TEST REPORT

Product Name:	LoRa Module
FCC ID:	2ATPO-RA-01SC
Trademark:	B&T 博安通 , 安信可科技 Ai-Thinker
Model Number:	Ra-01SC
Prepared For:	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:	Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China
Sample Received Date:	May. 14, 2021
Sample tested Date:	May. 14, 2021 - Jun. 25, 2021
Issue Date:	Jun. 25, 2021
Report No.:	CTB210525029RFX
Test Standards	FCC Part15.231 ANSI C63.10:2013
Test Results	PASS
Remark:	This is 433MHz radio test report.

Compiled by:	Reviewed by:	Approved by:
Arron Liu	Bin Mei	Rita Xiao / Director

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. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.

TABLE OF CONTENT

(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB210525029RFX	Jun. 25, 2021	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 C63.10-2013	N/A
Radiated Emission	47 CFR Part 15 Subpart C Section 15.209; 15.231(b)	ANSI C63.10-2013	PASS
Dwell Time	47 CFR Part 15 Subpart C Section 15.231 (a)	ANSI C63.10-2013	PASS
Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.231(c)	ANSI C63.10-2013	PASS
Antenna requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2013	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=±54.3Hz
Conducted output power Above 1G	U=±1.0dB
Conducted output power below 1G	U=±0.9dB
Power Spectral Density , Conduction	U=±1.0dB
Conduction spurious emissions	U=±2.8dB
Out of band emission	U=±54Hz
3m camber Radiated spurious emission(30MHz-1GHz)	U=±4.3dB
3m chamber Radiated spurious emission(1GHz-18GHz)	U=±4.5dB
humidity uncertainty	U=±5.3%
Temperature uncertainty	U=±0.59℃
Supply voltages	U=±3%
Time	U=±5%

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	Ra-01SC
Model Description:	N/A
Hardware Version:	V1.1
Software Version:	V1.1
Operation Frequency:	410-525MHz
Type of Modulation:	ASK
Antenna installation:	Spring antenna
Antenna Gain:	0dBi
Ratings:	DC 3.3V from PC

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

No.	Device Type	Brand	Model	Series No.	Data Cable	Power Cord
1.	PC	lenovo	V130	N/A	1.2	AC

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(%):	55
Atmospheric Pressure(kPa):	101.1
Normal Voltage(DC):	5.0
Normal Temperature(℃)	25

4.6 Test Channel

Channel	Frequency （MHz）
01	410MHz
02	411MHz
…	…
58	467MHz
59	468MHz
…	…
115	524 MHz
116	525 MHz

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

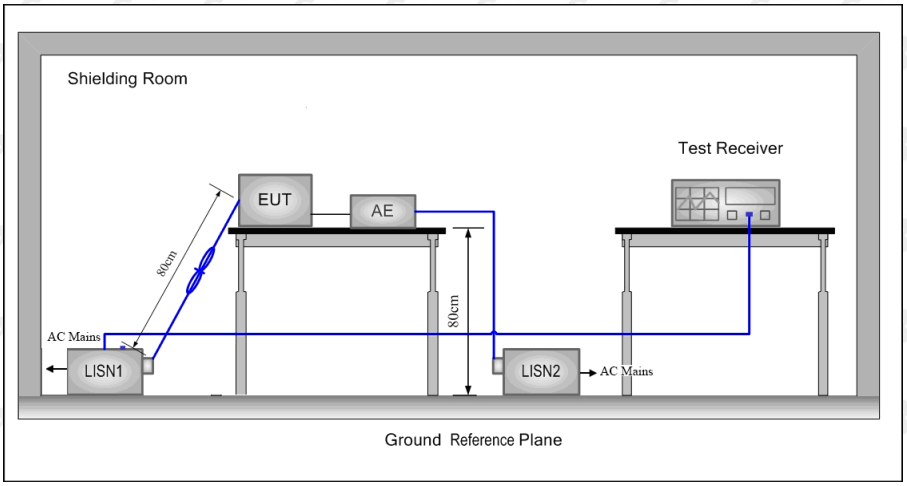
Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	Sep. 28, 2020	Sep. 28, 2021
2	Power Sensor	Agilent	U2021XA	MY56120032	Sep. 28, 2020	Sep. 28, 2021
3	Power Sensor	Agilent	U2021XA	MY56120034	Sep. 28, 2020	Sep. 28, 2021
4	Communication test set	R&S	CMW500	108058	Sep. 28, 2020	Sep. 28, 2021
5	Spectrum Analyzer	R&S	FSP40	100550	Sep. 28, 2020	Sep. 28, 2021
6	Signal Generator	Agilent	N5181A	MY49060920	Sep. 28, 2020	Sep. 28, 2021
7	Signal Generator	Agilent	N5182A	MY47420195	Sep. 28, 2020	Sep. 28, 2021
8	Communication test set	Agilent	E5515C	MY50102567	Oct. 10, 2020	Oct. 10, 2021
9	band rejection filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	Sep. 28, 2020	Sep. 28, 2021
10	band rejection filter	Shenxiang	MSF5150-5850MS-1155	20181015001	Sep. 28, 2020	Sep. 28, 2021
11	band rejection filter	Xingbo	XBLBQ-DZA120	190821-1-1	Sep. 28, 2020	Sep. 28, 2021
12	BT&WI-FI Automatic test software	Micowave	MTS8310	Ver. 2.0.0.0	\	\
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	Sep. 28, 2020	Sep. 28, 2021
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	Sep. 28, 2020	Sep. 28, 2021
15	234G Automatic test software	Micowave	MTS8200	Ver. 2.0.0.0	\	\
16	966 chamber	C.R.T.	966 Room	966	Nov. 9, 2019	Nov. 08, 2022
17	Receiver	R&S	ESPI	100362	Sep. 28, 2020	Sep. 28, 2021
18	Amplifier	HP	8447E	2945A02747	Sep. 28, 2020	Sep. 28, 2021

19	Amplifier	Agilent	8449B	3008A01838	Sep. 28, 2020	Sep. 28, 2021
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	Nov. 02, 2020	Nov. 01, 2021
21	Horn Antenna	Schwarzbeck	BBHA9120D	1911	Nov. 02, 2020	Nov. 01, 2021
22	Software	Fala	EZ-EMC	FA-03A2 RE	\	\
23	3-Loop Antenna	Daze	ZN30401	17014	Sep. 28, 2020	Sep. 28, 2021
24	loop antenna	ZHINAN	ZN30900A	/	Sep. 28, 2020	Sep. 28, 2021
25	Horn antenna	A/H/System	SAS-574	588	Sep. 28, 2020	Sep. 28, 2021
26	Amplifier	AEROFLEX	/	S/N/ 097	Sep. 28, 2020	Sep. 28, 2021

Conducted emissions Test					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
AMN	ROHDE&SCHWARZ	ESH3-Z5	100318	Sep. 28, 2020	Sep. 28, 2021
Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	Sep. 28, 2020	Sep. 28, 2021
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCS30	834115/006	Sep. 28, 2020	Sep. 28, 2021
Coaxial cable	ZDECL	Z302S	18091804	Sep. 28, 2020	Sep. 28, 2021
ISN	TESEQ	NTFM8158	183	Sep. 28, 2020	Sep. 28, 2021
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428/003	Sep. 28, 2020	Sep. 28, 2021
Software	Fala	EZ-EMC	EMC-CON 3A1.1	\	\

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 50Ω/50μH + 5Ω 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.

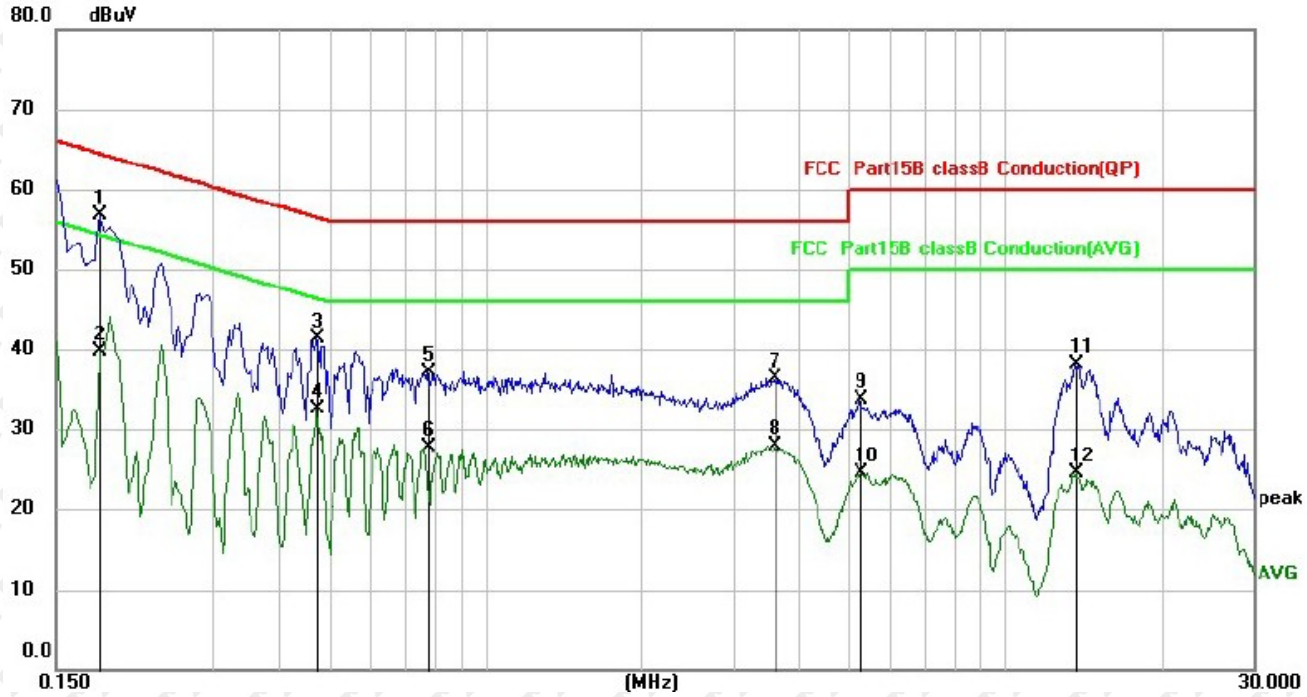
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,

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.

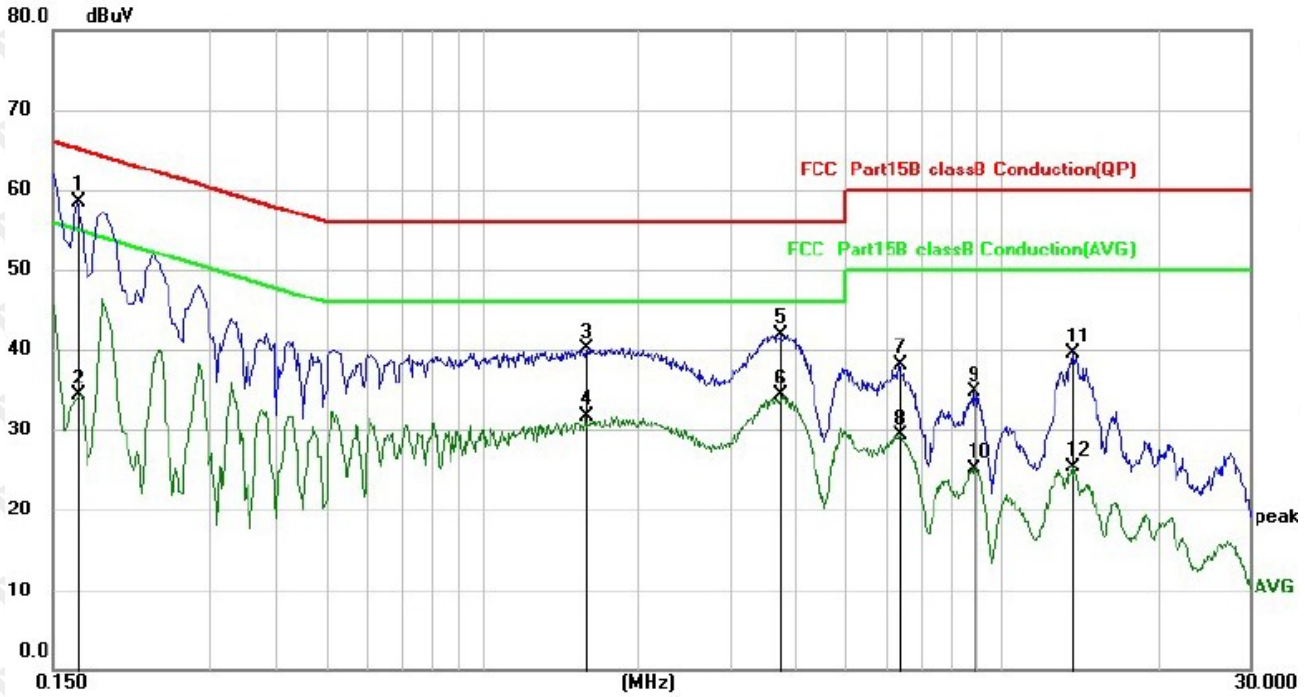
6.4 Test Result

L:



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1819	46.81	9.96	56.77	64.40	-7.63	QP
2		0.1819	29.75	9.96	39.71	54.40	-14.69	AVG
3		0.4740	31.44	9.96	41.40	56.44	-15.04	QP
4		0.4740	22.50	9.96	32.46	46.44	-13.98	AVG
5		0.7780	27.16	9.96	37.12	56.00	-18.88	QP
6		0.7780	17.78	9.96	27.74	46.00	-18.26	AVG
7		3.6220	26.25	10.10	36.35	56.00	-19.65	QP
8		3.6220	17.81	10.10	27.91	46.00	-18.09	AVG
9		5.2740	23.49	10.20	33.69	60.00	-26.31	QP
10		5.2740	14.36	10.20	24.56	50.00	-25.44	AVG
11		13.6260	27.21	10.92	38.13	60.00	-21.87	QP
12		13.6260	13.65	10.92	24.57	50.00	-25.43	AVG

N:



Remark:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1660	48.63	9.96	58.59	65.16	-6.57	QP
2		0.1660	24.42	9.96	34.38	55.16	-20.78	AVG
3		1.5900	30.11	9.99	40.10	56.00	-15.90	QP
4		1.5900	21.63	9.99	31.62	46.00	-14.38	AVG
5		3.7620	31.80	10.10	41.90	56.00	-14.10	QP
6		3.7620	24.17	10.10	34.27	46.00	-11.73	AVG
7		6.3620	27.80	10.34	38.14	60.00	-21.86	QP
8		6.3620	19.03	10.34	29.37	50.00	-20.63	AVG
9		8.8260	24.03	10.65	34.68	60.00	-25.32	QP
10		8.8260	14.49	10.65	25.14	50.00	-24.86	AVG
11		13.7180	28.65	10.93	39.58	60.00	-20.42	QP
12		13.7180	14.45	10.93	25.38	50.00	-24.62	AVG

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

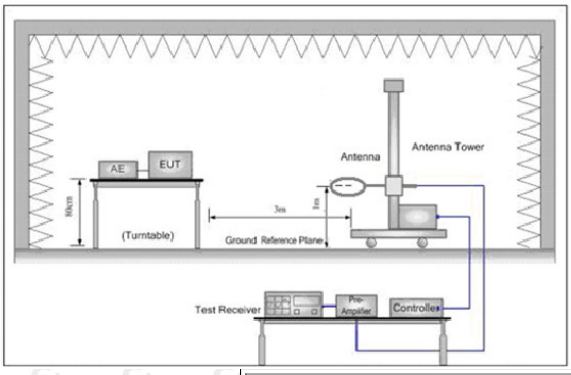
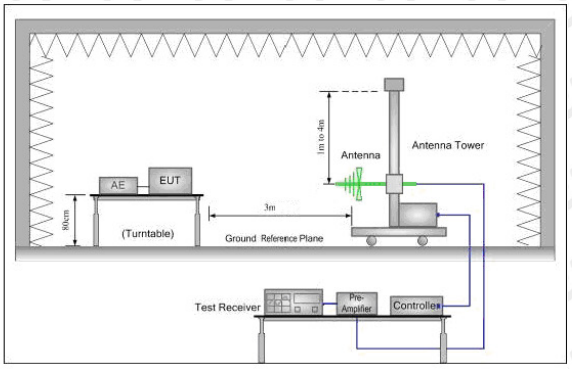


Figure 2. 30MHz to 1GHz



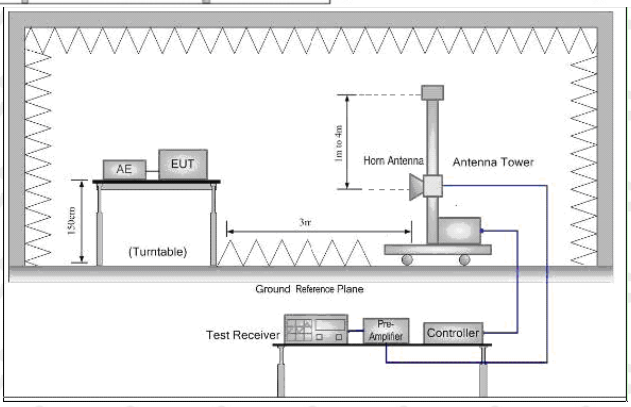


Figure 3. Above 1GHz

7.2 Limit

Spurious Emissions:

Frequency	Field strength (dBμV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	20log 2400/F (kHz) + 80	-	3
0.490MHz-1.705MHz	20log 24000/F (kHz) + 40	-	3
1.705MHz-30MHz	20log 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, μV/m at 3 meters = 56.81818(F) - 6136.3636; for the band 260-470 MHz, μV/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 (dBμV/m @3m)	Remark
410MHz	80	Average Value
	100	Peak Value

7.3 Test procedure

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The ant enna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizont al and vertical pol arizations of the antenna are set to make the measurement.

d. 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 30M Hz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and S pecified Bandwidth with M aximum Hold Mode.

f. 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:

g. Different bet ween above is the test site, change from S emi- Anechoic Cham ber to fully Anec hoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).

h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel

j. Repeat above procedures until all frequencies measured was complete.

Receiver set:

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

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

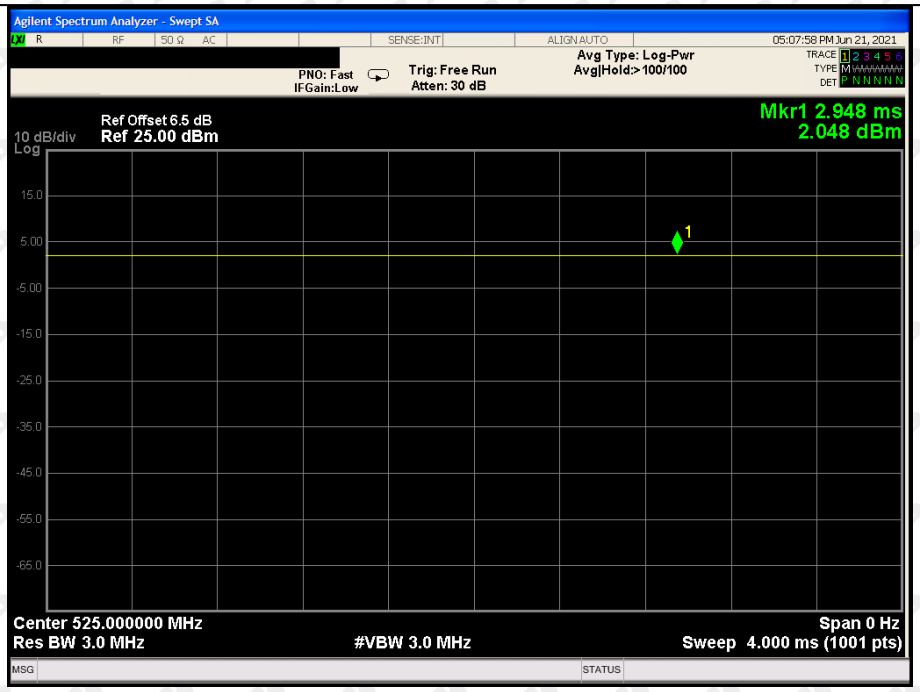
Calculation of average factor

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.

411 MHz

467 MHz

525 MHz



Duty cycle = T on time / T period =100%
PDCF =0

Radiated Spurious Emission

Frequency Range (9 kHz-30MHz)

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

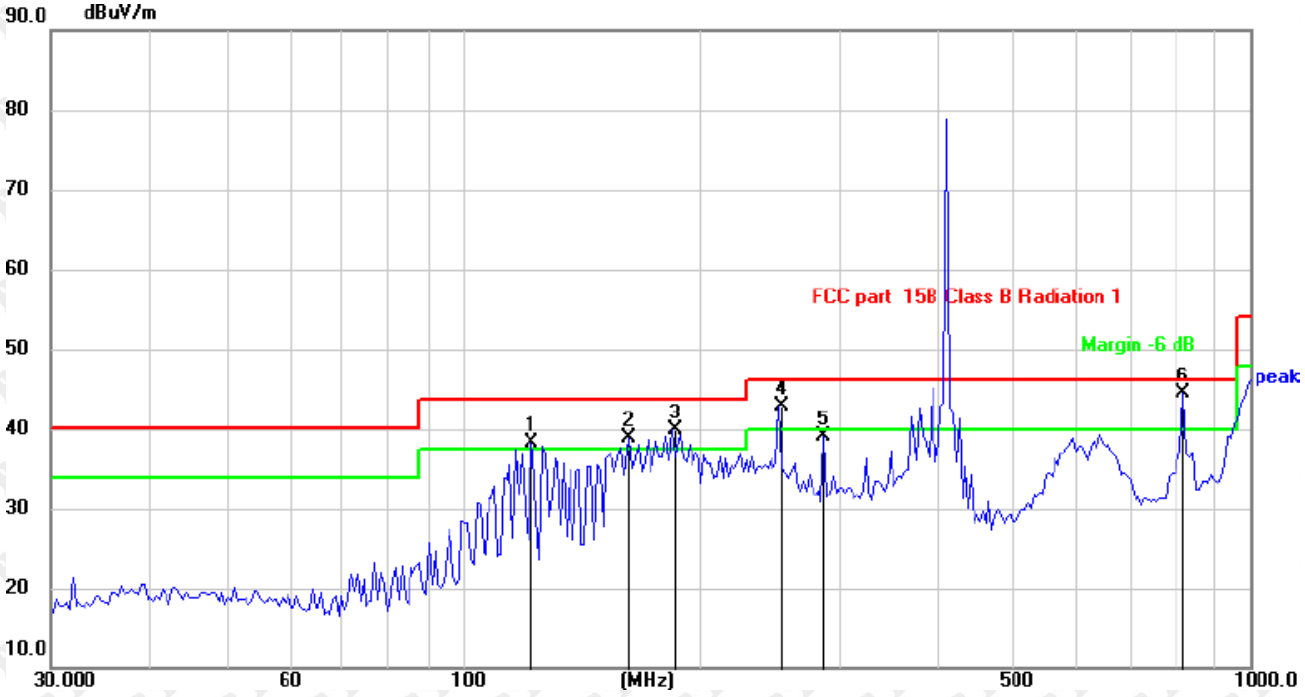
Note: *1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor*

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

About 30MHz-1GHz Test Results:

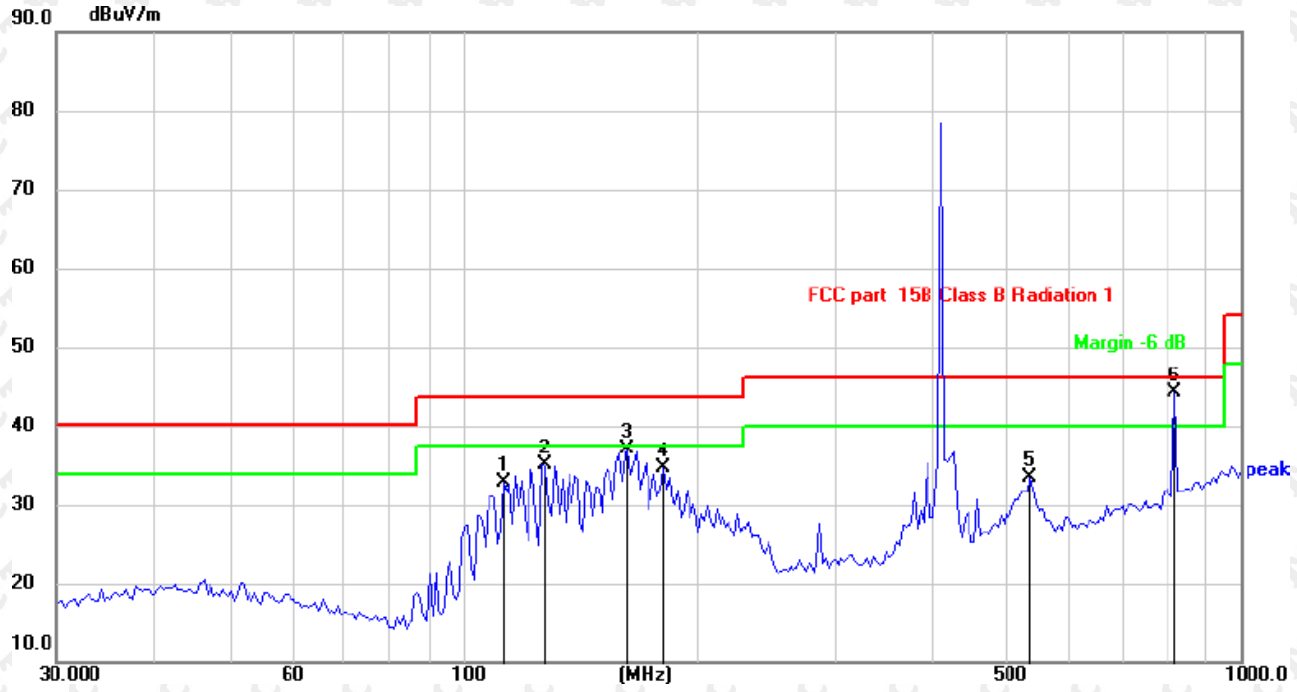
410MHz

Antenna polarity: H



Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
121.9755	46.72	-8.50	38.22	43.50	-5.28	QP
162.8959	45.90	-6.95	38.95	43.50	-4.55	QP
184.1667	48.88	-9.01	39.87	43.5	-3.63	QP
252.5051	50.87	-8.01	42.86	46.00	-3.14	QP
287.9904	46.27	-7.08	39.19	46.00	-6.81	QP
410.0287	82.76	-4.73	78.03	100.00	-21.97	PK
822.5968	39.96	4.59	44.55	80.04	-35.45	PK

Antenna polarity: V

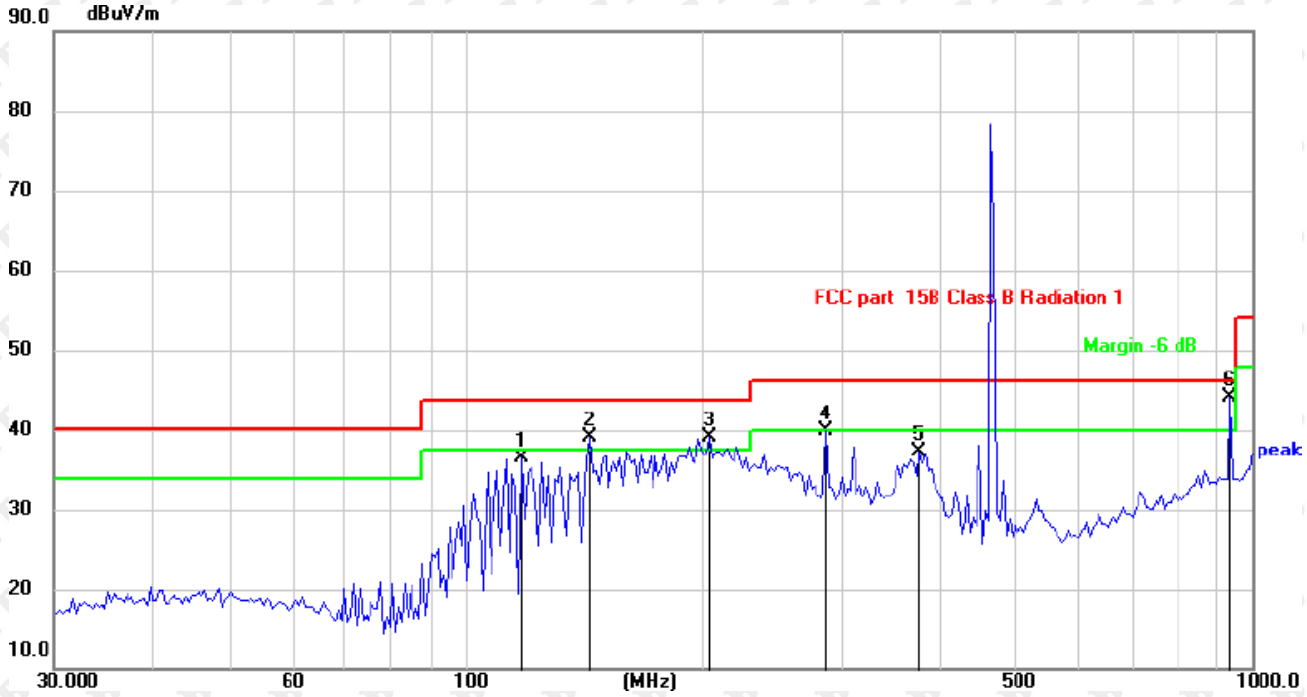


Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
112.7218	42.10	-9.17	32.93	43.50	-10.57	QP
126.3286	43.50	-8.31	35.19	43.50	-8.31	QP
162.8959	44.14	-6.95	37.19	43.50	-6.31	QP
180.9658	43.41	-8.65	34.76	43.50	-8.74	QP
410.0287	83.26	-4.73	78.53	100.00	-21.47	PK
536.6473	34.70	-1.17	33.53	46.00	-12.47	QP
822.5968	39.71	4.59	44.30	80.00	-35.70	PK

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

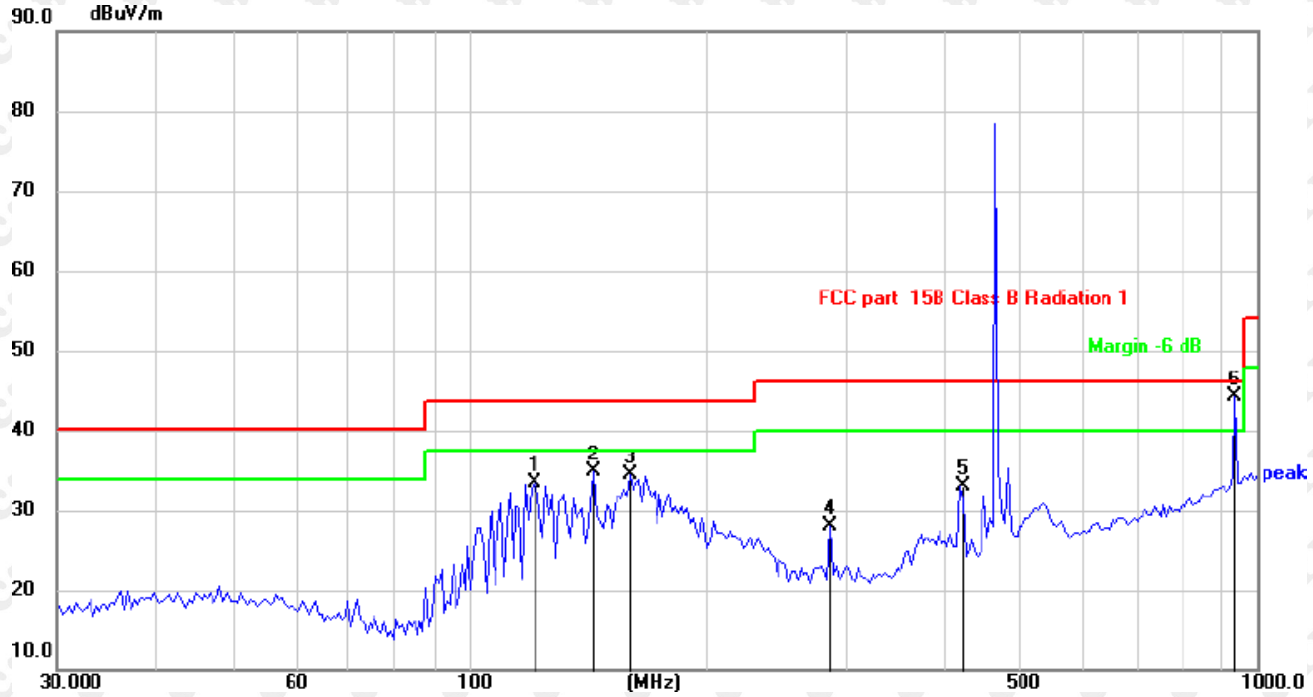
467MHz

Antenna polarity: H



Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
117.7725	45.29	-8.77	36.52	43.50	-6.98	QP
144.0819	46.28	-7.20	39.08	43.50	-4.42	QP
204.5961	49.17	-10.05	39.12	43.5	-4.38	QP
287.9904	47.80	-7.08	40.00	46.00	-6.00	QP
377.9211	42.34	-5.12	37.22	46.00	-8.78	QP
467.0287	83.58	-4.65	78.93	101.85	-22.92	PK
940.4801	37.08	6.98	44.06	81.85	-37.79	PK

Antenna polarity: V

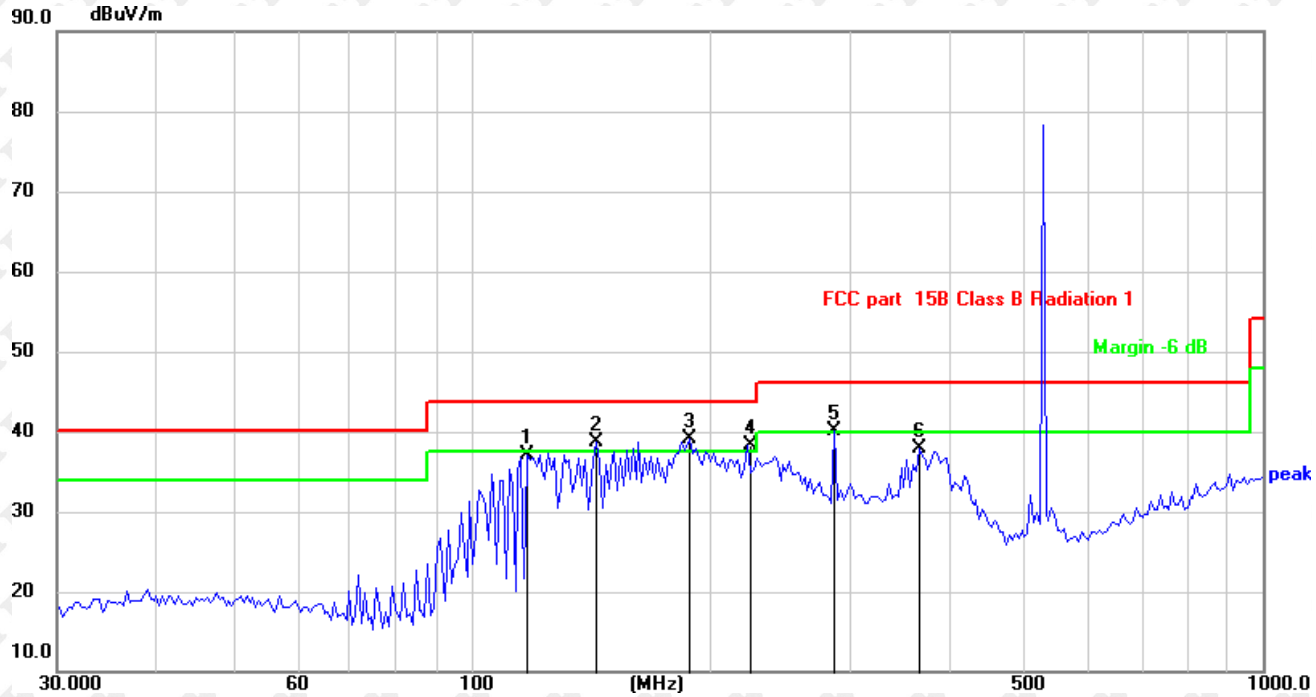


Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
12.9109	42.00	-8.55	33.45	43.50	-10.05	QP
144.0819	42.06	-7.20	34.86	43.50	-8.64	QP
160.0648	41.10	-6.60	34.50	43.5	-9.00	QP
287.9904	35.27	-7.08	28.19	46.00	-17.81	QP
419.8436	37.26	-4.19	33.07	46	-12.93	QP
467.0287	83.46	-4.65	78.81	101.85	-23.04	PK
940.4801	37.31	6.98	44.29	81.85	-37.56	QP

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

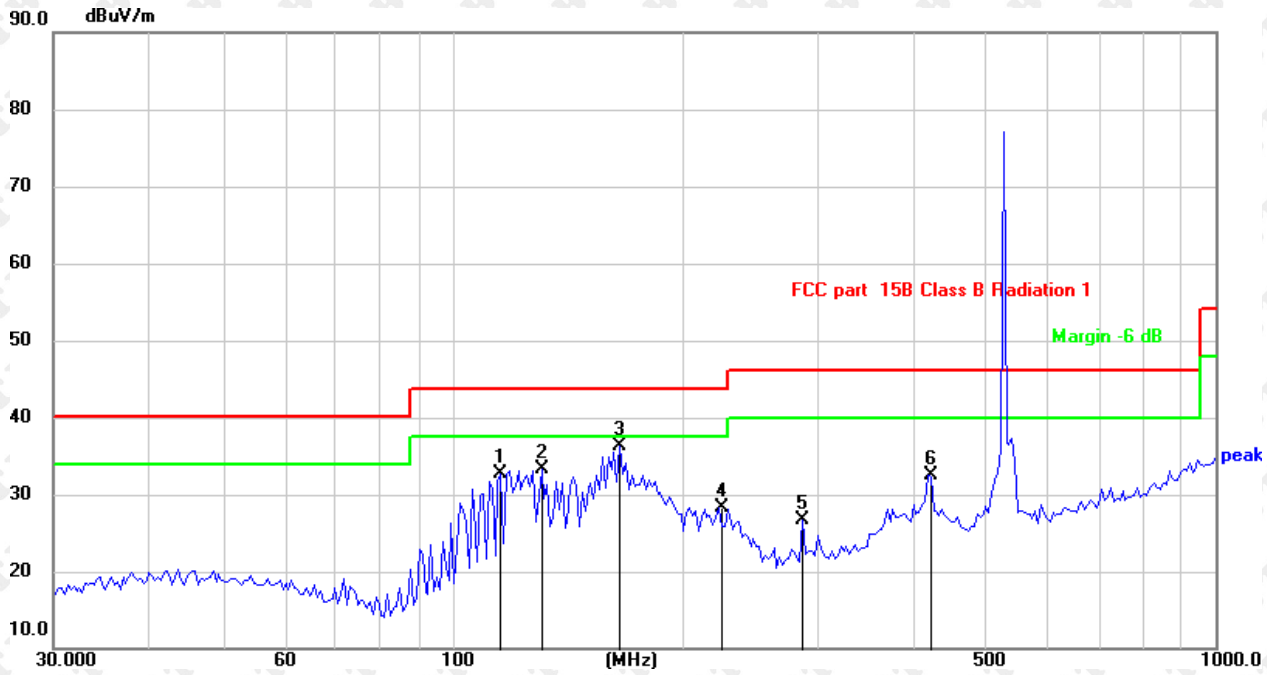
525MHz

Antenna polarity: H



Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
117.7725	45.95	-8.7	37.18	43.50	-6.32	QP
144.0819	45.91	-7.20	38.71	43.50	-4.79	QP
189.0743	48.70	-9.56	39.14	43.5	-4.36	QP
223.3415	47.38	-8.99	38.39	43.5	-5.11	QP
287.9904	47.25	-7.08	40.17	46.0	-5.83	QP
368.1116	43.31	-5.33	37.98	46.0	-8.02	QP
511.0287	83.16	-4.13	79.03	101.94	-22.91	PK

Antenna polarity: V



Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
115.7256	41.59	-8.93	32.66	43.50	-10.84	QP
130.8369	41.43	-8.07	33.36	43.50	-10.14	QP
165.7771	43.69	-7.31	36.38	43.5	-7.12	QP
223.3415	37.25	-8.99	28.26	43.5	-15.24	QP
287.9904	33.69	-7.08	26.61	46	-19.39	QP
419.8436	36.72	-4.19	32.53	46.00	-13.47	QP
511.0287	83.02	-4.13	78.89	101.94	-23.05	PK

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

For average Emission

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	AverageLevel dBuV/m	Limit AV	Margin	Polarization
410.00	78.03	0	78.03	80.00	-1.97	Horizontal
467.00	78.93	0	78.93	81.85	-2.92	Horizontal
525.00	79.03	0	79.03	81.94	-2.91	Horizontal
820.00	44.55	0	44.55	60.00	-15.45	Horizontal
934.00	44.06	0	44.06	61.85	-17.79	Horizontal
410.00	78.53	0	78.53	80.00	-1.47	Vertical
467.00	78.81	0	78.81	81.85	-3.04	Vertical
525.00	78.89	0	78.89	81.94	-3.05	Vertical
820.00	44.3	0	44.3	60.00	-15.70	Vertical
934.00	44.29	0	44.29	61.85	-17.56	Vertical

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

Above 1GHz Test Results

410MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1231.71	50.20	0.00	50.20	80.0	60.0	-29.80	-9.80	Vertical
1641.26	46.61	0.00	46.61	80.0	60.0	-33.39	-13.39	Vertical
2461.56	43.40	0.00	43.40	80.0	60.0	-36.60	-16.60	Vertical
2871.43	39.64	0.00	39.64	80.0	60.0	-40.36	-20.36	Vertical
3281.35	40.36	0.00	40.36	80.0	60.0	-39.64	-19.64	Vertical
3691.24	40.74	0.00	40.74	80.0	60.0	-39.26	-19.26	Vertical
1231.71	49.88	0.00	49.88	80.0	60.0	-30.12	-10.12	Horizontal
1641.26	47.90	0.00	47.90	80.0	60.0	-32.10	-12.10	Horizontal
2461.56	43.65	0.00	43.65	80.0	60.0	-36.35	-16.35	Horizontal
2871.43	40.03	0.00	40.03	80.0	60.0	-39.97	-19.97	Horizontal
3281.35	41.73	0.00	41.73	80.0	60.0	-38.27	-18.27	Horizontal
3691.24	41.06	0.00	41.06	80.0	60.0	-38.94	-18.94	Horizontal

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

467MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1401.71	49.04	0.00	49.04	81.85	61.85	-32.81	-12.81	Vertical
1868.26	48.57	0.00	48.57	81.85	61.85	-33.28	-13.28	Vertical
2335.56	42.32	0.00	42.32	81.85	61.85	-39.53	-19.53	Vertical
2802.43	43.10	0.00	43.10	81.85	61.85	-38.75	-18.75	Vertical
3269.35	40.48	0.00	40.48	81.85	61.85	-41.37	-21.37	Vertical
3736.24	40.13	0.00	40.13	81.85	61.85	-41.72	-21.72	Vertical
1401.71	50.58	0.00	50.58	81.85	61.85	-31.27	-11.27	Horizontal
1868.26	46.22	0.00	46.22	81.85	61.85	-35.63	-15.63	Horizontal
2335.56	42.90	0.00	42.90	81.85	61.85	-38.95	-18.95	Horizontal
2802.43	43.20	0.00	43.20	81.85	61.85	-38.65	-18.65	Horizontal
3269.35	41.65	0.00	41.65	81.85	61.85	-40.20	-20.20	Horizontal
3736.24	41.59	0.00	41.59	81.85	61.85	-40.26	-20.26	Horizontal

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

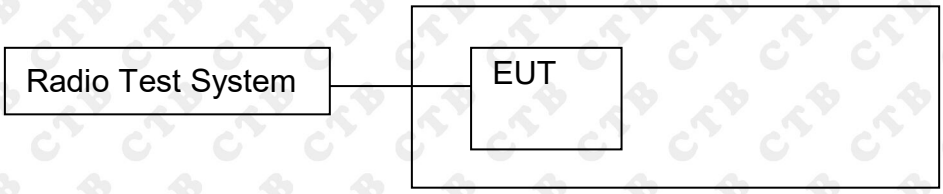
525MHz

Frequency MHz	Peak Level dBuV/m	Duty cycle factor	Average Level dBuV/m	Limit		Margin dB		Polarization
				PK	AV	PK	AV	
1050.71	51.02	0.00	51.02	81.94	61.94	-30.92	-10.92	Vertical
1575.26	48.80	0.00	48.80	81.94	61.94	-33.14	-13.14	Vertical
2625.56	44.31	0.00	44.31	81.94	61.94	-37.63	-17.63	Vertical
3150.43	41.30	0.00	41.30	81.94	61.94	-40.64	-20.64	Vertical
3269.35	41.83	0.00	41.83	81.94	61.94	-40.11	-20.11	Vertical
3675.24	41.25	0.00	41.25	81.94	61.94	-40.69	-20.69	Vertical
1050.71	50.50	0.00	50.50	81.94	61.94	-31.44	-11.44	Horizontal
1575.26	48.86	0.00	48.86	81.94	61.94	-33.08	-13.08	Horizontal
2625.56	44.48	0.00	44.48	81.94	61.94	-37.46	-17.46	Horizontal
3150.43	43.45	0.00	43.45	81.94	61.94	-38.49	-18.49	Horizontal
3269.35	41.76	0.00	41.76	81.94	61.94	-40.18	-20.18	Horizontal
3675.24	41.55	0.00	41.55	81.94	61.94	-40.39	-20.39	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.

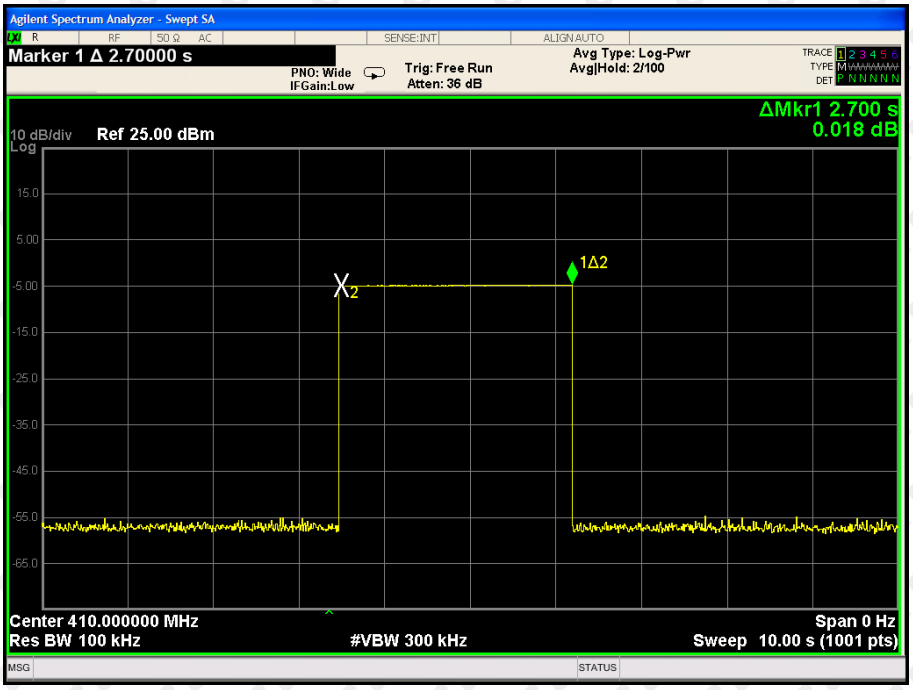
8.3 Test procedure

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

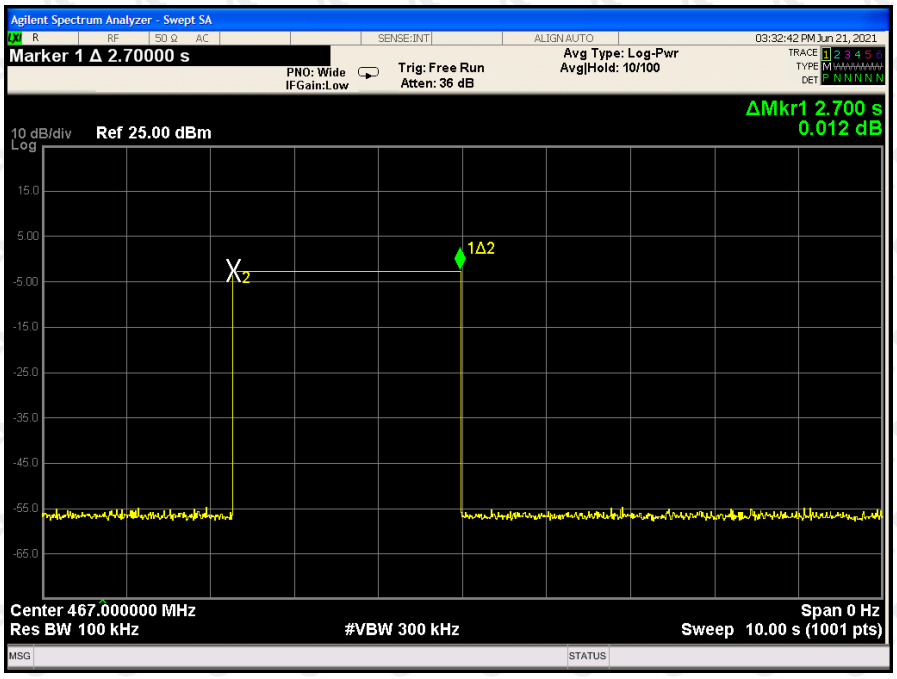
410MHz

Transmitting time(S)	Limit (S)	Results
2.700	≤5	Pass



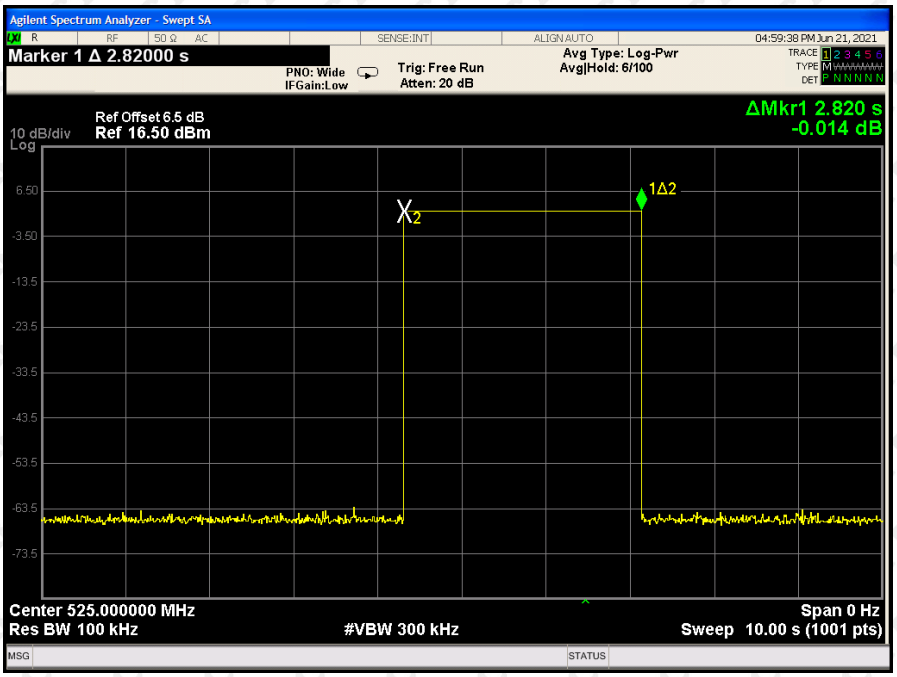
467MHz

Transmitting time(S)	Limit (S)	Results
2.700	≤5	Pass



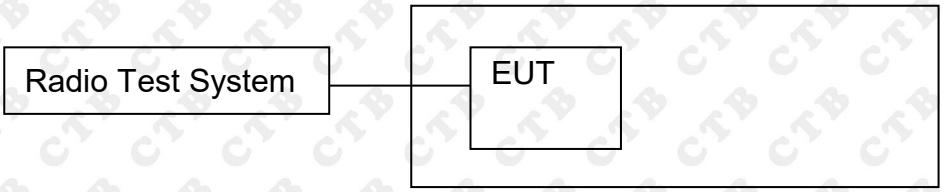
525MHz

Transmitting time(S)	Limit (S)	Results
2.820	≤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% * 411MHz = 1.0275MHz
B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 467MHz = 1.1675MHz
B.W (20dBc) Limit = 0.25% * f(MHz) = 0.25% * 525MHz = 1.3125MHz

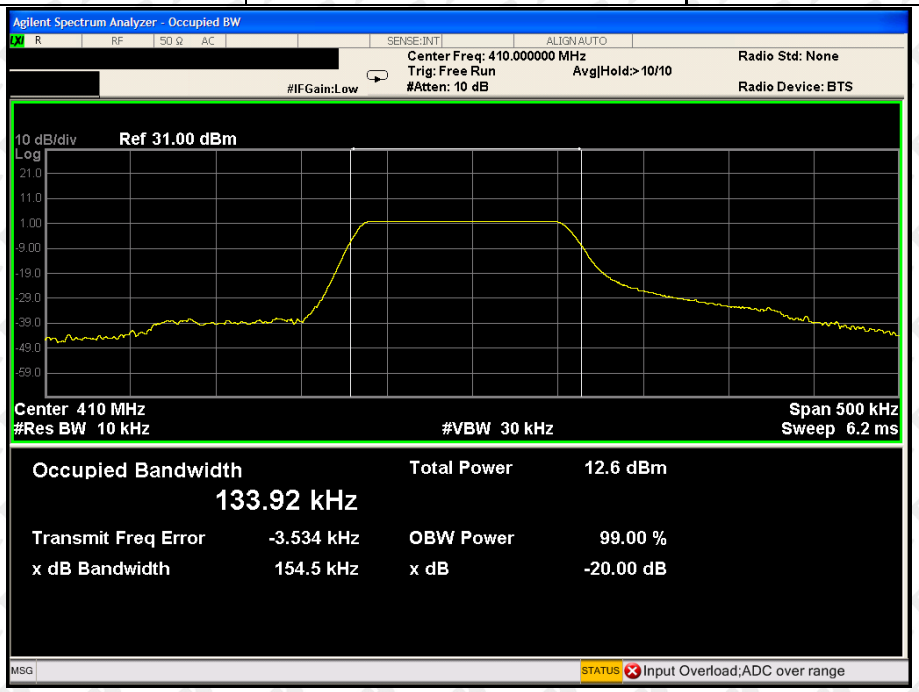
9.3 Test procedure

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

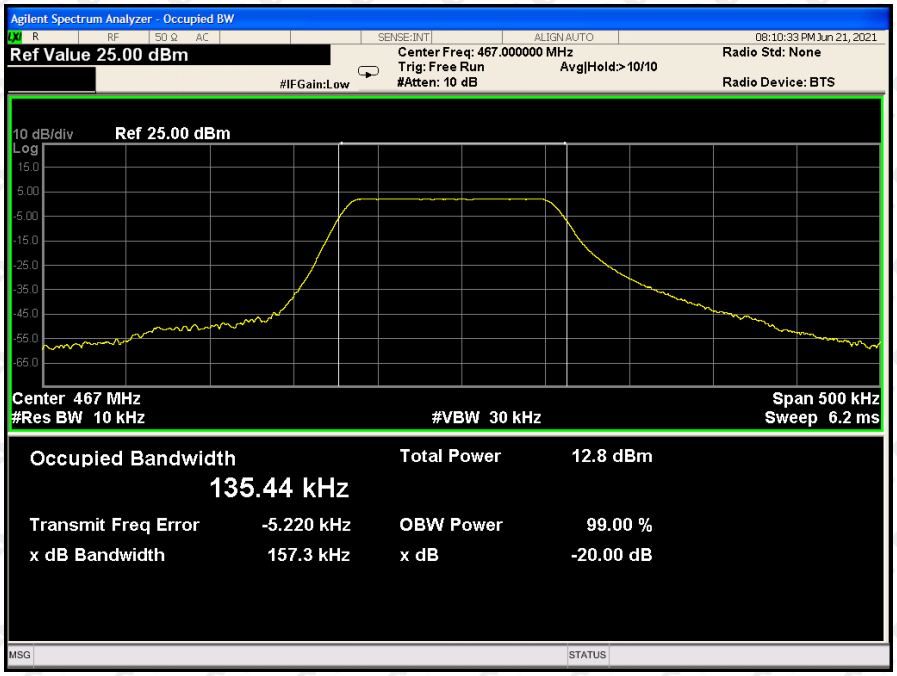
410MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
154.5	1.0275	Pass



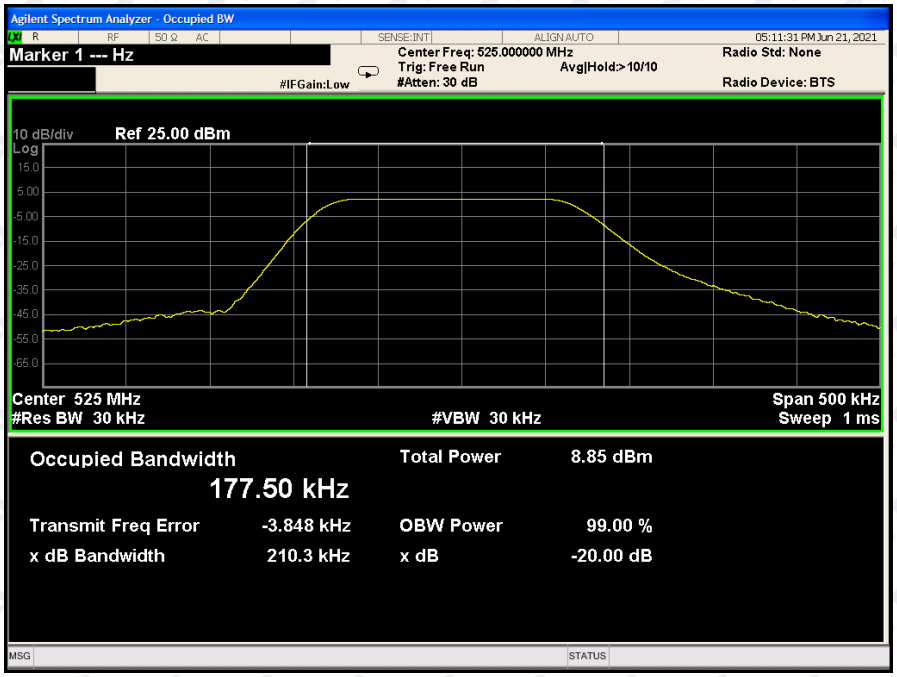
467MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
157.3	1.1675	Pass



525MHz

20dB bandwidth (kHz)	Limit (MHz)	Results
210.3	1.3125	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.

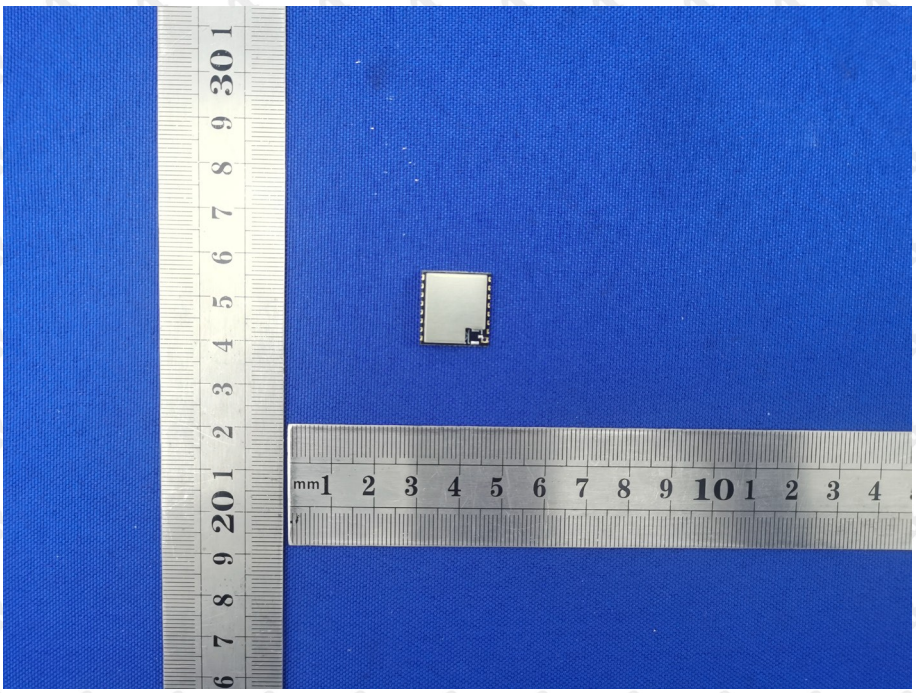
EUT Antenna:

The antenna is Spring antenna and no consideration of replacement. The best case gain of the antenna is 1dBi.

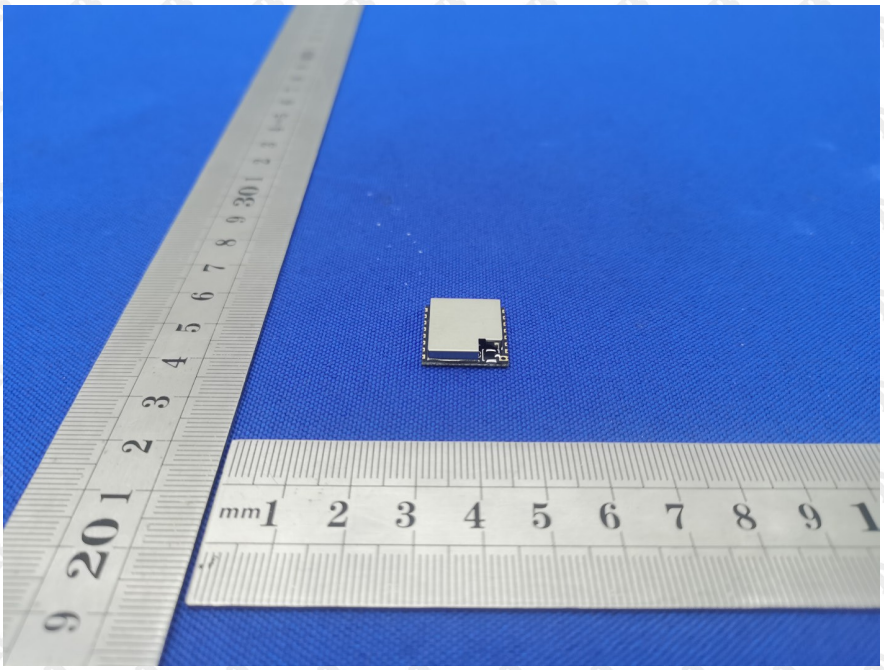
11. EUT PHOTOGRAPHS

External Photos

EUT Photo 1



EUT Photo 2



2. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1GHz

Above 1GHz

Conducted emissions

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