

Specification

- Part No. : **MA9909.A.002.wm**
- Product Name : GuardianX 9in1 GNSS & 8*LTE MIMO Antenna
 1*Active GNSS with RG-174 & SMA(M)
 8*LTE MIMO with TGC-200 & SMA(M)
- Features : Low-profile Wall Mount Multi-antenna
 1* GPS-GLONASS Antenna
 8* LTE MIMO 698 to 960MHz/1710 to 2170MHz/ 2490 to 2690MHz/ 3300 to 3600MHz
 Worldwide 4G Bands including 3G and 2G
 IP67 Rated Waterproof Enclosure
 Cables: 1M Low Loss TGC-200 and RG174
 Connectors: SMA(M)
 Dimensions: 360 * 160 * 16.5mm
RoHS Compliant



1. Introduction

The Taoglas Guardian X MA9909 is a low profile heavy duty, fully IP67 waterproof antenna. It combines 9 antenna elements into one enclosure, 1 GPS/GLONASS/Galileo, 8* LTE MIMO (698 to 960MHz/1710 to 2170MHz/ 2490 to 2690MHz/ 3300 to 3600MHz). This unique product delivers powerful worldwide 4G LTE MIMO antenna technology at 700MHz/800MHz/1700MHz/1800MHz/2600MHz and GNSS.

Typical applications include:

- Passenger Bus / Rail / Air Applications.
- Automotive and Heavy Equipment Vehicle Tracking and Telematics
- Remote Asset and Pipeline Monitoring
- HD Video over LTE
- First Responder and Emergency Services
- M2M Applications/IoT

LTE 4G applications demand high speed data uplink and downlink. High efficiency and high gain MIMO antennas are necessary to achieve the required signal to noise ratio and throughput required to solve these challenges. Taoglas also takes care to have high isolation between the two MIMO antennas to prevent self-interference. Low loss cables are used to keep efficiency high over long cable lengths. In contrast, smaller MIMO antennas with poorer quality thinner cables will have much reduced efficiency and isolation, which would lead to a large drop in system throughput, increased number of drops, and may indeed not make a system connection at all.

Cable length and connector types are customizable. Contact your regional Taoglas customer support team for further information.

2. Specification

2G/3G/4G MIMO Antenna								
Frequency (MHz)		LTE700	GSM850	GSM900	DCS	PCS	UMTS1	LTE2600
		698~806	824~894	880~960	1710~1880	1850~1990	1920~2170	2490~2690
Efficiency (%)								
LTE1	0.3M	40.43	46.11	55.89	48.39	52.24	59.34	48.34
	1M	38.32	44.05	53.36	44.13	47.66	54.74	44.09
	2M	35.76	40.36	48.67	39.33	42.11	47.96	38.32
	3M	33.11	37.49	45.22	34.96	37.09	42.41	33.39
	5M	30.67	34.83	42.02	31.08	32.68	37.51	29.10
LTE2	0.3M	29.45	29.73	31.73	17.97	54.87	67.07	68.57
	1M	27.95	28.40	30.30	16.77	50.04	61.15	63.21
	2M	26.09	26.03	27.64	14.95	44.60	54.04	55.36
	3M	24.14	24.17	25.69	13.44	39.64	47.58	48.97
	5M	22.34	22.45	23.88	12.09	35.23	41.90	43.31
LTE3	0.3M	42.76	53.50	53.81	56.38	63.42	65.38	46.32
	1M	40.55	51.09	51.38	51.41	57.85	60.26	42.24
	2M	37.84	46.81	46.86	45.82	51.13	52.79	36.70
	3M	35.02	43.49	43.58	40.73	45.02	46.68	31.95
	5M	32.42	40.40	40.53	36.20	39.64	41.28	27.82
LTE4	0.3M	34.69	38.21	33.37	44.24	40.48	39.12	54.81
	1M	32.90	36.49	31.86	40.36	36.93	36.03	49.99
	2M	30.70	33.44	29.06	35.97	32.67	31.60	43.44
	3M	28.42	31.06	27.04	31.98	28.75	27.90	37.83
	5M	26.31	28.85	25.15	28.43	25.30	24.64	32.95
LTE5	0.3M	33.63	37.30	33.06	44.90	39.93	38.90	54.66
	1M	31.89	35.63	31.57	40.96	36.40	35.82	49.84
	2M	29.76	32.65	28.80	36.51	32.21	31.43	43.30
	3M	27.54	30.32	26.78	32.46	28.34	27.74	37.71
	5M	25.49	28.16	24.91	28.86	24.94	24.49	32.84
LTE6	0.3M	43.09	51.93	52.88	55.26	64.68	66.42	45.37
	1M	40.85	49.59	50.50	50.41	58.99	61.21	41.39
	2M	38.13	45.43	46.06	44.93	52.14	53.63	35.95
	3M	35.29	42.21	42.83	39.93	45.90	47.42	31.30
	5M	32.67	39.21	39.83	35.49	40.42	41.94	27.26
LTE7	0.3M	29.19	30.19	32.01	49.76	66.45	65.00	36.72
	1M	27.72	28.84	30.58	45.38	60.59	59.89	33.48
	2M	25.87	26.43	27.89	40.44	53.56	52.47	29.09
	3M	23.93	24.55	25.92	35.93	47.15	46.40	25.34
	5M	22.14	22.80	24.09	31.92	41.51	41.04	22.07
LTE8	0.3M	38.75	50.32	54.81	45.83	52.11	59.53	46.12
	1M	36.71	48.07	52.34	41.79	47.53	54.90	42.07
	2M	34.26	44.05	47.74	37.25	41.99	48.09	36.57

	3M	31.73	40.91	44.38	33.11	36.99	42.53	31.86
	5M	29.39	38.01	41.26	29.43	32.59	37.62	27.77
Average Gain (dB)								
LTE1	0.3M	-3.93	-3.36	-2.53	-3.15	-2.82	-2.27	-3.16
	1M	-4.17	-3.56	-2.73	-3.55	-3.22	-2.62	-3.56
	2M	-4.47	-3.94	-3.13	-4.05	-3.76	-3.19	-4.17
	3M	-4.80	-4.26	-3.45	-4.56	-4.31	-3.73	-4.76
	5M	-5.13	-4.58	-3.77	-5.08	-4.86	-4.26	-5.36
LTE2	0.3M	-5.31	-5.27	-4.99	-7.46	-2.61	-1.73	-1.64
	1M	-5.54	-5.47	-5.19	-7.75	-3.01	-2.14	-1.99
	2M	-5.84	-5.85	-5.59	-8.25	-3.51	-2.67	-2.57
	3M	-6.17	-6.17	-5.90	-8.72	-4.02	-3.23	-3.10
	5M	-6.51	-6.49	-6.22	-9.18	-4.53	-3.78	-3.63
LTE3	0.3M	-3.69	-2.72	-2.69	-2.49	-1.98	-1.85	-3.34
	1M	-3.92	-2.92	-2.89	-2.89	-2.38	-2.20	-3.74
	2M	-4.22	-3.30	-3.29	-3.39	-2.91	-2.77	-4.35
	3M	-4.56	-3.62	-3.61	-3.90	-3.47	-3.31	-4.96
	5M	-4.89	-3.94	-3.92	-4.41	-4.02	-3.84	-5.56
LTE4	0.3M	-4.60	-4.18	-4.77	-3.54	-3.93	-4.08	-2.61
	1M	-4.83	-4.38	-4.97	-3.94	-4.33	-4.43	-3.01
	2M	-5.13	-4.76	-5.37	-4.44	-4.86	-5.00	-3.62
	3M	-5.46	-5.08	-5.68	-4.95	-5.41	-5.54	-4.22
	5M	-5.80	-5.40	-5.99	-5.46	-5.97	-6.08	-4.82
LTE5	0.3M	-4.73	-4.28	-4.81	-3.48	-3.99	-4.10	-2.62
	1M	-4.96	-4.48	-5.01	-3.88	-4.39	-4.46	-3.02
	2M	-5.26	-4.86	-5.41	-4.38	-4.92	-5.03	-3.63
	3M	-5.60	-5.18	-5.72	-4.89	-5.48	-5.57	-4.24
	5M	-5.94	-5.50	-6.04	-5.40	-6.03	-6.11	-4.84
LTE6	0.3M	-3.66	-2.85	-2.77	-2.58	-1.89	-1.78	-3.43
	1M	-3.89	-3.05	-2.97	-2.97	-2.29	-2.13	-3.83
	2M	-4.19	-3.43	-3.37	-3.47	-2.83	-2.71	-4.44
	3M	-4.52	-3.75	-3.68	-3.99	-3.38	-3.24	-5.04
	5M	-4.86	-4.07	-4.00	-4.50	-3.93	-3.77	-5.65
LTE7	0.3M	-5.35	-5.20	-4.95	-3.03	-1.77	-1.87	-4.35
	1M	-5.57	-5.40	-5.15	-3.43	-2.18	-2.23	-4.75
	2M	-5.87	-5.78	-5.55	-3.93	-2.71	-2.80	-5.36
	3M	-6.21	-6.10	-5.86	-4.45	-3.27	-3.33	-5.96
	5M	-6.55	-6.42	-6.18	-4.96	-3.82	-3.87	-6.56
LTE8	0.3M	-4.12	-2.98	-2.61	-3.39	-2.83	-2.25	-3.36
	1M	-4.35	-3.18	-2.81	-3.79	-3.23	-2.60	-3.76
	2M	-4.65	-3.56	-3.21	-4.29	-3.77	-3.18	-4.37
	3M	-4.99	-3.88	-3.53	-4.80	-4.32	-3.71	-4.97
	5M	-5.32	-4.20	-3.85	-5.31	-4.87	-4.25	-5.56

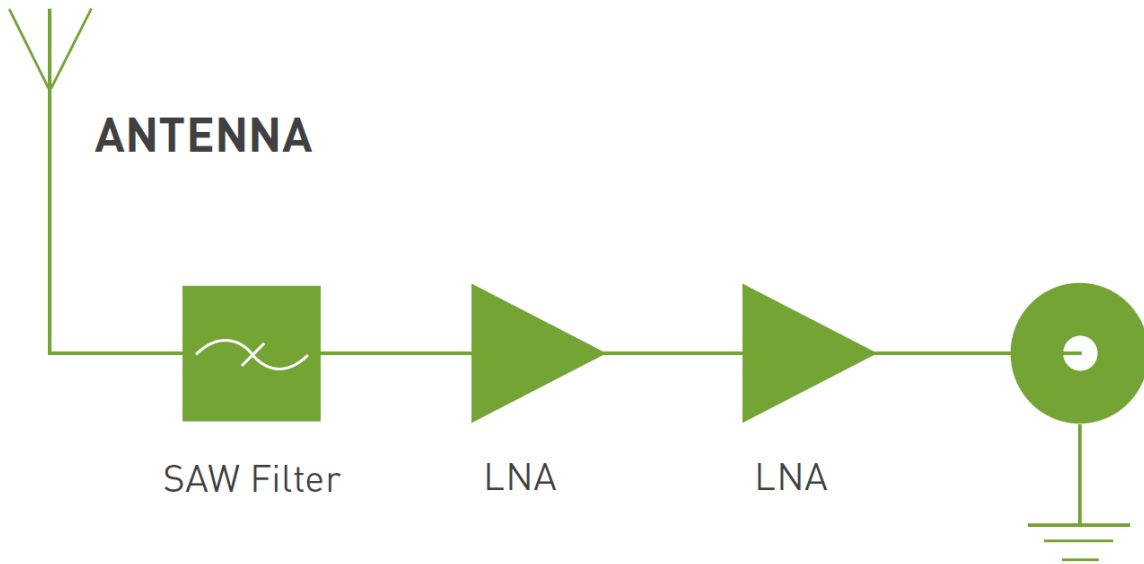
Peak Gain (dBi)								
LTE1	0.3M	1.5	1.6	1.92	-4.21	3.2	3.15	3.27
	1M	1.2	1.4	1.72	-4.51	2.8	2.75	2.97
	2M	0.9	1	1.32	-5.01	2.3	2.15	2.37
	3M	0.6	0.7	1.02	-5.51	1.8	1.65	1.87
	5M	0.3	0.4	0.72	-6.01	1.3	1.15	1.37
LTE2	0.3M	-1.01	-1.44	-0.5	-0.96	1.38	3.07	3.42
	1M	-1.21	-1.64	-0.7	-1.26	0.98	2.67	3.12
	2M	-1.51	-2.04	-1.1	-1.76	0.48	2.07	2.52
	3M	-1.85	-2.34	-1.4	-2.26	-0.02	1.57	2.02
	5M	-2.15	-2.64	-1.7	-2.76	-0.52	1.07	1.52
LTE3	0.3M	0.5	1.65	1.77	3.23	3.93	4.12	2.35
	1M	0.26	1.45	1.57	2.83	3.53	3.82	1.95
	2M	-0.04	1.05	1.17	2.33	2.93	3.22	1.25
	3M	-0.4	0.75	0.87	1.83	2.43	2.72	0.65
	5M	-0.7	0.45	0.57	1.33	1.93	2.22	0.05
LTE4	0.3M	1.48	1.25	0.66	2.18	2.18	2.08	3.75
	1M	1.28	1.05	0.46	1.78	1.78	1.68	3.35
	2M	0.98	0.65	0.06	1.28	1.28	1.18	2.75
	3M	0.68	0.35	-0.24	0.78	0.78	0.58	2.15
	5M	0.38	0.05	-0.54	0.28	0.28	0.05	1.55
LTE5	0.3M	2.02	1.11	0.45	2.16	3.03	3.03	4.11
	1M	1.72	0.91	0.25	1.76	2.63	2.63	3.71
	2M	1.42	0.51	-0.15	1.26	2.03	2.03	3.11
	3M	1.12	0.21	-0.45	0.76	1.53	1.53	2.51
	5M	0.82	-0.09	-0.75	0.26	1.03	1.03	1.91
LTE6	0.3M	0.83	1.5	1.65	2.69	3.73	3.73	2.67
	1M	0.63	1.3	1.45	2.29	3.33	3.33	2.27
	2M	0.33	0.9	1.05	1.79	2.73	2.73	1.57
	3M	-0.07	0.6	0.75	1.29	2.23	2.23	0.97
	5M	-0.41	0.3	0.45	0.79	1.73	1.73	0.37
LTE7	0.3M	-0.98	-1.6	-0.76	1.77	2.66	3.15	0.99
	1M	-1.18	-1.8	-0.96	1.37	2.26	2.85	0.59
	2M	-1.48	-2.2	-1.36	0.87	1.66	2.25	-0.01
	3M	-1.78	-2.5	-1.66	0.37	1.16	1.65	-0.51
	5M	-2.08	-2.8	-1.96	-0.13	0.66	1.05	-1.01
LTE8	0.3M	2.32	1.55	2.78	3.07	2.73	2.35	2.46
	1M	2.02	1.35	2.58	2.67	2.33	2.05	2.06
	2M	1.72	0.95	2.18	2.17	1.83	1.45	1.36
	3M	1.42	0.65	1.88	1.67	1.33	0.95	0.76
	5M	1.12	0.35	1.58	1.17	0.83	0.45	0.16
Impedance	50 Ω							
Polarization	Vertical							

CERAMIC PATCH			
Frequency	1574~1610MHz		
Gain @ Zenith	1575.42MHz 1.5 dBic Typ. @ Zenith 1602MHz +0 dBic Typ. @ Zenith		
Gain at 90° with LNA	1575.42MHz: 31 ± 3dBic 1602MHz: 30 ± 3dBic		
Polarization	RHCP		
Axial Ratio	6.0dB max. @ 1575.42MHz Zenith 14.0dB max. @ 1602MHz Zenith		
Patch Dimension	25.1*25.1*4mm		
LNA			
Frequency	1574~1610MHz		
Outer Band Attenuation	1592±140MHz 15dB min.		
Output Impedance	50Ω		
Output VSWR	2.0 Max		
Pout at 1dB Gain	Typ. -2dBm		
Compression point	Min. -6dBm		
Input Voltage	Min:1.8V Typ. 3.0V Max:5V		
LNA Gain, Power Consumption and Noise Figure			
Input Voltage	Min:1.8V	Typ. 3.0V	Max: 5.5V
Total Gain @ Zenith	25dBic	31dBic	34dBic
Current Consumption	5mA	10mA	23mA
Noise Figure	3dB	3dB	3.3dB
Cable	3m RG174 standard, fully customizable		
Connector	SMA(M) standard, standard, fully customizable		

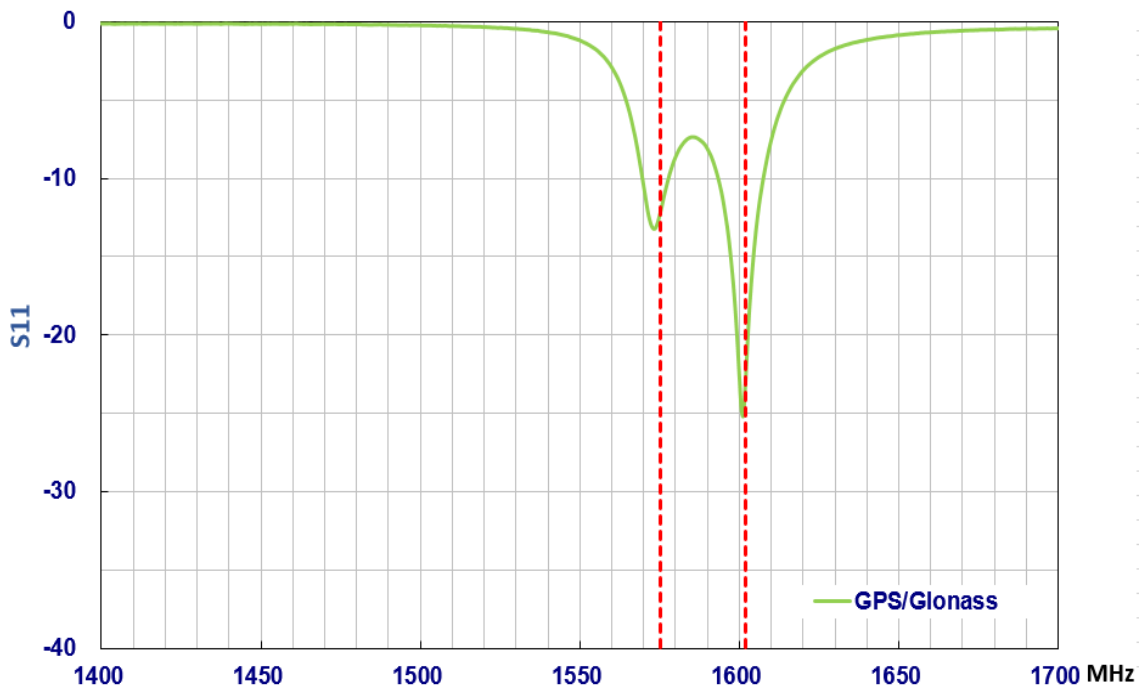
MECHANICAL	
Dimensions	360mm * 160mm * 16.5mm
Cable	1M TGC-200 for LTE Antenna – Fully Customizable 1M RF174 for GPS Antenna – Fully Customizable
Connector	SMA-Male – Fully Customizable
Casing	UV Resistant PC
Sealant	Rubber O-Ring
Weight	1300g
ENVIRONMENTAL	
Protection	IP67
Temperature Range	-40°C to +85°C
Thermal Shock	100 cycles -40°C to +85°C
Humidity	Non-condensing 65°C 95% RH

3. Antenna Characteristics

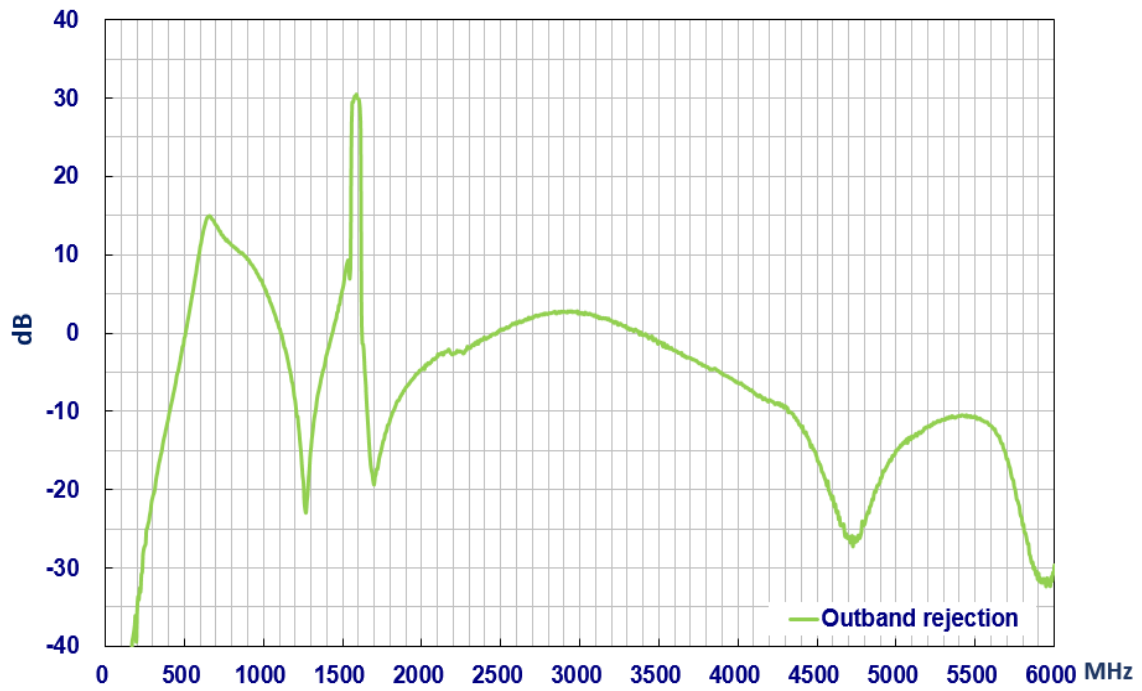
3.1 Block Diagram (Active antenna)



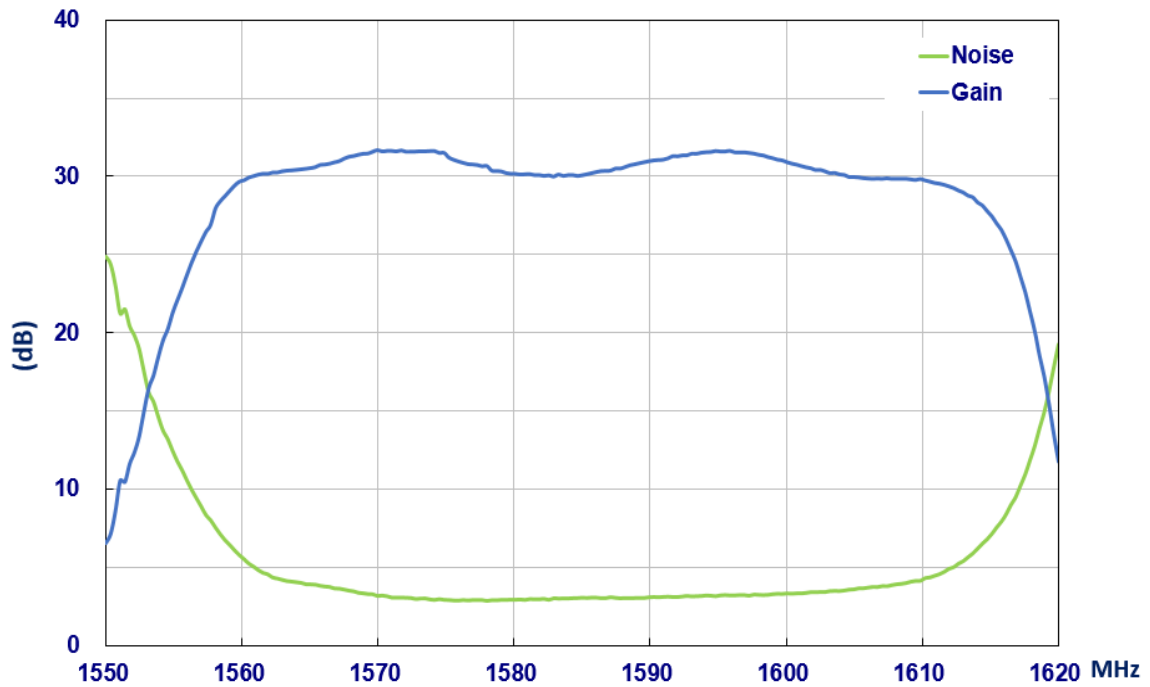
3.1.1 Return Loss



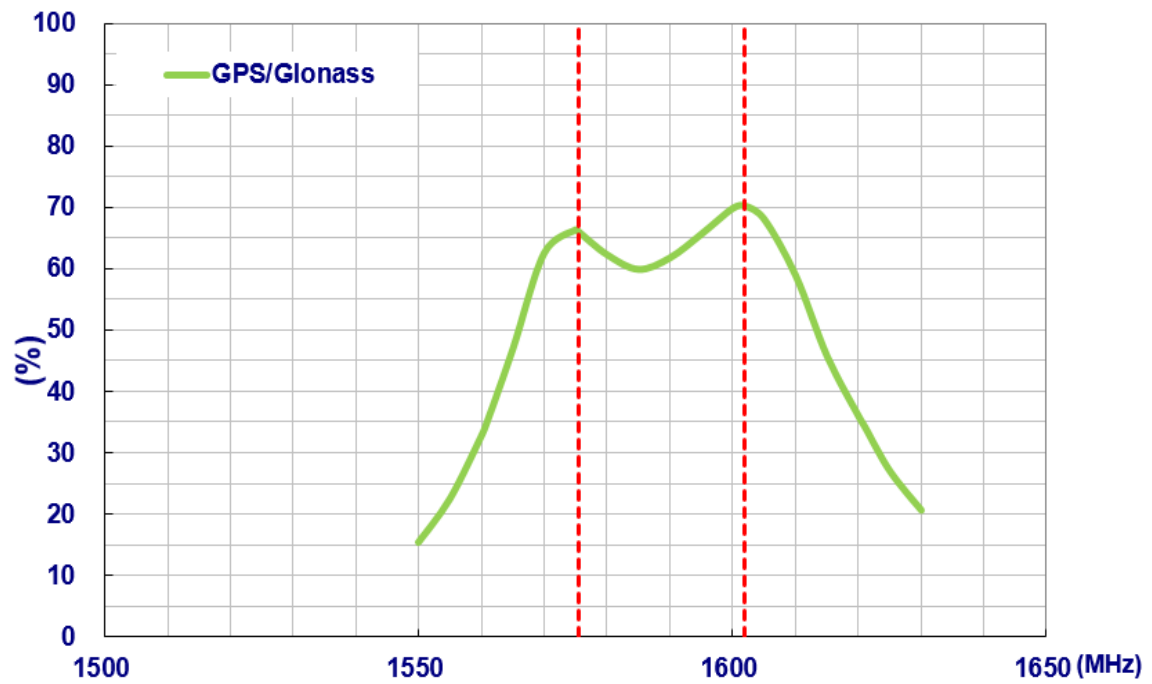
3.1.2 Out Band Rejection @3V



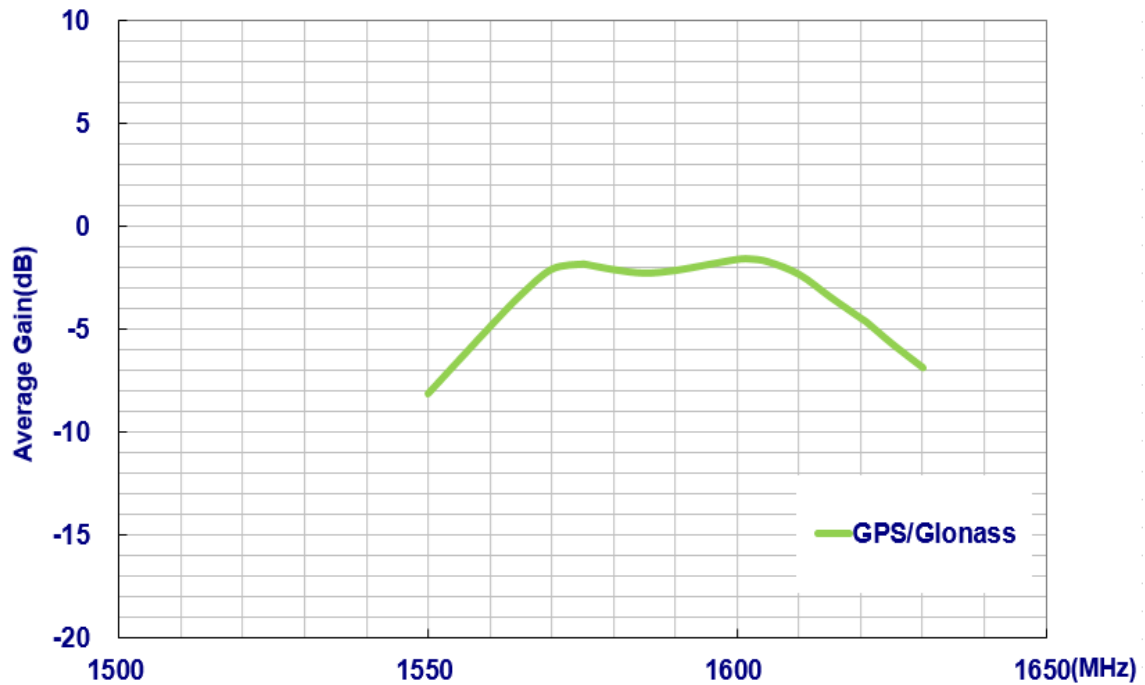
3.1.3 LNA Noise Figure and Gain @3V



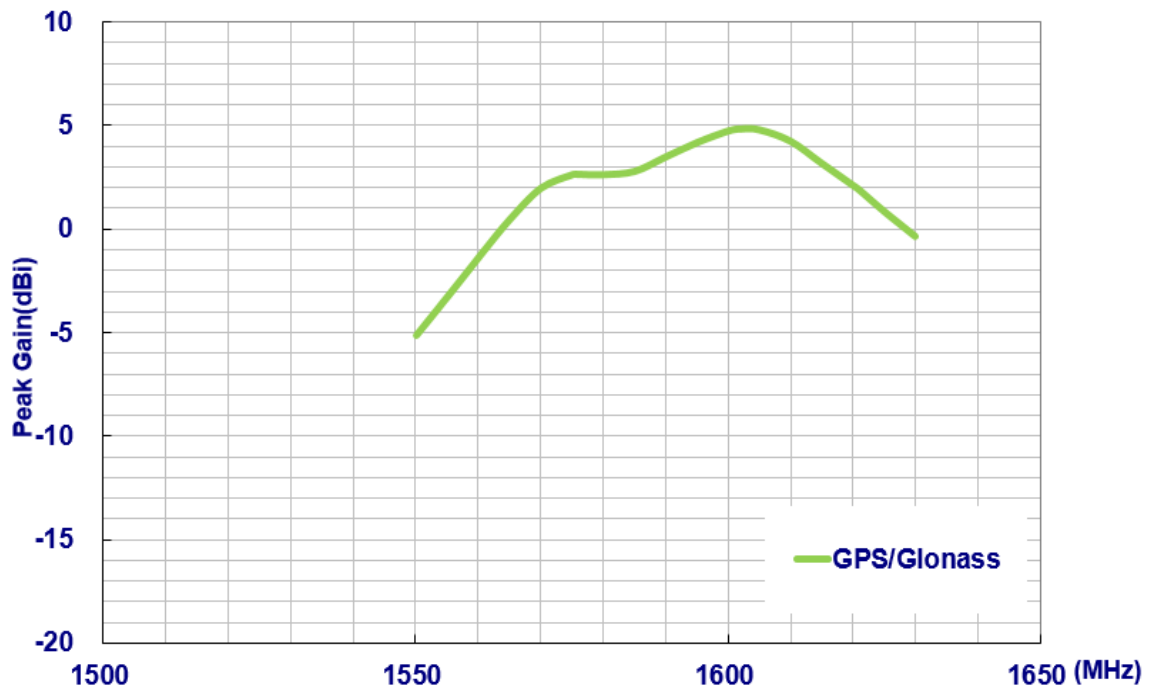
3.1.4 Efficiency



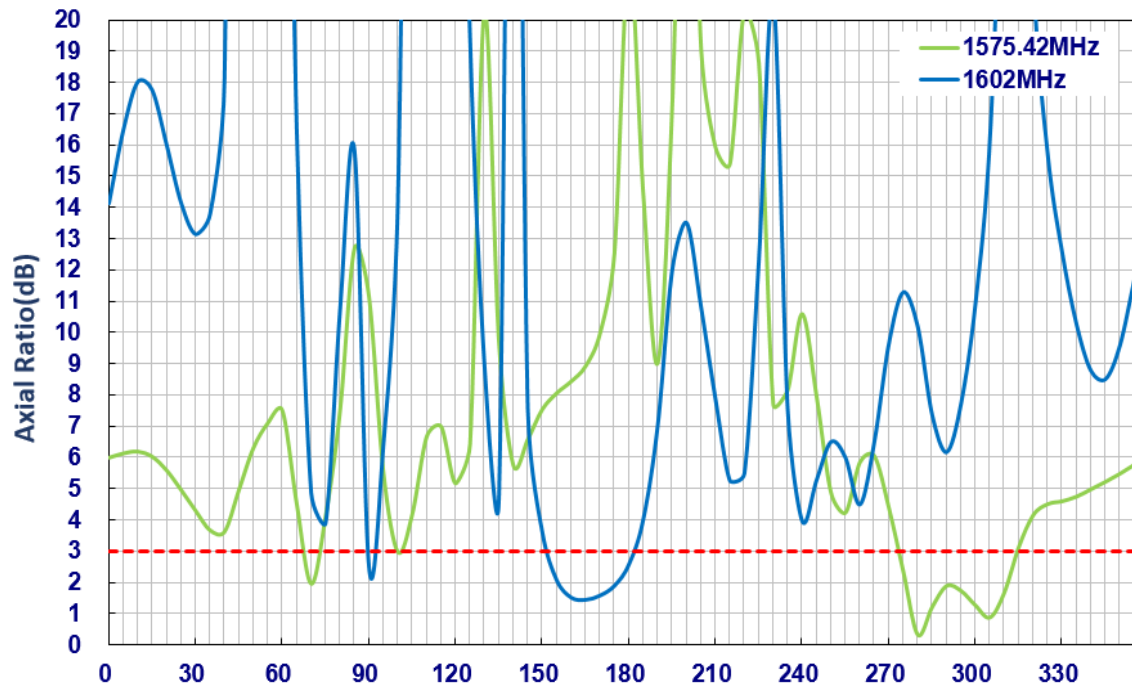
3.1.5 Average Gain



3.1.6 Peak Gain

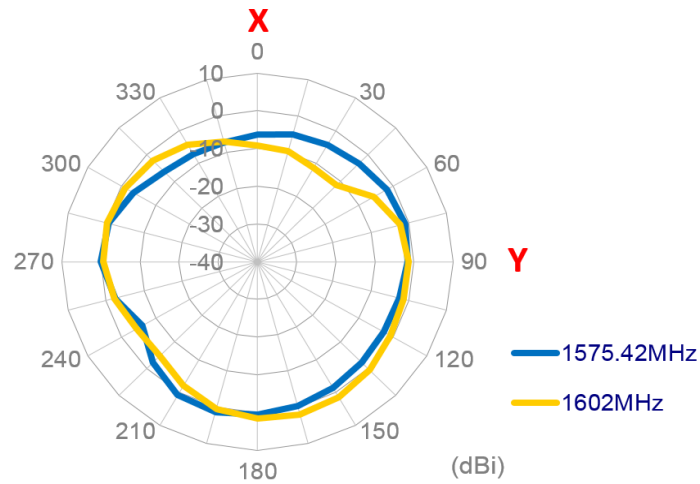


3.1.7 Axial Ratio

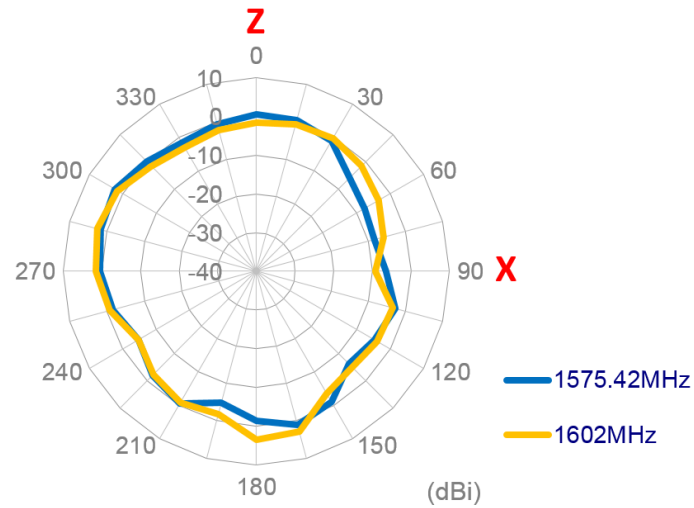


3.1.8 2D Radiation Patterns

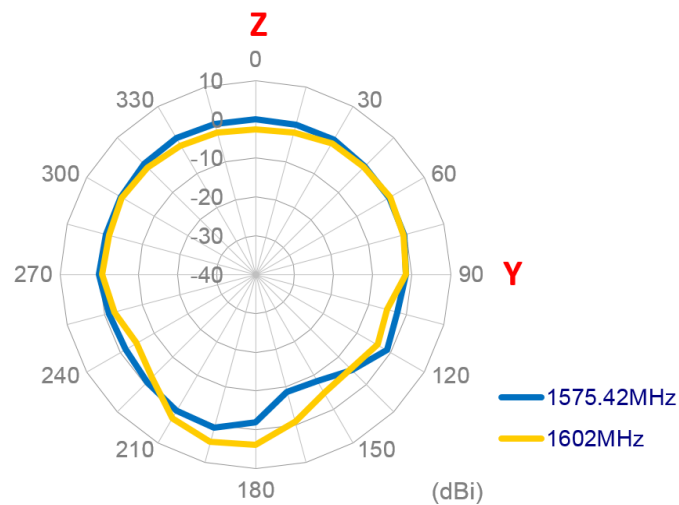
XY Plane



ZX Plane

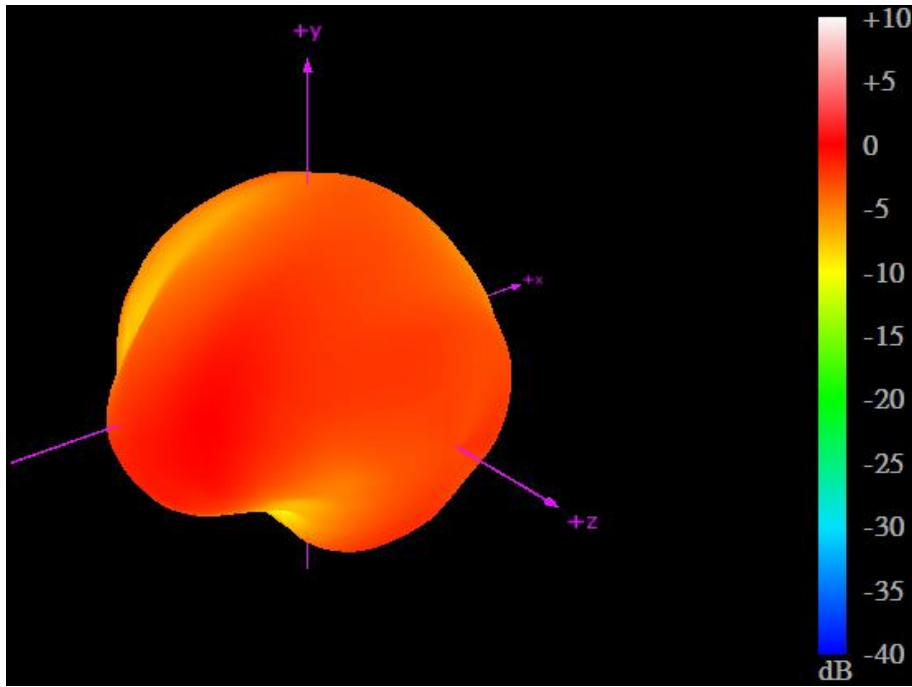


ZY Plane

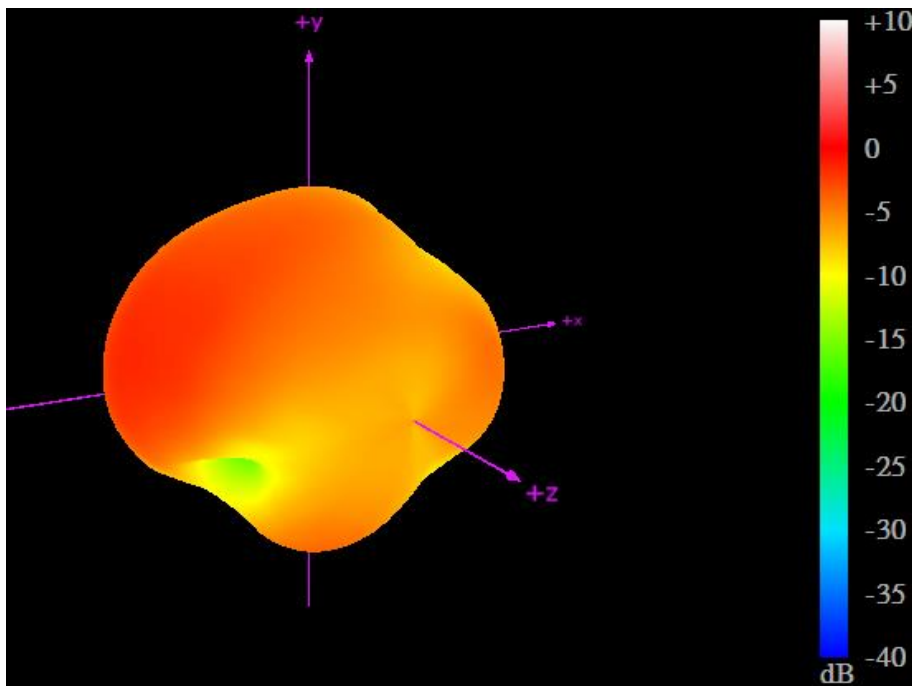


3.1.9 3D Radiation Patterns

1575.42MHz

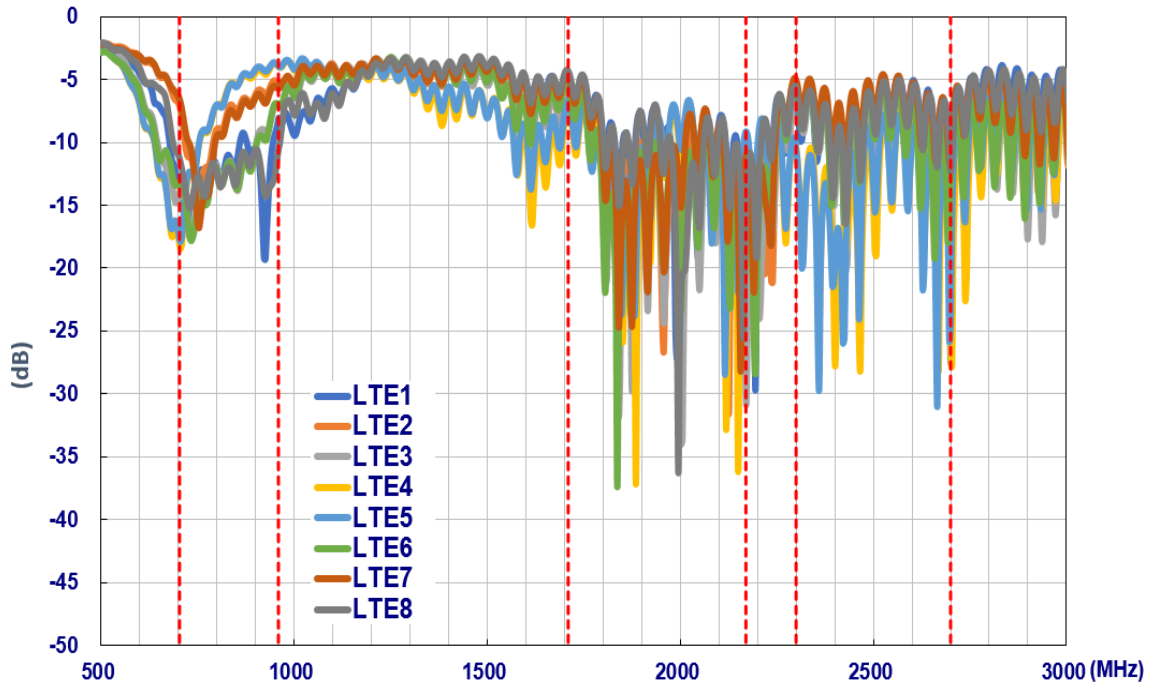


1602MHz

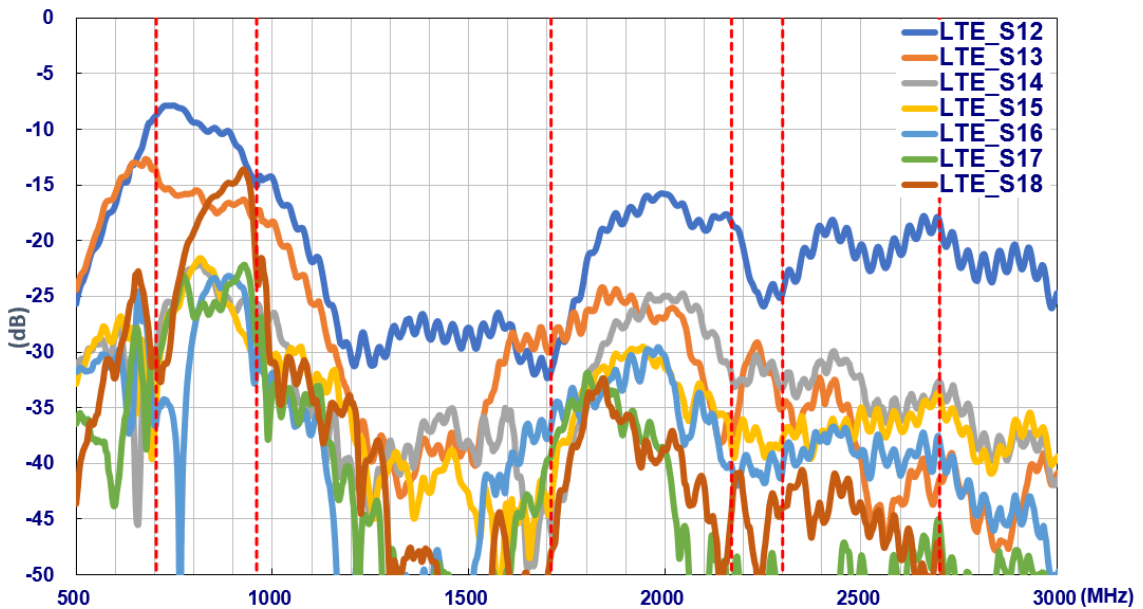


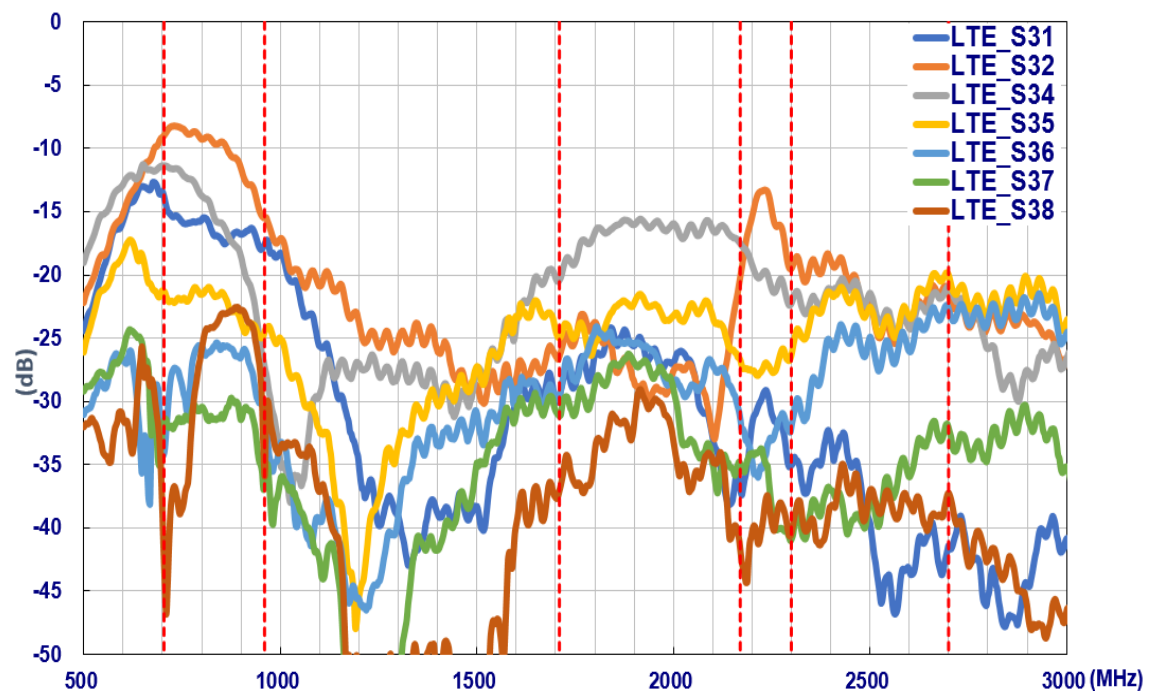
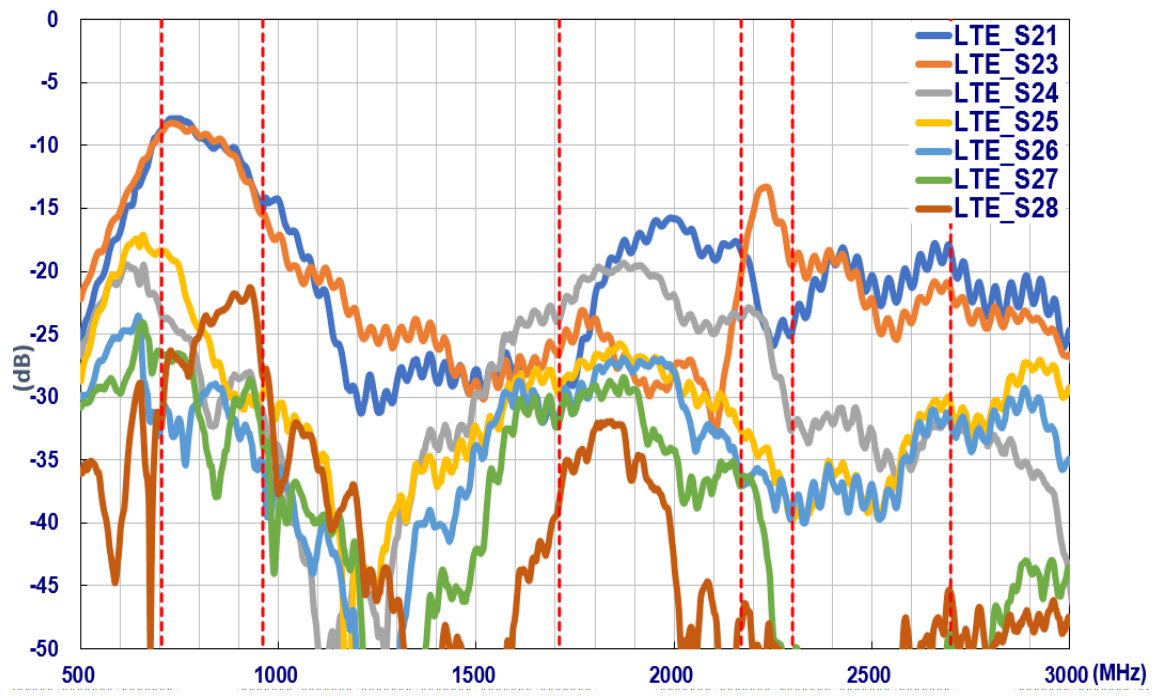
3.2 LTE Antenna

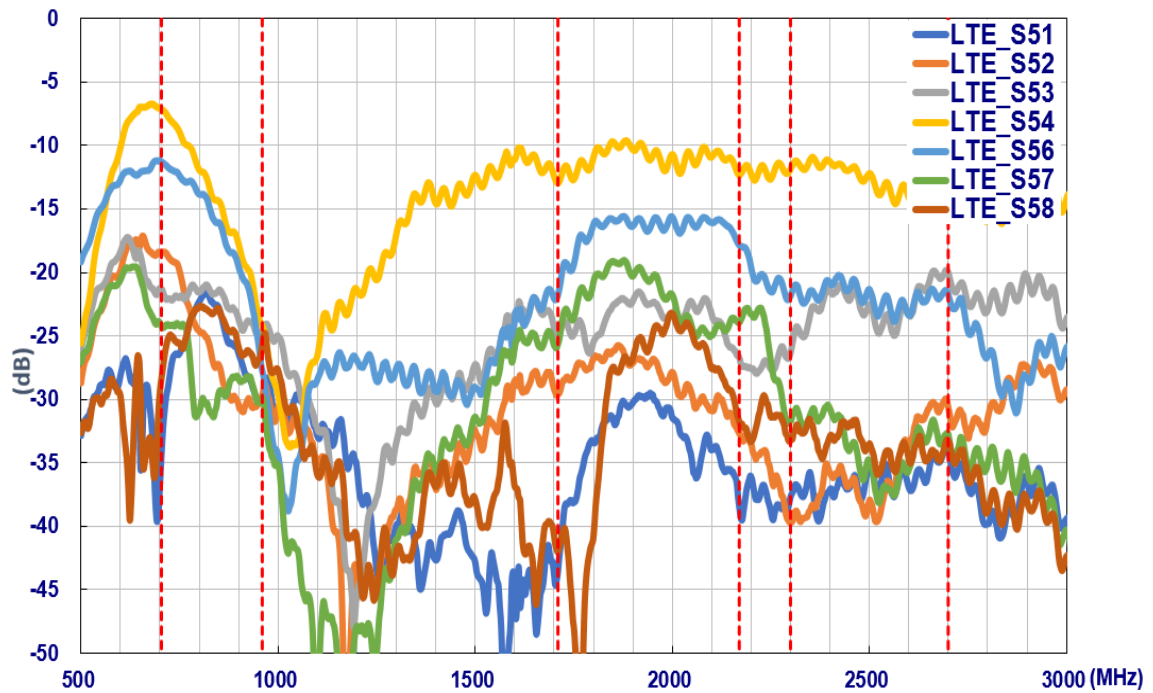
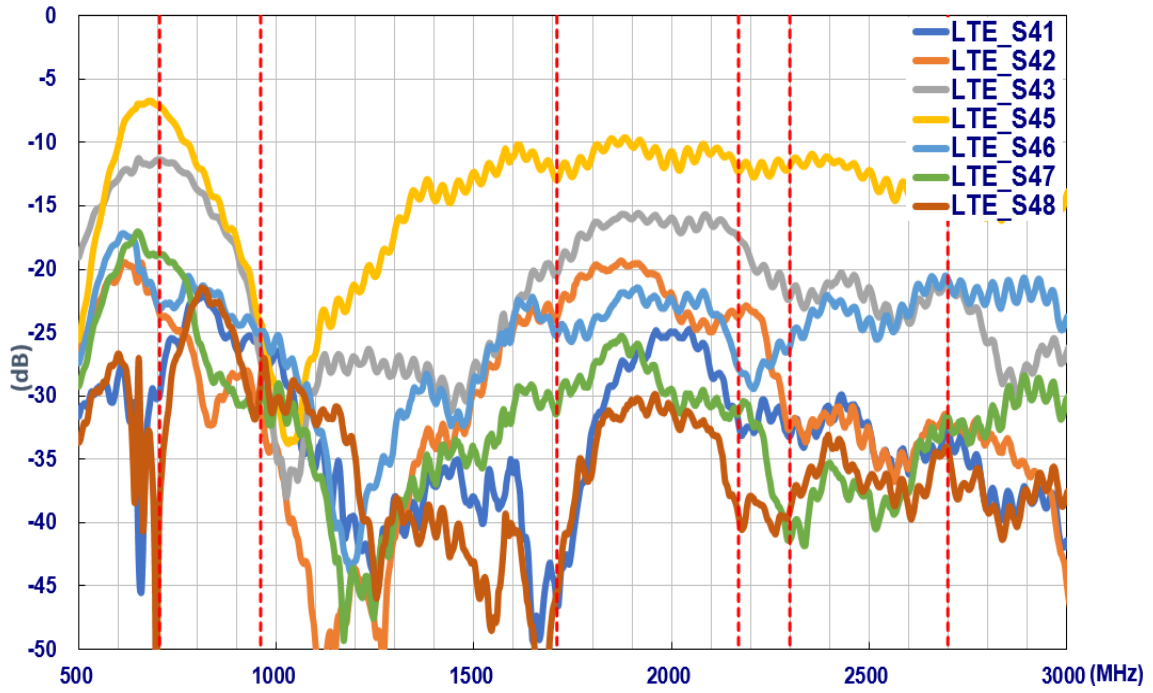
3.2.1 Return Loss

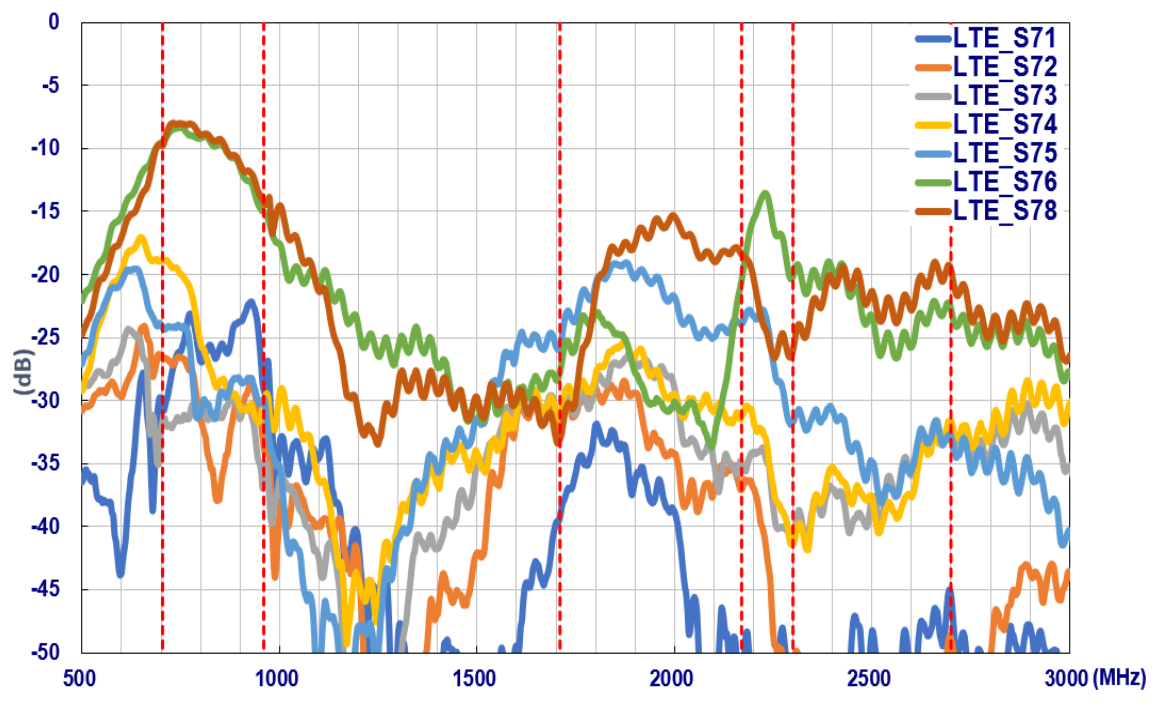
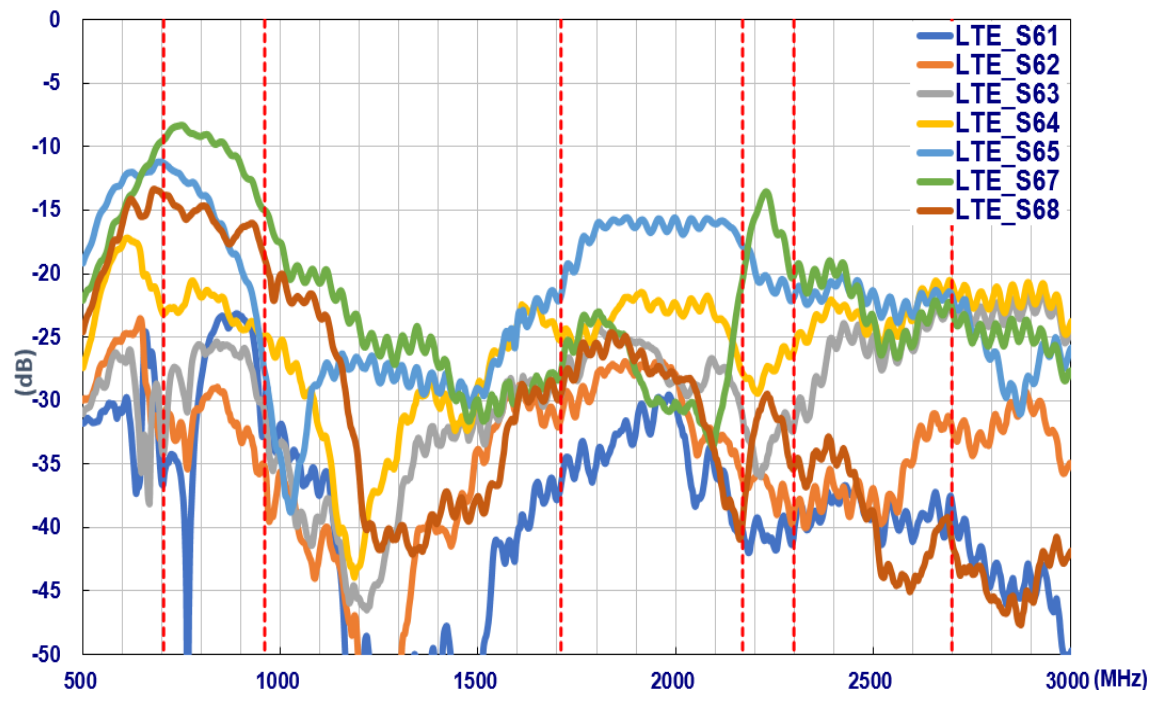


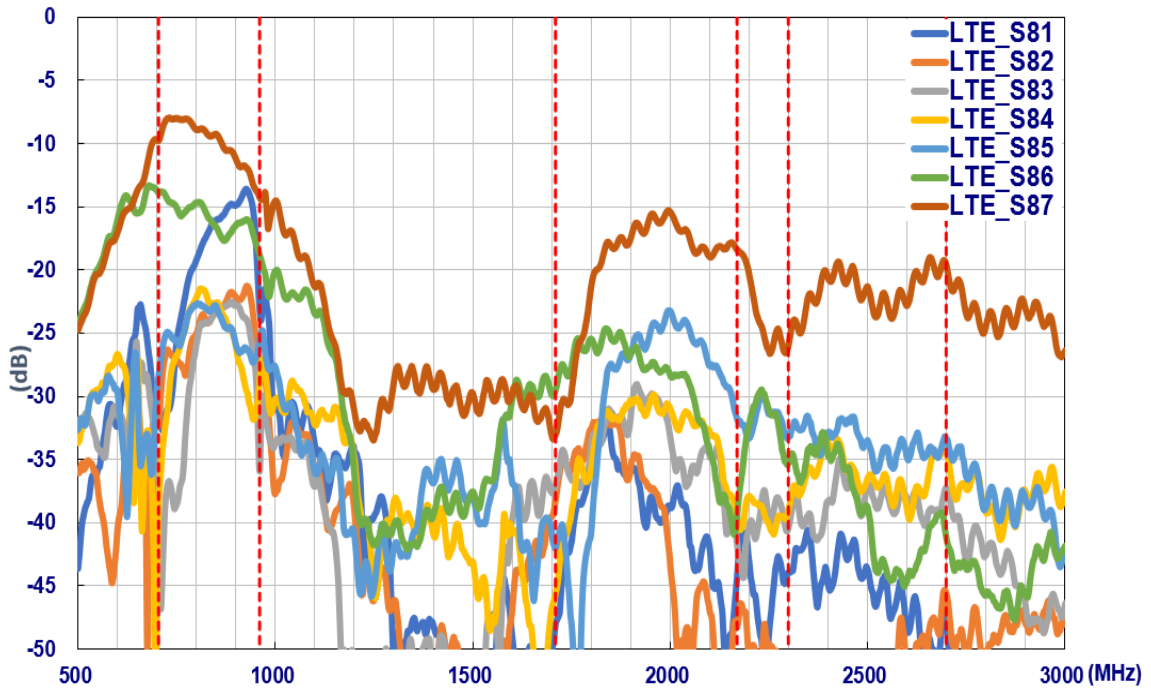
3.2.2 Isolation



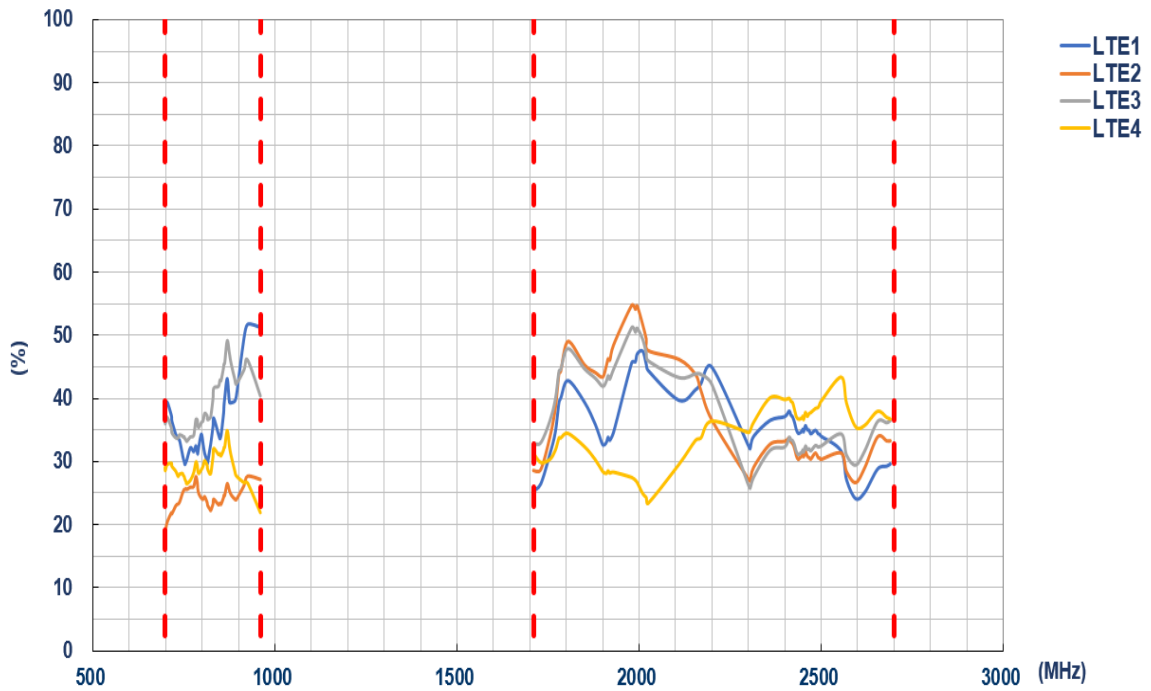


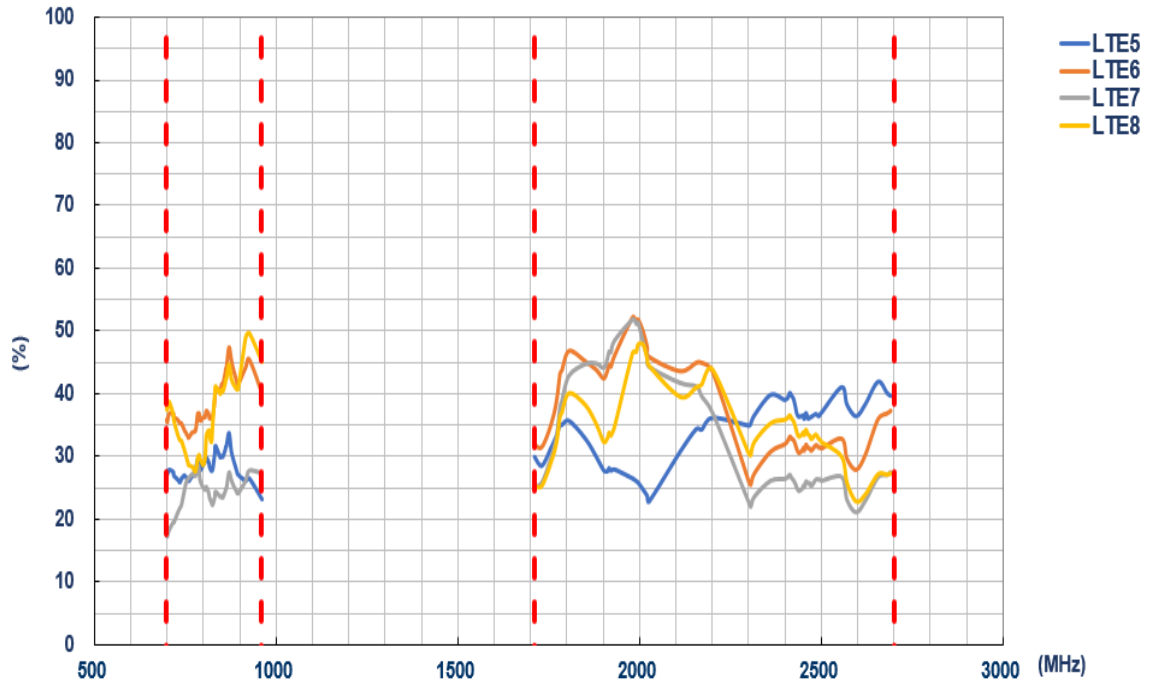




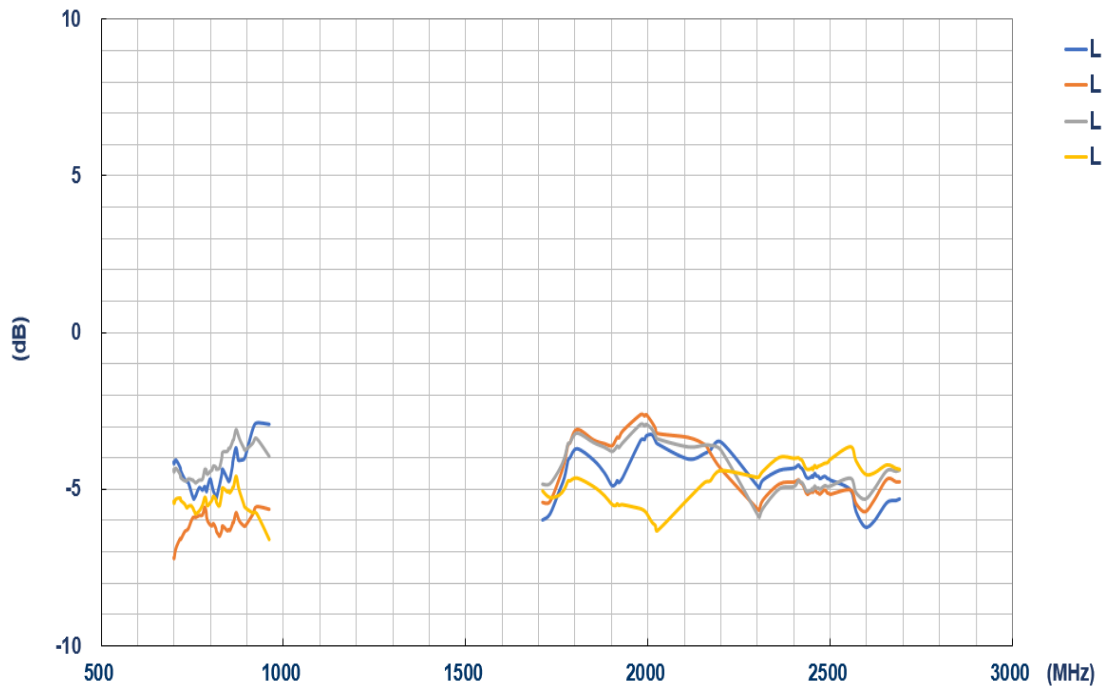


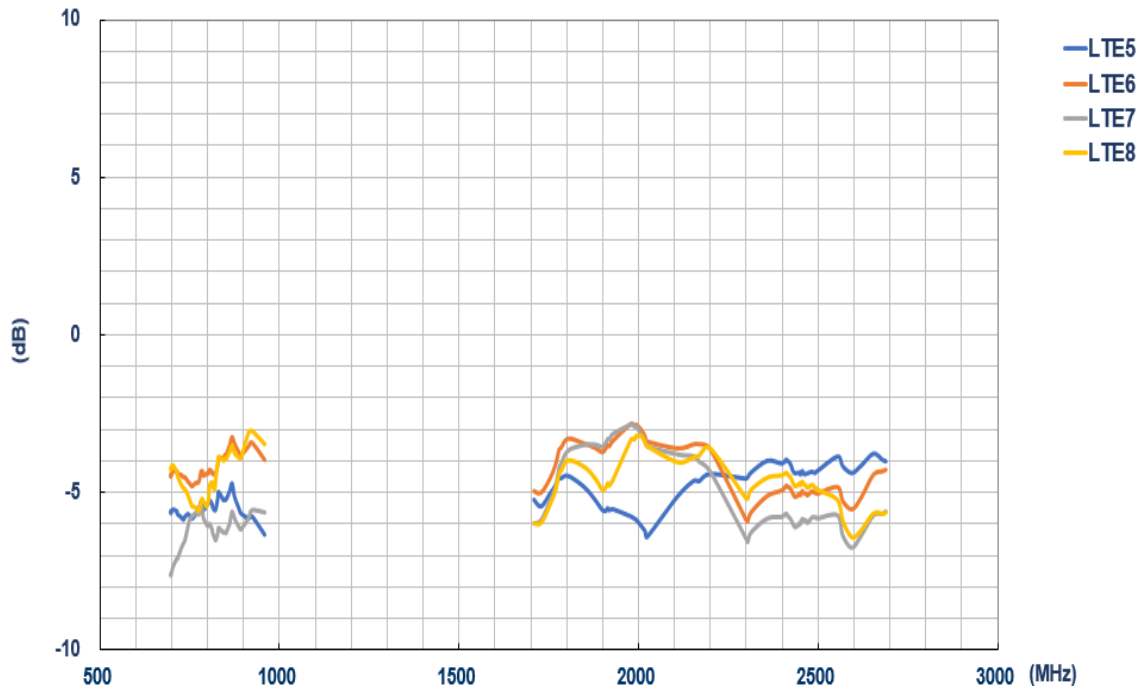
3.2.3 Efficiency



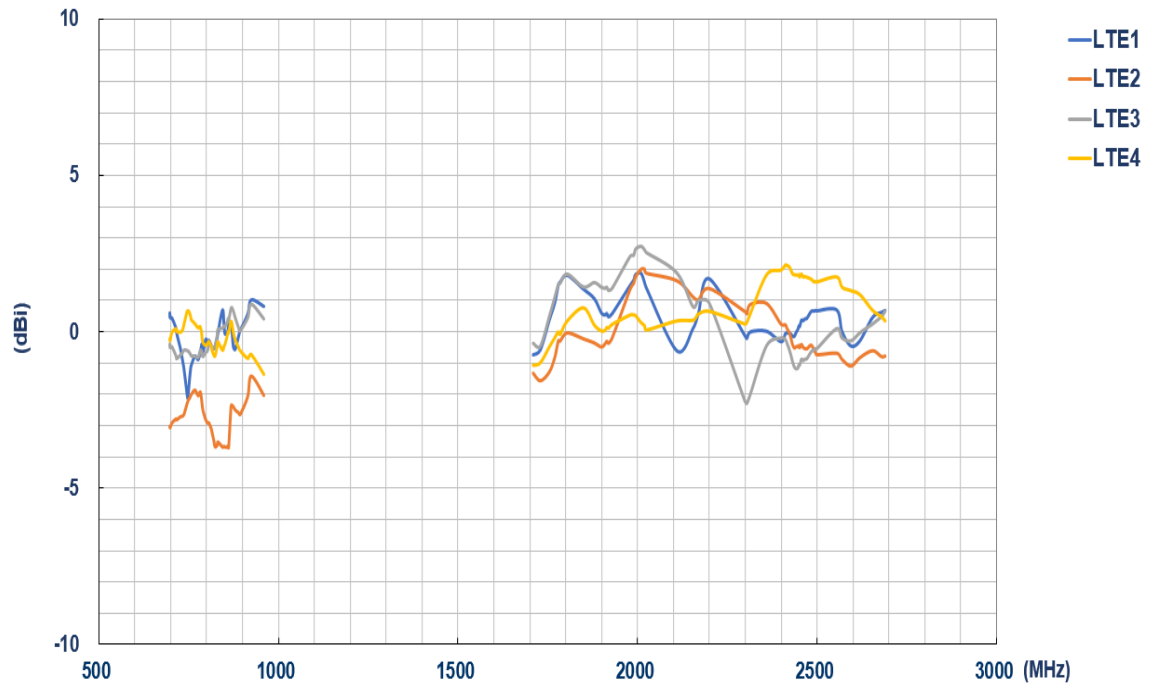


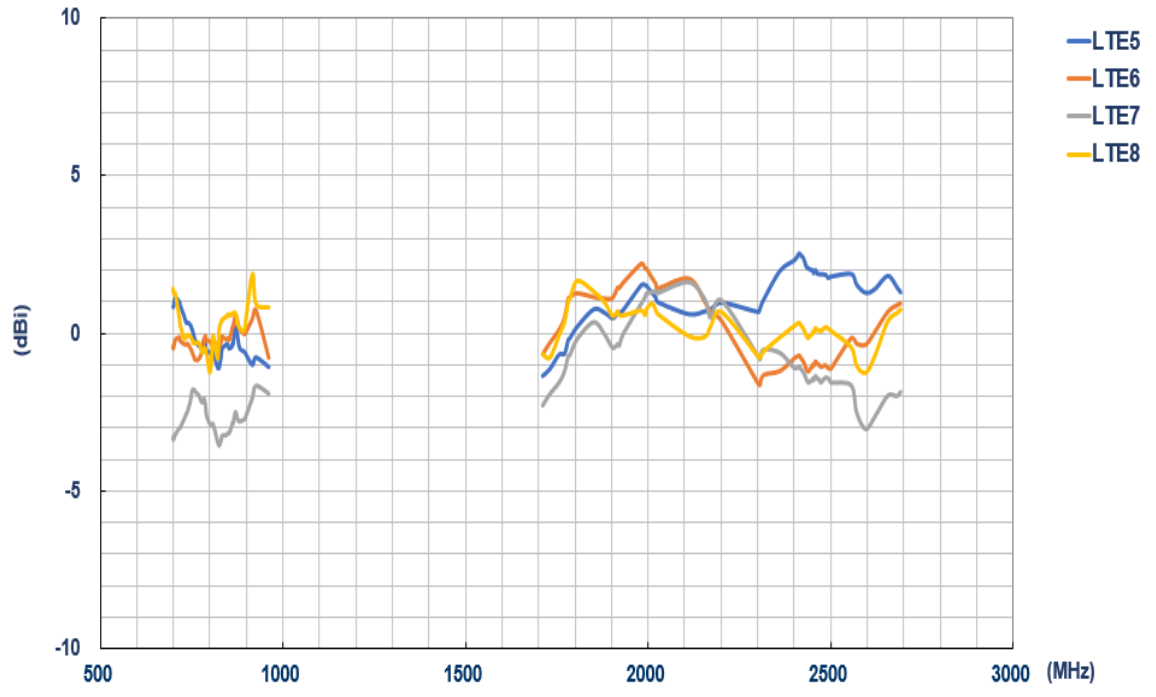
3.2.4 Average Gain





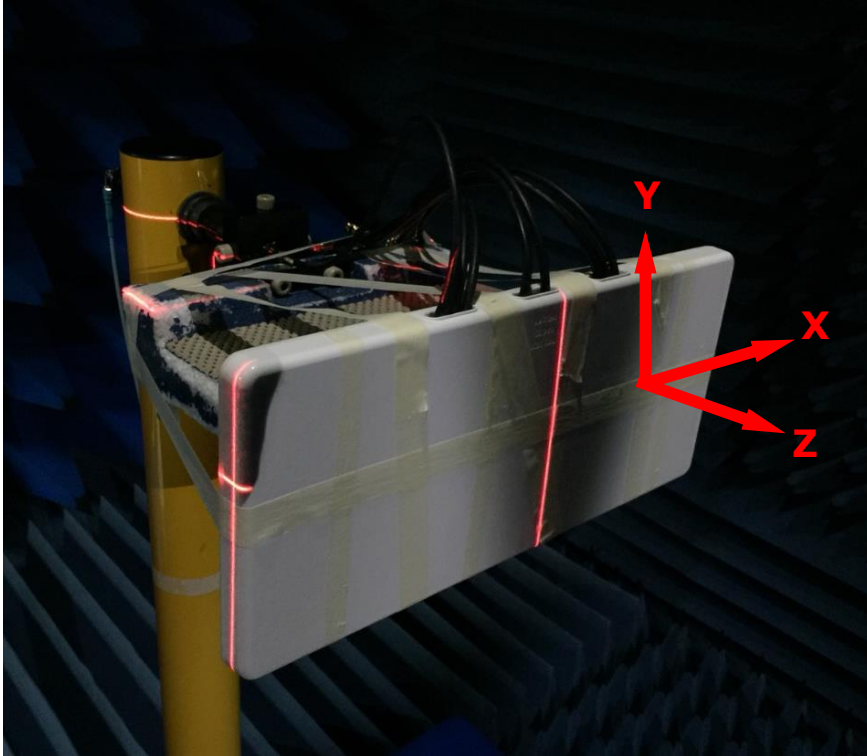
3.2.5 Peak Gain





4. Antenna Radiation Patterns

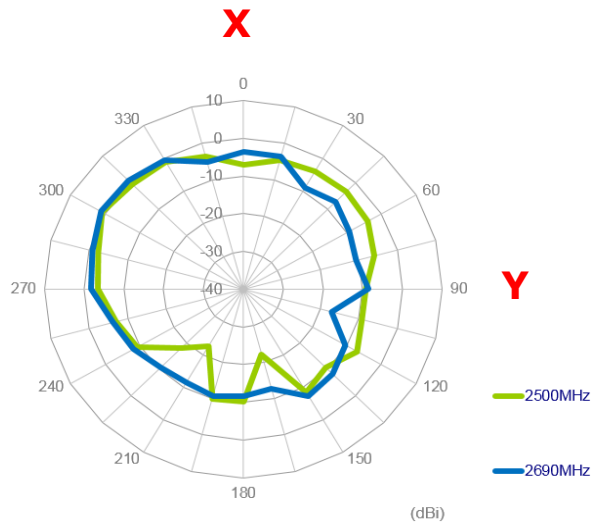
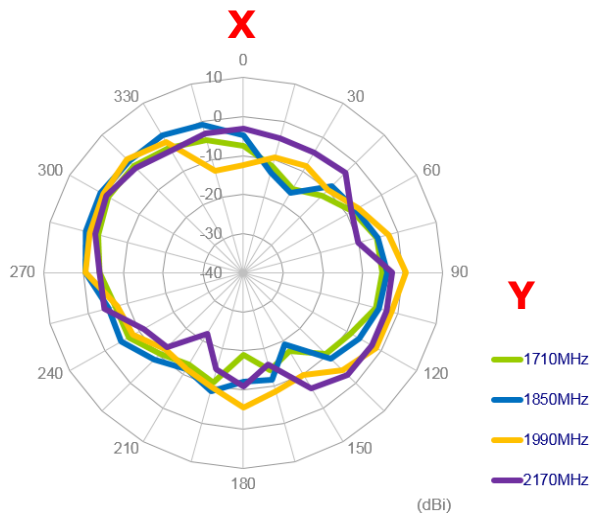
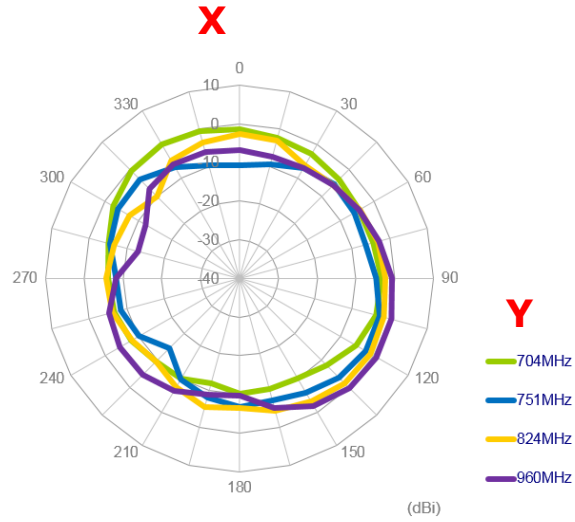
4.1 Antenna Setup (Antenna Test Setup in Anechoic Chamber)



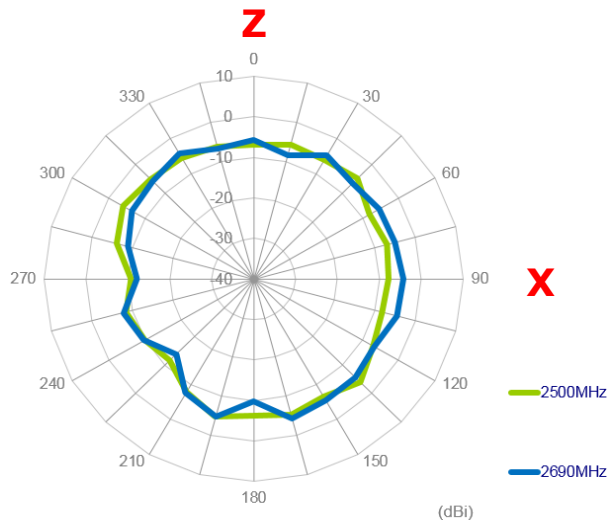
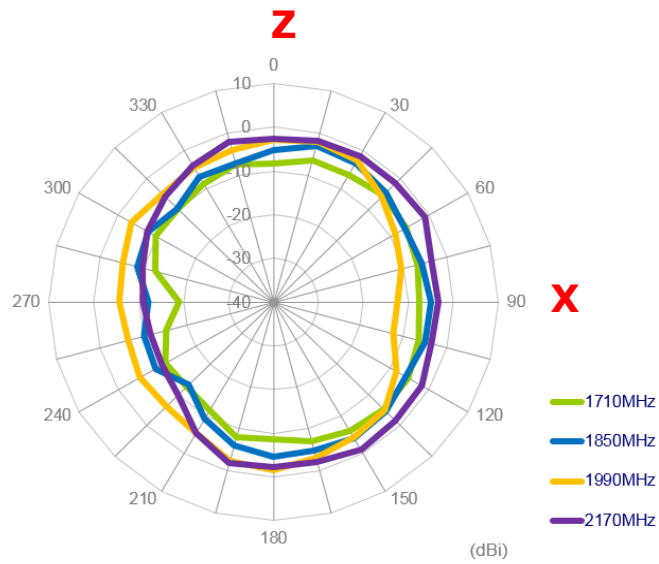
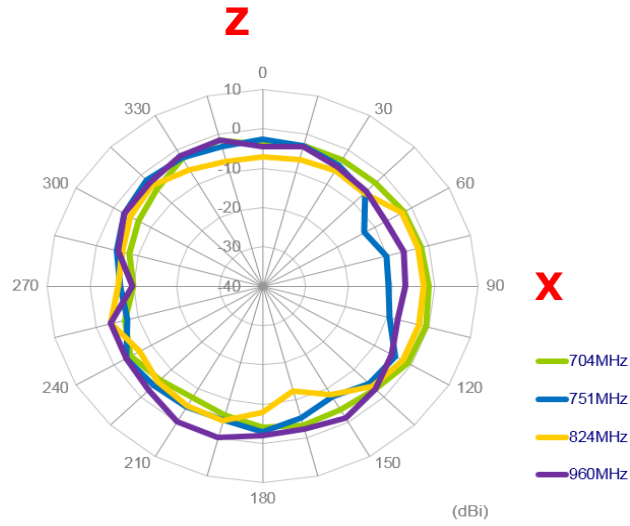
4.2 2D Radiation Patterns

4.2.1 LTE 1

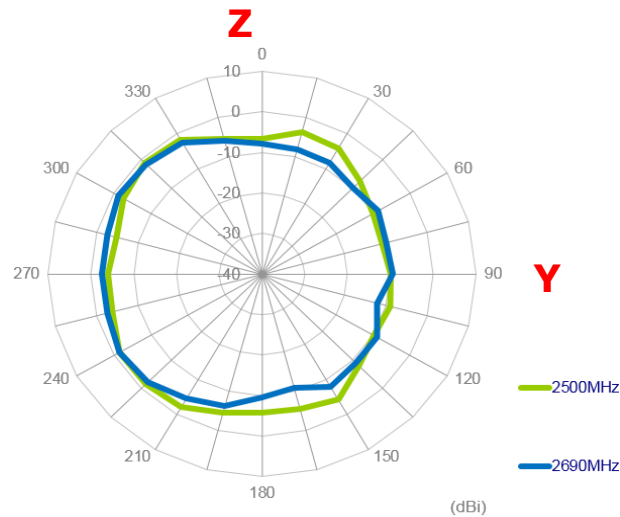
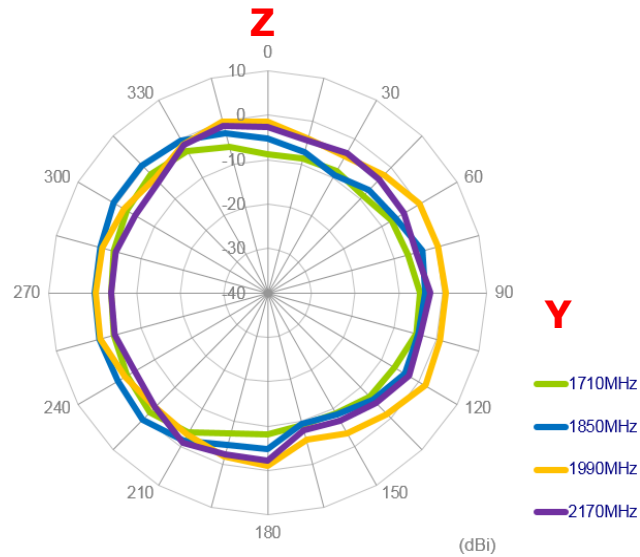
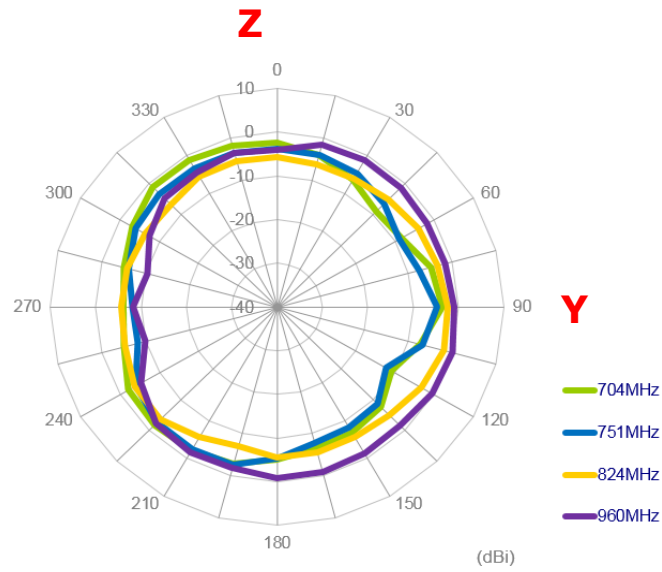
XY Plane



XZ Plane

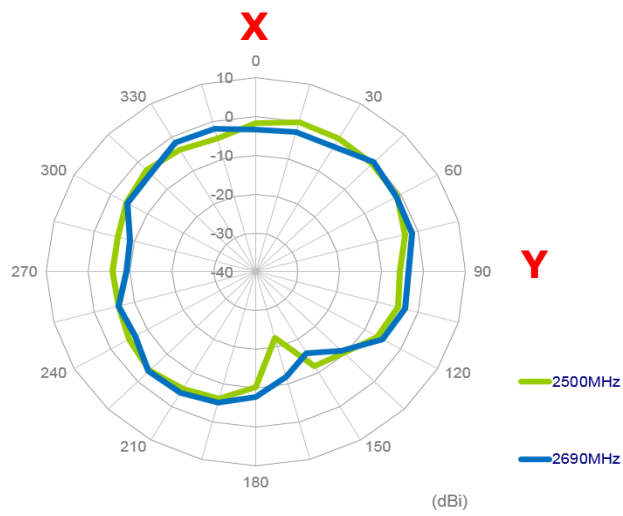
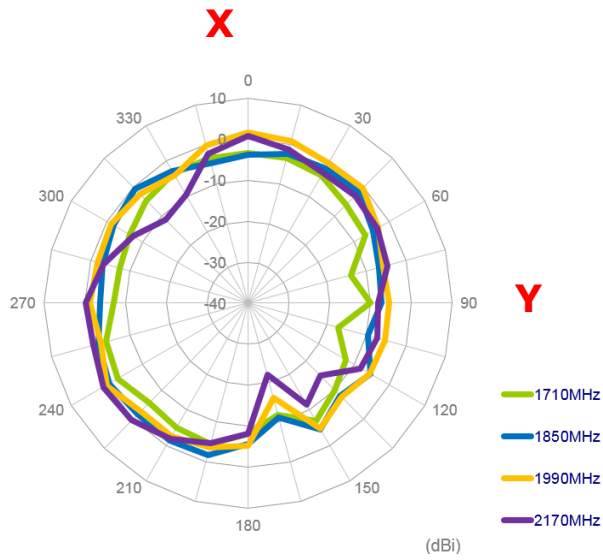
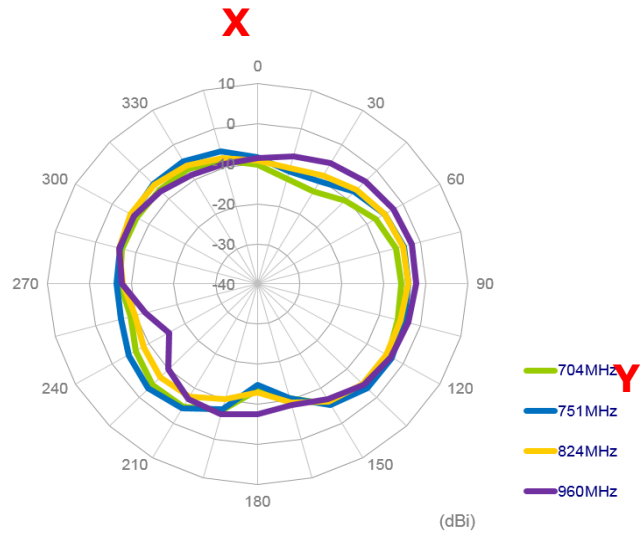


YZ Plane

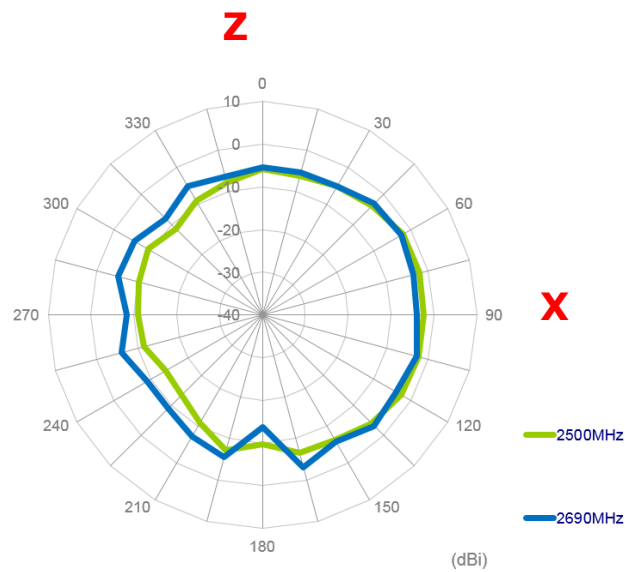
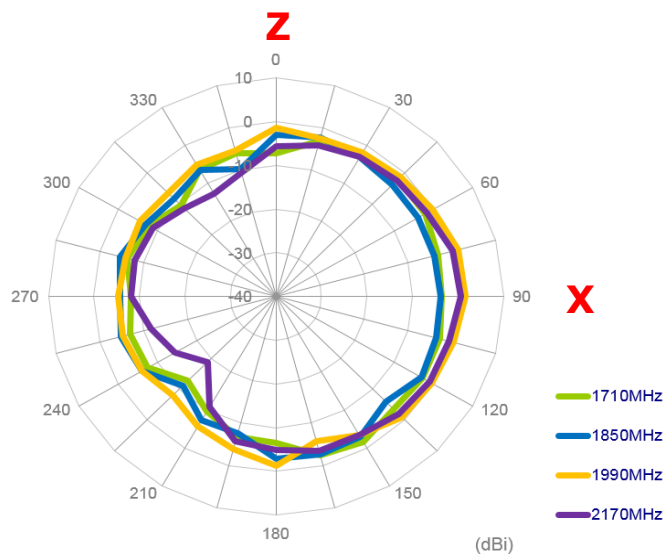
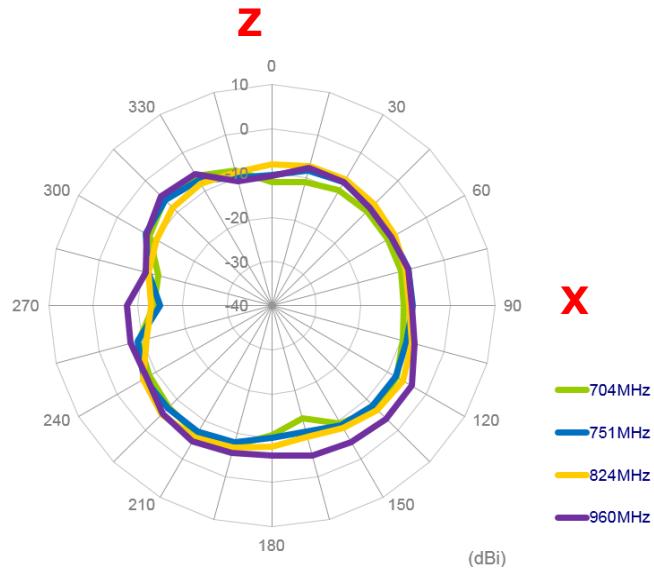


4.2.2 LTE 2

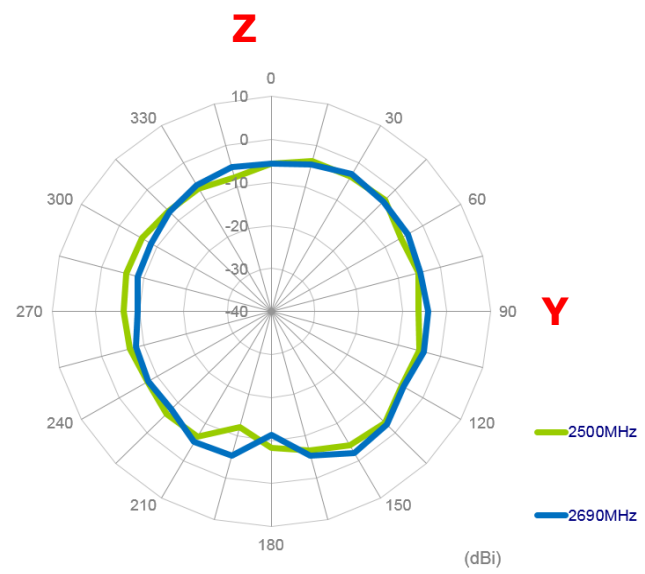
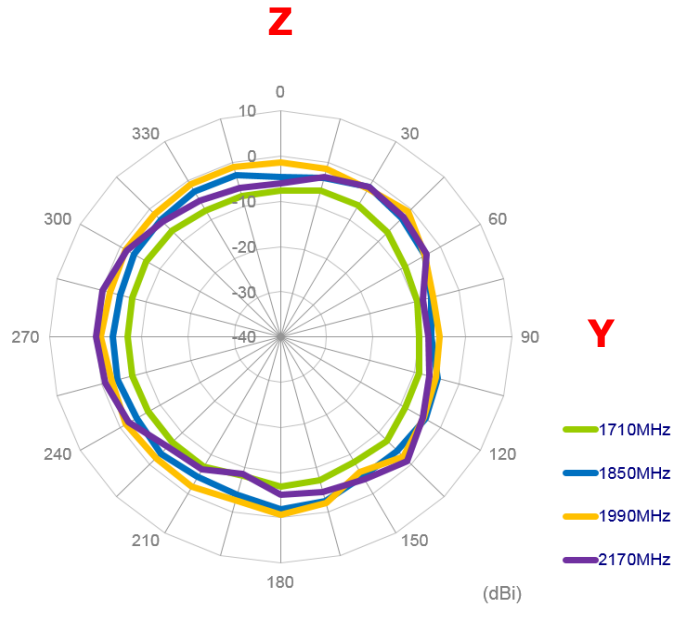
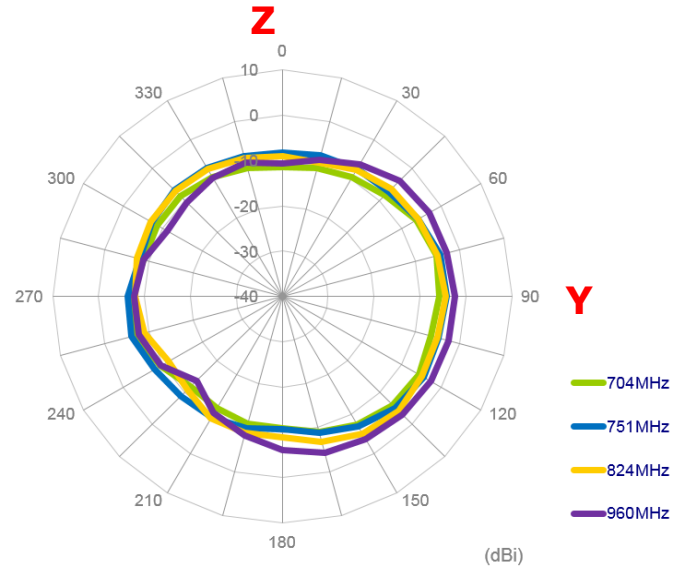
XY Plane



XZ Plane

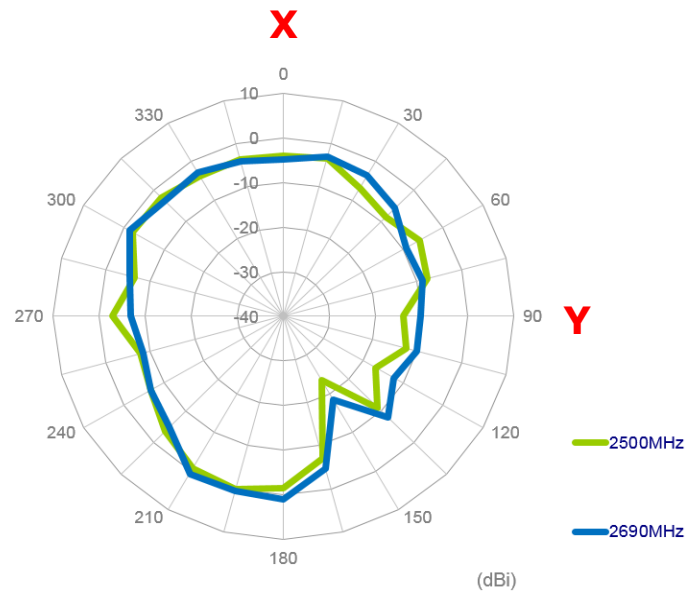
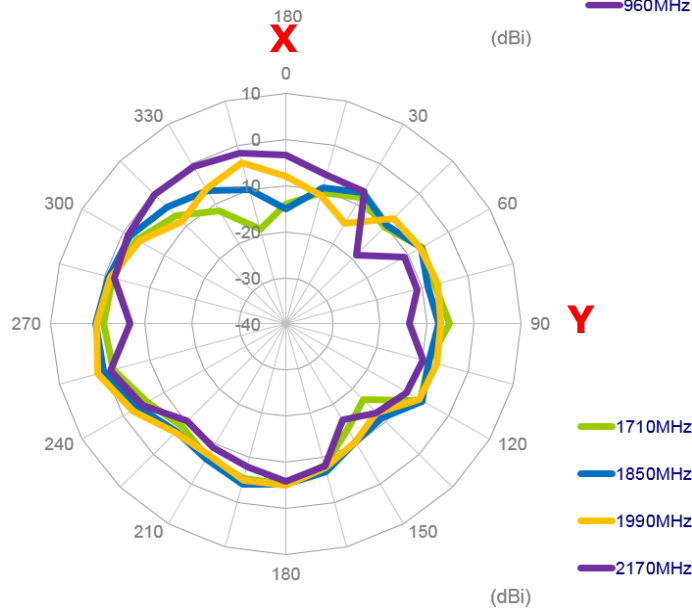
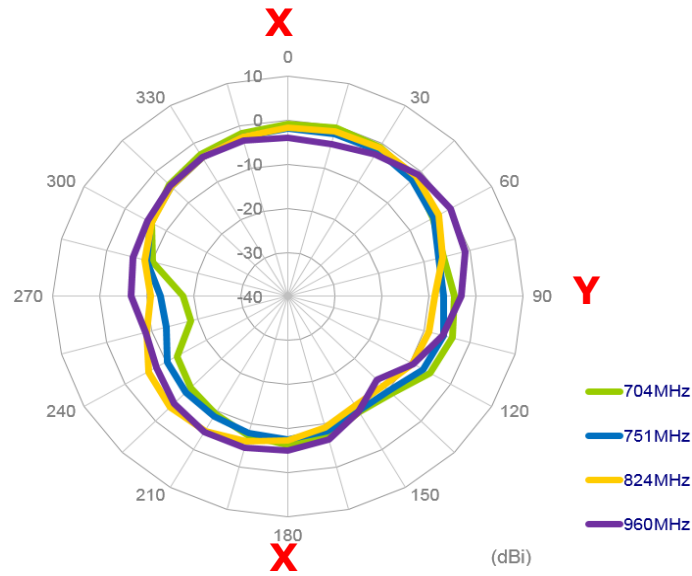


YZ Plane

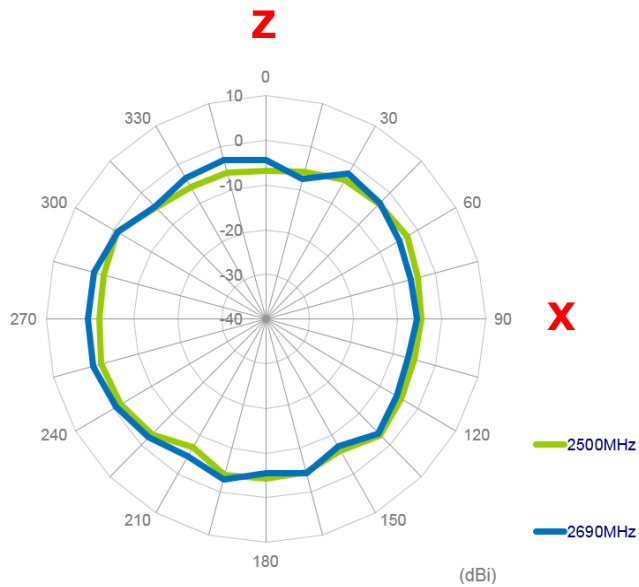
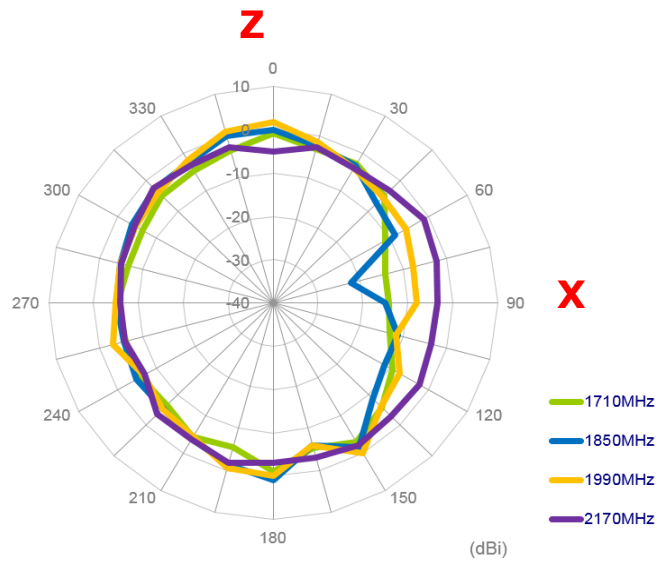
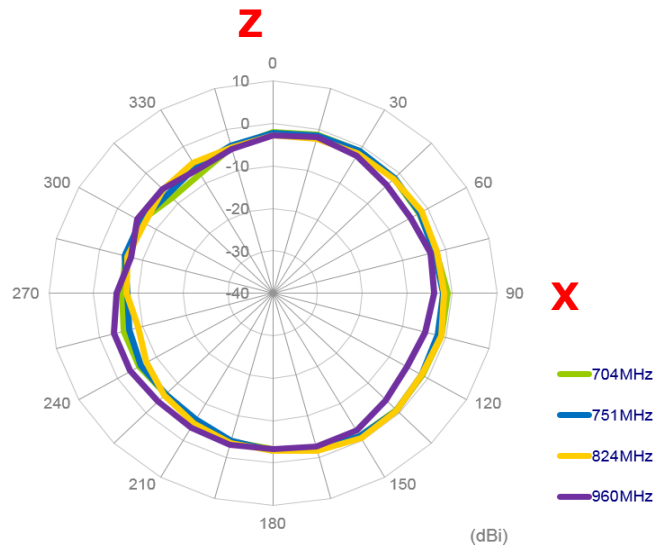


4.2.3 LTE 3

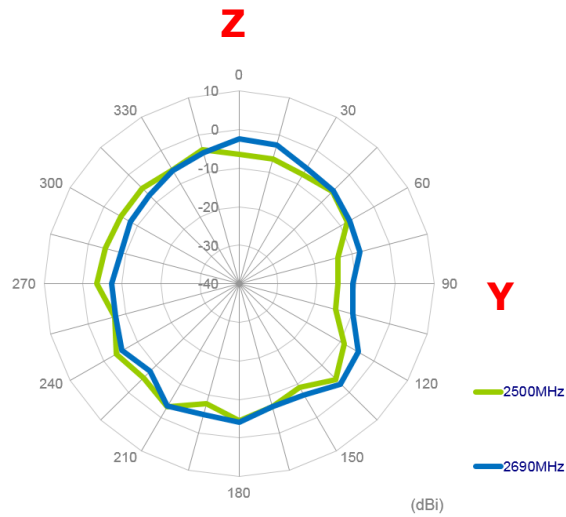
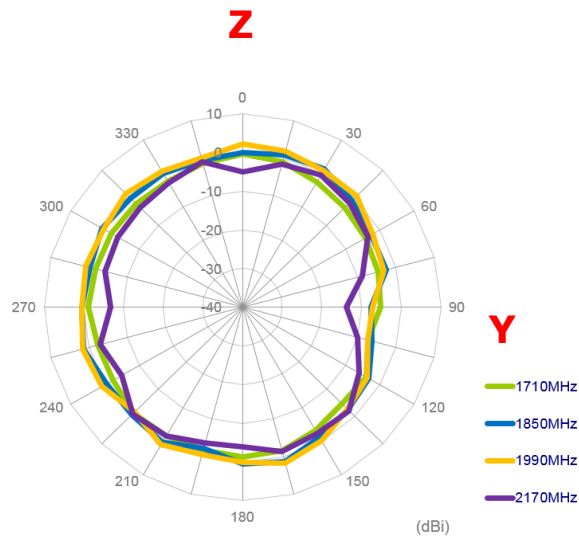
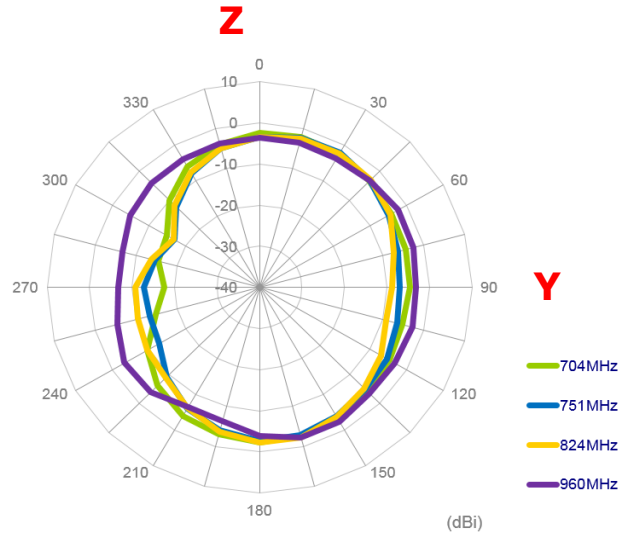
XY Plane



XZ Plane

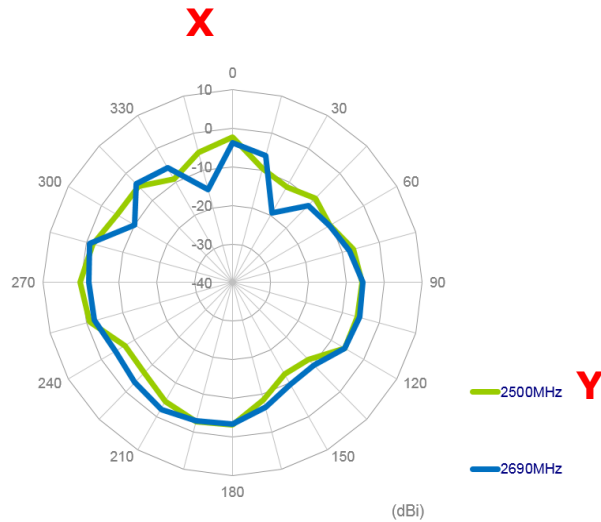
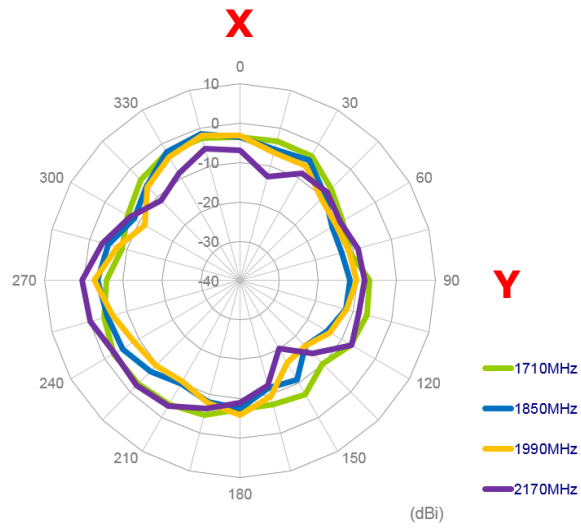
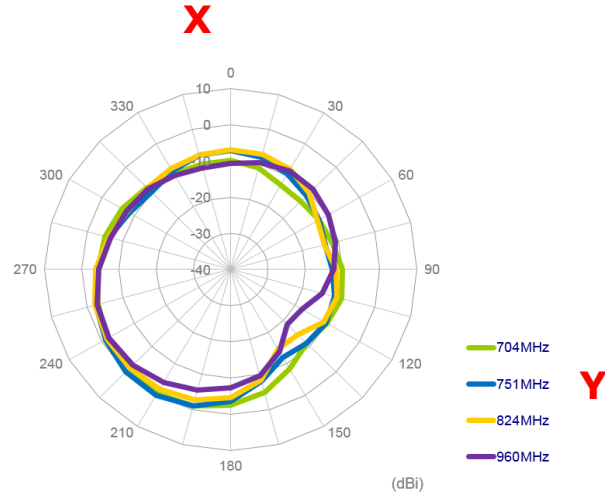


YZ Plane

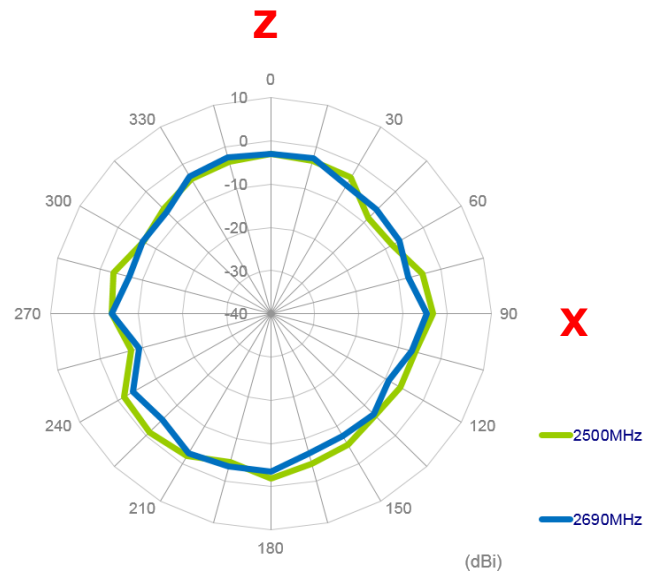
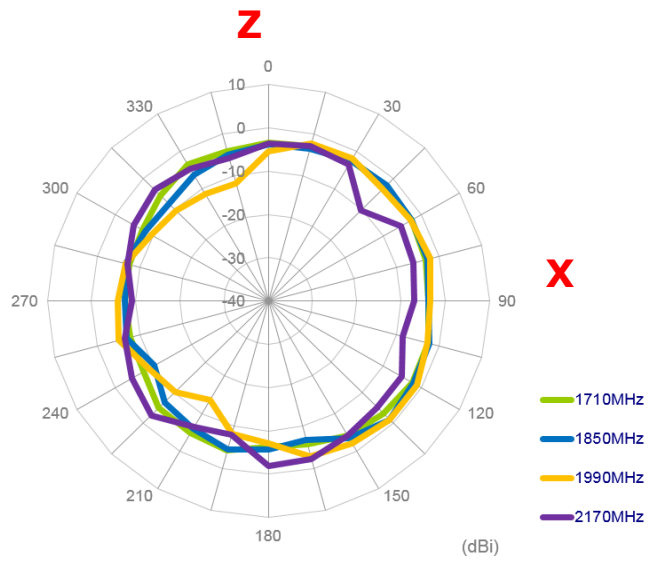
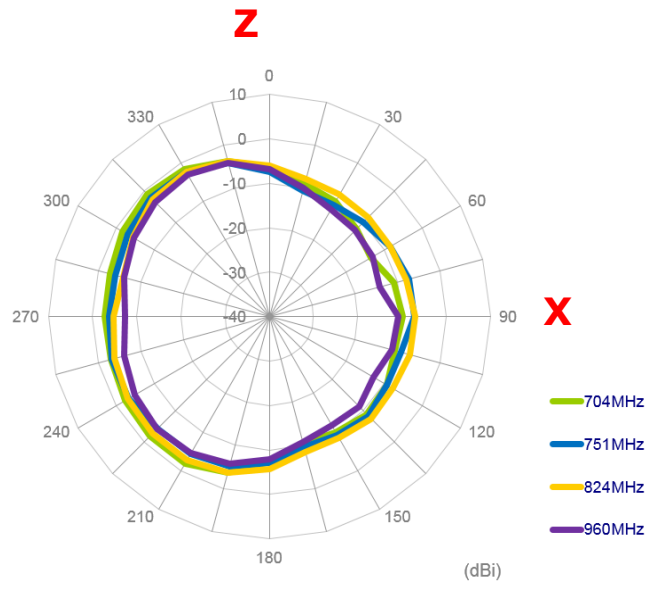


4.2.4 LTE 4

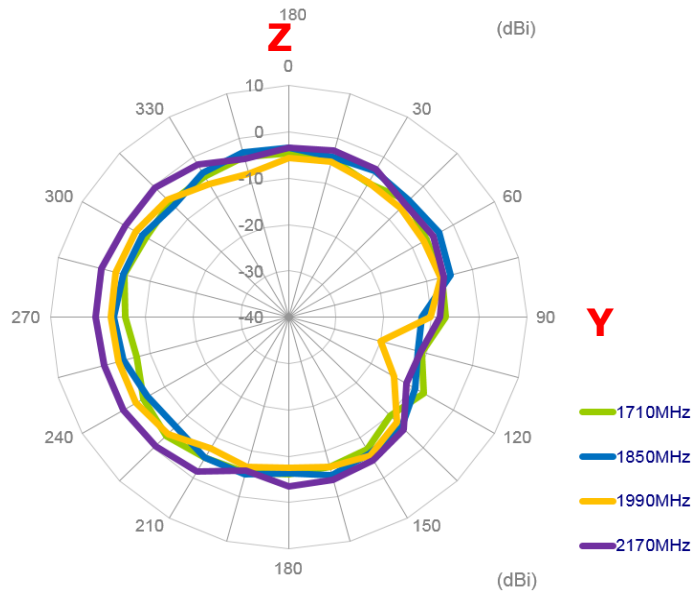
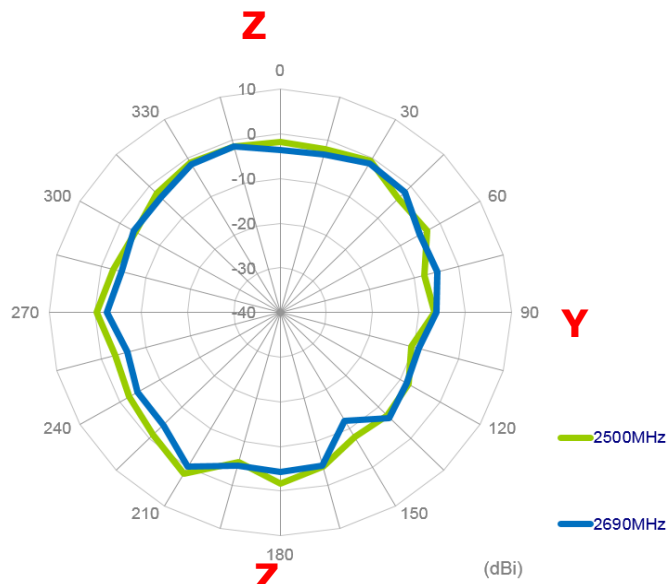
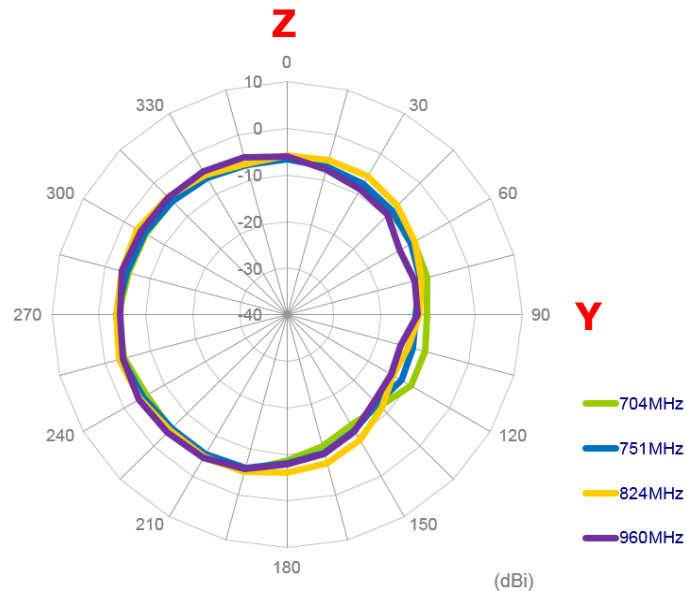
XY Plane



XZ Plane

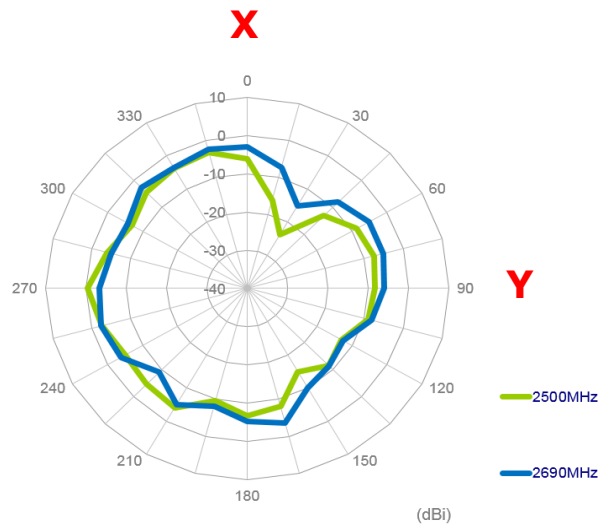
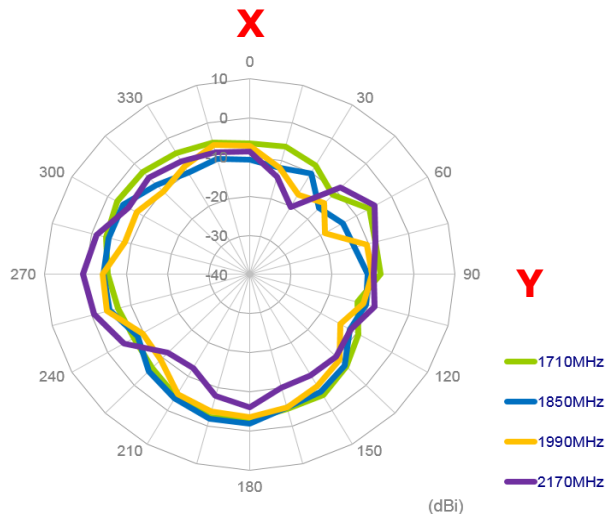
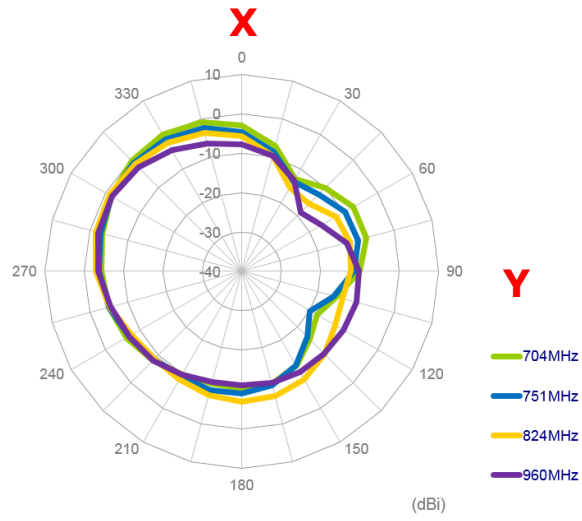


YZ Plane

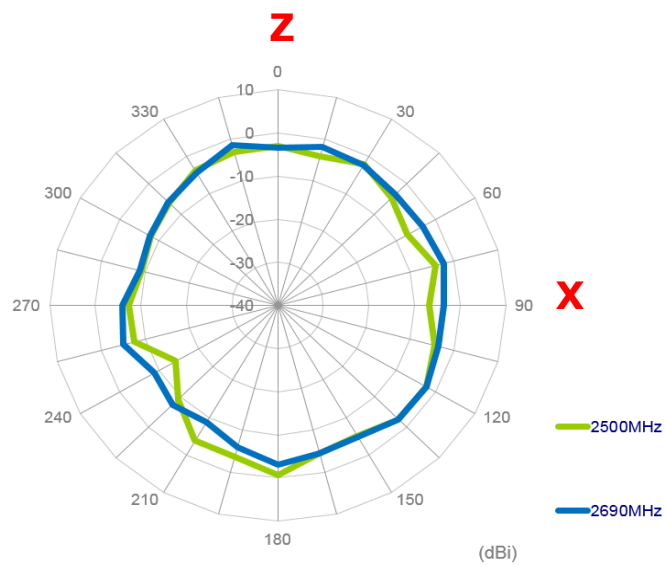
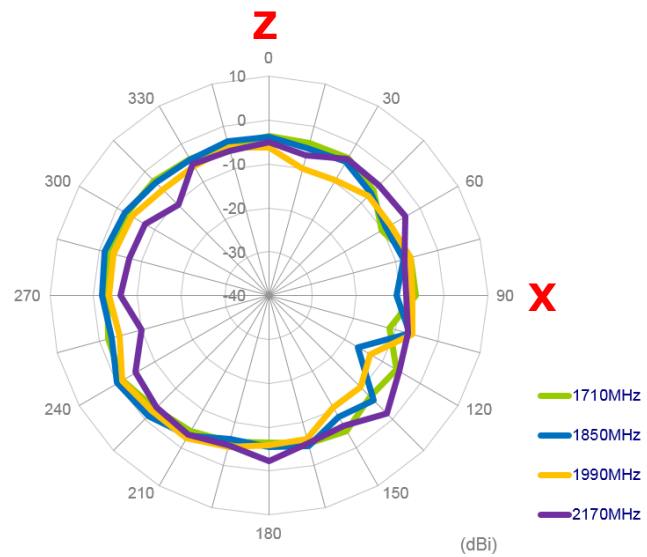
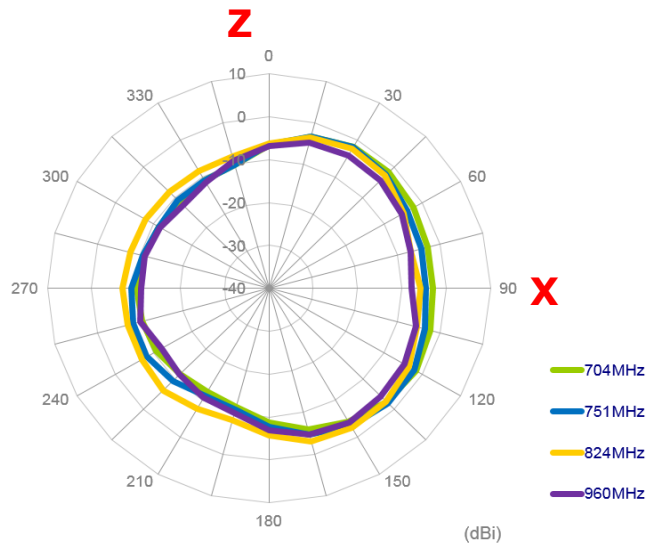


4.2.5 LTE 5

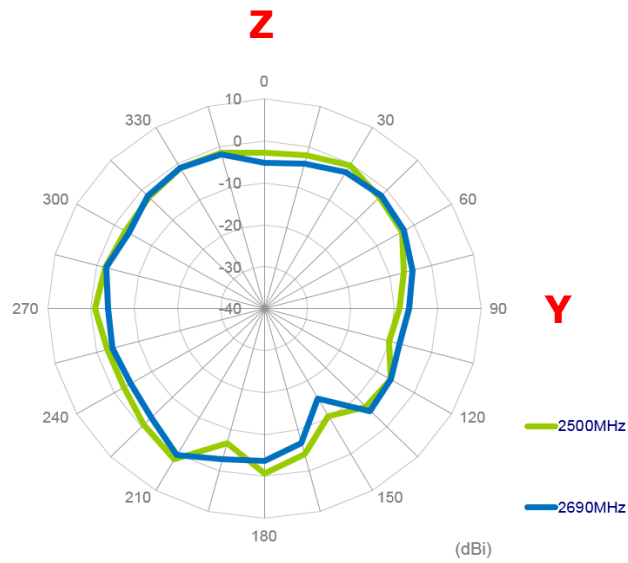
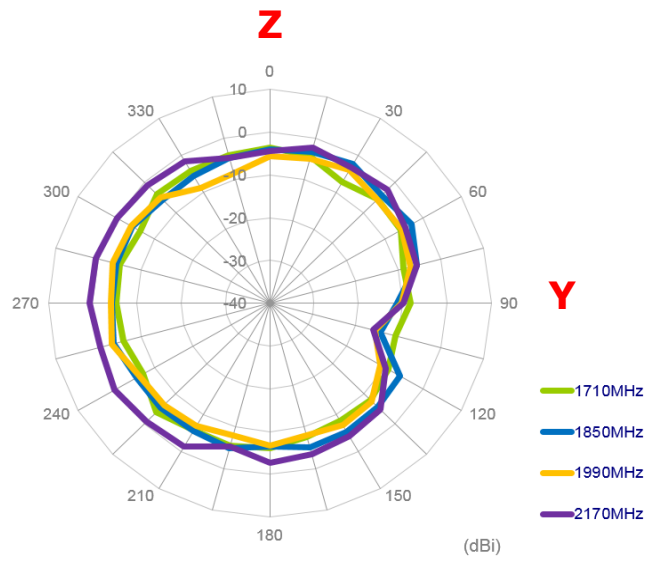
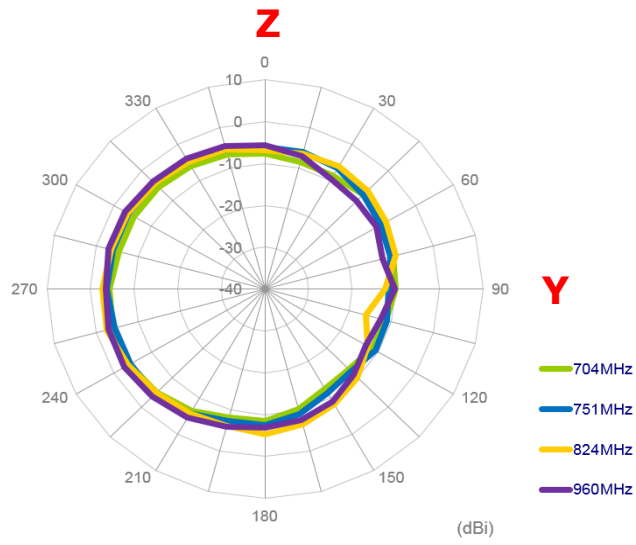
XY Plane



Z-X Plane

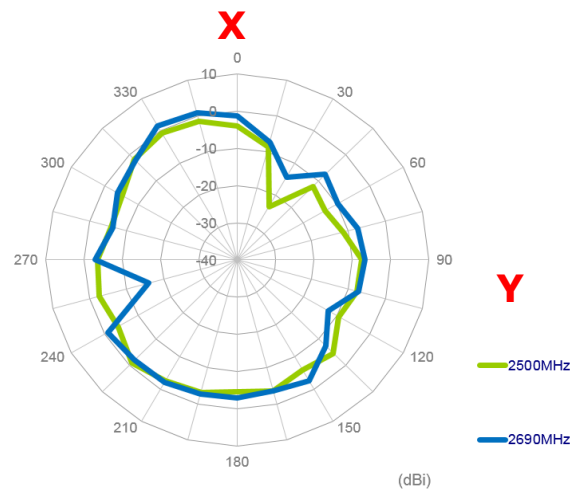
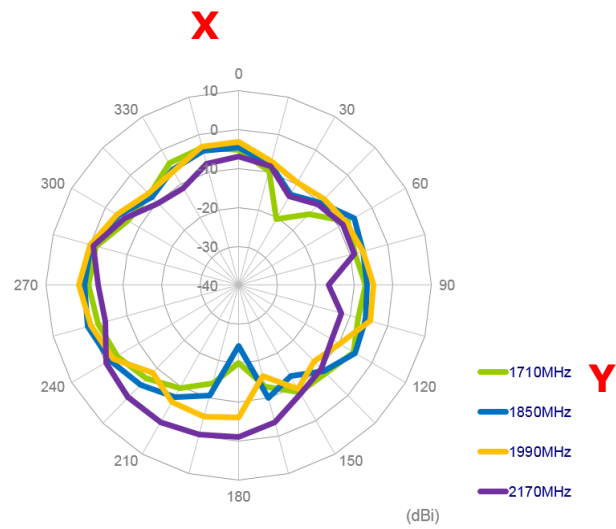
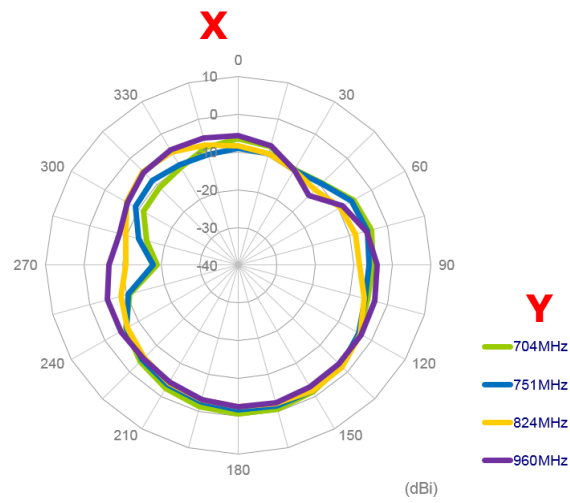


YZ Plane

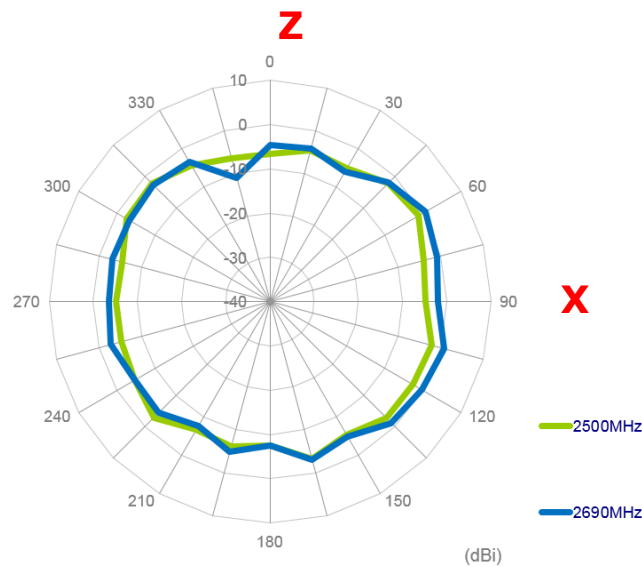
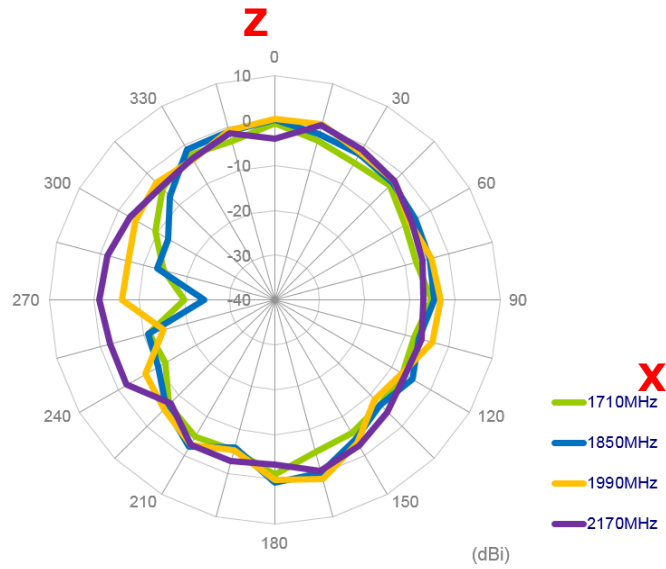
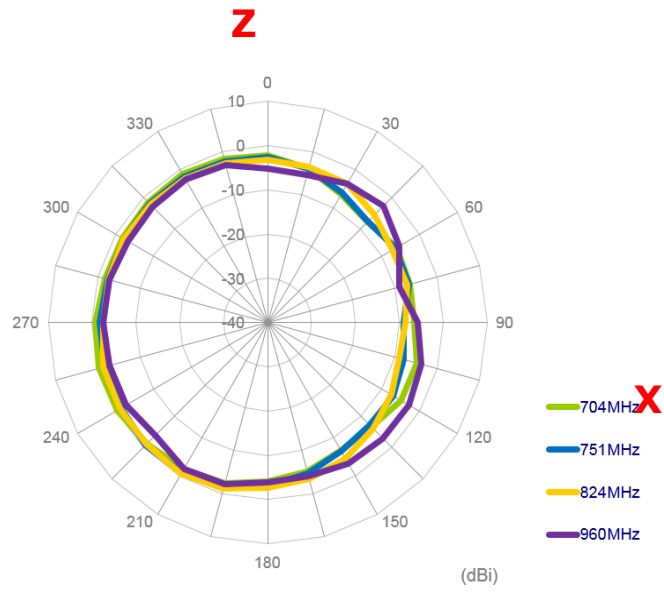


4.2.6 LTE 6

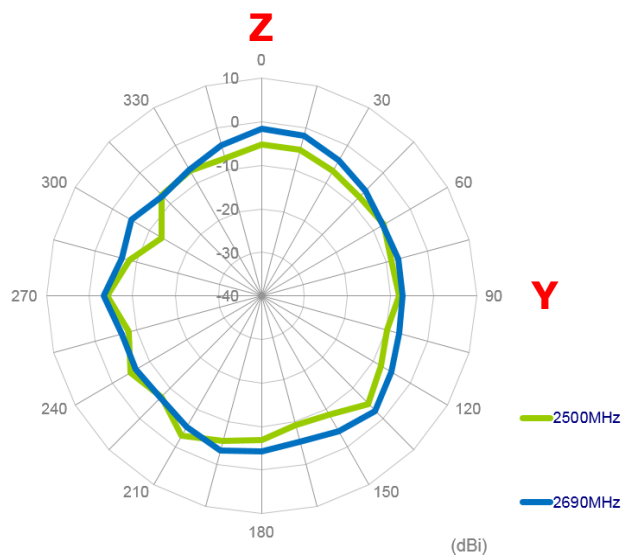
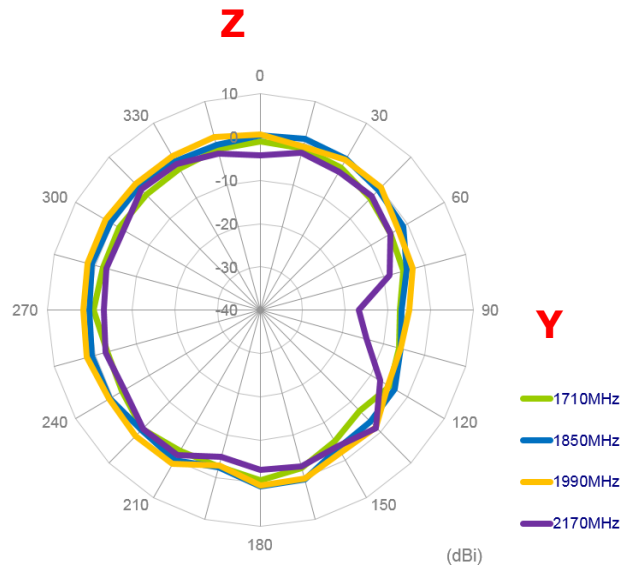
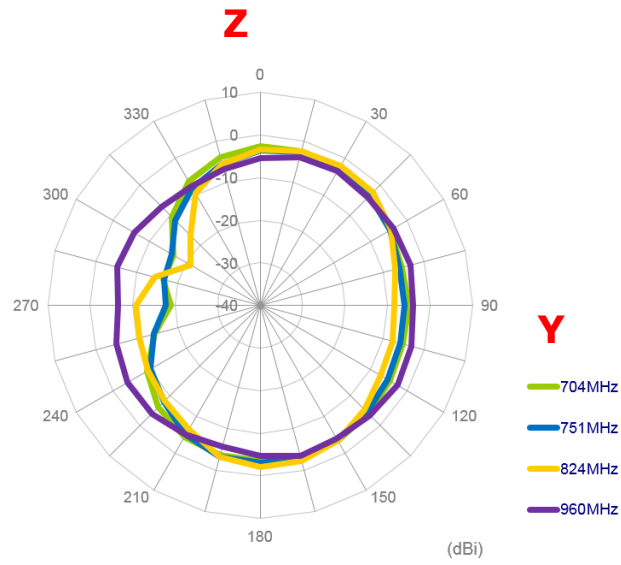
XY Plane



XZ Plane

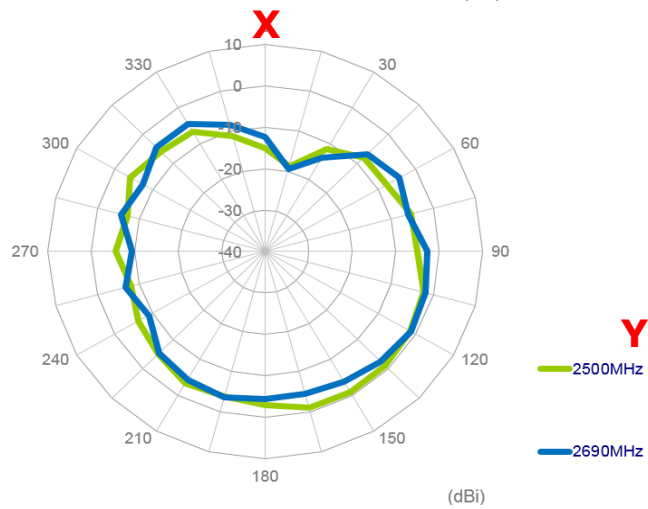
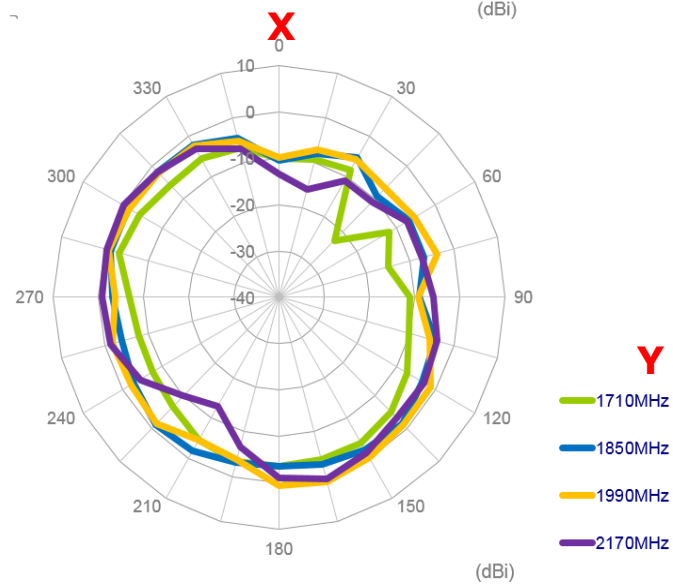
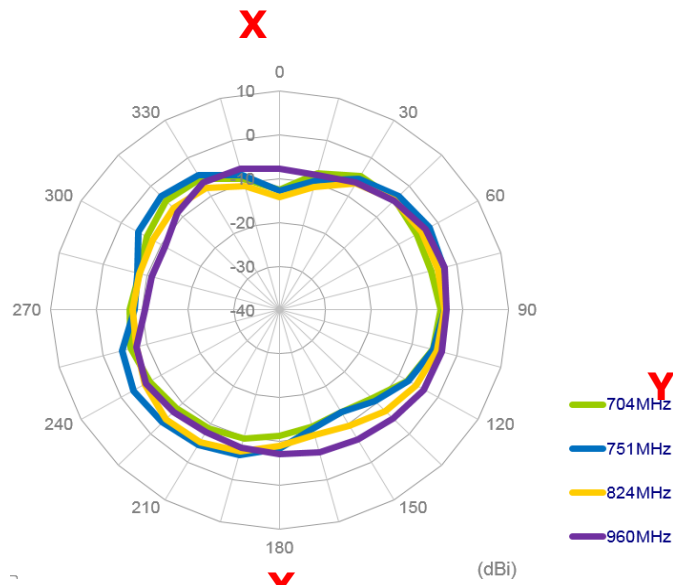


YZ Plane

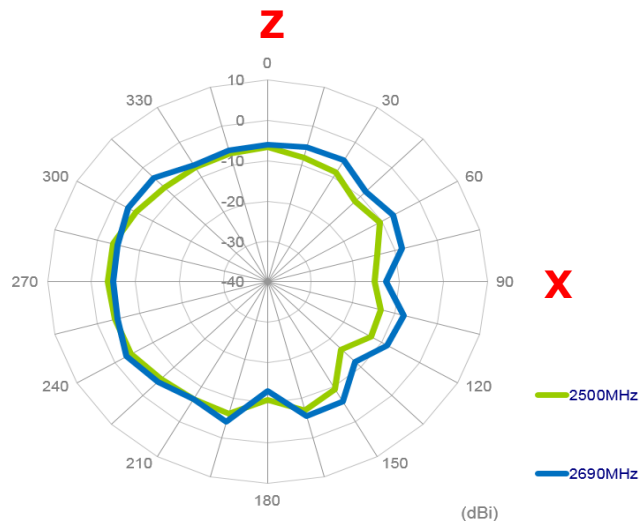
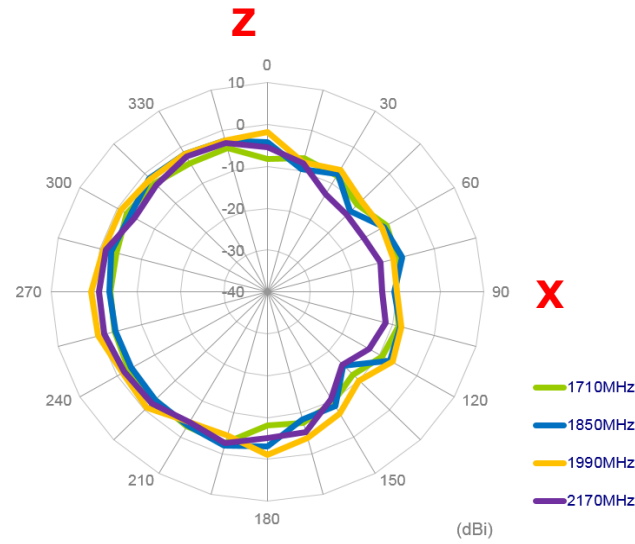
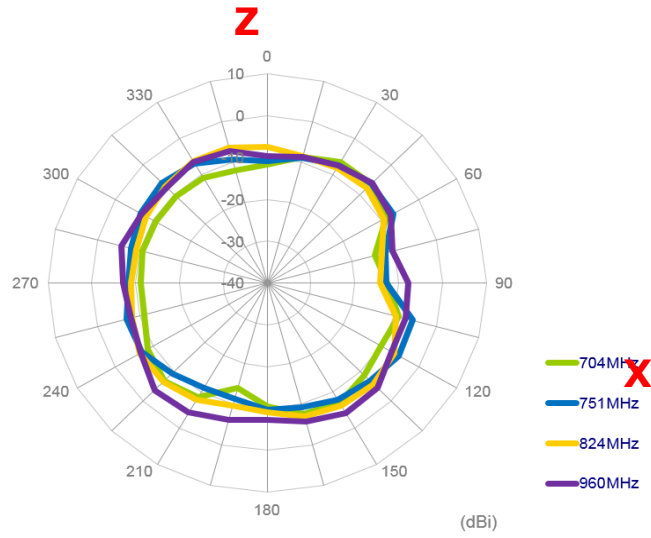


4.2.7 LTE 7

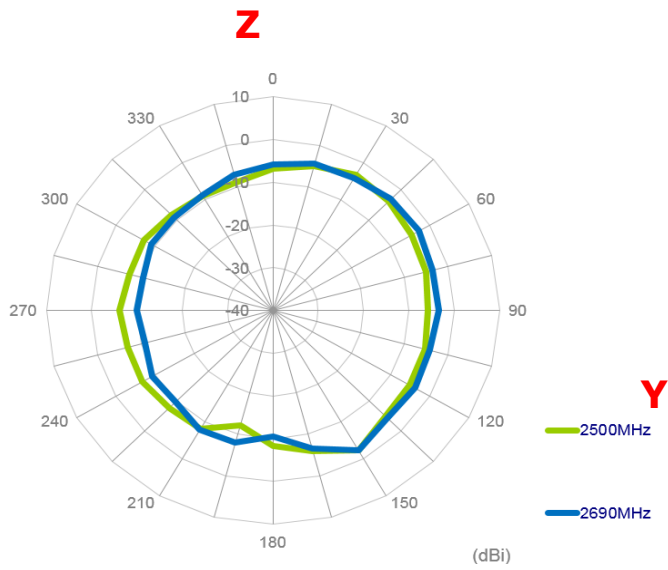
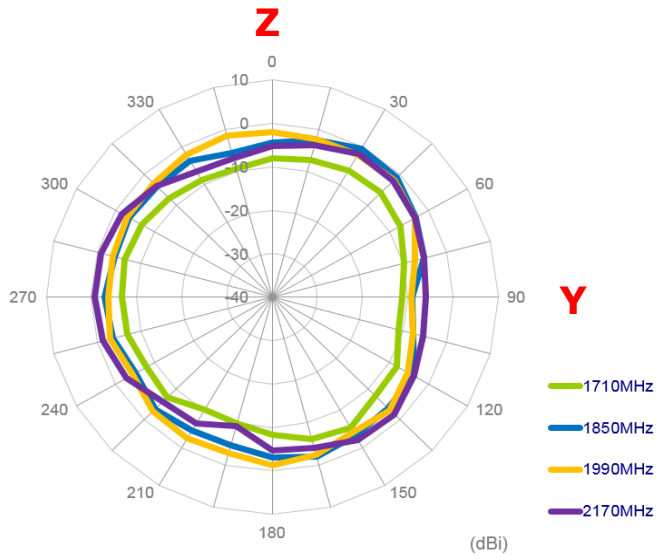
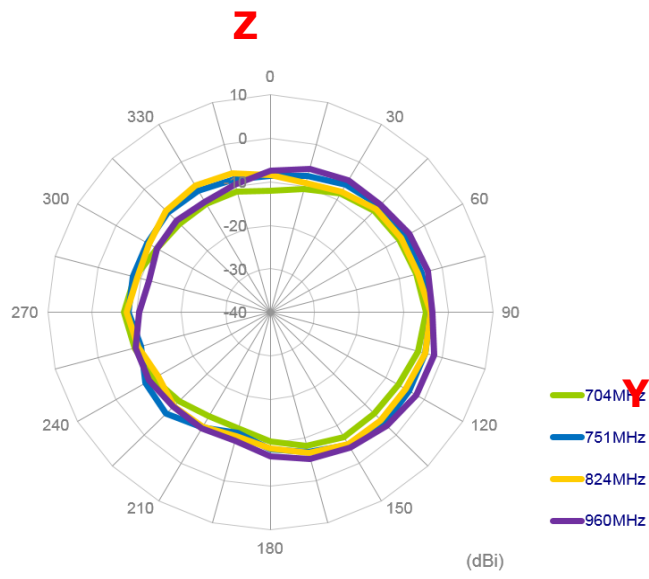
XY Plane



XZ Plane

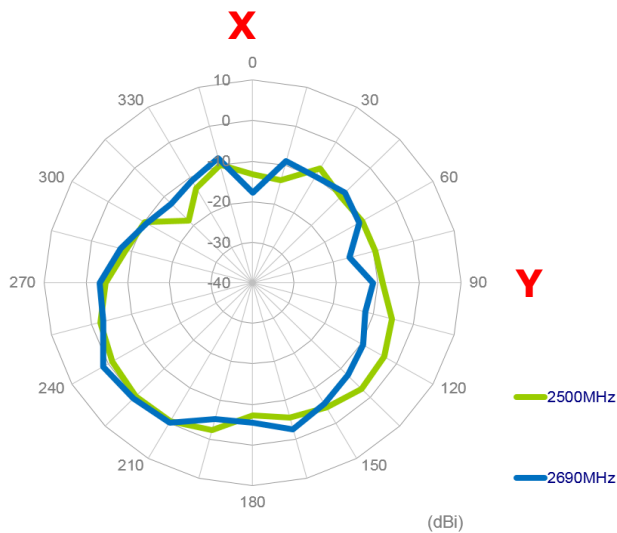
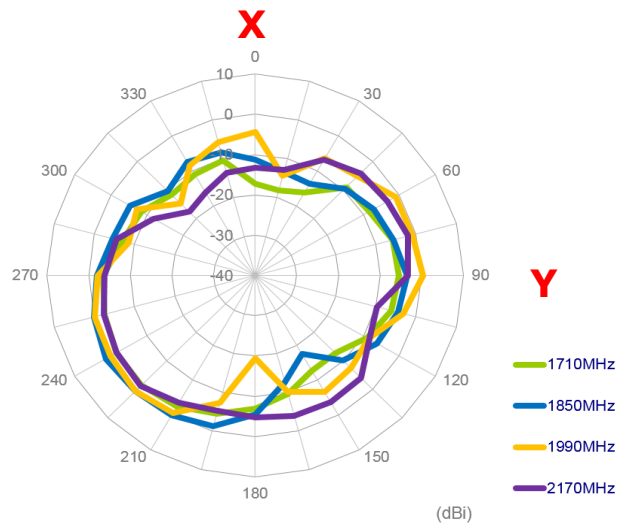
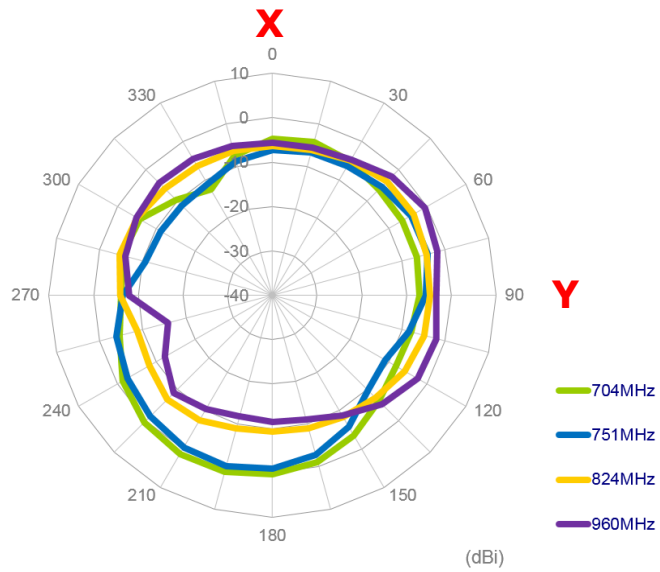


YZ Plane

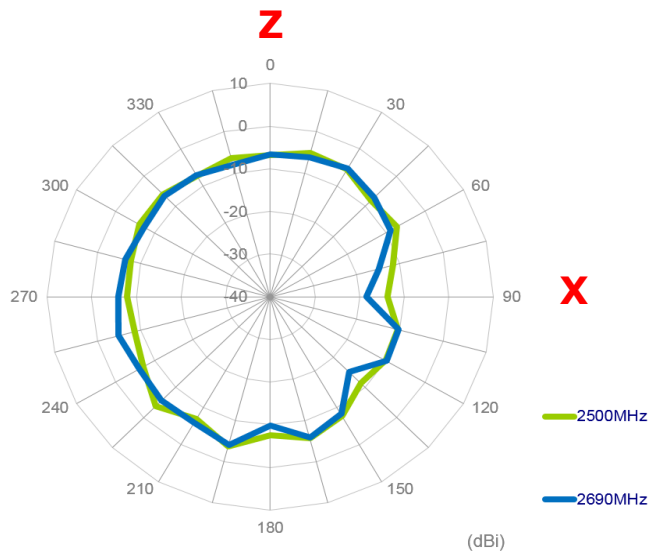
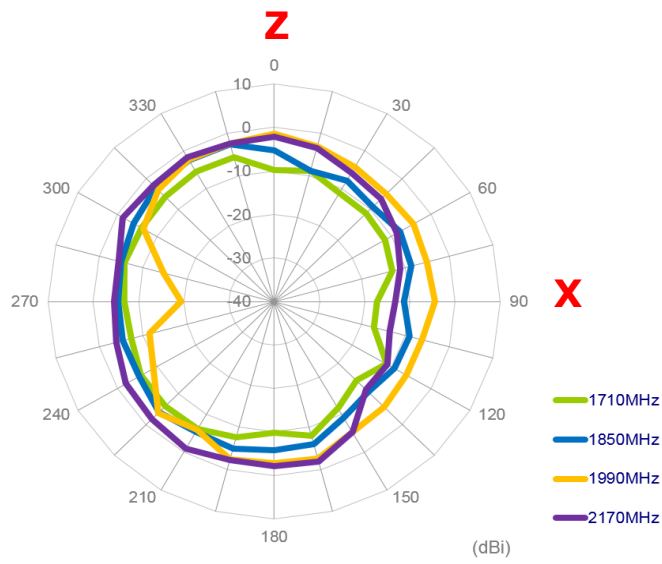
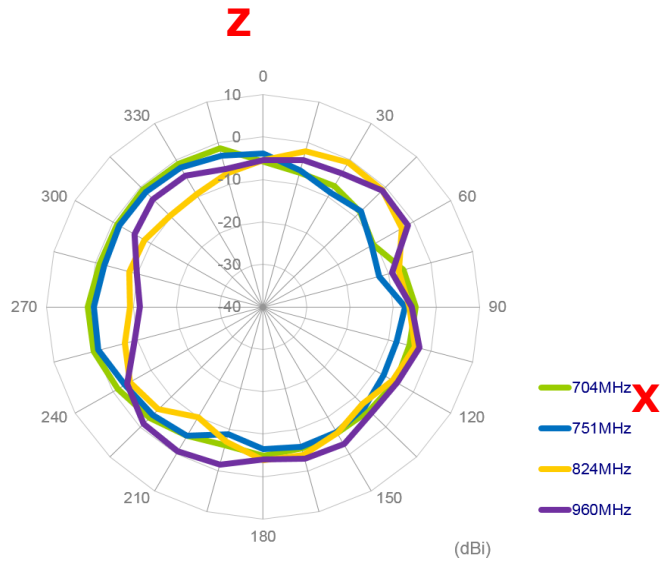


4.2.8 LTE 8

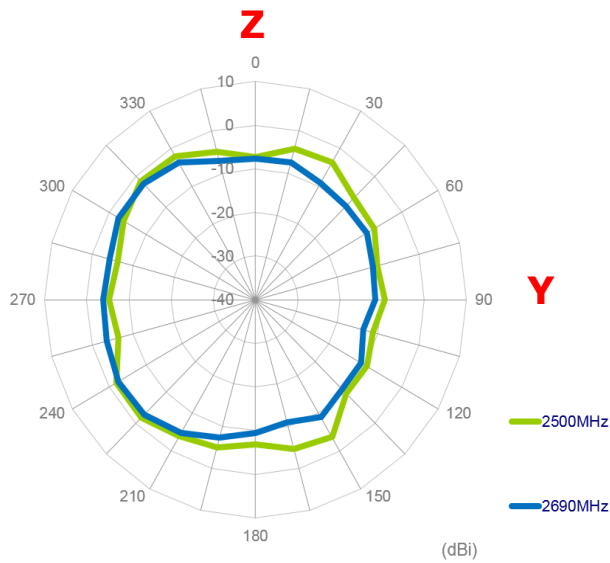
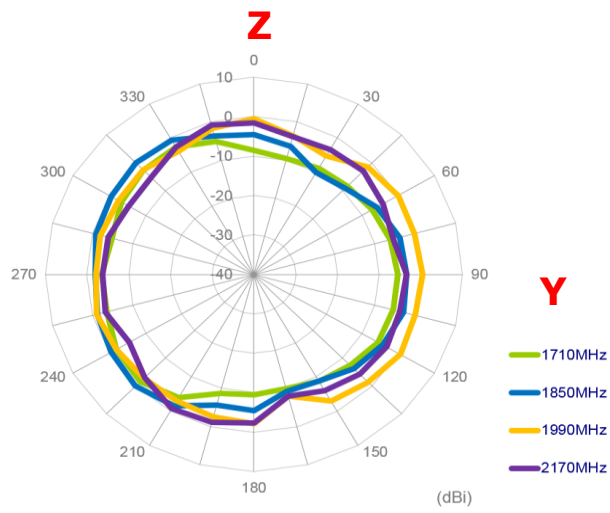
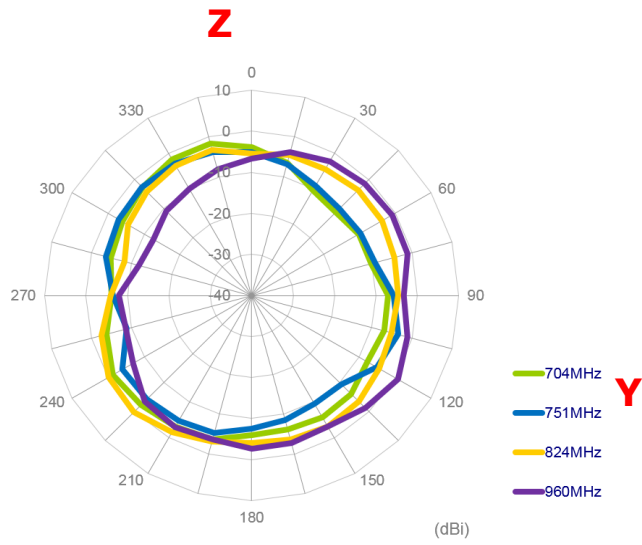
XY Plane



XZ Plane

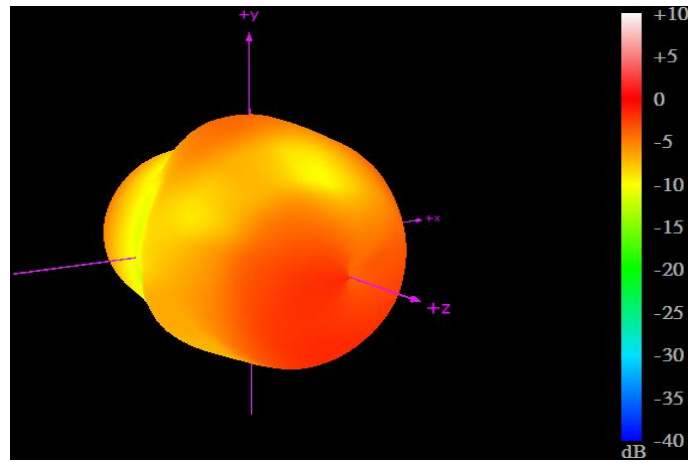


YZ Plane

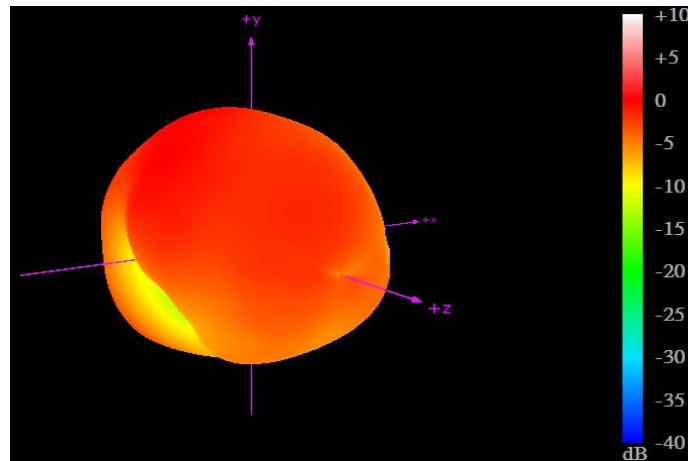


4.3 3D Radiation Patterns

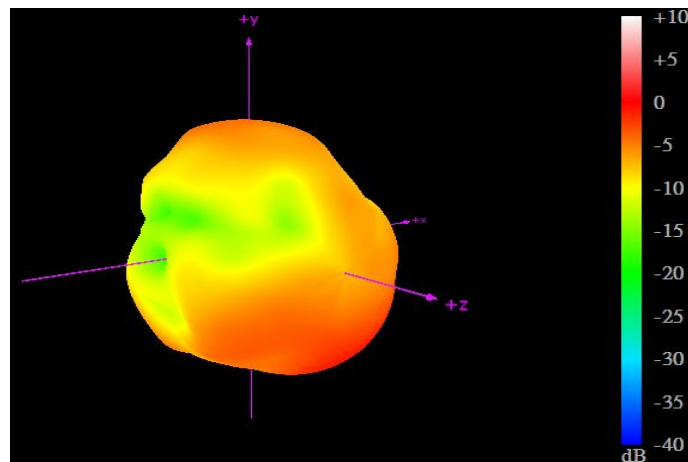
4.3.1 LTE 1



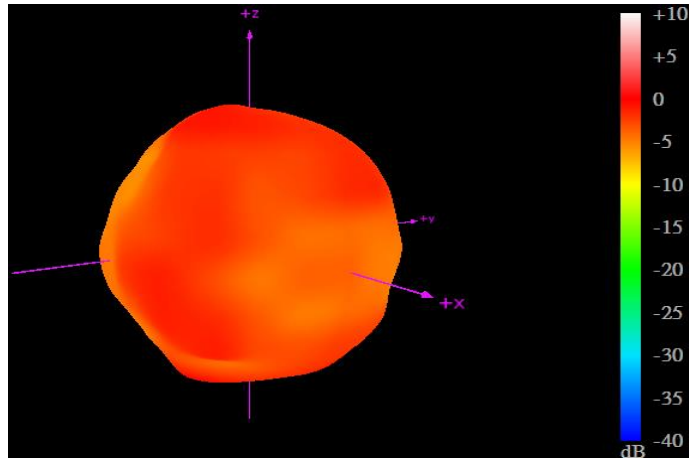
704MHz



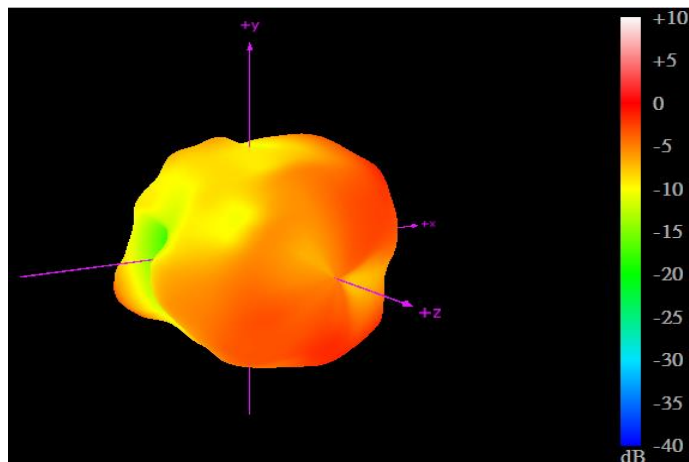
960MHz



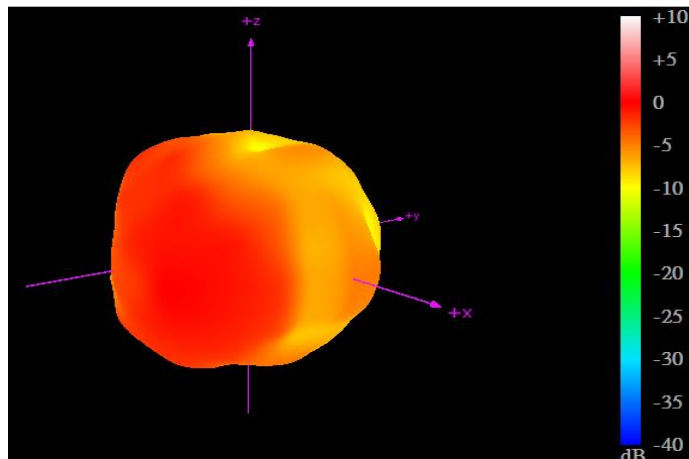
1710MHz



2170MHz

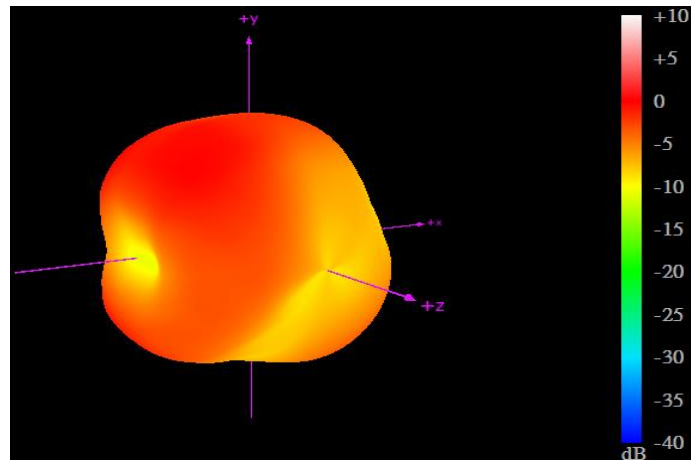


2300MHz

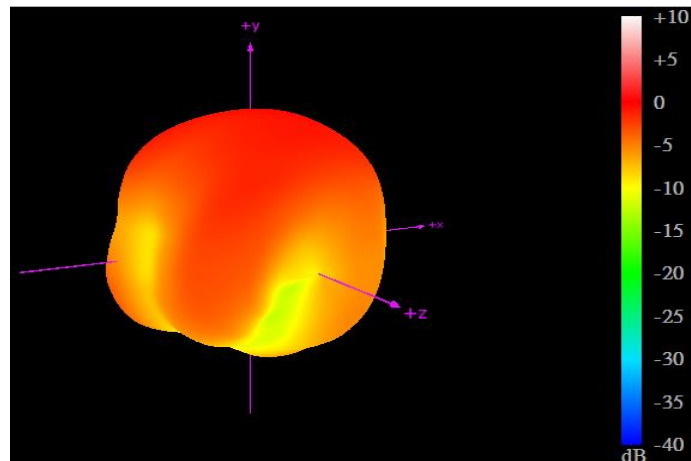


2690MHz

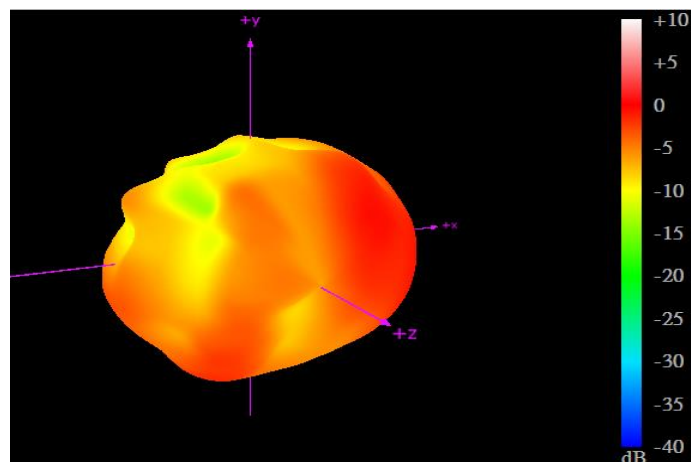
4.3.2 LTE 2



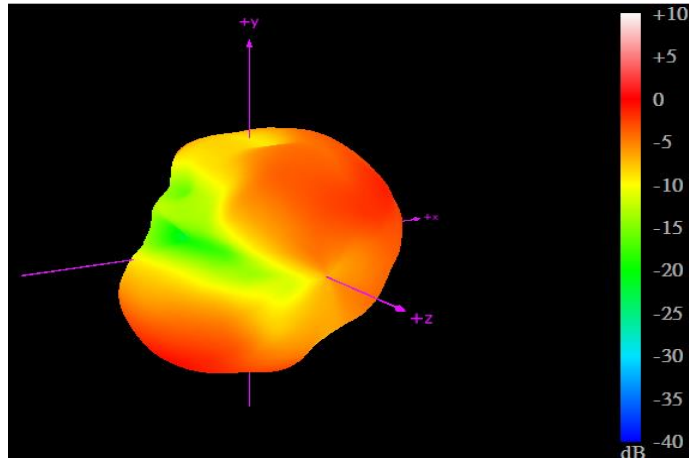
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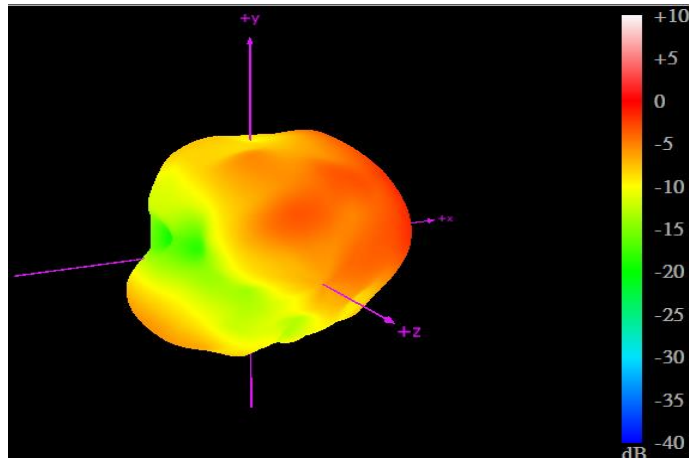
960MHz



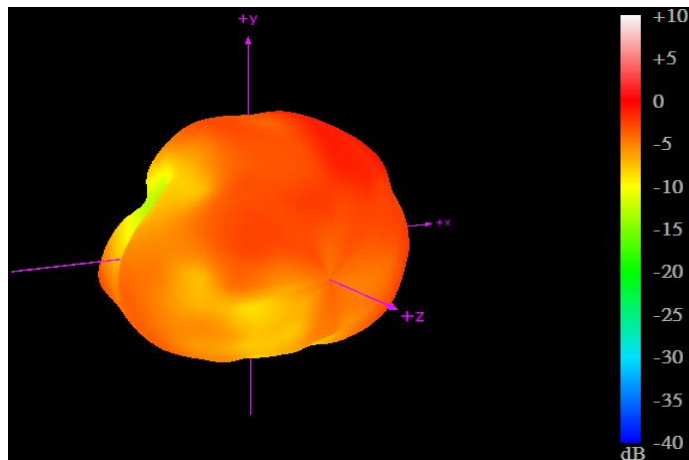
1710MHz



2170MHz

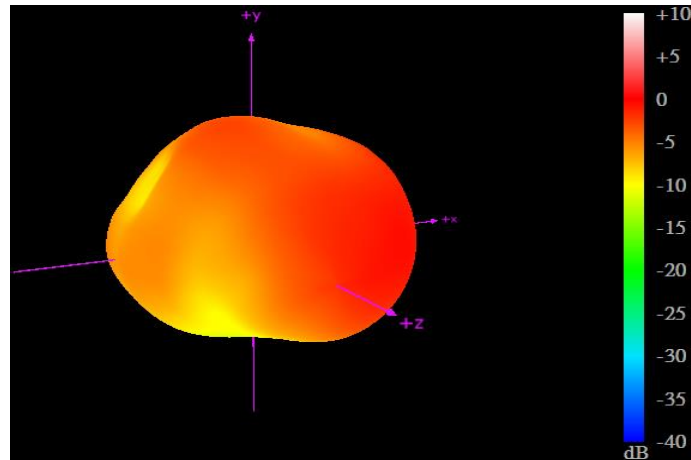


2300MHz

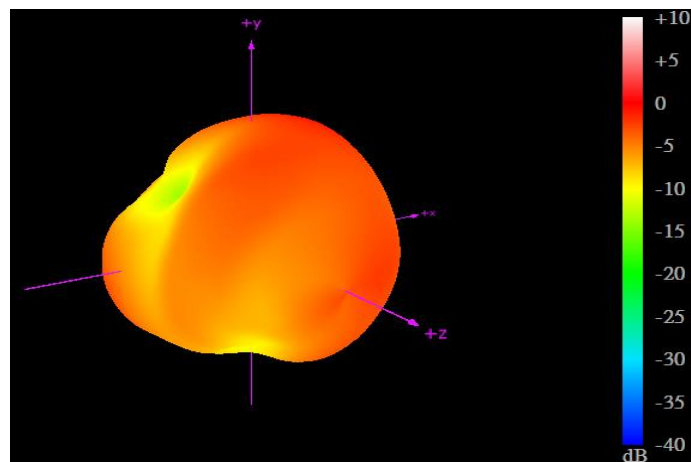


2690MHz

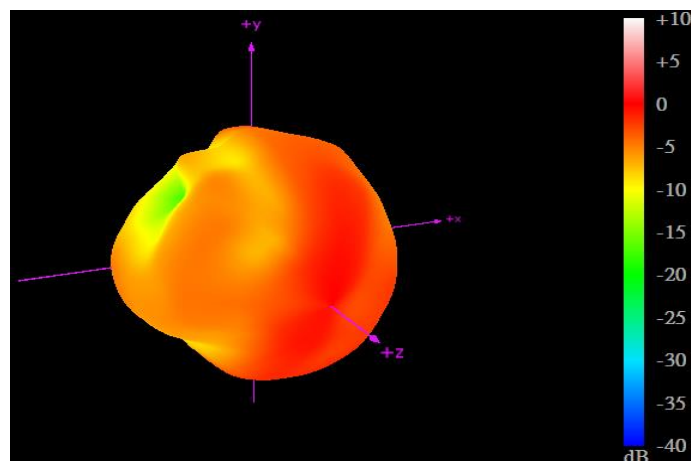
4.3.3 LTE 3



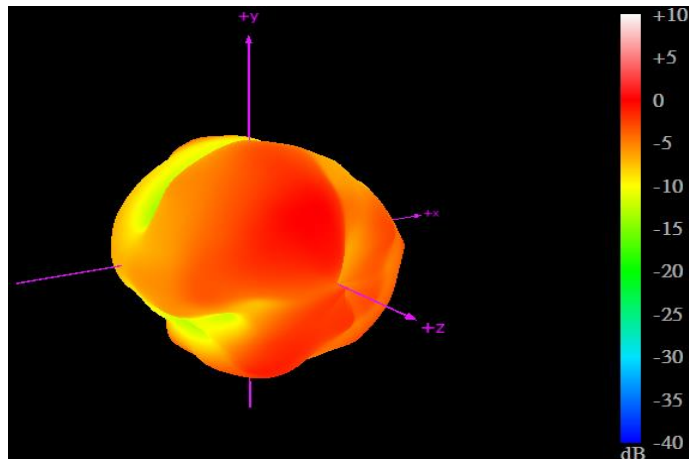
704MHz



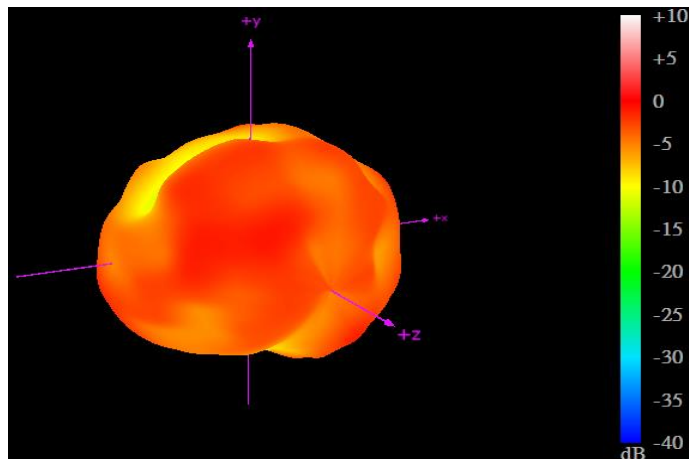
960MHz



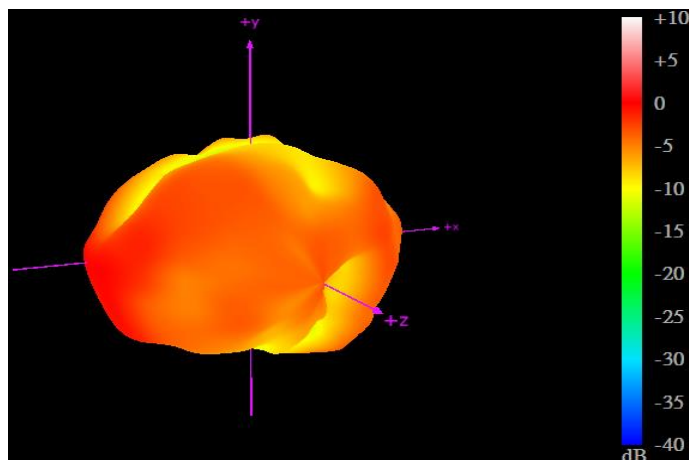
1710MHz



2170MHz

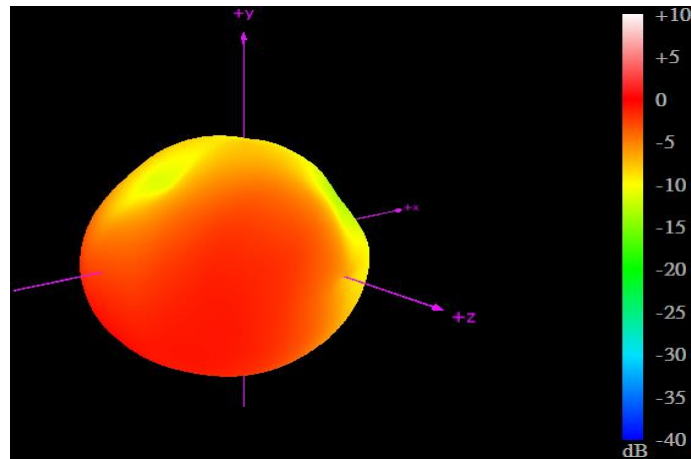


2300MHz

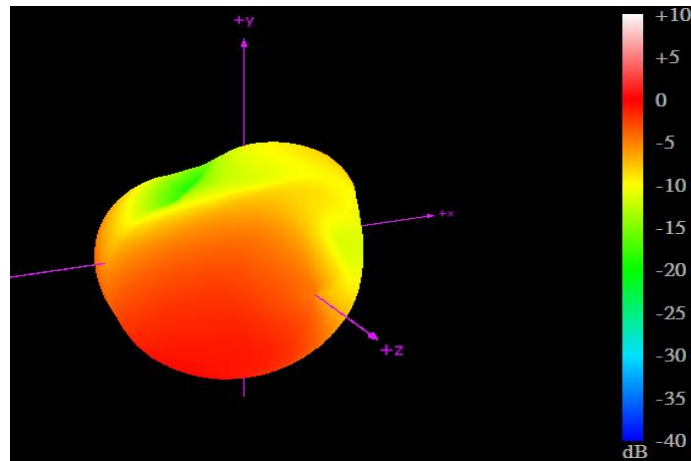


2690MHz

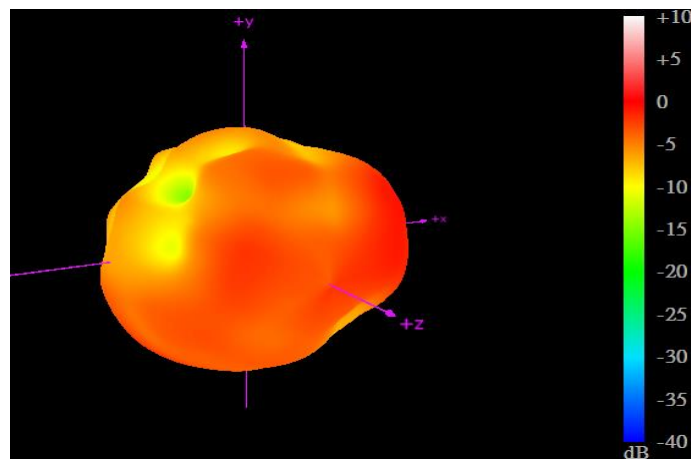
4.3.4 LTE 4



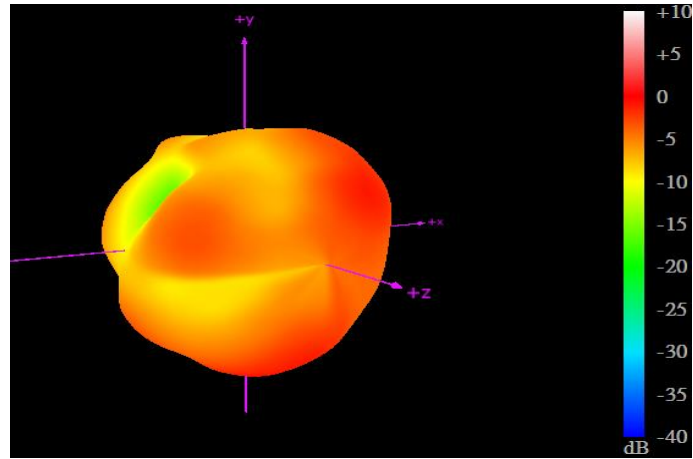
704MHz



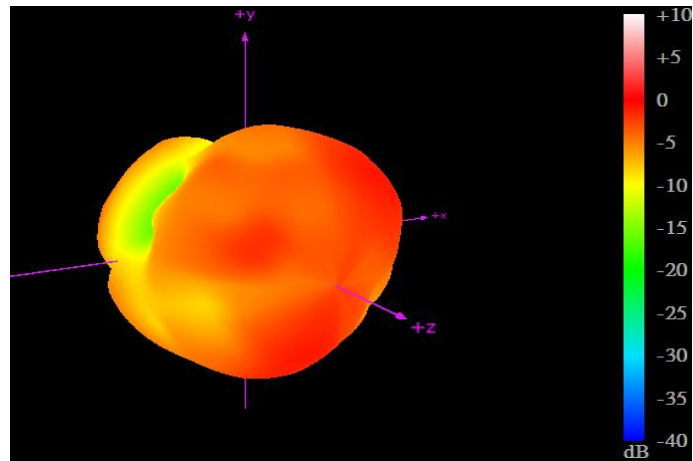
960MHz



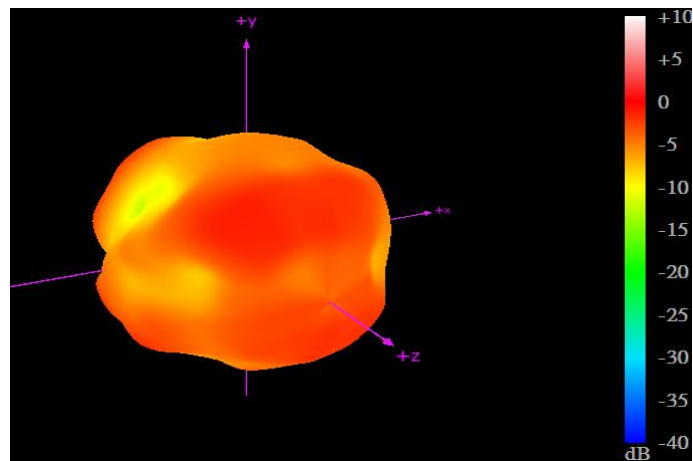
1710MHz



2170MHz

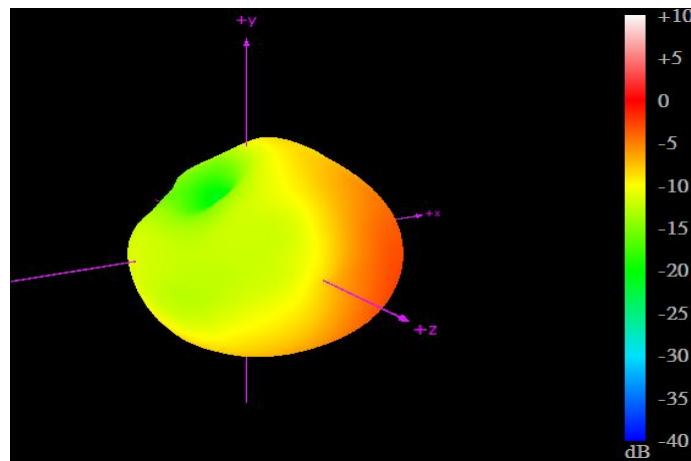


2300MHz

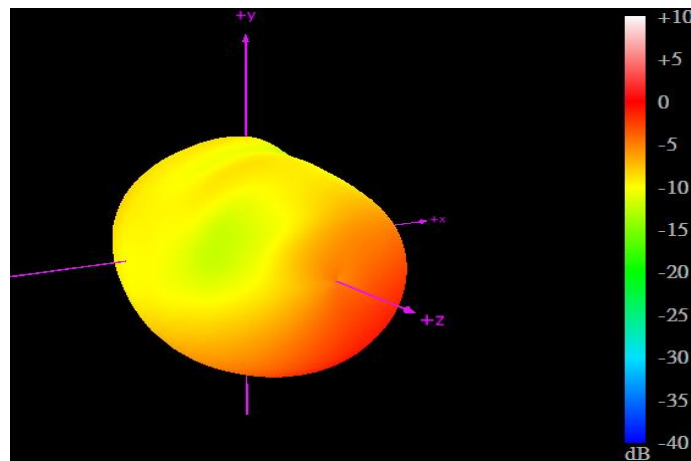


2690MHz

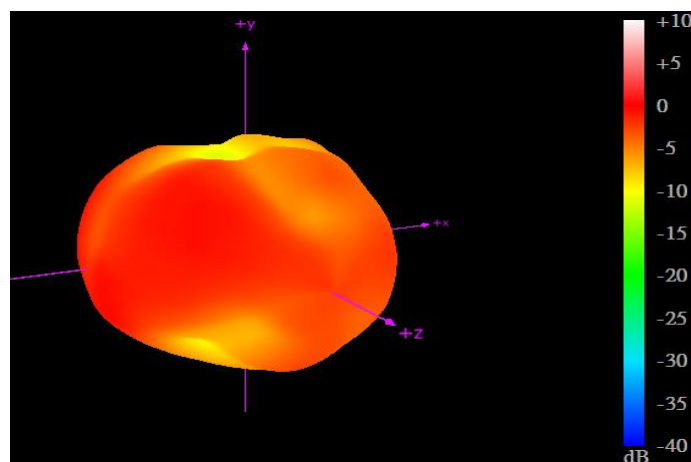
4.3.5 LTE5



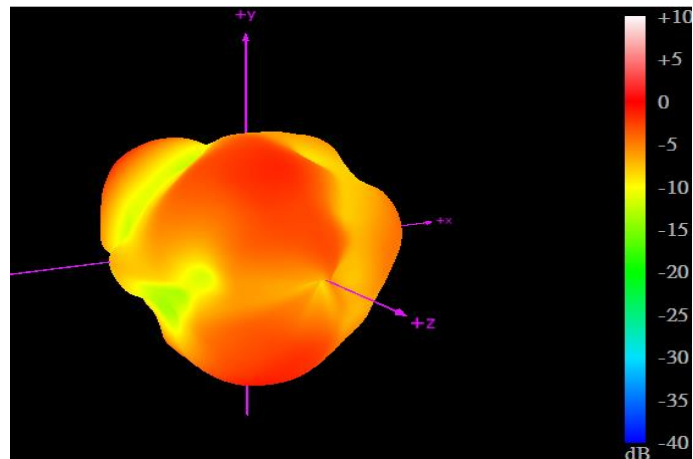
704MHz



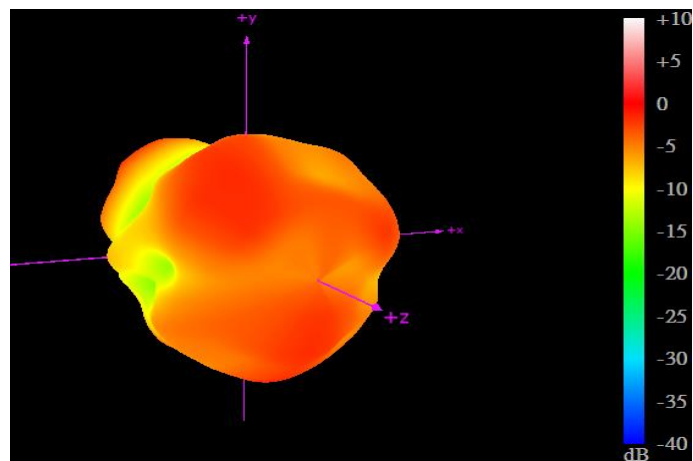
960MHz



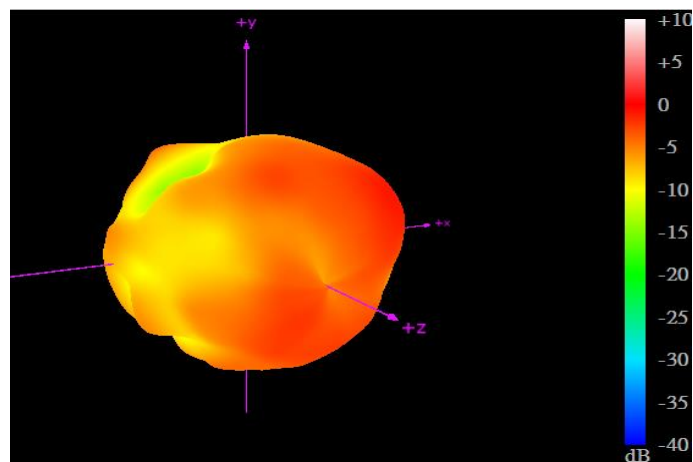
1710MHz



2170MHz

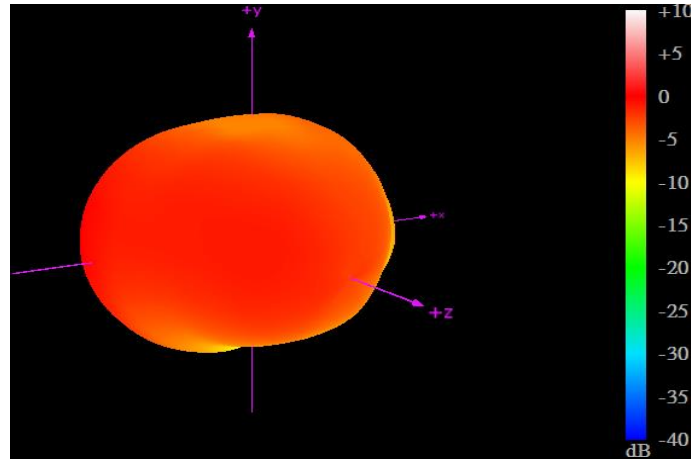


2300MHz

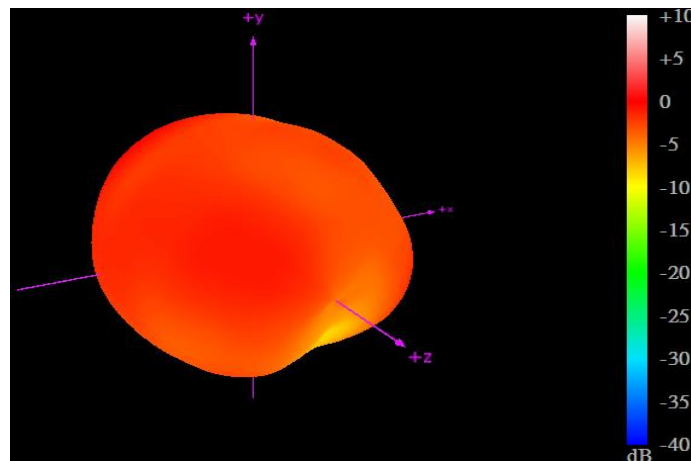


2690MHz

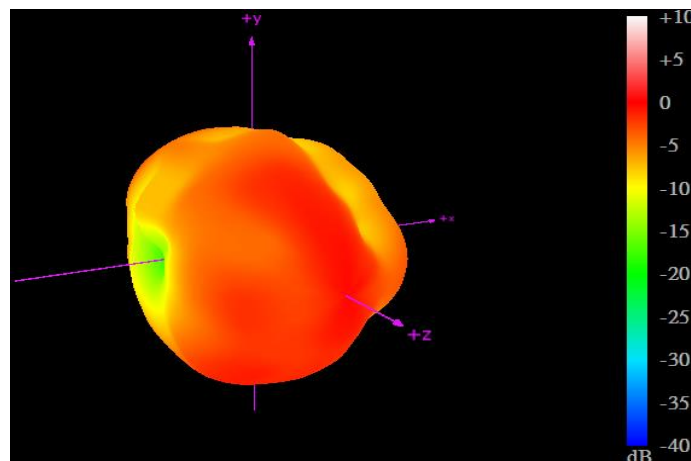
4.3.6 LTE 6



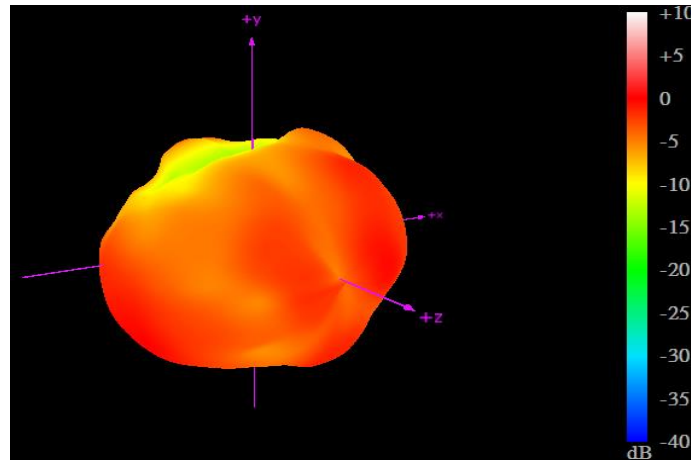
704MHz



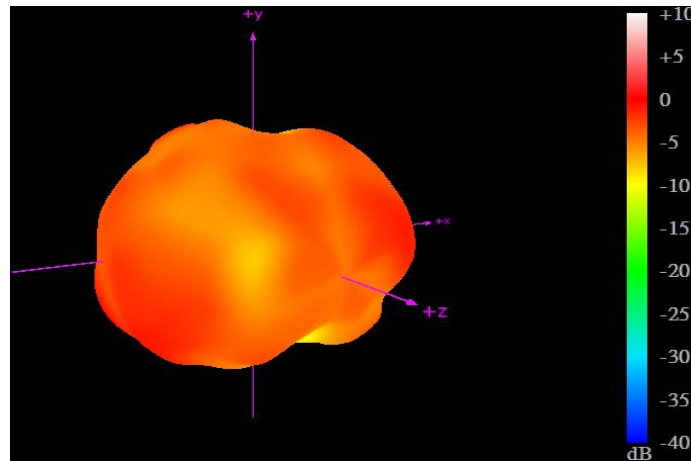
960MHz



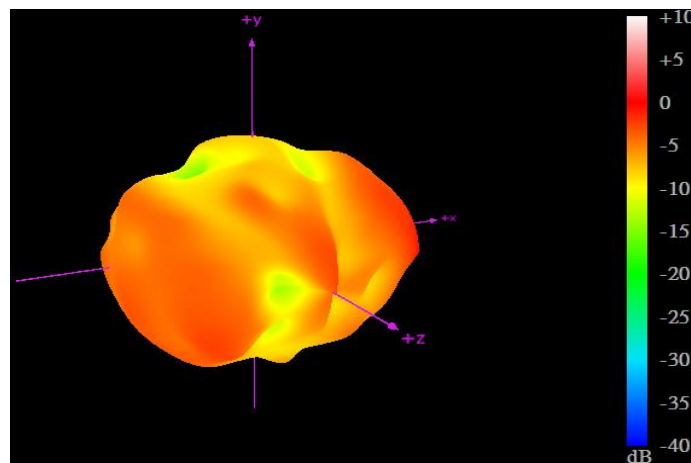
1710MHz



2170MHz

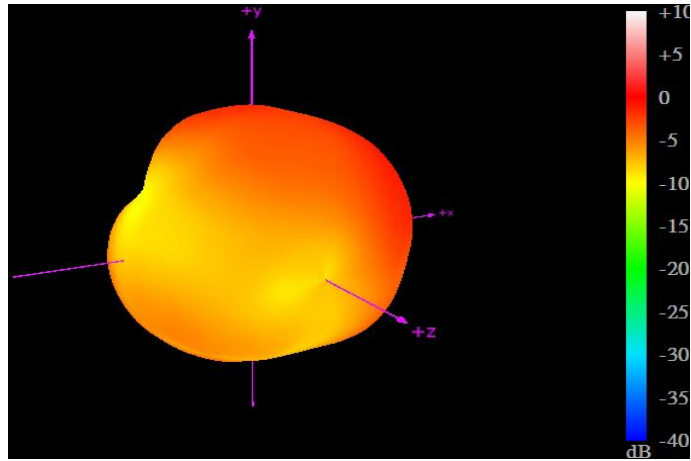


2300MHz

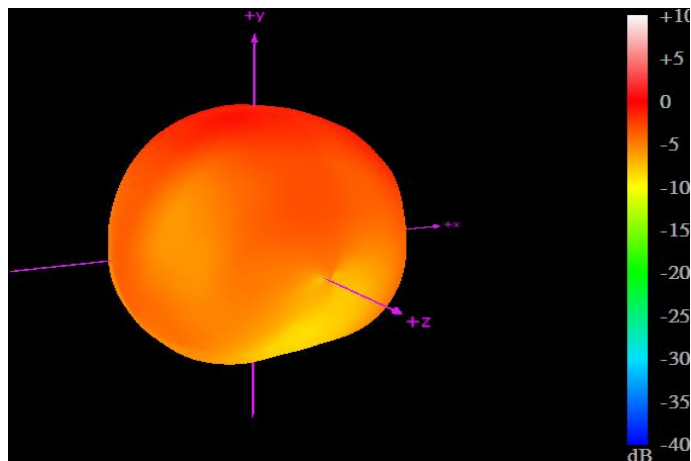


2690MHz

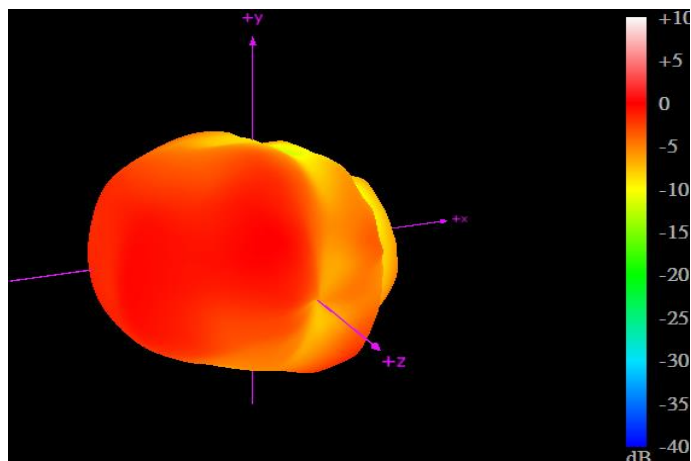
4.3.7 LTE 7



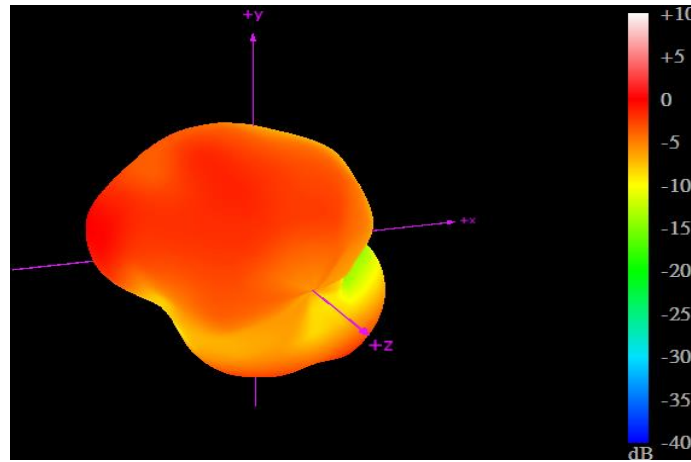
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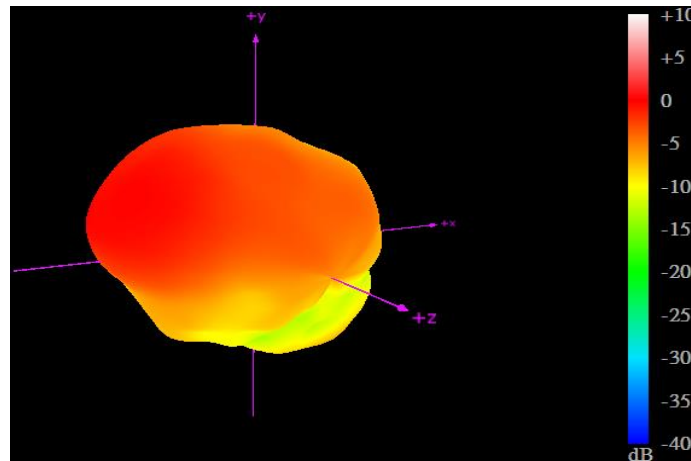
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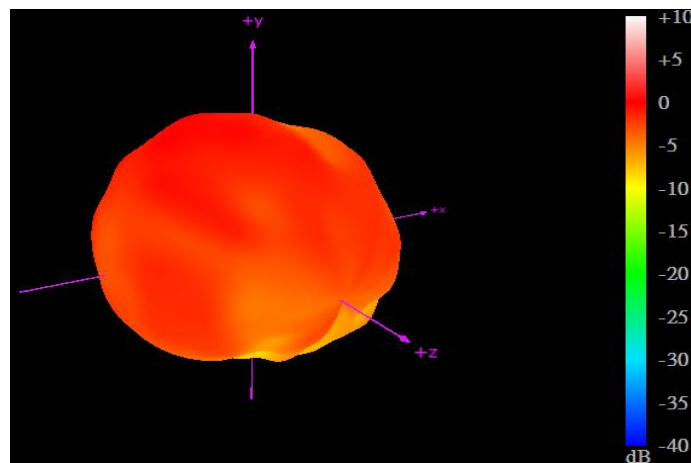
1710MHz



2170MHz

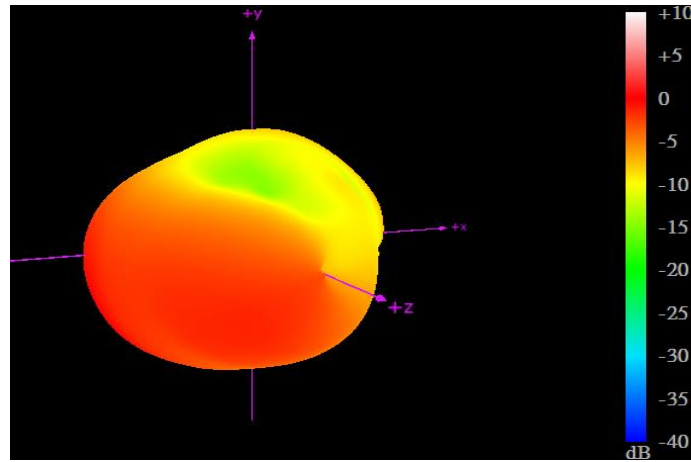


2300MHz

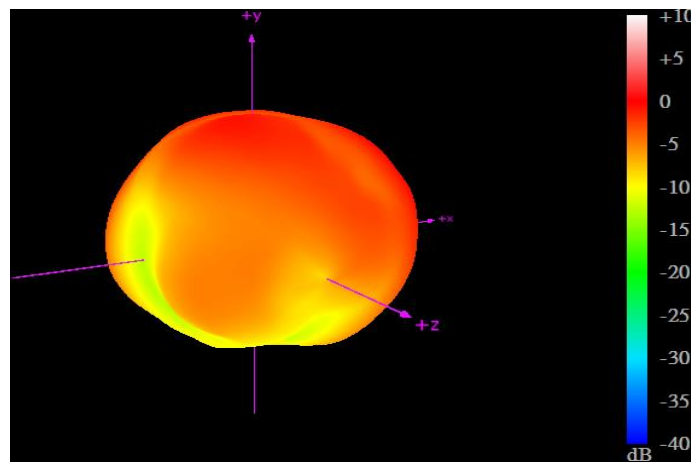


2690MHz

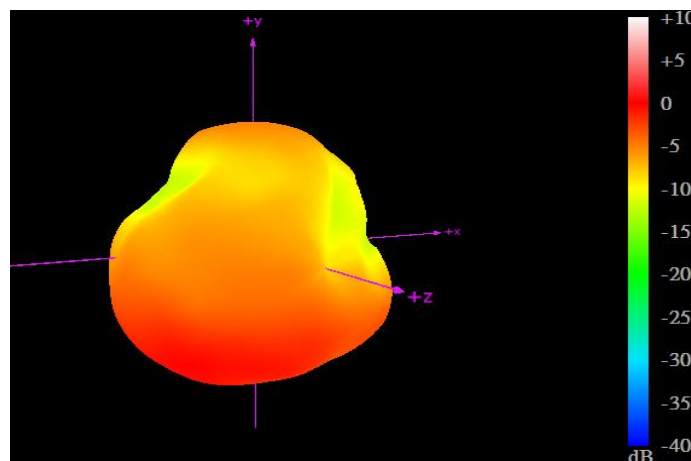
4.3.8 LTE 8



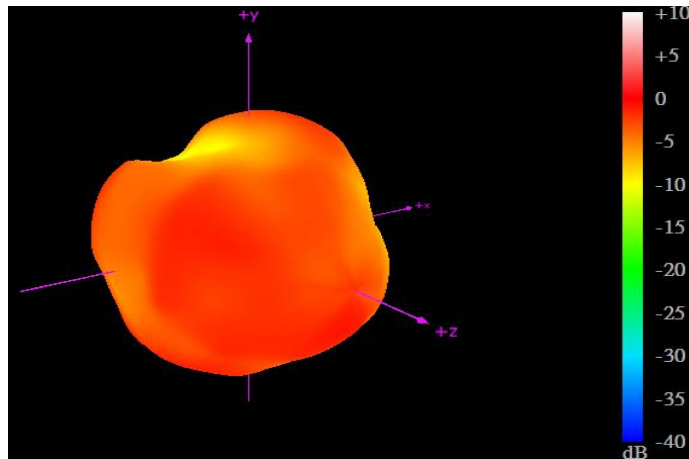
704MHz



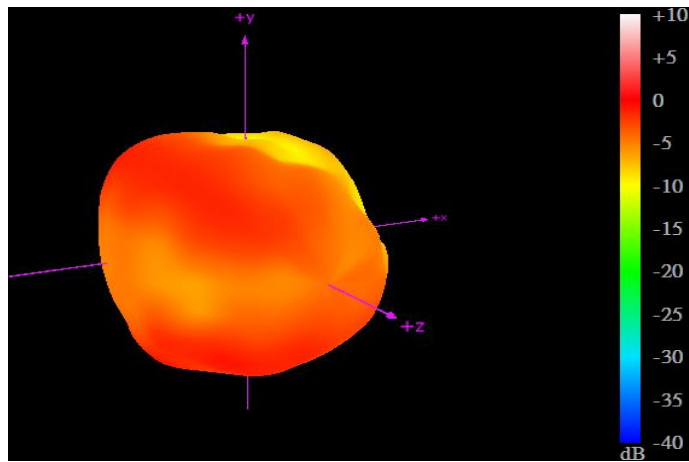
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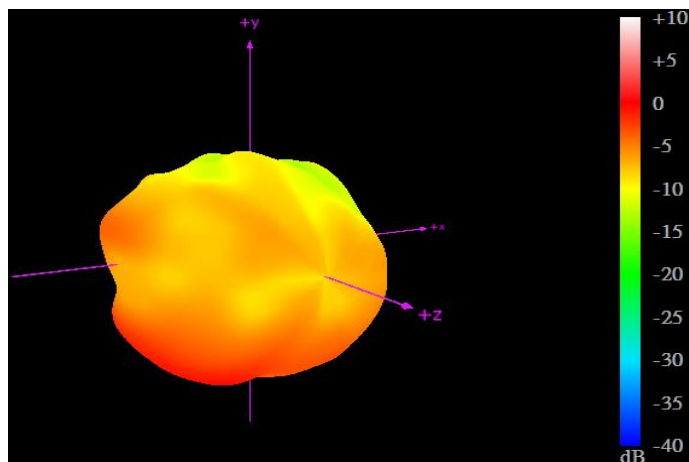
1710MHz



2170MHz

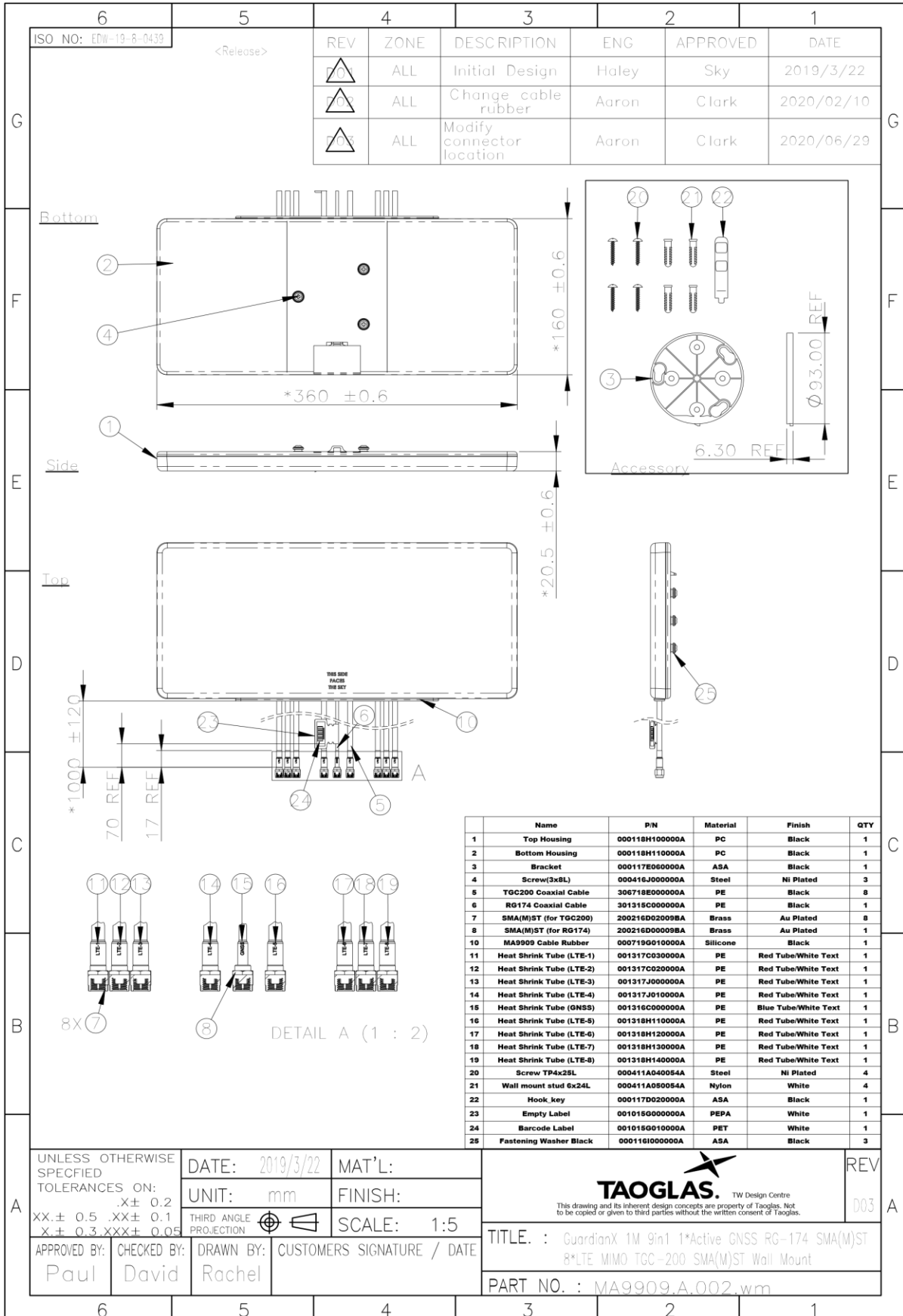


2300MHz



2690MHz

5. Mechanical Drawing (Unit: mm)



6. Packaging

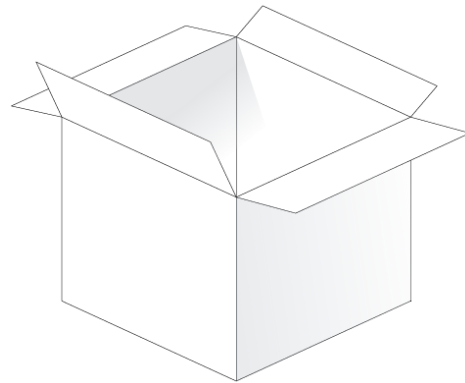
1pcs per Large PE Bag

Weight: 1.2Kg



7pcs MA9909.A.002.wm per Carton

Weight: 10Kg

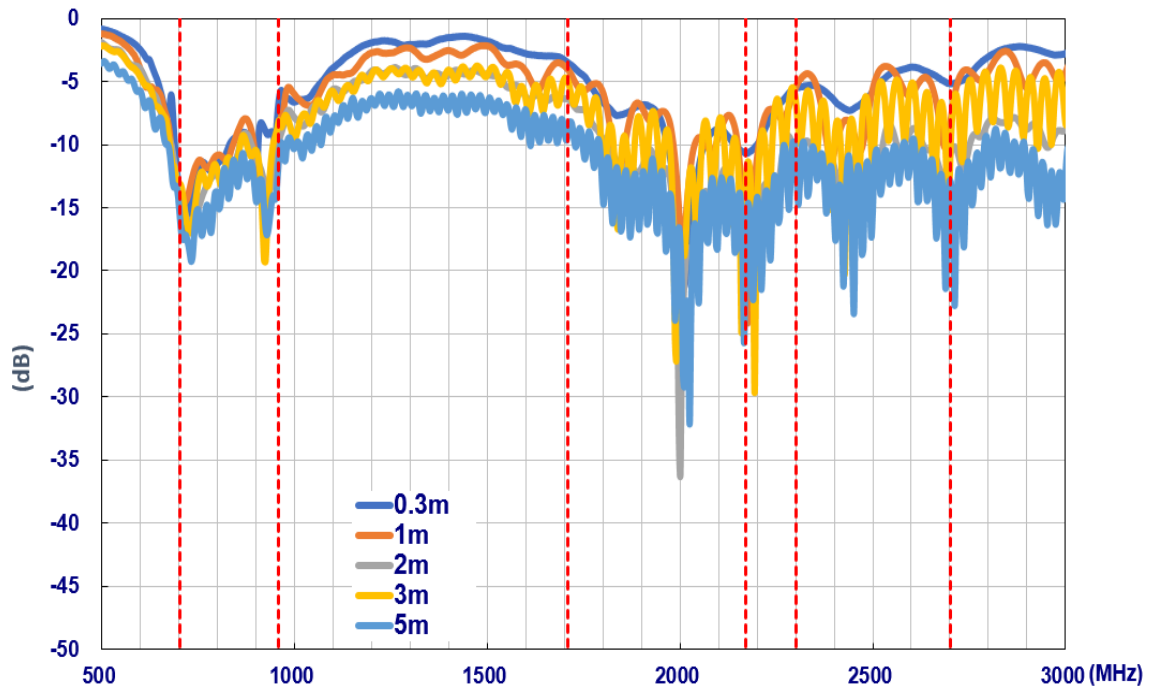


7. Application Note

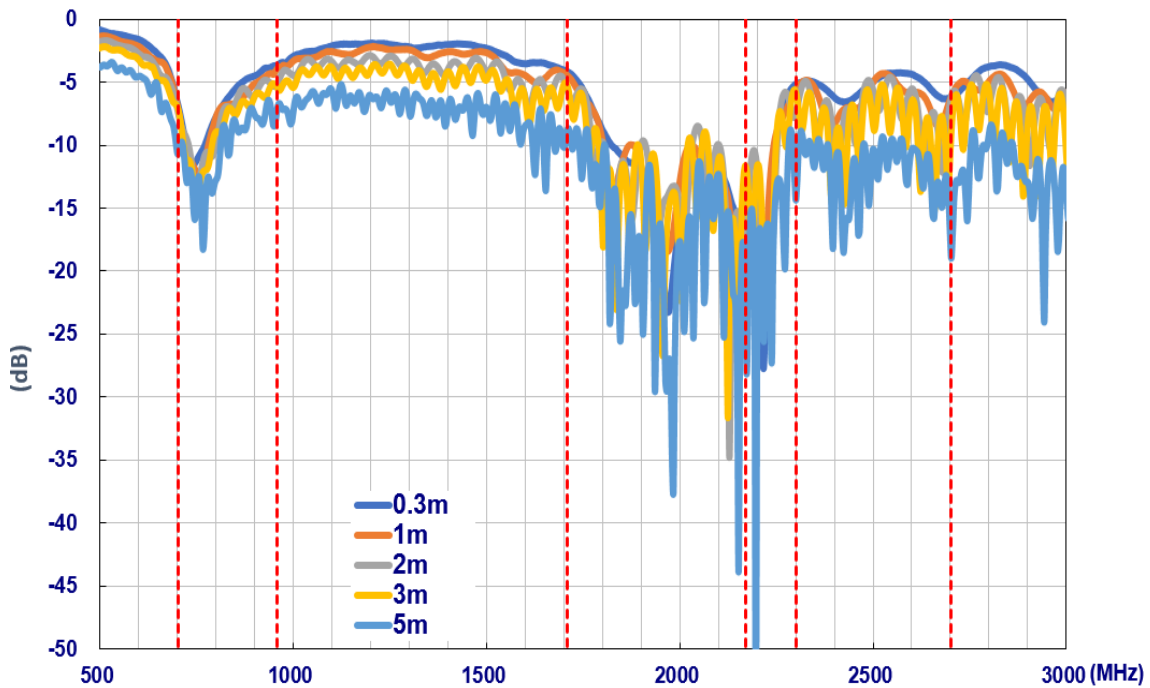
The MA9909 antenna performance with different cable lengths is shown below.

7.1. Return Loss

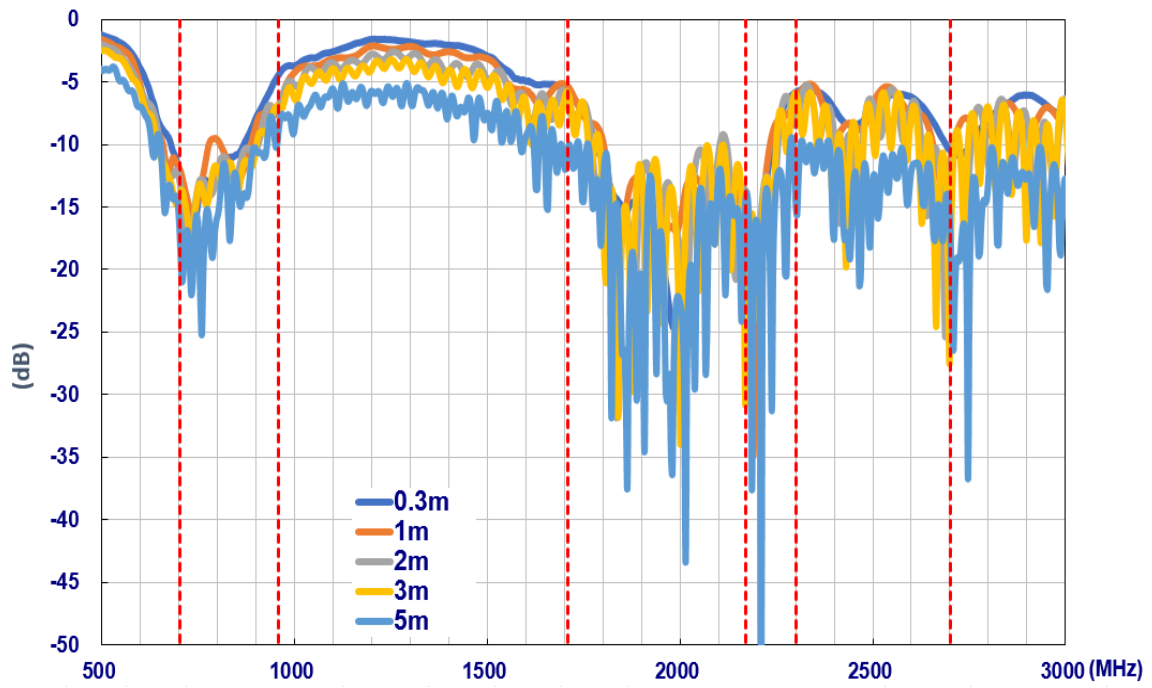
7.1.1 LTE 1



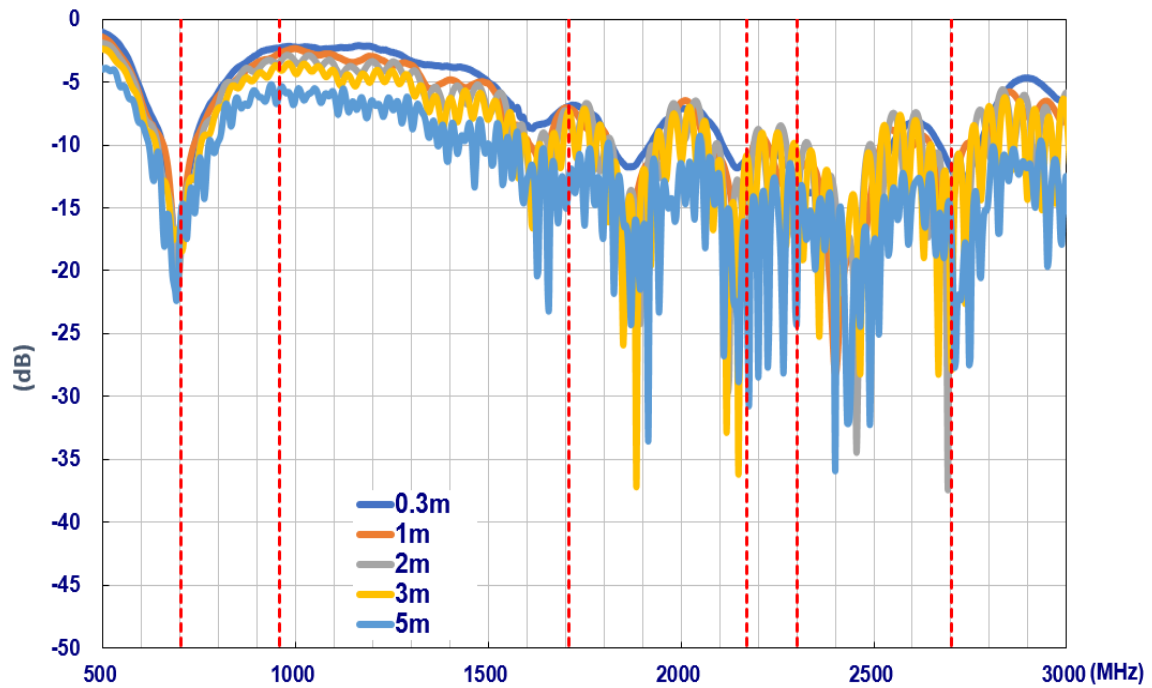
7.1.2 LTE 2



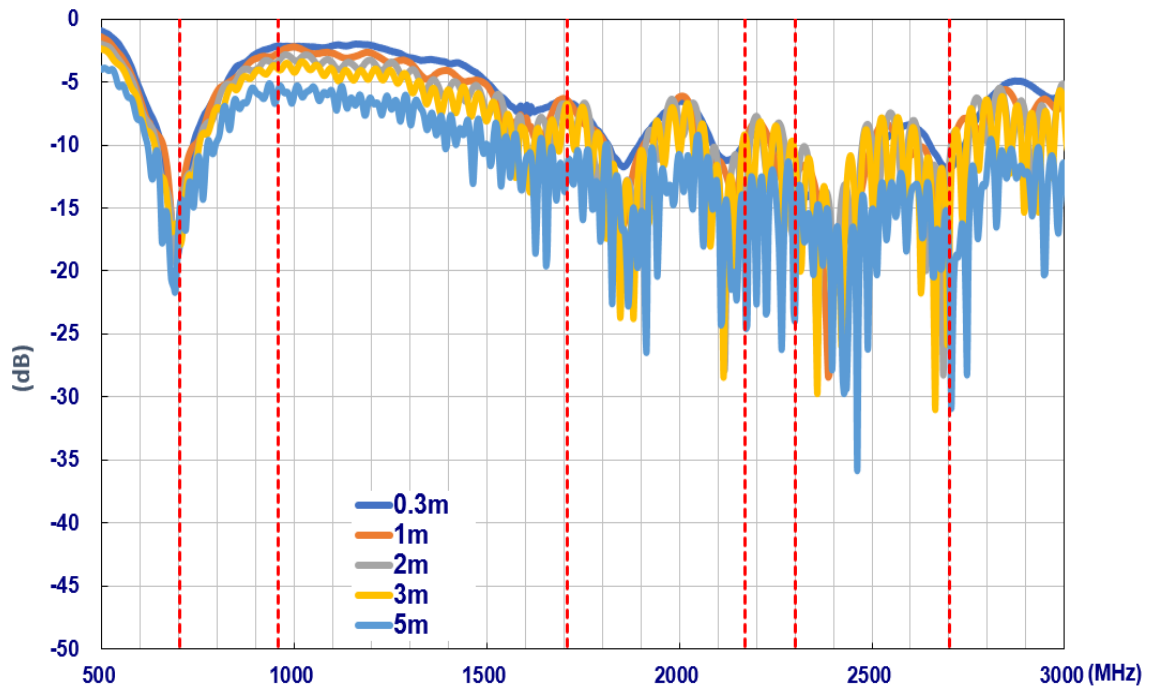
7.1.3 LTE 3



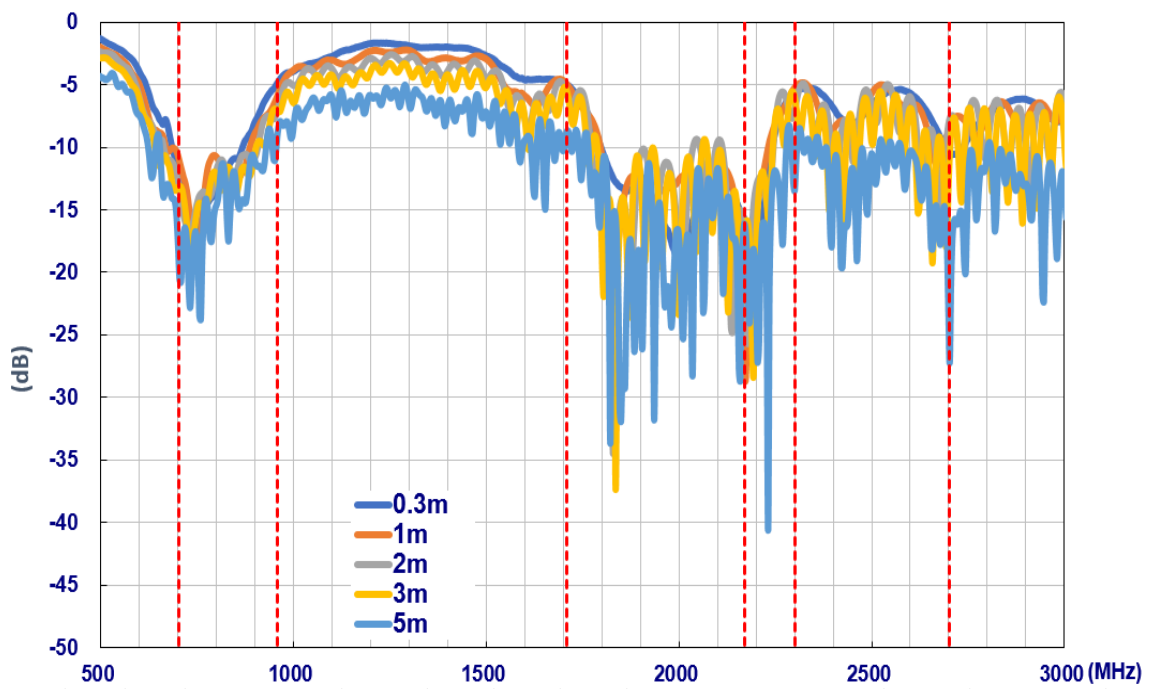
7.1.4 LTE 4



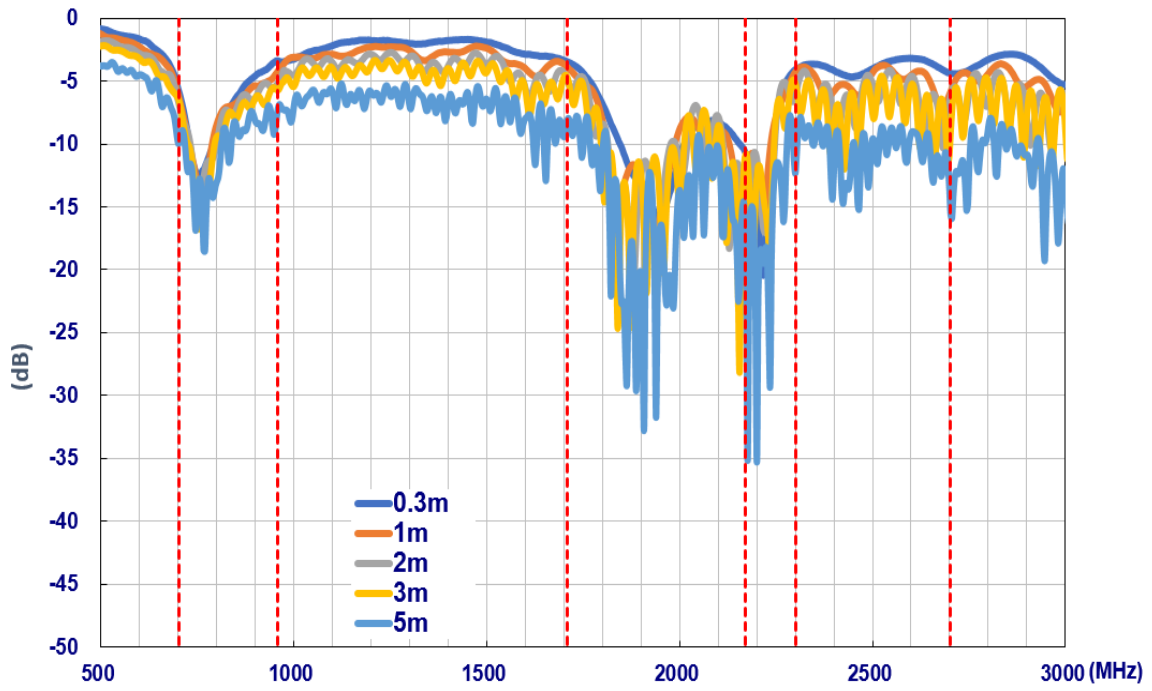
7.1.5 LTE 5



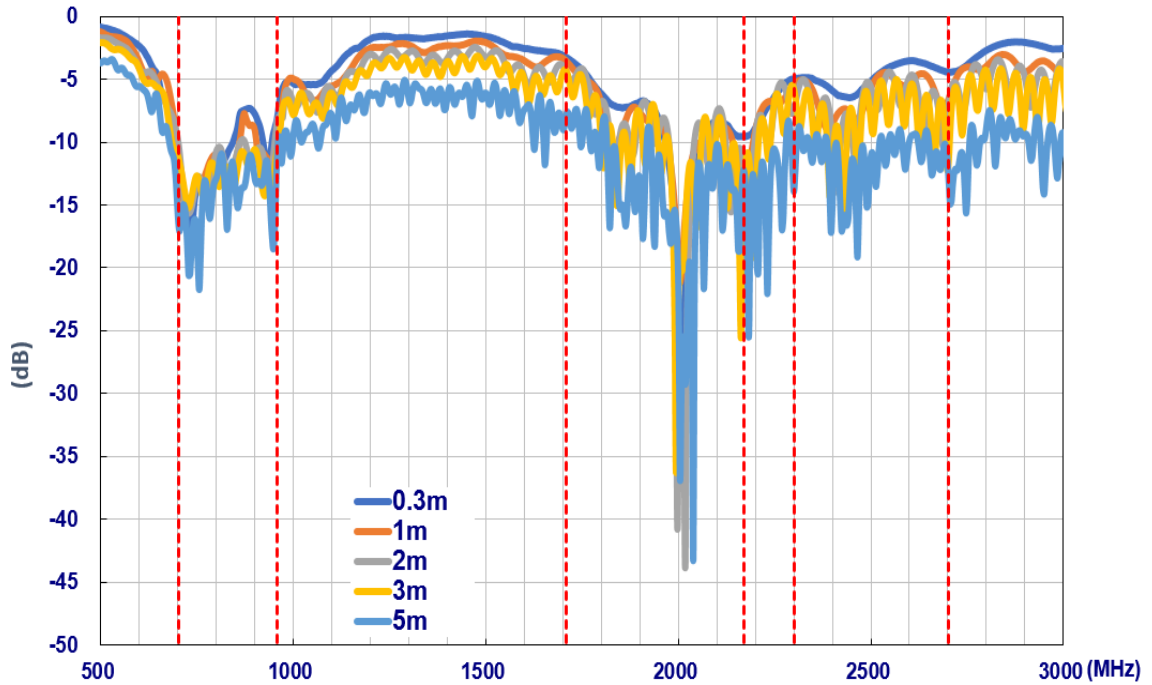
7.1.6 LTE 6



7.1.7 LTE 7

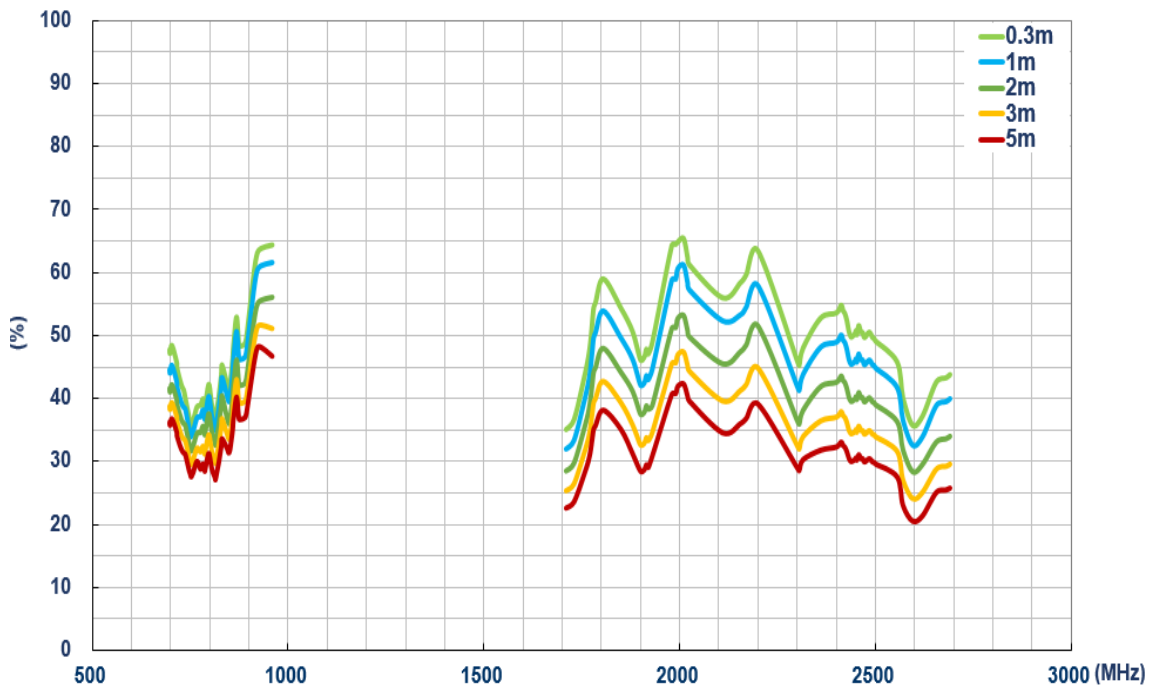


7.1.8 LTE 8

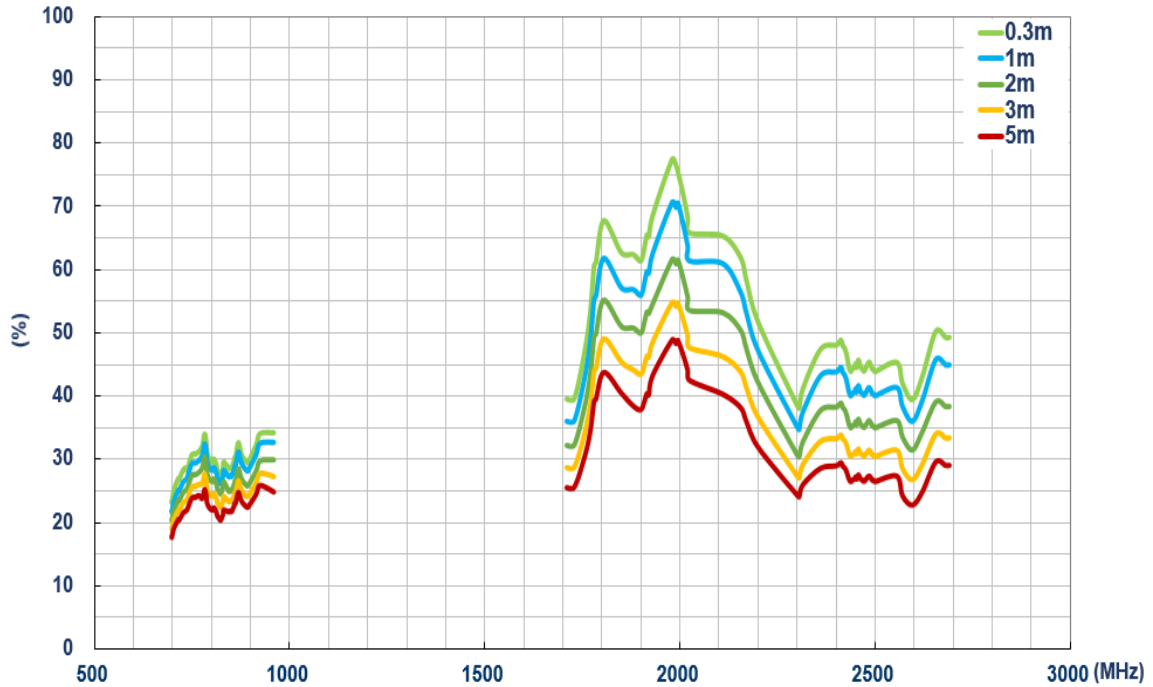


7.2. Efficiency

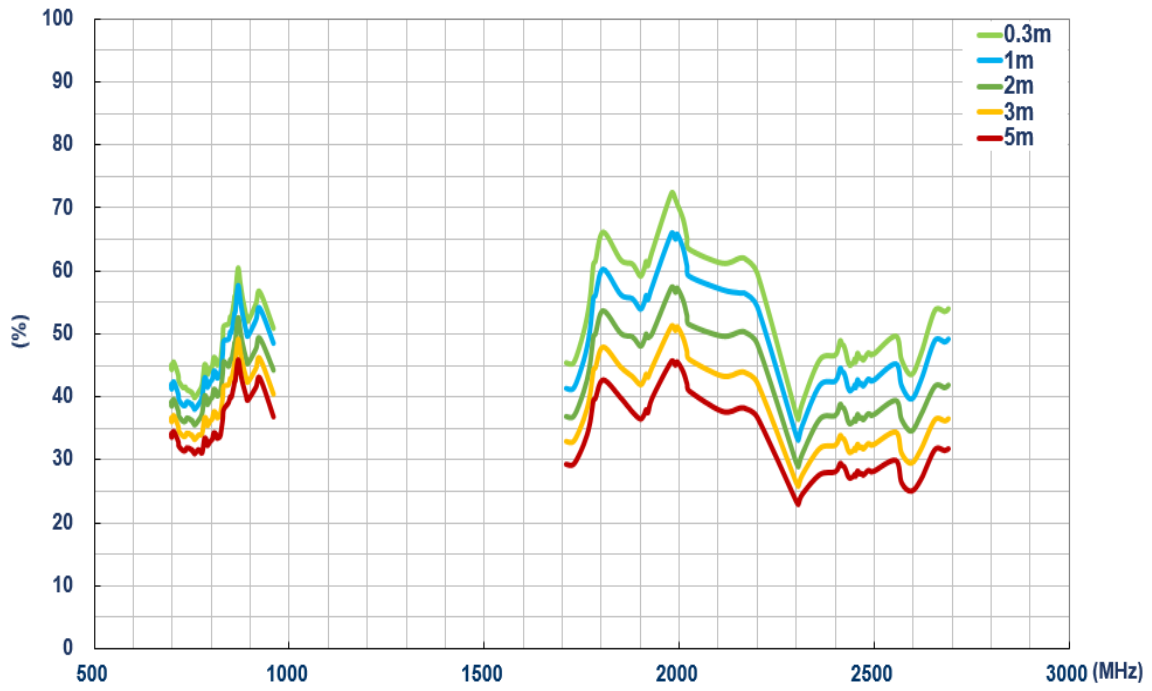
7.2.1 LTE 1



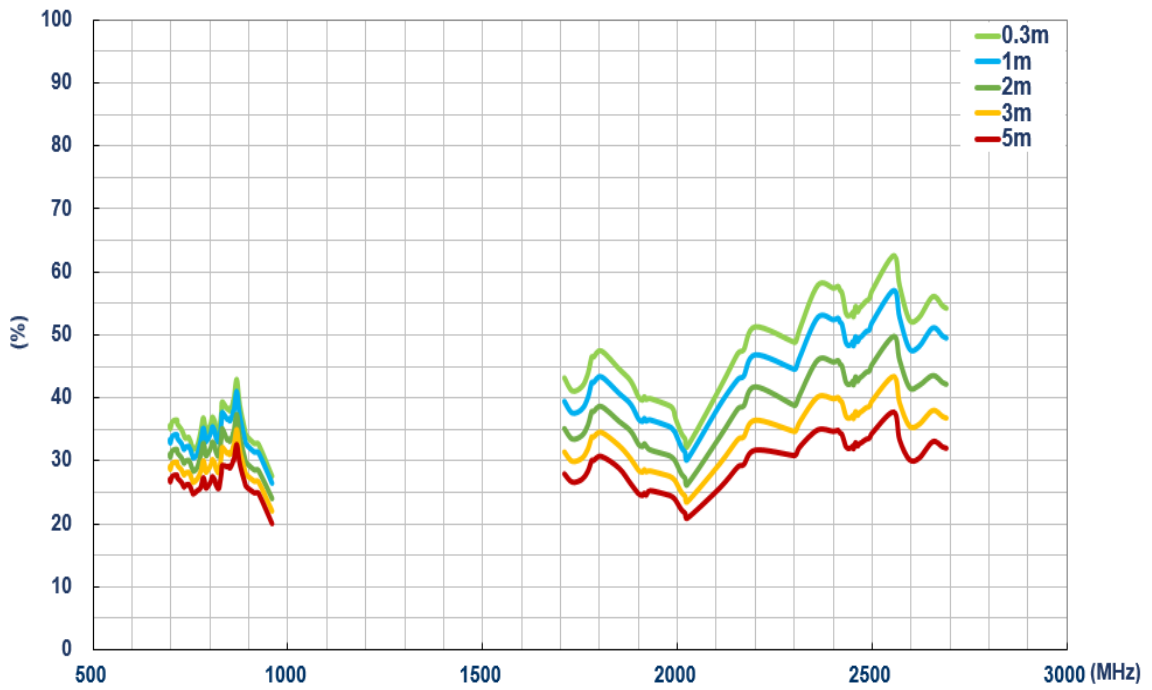
7.2.2 LTE 2



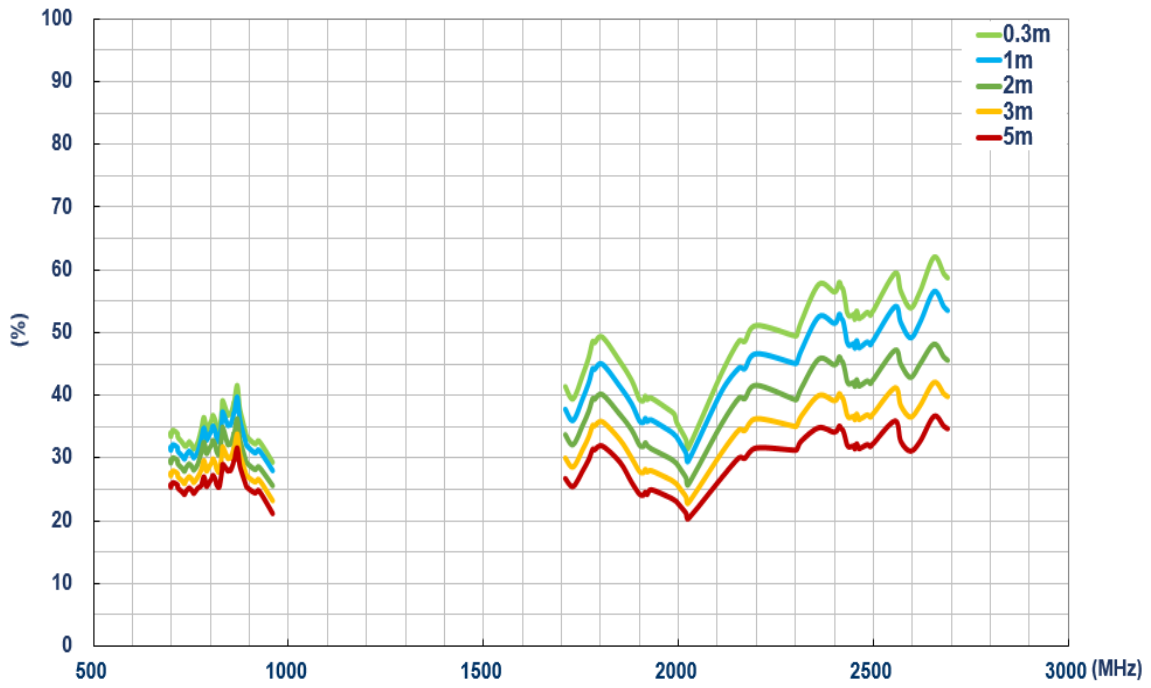
7.2.3 LTE 3



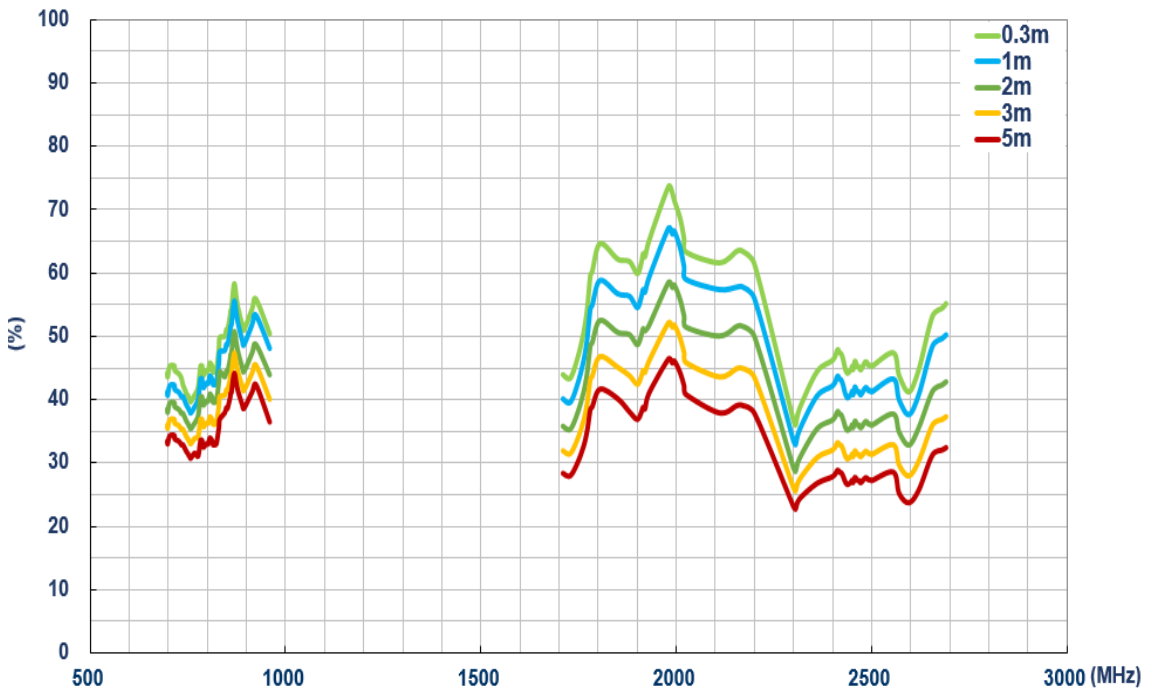
7.2.4 LTE 4



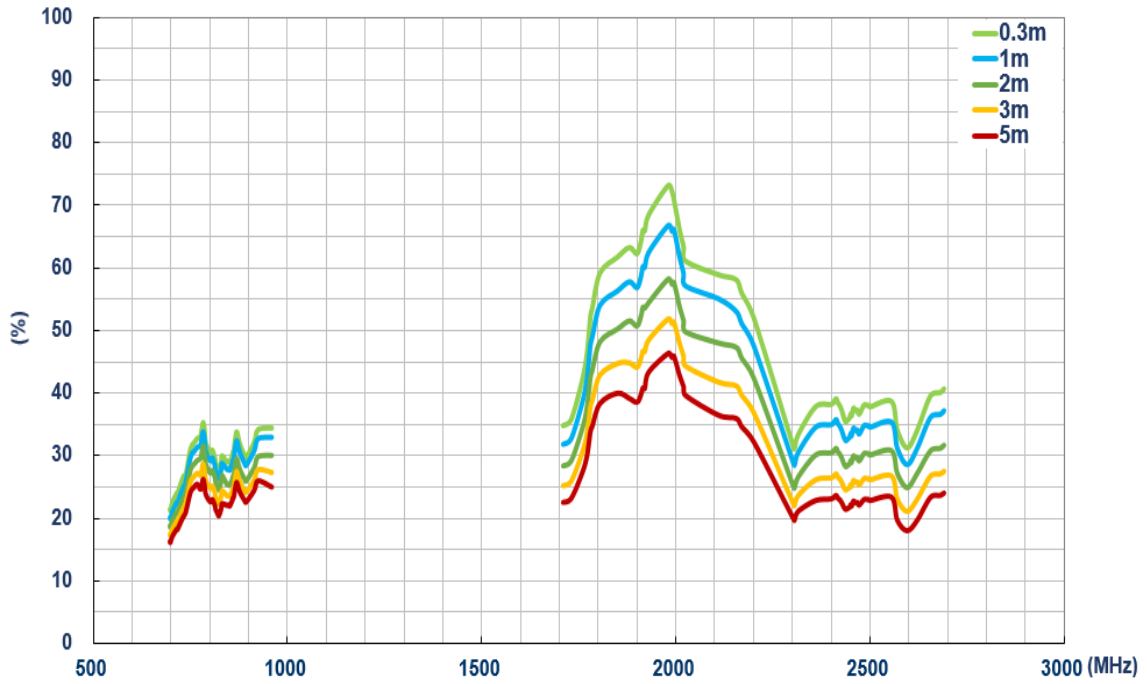
7.2.5 LTE 5



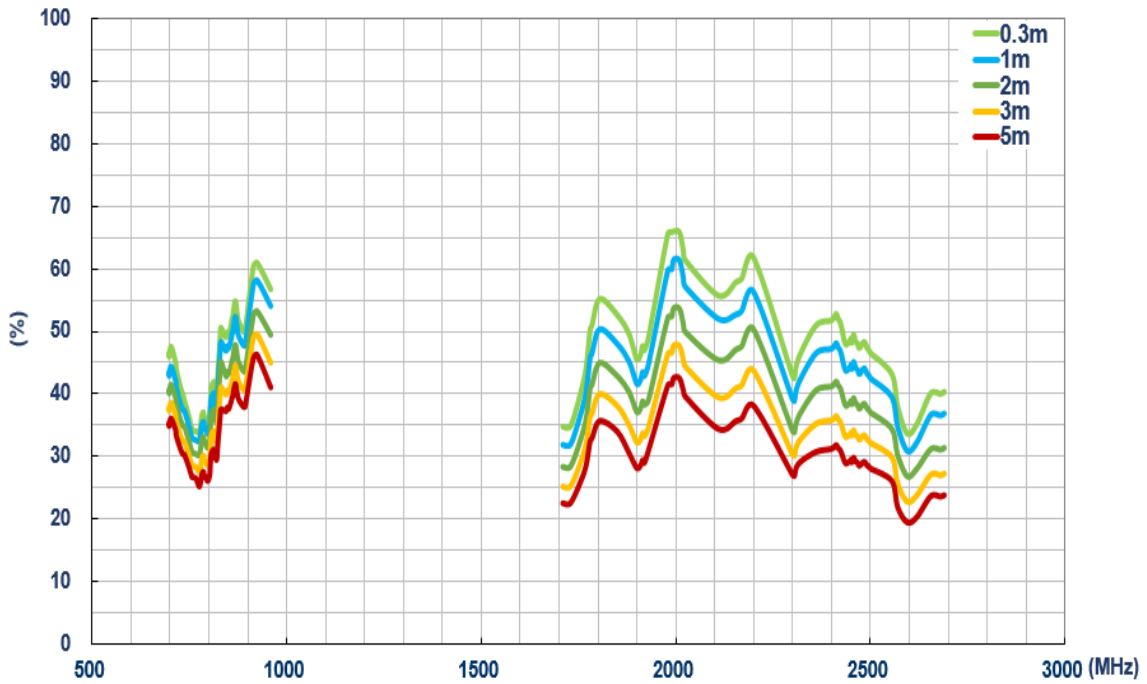
7.2.6 LTE 6



7.2.7 LTE 7

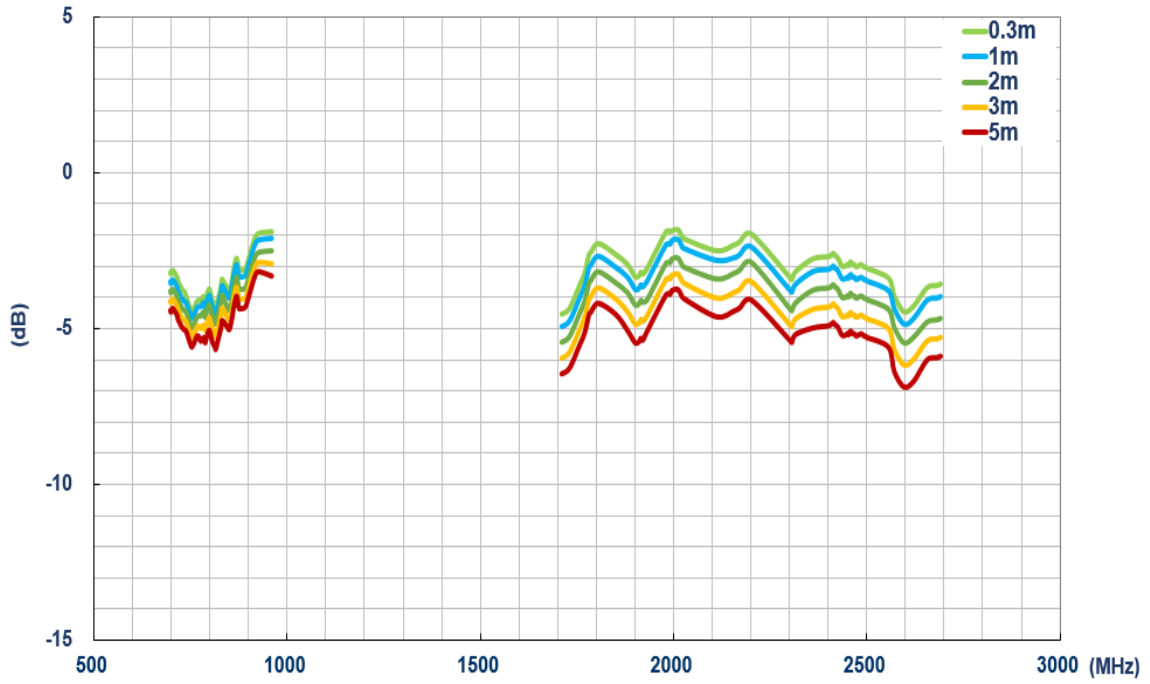


7.2.8 LTE 8

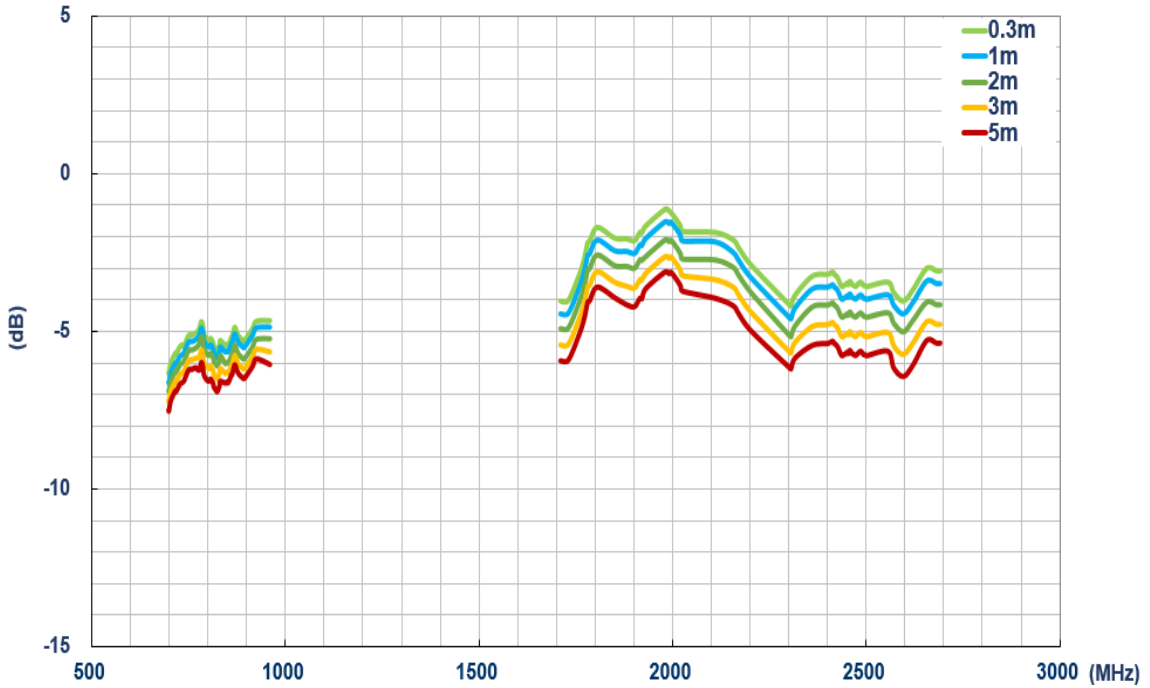


7.3. Average Gain

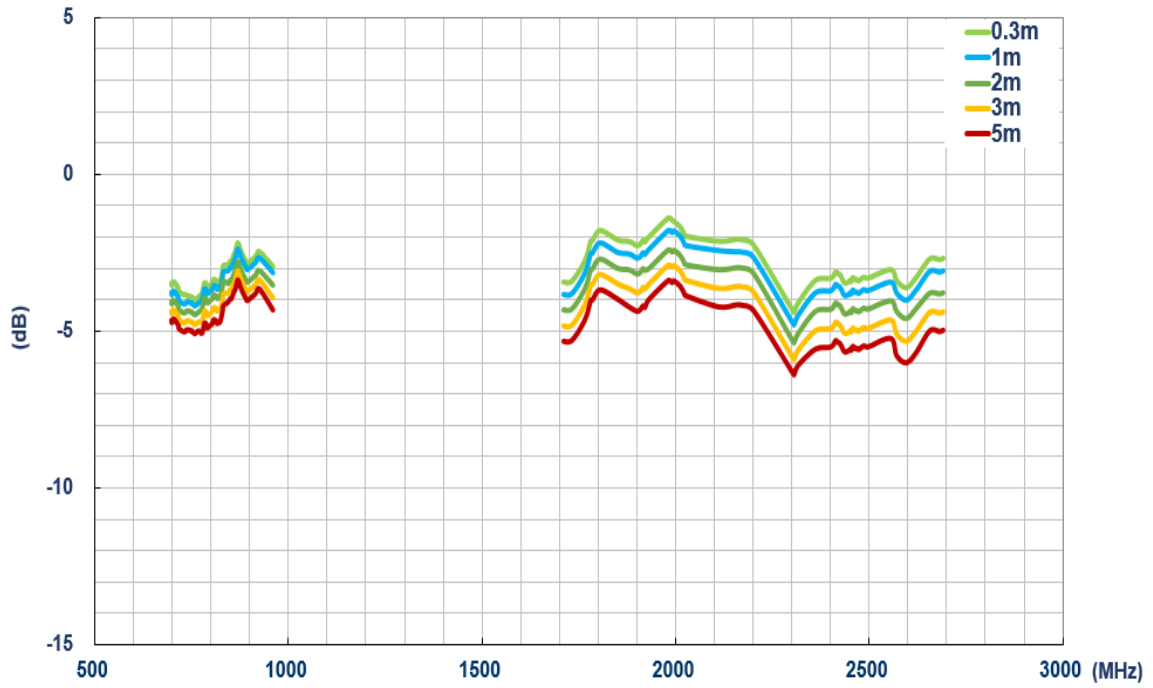
7.3.1 LTE 1



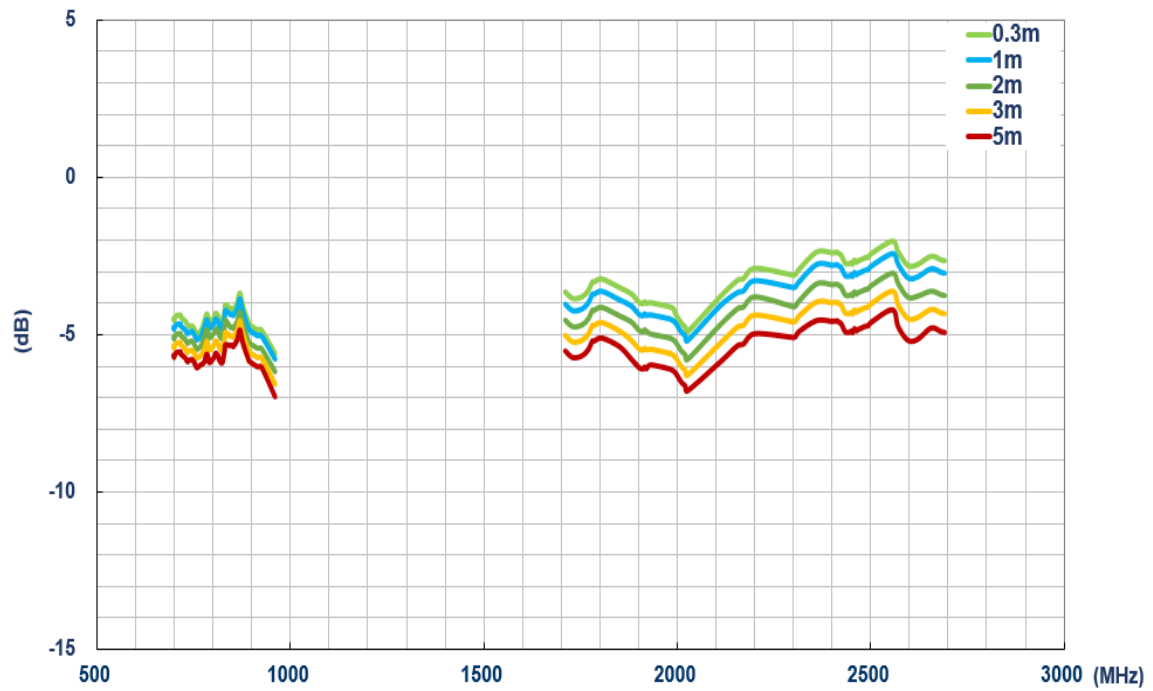
7.3.2 LTE 2



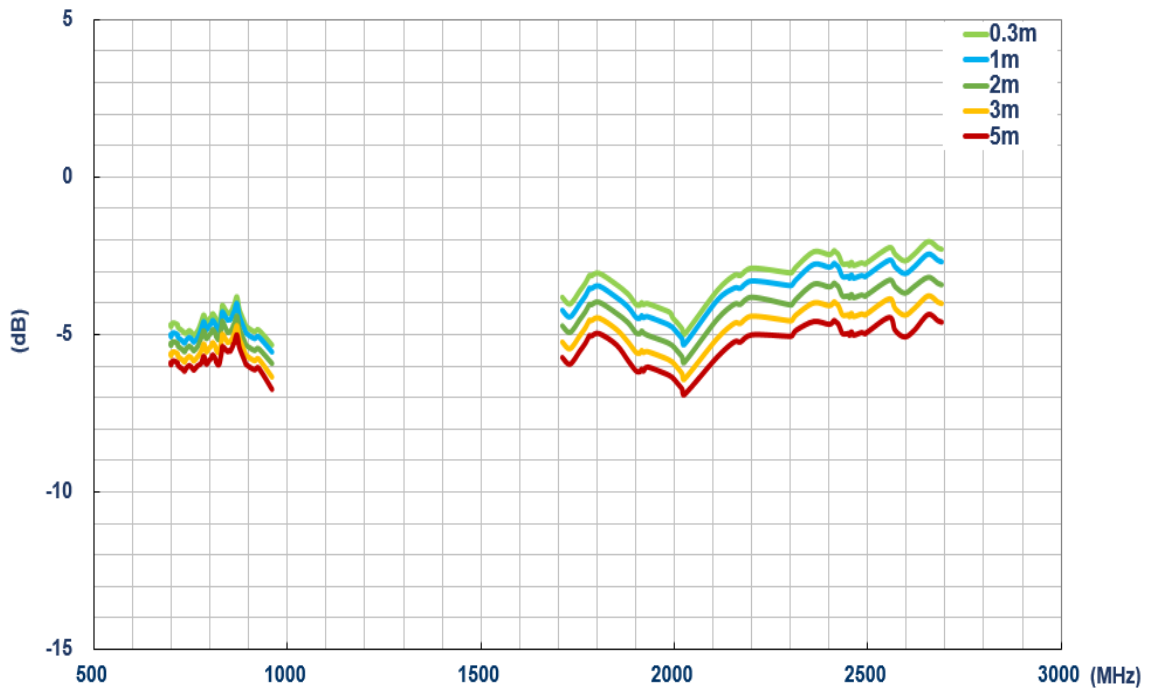
7.3.3 LTE 3



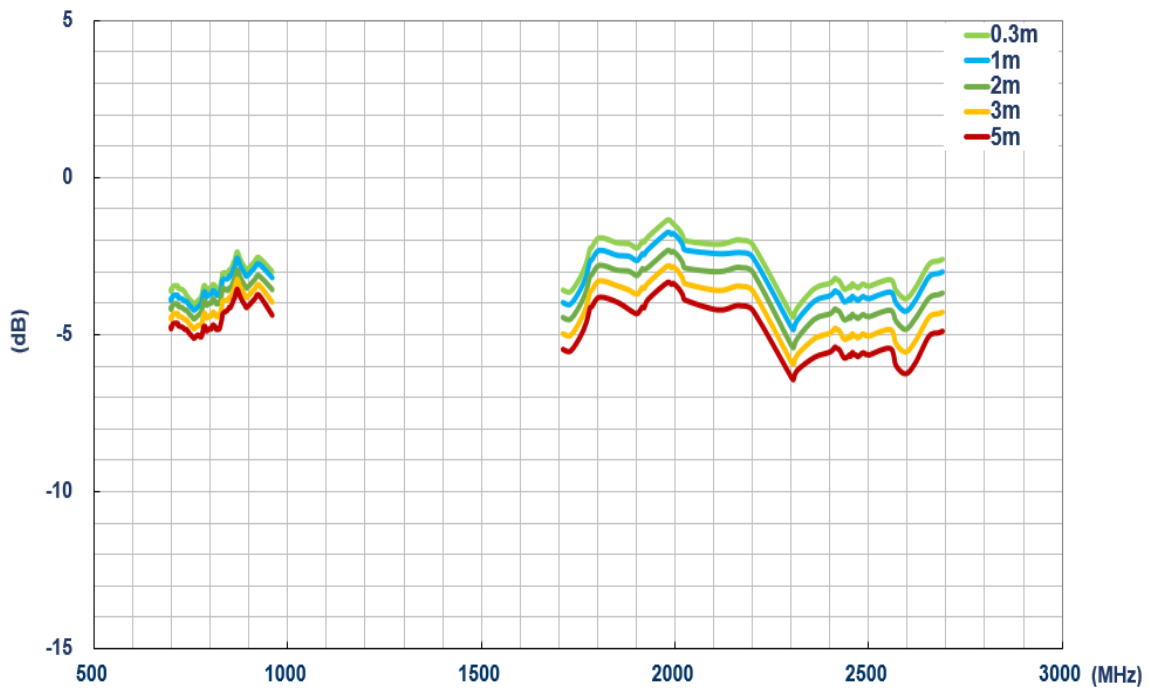
7.3.4 LTE 4



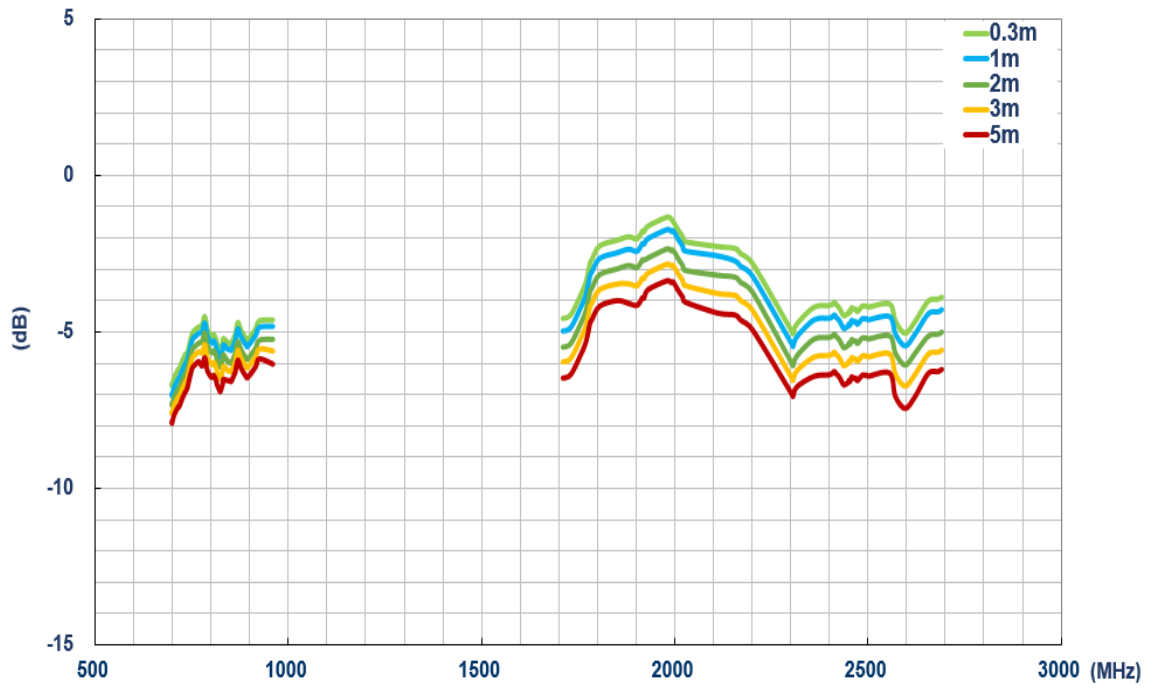
7.3.5 LTE 5



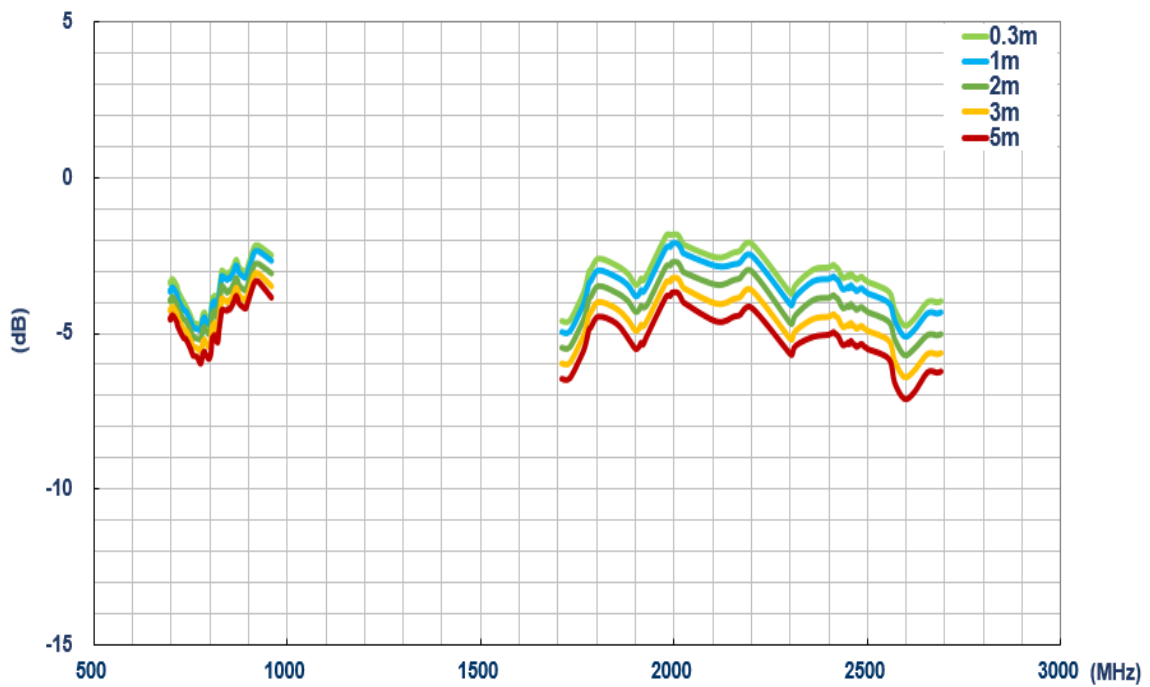
7.3.6 LTE 6



7.3.7 LTE 7

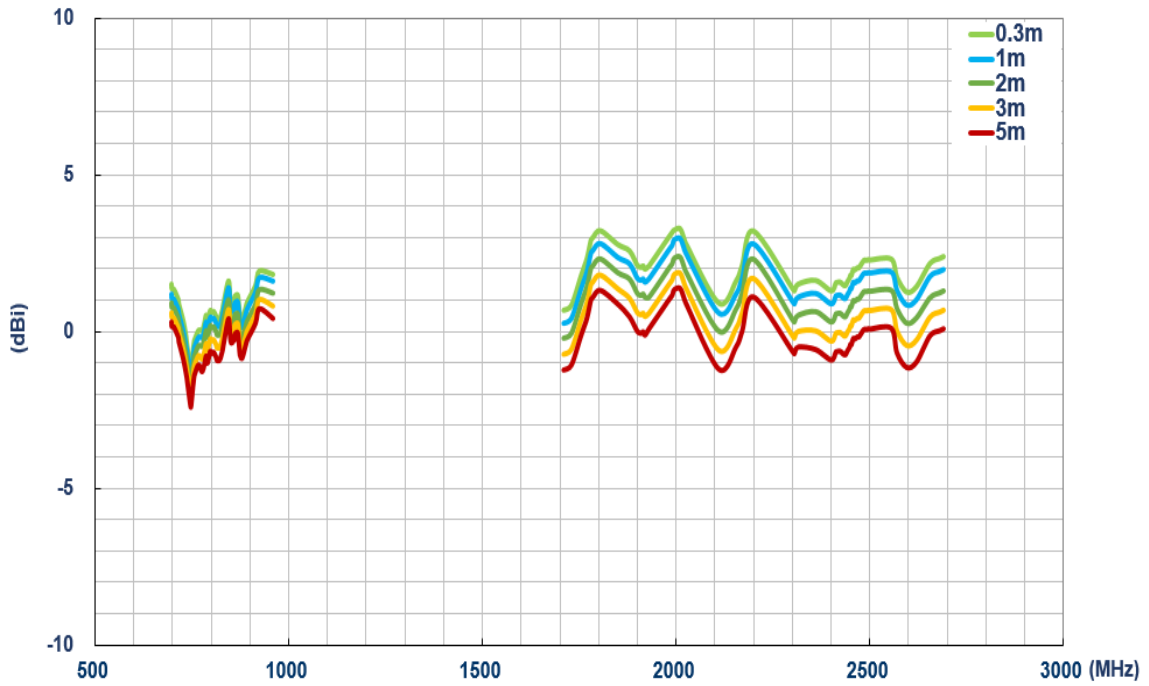


7.3.8 LTE 8

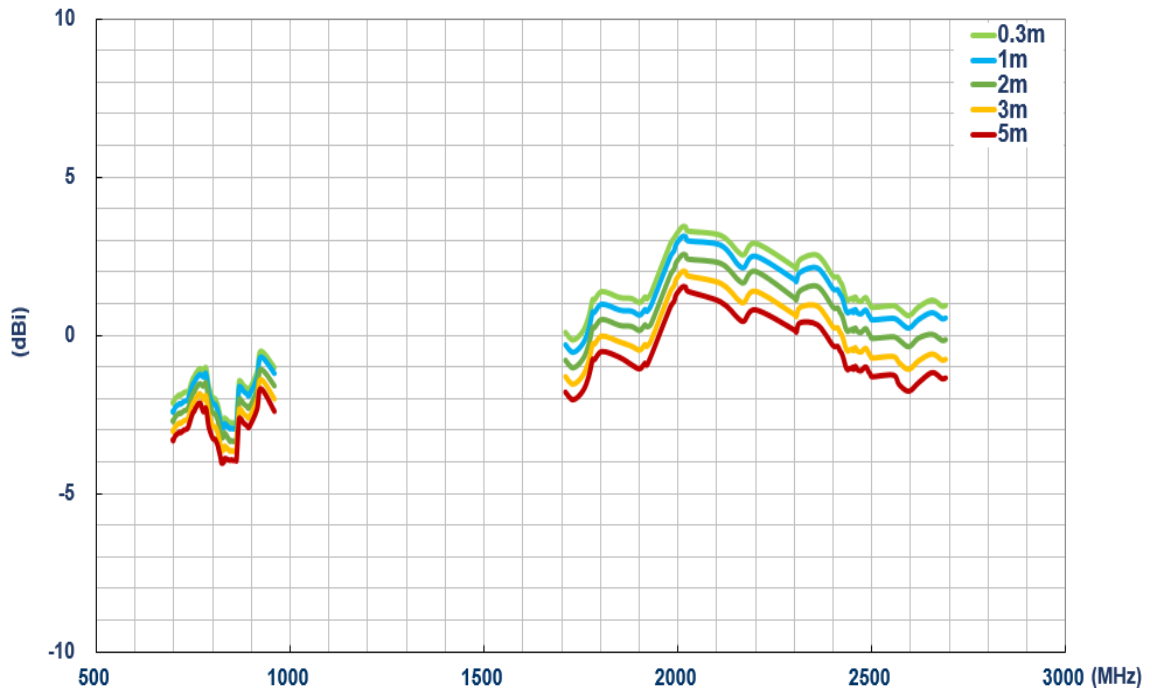


7.4. Peak Gain

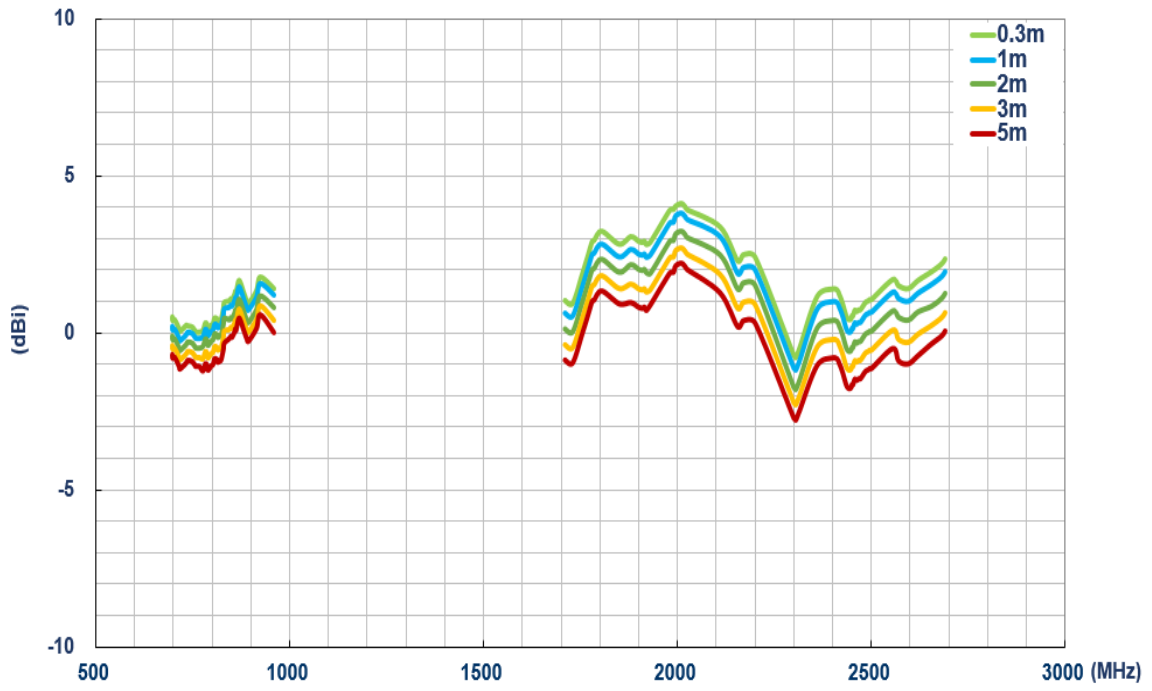
7.4.1 LTE 1



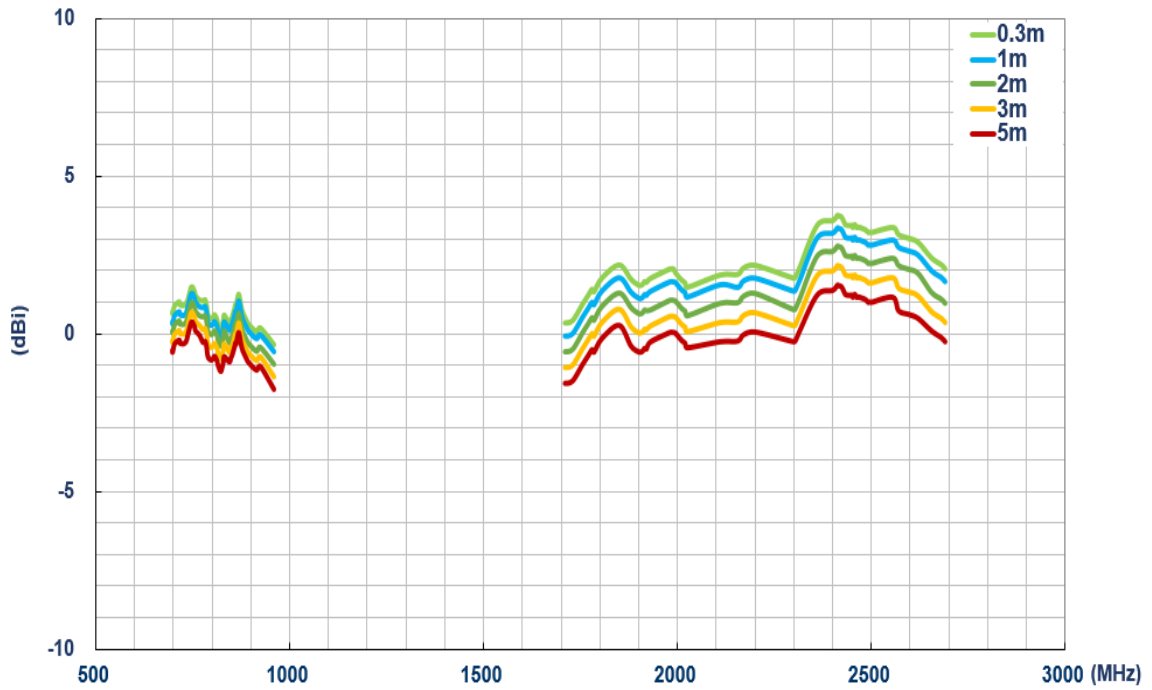
7.4.2 LTE 2



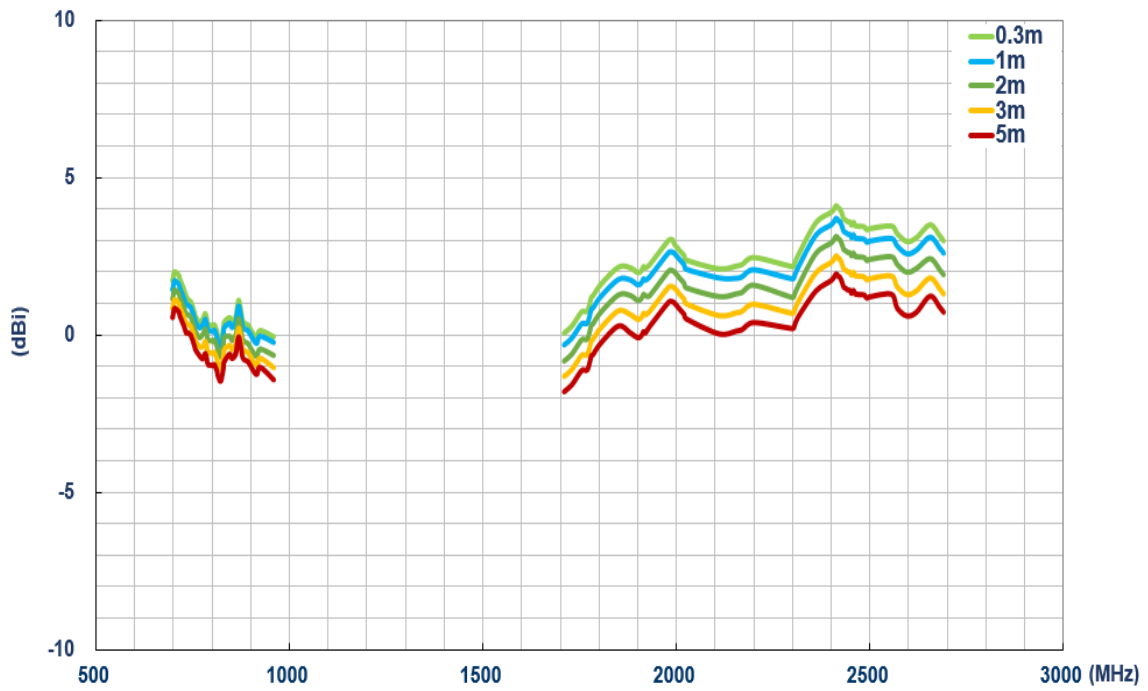
7.4.3 LTE 3



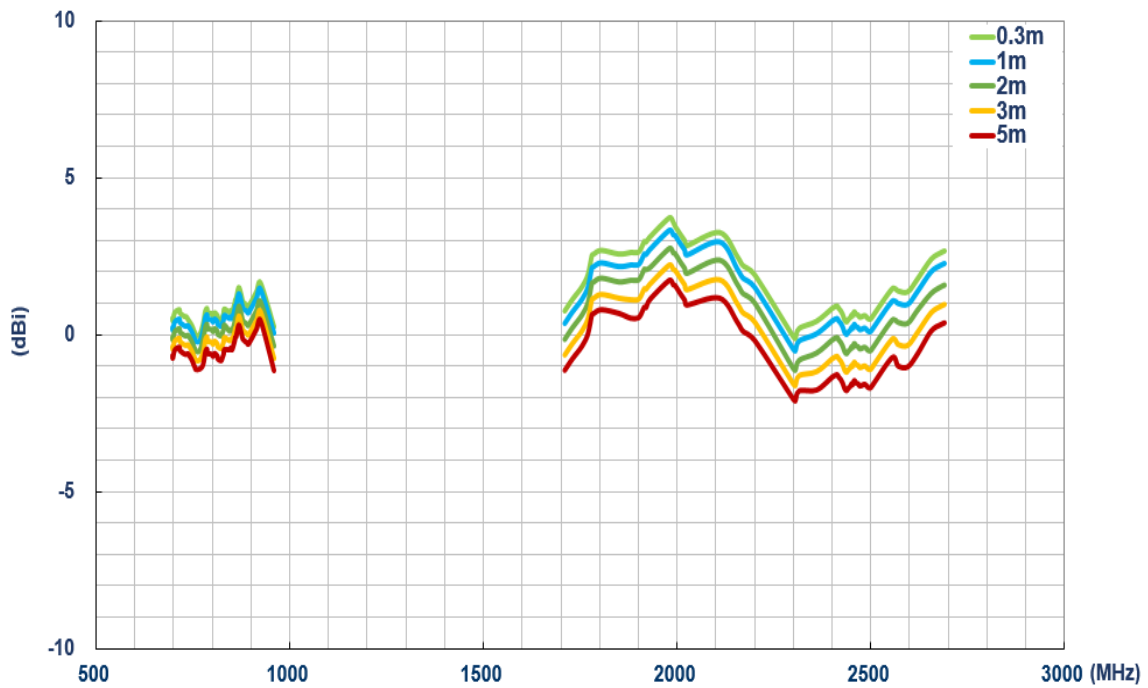
7.4.4 LTE 4



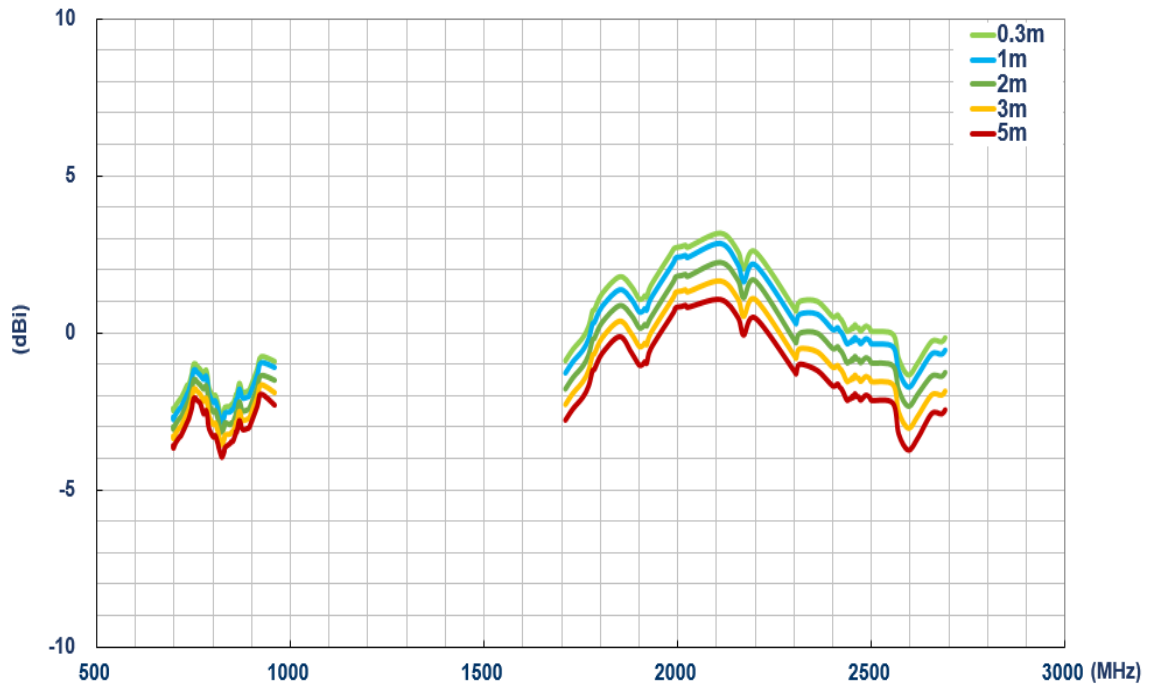
7.4.5 LTE 5



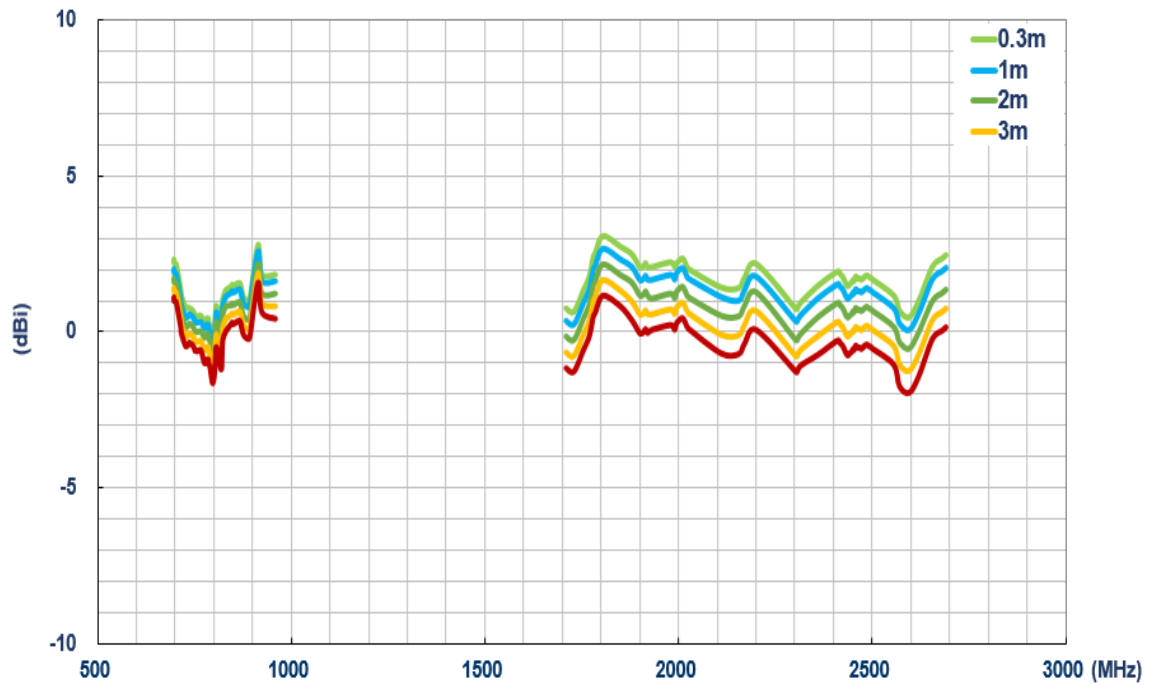
7.4.6 LTE 6



7.4.7 LTE 7



7.4.8 LTE 8



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