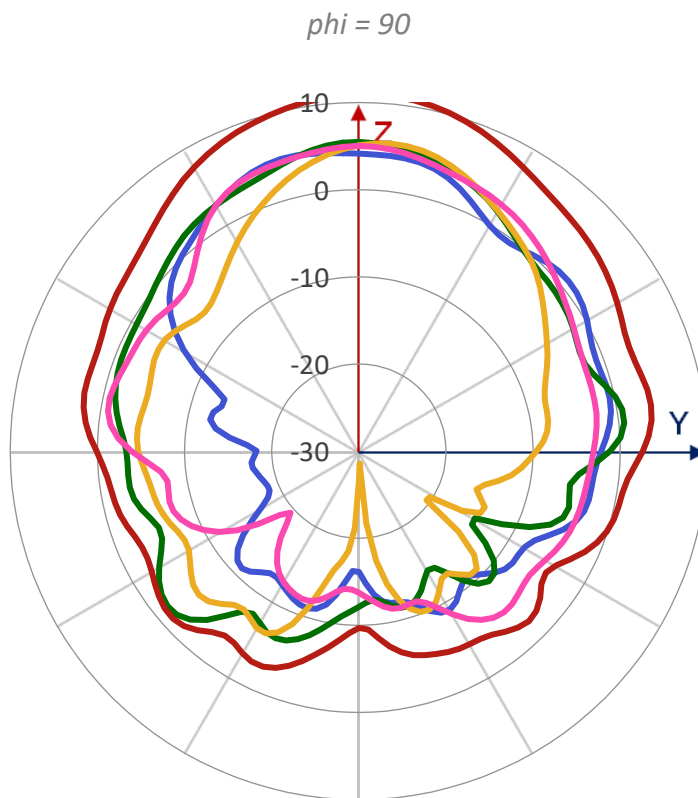


Realized Gain Pattern

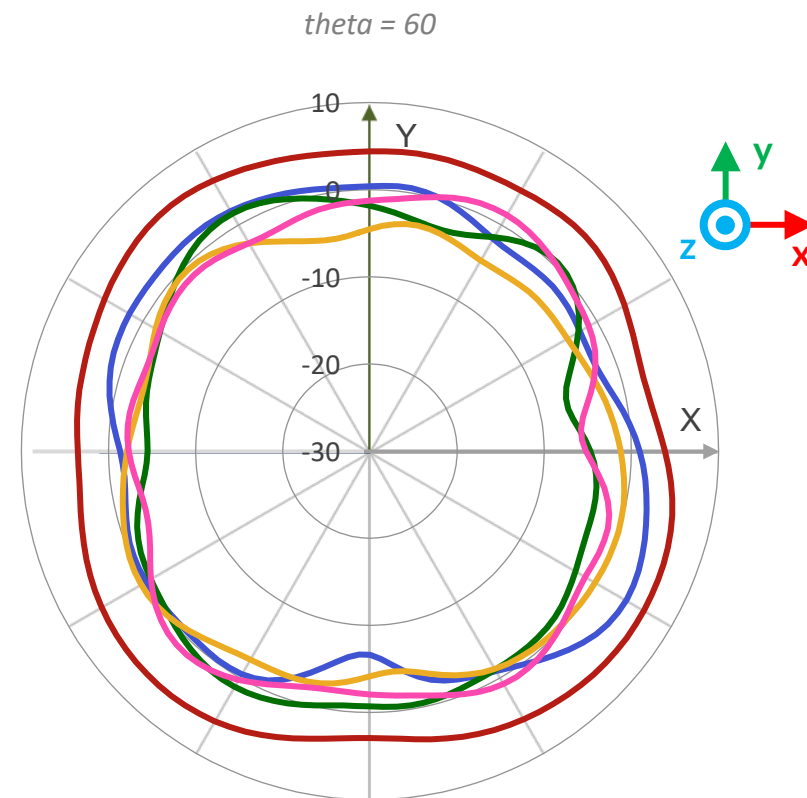
Wi-Fi Tri-Band @6885MHz for Gtotal



— TB1 — TB2 — TB3
— TB4 — Composite



— TB1 — TB2 — TB3
— TB4 — Composite



— TB1 — TB2 — TB3
— TB4 — Composite

Wi-Fi 5G



- **Maximum VSWR**

- 2.0:1 on 5GHz

- **Minimum Isolation**

- 31.4dB on 5GHz

- **Average Efficiency**

- ~59% on 5GHz

- **Peak Gain**

- 5.2dBi on 5GHz

- **Cable Length**

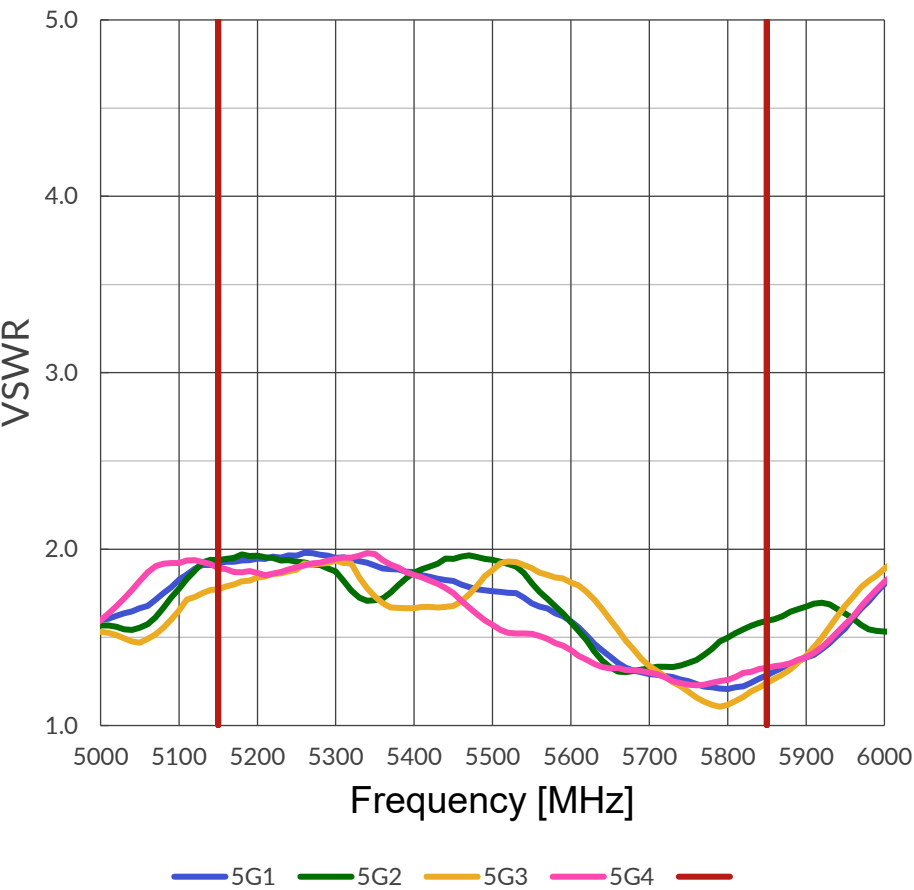
5G1 : 134mm

5G2 : 325mm

5G3 : 282mm

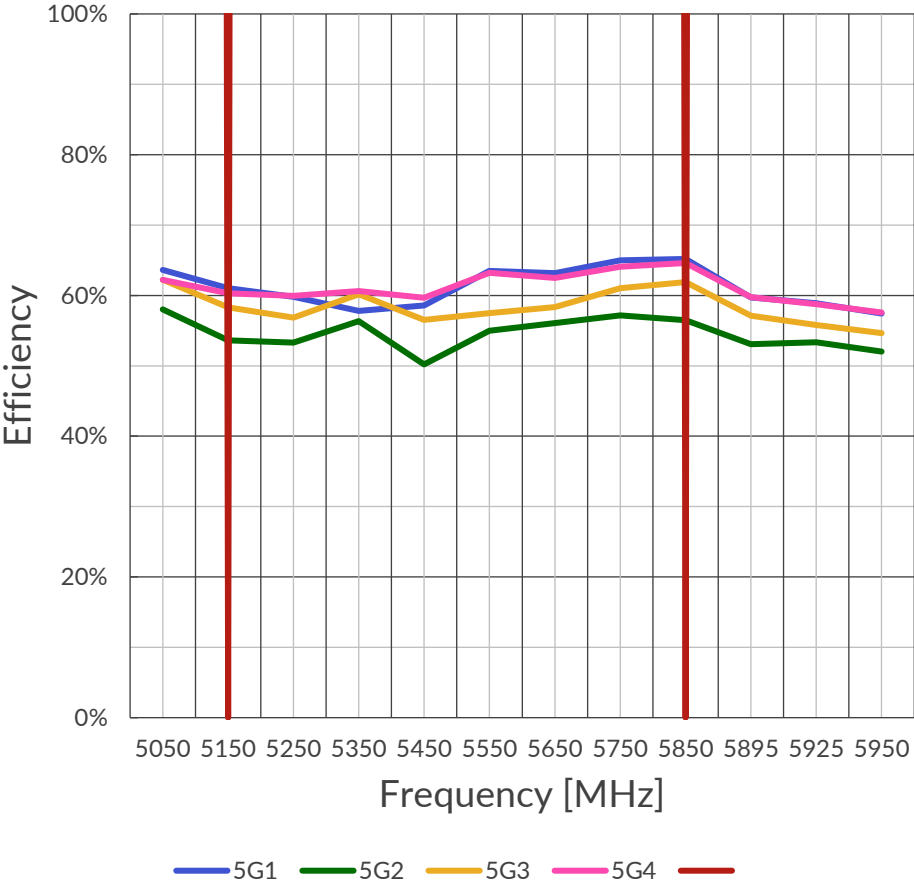
5G4 : 99mm

VSWR Wi-Fi 5G



5GHz	Max	Mean	Min
5G1	2.0	1.7	1.2
5G2	2.0	1.7	1.3
5G3	1.9	1.6	1.1
5G4	2.0	1.6	1.2
Summary	2.0	1.7	1.1

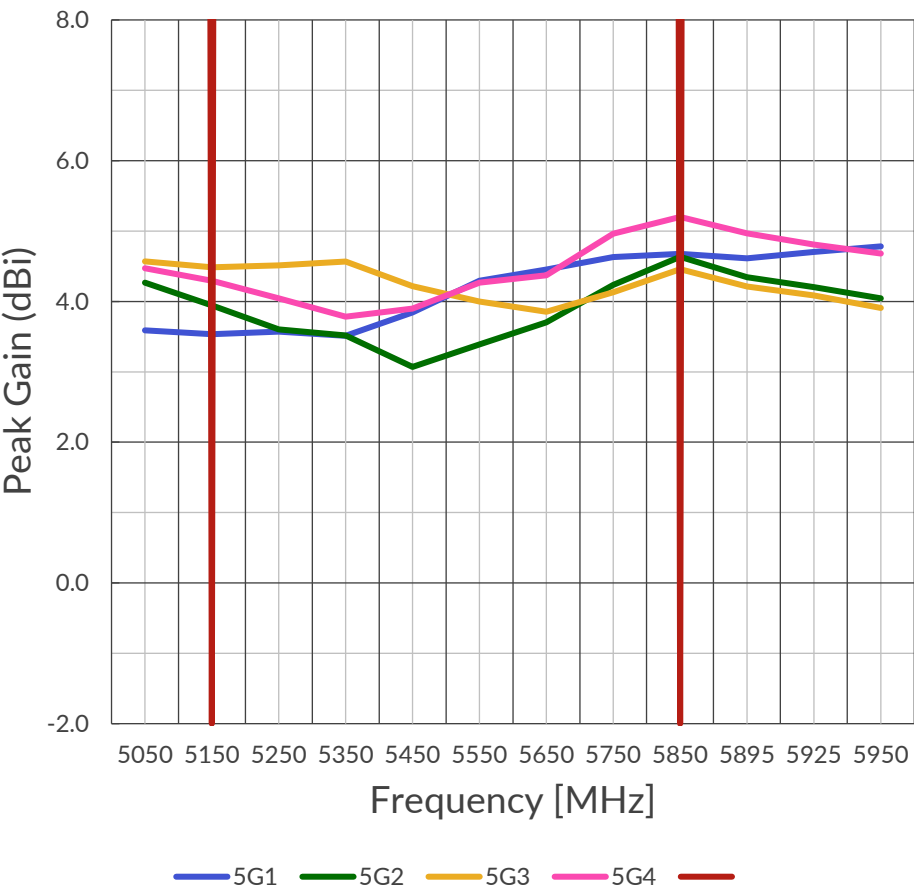
Efficiency Wi-Fi 5G



5GHz	Max	Mean	Min
5G1	65 %	62 %	58 %
5G2	57 %	55 %	50 %
5G3	62 %	59 %	57 %
5G4	65 %	62 %	60 %
Summary	65 %	59 %	50 %

- Cable Length
- 5G1 : 134mm
 - 5G2 : 325mm
 - 5G3 : 282mm
 - 5G4 : 99mm

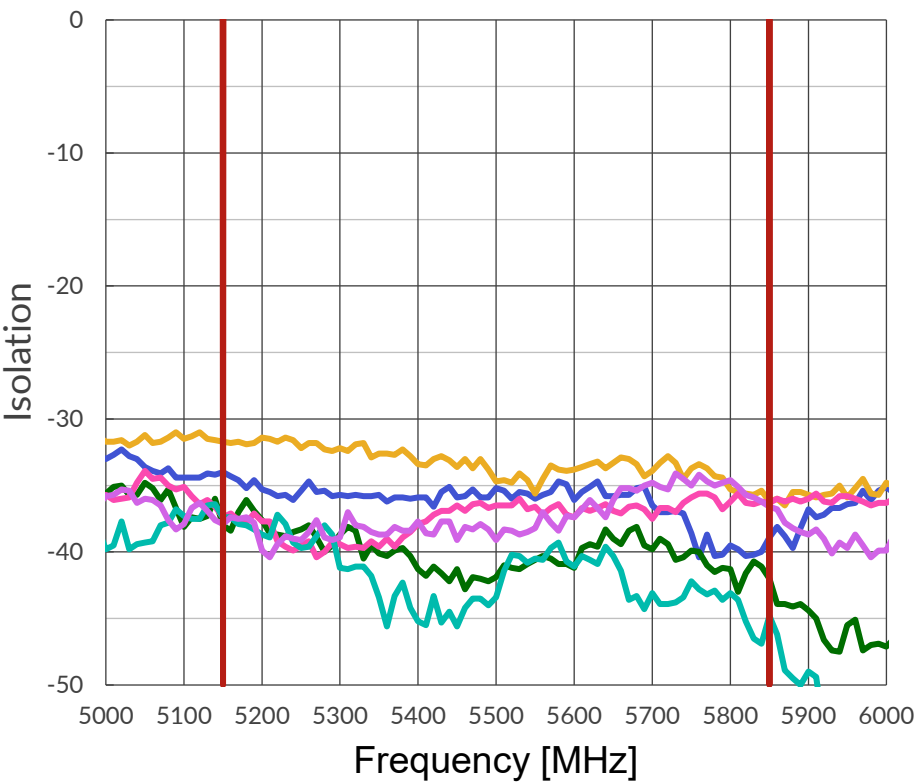
Peak Gain Wi-Fi 5G



5GHz	Max	Mean	Min
5G1	4.7 dBi	4.1 dBi	3.5 dBi
5G2	4.6 dBi	3.8 dBi	3.1 dBi
5G3	4.6 dBi	4.3 dBi	3.9 dBi
5G4	5.2 dBi	4.4 dBi	3.8 dBi
Summary	5.2 dBi	4.1 dBi	3.1 dBi

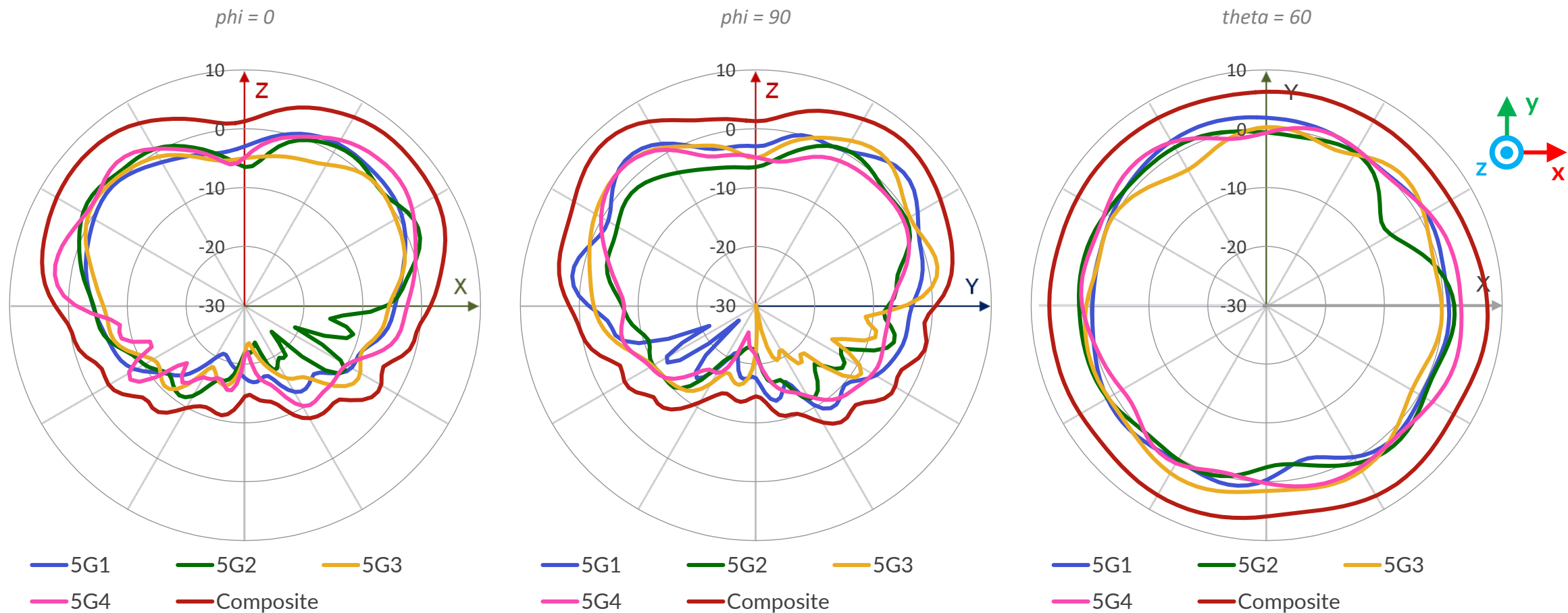
- Cable Length
- 5G1 : 134mm
 - 5G2 : 325mm
 - 5G3 : 282mm
 - 5G4 : 99mm

Isolation Wi-Fi 5G



5GHz	Max	Mean	Min
5G1-5G2	-34.0	-36.3	-40.4
5G1-5G3	-36.1	-40.0	-43.0
5G1-5G4	-31.4	-33.3	-36.2
5G2-5G3	-35.6	-37.4	-40.4
5G2-5G4	-37.2	-41.8	-46.9
5G3-5G4	-34.1	-37.3	-40.4
Summary	-31.4	-37.7	-46.9

Realized Gain Pattern Wi-Fi 5G @5450MHz for Gtotal



Wi-Fi 6G



- **Maximum VSWR**

- 2.0:1 on 6GHz

- **Minimum Isolation**

- 28.8dB on 6GHz

- **Average Efficiency**

- ~63% on 6GHz

- **Peak Gain**

- 6.0dBi on 6GHz

- **Cable Length**

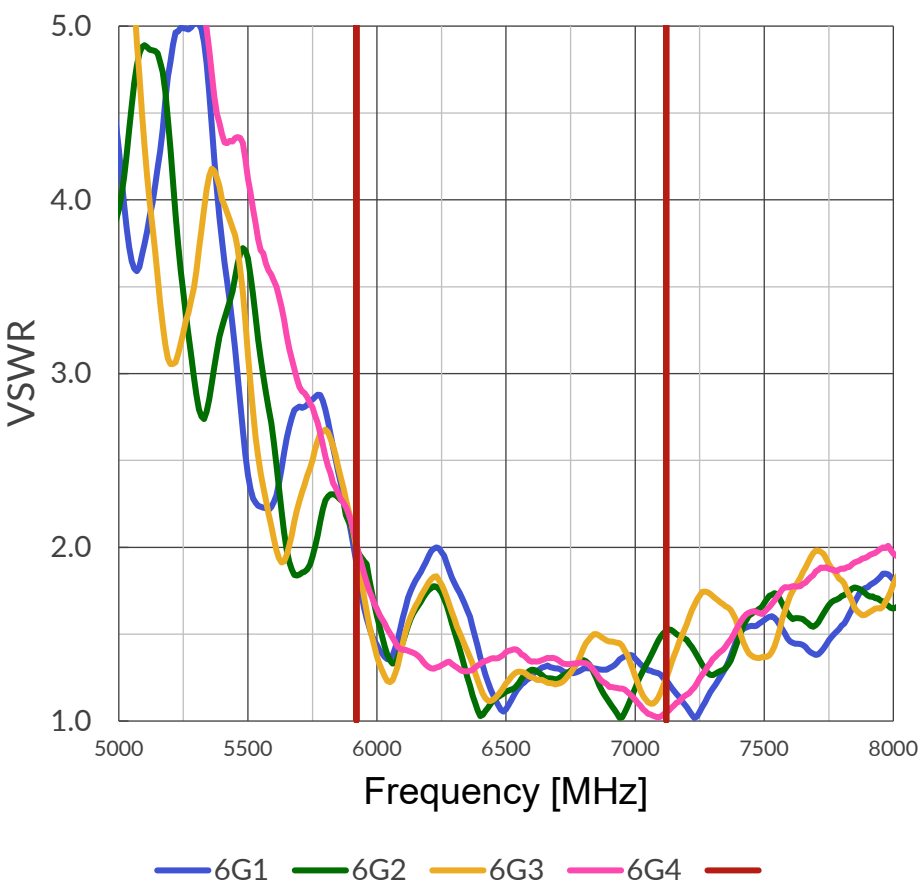
6G1 : 209mm

6G2 : 277mm

6G3 : 244mm

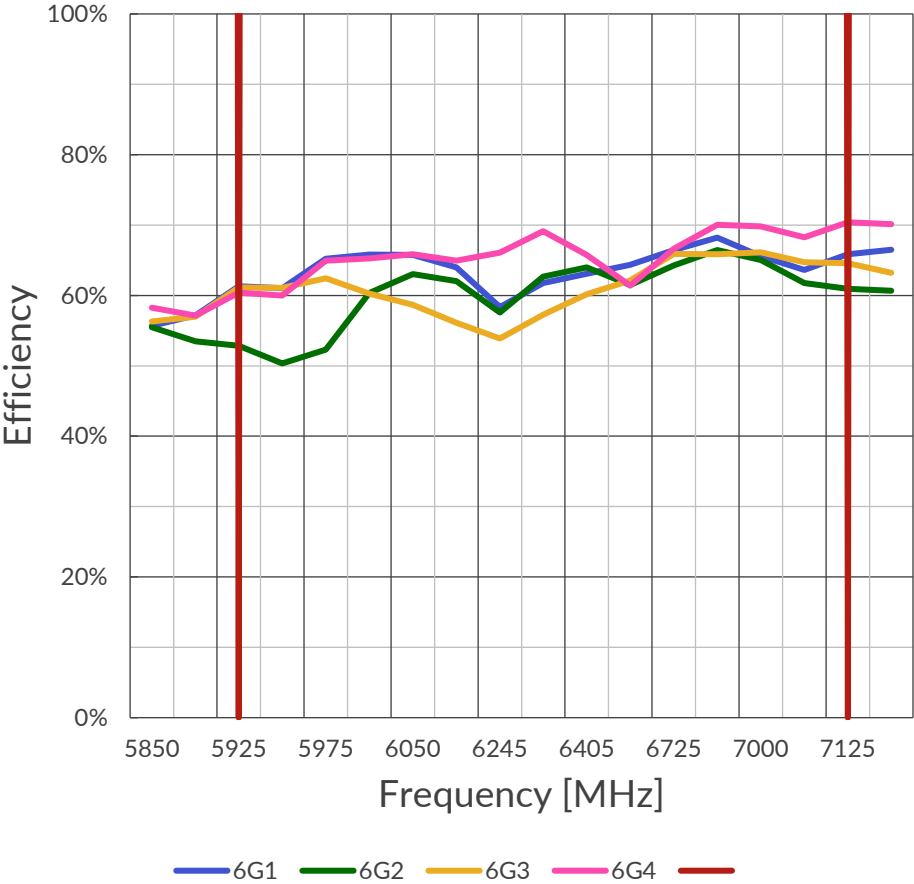
6G4 : 47mm

VSWR Wi-Fi 6G



6GHz	Max	Mean	Min
6G1	2.0	1.4	1.1
6G2	2.0	1.4	1.0
6G3	2.0	1.4	1.1
6G4	2.0	1.3	1.0
Summary	2.0	1.4	1.0

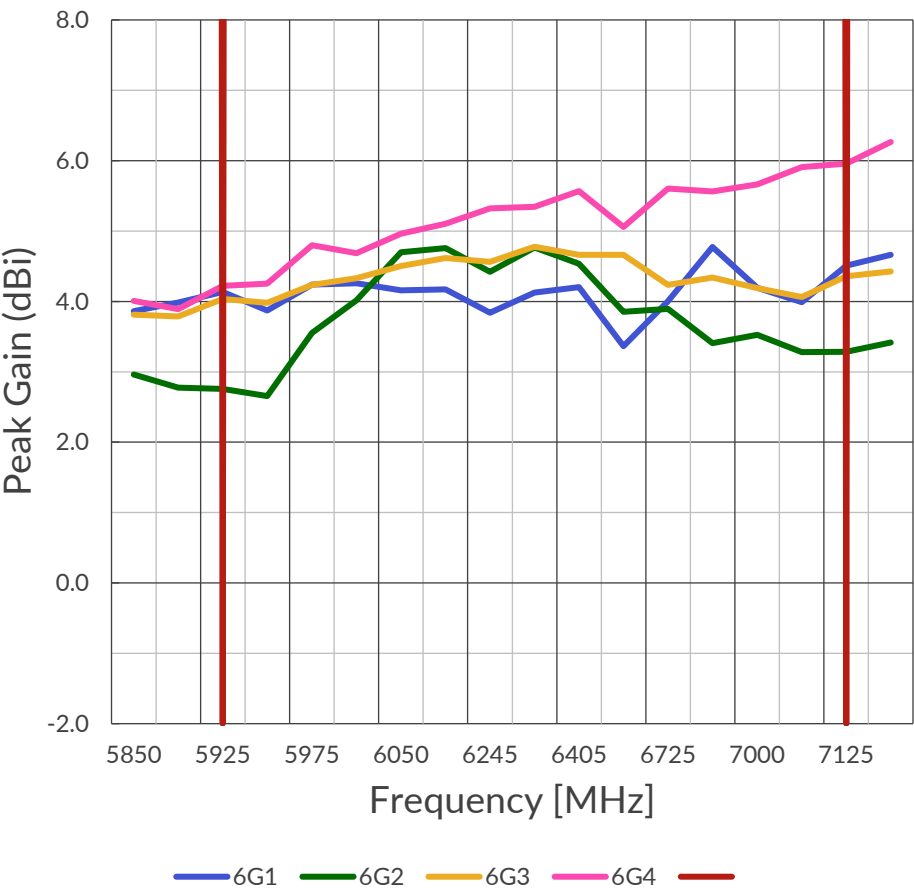
Efficiency Wi-Fi 6G



5GHz	Max	Mean	Min
6G1	68 %	64 %	58 %
6G2	66 %	60 %	50 %
6G3	66 %	61 %	54 %
6G4	70 %	66 %	60 %
Summary	70 %	63 %	50 %

- Cable Length
- 6G1 : 209mm
 - 6G2 : 277mm
 - 6G3 : 244mm
 - 6G4 : 47mm

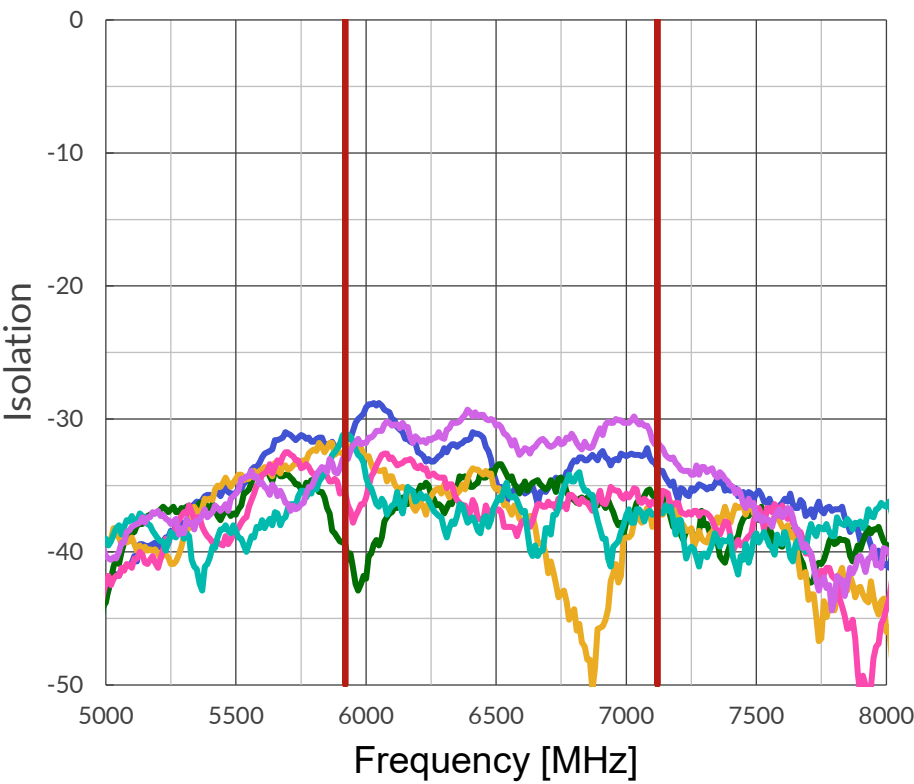
Peak Gain Wi-Fi 6G



5GHz	Max	Mean	Min
6G1	4.8 dBi	4.1 dBi	3.4 dBi
6G2	4.8 dBi	3.8 dBi	2.7 dBi
6G3	4.8 dBi	4.4 dBi	4.0 dBi
6G4	6.0 dBi	5.2 dBi	4.2 dBi
Summary	6.0 dBi	4.4 dBi	2.7 dBi

- Cable Length
- 6G1 : 209mm
 - 6G2 : 277mm
 - 6G3 : 244mm
 - 6G4 : 47mm

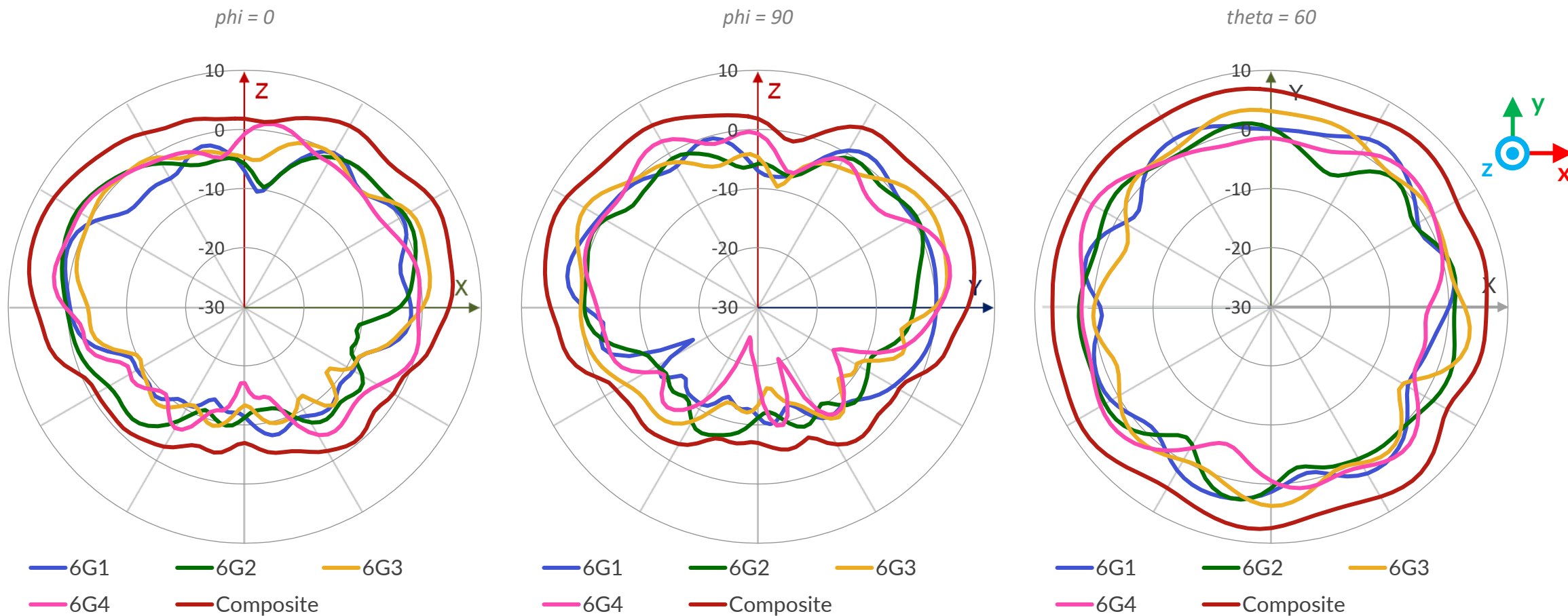
Isolation Wi-Fi 6G



6GHz	Max	Mean	Min
6G1-6G2	-28.8	-32.7	-36.4
6G1-6G3	-33.4	-36.3	-42.9
6G1-6G4	-31.8	-37.8	-50.4
6G2-6G3	-32.6	-35.8	-38.8
6G2-6G4	-31.2	-36.7	-41.1
6G3-6G4	-29.3	-31.1	-33.0
Summary	-28.8	-35.0	-50.4

6G1-6G2 6G1-6G3 6G1-6G4 6G2-6G3
6G2-6G4 6G3-6G4

Realized Gain Pattern Wi-Fi 6G @6565MHz for Gtotal



Scanning



■ Maximum VSWR

- 2.0:1 on 2.4GHz / 2.0:1 on 5-7GHz

■ Minimum Isolation

- 30.5dB on 2.4GHz / 35.0dB on 5-7GHz

■ Average Efficiency

- ~60% on 2.4GHz / ~65% on 5-7GHz

■ Peak Gain

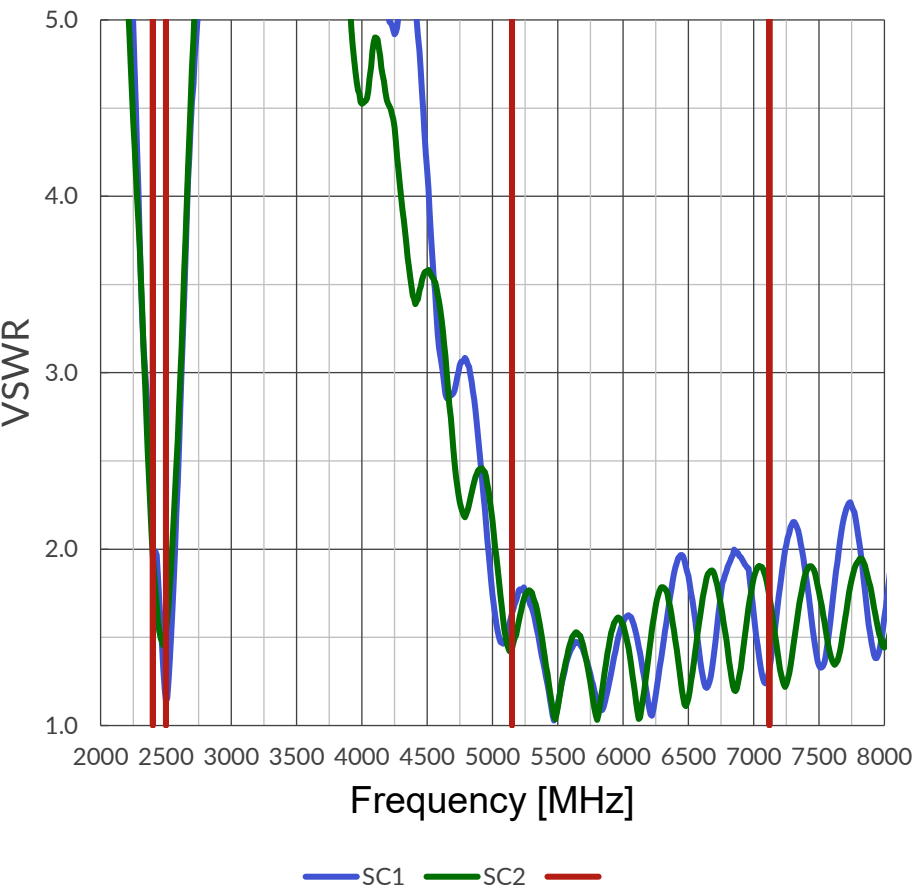
- 3.9dBi on 4.0GHz / 5.9dBi on 5-7GHz

■ Cable Length

SC1 : 226mm

SC2 : 268mm

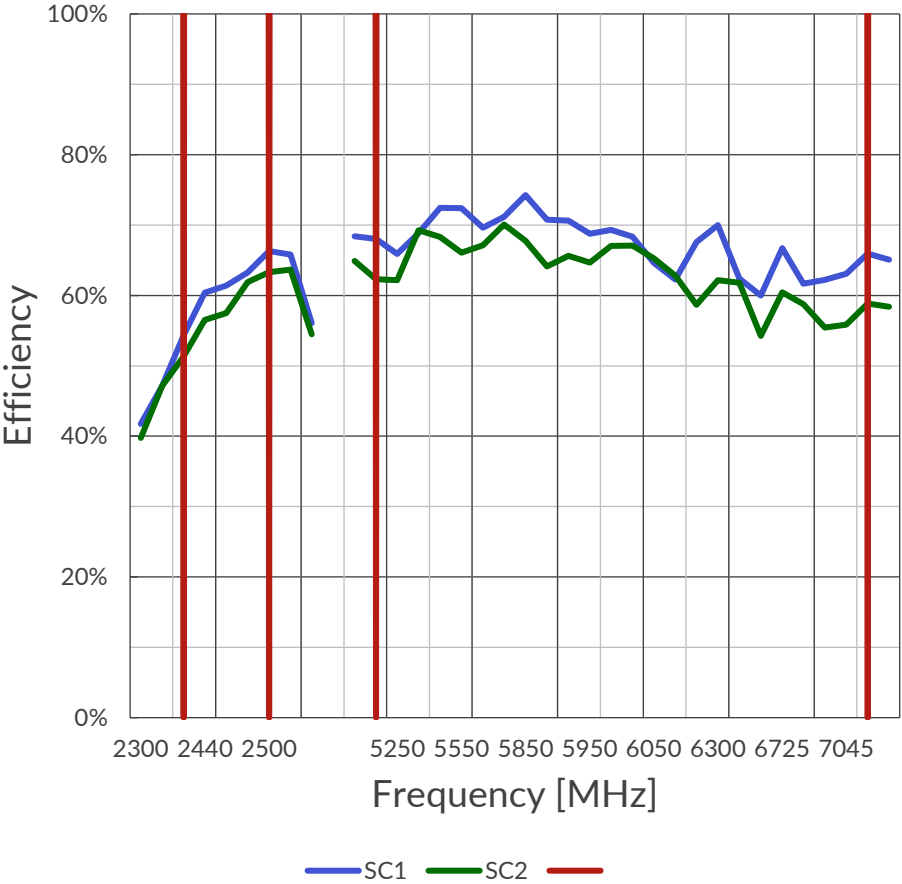
VSWR Scanning



2.4GHz	Max	Mean	Min
SC1	2.0	1.5	1.1
SC2	2.0	1.6	1.2
Summary	2.0	1.5	1.1

5GHz	Max	Mean	Min
SC1	2.0	1.5	1.0
SC2	2.0	1.5	1.1
Summary	2.0	1.5	1.0

Efficiency Scanning



2.4GHz	Max	Mean	Min
SC1	66 %	61 %	54 %
SC2	63 %	58 %	51 %
Summary	66 %	60 %	51 %

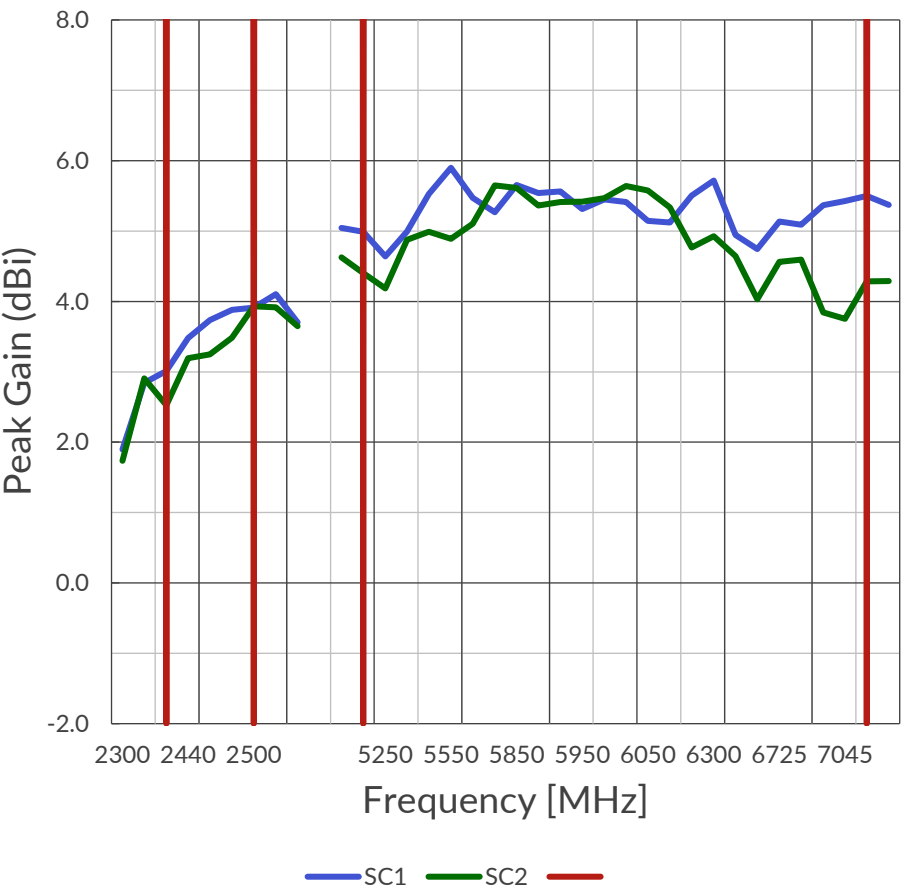
5GHz	Max	Mean	Min
SC1	74 %	67 %	60 %
SC2	70 %	63 %	54 %
Summary	74 %	65 %	54 %

■ Cable Length

SC1 : 226mm

SC2 : 268mm

Peak Gain Scanning



2.4GHz	Max	Mean	Min
SC1	3.9 dBi	3.6 dBi	3.0 dBi
SC2	3.9 dBi	3.3 dBi	2.5 dBi
Summary	3.9 dBi	3.4 dBi	2.5 dBi

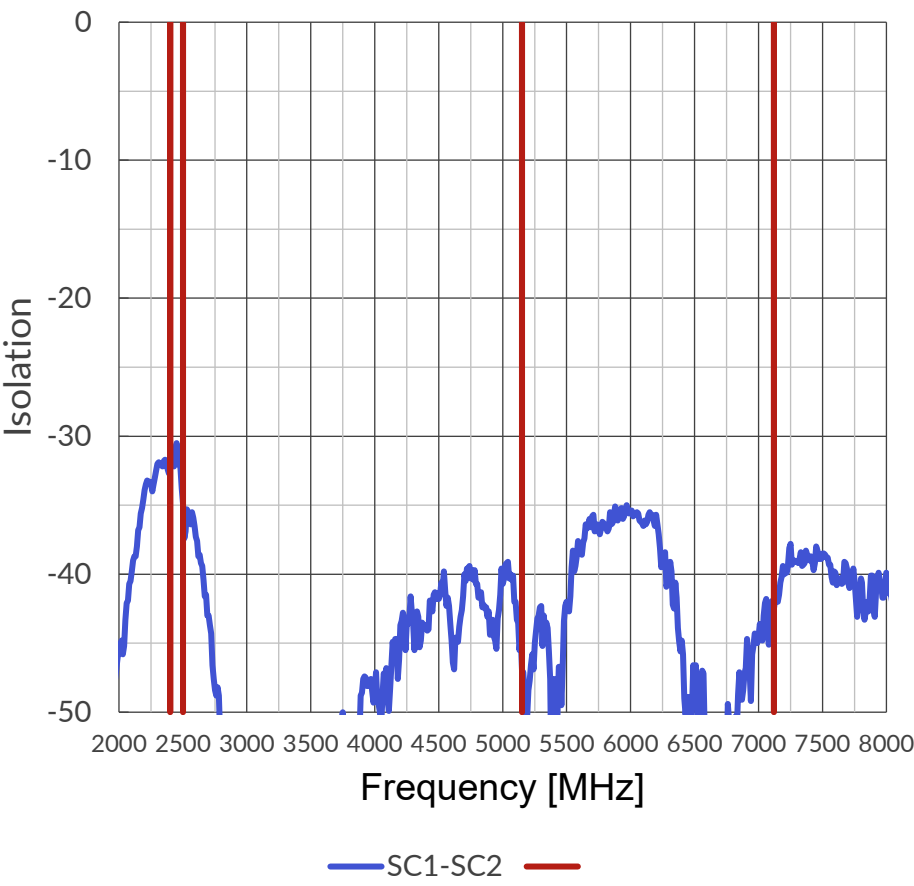
5GHz	Max	Mean	Min
SC1	5.9 dBi	5.3 dBi	4.6 dBi
SC2	5.6 dBi	4.9 dBi	3.8 dBi
Summary	5.9 dBi	5.1 dBi	3.8 dBi

■ Cable Length

SC1 : 226mm

SC2 : 268mm

Isolation Scanning

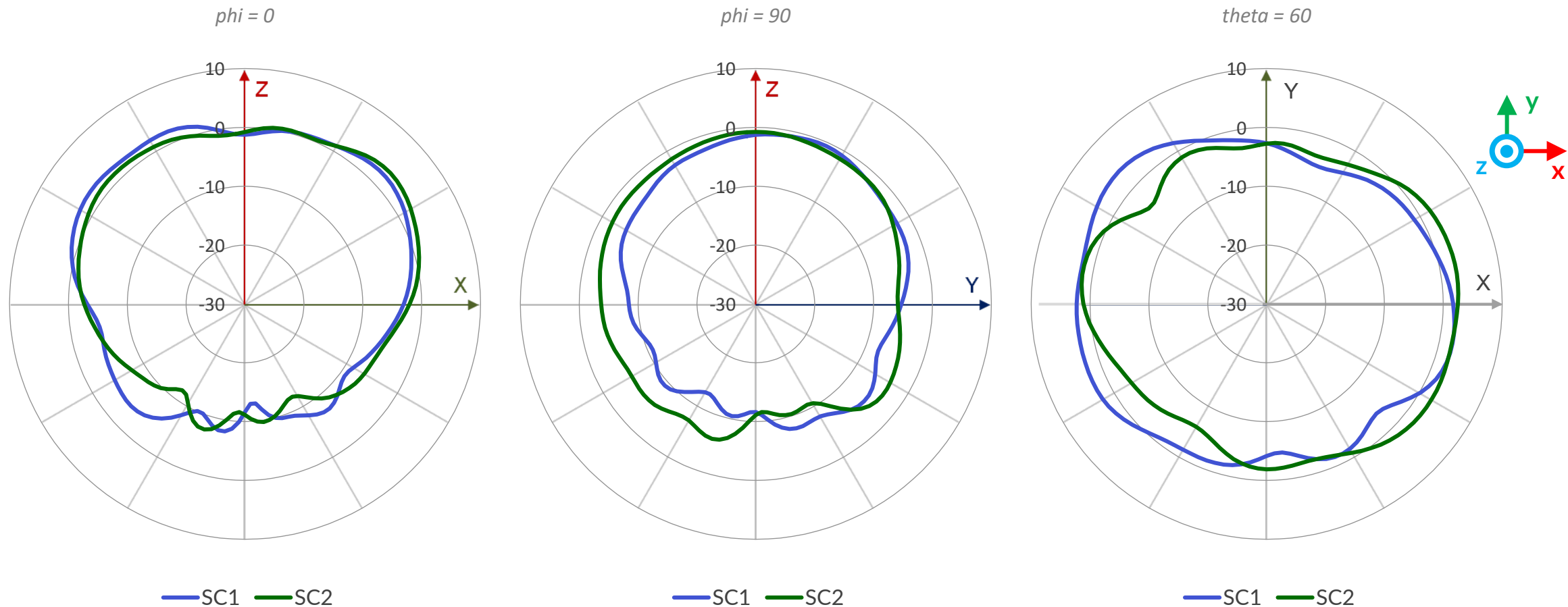


2.4GHz	Max	Mean	Min
SC1-SC2	-30.5	-32.1	-34.9

5GHz	Max	Mean	Min
SC1-SC2	-35.0	-43.3	-57.5

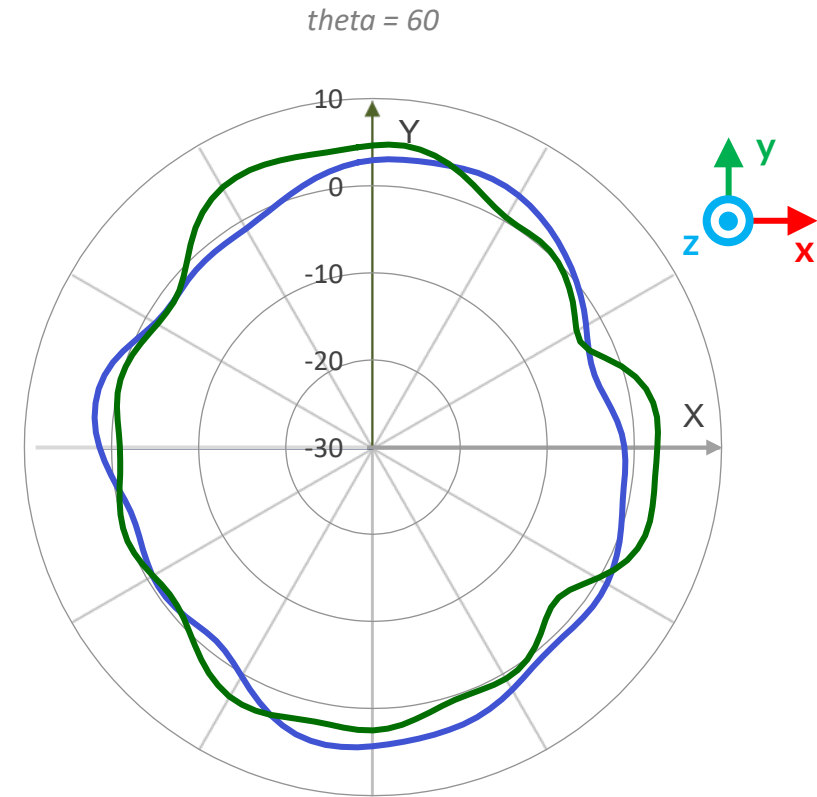
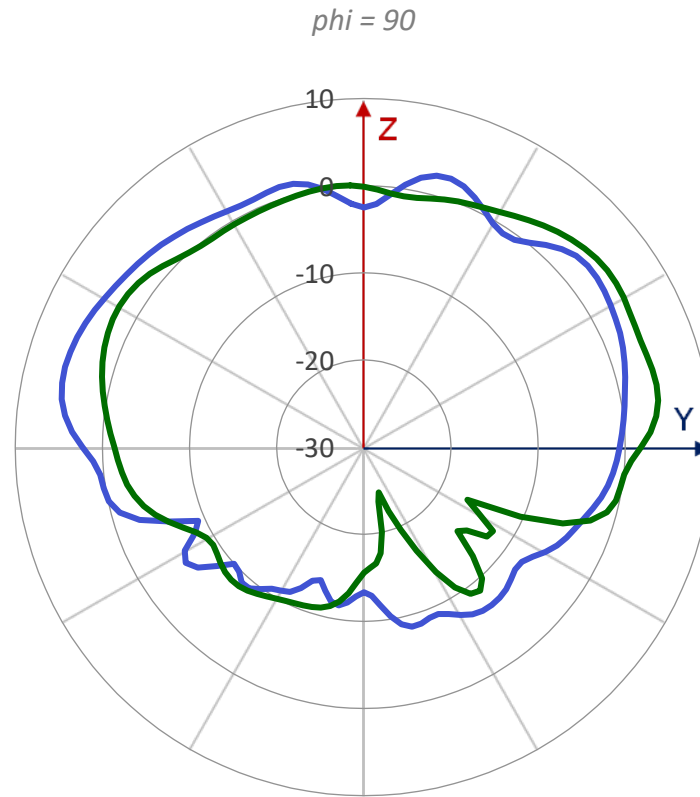
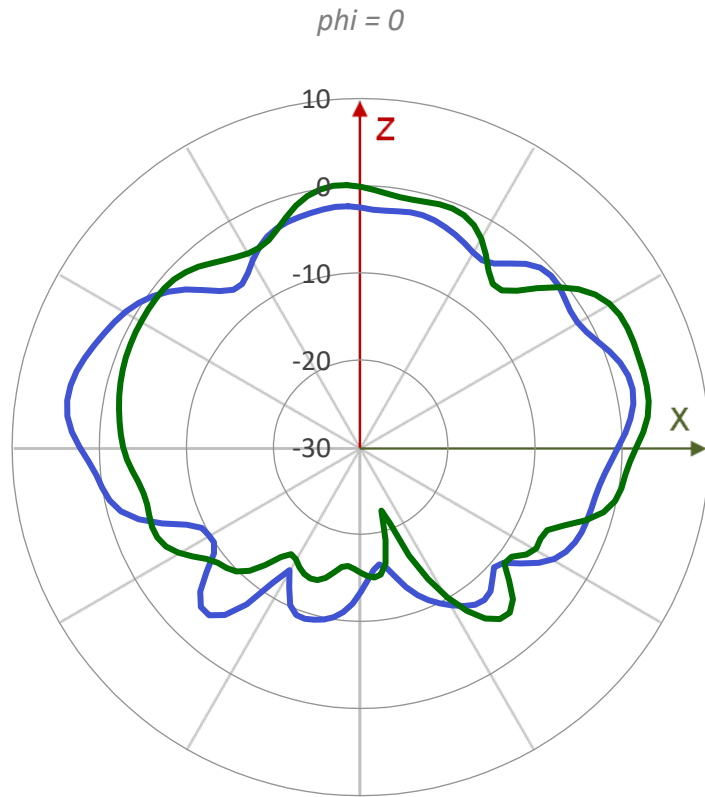
Realized Gain Pattern

Scanning @2450MHz for Gtotal



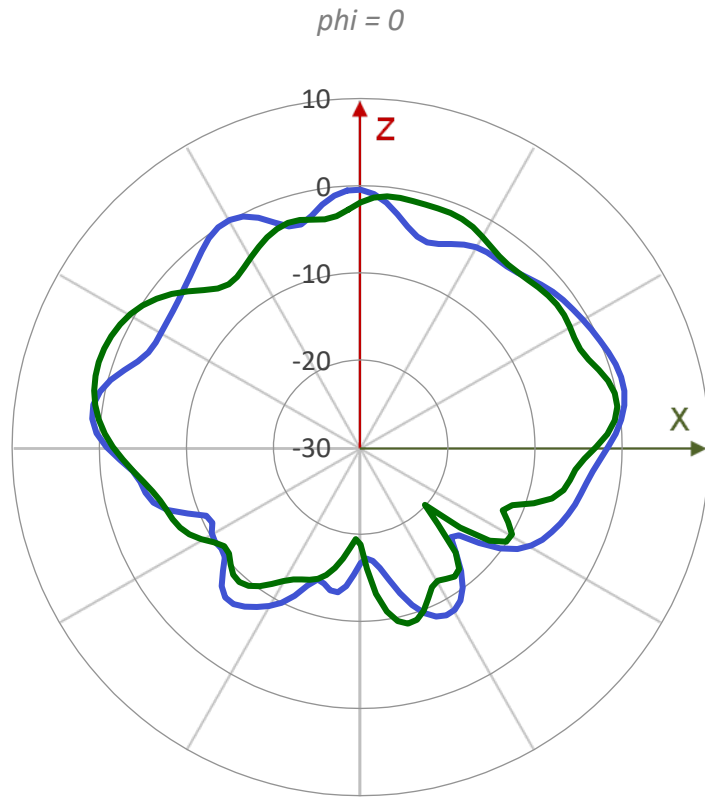
Realized Gain Pattern

Scanning @5450MHz for Gtotal

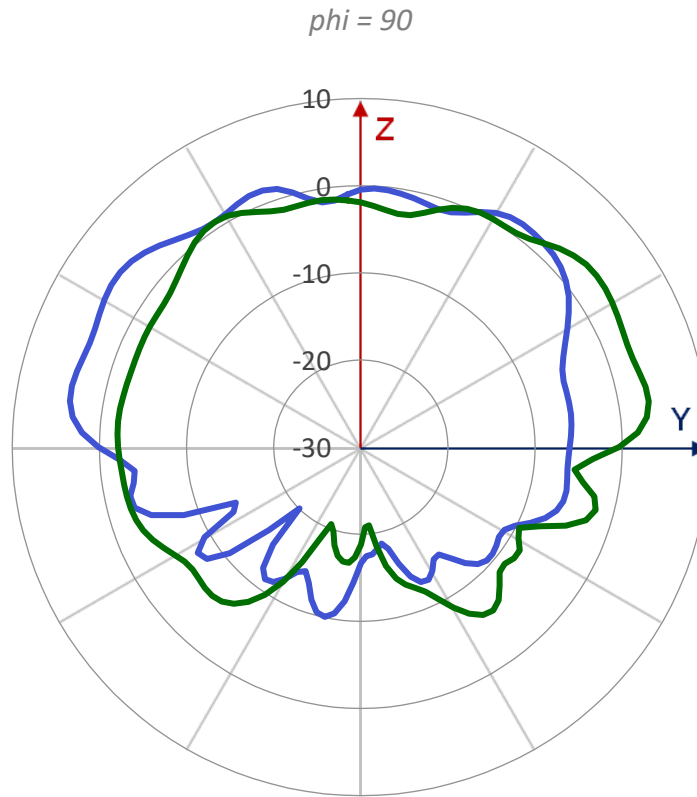


Realized Gain Pattern

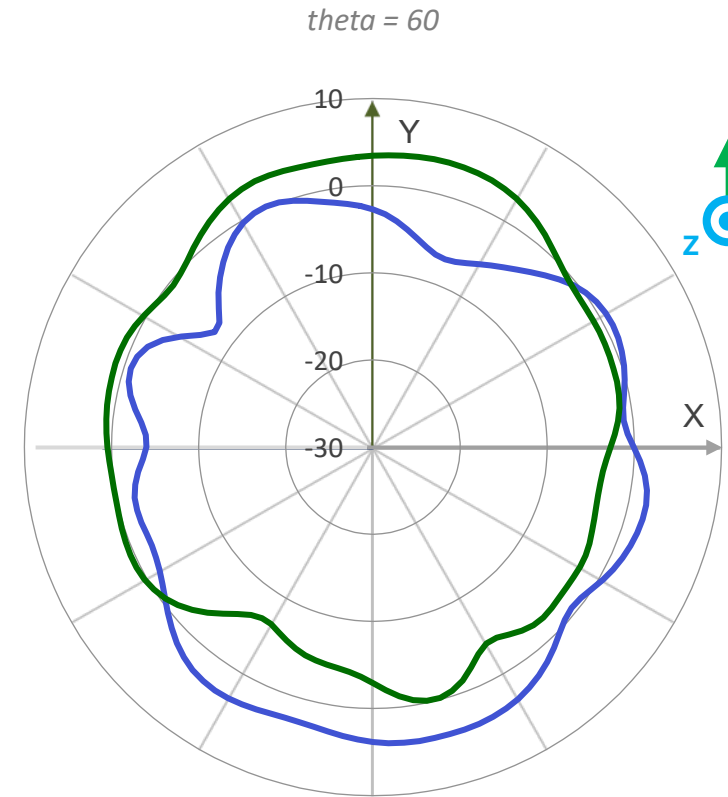
Scanning @6565MHz for Gtotal



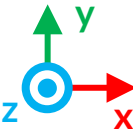
— SC1 — SC2 —



— SC1 — SC2 —



— SC1 — SC2



Zigbee(Thread)



- **Maximum VSWR**

- 1.5:1 on 2.4GHz

- **Average Efficiency**

- ~68% on 2.4GHz

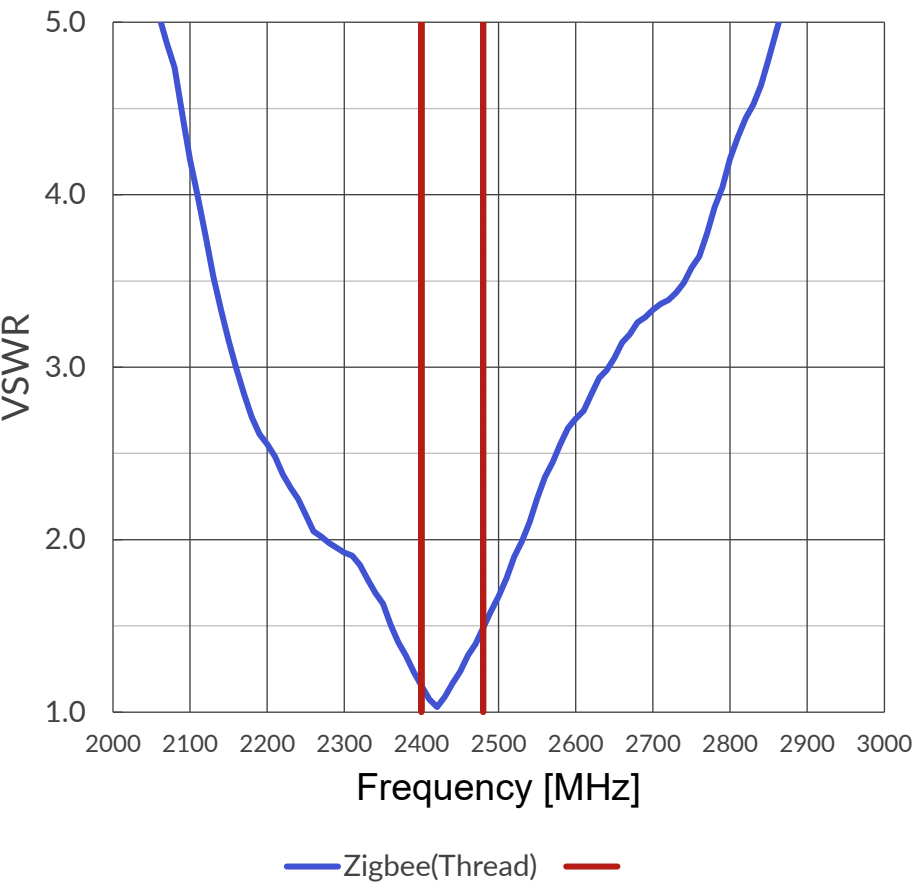
- **Peak Gain**

- 3.9dBi on 2.4GHz

- **Cable Length**

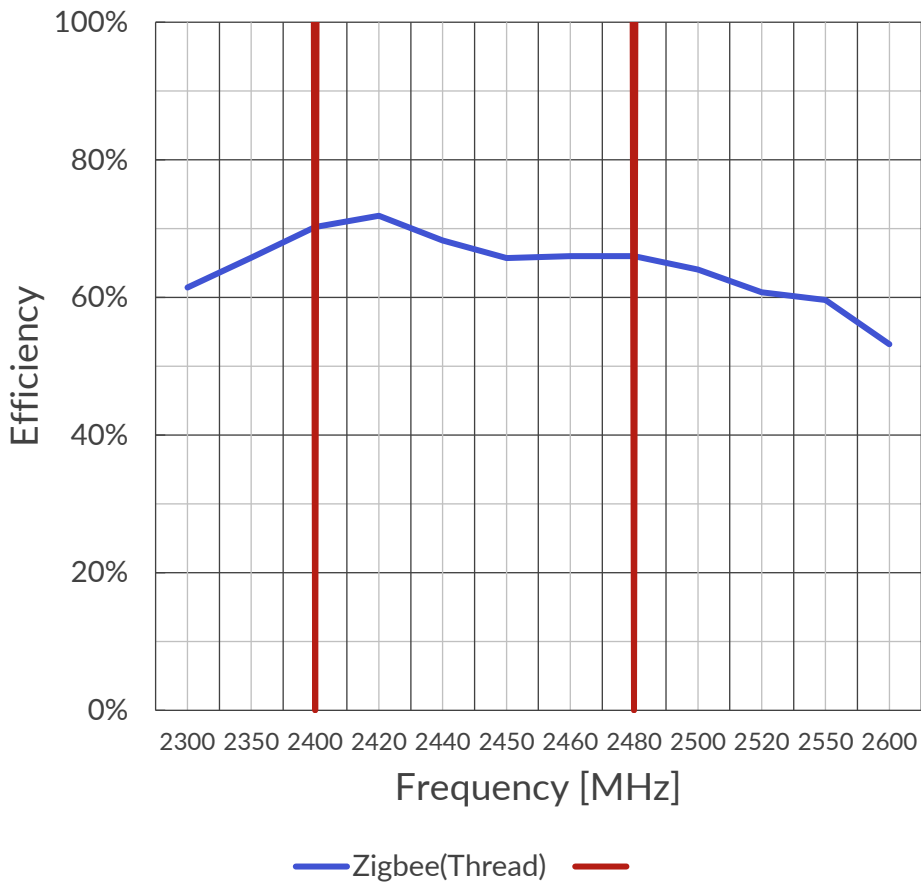
Zigbee(Thread) : 232mm

VSWR Zigbee(Thread)



2.4GHz	Max	Mean	Min
Zigbee(Thread)	1.5	1.2	1.0

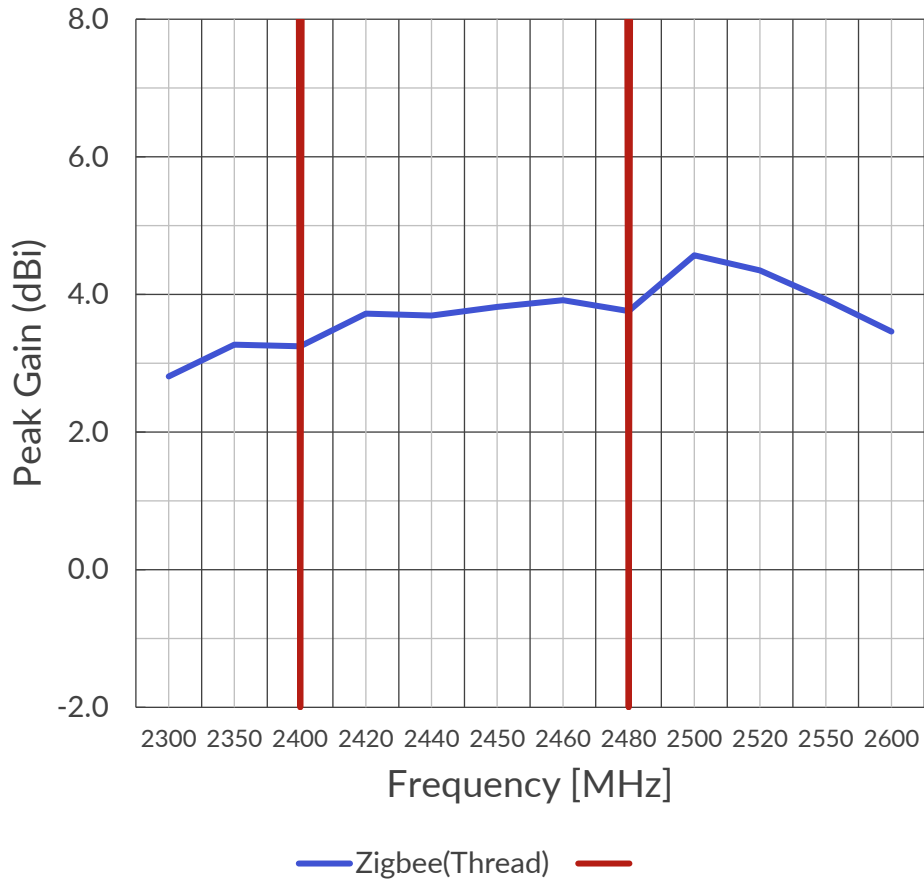
Efficiency Zigbee(Thread)



2.4GHz	Max	Mean	Min
Zigbee(Thread)	70 %	68 %	66 %

■ Cable Length
Zigbee(Thread) : 232mm

Peak Gain Zigbee(Thread)



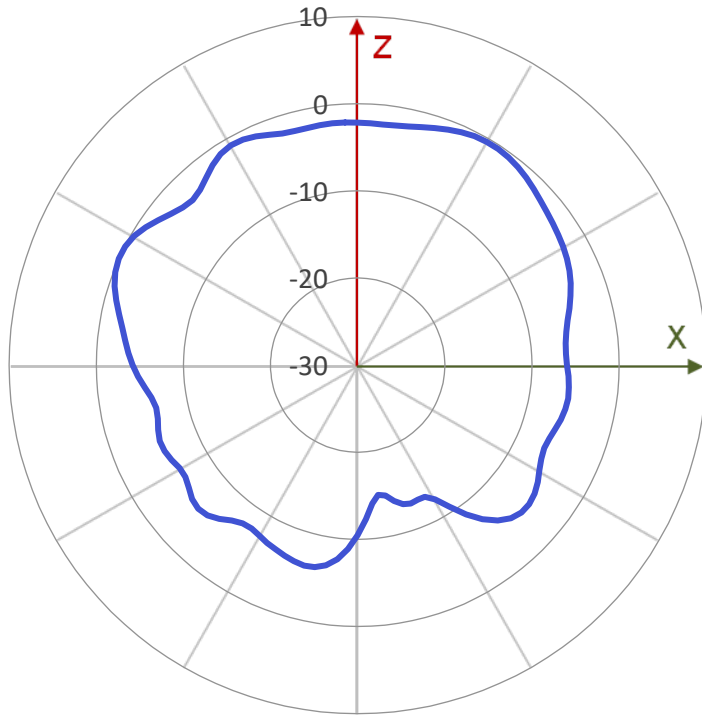
2.4GHz	Max	Mean	Min
Zigbee(Thread)	3.9 dBi	3.7 dBi	3.2 dBi

■ Cable Length

Zigbee(Thread) : 232mm

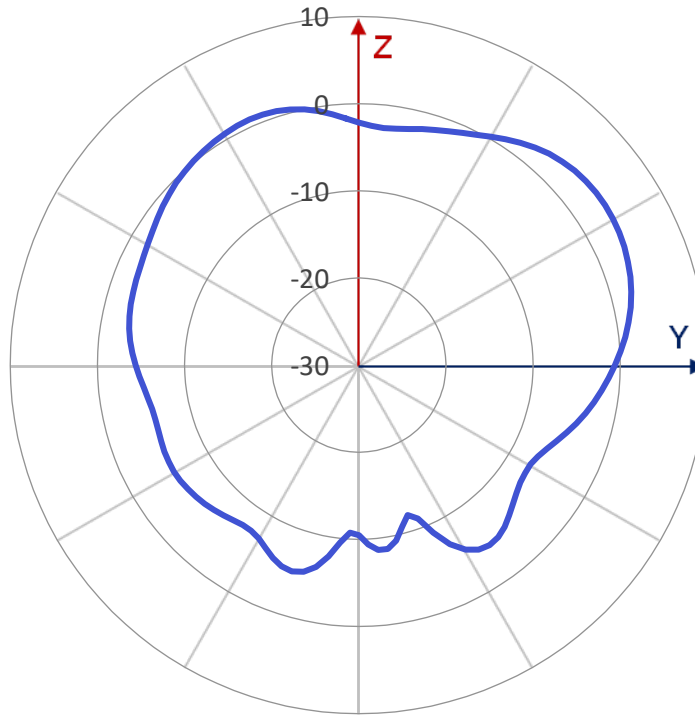
Realized Gain Pattern Zigbee(Thread) @2440MHz for Gtotal

$\phi = 0$



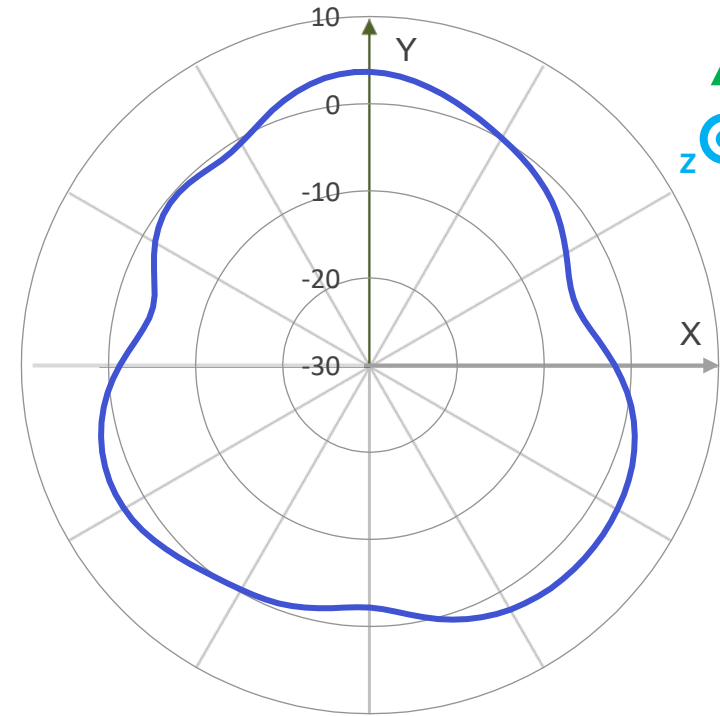
— Zigbee(Thread)

$\phi = 90$

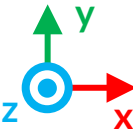


— Zigbee(Thread)

$\theta = 60$



— Zigbee(Thread)



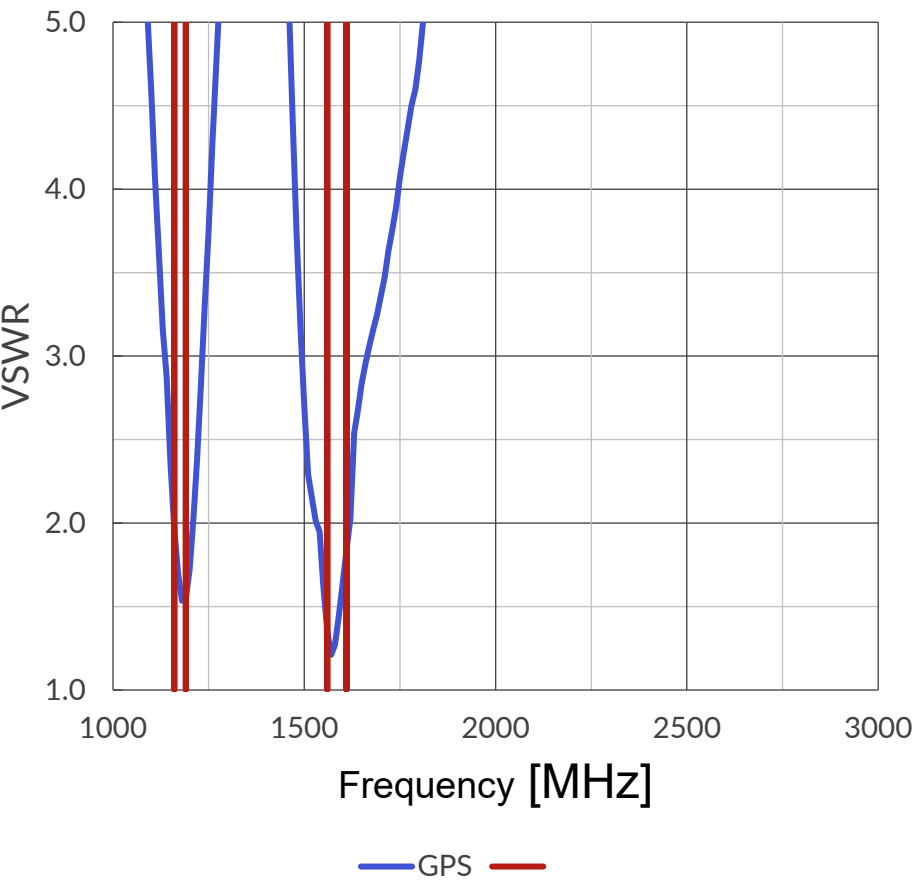
GPS



- **Maximum VSWR**
 - 1.8:1 on L1 / 2.0:1 on L5
- **Minimum Isolation**
 - 23.9dB on 2.4GHz
- **Average Efficiency**
 - ~59% on L1 / ~61% on L5
- **Peak Gain**
 - 2.6dBi on L1 / 2.9dBi on L5

- **Cable Length**
GPS : 314mm

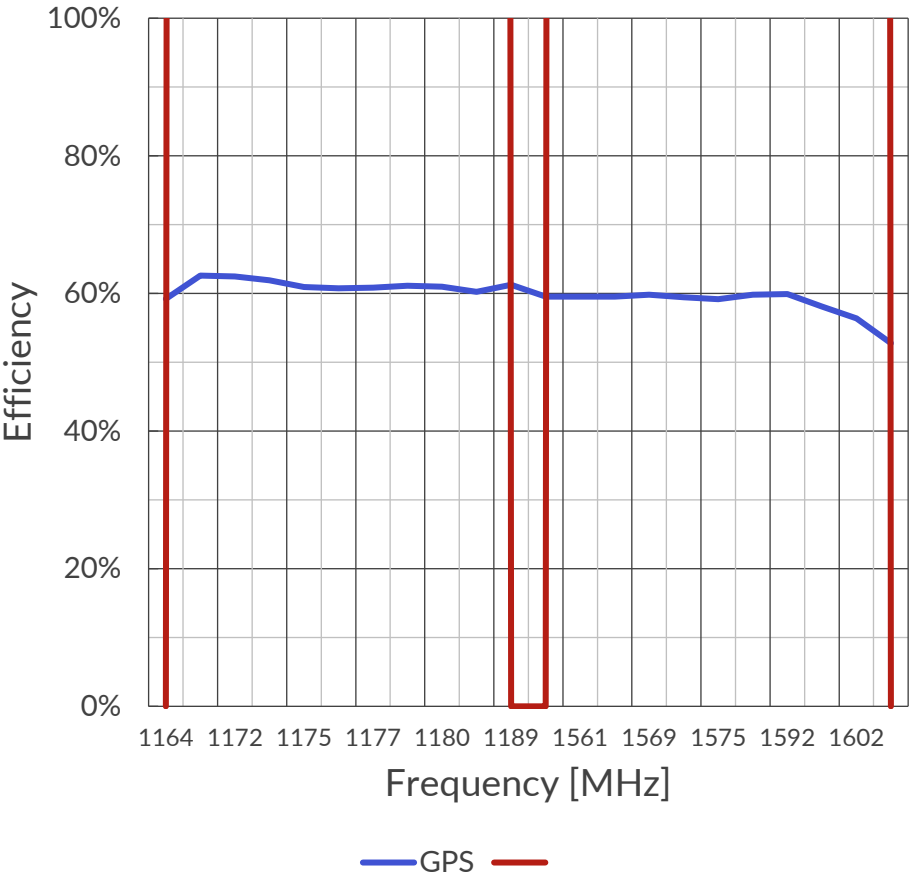
VSWR GPS



L1	Max	Mean	Min
GPS	1.8	1.5	1.2

L5	Max	Mean	Min
GPS	2.0	1.7	1.5

Efficiency GPS



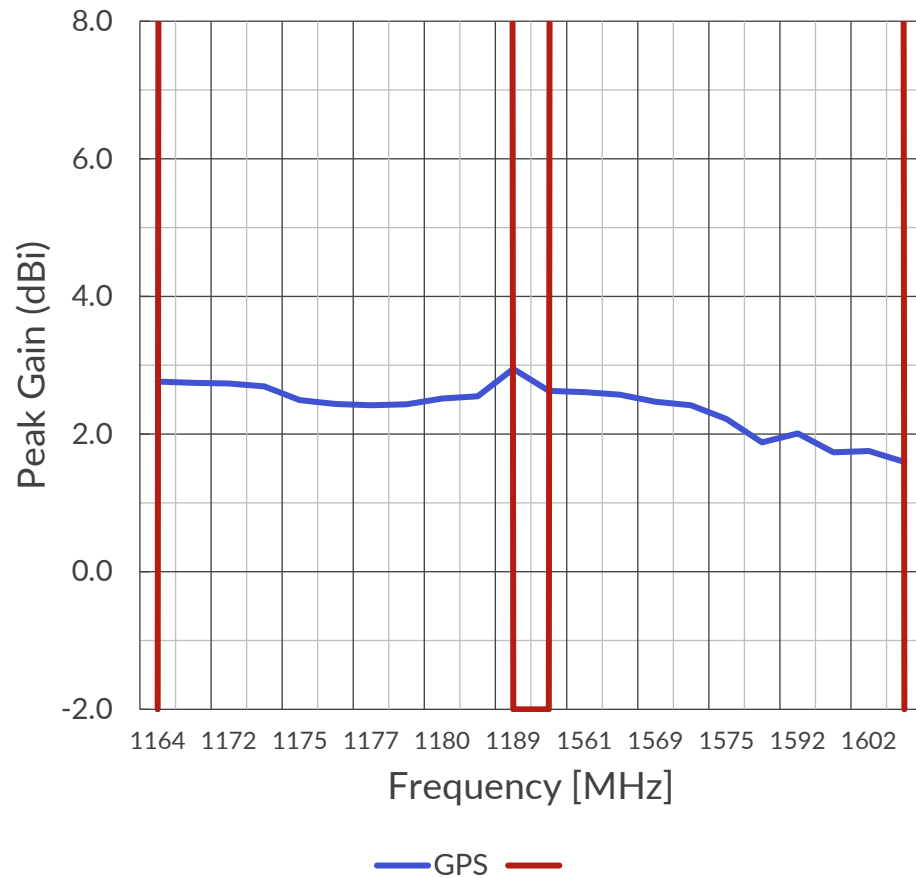
L1	Max	Mean	Min
GPS	60 %	59 %	53 %

L5	Max	Mean	Min
GPS	63 %	61 %	59 %

■ Cable Length

GPS : 314mm

Peak Gain **GPS**

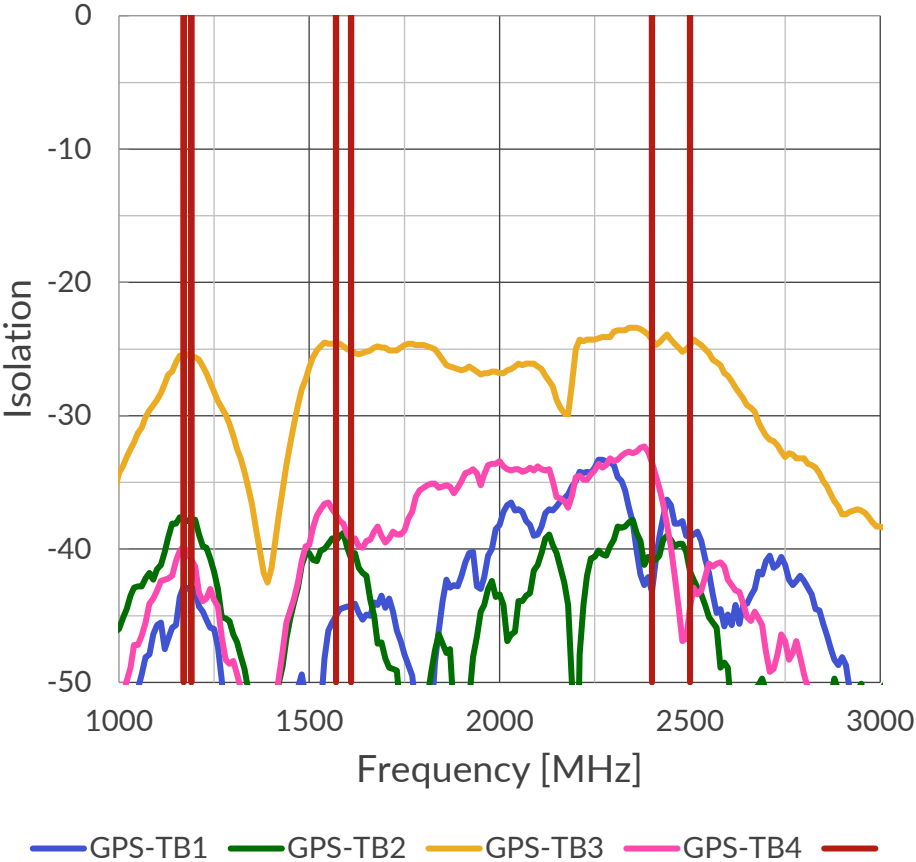


L1	Max	Mean	Min
GPS	2.6 dBi	2.2 dBi	1.6 dBi

L5	Max	Mean	Min
GPS	2.9 dBi	2.6 dBi	2.4 dBi

■ Cable Length
GPS : 314mm

Isolation



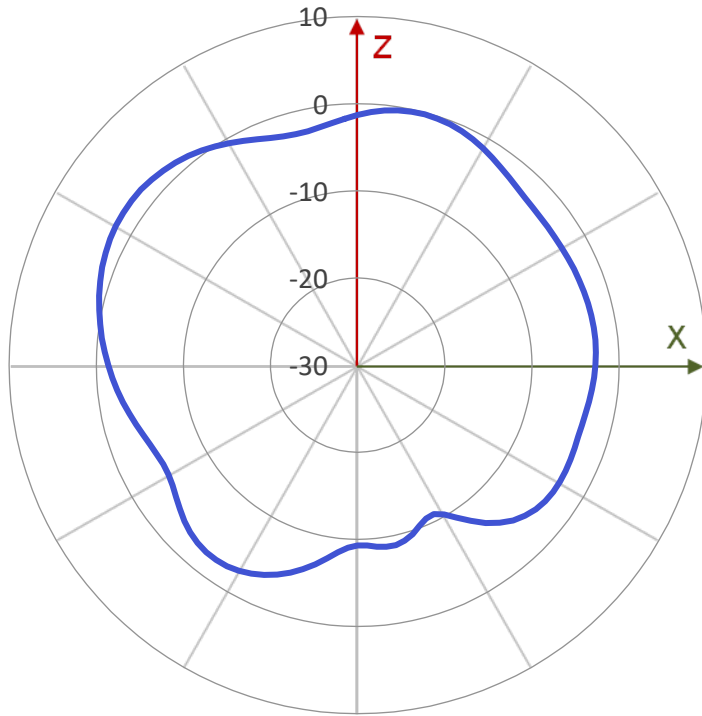
L1	Max	Mean	Min
GPS-TB1	-44.3	-44.5	-45.0
GPS-TB2	-38.8	-39.6	-40.7
GPS-TB3	-24.6	-24.8	-25.1
GPS-TB4	-37.4	-38.3	-39.3
Summary	-24.6	-36.9	-45.0

L5	Max	Mean	Min
GPS-TB1	-42.8	-42.9	-43.0
GPS-TB2	-37.7	-37.8	-37.9
GPS-TB3	-25.4	-25.5	-25.6
GPS-TB4	-39.8	-40.3	-40.8
Summary	-25.4	-36.6	-43.0

2.4GHz	Max	Mean	Min
GPS-TB1	-36.3	-38.7	-43.2
GPS-TB2	-39.0	-40.0	-41.7
GPS-TB3	-23.9	-24.6	-25.2
GPS-TB4	-33.5	-40.2	-46.9
Summary	-23.9	-35.9	-46.9

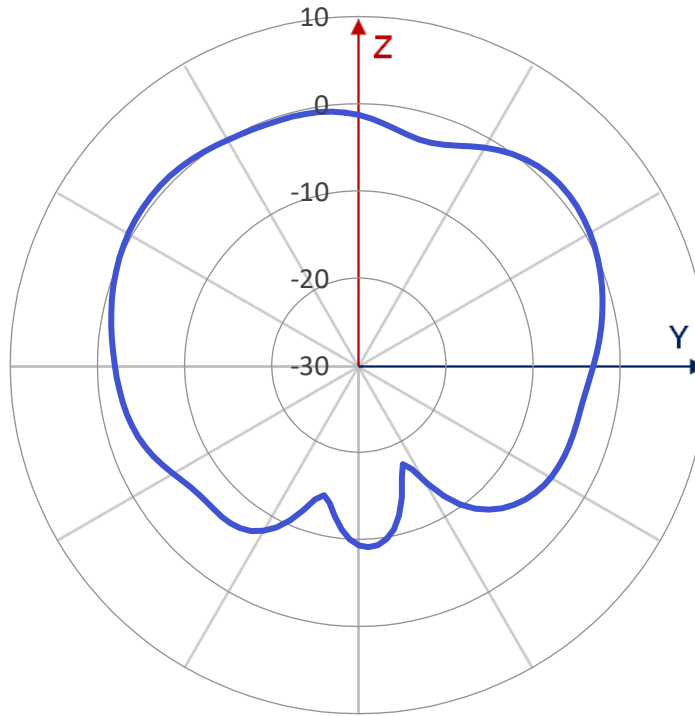
Realized Gain Pattern GPS @1575MHz for Gtotal

$\phi = 0$



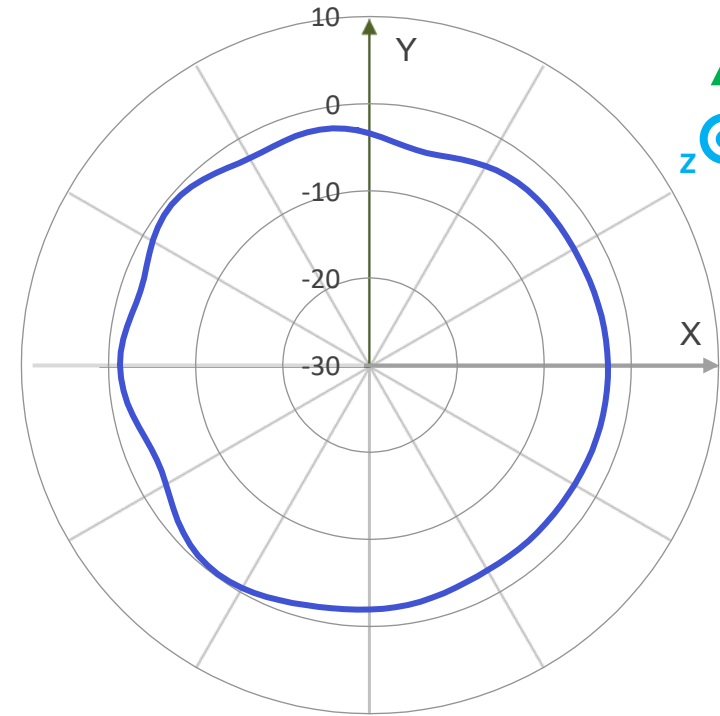
— GPS

$\phi = 90$

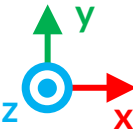


— GPS

$\theta = 90$

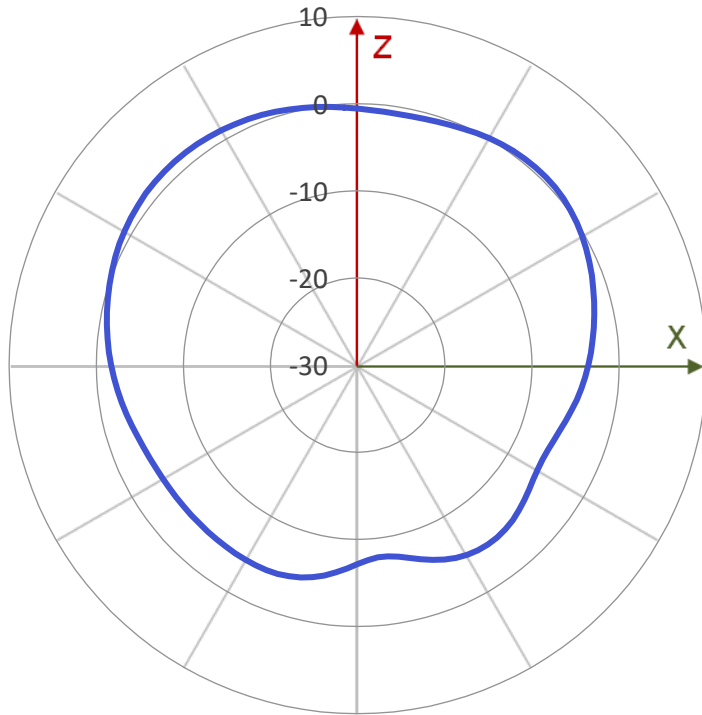


— GPS



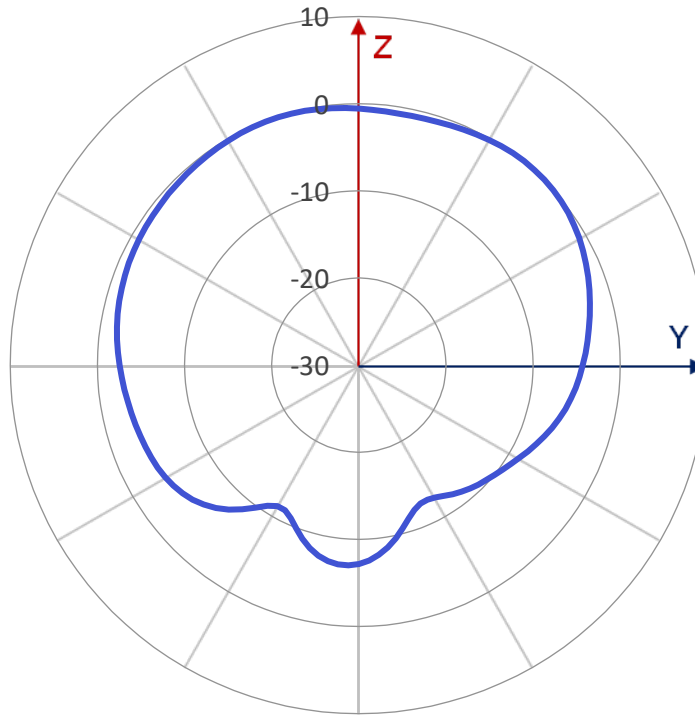
Realized Gain Pattern GPS @1176MHz for Gtotal

$\phi = 0$



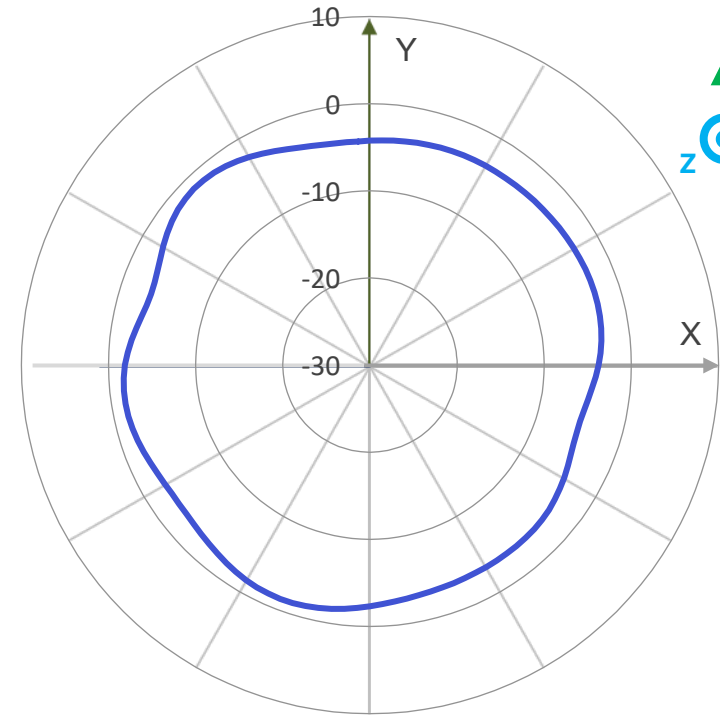
— GPS

$\phi = 90$

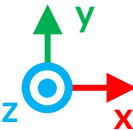


— GPS

$\theta = 90$



— GPS



UWB_TWR



■ Maximum VSWR

- 3.4:1 on Ch5 / 1.5:1 on Ch9

■ Average Efficiency

- ~41% on Ch5 / ~61% on Ch9

■ Peak Gain

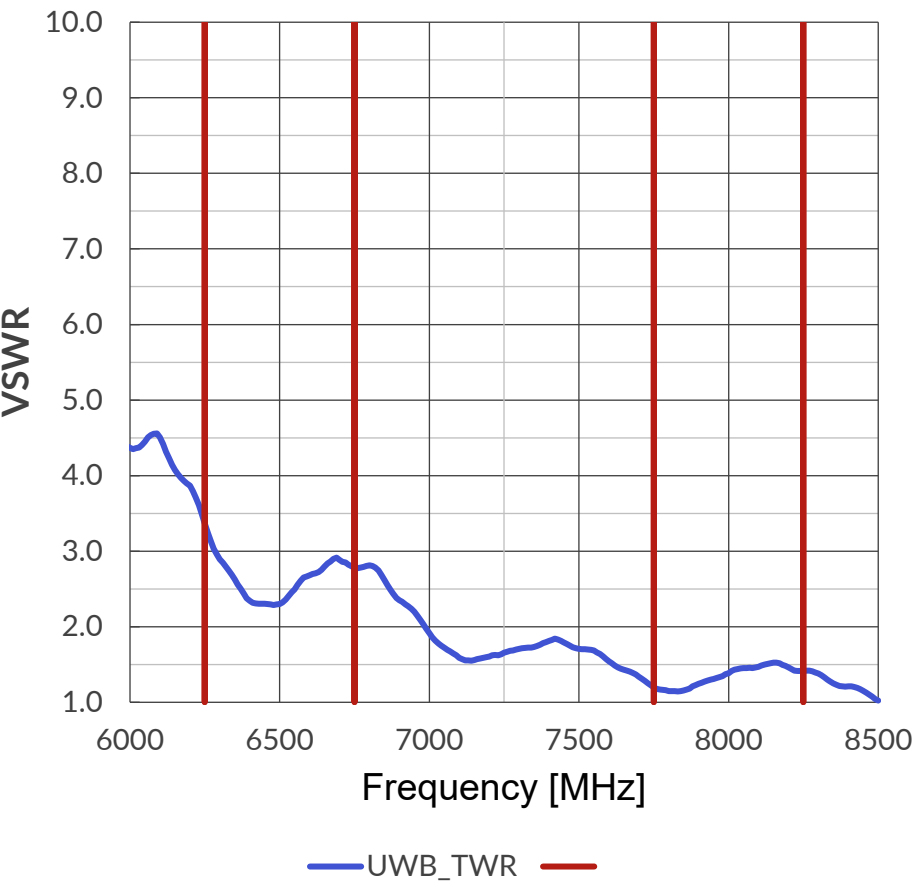
- 4.2dBi on Ch5 / 4.7dBi on Ch9

■ Cable Length

UWB-TWR : 142mm

VSWR

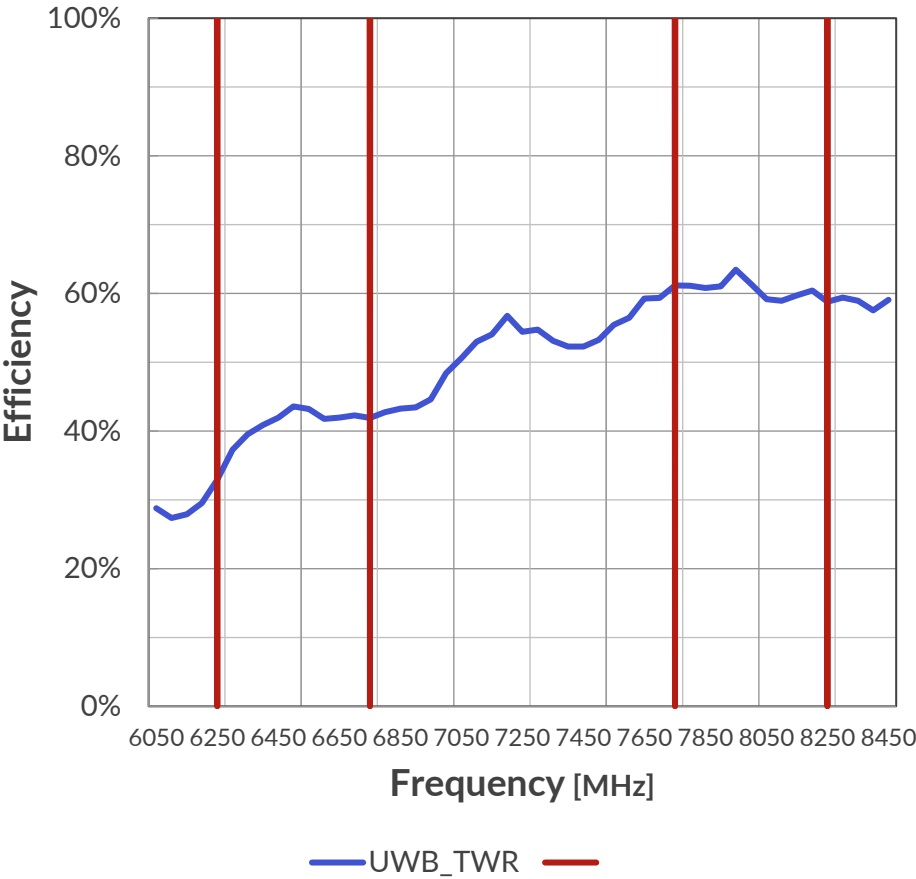
UWB_TWR



Ch5	Max	Mean	Min
UWB_TWR	3.4	2.6	2.3

Ch9	Max	Mean	Min
UWB_TWR	1.5	1.3	1.1

Efficiency **UWB_TWR**

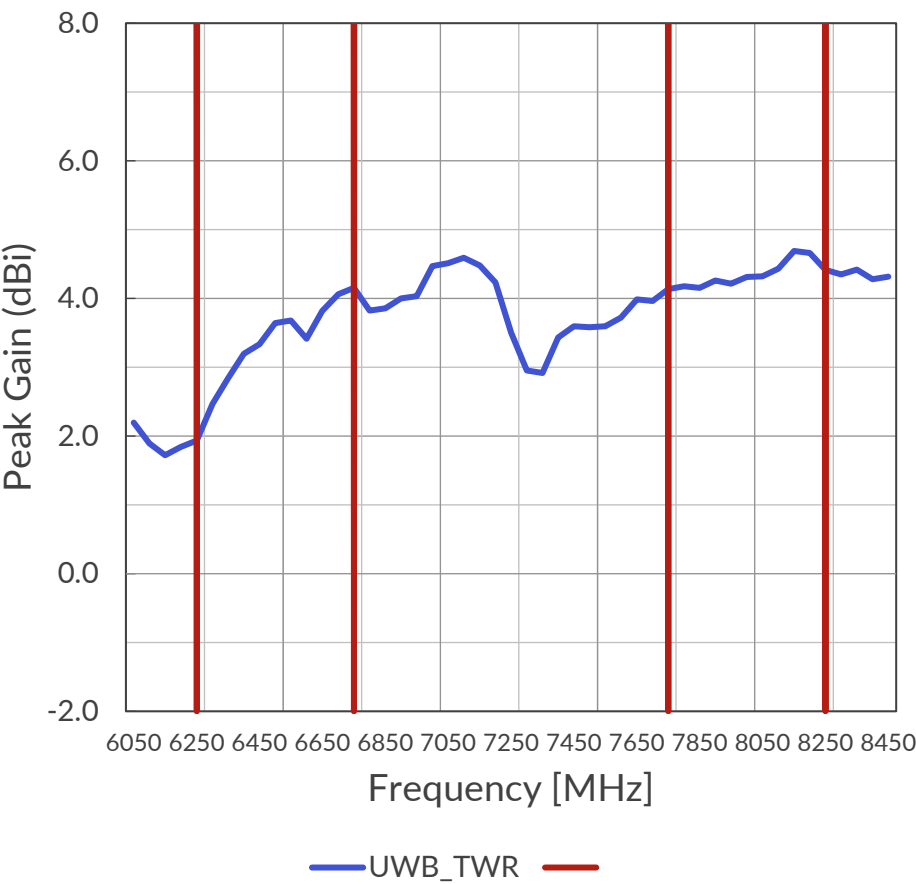


Ch5	Max	Mean	Min
TWR	44 %	41 %	33 %

Ch9	Max	Mean	Min
TWR	63 %	61 %	59 %

■ Cable Length
UWB_TWR : 142mm

Peak Gain UWB_TWR



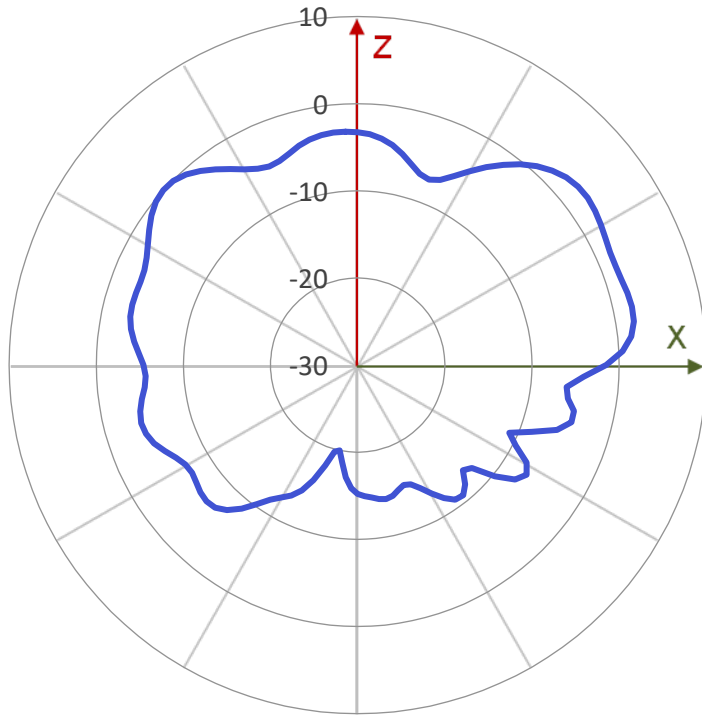
Ch5	Max	Mean	Min
UWB_TWR	4.2 dBi	3.3 dBi	1.9 dBi

Ch9	Max	Mean	Min
UWB_TWR	4.7 dBi	4.3 dBi	4.1 dBi

■ Cable Length
UWB_TWR : 142mm

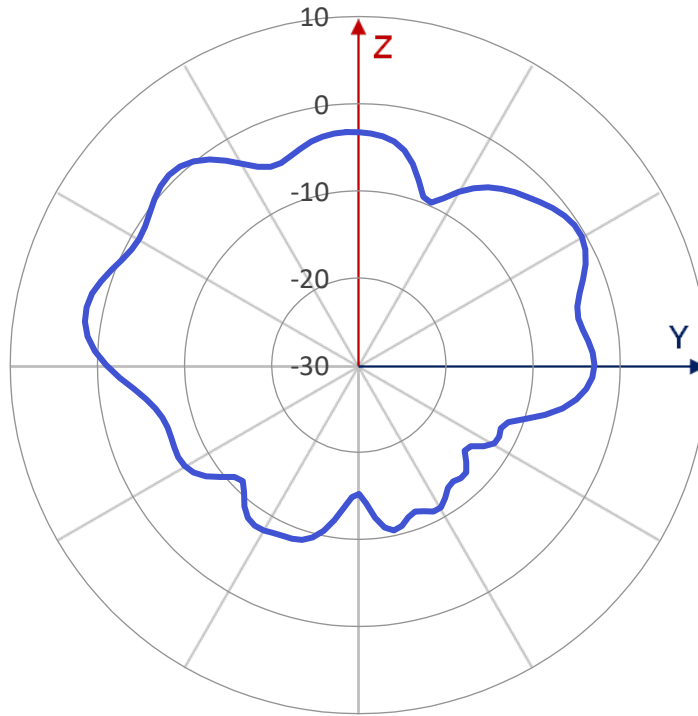
Realized Gain Pattern UWB_TWR@6500MHz for Gtotal

$\phi = 0$



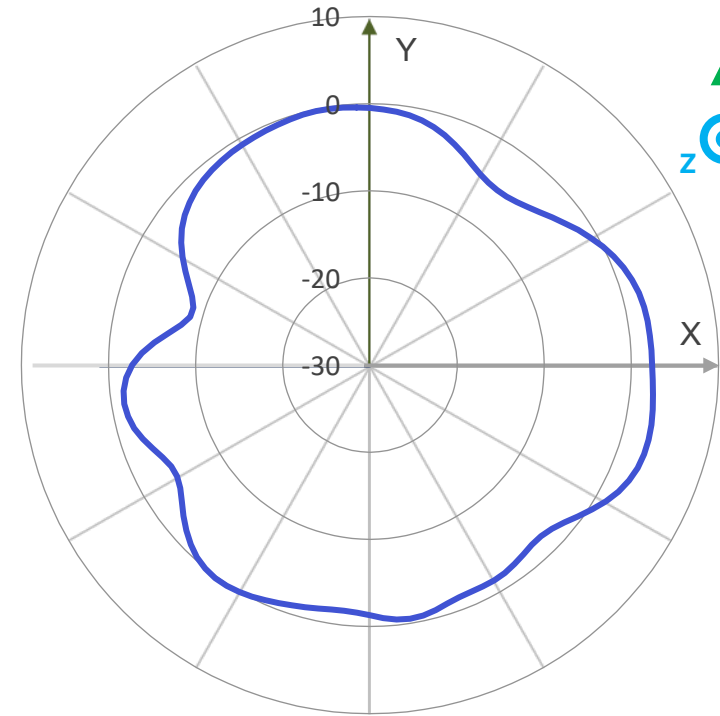
—UWB_TWR

$\phi = 90$

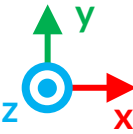


—UWB_TWR

$\theta = 60$

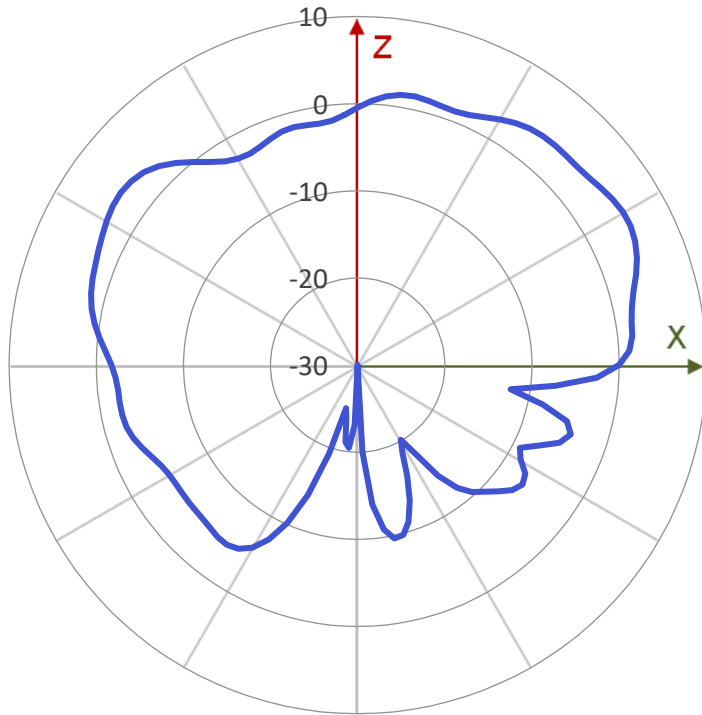


—UWB_TWR



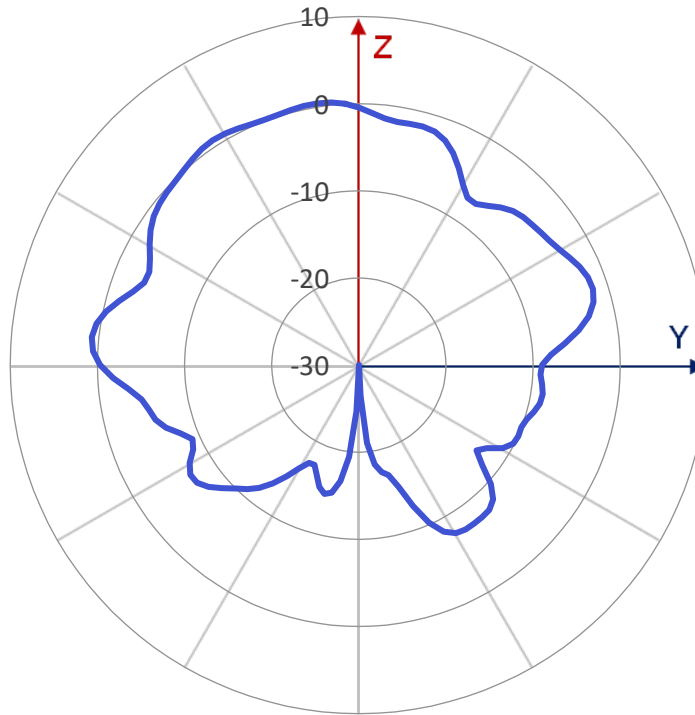
Realized Gain Pattern UWB_TWR @8000MHz for Gtotal

$\phi = 0$



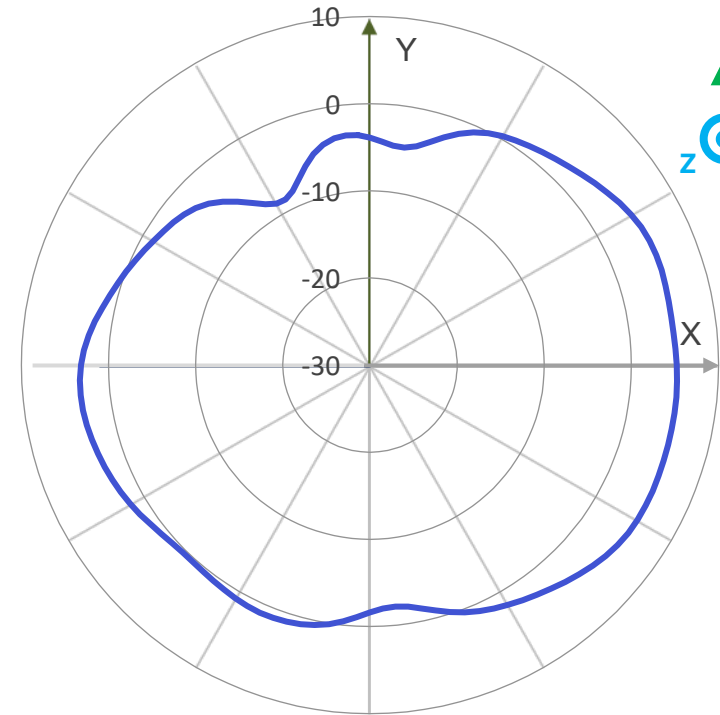
—UWB_TWR

$\phi = 90$

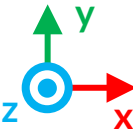


—UWB_TWR

$\theta = 60$



—UWB_TWR



UWB_PDoA



- **Maximum VSWR**

- 2.7:1 on Ch9

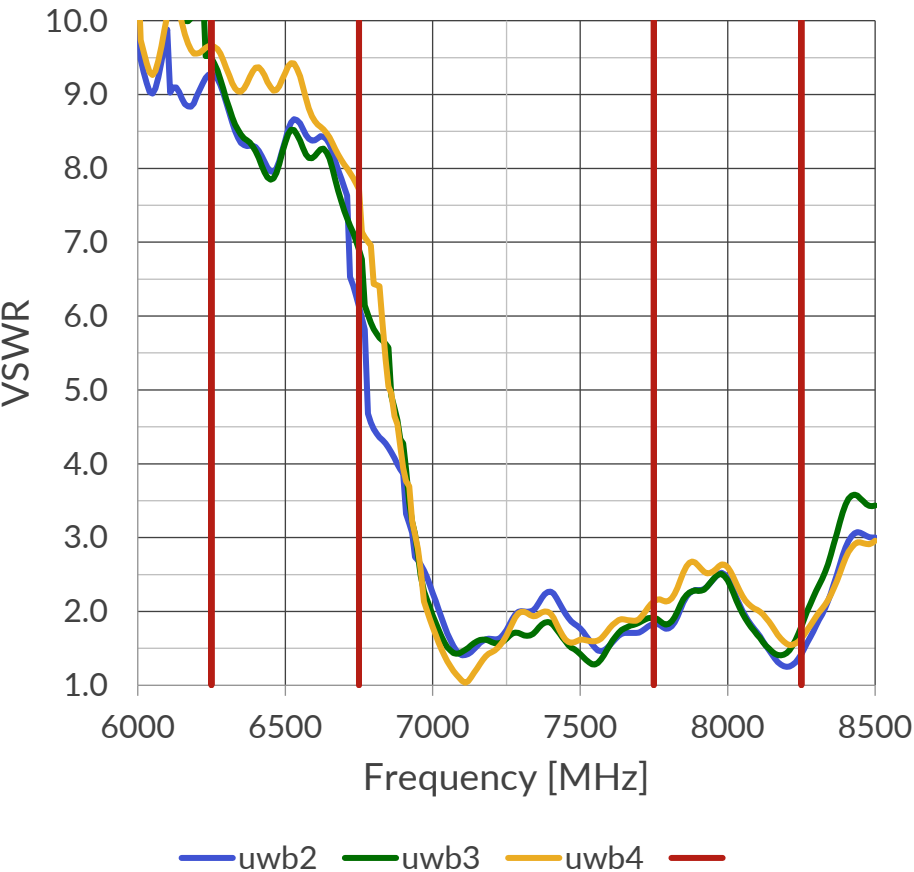
- **Average Efficiency**

- ~19% on Ch9

- **Peak Gain**

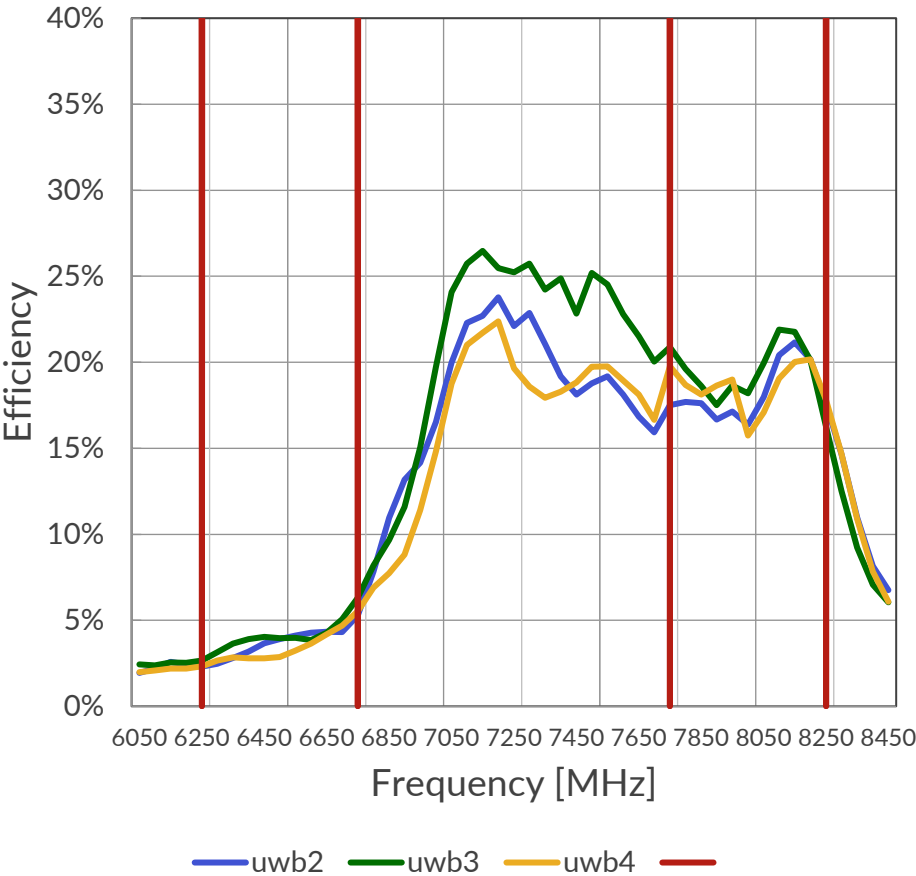
- 1.8dBi on Ch9

VSWR UWB_PDoA



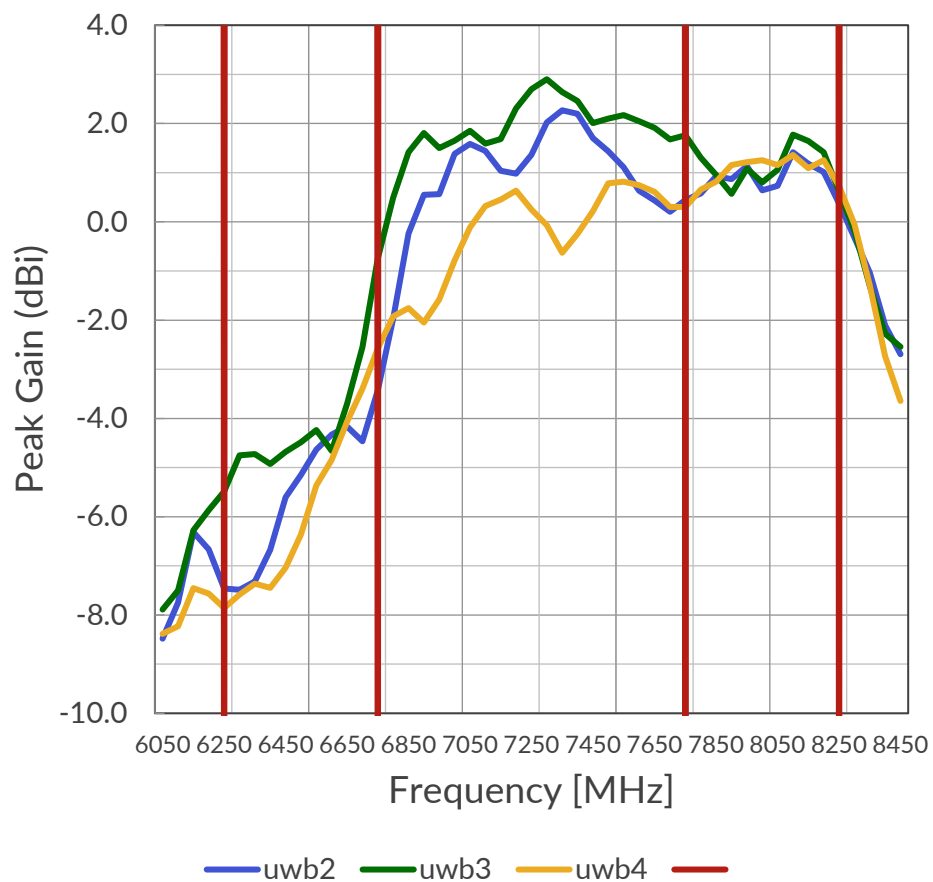
Ch9	Max	Mean	Min
uwb2	2.5	1.9	1.3
uwb3	2.5	1.9	1.4
uwb4	2.7	2.1	1.5
Summary	2.7	2.0	1.3

Efficiency UWB_PDoA



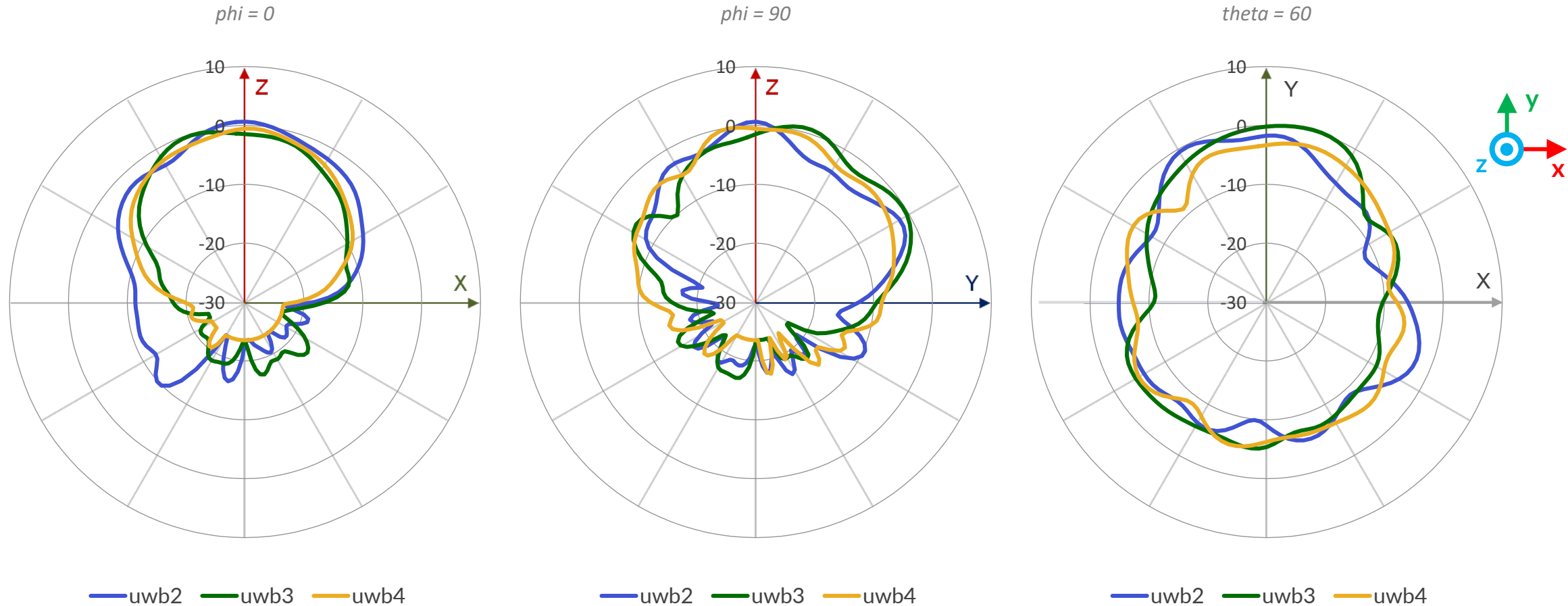
Ch9	Max	Mean	Min
uwb2	21 %	18 %	16 %
uwb3	22 %	19 %	16 %
uwb4	20 %	19 %	16 %
Summary	22 %	19 %	16 %

Peak Gain UWB_PDoA



Ch9	Max	Mean	Min
uwb2	1.4 dBi	0.8 dBi	0.4 dBi
uwb3	1.8 dBi	1.2 dBi	0.6 dBi
uwb4	1.4 dBi	1.0 dBi	0.3dBi
Summary	1.8 dBi	1.0 dBi	0.3 dBi

Realized Gain Pattern UWB_PDoA @8000MHz for Gtotal



Isolation among Radios

- **Wi-Fi 5G to Wi-Fi Tri-Band**

- 41.6dB on 2.4GHz / 35.7dB on 5-7GHz

- **Wi-Fi 6G to Wi-Fi Tri-Band**

- 36.3dB on 2.4GHz / 30.0dB on 5-7GHz

- **Wi-Fi 6G to Wi-Fi 5G**

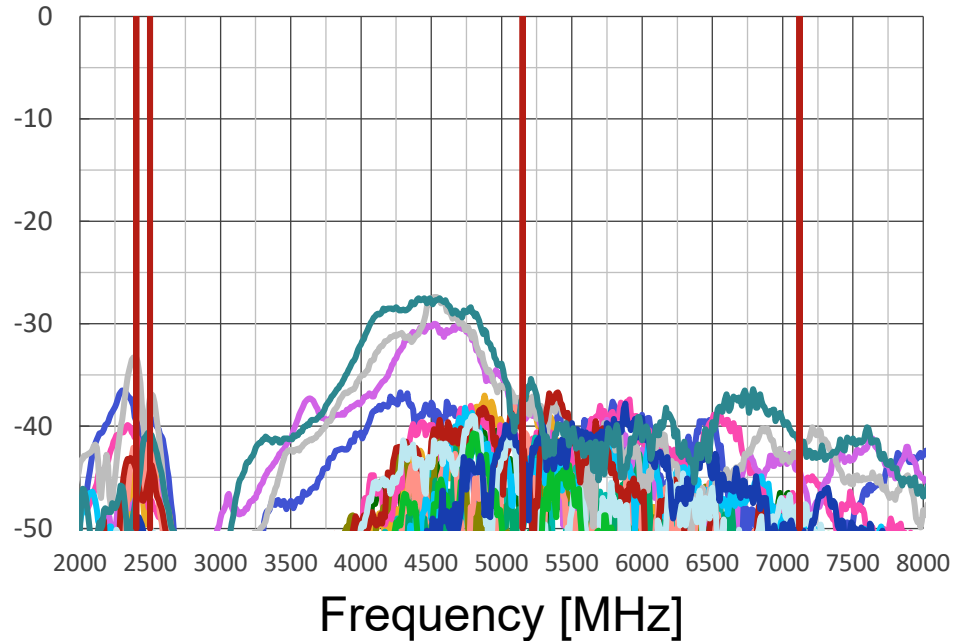
- 31dB on 5-7GHz

- **UWB-TWR to Wi-Fi Radios**

- 26.7dB on 5GHz / 27.8dB on 6GHz / 25.9dB on Ch9

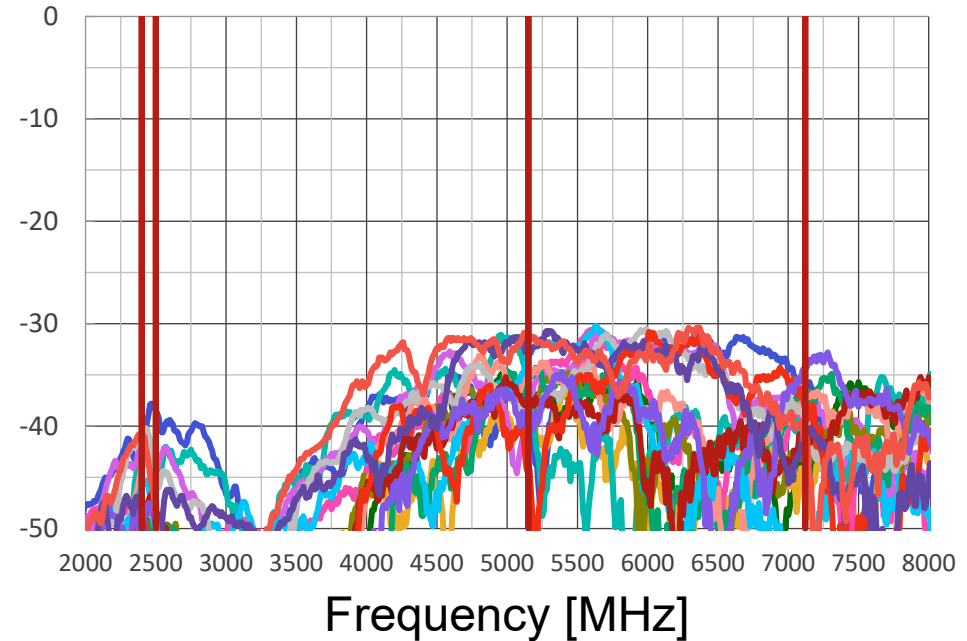
Isolation Wi-Fi 5G to Wi-Fi Tri-Band / Wi-Fi 6G to Wi-Fi Tri-Band

➤ Wi-Fi 5G to Wi-Fi Tri-Band



5G1-TB1 5G1-TB2 5G1-TB3 5G1-TB4
5G2-TB1 5G2-TB2 5G2-TB3 5G2-TB4
5G3-TB1 5G3-TB2 5G3-TB3 5G3-TB4
5G4-TB1 5G4-TB2 5G4-TB3 5G4-TB4

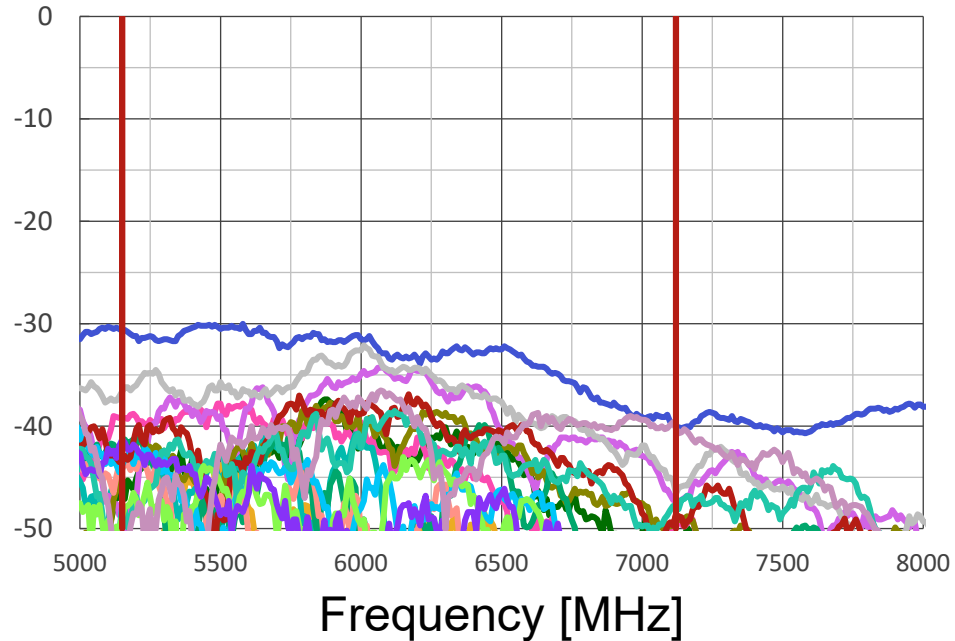
➤ Wi-Fi 6G to Wi-Fi Tri-Band



6G1-TB1 6G1-TB2 6G1-TB3 6G1-TB4
6G2-TB1 6G2-TB2 6G2-TB3 6G2-TB4
6G3-TB1 6G3-TB2 6G3-TB3 6G3-TB4
6G4-TB1 6G4-TB2 6G4-TB3 6G4-TB4

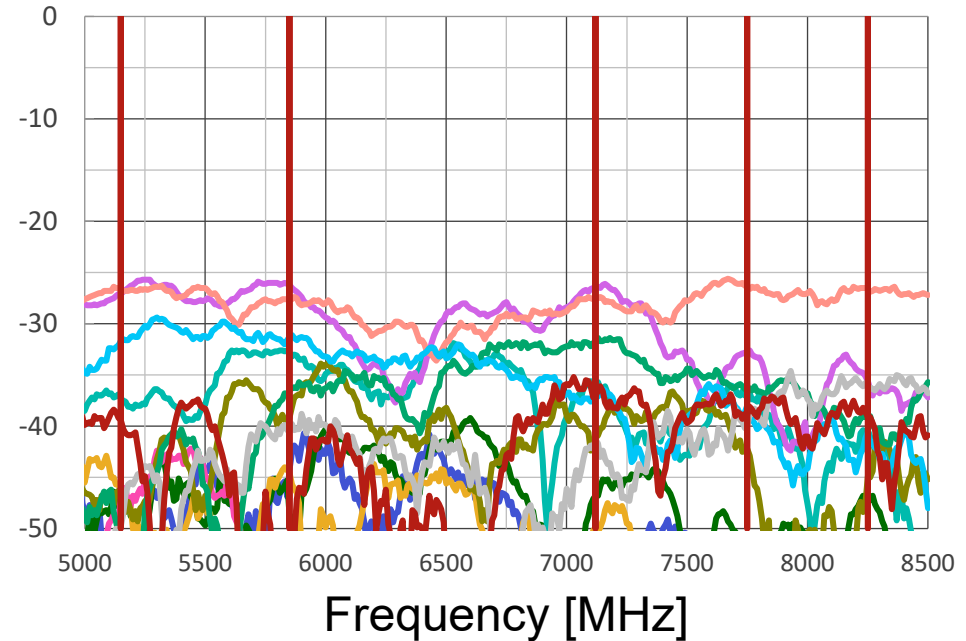
Isolation Wi-Fi 5G to Wi-Fi 6G / UWB - TWR to Wi-Fi Radios

➤ Wi-Fi 5G to Wi-Fi 6G



5G1-6G1 5G1-6G2 5G1-6G3 5G1-6G4
5G2-6G1 5G2-6G2 5G2-6G3 5G2-6G4
5G3-6G1 5G3-6G2 5G3-6G3 5G3-6G4
5G4-6G1 5G4-6G2 5G4-6G3 5G4-6G4

➤ UWB - TWR to Wi-Fi Radios



UWB_TWR-5G1 UWB_TWR-5G2 UWB_TWR-5G3
UWB_TWR-5G4 UWB_TWR-6G1 UWB_TWR-6G2
UWB_TWR-6G3 UWB_TWR-6G4 UWB_TWR-TB1
UWB_TWR-TB2 UWB_TWR-TB3 UWB_TWR-TB4

BLE Array – Directional Beam



■ Efficiency

- ~16% on 2.4GHz [Beam1~Beam8]
- ~27% on 2.4GHz [Beam9]

■ Peak Gain

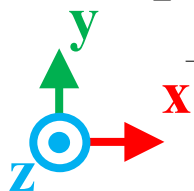
- 4.2dBi on 2.4GHz [Beam1~Beam8]
- 3.0dBi on 2.4GHz [Beam9]

■ Beam Width

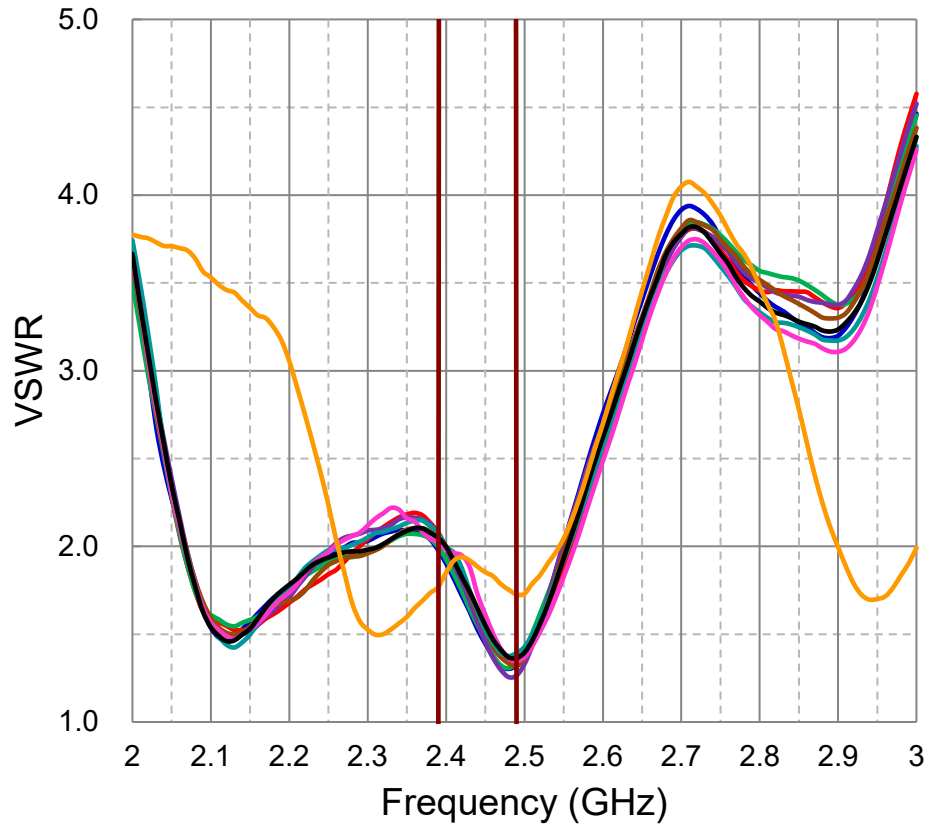
- ~48° on 2.4GHz [Beam1~Beam8]

■ Front to Back Ratio

- ~12.0dB on 2.4GHz [Beam1~Beam8]



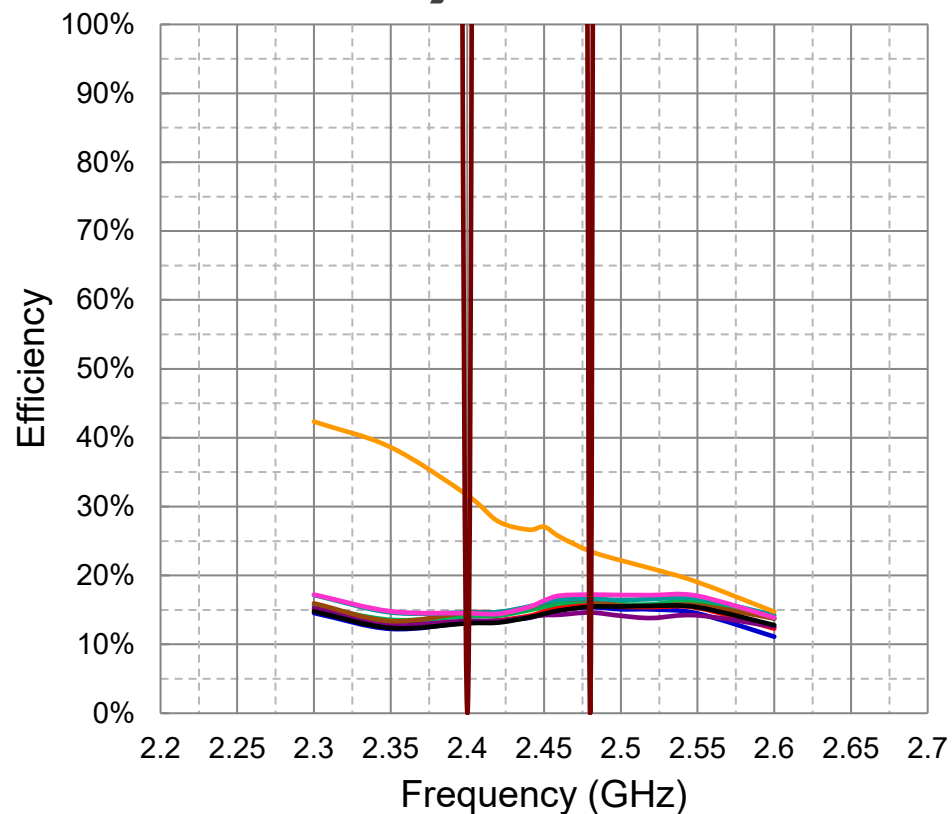
VSWR Directional Beam



— Beam1 — Beam2 — Beam3 — Beam4 — Beam5
— Beam6 — Beam7 — Beam8 — Beam9 —

2.4GHz	Max	Mean	Min
Beam 1	1.9	1.6	1.3
Beam 2	2.0	1.6	1.3
Beam 3	1.9	1.6	1.3
Beam 4	2.0	1.6	1.3
Beam 5	2.0	1.6	1.3
Beam 6	2.0	1.7	1.4
Beam 7	2.0	1.7	1.4
Beam 8	2.0	1.7	1.4
Beam 9	1.9	1.9	1.8

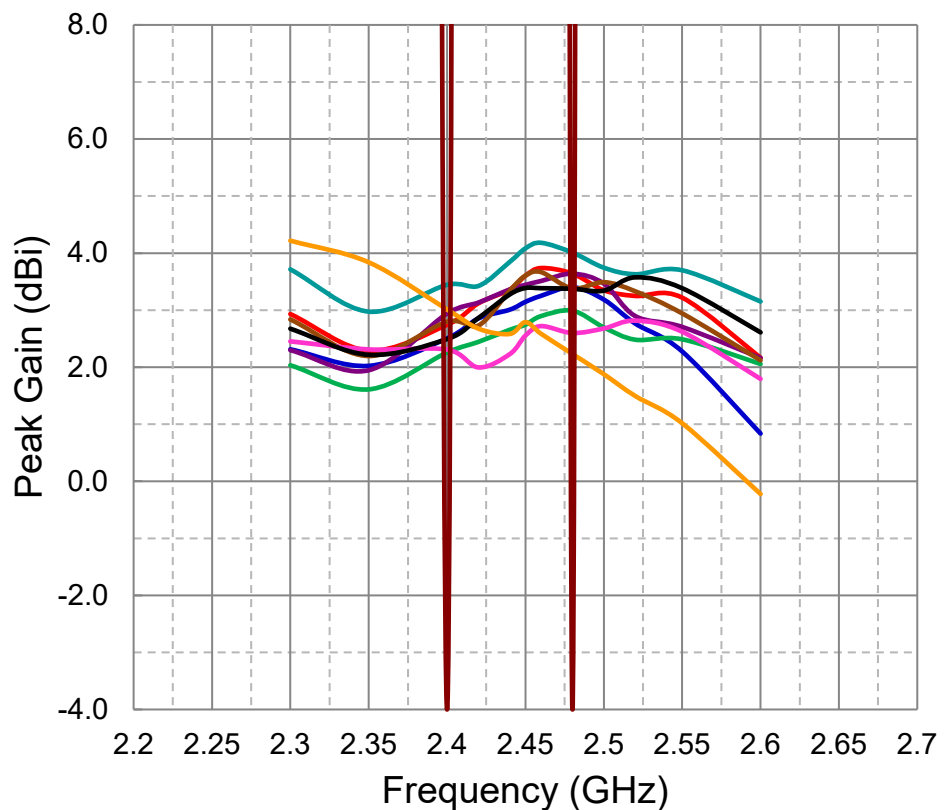
Efficiency Directional Beam



— Beam1 — Beam2 — Beam3 — Beam4 — Beam5
— Beam6 — Beam7 — Beam8 — Beam9 —

2.4GHz	Max	Mean	Min
Beam 1	15 %	14 %	13 %
Beam 2	16 %	14 %	13 %
Beam 3	16 %	15 %	14 %
Beam 4	15 %	14 %	13 %
Beam 5	16 %	16 %	15 %
Beam 6	17 %	16 %	15 %
Beam 7	17 %	16 %	14 %
Beam 8	15 %	14 %	13 %
Beam 9	32 %	27 %	24 %

Peak Gain Directional Beam

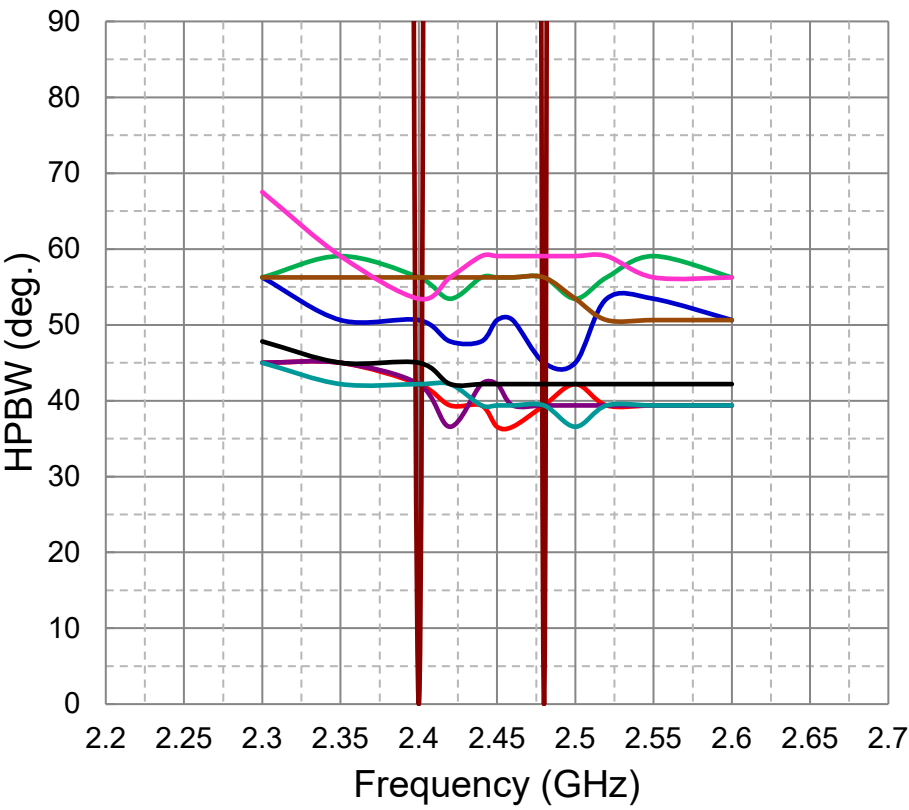


2.4GHz	Max	Mean	Min
Beam 1	3.4 dBi	3.0 dBi	2.5 dBi
Beam 2	3.7 dBi	3.4 dBi	2.7 dBi
Beam 3	3.0 dBi	2.7 dBi	2.3 dBi
Beam 4	3.6 dBi	3.3 dBi	2.9 dBi
Beam 5	3.7 dBi	3.3 dBi	2.7 dBi
Beam 6	4.2 dBi	3.8 dBi	3.4 dBi
Beam 7	2.7 dBi	2.4 dBi	2.0 dBi
Beam 8	3.4 dBi	3.1 dBi	2.5 dBi
Beam 9	3.0 dBi	2.6 dBi	2.2 dBi

Beam1 Beam2 Beam3 Beam4 Beam5
 Beam6 Beam7 Beam8 Beam9

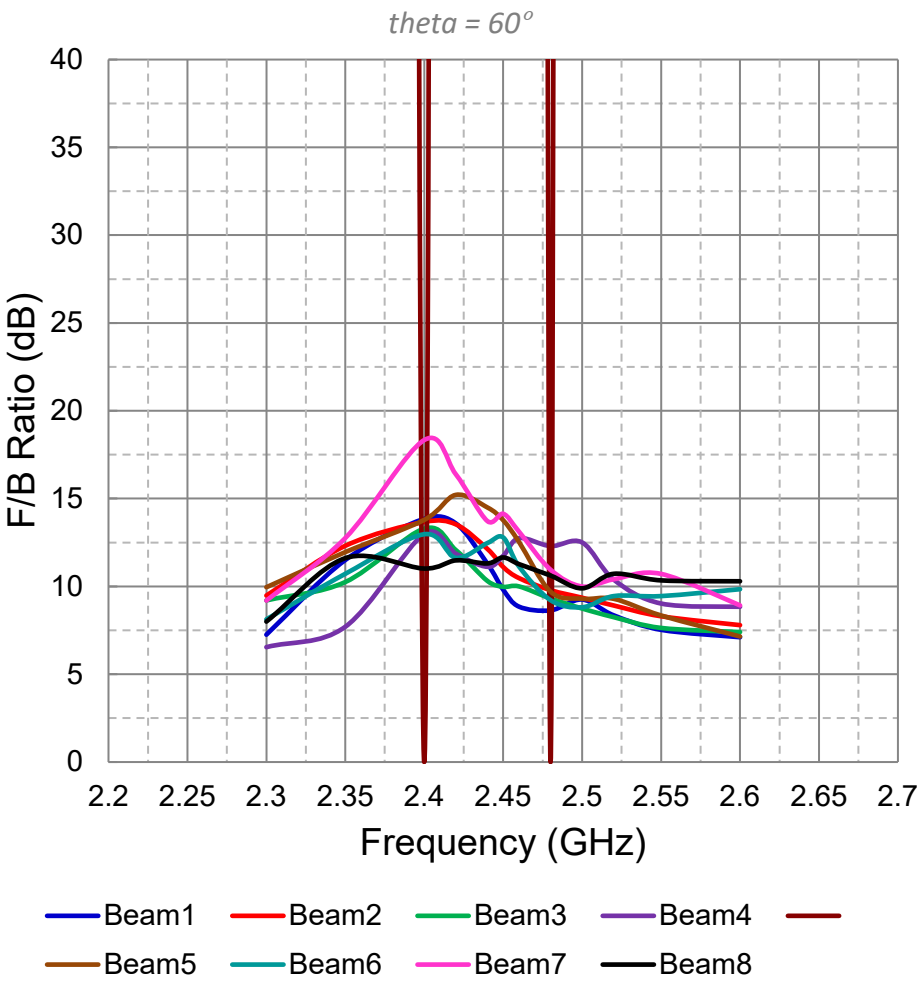
3dB Beam Width Directional Beam

$\theta = 60^\circ$



2.4GHz	Max	Mean	Min
Beam 1	51	49	45
Beam 2	42	39	37
Beam 3	56	56	53
Beam 4	42	40	37
Beam 5	56	56	56
Beam 6	42	40	39
Beam 7	59	58	53
Beam 8	45	43	42
Summary	59	48	37

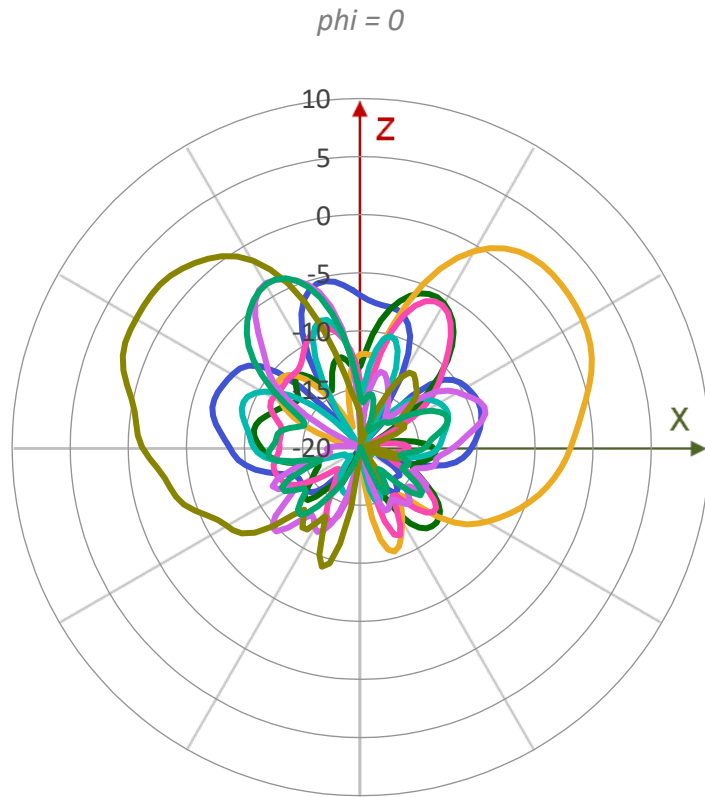
Front to Back Ratio Directional Beam



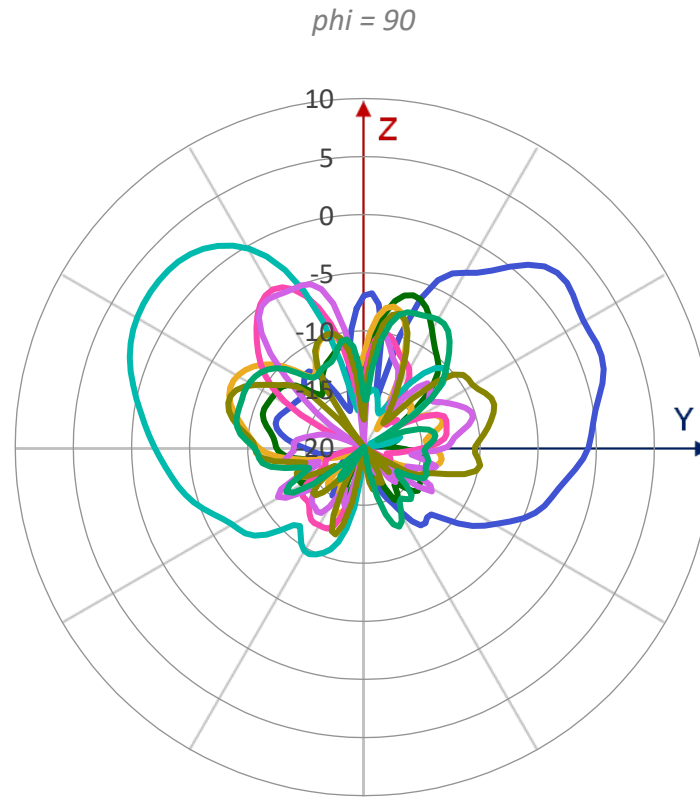
2.4GHz	Max	Mean	Min
Beam 1	13.9	11.0	8.6
Beam 2	13.7	11.8	9.8
Beam 3	13.3	10.8	9.3
Beam 4	13.0	12.1	11.1
Beam 5	15.2	13.3	9.7
Beam 6	13.0	11.7	9.2
Beam 7	18.3	14.4	11.0
Beam 8	11.6	11.2	10.6
Summary	18	12	9

Realized Gain Pattern

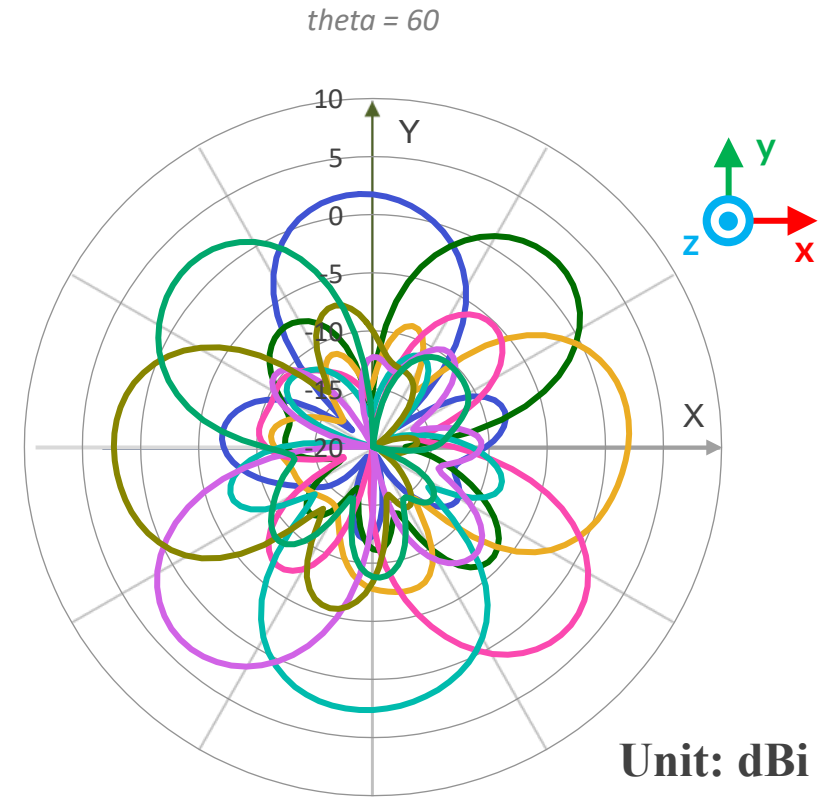
Directional Beam 1-8 @2400MHz for G_{total}



— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8



— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8

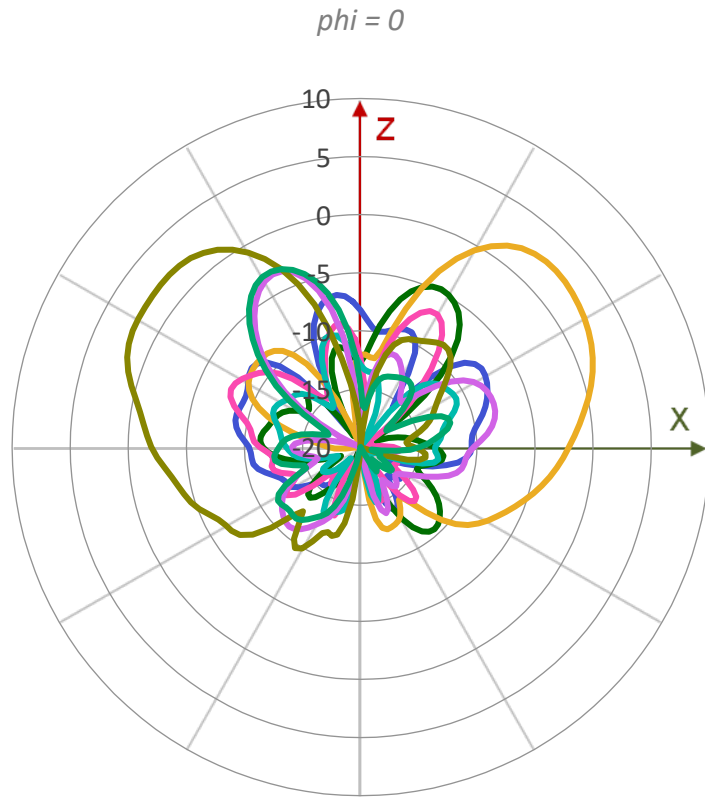


Unit: dBi

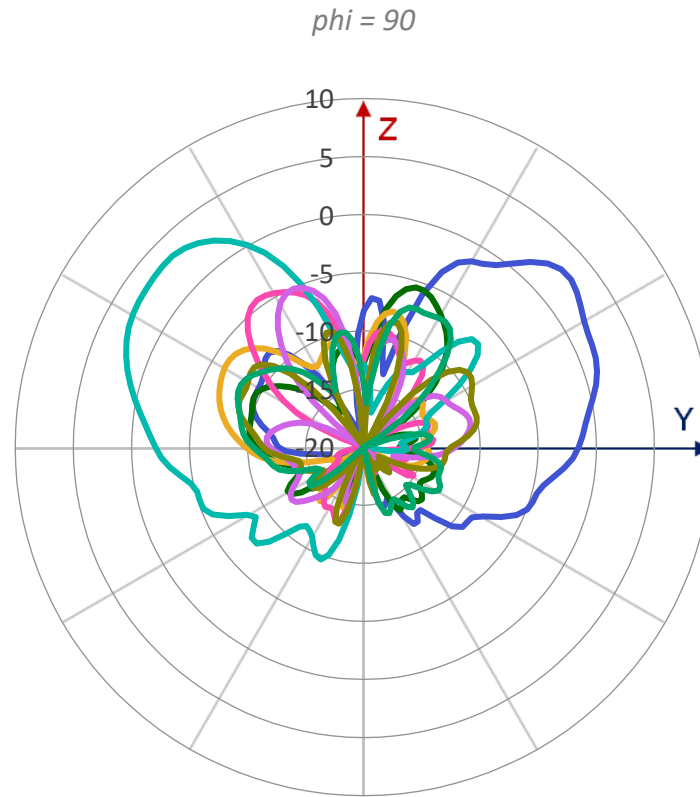
— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8

Realized Gain Pattern

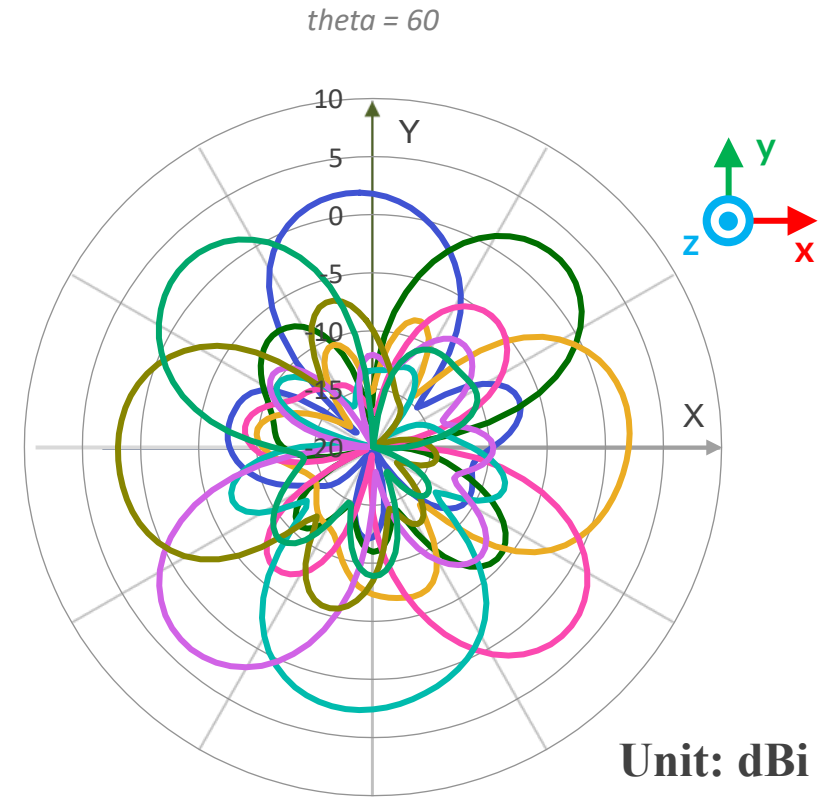
Directional Beam 1-8 @2440MHz for G_{total}



— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8



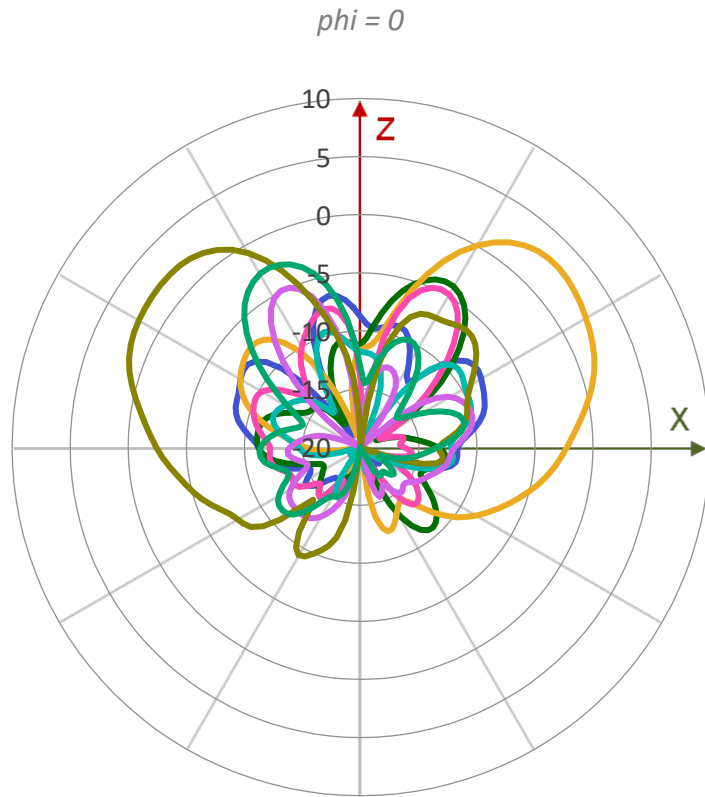
— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8



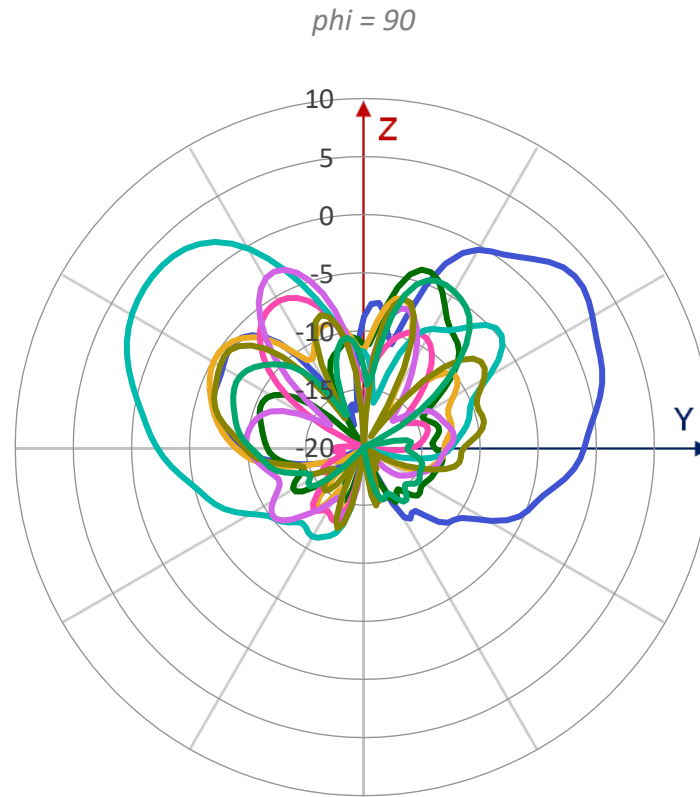
— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8

Realized Gain Pattern

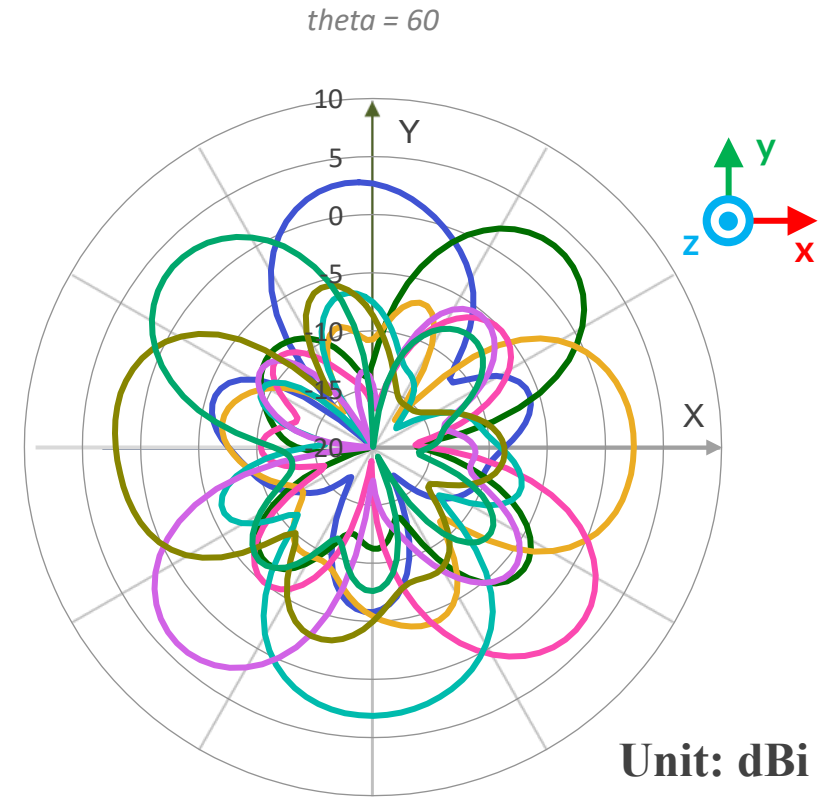
Directional Beam 1-8 @2480MHz for G_{total}



— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8



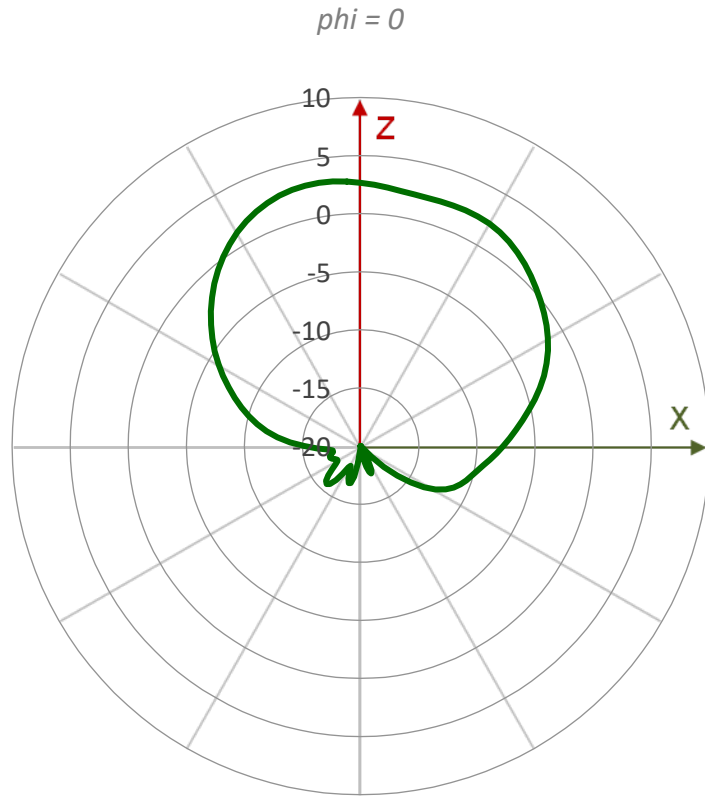
— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8



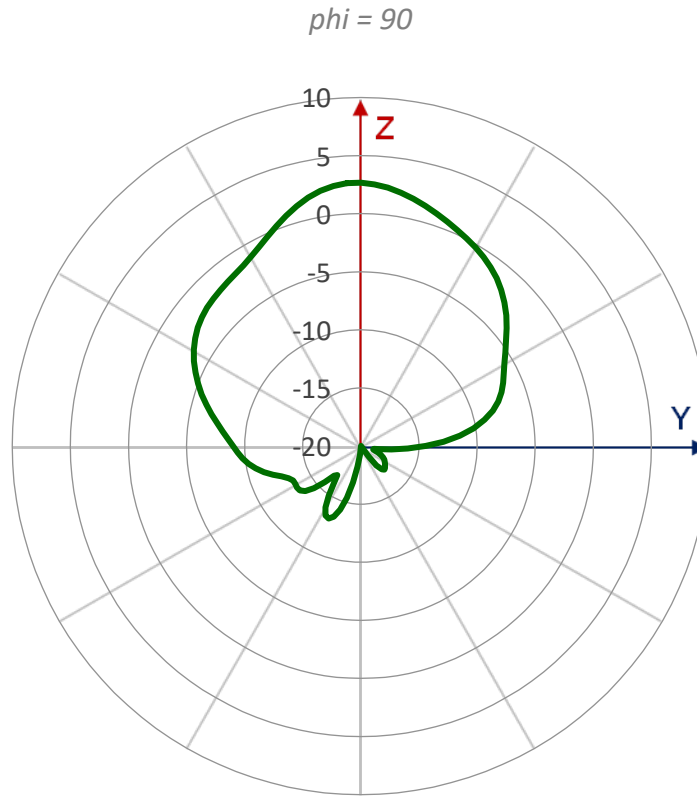
— Beam1 — Beam2 — Beam3 — Beam4
— Beam5 — Beam6 — Beam7 — Beam8

Realized Gain Pattern

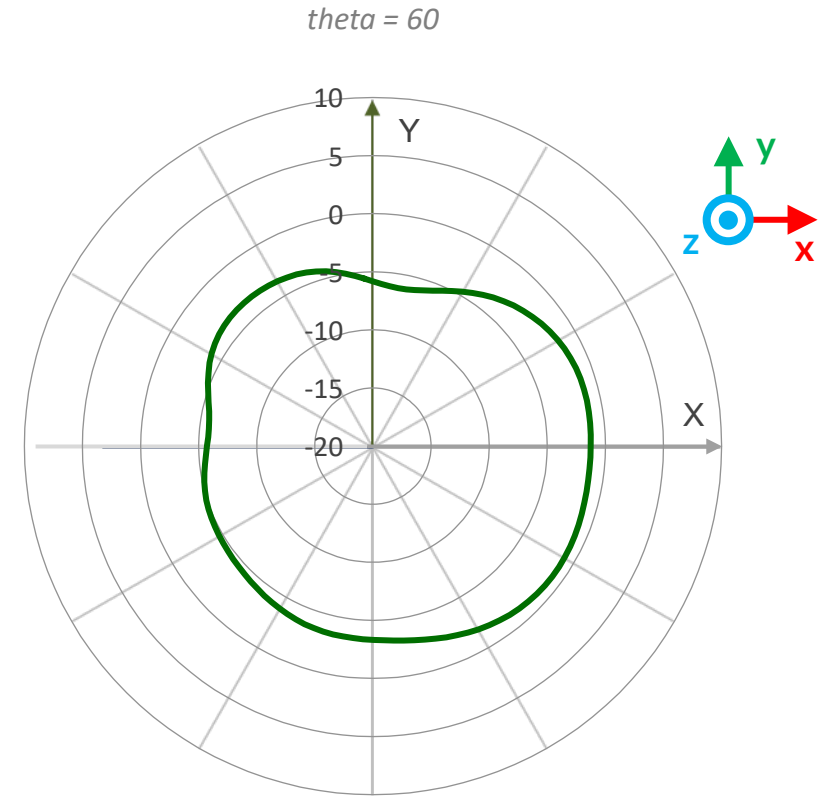
Directional Beam 9 @2400MHz for Gtotal



— Beam9



— Beam9

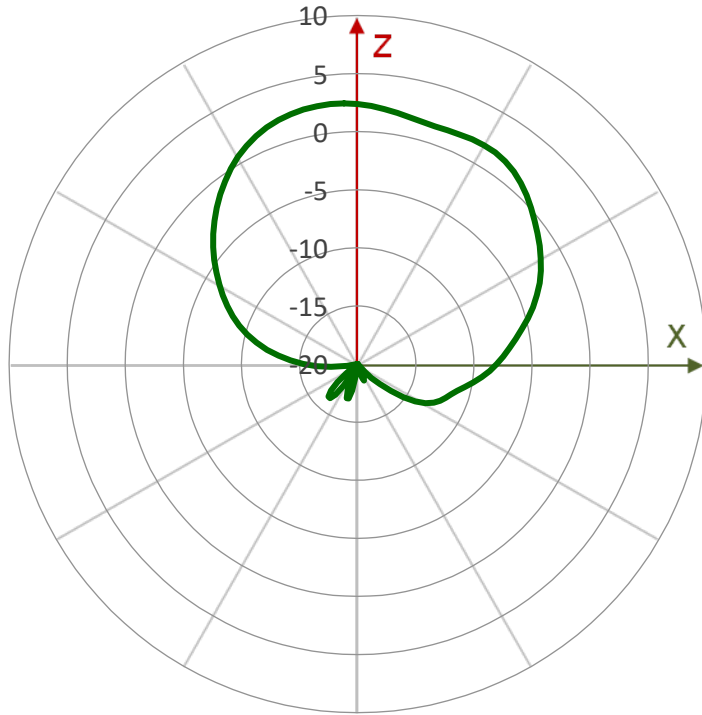


— Beam9

Realized Gain Pattern

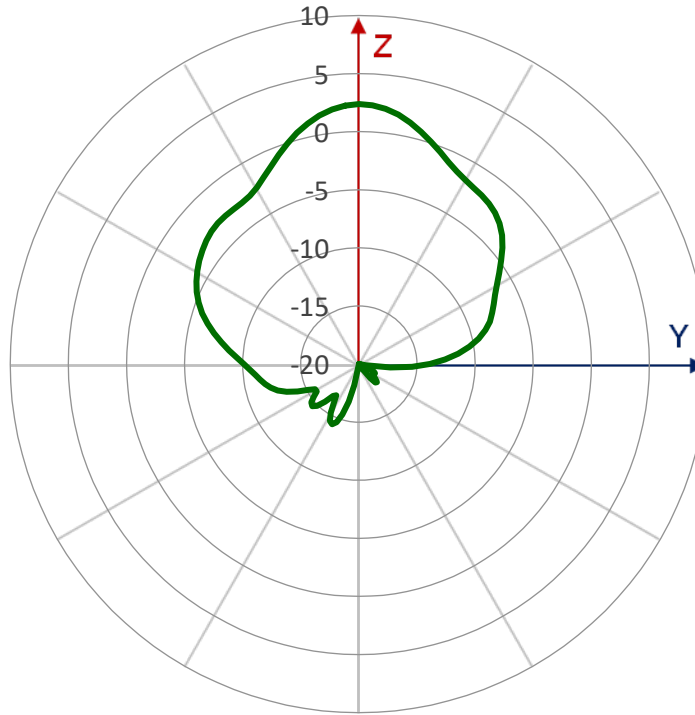
Directional Beam 9 @2440MHz for Gtotal

$\phi = 0$



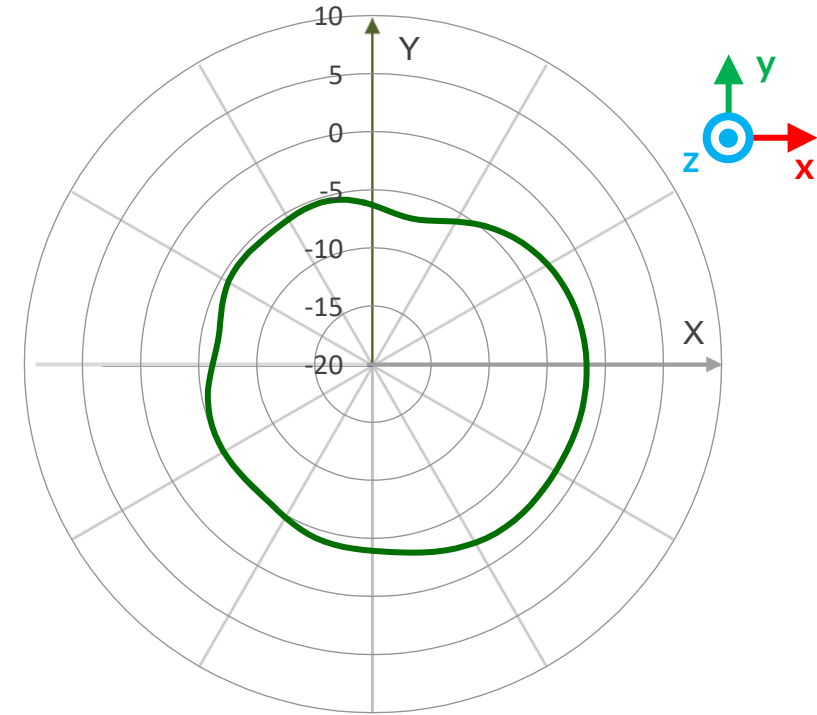
— Beam9

$\phi = 90$



— Beam9

$\theta = 60$

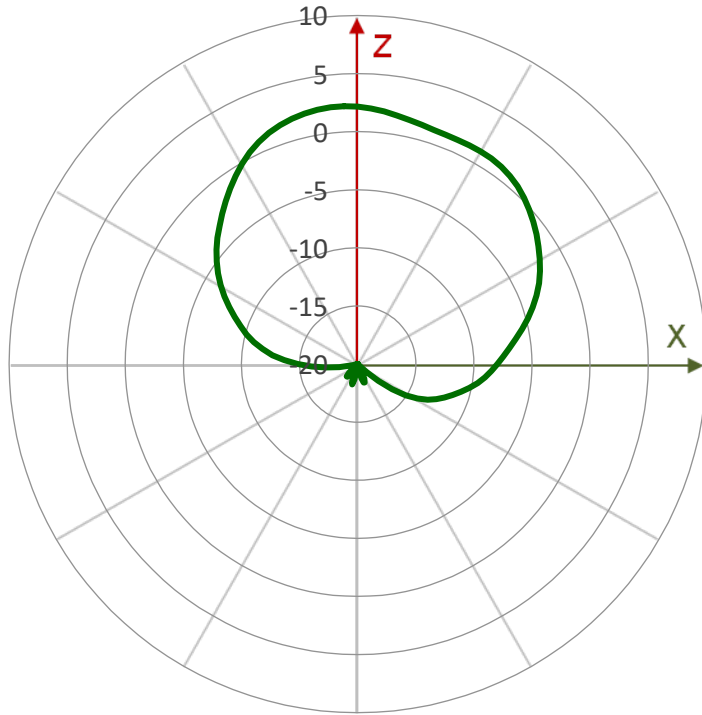


— Beam9

Realized Gain Pattern

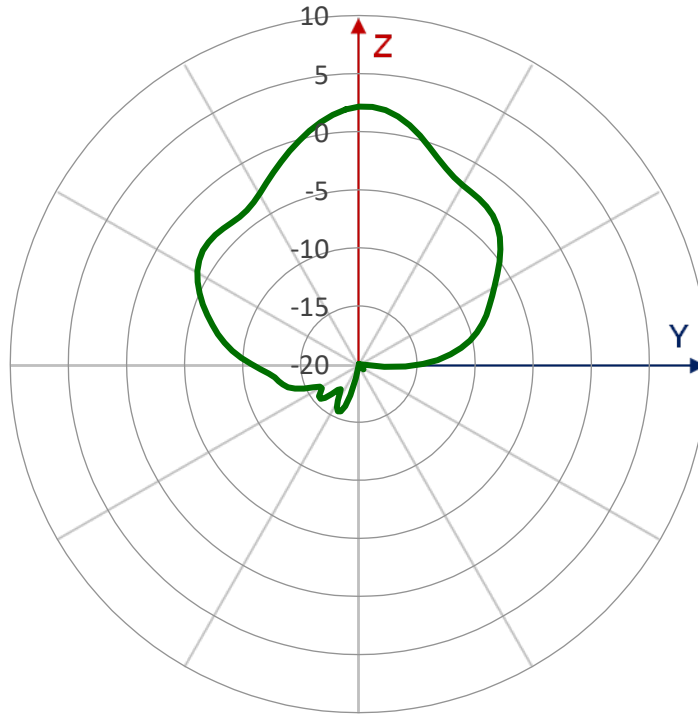
Directional Beam 9 @2480MHz for Gtotal

$\phi = 0$



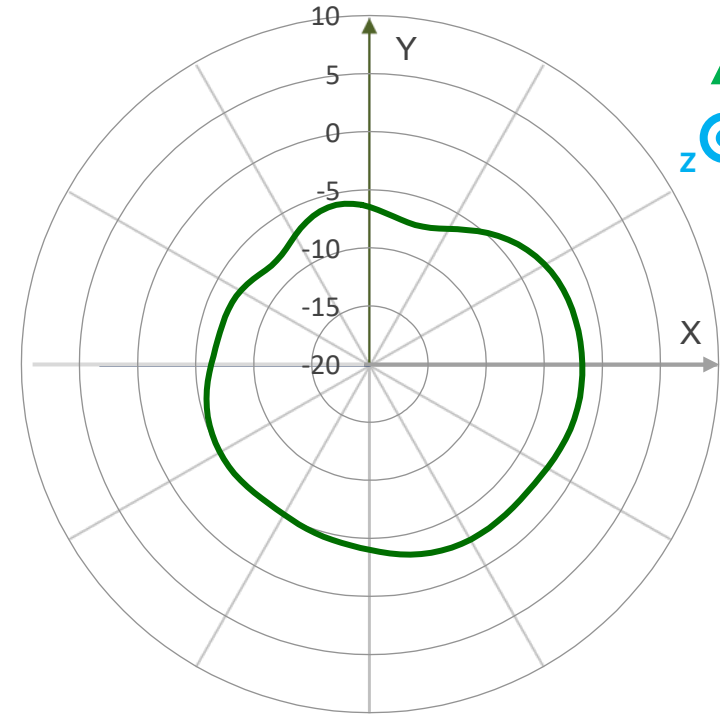
— Beam9

$\phi = 90$



— Beam9

$\theta = 60$

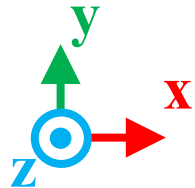


— Beam9

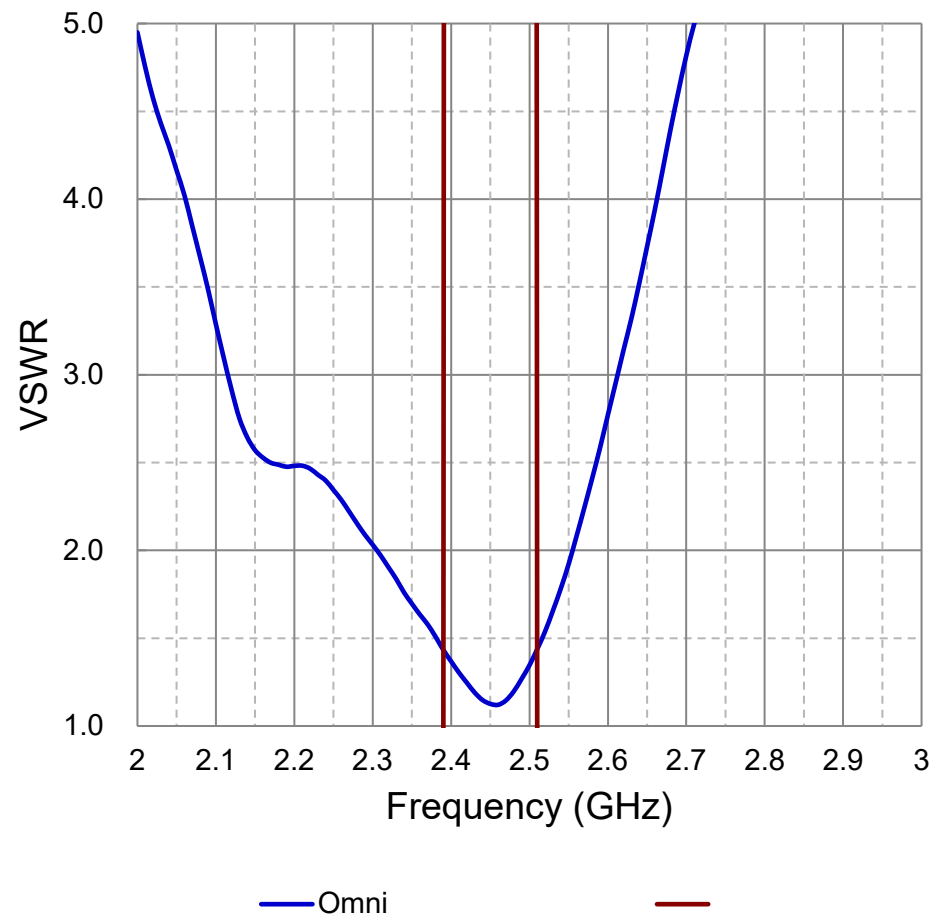
BLE Array – Omni Beam



- **Maximum VSWR**
 - 1.4:1 on 2.4GHz
- **Efficiency**
 - ~19% on 2.4GHz
- **Peak Gain**
 - -0.4dBi on 2.4GHz

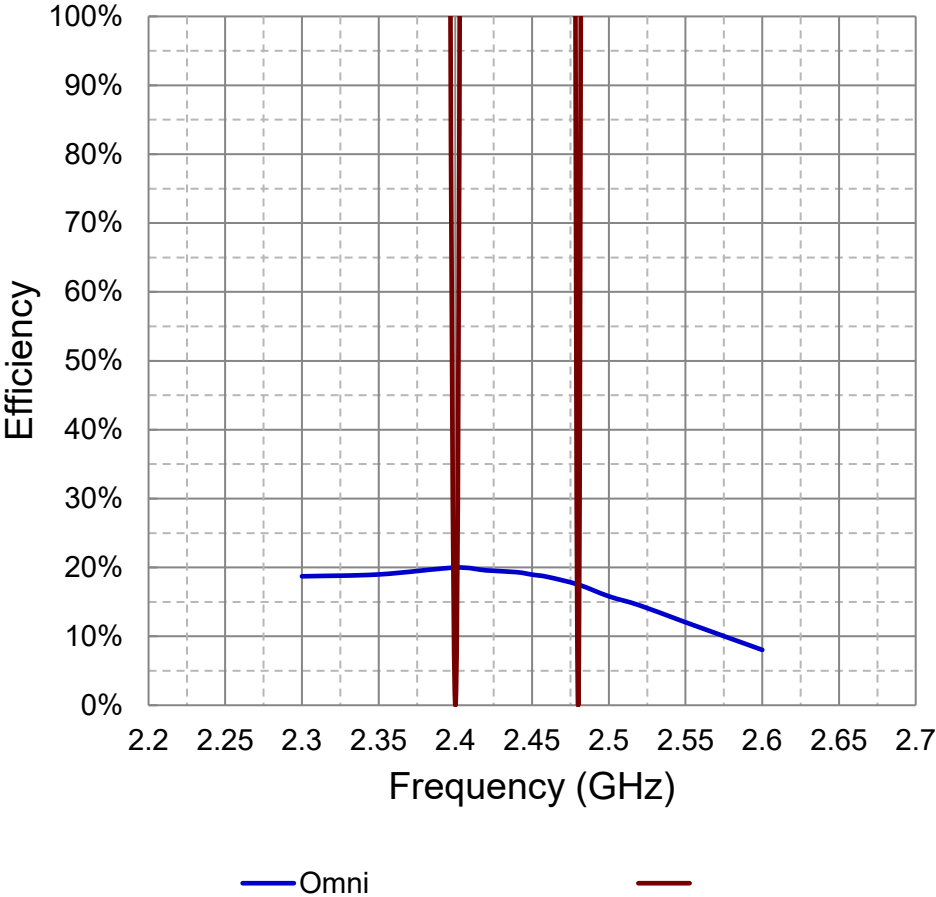


VSWR Omni Beam



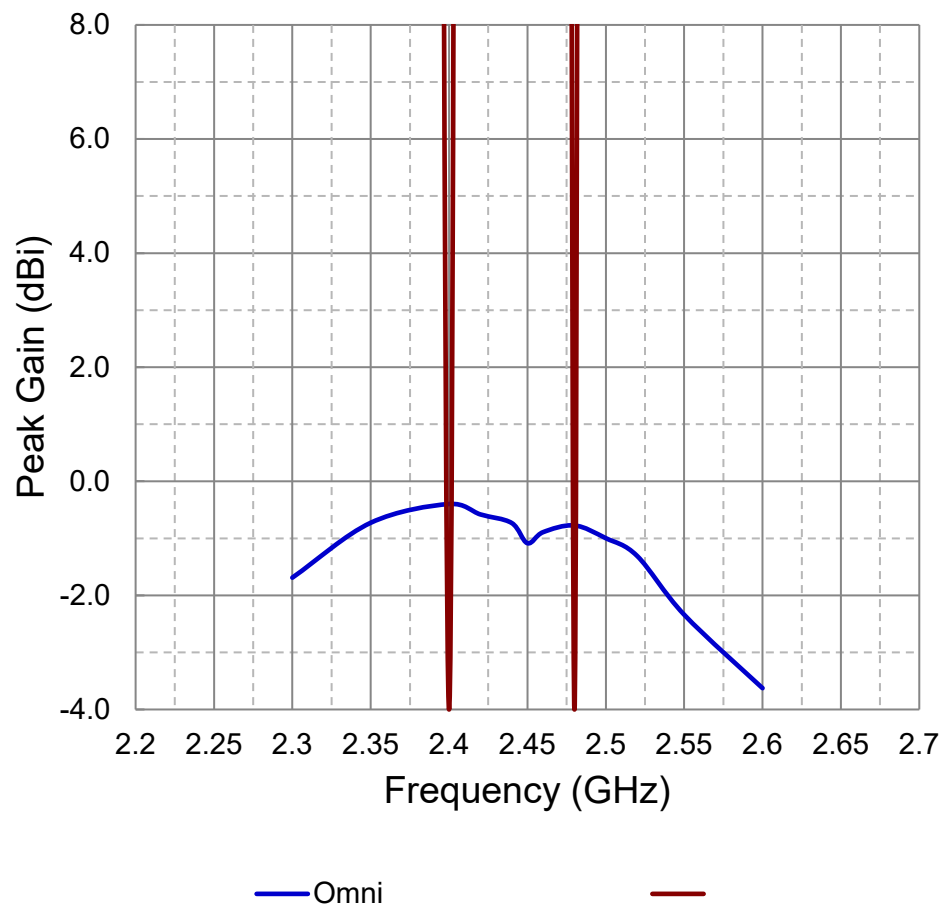
2.4GHz	Max	Mean	Min
Omni	1.4	1.2	1.1

Efficiency Omni Beam



2.4GHz	Max	Mean	Min
Omni	20 %	19 %	18 %

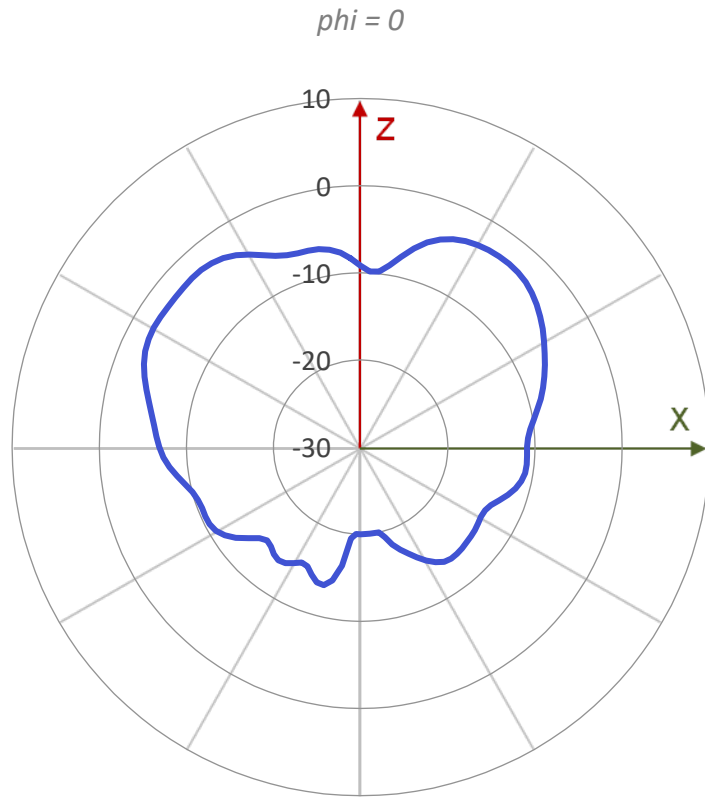
Peak Gain **Omni Beam**



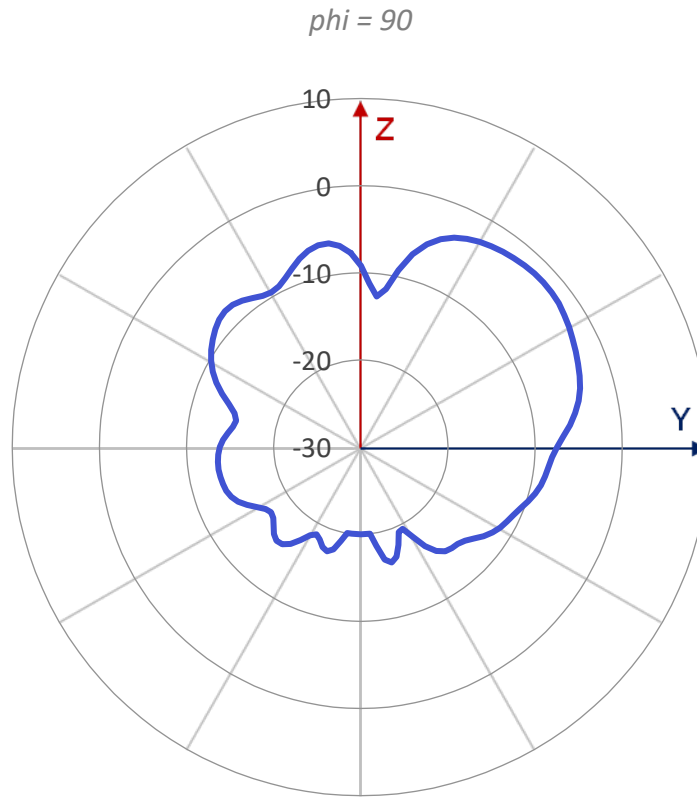
2.4GHz	Max	Mean	Min
Sub1	-0.4 dBi	-0.7 dBi	-1.1 dBi

Realized Gain Pattern

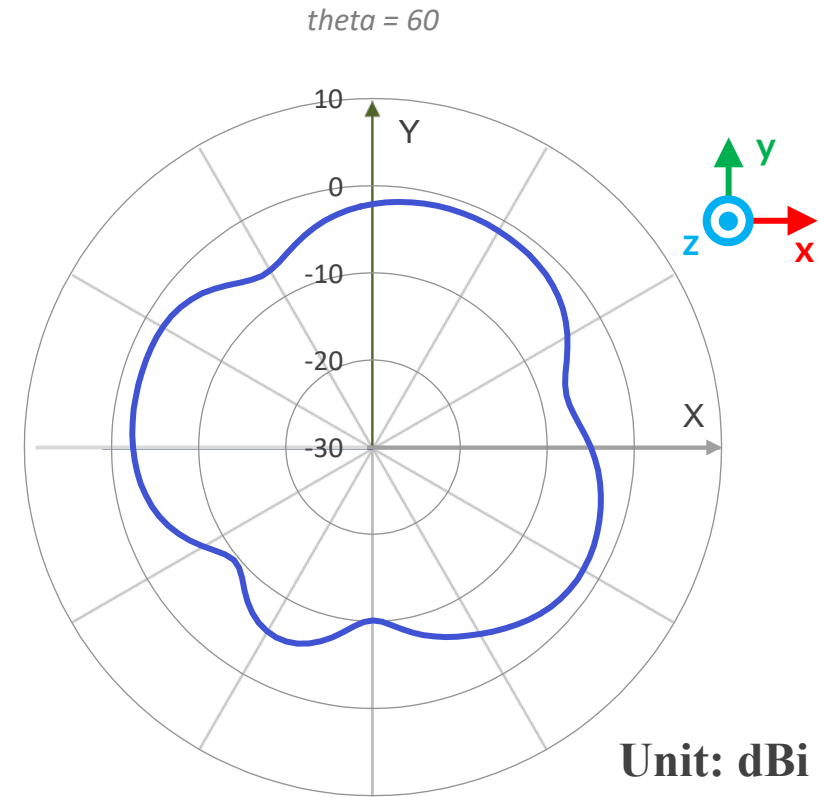
Omni Beam @2440MHz for G_{total}



— Omni



— Omni



— Omni