



4.5 Spurious Emission Measurement

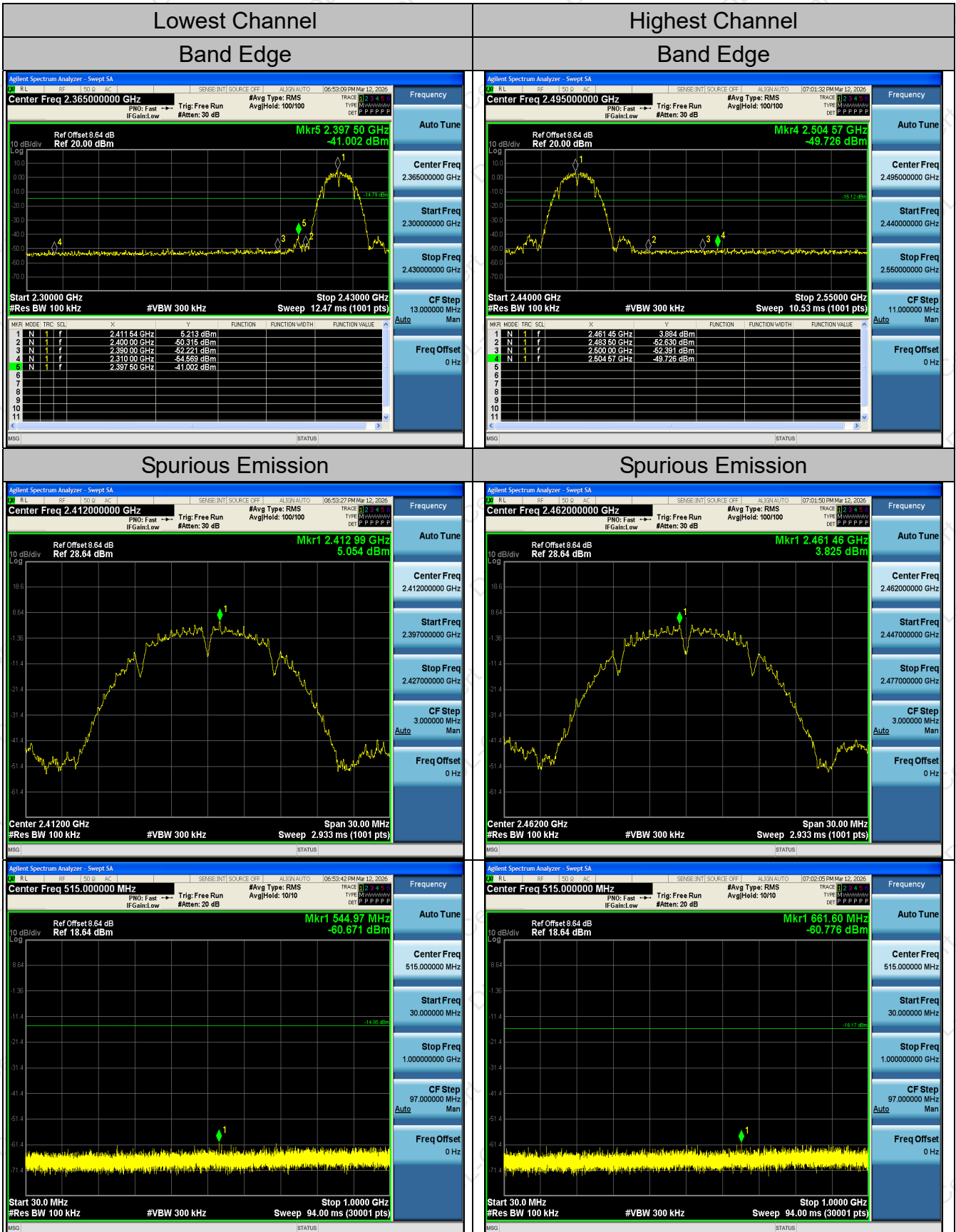
Test Specification

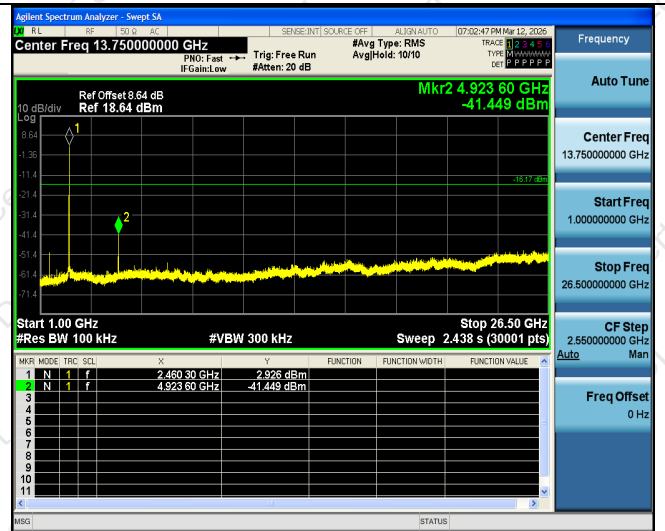
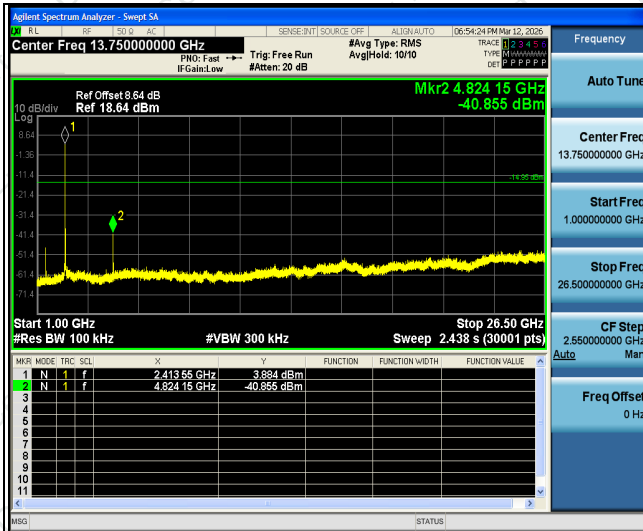
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 15.247 Meas Guidance v05r02
Limit:	In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement and radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).
Test Setup:	 The diagram illustrates the test setup. On the left is a green box labeled 'Spectrum Analyzer'. A black line representing an RF cable connects it to a yellow box on the right labeled 'EUT'.
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC KDB Publication 558074 D01 15.247 Meas Guidance v05r02. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d). 5. Measure and record the results in the test report. 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS



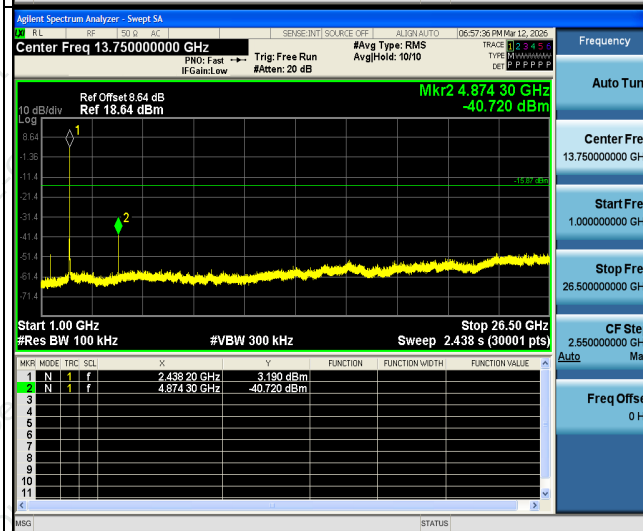
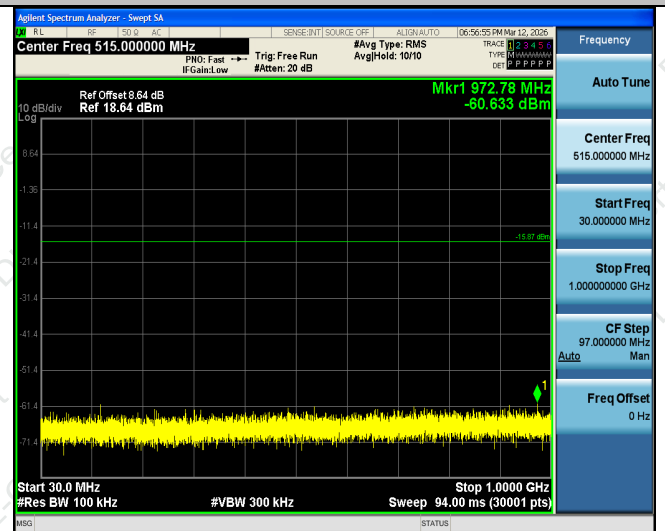
Test Data

802.11b Modulation



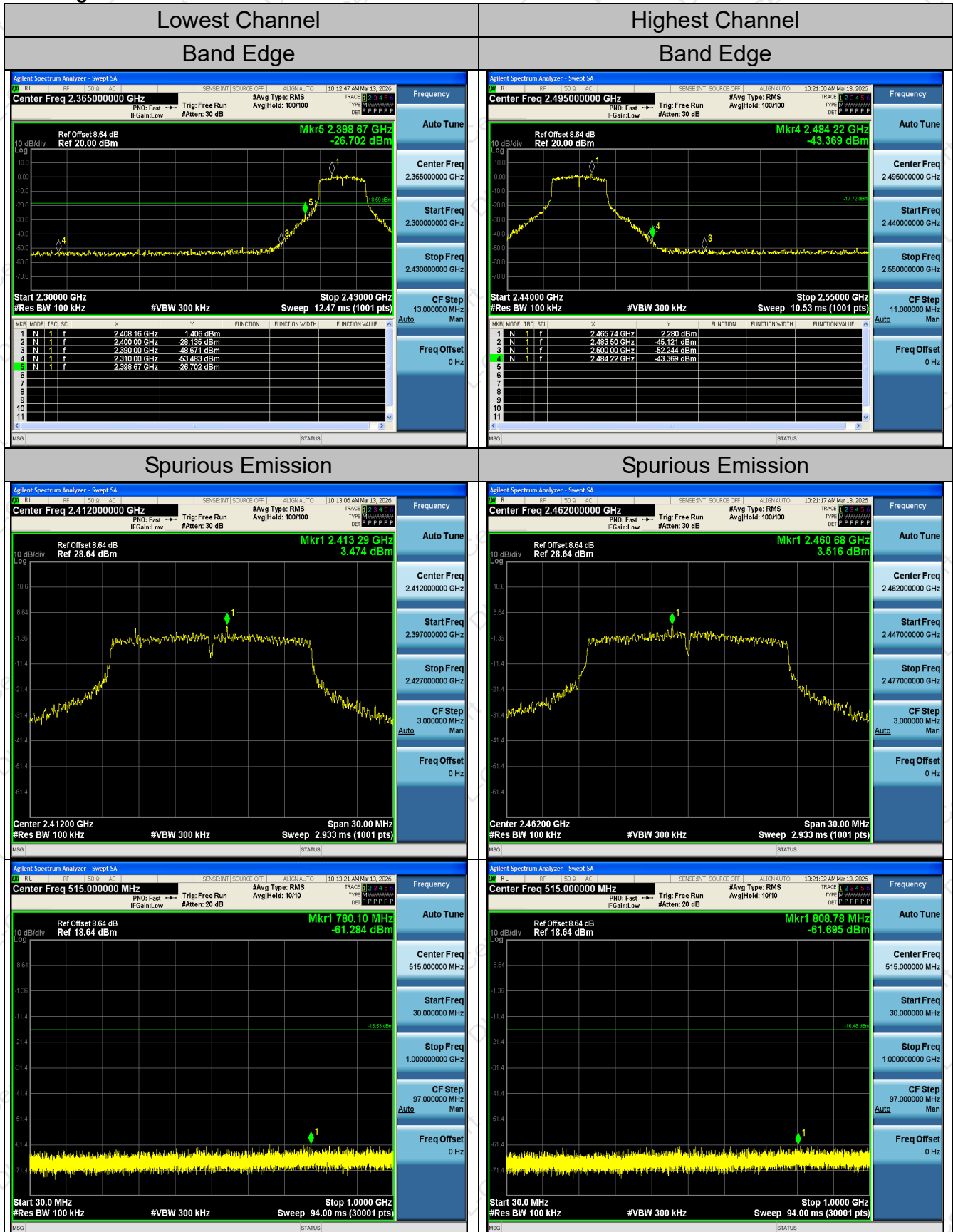


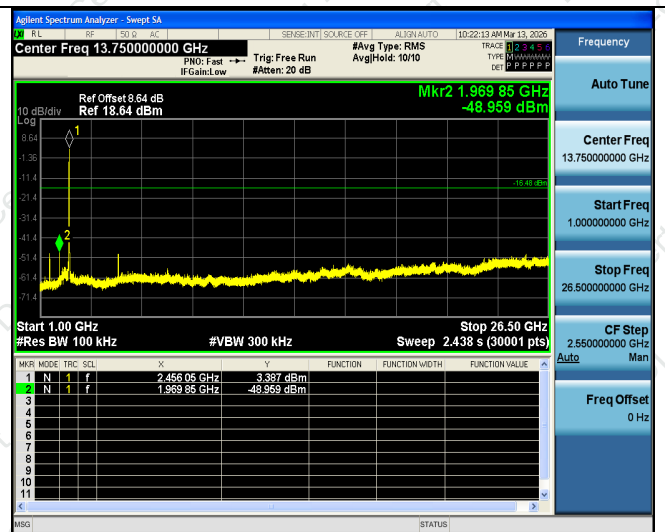
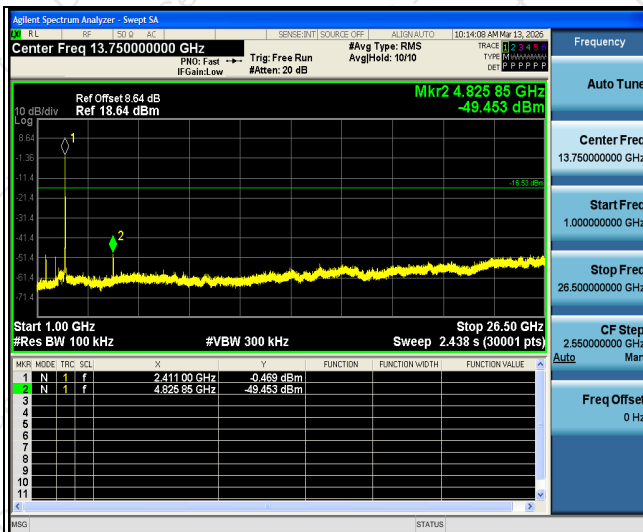
Middle Channel Spurious Emission



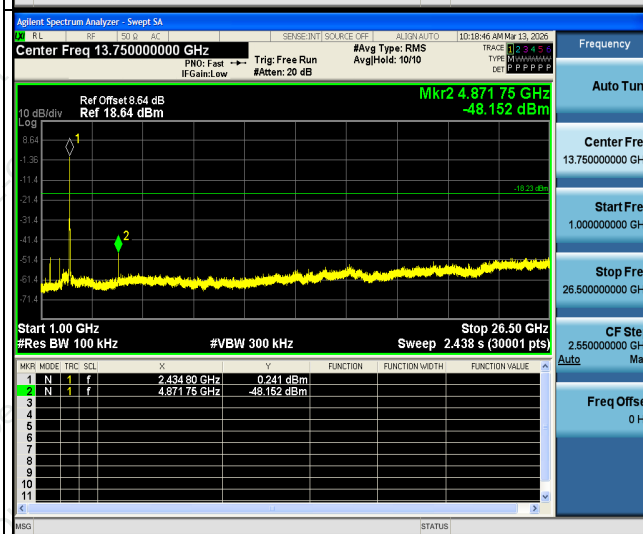
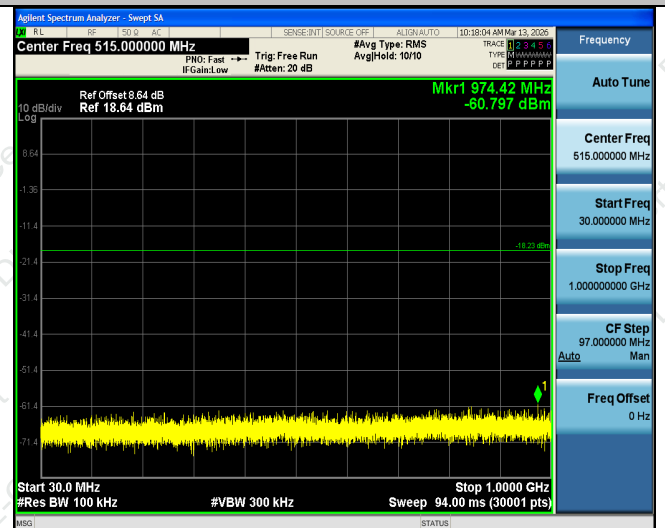


802.11g Modulation





Middle Channel Spurious Emission

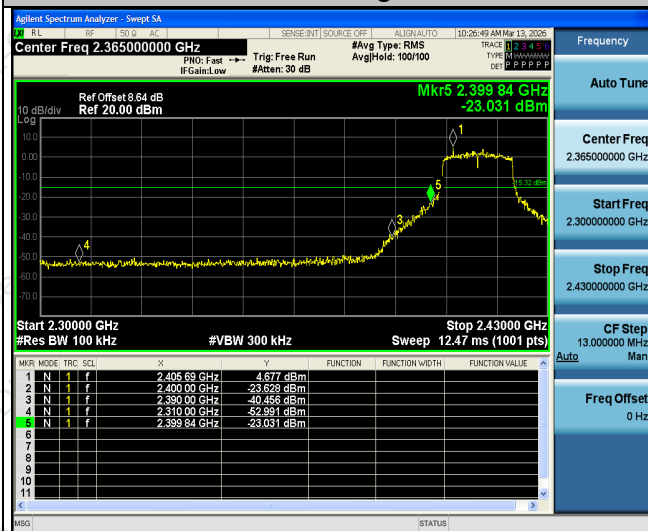




802.11n (HT20) Modulation

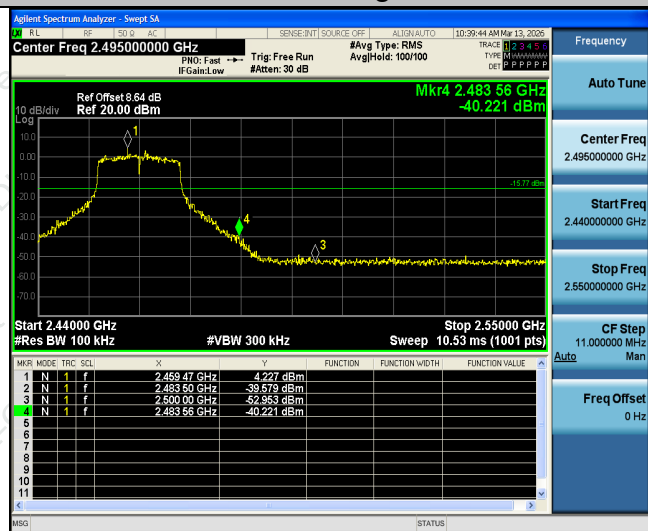
Lowest Channel

Band Edge



Highest Channel

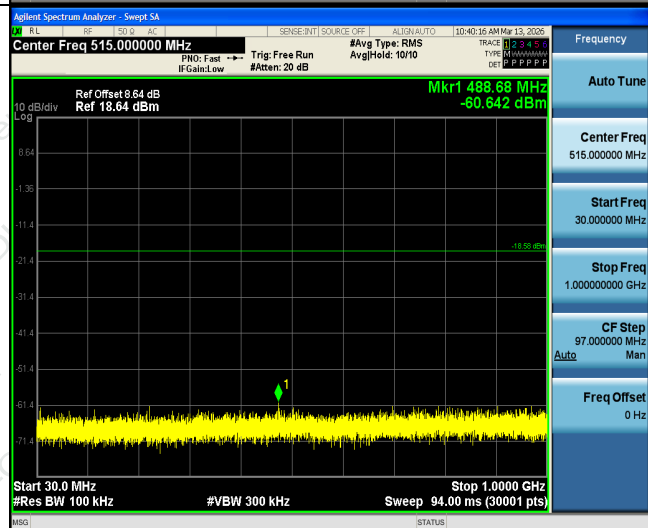
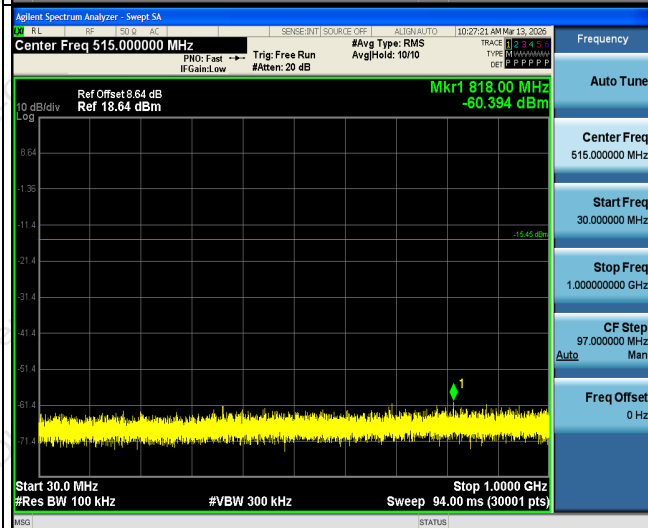
Band Edge

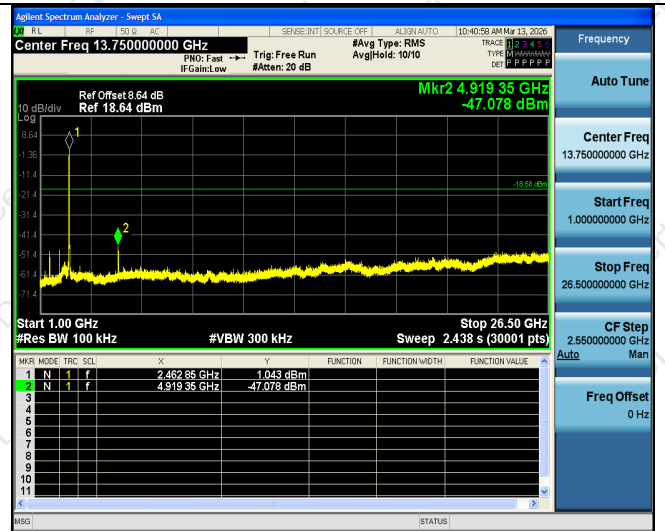
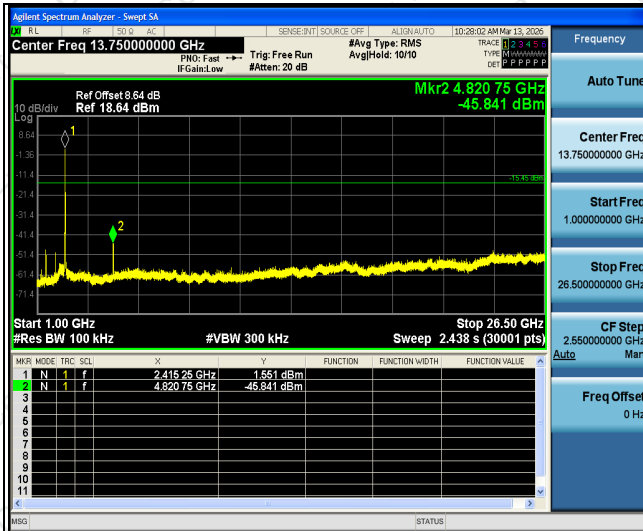


Spurious Emission

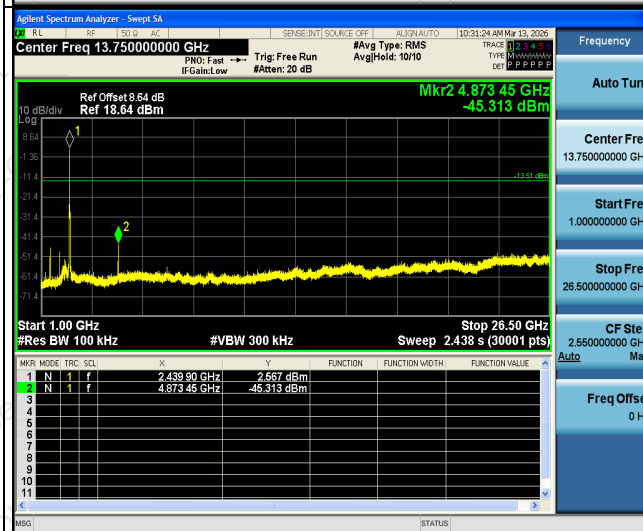
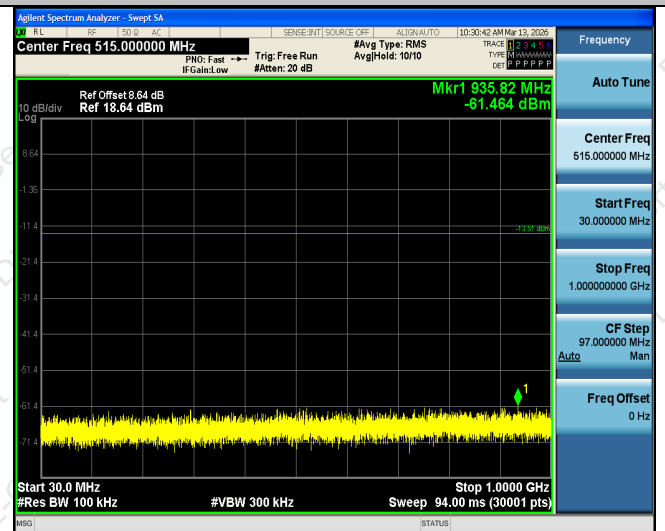


Spurious Emission





Middle Channel Spurious Emission





802.11n (HT40) Modulation

Lowest Channel

Band Edge

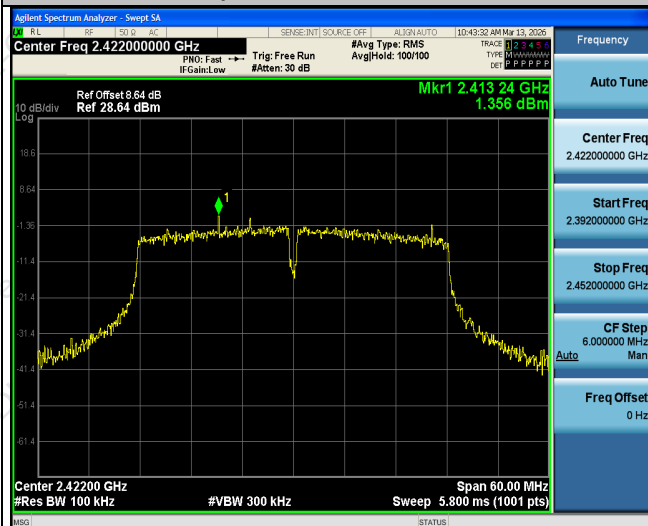


Highest Channel

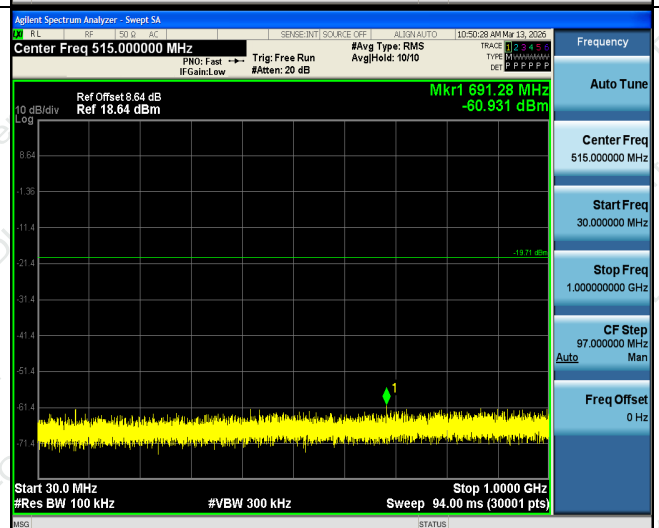
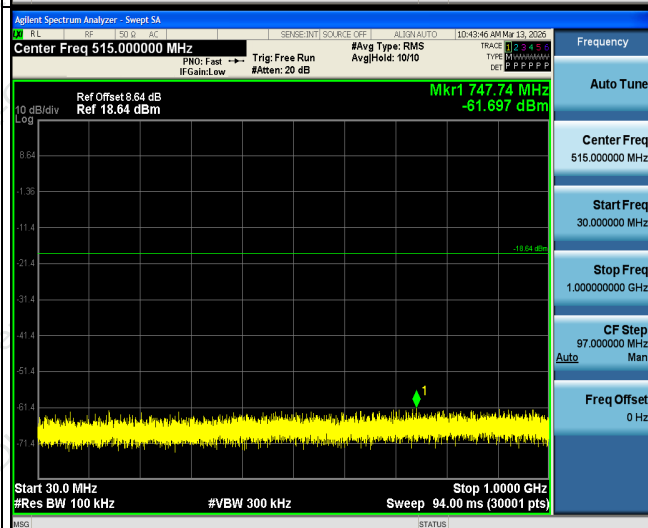
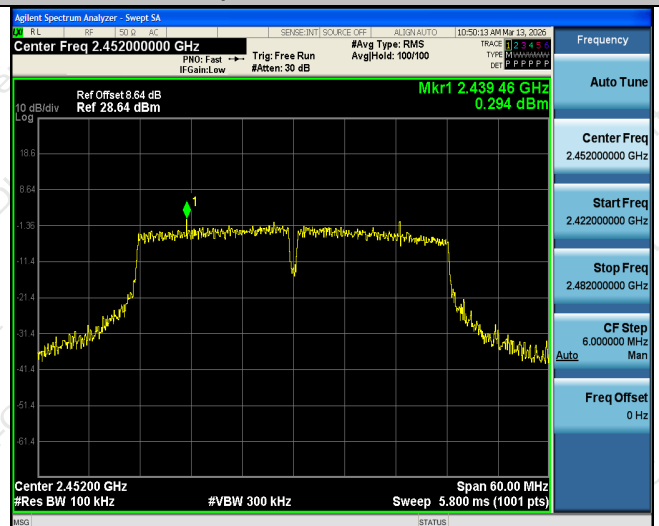
Band Edge

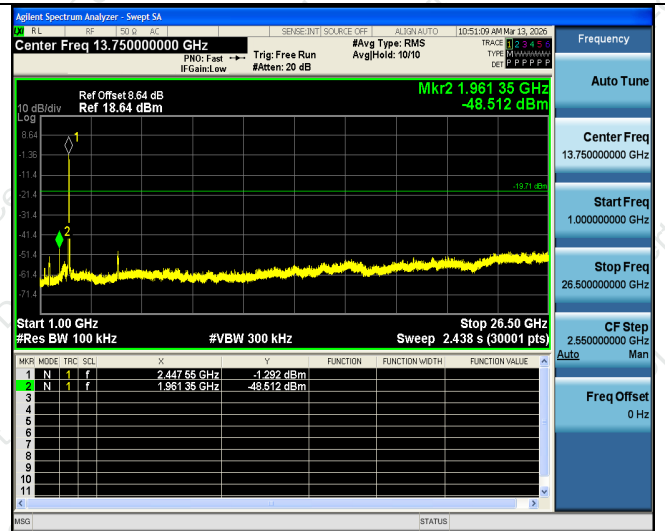
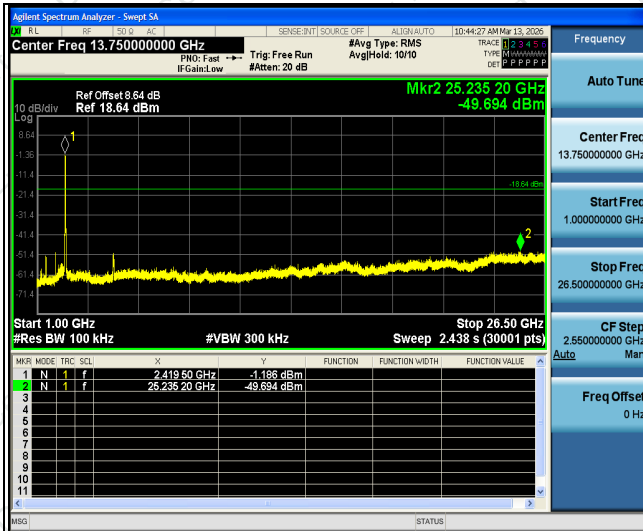


Spurious Emission

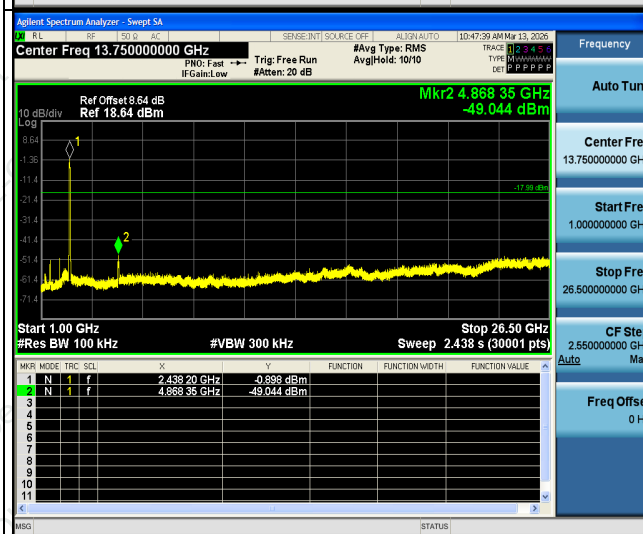
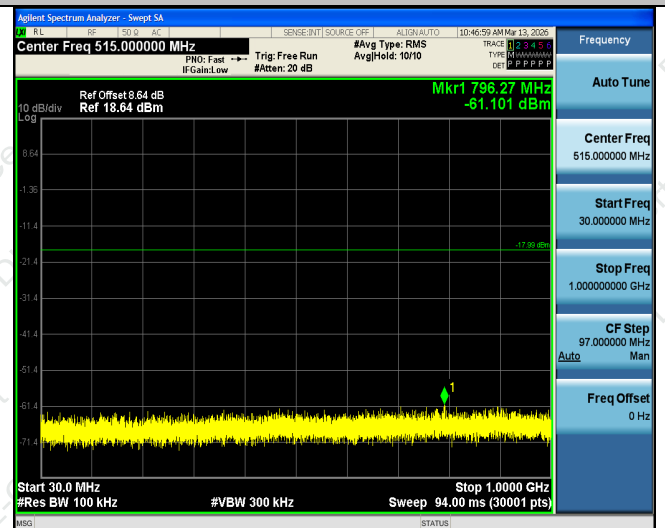
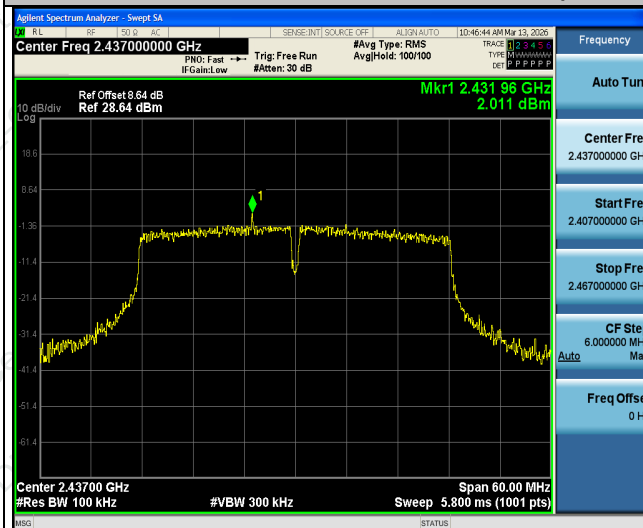


Spurious Emission





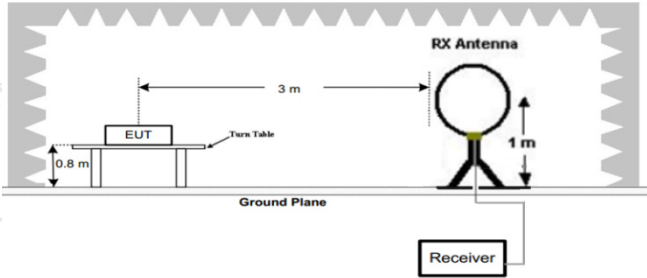
Middle Channel Spurious Emission





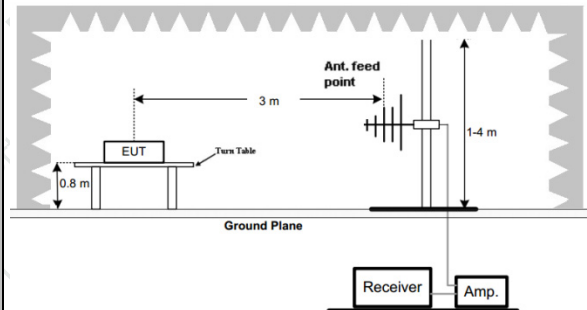
4.6 Radiated Spurious Emission Measurement

Test Specification

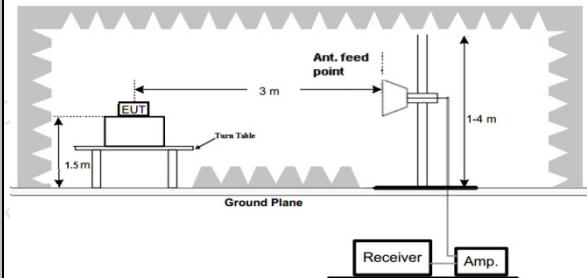
Test Requirement:	FCC Part15 C Section 15.209			
Test Method:	ANSI C63.10: 2020			
Frequency Range:	9 kHz to 26 GHz			
Measurement Distance:	3 m			
Antenna Polarization:	Horizontal & Vertical			
Operation Mode:	Transmitting mode with modulation			
Receiver Setup:	Frequency	Detector	RBW	VBW
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz
	30MHz-1GHz	Quasi-peak	120KHz	300KHz
	Above 1GHz	Peak	1MHz	3MHz
Limit:				Remark
				Quasi-peak Value
				Quasi-peak Value
				Quasi-peak Value
				Peak Value
				Average Value
	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	
	0.009-0.490	2400/F(KHz)	300	
	0.490-1.705	24000/F(KHz)	30	
	1.705-30	30	30	
Test Setup:	Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
	Above 1GHz	500	3	Average
		5000	3	Peak
	For radiated emissions below 30MHz			
				



30MHz to 1GHz



Above 1GHz

**Test Procedure:**

1. For the radiated emission test below 1GHz:
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.
2. For the radiated emission test above 1GHz:
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.



	The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. 3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level 4. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported. 5. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=120 kHz for $f < 1$ GHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold; (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement. 6. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Test Results:	PASS

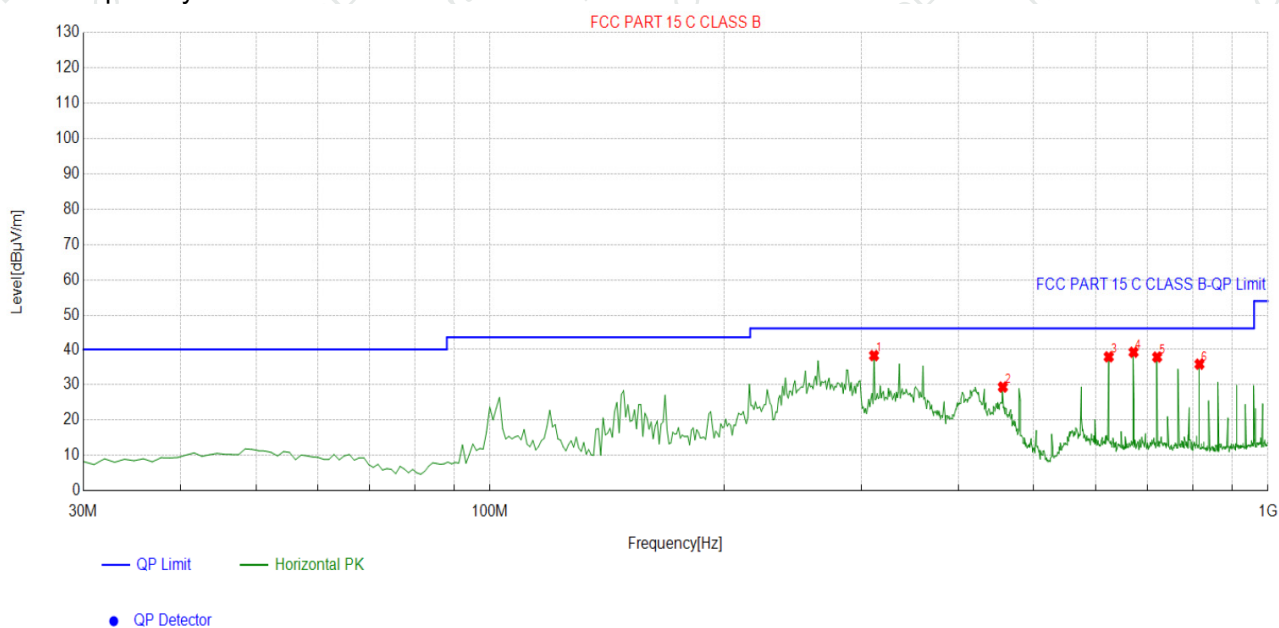


Test Data

Below 1GHz Test Results

All the test modes completed for test. Only the worst result was reported as below:

Antenna polarity: Horizontal

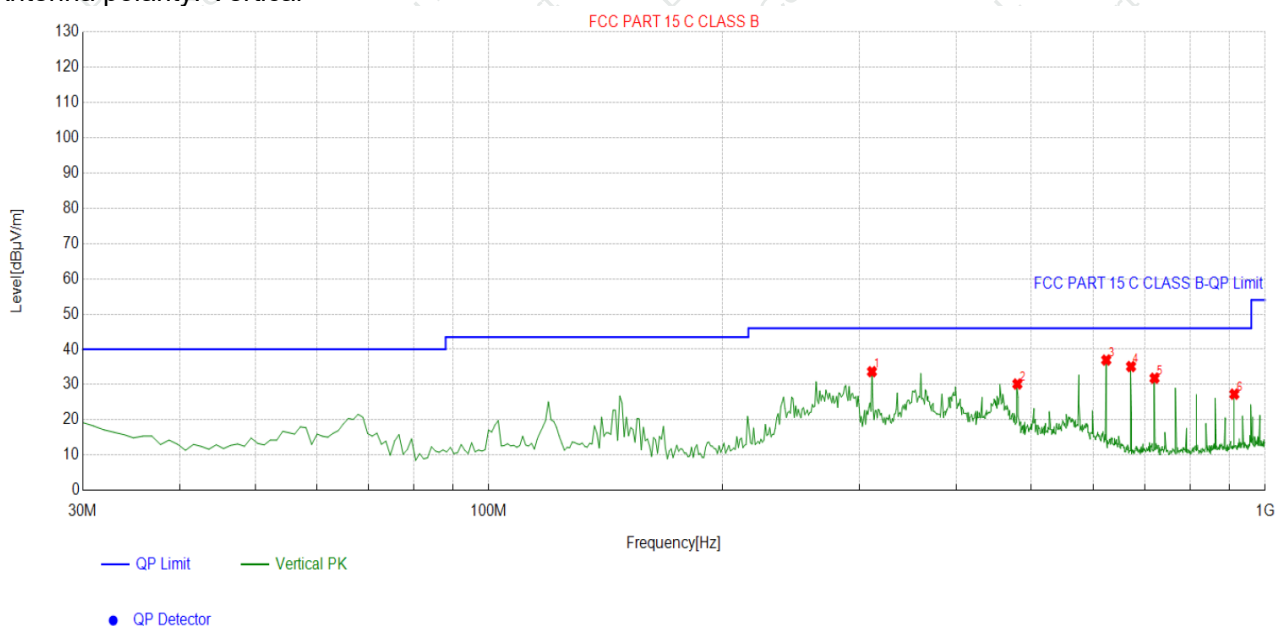


Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	311.582	-11.80	50.09	38.29	46.00	7.71	100	327	Horizontal
2	456.256	-8.81	38.20	29.39	46.00	16.61	100	334	Horizontal
3	624.234	-5.19	43.12	37.93	46.00	8.07	100	127	Horizontal
4	671.812	-4.45	43.69	39.24	46.00	6.76	100	130	Horizontal
5	720.360	-3.96	41.82	37.86	46.00	8.14	100	119	Horizontal
6	816.486	-2.25	38.11	35.86	46.00	10.14	100	160	Horizontal

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



Antenna polarity: Vertical



Suspected List

NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	311.582	-11.80	45.48	33.68	46.00	12.32	100	39	Vertical
2	479.560	-8.19	38.38	30.19	46.00	15.81	100	256	Vertical
3	624.234	-5.19	42.16	36.97	46.00	9.03	100	307	Vertical
4	671.812	-4.45	39.58	35.13	46.00	10.87	100	17	Vertical
5	720.360	-3.96	35.78	31.82	46.00	14.18	100	318	Vertical
6	912.613	-1.23	28.54	27.31	46.00	18.69	100	39	Vertical

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level

Harmonics and Spurious Emissions

Frequency Range (9kHz-30MHz)

Frequency (MHz)	Level@3m (dBμV/m)	Limit@3m (dBμV/m)
--	--	--
--	--	--
--	--	--
--	--	--

Note:1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor.

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement.

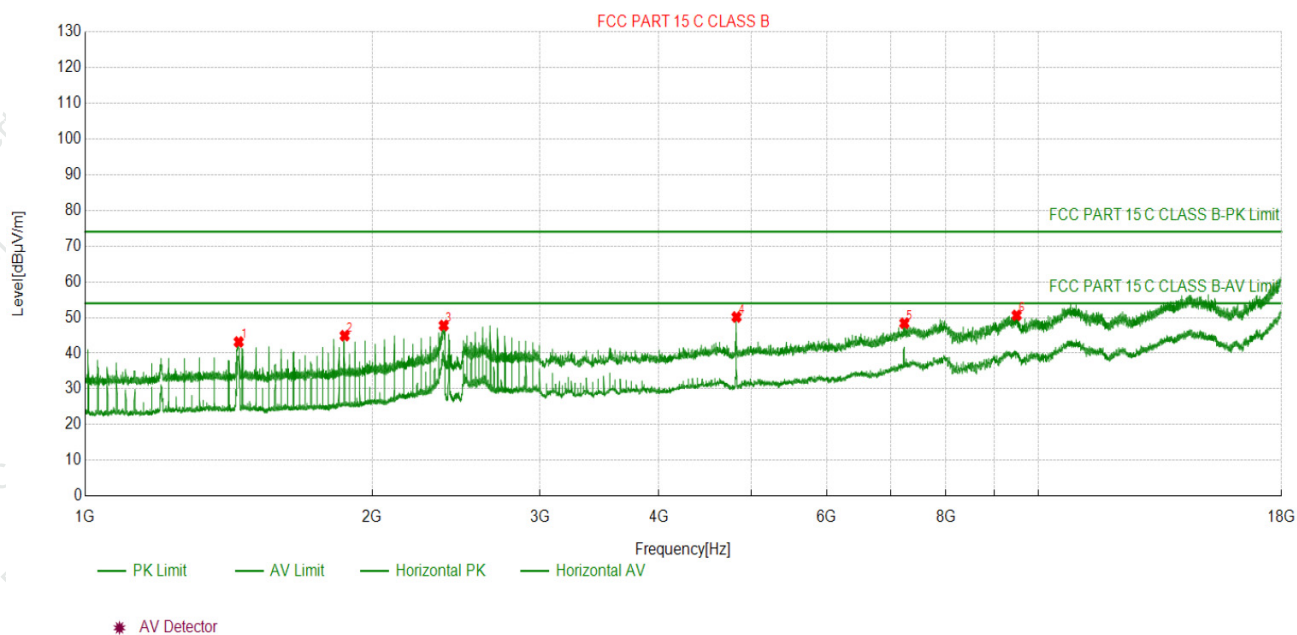


Above 1GHz Test Results

All the test modes completed for test. Only the worst result was reported as below:

For 1GHz to 18GHz

Antenna polarity: Horizontal

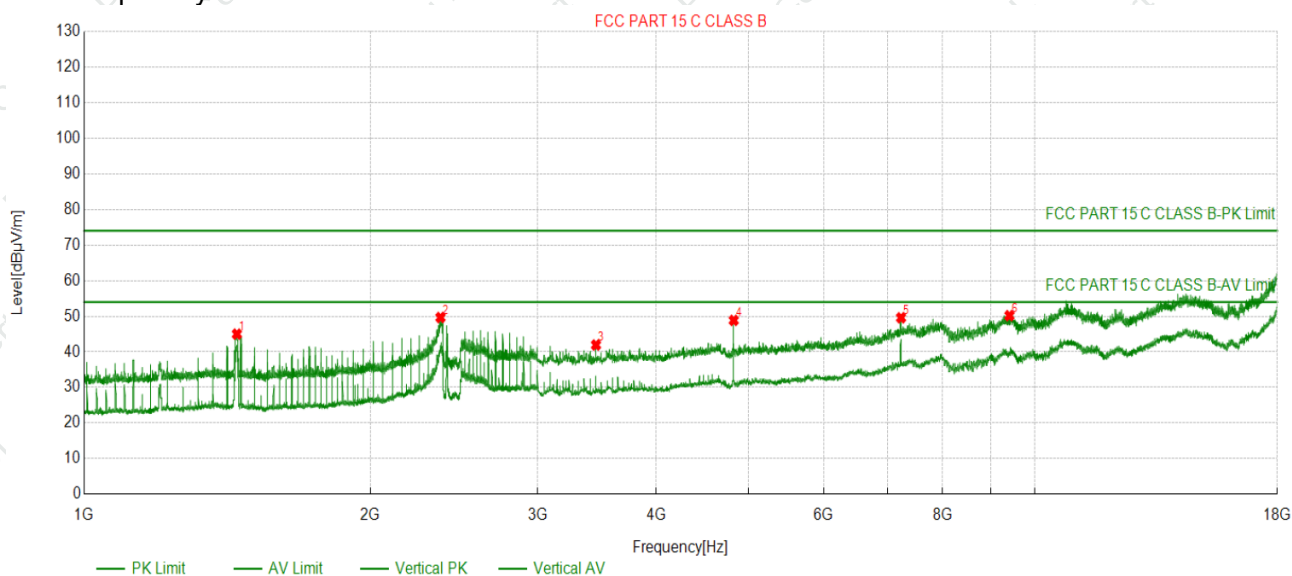


Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	PK Level [dBμV/m]	Factor [dB]	PK Limit [dBμV/m]	PK Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1449.245	61.67	43.17	-18.50	74.00	30.83	150	87	Horizontal
2	1872.087	62.15	44.92	-17.23	74.00	29.08	150	105	Horizontal
3	2377.938	62.28	47.77	-14.51	74.00	26.23	150	124	Horizontal
4	4824.182	60.06	50.14	-9.92	74.00	23.86	150	326	Horizontal
5	7236.424	52.17	48.40	-3.77	74.00	25.60	150	111	Horizontal
6	9491.149	50.55	50.61	0.06	74.00	23.39	150	141	Horizontal

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



Antenna polarity: Vertical



* AV Detector

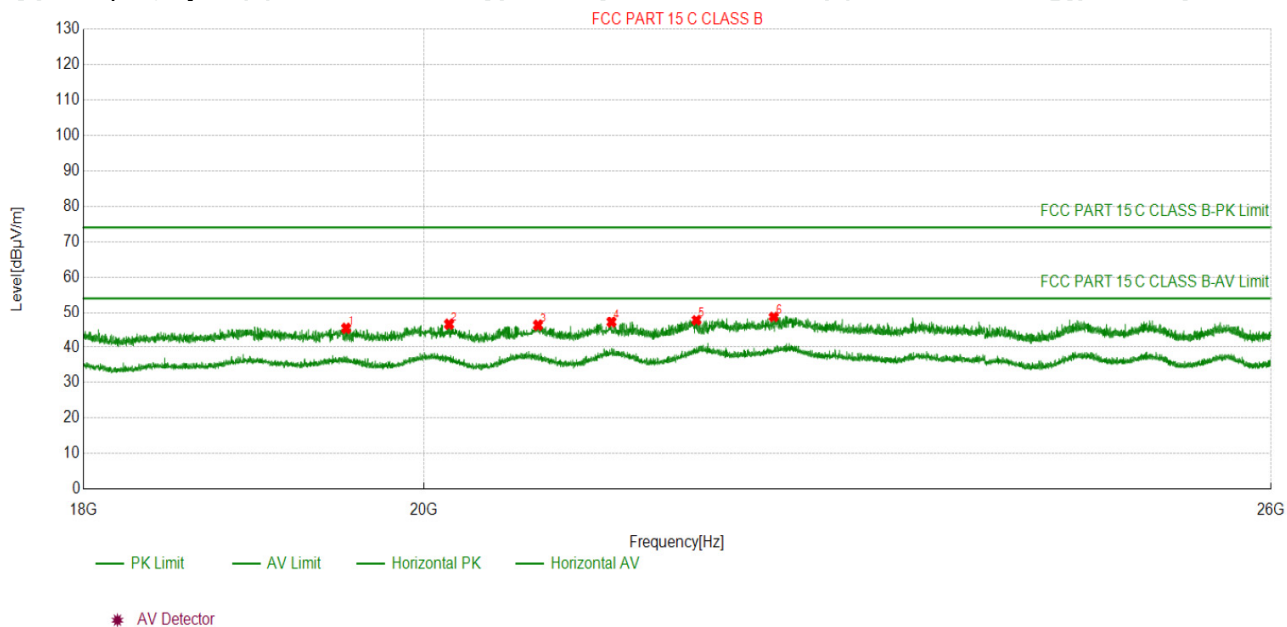
Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	PK Level [dBμV/m]	Factor [dB]	PK Limit [dBμV/m]	PK Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1448.045	63.50	45.00	-18.50	74.00	29.00	150	360	Vertical
2	2371.137	64.16	49.66	-14.50	74.00	24.34	150	34	Vertical
3	3456.046	55.32	41.94	-13.38	74.00	32.06	150	2	Vertical
4	4824.182	58.76	48.84	-9.92	74.00	25.16	150	212	Vertical
5	7234.923	53.35	49.58	-3.77	74.00	24.42	150	82	Vertical
6	9407.141	50.92	50.17	-0.75	74.00	23.83	150	115	Vertical

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



For 18GHz to 26GHz

Antenna polarity: Horizontal



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	PK Level [dBμV/m]	Factor [dB]	PK Limit [dBμV/m]	PK Margin [dB]	Height [cm]	Angle [°]	Polarity
1	19525.753	39.19	45.29	6.10	74.00	28.71	150	210	Horizontal
2	20157.816	40.34	46.45	6.11	74.00	27.55	150	320	Horizontal
3	20720.272	40.43	46.17	5.74	74.00	27.83	150	220	Horizontal
4	21197.120	41.80	47.09	5.29	74.00	26.91	150	350	Horizontal
5	21761.976	42.17	47.69	5.52	74.00	26.31	150	340	Horizontal
6	22289.229	42.92	48.64	5.72	74.00	25.36	150	320	Horizontal

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



Antenna polarity: Vertical



Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	PK Level [dBμV/m]	Factor [dB]	PK Limit [dBμV/m]	PK Margin [dB]	Height [cm]	Angle [°]	Polarity
1	19991.399	40.00	46.21	6.21	74.00	27.79	150	220	Vertical
2	20558.656	40.17	46.09	5.92	74.00	27.91	150	250	Vertical
3	21273.127	41.73	47.01	5.28	74.00	26.99	150	190	Vertical
4	21809.181	42.33	47.90	5.57	74.00	26.10	150	100	Vertical
5	23323.732	42.00	47.67	5.67	74.00	26.33	150	310	Vertical
6	24479.848	42.03	47.74	5.71	74.00	26.26	150	300	Vertical

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



4.7 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247, if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance.

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Antenna Connected Construction

The antenna used in this product is a External Antenna, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 3.6dBi.

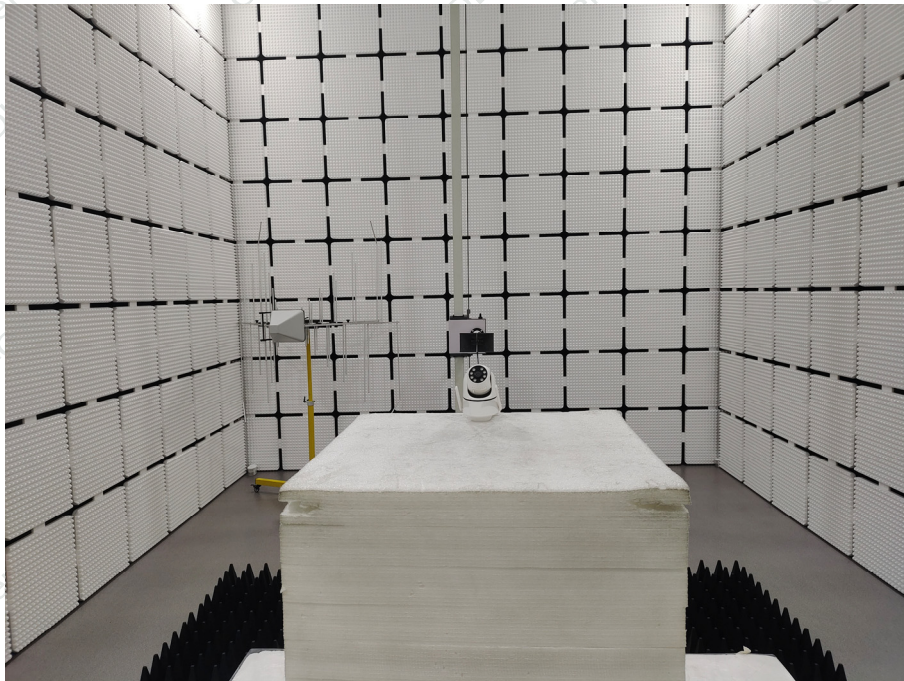
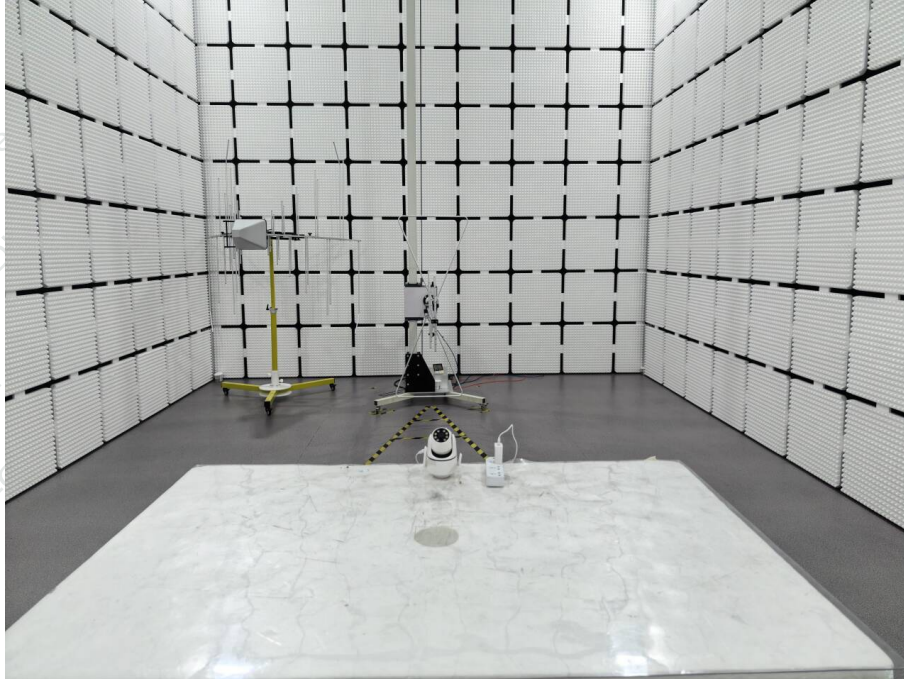
WIFI ANTENNA





5. Test Setup Photos of the EUT

Radiated Emission

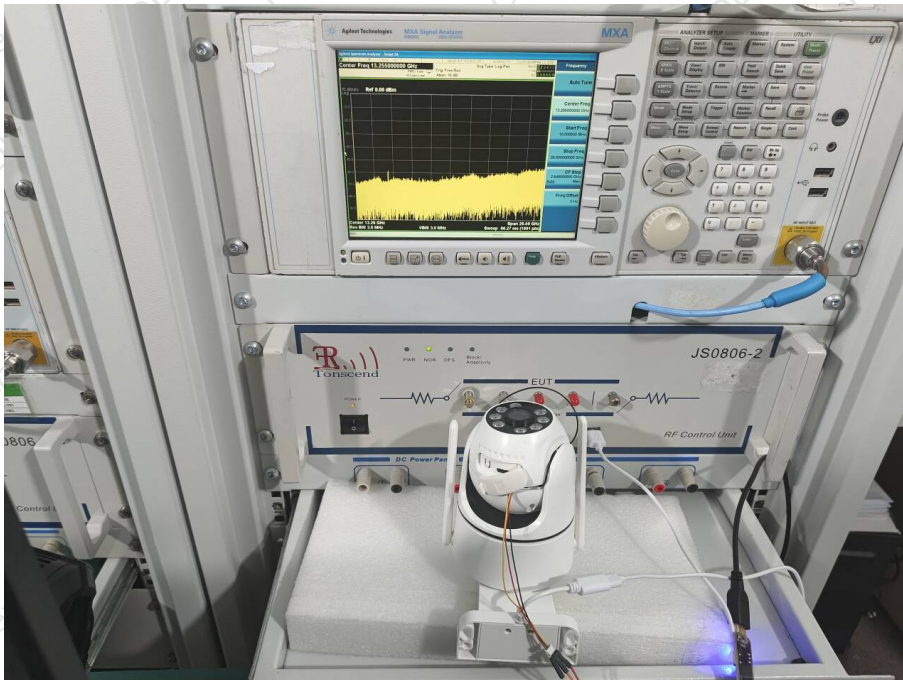




AC Conducted Emission



RF Conducted Emission





6. Photos of the EUT

Reference to the report: ANNEX A of external photos and ANNEX B of internal photos.

-----End of test report-----