

TEST REPORT

Applicant: Zhejiang Lierda Internet of Things Technology Co., Ltd.
Address: Room 1402, Building 1, No. 1326, Wenyi West Road Cangqian street, Yuhang District, Hangzhou, Zhejiang Prov., China
Equipment Type: CP18 series 2.4G transmission module
Model Name: CP18-GP (refer to section 2.3)
Brand Name: Lierda
FCC ID: 2AOFDL-LRNCP18
ISED Number: 25210-LLRNCP18
HVIN Number: L-LRNCP18-G9PI4
Test Standard: 47 CFR Part 15 Subpart C
RSS-Gen Issue 5
RSS-247 Issue 3
(refer to section 3.1)
Sample Arrival Date: Oct. 23, 2023
Test Date: Oct. 25, 2023 - Dec. 19, 2023
Date of Issue: Dec. 28, 2023

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Si Xiao

Checked by: Ye Hongji

Approved by: Liao Jianming
(Technical Director)

Si Xiao

Ye Hongji

Liao Jianming

Revision History		
Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Dec. 28, 2023</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION	4
1.1	Test Laboratory	4
1.2	Test Location	4
2	PRODUCT INFORMATION	5
2.1	Applicant Information	5
2.2	Manufacturer Information	5
2.3	General Description for Equipment under Test (EUT)	5
2.4	Technical Information	6
3	SUMMARY OF TEST RESULTS	9
3.1	Test Standards	9
3.2	Verdict	9
4	GENERAL TEST CONFIGURATIONS	10
4.1	Test Environments	10
4.2	Test Equipment List	10
4.3	Test Software List	11
4.4	Measurement Uncertainty	12
4.5	Description of Test Setup	12
4.6	Measurement Results Explanation Example	15
5	TEST ITEMS	16
5.1	Antenna Requirements	16
5.2	Number of Hopping Frequency	17
5.3	Peak Output Power and E.I.R.P	18
5.4	Occupied Bandwidth	19
5.5	Carrier Frequency Separation	20

5.6	Time of Occupancy (Dwell time)	21
5.7	Conducted Spurious Emission & Authorized-band band-edge	22
5.8	Conducted Emission	23
5.9	Radiated Spurious Emission	24
5.10	Band Edge (Restricted-band band-edge).....	26
ANNEX A	TEST RESULT	27
A.1	Number of Hopping Frequency	27
A.2	Peak Output Power and E.I.R.P	28
A.3	Occupied Bandwidth	30
A.4	Hopping Frequency Separation.....	32
A.5	Time of Occupancy (Dwell time)	33
A.6	Conducted Spurious Emissions & Authorized-band band-edge	34
A.7	Conducted Emissions.....	38
A.8	Radiated Emission	40
A.9	Band Edge (Restricted-band band-edge).....	48
ANNEX B	TEST SETUP PHOTOS	50
ANNEX C	EUT EXTERNAL PHOTOS	50
ANNEX D	EUT INTERNAL PHOTOS	50

1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	<input checked="" type="checkbox"/> Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	<input type="checkbox"/> 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Zhejiang Lierda Internet of Things Technology Co., Ltd.
Address	Room 1402, Building 1, No. 1326, Wenyi West Road Cangqian street, Yuhang District, Hangzhou, Zhejiang Prov., China

2.2 Manufacturer Information

Manufacturer	Zhejiang Lierda Internet of Things Technology Co., Ltd.
Address	Room 1402, Building 1, No. 1326, Wenyi West Road Cangqian street, Yuhang District, Hangzhou, Zhejiang Prov., China

2.3 General Description for Equipment under Test (EUT)

EUT Name	CP18 series 2.4G transmission module
Model Name Under Test	CP18-GP
Series Model Name	L-LRNCP18-G9PI4
Description of Model name differentiation	All models are same with electrical parameters and internal circuit structure, but only differ in model name. (this information provided by the applicant)
Serial Number	0G82312000281
HVIN Number	L-LRNCP18-G9PI4
Hardware Version	V2
Software Version	V1
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	LoRa
-----------------------------------	------

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	LoRa
Product Type	<input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable <input type="checkbox"/> Fix Location
Frequency Range	The frequency range used is 2402.1 MHz – 2477.1 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of Channel	151 (See note 1)
Tested Channel	Low channel (2402.1 MHz), Middle channel(2439.6 MHz), High channel (2477.1 MHz)
Antenna Type	Dipole Antenna
Antenna Gain	4.76 dBi
Adaptive or non-adaptive	non-adaptive
The Max RF Output power	28.48 dBm

Channel List

Number	Frequency (MHz)	Number	Frequency (MHz)
0	2402.1(Low)	76	2440.1
1	2402.6	77	2440.6
2	2403.1	78	2441.1
3	2403.6	79	2441.6
4	2404.1	80	2442.1
5	2404.6	81	2442.6
6	2405.1	82	2443.1
7	2405.6	83	2443.6
8	2406.1	84	2444.1
9	2406.6	85	2444.6
10	2407.1	86	2445.1
11	2407.6	87	2445.6
12	2408.1	88	2446.1
13	2408.6	89	2446.6
14	2409.1	90	2447.1
15	2409.6	91	2447.6
16	2410.1	92	2448.1
17	2410.6	93	2448.6
18	2411.1	94	2449.1
19	2411.6	95	2449.6
20	2412.1	96	2450.1
21	2412.6	97	2450.6
22	2413.1	98	2451.1
23	2413.6	99	2451.6
24	2414.1	100	2452.1
25	2414.6	101	2452.6
26	2415.1	102	2453.1
27	2415.6	103	2453.6
28	2416.1	104	2454.1
29	2416.6	105	2454.6
30	2417.1	106	2455.1
31	2417.6	107	2455.6
32	2418.1	108	2456.1
33	2418.6	109	2456.6
34	2419.1	110	2457.1
35	2419.6	111	2457.6
36	2420.1	112	2458.1
37	2420.6	113	2458.6
38	2421.1	114	2459.1
39	2421.6	115	2459.6
40	2422.1	116	2460.1

41	2422.6	117	2460.6
42	2423.1	118	2461.1
43	2423.6	119	2461.6
44	2424.1	120	2462.1
45	2424.6	121	2462.6
46	2425.1	122	2463.1
47	2425.6	123	2463.6
48	2426.1	124	2464.1
49	2426.6	125	2464.6
50	2427.1	126	2465.1
51	2427.6	127	2465.6
52	2428.1	128	2466.1
53	2428.6	129	2466.6
54	2429.1	130	2467.1
55	2429.6	131	2467.6
56	2430.1	132	2468.1
57	2430.6	133	2468.6
58	2431.1	134	2469.1
59	2431.6	135	2469.6
60	2432.1	136	2470.1
61	2432.6	137	2470.6
62	2433.1	138	2471.1
63	2433.6	139	2471.6
64	2434.1	140	2472.1
65	2434.6	141	2472.6
66	2435.1	142	2473.1
67	2435.6	143	2473.6
68	2436.1	144	2474.1
69	2436.6	145	2474.6
70	2437.1	146	2475.1
71	2437.6	147	2475.6
72	2438.1	148	2476.1
73	2438.6	149	2476.6
74	2439.1	150	2477.1(High)
75	2439.6(Middle)	--	--

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
3	RSS-247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
4	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
5	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

3.2 Verdict

No.	Description	FCC Part No.	ISED Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	RSS-247, 5.4 (6)	--	Pass ^{Note 1}
2	Number of Hopping Frequency	15.247(a)	RSS-247, 5.1 (4)	ANNEX A.1	Pass
3	Peak Output Power and E.I.R.P	15.247(b)	RSS-247, 5.4 (2)	ANNEX A.2	Pass
4	Occupied Bandwidth	15.247(a)	RSS-247, 5.1 (1)	ANNEX A.3	Pass
5	Hopping Frequency Separation	15.247(a)	RSS-247, 5.1 (2)	ANNEX A.4	Pass
6	Time of Occupancy (Dwell time)	15.247(a)	RSS-247, 5.1 (4)	ANNEX A.5	Pass
7	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	RSS-247, 5.5	ANNEX A.6	Pass
8	Conducted Emission	15.207	RSS-GEN, 8.8	ANNEX A.7	Pass
9	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.8	Pass
10	Band Edge (Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.9	Pass
11	Receiver Spurious Emissions	--	RSS-Gen, 7.1.2	--	N/A ^{Note 2}

Note ¹: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note ²: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	42% to 66%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	20.3°C to +24.4°C
Working Voltage of the EUT	NV (Normal Voltage)	5.0 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY56060183	2023.09.05	2024.09.04
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-40	101544	2022.12.28	2023.12.27
Spectrum Analyzer	KEYSIGHT	N9020A	MY50531259	2023.09.05	2024.09.04
Signaling Unit	ROHDE&SCHWARZ	CMW500	171150	2023.06.19	2024.06.18
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	02460	2021.05.20	2024.05.19
Test Antenna-Horn	A-INFO	LB- 180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	140	2022.02.19	2024.08.15
Amplifier	COM-MV	ZT30- 1000M	07210897	2023.09.05	2024.09.04
Amplifier	COM-MV	LSCX_LNA 1-12G-01	7210214	2023.09.05	2024.09.04
Amplifier	COM-MV	XKu_LNA7- 18G-01	7210209	2023.09.05	2024.09.04
Amplifier	COM-MV	KA LNA18 40G-01	18050001	2022.12.07	2023.12.06
				2023.12.06	2024.12.05
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9168	9168-01162	2023.08.04	2024.08.03
Amplifier	COM-MV	ZT30- 1000M	B201805455 8	2022.12.07	2023.12.06
				2023.12.05	2024.12.04
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	130	2021.08.15	2024.08.14
EMI Receiver	KEYSIGHT	N9010B	MY57110309	2023.09.05	2024.09.04
LISN	SCHWARZBECK	NSLK 8127	8127-687	2023.05.16	2024.05.15
Shielded Enclosure	YiHeng Electronic Co., Ltd	3.5m*3.1m* 2.8m	112	2022.02.19	2025.02.18

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V19.8.28.435	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8°C
Humidity	4%

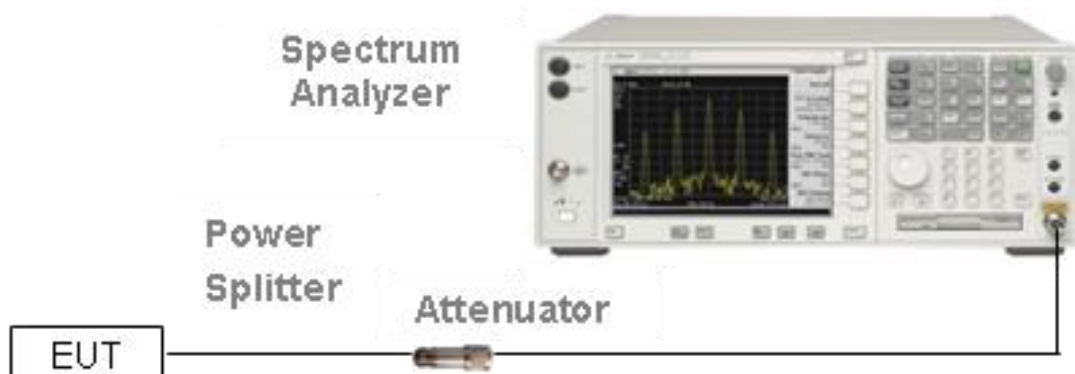
4.5 Description of Test Setup

4.4.1 For Antenna Port Test

Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

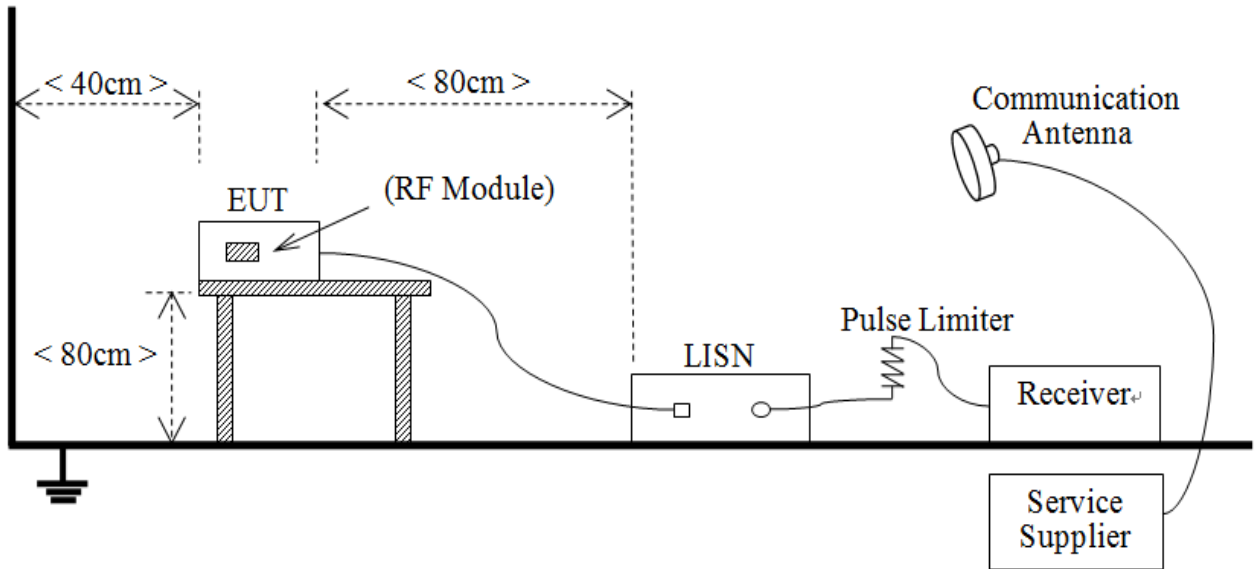
For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



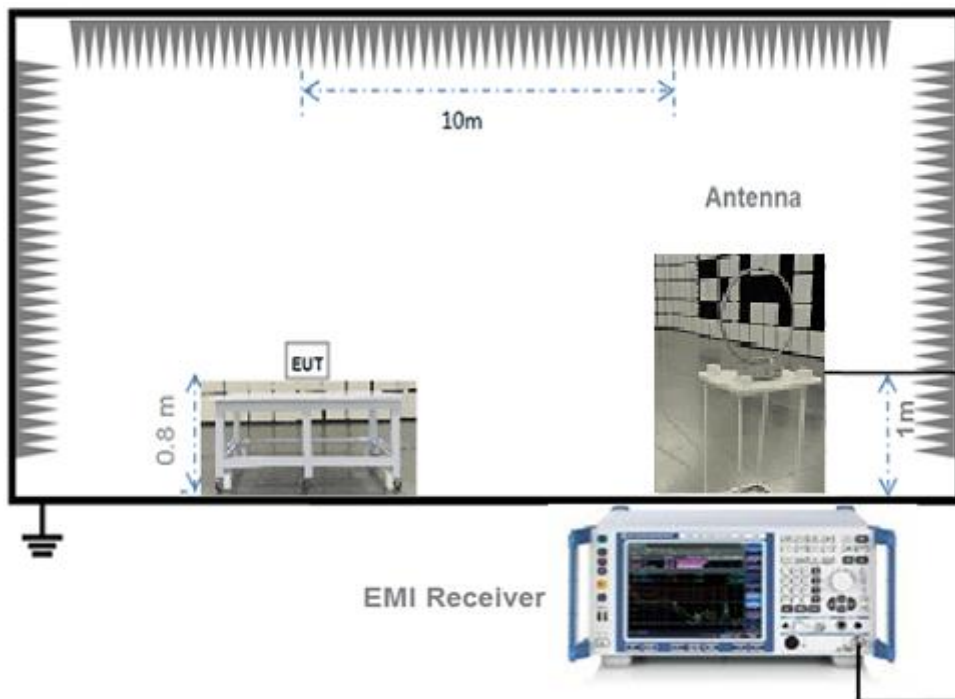
(Diagram 1)

4.4.2 For AC Power Supply Port Test



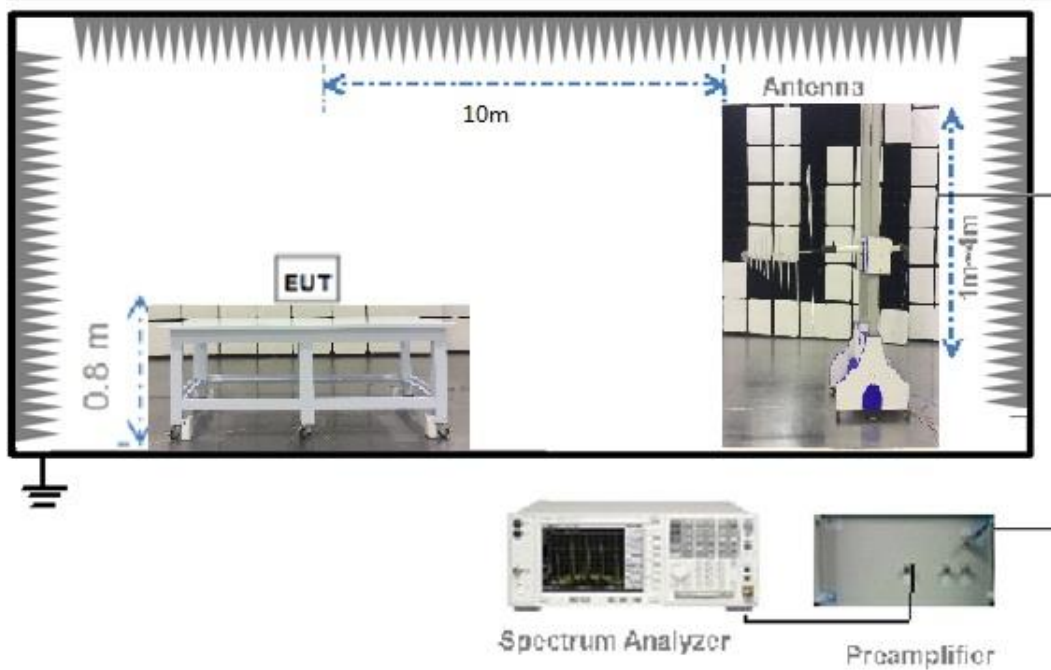
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



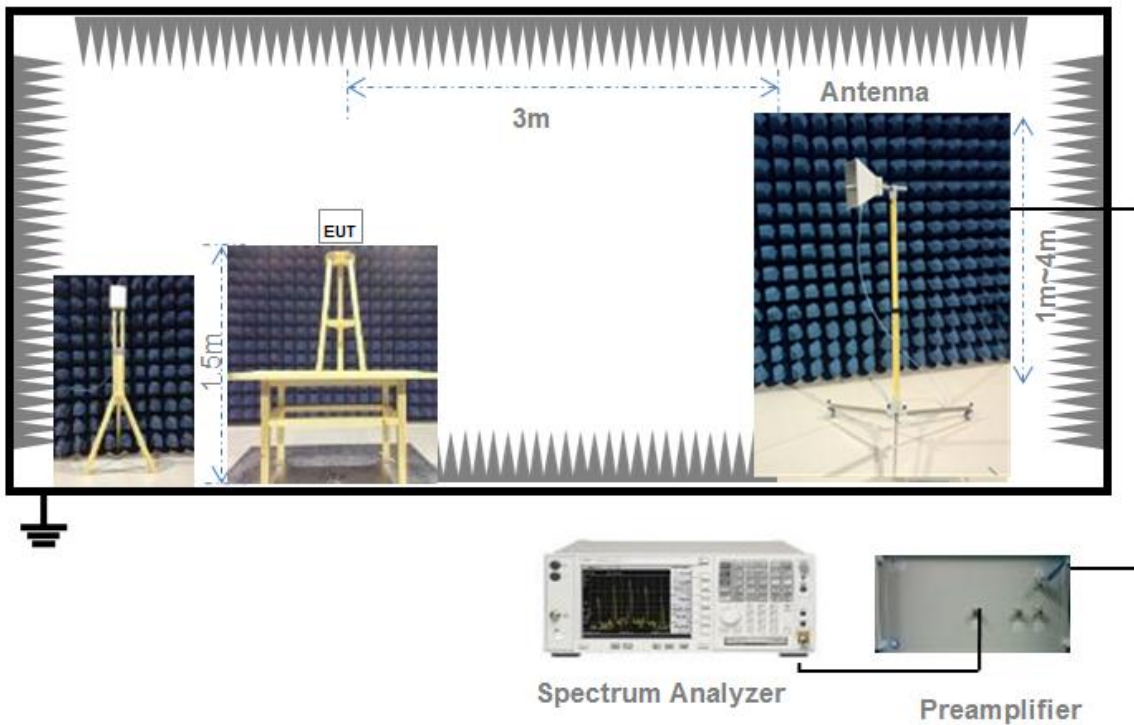
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.6 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

4.5.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.

The average level is derived from the peak level corrected with "Duty cycle correction factor".

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)

Duty cycle correction factor (dB) = $20 * \log(\text{Duty cycle})$.

Duty cycle = on time / 100 milliseconds

On time = dwell time * hopping number in 100 ms

For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then

Duty cycle correction factor (dB) = $20 * \log((2.9 * 3) / 100) = -21.21 \text{ dB}$

Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.

Example:

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)
= $45.61 + (-21.21) = 24.4 \text{ (dBuV/m)}$

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

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 shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	The antenna is welded on the mainboard, can't be replaced by the consumer

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequency

5.2.1 Limit

FCC §15.247(a) (1) (iii); RSS-247, 5.1 (4)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

5.2.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Peak Output Power and E.I.R.P

5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 (2)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a); RSS-247, 5.1 (1)

Measurement of the 20dB bandwidth of the modulated signal.

5.4.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW \geq 1% of the 20 dB bandwidth

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Carrier Frequency Separation

5.5.1 Limit

FCC §15.247(a); RSS-247, 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

5.5.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) \geq 1% of the span

Video (or Average) Bandwidth (VBW) \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1 (4)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The average time of occupancy on any channel within the Period can be calculated with formulas:

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * \{\text{Number of Hopping Frequency in Period}\}$$

$$\{\text{Period}\} = 0.4\text{s} * \{\text{Number of Hopping Frequency}\}$$

The middle channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.6.4 Test Result

Please refer to ANNEX A.5

5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.7.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Conducted Emission

5.8.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.8.2 Test Setup

See section 4.5.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. Field Strength (dB $\mu\text{V}/\text{m}$) = $20 \cdot \log[\text{Field Strength } (\mu\text{V}/\text{m})]$.
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dB $\mu\text{V}/\text{m}@3\text{m}$ (AV) and 74dB $\mu\text{V}/\text{m}@3\text{m}$ (PK).

5.9.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

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.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

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.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

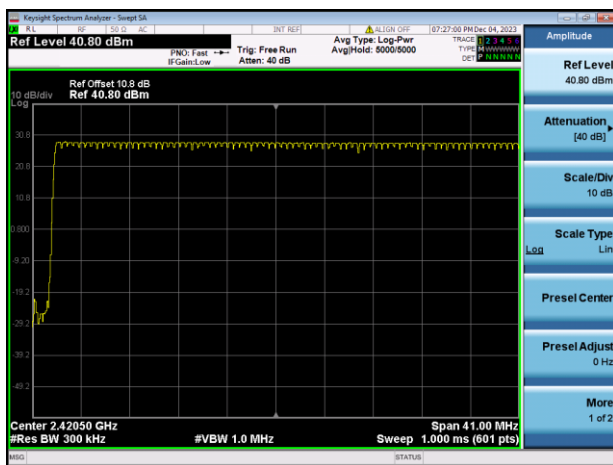
A.1 Number of Hopping Frequency

Test Data

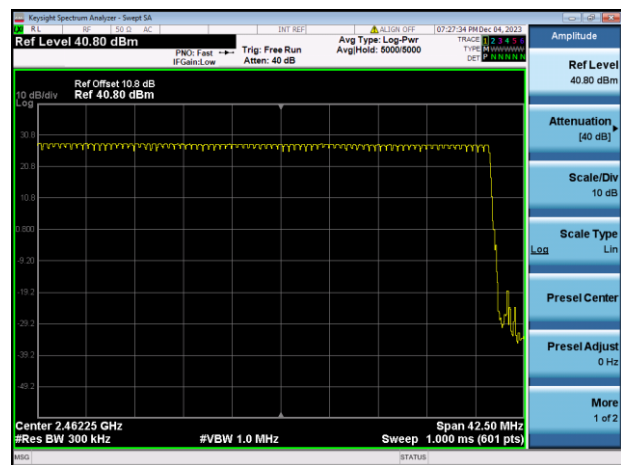
Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
LORA	2400 - 2483.5	151	15	Pass

Test plots

LORA 2.4 GHz ~ 2.4415 GHz



LORA 2.4415 GHz ~ 2.4835 GHz



A.2 Peak Output Power and E.I.R.P

Peak Power Test Data

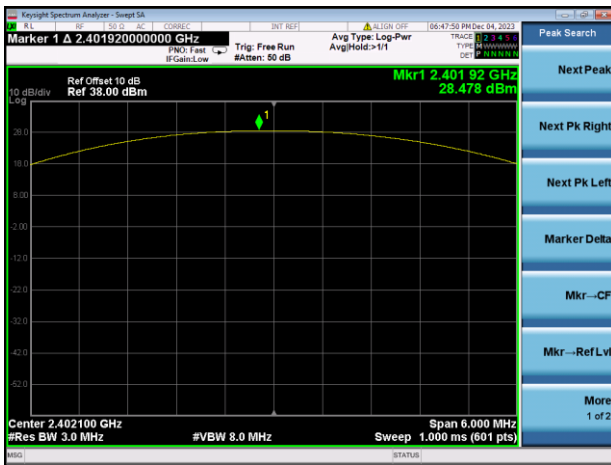
Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	28.48	704.37	30	1000	Pass
Middle	27.98	628.20			Pass
High	27.57	571.08			Pass

E.I.R.P Test Data (For ISED)

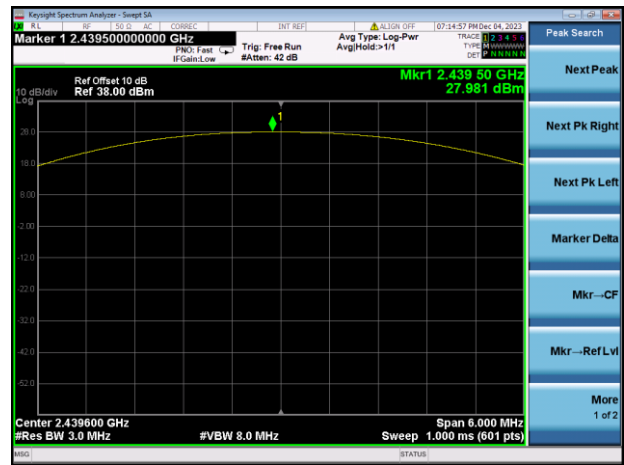
Channel	E.I.R.P		Limit		Verdict
	dBm	mW	dBm	mW	
Low	33.24	2108.63	36	4000	Pass
Middle	32.74	1879.32			Pass
High	32.33	1710.02			Pass

Test plots

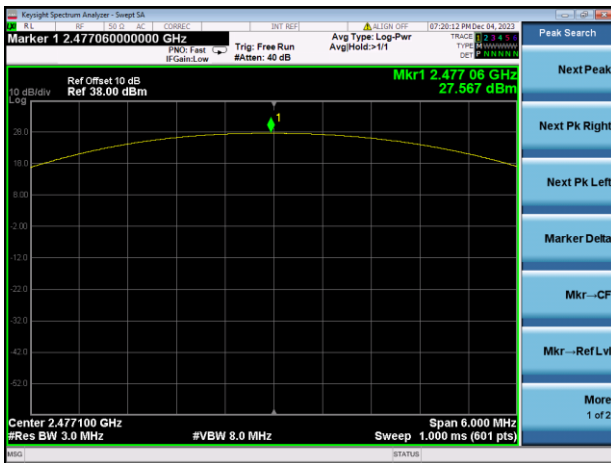
LORA LOW CHANNEL



LORA MIDDLE CHANNEL



LORA HIGH CHANNEL



A.3 Occupied Bandwidth

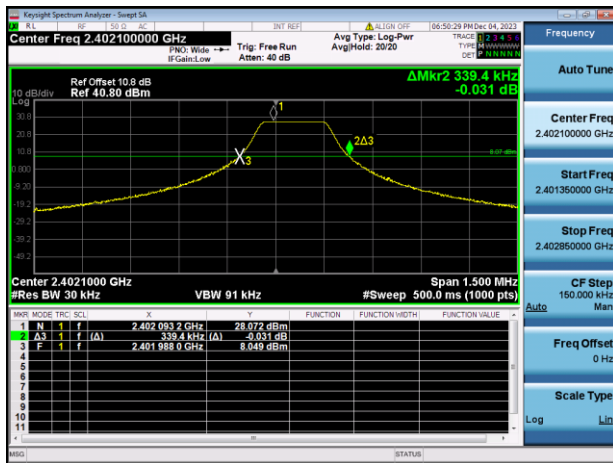
Test Data

Test Mode	LORA	
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	0.339400	0.277610
Middle Channel	0.349600	0.278640
High Channel	0.344000	0.278930

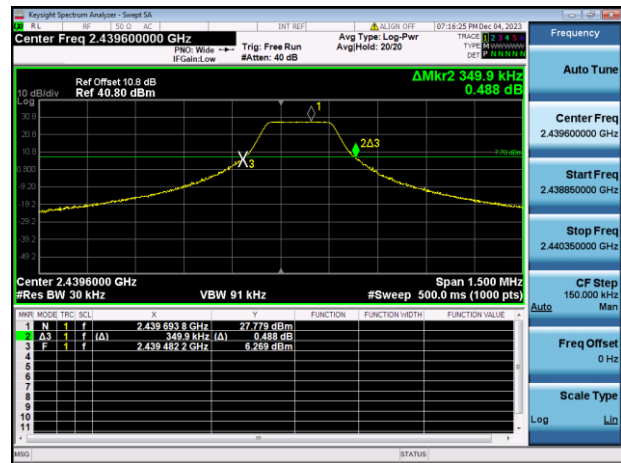
Test plots

20 dB Bandwidth

LORA LOW CHANNEL



LORA MIDDLE CHANNEL

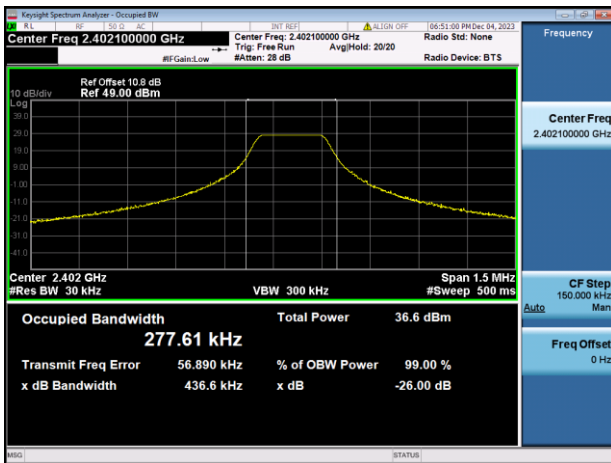


LORA HIGH CHANNEL

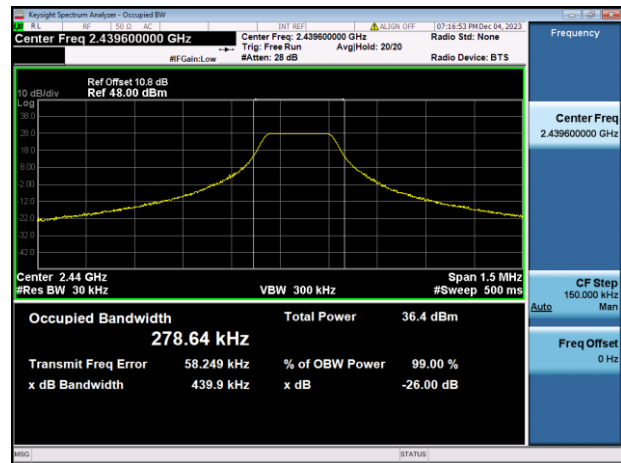


99% Bandwidth

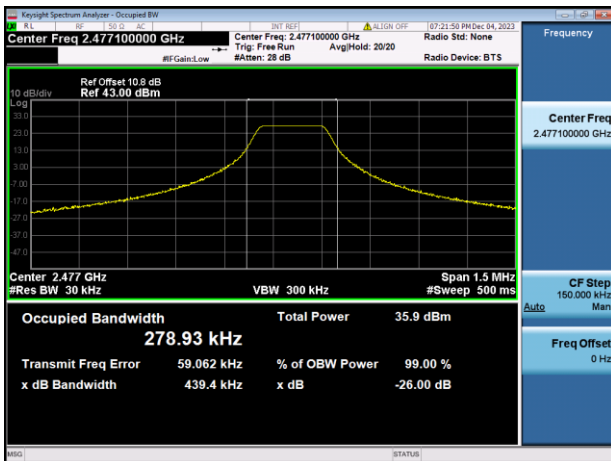
LORA LOW CHANNEL



LORA MIDDLE CHANNEL



LORA HIGH CHANNEL



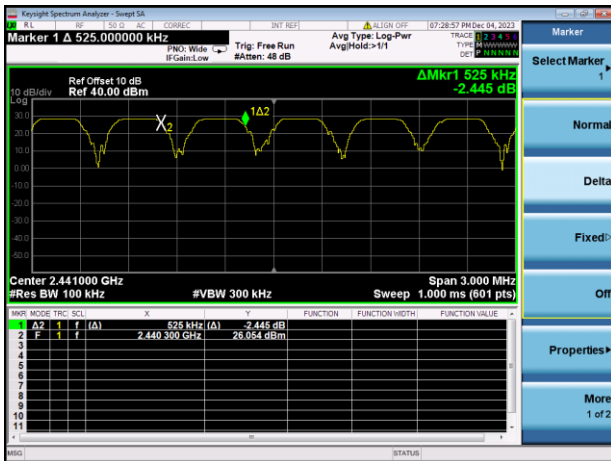
A.4 Hopping Frequency Separation

Test Data

Mode	Frequency separation (MHz)	Max 20 dB Bandwidth (MHz)	Verdict
LORA	0.525	0.350	Pass

Test Plots

LORA



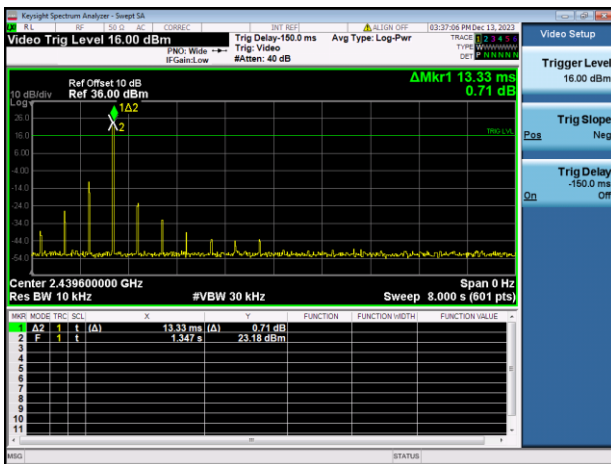
A.5 Time of Occupancy (Dwell time)

Test Data

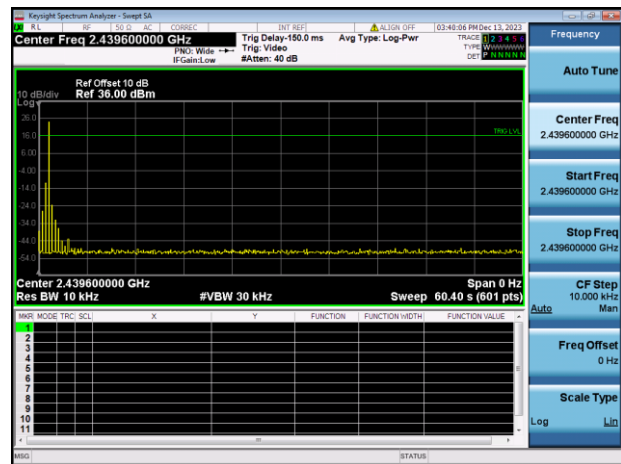
LORA			
Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
13.33	13.33	0.4	Pass

Test Plots

Pulse Width



Total of Dwell



A.6 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

GFSK Mode:

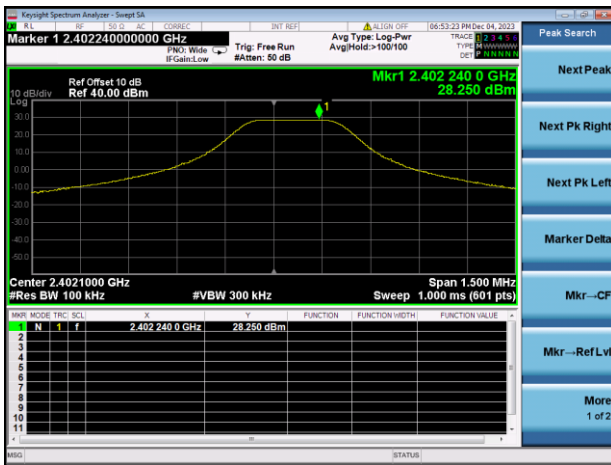
LORA				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-16.06	28.25	8.25	Pass
Middle	-26.28	27.95	7.95	Pass
High	-26.63	27.49	7.49	Pass

Hopping Mode:

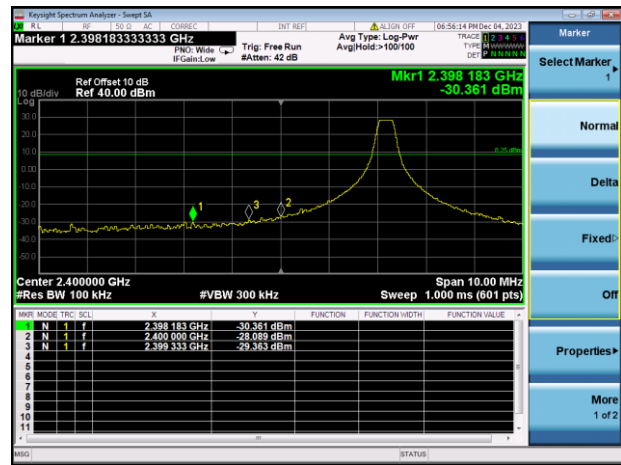
LORA				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
LORA	-24.42	28.94	8.94	Pass

Test Plots

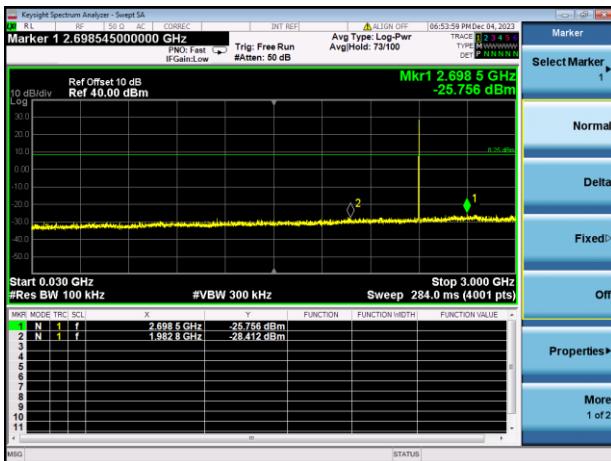
LORA LOW CHANNEL, CARRIER LEVEL



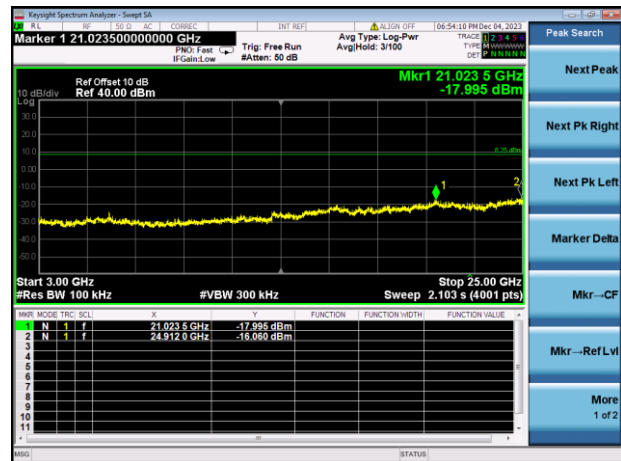
LORA LOW CHANNEL, BAND EDGE



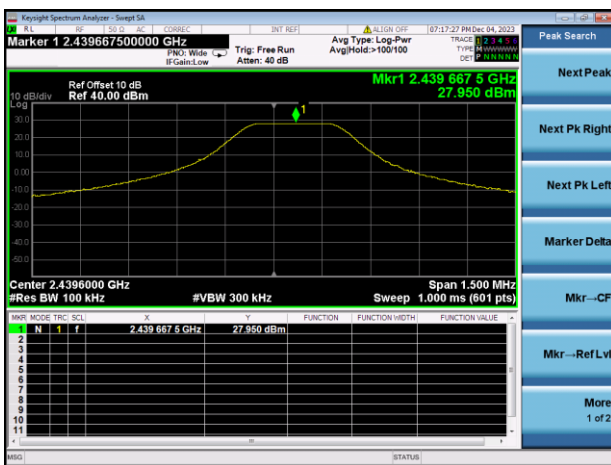
LORA LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



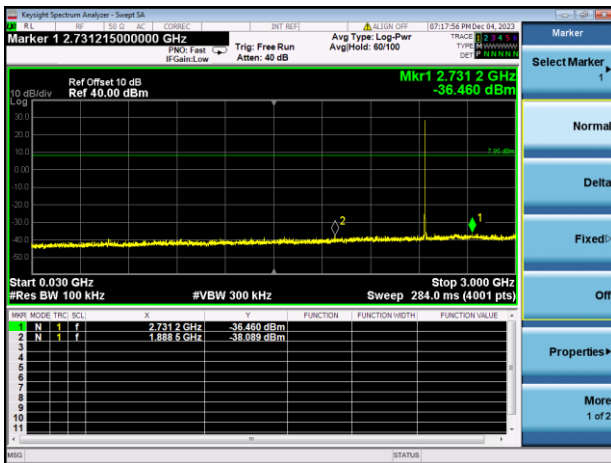
LORA LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



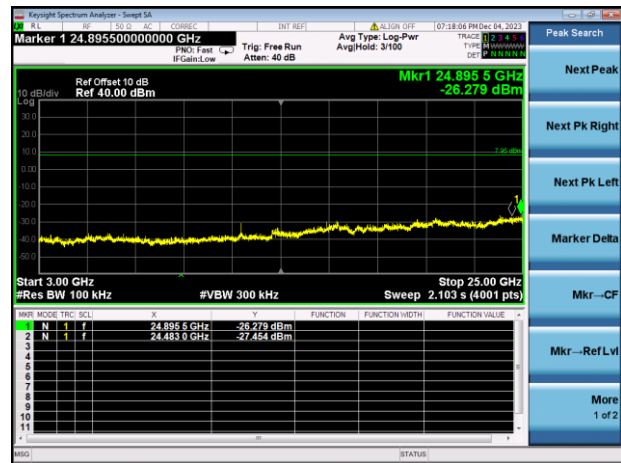
LORA MIDDLE CHANNEL, CARRIER LEVEL



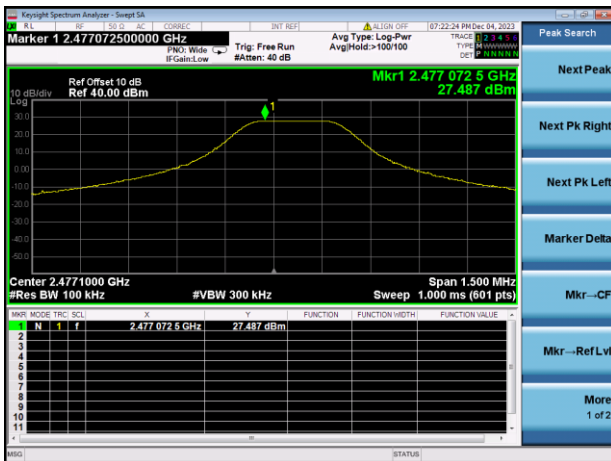
LORA MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



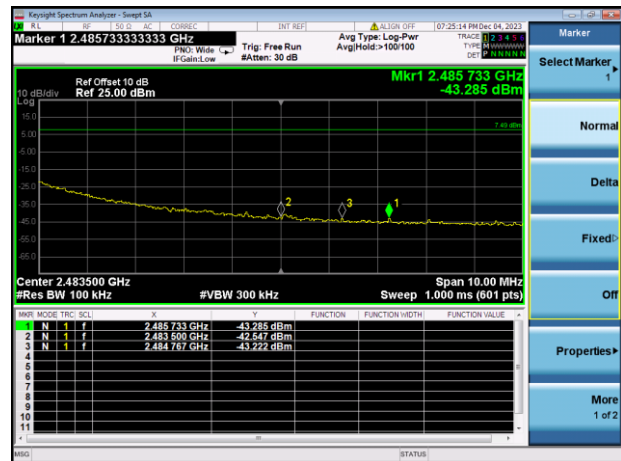
LORA MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



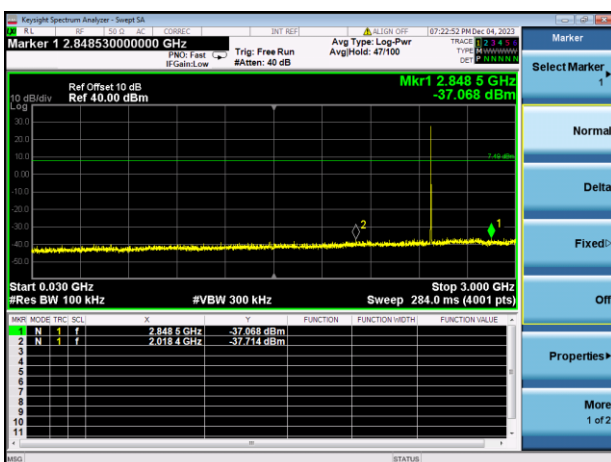
LORA HIGH CHANNEL, CARRIER LEVEL



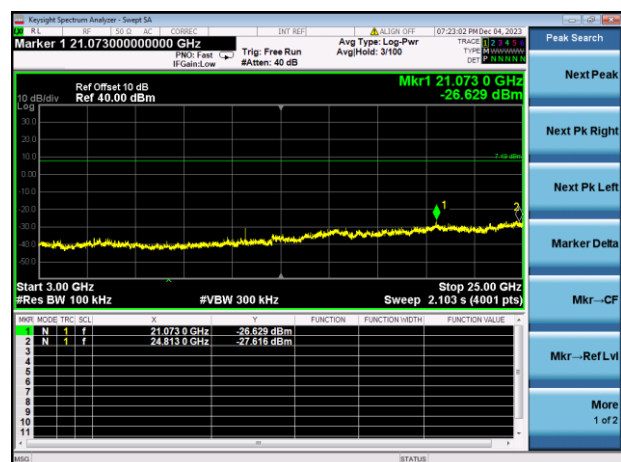
LORA HIGH CHANNEL, BAND EDGE



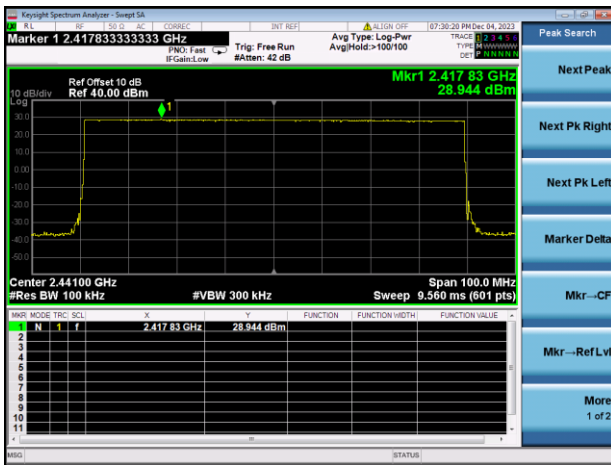
LORA HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



LORA HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



LORA HOPPING, CARRIER LEVEL



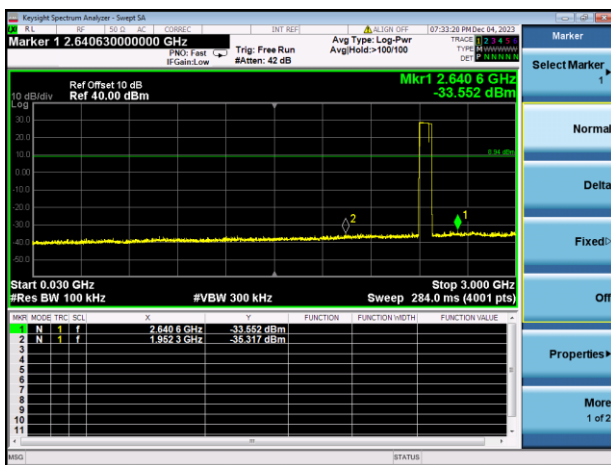
LORA HOPPING BAND EDGE (LOW)



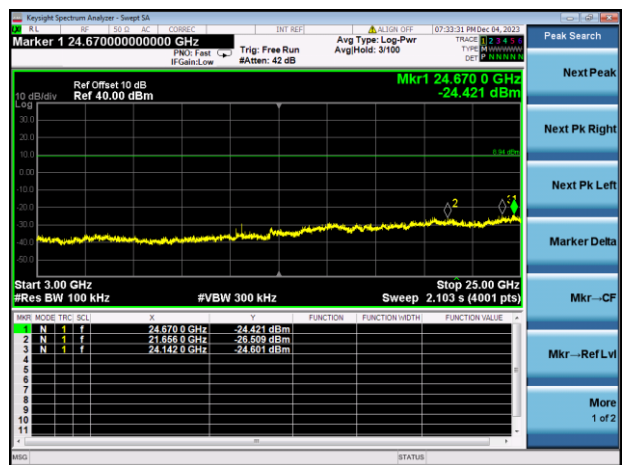
LORA HOPPING BAND EDGE (HIGH)



LORA Hopping Mode, SPURIOUS 30 MHz ~ 3 GHz



LORA Hopping Mode, SPURIOUS 3GHz ~ 25 GHz



A.7 Conducted Emissions

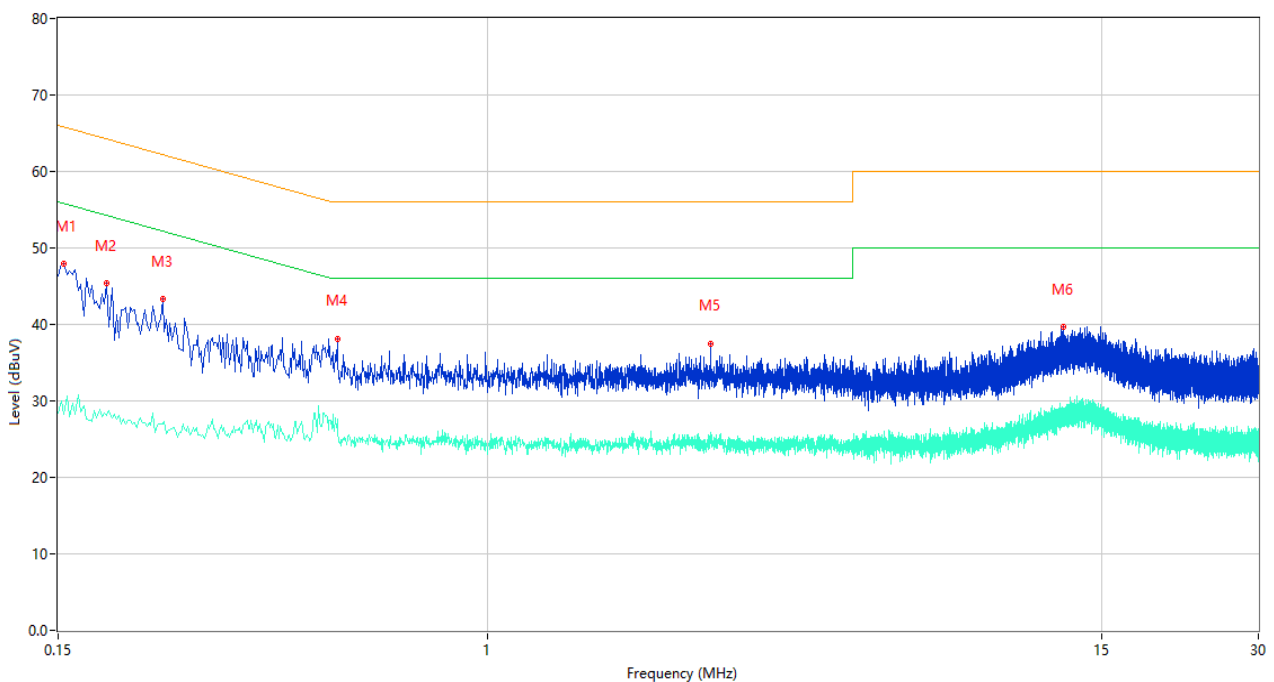
Note 1: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note 2: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note 3: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

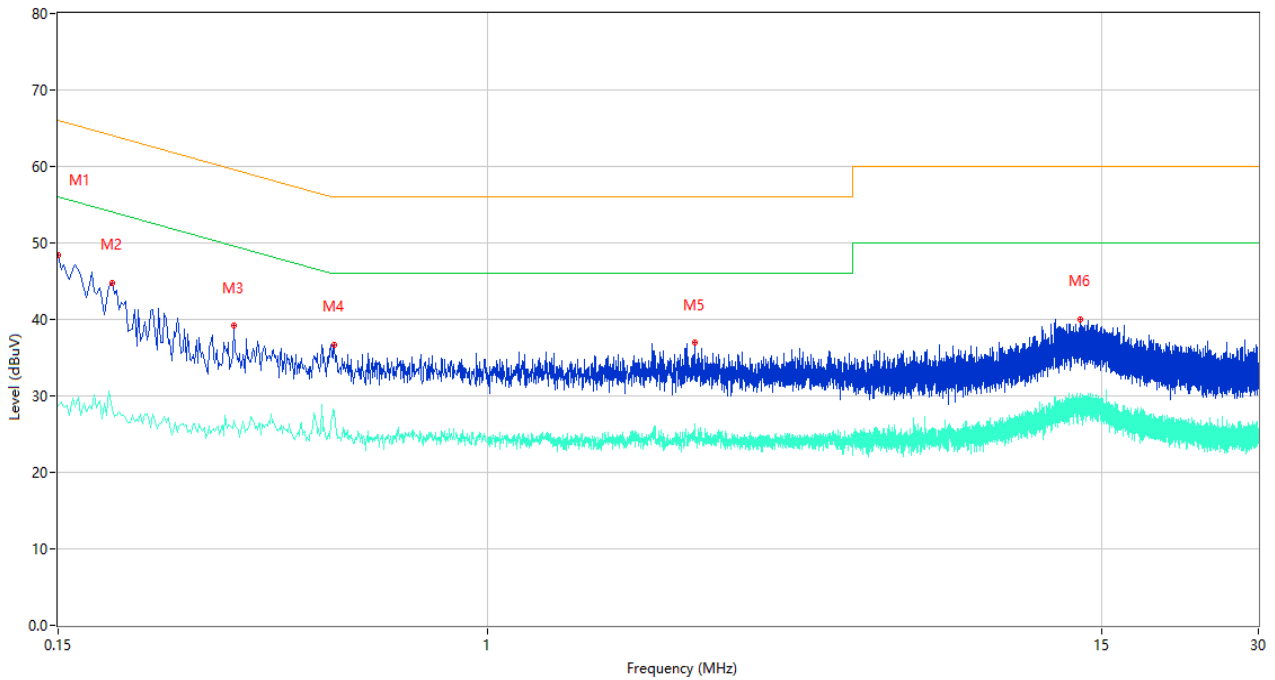
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.154	47.91	9.78	65.78	17.87	Peak	L	Pass
1**	0.154	28.19	9.78	55.78	27.59	AV	L	Pass
2	0.186	45.34	9.78	64.21	18.87	Peak	L	Pass
2**	0.186	28.11	9.78	54.21	26.10	AV	L	Pass
3	0.238	43.32	9.77	62.17	18.85	Peak	L	Pass
3**	0.238	26.93	9.77	52.17	25.24	AV	L	Pass
4	0.514	38.14	10.00	56.00	17.86	Peak	L	Pass
4**	0.514	27.57	10.00	46.00	18.43	AV	L	Pass
5	2.668	37.53	10.14	56.00	18.47	Peak	L	Pass
5**	2.668	25.89	10.14	46.00	20.11	AV	L	Pass
6	12.718	39.68	10.59	60.00	20.32	Peak	L	Pass
6**	12.718	28.58	10.59	50.00	21.42	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.150	48.35	9.78	66.00	17.65	Peak	N	Pass
1**	0.150	28.66	9.78	56.00	27.34	AV	N	Pass
2	0.190	44.76	9.78	64.04	19.28	Peak	N	Pass
2**	0.190	28.29	9.78	54.04	25.75	AV	N	Pass
3	0.326	39.13	10.28	59.55	20.42	Peak	N	Pass
3**	0.326	26.79	10.28	49.55	22.76	AV	N	Pass
4	0.508	36.70	9.99	56.00	19.30	Peak	N	Pass
4**	0.508	28.17	9.99	46.00	17.83	AV	N	Pass
5	2.492	36.97	10.17	56.00	19.03	Peak	N	Pass
5**	2.492	26.37	10.17	46.00	19.63	AV	N	Pass
6	13.668	40.07	10.72	60.00	19.93	Peak	N	Pass
6**	13.668	29.37	10.72	50.00	20.63	AV	N	Pass

A.8 Radiated Emission

Test Data and Plots

Note ¹: The symbol of "--" in the table which means not application.

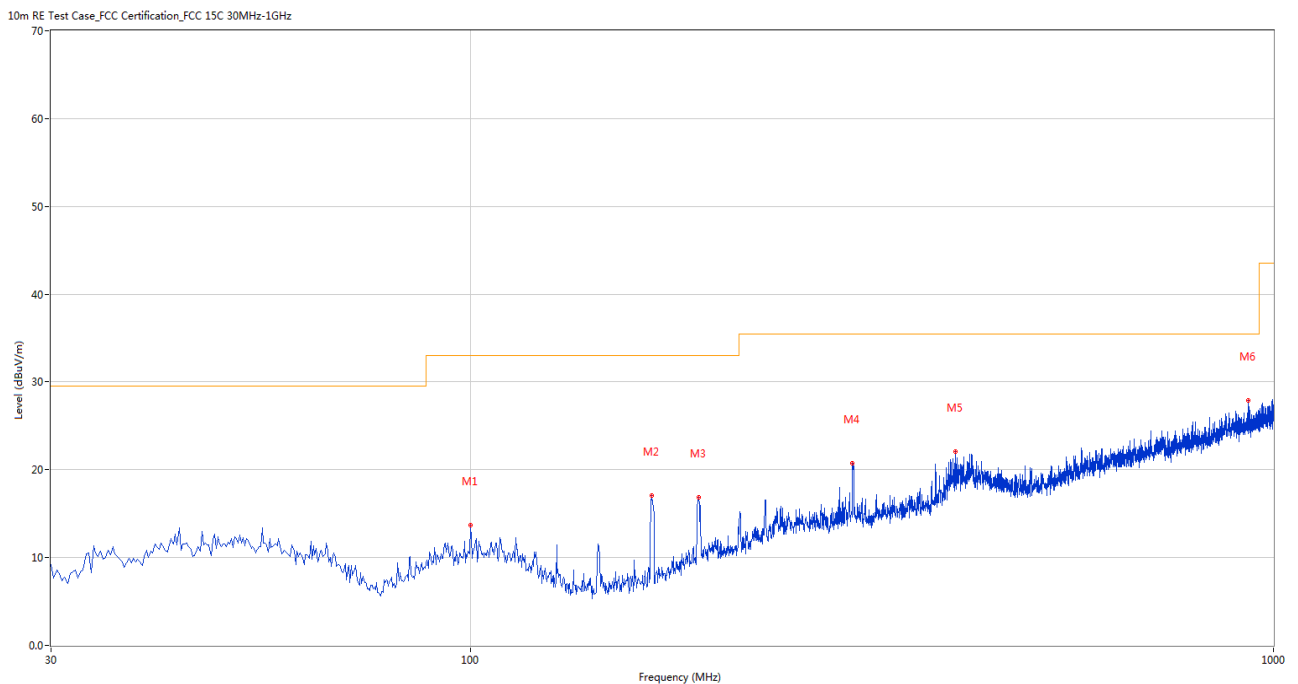
Note ²: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ³: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and Hopping mode is the worst.

Note ⁴: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

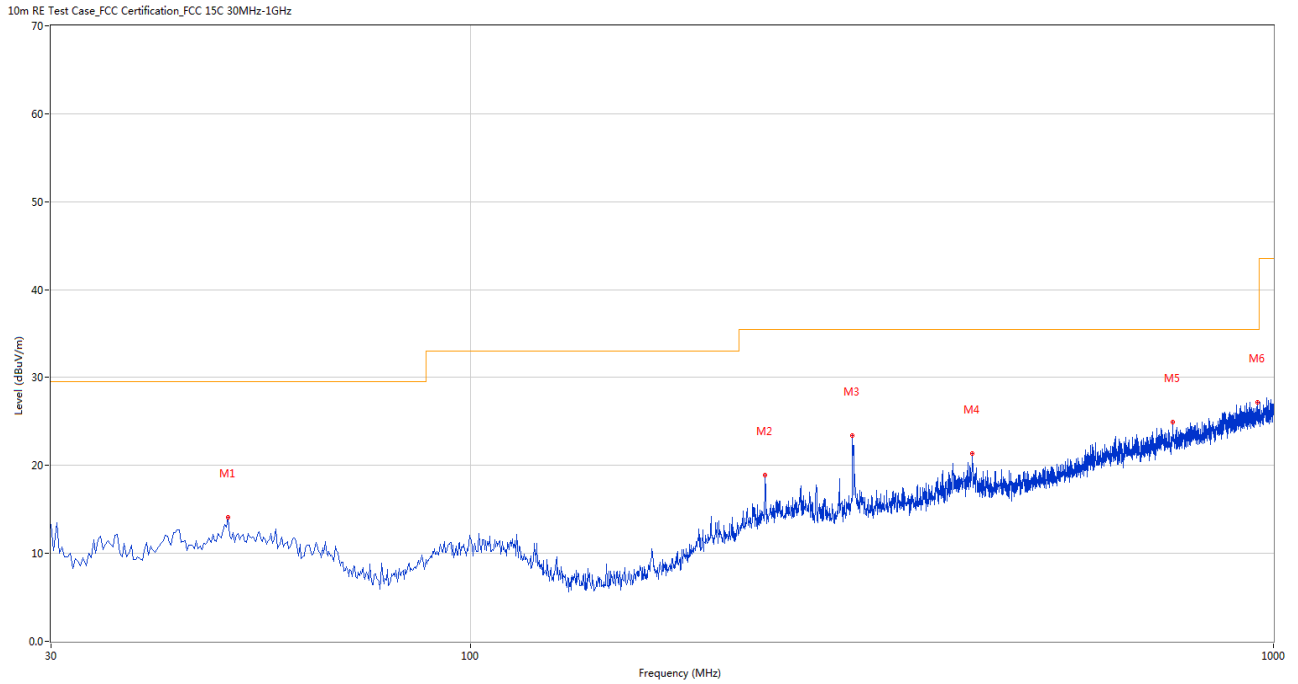
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	99.823	13.65	-27.98	33.0	19.35	Peak	0.00	200	Horizontal	Pass
2	167.948	17.06	-30.48	33.0	15.94	Peak	211.00	200	Horizontal	Pass
3	192.192	16.84	-28.44	33.0	16.16	Peak	199.00	200	Horizontal	Pass
4	298.865	20.74	-25.22	35.5	14.76	Peak	295.00	200	Horizontal	Pass
5	401.660	22.09	-22.55	35.5	13.41	Peak	0.00	200	Horizontal	Pass
6	929.450	27.89	-12.54	35.5	7.61	Peak	233.00	200	Horizontal	Pass

30 MHz to 1 GHz, ANT V



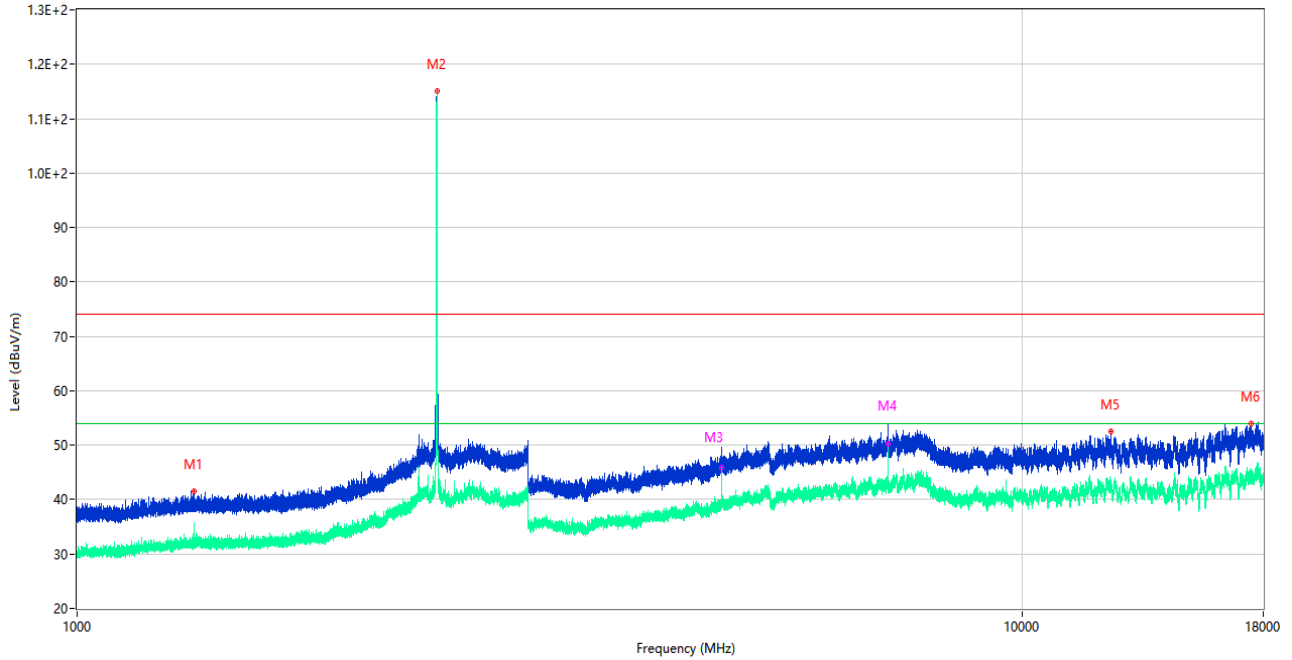
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	49.880	14.11	-26.31	29.5	15.39	Peak	313.00	200	Vertical	Pass
2	232.679	18.86	-27.00	35.5	16.64	Peak	214.00	100	Vertical	Pass
3	298.865	23.40	-25.22	35.5	12.10	Peak	353.00	100	Vertical	Pass
4	421.297	21.36	-22.02	35.5	14.14	Peak	2.00	100	Vertical	Pass
5	749.560	24.95	-15.09	35.5	10.55	Peak	329.00	200	Vertical	Pass
6	954.179	27.22	-11.88	35.5	8.28	Peak	0.00	200	Vertical	Pass

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

LORA LOW CHANNEL 1 GHz to 18 GHz, ANT H

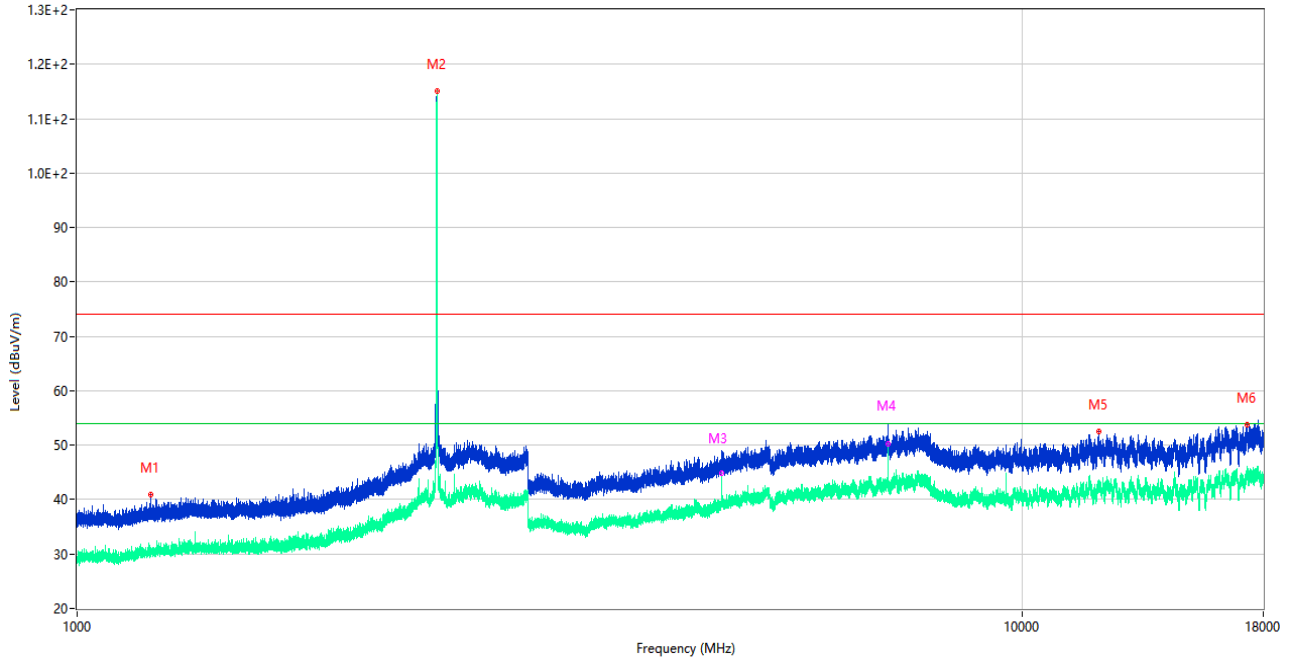
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.000	41.54	-16.94	74.0	32.46	Peak	319.00	400	Horizontal	Pass
1**	1329.000	32.19	-16.94	54.0	21.81	AV	319.00	400	Horizontal	Pass
2	2402.100	115.14	-10.60	74.0	-41.14	Peak	149.00	200	Horizontal	N/A
2**	2402.100	115.05	-10.60	54.0	-61.05	AV	149.00	200	Horizontal	N/A
3	4804.250	49.53	-3.21	74.0	24.47	Peak	158.00	200	Horizontal	Pass
3**	4804.250	45.92	-3.21	54.0	8.08	AV	158.00	200	Horizontal	Pass
4	7206.750	53.43	-0.04	74.0	20.57	Peak	131.00	200	Horizontal	Pass
4**	7206.750	50.25	-0.04	54.0	3.75	AV	131.00	200	Horizontal	Pass
5	12413.700	52.45	1.09	74.0	21.55	Peak	141.00	400	Horizontal	Pass
5**	12413.700	42.44	1.09	54.0	11.56	AV	141.00	400	Horizontal	Pass
6	17467.650	53.94	5.24	74.0	20.06	Peak	215.00	100	Horizontal	Pass
6**	17467.650	44.39	5.24	54.0	9.61	AV	215.00	100	Horizontal	Pass

LORA LOW CHANNEL 1 GHz to 18 GHz, ANT V

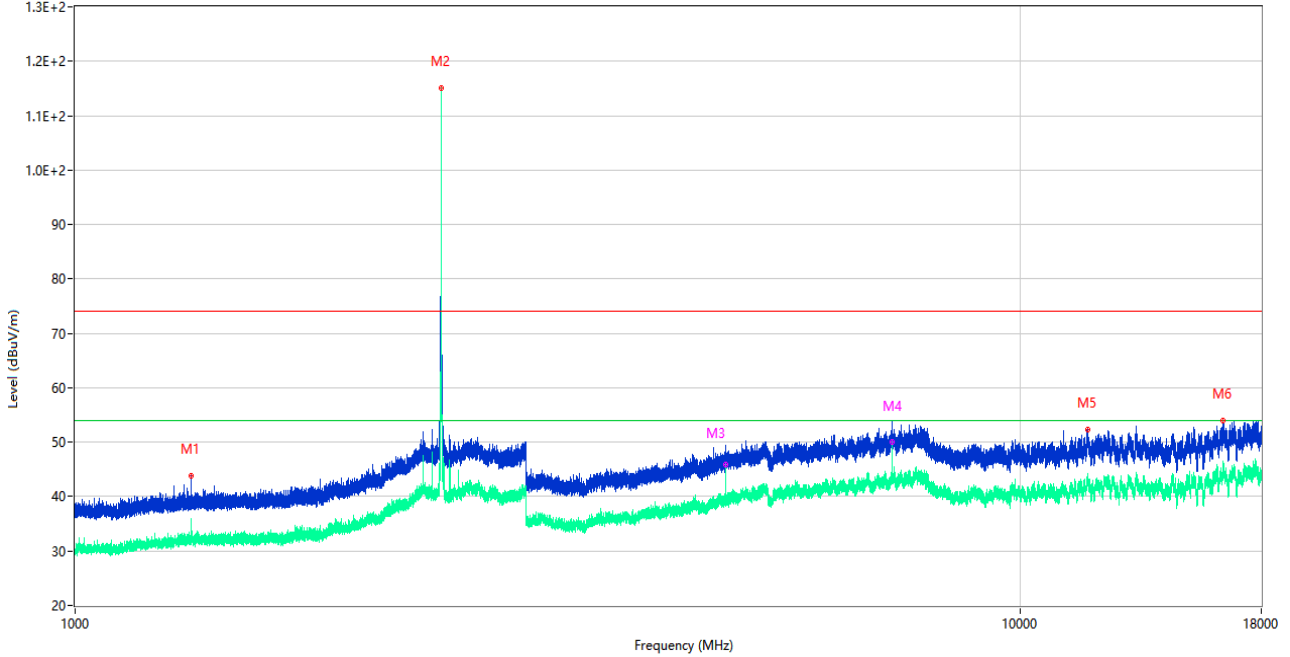
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1196.500	40.83	-17.86	74.0	33.17	Peak	23.00	200	Vertical	Pass
1**	1196.500	30.55	-17.86	54.0	23.45	AV	23.00	200	Vertical	Pass
2	2402.200	115.14	-10.59	74.0	-41.14	Peak	206.00	100	Vertical	N/A
2**	2402.200	115.13	-10.59	54.0	-61.13	AV	206.00	100	Vertical	N/A
3	4804.500	48.94	-3.20	74.0	25.06	Peak	19.00	200	Vertical	Pass
3**	4804.500	44.88	-3.20	54.0	9.12	AV	19.00	200	Vertical	Pass
4	7206.500	53.55	-0.05	74.0	20.45	Peak	178.00	200	Vertical	Pass
4**	7206.500	50.21	-0.05	54.0	3.79	AV	178.00	200	Vertical	Pass
5	12061.013	52.54	-0.21	74.0	21.46	Peak	349.00	400	Vertical	Pass
5**	12061.013	42.40	-0.21	54.0	11.60	AV	349.00	400	Vertical	Pass
6	17310.675	53.84	2.73	74.0	20.16	Peak	359.00	400	Vertical	Pass
6**	17310.675	44.24	2.73	54.0	9.76	AV	359.00	400	Vertical	Pass

LORA MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

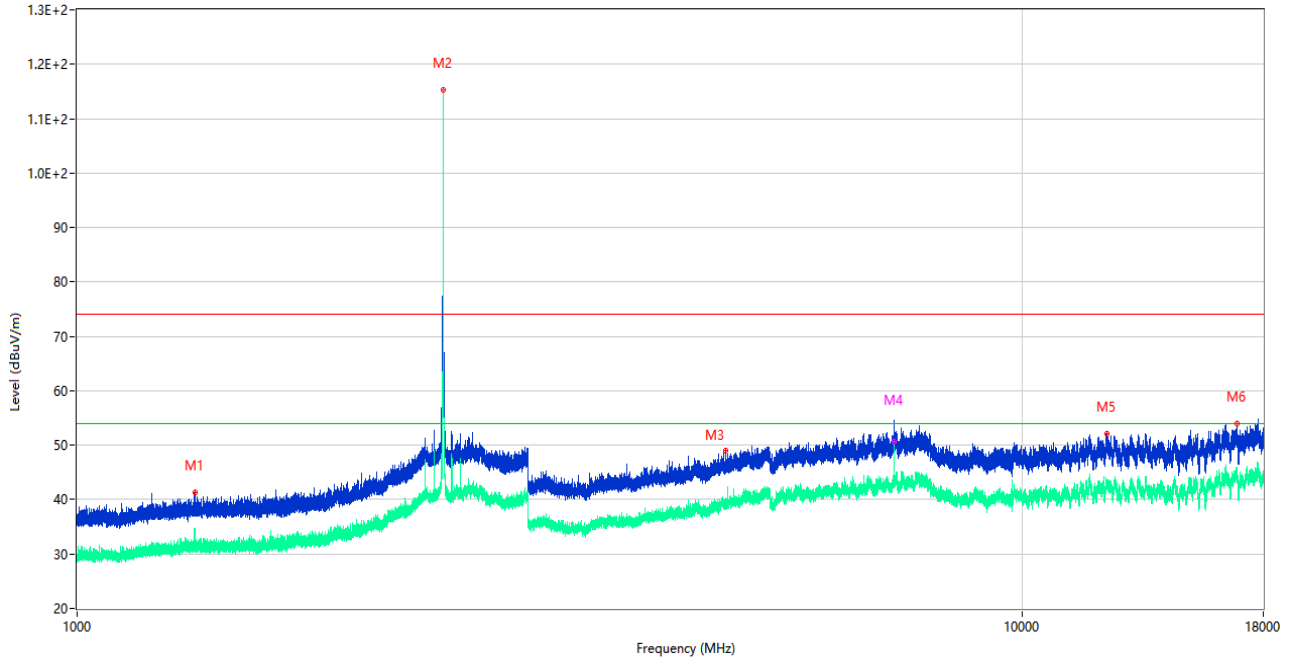
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.700	43.84	-16.94	74.0	30.16	Peak	230.00	100	Horizontal	Pass
1**	1327.700	33.18	-16.94	54.0	20.82	AV	230.00	100	Horizontal	Pass
2	2439.600	115.09	-10.32	74.0	-41.09	Peak	156.00	200	Horizontal	N/A
2**	2439.600	115.02	-10.32	54.0	-61.02	AV	156.00	200	Horizontal	N/A
3	4879.500	48.73	-3.78	74.0	25.27	Peak	138.00	200	Horizontal	Pass
3**	4879.500	45.89	-3.78	54.0	8.11	AV	138.00	200	Horizontal	Pass
4	7319.000	53.26	0.56	74.0	20.74	Peak	118.00	200	Horizontal	Pass
4**	7319.000	49.94	0.56	54.0	4.06	AV	118.00	200	Horizontal	Pass
5	11793.588	52.33	-0.15	74.0	21.67	Peak	287.00	100	Horizontal	Pass
5**	11793.588	42.76	-0.15	54.0	11.24	AV	287.00	100	Horizontal	Pass
6	16393.762	54.02	2.93	74.0	19.98	Peak	284.00	300	Horizontal	Pass
6**	16393.762	45.41	2.93	54.0	8.59	AV	284.00	300	Horizontal	Pass

LORA MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

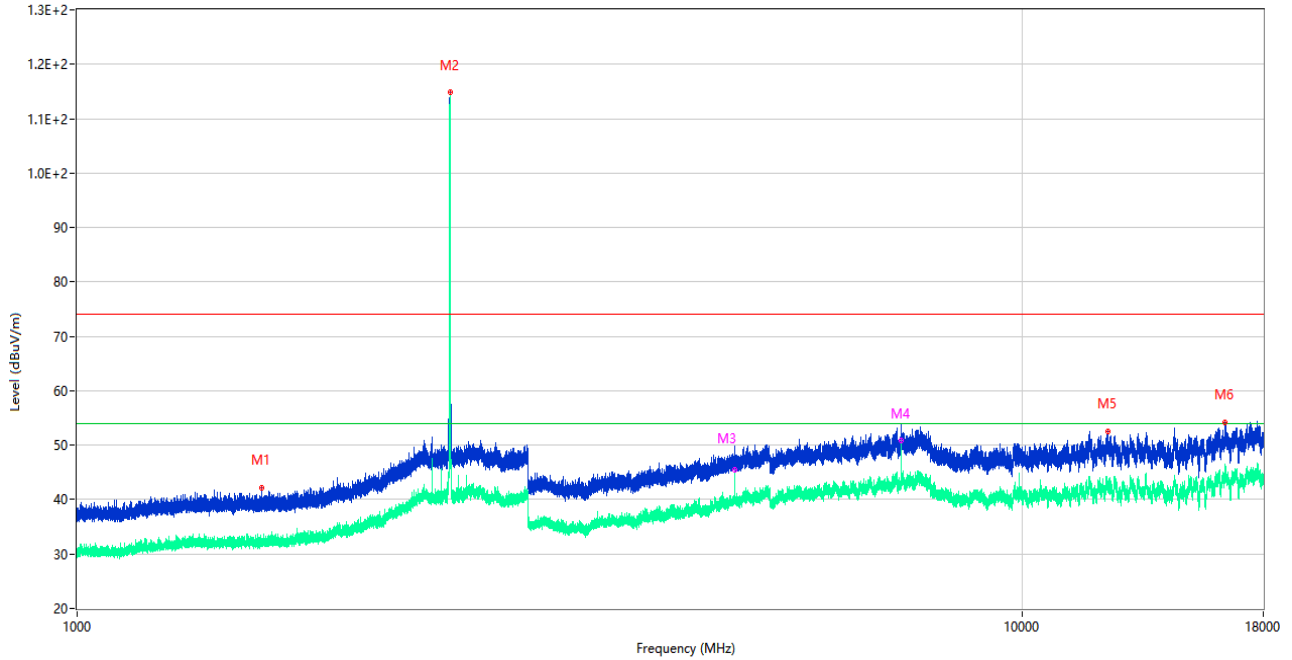
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1331.700	41.27	-16.90	74.0	32.73	Peak	239.00	100	Vertical	Pass
1**	1331.700	30.62	-16.90	54.0	23.38	AV	239.00	100	Vertical	Pass
2	2439.800	115.24	-10.27	74.0	-41.24	Peak	39.00	150	Vertical	N/A
2**	2439.800	115.23	-10.27	54.0	-61.23	AV	39.00	150	Vertical	N/A
3	4857.500	49.03	-3.58	74.0	24.97	Peak	160.00	200	Vertical	Pass
3**	4857.500	38.70	-3.58	54.0	15.30	AV	160.00	200	Vertical	Pass
4	7319.250	53.81	0.36	74.0	20.19	Peak	360.00	200	Vertical	Pass
4**	7319.250	50.71	0.36	54.0	3.29	AV	360.00	200	Vertical	Pass
5	12307.063	52.09	0.60	74.0	21.91	Peak	268.00	100	Vertical	Pass
5**	12307.063	43.01	0.60	54.0	10.99	AV	268.00	100	Vertical	Pass
6	16869.151	53.96	3.24	74.0	20.04	Peak	19.00	300	Vertical	Pass
6**	16869.151	45.19	3.24	54.0	8.81	AV	19.00	300	Vertical	Pass

LORA HIGH CHANNEL 1 GHz to 18 GHz, ANT H

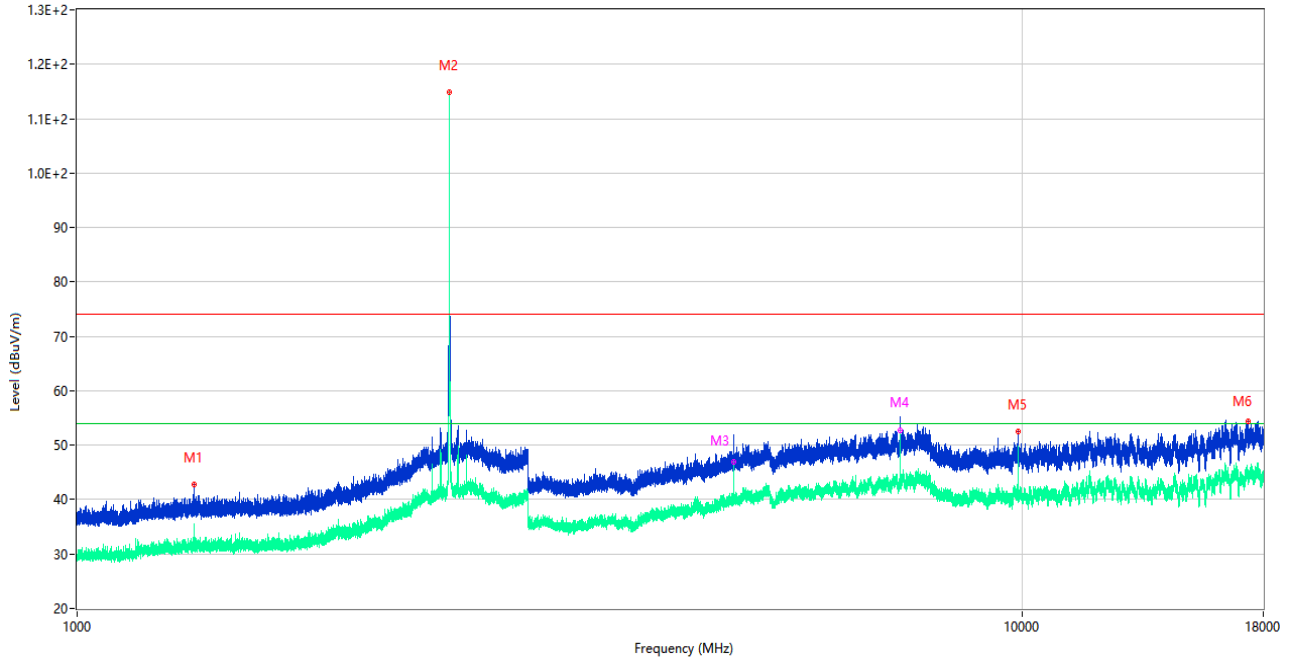
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1569.000	42.25	-17.23	74.0	31.75	Peak	225.00	300	Horizontal	Pass
1**	1569.000	32.64	-17.23	54.0	21.36	AV	225.00	300	Horizontal	Pass
2	2480.100	114.81	-11.10	74.0	-40.81	Peak	145.00	200	Horizontal	N/A
2**	2480.100	114.75	-11.10	54.0	-60.75	AV	145.00	200	Horizontal	N/A
3	4960.500	49.73	-3.57	74.0	24.27	Peak	360.00	100	Horizontal	Pass
3**	4960.500	45.55	-3.57	54.0	8.45	AV	360.00	100	Horizontal	Pass
4	7440.500	52.29	0.62	74.0	21.71	Peak	360.00	100	Horizontal	Pass
4**	7440.500	50.80	0.62	54.0	3.20	AV	360.00	100	Horizontal	Pass
5	12342.450	52.62	0.80	74.0	21.38	Peak	107.00	100	Horizontal	Pass
5**	12342.450	42.42	0.80	54.0	11.58	AV	107.00	100	Horizontal	Pass
6	16412.401	54.27	3.00	74.0	19.73	Peak	198.00	400	Horizontal	Pass
6**	16412.401	45.48	3.00	54.0	8.52	AV	198.00	400	Horizontal	Pass

LORA HIGH CHANNEL 1 GHz to 18 GHz, ANT V

RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1328.800	42.80	-16.94	74.0	31.20	Peak	200.00	400	Vertical	Pass
1**	1328.800	31.00	-16.94	54.0	23.00	AV	200.00	400	Vertical	Pass
2	2477.100	114.94	-11.14	74.0	-40.94	Peak	227.00	100	Vertical	N/A
2**	2477.100	114.84	-11.14	54.0	-60.84	AV	227.00	100	Vertical	N/A
3	4954.500	51.34	-3.56	74.0	22.66	Peak	122.00	100	Vertical	Pass
3**	4954.500	46.99	-3.56	54.0	7.01	AV	122.00	100	Vertical	Pass
4	7431.750	54.99	0.76	74.0	19.01	Peak	143.00	100	Vertical	Pass
4**	7431.750	52.81	0.76	54.0	1.19	AV	143.00	100	Vertical	Pass
5	9908.550	52.46	-2.38	74.0	21.54	Peak	360.00	100	Vertical	Pass
5**	9908.550	49.92	-2.38	54.0	4.08	AV	360.00	100	Vertical	Pass
6	17330.362	54.38	2.91	74.0	19.62	Peak	180.00	400	Vertical	Pass
6**	17330.362	44.38	2.91	54.0	9.62	AV	180.00	400	Vertical	Pass

A.9 Band Edge (Restricted-band band-edge)

Note ¹: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

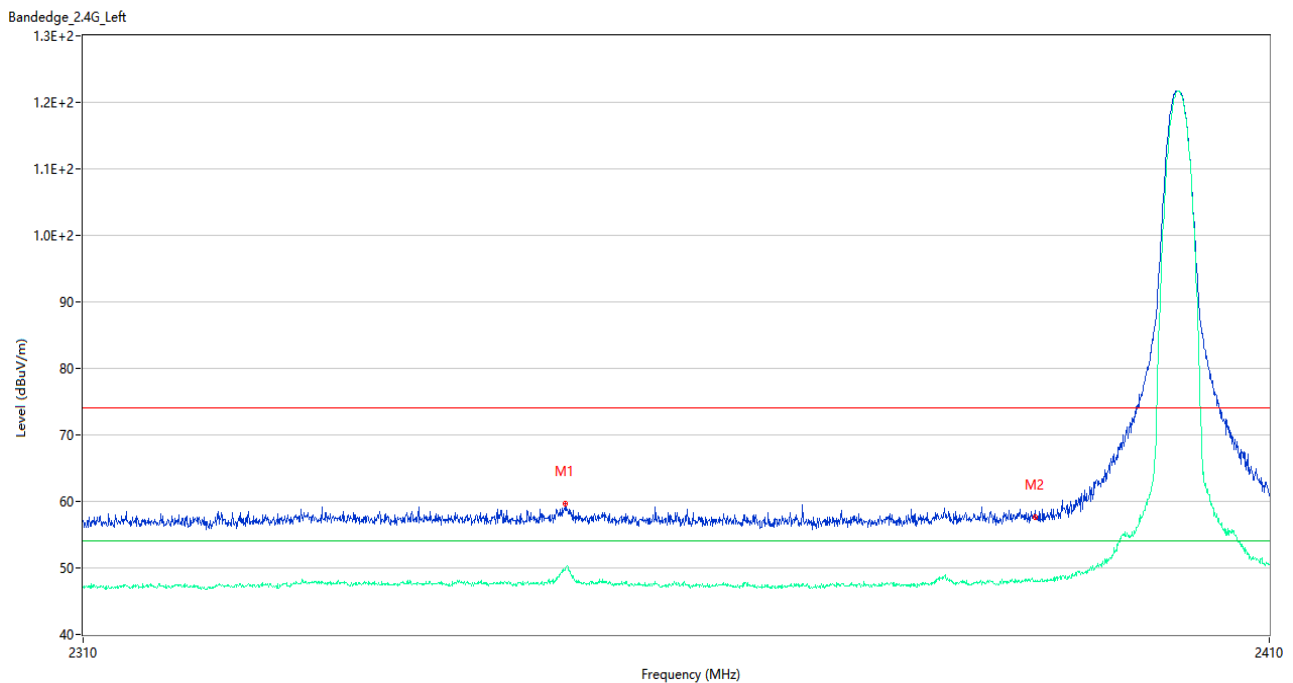
Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note ³: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ⁴: The Level (dBuV/m) has been corrected by factor.

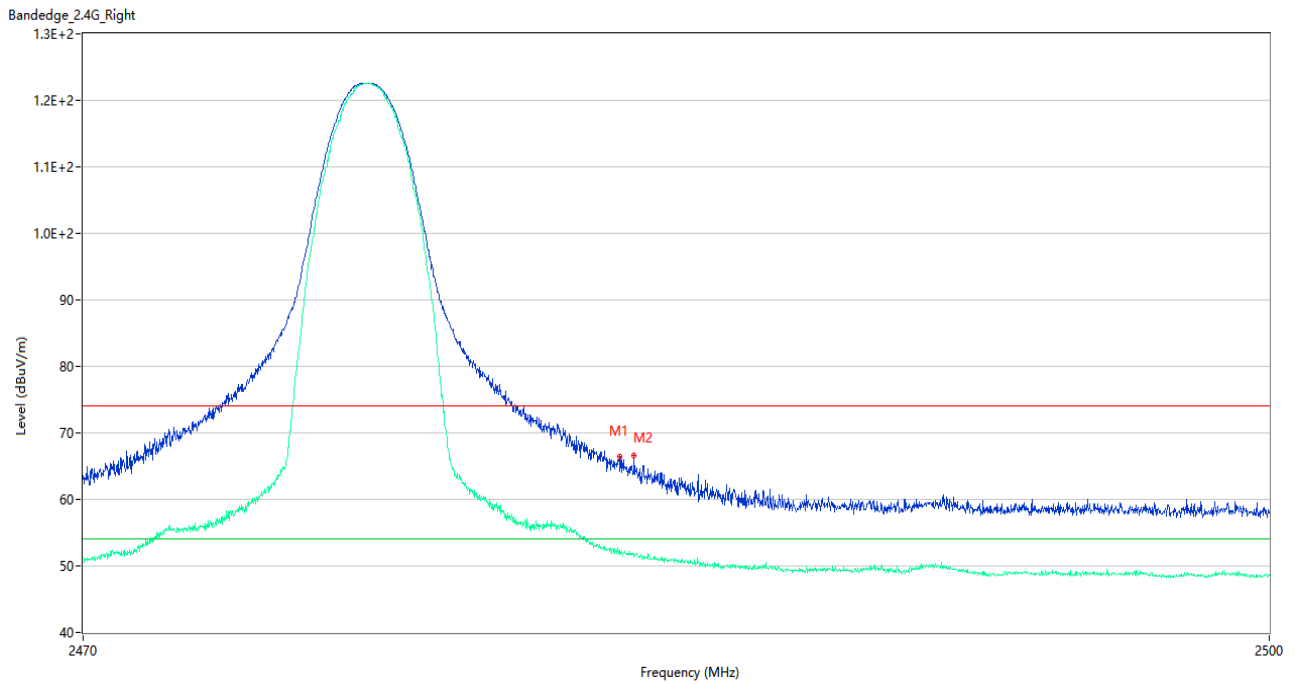
Test Data

LORA LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2350.150	59.64	-0.97	74.0	14.36	Peak	151.00	100	Vertical	Pass
1**	2350.150	49.96	-0.97	54.0	4.04	AV	151.00	100	Vertical	Pass
2	2389.950	57.58	-1.82	74.0	16.42	Peak	258.00	150	Vertical	Pass
2**	2389.950	48.02	-1.82	54.0	5.98	AV	258.00	150	Vertical	Pass

LORA HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.515	66.44	-1.10	74.0	7.56	Peak	137.00	150	Vertical	Pass
1**	2483.515	51.76	-1.10	54.0	2.24	AV	137.00	150	Vertical	Pass
2	2483.890	66.53	-1.03	74.0	7.47	Peak	156.00	200	Vertical	Pass
2**	2483.890	51.73	-1.03	54.0	2.27	AV	156.00	200	Vertical	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ23A0833-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ23A0833-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ23A0833-AI.PDF”.

Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
2. The report without China inspection body and laboratory Mandatory Approval (CMA) mark has no effect of proving to the society.
3. For the report with CNAS mark or A2LA mark, the items marked with "☆" are not within the accredited scope.
4. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the "inspection and testing dedicated stamp" or test report stamp.
5. The test data and results are only valid for the tested samples provided by the customer.
6. This report shall not be partially reproduced without the written permission of the laboratory.
7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--END OF REPORT--