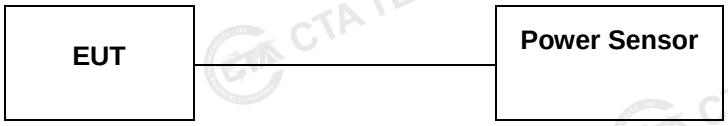
4.5. Maximum Average Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 Section E3 Measurement using a Power Meter (PM):

a. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied
   1. The EUT is configured to transmit continuously or to transmit with a constant duty cycle
   2. At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
   3. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b. If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section II.B

c. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

Adjust the measurement in dBm by adding 10 log(1/x) where x is the duty cycle (e.g., 10 log(1/0.25) if the duty cycle is 25 percent).

LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

Frequency Range (MHz)	Limit
5150-5250	Fixed:1 Watt (30dBm) Mobile and portable: 250mW (24dBm)
5250-5350	250mW (24dBm)
5470-5725	250mW (24dBm)
5725-5850	1 Watt (30dBm)
Note: The maximum e.i.r.p at anyelevation angle above 30 degrees as measured from the horizon must not exceed 125mW(21dBm)	

TEST RESULTS

Please refer to Appendix C.

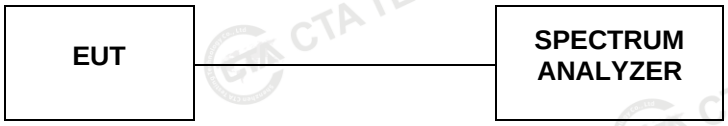
MIMO:

Test Mode	Frequency[MHz]	Antenna1 [dBm]	Antenna2 [dBm]	MIMO [dBm]	Limit [dBm]	Verdict
11N20SISO	5180	9.97	11.39	13.75	22.9	PASS
	5220	11.34	12.61	15.03	22.9	PASS
	5240	11.44	12.83	15.20	22.9	PASS
	5260	11.36	12.75	15.12	22.9	PASS
	5300	11.30	12.37	14.88	22.9	PASS
	5320	11.33	12.3	14.85	22.9	PASS
	5500	11.27	11.67	14.48	22.9	PASS
	5580	11.42	12.01	14.74	22.9	PASS
	5700	11.61	10.82	14.24	22.9	PASS
	5745	10.74	10.01	13.40	28.92	PASS
	5785	11.00	11.58	14.31	28.92	PASS
	5825	10.66	10.29	13.49	28.92	PASS
11N40SISO	5190	10.53	12.14	14.42	22.9	PASS
	5230	11.51	12.84	15.24	22.9	PASS
	5270	11.52	12.89	15.27	22.9	PASS
	5310	11.83	12.8	15.35	22.9	PASS
	5510	11.54	12.06	14.82	22.9	PASS
	5550	11.47	12.3	14.92	22.9	PASS
	5670	11.92	11.21	14.59	22.9	PASS
	5755	11.34	10.64	14.01	28.92	PASS
	5795	10.79	11.5	14.17	28.92	PASS
11AC20SISO	5180	9.91	11.44	13.75	22.9	PASS
	5220	11.29	12.61	15.01	22.9	PASS
	5240	11.41	12.89	15.22	22.9	PASS
	5260	11.34	12.86	15.18	22.9	PASS
	5300	11.25	12.47	14.91	22.9	PASS
	5320	11.42	12.46	14.98	22.9	PASS
	5500	11.24	11.73	14.50	22.9	PASS
	5580	11.50	11.98	14.76	22.9	PASS
	5700	11.64	10.83	14.26	22.9	PASS
	5745	10.88	10	13.47	28.92	PASS
	5785	11.18	11.82	14.52	28.92	PASS
	5825	10.85	10.21	13.55	28.92	PASS
11AC40SISO	5190	10.61	12.28	14.54	22.9	PASS
	5230	11.57	12.96	15.33	22.9	PASS
	5270	11.50	12.99	15.32	22.9	PASS
	5310	11.77	12.86	15.36	22.9	PASS
	5510	11.92	12.2	15.07	22.9	PASS
	5550	11.71	12.36	15.06	22.9	PASS
	5670	12.03	11.1	14.60	22.9	PASS
	5755	11.40	10.54	14.00	28.92	PASS
	5795	10.86	11.45	14.18	28.92	PASS
11AC80SISO	5210	10.91	12.43	14.75	22.9	PASS
	5290	11.09	12.53	14.88	22.9	PASS
	5530	11.87	11.91	14.90	22.9	PASS
	5775	11.63	10.9	14.29	28.92	PASS
11AC160SISO	5250_UNII-1	5.91	4.56	8.30	22.9	PASS
	5250_UNII-2A	7.03	7.38	10.22	22.9	PASS
	5570	5.91	7.36	9.71	22.9	PASS
11AX20SISO	5180	10.25	11.82	14.12	22.9	PASS
	5220	11.46	12.78	15.18	22.9	PASS
	5240	11.54	13.18	15.45	22.9	PASS
	5260	11.29	12.97	15.22	22.9	PASS
	5300	11.23	12.59	14.97	22.9	PASS
	5320	11.66	12.63	15.18	22.9	PASS
	5500	11.62	11.92	14.78	22.9	PASS
	5580	11.87	12.17	15.03	22.9	PASS
	5700	11.76	11.2	14.50	22.9	PASS
	5745	10.98	10.4	13.71	28.92	PASS
	5785	11.14	11.8	14.49	28.92	PASS
	5825	10.82	10.53	13.69	28.92	PASS
11AX40SISO	5190	10.75	12.5	14.72	22.9	PASS
	5230	11.67	13.08	15.44	22.9	PASS
	5270	11.71	13.05	15.44	22.9	PASS
	5310	12.01	13.23	15.67	22.9	PASS

	5510	12.09	12.17	15.14	22.9	PASS
	5550	11.87	12.75	15.34	22.9	PASS
	5670	12.15	11.5	14.85	22.9	PASS
	5755	11.46	10.82	14.16	28.92	PASS
	5795	11.07	11.73	14.42	28.92	PASS
11AX80SISO	5210	11.13	12.82	15.07	22.9	PASS
	5290	11.37	12.79	15.15	22.9	PASS
	5530	12.03	12.14	15.10	22.9	PASS
	5775	11.91	11.36	14.65	28.92	PASS
11AX160SISO	5250_UNII-1	6.52	3.92	8.42	22.9	PASS
	5250_UNII-2A	7.37	6.55	9.99	22.9	PASS
	5570	6.16	7.34	9.80	22.9	PASS

4.6. Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

According to KDB 789033 D02 General UNII Test Procedures New Rules v01 F: The rules requires "maximum power spectral density" measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission

a. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power…". (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
b. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
c. Make the following adjustments to the peak value of the spectrum, if applicable:
    1. If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.
    2.) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
d. The result is the Maximum PSD over 1 MHz reference bandwidth.
e. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:
    1. Set RBW ≥ 1/T, where T is defined in section II.B.I.a).
    2. Set VBW ≥ 3 RBW.
    3. If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
    4. If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10log(1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
    5. Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

    Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHz is available on nearly all spectrum analyzers.
f. Adjust the measurement in dBm by adding 10 log(1/x) where x is the duty cycle (e.g., 10 log(1/0.25) if the duty cycle is 25 percent).

LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

Frequency Range (MHz)	Limit
5150-5250	Other then Mobile and portable:17dBm/MHz Mobile and portable:11dBm/MHz
5250-5350	11dBm/MHz
5470-5725	11dBm/MHz
5725-5850	30dBm/500kHz

TEST RESULTS

Please refer to Appendix D.

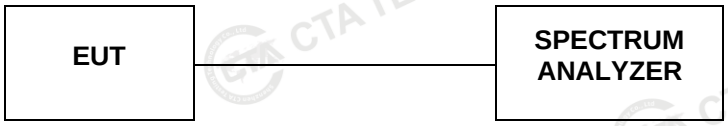
MIMO:

TestMode	Frequency[MHz]	Antenna 1 [dBm/MHz]	Antenna 2 [dBm/MHz]	MIMO [dBm/MHz]	Limit[dBm/MHz]	Verdict
11N20SISO	5180	-0.98	0.71	2.96	9.92	PASS
	5220	0.47	1.74	4.16	9.92	PASS
	5240	0.65	1.83	4.29	9.92	PASS
	5260	0.60	1.95	4.34	9.92	PASS
	5300	0.48	1.60	4.09	9.92	PASS
	5320	0.33	1.45	3.94	9.92	PASS
	5500	0.58	0.91	3.76	9.92	PASS
	5580	0.64	1.34	4.01	9.92	PASS
	5700	0.69	0.09	3.41	9.92	PASS
	5745	-2.71	-3.68	-0.16	28.92	PASS
	5785	-2.90	-1.97	0.60	28.92	PASS
	5825	-3.16	-3.31	-0.22	28.92	PASS
11N40SISO	5190	-1.48	-0.66	1.96	9.92	PASS
	5230	-1.60	-0.43	2.03	9.92	PASS
	5270	-1.60	-0.56	1.96	9.92	PASS
	5310	-1.30	-0.37	2.20	9.92	PASS
	5510	-0.94	-1.15	1.97	9.92	PASS
	5550	-1.17	-0.67	2.10	9.92	PASS
	5670	-0.83	-1.79	1.73	9.92	PASS
	5755	-4.40	-5.20	-1.77	28.92	PASS
	5795	-5.31	-4.56	-1.91	28.92	PASS
11AC20SISO	5180	-1.13	0.78	2.94	9.92	PASS
	5220	0.25	2.03	4.24	9.92	PASS
	5240	0.33	2.16	4.35	9.92	PASS
	5260	0.26	2.17	4.33	9.92	PASS
	5300	0.18	1.78	4.06	9.92	PASS
	5320	0.34	1.76	4.12	9.92	PASS
	5500	0.76	1.15	3.97	9.92	PASS
	5580	0.53	1.15	3.86	9.92	PASS
	5700	0.84	0.18	3.53	9.92	PASS
	5745	-2.89	-3.41	-0.13	28.92	PASS
	5785	-2.55	-1.98	0.75	28.92	PASS
	5825	-2.90	-3.21	-0.04	28.92	PASS
11AC40SISO	5190	-2.78	-0.62	1.44	9.92	PASS
	5230	-1.64	-0.18	2.16	9.92	PASS
	5270	-1.94	-0.15	2.06	9.92	PASS
	5310	-1.42	-0.20	2.24	9.92	PASS
	5510	-1.18	-0.70	2.08	9.92	PASS
	5550	-1.68	-0.47	1.98	9.92	PASS
	5670	-1.03	-1.91	1.56	9.92	PASS
	5755	-5.09	-5.33	-2.20	28.92	PASS
	5795	-5.63	-4.53	-2.03	28.92	PASS
11AC80SISO	5210	-5.16	-3.09	-0.99	9.92	PASS
	5290	-4.94	-3.12	-0.93	9.92	PASS
	5530	-4.34	-3.99	-1.15	9.92	PASS
	5775	-6.30	-7.12	-3.68	28.92	PASS
11AC160SISO	5250_UNII-1	-8.92	-10.61	-6.67	9.92	PASS
	5250_UNII-2A	-8.19	-8.81	-5.48	9.92	PASS
	5570	-12.34	-10.16	-8.10	9.92	PASS
11AX20SISO	5180	-0.57	1.10	3.36	9.92	PASS
	5220	0.53	1.75	4.19	9.92	PASS
	5240	0.38	2.64	4.67	9.92	PASS
	5260	0.20	2.12	4.28	9.92	PASS
	5300	0.17	1.67	3.99	9.92	PASS
	5320	0.67	1.56	4.15	9.92	PASS
	5500	0.88	1.14	4.02	9.92	PASS
	5580	0.86	1.54	4.22	9.92	PASS
	5700	0.48	0.18	3.34	9.92	PASS
	5745	-2.68	-3.28	0.04	28.92	PASS
	5785	-2.21	-1.58	1.13	28.92	PASS
	5825	-2.49	-2.67	0.43	28.92	PASS
11AX40SISO	5190	-2.45	-0.68	1.53	9.92	PASS
	5230	-1.68	0.46	2.53	9.92	PASS
	5270	-1.31	0.13	2.48	9.92	PASS
	5310	-1.28	-0.02	2.41	9.92	PASS

	5510	-1.18	-1.16	1.84	9.92	PASS
	5550	-1.60	-0.31	2.10	9.92	PASS
	5670	-1.30	-1.60	1.56	9.92	PASS
	5755	-4.99	-4.61	-1.79	28.92	PASS
	5795	-5.52	-3.75	-1.54	28.92	PASS
11AX80SISO	5210	-4.90	-2.75	-0.68	9.92	PASS
	5290	-4.86	-2.92	-0.77	9.92	PASS
	5530	-4.13	-3.94	-1.02	9.92	PASS
	5775	-6.83	-6.90	-3.85	28.92	PASS
11AC160SISO	5250_UNII-1	-9.17	-10.72	-6.87	9.92	PASS
	5250_UNII-2A	-8.33	-9.70	-5.95	9.92	PASS
	5570	-12.07	-9.93	-7.86	9.92	PASS

4.7. 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

a. Set RBW = 100 kHz.
b. Set the video bandwidth (VBW) ≥ 3 × RBW
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize
g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

LIMIT

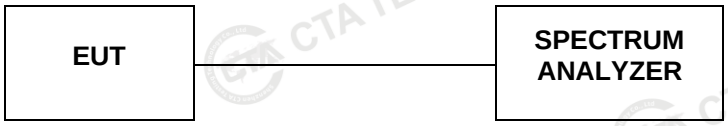
For Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz

TEST RESULTS

Please refer to Appendix A3.

4.8. 26dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for Emission Bandwidth (EBW) measurement:

a. Set RBW = 300 kHz (approximately 1% of the emission bandwidth).
b. Set the video bandwidth (VBW) = 1000 KHz (VBW > RBW)
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize
g. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

LIMIT

No Limits for 26dBc Bandwith

TEST RESULTS

Please refer to Appendix A1.

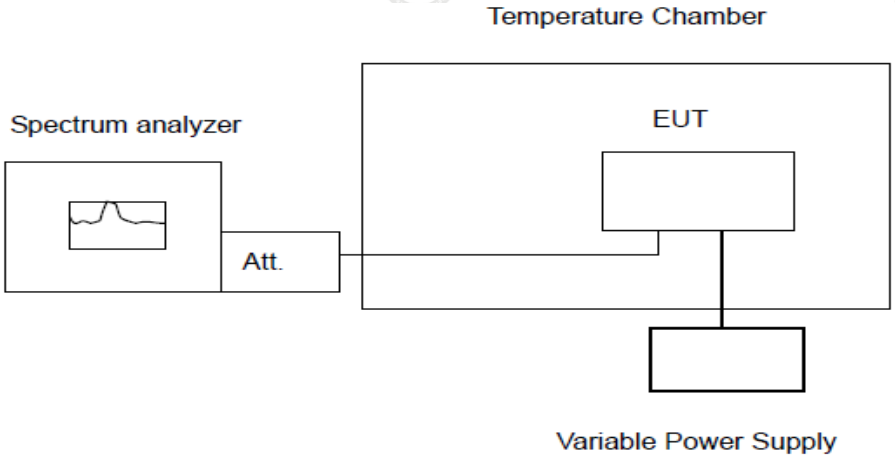
4.9. Frequency Stability

Standard Applicable

According to FCC §15.407(g) “Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.”
According to FCC §2.1055(a) “The frequency stability shall be measured with variation of ambient temperature as follows:”

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
(2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.
(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

Test Configuration



Test Procedure

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum anzlyer via feed through attenators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low engouh to obtain the desired frequency resoluation and measure EUT 20 degree operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30 degree. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure wuth 10 degree increased per stage until the highest temperature of +50 degree reached.

Test Results

PASS

Note: *Measured all conditions and recorded worst case.*

IEEE 802.11a Mode / 5180 – 5240 MHz / 5180 MHz

Enviroment Temperature (Dregree)	Voltage (Vdc)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	138	5179.978232	5150 – 5250	PASS
20	102	5179.997731	5150 – 5250	PASS
50	120	5179.971643	5150 – 5250	PASS
40	120	5179.924979	5150 – 5250	PASS
30	120	5179.943188	5150 – 5250	PASS
20	120	5179.919211	5150 – 5250	PASS
10	120	5179.918366	5150 – 5250	PASS
0	120	5179.954339	5150 – 5250	PASS
-10	120	5179.946445	5150 – 5250	PASS
-20	120	5179.913979	5150 – 5250	PASS
-30	120	5179.934682	5150 – 5250	PASS

IEEE 802.11ac VHT20 Mod / 5260 – 5320 MHz / 5260 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	138	5260.010342	5250 – 5350	PASS
20	102	5260.034081	5250 – 5350	PASS
50	120	5260.093373	5250 – 5350	PASS
40	120	5260.085562	5250 – 5350	PASS
30	120	5260.012759	5250 – 5350	PASS
20	120	5260.062645	5250 – 5350	PASS
10	120	5260.022978	5250 – 5350	PASS
0	120	5260.071839	5250 – 5350	PASS
-10	120	5260.034041	5250 – 5350	PASS
-20	120	5260.048051	5250 – 5350	PASS
-30	120	5260.092280	5250 – 5350	PASS

IEEE 802.11ac VHT20 Mode / 5500 – 5700 MHz / 5500 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	138	5500.046611	5470 – 5725	PASS
20	102	5500.071352	5470 – 5725	PASS
50	120	5500.085033	5470 – 5725	PASS
40	120	5500.015042	5470 – 5725	PASS
30	120	5500.053346	5470 – 5725	PASS
20	120	5500.019489	5470 – 5725	PASS
10	120	5500.078866	5470 – 5725	PASS
0	120	5500.077341	5470 – 5725	PASS
-10	120	5500.023938	5470 – 5725	PASS
-20	120	5500.052441	5470 – 5725	PASS
-30	120	5500.081329	5470 – 5725	PASS

IEEE 802.11a Mode / 5745 – 5825 MHz / 5745 MHz

Enviroment Temperature (Dregree)	Voltage (Vdc)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	138	5744.972033	5725 – 5850	PASS
20	102	5744.993562	5725 – 5850	PASS
50	120	5744.931011	5725 – 5850	PASS
40	120	5744.909371	5725 – 5850	PASS
30	120	5744.960191	5725 – 5850	PASS
20	120	5744.930588	5725 – 5850	PASS
10	120	5744.958679	5725 – 5850	PASS
0	120	5744.927235	5725 – 5850	PASS
-10	120	5744.921351	5725 – 5850	PASS
-20	120	5744.926049	5725 – 5850	PASS
-30	120	5744.951761	5725 – 5850	PASS

4.10. 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.

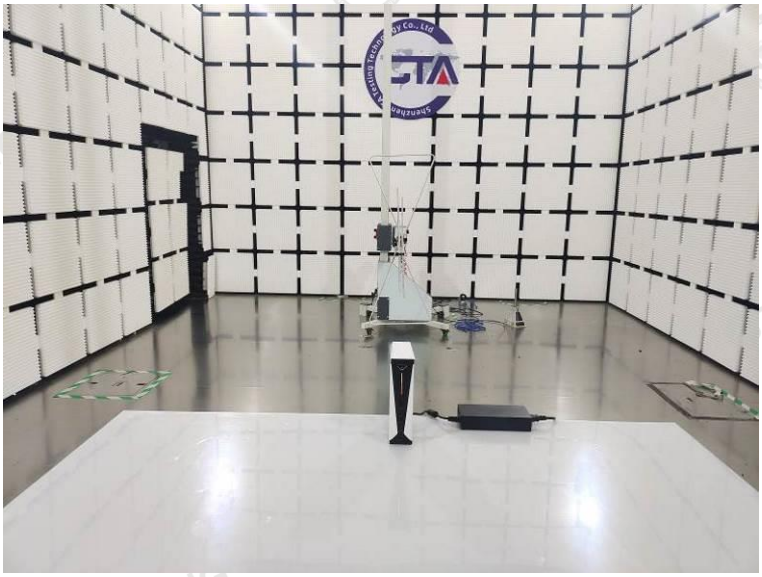
And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Information

The maximum gain of antenna were Antenna 4.31 dBi, Antenna 2: 3.83 dB, It meets the requirements of 15.203.

Remark: The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen CTA Testing Technology Co., Ltd. does not assume any responsibility.

5. Test Setup Photos of the EUT



6. External and Internal Photos of the EUT

Reference to the test report No. **CTA24072900901.**

.....End of Report.....