

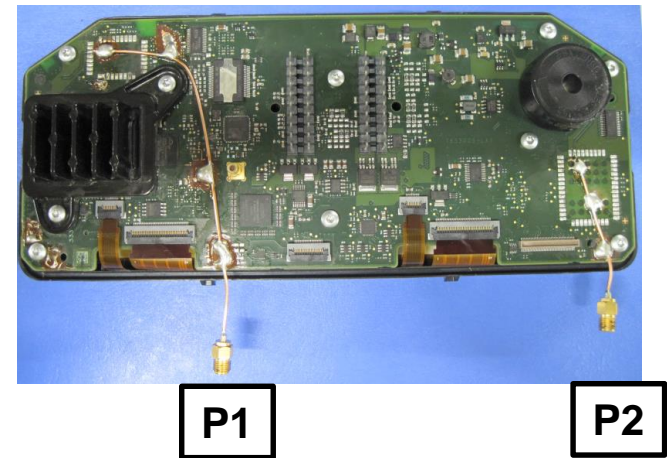
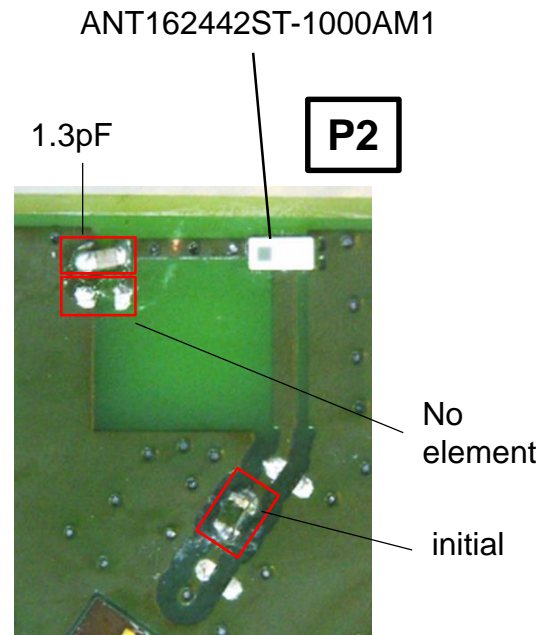
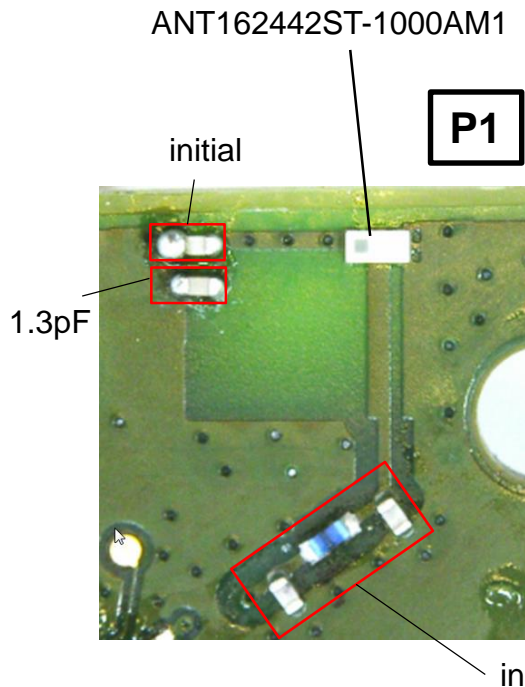
# TDK Antenna Measurement

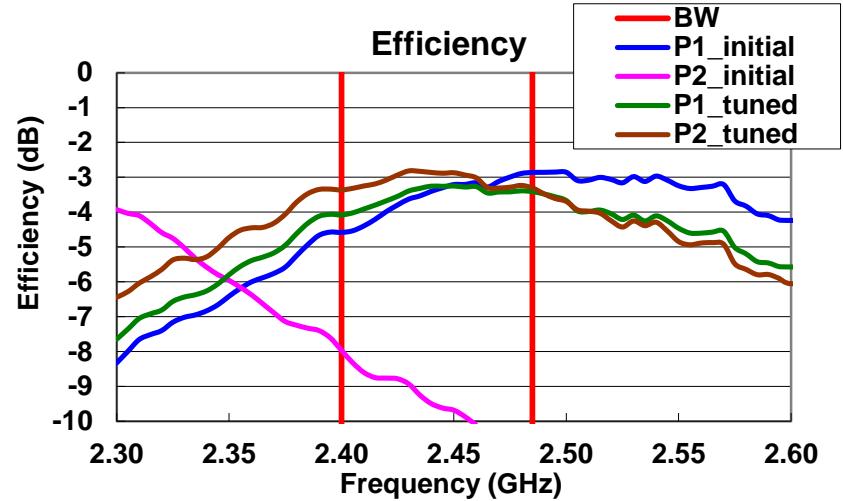
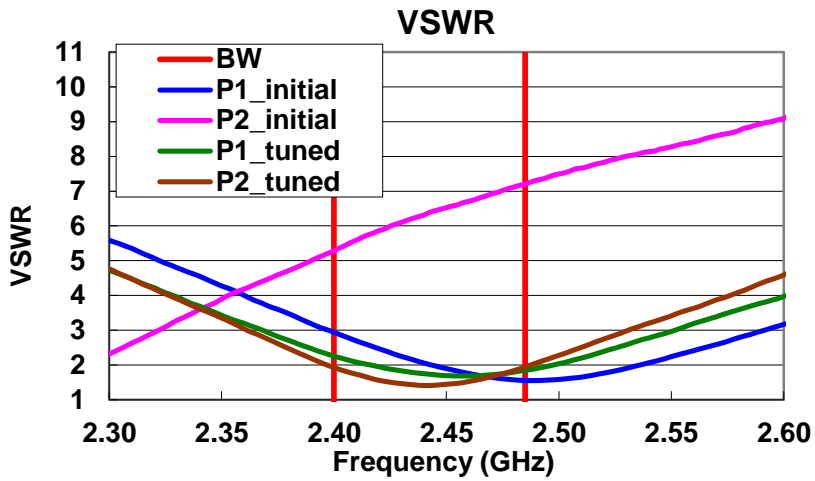
TDK Corporation  
Communication Devices Business Group  
Nov. 1, 2017

# Measurement Setup & Element Value

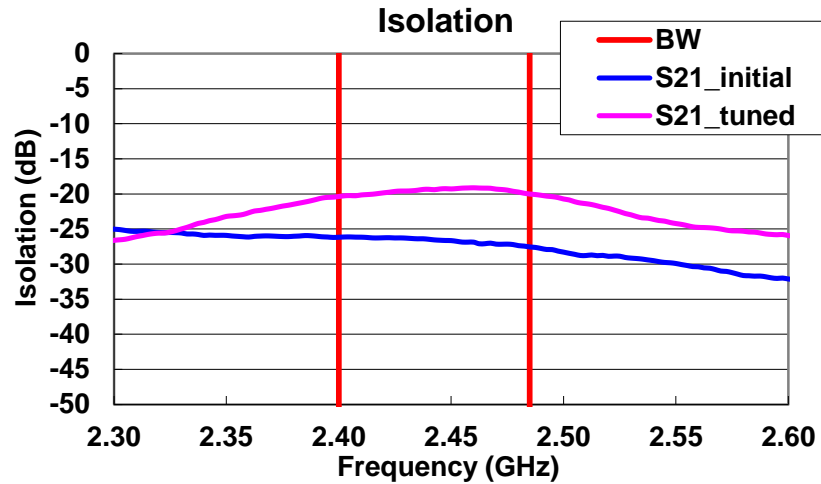


## Element Value

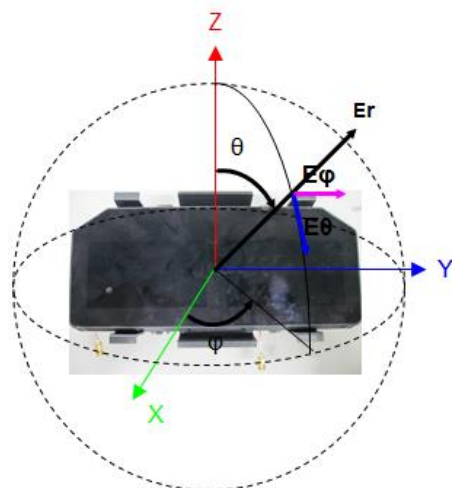




Frequency[GHz]	P1_initial			P2_initial			P1_tuned			P2_tuned		
	2.4	2.442	2.485	2.4	2.442	2.485	2.4	2.442	2.485	2.4	2.442	2.485
VSWR	2.94	2.05	1.55	5.28	6.31	7.20	2.25	1.75	1.85	1.92	1.41	1.94
Efficiency[dB]	-4.58	-3.40	-2.86	-7.96	-9.49	-10.57	-4.08	-3.25	-3.41	-3.36	-2.86	-3.31



Frequency[GHz]	S21_initial			S21_tuned		
	2.4	2.44	2.49	2.4	2.44	2.49
Isolation[dB]	-26.17	-26.46	-27.56	-20.37	-19.34	-20.02



P1 - Initial

x-Direction hemisphere AVG Gain

Frequency(GHz)	2.4	2.442	2.485
Z-X cut	-3.7	-2.4	-1.5
X-Y cut	-5.3	-4.1	-3.9
Total	-4.5	-3.3	-2.7

P2 - Initial

x-Direction hemisphere AVG Gain

Frequency(GHz)	2.4	2.442	2.485
Z-X cut	-8.3	-9.6	-10.5
X-Y cut	-6.2	-7.7	-9.2
Total	-7.2	-8.7	-9.8

P1-tuned

x-Direction hemisphere AVG Gain

Frequency(GHz)	2.4	2.442	2.485
Z-X cut	-3.2	-2.3	-2.1
X-Y cut	-5.5	-4.4	-4.4
Total	-4.3	-3.4	-3.3

P2-tuned

x-Direction hemisphere AVG Gain

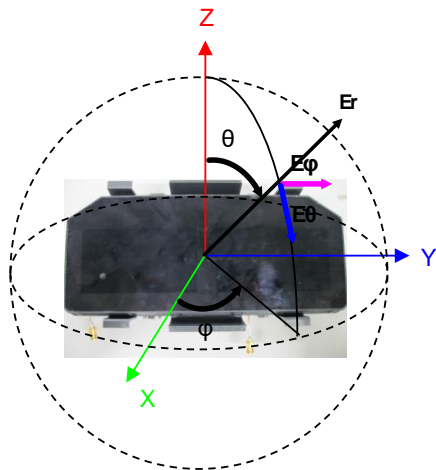
Frequency(GHz)	2.4	2.442	2.485
Z-X cut	-3.3	-2.5	-2.7
X-Y cut	-1.6	-1.1	-1.5
Total	-2.4	-1.8	-2.1

- We measured before & after tuning.
- Please see page 2 to know element value after tuning.

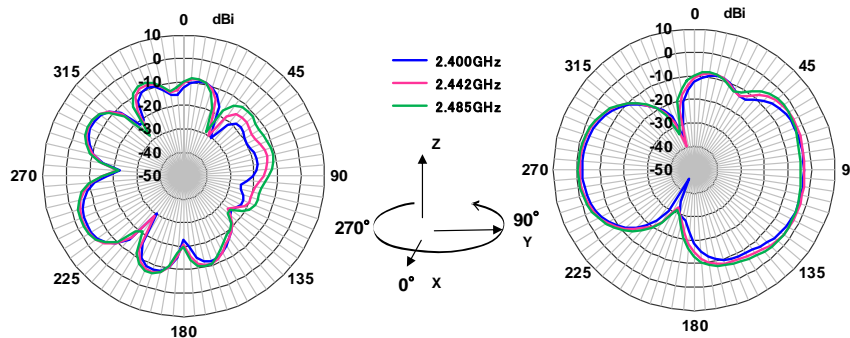
# Radiation Pattern

# Radiation Pattern (2.4GHz Band)

**P1\_initial**



XY plane



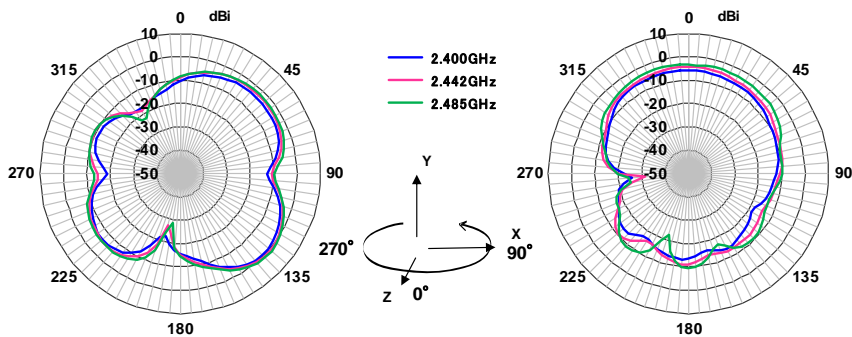
**Horizontal Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-10.9	-9.8	-9.2
Maximum[dBi]	-3.8	-2.7	-2.2
Minimum[dBi]	-30.3	-30.0	-29.1

**Vertical Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-6.5	-5.4	-5.3
Maximum[dBi]	-2.4	-1.2	-0.6
Minimum[dBi]	-45.5	-39.5	-33.7

XZ plane



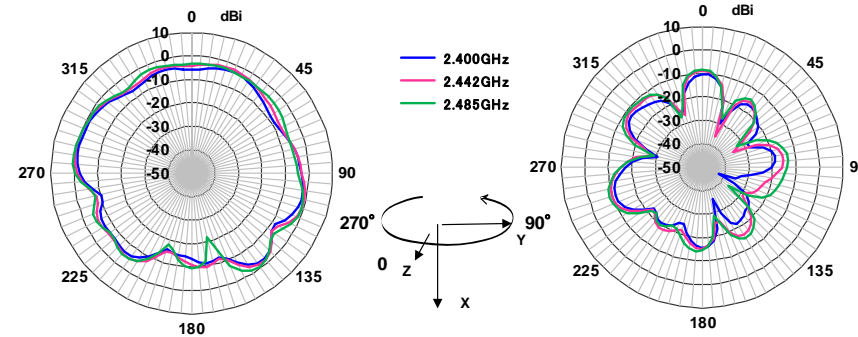
**Horizontal Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-6.9	-5.7	-5.2
Maximum[dBi]	-0.4	0.8	1.3
Minimum[dBi]	-22.3	-27.1	-28.6

**Vertical Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-10.13	-8.66	-7.31
Maximum[dBi]	-5.73	-4.19	-3.03
Minimum[dBi]	-25.79	-31.36	-25.13

YZ plane



**Horizontal Polarization**

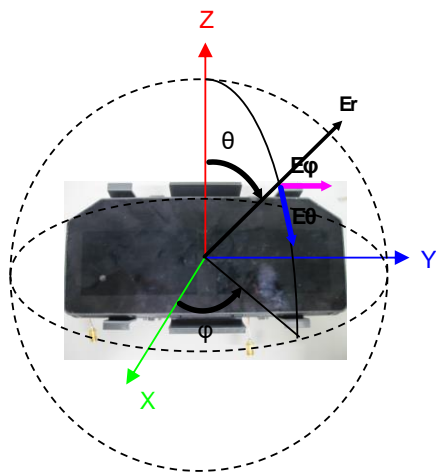
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-5.0	-3.9	-3.6
Maximum[dBi]	-0.7	0.5	1.0
Minimum[dBi]	-15.8	-15.1	-22.1

**Vertical Polarization**

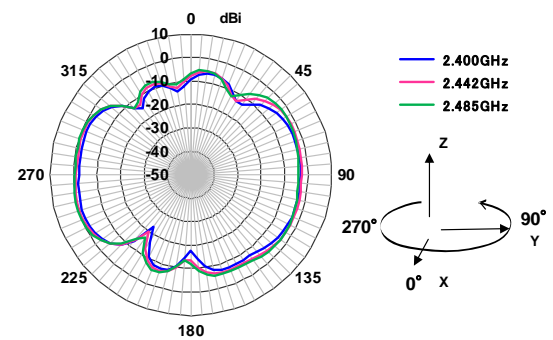
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-17.1	-15.4	-14.4
Maximum[dBi]	-10.3	-8.7	-8.3
Minimum[dBi]	-42.2	-35.7	-36.3

# Total Power (2.4GHz Band)

P1\_initial



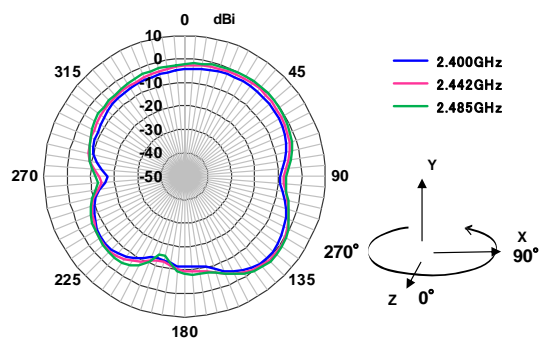
XY plane



**Total power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-5.2	-4.1	-3.8
Maximum(dBi)	-1.2	0.0	0.5
Minimum(dBi)	-22.4	-19.8	-17.0

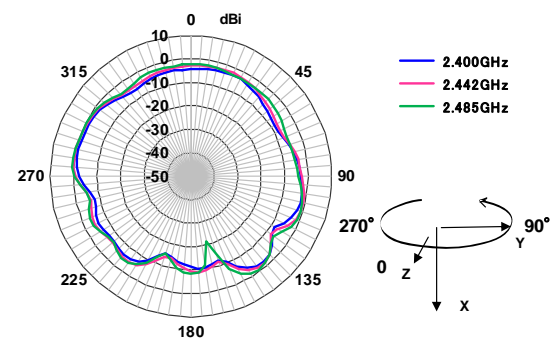
XZ plane



**Total Power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-5.2	-3.9	-3.1
Maximum(dBi)	-0.3	1.0	1.6
Minimum(dBi)	-17.4	-14.5	-15.3

YZ plane

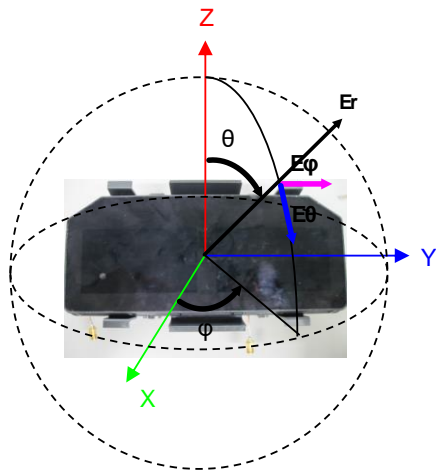


**Total power**

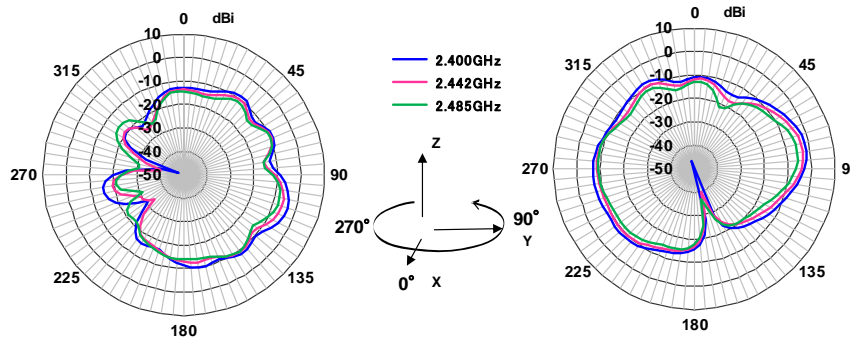
Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-4.7	-3.6	-3.2
Maximum(dBi)	-0.7	0.5	1.0
Minimum(dBi)	-15.3	-14.0	-21.3

# Radiation Pattern (2.4GHz Band)

P2\_initial



## XY plane



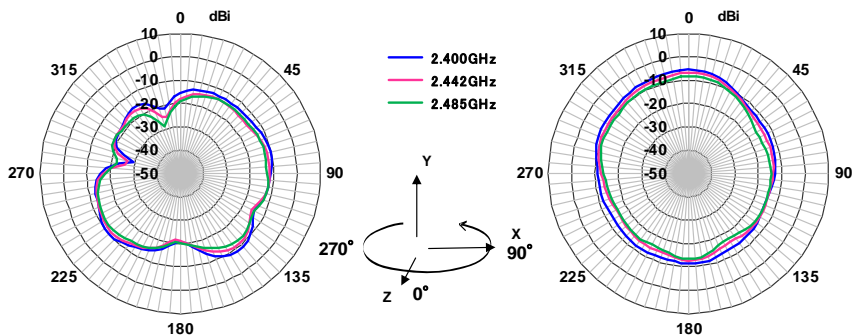
Horizontal Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-11.0	-12.8	-13.7
Maximum[dBi]	-3.6	-6.0	-7.9
Minimum[dBi]	-47.5	-40.0	-31.1

Vertical Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-8.4	-10.0	-11.7
Maximum[dBi]	-1.6	-3.1	-5.4
Minimum[dBi]	-53.3	-39.7	-36.9

## XZ plane



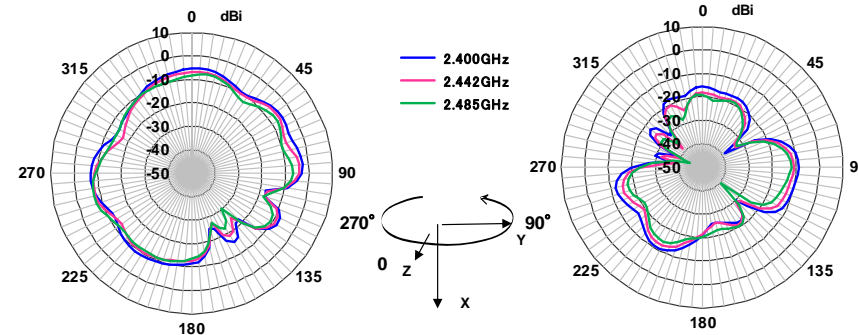
Horizontal Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-13.1	-14.4	-15.0
Maximum[dBi]	-8.7	-10.6	-12.0
Minimum[dBi]	-29.3	-27.0	-28.6

Vertical Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-9.88	-11.29	-12.46
Maximum[dBi]	-5.46	-6.69	-8.04
Minimum[dBi]	-14.64	-15.78	-17.48

## YZ plane



Horizontal Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-8.2	-9.5	-10.5
Maximum[dBi]	-2.4	-4.1	-6.7
Minimum[dBi]	-25.3	-27.1	-30.4

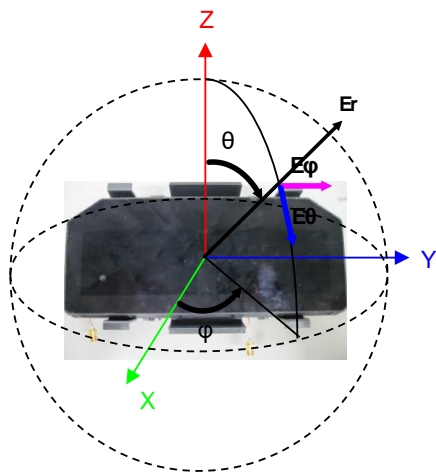
Vertical Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-15.2	-17.4	-18.9
Maximum[dBi]	-8.7	-10.8	-12.0
Minimum[dBi]	-38.7	-40.4	-44.4

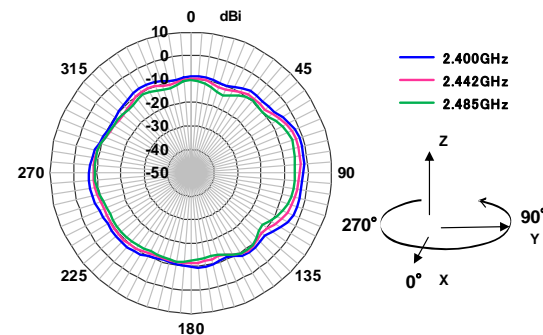


# Total Power (2.4GHz Band)

P2\_initial



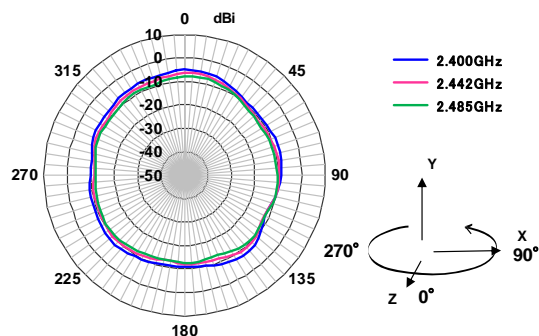
XY plane



**Total power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-6.5	-8.2	-9.6
Maximum(dBi)	-1.2	-2.7	-4.7
Minimum(dBi)	-11.1	-12.6	-14.1

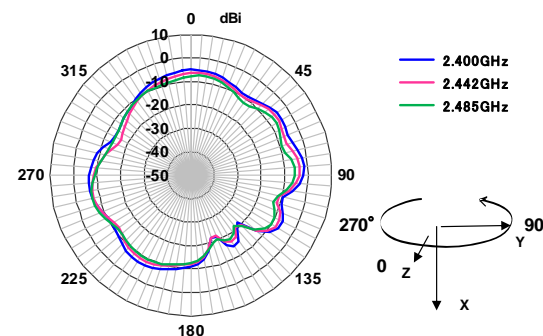
XZ plane



**Total Power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-8.2	-9.6	-10.5
Maximum(dBi)	-5.0	-6.3	-7.6
Minimum(dBi)	-11.5	-12.8	-13.2

YZ plane

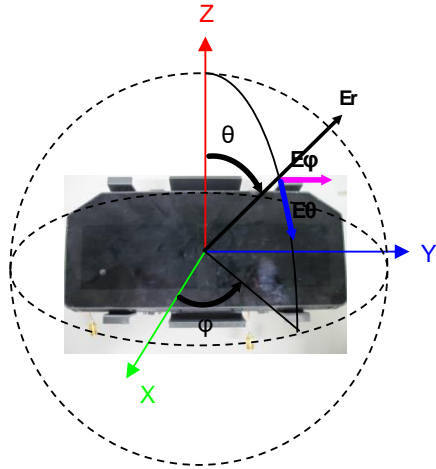


**Total power**

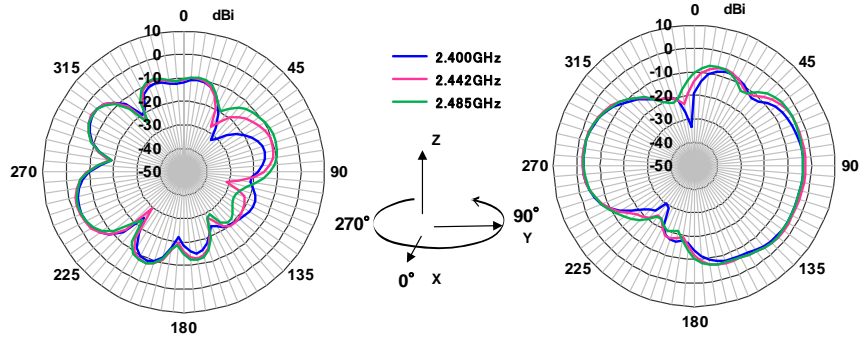
Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-7.4	-8.9	-9.9
Maximum(dBi)	-1.6	-3.3	-5.5
Minimum(dBi)	-22.0	-22.2	-21.7

# Radiation Pattern (2.4GHz Band)

**P1\_tuned**



XY plane



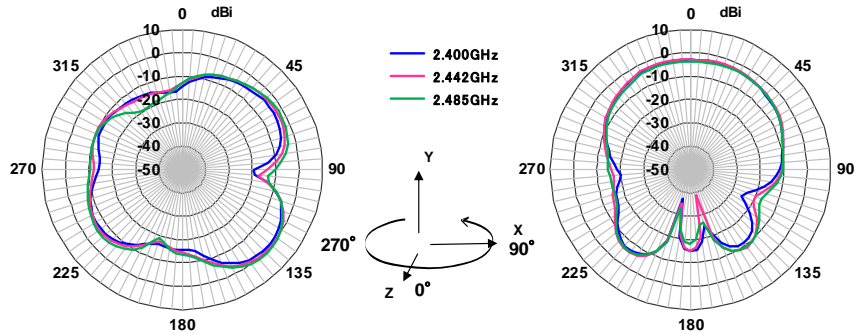
**Horizontal Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-10.5	-9.6	-9.6
Maximum[dBi]	-3.0	-2.4	-2.7
Minimum[dBi]	-32.0	-31.0	-28.9

**Vertical Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-6.8	-5.9	-6.2
Maximum[dBi]	-2.6	-2.3	-2.6
Minimum[dBi]	-33.2	-23.9	-23.7

XZ plane



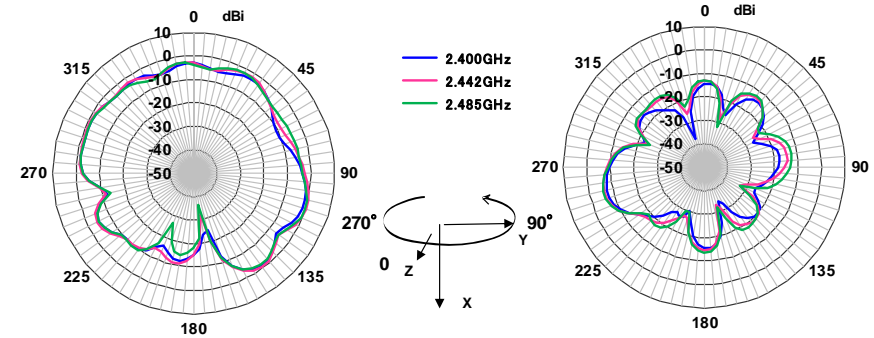
**Horizontal Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-7.3	-6.2	-5.8
Maximum[dBi]	-0.7	0.5	0.9
Minimum[dBi]	-19.3	-17.7	-19.6

**Vertical Polarization**

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-7.46	-7.02	-7.64
Maximum[dBi]	-2.77	-2.57	-3.30
Minimum[dBi]	-37.12	-38.78	-33.06

YZ plane



**Horizontal Polarization**

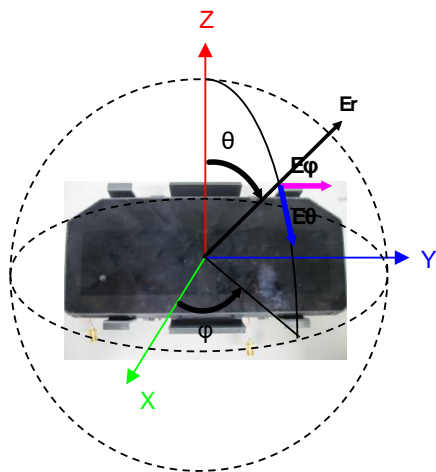
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-4.6	-3.9	-4.3
Maximum[dBi]	-1.1	0.3	-0.1
Minimum[dBi]	-24.9	-32.1	-36.1

**Vertical Polarization**

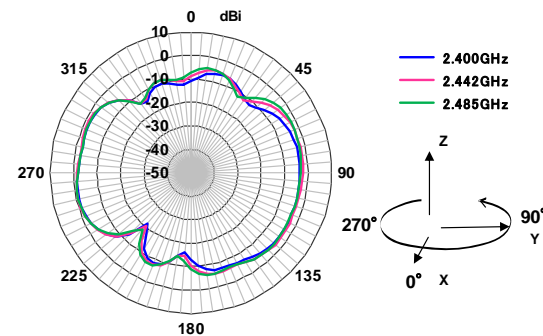
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-15.9	-14.6	-14.1
Maximum[dBi]	-7.4	-6.2	-6.0
Minimum[dBi]	-37.5	-33.2	-32.9

# Total Power (2.4GHz Band)

P1\_tuned



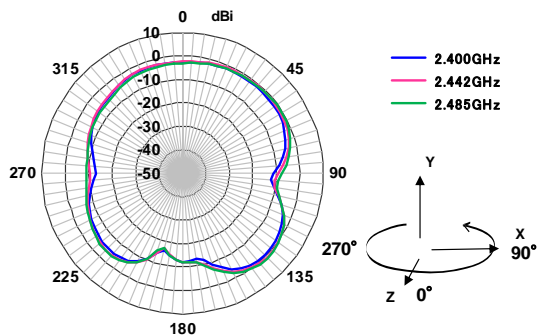
XY plane



Total power

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-5.3	-4.4	-4.5
Maximum(dBi)	-1.0	-0.5	-0.7
Minimum(dBi)	-21.4	-20.4	-18.1

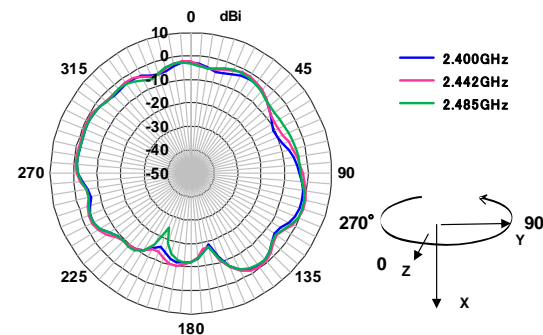
XZ plane



Total Power

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-4.4	-3.6	-3.6
Maximum(dBi)	-0.5	0.8	1.2
Minimum(dBi)	-16.1	-17.1	-17.4

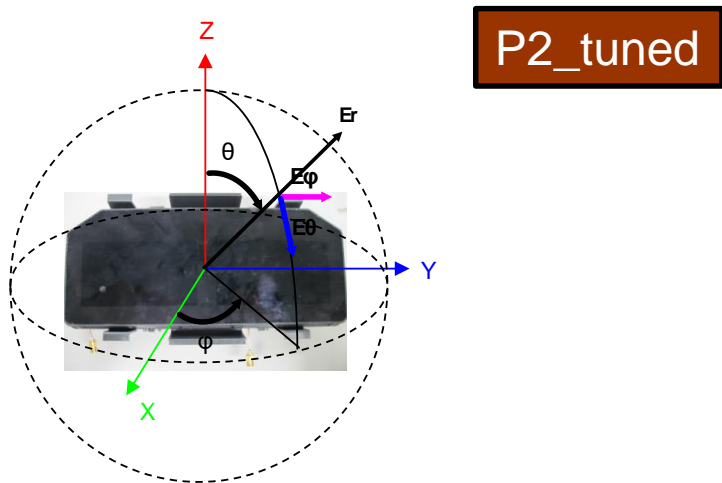
YZ plane



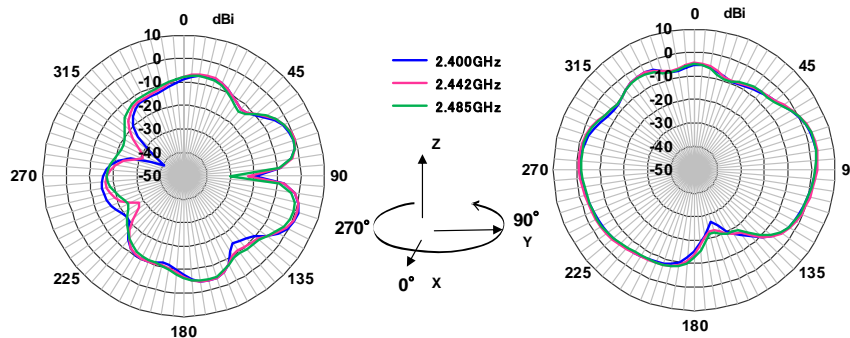
Total power

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-4.3	-3.5	-3.9
Maximum(dBi)	-1.0	0.3	-0.1
Minimum(dBi)	-18.7	-17.9	-25.0

# Radiation Pattern (2.4GHz Band)



XY plane



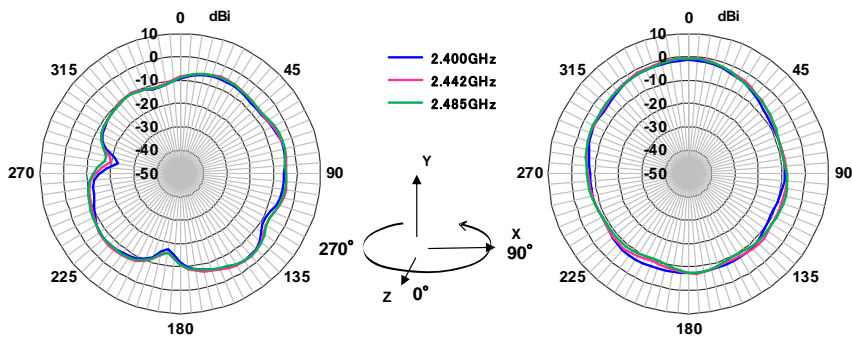
Horizontal Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-7.2	-6.9	-7.4
Maximum[dBi]	1.2	0.9	-0.5
Minimum[dBi]	-40.7	-31.0	-30.3

Vertical Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-3.6	-3.0	-3.6
Maximum[dBi]	2.6	3.1	2.6
Minimum[dBi]	-26.8	-23.1	-22.0

XZ plane



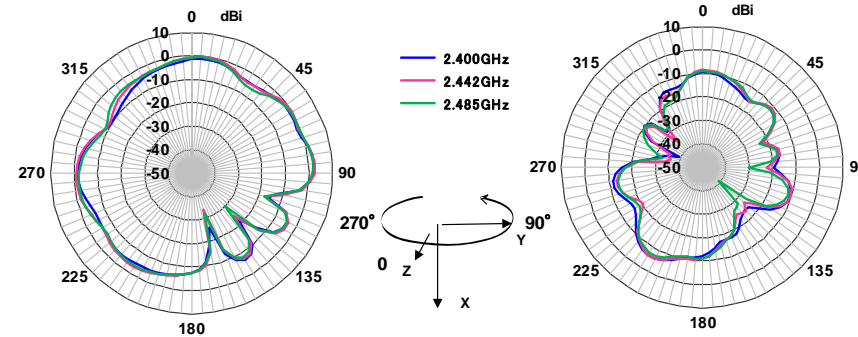
Horizontal Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-7.8	-7.1	-7.3
Maximum[dBi]	-3.7	-3.4	-3.5
Minimum[dBi]	-23.0	-19.9	-17.4

Vertical Polarization

Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-5.74	-5.20	-5.45
Maximum[dBi]	-1.42	-0.49	-0.58
Minimum[dBi]	-10.46	-9.22	-10.54

YZ plane



Horizontal Polarization

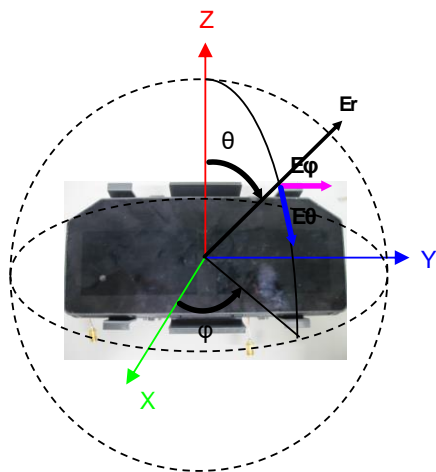
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-3.6	-3.0	-3.4
Maximum[dBi]	2.3	2.7	2.1
Minimum[dBi]	-25.8	-33.5	-31.9

Vertical Polarization

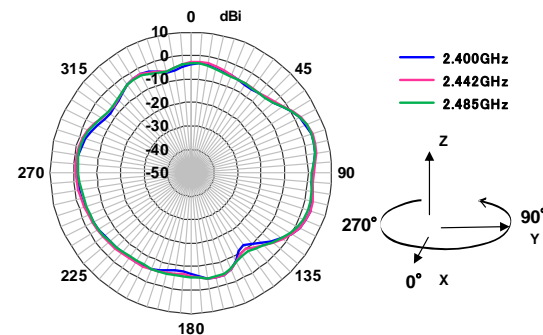
Frequency(GHz)	2.4	2.442	2.485
Average[dBi]	-13.0	-13.1	-13.7
Maximum[dBi]	-6.1	-6.3	-7.2
Minimum[dBi]	-39.2	-36.4	-40.7

# Total Power (2.4GHz Band)

P2\_tuned



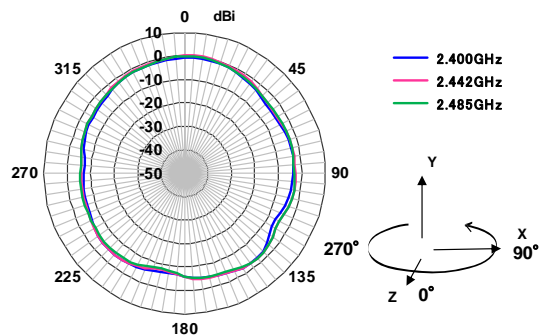
XY plane



**Total power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-2.0	-1.5	-2.1
Maximum(dBi)	4.0	4.5	4.1
Minimum(dBi)	-12.0	-9.9	-8.8

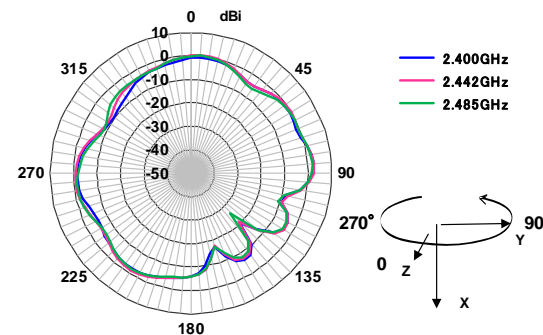
XZ plane



**Total Power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-3.7	-3.0	-3.3
Maximum(dBi)	-0.7	0.2	0.1
Minimum(dBi)	-7.3	-7.7	-8.5

YZ plane



**Total power**

Frequency(GHz)	2.4	2.442	2.485
Average(dBi)	-3.2	-2.6	-3.0
Maximum(dBi)	2.4	2.8	2.2
Minimum(dBi)	-20.2	-21.1	-26.1

