



TEST REPORT

Test item description: LoRa Module
FCC ID: 2ATPO-RA20
Trademark(s):  
Model/Type reference: Ra-20
Applicant's name: Shenzhen Ai-Thinker Technology Co., Ltd
Address: 410, Block C, Huafeng Smart Innovation Port. Gushu 2nd Road, Gushu Community, Xixiang Street, Baoan District, Shenzhen, China
Manufacturer: Shenzhen Ai-Thinker Technology Co., Ltd
Address: 410, Block C, Huafeng Smart Innovation Port. Gushu 2nd Road, Gushu Community, Xixiang Street, Baoan District, Shenzhen, China
Prepared By: Shenzhen CTB Testing Technology Co., Ltd.
Address: 1&2/F., Building A, No.26, Xinhe Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China
Sample Received Date: May. 06, 2026
Sample tested Date: May. 06, 2026 to Jul. 28, 2026
Issue Date: Jul. 28, 2026
Report No.: CTB26050609306RF02
Test Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.231
ANSI C63.10:2020
Test Results: PASS
Remark: This is 433MHz radio test report.

Compiled by:

Reviewed by:

Approved by:

Kai Chen

Martin Feng

Bin Mei

Kai Chen

Martin Feng

Bin Mei / Director

Note: If there is any objection to the inspection results in this report, please submit a written report to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. The tested sample(s) and the sample information are provided by the applicant. The authenticity, accuracy, and completeness of the provided information are the sole responsibility of the applicant. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The result decision rules of our laboratory are based solely on the direct comparison between the actual measured values of test results and the standard limits, without considering the measurement uncertainty. "★" indicates the testing items were fulfilled by subcontracted lab. "✖" indicates the items are not in CNAS accreditation scope.

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(Note: N/A means not applicable)



1. VERSION

Report No.	Issue Date	Description	Approved
CTB26050609306RF02	Jul. 28, 2026	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2020	PASS
Radiated Emission	47 CFR Part 15 Subpart C Section 15.209; 15.231(b)	ANSI C63.10-2020	PASS
Dwell Time	47 CFR Part 15 Subpart C Section 15.231 (a)	ANSI C63.10-2020	PASS
Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.231(c)	ANSI C63.10-2020	PASS
Antenna requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2020	PASS

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in C ISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Occupancy bandwidth	$U=\pm 54.3\text{Hz}$
Conducted output power Above 1G	$U=\pm 1.0\text{dB}$
Conducted output power below 1G	$U=\pm 0.9\text{dB}$
Power Spectral Density , Conduction	$U=\pm 1.0\text{dB}$
Conduction spurious emissions	$U=\pm 2.8\text{dB}$
Out of band emission	$U=\pm 54\text{Hz}$
3m chamber Radiated spurious emission(30MHz-1GHz)	$U=\pm 4.3\text{dB}$
3m chamber Radiated spurious emission(1GHz-18GHz)	$U=\pm 4.5\text{dB}$
humidity uncertainty	$U=\pm 5.3\%$
Temperature uncertainty	$U=\pm 0.59^{\circ}\text{C}$
Supply voltages	$U=\pm 3\%$
Time	$U=\pm 5\%$

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model/Type reference:	Ra-20
Model Description:	N/A
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	470-510MHz
Type of Modulation:	FSK
Antenna installation:	External antenna
Antenna Gain:	-1.80dBi
Ratings:	DC 3.3V PC power supply

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/TypeNo.	SeriesNo.	Note
1.	Laptop	DELL	Vostro 5490	N/A	AE

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode
Keep the EUT in transmitting mode with modulation.

4.5 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(DC)(V):	3.3
Normal Temperature(°C)	23

4.6 Test Channel

CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)
0	410	1	411	2	412	3	413
4	414	5	415	6	416	7	417
8	418	9	419	10	420	11	421
12	422	13	423	14	424	15	425
16	426	17	427	18	428	19	429
20	430	21	431	22	432	23	433
24	434	25	435	26	436	27	437
28	438	29	439	30	440	31	441
32	442	33	443	34	444	35	445
36	446	37	447	38	448	39	449
40	450	41	451	42	452	43	453
44	454	45	455	46	456	47	457
48	458	49	459	50	460	51	461
52	462	53	463	54	464	55	465
56	466	57	467	58	468	59	469
60	470	61	471	62	472	63	473
64	474	65	475	66	476	67	477
68	478	69	479	70	480	71	481
72	482	73	483	74	484	75	485
76	486	77	487	78	488	79	489
80	490	81	491	82	492	83	493
84	494	85	495	86	496	87	497
88	498	89	499	90	500	91	501
92	502	93	503	94	504	95	505
96	506	97	507	98	508	99	509
100	510	101	511	102	512	104	513
105	514	106	515	107	516	108	517
109	518	110	519	111	520	112	521
113	522	114	523	115	524	116	525

5. TEST FACILITY AND TEST INSTRUMENT USED**5.1 Test Facility**

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

	Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Calibrated Date	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	A.14.16	2026/5/14	2027/5/13
2	Power Sensor	Agilent	U2021XA	MY56120032	/	2026/5/14	2027/5/13
3	Power Sensor	Agilent	U2021XA	MY56120034	/	2026/5/14	2027/5/13
4	Communication test set	R&S	CMW500	108058	V3.5.80	2026/5/14	2027/5/13
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2026/5/14	2027/5/13
6	Signal Generator	Agilent	N5181A	MY50140365	A.01.60	2026/5/14	2027/5/13
7	Vector signal generator	Agilent	N5182A	MY47420195	A.01.87	2026/5/14	2027/5/13
8	Communication test set	Agilent	E5515C	MY50102567	B.19.07 (E1962B)	2026/5/14	2027/5/13
9	2.4 GHz Filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	/	2026/5/16	2027/5/15
10	5 GHz Filter	Shenxiang	MSF5150-5850MS-1155	20181015001	/	2026/5/16	2027/5/15
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	/	2026/5/16	2027/5/15
12	BT&WI-FI Automatic test software	Microwave	MTS8310	Ver. 2.0.0.0	/	/	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	/	2025/10/20	2026/10/19
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	/	2026/7/12	2027/7/11
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/	/	/
16	966 chamber	C.R.T.	966	/	/	2024/6/23	2027/6/22
17	Receiver	R&S	ESPI	100362	RF_ATTEN_7 (104489/003)	2026/5/15	2027/5/14
18	Amplifier	HP	8447E	2945A02747	/	2026/5/15	2027/5/14
19	Amplifier	Agilent	8449B	3008A01838	/	2026/5/14	2027/5/13
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	/	2026/5/17	2027/5/16

21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	/	2026/5/15	2027/5/14
22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/	/	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2026/5/17	2027/5/16
24	loop antenna	ZHINAN	ZN30900A	GTS534	/	/	/
25	40G Horn antenna	A/H/System	SAS-574	588	/	2026/6/1	2027/5/31
26	Amplifier	AEROFLEX	Aeroflex	097	/	2026/6/1	2027/5/31
27	Power Meter	KEYSIGHT	N1912AP	N/A	A.05.00	2026/6/1	2027/5/31

Continuous disturbance

No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated Date	Calibrated until
1	843 Shield Room	C/ R/ T	843	/	/	2024/6/22	2027/6/21
2	LISN	ROHDE&SCHWARZ	ESH3-Z5	831551852	/	2026/5/14	2027/5/13
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428	V4.42.SP3	2026/5/15	2027/5/14
4	Coaxial cable	ZDECL	Z302S	18091904	/	2026/5/14	2027/5/13
5	ISN	Schwarzbeck	NTFM8158	183	/	2026/5/18	2027/5/17
6	Voltage sensor	Schwarzbeck	TK 9420	01189	/	2026/5/16	2027/5/15
7	EZ-EMC	Frad	EMC-con3A1.1	/	/	/	/
8	Current Probe	FCC	F-52B	199453	/	2026/5/22	2027/5/21
9	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2026/5/14	2027/5/13
10	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2026/5/14	2027/5/13

Radiated emission(No.2 Chamber)

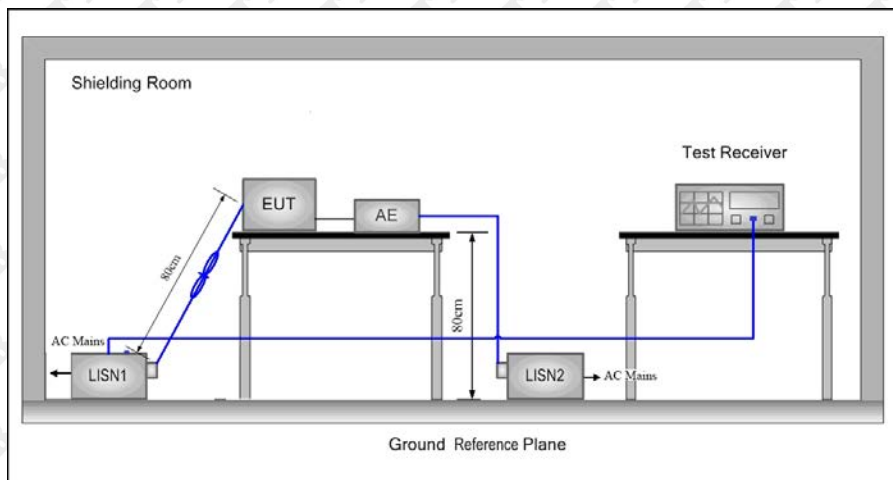
No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated Date	Calibrated until
1	966 Chamber	C/ R/ T	966	/	/	2024/6/8	2027/6/7
2	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	/	2026/5/15	2027/5/14
3	Broadband Antenna	Schwarzbeck	VULB 9168	1471	/	2025/9/19	2026/9/18
4	Amplifier	Agilent	8449B	3008A01838	/	2026/5/14	2027/5/13
5	Preamplifier	Schwarzbeck	BBV 9743 B	00500	/	2026/5/15	2027/5/14
6	EMI TEST RECEIVER	R&S	ESCI7	100861	/	2025/9/19	2026/9/18
7	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2026/5/14	2027/5/13
8	EMI test software	Farad	EZ-EMC	/	Ver. FARAD-3A1+	/	/
9	Coaxial cable	Rosenberg	8m	/	/	2026/5/16	2027/5/15
10	Coaxial cable	Times	2m	/	/	2026/5/16	2027/5/15



11	Coaxial cable	Times	2m	/	/	2026/5/16	2027/5/15
12	Coaxial cable	Times	1m	/	/	2026/5/16	2027/5/15
13	loop antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2026/5/17	2027/5/16
14	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2026/5/14	2027/5/13
15	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2026/5/14	2027/5/13

6.AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

* Decreasing linearly with the logarithm of the frequency

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

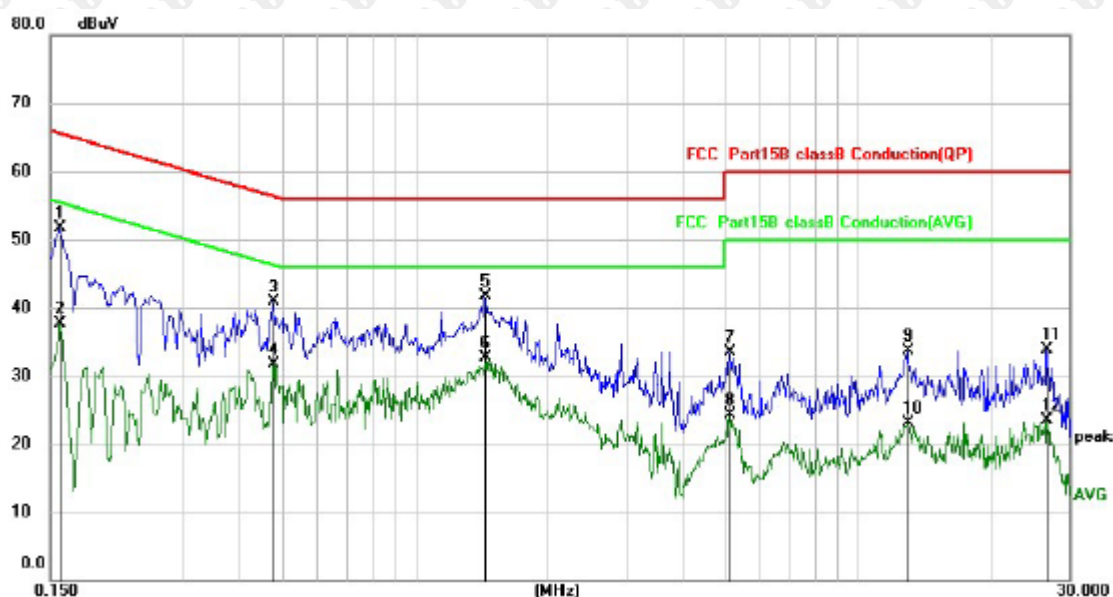
6.3 Test procedure

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

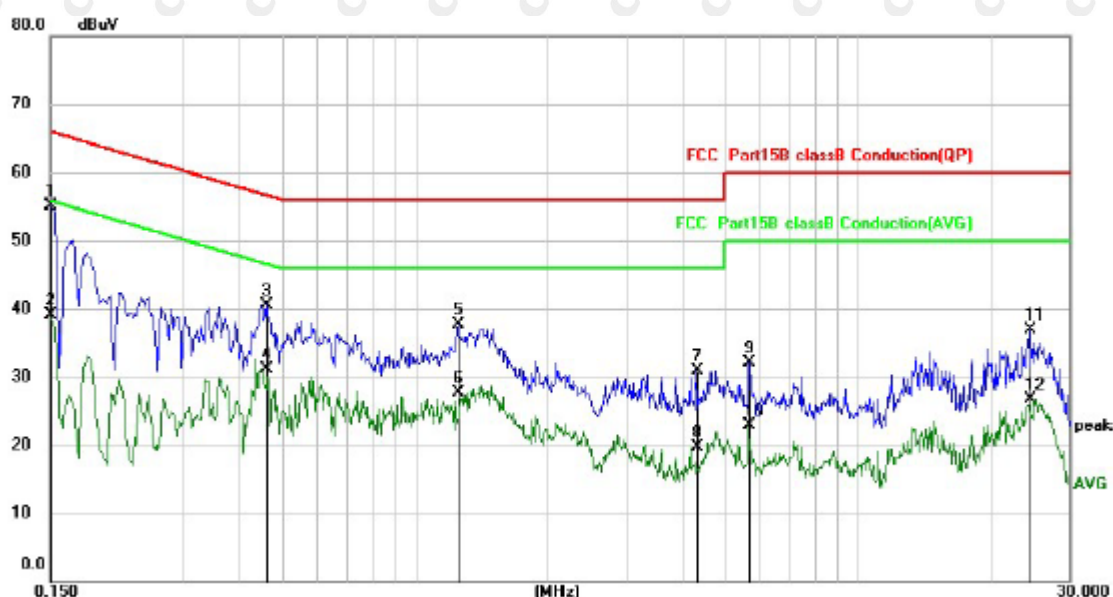
6.4 Test Result

L:



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1580	41.54	10.07	51.61	65.57	-13.96	QP
2		0.1580	27.55	10.07	37.62	55.57	-17.95	AVG
3		0.4780	30.82	10.09	40.91	56.37	-15.46	QP
4		0.4780	21.61	10.09	31.70	46.37	-14.67	AVG
5		1.4340	31.58	10.15	41.73	56.00	-14.27	QP
6	*	1.4340	22.53	10.15	32.68	46.00	-13.32	AVG
7		5.1139	23.12	10.29	33.41	60.00	-26.59	QP
8		5.1139	13.96	10.29	24.25	50.00	-25.75	AVG
9		12.9819	23.02	10.61	33.63	60.00	-26.37	QP
10		12.9819	12.48	10.61	23.09	50.00	-26.91	AVG
11		26.6820	22.71	11.21	33.92	60.00	-26.08	QP
12		26.6820	12.29	11.21	23.50	50.00	-26.50	AVG

N:



No.	Mk.	Freq. MHz	Reading Level dBμV	Correct Factor dB	Measure- ment dBμV	Limit dBμV	Over dB	Detector
1	*	0.1500	44.97	10.07	55.04	66.00	-10.96	QP
2		0.1500	29.04	10.07	39.11	56.00	-16.89	AVG
3		0.4620	30.36	10.09	40.45	56.66	-16.21	QP
4		0.4620	21.04	10.09	31.13	46.66	-15.53	AVG
5		1.2540	27.63	10.14	37.77	56.00	-18.23	QP
6		1.2540	17.61	10.14	27.75	46.00	-18.25	AVG
7		4.3338	20.63	10.26	30.89	56.00	-25.11	QP
8		4.3338	9.46	10.26	19.72	46.00	-26.28	AVG
9		5.6700	21.81	10.31	32.12	60.00	-27.88	QP
10		5.6700	12.54	10.31	22.85	50.00	-27.15	AVG
11		24.4340	25.65	11.17	36.82	60.00	-23.18	QP
12		24.4340	15.58	11.17	26.75	50.00	-23.25	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit All modes have been tested with only the worst data 411MHz

7. RADIATED EMISSION

7.1 Block Diagram Of Test Setup

Figure 1. Below 30MHz

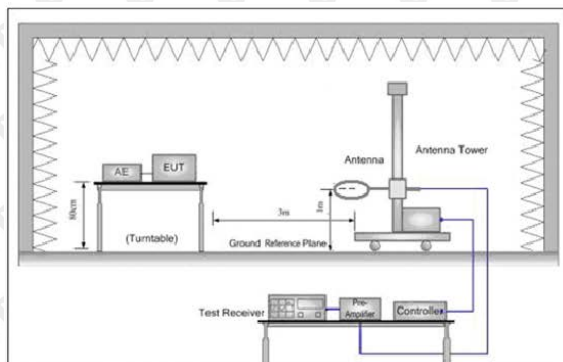


Figure 2. 30MHz to 1GHz

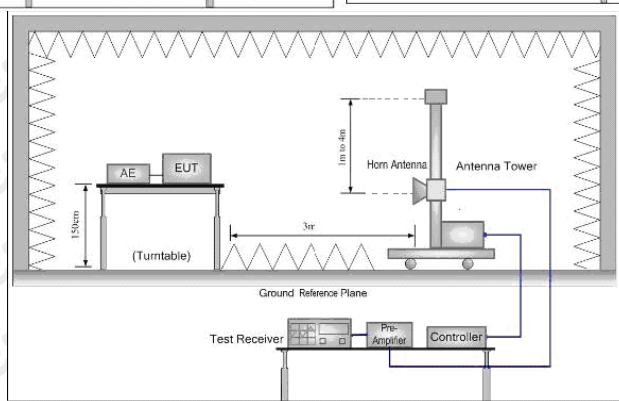
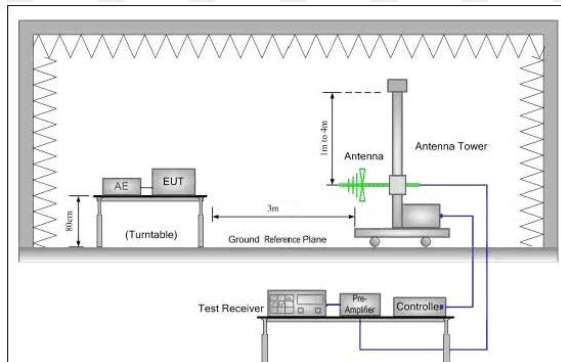


Figure 3. Above 1GHz

7.2 Limit

Spurious Emissions:

Frequency	Field strength (dBμV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	$20\log 2400/F \text{ (kHz)} + 80$	-	3
0.490MHz-1.705MHz	$20\log 24000/F \text{ (kHz)} + 40$	-	3
1.705MHz-30MHz	$20\log 30 + 40$	-	3
30MHz-88MHz	40.0	Quasi-peak	3
88MHz-216MHz	43.5	Quasi-peak	3
216MHz-960MHz	46.0	Quasi-peak	3
960MHz-1GHz	54.0	Quasi-peak	3
Above 1GHz	54.0	Average	3

Note: 15. 35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Field Strength of Fundamental Limit:

Fundamental and harm onics emission limits Frequency(MHz)	Field strength of Fundamental((microvolts/meter)	Field strength of spurious emissions(microvolts/meter)
40.66-40.70	2280	225
70-130	1250	125
130-174	1250 to 3750**	125 to 375**
174-260	3750	375
260-470	3750 to 12500**	375 to 1250**
Above 470	12500	1250

** linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$; for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

Frequency	Limit (dB $\mu\text{V/m}$ @3m)	Remark
470MHz	81.94	Average Value
	101.94	Peak Value
490MHz	81.94	Average Value
	101.94	Peak Value
510MHz	81.94	Average Value
	101.94	Peak Value

7.3 Test procedure

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotating table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

- Different from above is the test site, change from Semi-Anechoic Chamber to fully Anechoic Chamber and change from table 0.8 meter to 1.5 meter (Above 18GHz the distance is 1 meter and table is 1.5 meter).
- Test the EUT in the lowest channel, the middle channel, the Highest channel.
- Repeat above procedures until all frequencies measured was complete.

Receiver

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30KHz	Average

set:

0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

7.4 Test Result

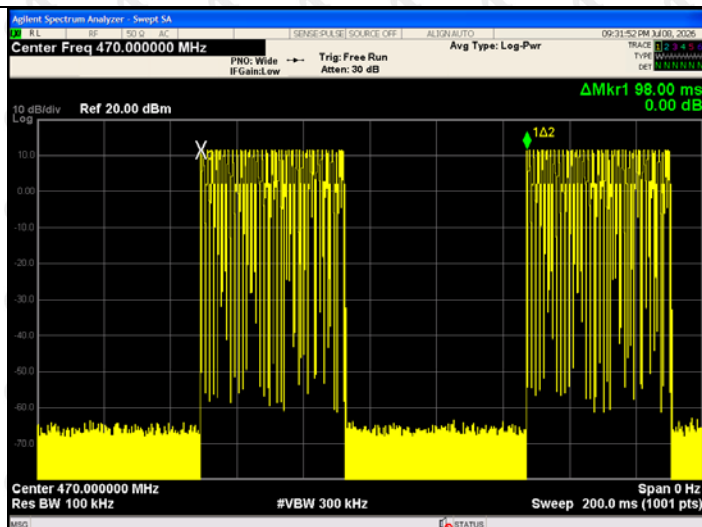
Calculation of average factor

The output field strengths of specification in accordance with the FCC rules specify measurements with an average detector. During the test, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

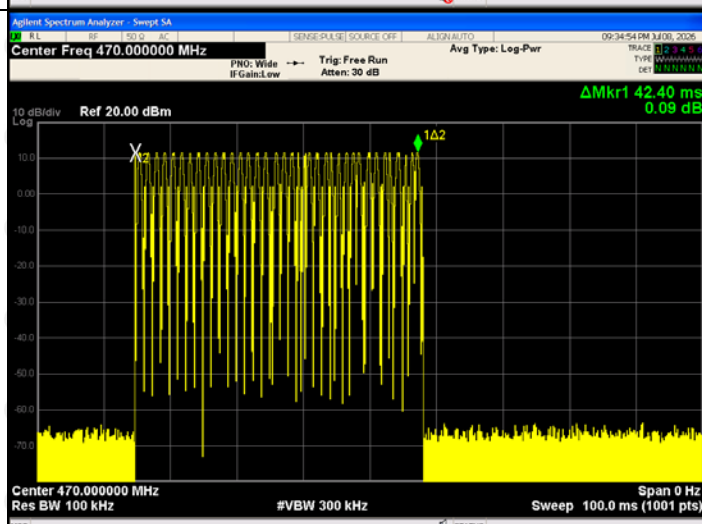
The duty cycle is measured in 100 ms or the repetition cycle period, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer to set zero span at 100kHz resolution bandwidth.

470MHz

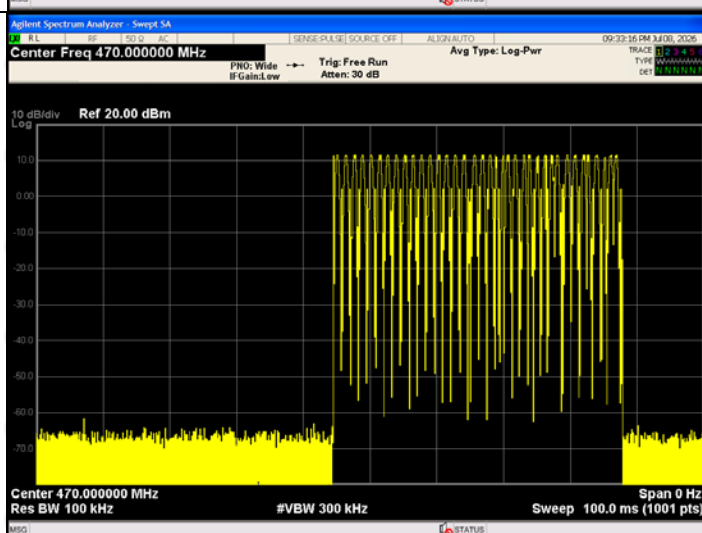
Cycle



Pulse



On-time 1



Average factor:

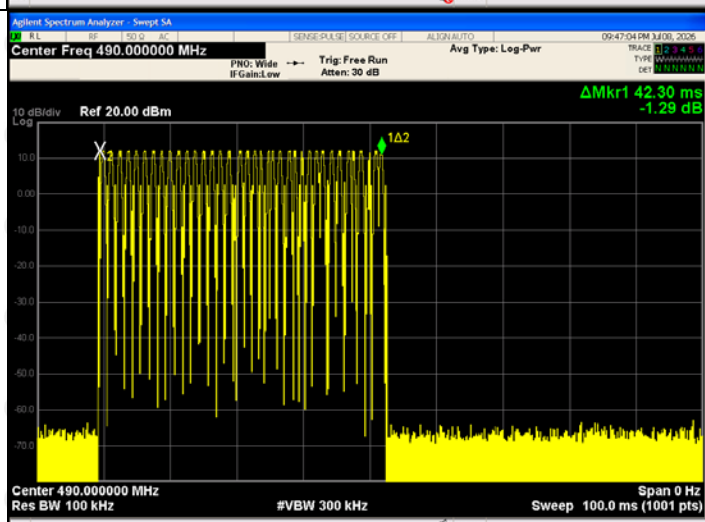
Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle = T on time / 100ms
Calculated average factor:	Ton time =42.4(ms); T period =98(ms)
	PDCF = 20 log(42.4/98)=-7.28dB

490MHz

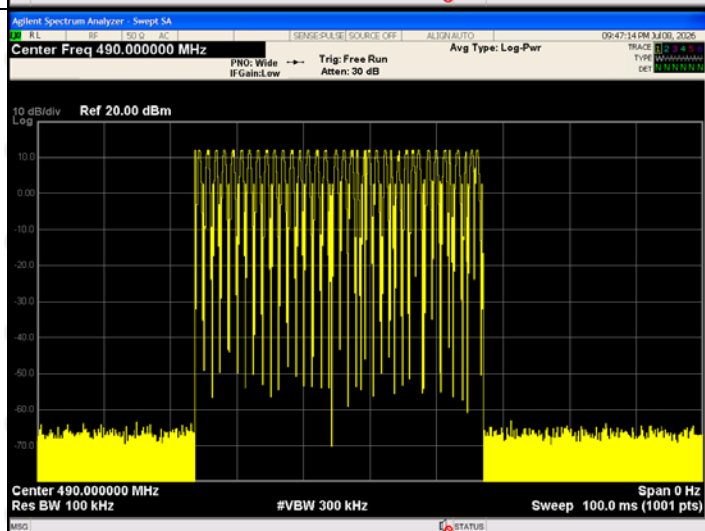
Cycle



Pulse



On-time 1



Average factor:

Calculate Formula:

Average value=Peak value + PDCF

PDCF=20 log(Duty cycle)

Duty cycle = T on time / 100ms

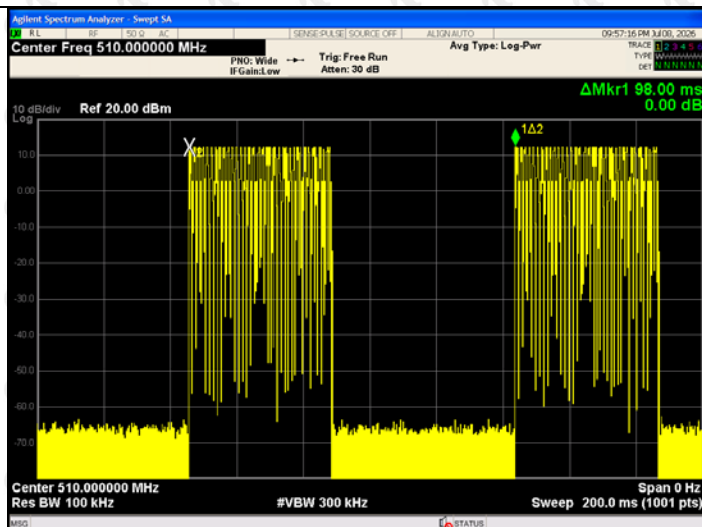
Calculated average factor:

Ton time =42.3(ms); T period =98(ms)

PDCF = 20 log(42.3/98)=-7.30dB

510MHz

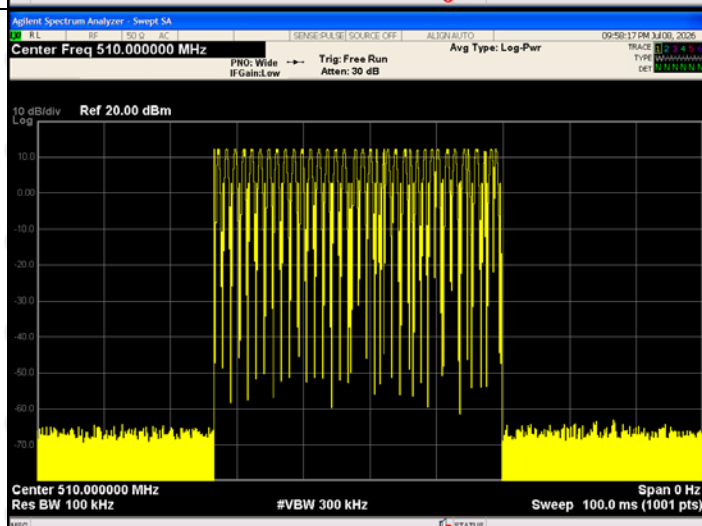
Cycle



Pulse



On-time



Average factor:

Calculate Formula:	Average value=Peak value + PDCF
	PDCF=20 log(Duty cycle)
	Duty cycle = T on time / 100ms
Calculated average factor:	Ton time =42.4(ms); T period =98(ms)
	PDCF = 20 log(42.4/98)=-7.28dB

Radiated Spurious Emission 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

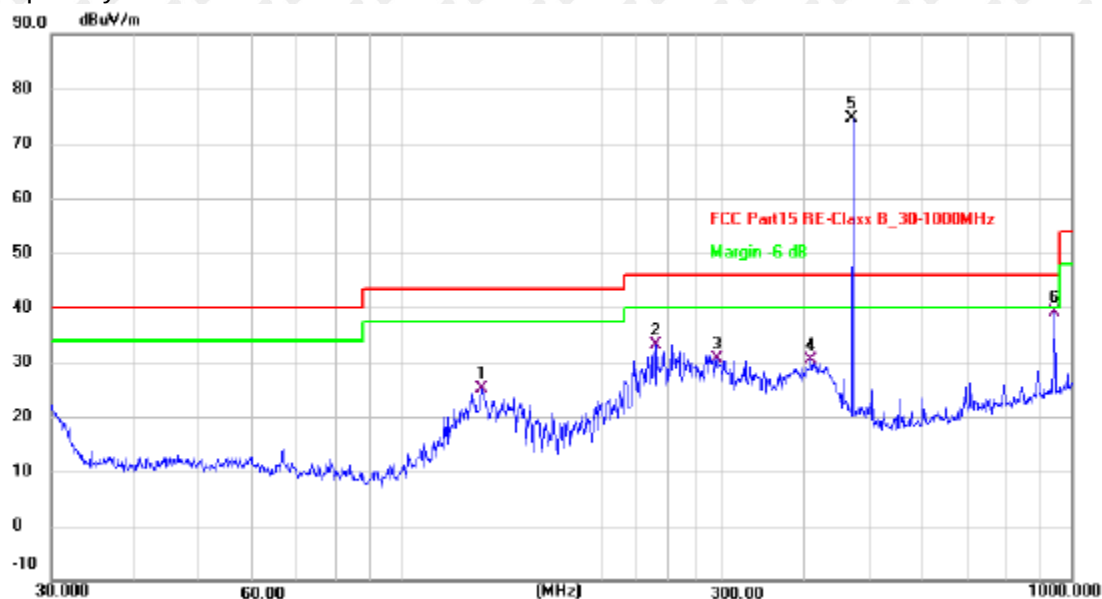
2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

470MHz:

About 30MHz-1GHz

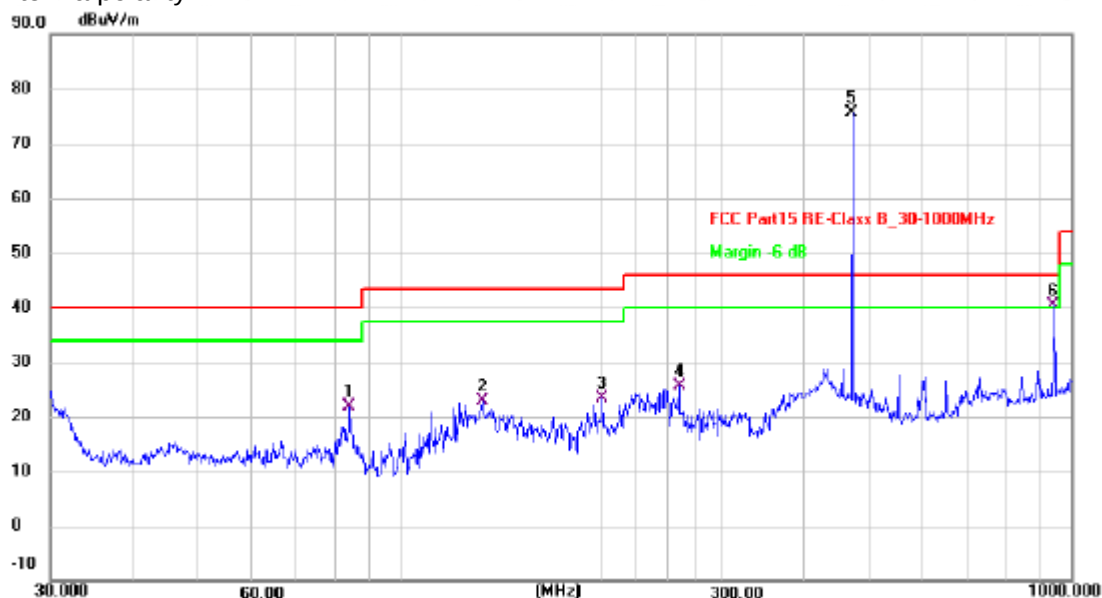
Test Results:

Antenna polarity: H



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	131.7577	39.60	-14.46	25.14	43.50	-18.36	QP
2	239.9873	47.44	-14.34	33.10	46.00	-12.90	QP
3	295.1468	43.08	-12.33	30.75	46.00	-15.25	QP
4	408.9460	40.39	-10.10	30.29	46.00	-15.71	QP
5 *	470.1760	83.41	-8.67	74.74	101.94	-27.2	peak
6	942.1304	39.36	-0.20	39.16	81.94	-42.76	peak

Antenna polarity: V



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	83.8155	38.92	-17.16	21.76	40.00	-18.24	QP
2	132.2204	37.19	-14.40	22.79	43.50	-20.71	QP
3	199.9855	39.18	-15.75	23.43	43.50	-20.07	QP
4	260.1444	39.34	-13.62	25.72	46.00	-20.28	QP
5 *	470.1760	84.28	-8.67	75.61	101.94	-26.33	peak
6 !	940.1304	40.59	-0.22	40.37	81.94	-41.57	peak

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Limit – Level

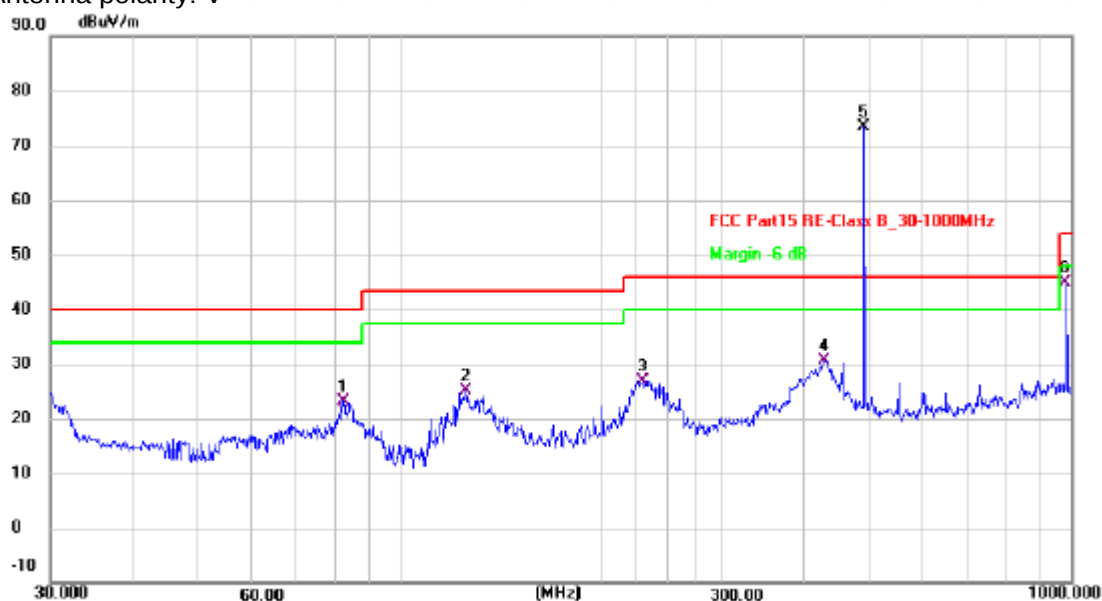
490MHz:

Antenna polarity: H



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	30.9618	35.83	-13.60	22.23	40.00	-17.77	QP
2	131.7576	40.10	-14.46	25.64	43.50	-17.86	QP
3	232.5318	47.06	-14.60	32.46	46.00	-13.54	QP
4	411.8240	42.70	-10.03	32.67	46.00	-13.33	QP
5 *	490.7445	80.19	-8.19	72.00	101.94	-29.94	peak
6	980.6200	42.72	0.35	43.07	81.94	-38.87	peak

Antenna polarity: V

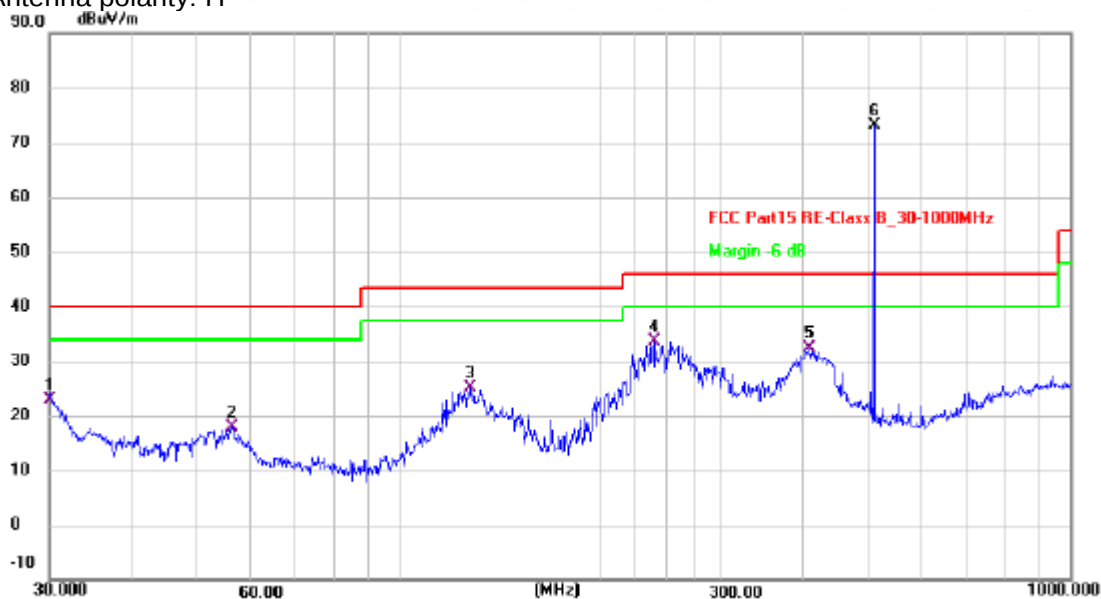


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	82.0704	40.10	-17.02	23.08	40.00	-16.92	QP
2	125.0065	40.63	-15.54	25.09	43.50	-18.41	QP
3	229.2930	41.69	-14.72	26.97	46.00	-19.03	QP
4	428.0192	40.27	-9.66	30.61	46.00	-15.39	QP
5 *	490.7445	81.52	-8.19	73.33	101.94	-28.61	peak
6	980.6200	44.50	0.35	44.85	81.94	-37.09	peak

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Limit – Level

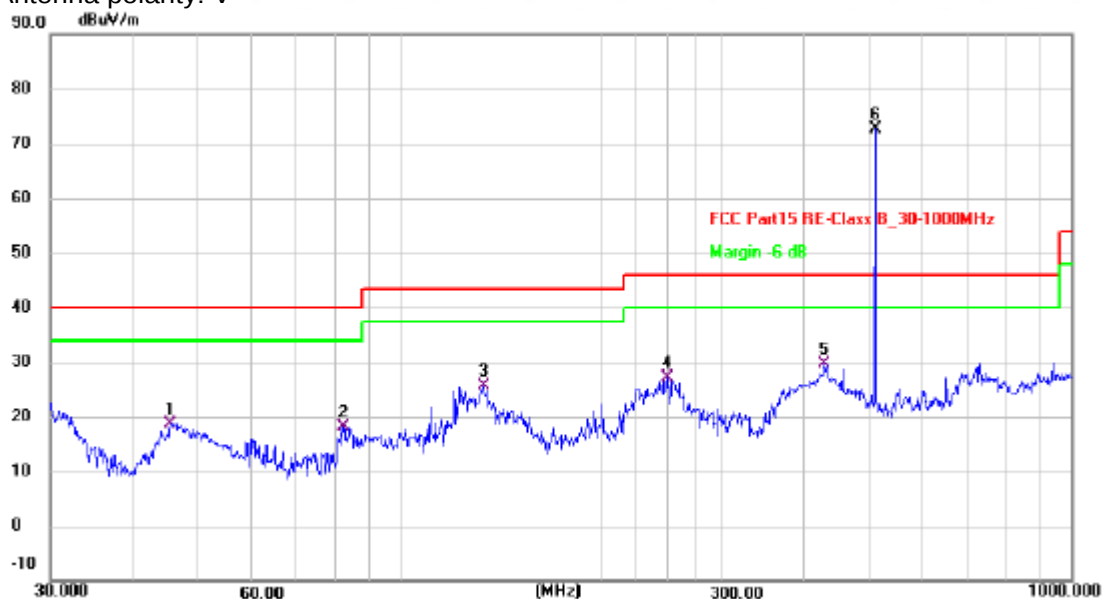
510MHz:

Antenna polarity: H



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	30.1051	36.49	-13.64	22.85	40.00	-17.15	QP
2	56.1974	31.27	-13.51	17.76	40.00	-22.24	QP
3	127.2176	40.44	-15.19	25.25	43.50	-18.25	QP
4	239.9873	47.94	-14.34	33.60	46.00	-12.40	QP
5	408.9460	42.39	-10.10	32.29	46.00	-13.71	QP
6 *	510.0434	80.83	-7.72	73.11	101.94	-28.83	peak

Antenna polarity: V



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	45.3753	31.74	-13.13	18.61	40.00	-21.39	QP
2	82.0704	35.10	-17.02	18.08	40.00	-21.92	QP
3	132.6850	39.97	-14.33	25.64	43.50	-17.86	QP
4	250.3010	41.20	-13.98	27.22	46.00	-18.78	QP
5	428.0192	39.27	-9.66	29.61	46.00	-16.39	QP
6 *	510.0434	80.45	-7.72	72.73	101.94	-29.21	peak

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Limit – Level

For average Emission

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit AV	Margin	Polarization
470.18	74.74	-7.28	67.46	81.94	-14.48	Horizontal
490.74	72	-7.30	64.7	81.94	-17.24	Horizontal
510.04	73.11	-7.28	65.83	81.94	-16.11	Horizontal
942.13	39.16	-7.28	31.88	61.94	-30.06	Horizontal
980.62	43.07	-7.30	35.77	61.94	-26.17	Horizontal
470.18	75.61	-7.28	68.33	81.94	-13.61	Vertical
490.74	73.33	-7.30	66.03	81.94	-15.91	Vertical
510.04	72.73	-7.28	65.45	81.94	-16.49	Vertical
942.13	40.37	-7.28	33.09	61.94	-28.85	Vertical
980.62	44.85	-7.30	37.55	61.94	-24.39	Vertical

Notes: Average emission Level = Peak Level + Duty cycle factor

Above 1GHz Test Results

470MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1410.54	49.20	-7.28	41.92	81.94	61.94	-32.74	-20.02	Vertical
1880.72	48.68	-7.28	41.40	81.94	61.94	-33.26	-20.54	Vertical
2350.9	42.36	-7.28	35.08	81.94	61.94	-39.58	-26.86	Vertical
2821.08	40.29	-7.28	33.01	81.94	61.94	-41.65	-28.93	Vertical
3291.26	41.31	-7.28	34.03	81.94	61.94	-40.63	-27.91	Vertical
3761.44	41.12	-7.28	33.84	81.94	61.94	-40.82	-28.10	Vertical
1410.54	49.61	-7.28	42.33	81.94	61.94	-32.33	-19.61	Horizontal
1880.72	48.66	-7.28	41.38	81.94	61.94	-33.28	-20.56	Horizontal
2350.9	43.32	-7.28	36.04	81.94	61.94	-38.62	-25.90	Horizontal
2821.08	39.25	-7.28	31.97	81.94	61.94	-42.69	-29.97	Horizontal
3291.26	41.57	-7.28	34.29	81.94	61.94	-40.37	-27.65	Horizontal
3761.44	40.33	-7.28	33.05	81.94	61.94	-41.61	-28.89	Horizontal

Notes: Average emission Level = Peak Level + Duty cycle factor

490MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1472.22	51.10	-7.31	43.79	81.94	61.94	-30.84	-18.15	Vertical
1962.96	47.14	-7.31	39.83	81.94	61.94	-34.80	-22.11	Vertical
2453.7	44.74	-7.31	37.43	81.94	61.94	-37.20	-24.51	Vertical
2944.44	43.32	-7.31	36.01	81.94	61.94	-38.62	-25.93	Vertical
3435.18	40.50	-7.31	33.19	81.94	61.94	-41.44	-28.75	Vertical
3925.92	40.01	-7.31	32.70	81.94	61.94	-41.93	-29.24	Vertical
1472.22	50.38	-7.31	43.07	81.94	61.94	-31.56	-18.87	Horizontal
1962.96	47.66	-7.31	40.35	81.94	61.94	-34.28	-21.59	Horizontal
2453.7	42.51	-7.31	35.20	81.94	61.94	-39.43	-26.74	Horizontal
2944.44	41.49	-7.31	34.18	81.94	61.94	-40.45	-27.76	Horizontal
3435.18	41.82	-7.31	34.51	81.94	61.94	-40.12	-27.43	Horizontal
3925.92	40.22	-7.31	32.91	81.94	61.94	-41.72	-29.03	Horizontal

Notes: Average emission Level = Peak Level + Duty cycle factor

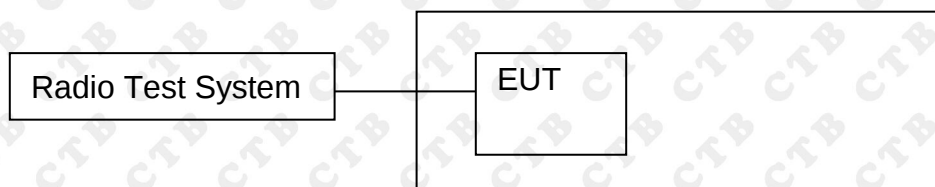
510MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1020.08	49.39	-7.28	42.11	81.94	61.94	-32.55	-19.83	Vertical
1530.12	48.00	-7.28	40.72	81.94	61.94	-33.94	-21.22	Vertical
2040.16	43.22	-7.28	35.94	81.94	61.94	-38.72	-26.00	Vertical
2550.2	41.24	-7.28	33.96	81.94	61.94	-40.70	-27.98	Vertical
3060.24	41.73	-7.28	34.45	81.94	61.94	-40.21	-27.49	Vertical
3570.28	41.96	-7.28	34.68	81.94	61.94	-39.98	-27.26	Vertical
1020.08	48.84	-7.28	41.56	81.94	61.94	-33.10	-20.38	Horizontal
1530.12	47.86	-7.28	40.58	81.94	61.94	-34.08	-21.36	Horizontal
2040.16	44.74	-7.28	37.46	81.94	61.94	-37.20	-24.48	Horizontal
2550.2	43.14	-7.28	35.86	81.94	61.94	-38.80	-26.08	Horizontal
3060.24	41.07	-7.28	33.79	81.94	61.94	-40.87	-28.15	Horizontal
3570.28	41.83	-7.28	34.55	81.94	61.94	-40.11	-27.39	Horizontal

Notes: Average emission Level = Peak Level + Duty cycle factor

8. DWELL TIME

8.1 Block Diagram Of Test Setup



8.2 Limit

According to FCC 15.231(a) requirement:

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

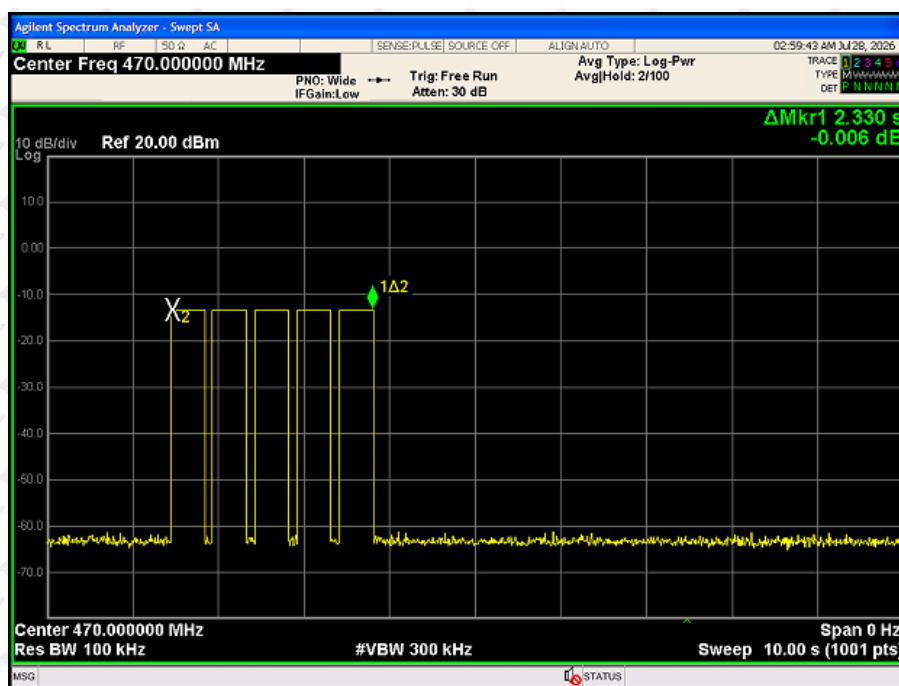
8.3 Test procedure

- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- e) Repeat above procedures until all measured frequencies were complete.

8.4 Test Result

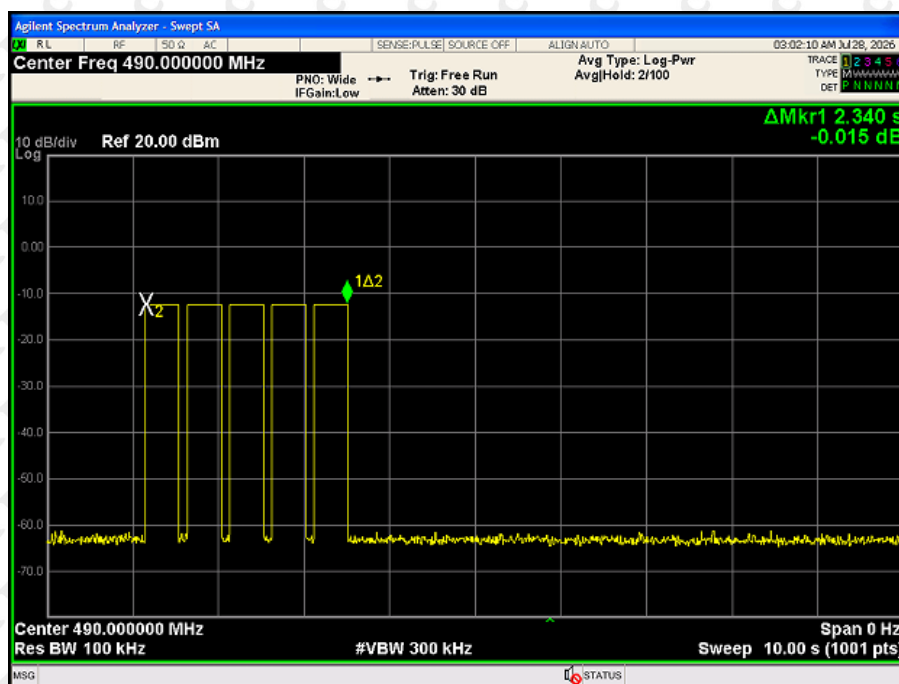
470MHz

Transmitting time(S)	Limit (S)	Results
2.330	≤5	Pass



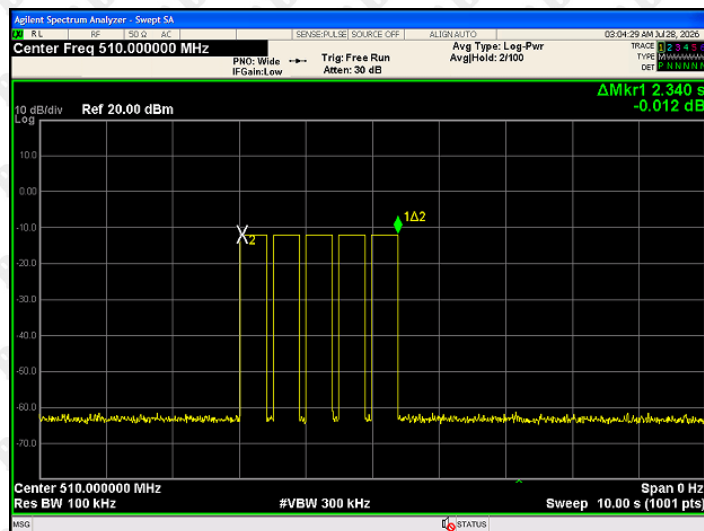
490MHz

Transmitting time(S)	Limit (S)	Results
2.340	≤5	Pass



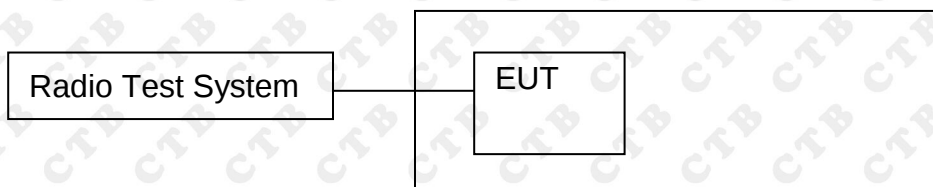
510MHz

Transmitting time(S)	Limit (S)	Results
2.340	≤5	Pass



9. OCCUPIED BANDWIDTH

9.1 Block Diagram Of Test Setup



9.2 Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 470.93MHz = 1.1773MHz

B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 490.3MHz = 1.2258MHz

B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 505.95MHz = 1.2649MHz

B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 510MHz = 1.2750MHz

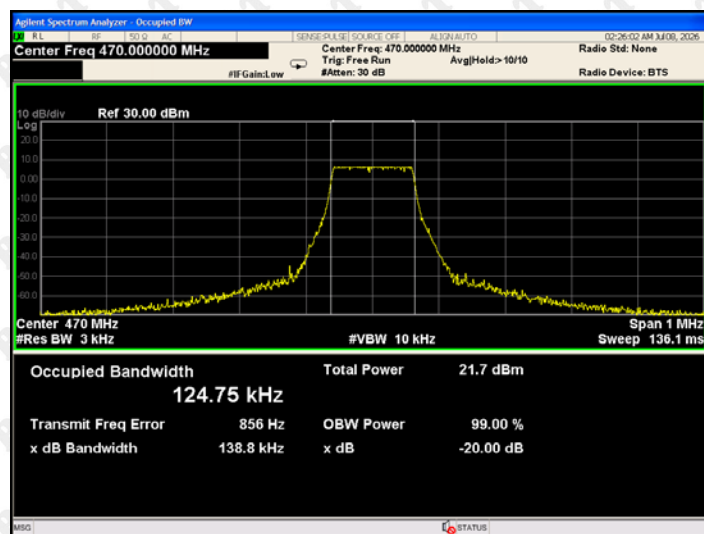
9.3 Test procedure

1. Set RBW = 10 kHz.
2. Set the video bandwidth (VBW) ≥ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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 20 dB relative to the maximum level measured in the fundamental emission.

9.4 Test Result

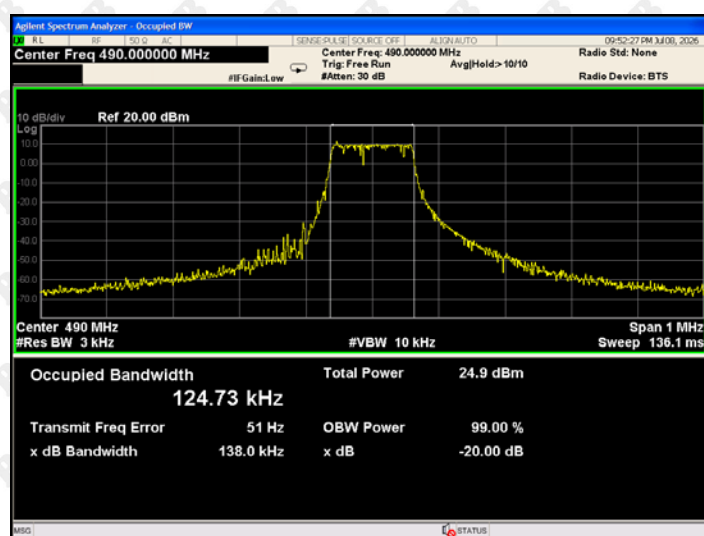
470MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
138.8	1.1773	Pass



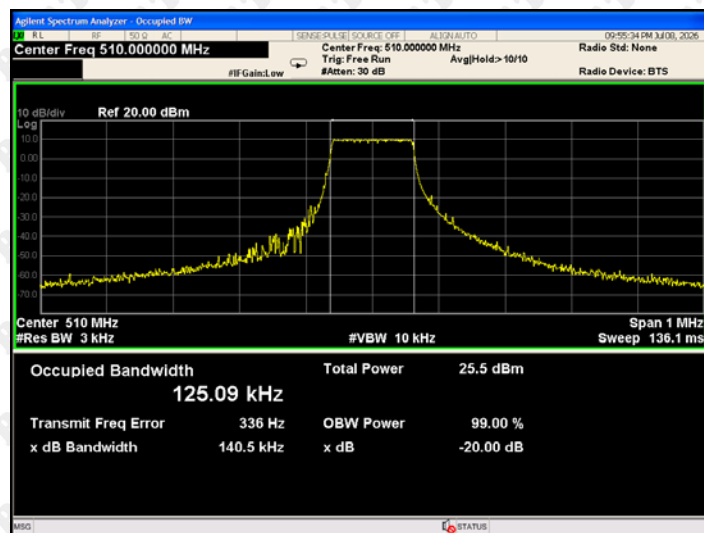
490MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
138	1.2258	Pass



510MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
140.5	1.2750	Pass



10. ANTENNA REQUIREMENT

15.203 requirement:

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

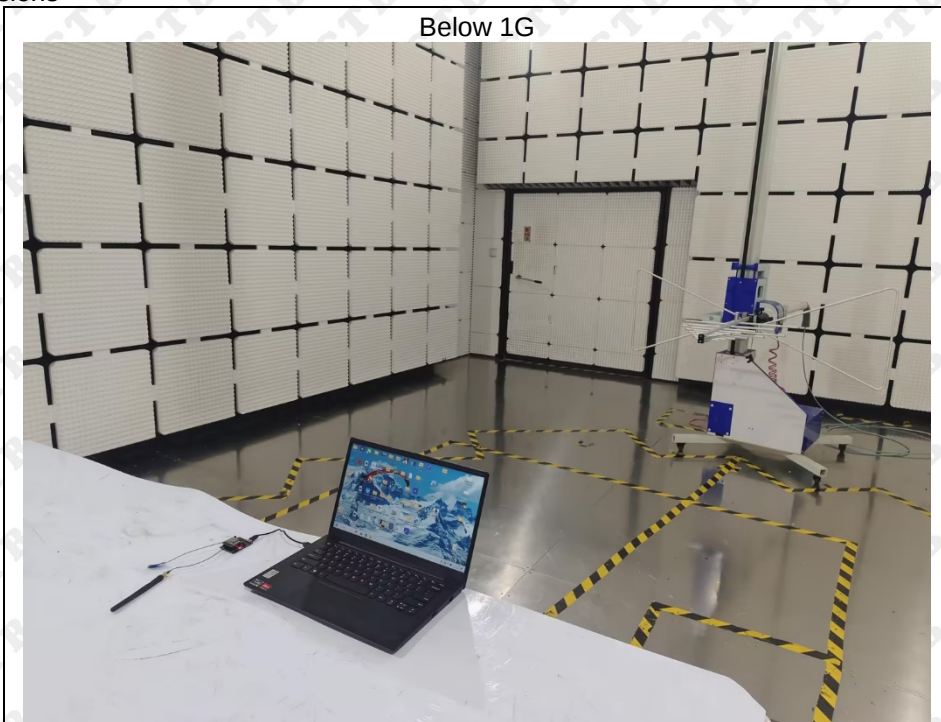
The antenna is external antenna and no consideration of replacement. The best case gain of the antenna is

-1.80dBi.

11. EUT TEST SETUP PHOTOGRAPHS

Radiated Emissions

Below 1G



Above 1G



Conducted emission



RF Conducted



***** END OF REPORT *****