



Quectel

IKOTEK / QDM549

Antenna Evaluation & Test & Debugging Report

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Date: 2024.02.02

Build a Smarter World

Revision History



Revision	Date	Reporter	Reviewer	Note
V1.0	2023-06-26	Austin Zhou		Antenna simulation report
V1.1	2023-08-14	Owen Deng		Antenna passive report
V1.2	2023-10-28	Owen Deng		Antenna active report
V1.3	2024-01-19	Owen Deng	Eleven Rong	Passive Debugging & OTA For Complete Device Testing
V1.4	2024-02-02	Owen Deng	Eleven Rong	OTA For Complete Device Testing
V1.5	2024-11-07	Owen Deng		Add 3D Radiation Pattern



Project Overview

Antenna Performance Evaluation and Debugging
Conclusion and Suggestion

Build a Smarter World



Project Overview



- Device Dimensions: 120 × 41.5 mm
- Mainboard Dimensions: 107.5 × 36 mm
- Antenna Quantity: 4
- Antenna OC: Y0IKO00ABAA/BA/CA/DA
- Network Standard and Frequency Band:
 - ✓ LTE: 698–960 MHz & 1710–2700 MHz
 - ✓ WIFI: 2.4G & 5G
 - ✓ BT: 2.4G
- Module Model: EG21-G
- Performance Requirements:
 - ✓ Efficiency: Based on actual debugging





Project Overview

Antenna Performance Evaluation and Debugging

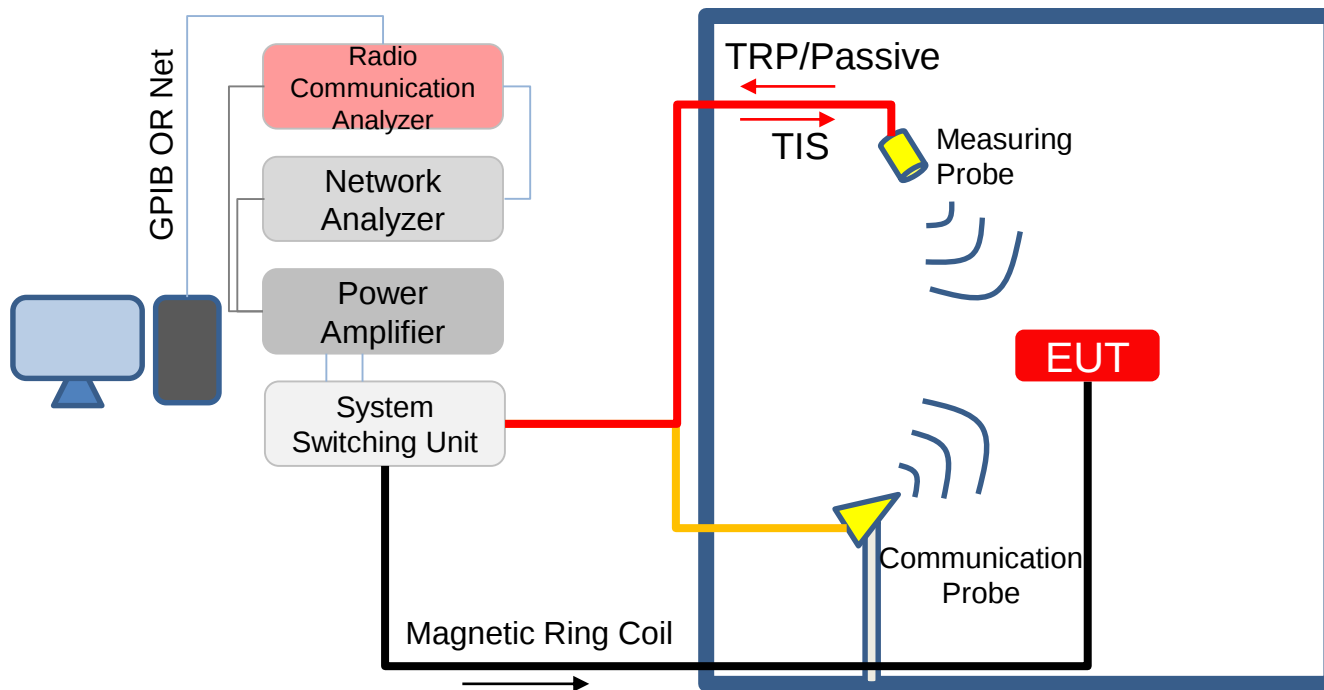
Conclusion and Suggestion

Build a Smarter World

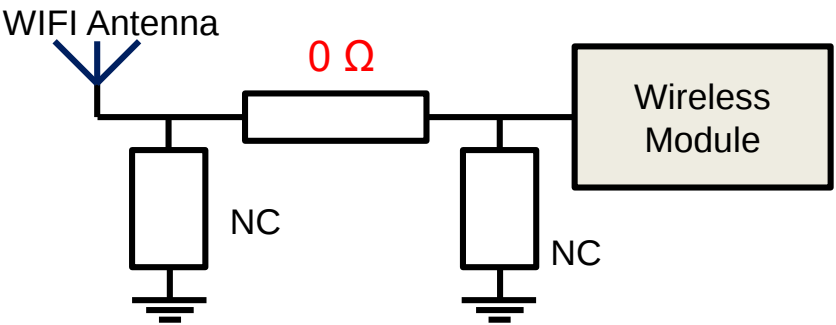
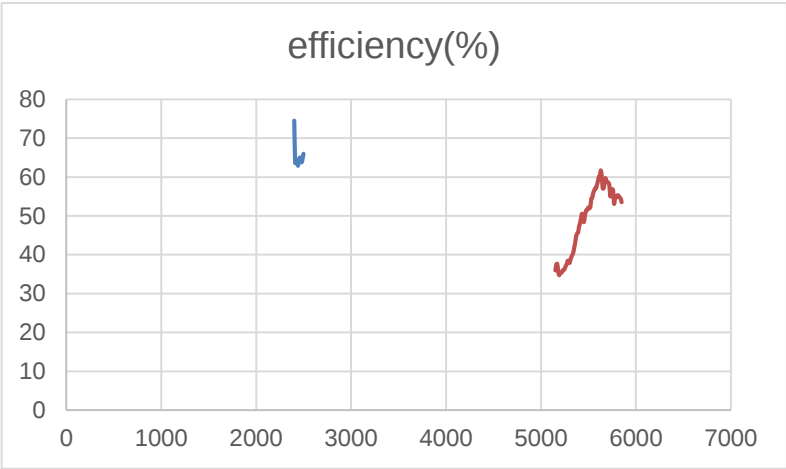


Antenna Test

- Chamber Coordinate System FS-S-1(SI2206)



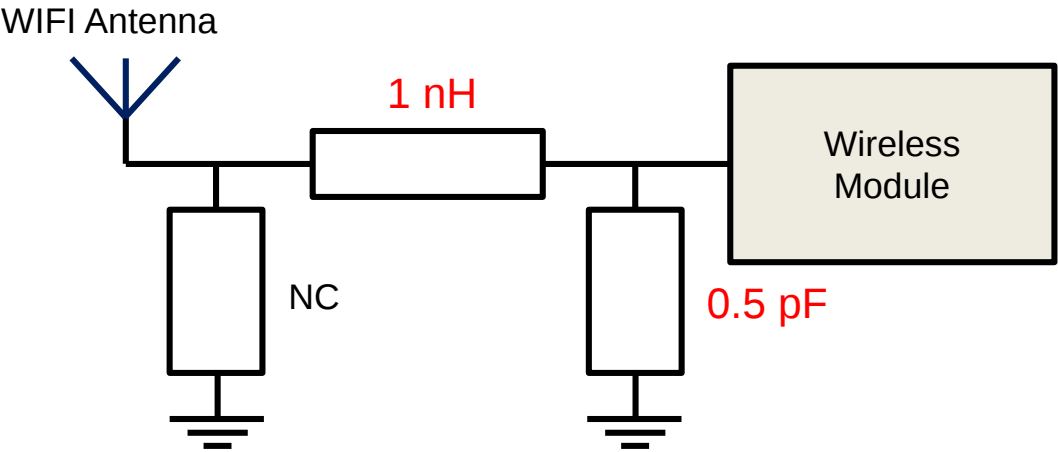
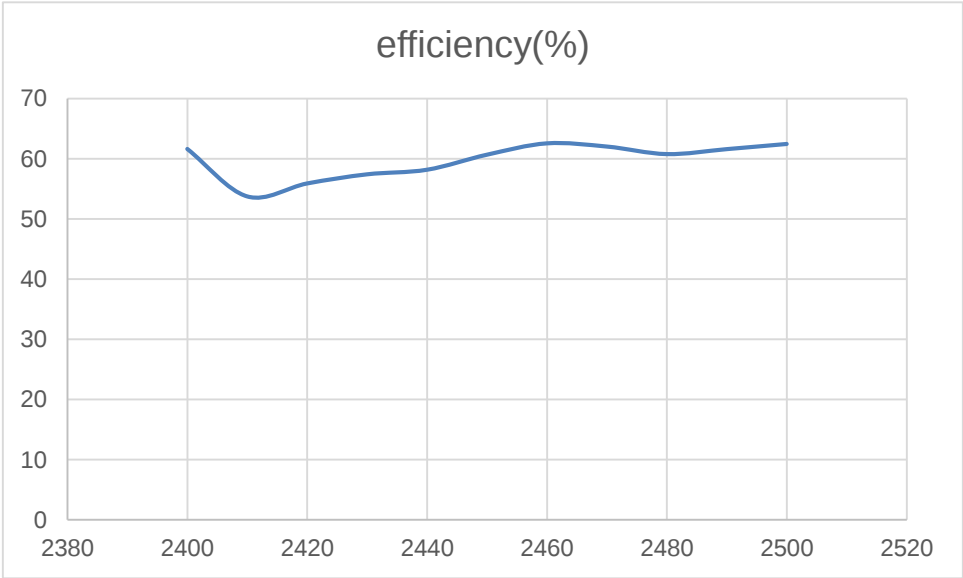
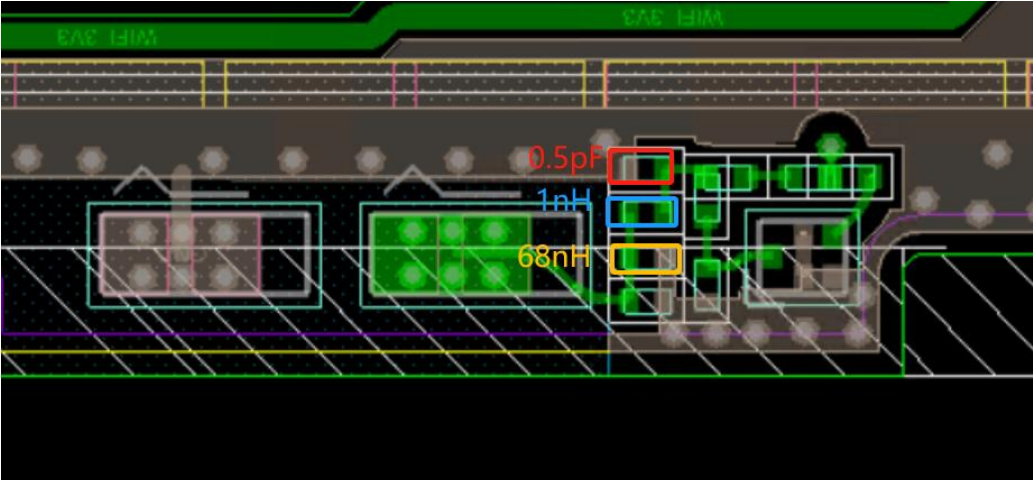
Passive Test-WIFI



freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
2400	1.96	-1.28	74.5
2410	0.58	-1.96	63.66
2420	0.57	-1.93	64.13
2430	0.52	-1.95	63.77
2440	0.64	-2.01	62.92
2450	0.84	-1.92	64.28
2460	0.93	-1.87	65.04
2470	1.03	-1.89	64.66
2480	0.81	-1.95	63.8
2490	0.99	-1.89	64.75
2500	1.25	-1.8	66
5150	-0.22	-4.44	35.95
5160	0.34	-4.27	37.45
5170	0.56	-4.25	37.62
5180	-0.23	-4.47	35.73
5190	-0.38	-4.6	34.7
5200	-0.06	-4.53	35.27
5210	0.1	-4.51	35.37
5220	0.21	-4.5	35.46
5230	0.22	-4.43	36.02
5240	0.35	-4.43	36.08
5250	0.41	-4.38	36.49
5260	0.63	-4.31	37.09
5270	0.82	-4.25	37.56
5280	1.16	-4.16	38.41
5290	1.02	-4.16	38.36
5300	0.9	-4.22	37.86
5310	1.06	-4.12	38.73
5320	1.29	-4.04	39.42
5330	1.38	-3.98	39.98
5340	1.48	-3.91	40.6
5350	1.63	-3.78	41.9
5360	1.79	-3.65	43.15
5370	1.95	-3.49	44.78
5380	2	-3.43	45.44
5390	2.02	-3.4	45.69
5400	2.1	-3.26	47.16
5410	2.21	-3.18	48.12
5420	2.47	-3.08	49.22
5430	2.59	-2.97	50.51

freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
5440	2.49	-2.98	50.32
5450	2.26	-3.15	48.38
5460	2.49	-3.04	49.63
5470	2.74	-2.93	50.93
5480	2.86	-2.88	51.56
5490	2.97	-2.88	51.58
5500	3.04	-2.82	52.21
5510	3.01	-2.84	51.97
5520	3.02	-2.81	52.34
5530	3.09	-2.64	54.43
5540	3.05	-2.62	54.69
5550	3.13	-2.53	55.89
5560	3.18	-2.48	56.48
5570	3.22	-2.43	57.08
5580	3.23	-2.43	57.1
5590	3.32	-2.36	58.05
5600	3.23	-2.3	58.92
5610	3.23	-2.21	60.12
5620	3.35	-2.2	60.22
5630	3.52	-2.09	61.74
5640	3.23	-2.19	60.35
5650	2.51	-2.43	57.11
5660	2.64	-2.44	57.04
5670	3.01	-2.33	58.51
5680	3.25	-2.24	59.75
5690	3.18	-2.29	59
5700	3.23	-2.31	58.69
5710	3.28	-2.32	58.57
5720	3.24	-2.36	58.04
5730	2.98	-2.59	55.11
5740	3.17	-2.53	55.85
5750	3.47	-2.45	56.92
5760	3.42	-2.47	56.65
5770	2.89	-2.75	53.14
5780	3.04	-2.64	54.43
5790	3.19	-2.62	54.67
5800	3.27	-2.59	55.11
5810	3.17	-2.57	55.35
5820	3.12	-2.59	55.1
5830	3.1	-2.62	54.75
5840	3.03	-2.64	54.48
5850	2.79	-2.71	53.53

Passive Test-BT



freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
2400	3.16	-2.1	61.64
2410	2.41	-2.69	53.78
2420	2.41	-2.52	55.93
2430	2.36	-2.41	57.44
2440	2.26	-2.35	58.2
2450	2.36	-2.17	60.69
2460	2.29	-2.04	62.57
2470	2.16	-2.07	62.04
2480	1.85	-2.16	60.79
2490	1.83	-2.1	61.61
2500	1.95	-2.04	62.47

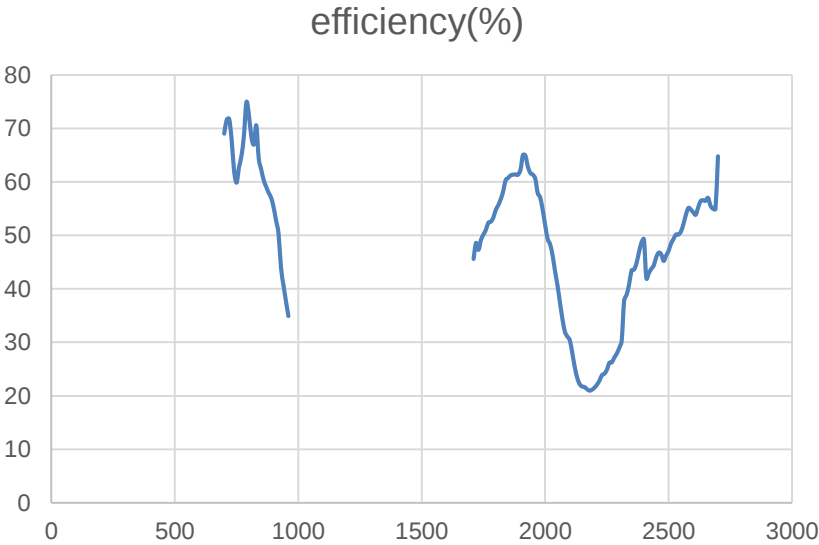
Passive Test-LTE-Main



freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
700	1.45	-1.61	69.01
710	1.87	-1.45	71.59
720	1.86	-1.44	71.79
730	1.82	-1.68	67.95
740	1.94	-2.07	62.08
750	1.72	-2.23	59.84
760	2.07	-2.02	62.74
770	2.36	-1.88	64.84
780	2.48	-1.63	68.71
790	3.2	-1.26	74.89
800	3.1	-1.4	72.51
810	2.8	-1.65	68.42
820	2.61	-1.74	66.98
830	2.78	-1.51	70.55
840	2.24	-1.92	64.32
850	2.14	-2.06	62.3
860	1.98	-2.2	60.31
870	1.73	-2.28	59.09
880	1.53	-2.37	57.94
890	1.58	-2.44	57.04
900	1.5	-2.58	55.26
910	1.37	-2.77	52.8
920	1.17	-2.98	50.36
930	-0.69	-3.57	43.99
940	-0.83	-3.9	40.7
950	-1.05	-4.23	37.72
960	-1.21	-4.57	34.9

freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
1710	2.08	-3.41	45.58
1720	2.73	-3.14	48.56
1730	2.11	-3.25	47.27
1740	2.44	-3.09	49.14
1750	2.79	-3	50.13
1760	3.05	-2.92	51.02
1770	3.22	-2.81	52.35
1780	3.34	-2.8	52.54
1790	3.46	-2.73	53.29
1800	3.57	-2.62	54.76
1810	3.64	-2.55	55.61
1820	3.67	-2.46	56.74
1830	3.82	-2.35	58.21
1840	4.15	-2.2	60.32
1850	4.11	-2.17	60.72
1860	4.04	-2.13	61.2
1870	4.07	-2.12	61.34
1880	4.11	-2.12	61.38
1890	4.03	-2.12	61.33
1900	4.09	-2.06	62.21
1910	4.21	-1.87	65
1920	4.19	-1.88	64.91
1930	3.88	-2.02	62.86
1940	3.89	-2.1	61.66
1950	4.03	-2.12	61.35
1960	3.99	-2.17	60.61
1970	3.89	-2.37	57.88
1980	3.96	-2.43	57.09
1990	3.91	-2.62	54.76
2000	3.75	-2.84	51.97
2010	3.51	-3.07	49.35
2020	3.5	-3.16	48.32
2030	3.37	-3.34	46.31
2040	3.09	-3.64	43.3
2050	2.78	-3.91	40.66
2060	2.22	-4.27	37.42
2070	1.63	-4.64	34.38
2080	1.14	-4.95	31.96
2090	0.69	-5.08	31.07
2100	0.15	-5.18	30.37
2110	-0.14	-5.53	27.96
2120	-0.46	-5.96	25.35
2130	-0.96	-6.32	23.32
2140	-1.19	-6.55	22.15
2150	-1.14	-6.63	21.72
2160	-1.19	-6.66	21.6
2170	-1.5	-6.74	21.2

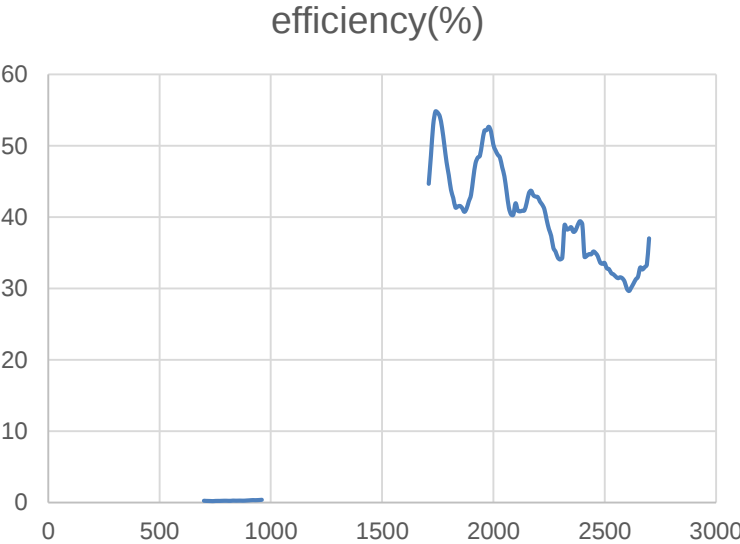
freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
2500	1.29	-3.27	47.09
2510	1.39	-3.15	48.45
2520	1.43	-3.07	49.32
2530	1.52	-3	50.14
2540	1.67	-3	50.14
2550	1.87	-2.95	50.7
2560	1.99	-2.83	52.06
2570	2.17	-2.69	53.82
2580	2.39	-2.59	55.11
2590	2.38	-2.61	54.82
2600	2.24	-2.65	54.29
2610	2.03	-2.69	53.85
2620	2.17	-2.58	55.23
2630	2.18	-2.49	56.41
2640	2.07	-2.48	56.56
2650	2.02	-2.48	56.44
2660	2.16	-2.44	57.01
2670	2.09	-2.56	55.52
2680	2.06	-2.6	54.96
2690	2.14	-2.6	54.91
2700	3.49	-1.89	64.77



Passive Test-LTE-DIV



freq(MHz)	Gain(dBi)	effi(dB)	effi(%)
700	-22.21	-25.87	0.26
710	-22.72	-26.19	0.24
720	-23.1	-26.39	0.23
730	-23.69	-26.65	0.22
740	-23.8	-26.8	0.21
750	-23.27	-26.46	0.23
760	-22.74	-26.13	0.24
770	-22.86	-26.14	0.24
780	-22.95	-26	0.25
790	-22.67	-25.83	0.26
800	-22.8	-25.89	0.26
810	-23.12	-26.06	0.25
820	-23.07	-26.01	0.25
830	-22.57	-25.58	0.28
840	-22.71	-25.71	0.27
850	-22.48	-25.63	0.27
860	-22.23	-25.56	0.28
870	-22.47	-25.71	0.27
880	-22.63	-25.71	0.27
890	-22.29	-25.42	0.29
900	-22.05	-25.12	0.31
910	-21.66	-24.84	0.33
920	-21.25	-24.58	0.35
930	-21.96	-24.66	0.34
940	-21.63	-24.53	0.35
950	-21.43	-24.33	0.37
960	-21.23	-24.12	0.39
1710	1.31	-3.5	44.66
1720	1.8	-3.13	48.66
1730	2.35	-2.77	52.88
1740	2.5	-2.61	54.78
1750	2.53	-2.63	54.63
1760	2.78	-2.67	54.06
1770	2.86	-2.8	52.47
1780	2.68	-3	50.11
1790	2.52	-3.21	47.7
1800	2.3	-3.38	45.87
1810	2.12	-3.58	43.81
1820	1.86	-3.7	42.68
1830	1.36	-3.84	41.34
1840	1.46	-3.82	41.47
1850	1.52	-3.81	41.56
1860	1.03	-3.84	41.27
1870	0.72	-3.9	40.73
1880	0.63	-3.85	41.18
1890	0.65	-3.75	42.2
1900	0.64	-3.66	43.1
1910	0.64	-3.43	45.44
1920	1.01	-3.23	47.51
1930	1.17	-3.16	48.32
1940	1.08	-3.13	48.6
1950	1.25	-2.98	50.39
1960	1.61	-2.83	52.1
1970	1.85	-2.83	52.17
1980	1.98	-2.79	52.65
1990	2.11	-2.84	51.95
2000	2.28	-3	50.16
2010	2.33	-3.07	49.35
2020	2.25	-3.12	48.74
2030	2.34	-3.16	48.33
2040	2.48	-3.28	46.97
2050	2.42	-3.4	45.71
2060	2.18	-3.62	43.5
2070	1.88	-3.84	41.33
2080	1.74	-3.94	40.37
2090	1.67	-3.94	40.32
2100	1.43	-3.77	41.93
2110	1.19	-3.88	40.92
2120	1.33	-3.89	40.8
2130	1.23	-3.88	40.89
2140	1.11	-3.88	40.94
2150	1.36	-3.77	41.99
2160	1.67	-3.63	43.34
2170	1.84	-3.6	43.7
2500	0.66	-4.74	33.57
2510	0.64	-4.84	32.83
2520	0.62	-4.85	32.7
2530	0.39	-4.93	32.15
2540	0.5	-4.95	31.97
2550	0.59	-4.99	31.67
2560	0.26	-5.03	31.44
2570	-0.02	-5.01	31.56
2580	0.16	-5.03	31.42
2590	0.17	-5.09	30.96
2600	-0.08	-5.23	29.99
2610	-0.16	-5.28	29.64
2620	0.05	-5.21	30.12
2630	0	-5.13	30.68
2640	-0.02	-5.05	31.26
2650	0.02	-5	31.63
2660	0.39	-4.82	32.92
2670	0.43	-4.86	32.65
2680	0.41	-4.82	32.98
2690	0.4	-4.77	33.34
2700	0.79	-4.32	37.02



Active Test-LTE

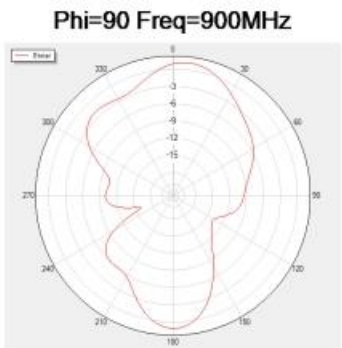
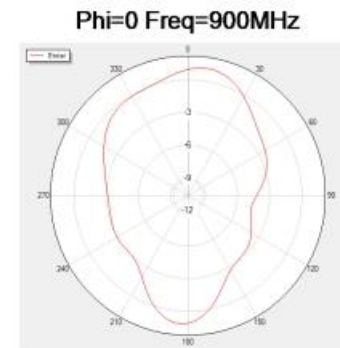
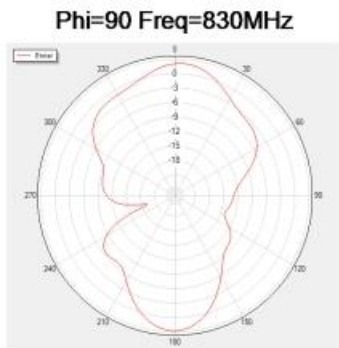
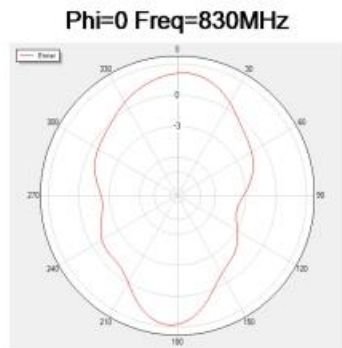
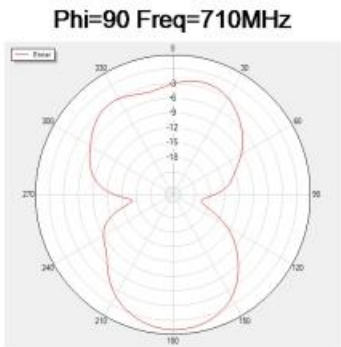
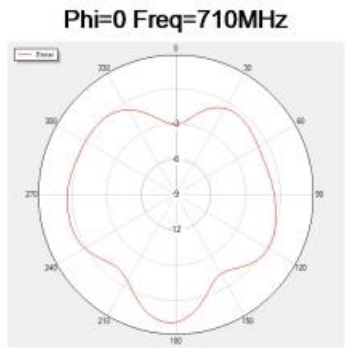
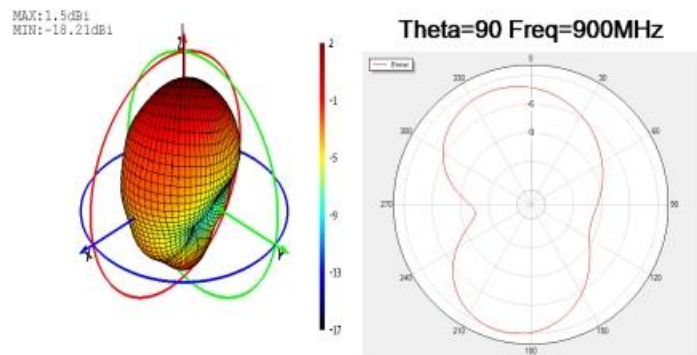
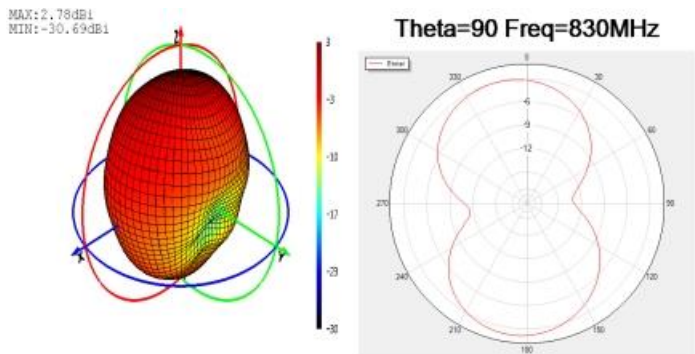
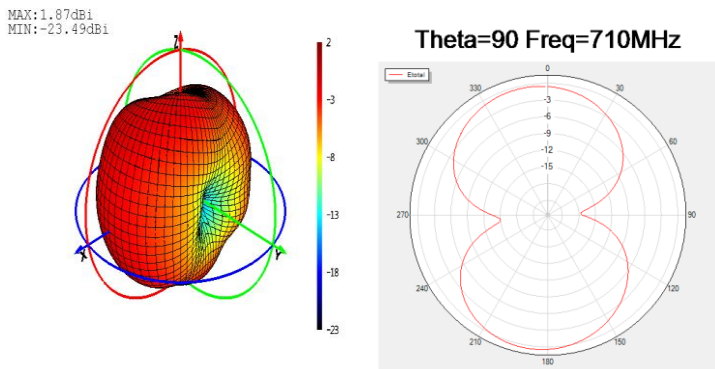


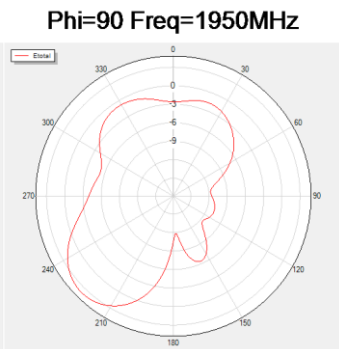
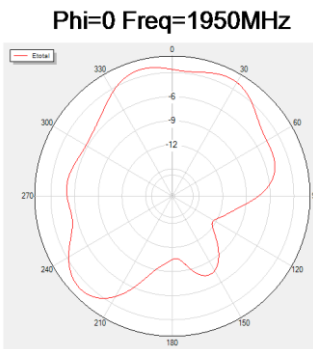
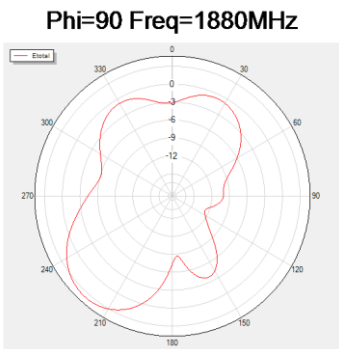
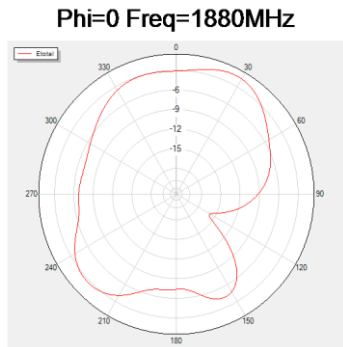
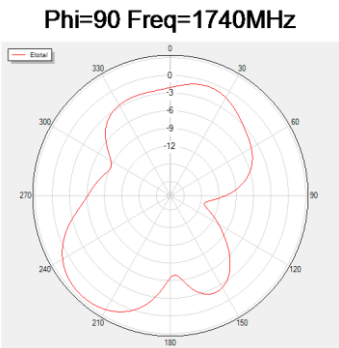
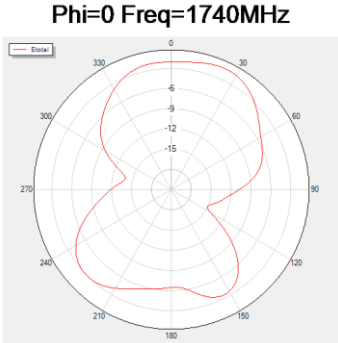
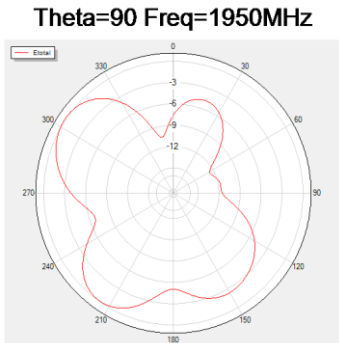
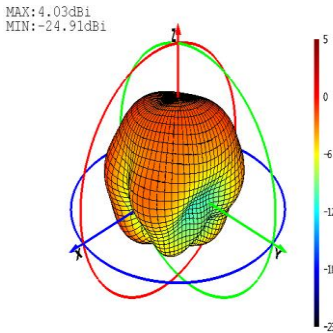
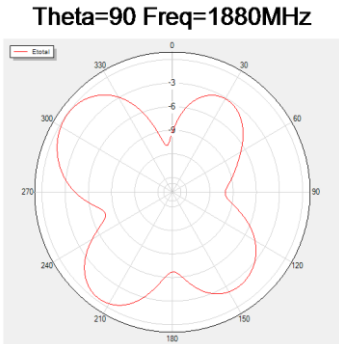
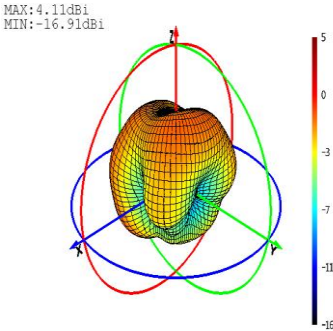
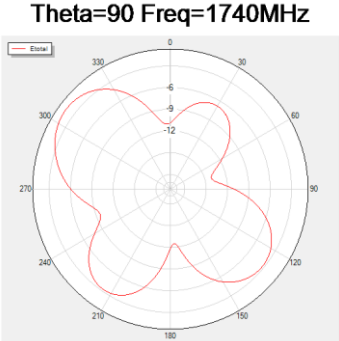
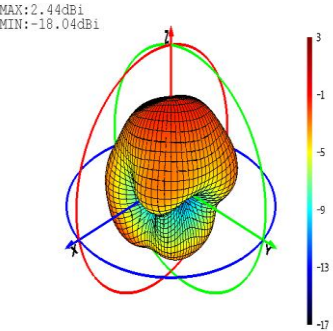
- OTA Data

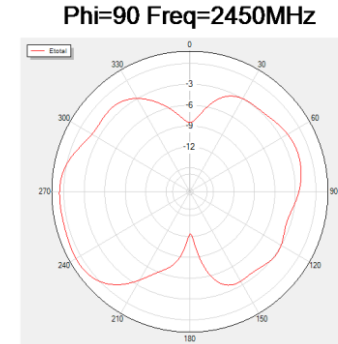
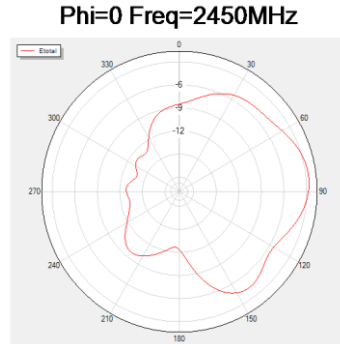
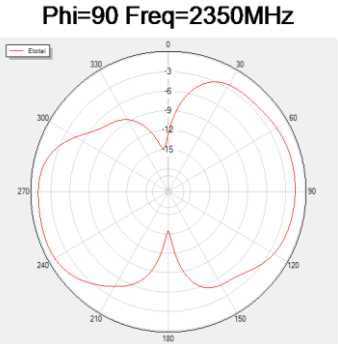
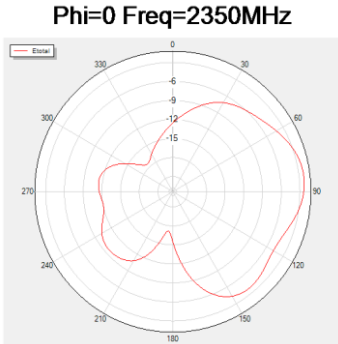
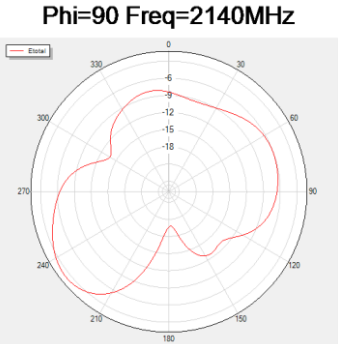
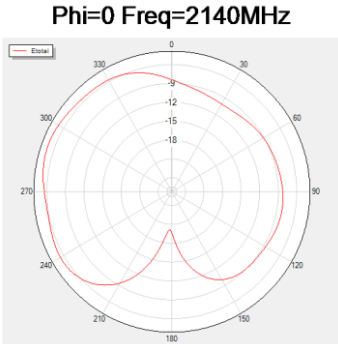
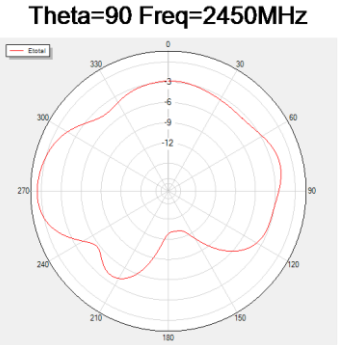
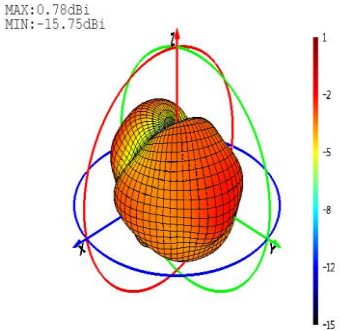
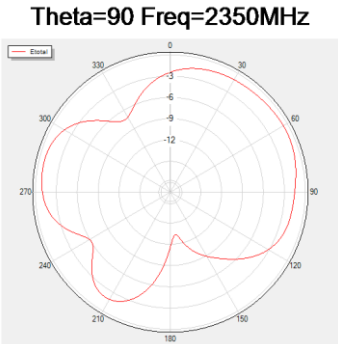
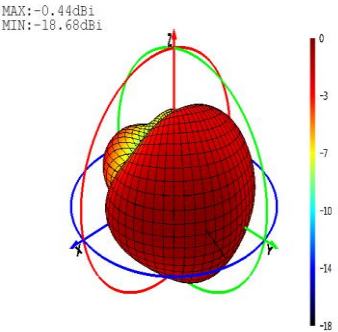
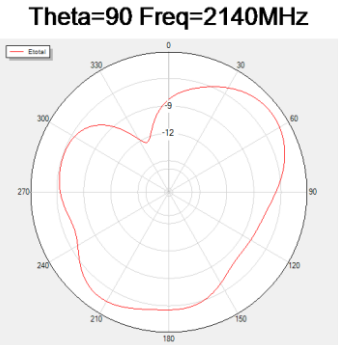
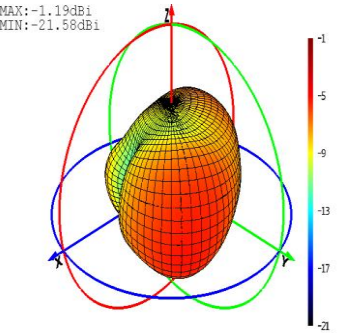
LTE														
Band	Channel	Frequency	TRP	Channel	Frequency	TIS		Band	Channel	Frequency	TRP	Channel	Frequency	TIS
FDD_B1	18050	1925	19.27	50	2115	-97		FDD_B18	23900	820	24.53	5900	865	-96.46
FDD_B1	18300	1950	19.45	300	2140	-97.9		FDD_B18	23925	822.5	24.5	5925	867.5	-95.61
FDD_B1	18550	1975	19.3	550	2165	-96.19		FDD_B18	23950	825	24.51	5950	870	-95.67
FDD_B2	18650	1855	19.4	650	1935	-94.57		FDD_B19	24050	835	24.36	6050	880	-95.64
FDD_B2	18900	1880	19.45	900	1960	-96.14		FDD_B19	24075	837.5	24.46	6075	882.5	-95.59
FDD_B2	19150	1905	18.65	1150	1985	-95.86		FDD_B19	24100	840	24.33	6100	885	-96.17
FDD_B3	19250	1715	19.37	1250	1810	-94.23		FDD_B20	24200	837	22.33	6200	796	-96.59
FDD_B3	19575	1747.5	19.88	1575	1842.5	-94.98		FDD_B20	24300	847	22.54	6300	806	-94.91
FDD_B3	19900	1780	19.66	1900	1875	-94.13		FDD_B20	24400	857	21.99	6400	816	-95.67
FDD_B4	20000	1715	18.9	2000	2115	-96.54		FDD_B26	26740	819	24.73	8740	864	-96.17
FDD_B4	20175	1732.5	19.71	2175	2132.5	-97.45		FDD_B26	26865	831.5	24.45	8865	876.5	-96.91
FDD_B4	20350	1750	19.75	2350	2150	-96.86		FDD_B26	26990	844	24.34	8990	889	-94.92
FDD_B5	20450	829	22.84	2450	874	-95.76		FDD_B28	27260	708	20.94	9260	763	-93.75
FDD_B5	20525	836.5	22.63	2525	881.5	-95.82		FDD_B28	27435	725.5	21.49	9435	780.5	-94.73
FDD_B5	20600	844	22.8	2600	889	-95.38		FDD_B28	27610	743	22.43	9610	798	-94.32
FDD_B7	20800	2505	21.84	2800	2625	-94.6		TDD_B38	37850	2580	21.46	37800	2575	-95.78
FDD_B7	21100	2535	22.09	3100	2655	-93.47		TDD_B38	38000	2595	21.28	38000	2595	-95.67
FDD_B7	21400	2565	20.85	3400	2685	-92.66		TDD_B38	38150	2610	21.33	38200	2615	-95.18
FDD_B8	21500	885	21.58	3500	930	-94.73		TDD_B39	38350	1890	20.08	38300	1885	-94.22
FDD_B8	21625	897.5	21.18	3625	942.5	-94.65		TDD_B39	38450	1900	19.55	38450	1900	-94.98
FDD_B8	21750	910	20.62	3750	955	-93.89		TDD_B39	38550	1910	20.12	38600	1915	-94.84
FDD_B12	23060	704	21.2	5060	734	-96.86		TDD_B40	38750	2310	19.95	38700	2305	-93.63
FDD_B12	23095	707.5	22.22	5095	737.5	-93.41		TDD_B40	39150	2350	21.44	39150	2350	-97.12
FDD_B12	23130	711	22.17	5130	741	-93.43		TDD_B40	39550	2390	20.9	39600	2395	-97.44
FDD_B13	23230	782	23.25	5230	751	-92.79		TDD_B41	39750	2506	21.18	39700	2501	-95.43
								TDD_B41	40620	2593	20.81	40620	2593	-94.44
								TDD_B41	41490	2680	20.29	41540	2685	-94.21

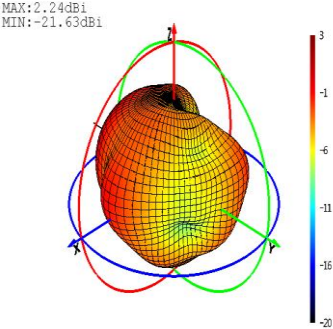
- OTA Data

WIFI				
Standard	Band	Channel	Frequency	Total
WIFI_A	A_6M	36	5180	16.78
WIFI_A	A_54M	36	5180	-71.82
WIFI_A	A_6M	149	5745	17.72
WIFI_A	A_54M	149	5745	-72.9
WIFI_A	A_6M	165	5825	16.86
WIFI_A	A_54M	165	5825	-73.08
WIFI_B	B_11M	1	2412	16.17
WIFI_B	B_11M	1	2412	-84.53
WIFI_B	B_11M	6	2437	16.14
WIFI_B	B_11M	6	2437	-85.27
WIFI_B	B_11M	11	2462	16.86
WIFI_B	B_11M	11	2462	-85.23
WIFI_G	G_6M	1	2412	16.44
WIFI_G	G_54M	1	2412	-69
WIFI_G	G_6M	6	2437	16.67
WIFI_G	G_54M	6	2437	-70.09
WIFI_G	G_6M	11	2462	16.57
WIFI_G	G_54M	11	2462	-72.08
WIFI_N	N_MCS0	1	2412	16.97
WIFI_N	N_MCS7	1	2412	-65.93
WIFI_N	N_MCS0	6	2437	16.57
WIFI_N	N_MCS7	6	2437	-68.03
WIFI_N	N_MCS0	11	2462	17.41
WIFI_N	N_MCS7	11	2462	-68.41

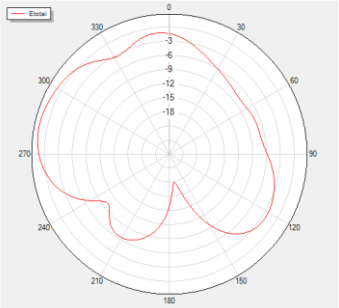




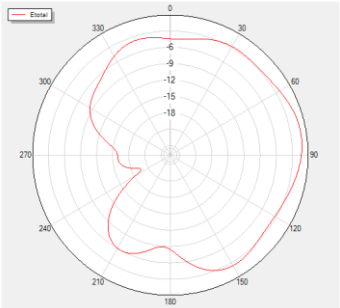




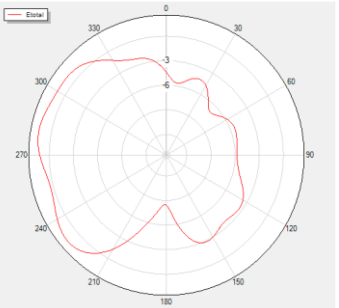
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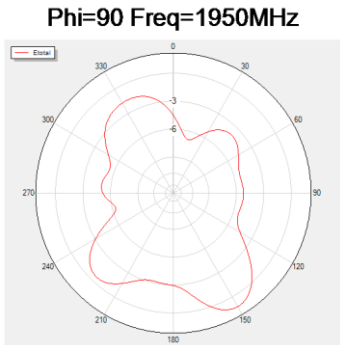
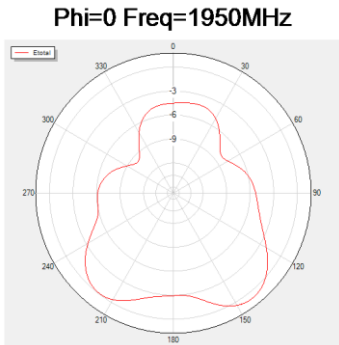
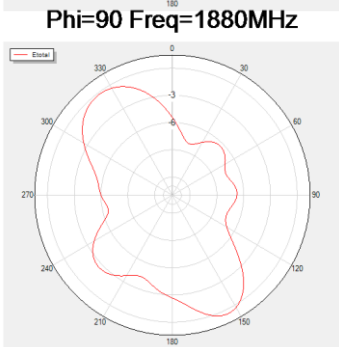
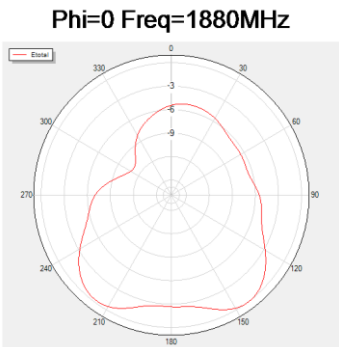
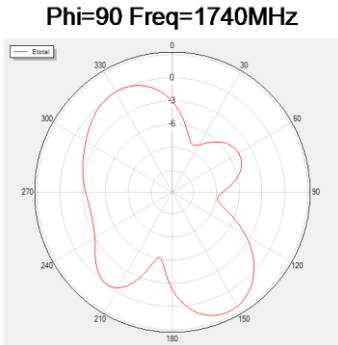
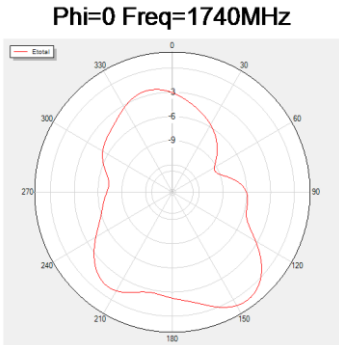
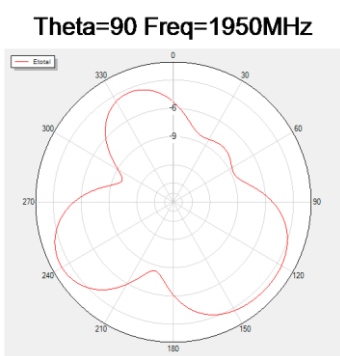
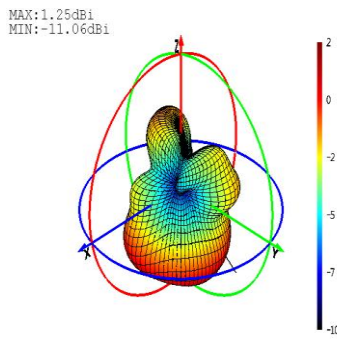
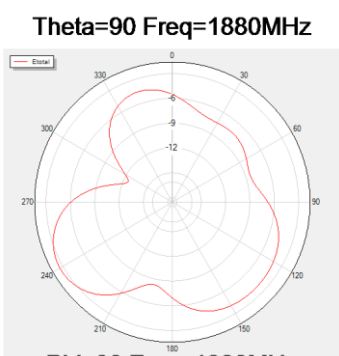
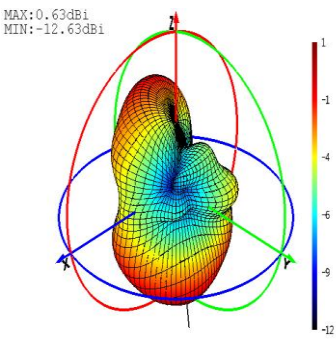
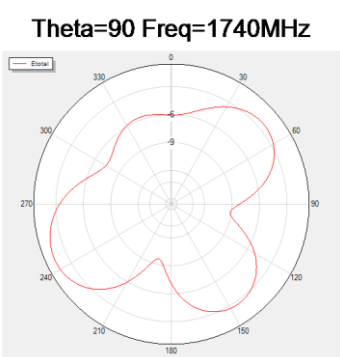
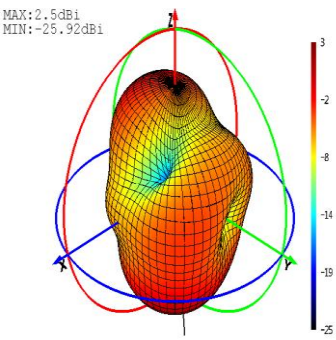


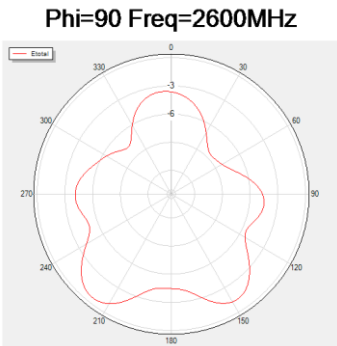
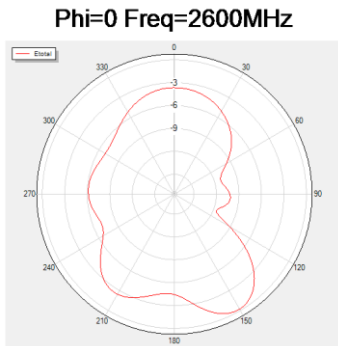
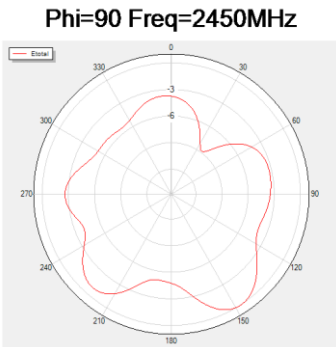
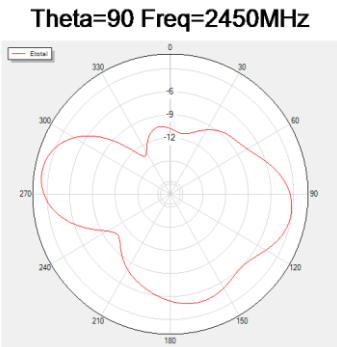
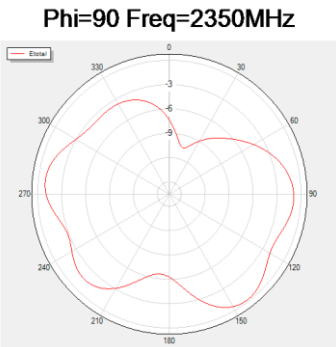
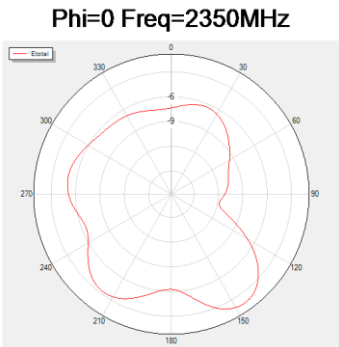
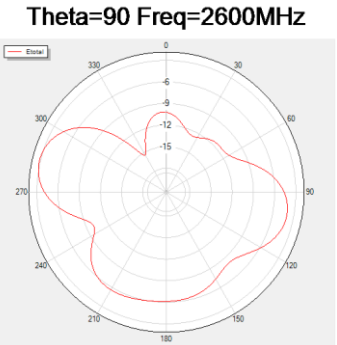
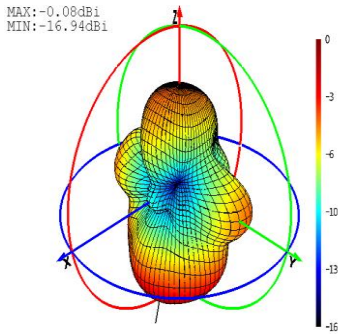
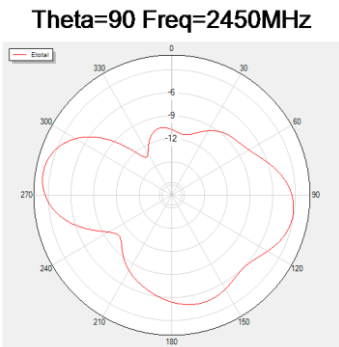
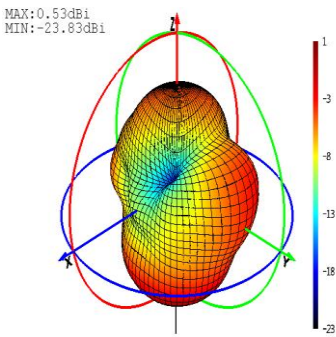
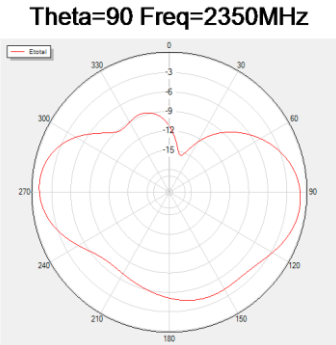
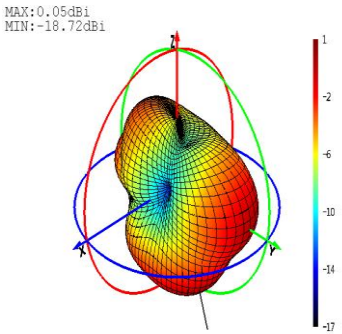
Phi=0 Freq=2600MHz



Phi=90 Freq=2600MHz



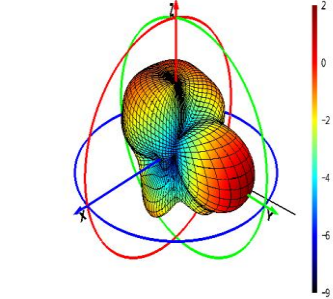




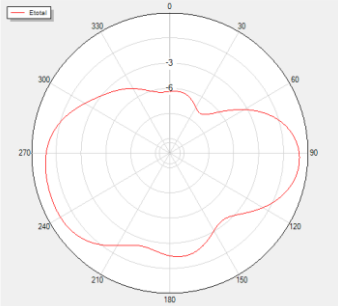
3D-Y0IKO00ABCA



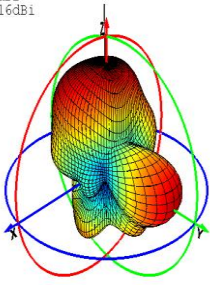
MAX:1.96dBi
MIN:-9.24dBi



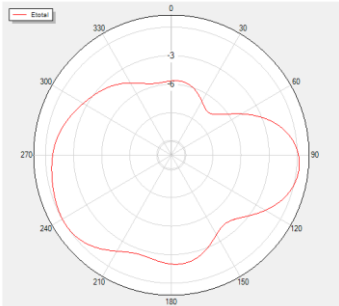
Theta=90 Freq=2400MHz



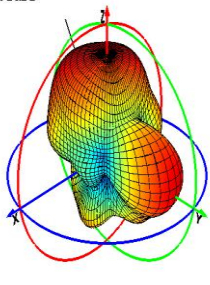
MAX:0.84dBi
MIN:-10.16dBi



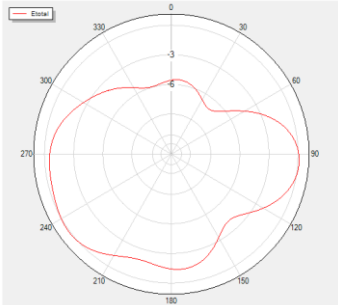
Theta=90 Freq=2450MHz



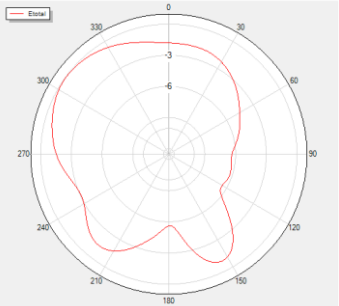
MAX:1.25dBi
MIN:-11.01dBi



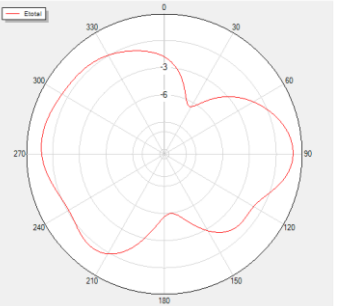
Theta=90 Freq=2500MHz



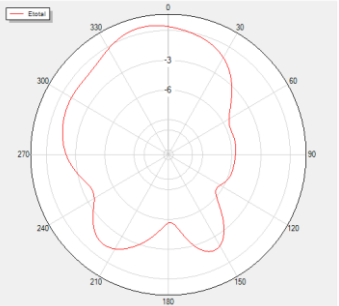
Phi=0 Freq=2400MHz



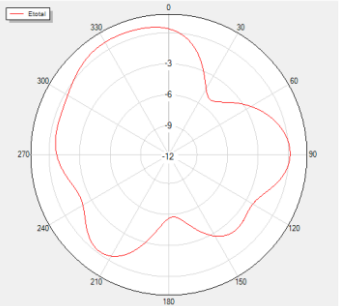
Phi=90 Freq=2400MHz



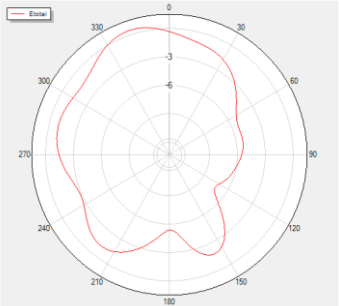
Phi=0 Freq=2450MHz



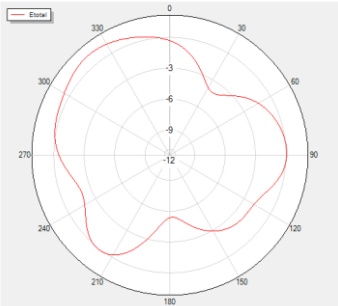
Phi=90 Freq=2450MHz



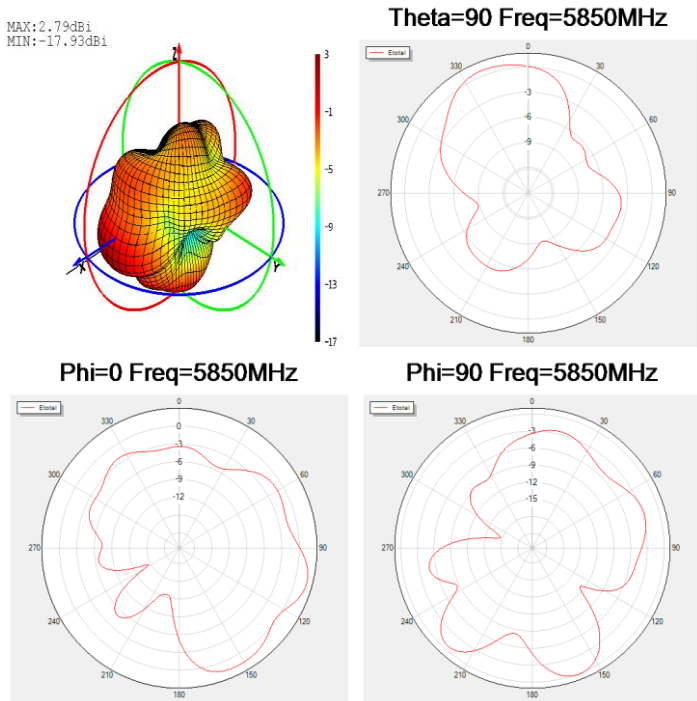
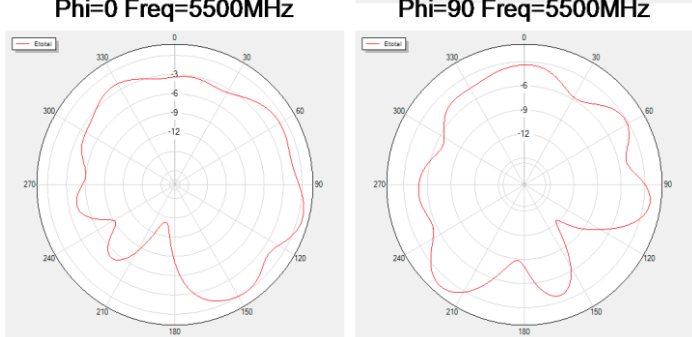
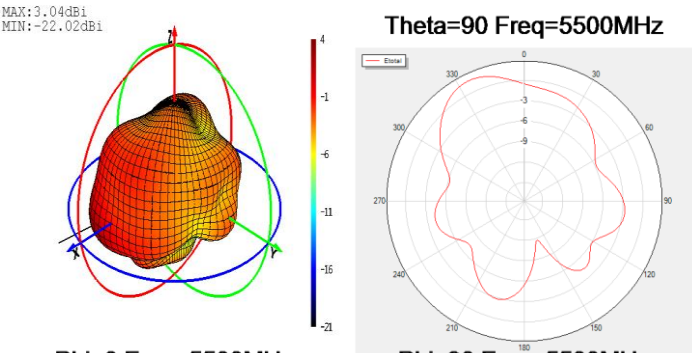
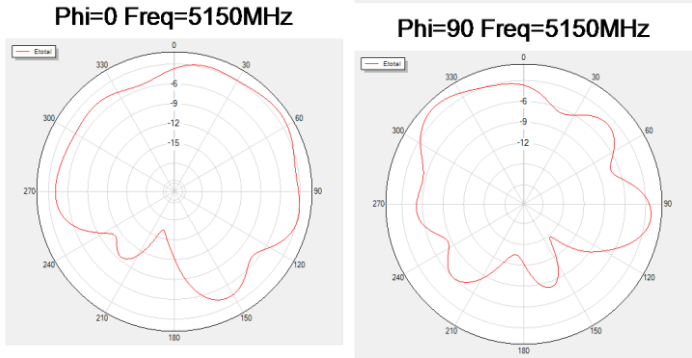
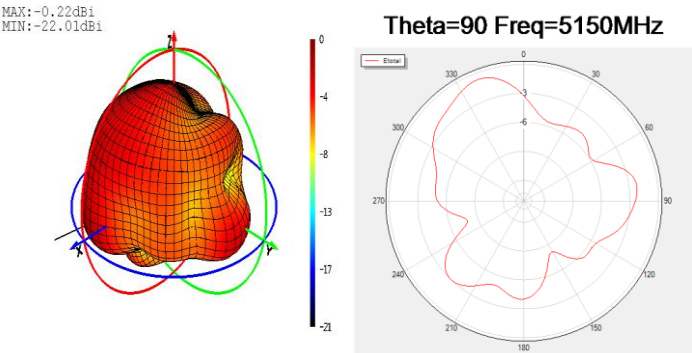
Phi=0 Freq=2500MHz



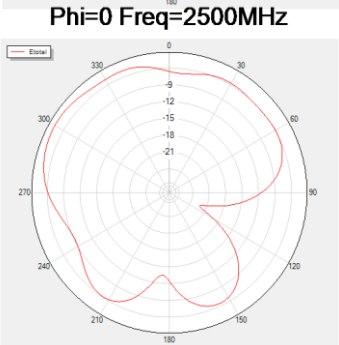
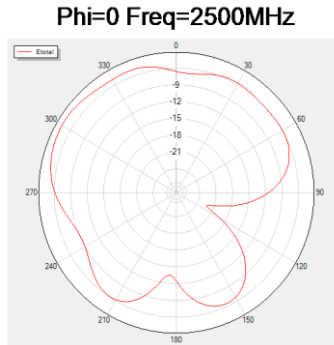
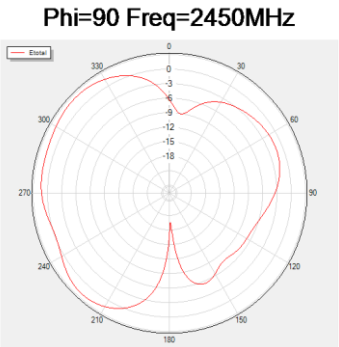
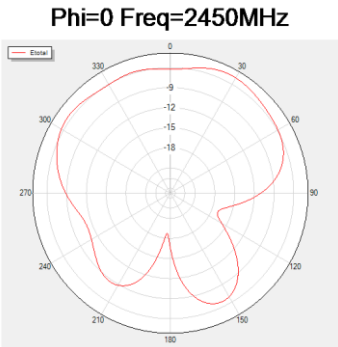
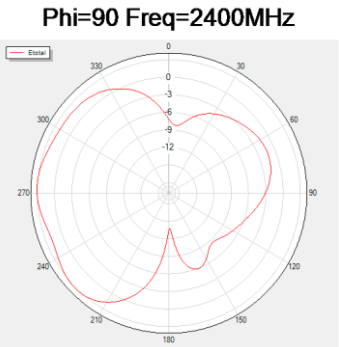
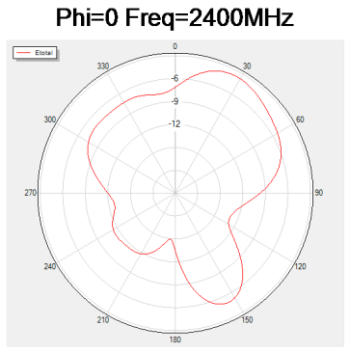
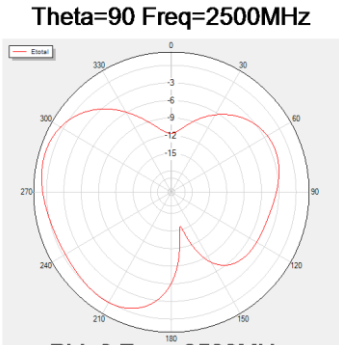
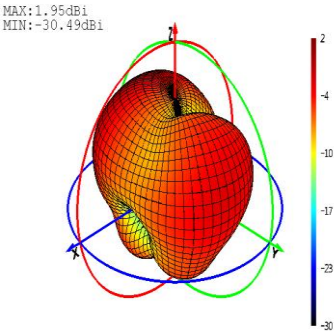
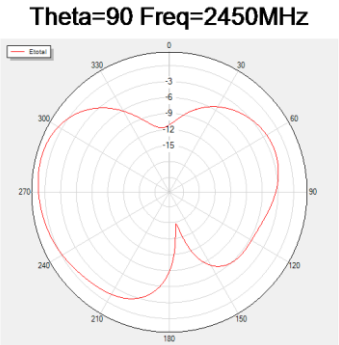
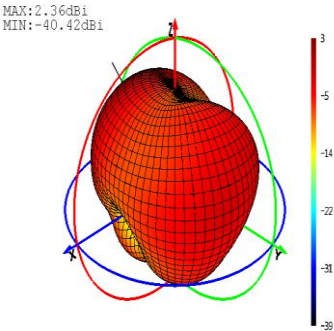
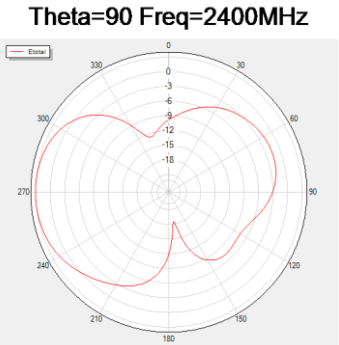
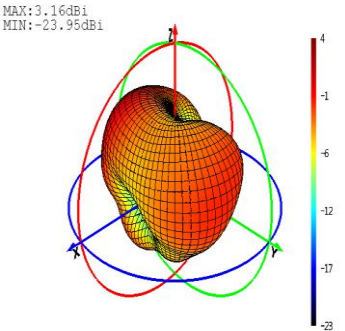
Phi=90 Freq=2500MHz



3D-Y0IKO00ABCA



3D-Y0IKO00ABDA





Project Overview

Antenna Performance Evaluation and Debugging

Conclusion and Suggestion

Build a Smarter World



- **Antenna Performance**

In summary:

1. The performance meets requirements;

- From the passive results, the WIFI & BT antenna efficiency is in the range of 35%~70%, the LTE antenna efficiency is in the range of 20%~70%;
- From the active results,
- LTE: TRP 18~24dBm, TIS -92~-97dBm, and the performance meets the requirements;
- And the performance of WIFI meets the requirements;

- **How to improve antenna performance**

- Antenna performance is good and there are no suggestions for improvement at this time.

- **Next step**

- Produce antenna samples and send to customers.



**We are a global IoT solutions provider,
backed by outstanding support and
services, to deliver a smarter world.**

- Unbeatable choice from the broadest module portfolio in the world
- High quality range of off-the-shelf and customized antennas
- Superb support with the largest R&D team in the industry
- Continuous innovation – in 5G, LPWA, Automotive, Smart module technology
- A passionate, dedicated team of "Quectelers" ensures our customers always come first

Thank You

Build a Smarter World

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