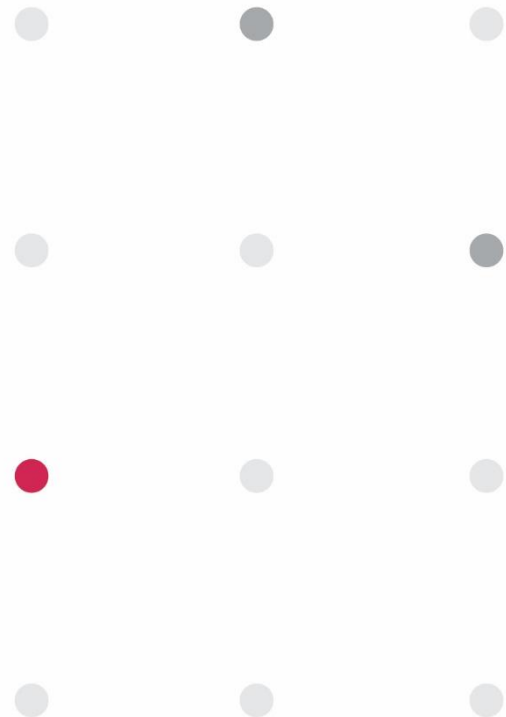


PSA

PASSIVE SYSTEM ALLIANCE
INPAQ TECHNOLOGY CO., LTD.



Presented by
YiAn Nien, **RF R&D Dept.**

INPAQ Technology Co., Ltd.

1F, No.38, Ke-Yi St., Zhunan Township, Miaoli
County 35059, Taiwan, R.O.C.

Last updated in .10.26. 2022

Customer : Foxconn

Project : Tracker

Product : Antenna LTE & GPS & WiFi

Antenna P/N:WAG-F-LTE12-00-066 :

Revised History

Released Date	Version	Record
Nov.22 th , 2021	0.0	Initial antenna test
Nov.24 th , 2021	0.1	Antenna fine tune
Nov.26 th , 2021	0.2	Add metal ground test
Dec.03 th , 2021	0.3	Antenna fine tune
Dec.06 th , 2021	0.4	Antenna fine tune
Dec.10 th , 2021	0.5	Antenna fine tune
Dec.16 th , 2021	0.6	Antenna add tuner fine tune
Dec.22 th , 2021	0.7	Antenna add tuner fine tune
Dec.29 th , 2021	0.8	Add shielding and increase via fine tune
Jan.12 th , 2022	0.9	fine tune
Jan.18 th , 2022	1.0	Compare with tuner or without tuner
Mar.08 th , 2022	1.1	Antenna fine tune
Mar.10 th , 2022	1.2	Compare FPCB with flat or uneven
Mar.15 th , 2022	1.3	Antenna fine tune
Mar.28 th , 2022	1.4	Antenna fine tune with QRCT tuner

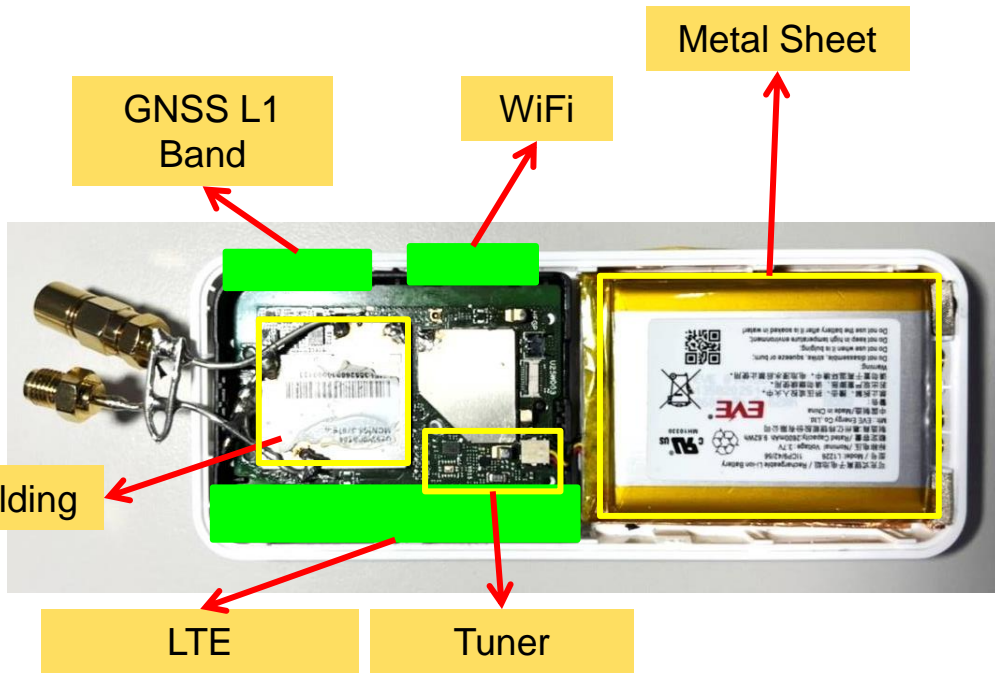
Revised History

Released Date	Version	Record
Mar.30 th , 2022	1.5	Antenna fine tune with shell
Apr.06 th , 2022	1.6	Antenna fine tune
Apr.22 th , 2022	1.7	Compare GND with two solution
Apr.25 th , 2022	1.8	Antenna fine tune
May.06 th , 2022	1.9	Compare GND with two solution
May.17 th , 2022	2.0	Antenna fine tune
Jun.06 th , 2022	2.1	Antenna fine tune
Jun.24 th , 2022	2.2	3516 vs. 5515
JuL.15 th , 2022	2.3	Antenna Matching
JuL.28 th , 2022	2.4	3516 GND with new spring
Aug.15 th , 2022	2.5	Antenna Fine Tune
Sep.06 th , 2022	2.6	GND with two solution
Sep.26 th , 2022	2.7	GND with two solution
Oct.26 th , 2022	2.8	GND with no GND

Contents

- **Product / Antenna Overview**
- **Matching Circuit**
- **Test Results**
 - VSWR
 - Isolation
 - 2D Radiation Pattern
 - 3D Radiation Pattern
 - Efficiency & Peak Gain
- **Conclusions**

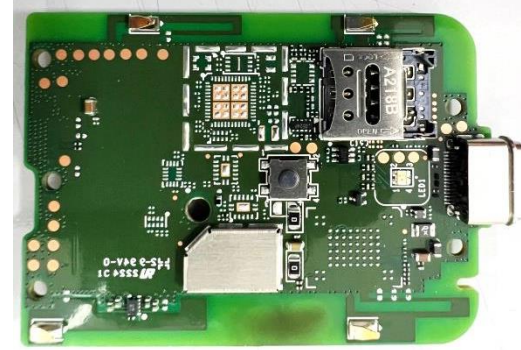
Product Overview



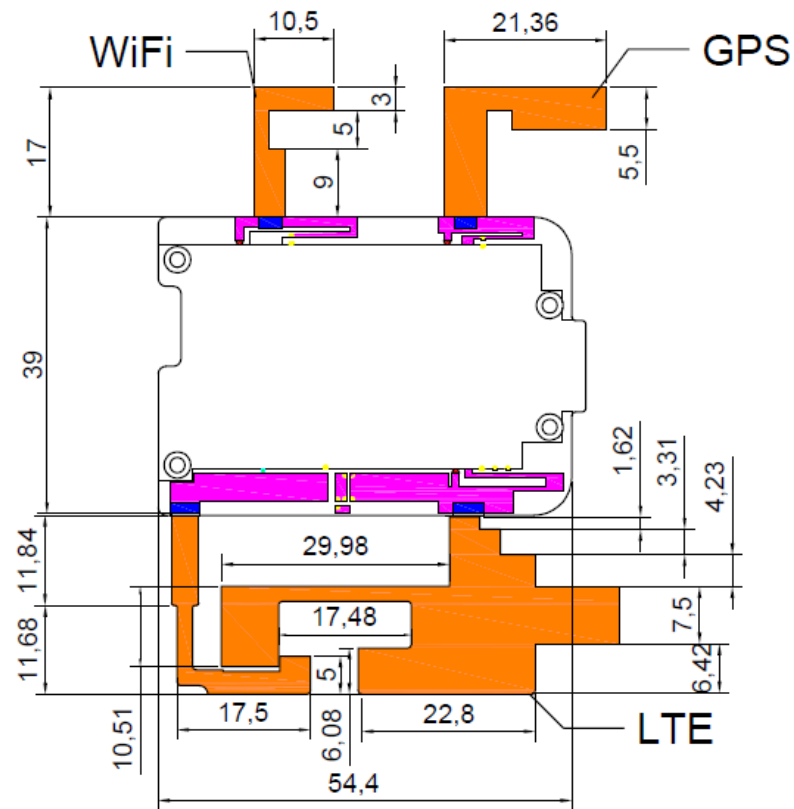
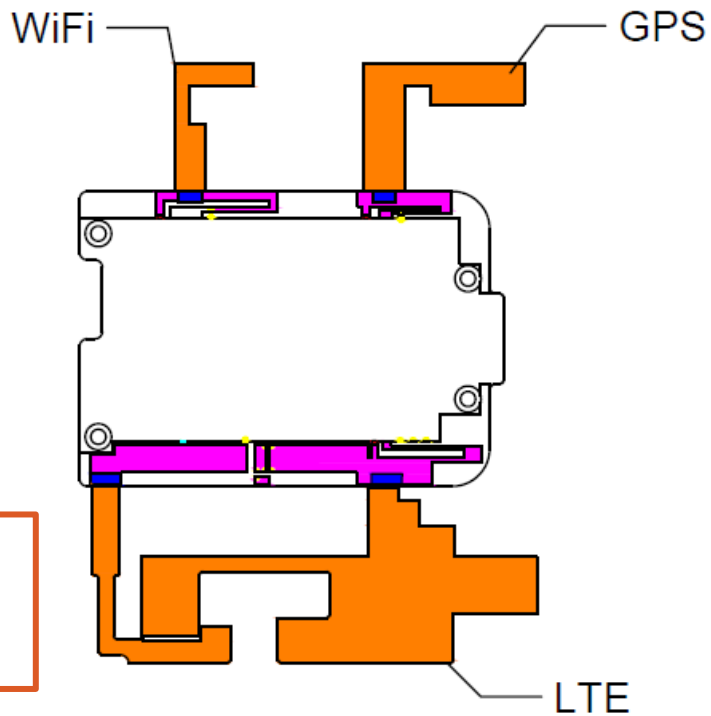
	Frequency	state
LTE_state1	700MHz-805MHz	0x0F
LTE_state2	790MHz-960MHz 1710MHz-2200MHz	0xF0

STATE	RF1	RF2	RF3	RF4
3516	5.6nH	5.6nH	5.6nH	5.6nH

Product Overview



Product Overview



Unit:mm

Feed
Spring
PCB Pattern
LTE Pattern

Product Overview

Front

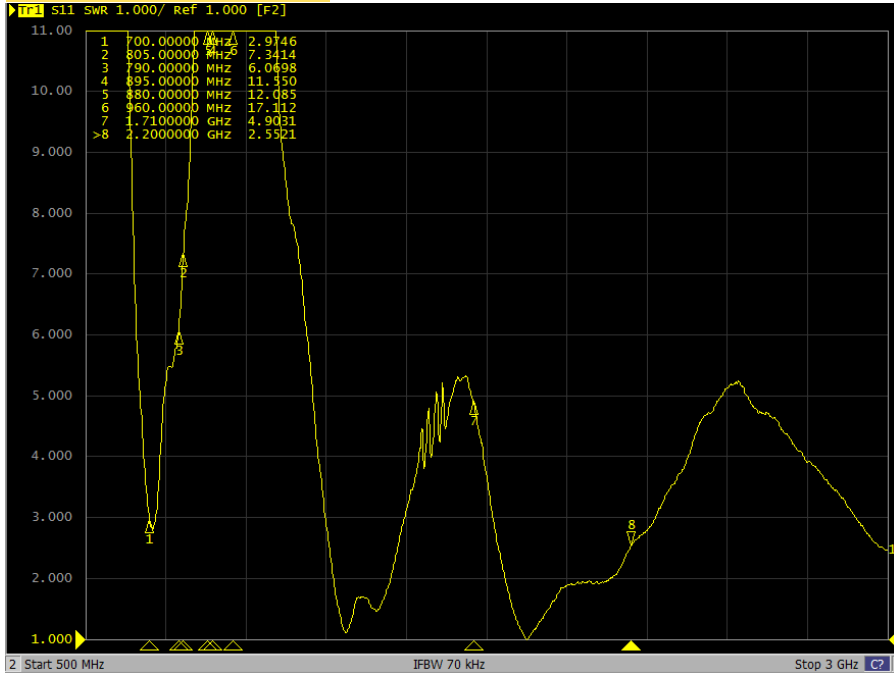


Back

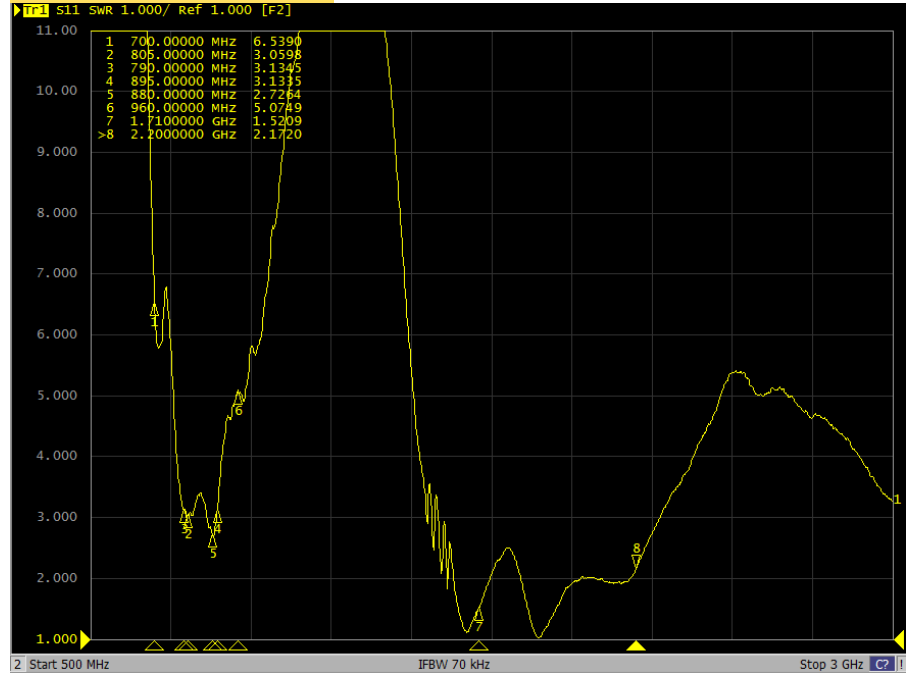


VSWR

LTE_state1

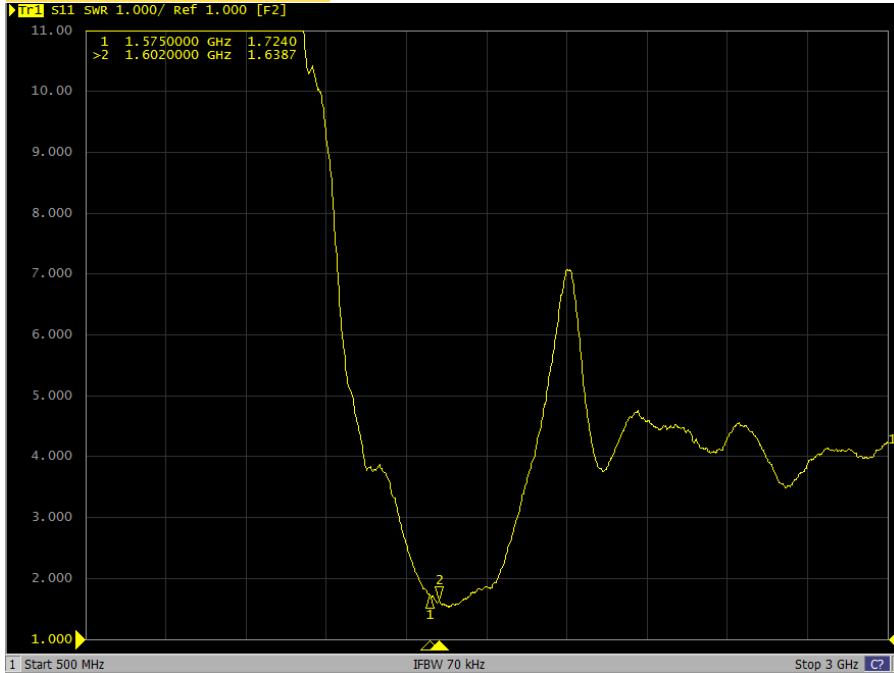


LTE_state2

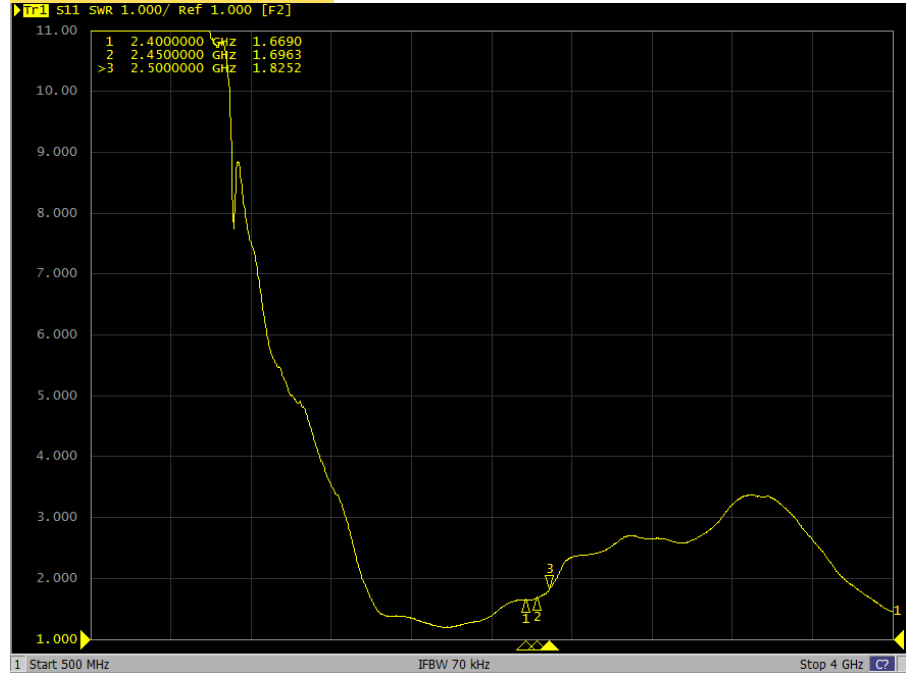


VSWR

GNSS

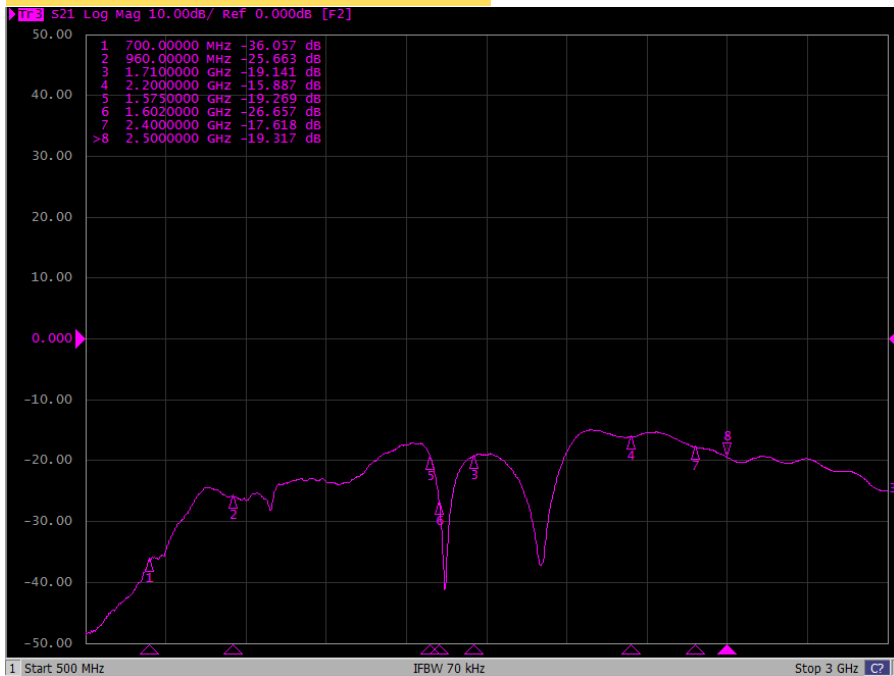


Wi-Fi

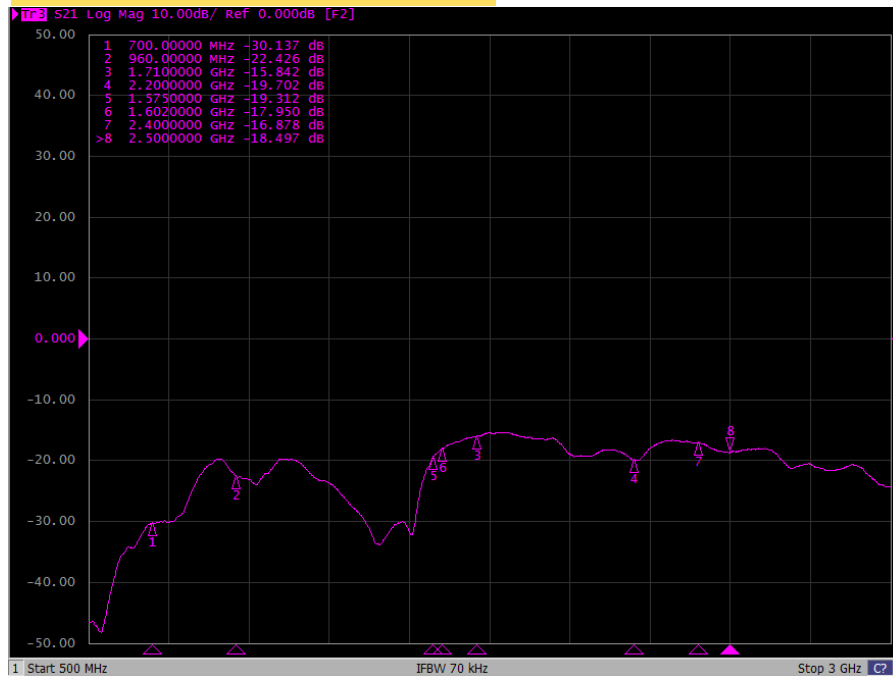


Isolation

LTE State1 _GNSS

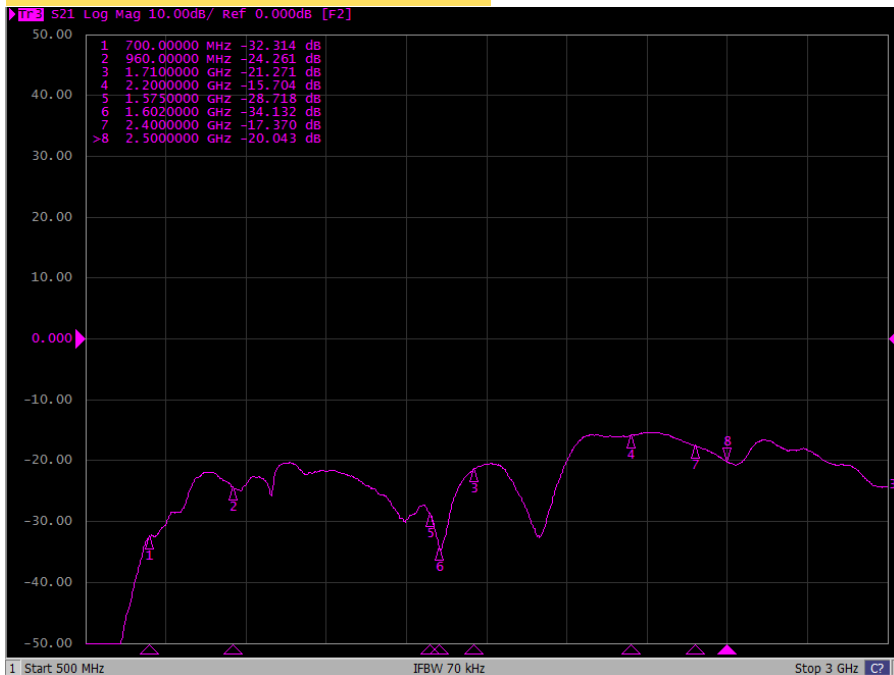


LTE State1 _WiFi

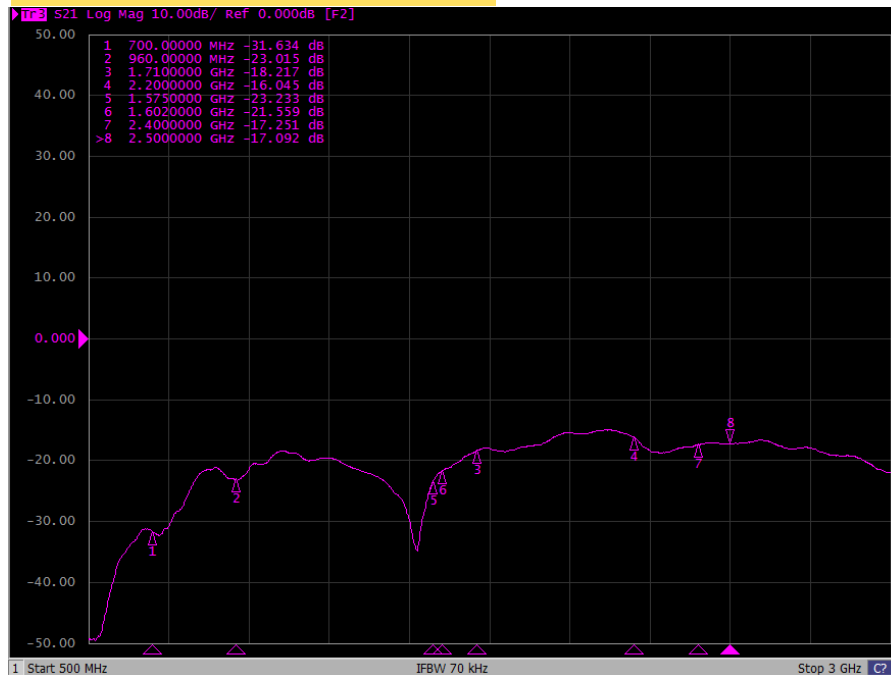


Isolation

LTE State2_GNSS

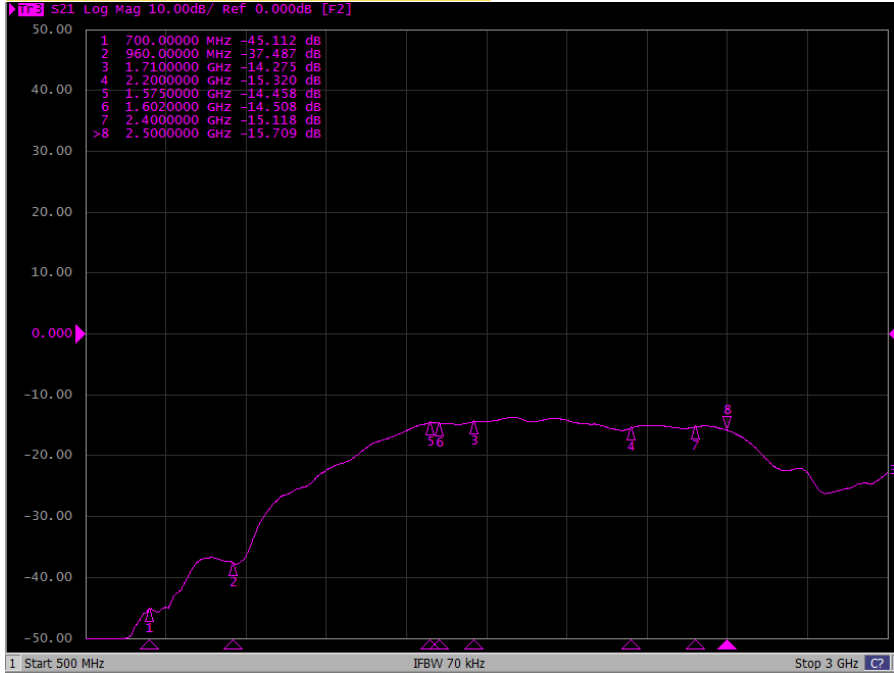


LTE State2_WiFi

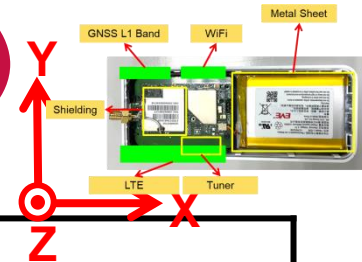


Isolation

WiFi_GNSS

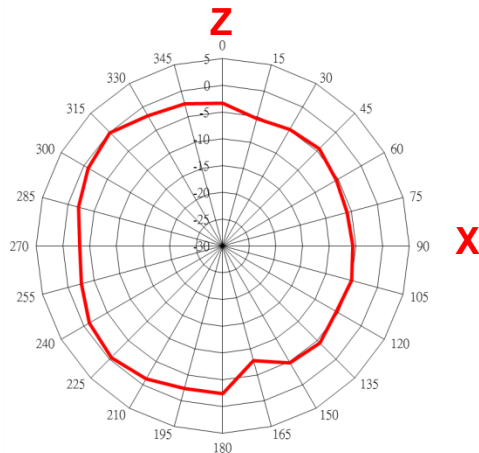


2D Radiation Pattern(GNSS L1 Band)

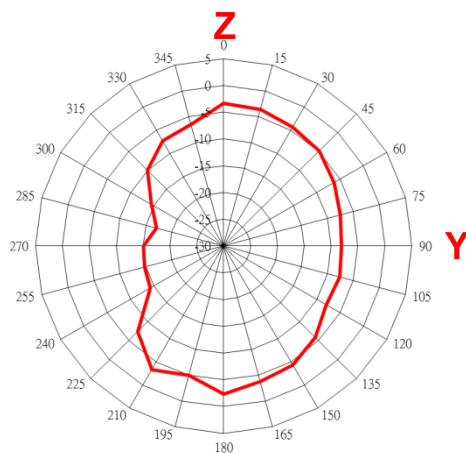


1575MHz

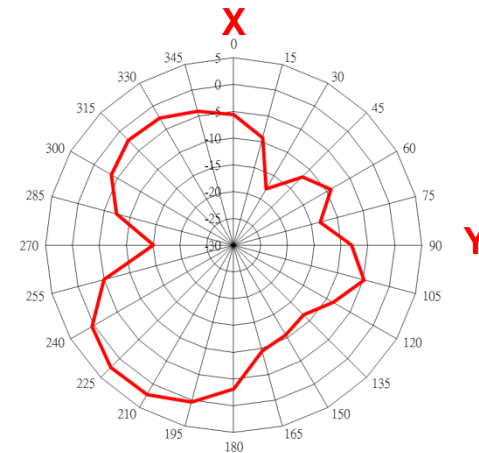
X-Z plane



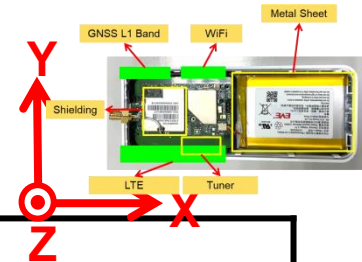
Y-Z plane



X-Y plane

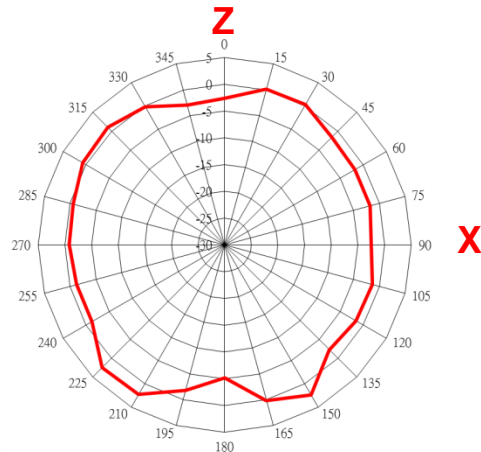


2D Radiation Pattern(WiFi)

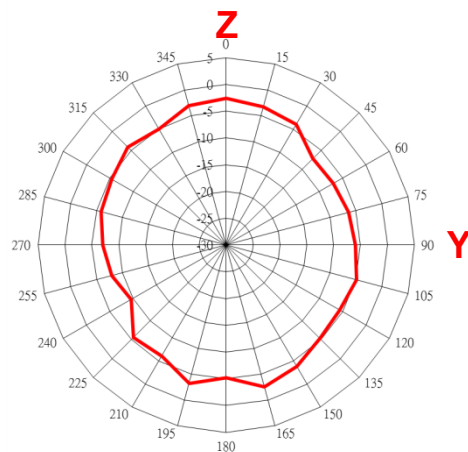


2450MHz

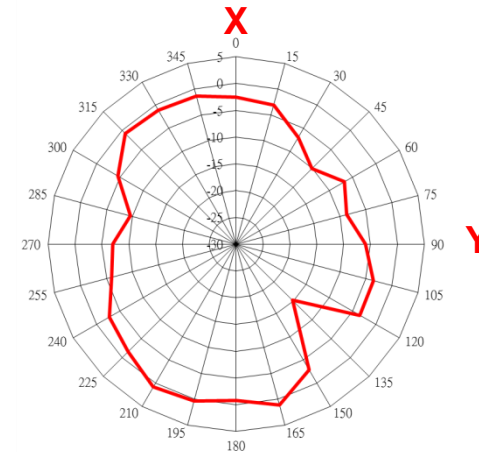
X-Z plane



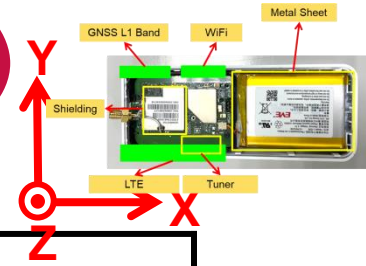
Y-Z plane



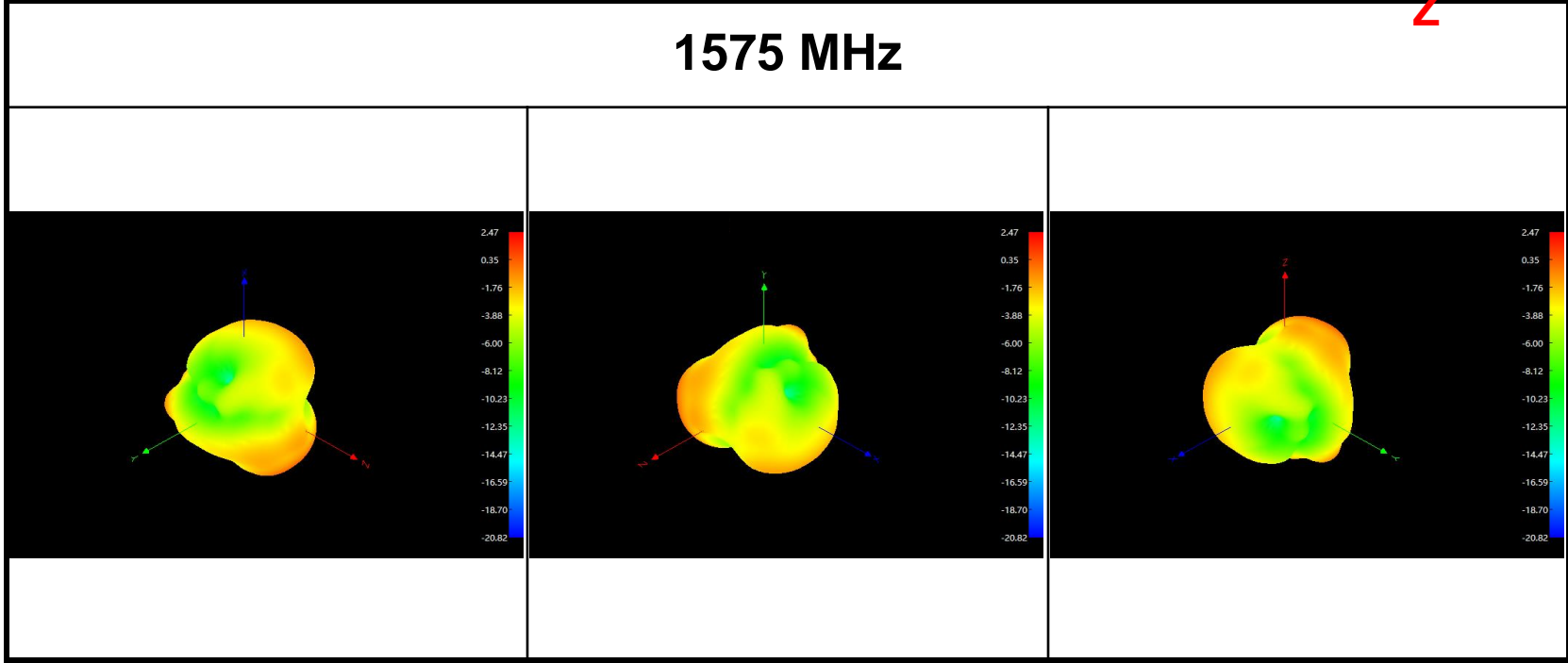
X-Y plane



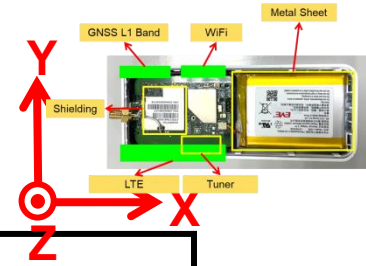
3D Radiation Pattern(GNSS L1 Band)



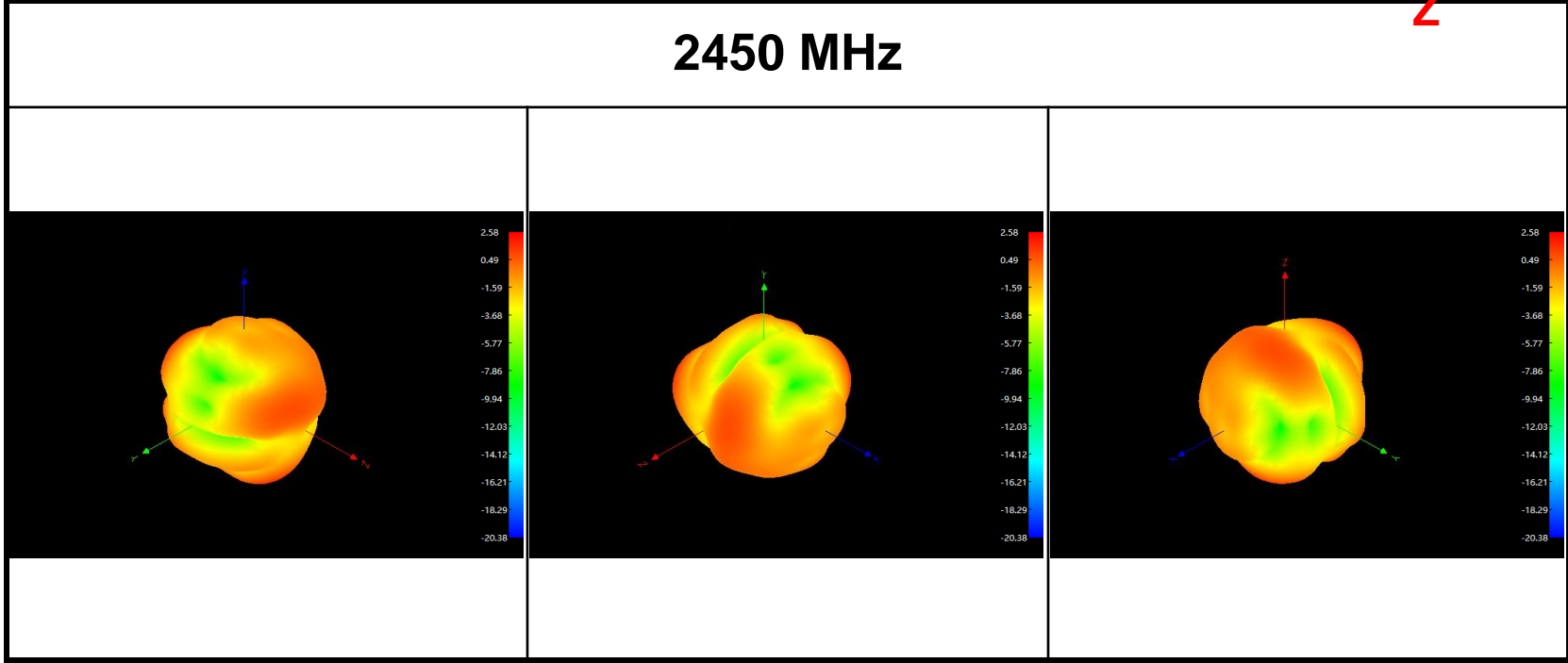
1575 MHz



3D Radiation Pattern(WiFi)



2450 MHz



Efficiency(No GND)

0x0F

LTE_state1			
Frequency (MHz)	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
700	0.10	-6.34	23.23
705	0.72	-6.29	23.50
710	1.28	-6.03	24.95
715	1.95	-5.66	27.16
720	1.18	-5.51	28.12
725	1.27	-5.07	31.12
730	1.78	-4.92	32.21
735	1.19	-4.76	33.42
740	2.14	-4.63	34.43
745	2.06	-4.09	38.99
750	1.94	-3.97	40.09
755	1.12	-3.85	41.21
760	1.19	-3.63	43.35
765	1.11	-3.56	44.06

LTE_state1			
Frequency (MHz)	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
770	1.73	-3.65	43.15
775	1.10	-3.78	41.88
780	1.22	-3.85	41.21
785	1.16	-3.93	40.46
790	0.91	-4.15	38.46
795	1.04	-4.39	36.39
800	1.43	-4.78	33.27
805	1.48	-5.16	30.48

Efficiency(No GND)

0xF0

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
790	2.36	-3.71	42.56
795	2.54	-3.68	42.85
800	3.11	-3.39	45.81
805	3.25	-3.23	47.53
810	3.34	-3.16	48.31
815	3.64	-3.03	49.77
820	3.39	-2.97	50.47
825	3.53	-2.86	51.76
830	3.08	-2.81	52.36
835	3.48	-2.76	52.97
840	3.43	-2.73	53.33
845	2.98	-2.64	54.45
850	3.07	-2.59	55.08
855	2.55	-2.71	53.58

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
860	3.19	-2.89	51.40
865	2.81	-3.17	48.19
870	3.23	-3.43	45.39
875	3.02	-3.58	43.85
880	2.87	-3.61	43.55
885	2.88	-3.63	43.35
890	2.61	-3.78	41.88
895	2.81	-3.88	40.93

Efficiency(No GND)

0xF0

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
880	2.87	-3.61	43.55
885	2.88	-3.63	43.35
890	2.61	-3.78	41.88
895	2.81	-3.88	40.93
900	2.31	-3.95	40.27
905	2.52	-3.99	39.90
910	2.24	-4.19	38.11
915	2.31	-4.32	36.98
920	2.03	-4.61	34.59
925	1.58	-4.71	33.81
930	1.51	-4.79	33.19
935	1.04	-4.83	32.89
940	1.07	-4.95	31.99
945	0.98	-5.02	31.48

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
950	1.17	-5.10	30.90
955	1.24	-5.16	30.48
960	1.46	-5.19	30.27

Efficiency(No GND)

0xF0

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
1710	3.05	-2.60	54.95
1730	2.69	-2.79	52.60
1750	2.47	-2.91	51.17
1770	2.06	-3.18	48.08
1790	1.64	-3.22	47.64
1810	1.07	-3.18	48.08
1830	1.93	-2.83	52.12
1850	2.37	-2.61	54.83
1870	2.65	-2.35	58.21
1890	2.36	-2.05	62.37
1910	1.53	-1.88	64.86
1930	2.19	-1.58	69.50
1950	2.53	-1.42	72.11
1970	3.07	-1.40	72.44

Frequency (MHz)	LTE_state2		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
1990	3.16	-1.46	71.45
2010	3.14	-2.11	61.52
2030	3.43	-2.14	61.09
2050	3.22	-2.35	58.21
2070	3.62	-2.48	56.49
2090	3.62	-2.57	55.34
2110	3.93	-2.66	54.20
2130	3.76	-2.74	53.21
2150	4.03	-2.77	52.84
2170	3.81	-2.87	51.64
2190	3.98	-2.92	51.05
2200	3.48	-3.00	50.12

Efficiency

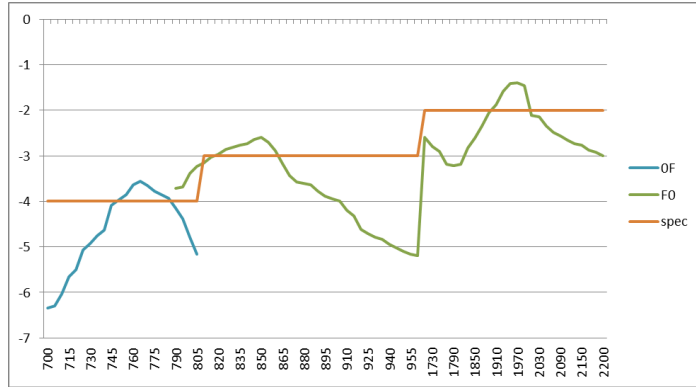
	GNSS L1 Band		
Frequency (MHz)	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
1565	2.34	-2.91	51.17
1570	2.42	-2.34	58.34
1575	2.47	-2.38	57.81
1580	2.55	-2.41	57.41
1585	2.64	-2.44	57.02
1597	2.76	-2.47	56.62
1602	2.83	-2.59	55.08
1605	2.88	-2.75	53.09

Efficiency

Frequency (MHz)	WiFi		
	Peak Gain(dBi)	Average Gain(dB)	Efficiency(%)
2400	1.64	-2.36	58.08
2410	1.77	-2.38	57.81
2420	1.85	-2.64	54.45
2430	2.13	-2.48	56.49
2440	2.37	-2.66	54.20
2450	2.58	-2.75	53.09
2460	2.63	-2.77	52.84
2470	2.69	-2.67	54.08
2480	2.75	-2.88	51.52
2490	2.79	-2.61	54.83
2500	2.81	-2.94	50.82

Conclusions

1. The LTE antenna Low Band performance show on the picture .



2. The efficiency of LTE antenna 1710-2200 without GND is about 50% to 72%.
3. The efficiency of WiFi antenna is about 50% to 58% .
4. The efficiency of GNSS L1 Band antenna is about 51% to 57%