TAOGLAS

Datasheet

Synergy 8 in 1 Antenna

Part No:
MA1508.AK.001

Description:

Synergy 8-in-1 Combination antenna with 1*Active GNSS, 4*5G/4G MIMO and 3*Wi-Fi MIMO

Features:

4 x 5G/4G MIMO Antenna

3 x Wi-Fi 2.4GHz/5.8GHz MIMO Antenna

1 x GPS/GLONASS/BeiDou Antenna Front End GNSS SAW Filter

IP67 Rated Waterproof Enclosure

High Efficiency/Peak Gain Outdoor Antenna

Dimensions: Ø161*55mm

Cable: 300mm RG-174 with 4700mm TGC-200

Connectors: SMA(M) for GNSS and 5G/4G / RP-SMA(M) for Wi-Fi

RoHS & REACH Compliant

1.	Introduction	3
2.	Specifications	4
3.	Active Antenna Characteristics	10
4.	Antenna Characteristics	16
5.	Radiation Patterns	24
6.	Mechanical Drawing	71
7.	Installation Guidelines	72
8.	Packaging	74
	Changelog	75

1. Introduction

The Taoglas Synergy MA1508 is a 8-in-1 next-generation permanent mount antenna for vehicle roof applications. It has a fully IP67 rated waterproof robust PC enclosure and base. The 9 antennas inside support 5G/4G, GPS/GLONASS/BeiDou, Wi-Fi (2.4GHz/5GHz). This outstanding patent-pending antenna delivers powerful MIMO antenna technology for 5G/4G, Wi-Fi 2.4/5.8GHz 802.11n and the emerging 802.11ac, and an optimized GPS/GLONASS/BeiDou patch antenna for location. The 5G/4G antennas also include backward compatibility to work at most worldwide 2G and 3G bands.

Typical Applications:
– Next Generation OEM Automotive Connectivity
– Multimedia, Navigation and Telematics Systems
– V2V, V2X and Fleet Management Applications
– Real-time HD Video Streaming
– First Net Responder Routers

The MA1508 is ideal for applications that require highly sophisticated antennas for real-time streaming applications that demand high-speed video uplink and downlink into the cabin of the vehicle. These challenges are resolved by the highly efficient, high gain MIMO antennas, with high isolation, all of which is necessary to achieve the required signal to noise ratio and throughput.

The MA1508 can also be customized for your particular wireless application and frequency band, subject to NRE and MOQ. There are 8x 300mm RG-174 cables, terminating in SMA(M) connectors for 5G/4G MIMO 4X4, and RP SMA(M) for Wi-Fi MIMO 3X3. There is a 300mm RG-174 cable for GNSS terminating in an SMA(M) connector.

All cable lengths and connector types are customizable. The Synergy MA1508 can be supplied with low loss TGC-200 cable extensions for longer cable runs. Contact your regional Taoglas customer services team for details and support.

2. Specifications

GNSS Frequency Bands Covered							
GPS/QZSS	L1 1575.42MHz	L2 1227.6MHz	L5 1176.45MHz	L6 1278.75MHz			
	■	□	□	□			
GLONASS	L5R 1176.45MHz	L3PT 1201.5MHz	L2PT 1246MHz	L1CR 1575.42MHz	L1PT 1602MHz		
	□	□	□	■	■		
Galileo	E5a 1176.45MHz	E5b 1201.5MHz	E4 1215MHz	E3 1256MHz	E6 1278.75MHz	E2 1561MHz	L1 1575.42MHz
	□	□	□	□	□	■	■
BeiDou	B1 1561MHz	B2 1207.14MHz	B3 1268.52MHz				
	■	□	□				
Compass	E5B(B2)/ E6(B3) 1268.56MHz	E2(B1) 1561MHz					
	□	■					
SBAS	Omnistar 1542.5MHz	WAAS/EGN OS 1575.42MHz					
	□	■					

GNSS Electrical			
Frequency (MHz)	**1561**	**1575.42**	**1602**
VSWR (max.)	2.5	2.5	2.5
Passive Antenna Efficiency (%) (Without cable loss)	40.02	48.39	44.29
Passive Antenna Gain at Zenith (dBic) (Without cable loss)	3.75	4.44	4.54
Axial Ratio (dB)	20	11	15
Polarization	RHCP		
Impedance	50Ω		
Cable	RG-174		
Connector	SMA(M)		

LNA and Filter Electrical Properties			
Frequency (MHz)	**1561**	**1575.42**	**1602**
VSWR (max.)	2.0:1	2.0:1	2.0:1
Gain@1.8V (dBic)	28.8 dB	28.8 dB	28 dB
Gain@3.0V (dBic)	29 dB	29 dB	28.3 dB
Gain@5.5V (dBic)	29.6 dB	29.4 dB	28.7 dB
Noise@1.8V (dB)	2.8 dB	2.3 dB	2.8 dB
Noise@3.0V (dB)	2.8 dB	2.2 dB	2.8 dB
Noise@5.5V (dB)	2.9 dB	2.3 dB	2.8 dB
Power consumption@1.8V (mA)	8.7 mA		
Power consumption@3.0V (mA)	9.0 mA		
Power consumption@5.5V (mA)	11 mA		
Total Specification (Through Antenna, SAW Filter and LNA)			
Frequency (MHz)	**1561**	**1575.42**	**1602**
Gain@3V (dBic)	31.7 ± 3	32.4 ± 3	32.4 ± 3
Output Impedance	50Ω		

5G/4G Antenna											
Frequency (MHz)		5G NR Band 71	LTE700	GSM 850/900	5G NR Band	DCS	PCS	UMTS1	LTE2600	5G NR Band 77, 78, 79	LTE5200/ Wi-Fi 5800
		617 ~698	698 ~824	824 ~960	1427 ~1518	1710 ~1880	1850 ~1990	1920 ~2170	2300 ~2690	3300 ~3800	5150 ~5925
Efficiency (%)											
MIMO 1	5m	30.79	30.39	34.96	39.48	46.48	32.68	32.15	43.45	49.25	49.39
MIMO 2	5m	18.62	31.96	30.24	43.80	42.07	37.06	38.94	44.95	31.36	44.49
MIMO 3	5m	30.07	30.40	32.11	47.07	42.70	34.09	33.14	41.63	49.49	20.60
MIMO 4	5m	21.05	30.90	32.56	38.32	42.80	39.73	38.88	43.70	29.88	48.09
Average Gain (dB)											
MIMO 1	5m	-5.12	-5.17	-4.56	-4.04	-3.33	-4.86	-4.93	-3.62	-3.08	-3.06
MIMO 2	5m	-7.30	-4.95	-5.19	-3.59	-3.76	-4.31	-4.10	-3.47	-5.04	-3.52
MIMO 3	5m	-5.22	-5.17	-4.93	-3.27	-3.70	-4.67	-4.80	-3.81	-3.06	-6.86
MIMO 4	5m	-6.77	-5.10	-4.87	-4.17	-3.69	-4.01	-4.10	-3.59	-5.25	-3.18
Peak Gain (dBi)											
MIMO 1	5m	-0.08	1.04	2.03	2.94	4.55	2.93	3.20	4.96	5.82	5.90
MIMO 2	5m	-0.58	0.49	1.42	3.76	3.31	2.32	3.75	4.84	3.77	5.89
MIMO 3	5m	0.25	1.44	1.63	3.47	3.77	2.45	3.00	5.06	5.99	5.57
MIMO 4	5m	-0.20	1.13	2.93	2.52	3.61	2.79	3.97	4.76	2.91	6.28
Impedance		50 Ω									
Polarization		Linear									
Radiation Pattern		Omni									
Max. input power		2W									

Wi-Fi MIMO			
Frequency (MHz)		**2400~2500**	**5150~5850**
Efficiency (%)			
MIMO 1	5m	33.16	42.72
MIMO 2	5m	47.59	47.92
MIMO 3	5m	35.95	35.76
Average Gain (dB)			
MIMO 1	5m	-4.79	-3.69
MIMO 2	5m	-3.22	-3.19
MIMO 3	5m	-4.44	-4.47
Peak Gain (dBi)			
MIMO 1	5m	2.11	5.78
MIMO 2	5m	3.12	7.03
MIMO 3	5m	2.16	5.30
Impedance		50 Ω	
Polarization		Linear	
Radiation Pattern		Omni	
Max. input power		2W	

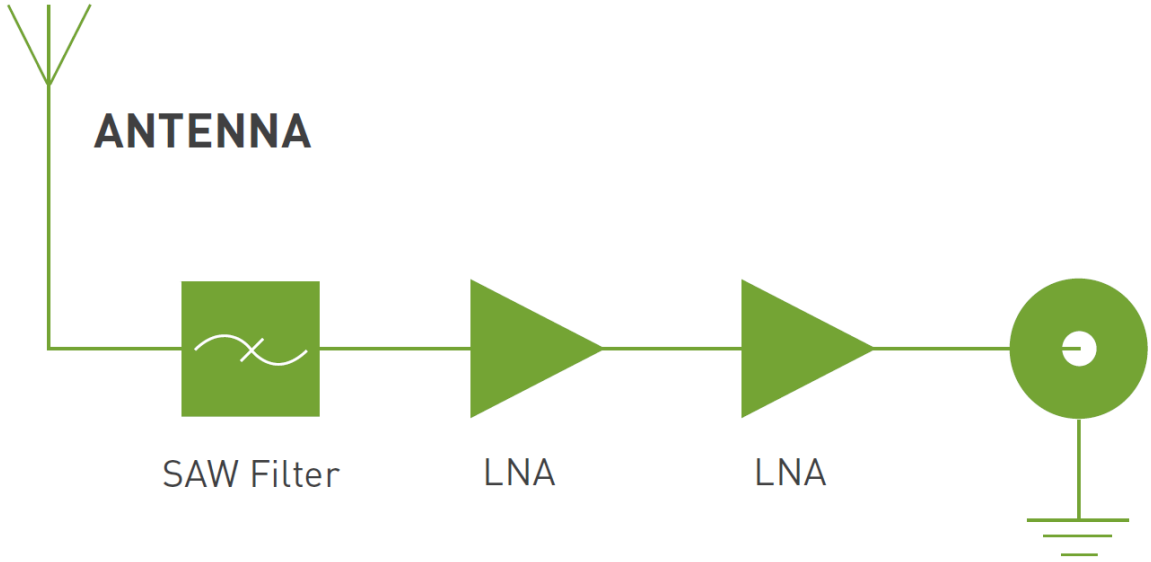
Mechanical	
Height	57.47mm
Planner Dimension	Ø160mm
Casing	PC
Cable	0.3m RG-174 with 4.7m TGC-200 for 5G/4G – Fully Customizable 0.3m RG-174 with 4.7m TGC-200 for Wi-Fi – Fully Customizable 0.3m RG174 with 4.7m TGC-200 for GNSS – Fully Customizable
Connector	5G/4G: SMA-Plug – Fully Customizable Wi-Fi: RP-SMA-Plug – Fully Customizable GNSS: SMA-Plug – Fully Customizable
Thread	18.23mm
Thread Diameter	M22
Sealant	Rubber Stopper and O-Ring
Weight	2.5Kg
Environmental	
Ingress Protection	IP67
Temperature Range	-40°C to 85°C
Humidity	Non-condensing 65°C 95% RH
Cable Pull	RG-174 4 Kg

5G/4G Bands			
Band Number	5GNR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA		
	Uplink	**Downlink**	**Covered**
1	UL: 1920 to 1980	DL: 2110 to 2170	✓
2	UL: 1850 to 1910	DL: 1930 to 1990	✓
3	UL: 1710 to 1785	DL: 1805 to 1880	✓
4	UL: 1710 to 1755	DL: 2110 to 2155	✓
5	UL: 824 to 849	DL: 869 to 894	✓
7	UL: 2500 to 2570	DL:2620 to 2690	✓
8	UL: 880 to 915	DL: 925 to 960	✓
9	UL: 1749.9 to 1784.9	DL: 1844.9 to 1879.9	✓
11	UL: 1427.9 to 1447.9	DL: 1475.9 to 1495.9	✓
12	UL: 699 to 716	DL: 729 to 746	✓
13	UL: 777 to 787	DL: 746 to 756	✓
14	UL: 788 to 798	DL: 758 to 768	✓
17	UL: 704 to 716	DL: 734 to 746 (LTE only)	✓
18	UL: 815 to 830	DL: 860 to 875 (LTE only)	✓
19	UL: 830 to 845	DL: 875 to 890	✓
20	UL: 832 to 862	DL: 791 to 821	✓
21	UL: 1447.9 to 1462.9	DL: 1495.9 to 1510.9	✓
22	UL: 3410 to 3490	DL: 3510 to 3590	✓
23	UL:2000 to 2020	DL: 2180 to 2200 (LTE only)	✓
24	UL:1625.5 to 1660.5	DL: 1525 to 1559 (LTE only)	✓
25	UL: 1850 to 1915	DL: 1930 to 1995	✓
26	UL: 814 to 849	DL: 859 to 894	✓
27	UL: 807 to 824	DL: 852 to 869 (LTE only)	✓
28	UL: 703 to 748	DL: 758 to 803 (LTE only)	✓
29	UL: -	DL: 717 to 728 (LTE only)	✓
30	UL: 2305 to 2315	DL: 2350 to 2360 (LTE only)	✓
31	UL: 452.5 to 457.5	DL: 462.5 to 467.5 (LTE only)	✗
32	UL: -	DL: 1452 - 1496	✓
35	1850 to 1910		✓
38	2570 to 2620		✓
39	1880 to 1920		✓
40	2300 to 2400		✓
41	2496 to 2690		✓
42	3400 to 3600		✓
43	3600 to 3800		✓
48	3550 to 3700		✓
66	UL: 1710-1780	DL: 2110-2200	✓
71	617 to 698		✓
74/75/76	1427 to 1518		✓
78	3300 to 3800		✓
79	4400 to 5000		✓

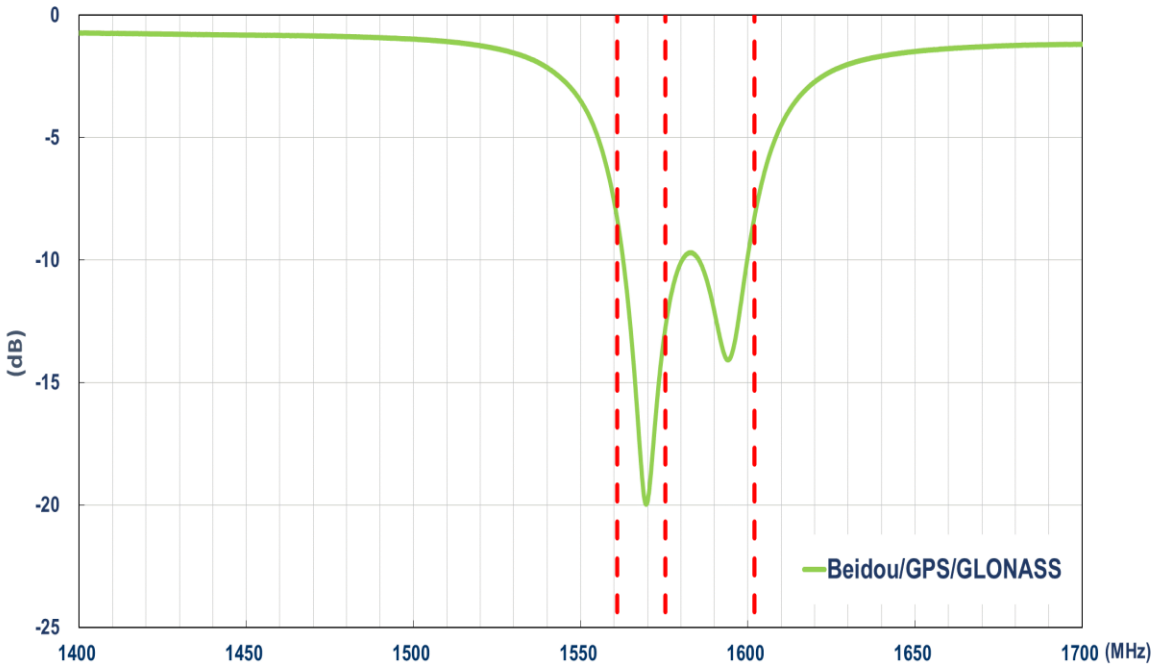
* Covered Bands represent greater than 20% efficiency

3. Active Antenna Characteristics

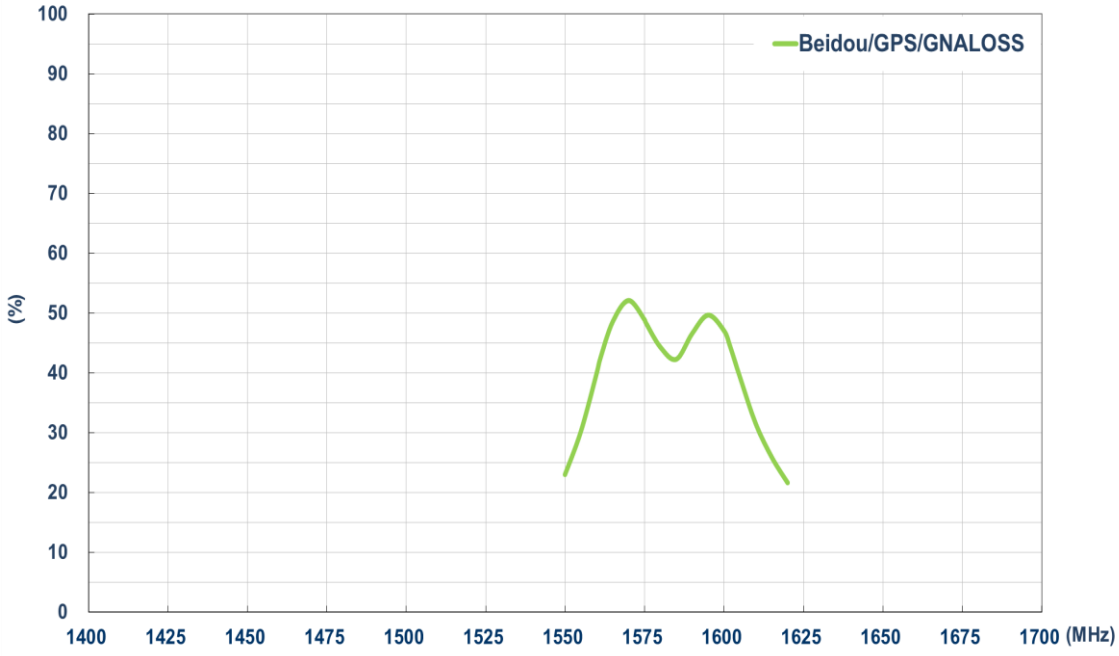
3.1 Block Diagram (Active antenna)



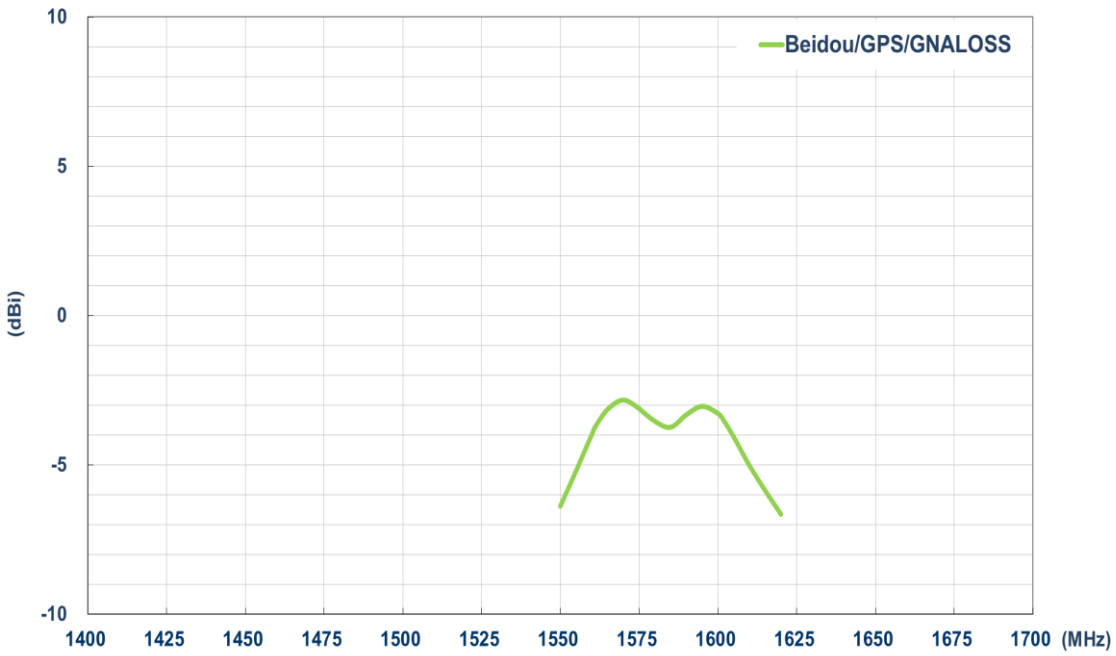
3.2 Passive Antenna Return Loss



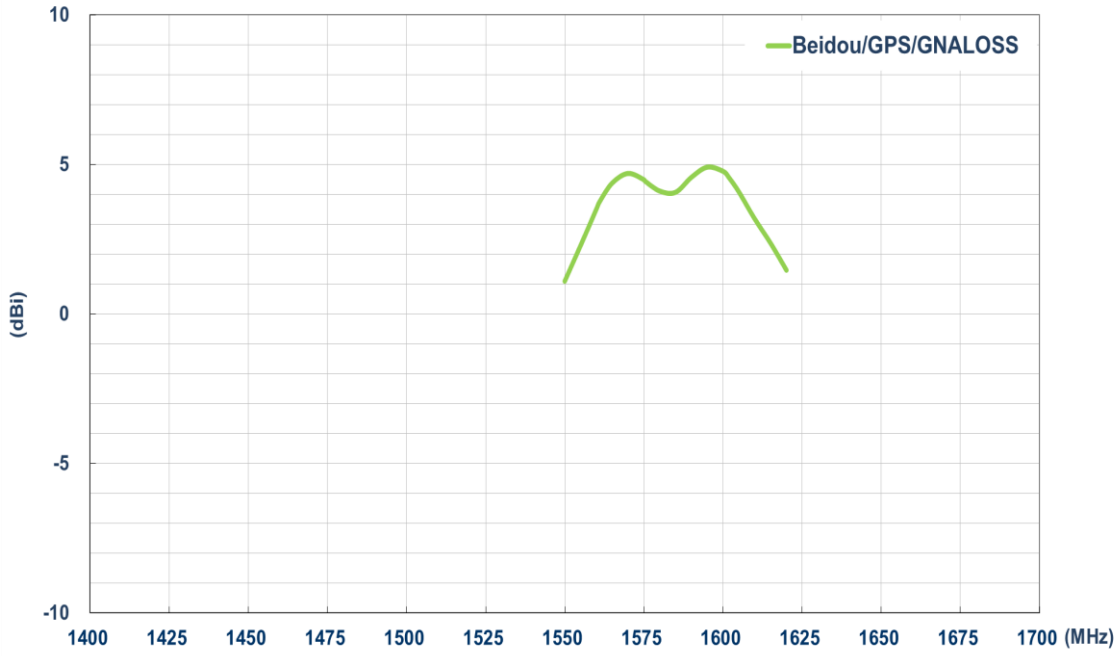
3.3 Passive Antenna Efficiency



3.4 Passive Antenna Average Gain

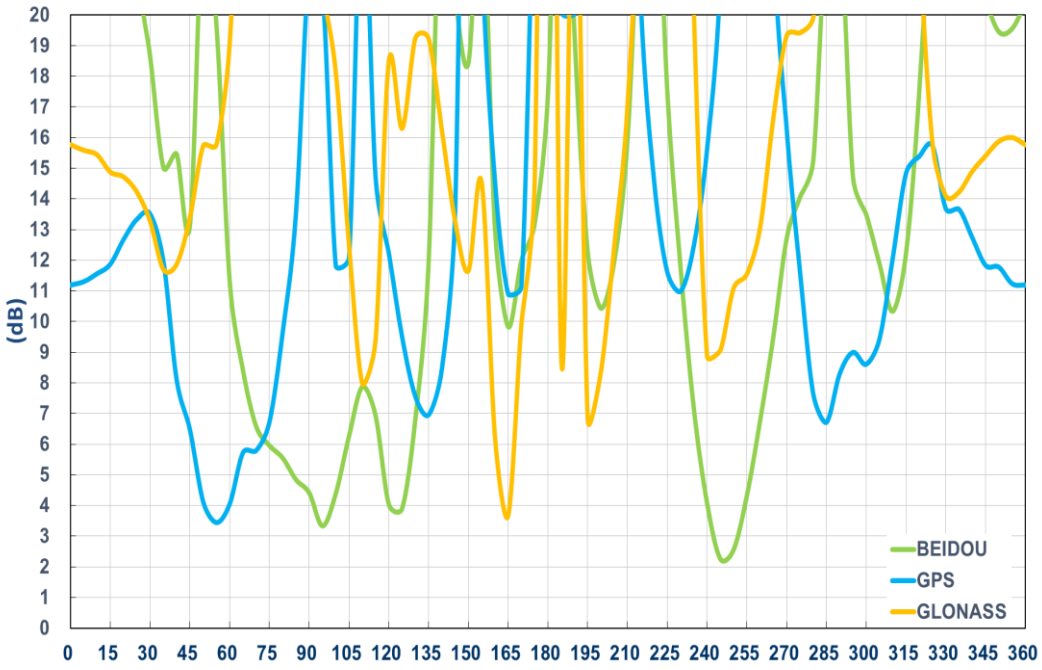


3.5 Passive Antenna Peak Gain

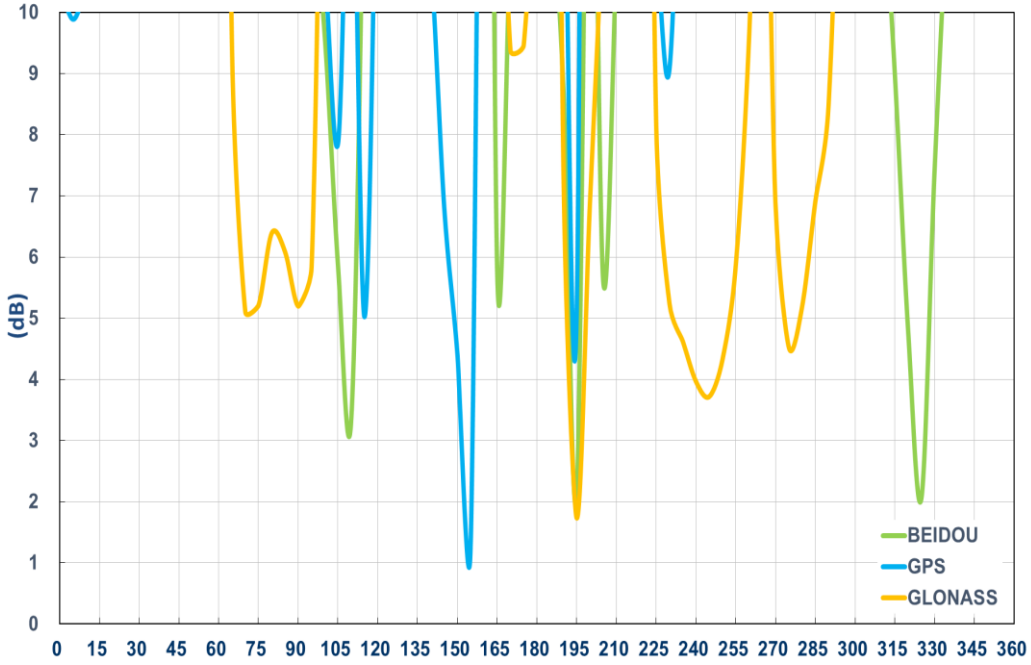


3.6 Passive Antenna Axial Ratio (Zenith is at 0°)

XZ-plane

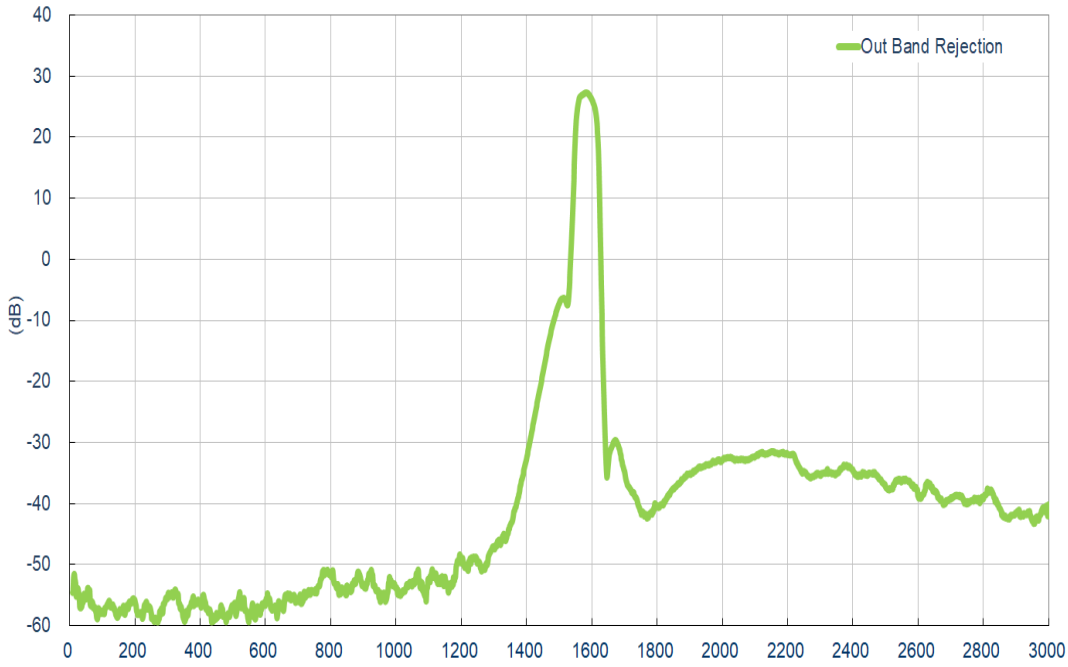


YZ-plane

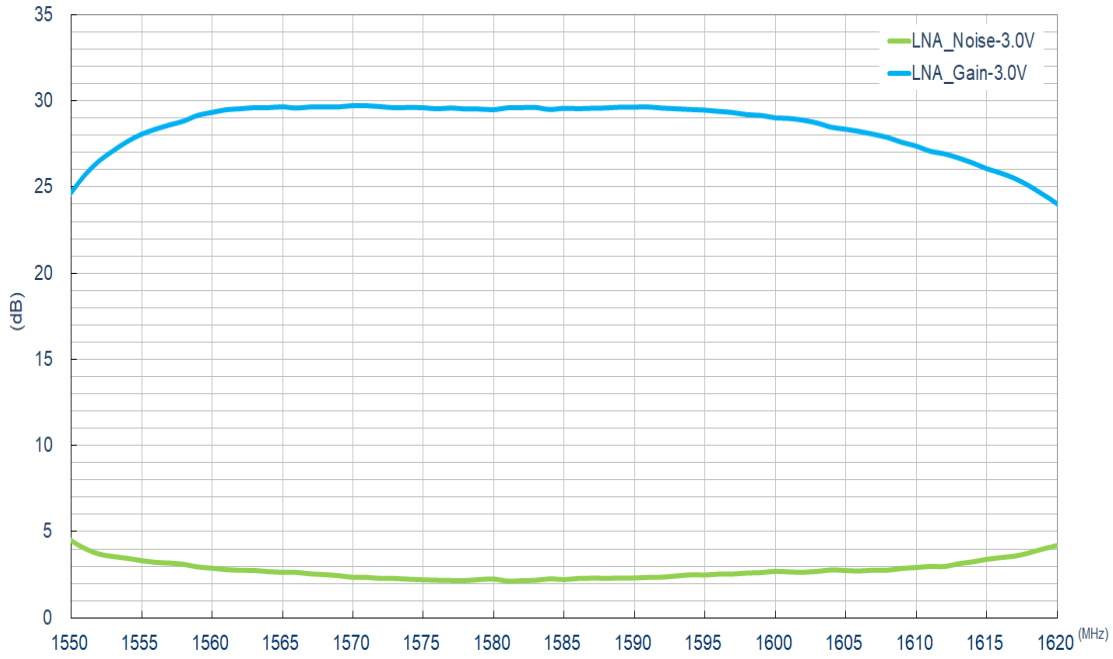

10
9
8
7
6
5
4
3
2
1
0
(dB)
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 360
BEIDOU
GPS
GLONASS

3.7 Active measurements

LNA Gain @ 3.0V

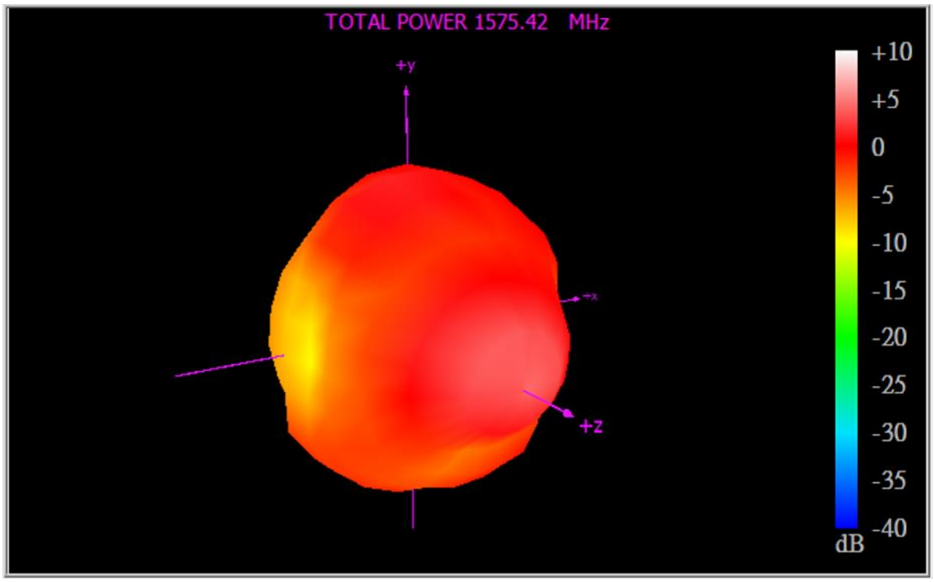


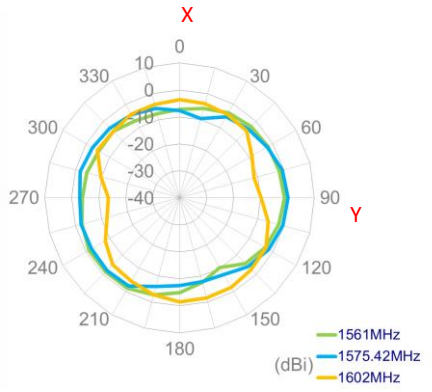
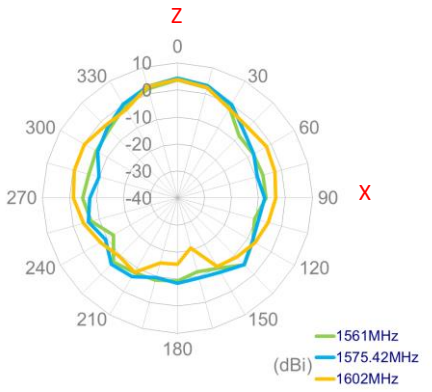
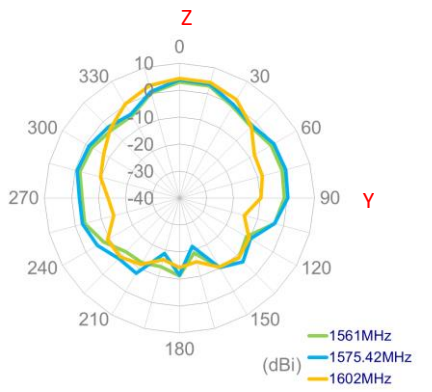
Noise Figure @ 3.0V



3.8 Passive Antenna Radiation Patterns

1575.42MHz

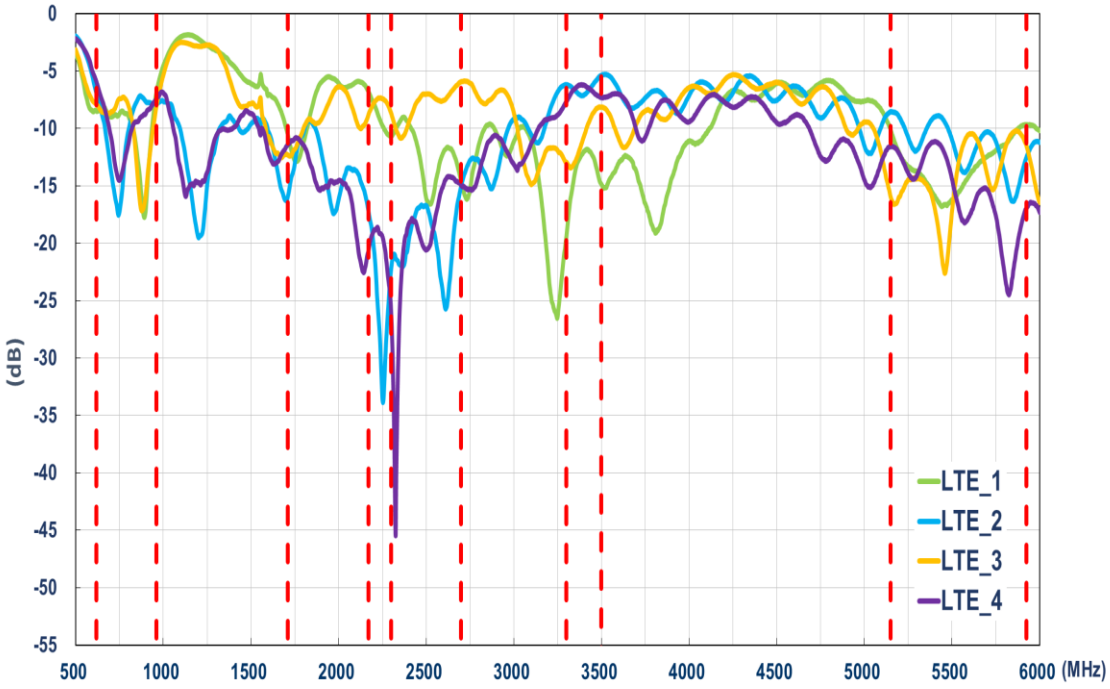


XY Plane	XZ Plane	YZ Plane
		

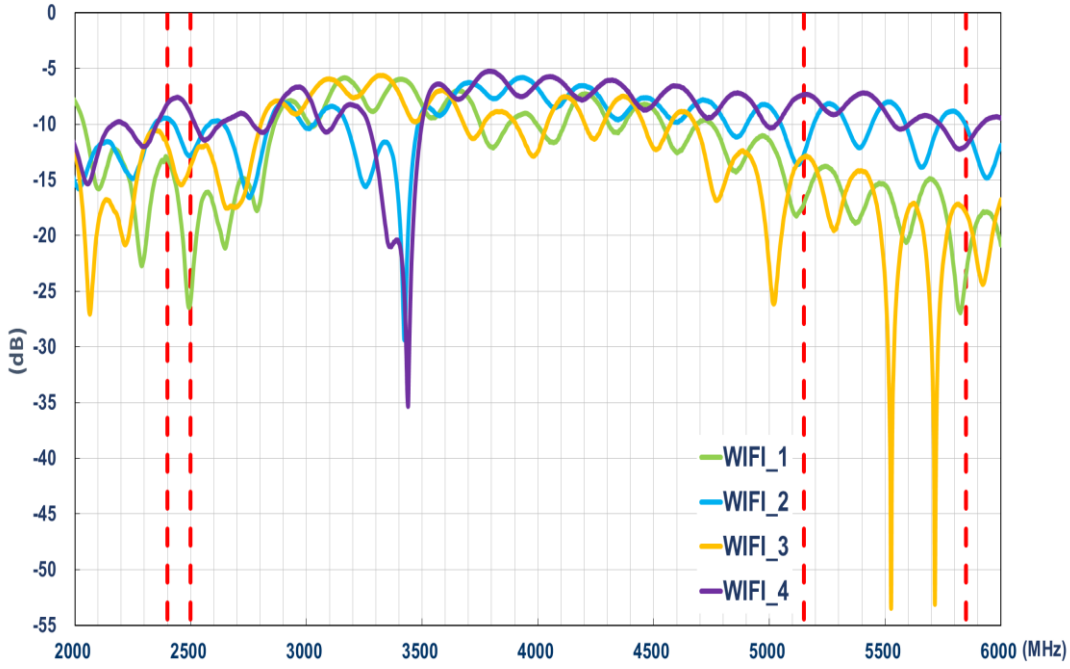
4. Antenna Characteristics

4.1 Return Loss

5G/4G MIMO

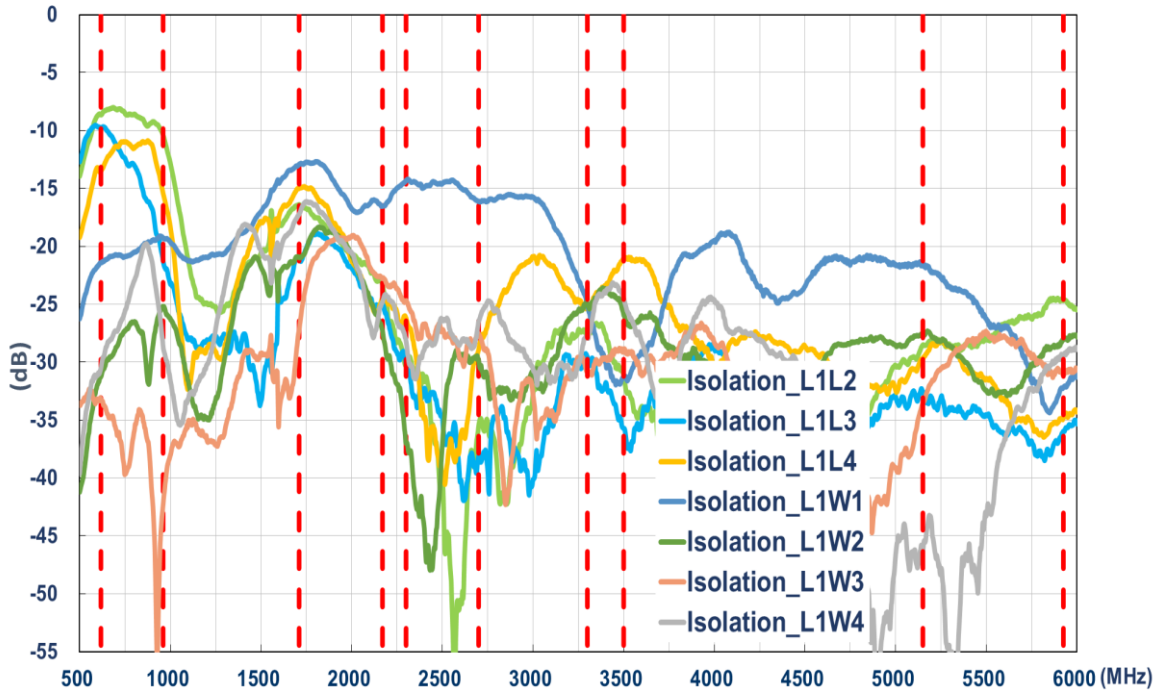


Wi-Fi MIMO

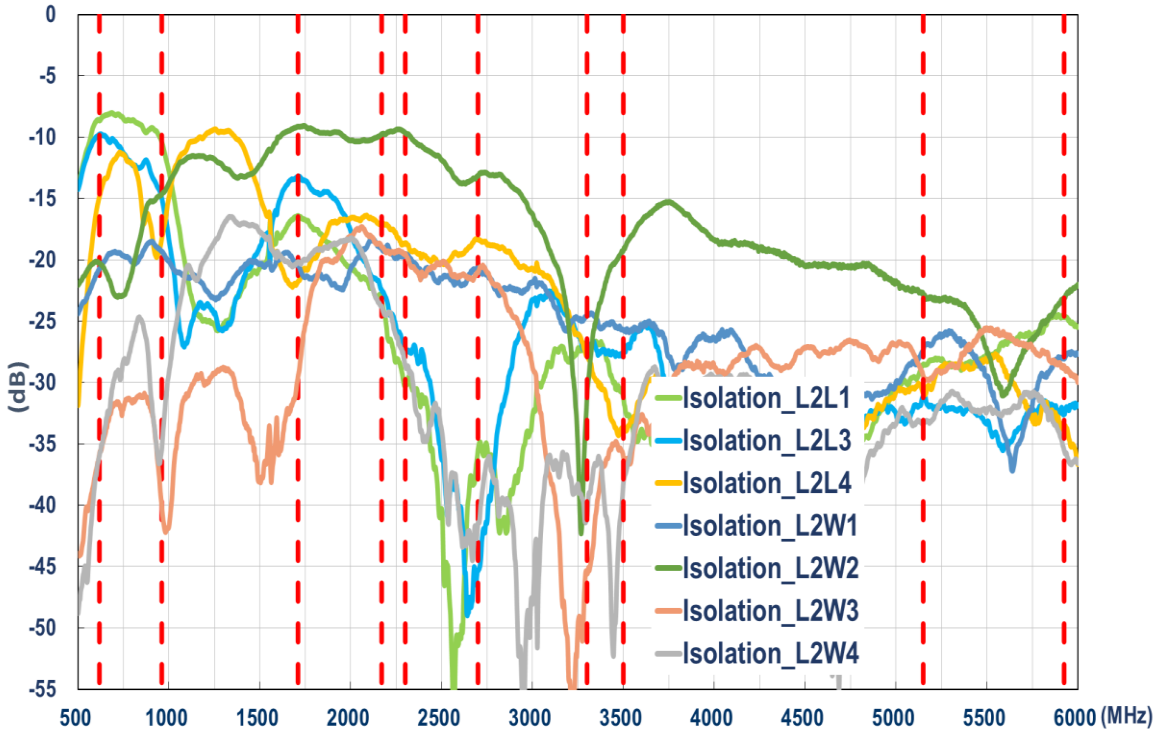


4.2 Isolation

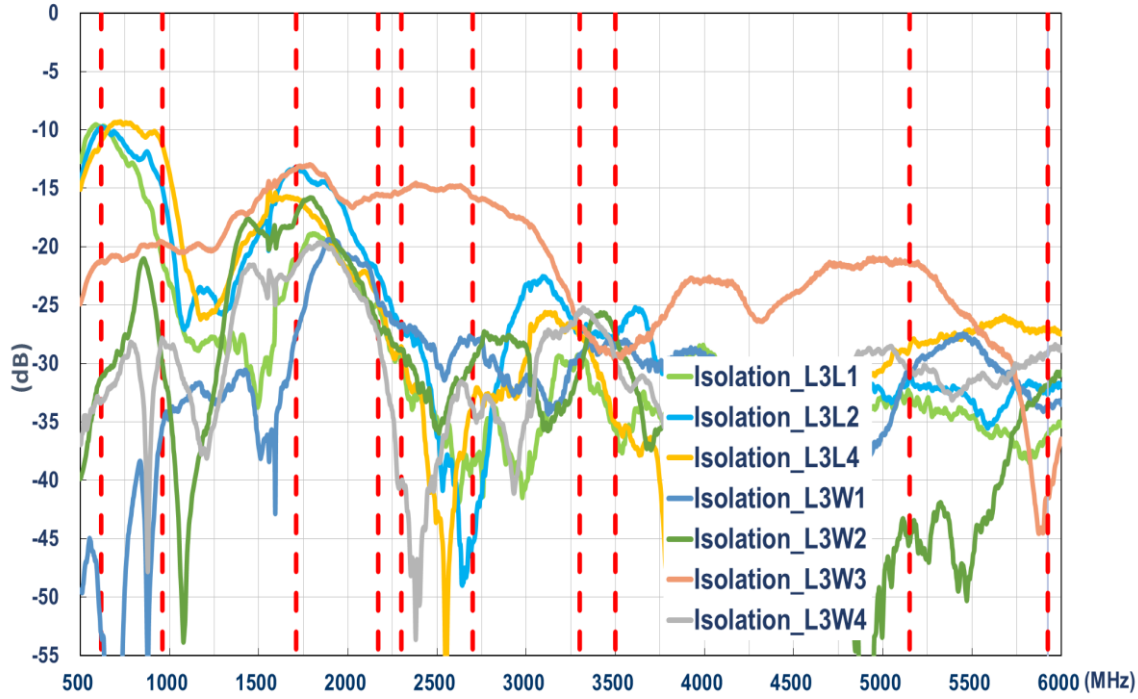
5G/4G 1



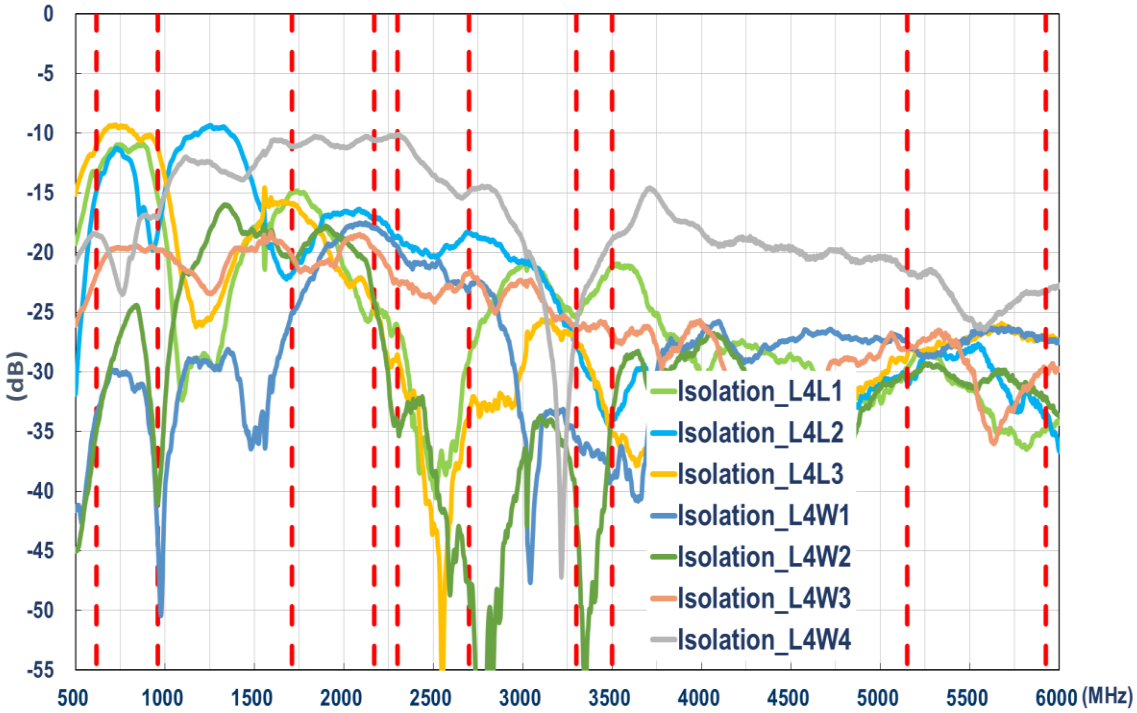
5G/4G 2



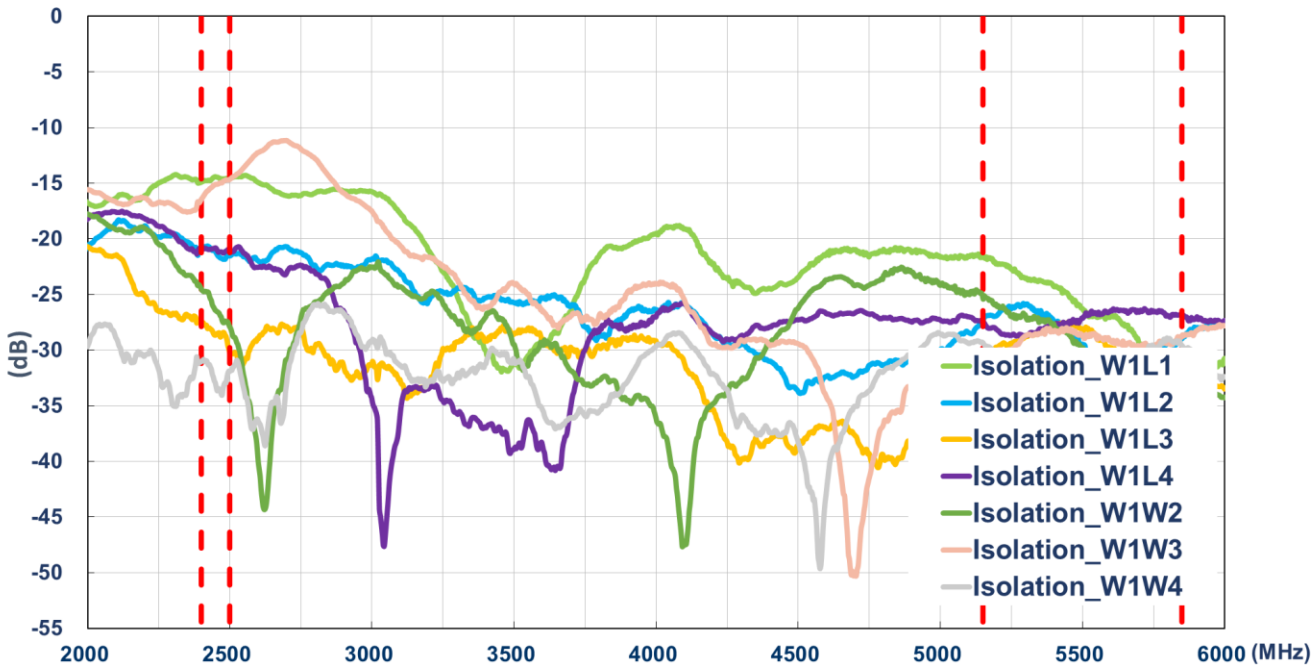
5G/4G 3


0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
(dB)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 (MHz)
Isolation_L3L1
Isolation_L3L2
Isolation_L3L4
Isolation_L3W1
Isolation_L3W2
Isolation_L3W3
Isolation_L3W4

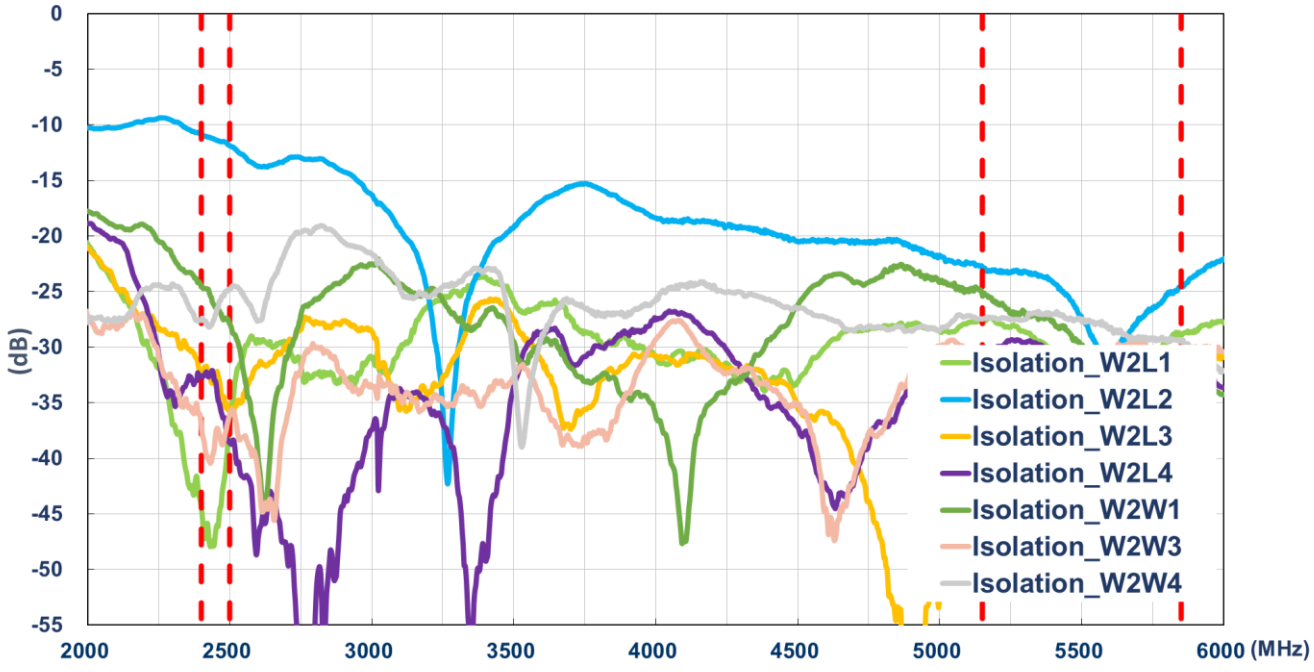
5G/4G 4


0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
(dB)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 (MHz)
Isolation_L4L1
Isolation_L4L2
Isolation_L4L3
Isolation_L4W1
Isolation_L4W2
Isolation_L4W3
Isolation_L4W4

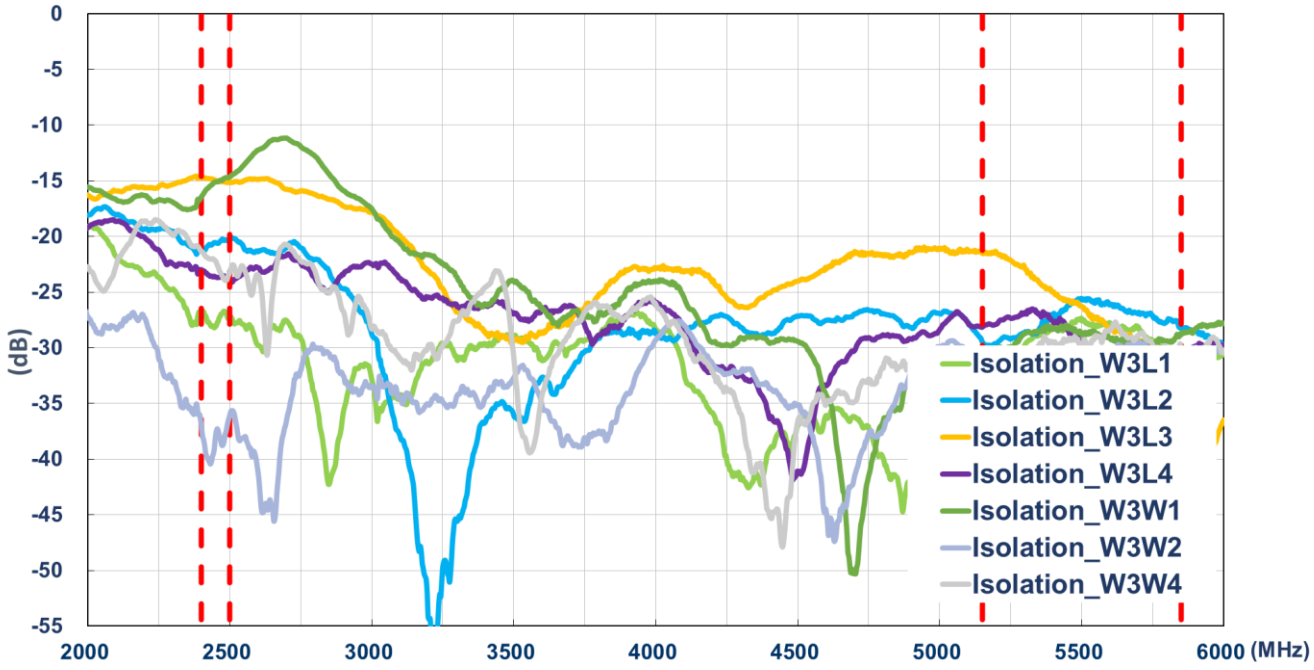
Wi-Fi 1


0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
(dB)
2000
2500
3000
3500
4000
4500
5000
5500
6000 (MHz)
Isolation_W1L1
Isolation_W1L2
Isolation_W1L3
Isolation_W1L4
Isolation_W1W2
Isolation_W1W3
Isolation_W1W4

Wi-Fi 2

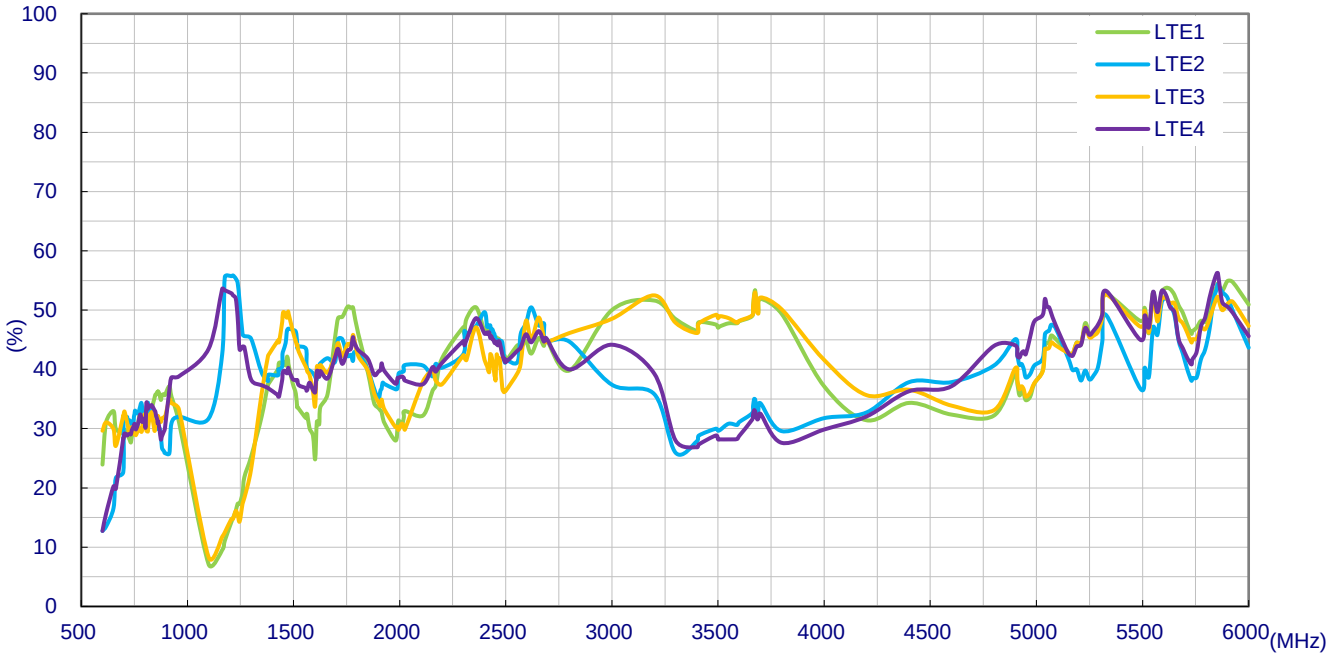

0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
(dB)
2000
2500
3000
3500
4000
4500
5000
5500
6000 (MHz)
Isolation_W2L1
Isolation_W2L2
Isolation_W2L3
Isolation_W2L4
Isolation_W2W1
Isolation_W2W3
Isolation_W2W4

Wi-Fi 3

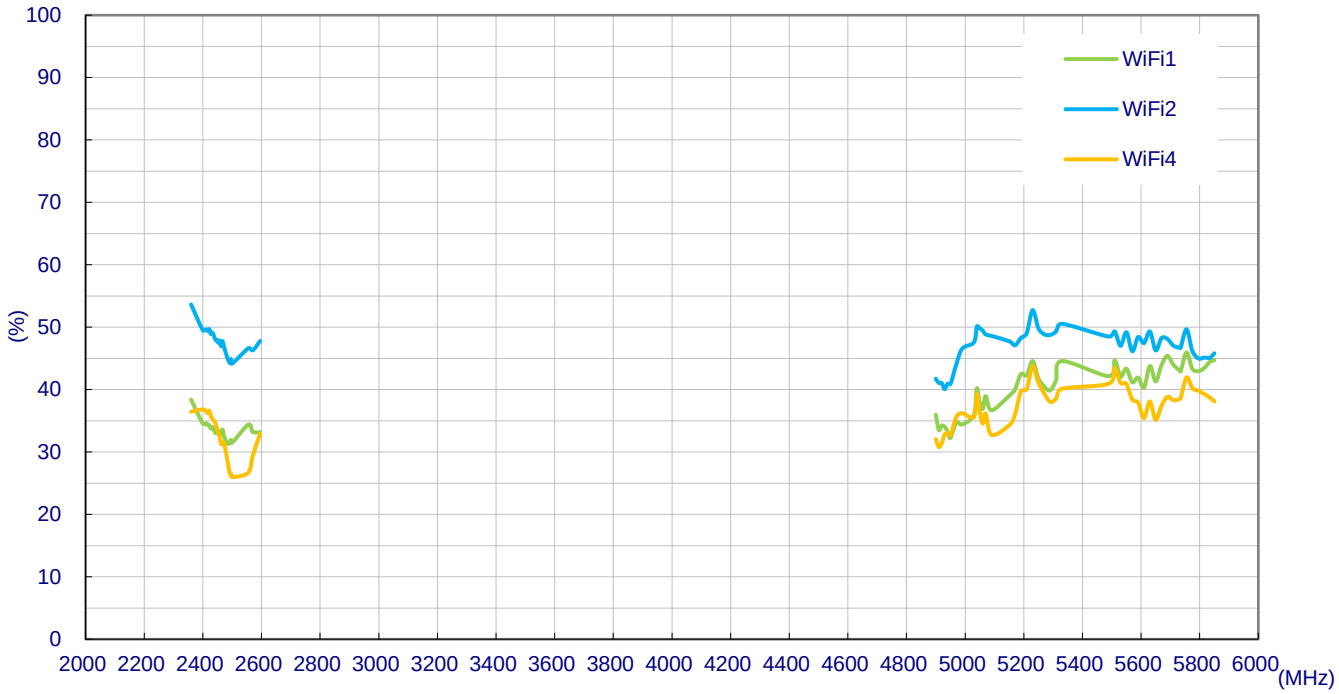


4.3 Efficiency

5G/4G MIMO

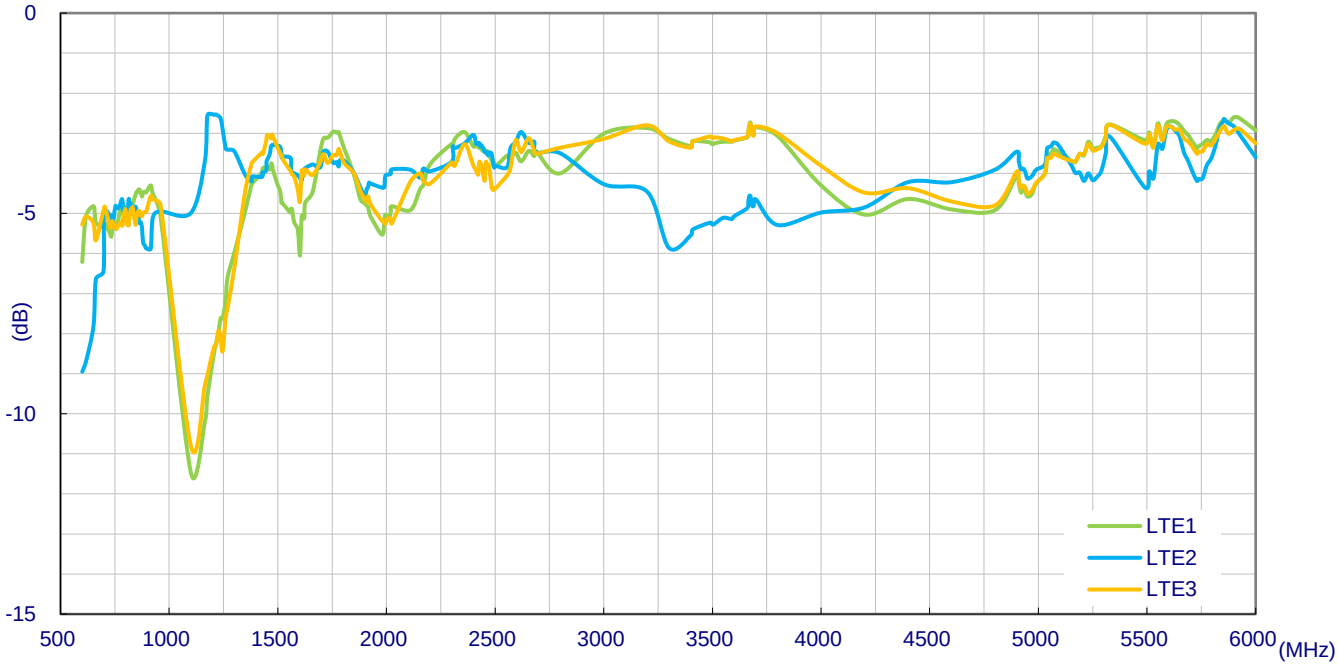


Wi-Fi MIMO

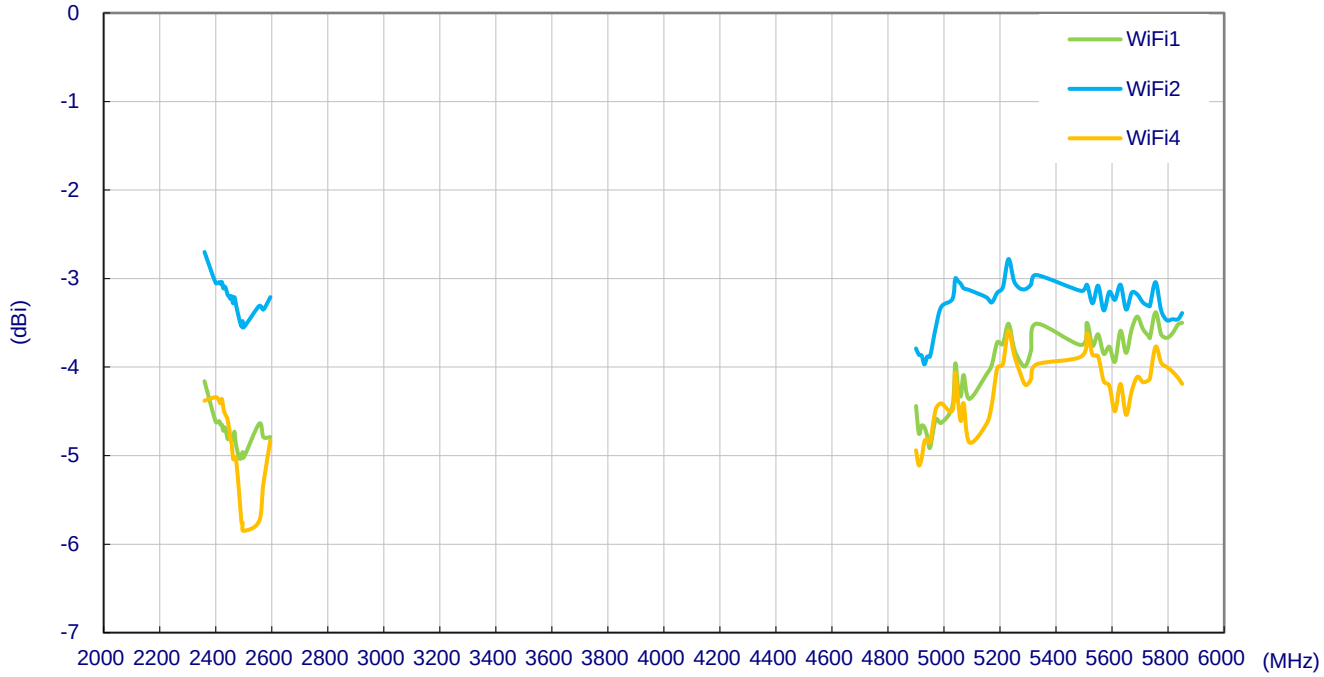


4.4 Average Gain

5G/4G MIMO

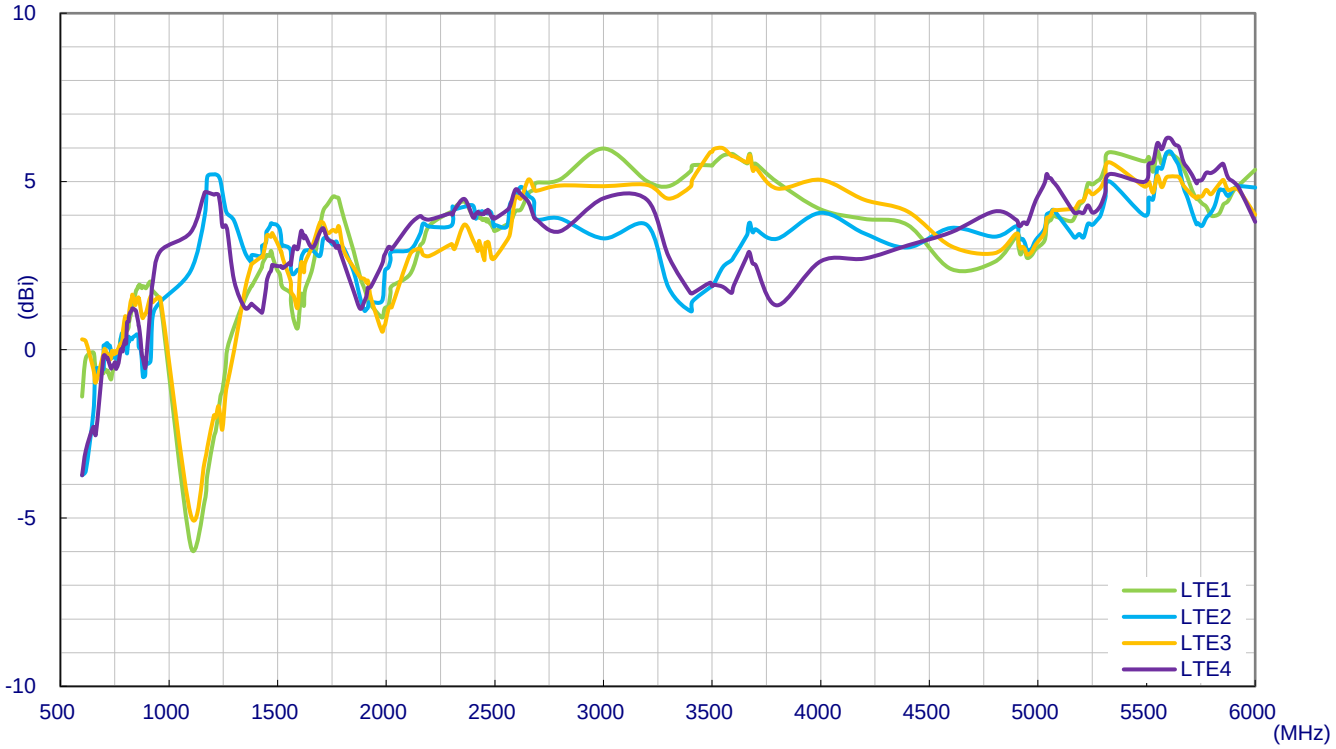


Wi-Fi MIMO

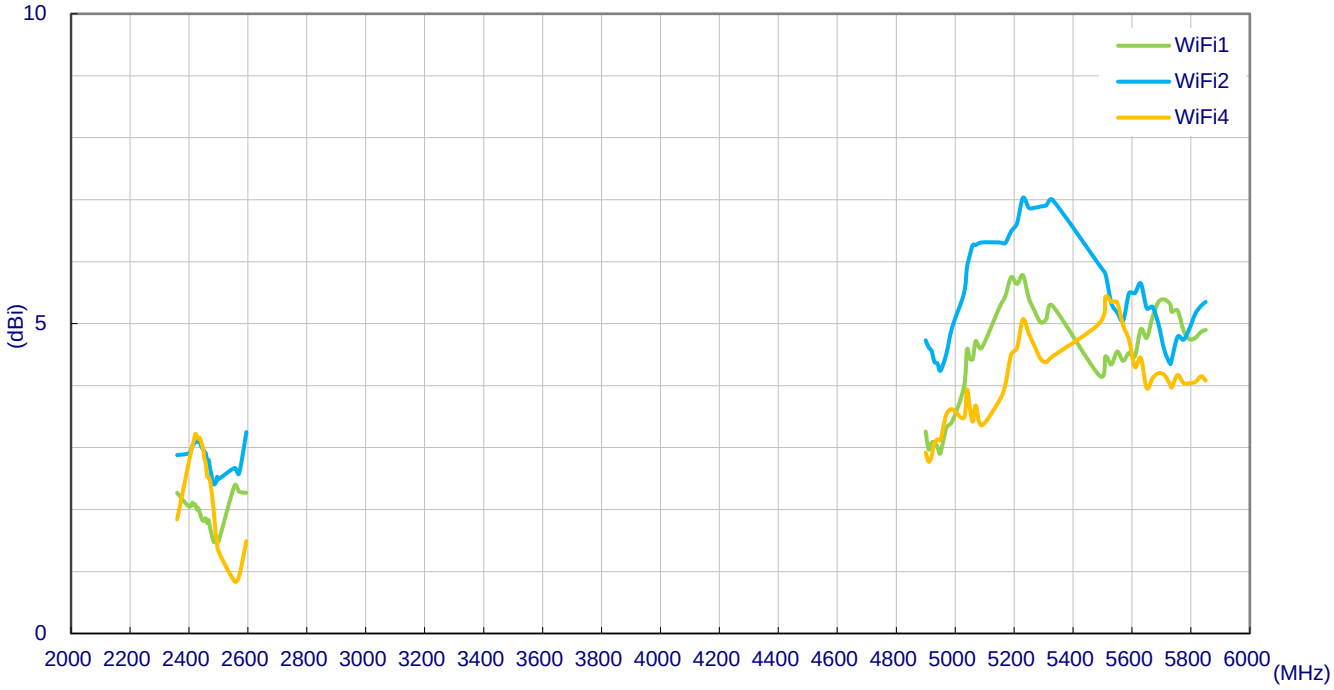


4.5 Peak Gain

5G/4G MIMO

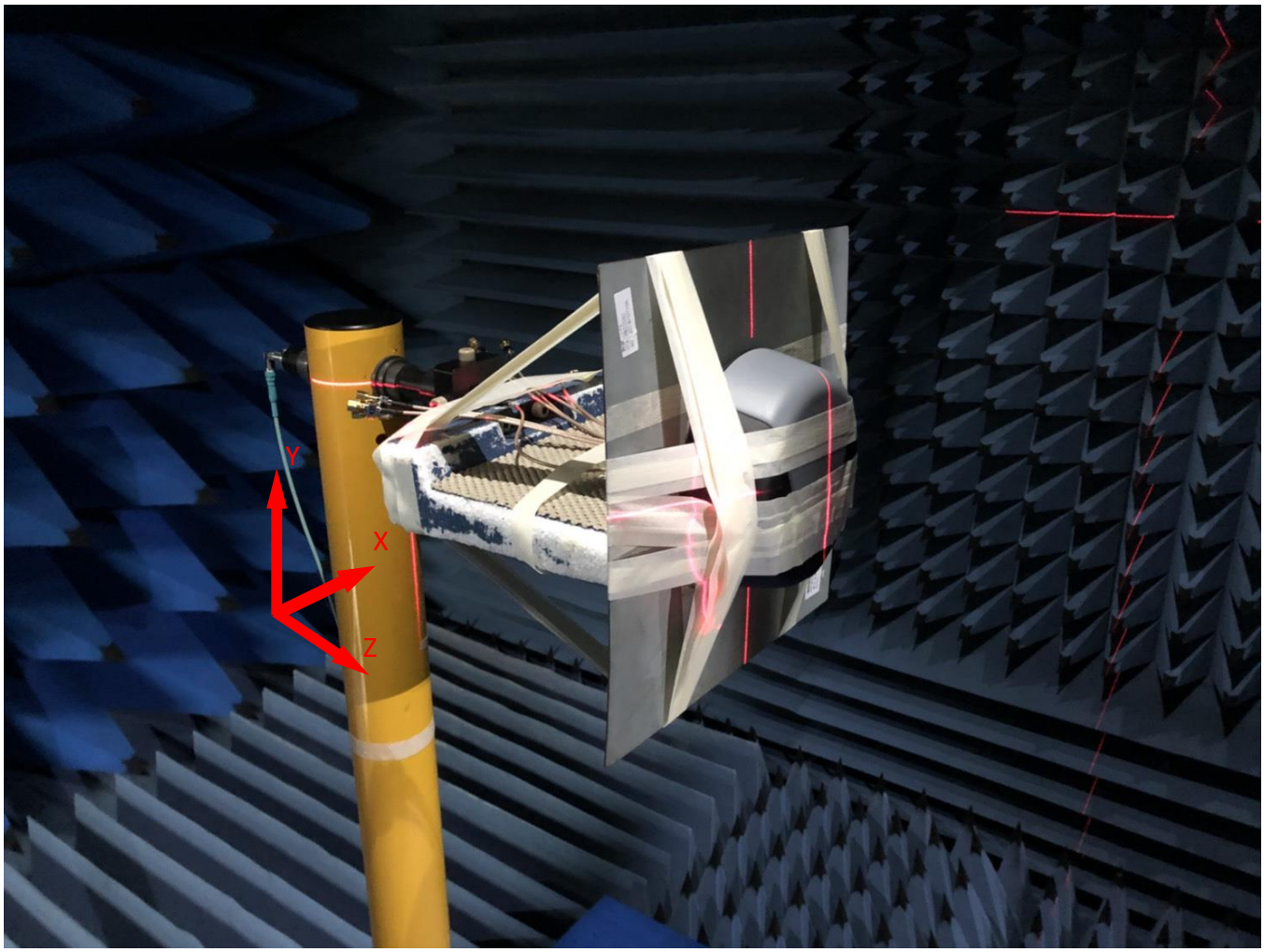


Wi-Fi MIMO


10
5
0
(dBi)
WiFi1
WiFi2
WiFi4
2000 2200 2400 2600 2800 3000 3200 3400 3600 3800 4000 4200 4400 4600 4800 5000 5200 5400 5600 5800 6000
(MHz)

5. Radiation Patterns

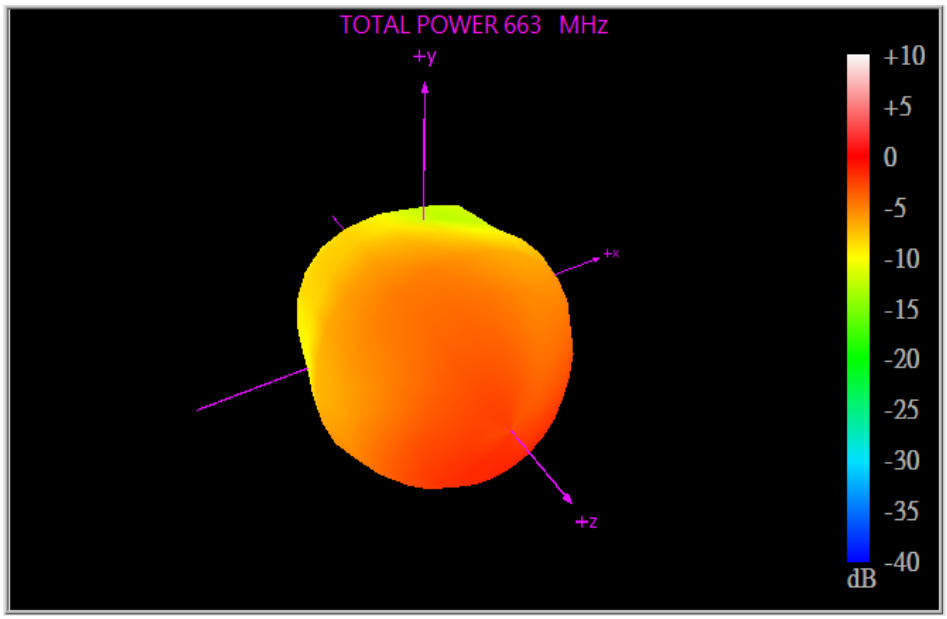
5.1 Test Setup

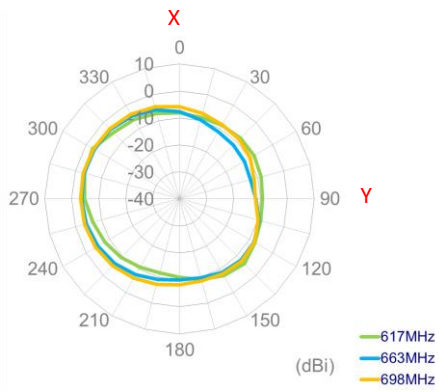
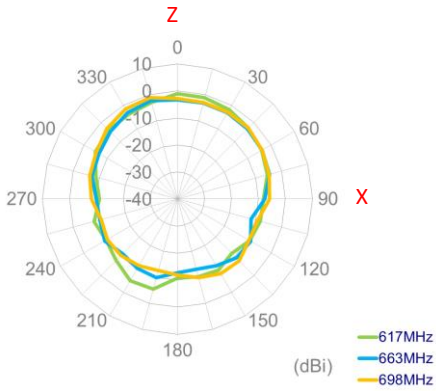
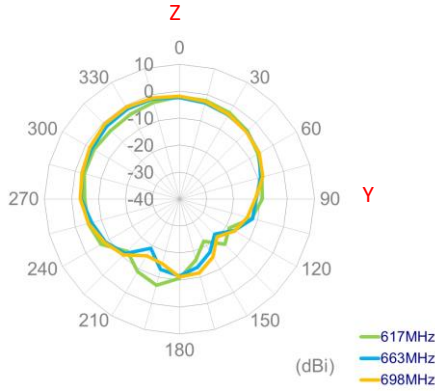


On 30x30cm Ground Plane

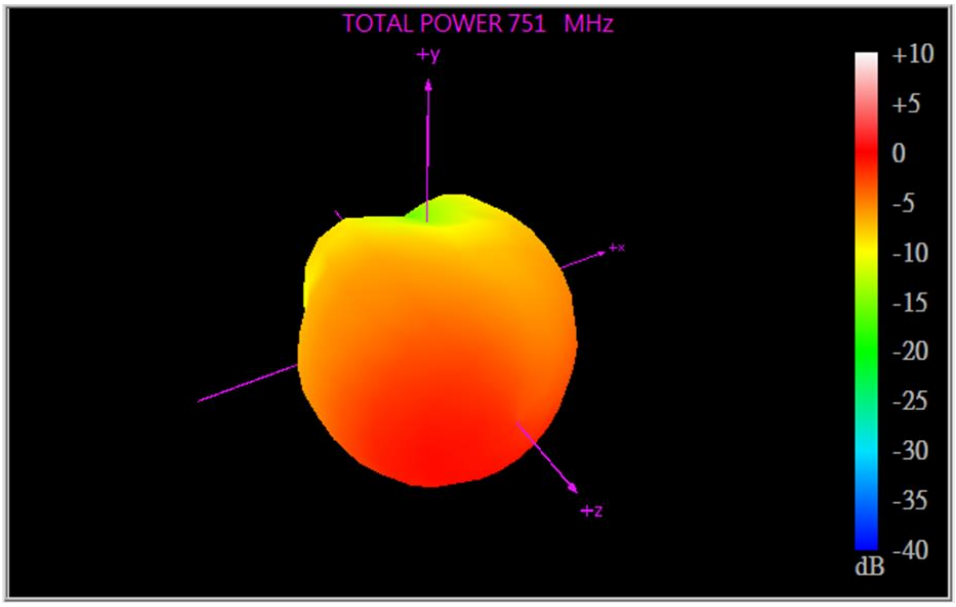
5.2 5G/4G MIMO 1 Radiation Pattern

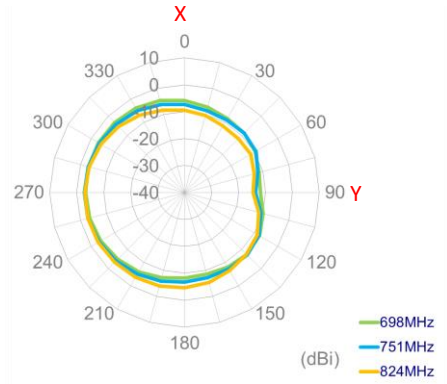
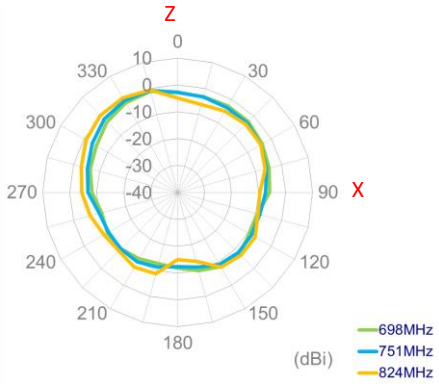
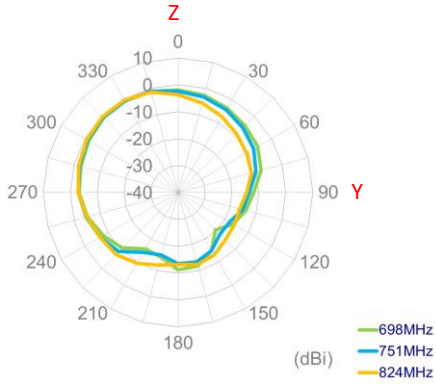
663MHz



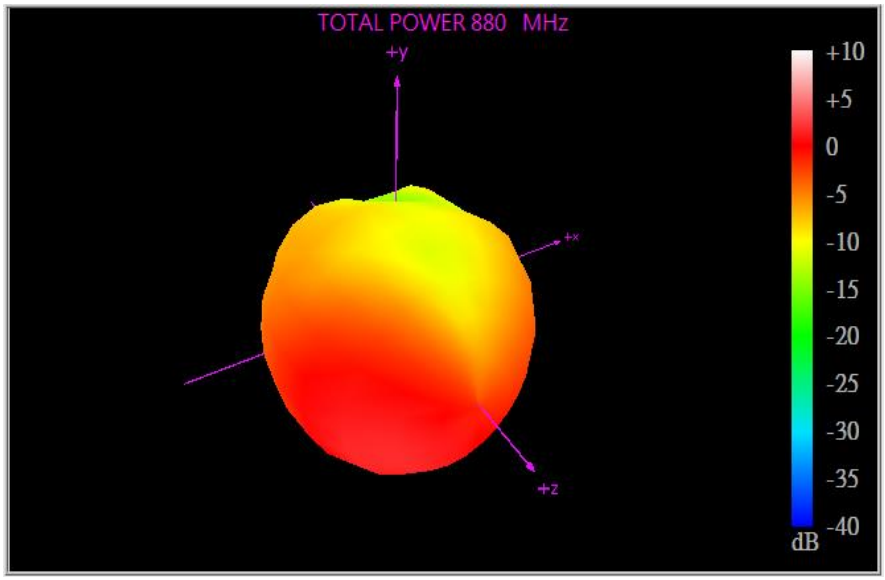
XY Plane	XZ Plane	YZ Plane
		

751MHz

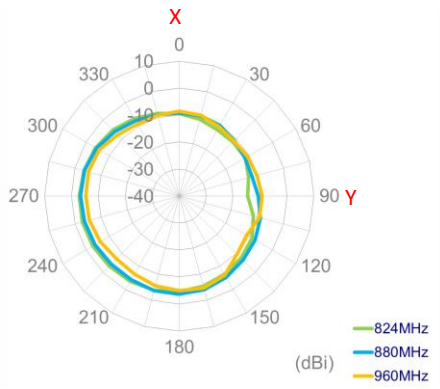


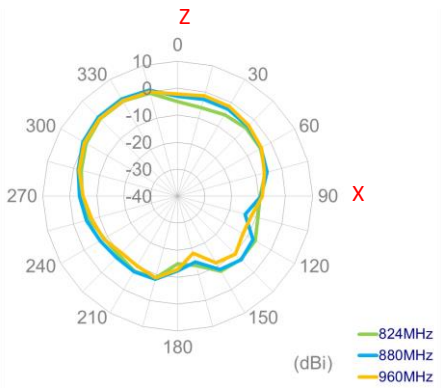
XY Plane	XZ Plane	YZ Plane
		

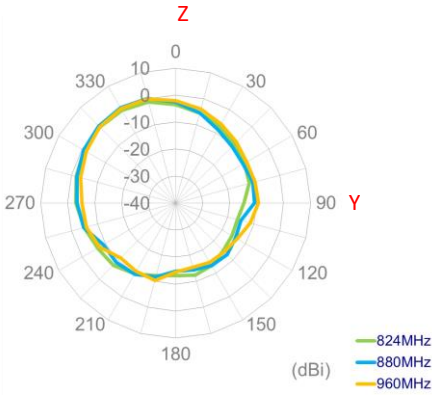
880MHz



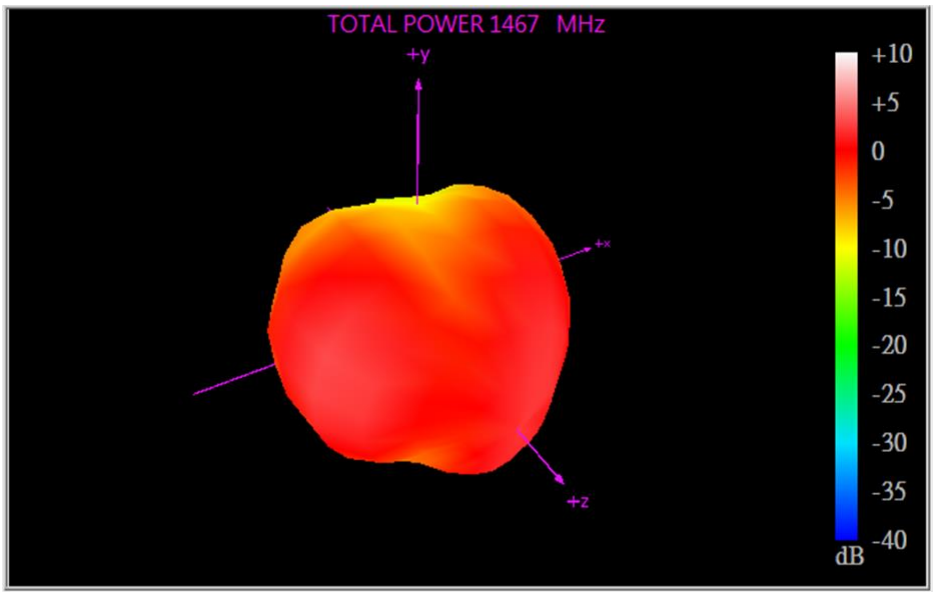
XY Plane	XZ Plane	YZ Plane



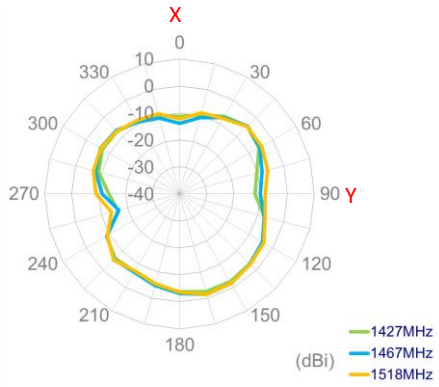


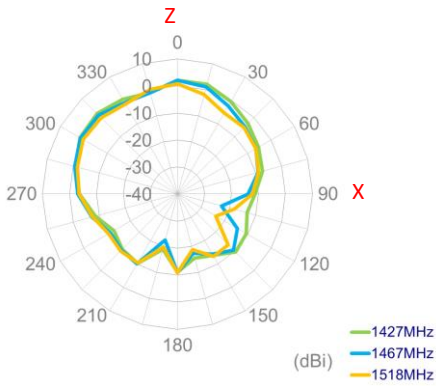


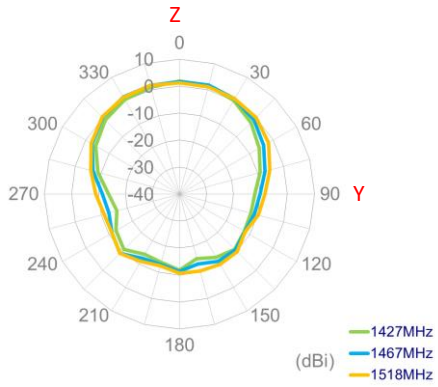
1467MHz



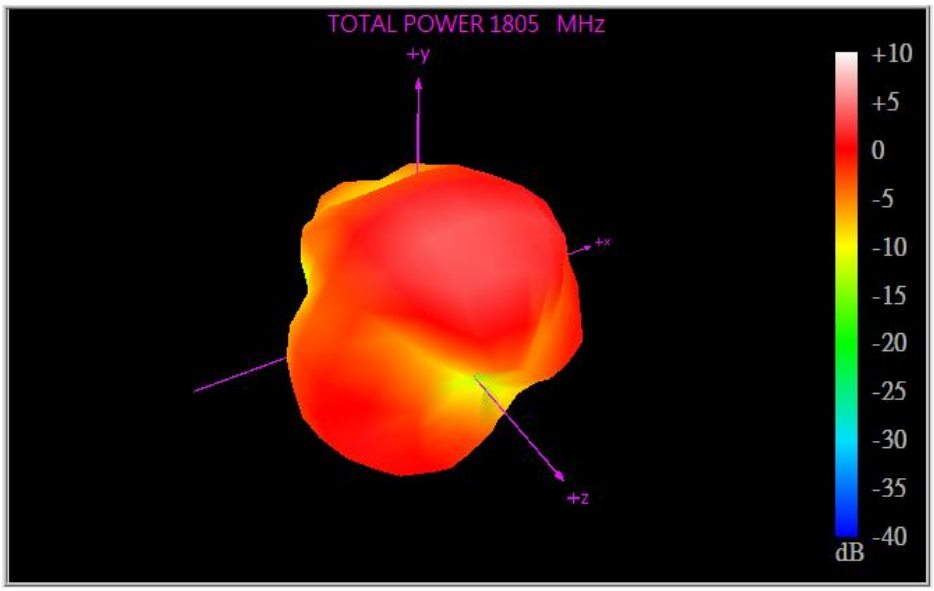
XY Plane	XZ Plane	YZ Plane



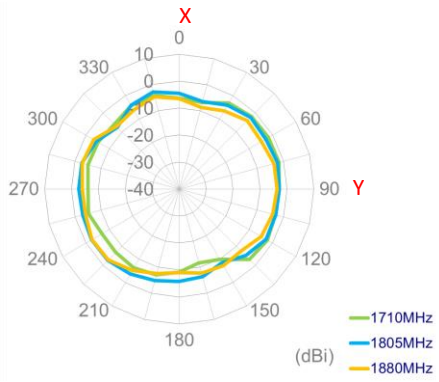


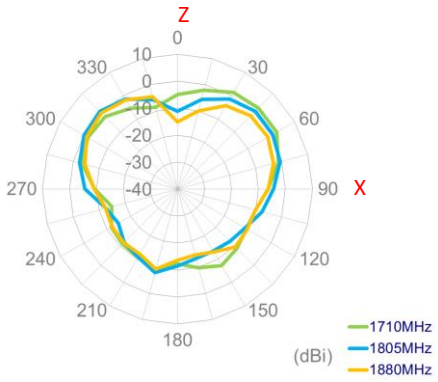


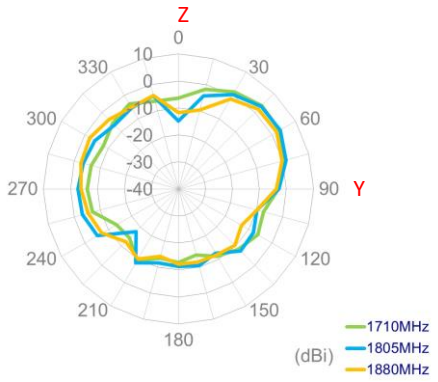
1805MHz



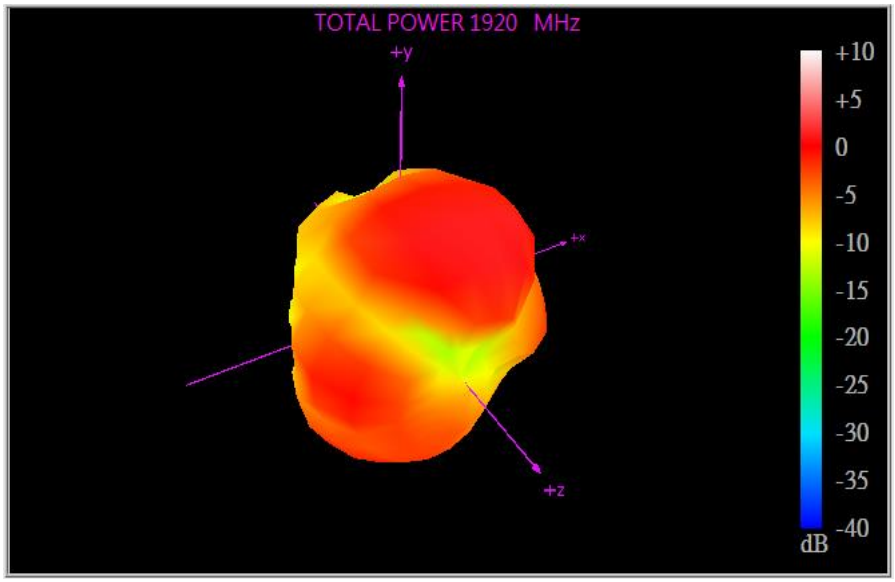
XY Plane	XZ Plane	YZ Plane



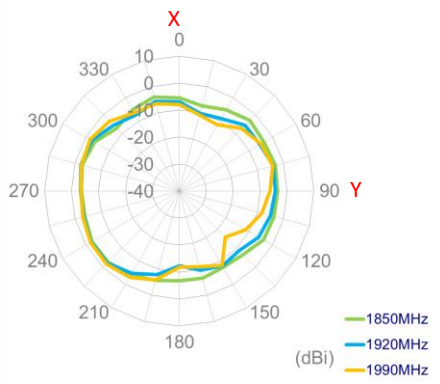


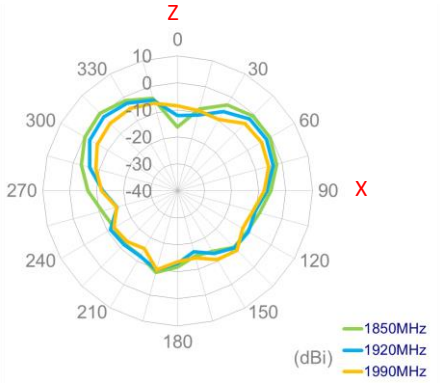


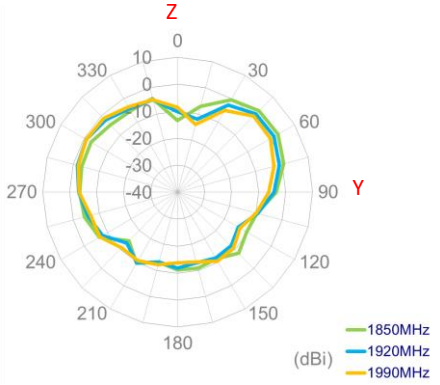
1920MHz



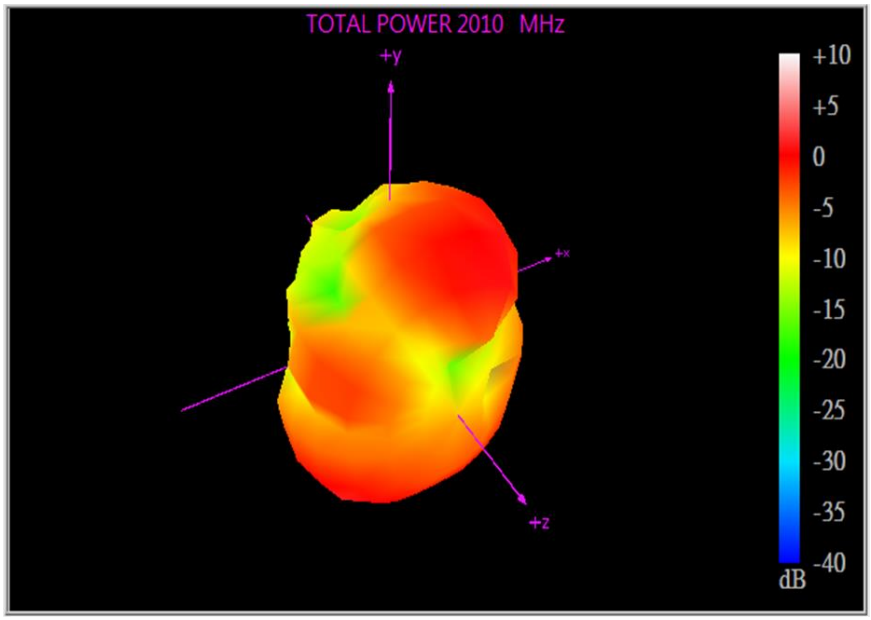
XY Plane	XZ Plane	YZ Plane



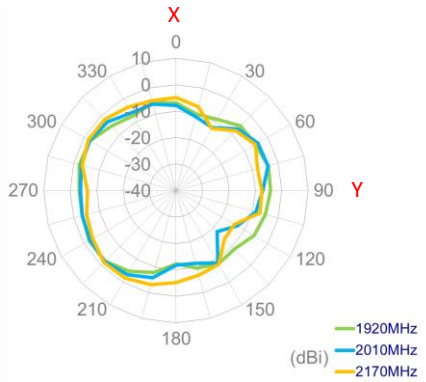


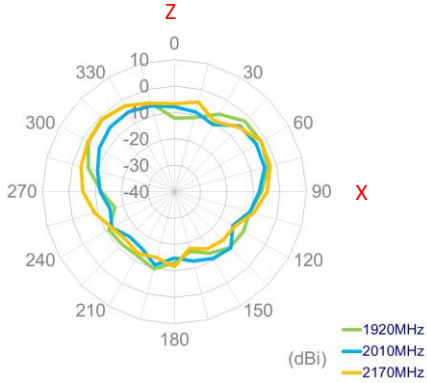


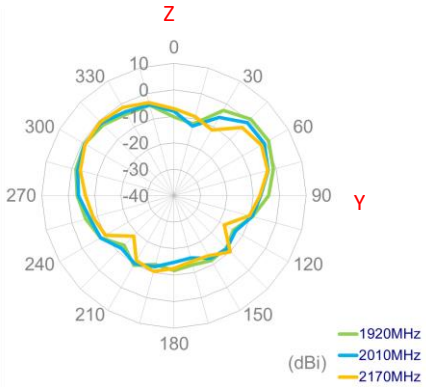
2010MHz



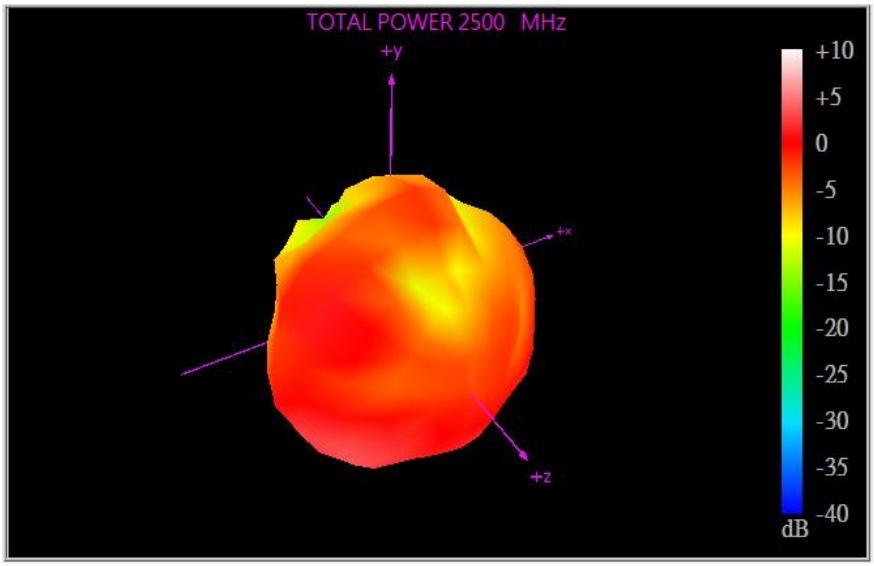
XY Plane	XZ Plane	YZ Plane



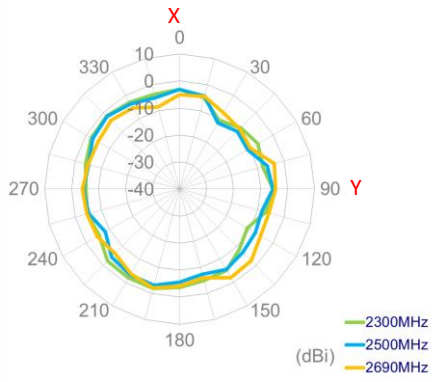


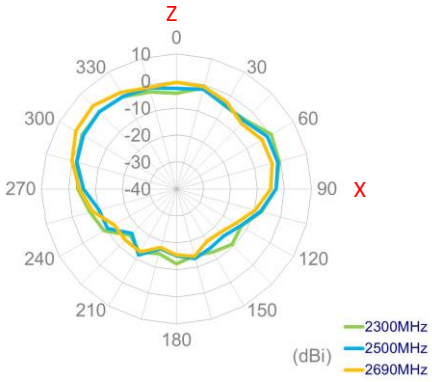


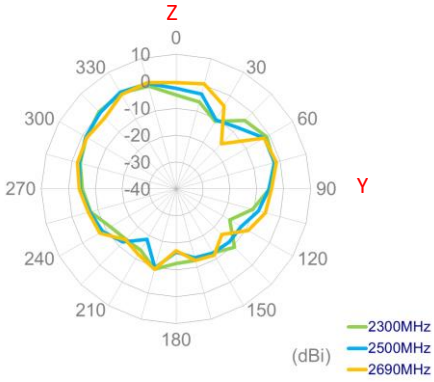
2500MHz



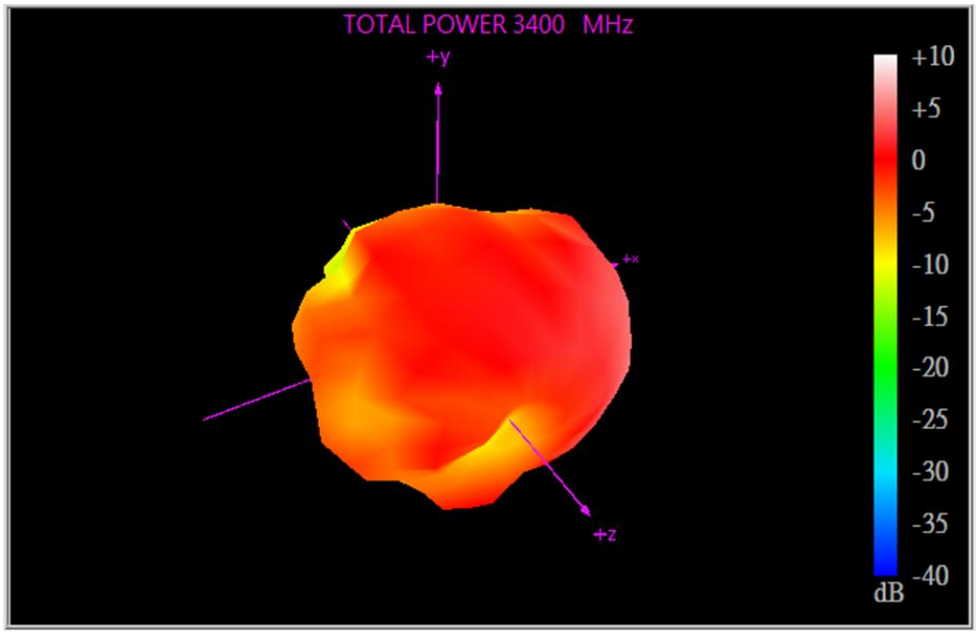
XY Plane	XZ Plane	YZ Plane



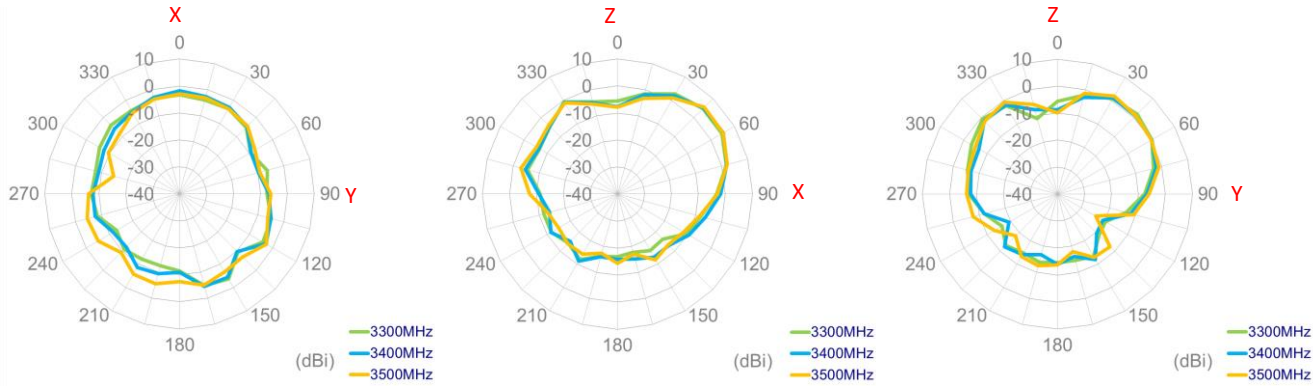




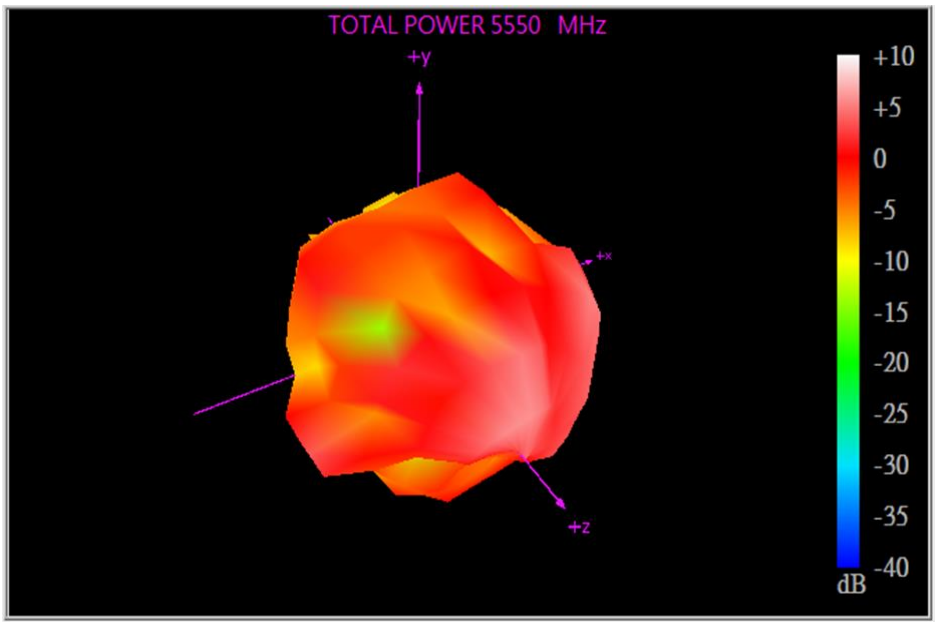
3300MHz



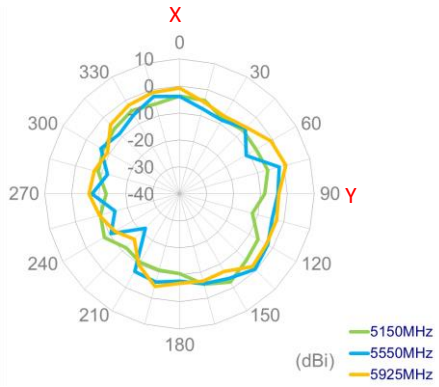
XY Plane	XZ Plane	YZ Plane

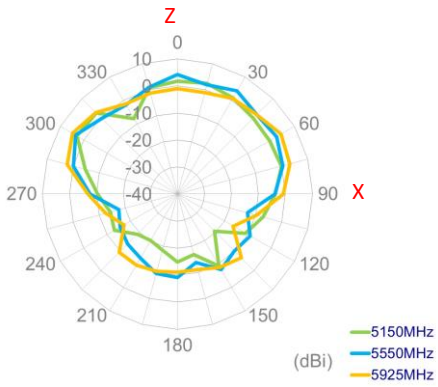


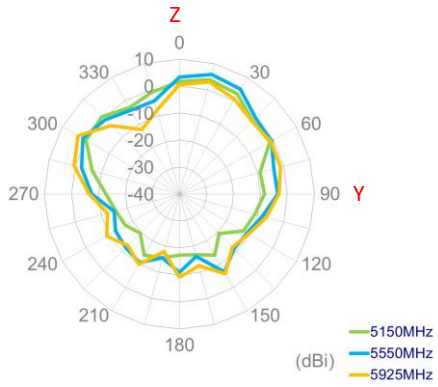
5550MHz



XY Plane	XZ Plane	YZ Plane

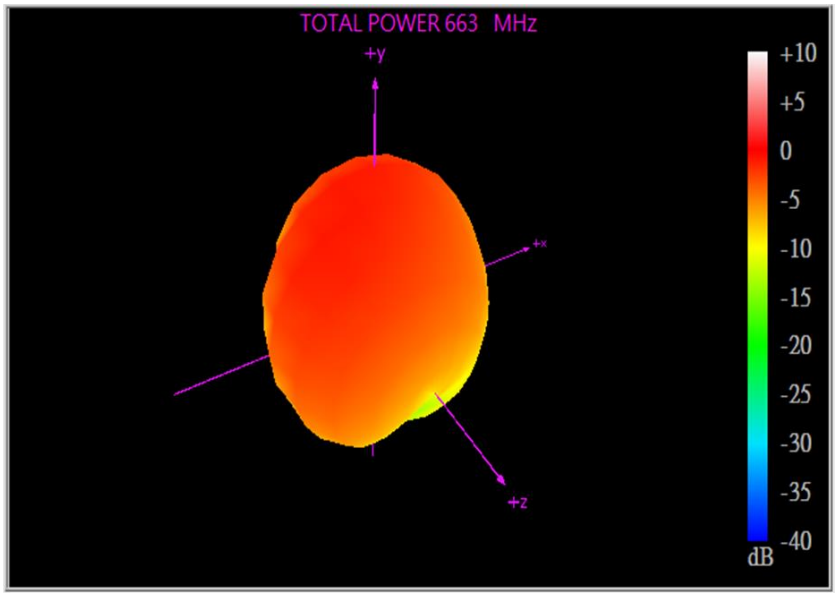




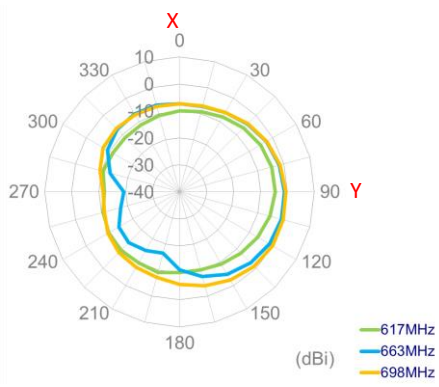


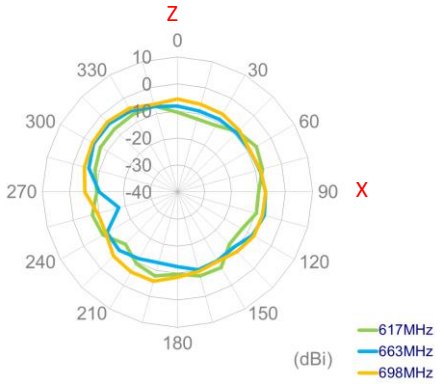
5.3 5G/4G MIMO 2 Radiation Pattern

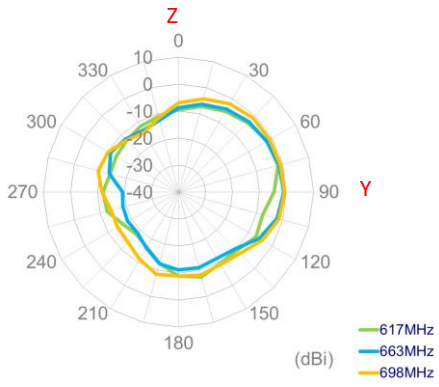
663MHz



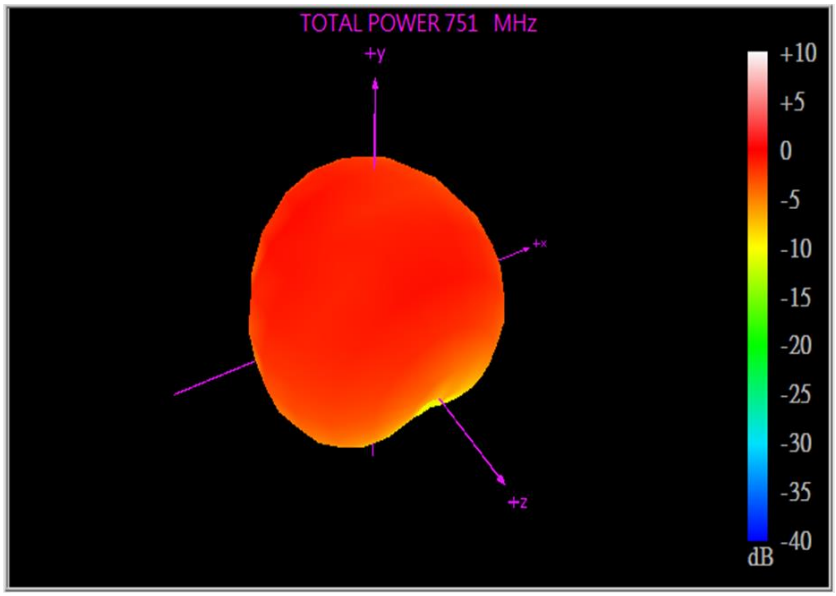
XY Plane	XZ Plane	YZ Plane



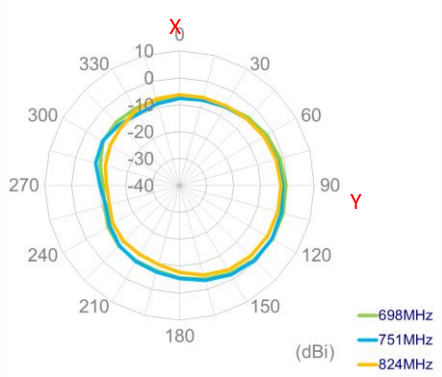


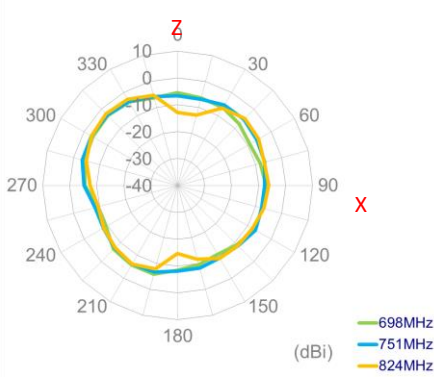


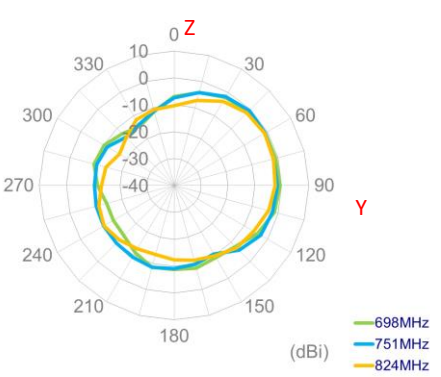
751MHz



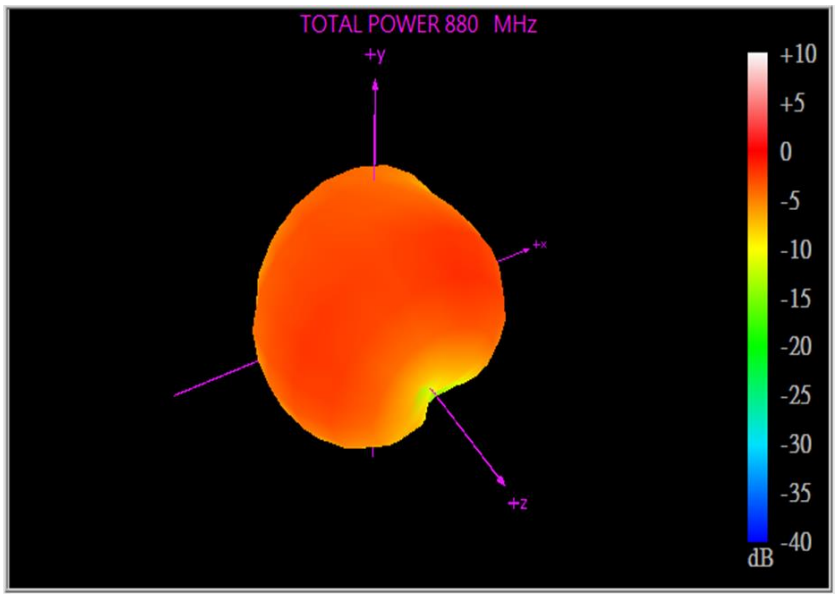
XY Plane	XZ Plane	YZ Plane



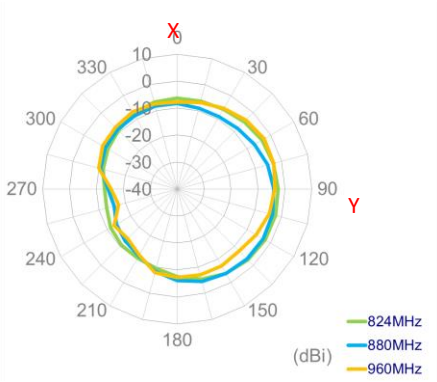


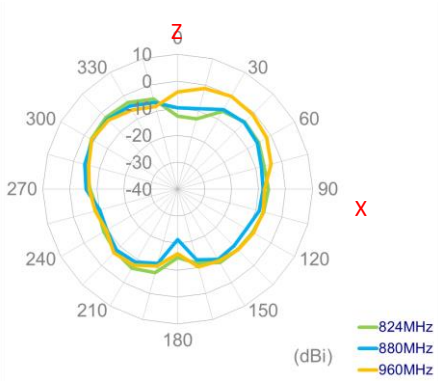


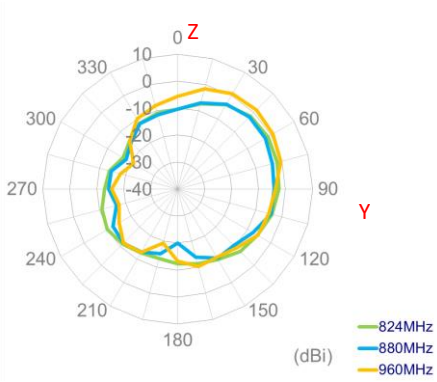
880MHz



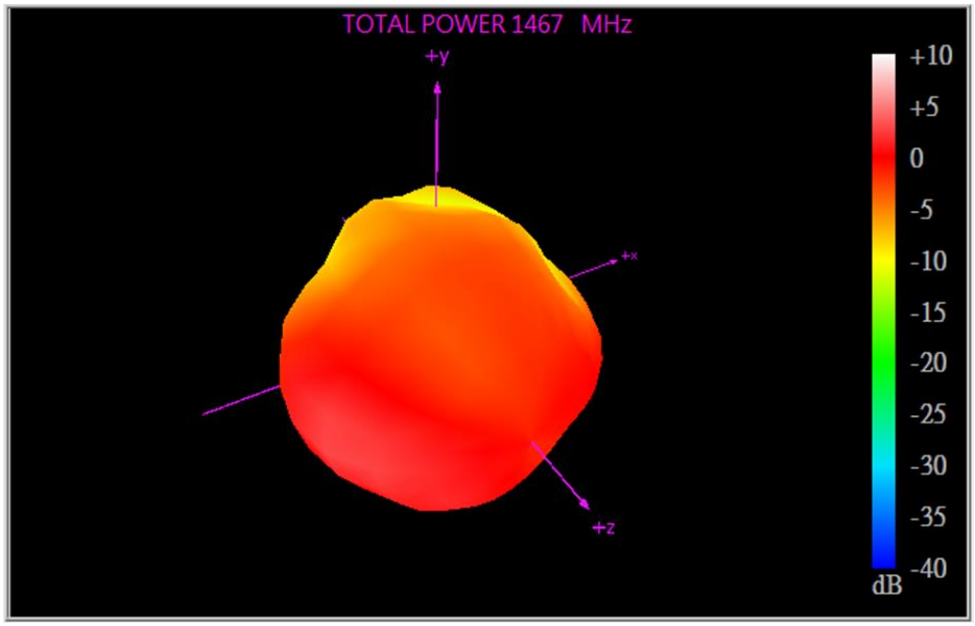
XY Plane	XZ Plane	YZ Plane



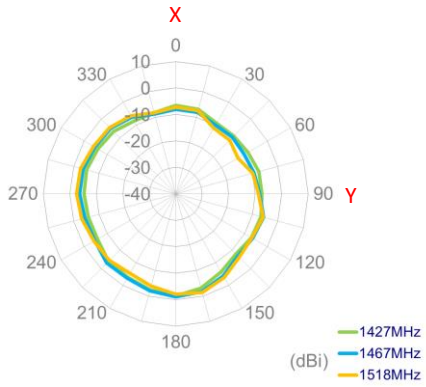


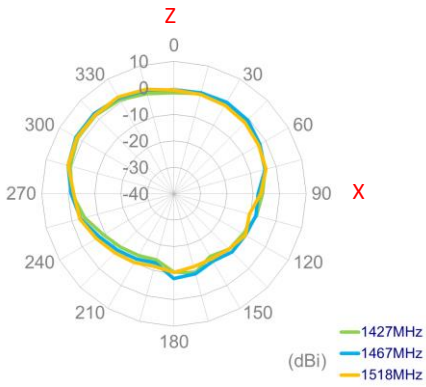


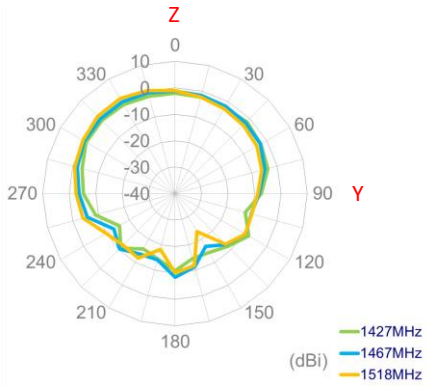
1467MHz



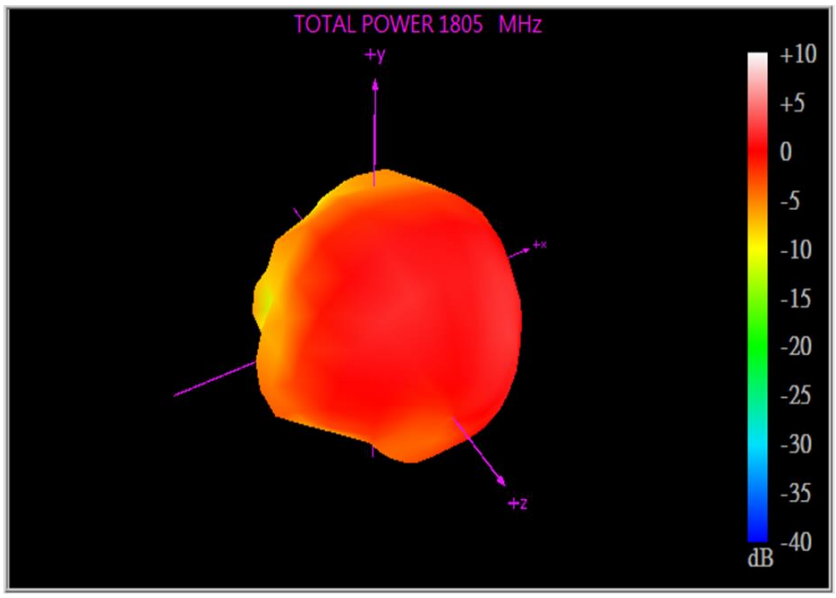
XY Plane	XZ Plane	YZ Plane



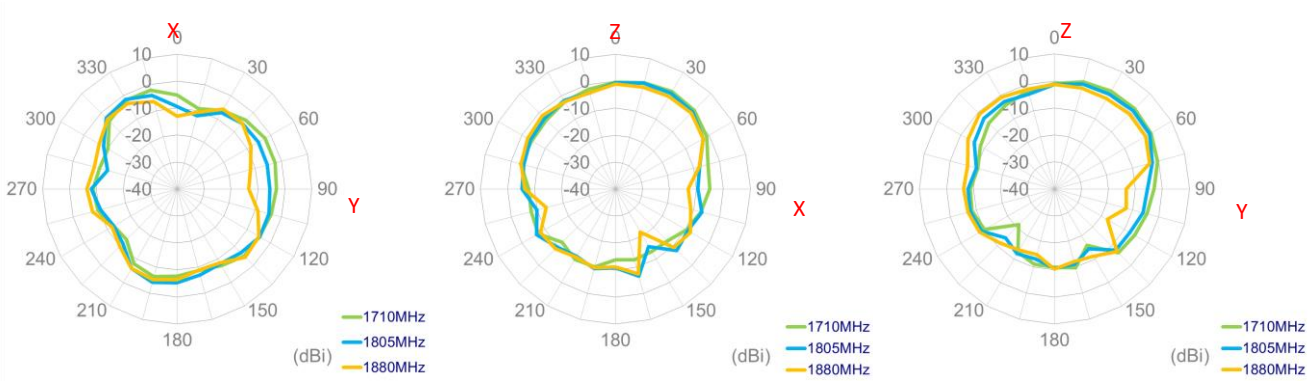




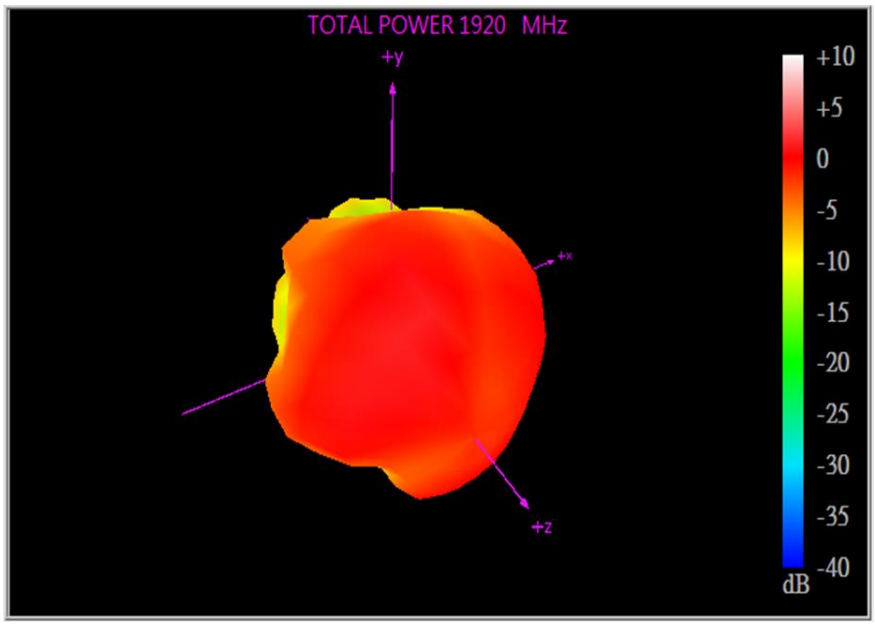
1805MHz



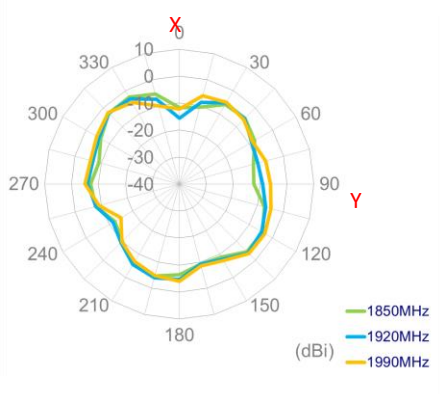
XY Plane	XZ Plane	YZ Plane

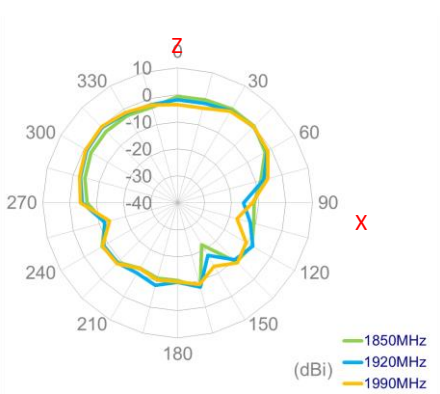


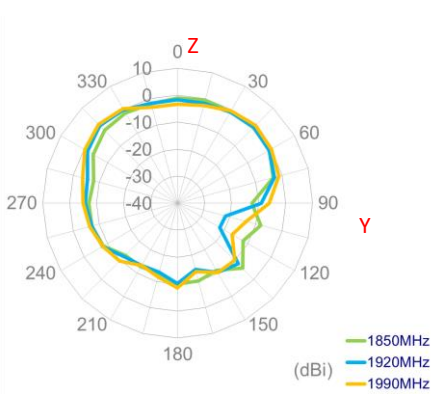
1920MHz



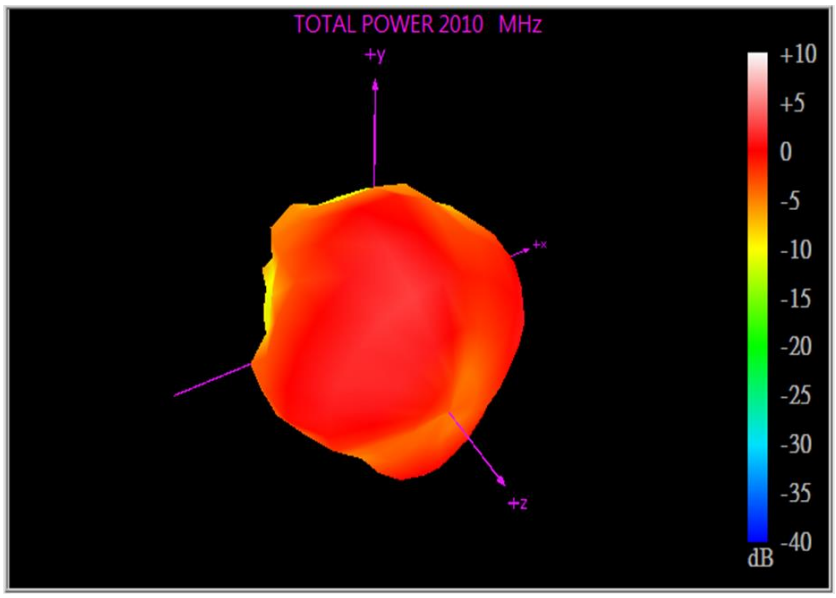
XY Plane	XZ Plane	YZ Plane



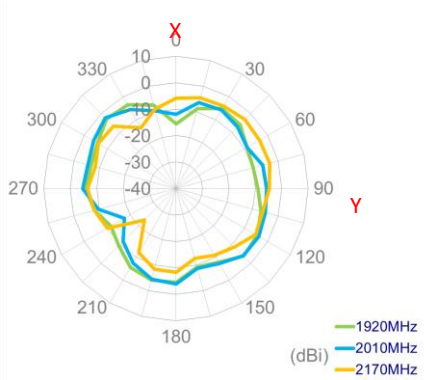


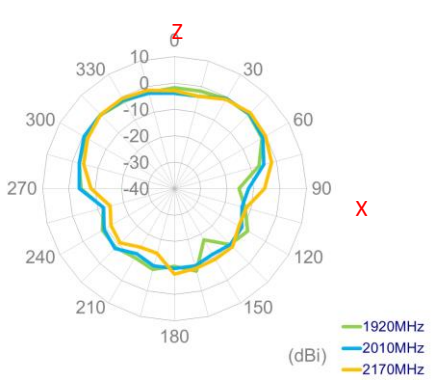


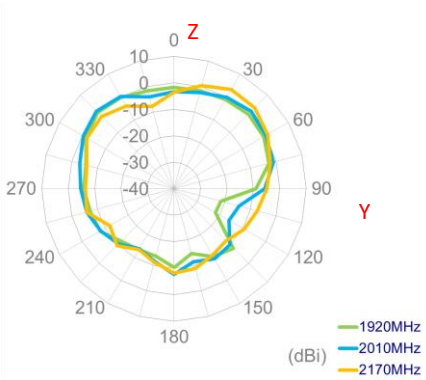
2010MHz



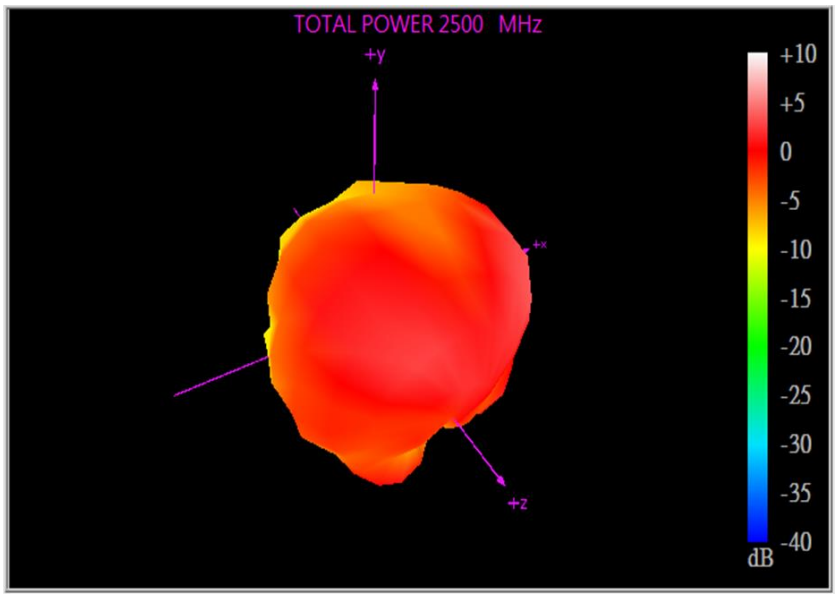
XY Plane	XZ Plane	YZ Plane



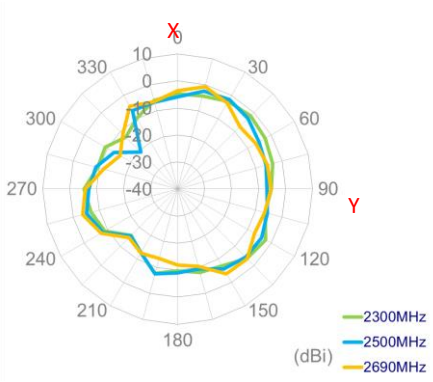


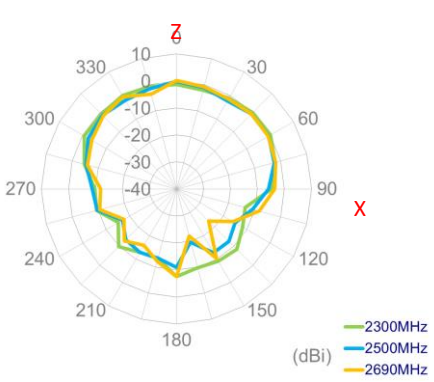


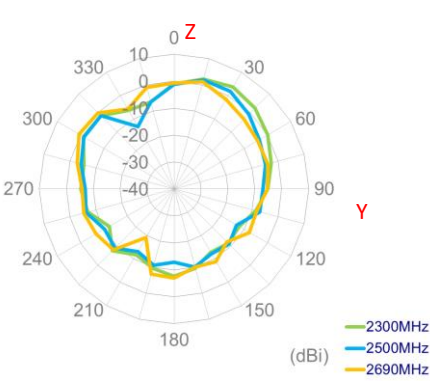
2500MHz



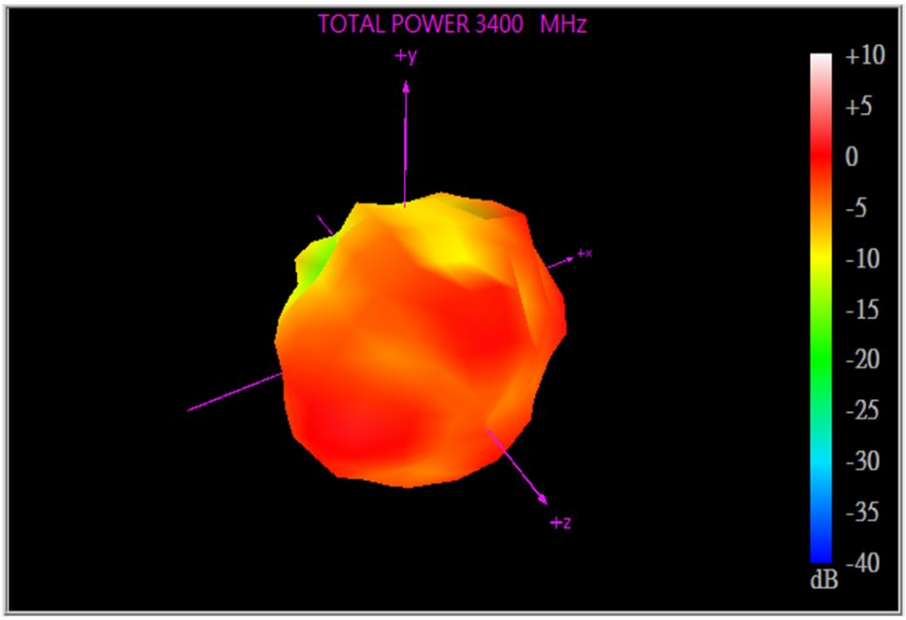
XY Plane	XZ Plane	YZ Plane



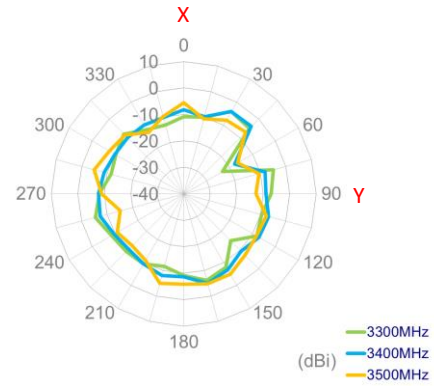


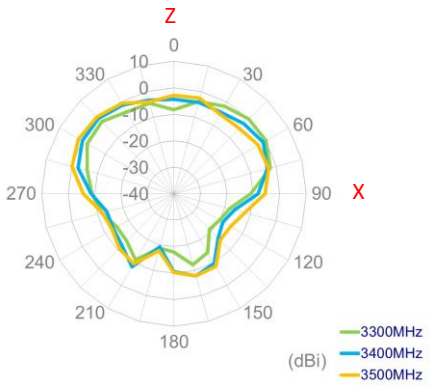


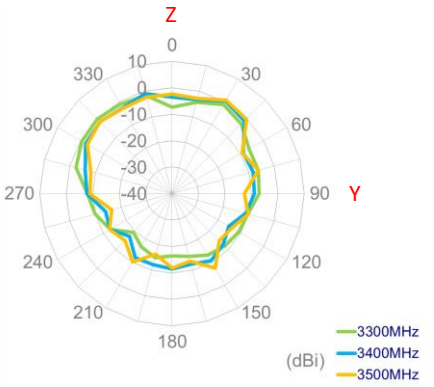
3400MHz



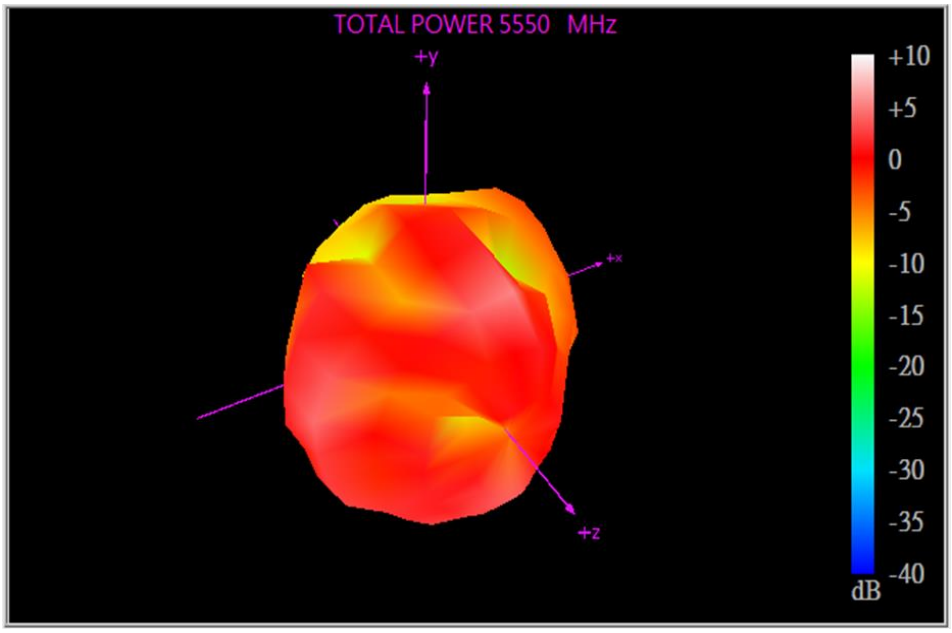
XY Plane	XZ Plane	YZ Plane



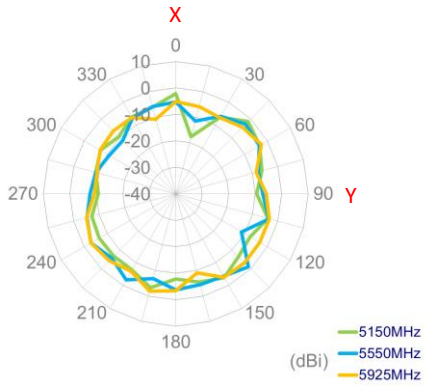


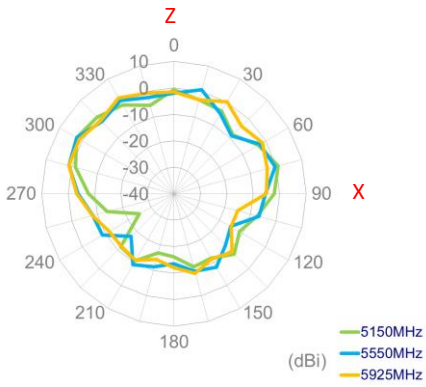


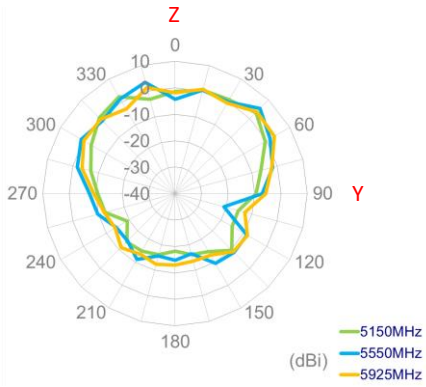
5550MHz



XY Plane	XZ Plane	YZ Plane

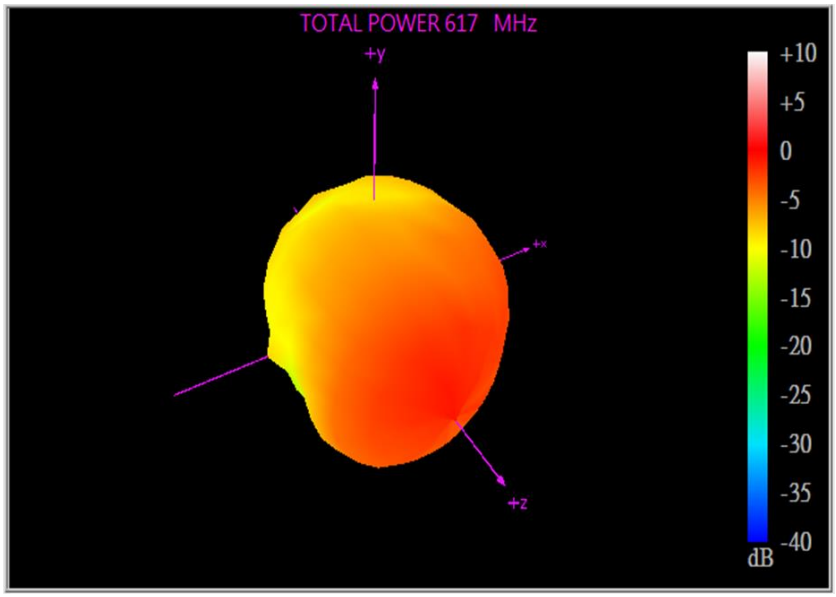


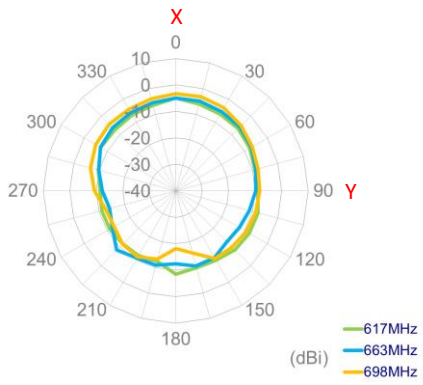
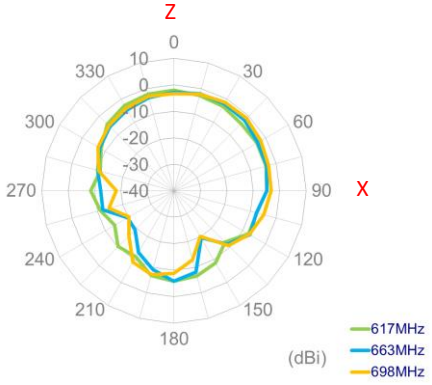
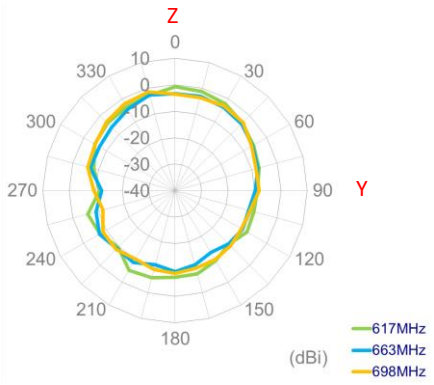




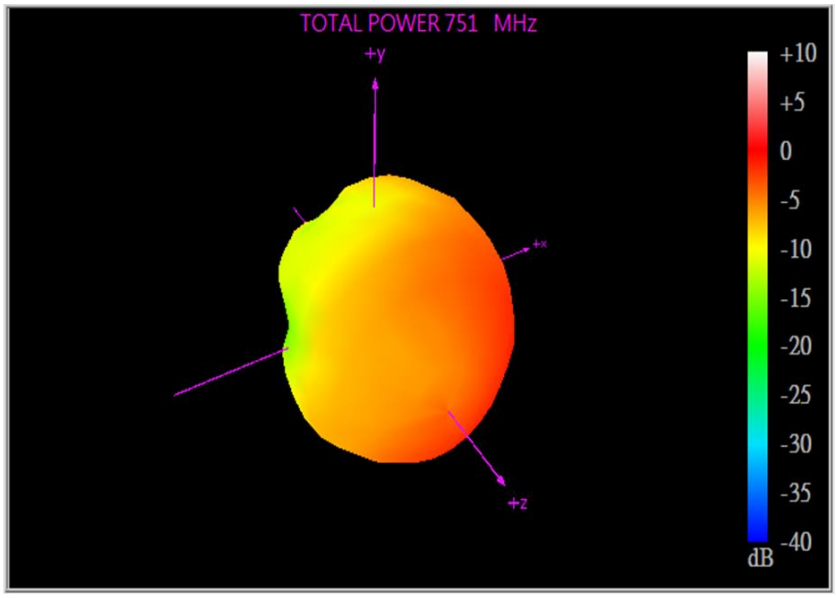
5.4 5G/4G MIMO 3 Radiation Pattern

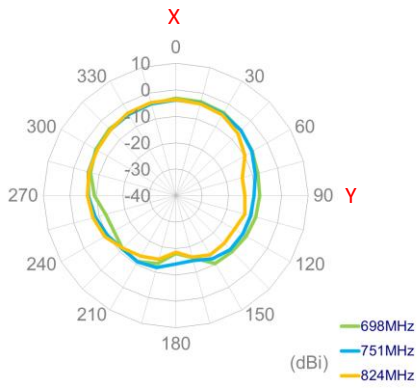
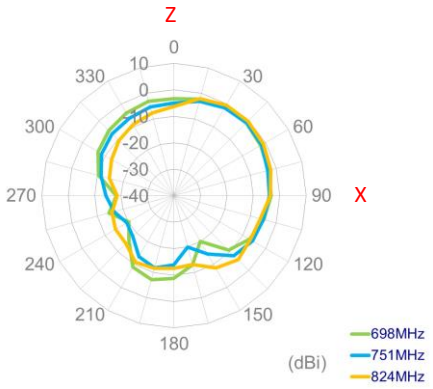
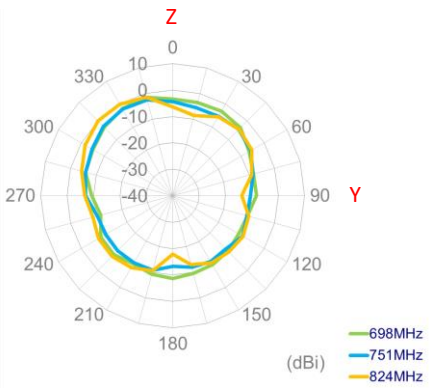
663MHz



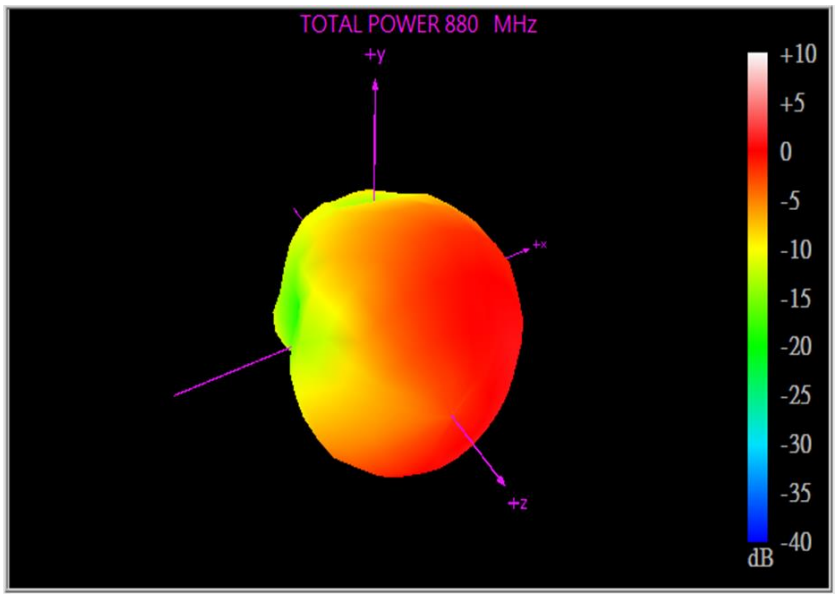
XY Plane	XZ Plane	YZ Plane
		

751MHz

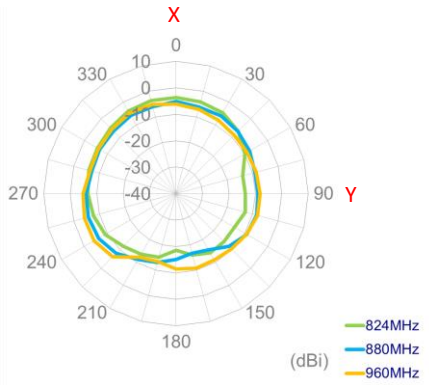


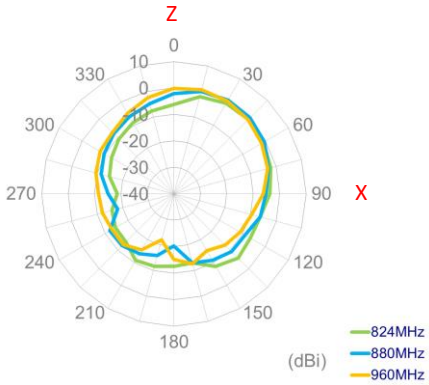
XY Plane	XZ Plane	YZ Plane
		

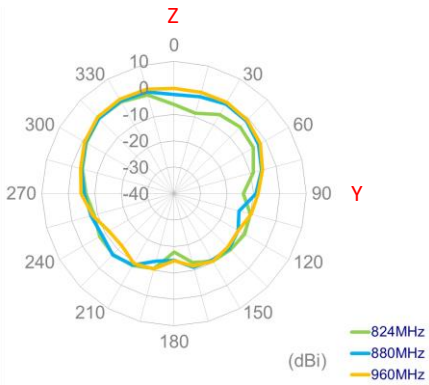
880MHz



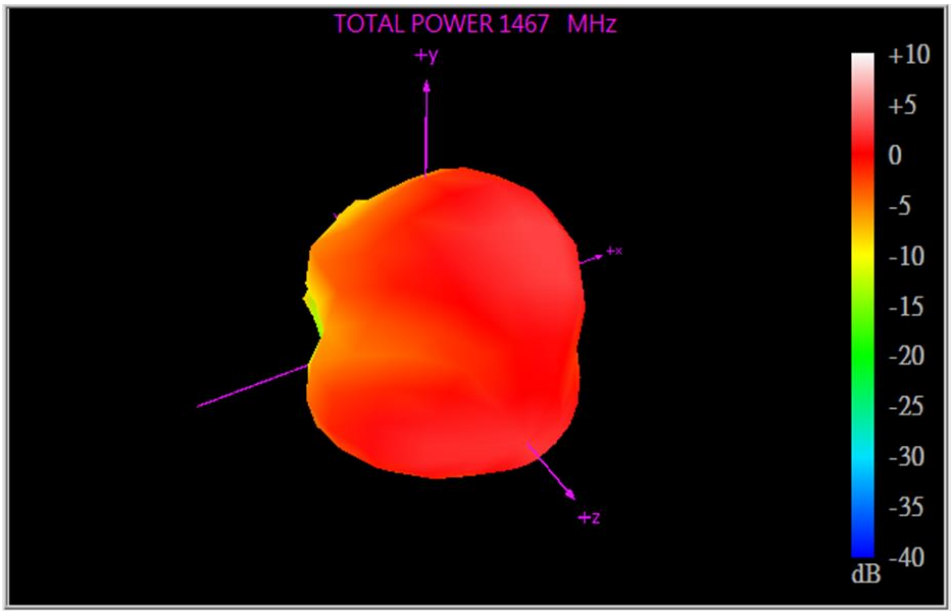
XY Plane	XZ Plane	YZ Plane



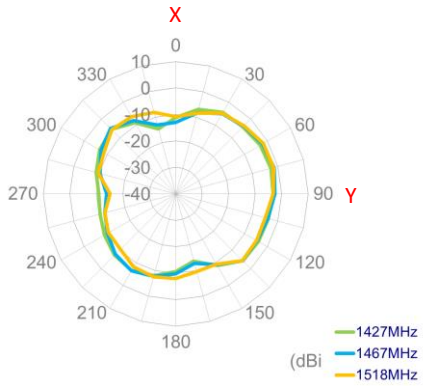


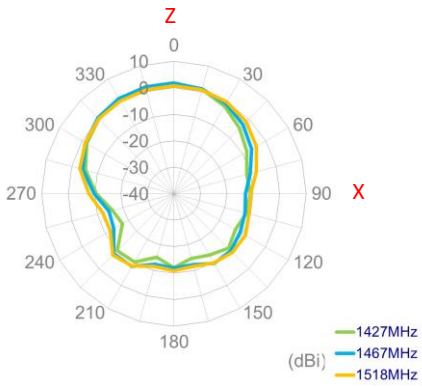


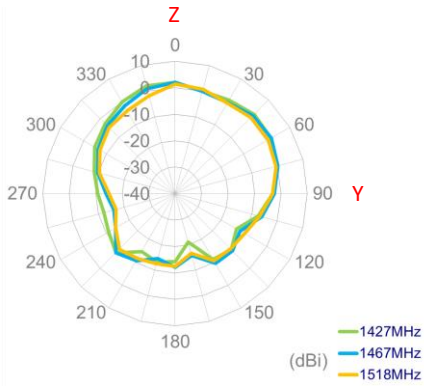
1467MHz



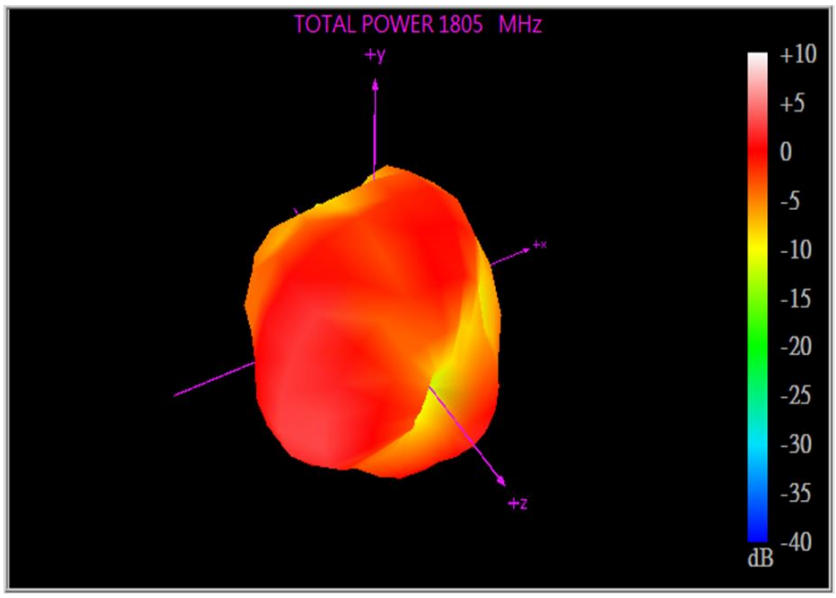
XY Plane	XZ Plane	YZ Plane

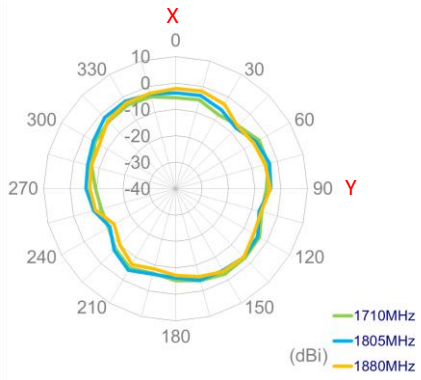
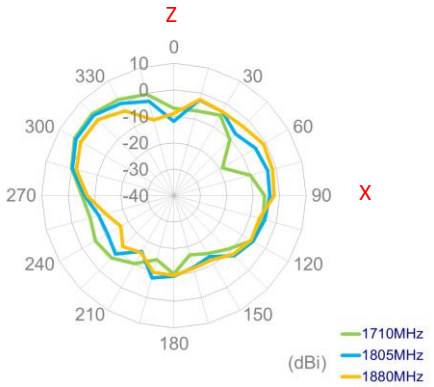
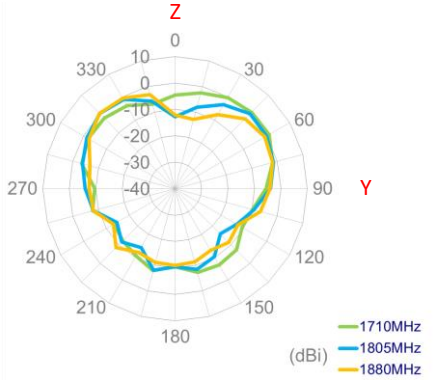




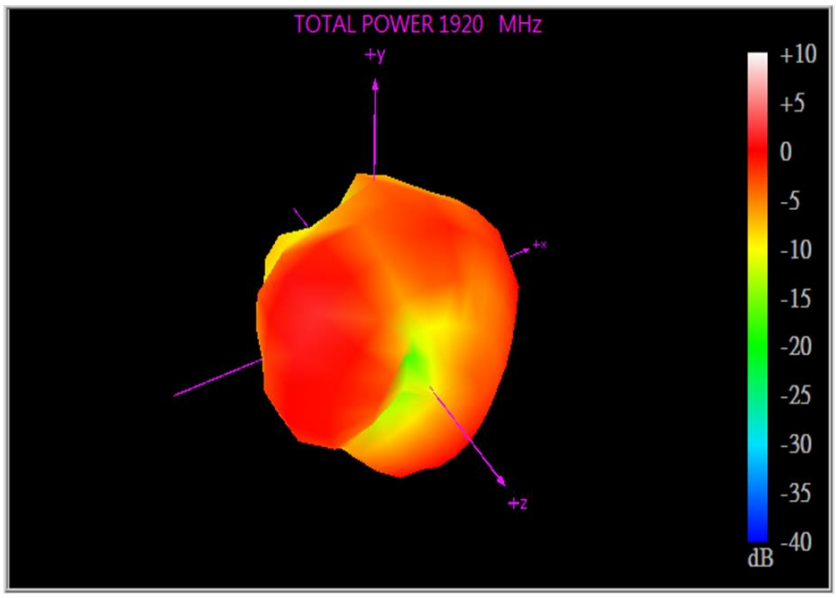


1805MHz

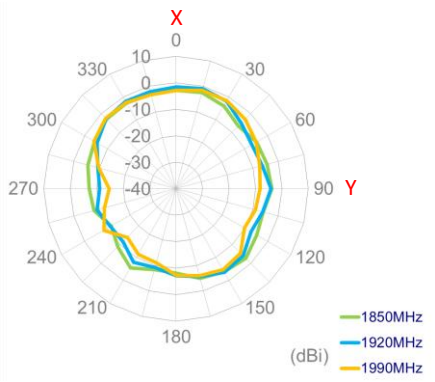


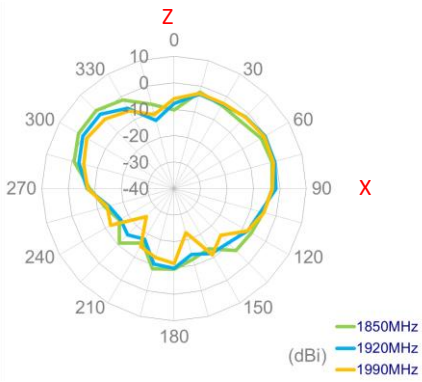
XY Plane	XZ Plane	YZ Plane
		

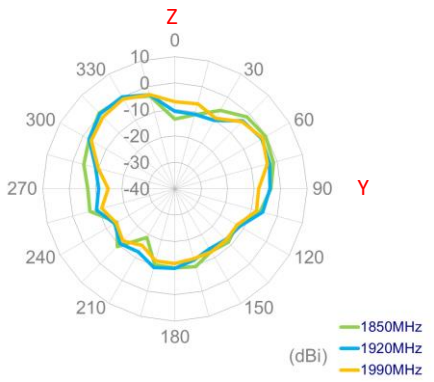
1920MHz



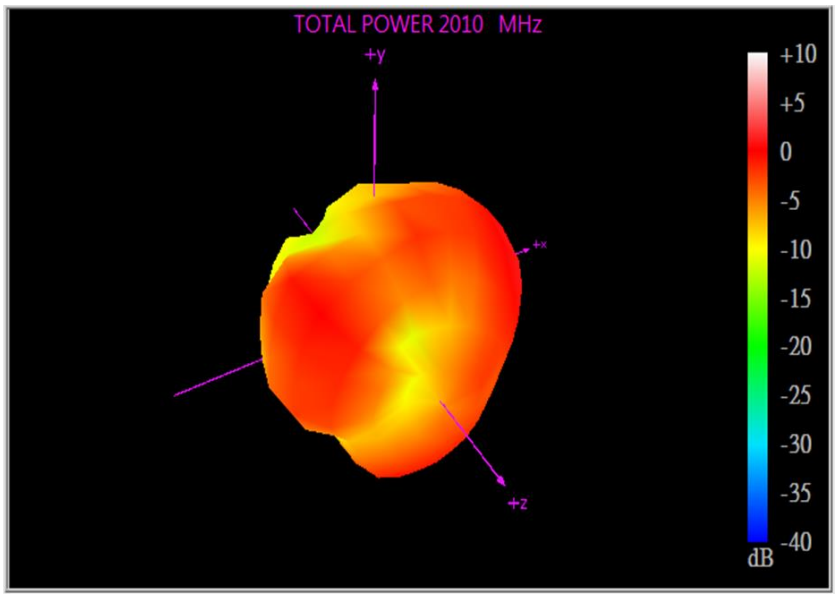
XY Plane	XZ Plane	YZ Plane



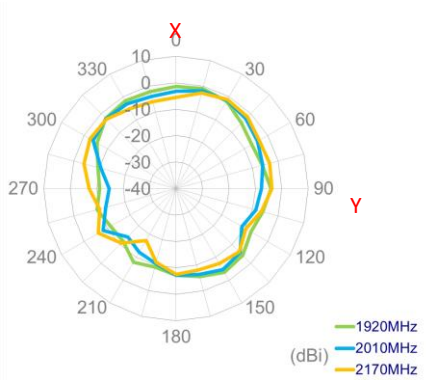


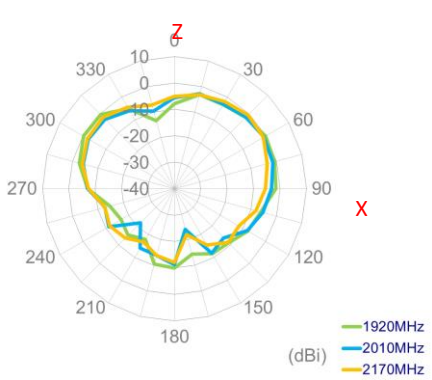


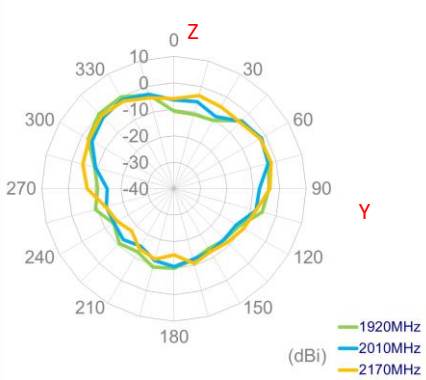
2010MHz



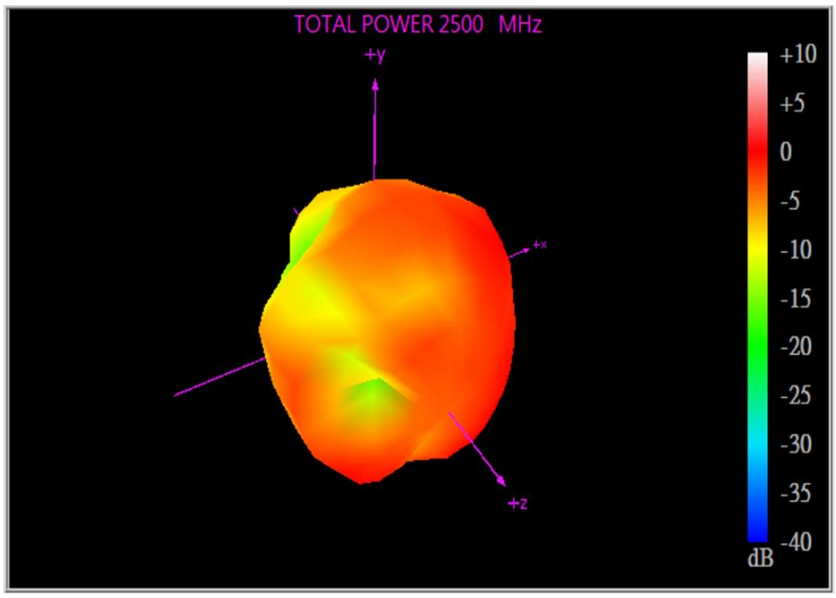
XY Plane	XZ Plane	YZ Plane



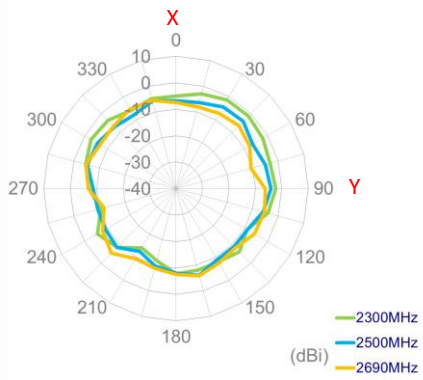


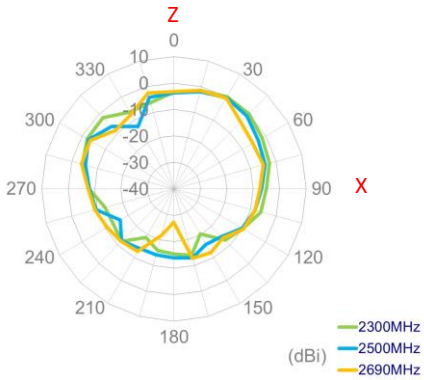


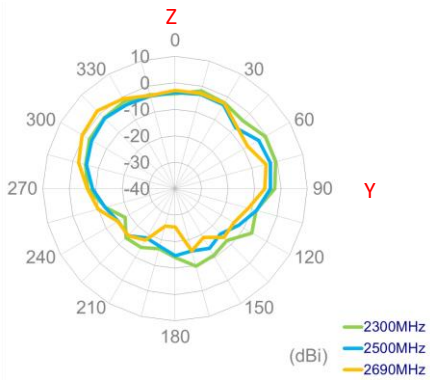
2500MHz



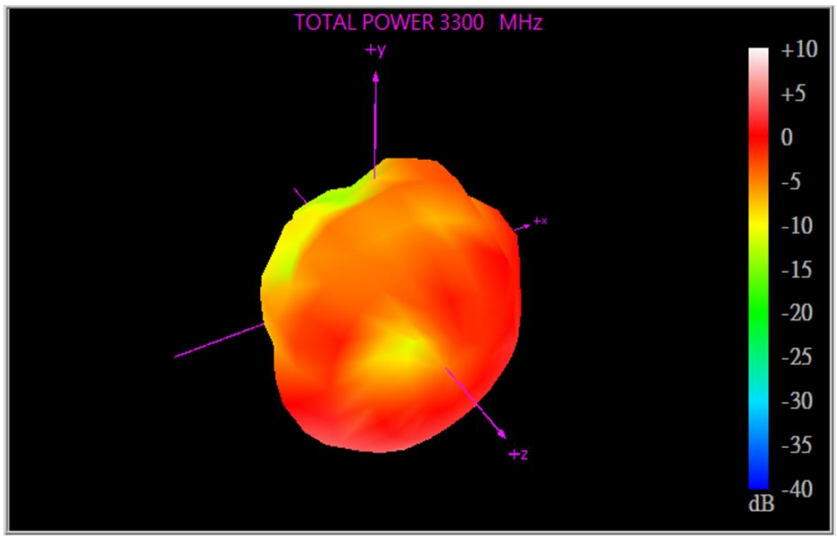
XY Plane	XZ Plane	YZ Plane



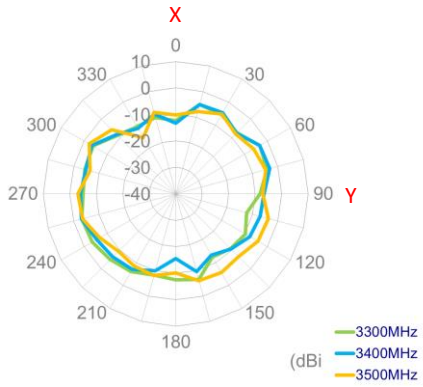


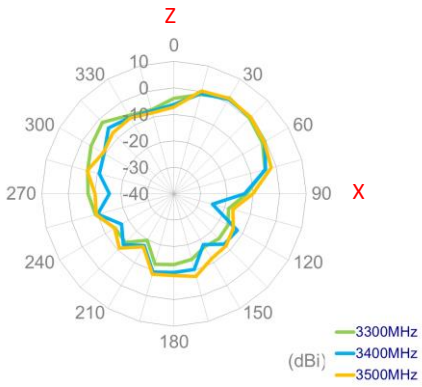


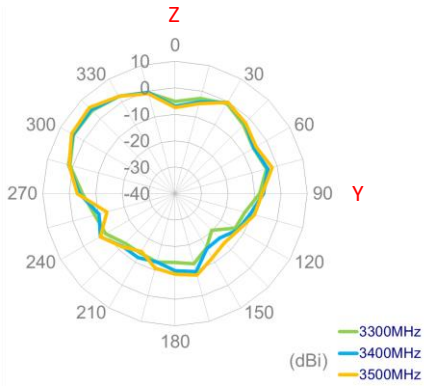
3300MHz



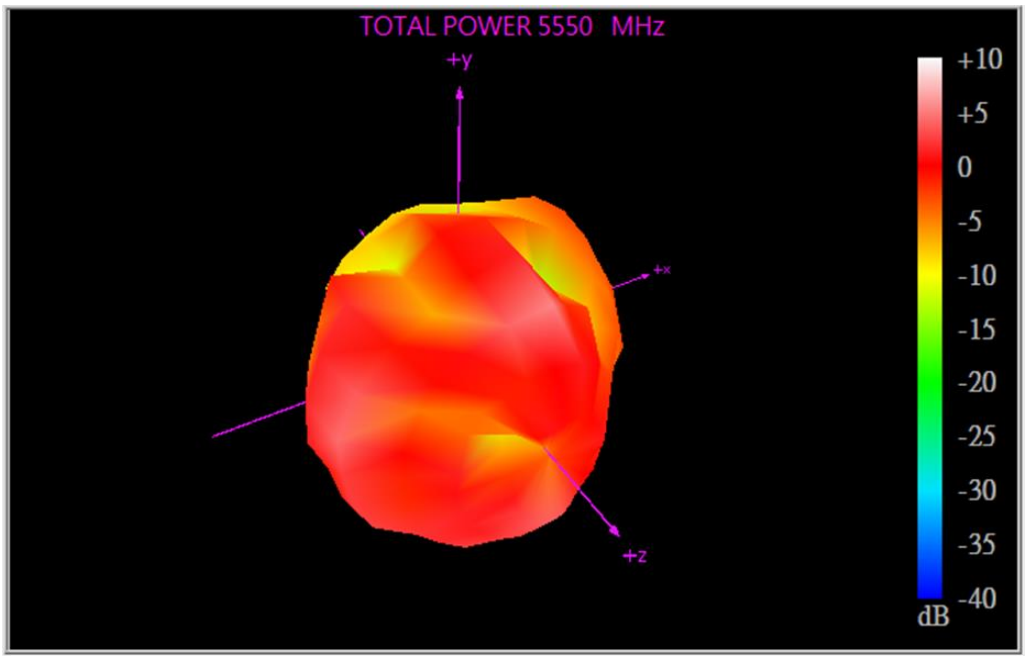
XY Plane	XZ Plane	YZ Plane



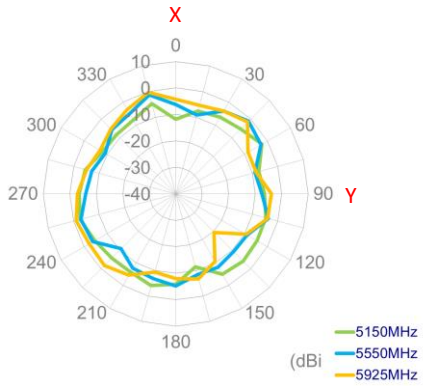


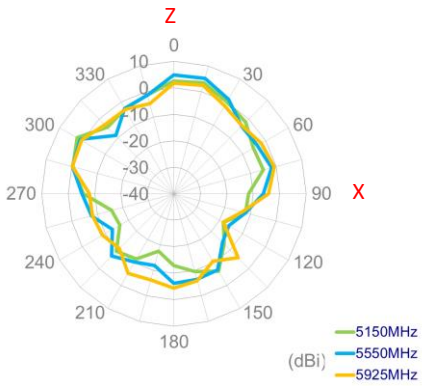


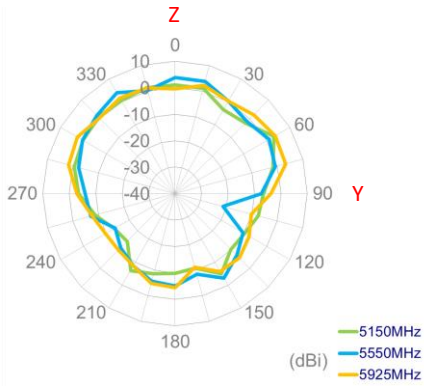
5550MHz



XY Plane	XZ Plane	YZ Plane

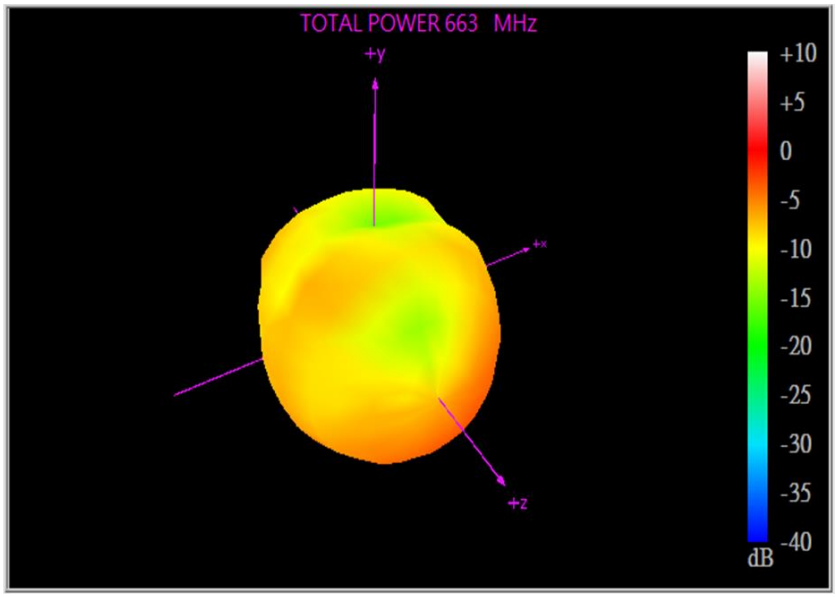




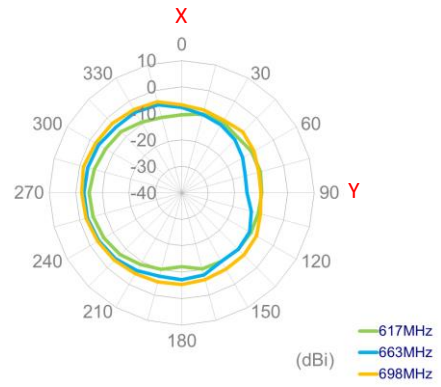


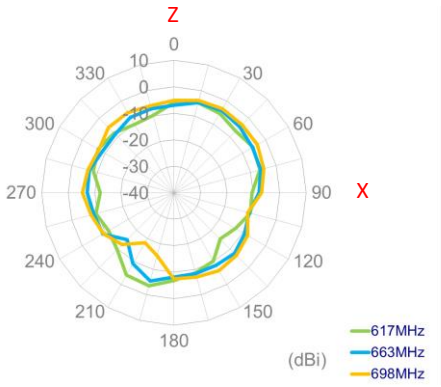
5.5 5G/4G MIMO 4 Radiation Pattern

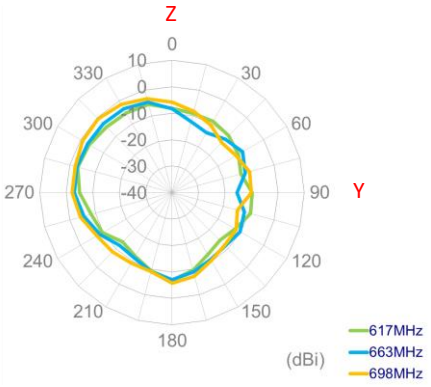
663MHz



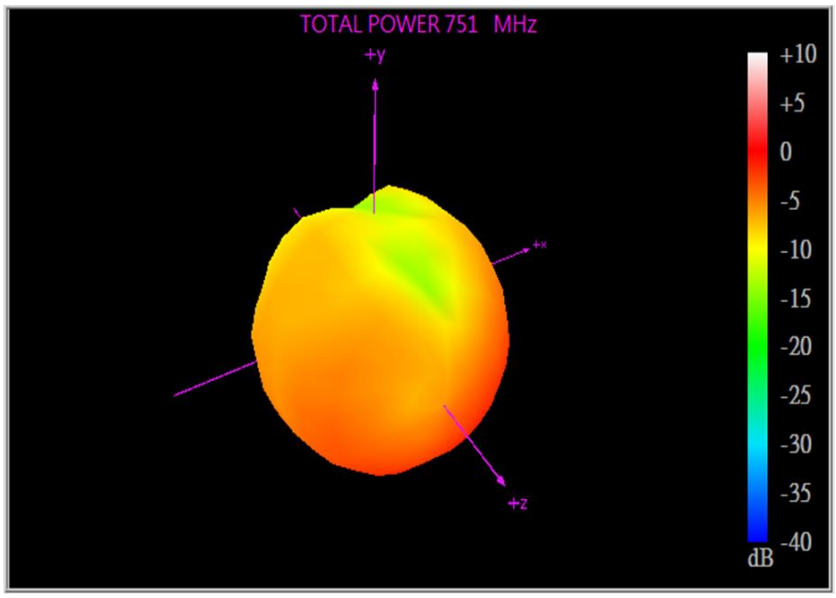
XY Plane	XZ Plane	YZ Plane

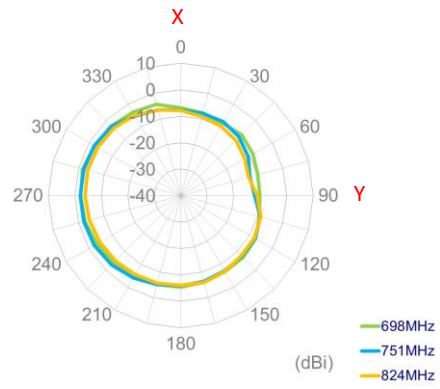
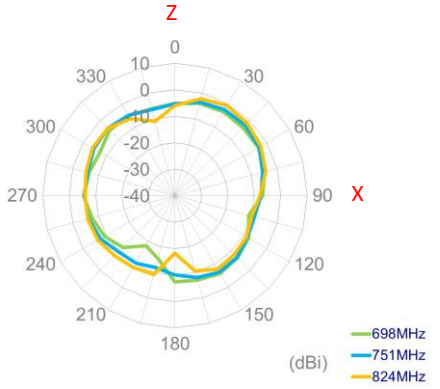
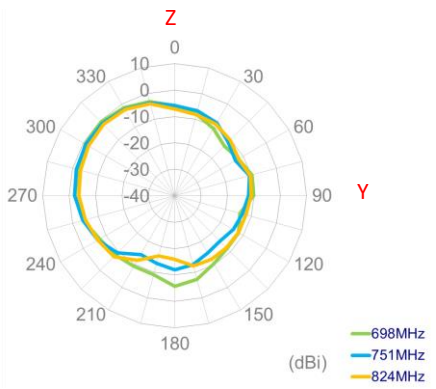




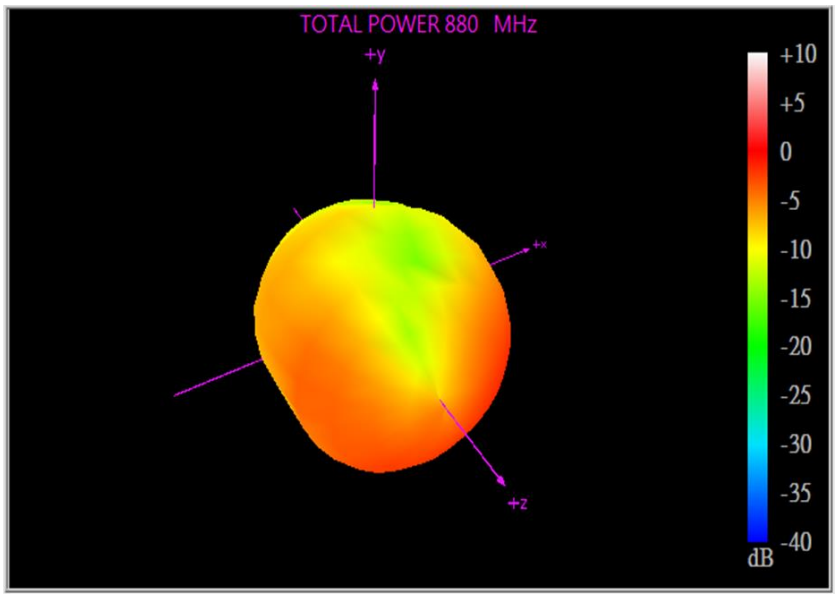


751MHz

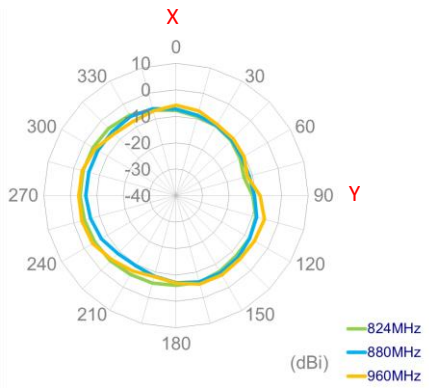


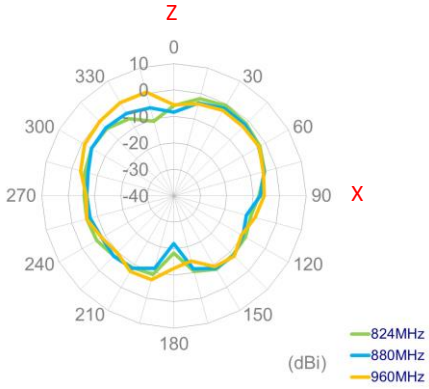
XY Plane	XZ Plane	YZ Plane
		

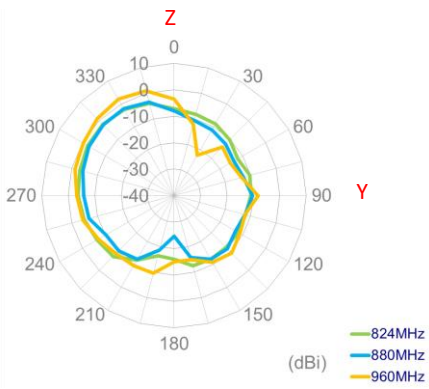
880MHz



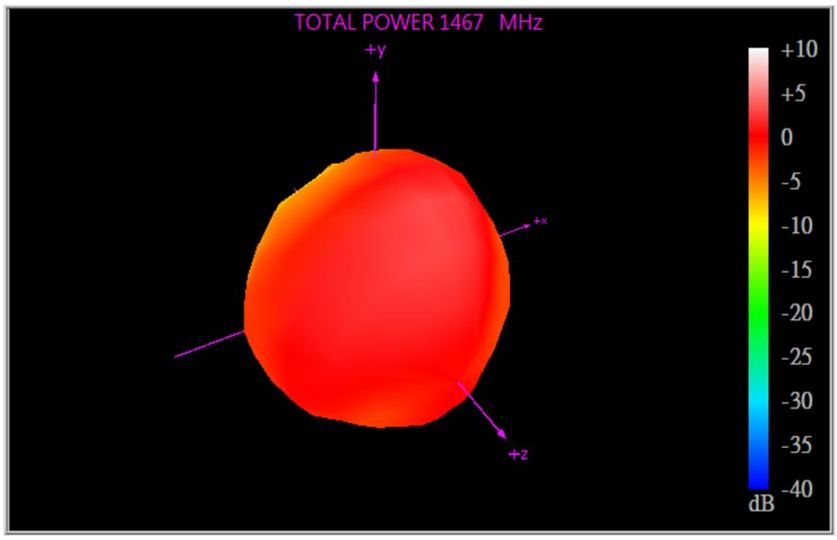
XY Plane	XZ Plane	YZ Plane



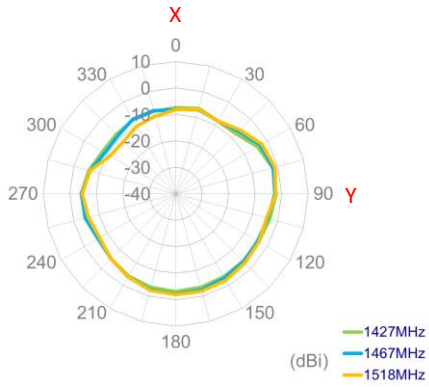


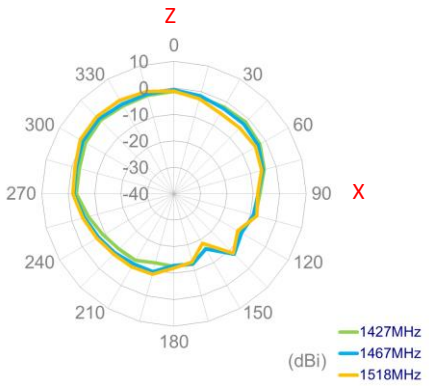


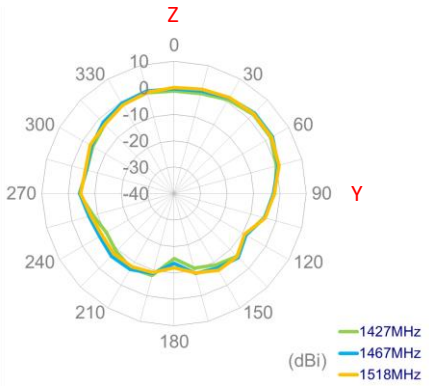
1467MHz



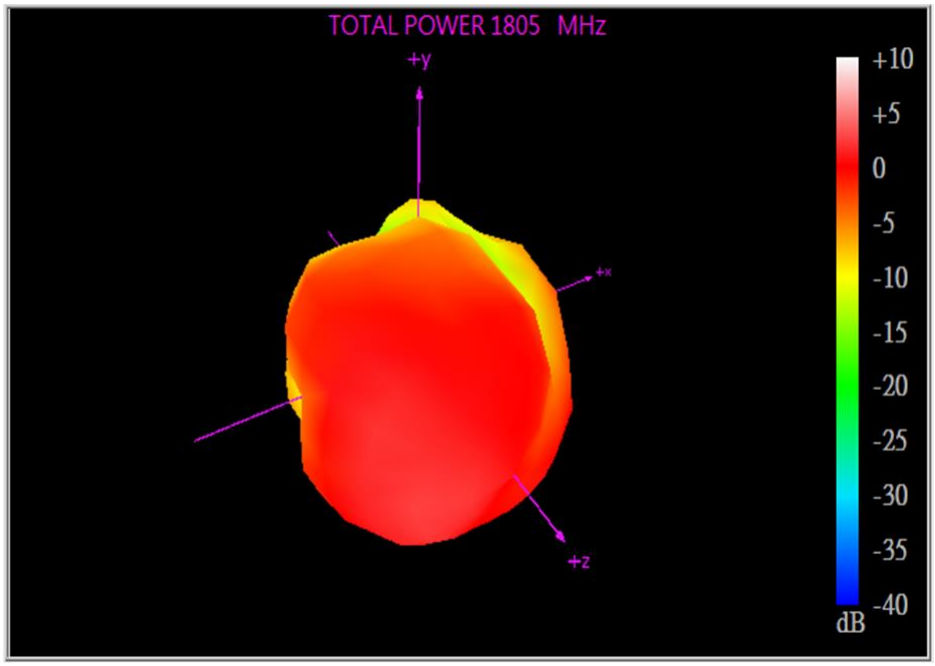
XY Plane	XZ Plane	YZ Plane

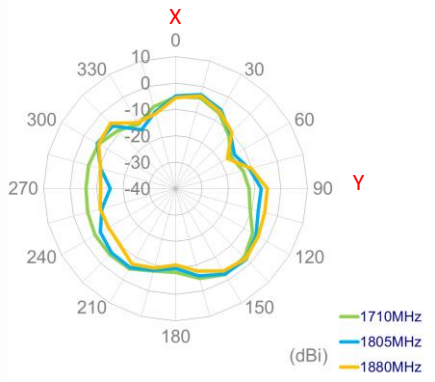
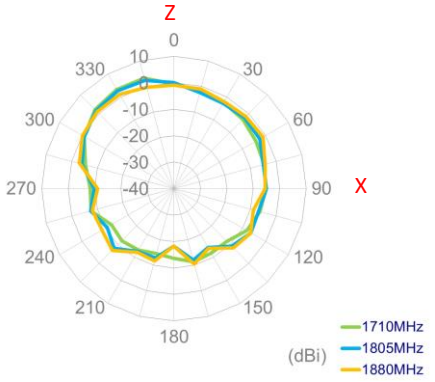
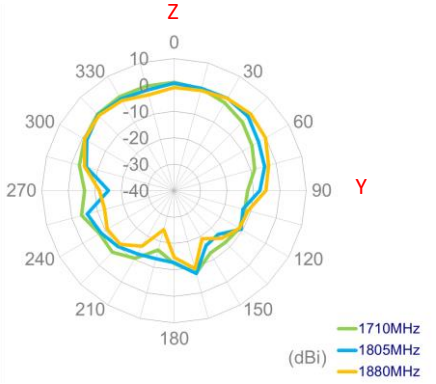




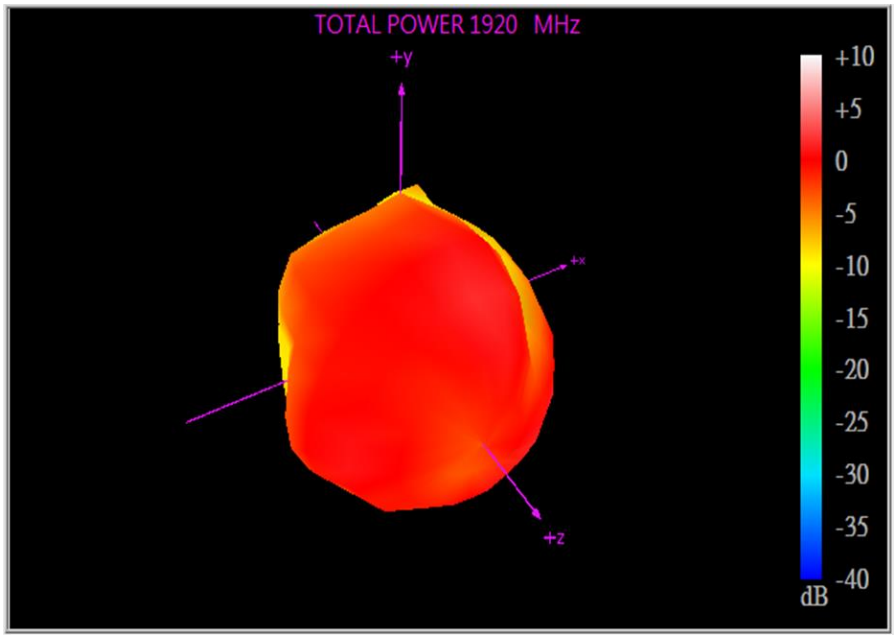


1805MHz

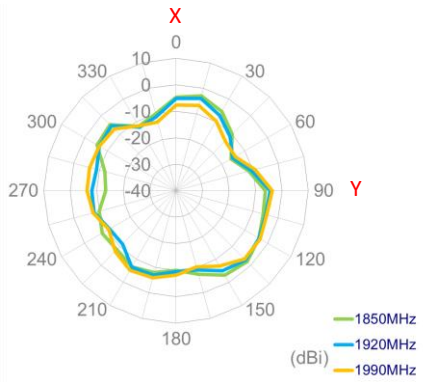


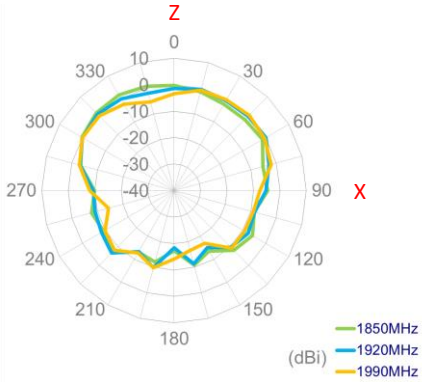
XY Plane	XZ Plane	YZ Plane
		

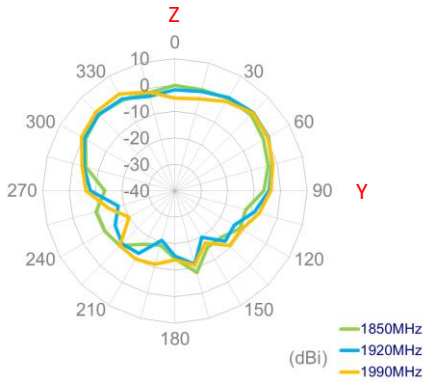
1920MHz



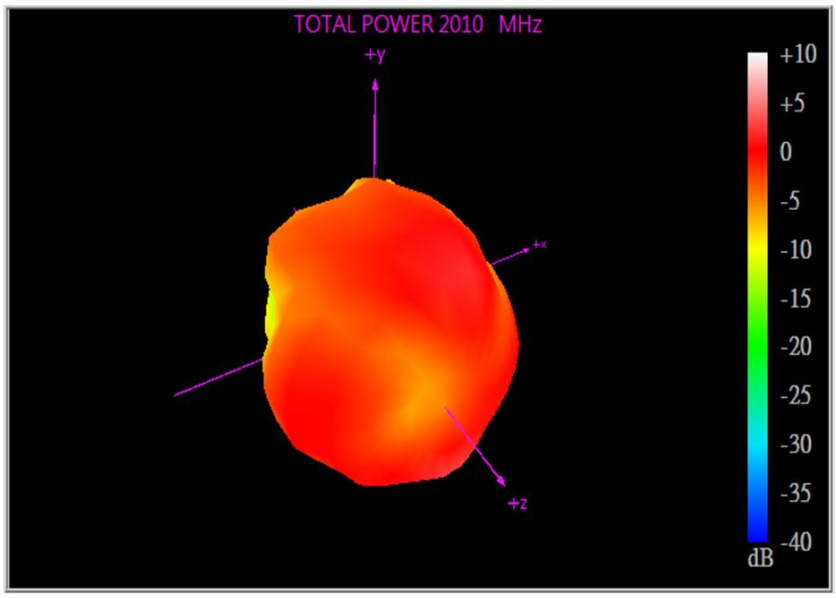
XY Plane	XZ Plane	YZ Plane



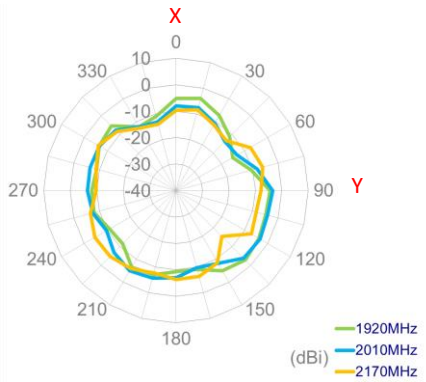


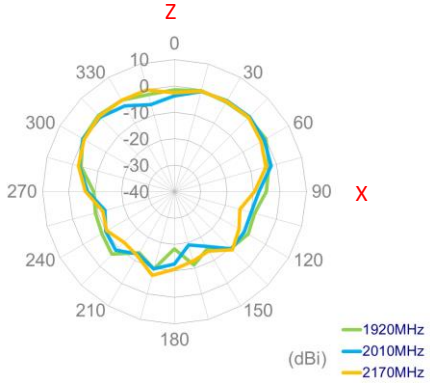


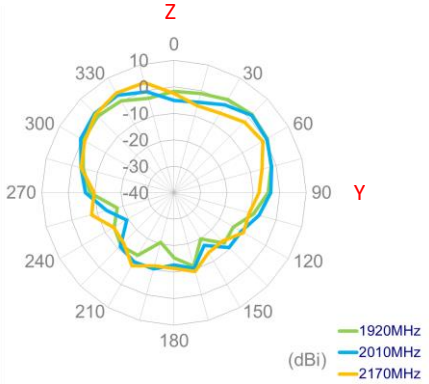
2010MHz



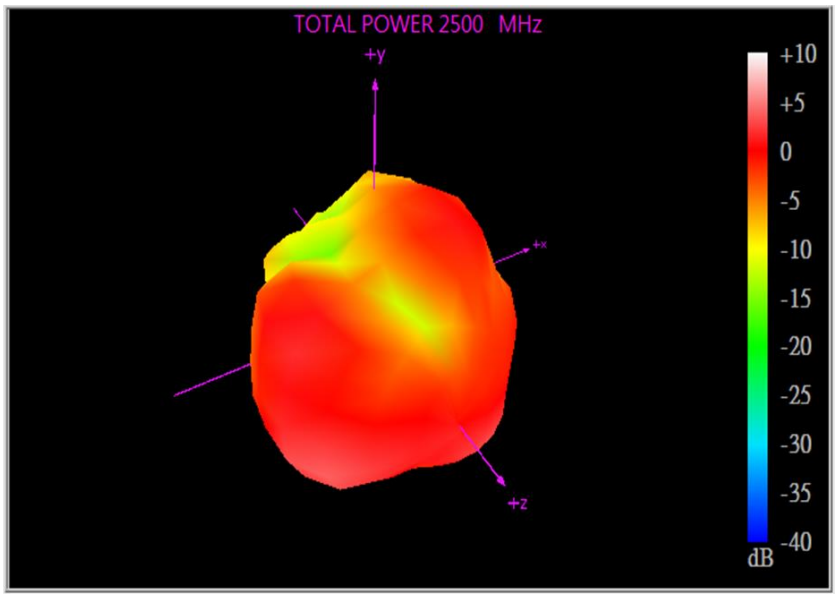
XY Plane	XZ Plane	YZ Plane



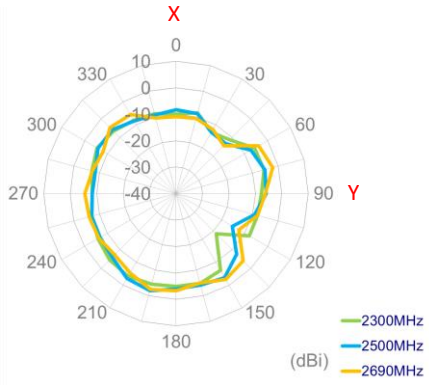


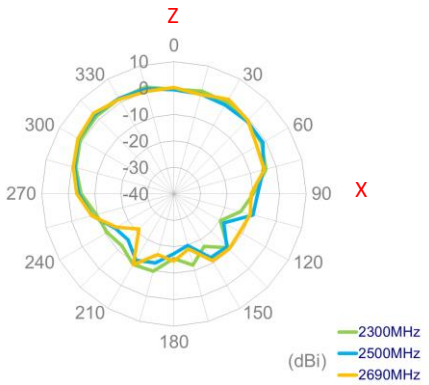


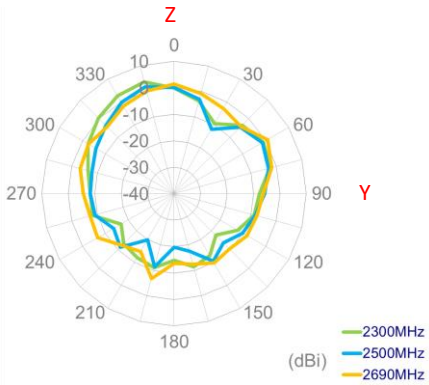
2500MHz



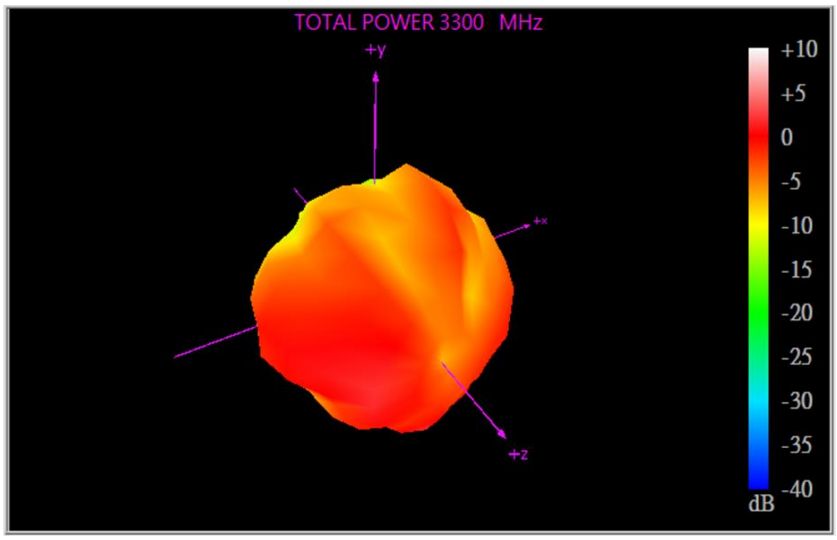
XY Plane	XZ Plane	YZ Plane



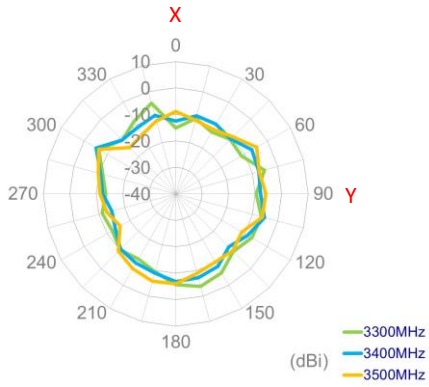


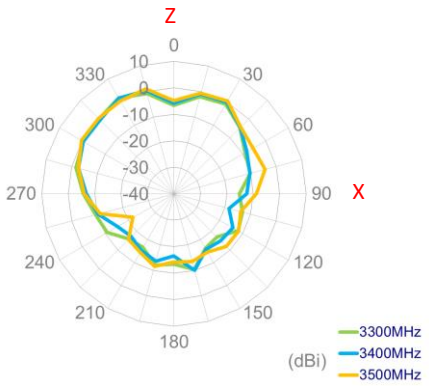


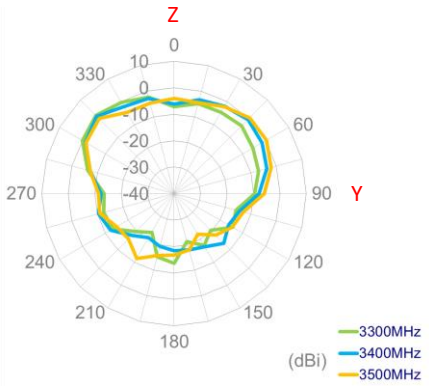
3300MHz



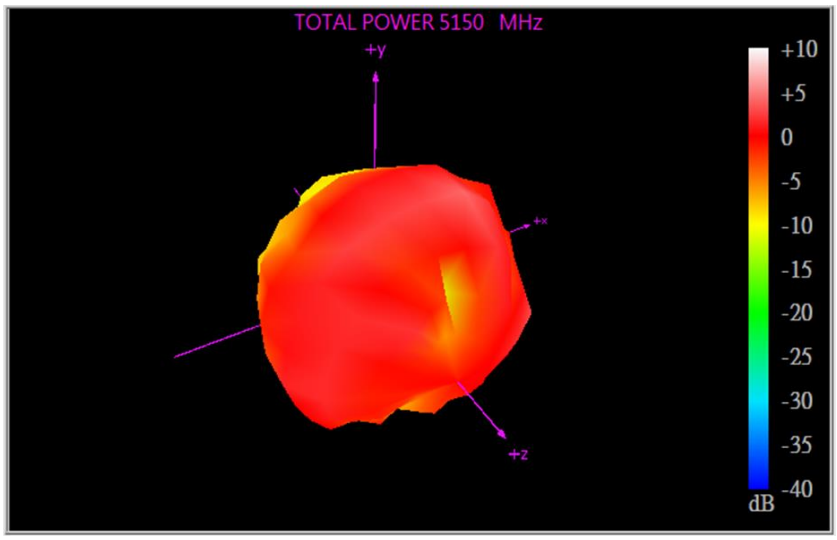
XY Plane	XZ Plane	YZ Plane



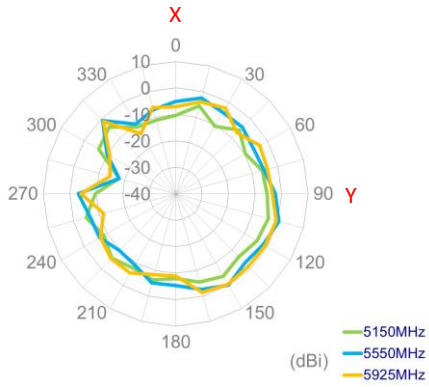


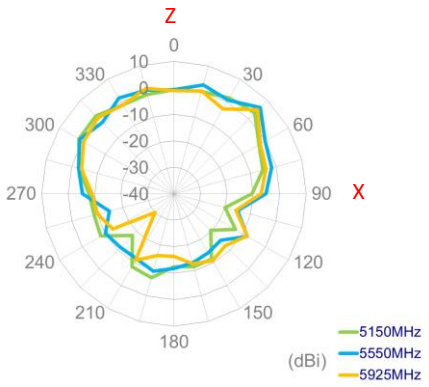


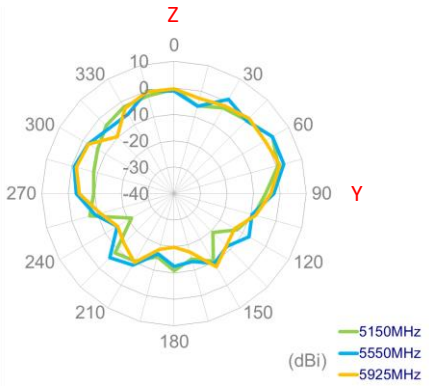
5150MHz



XY Plane	XZ Plane	YZ Plane

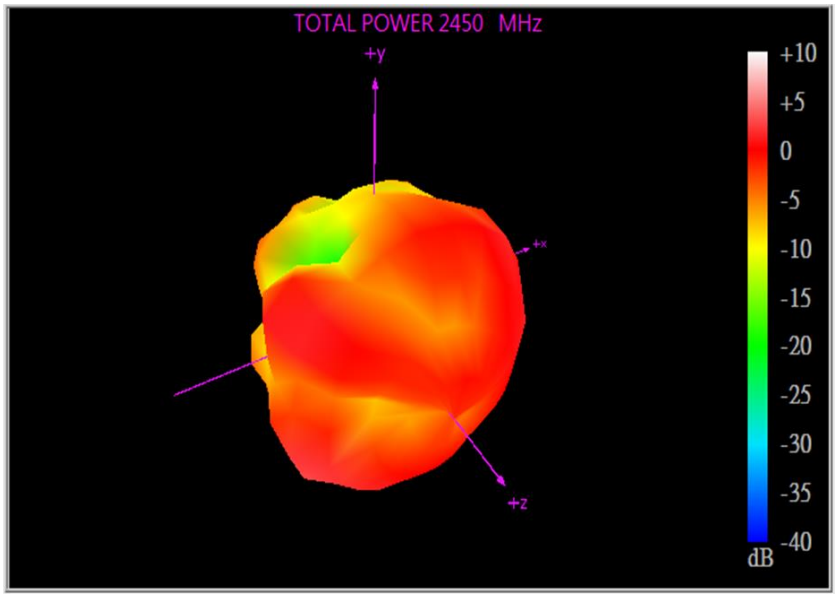




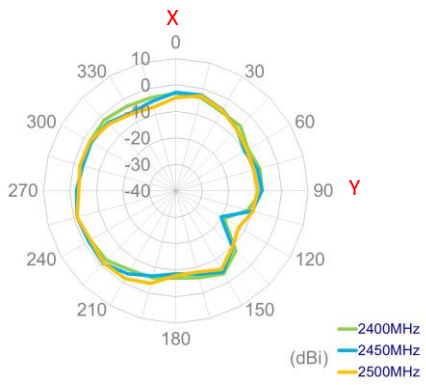


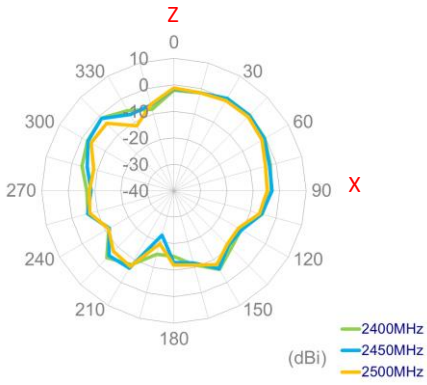
5.6 Wi-Fi MIMO 1 Radiation Pattern

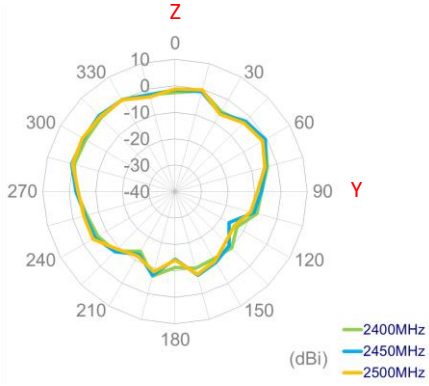
2450MHz



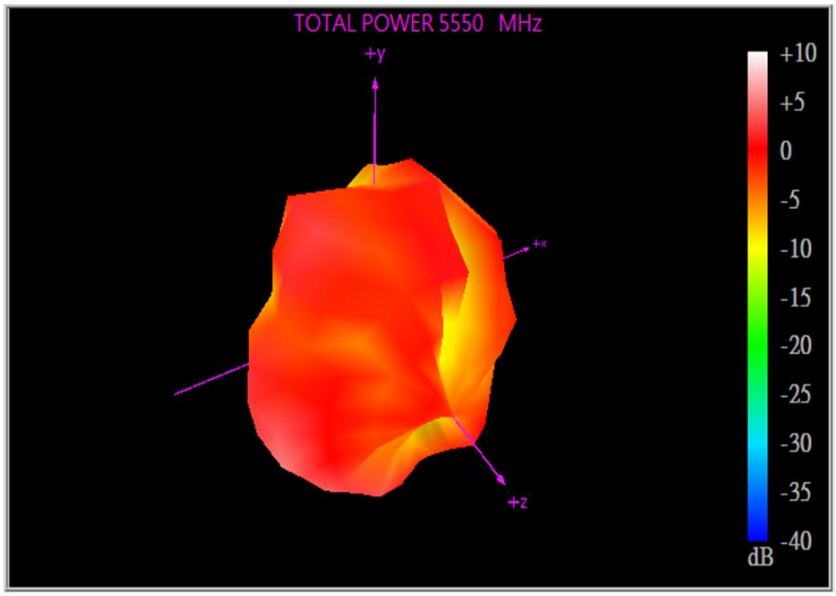
XY Plane	XZ Plane	YZ Plane



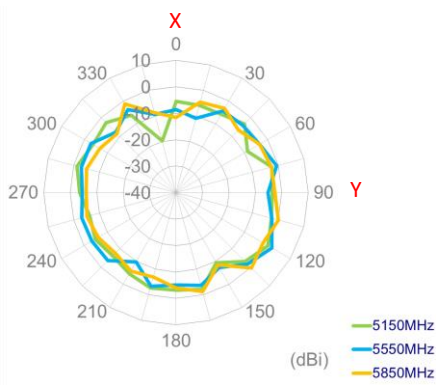


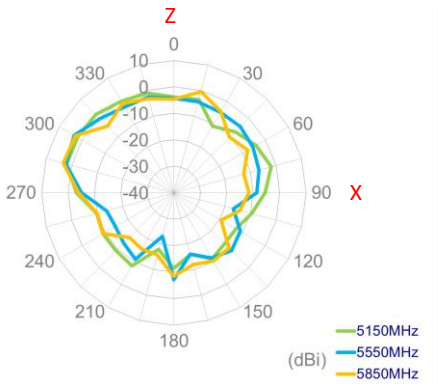


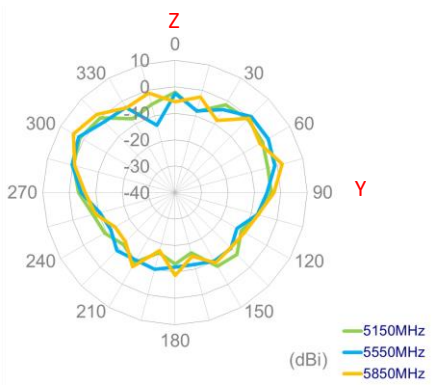
5550MHz



XY Plane	XZ Plane	YZ Plane

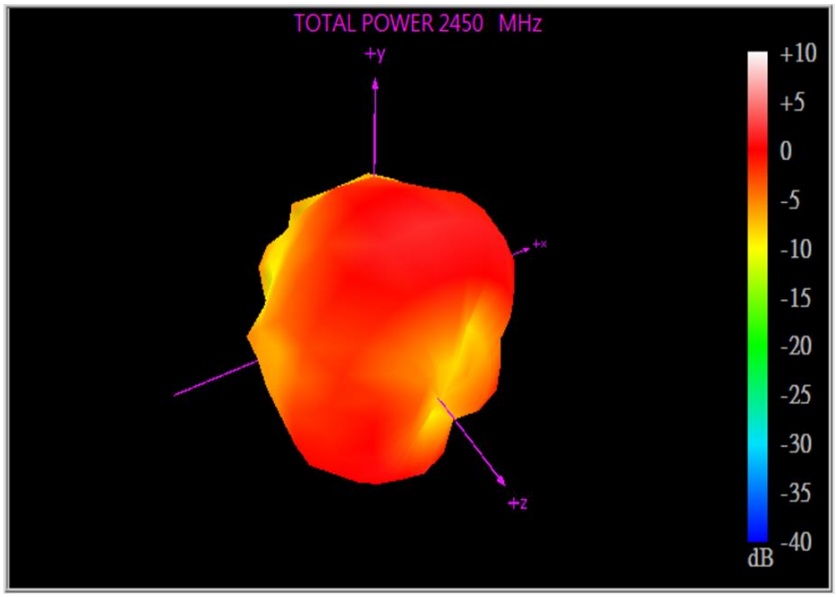




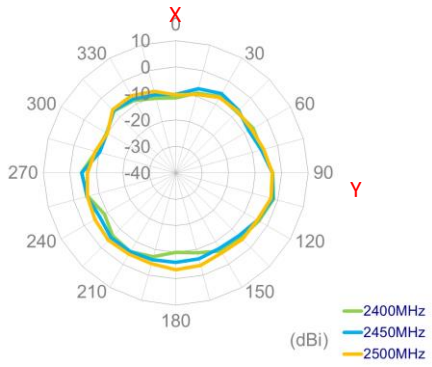


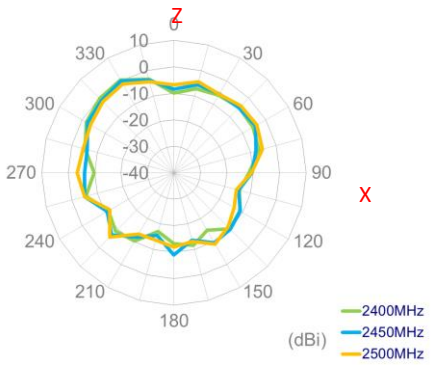
5.7 Wi-Fi MIMO 2 Radiation Pattern

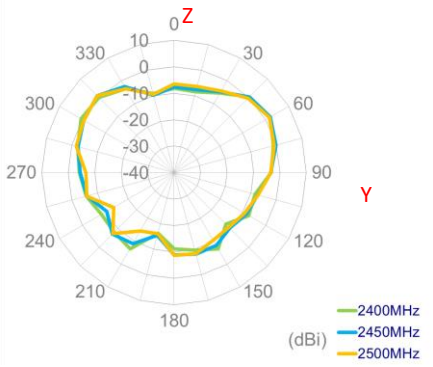
2450MHz



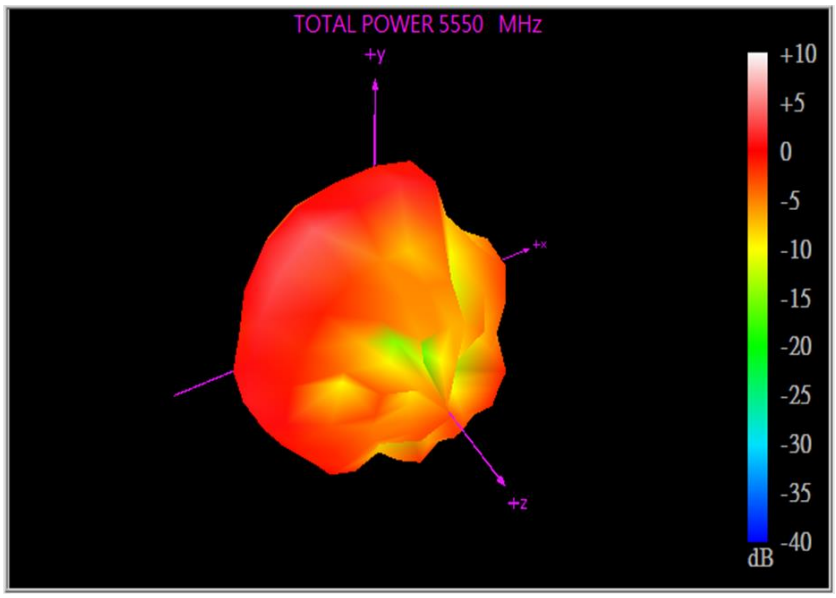
XY Plane	XZ Plane	YZ Plane



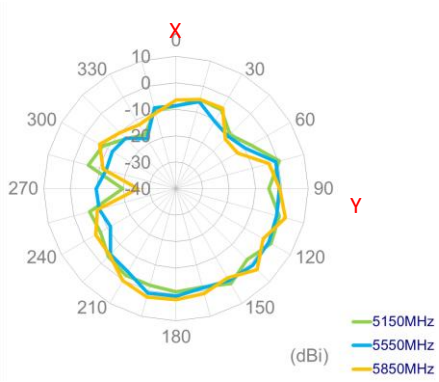


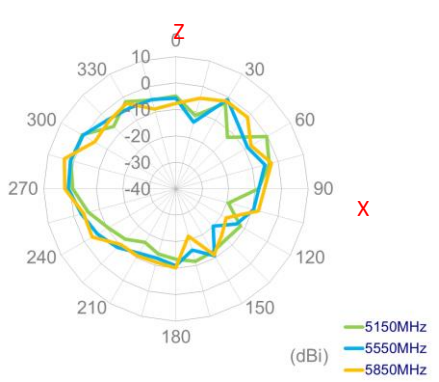


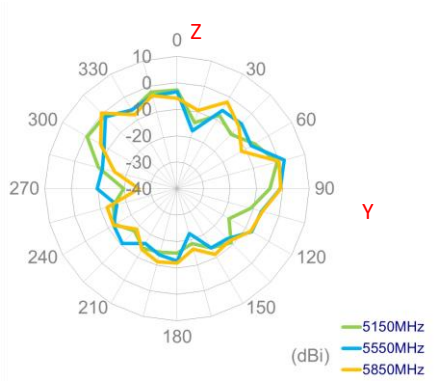
5550MHz



XY Plane	XZ Plane	YZ Plane

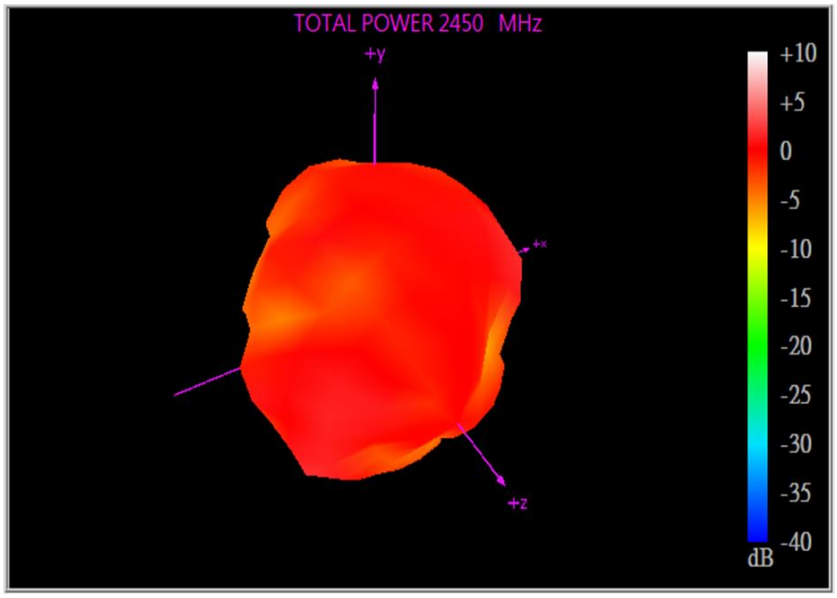




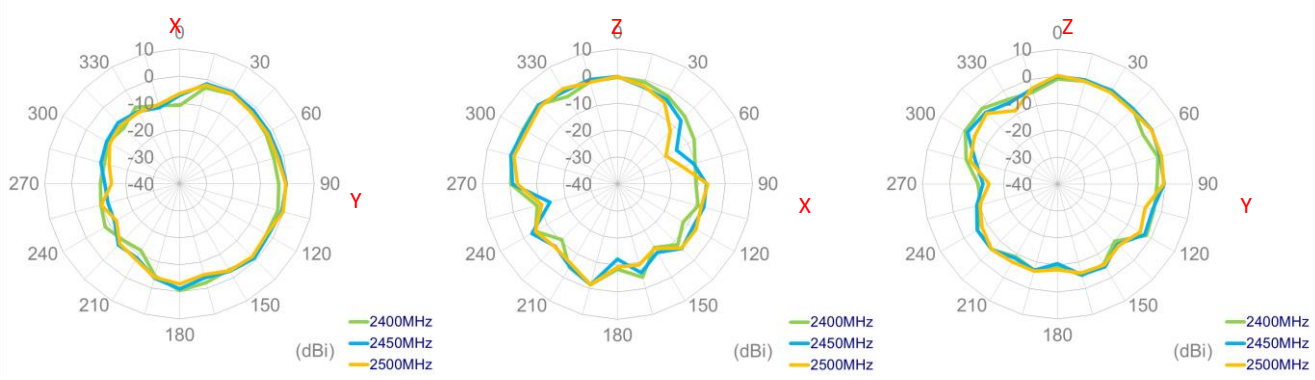


5.8 Wi-Fi MIMO 3 Radiation Pattern

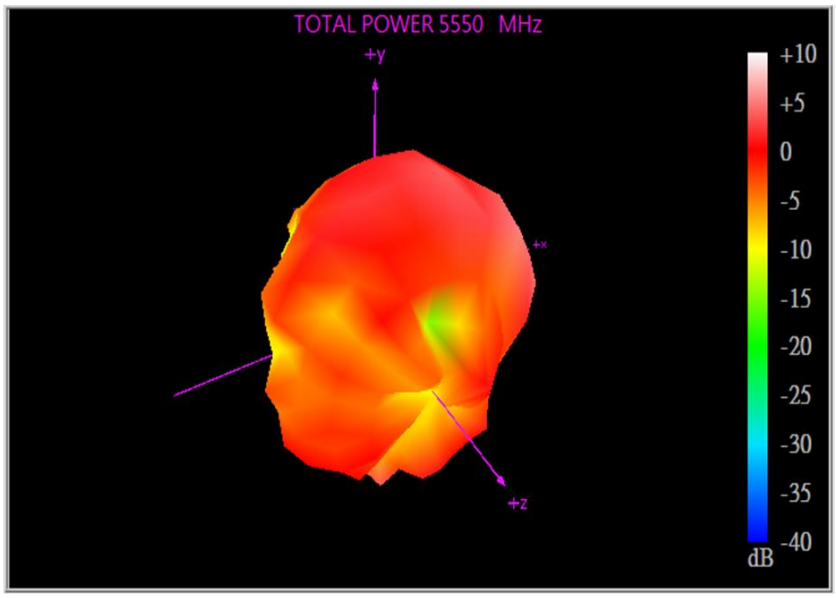
2450MHz



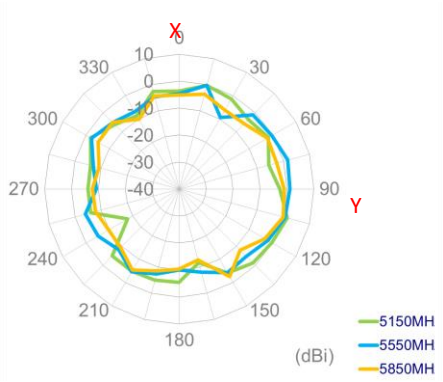
XY Plane	XZ Plane	YZ Plane

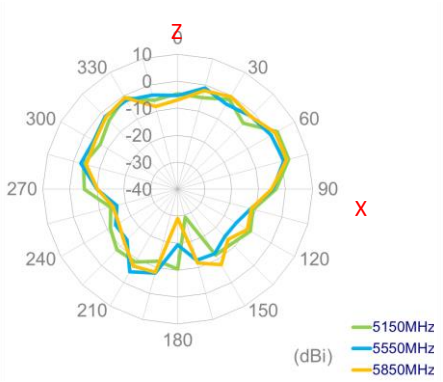


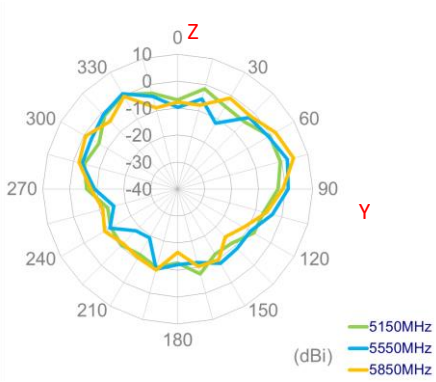
5550MHz



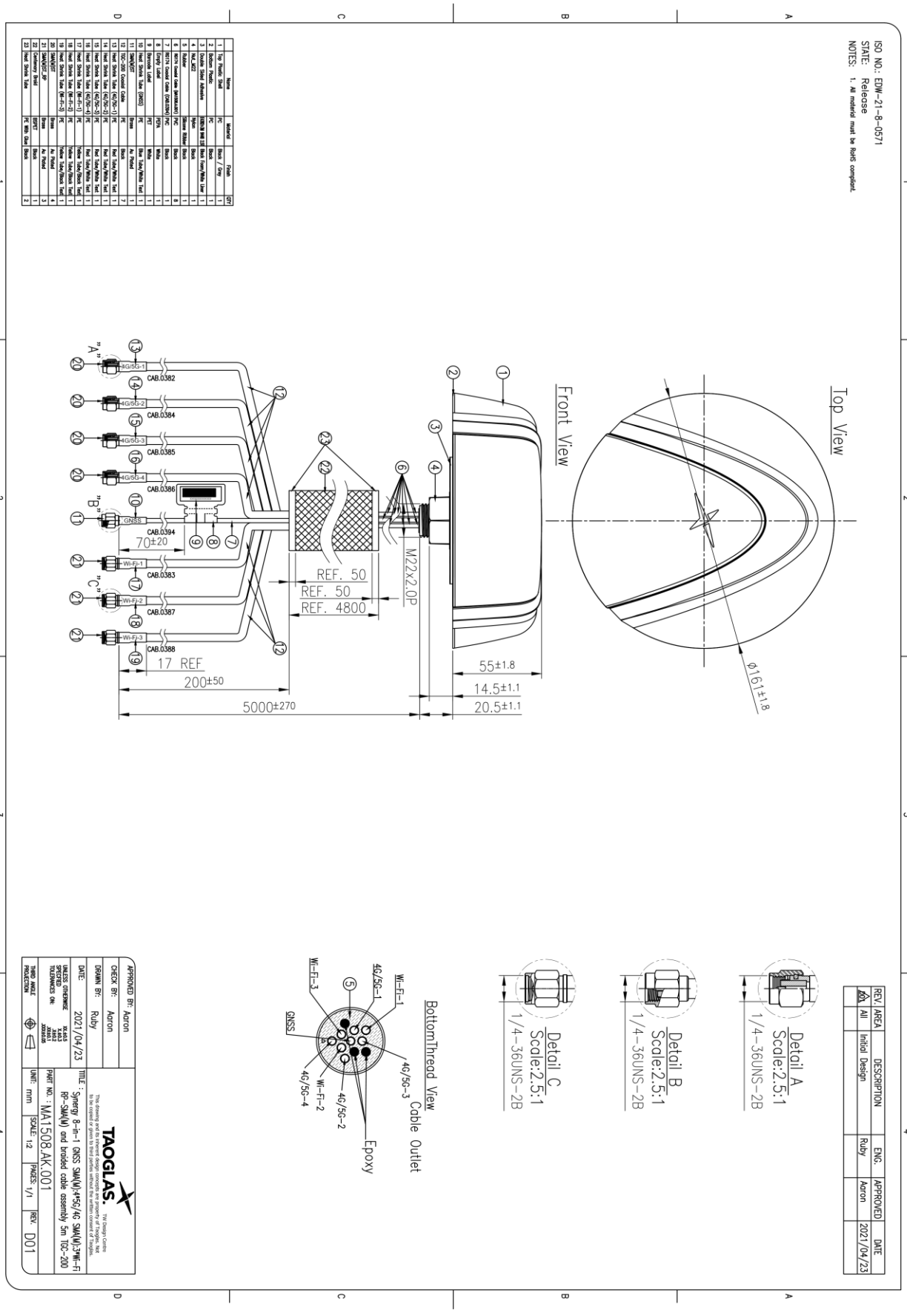
XY Plane	XZ Plane	YZ Plane







6. Mechanical Drawing (Units: mm)



ITEM	QTY	Name	Material	Finish
1	1	Top Plastic Shell	PC	Gloss / Grey
2	1	Bottom Plastic	PC	Gloss
3	1	Double Shot Adhesive	ISOPLAST 301	Black Translucent
4	1	Nut_M22	Nylon	Black
5	1	Rubber Gasket (use waterproof)	Silicone Rubber	Black
6	1	M8TX Coaxial Cable (MA1508.AK)	PVC	Black
7	8	Empty Label	PDPA	White
8	1	Barcode Label	PET	White
9	1	Heat Shrink Tube (Ø8S)	PE	Blue Tube/White Text
10	1	SMA(M)RF	Brass	Au Plated
11	1	RG316 Coaxial Cable	PE	Red Tube/White Text
12	2	Heat Shrink Tube (4G/5G-1)	PE	Red Tube/White Text
13	1	Heat Shrink Tube (4G/5G-2)	PE	Red Tube/White Text
14	1	Heat Shrink Tube (4G/5G-3)	PE	Red Tube/White Text
15	1	Heat Shrink Tube (4G/5G-4)	PE	Red Tube/White Text
16	1	Heat Shrink Tube (Wi-Fi-1)	PE	Yellow Tube/Black Text
17	1	Heat Shrink Tube (Wi-Fi-2)	PE	Yellow Tube/Black Text
18	1	Heat Shrink Tube (Wi-Fi-3)	PE	Yellow Tube/Black Text
19	1	Heat Shrink Tube (GNSS)	PE	Yellow Tube/Black Text
20	4	SMA(M)RP	Brass	Au Plated
21	3	SMA(M)F_IP	Brass	Au Plated
22	1	Centering Bead	EDPET	Black
23	1	Heat Shrink Tube	PE With Glue	Black

REV.	AREA	DESCRIPTION	ENG.	APPROVED	DATE
A	All	Initial Design	Ruby	Aaron	2021/04/23

7. Installation Guidelines

Installation Instructions

Synergy Series

GNSS, 5G/4G and Wi-Fi Permanent Mount Combination Antenna

A Introduction

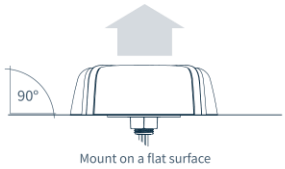
The Taoglas Synergy is an external permanent mount combination antenna. The Synergy can be provided with combinations of 5G/4G, active GNSS with front end saw and dual-band Wi-Fi. The Synergy is available with two versions of the enclosure, one designed specifically for the Ford Interceptor, both supplied with 3M adhesive, along with an M22 threaded boss for surface attachment. The Synergy is ideal for vehicle panels of up to 6mm(0.23") thick with a threaded boss length of 20.5mm(0.81").
The Synergy is IP67 rated and includes an O-Ring to seal from any water ingress.

Electrical Safety
The GPSD, SHK[G] & GPSDC contain an active GPS/GNSS antenna.
Rated voltage: 3-5VDC Rated current: 20mA maximum
The supply to this device must be provided with overcurrent protection of 1A maximum.

Power consumption@1.8V (mA) 8.7 mA
Power consumption@3.0V (mA) 9.0 mA
Power consumption@5.5V (mA) 11 mA

B Mounting & Location

For prime performance, the Synergy is recommended to be fitted on a conductive metal panel. When fitting on a non-metallic panel, a conductive metal ground plane of suitable size should be fitted underneath the mounting panel to achieve a better level of performance. Optimum ground plane size is 300mm x 300mm(11.8" x 11.8"). When mounting on a vehicle roof panel ensure to mount on a flat surface, and measure for central position. Care should be taken to mount the Synergy antenna as far as possible from other roof-mounted features such as the aircon unit, light bar etc.



Mount on a flat surface

Sealing
In order to ensure that the installation is properly sealed against the mounting surface care must be taken regarding curvature of the mounting panel. It is highly recommended to install the antenna on a clean, flat and level surface. After installation the compression of the rubber boot against the mounting panel should be checked and a small bead of neutral cure silicone sealant can be applied around the periphery of the mounting boot if required.

C Mounting Hole

When preparing to drill the hole, mask the area around the hole position to protect the surface. Drill a pilot hole and increase the hole size to 24mm(7/8") dia. Ensure the drill bit does not contact the headliner. Deburr and clean the area around the hole carefully removing all waste.

Remove paint and primer from under panel surface to ensure adequate earth contact by washer and nut. Apply petroleum jelly or paint around cut edge of the hole to prevent corrosion

Synergy/IG-19-8-001 www.taoglas.com

D Installation of the Antenna

Peel away the 3M adhesive protective and feed the cables through the hole. Position the antenna over the hole and press down onto the panel with pressure. A split nut is used to easily fit onto the thread through the cables. The nut is attached from the underside of the panel, it should easily twist onto the thread and only a final tighten by spanner is required.

E Routing and Connection of the Cables

The Cables supplied are RG-174 for the GNSS feed and TGC-200 for the other feeds. The heatshrink will denote which cable is which for ease of installation. Connect each individual connector to the correct port of the router, if any cable is unused please fit a 50Ω terminator to the individual connection.

G Notices

Caution
To comply with FCC RF Exposure requirements in section 1.1310 of the FCC Rules, antennas used with this device must be installed to provide a separation distance of at least 20 cm from all persons to satisfy RF exposure compliance.

Warning
Do not Operate the transmitter when someone is within 20 cm of the antenna.
Do not operate the equipment in an explosive atmosphere.

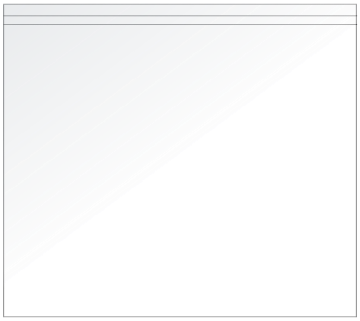
European Waste Electronic Equipment Directive 2002/96/EC
Please ensure that your old Waste Electricals and Electronics are recycled do not throw them away into standard waste.

Directive 2014/53/EU Radio Equipment Directive (RED)

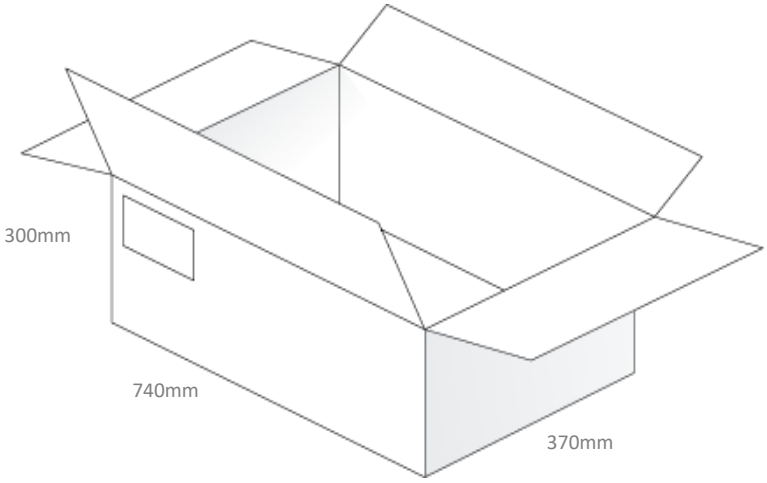
Harmonised Standards and References:
EN 301 489-1 (V2.2.1): ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements. Referencing CENELEC EN 55032 Class B.

8. Packaging

1pc MA1508.AK.001 per PE Bag
Weight: 2.5Kg



4pcs MA1508.AK.001 per Carton
Carton Dimensions: 740*370*300mm
Weight: 10.4Kg



Changelog for the datasheet

SPE-20-8-031 - MA1508.AK.001

Revision: A (Original First Release)	
Date:	2021-04-23
Notes:	Initial Release
Author:	Jack Conroy

Previous Revisions

TAOGLAS®

www.taoglas.com