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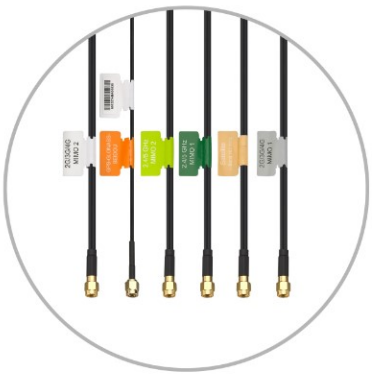
DRAFT SPECIFICATION

PATENT PENDING

Part No.	:	**MA931.A.LBICGH.001**
Product Name	:	MA931 Guardian 6in1 Adhesive Mount Antenna LTE*2+Wi-Fi*3+GNSS
Features	:	Low-profile Housing – Mounts flush to Wall 2* LTE MIMO 698-960MHz/1710-2170MHz/ 2490-2690MHz/ 3300-3600MHz 3* Wi-Fi MIMO 2.4GHz/5.8GHz 1* GPS-GLONASS-BeiDou Antenna Worldwide 4G Bands including 3G and 2G IP67 Waterproof Resistant Enclosure Dims: 146*134*20mm 1M Low Loss KSR200-P and RG174 with SMA(M)/RP-SMA(M) connectors Cables and Connectors Customizable **RoHS Compliant**



1. Introduction

The MA931 Guardian is a next generation combination antenna. The first panel antenna worldwide designed for IoT Gateway and Router devices. It is a low profile 6in1 wall and adhesive mount antenna. It is a heavy-duty, fully IP67 waterproof resistant external M2M antenna for use by RF professionals in

- IoT Gateway and Routers
- HD Video Streaming
- Transportation
- Remote Monitoring Applications

This antenna delivers powerful MIMO antenna technology for worldwide 4G LTE bands at 698-960MHz /1710-2170MHz /2490-2690MHz /3300-3600MHz, dual-band 2.4/5.8GHz Wi-Fi, plus GPS-GLONASS-BeiDou for location accuracy. It enables designers to install only one antenna to cover all of these technologies.

4G wireless 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 among these antennas to prevent self-interference. Low loss cables used to keep efficiency high over long cable lengths.

The GPS-GLONASS-BeiDou active antenna has been carefully designed for excellent performance across all GNSS bands, leading to higher location accuracy and stability of tracking in urban environments.

The housing dimension is 146*134*20mm. It is IP67 waterproof and comes with a 3M foam adhesive. The antenna can be mounted internally or externally on a vehicle. The MA931 comes with 1 meter, low loss KSR-200P coaxial cables for the LTE and Wi-Fi antennas, and RG174 coaxial cable for the GNSS antenna as standard. Customized cables and connector versions are also available.

Specification

BeiDou-GPS-GLONASS				
Center Frequency	BeiDou:1561.098±2.046MHz GPS:1575.42±1.023MHz GLONASS:1602±5MHz			
Passive Antenna Efficiency(without cable loss)	BeiDou: 63% GPS: 48% GLONASS: 57%			
Passive Antenna Average Gain(without cable loss)	BeiDou: -1.97dBi GPS: -3.13dBi GLONASS: -2.39dBi			
Passive Antenna Peak Gain(without cable loss)	BeiDou: 3dBi GPS: 1.98dBi GLONASS: 3.01dBi			
VSWR	3:1 Max			
Impedance	50Ω			
Axial Ratio	BeiDou:<9.7 GPS:<14.02 GLONASS:<5.9			
Polarization	RHCP			
Cable	1 meter RG174 standard, fully customizable			
Connector	SMA(M) standard, fully customizable			
LNA and Filter Electrical Properties				
Center Frequency	BeiDou: 1561.098±2.046MHz GPS:1575.42±1.023MHz GLONASS:1602±5MHz			
Output Impedance	50Ω			
VSWR	< 2:1			
Return Loss	10dB Min.			
LNA Gain, Current Draw, and Noise Figure@GPS	Voltage	LNA Gain(Typ)	Current Draw(mA) Typ	Noise Figure(Typ)
	Min 1.8V	28dB	7.9mA	1.13dB
	Typ 3.0V	30dB	9.0mA	1.13dB
	Max 5.5V	33dB	9.9mA	1.14dB
Total Specification(Through Antenna, SAW Filter, and LNA)				
Frequency	1561.098±2.046MHz	1575.42±1.023MHz	1602±5MHz	
Gain@3V	1561MHz:28±3dBi	1575.42MHz:28±3dBi	1602MHz:28±3dBi	
Output Impedance	50Ω			

2G/3G/4G LTE Antenna									
Frequency (MHz)		LTE700	GSM850	GSM900	DCS	PCS	UMTS1	LTE2600	LTE3500
		698~803	824~894	880~960	1710~1880	1850~1990	1920~2170	2490~2690	3300~3600
Efficiency (%)									
MIMO_1	Free space	50.82	55.85	41.29	66.47	70.19	71.51	49.20	50.92
	ABS	68.31	69.61	61.27	66.31	70.86	70.00	50.61	51.88
	Glass	67.99	67.37	62.94	66.89	71.80	69.58	51.00	52.83
	Metal	42.12	51.55	58.33	39.49	47.20	47.71	44.36	44.85
	Wall	67.97	70.42	66.80	63.91	64.94	63.35	50.37	51.49
MIMO_2	Free space	54.13	58.97	48.65	61.54	68.31	68.39	54.62	52.55
	ABS	71.74	66.05	58.58	63.18	69.29	69.23	53.95	54.95
	Glass	64.53	55.70	45.22	64.94	67.87	65.86	50.05	51.77
	Metal	55.62	63.13	56.59	32.14	40.89	43.97	54.22	52.90
	Wall	61.91	48.38	52.88	58.00	56.47	56.36	54.68	48.72
Average Gain (dBi)									
MIMO_1	Free space	-2.96	-2.62	-3.85	-1.78	-1.54	-1.46	-3.12	-2.96
	ABS	-1.68	-1.59	-2.13	-1.79	-1.50	-1.55	-3.00	-2.87
	Glass	-1.73	-1.73	-2.02	-1.75	-1.44	-1.58	-2.96	-2.79
	Metal	-3.94	-2.88	-2.37	-4.07	-3.27	-3.23	-3.57	-3.51
	Wall	-1.70	-1.53	-1.76	-1.95	-1.88	-1.99	-3.00	-2.89
MIMO_2	Free space	-2.72	-2.32	-3.17	-2.11	-1.66	-1.66	-2.65	-2.83
	ABS	-1.47	-1.81	-2.33	-2.00	-1.59	-1.60	-2.71	-2.63
	Glass	-1.93	-2.56	-3.46	-1.88	-1.68	-1.82	-3.04	-2.87
	Metal	-2.61	-2.00	-2.50	-4.95	-3.90	-3.59	-2.67	-2.77
	Wall	-2.09	-3.15	-2.79	-2.37	-2.48	-2.50	-2.63	-3.15
Peak Gain (dBi)									
MIMO_1	Free space	3.18	3.60	2.14	3.98	4.37	4.37	3.70	4.49
	ABS	4.65	4.00	3.45	5.24	6.05	6.05	4.69	3.18
	Glass	3.71	3.92	4.35	5.28	6.16	7.67	5.34	3.87
	Metal	5.09	3.10	4.73	4.50	4.96	5.69	6.02	4.96
	Wall	4.74	4.97	3.67	5.44	4.84	4.84	5.08	3.75
MIMO_2	Free space	5.83	3.66	2.57	3.78	4.01	4.01	3.87	3.97
	ABS	4.33	4.52	4.41	4.34	4.73	5.69	5.64	5.42
	Glass	3.02	3.14	1.36	4.99	5.89	6.02	6.18	4.42
	Metal	3.54	3.11	3.33	3.12	4.36	5.02	7.16	4.95
	Wall	3.21	1.77	2.15	5.49	5.49	7.20	6.10	4.74
Impedance		50Ω							
Polarization		Linear							
VSWR		< 3							
Cable		1 meter KSR200-P standard, fully customizable							
Connector		SMA(M) standard, fully customizable							

2.4GHz/5.8GHz Wi-Fi Antenna			
Frequency (MHz)		2400~2500	4900~5850
Efficiency (%)			
MIMO_1	Free space	57.73	48.06
	ABS	53.59	49.42
	Glass	53.98	47.16
	Metal	51.80	46.70
	Wall	61.02	46.29
MIMO_2	Free space	44.09	47.04
	ABS	46.34	46.79
	Glass	40.79	46.88
	Metal	45.58	45.59
	Wall	50.62	43.60
MIMO_3	Free space	TBC	TBC
	ABS	TBC	TBC
	Glass	TBC	TBC
	Metal	TBC	TBC
	Wall	TBC	TBC
Average Gain (dBi)			
MIMO_1	Free space	-2.39	-3.25
	ABS	-2.71	-3.13
	Glass	-2.68	-3.36
	Metal	-2.86	-3.44
	Wall	-2.15	-3.42
MIMO_2	Free space	-3.57	-3.33
	ABS	-3.37	-3.36
	Glass	-3.91	-3.35
	Metal	-3.45	-3.52
	Wall	-2.96	-3.67
MIMO_3	Free space	TBC	TBC
	ABS	TBC	TBC
	Glass	TBC	TBC
	Metal	TBC	TBC
	Wall	TBC	TBC
Peak Gain (dBi)			
MIMO_1	Free space	4.35	4.84
	ABS	5.34	5.18
	Glass	2.99	5.03
	Metal	5.22	5.98
	Wall	5.47	5.77
MIMO_2	Free space	2.94	5.70
	ABS	2.18	5.43
	Glass	3.75	7.07
	Metal	6.02	6.76
	Wall	3.23	5.97
MIMO_3	Free space	TBC	TBC
	ABS	TBC	TBC
	Glass	TBC	TBC
	Metal	TBC	TBC
	Wall	TBC	TBC

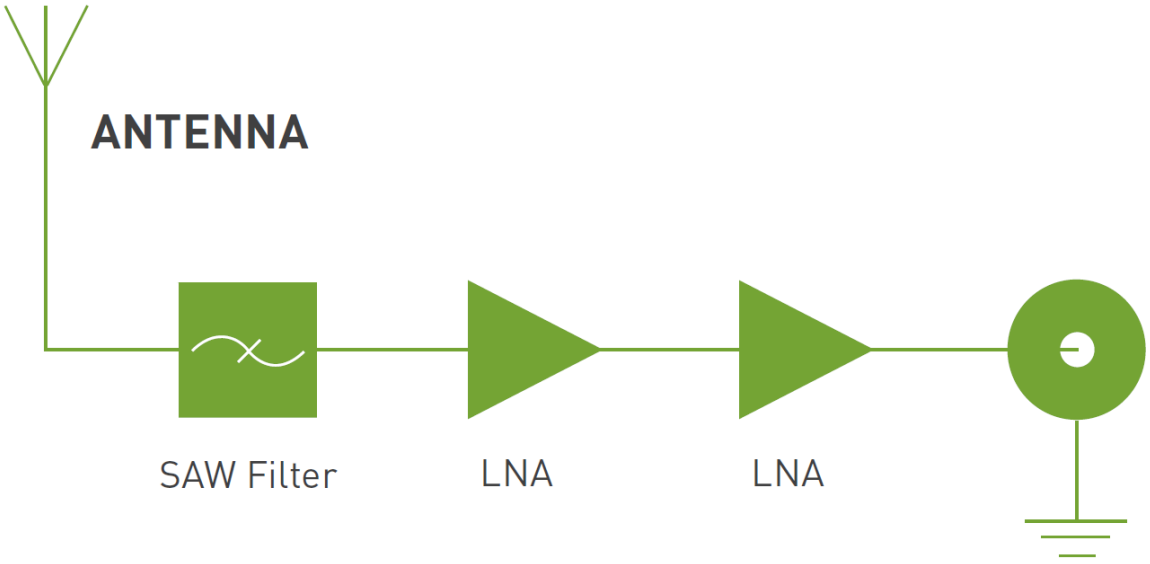
2.4GHz/5.8GHz Wi-Fi Antenna	
Impedance	50Ω
Polarization	Linear
VSWR	< 3
Cable	1 meter KSR200-P standard, fully customizable
Connector	RP-SMA(M) standard, fully customizable

MECHANICAL	
Antenna Dimensions	146*134*20mm
Casing	ASA
Weight (including cable)	438g
Ingress Protection Rating	IP67
ENVIRONMENTAL	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 90°C
Humidity	Non-condensing 65°C 95% RH

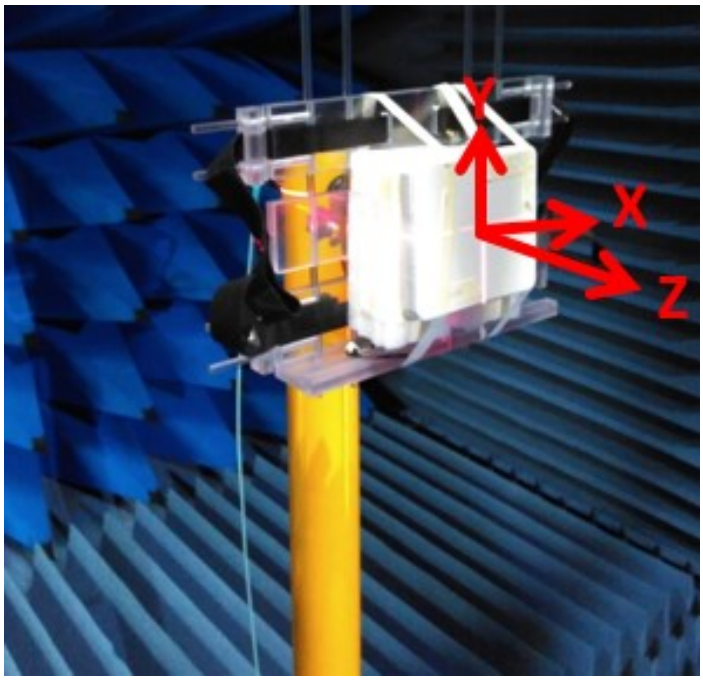
3. Antenna Characteristics

3.1 BeiDou-GPS-GLONASS

3.1.1 Block Diagram (Active antenna)

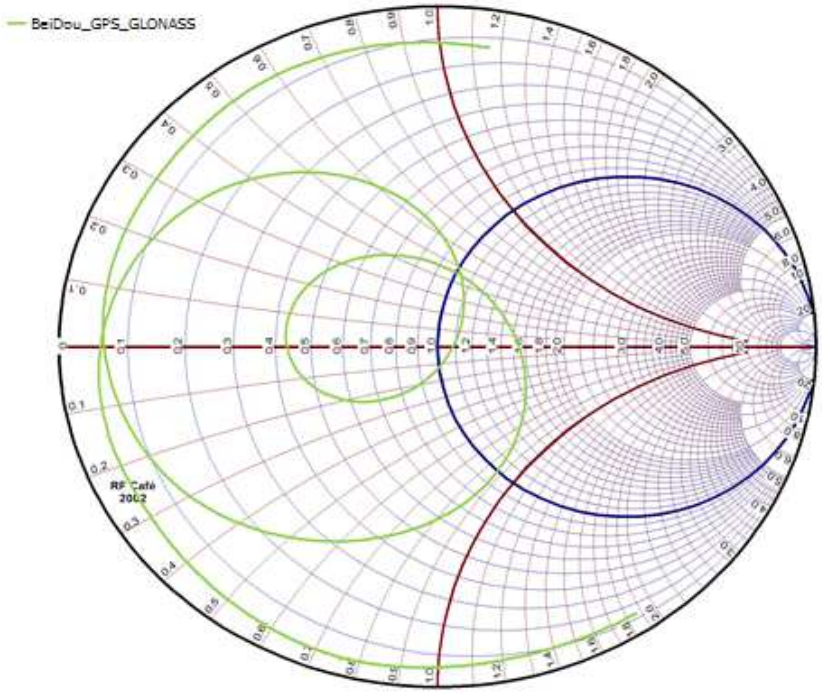


3.1.2 Test Setup

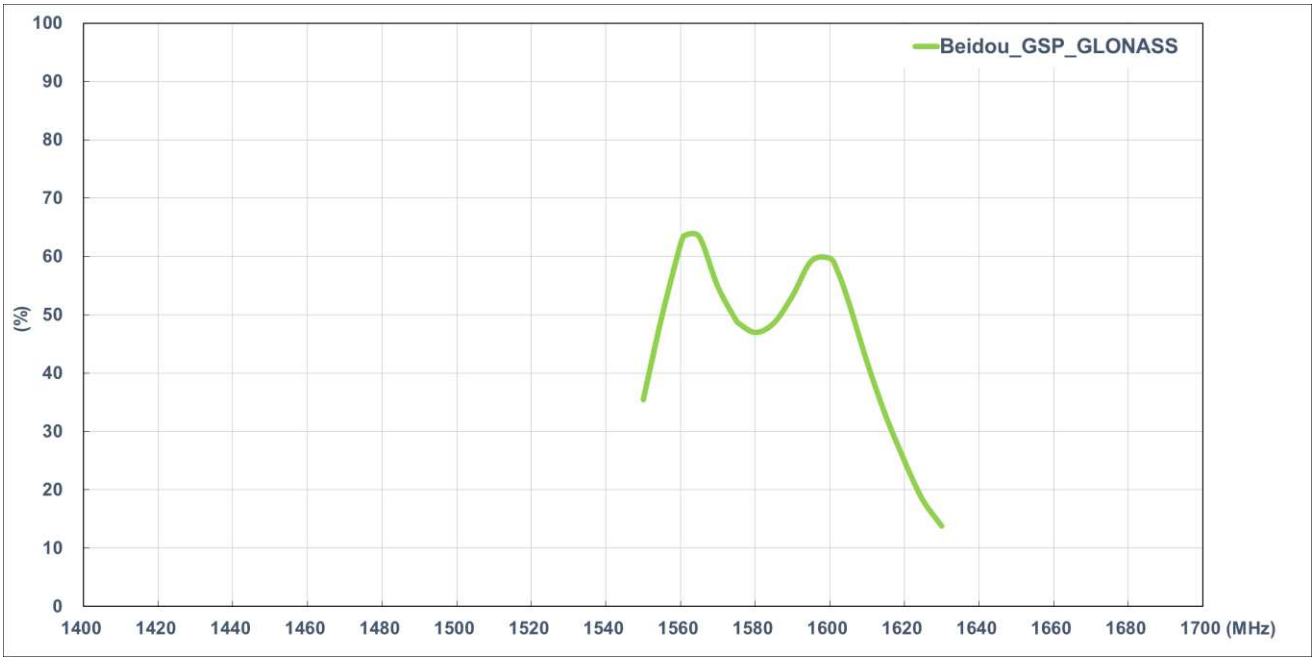


3.1.3 BeiDou-GPS-GLONASS Return Loss (Passive antenna)

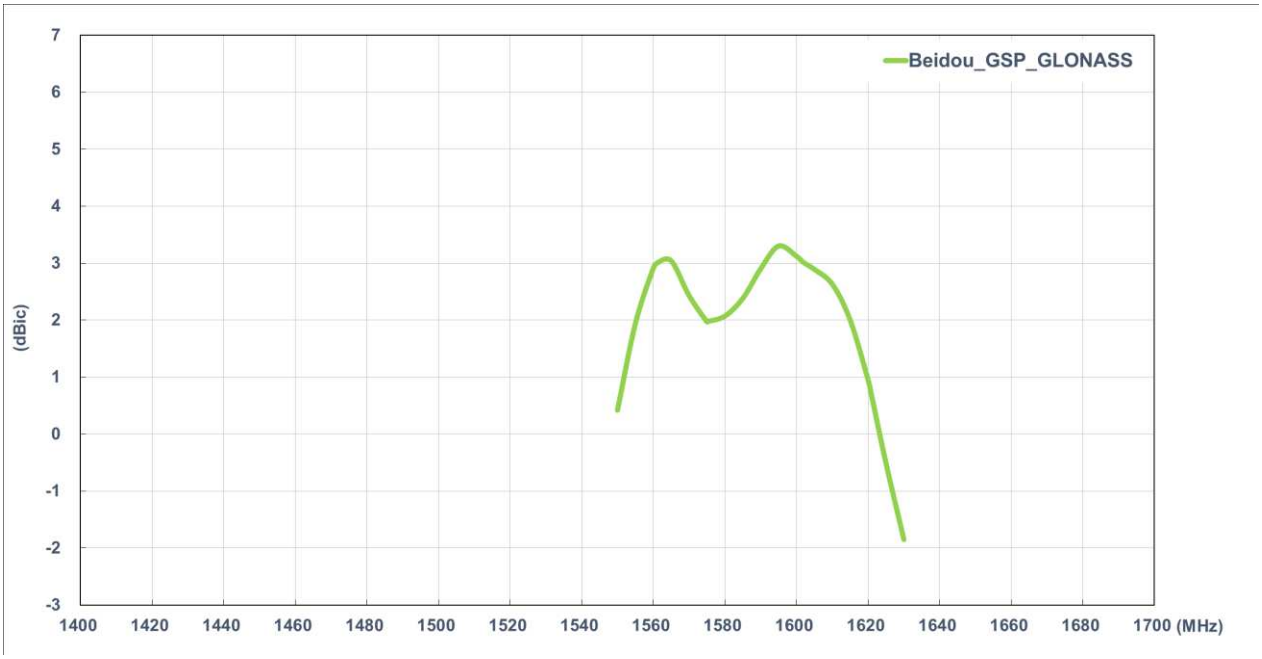
3.1.4 BeiDou-GPS-GLONASS Smith Chart (Passive antenna)



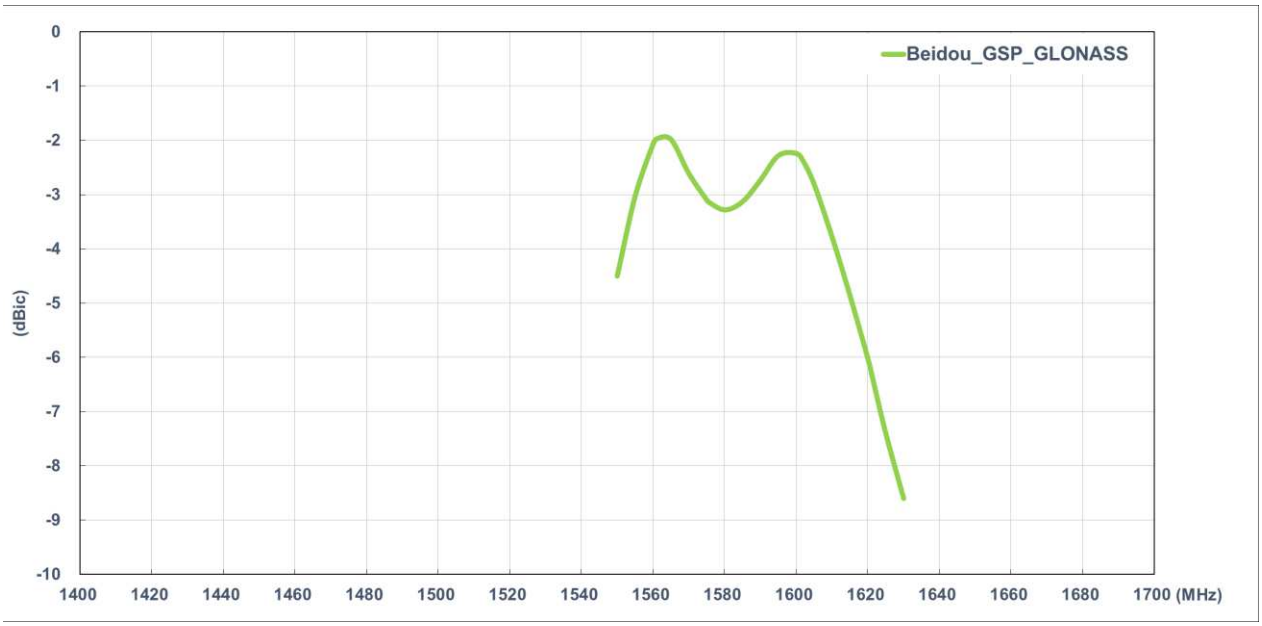
3.1.5 BeiDou-GPS-GLONASS Efficiency (Passive antenna)



3.1.6 BeiDou-GPS-GLONASS Peak Gain (Passive antenna)

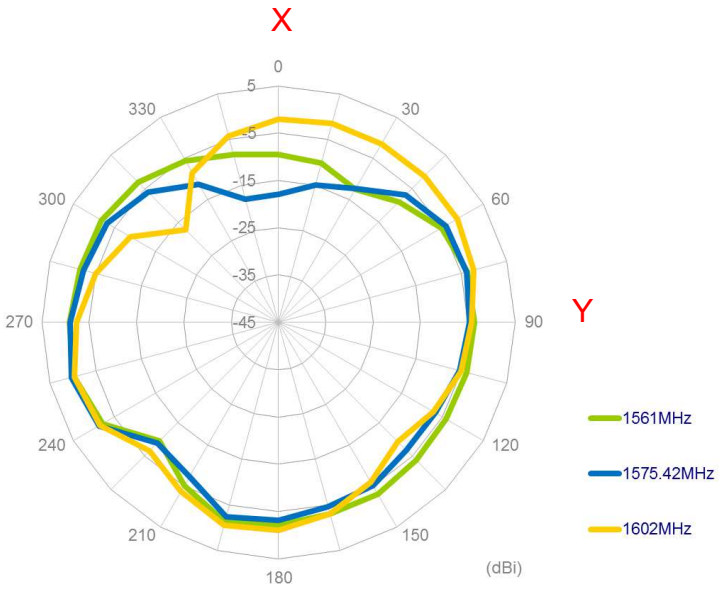


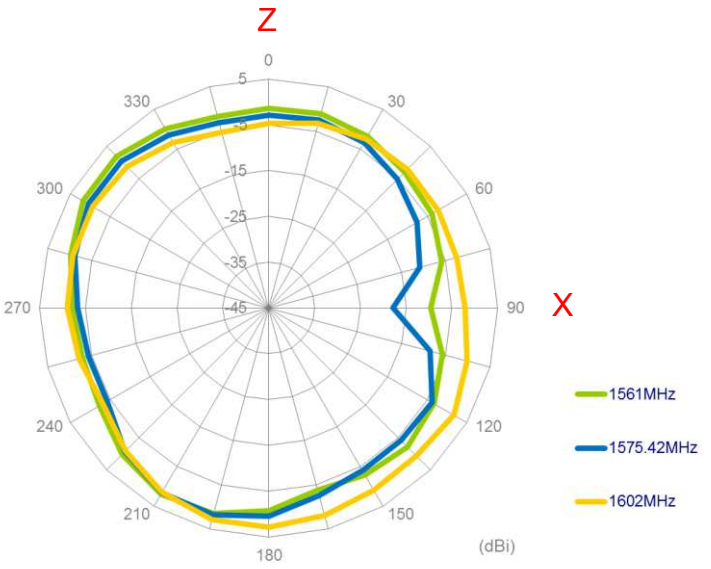
3.1.7 BeiDou-GPS-GLONASS Average Gain (Passive antenna)

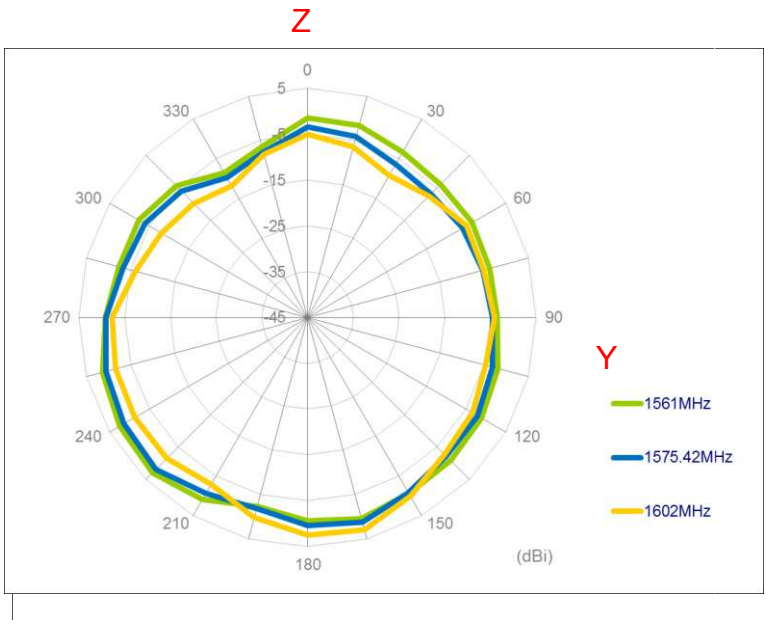


3.1.8 BeiDou-GPS-GLONASS Radiation Pattern (Passive antenna)

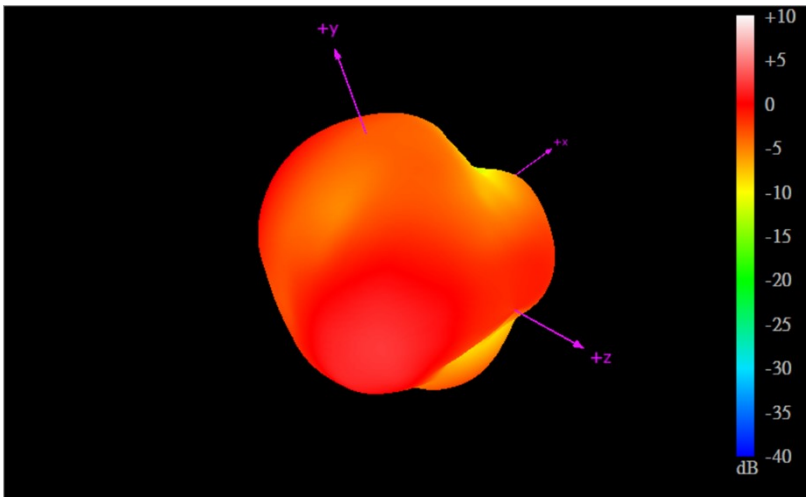
2D Radiation Pattern



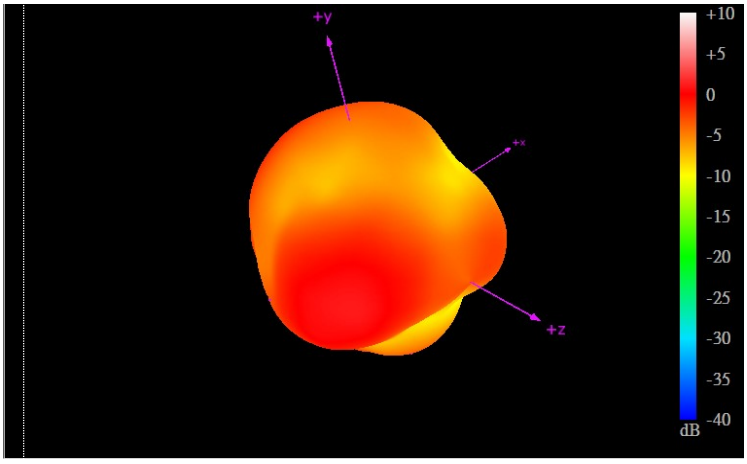




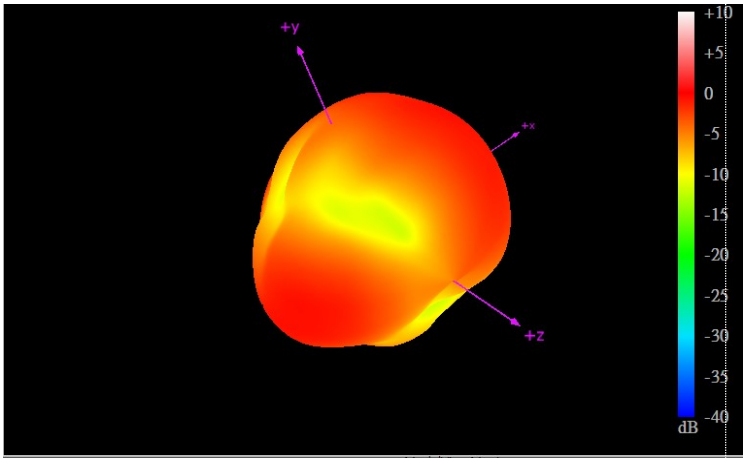
3D Radiation Pattern (Passive antenna)



1561MHz

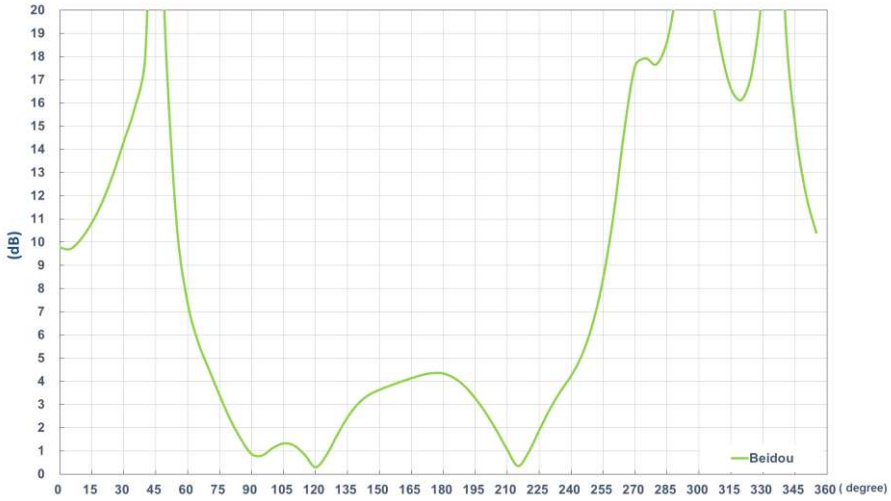


1575.42MHz

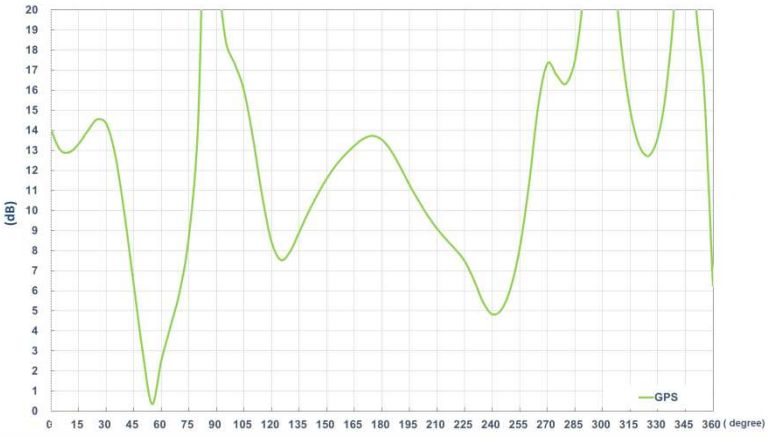


1602MHz

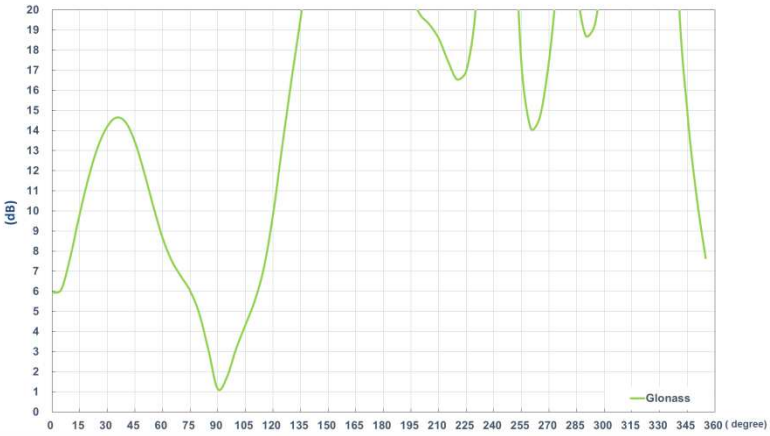
3.1.9 Axial Ratio (Passive antenna)



1561MHz

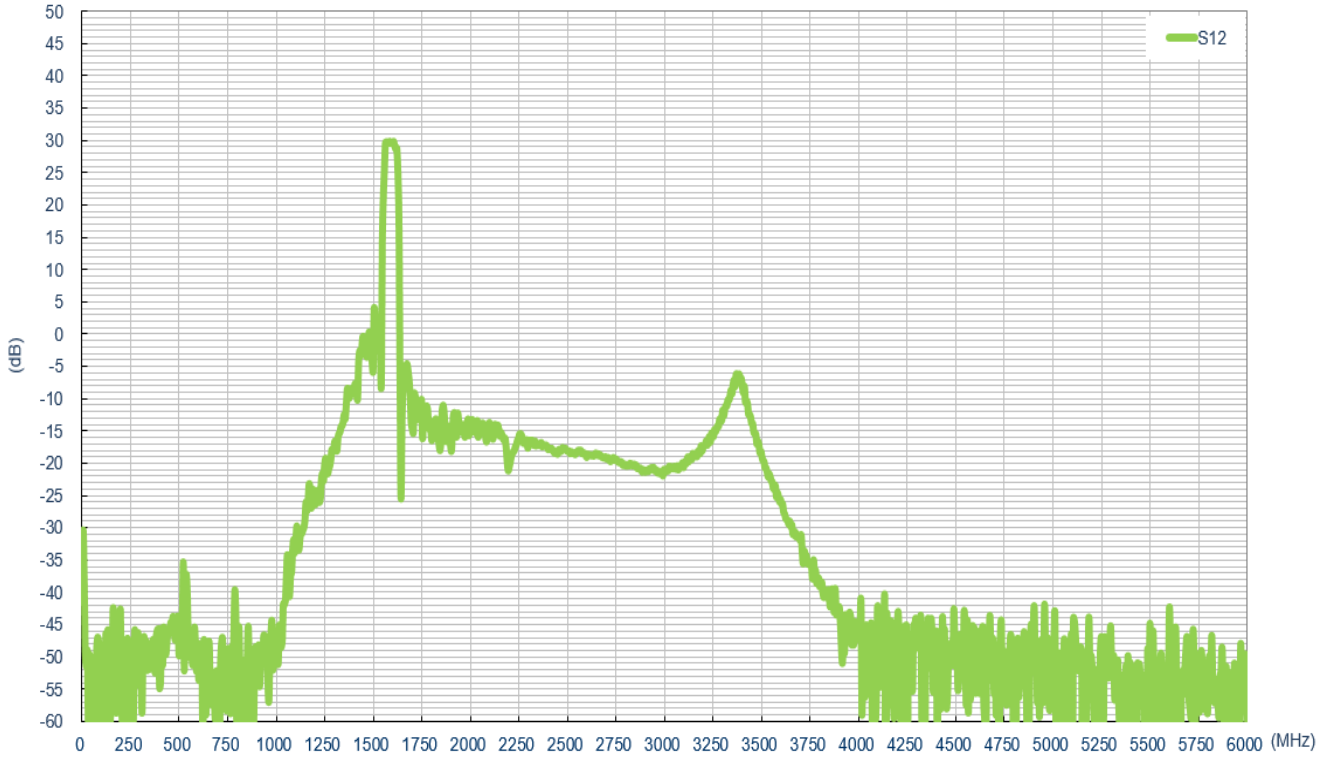


1575.42MHz

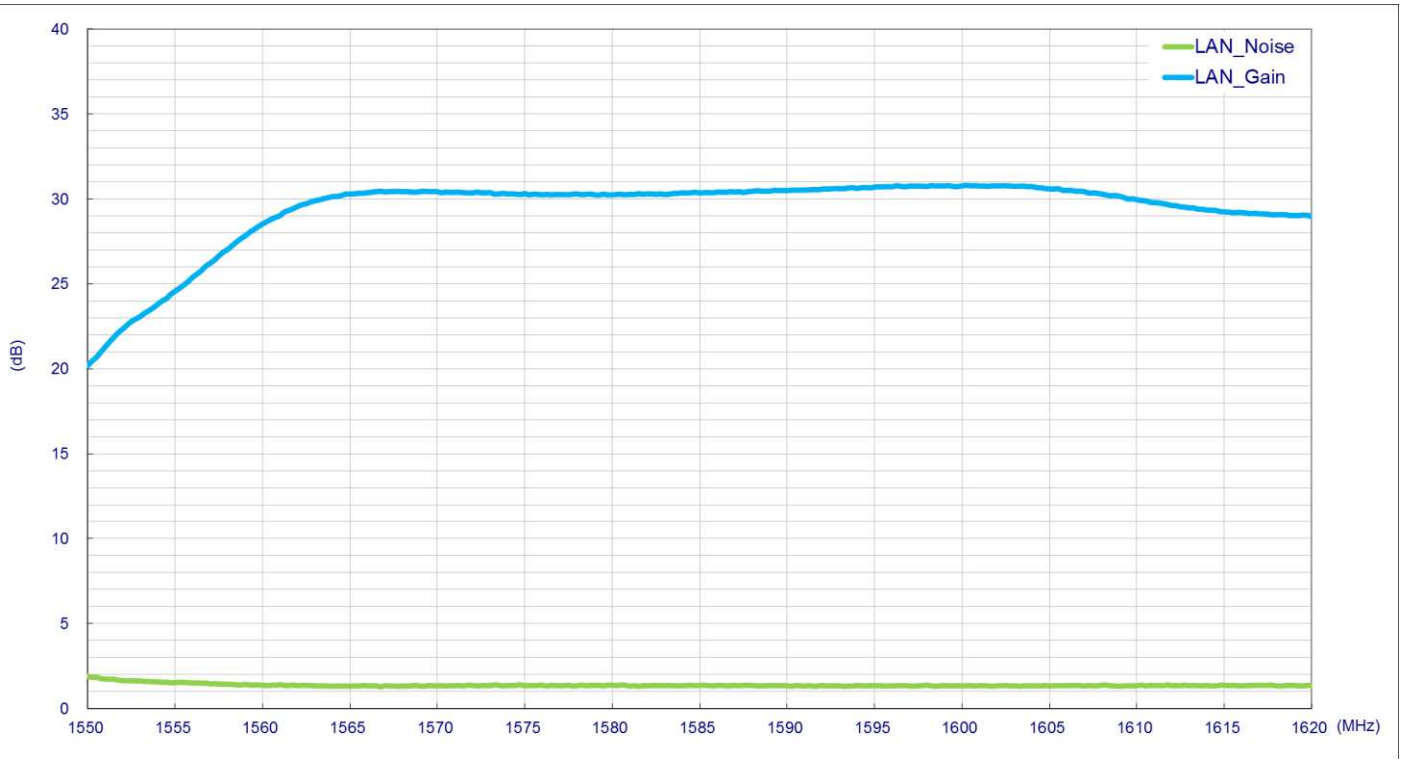


1602MHz

3.1.10 BeiDou-GPS-GLONASS LNA Gain and Noise Figure (Active antenna)



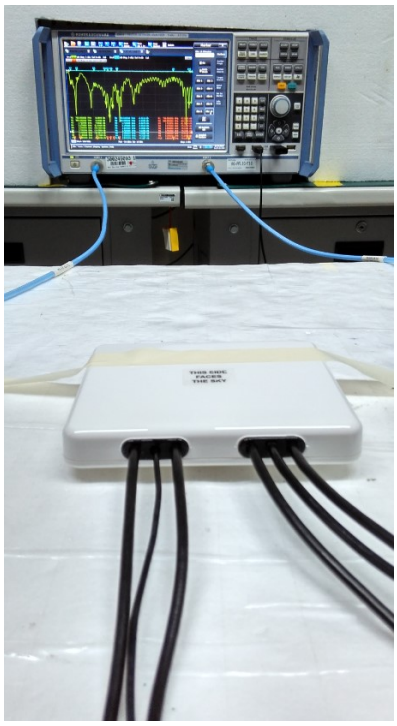
LNA Gain@3.0V



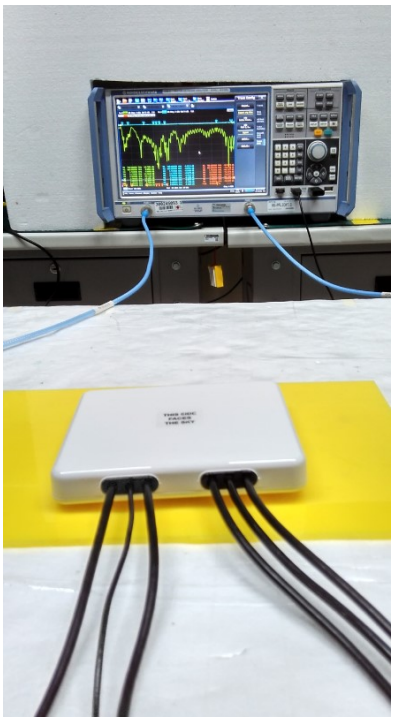
LNA Noise Figure @3.0V

3.2 LTE_MIMO/Wi-Fi_MIMO Antenna

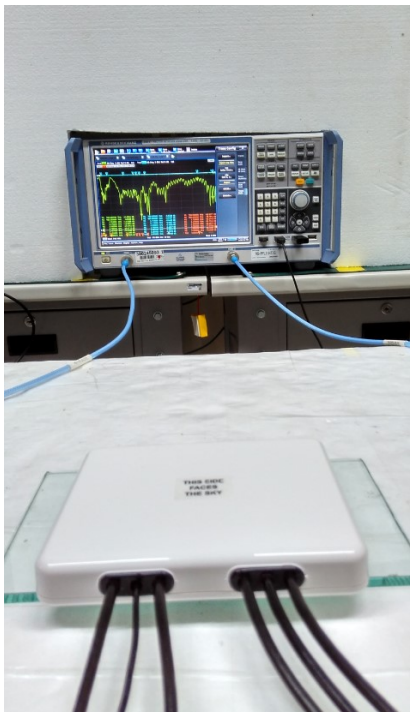
3.2.1 Test Setup



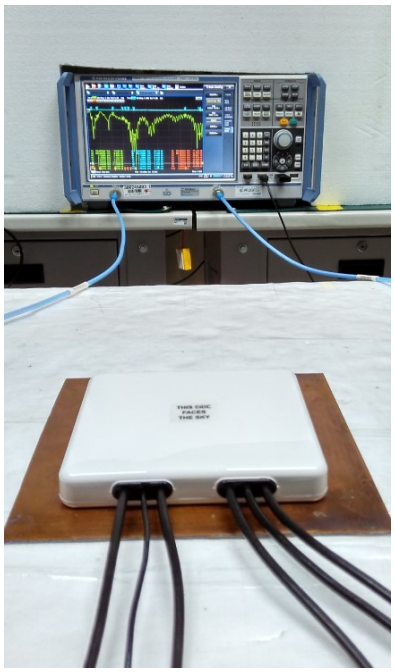
Free space



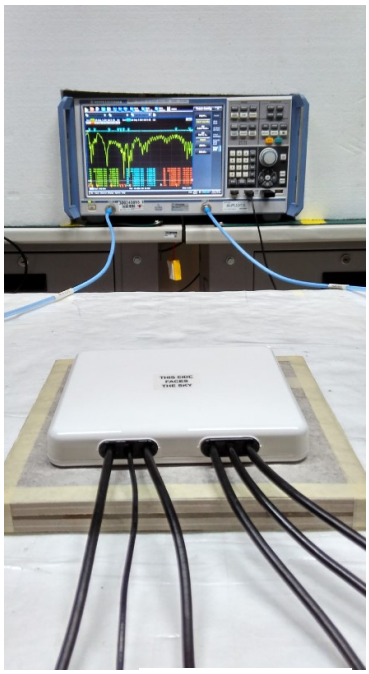
ABS



Glass



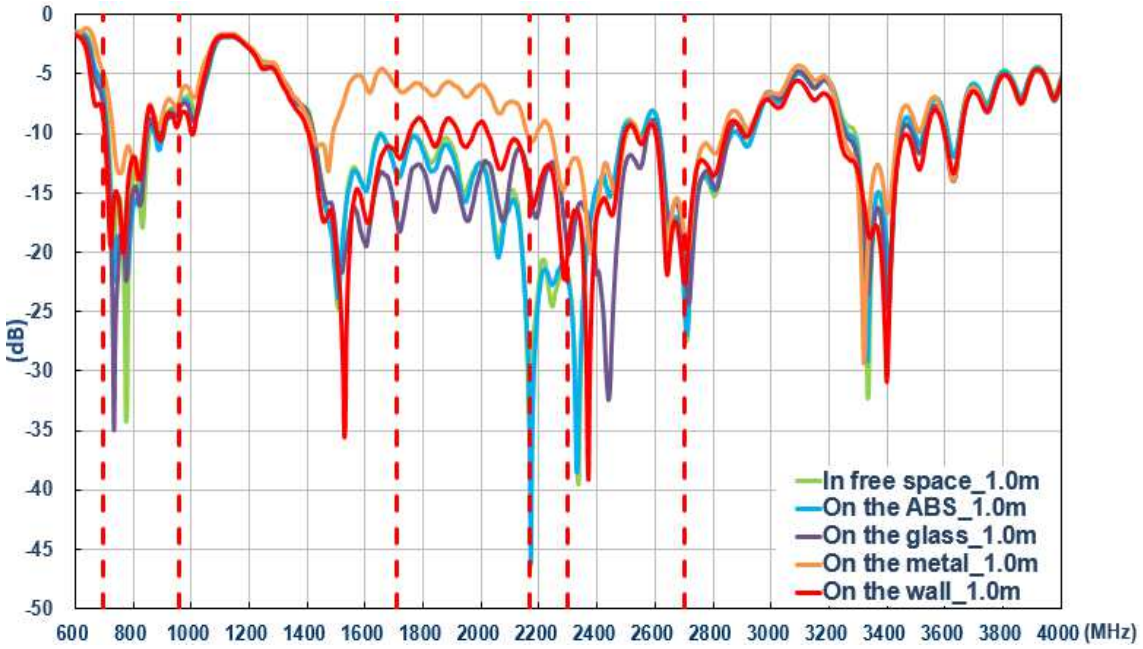
Metal



Wall

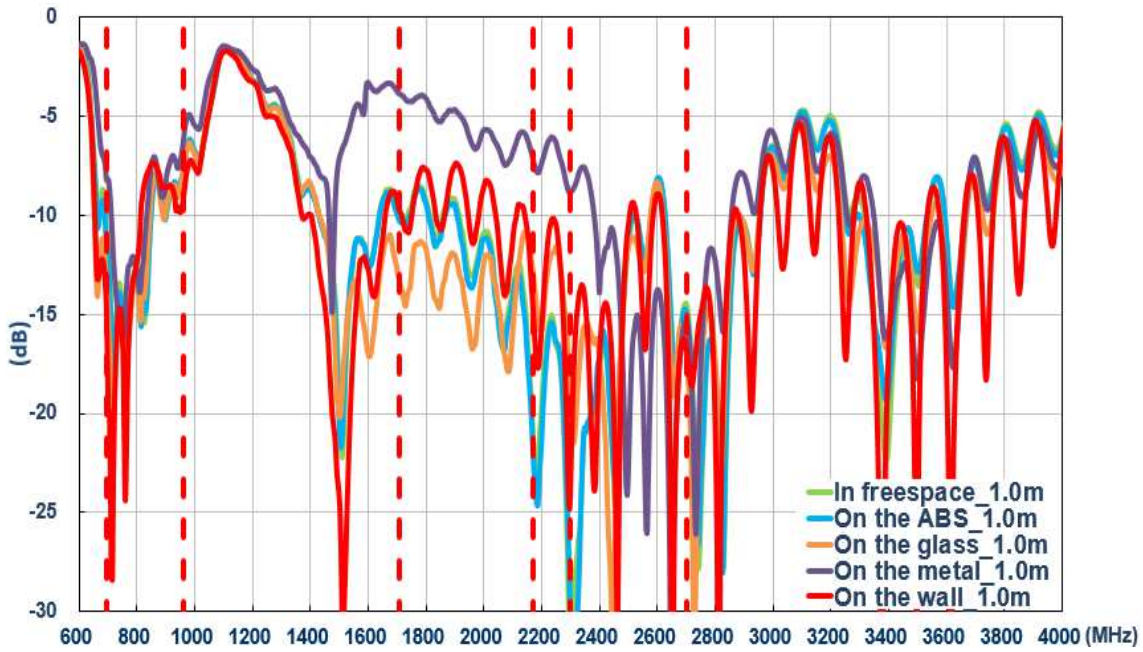
3.2.2 LTE_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



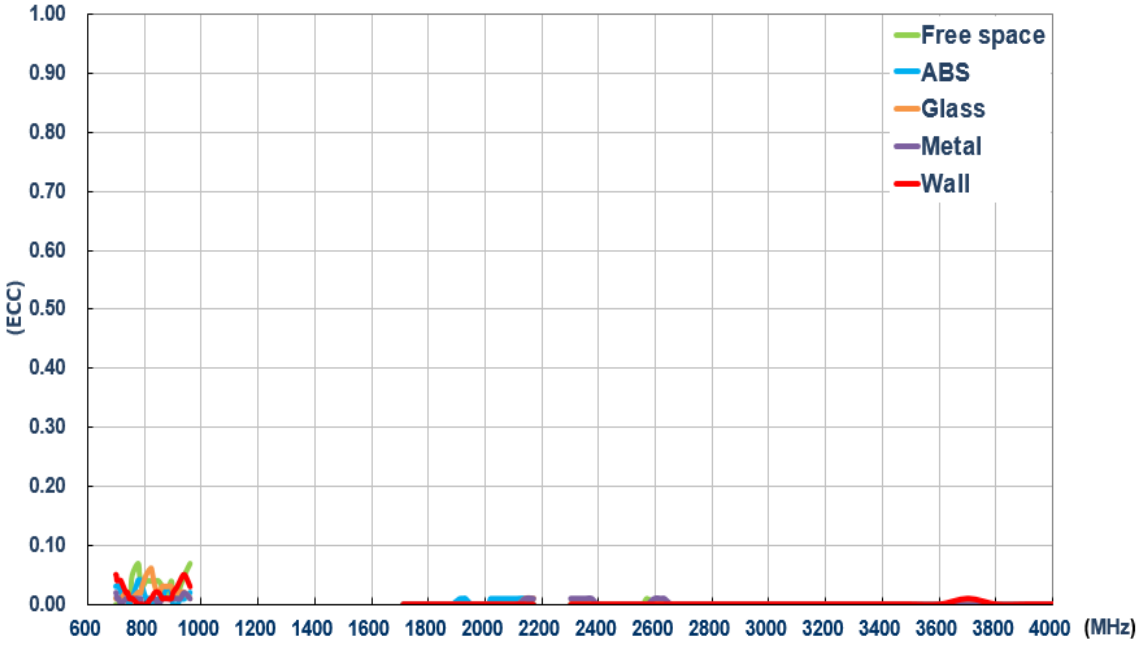
3.2.3 LTE_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



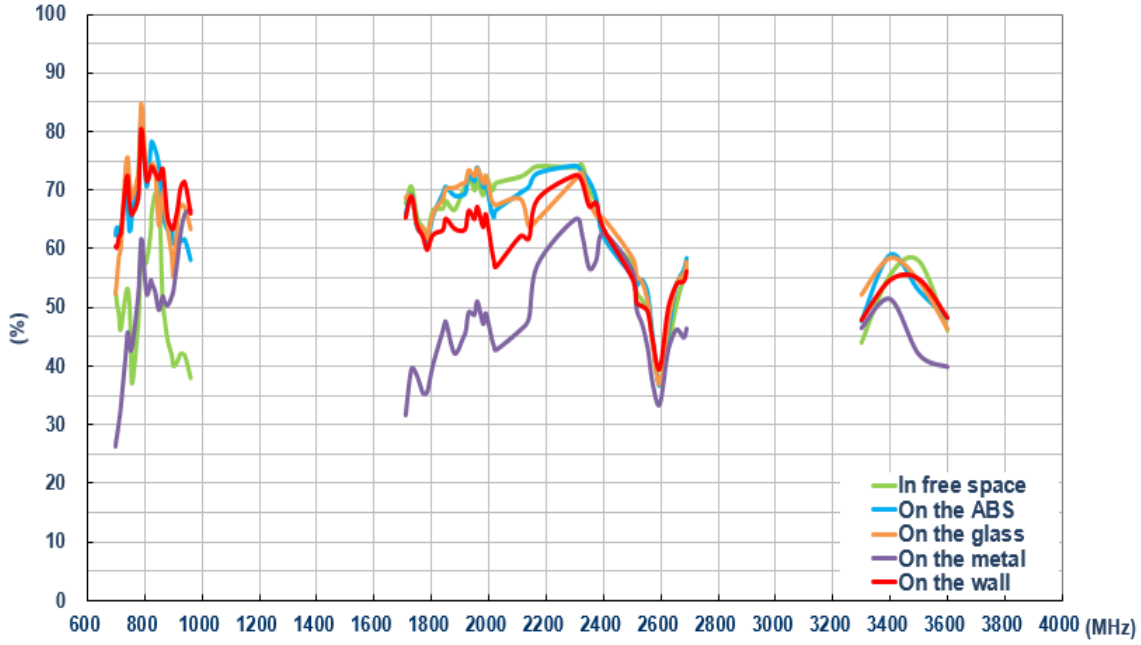
3.2.4 LTE Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



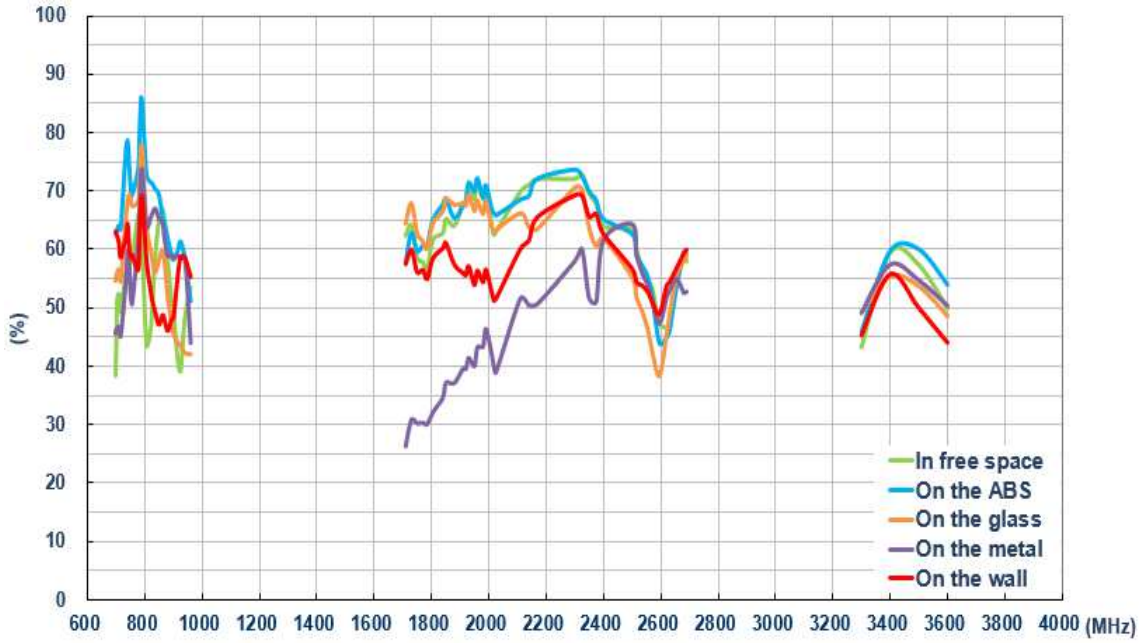
3.2.5 LTE_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



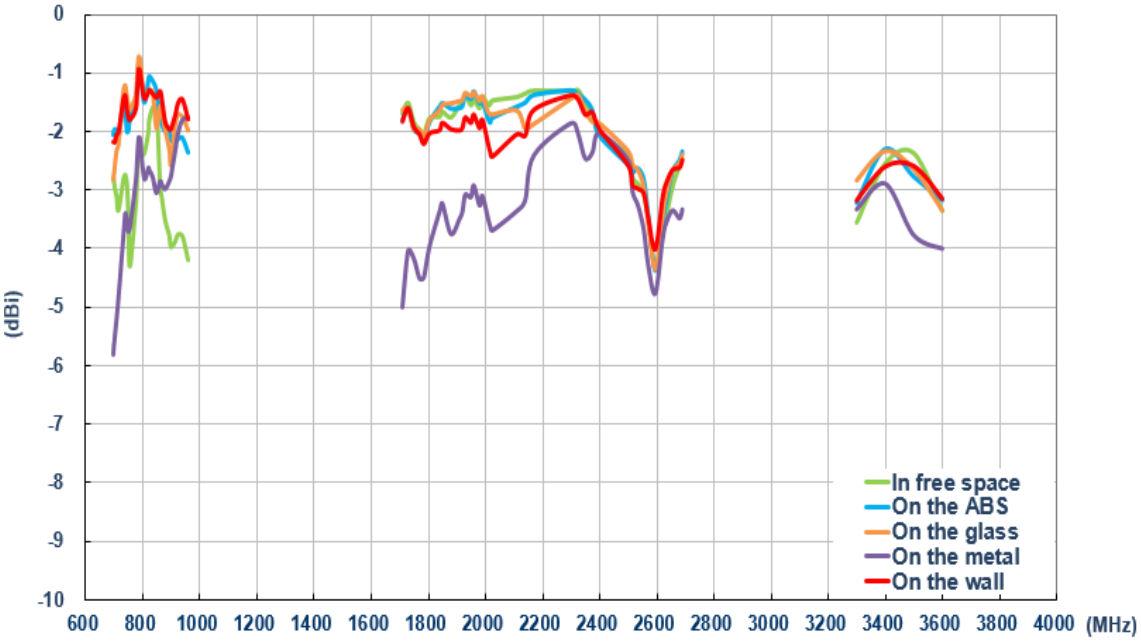
3.2.6 LTE_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



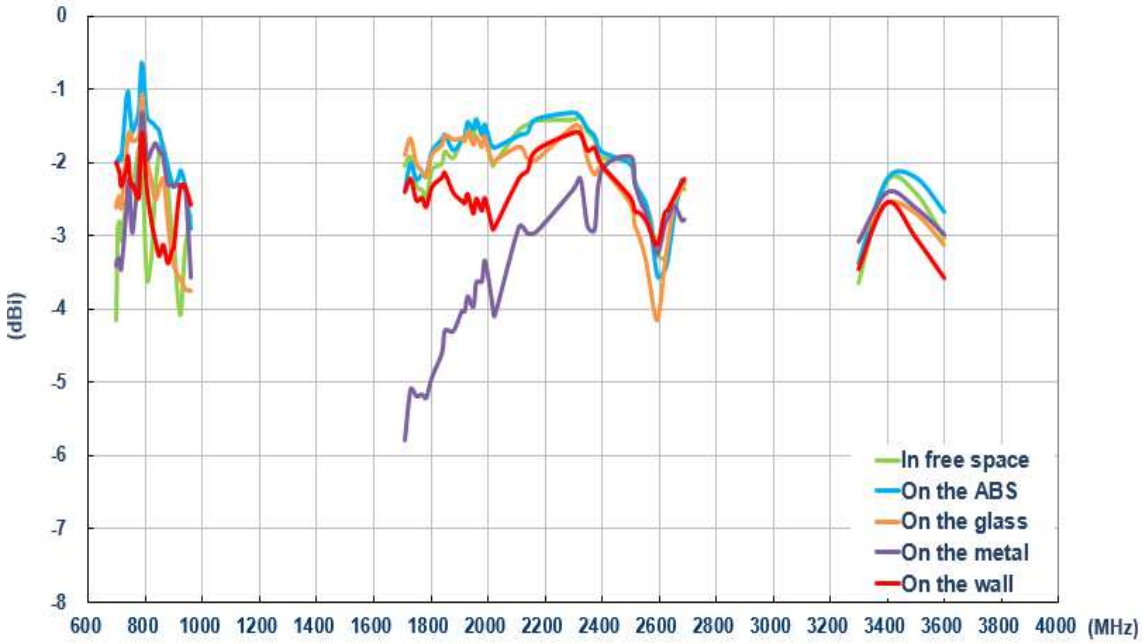
3.2.7 LTE_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



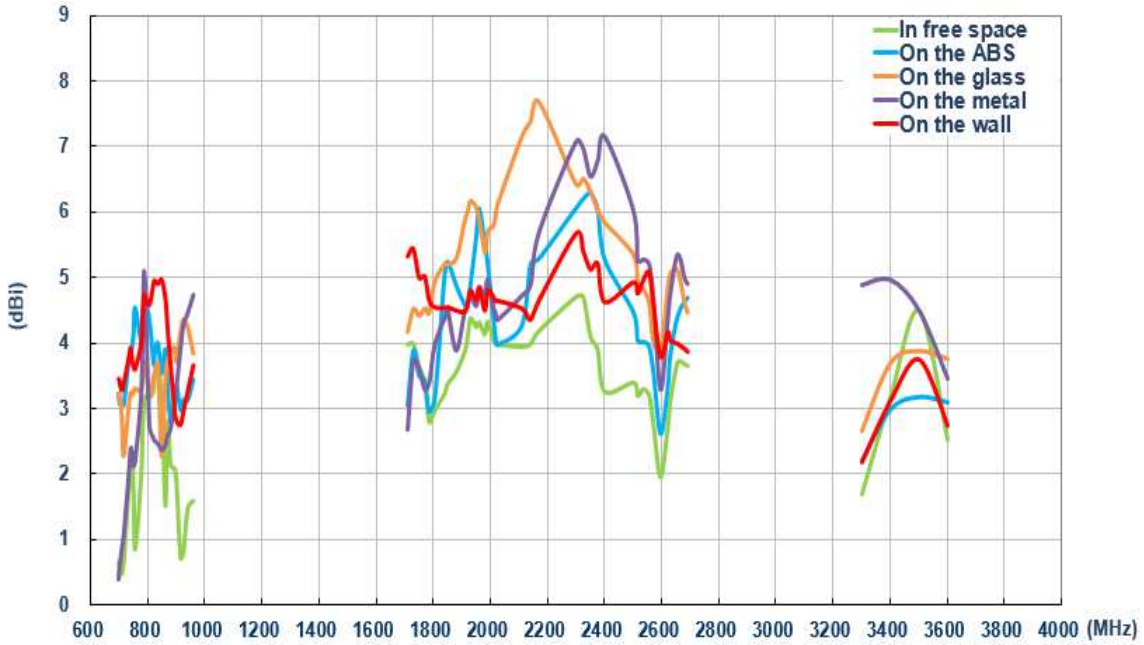
3.2.8 LTE_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



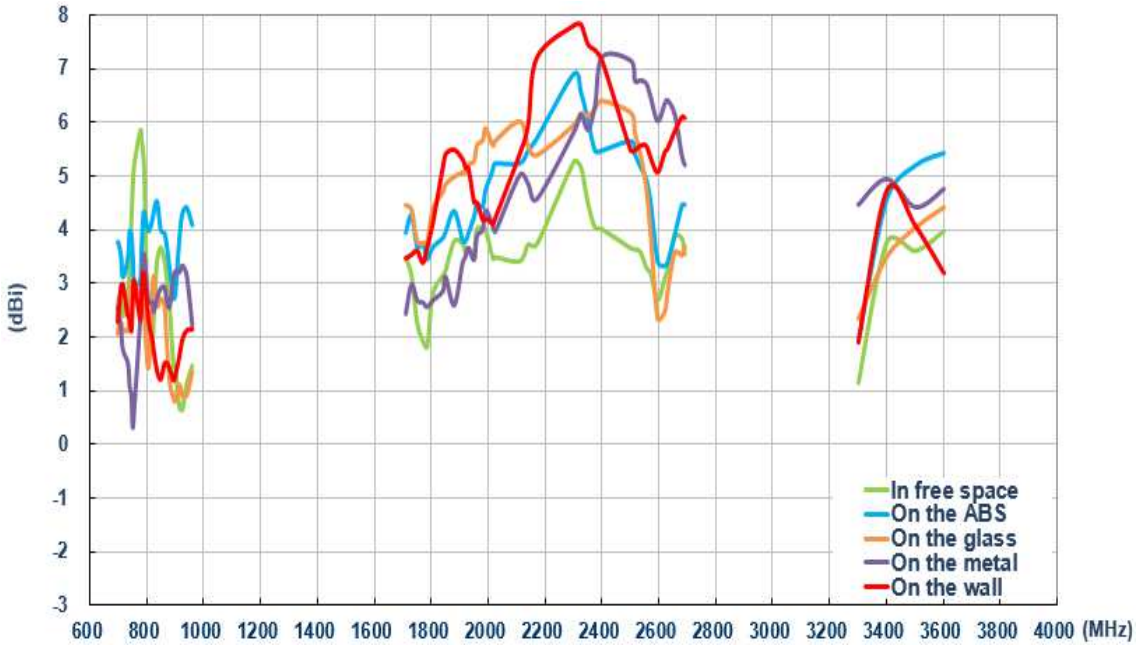
3.2.9 LTE_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length



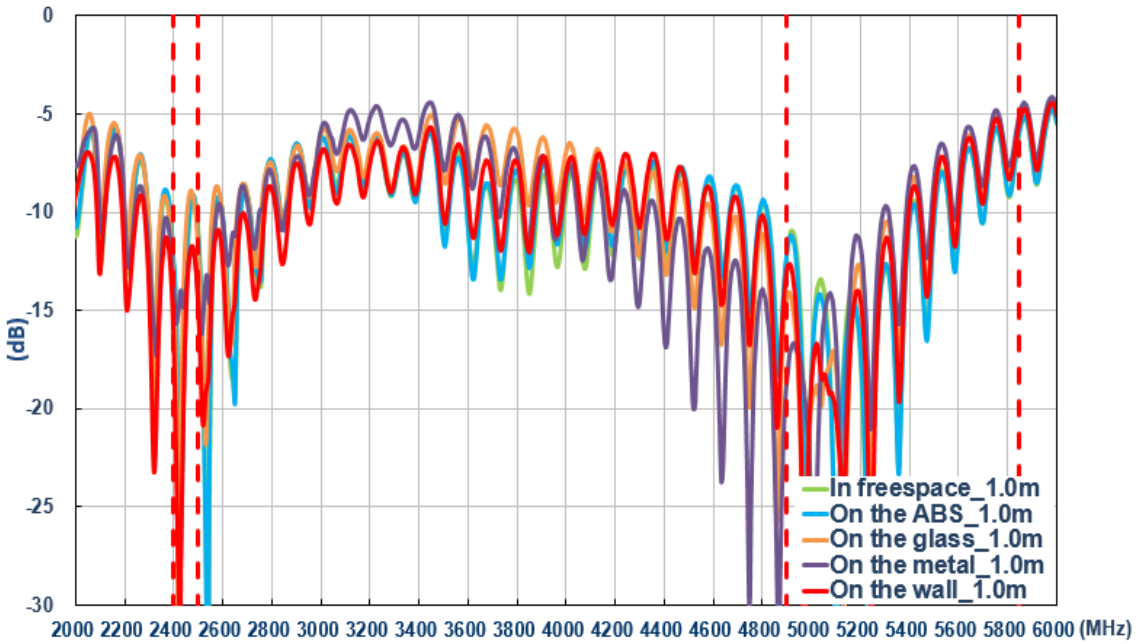
3.2.10 LTE_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



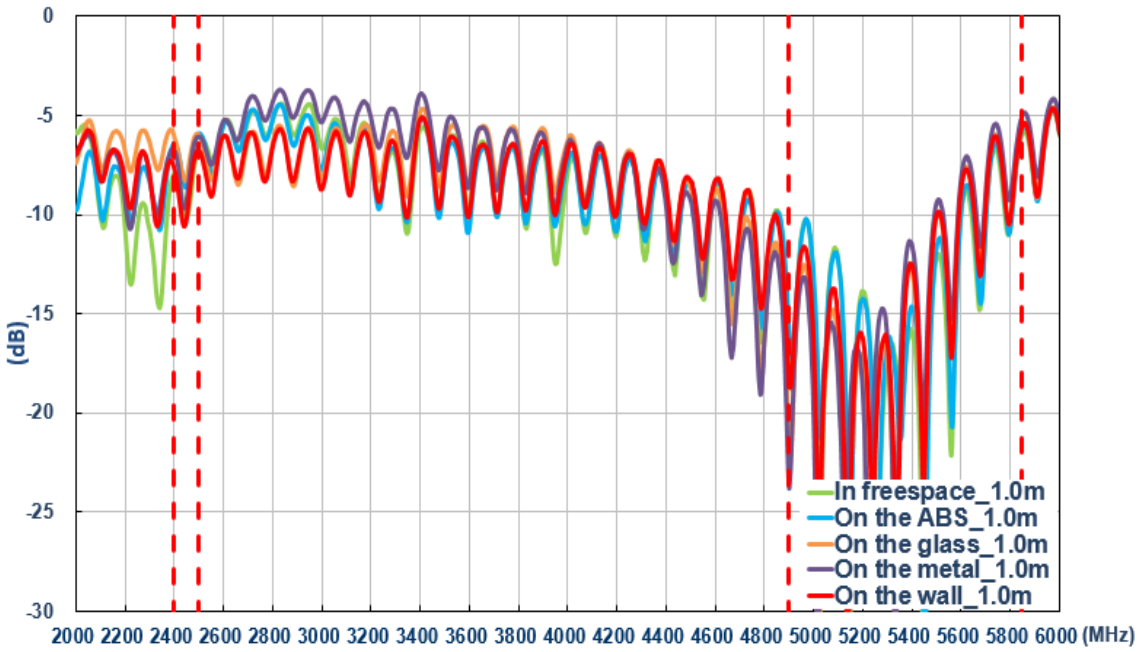
3.2.11 Wi-Fi_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



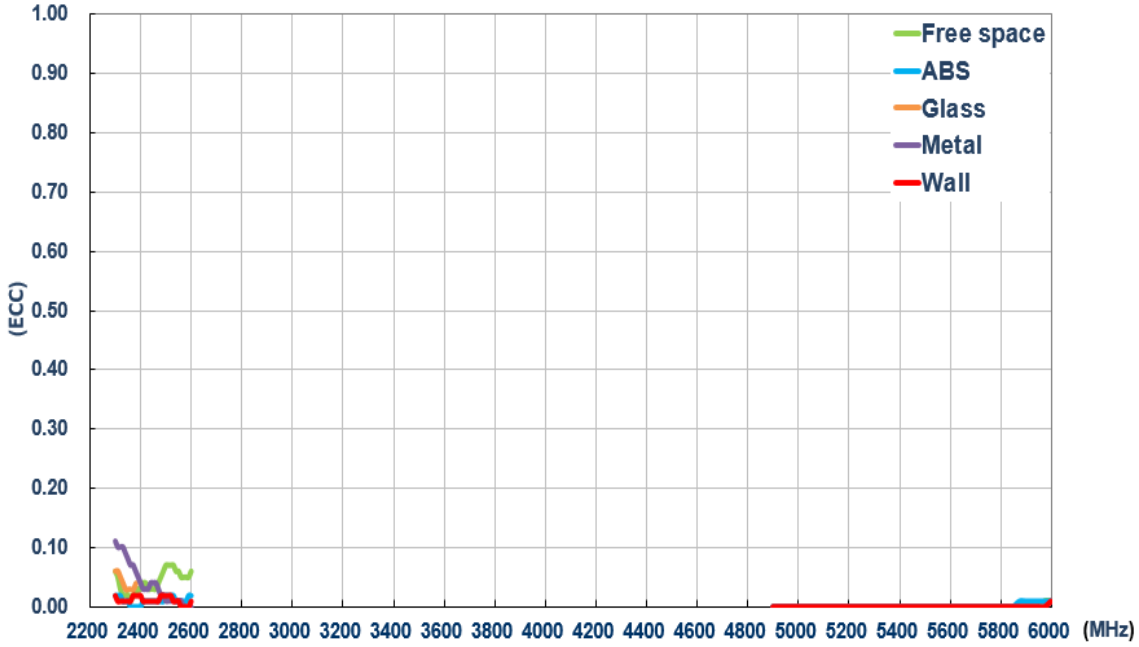
3.2.12 Wi-Fi_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



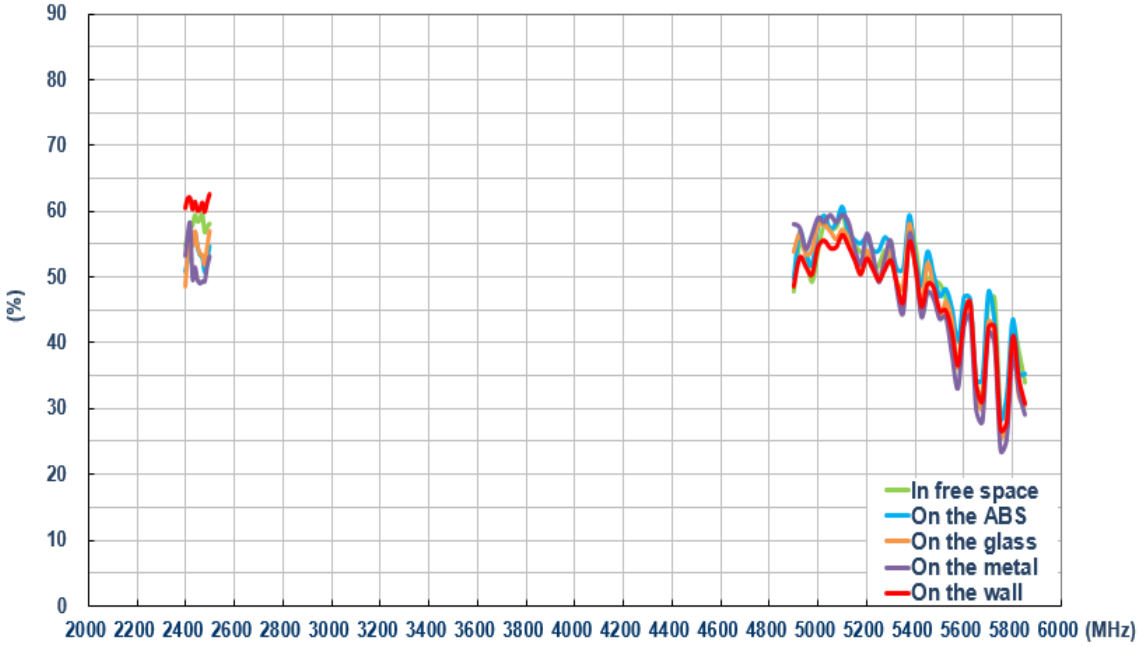
3.2.13 Wi-Fi Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



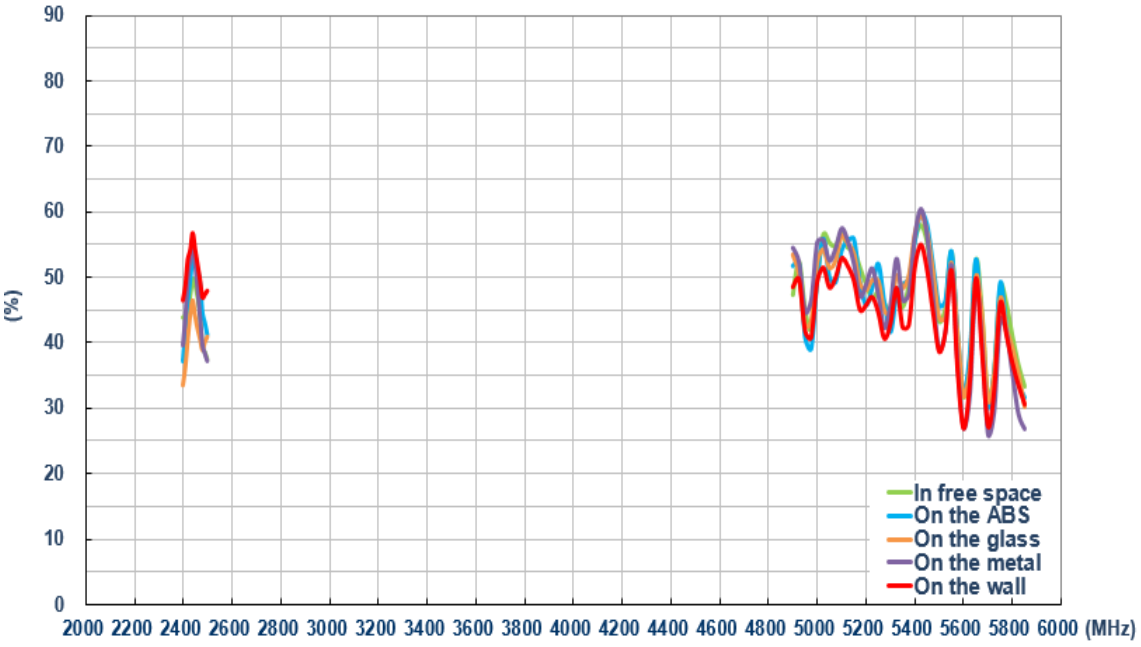
3.2.14 Wi-Fi_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



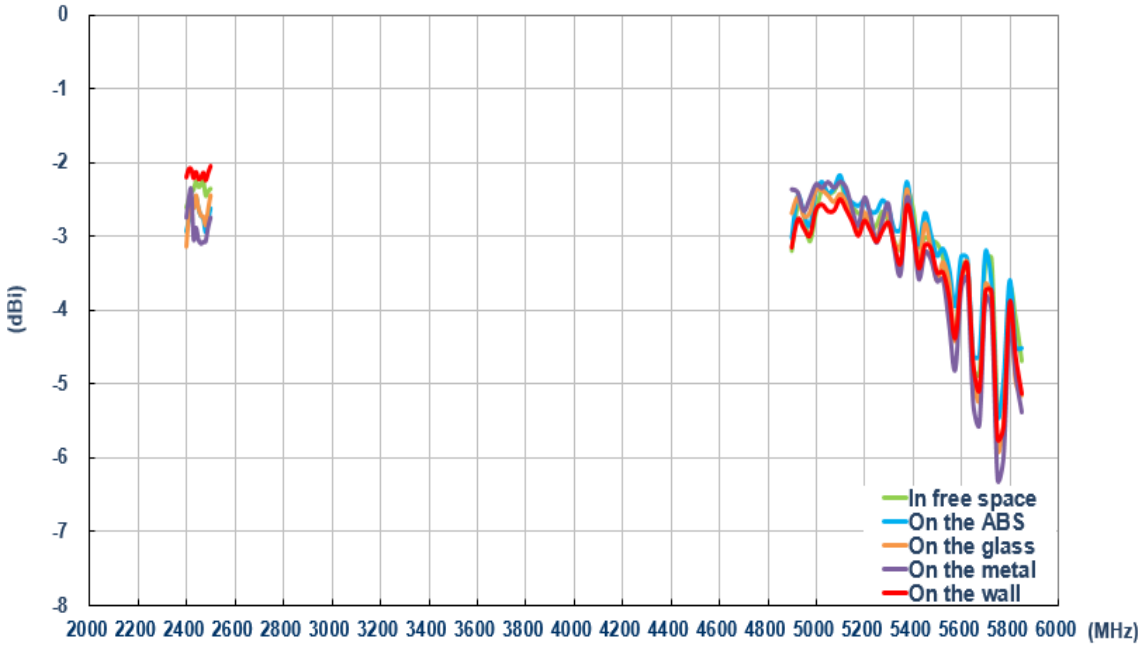
3.2.15 Wi-Fi_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



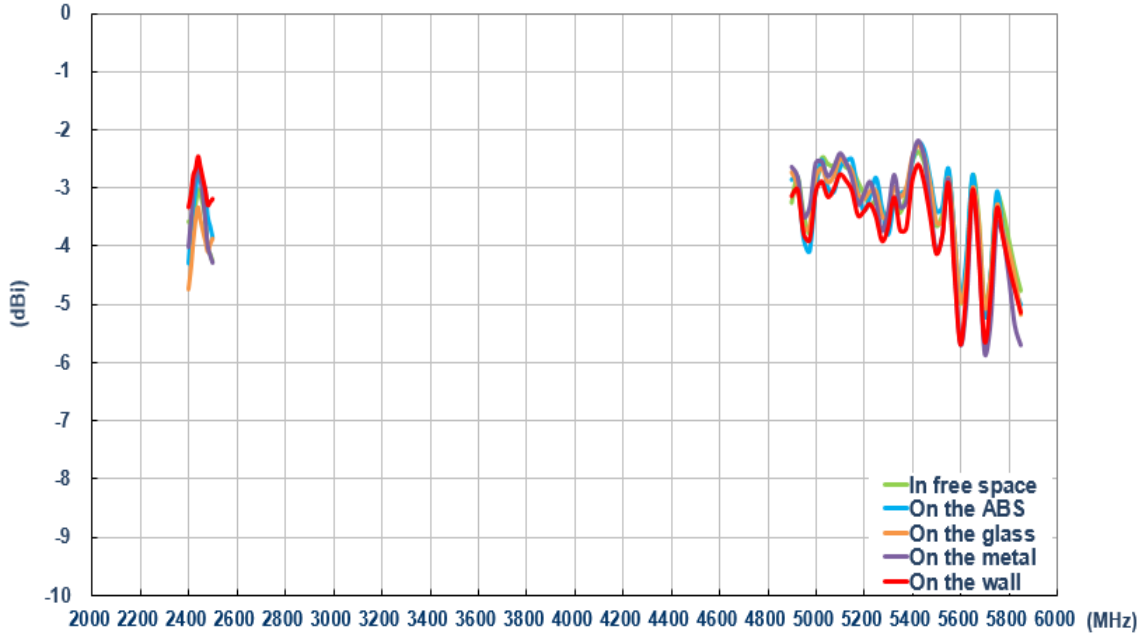
3.2.16 Wi-Fi_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



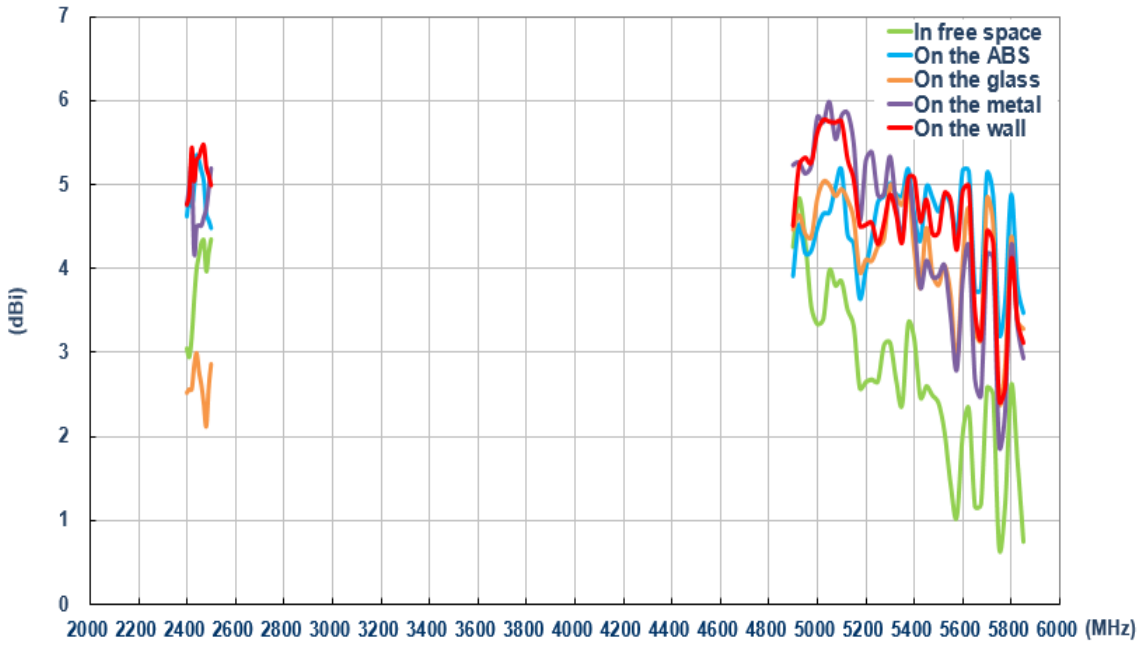
3.2.17 Wi-Fi_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



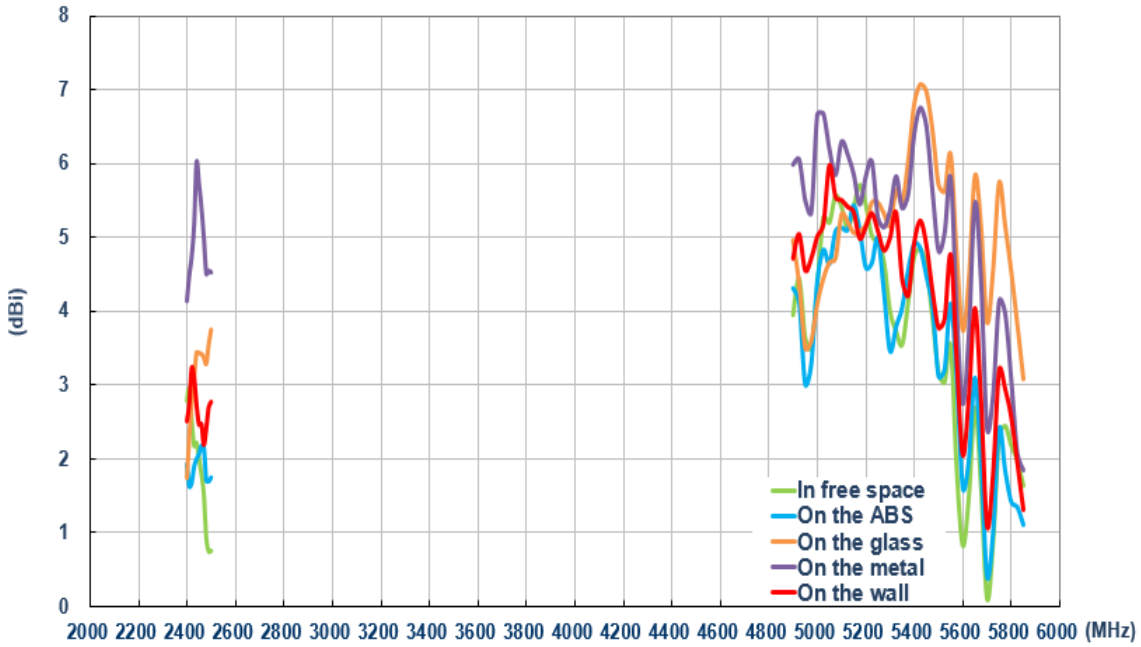
3.2.18 Wi-Fi_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length

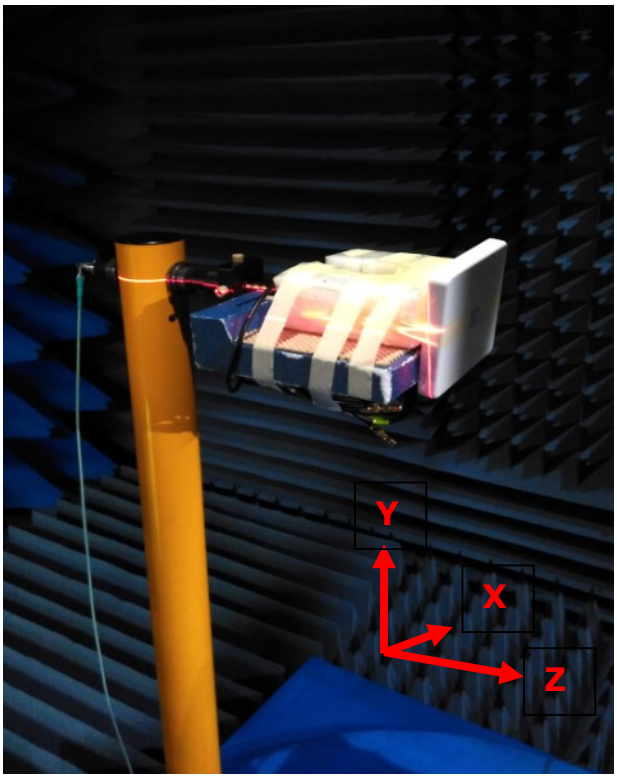


3.2.19 Wi-Fi_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



3.2.20 Test Setup For Antenna Radiation Pattern



In free space