

Antenna Specification

1. Antenna information



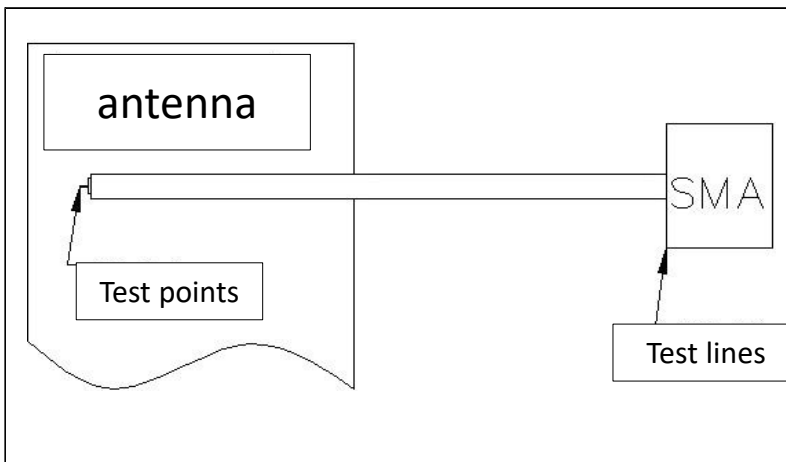
Dimension:

BT/WiFi/GPS Antenna	1.3mm*21mm
WWAN Main Antenna	7mm*52mm
Diversity Antenna	9mm*33mm

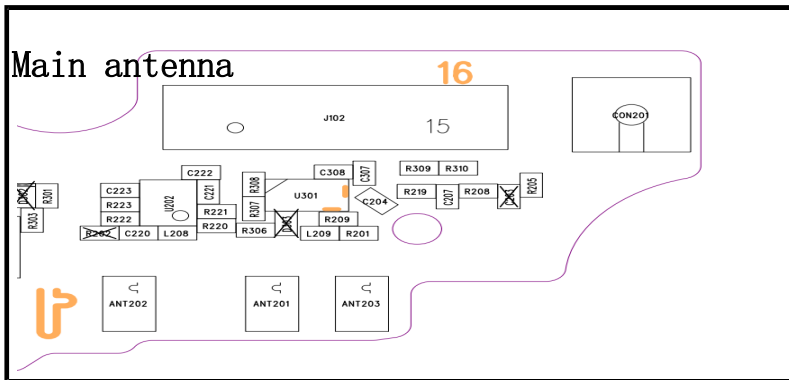
2. Test fixtures

Purpose: To test the passive parameters of the antenna as accurately as possible.

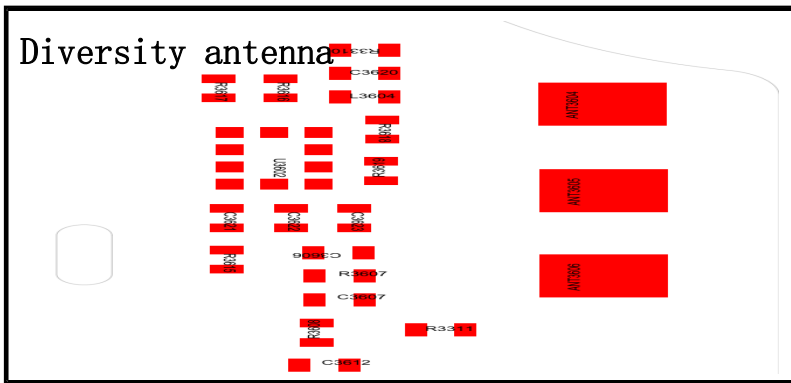
How to make: The prototyping mechanism is made of a 50 ohm coaxial cable, one end is connected to the test point at the back of the matching circuit of the prototype motherboard (the front of the RF test hole), and the other end is connected to the SMA connector. The schematic diagram is as follows:



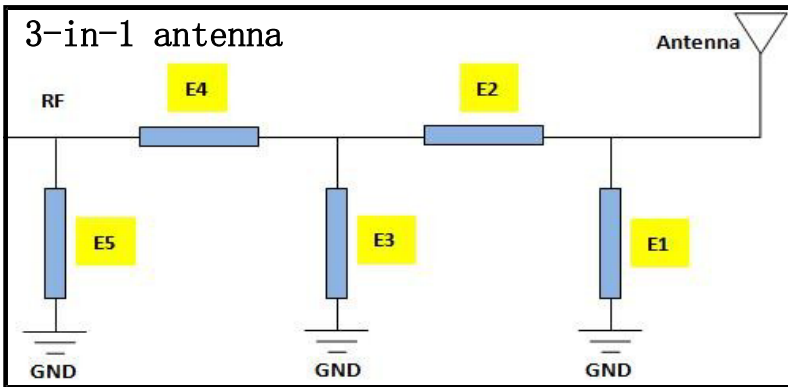
3. Matching circuits



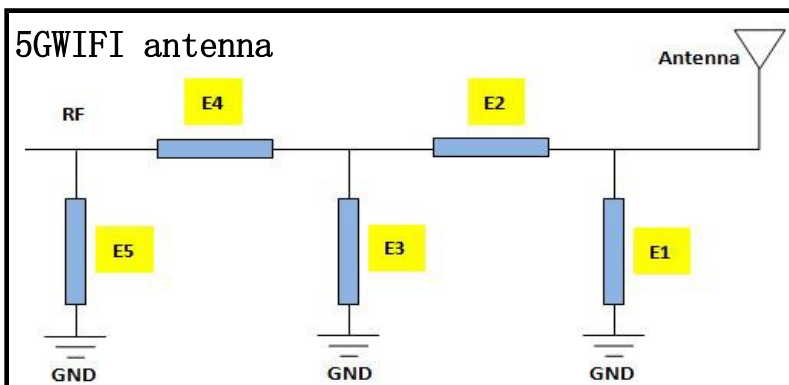
Main circuit electronic components		Tuner electronic components	
L209	120nH	R202	N/C
R209	47pF	C220	56pF
C204	10nH	L208	120nH
R219	0Ω	RF1	0Ω
C207	1pF	RF2	3.9nH
R208	3nH	RF3	18nH
C203	N/A	RF4	33nH
R205	0Ω		



Main circuit electronic components		Tuner electronic components	
C3606	10nH	R3310	N/A
R3607	0Ω	C3620	0Ω
C3607	N/A	L3604	N/A
R3608	0Ω	RF1	0Ω
C3612	N/A	RF2	3nH
		RF3	15nH
		RF4	39nH



Element	Value	specification
E1	N/A	
E2	0Ω	
E3	N/A	
E4	0Ω	
E5	N/A	



Element	Value	specification
E1	N/A	
E2	0Ω	
E3	N/A	
E4	0Ω	
E5	N/A	

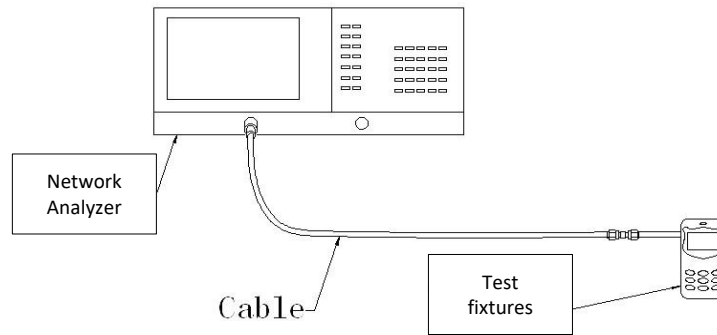
4. S11 test

5. S11 Test Method Description

6. Test Equipment: Network Analyzer (E5071C)

7. Test method: A 50 ohm CABLE cable is derived from the instrument test port, and the SMA connector of the prototype is connected after calibration using the calibrator to record the return loss and standing wave ratio corresponding to the relevant frequency point.

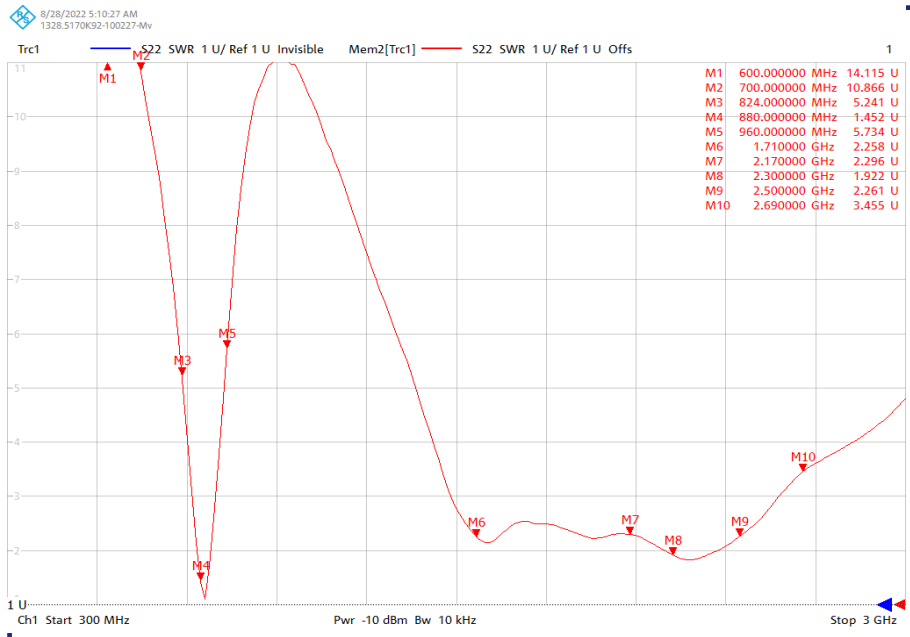
The test diagram is as follows:



Test the schematic

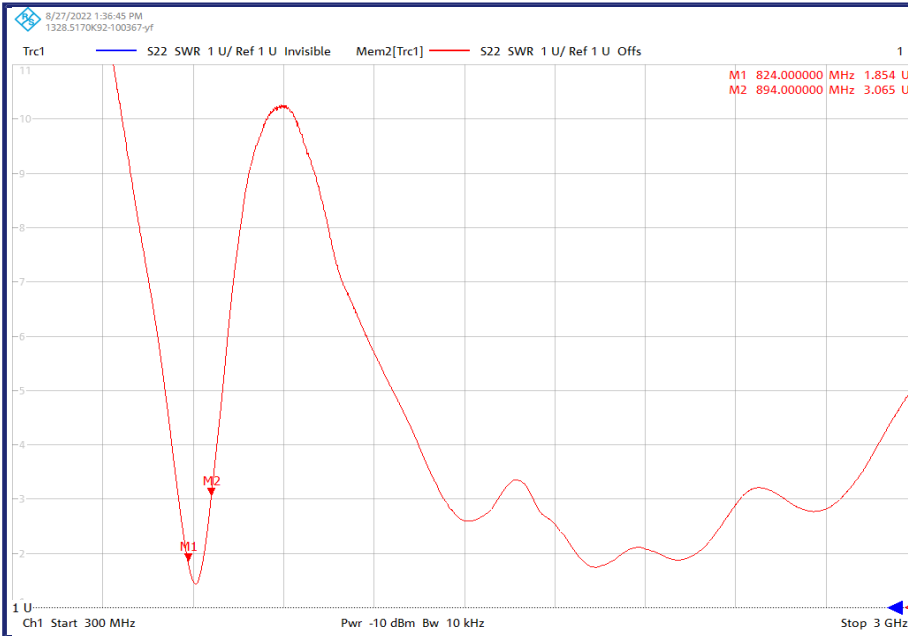
4.2 S11 parameter

Primary antenna/RF1



	Main antenna
frequency (MHz)	VSWR
880	1.42
960	5.73
1710	2.58
2170	2.29
2300	1.92
2400	2.26
2690	3.45

Primary antenna/RF2



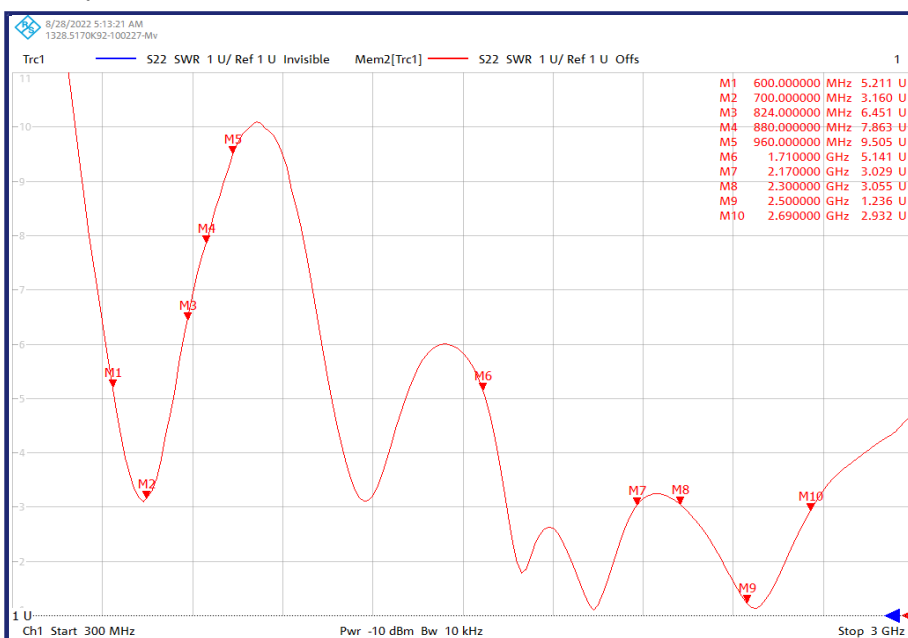
	Main antenna
frequency (MHz)	VSWR
824	1.85
894	3.06

Primary antenna/RF3



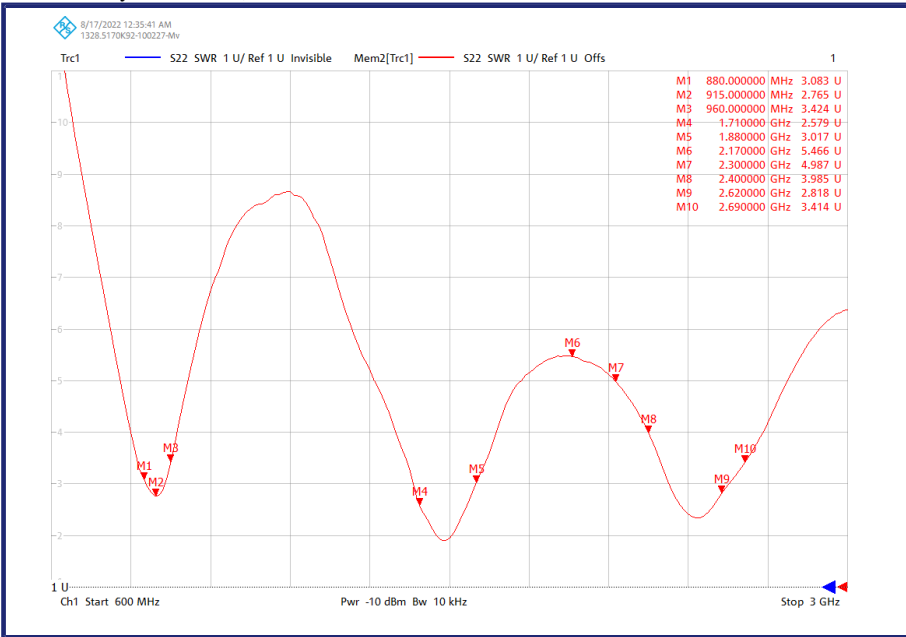
	Main antenna
frequency (MHz)	VSWR
700	3.03
800	3.60
2500	1.627
2690	2.25

Primary antenna/RF4



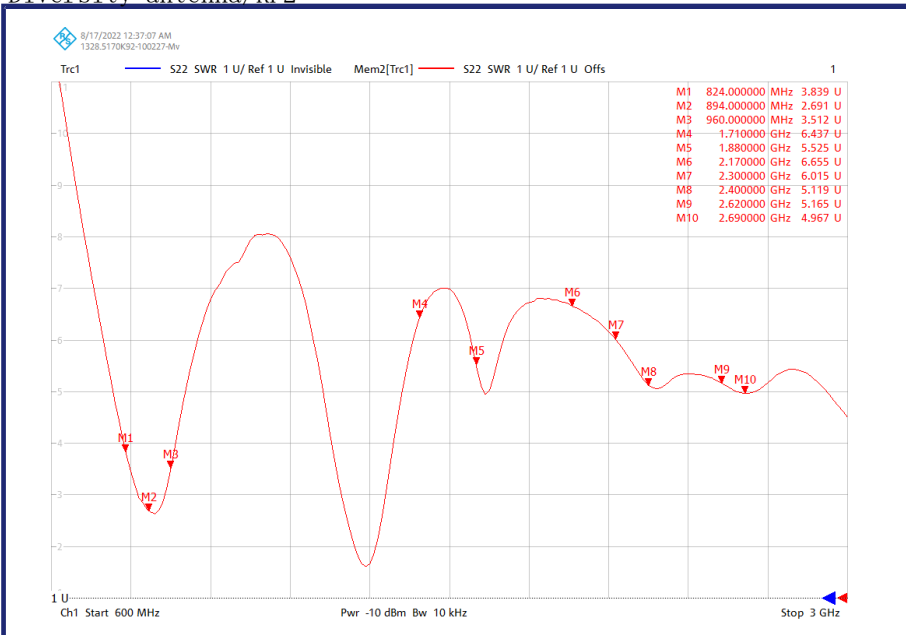
	Main antenna
frequency (MHz)	VSWR
600	5.21
700	3.16

Diversity antenna/RF1



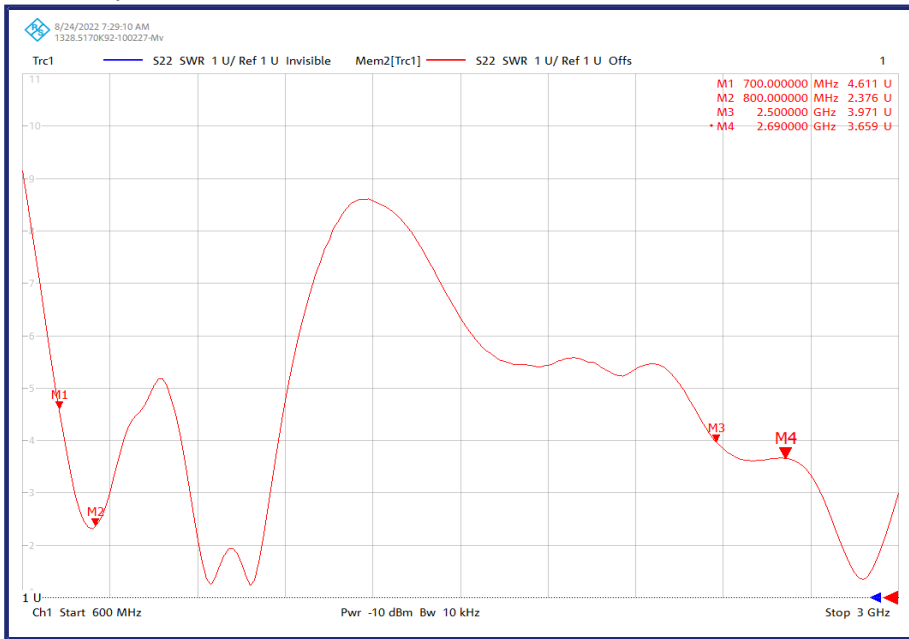
frequency (MHz)	VSWR
880	3.08
960	3.42
1710	2.57
1880	3.01
2170	5.46
2300	4.98
2400	3.98
2620	2.81
2690	3.41

Diversity antenna/RF2



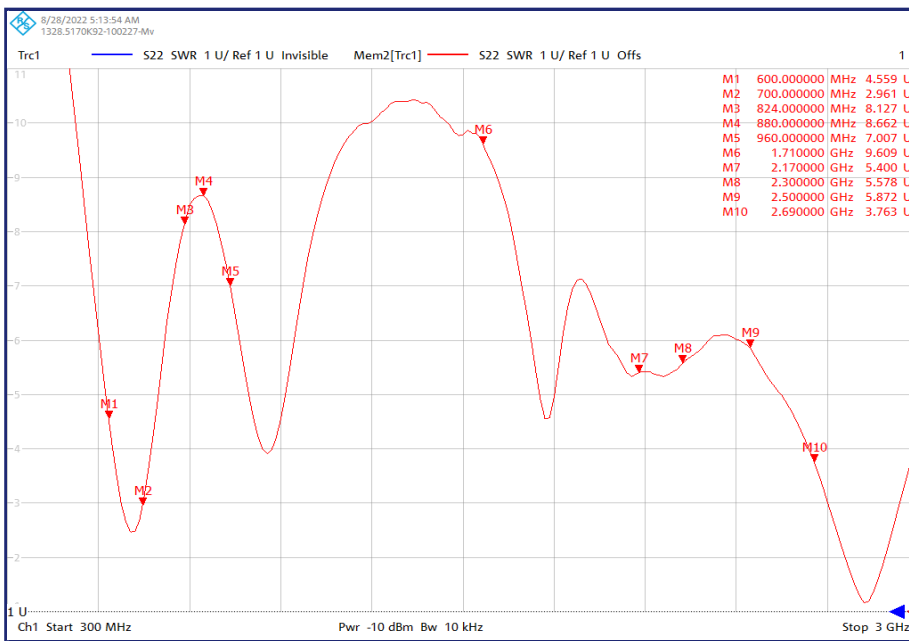
frequency (MHz)	VSWR
824	3.83
894	2.69

Diversity antenna/RF3



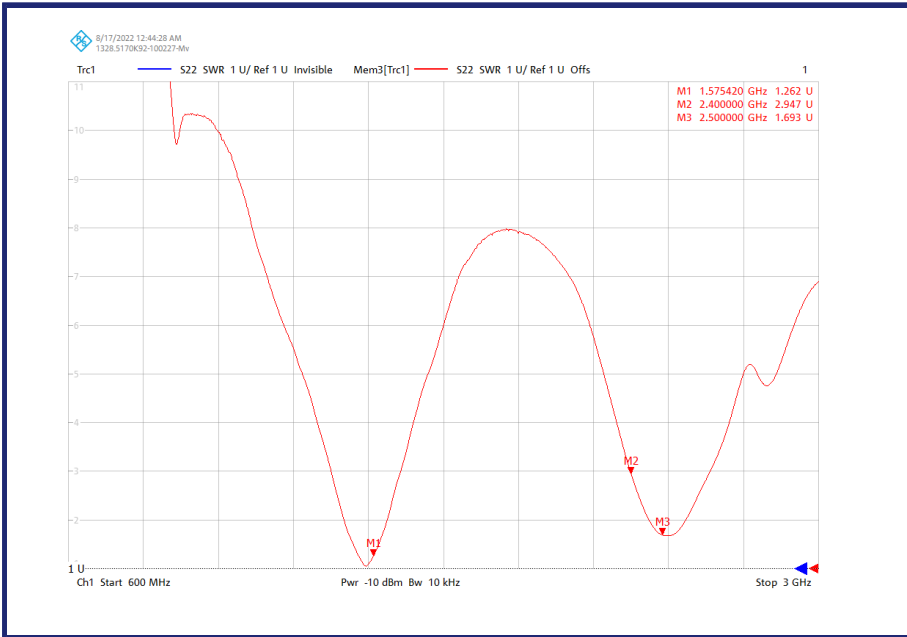
	Main antenna
frequency (MHz)	VSWR
700	4.61
800	2.37
2620	3.97
2690	3.65

Diversity antenna/RF4



	Main antenna
frequency (MHz)	VSWR
600	4.55
700	2.96

2. 4GWIFI+GPS antenna



	Main antenna
frequency (MHz)	VSWR
1575.42	1.26
2400	2.94
2500	1.69

5GWIFI antenna



	Main antenna
frequency (MHz)	VSWR
5180	1.37
5800	2.48

5 Darkroom test data

Test system: Shielded darkroom

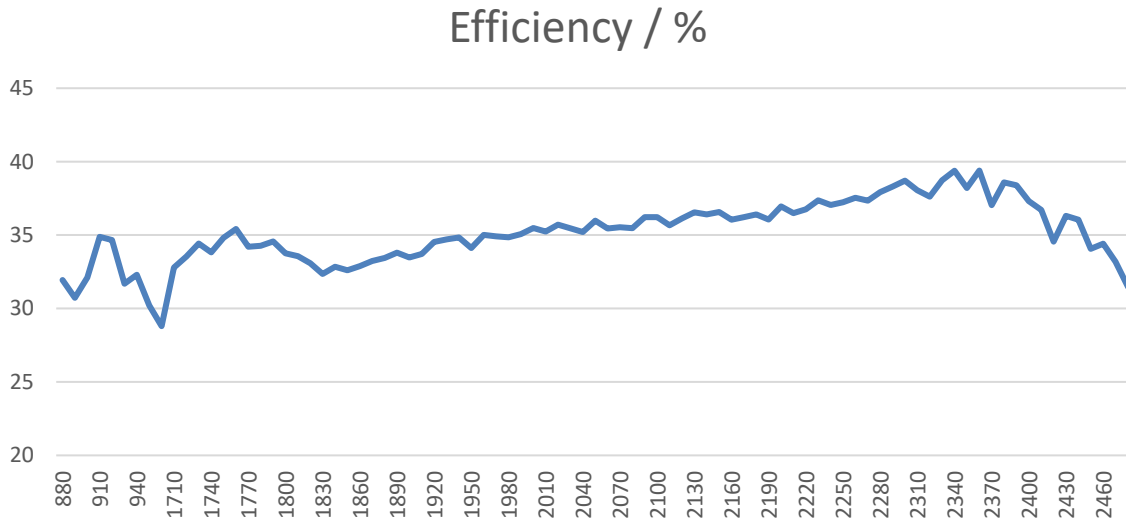
Test environment: temperature $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$, humidity $50\% \pm 15\%$

Test equipment: When testing passive data, use the Network Analyzer Agilent E5062C

When testing active data, the Comprehensive Tester Agilent 8960 /CMW500/E4438C is used

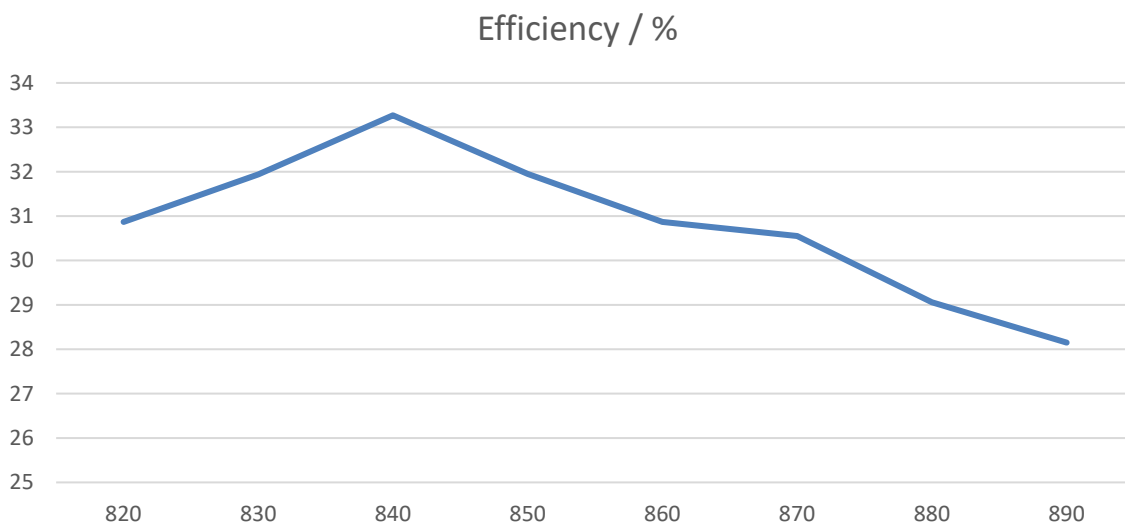
5.1 Passive test data

Main antenna RF1 passive efficiency



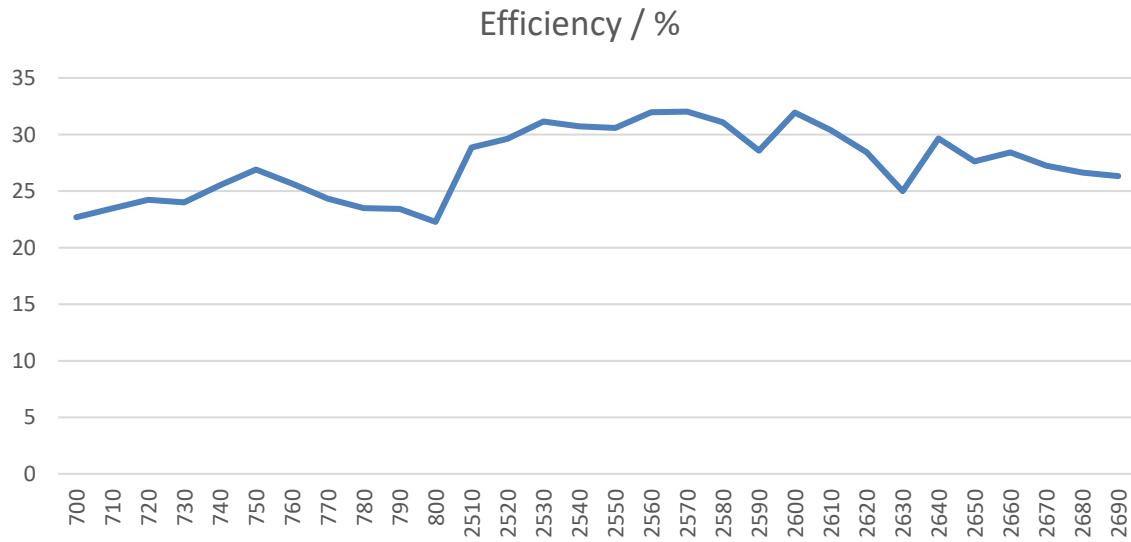
Freq.(MHz)	880--960			1710--2170			2300--2480		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Effi(%)	28.8	34.88	31.92	32.35	36.57	34.68	31.47	39.39	36.74
Effi(dB)	-5.41	-4.57	-4.96	-4.9	-4.37	-4.59	-5.02	-4.05	-4.35
Gain(dBi)	-7.64	-2.01	-4.88	-2.45	1.61	-0.96	-1.5	1.21	-0.30

Main antenna RF2 passive efficiency



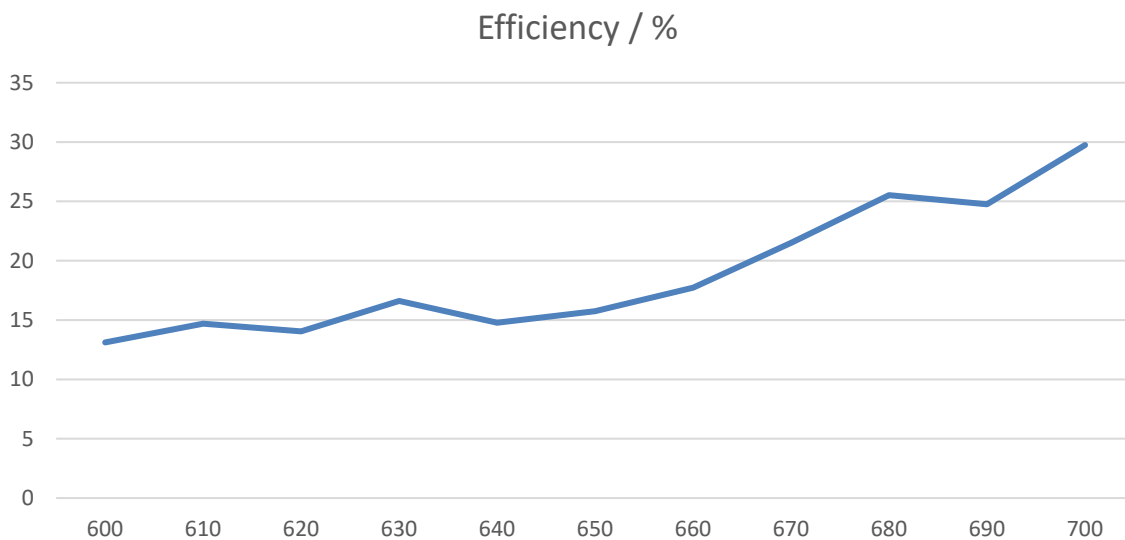
Freq.(MHz)	820--900		
	Min	Max	Avg
Effi(%)	28.15	33.27	30.83
Effi(dB)	-5.51	-4.78	-5.11
Gain(dBi)	-5.31	-0.26	-2.16

Main antenna RF3 passive efficiency



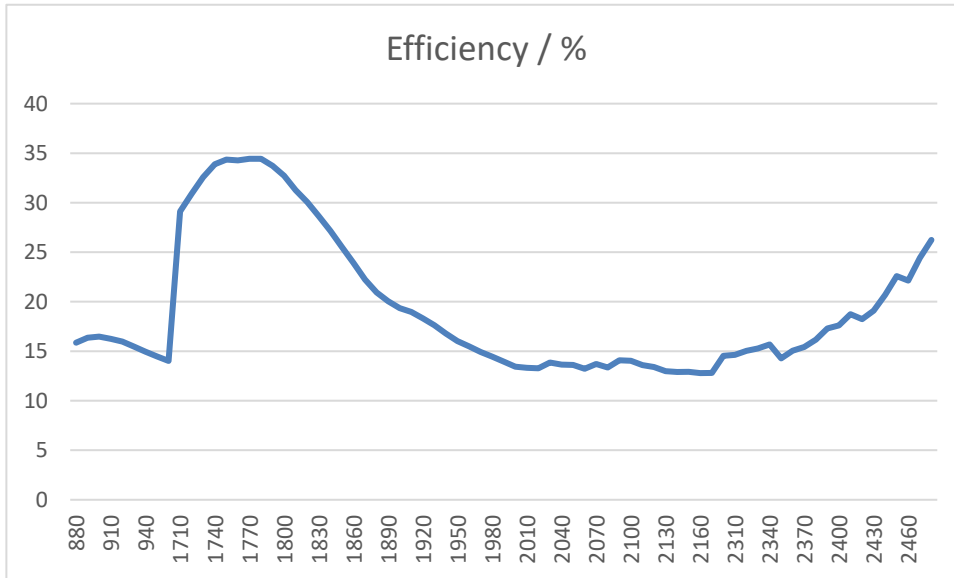
Freq.(MHz)	700—800			2500--2690		
	Min	Max	Avg	Min	Max	Avg
Effi(%)	22.68	26.91	24.18	25	32.03	29.27
Effi(dB)	-6.52	-5.7	-6.17	-6.02	-4.94	-5.34
Gain(dBi)	-3.1	0.05	-1.35	-3.57	-0.86	-1.74

Main antenna RF4 passive efficiency



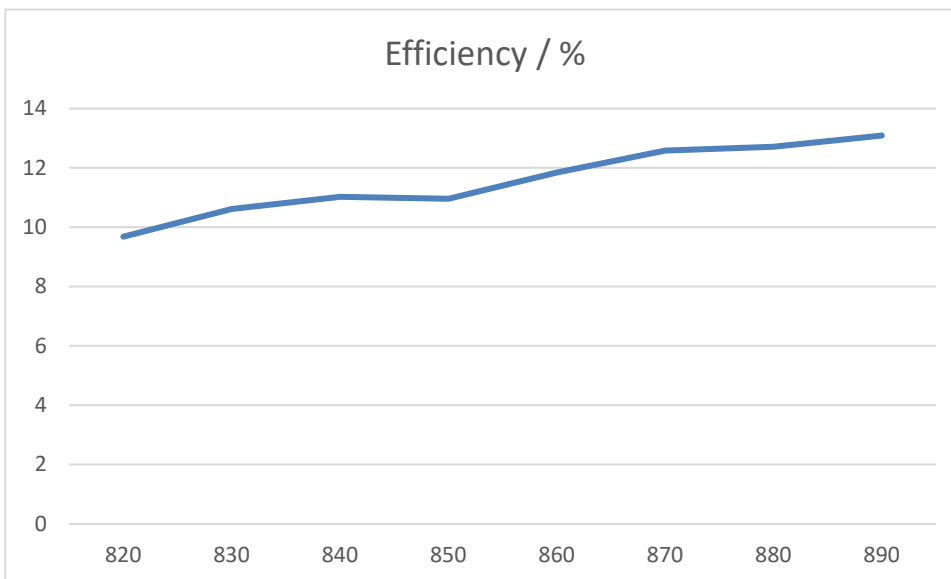
Freq.(MHz)	600--700		
	Min	Max	Avg
Effi(%)	13.11	29.74	18.93
Effi(dB)	-8.82	-5.27	-7.38
Gain(dBi)	-3.56	-0.27	-1.19

Diversity antenna RF1 passive efficiency



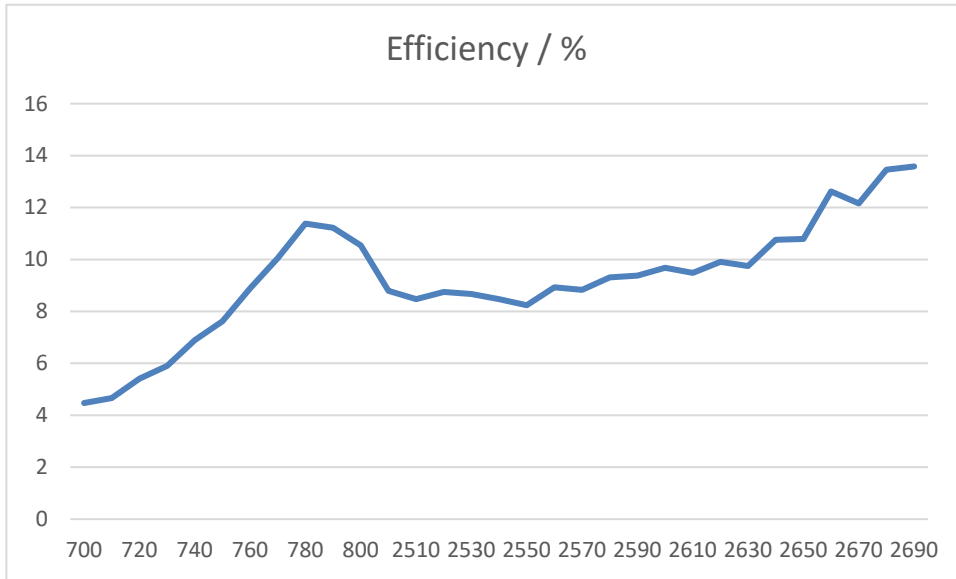
Freq.(MHz)	880--960			1710--2170			2300--2690		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Effi(%)	14.02	16.47	15.53	12.79	34.43	20.57	14.27	26.24	18.06
Effi(dB)	-8.53	-7.83	-8.09	-8.93	-4.63	-7.17	-8.46	-5.81	-7.50
Gain(dBi)	-4.16	-2.4	-3.05	-5.79	-0.2	-3.45	-4.87	-0.82	-2.58

Diversity antenna RF2 passive efficiency



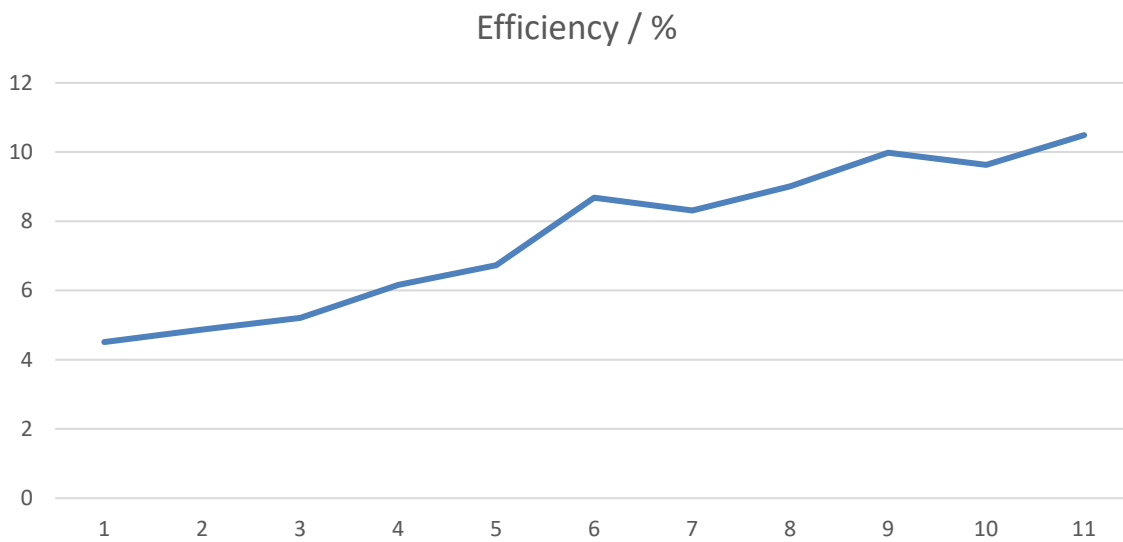
Freq.(MHz)	880--900		
	Min	Max	Avg
Effi(%)	9.68	13.09	11.56
Effi(dB)	-10.14	-8.83	-9.39
Gain(dBi)	-6.25	-4.17	-5.16

Diversity antenna RF3 passive efficiency



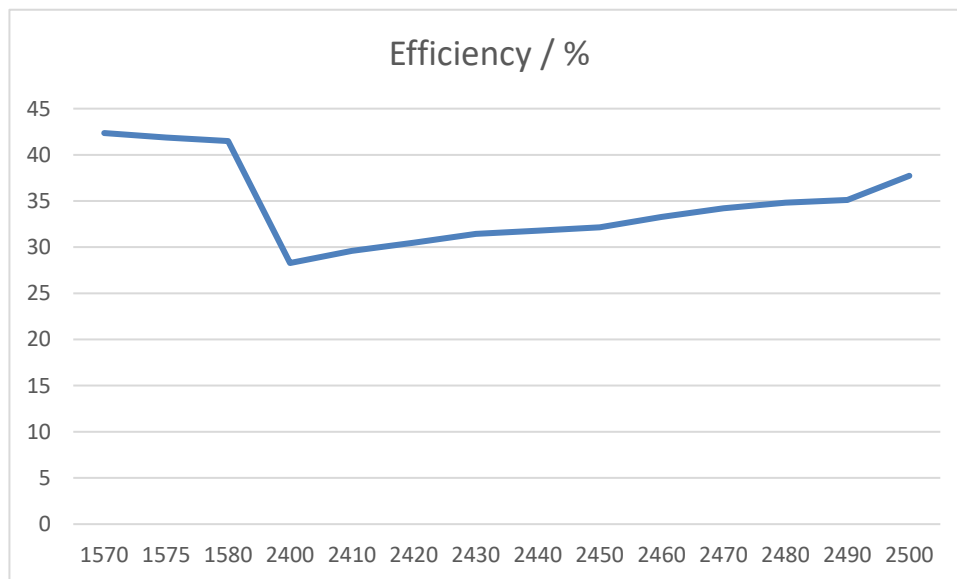
Freq.(MHz)	700--800			2500--2690		
	Min	Max	Avg	Min	Max	Avg
Effi(%)	4.47	11.38	7.91	8.24	13.58	10.00
Effi(dB)	-13.5	-9.44	-11.25	-10.84	-8.67	-10.05
Gain(dBi)	-5.55	-4.31	-5.27	-7.09	-5.06	-6.19

Diversity antenna RF4 passive efficiency



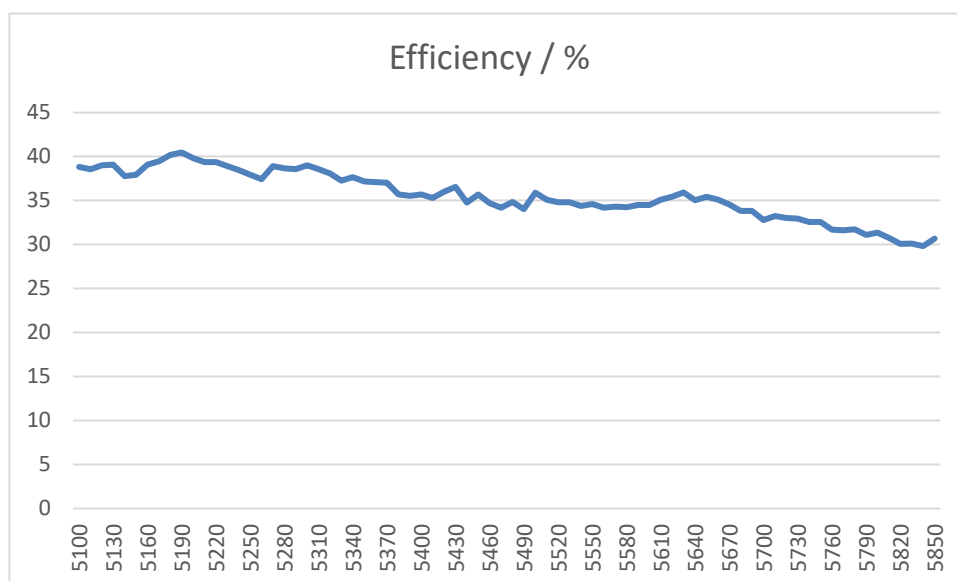
Freq.(MHz)	600--700		
	Min	Max	Avg
Effi(%)	4.51	10.49	7.59
Effi(dB)	-13.46	-9.79	-11.36
Gain(dBi)	-7.65	-3.49	-5.82

2. 4G WIFI+ GPS antenna passive efficiency

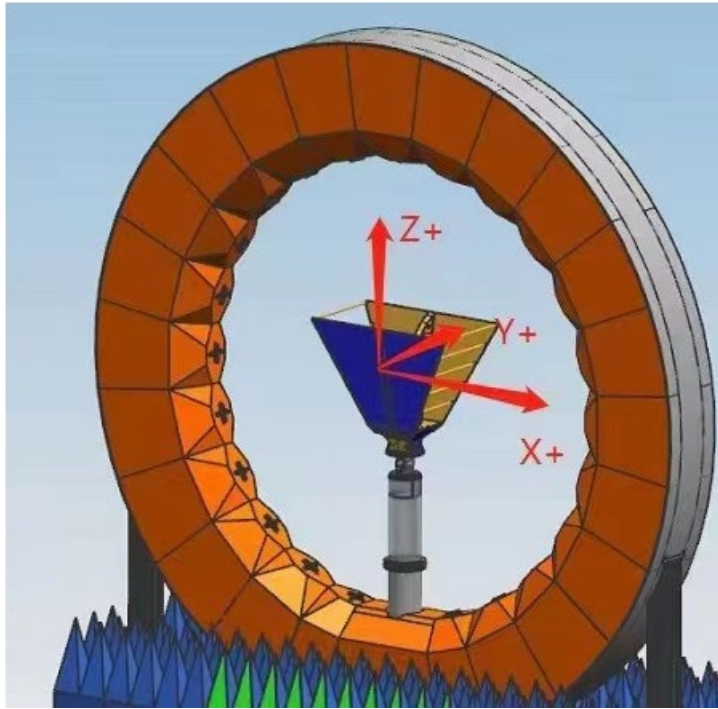


Freq.(MHz)	1570-1580			2400-2500		
	Min	Max	Avg	Min	Max	Avg
Effi(%)	41.88	42.36	41.91	28.28	37.73	32.62
Effi(dB)	3.82	3.73	3.77	6.52	4.47	-5.24
Gain(dBi)	0.8	0.96	0.87	-0.89	1.28	0.47

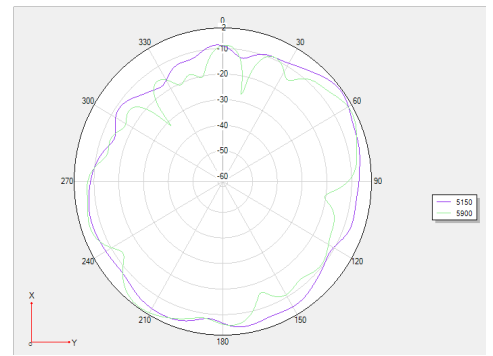
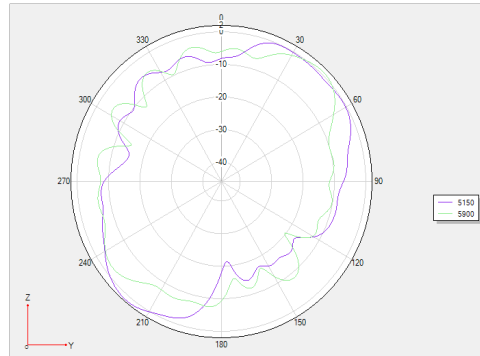
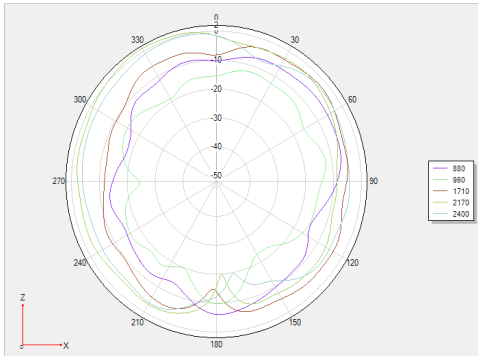
Passive efficiency of 5GWIFI antennas



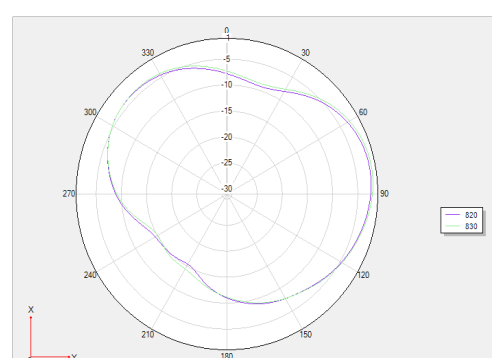
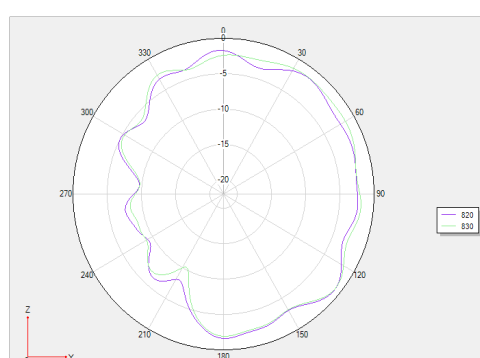
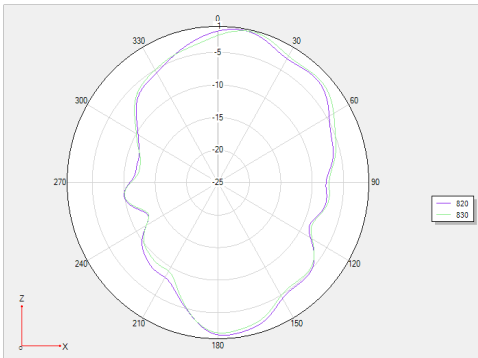
Freq.(MHz)	5100-5850		
	Min	Max	Avg
Effi(%)	29.81	40.46	35.57
Effi(dB)	-6.6	-3.93	-5.07
Gain(dBi)	1.66	3.43	2.79

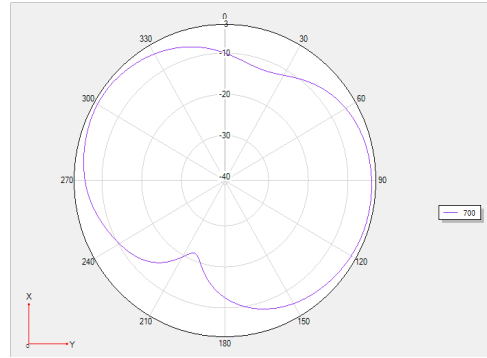
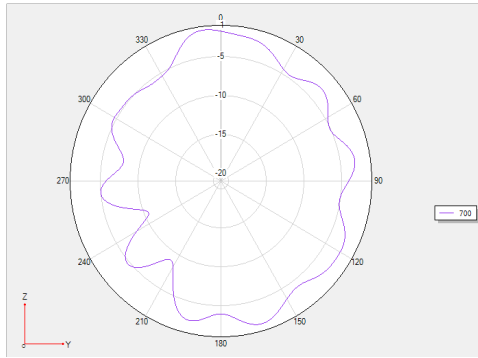
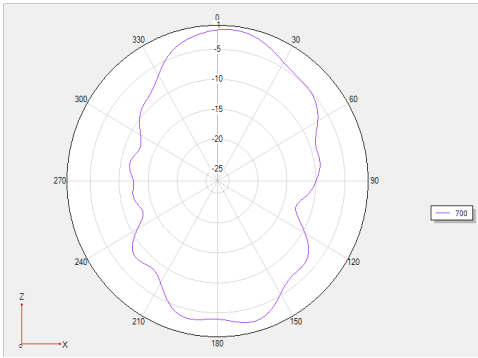


Primary antenna/RF1

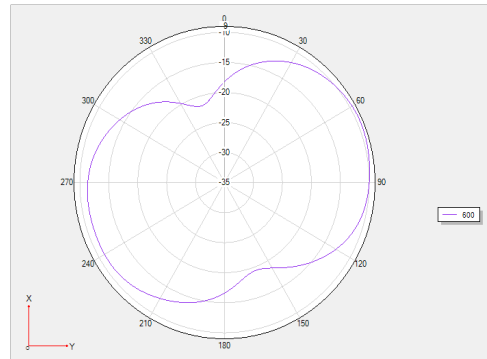
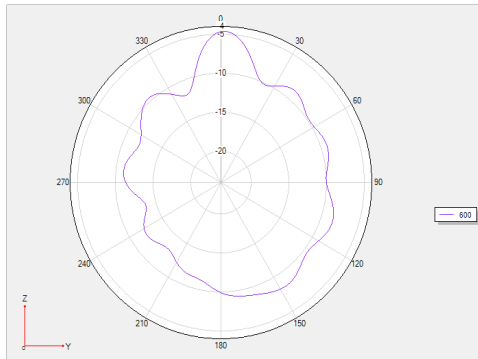
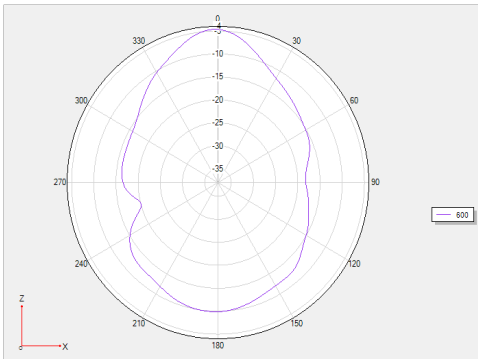


Primary antenna/RF2

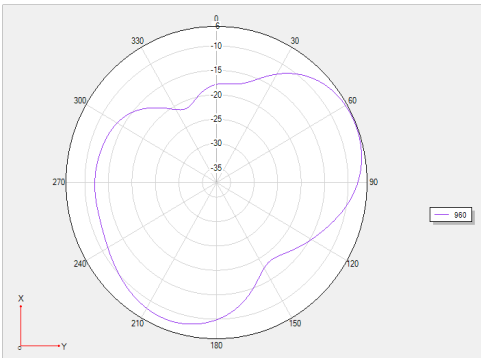
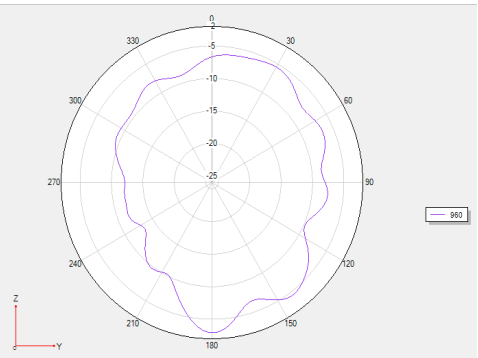
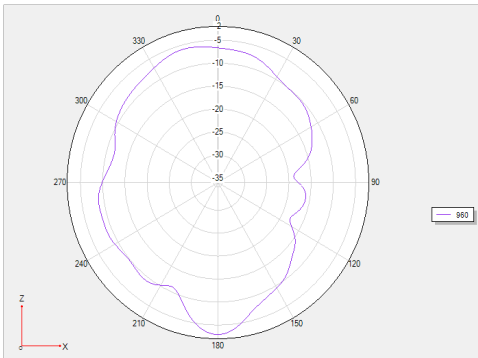




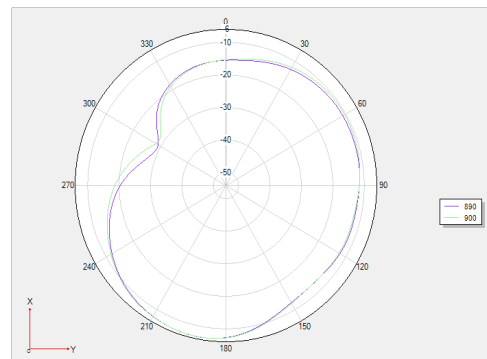
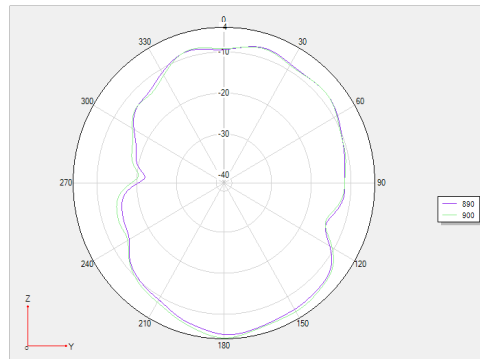
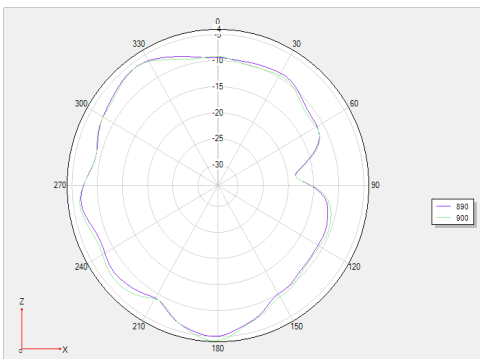
Primary antenna/RF4

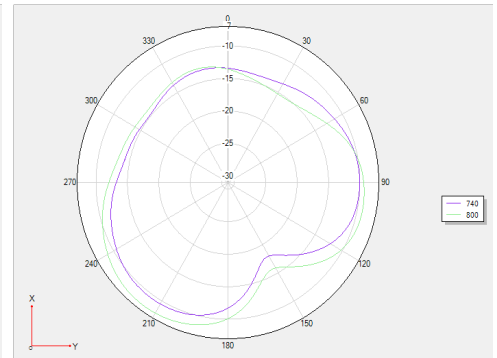
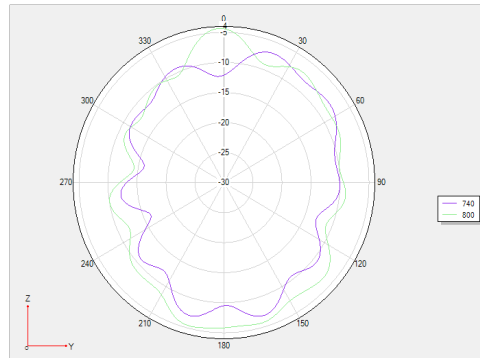
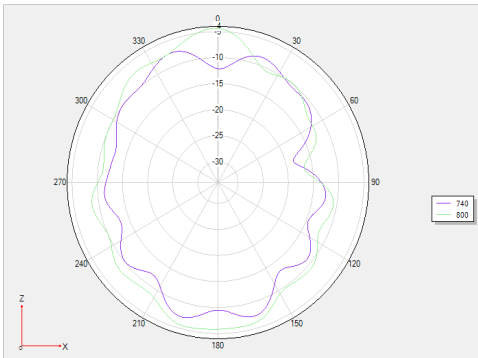


Diversity antenna/RF1

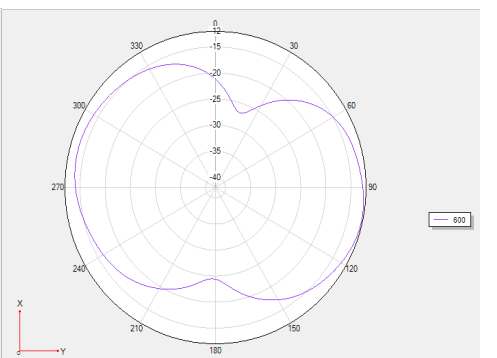
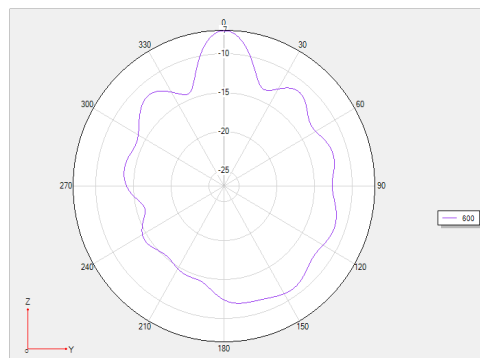
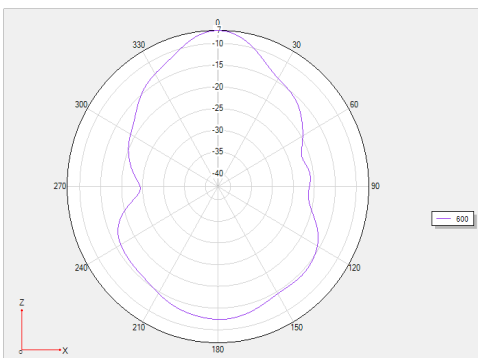


Diversity antenna/RF2

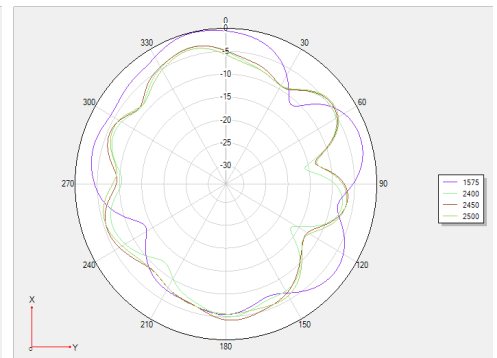
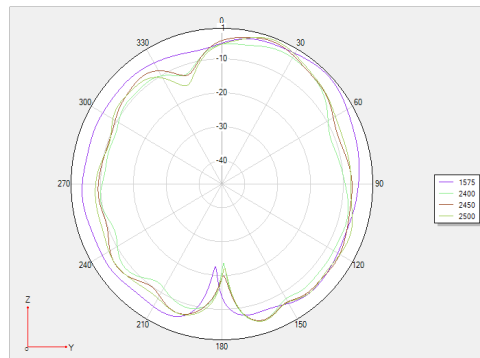
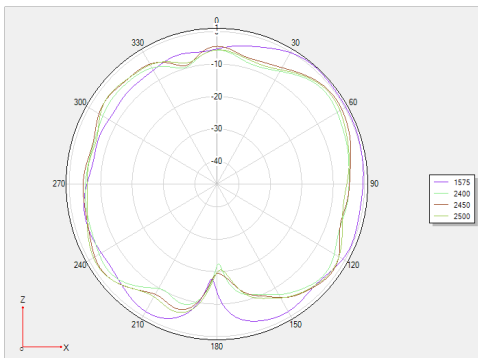




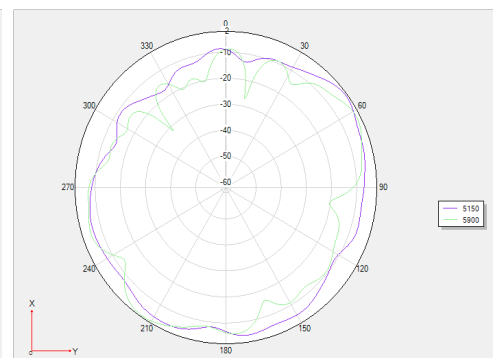
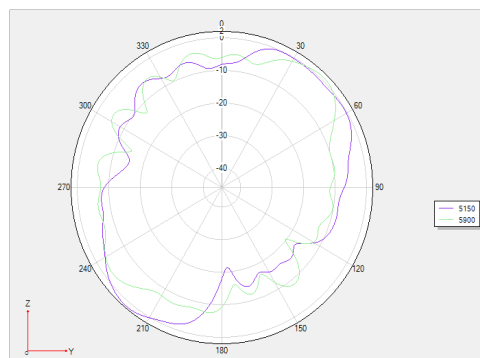
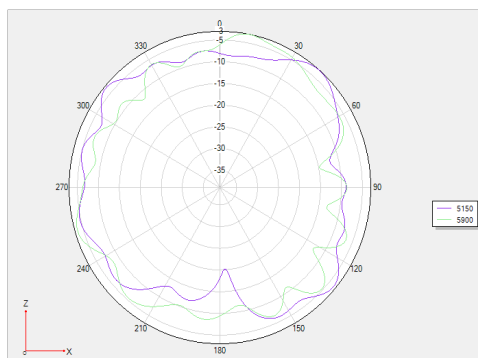
Diversity antenna/RF4



2.4G WIFI+GPS



5G WIFI



5.2 Active test data

Main antenna active test data (free space, bright screen)

Band	channel	frequency (MHz)	OTA (dB)		Band	channel	frequency (MHz)	OTA (dB)	
			TRP	TIS				TRP	TIS
GSM_850	128	824.2	26.38		FDD_B3 (10M)	19250	1715	18.24	
	190	836.6	26.72			19575	1747.5	18.44	
	251	848.8	26.53	-102.61		19900	1780	18.18	-92.08
GSM_900	1	880.2	26.02		FDD_B4 (10M)	20000	1715	18.22	
	38	897.6	26.38			20175	1732.5	18.23	
	124	914.8	26.29	-102.22		20350	1750	18.16	-92.17
GSM_1800	512	1710.2	24.09		FDD_B5 (10M)	20450	829	16.89	
	698	1747.6	24.13			20525	836.5	17.28	
	885	1784.8	24.11	-102.72		20600	844	16.93	-92.58
GSM_1900	512	1850.2	24.72		FDD_B7 (10M)	2505	16.73	18.65	
	661	1880	25.13			2535	17.15	18.86	
	810	1909.8	24.97	-104.34		2565	17.03	18.53	-92.5
WCDMA_B 1	9612	1922.4	18.08		FDD_B12 (10M)	23060	704	16.48	
	9750	1950	18.61			23095	707.5	16.63	
	9888	1977.6	19.36	-104.24		23130	711	16.69	-90.57
WCDMA_B 2	9262	1852.4	17.67		FDD_B13 (10M)	23230	782	17.03	
	9400	1880	17.76						
	9538	1907.6	17.71	-104.21					-91.52
WCDMA_B 4	1312	1712.4	17.86		FDD_B14 (10M)	23330	793	17.28	
	1413	1732.6	18.31						
	1513	1752.6	17.75	-104.36					-90.12
WCDMA_B 5	4132	826.4	17.35		FDD_B17 (10M)	23780	709	16.37	
	4183	836.6	17.62			23790	710	16.61	
	4233	846.6	17.51	-103.62		23800	711	16.52	-91.6
WCDMA_B 8	2712	882.4	17.43		FDD_B18 (10M)	23900	820	16.62	
	2787	897.4	17.57			23925	822.5	17.28	
	2863	912.6	17.39	-103.43		23950	825	17.37	-92.71
FDD_B1 (10M)	18050	1925	18.31		FDD_B19 (10M)	24050	835	16.69	
	18300	1950	18.83			24075	837.5	17.31	
	18550	1975	19.21	-92.13		24100	840	17.02	-93.51
FDD_B2 (10M)	18650	1855	18.12		FDD_B25 (10M)	26090	1855	17.68	
	18900	1880	18.31			26365	1882.5	17.51	
	19150	1905	18.37	-92.34		26640	1910	18.26	-92.64

Band	channel	frequency (MHz)	OTA (dB)		Band	channel	frequency (MHz)	OTA (dB)	
			TRP	TIS				TRP	TIS
FDD_B26 (10M)	26740	819	16.92		FDD_B71 (10M)	133172	668	15.63	
	26865	831.5	17.11			133297	680.5	15.75	
	26990	844	17.41	-90.9		133422	693	15.64	-88.36
FDD_B28 (10M)	27260	708	16.11		TDD_B38 (20M)	37850	2580	18.53	
	27435	725.5	16.49			38000	2595	19.02	
	27460	743	16.85	-90.29		38150	2610	18.71	-90.75
FDD_B30 (10M)	27710	2613	18.51		TDD_B41 (20M)	40340	2565	18.49	
				-93.02		40740	2605	18.78	
						41140	2645	17.78	-90.31
FDD_B66 (10M)	132022	1715	18.17						
	132322	1745	18.96						
	132622	1775	18.31	-93.34					

3-in-1 antenna active test data (free space, bright screen measurement 100%)

Band	channel	frequency (MHz)	OTA (dB)	
			TRP	TIS
2.4G 802.11B (11Mbps)	1	2412	12.58	
	6	2437	13.08	
	11	2472	12.71	-82.15
2.4G 802.11G (11Mbps)	1	2412	10.82	
	6	2437	11.18	
	11	2472	10.95	-69.53
2.4G 802.11N (11Mbps)	1	2412	9.08	
	6	2437	10.15	
	11	2472	9.63	-67.34
5.8G 802.11A (11Mbps)	36	51800	10.34	
	149	5500	10.26	
	165	5825	10.15	-71.46

Band	channel	frequency (MHz)	OTA (dB)	
			TRP	TIS
GPS		1575.42		-147.41

Certified antenna test gain

GSM/DCS/PCS/GPRS/EGPRS					
GSM	850		V	Antenna Gain (dBi)	-2.02
P-GSM	900		V		-1.65
E-GSM	900				
DCS	1800		V		-0.28
PCS	1900		V		-0.56
Voice					
GPRS		V	Multi-slot Class	class 12 (sw)	
EDGE/EGPRS		uplink and downlink	Multi-slot Class	class 12 (sw)	
EDGE/EGPRS			Modulation	GMSK and 8PSK	
Dual Transfer Mode (DTM)	GPRS		device class	Multi-slot Class	
	EGPRS		device class	Multi-slot Class	

WCDMA/HSDPA/HSPUA/HSPA+					
Band 1	1920-1980		V	Antenna Gain (dBi)	0.92
Band 2	1850-1910		V		-0.56
Band 4	1710-1755		V		0.44
Band 5	824-849		V		-2.02
Band 6	830-840				
Band 8	880-915		V		-1.65
Band 9	1767-1877				
Band 19	832-842				
HSDPA		V	Category		24(sw)
HSUPA		V	Category	7(sw)	
DC-HSDPA			Category		
HSPA+		V	Category		
DC-HSUPA			Category		
Rx Diversity					

Certified antenna test gain

LTE						
FDD Band 1	1920-1980	V		3		0.92
FDD Band 2	1850-1910	V		3		-0.56
FDD Band 3	1701-1785	V		3		-0.28
FDD Band 4	1710-1785	V		3		-0.28
FDD Band 5	824-849	V		3		-2.02
FDD Band 6	830-840					
FDD Band 7	2500-2570	V		3		0.3
FDD Band 8	880-915					
FDD Band 9	1749.9-1784.9					
FDD Band 10	1710-1770					
FDD Band 11	1427.9-1447.9					
FDD Band 12	698-716	V		3		-3.4
FDD Band 13	777-787	V		3		-4.31
FDD Band 14	788-798	V		3		-4.02
FDD Band 17	704-716	V		3		-3.4
FDD Band 18	815-830	V		3		-2.37
FDD Band 19	830-845	V		3		-2.02
FDD Band 20	832-862					
FDD Band 21	1447.9-1462.9					
FDD Band 22	3410-3490					
FDD Band 23	2000-2020					
FDD Band 24	1626.5-1660.5					
FDD Band 25	1850-1915	V	Power Class	3	Antenna Gain (dBi)	-1.57
FDD Band 26	814-849	V		3		-2.02
FDD Band 27	807-824					
FDD Band 28	703-748	V		3		-3.4
FDD Band 30	2305-2315	V		3		0.69
FDD Band 31	452.5-457.5					
FDD Band 66	1710-1780	V		3		-0.28
FDD Band 71	663-698	V		3		-3.58
FDD Other Bands						
TDD Band 33	1900-1920					
TDD Band 34	2010-2025					
TDD Band 35	1850-1910					
TDD Band 36	1930-1990					
TDD Band 37	1910-1930					
TDD Band 38	2570-2620	V		3		0.39
TDD Band 39	1880-1920					
TDD Band 40	2300-2400					
TDD Band 41	2496-2690	V		3		0.39
TDD Band 42	3400-3600					
TDD Band 43	3600-3800					
TDD Band 44	703-803					
TDD Other Bands						

Certified antenna test gain

WLAN b/g/n/a/ac					
802.11b	ch 1-11				
	ch 1-13	V		2.7	17.5
	ch 14 for JP				
802.11g	ch 1-11				
	ch 1-13	V		2.7	15
	ch 14 for JP				
802.11n (20M)		V		2.7	14.5
802.11n (40M)		V		2.7	13
802.11ax (20M)					
802.11ax (40M)					
802.11a	5150-5250	V		1.8	15
	5250-5350	V		1.8	15
	5470-5725	V		1.8	15
	5725-5850	V		1.8	15
802.11n (20M)	5150-5250	V		1.8	14
	5250-5350	V		1.8	14
	5470-5725	V		1.8	14
	5725-5850	V		1.8	14
802.11n (40M)	5150-5250	V		1.8	14
	5250-5350	V		1.8	14
	5470-5725	V		1.8	14
	5725-5850	V		1.8	14
802.11ac (20M)	5150-5250	V		1.8	14
	5250-5350	V	Antenna	1.8	14
	5470-5725	V	Gain (dBi)	1.8	14
	5725-5850	V		1.8	14
802.11ac (40M)	5150-5250	V		1.8	13
	5250-5350	V		1.8	13
	5470-5725	V		1.8	13
	5725-5850	V		1.8	13
802.11ac (80M)	5150-5250	V		1.8	12
	5250-5350	V		1.8	12
	5470-5725	V		1.8	12
	5725-5850	V		1.8	12
822.11 ac (160M)	5150-5350				
802.11ax (20M)	5150-5250				
	5250-5350				
	5470-5725				
	5725-5850				
802.11ax (40M)	5150-5250				
	5250-5350				
	5470-5725				
	5725-5850				
802.11ax (80M)	5150-5250				
	5250-5350				
	5470-5725				
	5725-5850				
822.11 ax (160M)	5150-5350				
802.11ax(OFDMA)					

6. Mass production antenna indicators

When the antenna is mass-produced, the standing wave ratio is used as the mass production test standard. According to the differences in the project itself, the following criteria are given:

frequency (MHz)	Mass production standards
Main antenna 600--960; 1710—2690	VSWR (Mass production performance) <VSWR(Acknowledge performance)+0.5
Diversity antenna 600--960; 1710--2690	VSWR (Mass production performance) <VSWR(Acknowledge performance)+0.5
Three-in-one antenna 1575.42; 2400--2500	VSWR (Mass production performance) <VSWR(Acknowledge performance)+0.5
5G WIFI antenna 5100-5850	VSWR (Mass production performance) <VSWR(Acknowledge performance)+0.5