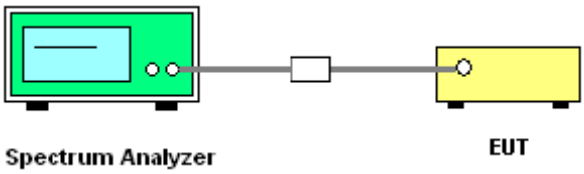
4.5 Conducted Band Edge and Spurious Emission Measurement

4.5.1 Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB558074 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:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. 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

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4.5.2 Test Instruments

RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-025	Feb. 20, 2024	Feb. 19, 2025
RF cable	Times	1-40G	HKE-034	Feb. 20, 2024	Feb. 19, 2025
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Feb. 20, 2024	Feb. 19, 2025
RF Test Software	Tonscend	JS1120-3 Version 3.3.23	HKE-083	N/A	N/A

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

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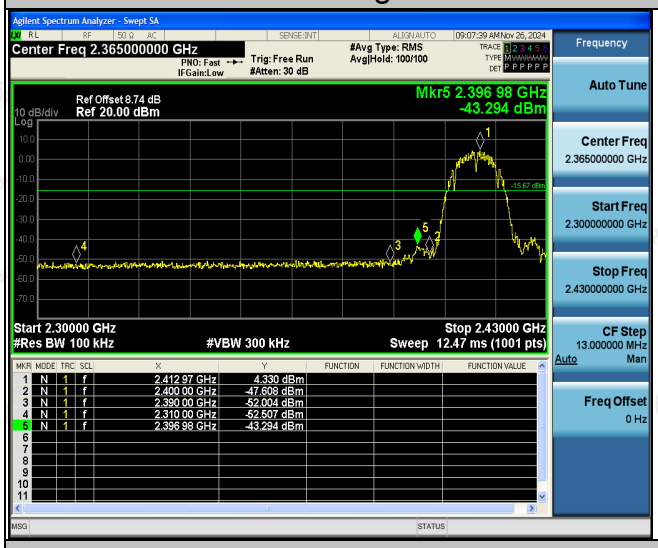
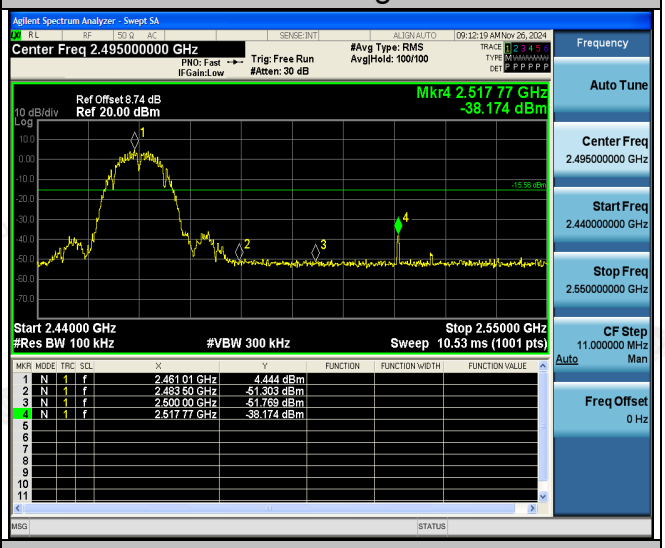
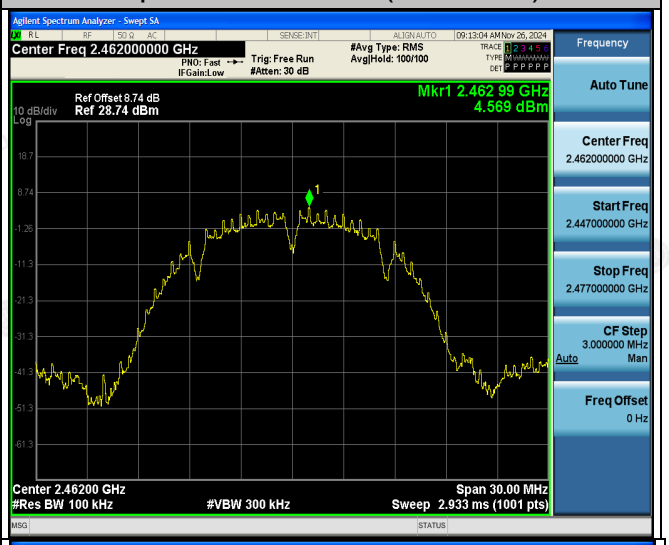
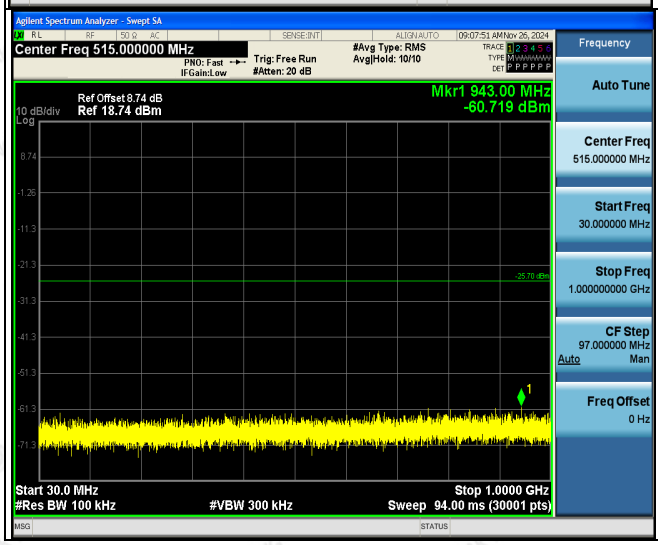
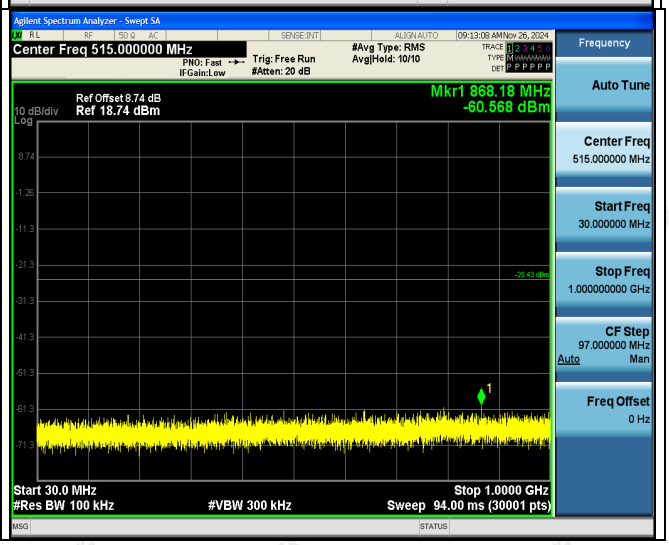
4.5.3 Test Data

802.11b Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious Emission(2412MHz)	Spurious Emission(2462MHz)
	
	

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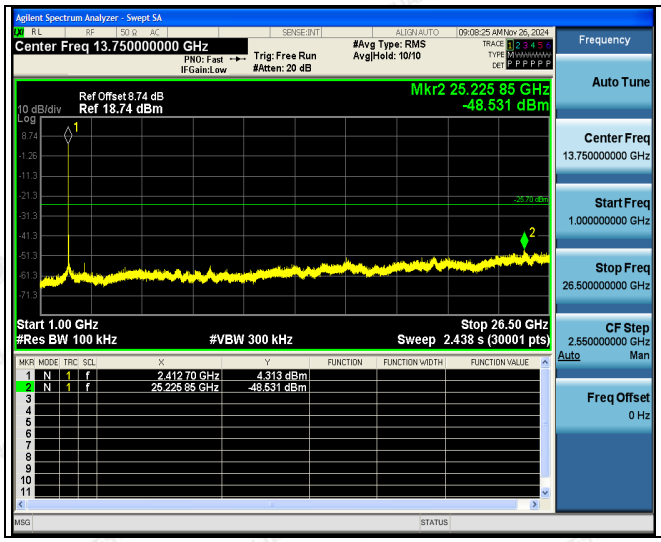
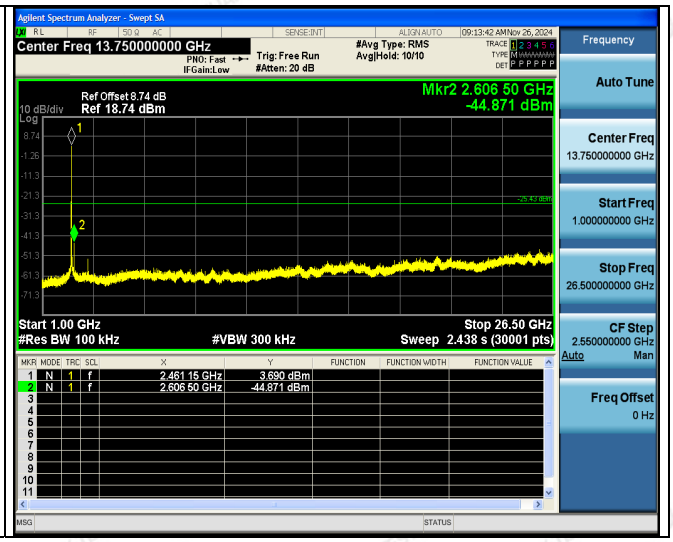
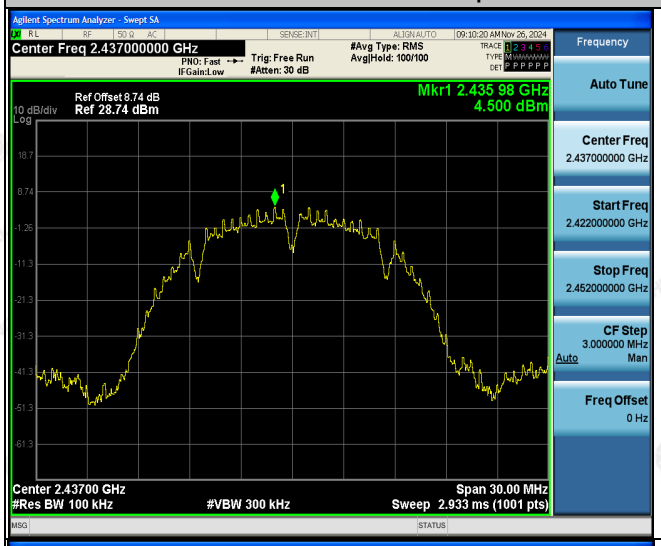
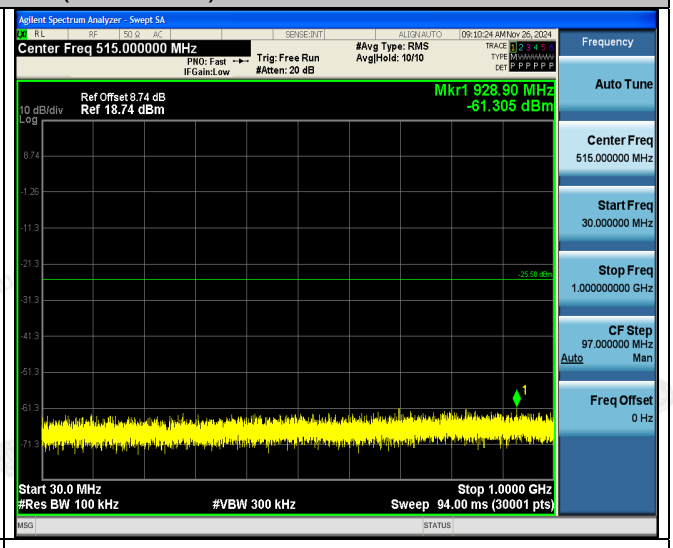
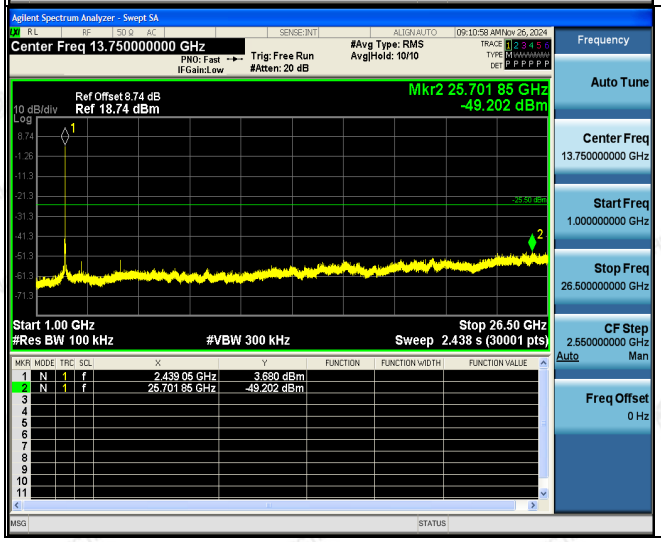




Spurious Emission(2437MHz)







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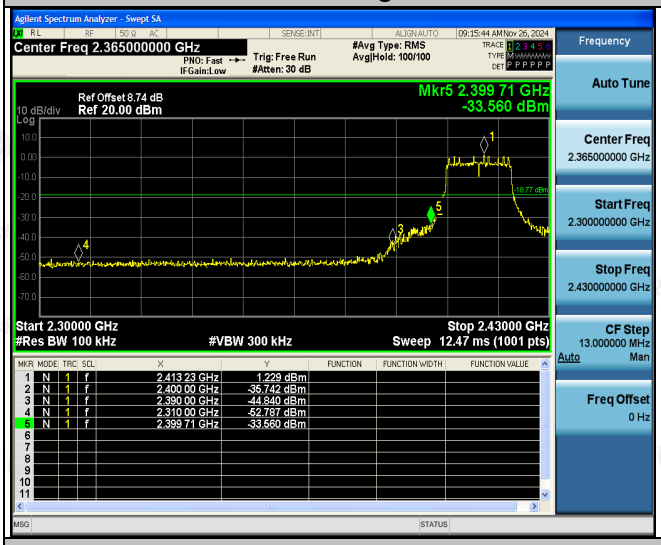
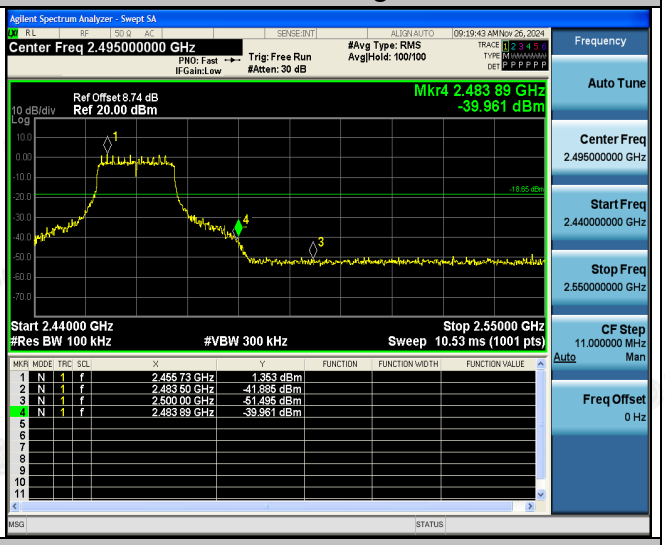
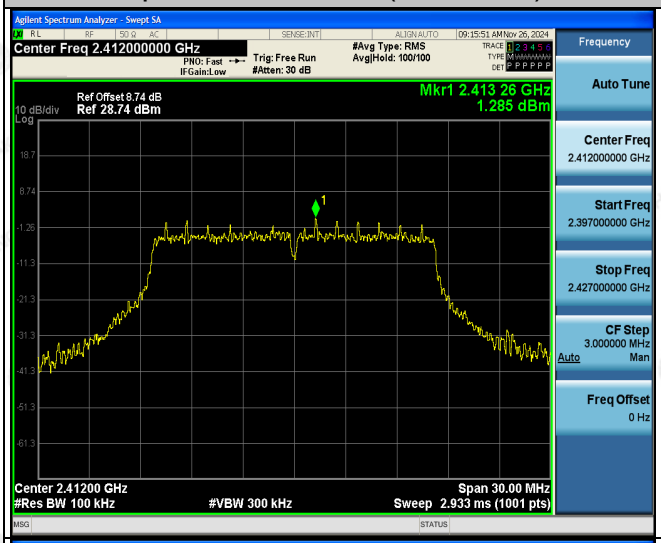
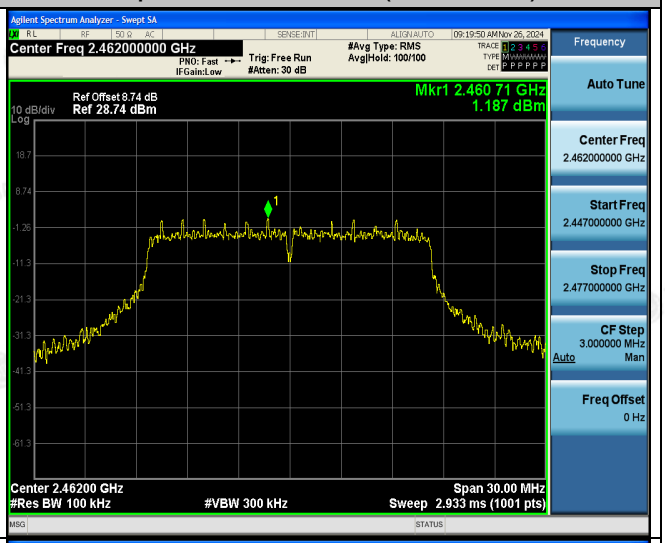
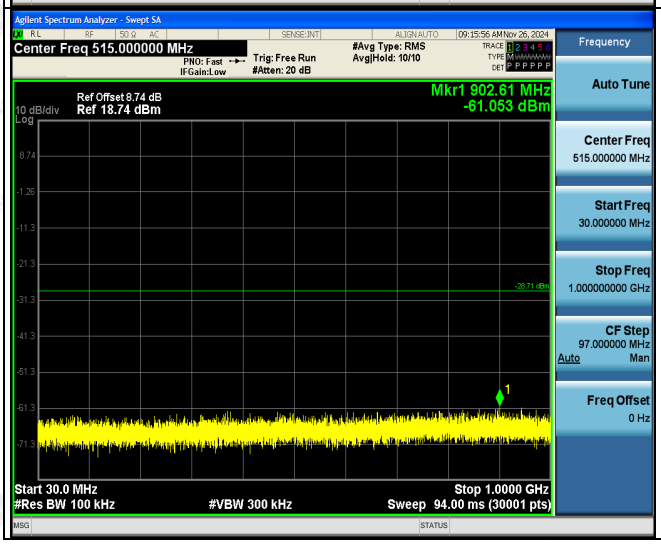
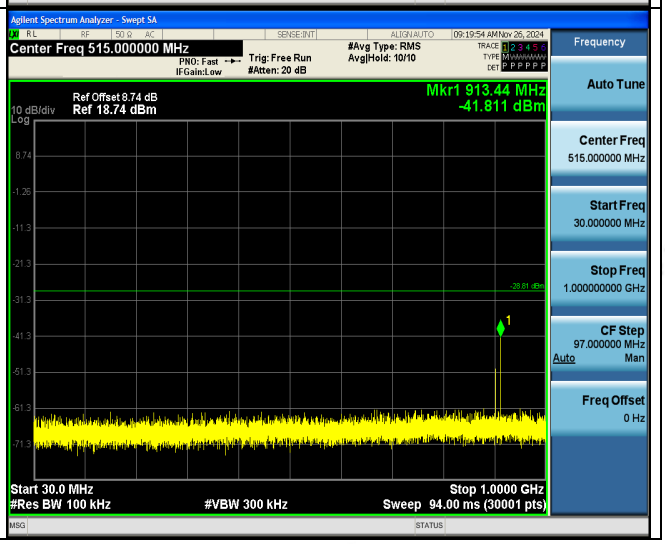
802.11g Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious Emission(2412MHz)	Spurious Emission(2462MHz)
	
	

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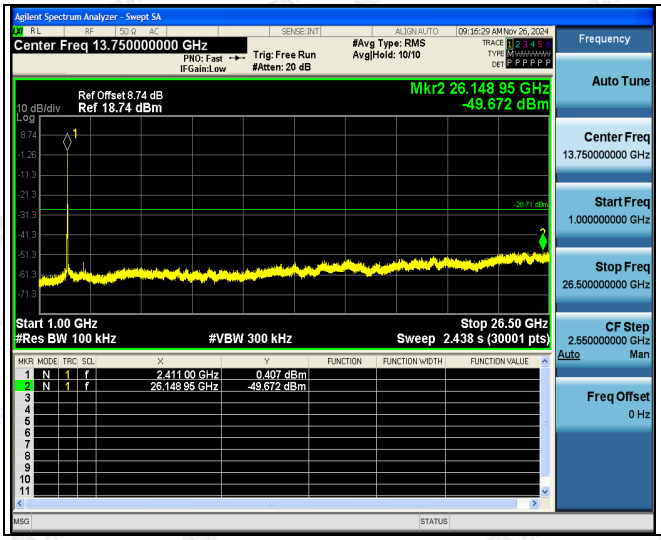
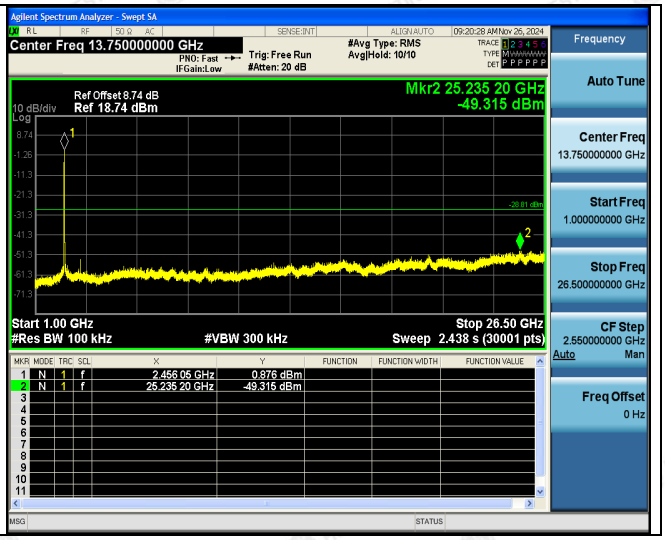
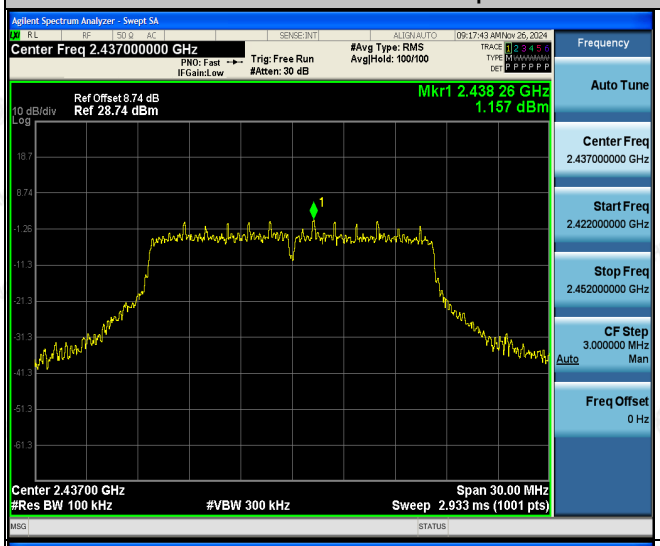
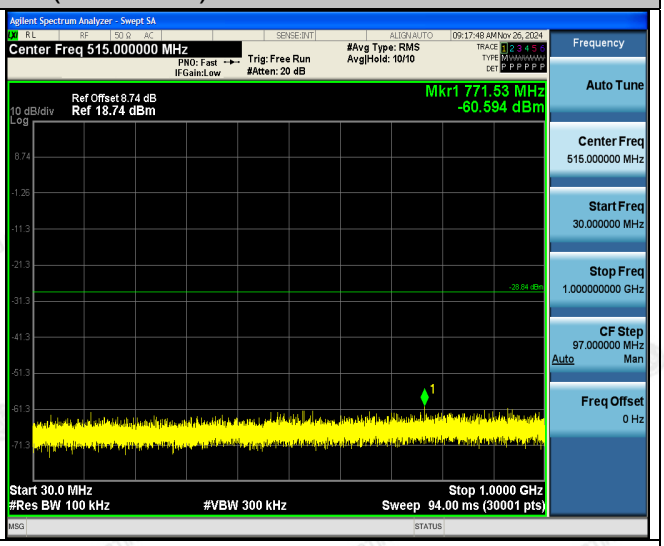
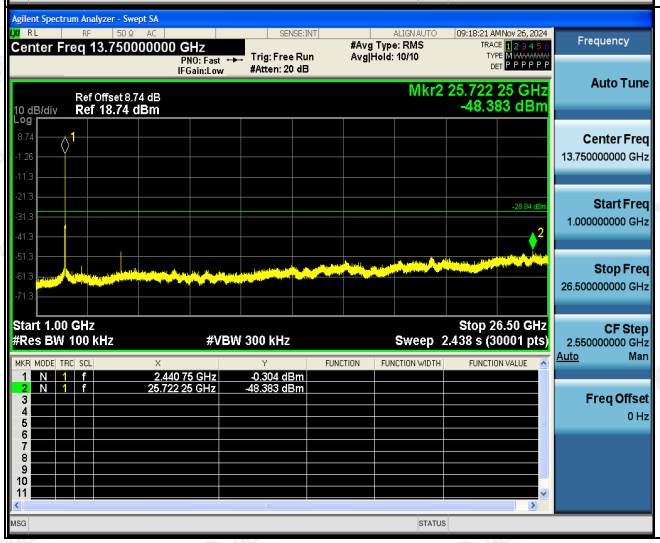




Spurious Emission(2437MHz)







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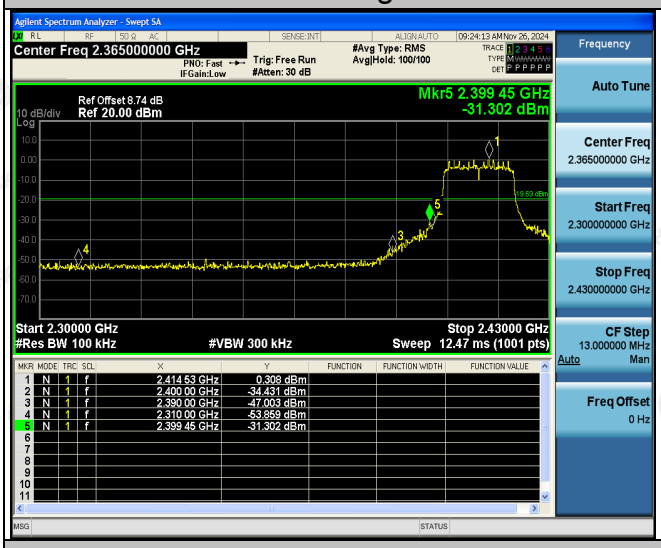
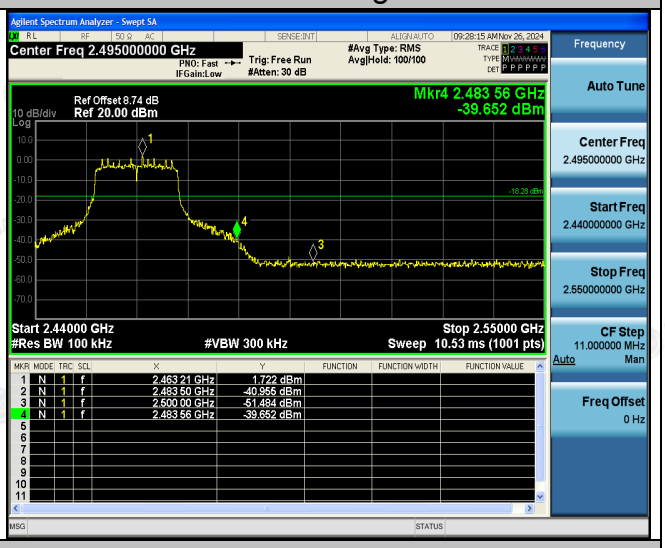
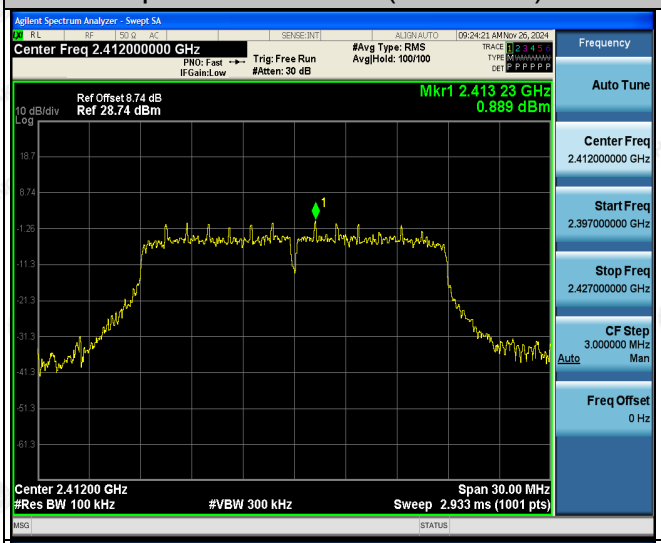
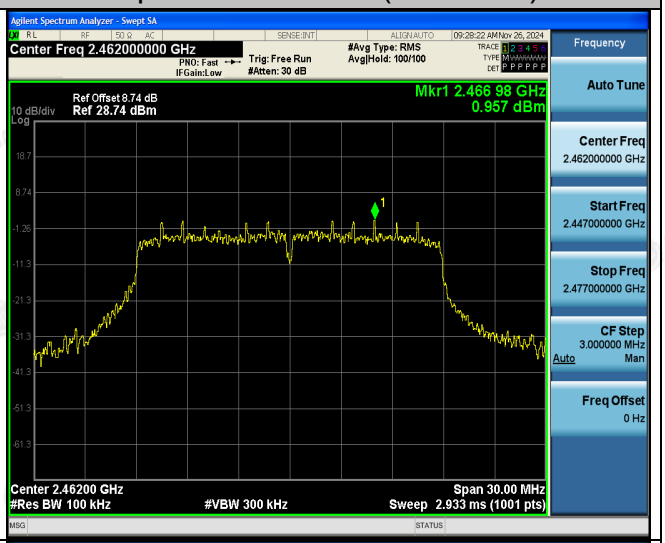
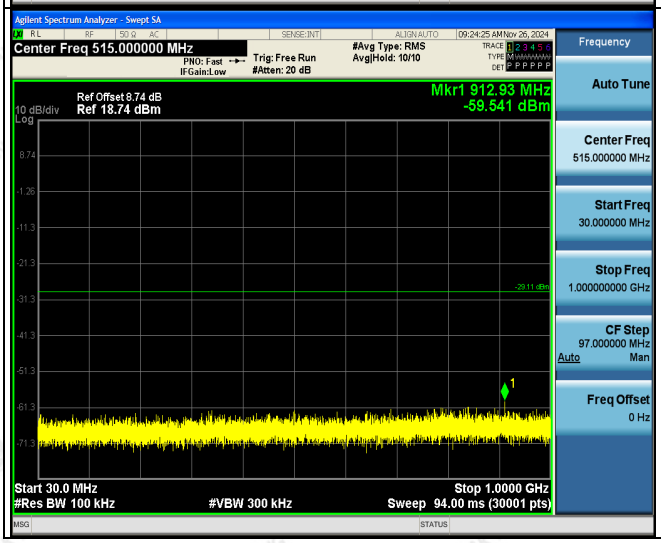
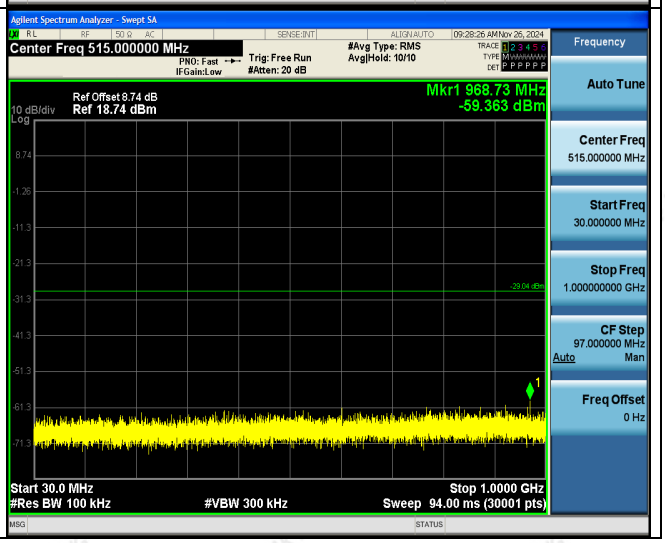
802.11n (HT20) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious Emission(2412MHz)	Spurious Emission(2462MHz)
	
	

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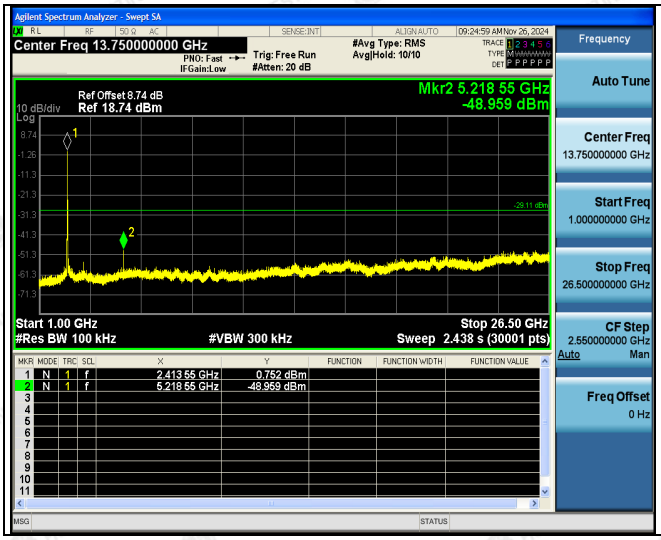
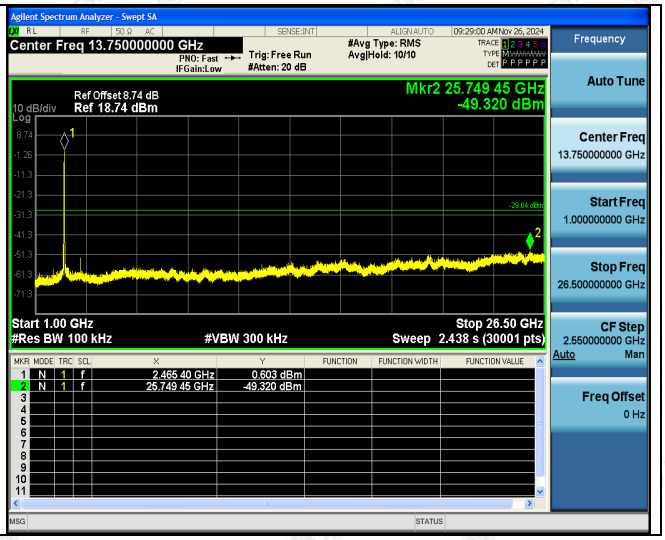
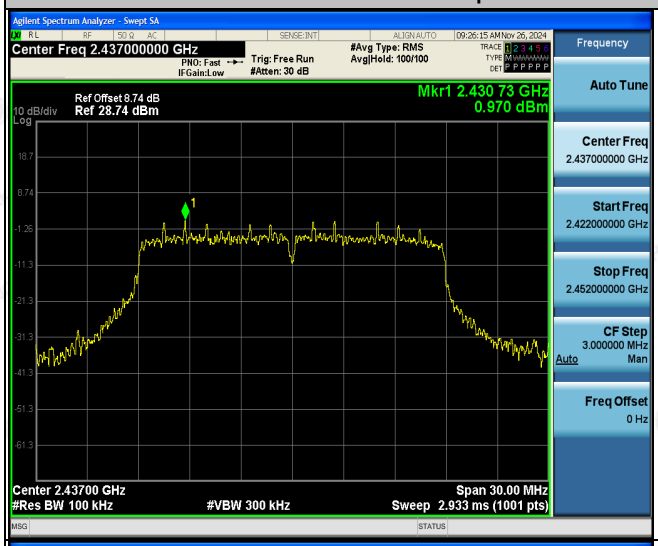
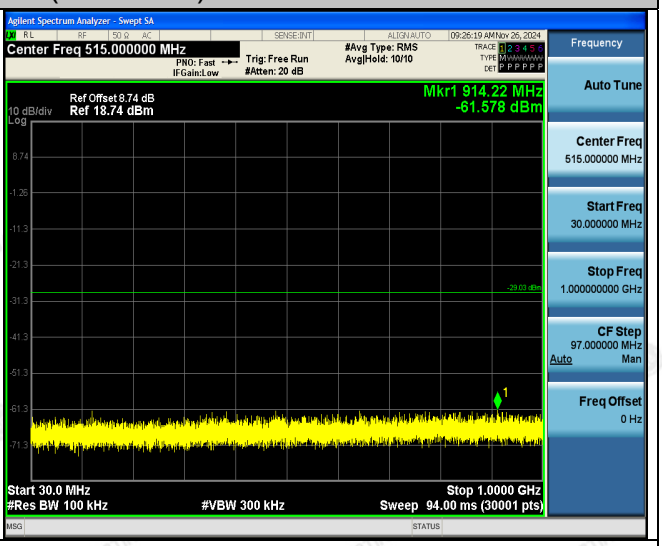
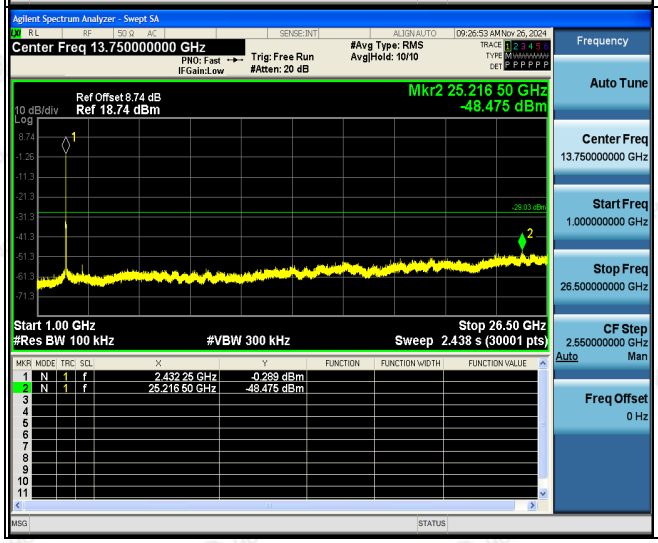




Spurious Emission(2437MHz)







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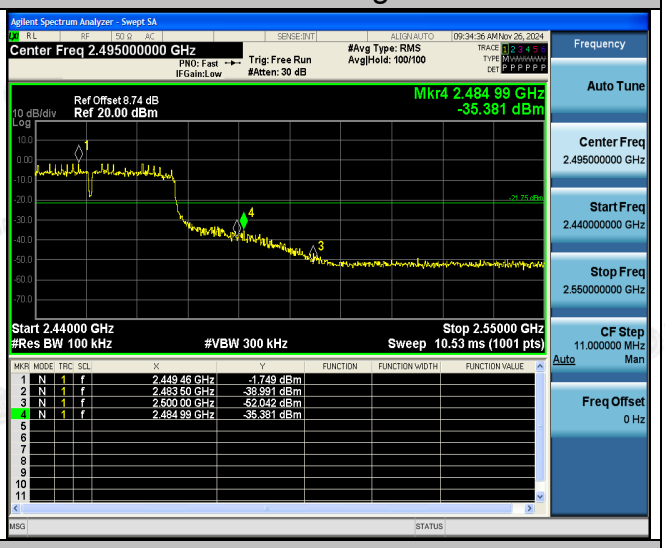
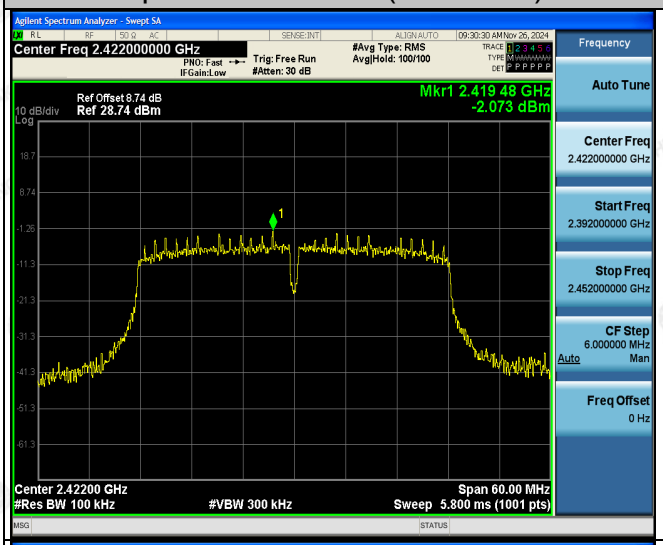
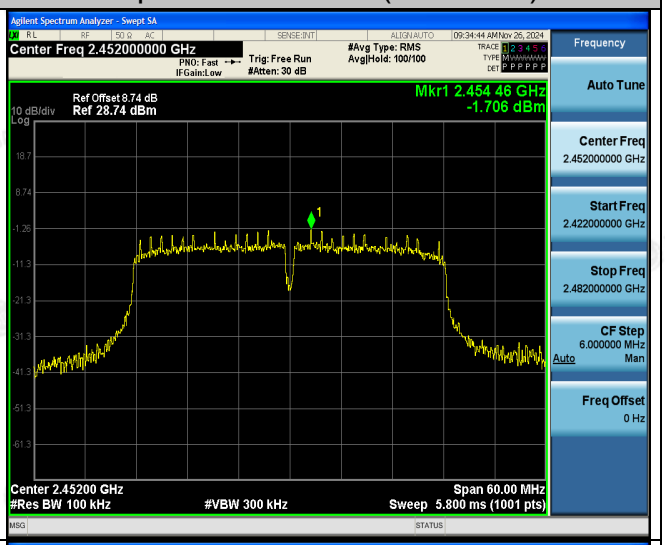
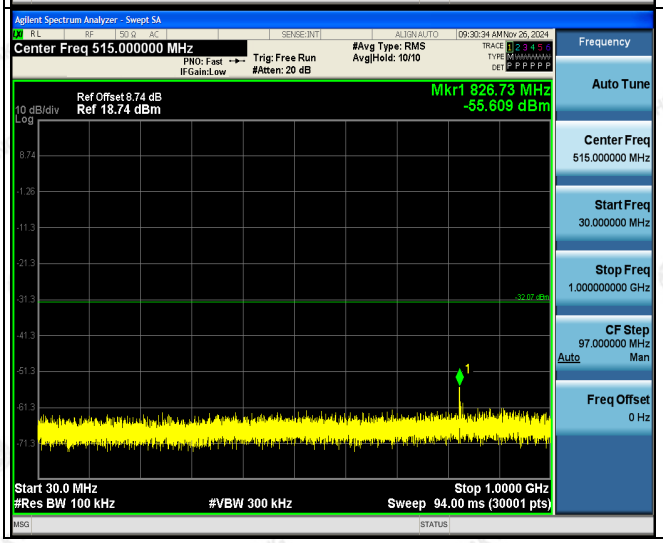
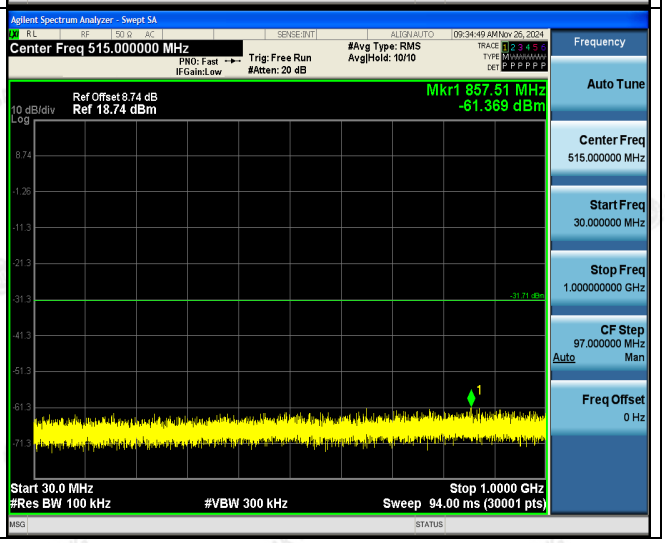
802.11n (HT40) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious Emission(2422MHz)	Spurious Emission(2452MHz)
	
	

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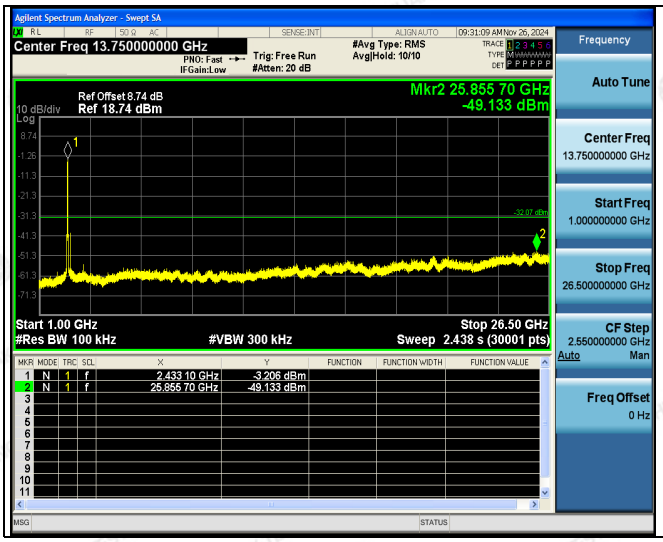
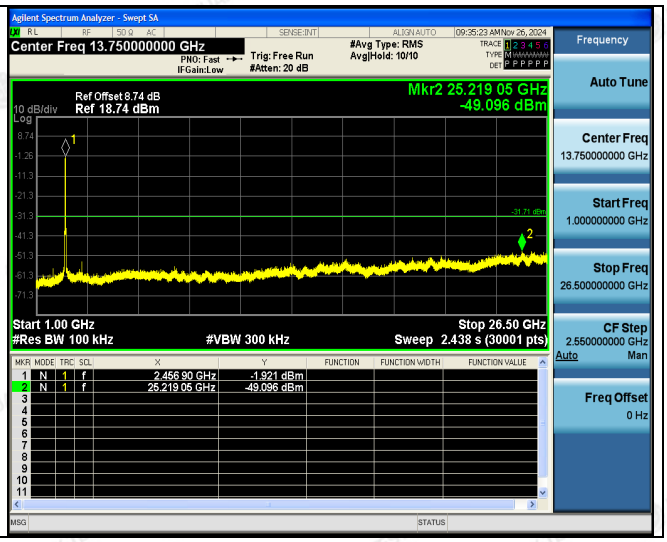
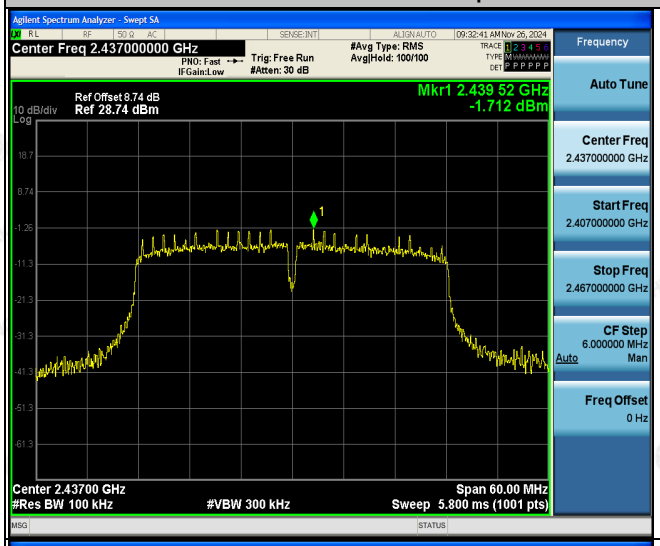
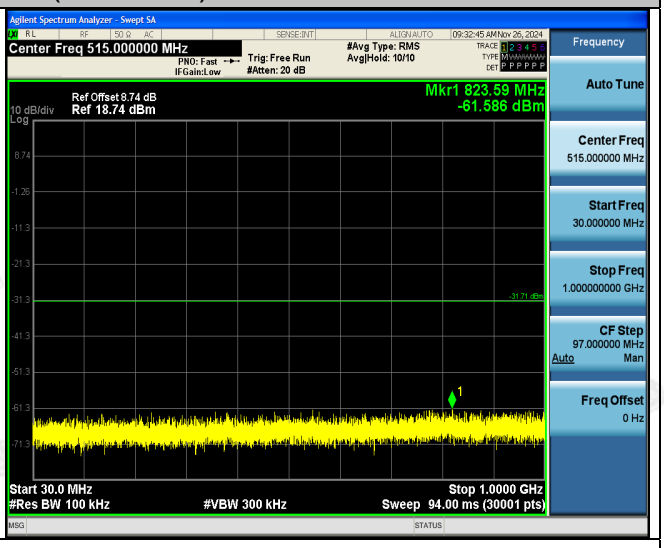
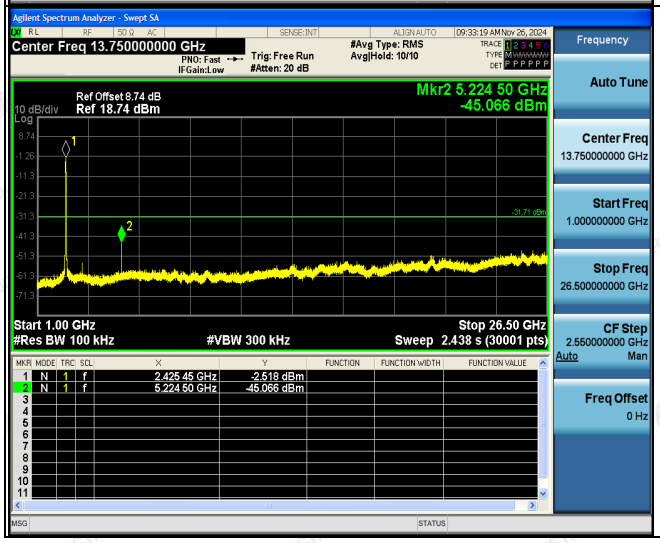




Spurious Emission(2437MHz)







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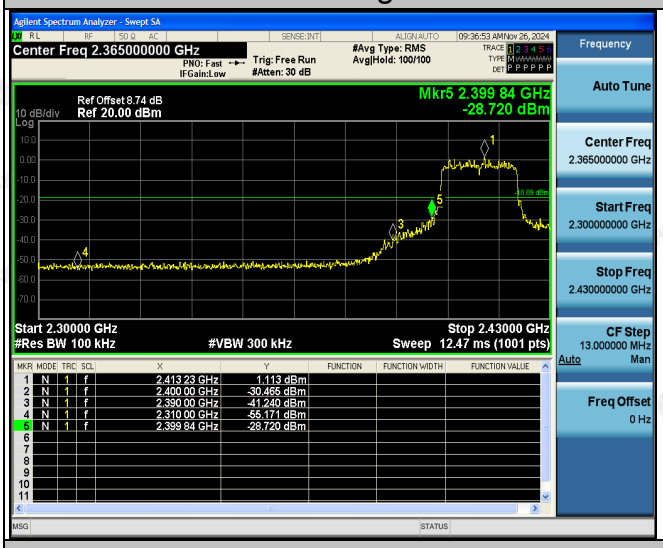
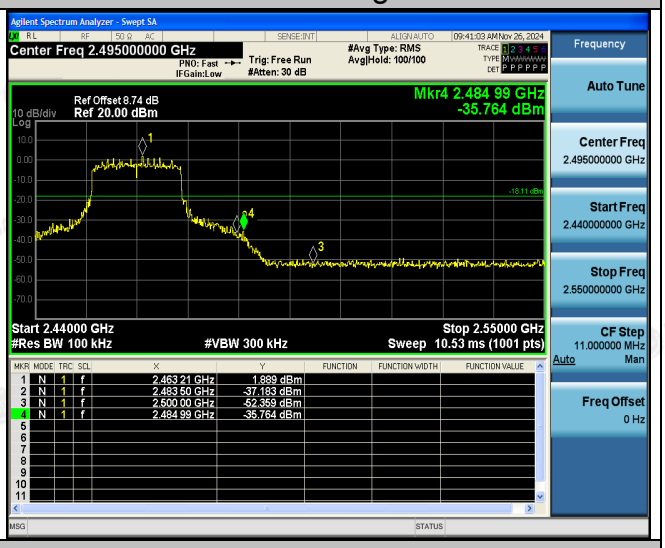
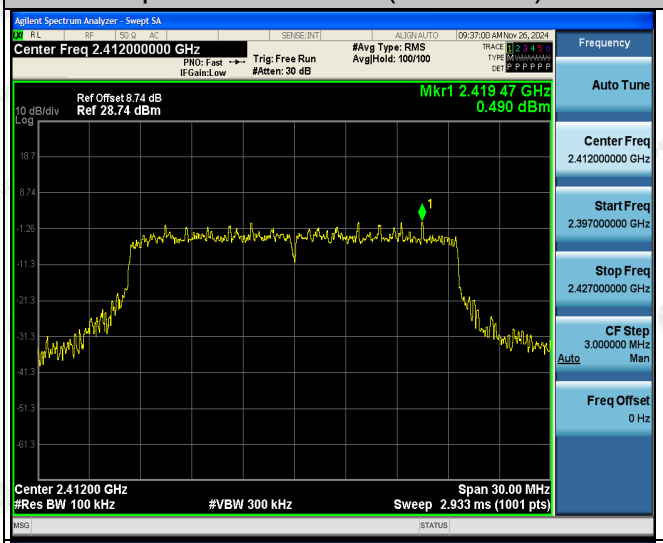
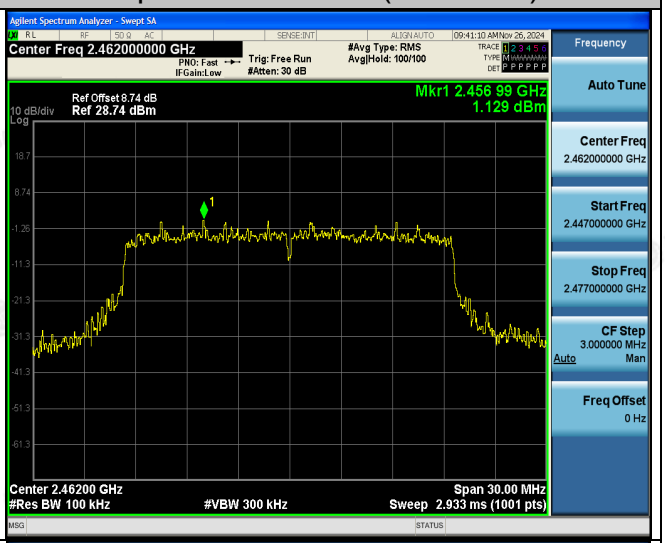
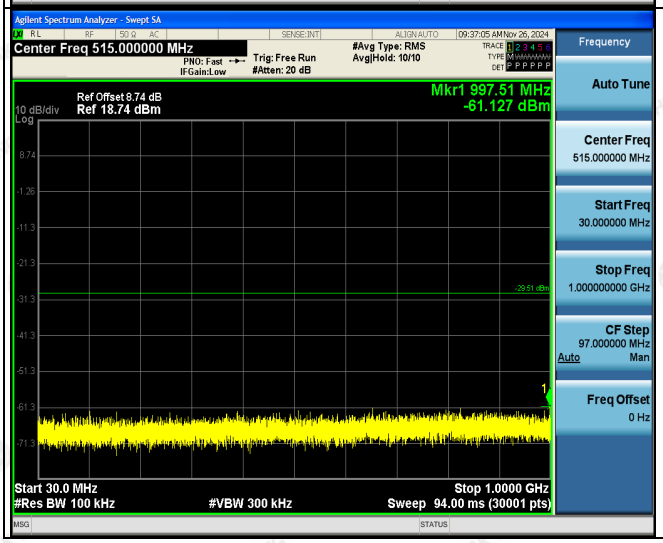
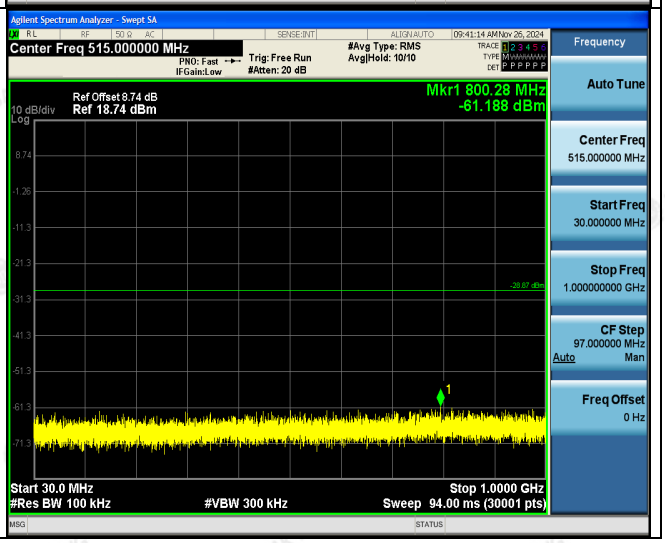
802.11ax (HT20) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious Emission(2412MHz)	Spurious Emission(2462MHz)
	
	

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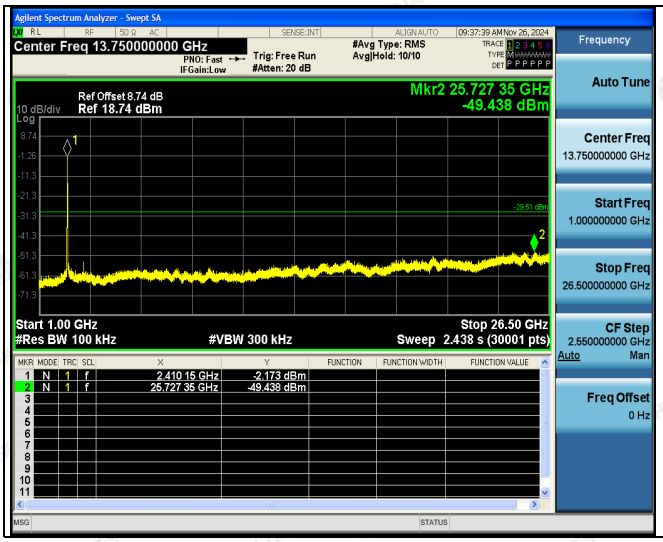
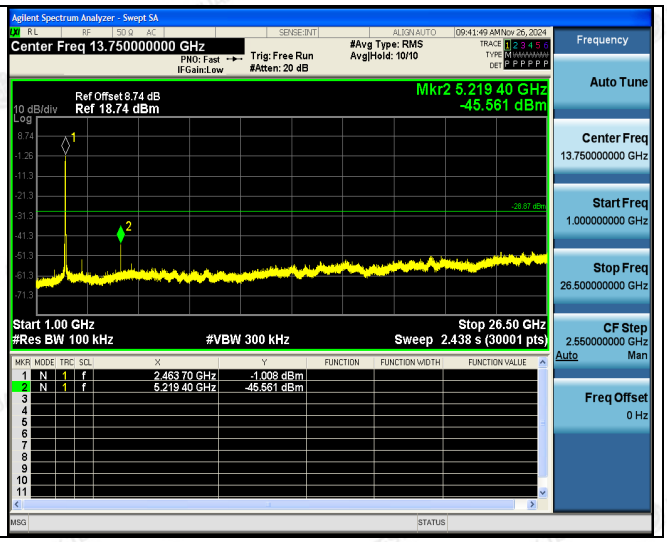
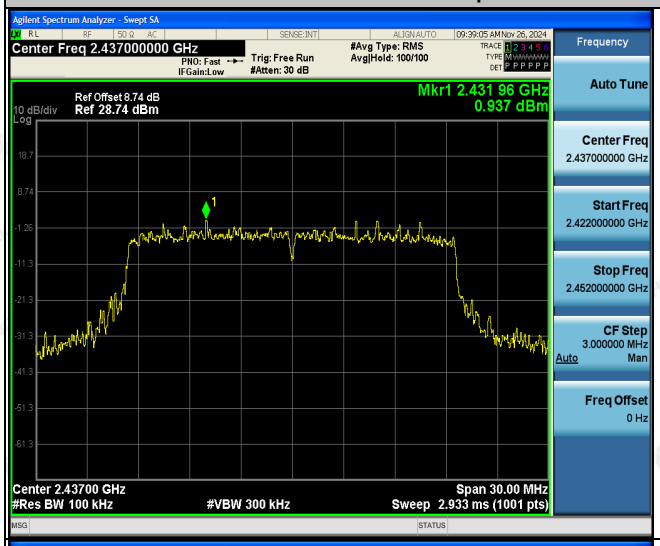
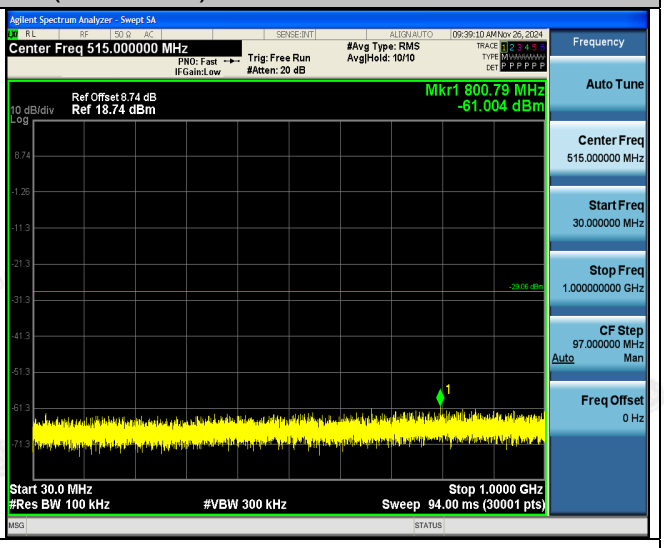
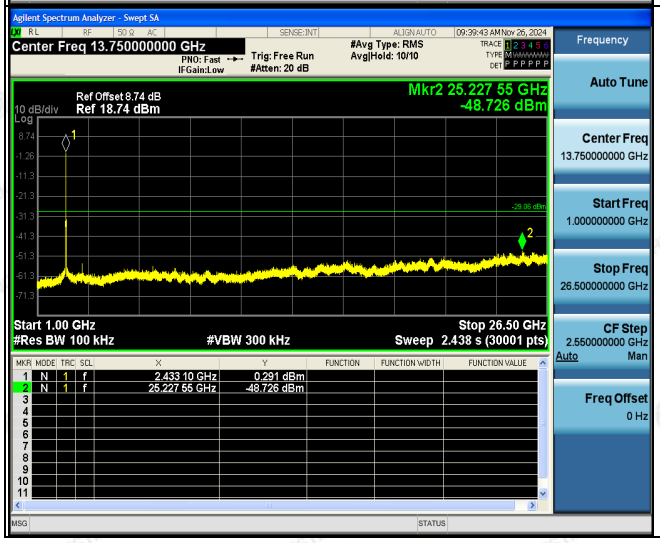




Spurious Emission(2437MHz)







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4.6 Radiated Spurious Emission Measurement

4.6.1 Test Specification

Test Requirement:	FCC Part15 C Section 15.209
Test Method:	ANSI C63.10: 2013
Frequency Range:	9 kHz to 25 GHz
Measurement Distance:	3 m
Antenna Polarization:	Horizontal & Vertical
Operation mode:	Transmitting mode with modulation

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
150kHz-30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	Peak	1MHz	10Hz	Average Value

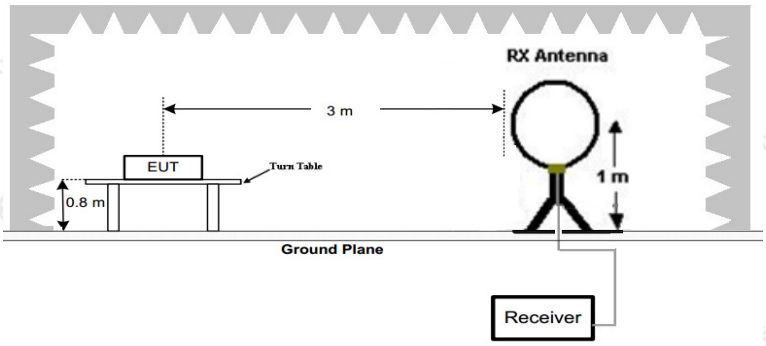
Limit:

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
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
Above 1GHz	500	3	Average
	5000	3	Peak

Test setup:

For radiated emissions below 30MHz



30MHz to 1GHz

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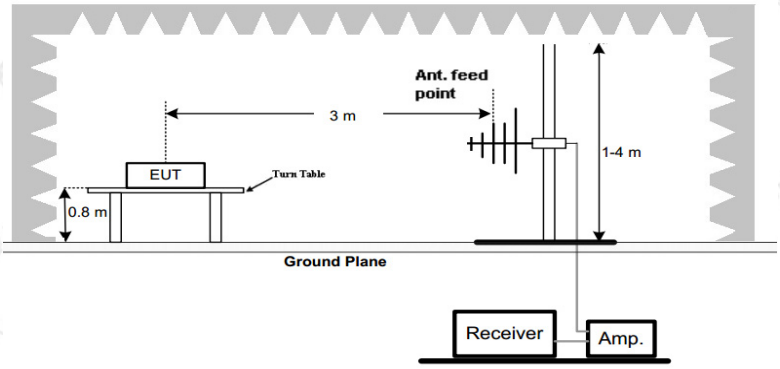
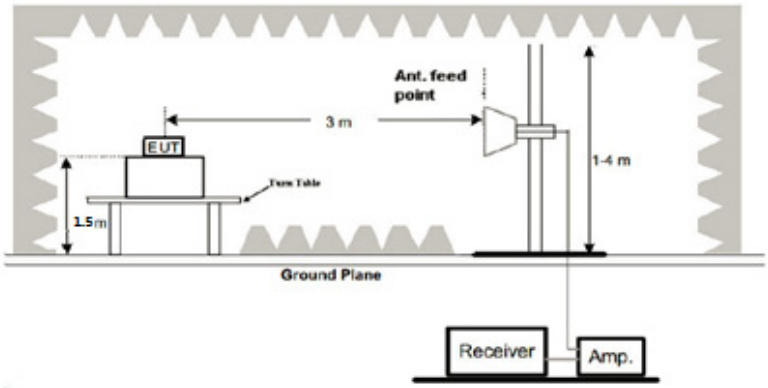
	 Above 1GHz 
Test Procedure:	1. For the radiated emission test below 1GHz: The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst 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.

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	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=100 kHz for f < 1 GHz; VBW ≥RBW; Sweep = auto; Detector function = peak; Trace = max hold; (3) Set RBW = 1 MHz, VBW= 3MHz for f 1 GHz for peak measurement. 6. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW ≥ 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

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4.6.2 Test Instruments

Radiated Emission Test Site (966)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-025	Feb. 20, 2024	Feb. 19, 2025
Spectrum analyzer	R&S	FSV3044	HKE-126	Feb. 20, 2024	Feb. 19, 2025
Preamplifier	EMCI	EMC051845 S	HKE-006	Feb. 20, 2024	Feb. 19, 2025
Preamplifier	Schwarzbeck	BBV 9743	HKE-016	Feb. 20, 2024	Feb. 19, 2025
Preamplifier	A.H. Systems	SAS-574	HKE-182	Feb. 20, 2024	Feb. 19, 2025
6dB Attenuator	Pasternack	6db	HKE-184	Feb. 20, 2024	Feb. 19, 2025
EMI Test Receiver	Rohde & Schwarz	ESR-7	HKE-010	Feb. 20, 2024	Feb. 19, 2025
Broadband Antenna	Schwarzbeck	VULB9168	HKE-167	Feb. 21, 2024	Feb. 20, 2026
Loop Antenna	COM-POWER	AL-130R	HKE-014	Feb. 21, 2024	Feb. 20, 2026
Horn Antenna	Schwarzbeck	9120D	HKE-013	Feb. 21, 2024	Feb. 20, 2026
EMI Test Software	Tonscend	JS32-RE 5.0.0	HKE-082	N/A	N/A
RSE Test Software	Tonscend	JS36-RSE 5. 0.0	HKE-184	N/A	N/A

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

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4.6.3 Test Data

Please refer to following diagram for individual

Below 1GHz

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

Horizontal

Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	35.825826	-14.54	38.27	23.73	40.00	16.27	100	48	Horizontal
2	55.245245	-14.00	33.51	19.51	40.00	20.49	100	324	Horizontal
3	249.43943	-13.41	28.65	15.24	46.00	30.76	100	82	Horizontal
4	333.91391	-10.67	32.65	21.98	46.00	24.02	100	262	Horizontal
5	429.06906	-8.75	29.90	21.15	46.00	24.85	100	171	Horizontal
6	731.04104	-3.47	25.88	22.41	46.00	23.59	100	74	Horizontal

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

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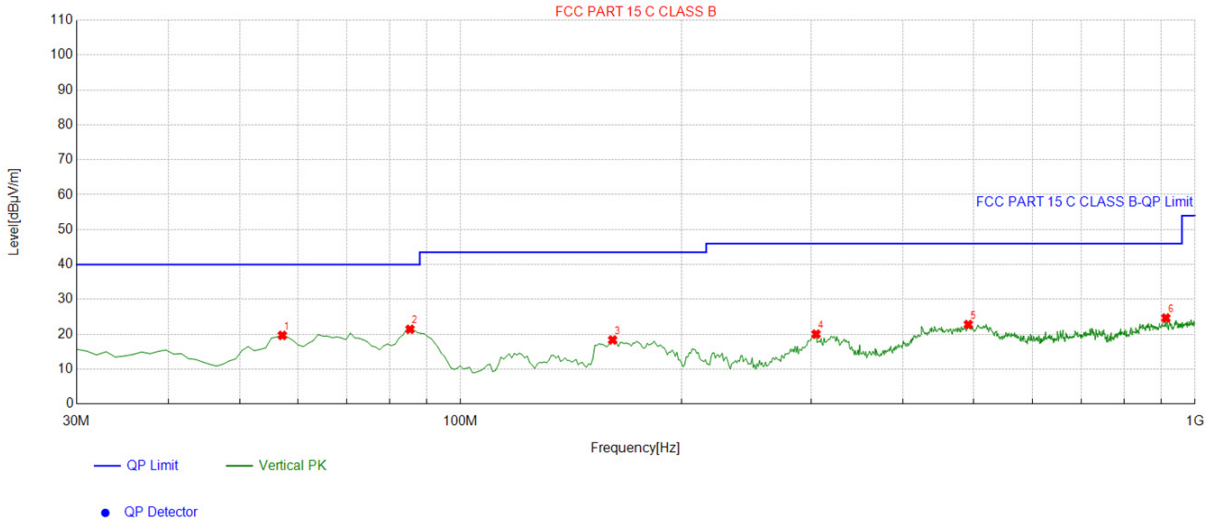
Vertical



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	57.187187	-13.76	33.44	19.68	40.00	20.32	100	59	Vertical
2	85.345345	-17.82	39.25	21.43	40.00	18.57	100	162	Vertical
3	161.08108	-17.67	36.04	18.37	43.50	25.13	100	98	Vertical
4	304.78478	-11.91	31.95	20.04	46.00	25.96	100	68	Vertical
5	491.21121	-7.88	30.68	22.80	46.00	23.20	100	346	Vertical
6	912.61261	-1.07	25.73	24.66	46.00	21.34	100	187	Vertical

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

Harmonics and Spurious Emissions

Frequency Range (9 kHz-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

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Above 1GHz

Radiated Emission Test

LOW CH1 (802.11b Mode)/2412

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	55.19	-3.64	51.55	74	-22.45	peak
4824	42.87	-3.64	39.23	54	-14.77	AVG
7236	52.24	-0.95	51.29	74	-22.71	peak
7236	40.93	-0.95	39.98	54	-14.02	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	56.82	-3.64	53.18	74	-20.82	peak
4824	44.17	-3.64	40.53	54	-13.47	AVG
7236	52.94	-0.95	51.99	74	-22.01	peak
7236	41.66	-0.82	40.84	54	-13.16	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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MID CH6 (802.11b Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	54.09	-3.51	50.58	74	-23.42	peak
4874	45.92	-3.51	42.41	54	-11.59	AVG
7311	53.56	-0.82	52.74	74	-21.26	peak
7311	42.78	-0.82	41.96	54	-12.04	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	56.29	-3.51	52.78	74	-21.22	peak
4874	44.97	-3.51	41.46	54	-12.54	AVG
7311	55.14	-0.82	54.32	74	-19.68	peak
7311	42.26	-0.82	41.44	54	-12.56	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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HIGH CH11 (802.11b Mode)/2462

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	55.17	-3.43	51.74	74	-22.26	peak
4924	41.94	-3.43	38.51	54	-15.49	AVG
7386	50.16	-0.75	49.41	74	-24.59	peak
7386	40.32	-0.75	39.57	54	-14.43	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	54.55	-3.43	51.12	74	-22.88	peak
4924	44.84	-3.43	41.41	54	-12.59	AVG
7386	52.06	-0.75	51.31	74	-22.69	peak
7386	43.09	-0.75	42.34	54	-11.66	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4)The emissions are attenuated more than 20dB below the permissible limits are not record in the report.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions of ANT.1 are reported.

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LOW CH1 (802.11g Mode)/2412

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	56.17	-3.64	52.53	74	-21.47	peak
4824	42.42	-3.64	38.78	54	-15.22	AVG
7236	51.82	-0.95	50.87	74	-23.13	peak
7236	40.36	-0.95	39.41	54	-14.59	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	55.18	-3.64	51.54	74	-22.46	peak
4824	44.29	-3.64	40.65	54	-13.35	AVG
7236	53.36	-0.95	52.41	74	-21.59	peak
7236	42.07	-0.95	41.12	54	-12.88	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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MID CH6 (802.11g Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	54.94	-3.51	51.43	74	-22.57	peak
4874	43.58	-3.51	40.07	54	-13.93	AVG
7311	50.21	-0.82	49.39	74	-24.61	peak
7311	40.66	-0.82	39.84	54	-14.16	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	52.09	-3.51	48.58	74	-25.42	peak
4874	42.35	-3.51	38.84	54	-15.16	AVG
7311	50.71	-0.82	49.89	74	-24.11	peak
7311	40.84	-0.82	40.02	54	-13.98	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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HIGH CH11 (802.11g Mode)/2462

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	55.32	-3.43	51.89	74	-22.11	peak
4924	42.18	-3.43	38.75	54	-15.25	AVG
7386	50.07	-0.75	49.32	74	-24.68	peak
7386	41.49	-0.75	40.74	54	-13.26	AVG

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

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	54.52	-3.43	51.09	74	-22.91	peak
4924	42.36	-3.43	38.93	54	-15.07	AVG
7386	51.25	-0.75	50.5	74	-23.5	peak
7386	40.73	-0.75	39.98	54	-14.02	AVG

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

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4)The emissions are attenuated more than 20dB below the permissible limits are not record in the report
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions of ANT.1 are reported.

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LOW CH1 (802.11n/HT20 Mode)/2412

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	52.21	-3.64	48.57	74	-25.43	peak
4824	42.17	-3.64	38.53	54	-15.47	AVG
7236	51.44	-0.95	50.49	74	-23.51	peak
7236	40.83	-0.95	39.88	54	-14.12	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	56.02	-3.64	52.38	74	-21.62	peak
4824	42.78	-3.64	39.14	54	-14.86	AVG
7236	51.59	-0.95	50.64	74	-23.36	peak
7236	40.91	-0.95	39.96	54	-14.04	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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MID CH6 (802.11n/HT20 Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874.00	55.76	-3.51	52.25	74.00	-21.75	peak
4874.00	43.84	-3.51	40.33	54.00	-13.67	AVG
7311.00	53.25	-0.82	52.43	74.00	-21.57	peak
7311.00	41.96	-0.82	41.14	54.00	-12.86	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874.00	52.73	-3.51	49.22	74.00	-24.78	peak
4874.00	44.82	-3.51	41.31	54.00	-12.69	AVG
7311.00	51.57	-0.82	50.75	74.00	-23.25	peak
7311.00	41.03	-0.82	40.21	54.00	-13.79	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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HIGH CH11 (802.11n/HT20 Mode)/2462

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	53.79	-3.43	50.36	74	-23.64	peak
4924	45.07	-3.43	41.64	54	-12.36	AVG
7386	51.21	-0.75	50.46	74	-23.54	peak
7386	41.66	-0.75	40.91	54	-13.09	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	54.91	-3.43	51.48	74	-22.52	peak
4924	44.36	-3.43	40.93	54	-13.07	AVG
7386	51.84	-0.75	51.09	74	-22.91	peak
7386	42.22	-0.75	41.47	54	-12.53	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4)The emissions are attenuated more than 20dB below the permissible limits are not record in the report
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions of ANT.1 are reported.

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LOW CH3 (802.11n/HT40 Mode)/2422

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4844	54.91	-3.63	51.28	74	-22.72	peak
4844	44.56	-3.63	40.93	54	-13.07	AVG
7266	53.89	-0.94	52.95	74	-21.05	peak
7266	41.17	-0.94	40.23	54	-13.77	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4844	52.34	-3.63	48.71	74	-25.29	peak
4844	42.29	-3.63	38.66	54	-15.34	AVG
7266	50.08	-0.94	49.14	74	-24.86	peak
7266	40.71	-0.94	39.77	54	-14.23	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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MID CH6 (802.11n/HT40 Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	53.84	-3.51	50.33	74	-23.67	peak
4874	43.25	-3.51	39.74	54	-14.26	AVG
7311	50.17	-0.82	49.35	74	-24.65	peak
7311	42.93	-0.82	42.11	54	-11.89	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	56.67	-3.51	53.16	74	-20.84	peak
4874	43.26	-3.51	39.75	54	-14.25	AVG
7311	53.09	-0.82	52.27	74	-21.73	peak
7311	42.81	-0.82	41.99	54	-12.01	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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HIGH CH9 (802.11n/HT40 Mode)/2452

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4904	54.81	-3.43	51.38	74	-22.62	peak
4904	45.49	-3.43	42.06	54	-11.94	AVG
7356	52.32	-0.75	51.57	74	-22.43	peak
7356	43.07	-0.75	42.32	54	-11.68	AVG

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

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4904	56.58	-3.43	53.15	74	-20.85	peak
4904	43.26	-3.43	39.83	54	-14.17	AVG
7356	54.29	-0.75	53.54	74	-20.46	peak
7356	41.64	-0.75	40.89	54	-13.11	AVG

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

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) The emissions are attenuated more than 20dB below the permissible limits are not record in the report.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions of MIMO are reported.

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LOW CH1 (802.11ax/HT20 Mode)/2412

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	54.52	-3.64	50.88	74	-23.12	peak
4824	42.18	-3.64	38.54	54	-15.46	AVG
7236	51.29	-0.95	50.34	74	-23.66	peak
7236	41.03	-0.95	40.08	54	-13.92	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	51.96	-3.64	48.32	74	-25.68	peak
4824	44.27	-3.64	40.63	54	-13.37	AVG
7236	51.04	-0.95	50.09	74	-23.91	peak
7236	41.97	-0.95	41.02	54	-12.98	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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MID CH6 (802.11ax/HT20 Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874.00	54.32	-3.51	50.81	74.00	-23.19	peak
4874.00	43.88	-3.51	40.37	54.00	-13.63	AVG
7311.00	52.69	-0.82	51.87	74.00	-22.13	peak
7311.00	40.73	-0.82	39.91	54.00	-14.09	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874.00	52.25	-3.51	48.74	74.00	-25.26	peak
4874.00	43.11	-3.51	39.60	54.00	-14.40	AVG
7311.00	50.08	-0.82	49.26	74.00	-24.74	peak
7311.00	41.94	-0.82	41.12	54.00	-12.88	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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HIGH CH11 (802.11ax/HT20 Mode)/2462

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	54.26	-3.43	50.83	74	-23.17	peak
4924	45.84	-3.43	42.41	54	-11.59	AVG
7386	52.07	-0.75	51.32	74	-22.68	peak
7386	43.23	-0.75	42.48	54	-11.52	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	53.58	-3.43	50.15	74	-23.85	peak
4924	41.29	-3.43	37.86	54	-16.14	AVG
7386	52.36	-0.75	51.61	74	-22.39	peak
7386	43.47	-0.75	42.72	54	-11.28	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) The emissions are attenuated more than 20dB below the permissible limits are not record in the report.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions of MIMO are reported.

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Test Result of Radiated Spurious at Band edges

Operation Mode:
802.11b Mode TX CH Low (2412MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	54.15	-5.81	48.34	74	-25.66	peak
2310	/	-5.81	/	54	/	AVG
2390	52.28	-5.84	46.44	74	-27.56	peak
2390	/	-5.84	/	54	/	AVG
2400	51.36	-5.84	45.52	74	-28.48	peak
2400	/	-5.84	/	54	/	AVG

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

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	54.07	-5.81	48.26	74	-25.74	peak
2310	/	-5.81	/	54	/	AVG
2390	53.42	-5.84	47.58	74	-26.42	peak
2390	/	-5.84	/	54	/	AVG
2400	50.83	-5.84	44.99	74	-29.01	peak
2400	/	-5.84	/	54	/	AVG

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

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Operation Mode: TX CH High (2462MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	53.96	-5.65	48.31	74	-25.69	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	52.11	-5.65	46.46	74	-27.54	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	53.28	-5.65	47.63	74	-26.37	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.07	-5.65	45.42	74	-28.58	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

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Operation Mode: 802.11g Mode TX CH Low (2412MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.93	-5.81	51.12	74	-22.88	peak
2310	/	-5.81	/	54	/	AVG
2390	53.61	-5.84	47.77	74	-26.23	peak
2390	/	-5.84	/	54	/	AVG
2400	51.83	-5.84	45.99	74	-28.01	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	55.27	-5.81	49.46	74	-24.54	peak
2310	/	-5.81	/	54	/	AVG
2390	54.58	-5.84	48.74	74	-25.26	peak
2390	/	-5.84	/	54	/	AVG
2400	52.09	-5.84	46.25	74	-27.75	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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Operation Mode: TX CH High (2462MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	53.46	-5.65	47.81	74	-26.19	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.18	-5.65	45.53	74	-28.47	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	53.29	-5.65	47.64	74	-26.36	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.47	-5.65	45.82	74	-28.18	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

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Operation Mode: 802.11n/HT20 Mode TX CH Low (2412MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	55.36	-5.81	49.55	74	-24.45	peak
2310	/	-5.81	/	54	/	AVG
2390	54.22	-5.84	48.38	74	-25.62	peak
2390	/	-5.84	/	54	/	AVG
2400	52.15	-5.84	46.31	74	-27.69	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	54.49	-5.81	48.68	74	-25.32	peak
2310	/	-5.81	/	54	/	AVG
2390	53.07	-5.84	47.23	74	-26.77	peak
2390	/	-5.84	/	54	/	AVG
2400	52.98	-5.84	47.14	74	-26.86	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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Operation Mode: TX CH High (2462MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	55.34	-5.65	49.69	74	-24.31	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.26	-5.65	47.61	74	-26.39	peak
2500.00	/	-5.65	/	54	/	AVG

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

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	51.15	-5.65	45.5	74	-28.5	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.73	-5.65	46.08	74	-27.92	peak
2500.00	/	-5.65	/	54	/	AVG

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

Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.

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Operation Mode: 802.11n/HT40 Mode TX CH Low (2422MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	55.95	-5.81	50.14	74	-23.86	peak
2310	/	-5.81	/	54	/	AVG
2390	53.72	-5.84	47.88	74	-26.12	peak
2390	/	-5.84	/	54	/	AVG
2400	51.31	-5.84	45.47	74	-28.53	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.49	-5.81	50.68	74	-23.32	peak
2310	/	-5.81	/	54	/	AVG
2390	54.91	-5.84	49.07	74	-24.93	peak
2390	/	-5.84	/	54	/	AVG
2400	51.47	-5.84	45.63	74	-28.37	peak
2400	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

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Operation Mode: TX CH High (2452MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	54.89	-5.65	49.24	74	-24.76	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.21	-5.65	45.56	74	-28.44	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	52.39	-5.65	46.74	74	-27.26	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	51.28	-5.65	45.63	74	-28.37	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

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Operation Mode: 802.11ax/HT20 Mode TX CH Low (2412MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	54.73	-5.81	48.92	74	-25.08	peak
2310	/	-5.81	/	54	/	AVG
2390	52.95	-5.84	47.11	74	-26.89	peak
2390	/	-5.84	/	54	/	AVG
2400	51.71	-5.84	45.87	74	-28.13	peak
2400	/	-5.84	/	54	/	AVG

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

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	55.92	-5.81	50.11	74	-23.89	peak
2310	/	-5.81	/	54	/	AVG
2390	53.83	-5.84	47.99	74	-26.01	peak
2390	/	-5.84	/	54	/	AVG
2400	54.47	-5.84	48.63	74	-25.37	peak
2400	/	-5.84	/	54	/	AVG

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

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Operation Mode: TX CH High (2462MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	54.36	-5.65	48.71	74	-25.29	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.22	-5.65	47.57	74	-26.43	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	56.13	-5.65	50.48	74	-23.52	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	52.04	-5.65	46.39	74	-27.61	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Remark:
1. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
2. In restricted bands of operation, the spurious emissions below the permissible value more than 20dB.
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

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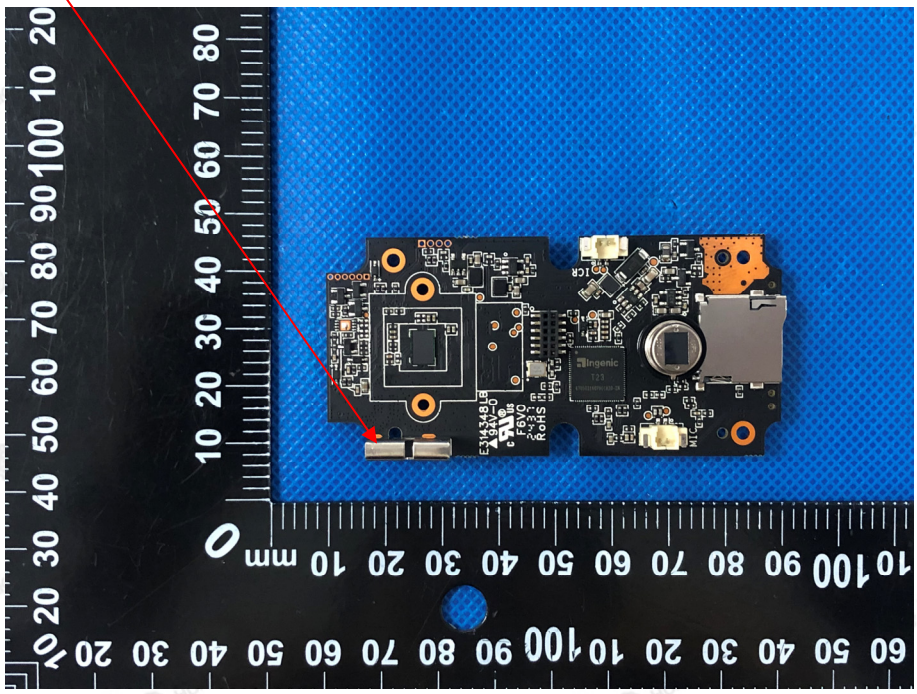
4.7 Antenna Requirement

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 an Internal antenna, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 2.81dBi.

WIFI Antenna



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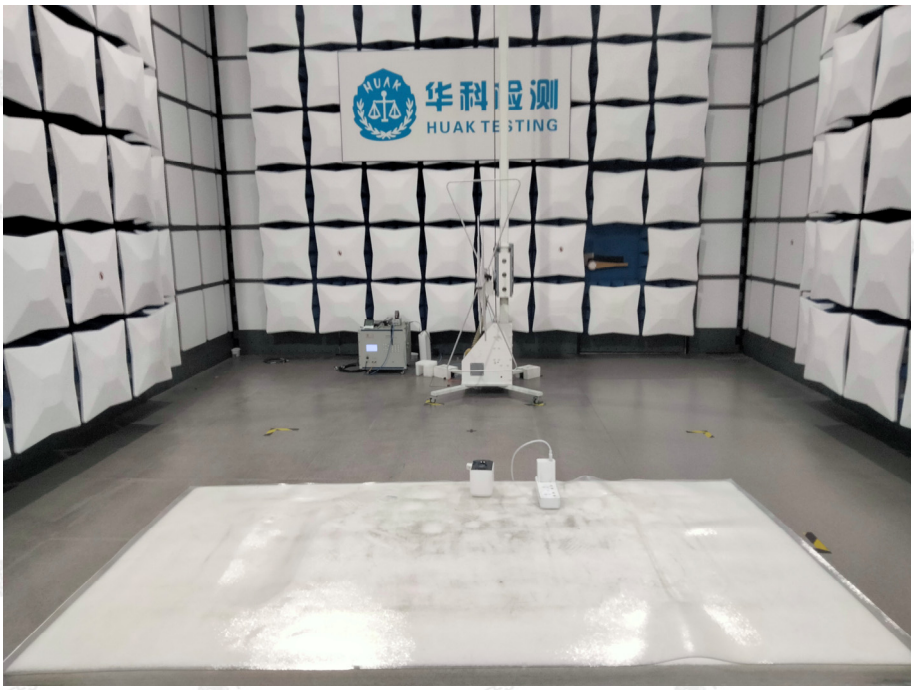
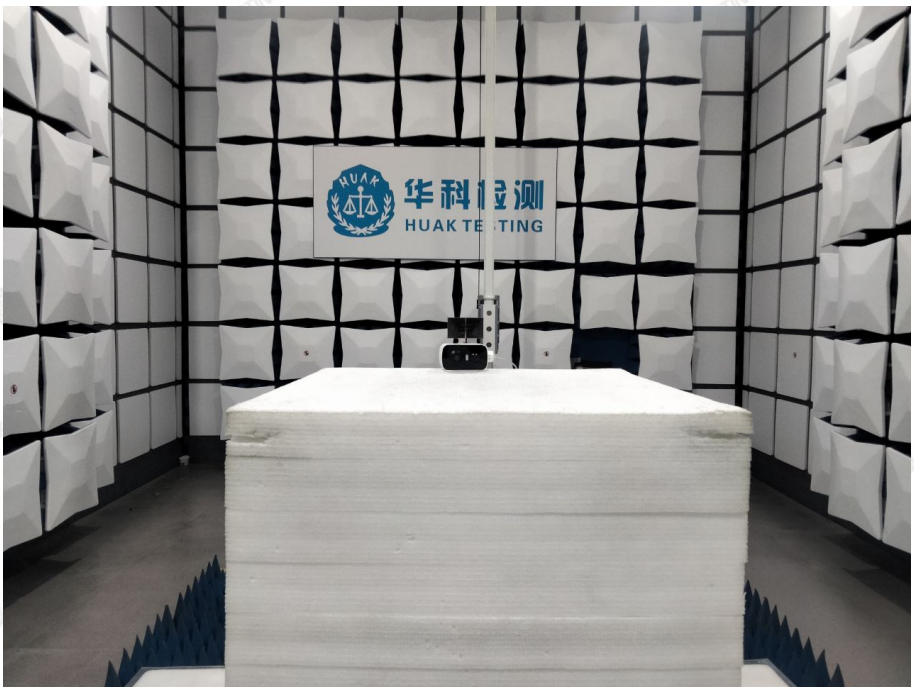
5. Photograph of Test

Radiated Emission





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Conducted Emission

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6. Photos of the EUT

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

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

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