Test Report

Verified code: 016709

Report No.: E20240506136401-2

Customer:	Lumi United Technology Co., Ltd
Address:	B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China
Sample Name:	Vibration Sensor T1
Sample Model:	VB-S01D
Receive Sample Date:	May.10, 2024
Test Date:	May.11,2024 ~ May.16,2024
Reference Document:	CFR 47 FCC Part 15 Subpart C RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators
Test Result:	Pass

Prepared by: Reviewed by: Approved by:

GRG METROLOGY & TEST GROUP CO., LTD

Issued Date: 2024-09-02

GRG METROLOGY & TEST GROUP CO., LTD.
Address: No.163, Pingyun Road, West of Huangpu Avenue, Guangzhou, Guangdong, China
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Statement

1. The report is invalid without "special seal for inspection and testing"; some copies are invalid; The report is invalid if it is altered or missing; The report is invalid without the signature of the person who prepared, reviewed and approved it.

2. The sample information is provided by the client and responsible for its authenticity; The content of the report is only valid for the samples sent this time.

3. When there are reports in both Chinese and English, the Chinese version will prevail when the language problems are inconsistent.

4. If there is any objection concerning the report, please inform us within 15 days from the date of receiving the report.

5. This testing report is only for scientific research, teaching, internal quality control, etc.

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20240506136401-2	Original Issue	2024-08-23

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1. TEST RESULT SUMMARY

Technical Requirements		
CFR 47, FCC Part 15 Subpart C (§15.247) ANSI C63.10-2020 KDB 558074 D01 15.247 measurement guidance v05r02		
Limit / Severity	**Item**	**Result**
§15.207	Conducted emission AC power port	Not Applicable[1]
§15.247(b)(3)	Maximum output power	Pass
§15.247(e)	Power spectral density	Pass
§15.247(a)(2)	6dB bandwidth	Pass
§15.247(d)	RF conducted spurious emissions	Pass
§15.247(d)	Band edge	Pass
§15.247(d) & §15.209(a) & §15.205(a)(c)	Radiated spurious emissions & restricted bands of operation	Pass
§15.203	Antenna requirement	Pass[2]

Note 1: The EUT is power by battery, not applicable.
2.The EUT is PCB printed antenna with 2dBi gain (Max). which accordance 15.203 is considered sufficient to comply with the provisions of this section.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name:	Lumi United Technology Co., Ltd
Address:	B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

2.2 MANUFACTURER

Name:	Lumi United Technology Co., Ltd
Address:	B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

2.3 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	Vibration Sensor T1
Model No.:	VB-S01D
Adding Model:	/
Trade Name:	Aqara
Power Supply:	3.0V DC supplied by button cell
Battery Specification:	CR2032 3.0V DC
FCC ID:	2AKIT-VBS01D
Frequency Range:	ZigBee: 2405MHz-2480MHz
Conducted maximum output Power:	8.41dBm
Modulation type:	O-QPSK
Antenna Specification:	PCB printed antenna with 2dBi gain (Max)
Temperature Range:	-10 ℃ ~ 50 ℃
Hardware Version:	V1.0
Software Version:	V1.0.0.1
Sample No:	E20240506136401-0001, E20240506136401-0003
Note:	The basic description of the EUT is provided by the applicant. This report is made Solely yon the basis of such data and/or information.We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.

2.4 CHANNEL LIST

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
11	2405*	12	2410	13	2415	14	2420
15	2425	16	2430	17	2435	18	2440*
19	2445	20	2450	21	2455	22	2460
23	2465	24	2470	25	2475	26	2480*

* is the test frequency

2.5 TEST OPERATION MODE

Mode No.	Description of the modes
1	Zigbee fixed frequency transmitting

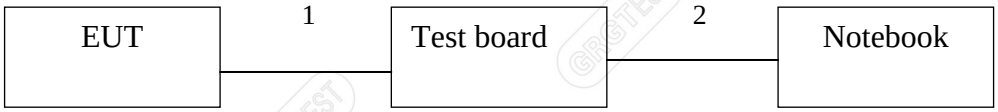
2.6 LOCAL SUPPORTIVE

No.	Name of Equipment	Manufacturer	Model	Serial Number	Note
A	Notebook	DELL	Latitude 3400	CY0GJW2	2#
B	Test board	/	/	/	Test board

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	serial cable	1	No	No	0.2m
2	USB-MINI cable	1	No	No	0.5m

Note: The notebook is just used to produce fixed frequency transmitting.

2.7 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
QCOM_V1.0	2405MHz: 8 2440MHz: 8 2480MHz: 8

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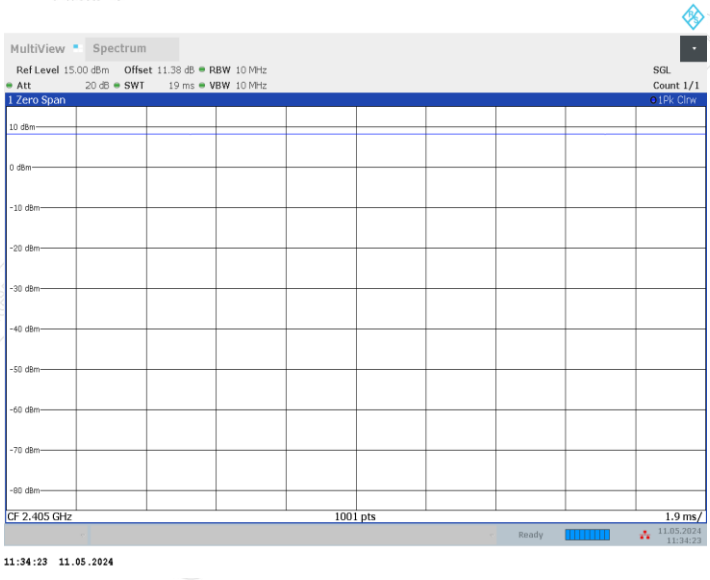
2.8 DUTY CYCLE

Environment: 26.3℃/59%RH/101.0kPa Voltage: DC 3V

Tested By: Qin tingting Date: 2024-05-11

Test Mode	Antenna	Frequency [MHz]	ON Time [ms]	Period [ms]	DC [%]	T [s]
ZigBee	Ant1	2405	19	19	100	0.019

ZigBee_2405MHz



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3. LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

Add	:	Address: No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China
P.C.	:	518110
Tel	:	0755-61180008
Fax	:	0755-61180008

4. ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025:2017.

USA	A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	ISED (Company Number: 24897，CAB identifier:CN0069)
USA	FCC (Registration Number: 759402，Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site, http://www.grgtest.com

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5. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	X	9kHz～30MHz	4.4dB[1)]
	Y	9kHz～30MHz	4.4dB[1)]
	Z	9kHz～30MHz	4.4dB[1)]
	Horizontal	30MHz～200MHz	4.6dB[1)]
		200MHz～1000MHz	4.8dB[1)]
		1GHz～18GHz	5.0dB[1)]
		18GHz～26.5GHz	5.2dB[1)]
	Vertical	30MHz～200MHz	4.7dB[1)]
		200MHz～1000MHz	4.7dB[1)]
		1GHz～18GHz	5.1dB[1)]
		18GHz～26.5GHz	5.4dB[1)]

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.80dB
Power spectral density conducted	0.80dB
Occupied channel bandwidth	0.40dB
Unwanted emission, conducted	0.70dB
Humidity	6.0%
Temperature	2.0℃

Note:
[1)] This uncertainty represents an expanded uncertainty expressed at approximately the 95%.
This uncertainty represents an expanded uncertainty factor of *k*=2.

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6. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission & Restricted bands of operation				
Test S/W	Tonscend	JS32-RE/5.0.0		
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2024-07-15
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3402	2024-10-06
Horn Antenna	Schwarzbeck	BBHA 9120D	02143	2024-09-23
Test Receiver	R&S	ESR26	101758	2024-09-22
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2024-09-18
Amplifier	SHIRONG ELECTRONIC	DLNA-30M1G-G40	20200928001	2025-01-30
Amplifier	Tonscend	TAP01018048	AP20E8060075	2025-03-01
Amplifier	Tonscend	TAP184050	AP20E806071	2025-03-01
Amplifier	SHIRONG ELECTRONIC	DLNA-1G18G-G40	20200928005	2024-08-17
6dB Bandwidth &Conducted band edges and Spurious Emission &Power Spectral Density				
Spectrum Analyzer	R&S	FSW43	102072	2024-07-09
Automatic power test unit	TONSCEND	JS0806-2	21B8060365	2024-12-28
BT/WIFI System	Tonscend	JS1120-3		
Maximum peak output power				
Pulse power sensor	Anristu	MA2411B	1126150	2025-01-11
Power meter	Anristu	ML2495A	1204003	2025-01-11

Note: The calibration cycle of the above instruments is 12 months.

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7. RADIATED SPURIOUS EMISSIONS

7.1 LIMITS

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30~88	100	3	40
88~216	150	3	43.5
216~960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.
(2) Above 18GHz test distance is 1m, so the Peak Limit=74+20*log(3/1)=83.54 (dBμV/m).
The Avg Limit=54+20*log(3/1)=63.54 (dBμV/m).

7.2 TEST PROCEDURES

a) Sequence of testing 9kHz to 30MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate fixedfrequencytransmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna height is 1.0 meter.

--- The antenna is polarized X,Y and Z.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the pre measurement the software maximizes by rotating the turntable position (0 °to 360 °) and by rotating the elevation axes (0 °to 360 °).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QP detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement and the limit will be stored.

b) Sequence of testing 30MHz to 1GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

---- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 4 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

c) Sequence of testing 1GHz to 18GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 4 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

d) Sequence of testing above 18GHz
Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 4 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

NOTE:
(1).The frequency from 9kHz to 150kHz, Set RBW=300Hz(for Peak&AVG), VBW=300Hz(for Peak&AVG). The frequency from 150kHz to 30MHz, Set RBW=9kHz, VBW=9kHz, (for QP Detector).
(2).The frequency from 30MHz to 1GHz, Set RBW=120kHz, VBW=300kHz, (for QP Detector).
(3).The frequency above 1GHz, for Peak detector: Set RBW=1MHz,VBW=3MHz.
(4). The frequency above 1GHz, for Avg detector: Set RBW=1MHz,if the EUT is configured to transmit with duty cycle ≥98%，set VBW≤RBW/100 (i.e.,10kHz) but not less than 10 Hz. If the EUT duty cycle is ＜98%， set VBW≥1/T, Where T is defined in section 2.8.

7.3 TEST SETUP

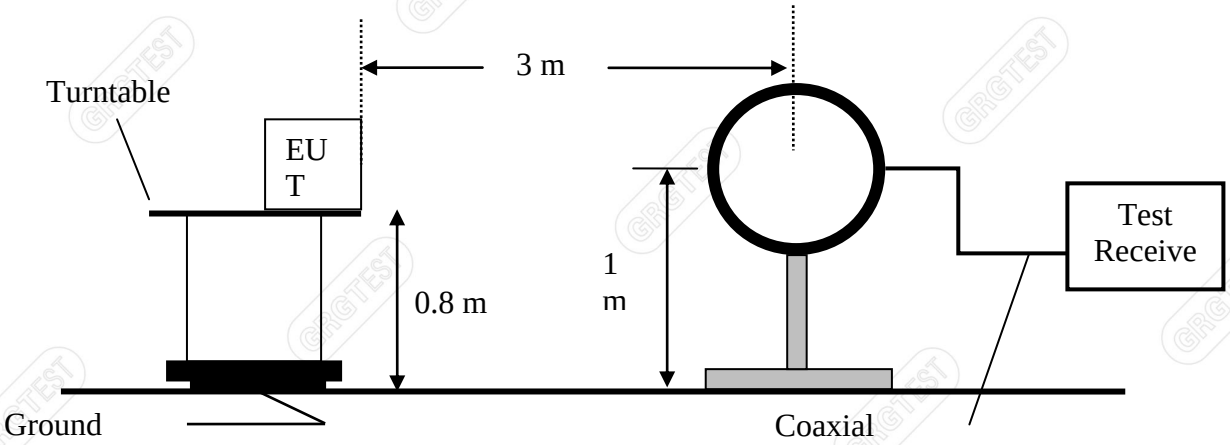

Figure 1. 9kHz to 30MHz radiated emissions test configuration

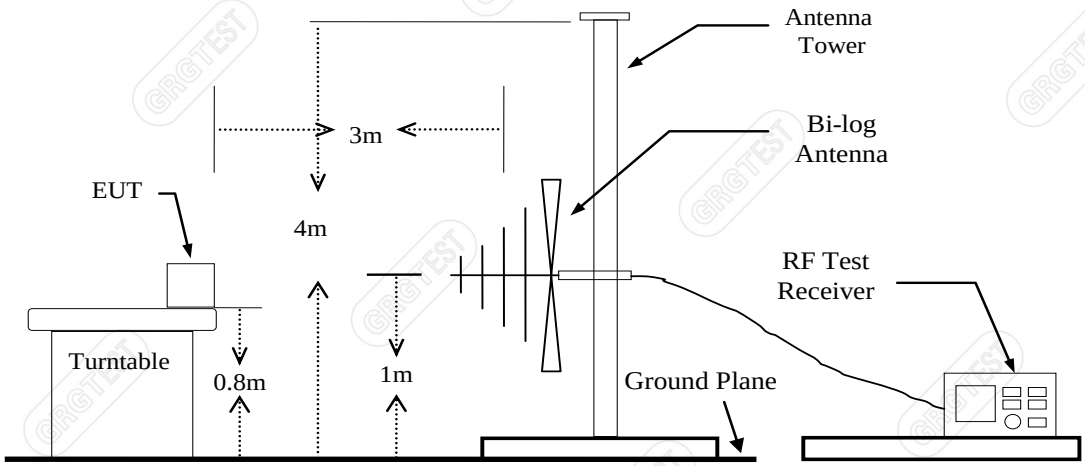

Figure 2. 30MHz to 1GHz radiated emissions test configuration

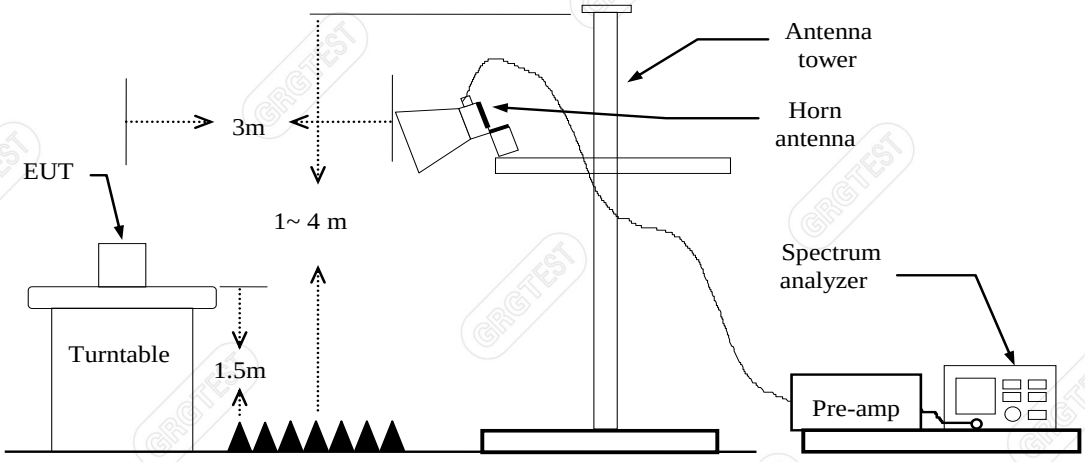

Figure 3. 1GHz to 18GHz radiated emissions test configuration

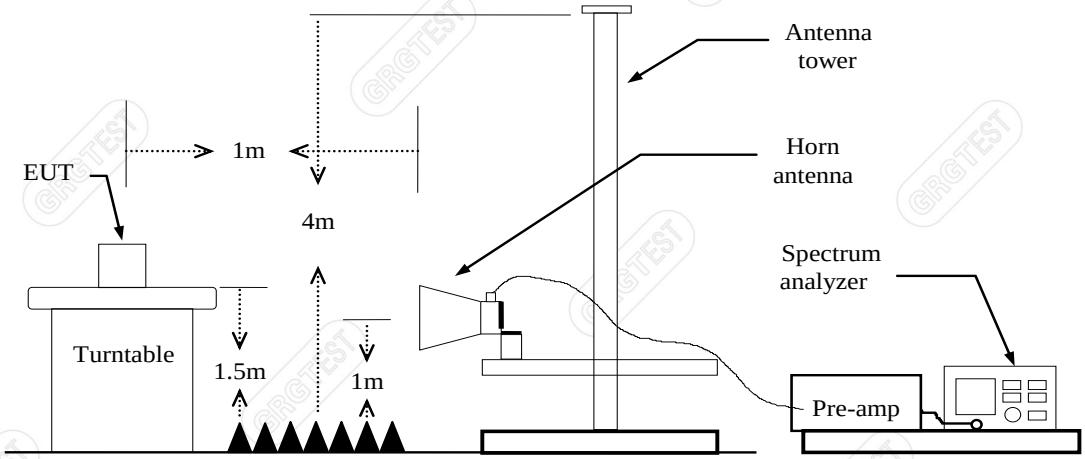

Figure 4. 18GHz to 26.5GHz radiated emissions test configuration

7.4 DATA SAMPLE

30MHz to 1GHz

Suspected Data List											
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
xxx	xxx	57.15	25.66	-31.49	40.00	14.34	PK	200	359	Horizontal	PASS

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV/m) = Uncorrected Analyzer / Receiver reading

Factor (dB) = Antenna factor + Cable loss – Amplifier gain

Result (dBμV/m) = Reading (dBμV/m) + Factor (dB)

Limit (dBμV/m) = Limit stated in standard

Margin (dB) = Result (dBμV/m)-Limit (dBμV/m)

Peak = Peak Reading

QP = Quasi-peak Reading

1GHz-18GHz

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
xxx	xxx	49.54	40.49	-9.05	74.00	33.51	100	256	Horizontal

Above 18GHz

Suspected Data List										
NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
xxx	xxx	63.77	46.82	37.28	-16.95	74	36.72	100	307	Horizontal

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV/m) = Uncorrected Analyzer / Receiver reading

Factor (dB) = Antenna factor + Cable loss – Amplifier gain

Level for 1m (dBμV/m)	= Reading (dBuV/m) + Factor (dB)
Level for 3m (dBμV/m)	= Level for 1m (dBμV/m) + 20*log(1/3)
Limit (dBμV/m)	= Limit stated in standard
Margin (dB)	= Limit (dBμV/m) – Level (dBμV/m)
Polarity	= Antenna polarization
Peak	= Peak Reading
AVG	= Average Reading

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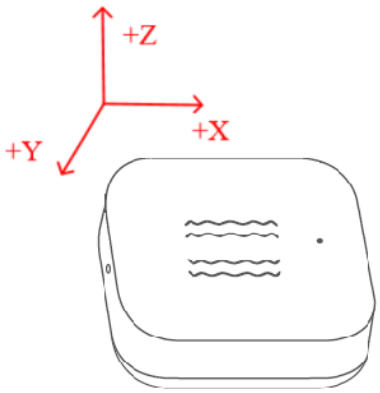
7.5 TEST RESULTS

The test are under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown the X position only.



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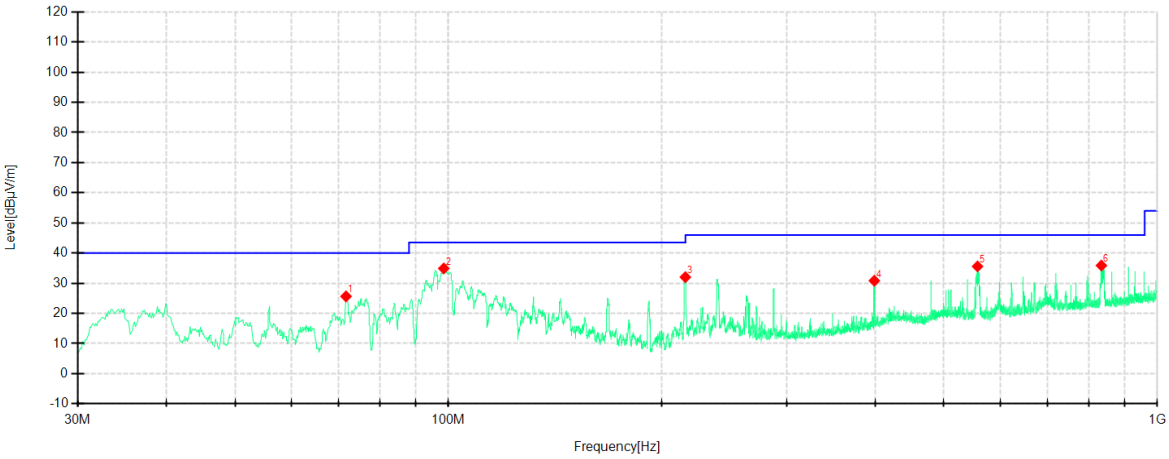
Below 1GHz

Pretest all case, only the worst mode and channel were recorded in this report. (ZigBee 2480MHz)

EUT Name:	Vibration Sensor T1	Test Mode:	Mode 1
Model:	VB-S01D	Sample No:	E20240506136401-0003
Power supply:	DC 3V	Environmental Conditions:	25.3℃/54%RH/101.0kPa
Test Engineer:	Wen wenwen	Test Date:	2024-05-15



Suspected Data List											
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	71.7152	57.15	25.66	-31.49	40.00	14.34	QP	200	359	Horizontal	PASS
2	98.5148	67.14	34.92	-32.22	43.50	8.58	QP	200	217	Horizontal	PASS
3	215.8995	63.20	32.03	-31.17	43.50	11.47	QP	200	244	Horizontal	PASS
4	398.8886	54.98	30.84	-24.14	46.00	15.16	QP	100	248	Horizontal	PASS
5	557.7460	55.80	35.58	-20.22	46.00	10.42	QP	200	283	Horizontal	PASS
6	833.9880	52.25	35.88	-16.37	46.00	10.12	QP	200	244	Horizontal	PASS

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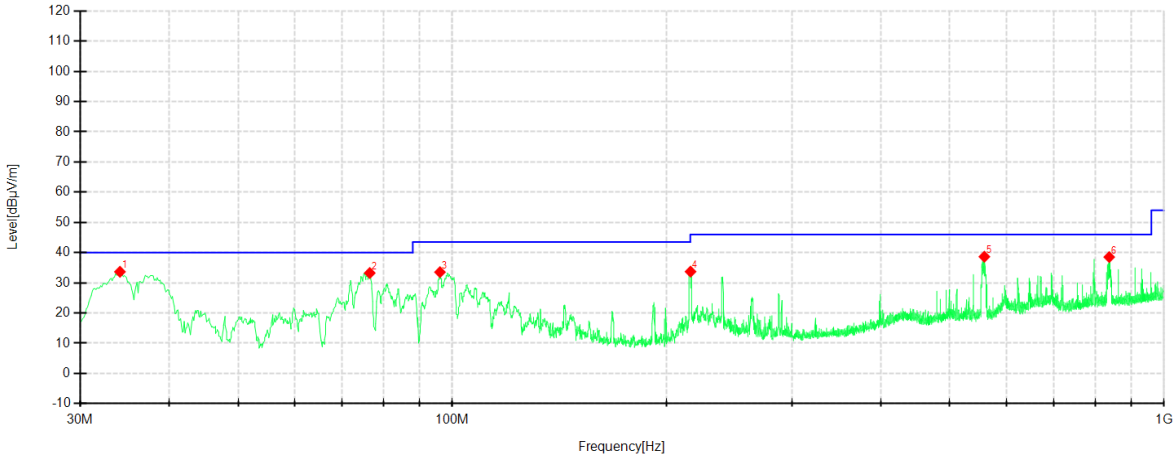

Suspected Data List											
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	34.1230	63.34	33.66	-29.68	40.00	6.34	QP	100	19	Vertical	PASS
2	76.5658	66.04	33.25	-32.79	40.00	6.75	QP	100	19	Vertical	PASS
3	96.0895	66.19	33.55	-32.64	43.50	9.95	QP	200	104	Vertical	PASS
4	216.1420	64.87	33.72	-31.15	46.00	12.28	QP	100	217	Vertical	PASS
5	559.2012	58.79	38.65	-20.14	46.00	7.35	QP	200	196	Vertical	PASS
6	837.5047	54.78	38.54	-16.24	46.00	7.46	QP	100	359	Vertical	PASS

Remark:

1 Radiated emissions measured in frequency range from 30MHz to 1GHz were made with an instrument using Quasi-peak detector mode.

2 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

3 No emission found between lowest internal used/generated frequency to 30MHz.

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1GHz-18GHz:
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Mode: TX/ ZigBee
Lowest Frequency (2405MHz)
Environment: 25℃/46%RH/101.0kPa Voltage: DC 3V
Tested By:Wen wenwen Date: 2024-05-16

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1241.4000	49.54	40.49	-9.05	74.00	33.51	100	256	Horizontal
2	2278.2000	47.00	43.86	-3.14	74.00	30.14	200	68	Horizontal
3	2497.8000	46.61	46.36	-0.25	74.00	27.64	100	339	Horizontal
4	4809.0000	53.05	45.92	-7.13	74.00	28.08	100	323	Horizontal
5	6864.0000	43.40	43.28	-0.12	74.00	30.72	100	21	Horizontal
6	16767.0000	37.75	46.07	8.32	74.00	27.93	200	171	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1295.8000	50.80	42.91	-7.89	74.00	31.09	100	255	Vertical
2	2492.8000	46.87	46.35	-0.52	74.00	27.65	200	139	Vertical
3	2778.2000	48.25	46.57	-1.68	74.00	27.43	100	305	Vertical
4	3988.5000	55.32	44.53	-10.79	74.00	29.47	100	20	Vertical
5	7213.5000	43.53	44.43	0.90	74.00	29.57	100	123	Vertical
6	7684.5000	43.47	45.54	2.07	74.00	28.46	200	354	Vertical

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Mode: TX/ ZigBee
Middle Frequency (2440MHz)
Environment: 25℃/46%RH/101.0kPa Voltage: DC 3V
Tested By:Wen wenwen Date: 2024-05-16

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1897.6000	46.88	43.14	-3.74	74.00	30.86	200	308	Horizontal
2	2497.8000	47.41	47.16	-0.25	74.00	26.84	100	305	Horizontal
3	3199.5000	51.92	38.71	-13.21	74.00	35.29	100	257	Horizontal
4	4881.0000	52.88	45.99	-6.89	74.00	28.01	100	340	Horizontal
5	7942.5000	40.95	44.56	3.61	74.00	29.44	100	321	Horizontal
6	10653.0000	38.33	47.45	9.12	74.00	26.55	200	86	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2495.0000	47.22	46.74	-0.48	74.00	27.26	200	273	Vertical
2	2660.8000	49.19	46.50	-2.69	74.00	27.50	100	89	Vertical
3	3985.5000	51.79	41.02	-10.77	74.00	32.98	100	307	Vertical
4	7975.5000	42.09	45.83	3.74	74.00	28.17	100	222	Vertical
5	15643.5000	35.96	47.57	11.61	74.00	26.43	100	155	Vertical
6	2860.8000	36.39	35.07	-1.32	54.00	18.93	100	205	Vertical

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Mode: TX/ ZigBee
Highest Frequency (2480MHz)
Environment: 25℃/46%RH/101.0kPa Voltage: DC 3V
Tested By:Wen wenwen Date: 2024-05-16

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1889.8000	48.53	44.61	-3.92	74.00	29.39	100	241	Horizontal
2	2990.4000	47.49	46.63	-0.86	74.00	27.37	100	121	Horizontal
3	4960.5000	53.39	47.05	-6.34	74.00	26.95	100	223	Horizontal
4	6969.0000	43.58	43.45	-0.13	74.00	30.55	100	171	Horizontal
5	8484.0000	40.79	45.17	4.38	74.00	28.83	200	322	Horizontal
6	13914.0000	35.39	47.87	12.48	74.00	26.13	100	189	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1916.2000	47.76	44.06	-3.70	74.00	29.94	200	324	Vertical
2	3199.5000	53.31	39.60	-13.71	74.00	34.40	100	287	Vertical
3	3331.5000	53.68	40.80	-12.88	74.00	33.20	100	220	Vertical
4	3982.5000	52.97	42.20	-10.77	74.00	31.80	100	305	Vertical
5	6871.5000	44.64	44.52	-0.12	74.00	29.48	100	49	Vertical
6	16804.5000	37.00	45.16	8.16	74.00	28.84	200	322	Vertical

Remark:

1 Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency.
2 Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3 Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4 Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

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18GHz to 26.5GHz

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Pre-scan all modes, only the worst case(TX/ZigBee_2405MHz) was recorded in this report.
Mode: TX/ ZigBee
Lowest Frequency (2405MHz)
Environment: 25℃/46%RH/101.0kPa Voltage: DC 3V
Tested By:Wen wenwen Date: 2024-05-16

Suspected Data List										
NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	19025.1000	63.77	46.82	37.28	-16.95	74	36.72	100	307	Horizontal
2	19938.0000	62.15	45.61	36.07	-16.54	74	37.93	150	140	Horizontal
3	22372.8250	62.90	47.54	38.00	-15.36	74	36.00	100	78	Horizontal
4	24071.1250	63.92	49.68	40.14	-14.24	74	33.86	200	338	Horizontal
5	24272.5750	63.67	49.39	39.85	-14.28	74	34.15	150	174	Horizontal
6	26406.0750	65.56	51.63	42.09	-13.93	74	31.91	100	47	Horizontal

Suspected Data List										
NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18914.1750	63.09	45.99	36.45	-17.10	74	37.55	200	309	Vertical
2	19763.7500	62.34	45.43	35.89	-16.91	74	38.11	100	115	Vertical
3	22612.9500	63.90	48.74	39.20	-15.16	74	34.80	150	146	Vertical
4	24049.4500	64.45	49.89	40.35	-14.56	74	33.65	100	21	Vertical
5	25461.7250	64.50	50.44	40.90	-14.06	74	33.10	150	276	Vertical
6	25907.5500	64.48	50.13	40.59	-14.35	74	33.41	100	177	Vertical

Remark:

1 Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.

2 Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

3 Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.

4 Note: Above 18G test distance is 1m, so the Level for 3m= Level for 1m + 20*log(1/3). The pre measurement result margin is greater than 20dB, and final measurement is not required.

8. 6dB BANDWIDTH

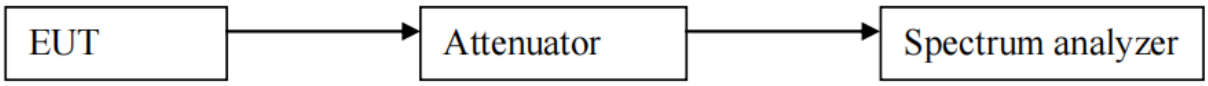
8.1 LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2 TEST PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer**.**
2) Set resolution bandwidth (RBW) = 100kHz.Set the video bandwidth (VBW) ≥ 3 x RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
3) Repeat above procedures until all frequencies measured were complete.

8.3 TEST SETUP



8.4 TEST RESULTS

Environment: 26.3℃/59%RH/101.0kPa Voltage: DC 3V

Tested By: Qin tingting Date: 2024-05-11

Channel	Frequency (MHz)	Bandwidth [kHz]	Limit[kHz]	Verdict
Lowest	2405	1340	>500	PASS
Middle	2440	1330		PASS
Highest	2480	1410		PASS

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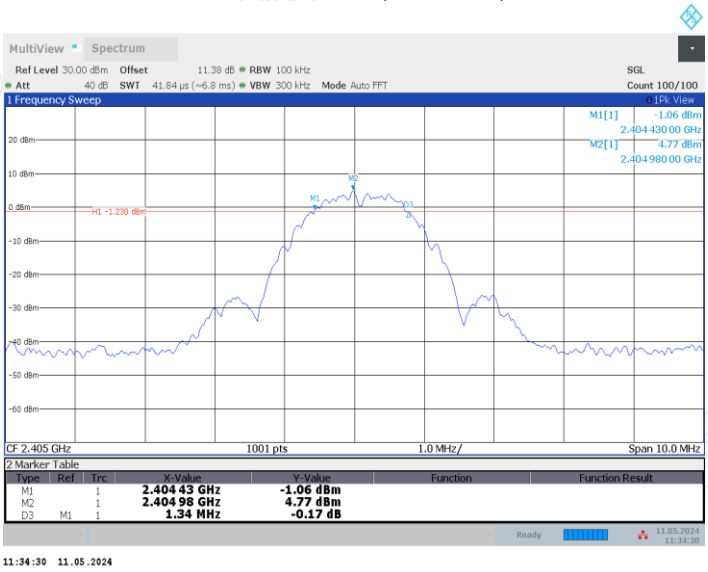
Lowest channel (2405MHz)



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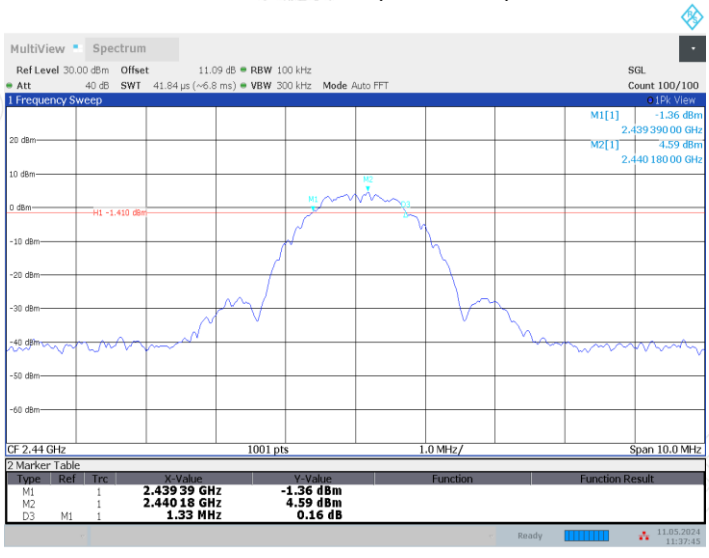
Middle channel (2440 MHz)



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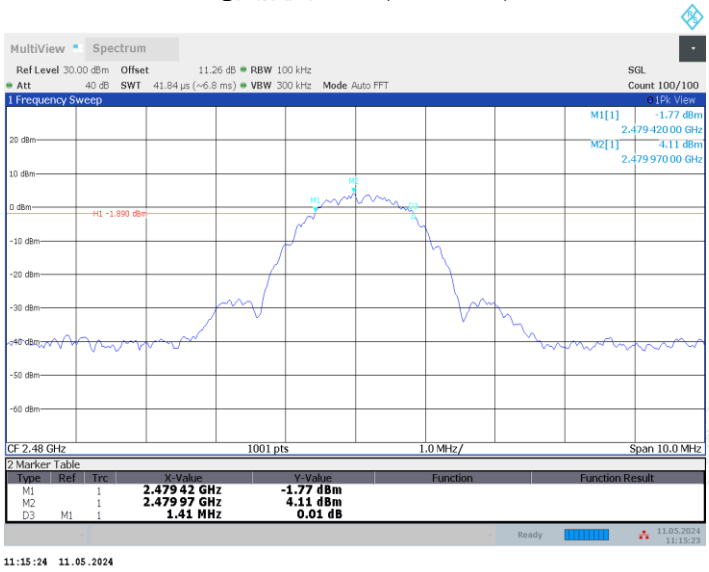
Highest channel (2480MHz)



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9. MAXIMUM OUTPUT POWER

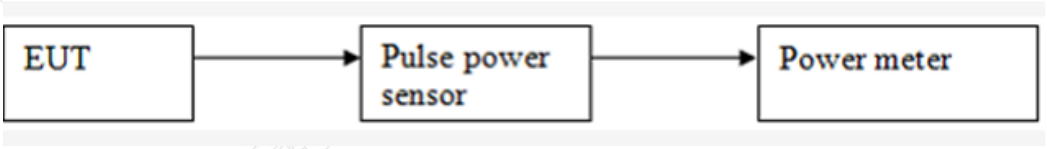
9.1 LIMITS

The maximum Peak output power measurement is 1W

9.2 TEST PROCEDURES

1) Place the EUT on a bench and set it in transmitting mode.
2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

9.3 TEST SETUP



9.4 TEST RESULTS

Environment: 26.3℃/59%RH/101.0kPa Voltage: DC 3V

Tested By: Qin tingting Date: 2024-05-11

Channel	Frequency (MHz)	Conducted maximum output power (dBm)	Limit	Peak/ Average	Result
Lowest	2405	8.34	1W (30dBm)	Peak	Pass
Middle	2440	8.41			Pass
Highest	2480	8.32			Pass

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10. POWER SPECTRAL DENSITY

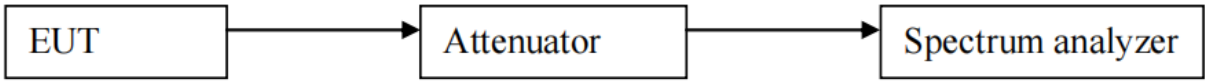
10.1 LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

10.2 TEST PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
2) Position the EUT was set 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.
3) Set the analyzer span to 1.5 times the DTS bandwidth. Set the RBW = 3 kHz. Set the VBW ≥3 RBW. Detector = peak. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW (use of a greater number of measurement points than this minimum requirement is recommended).
4) Repeat above procedures until all frequencies measured were complete.

10.3 TEST SETUP



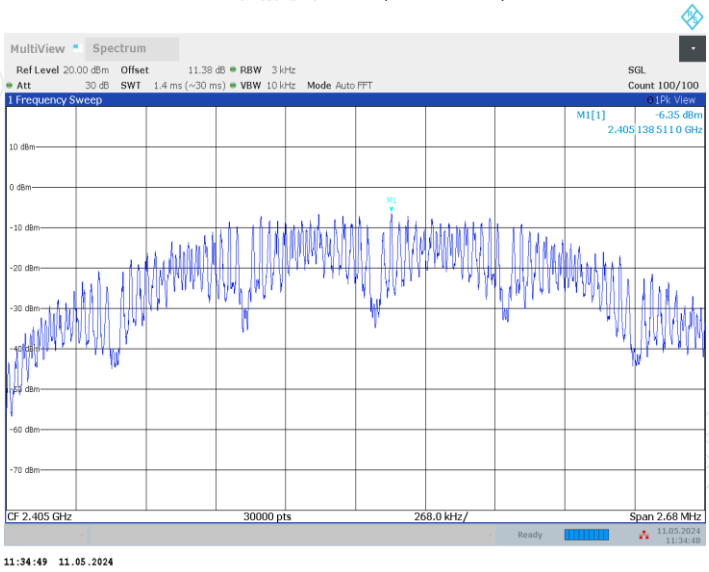
10.4 TEST RESULTS

Environment: 26.3℃/59%RH/101.0kPa Voltage: DC 3V

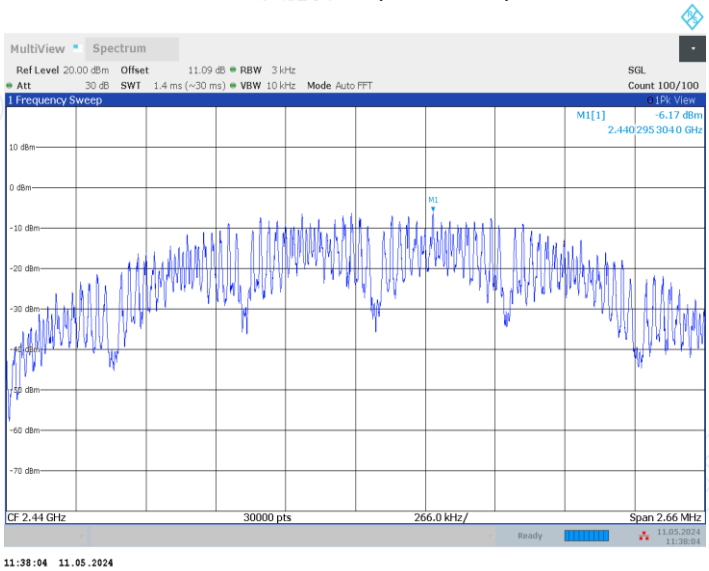
Tested By: Qin tingting Date: 2024-05-11

Channel No.	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest	2405	-6.35	8.00	Pass
Middle	2440	-6.17	8.00	Pass
Highest	2480	-5.71	8.00	Pass

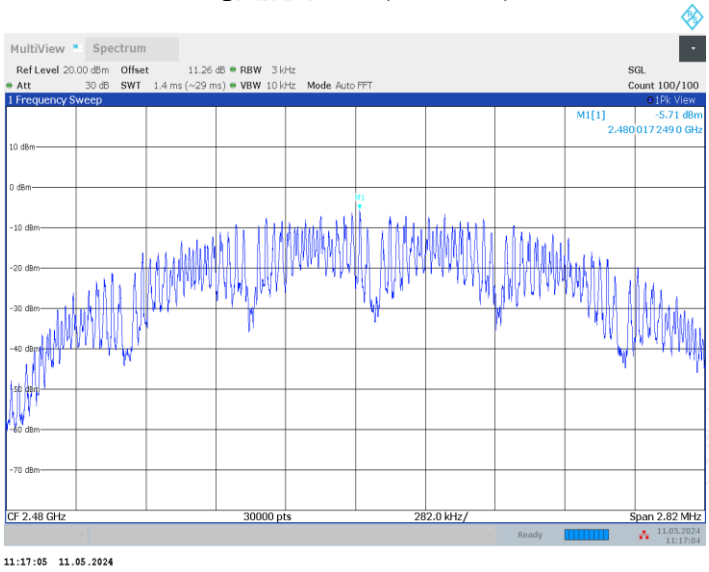
Lowest channel (2405MHz)



Middle channel (2440 MHz)



Highest channel (2480MHz)



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11. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

11.1 LIMITS

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

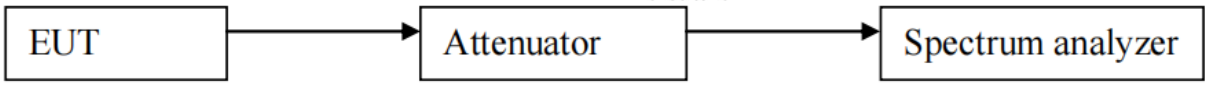
11.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance v05r02.

Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.

1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
2) Set the spectrum analyzer: RBW =100KHz; VBW =300KHz, Span = 10MHz to 26.5GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3) Measure and record the results in the test report.
4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
5) Measurements are made over the 9 kHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels. No emission found between lowest internal used/generated frequency to 10MHz，it is only recorded 10MHz to 26GHz.

11.3 TEST SETUP



11.4 TEST RESULTS

Environment: 26.3℃/59%RH/101.0kPa Voltage: DC 3V

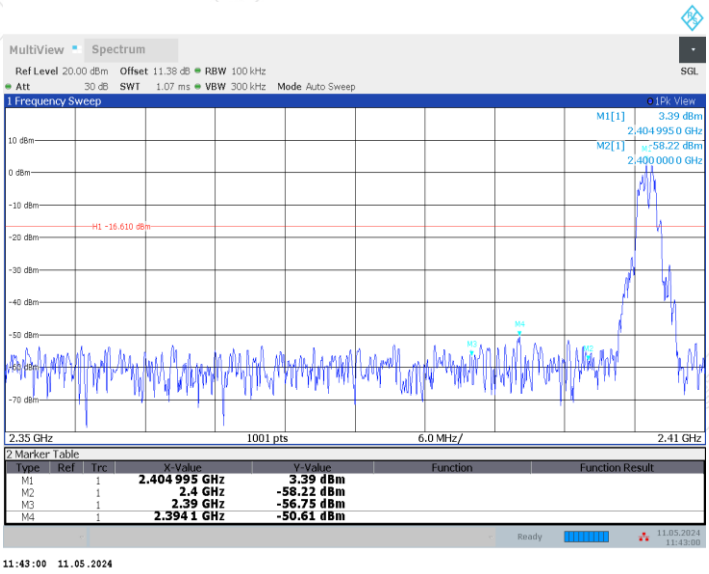
Tested By: Qin tingting Date: 2024-05-11

Band edge

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	Low	2405	3.39	-50.61	≤-16.61	PASS
		High	2480	2.78	-48.04	≤-17.22	PASS

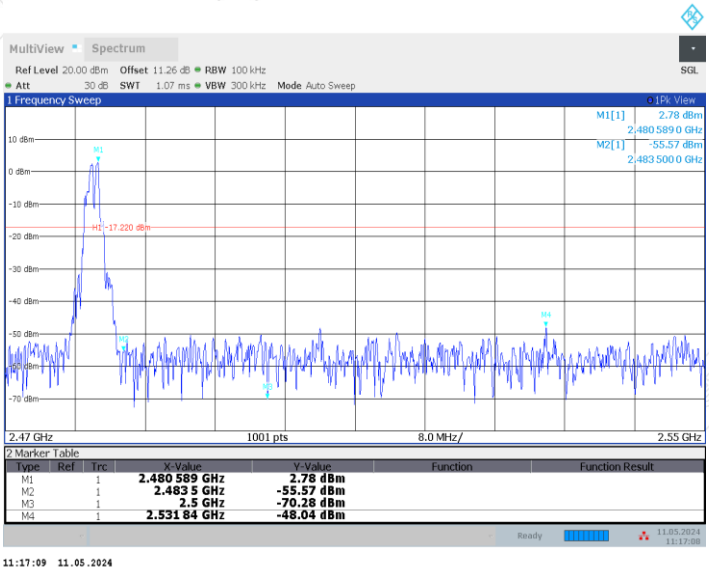
Lowest channel (2405MHz)

2.35GHz-2.405GHz



Highest channel (2480MHz)

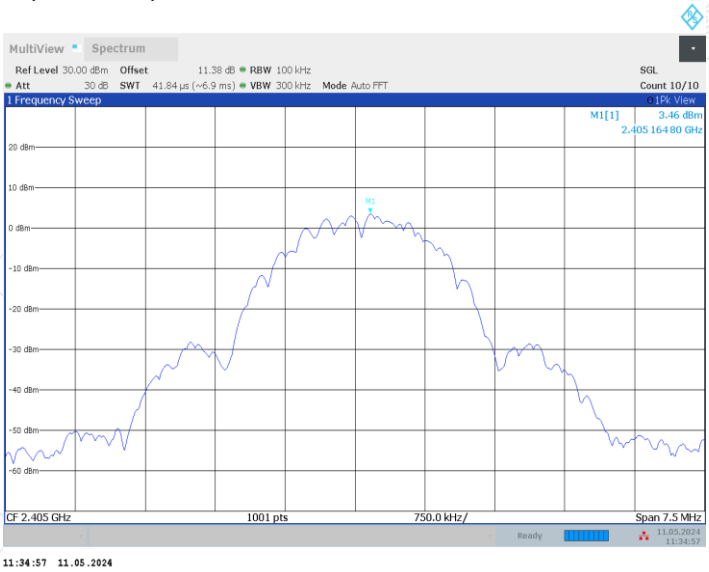
2.47GHz-2.55GHz



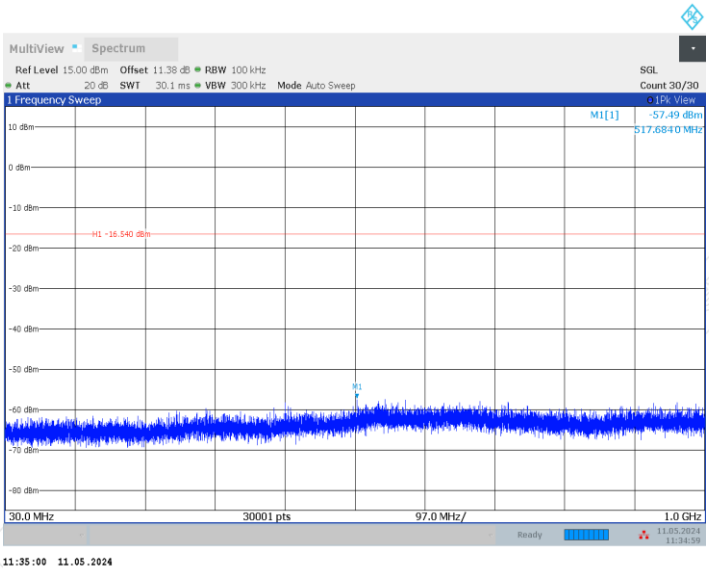
Conducted Spurious Emission

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	2405	Reference	3.46	3.46	---	PASS
			30~1000	3.46	-57.49	≤-16.54	PASS
			1000~26500	3.46	-43.24	≤-16.54	PASS
		2440	Reference	4.70	4.70	---	PASS
			30~1000	4.70	-58.16	≤-15.3	PASS
			1000~26500	4.70	-43.48	≤-15.3	PASS
		2480	Reference	4.27	4.27	---	PASS
			30~1000	4.27	-56.32	≤-15.73	PASS
			1000~26500	4.27	-42.32	≤-15.73	PASS

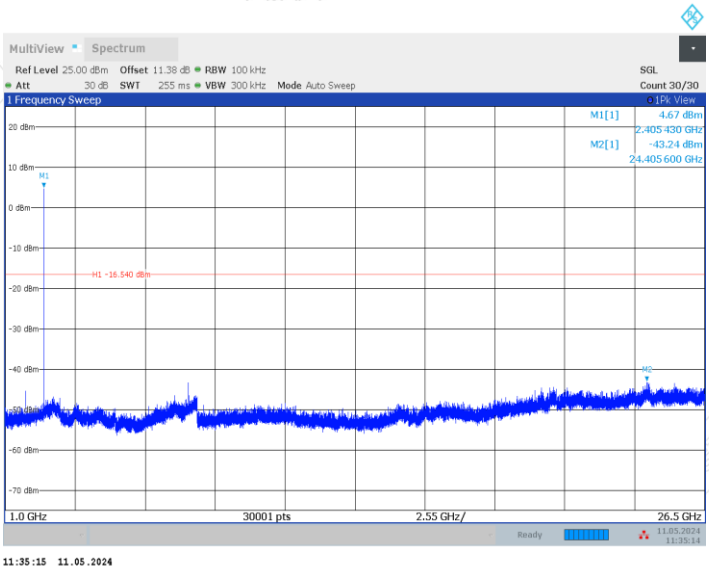
Lowest channel (2405MHz)



0.03GHz-1GHz



1GHz-26.5GHz



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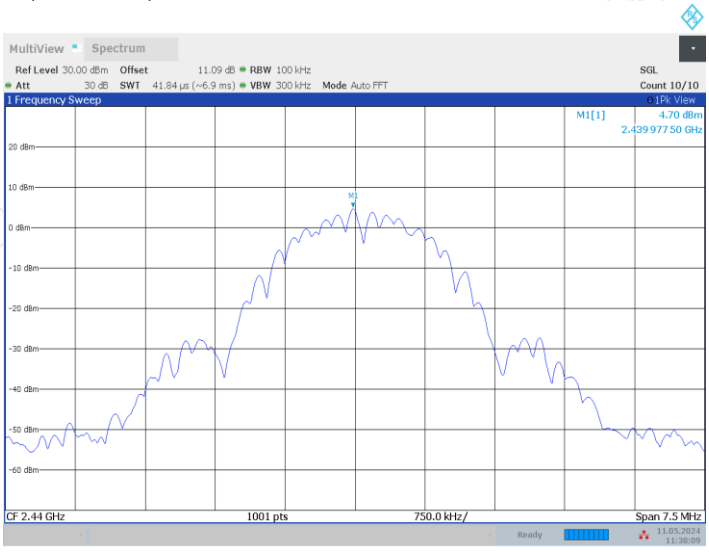
Middle channel (2440MHz)



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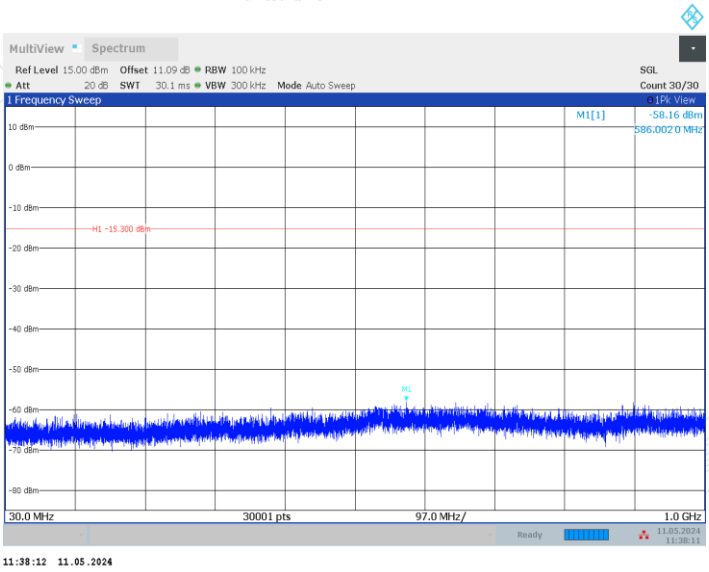
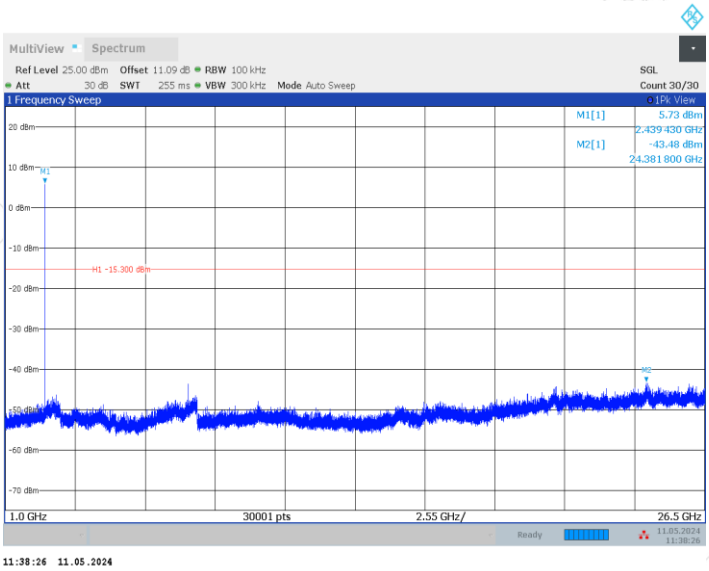
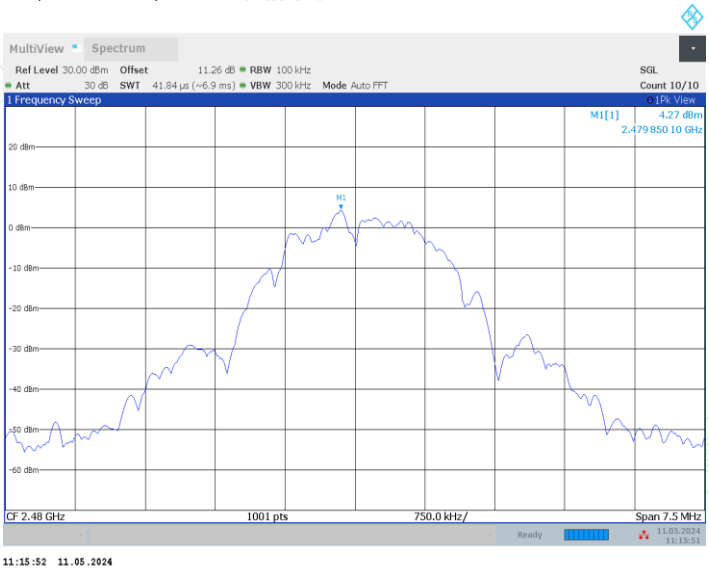
0.03GHz-1GHz



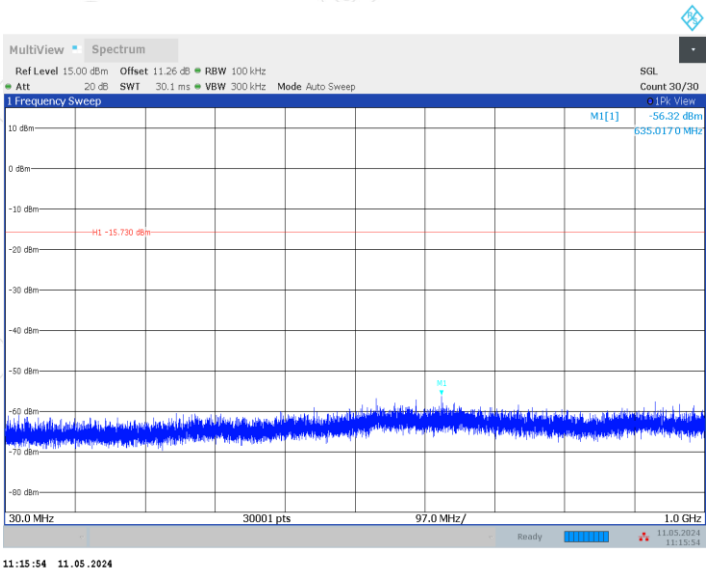
1GHz-26.5GHz



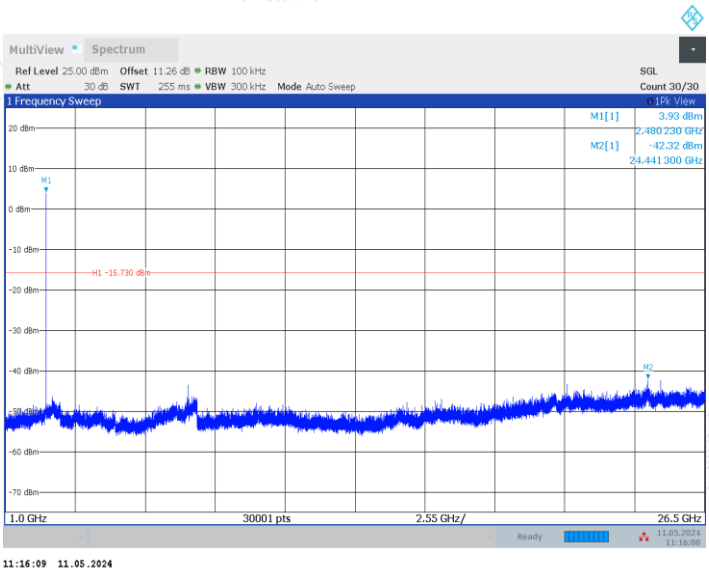
Highest channel (2480MHz)



0.03GHz-1GHz



1GHz-26.5GHz



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12. RESTRICTED BANDS OF OPERATION

12.1 LIMITS

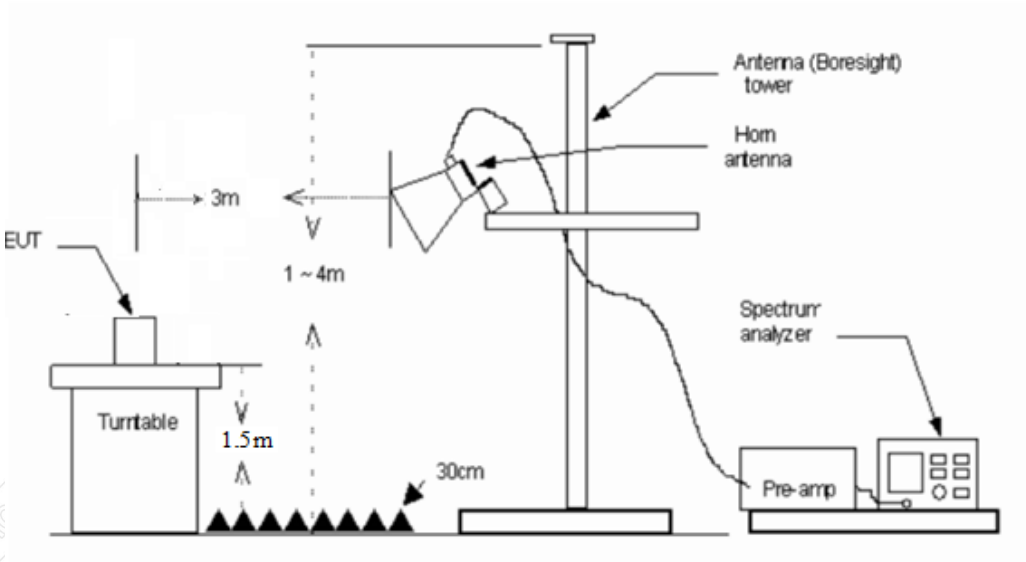
Section 15.247(d) In addition, Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			

12.2 TEST PROCEDURES

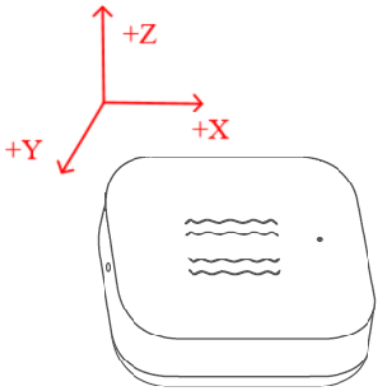
1) The EUT is placed on a turntable, which is 1.5m above the ground plane.
2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4) Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   a) PEAK: RBW=1MHz / VBW=1MHz / Sweep=AUTO
   b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO
5) Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

12.3 TEST SETUP



12.4 TEST RESULTS

The test are under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown the X position only.



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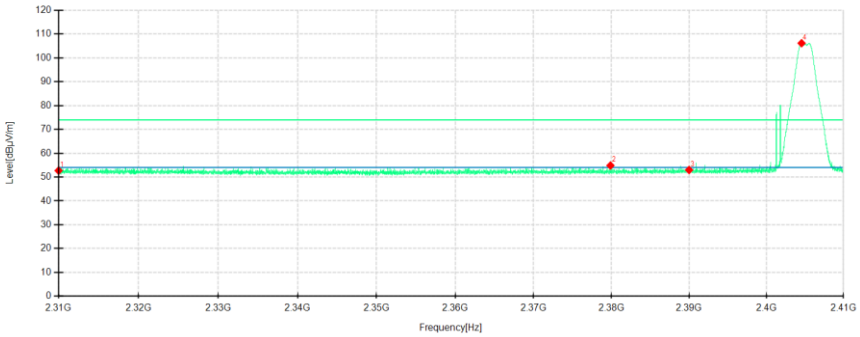
Environment: 25℃/46%RH/101.0kPa Voltage: DC 3V

Tested By: Wen wenwen Date: 2024-05-16

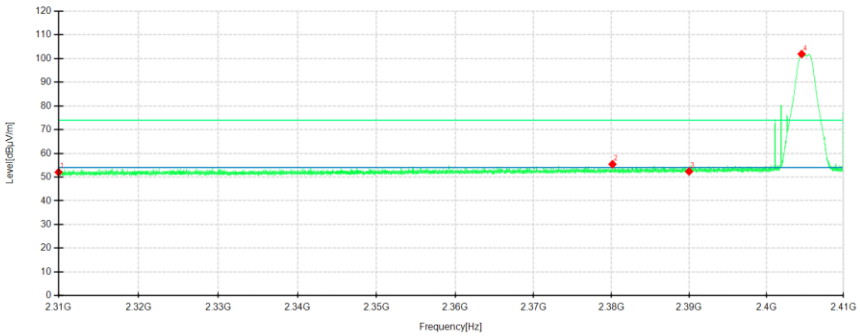
Lowest Channel

Channel 2405MHz

Detector mode: Peak Polarity: Horizontal

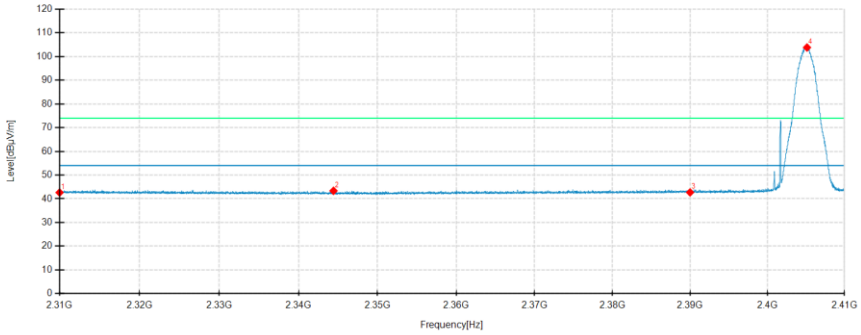


Detector mode: Peak Polarity: Vertical

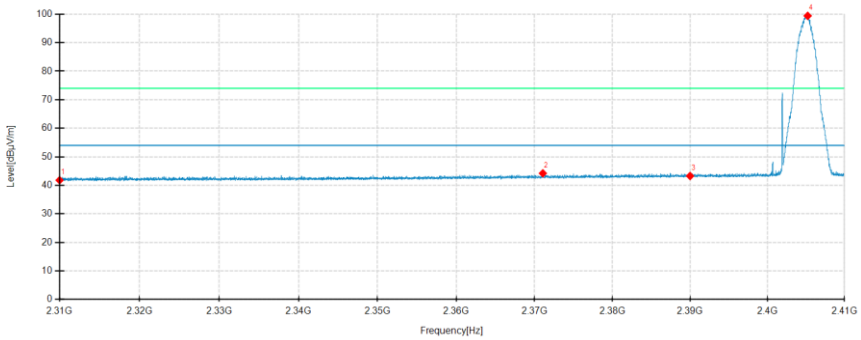


No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2310.0000	57.66	52.70	-4.96	74.00	21.30	100	151	Horizontal	/
2	2379.8750	60.64	54.85	-5.79	74.00	19.15	200	287	Horizontal	/
3	2390.0000	58.81	52.98	-5.83	74.00	21.02	200	156	Horizontal	
4	2404.5625	112.01	106.15	-5.86	---	---	100	309	Horizontal	N/A
1	2310.0000	57.72	52.06	-5.66	74.00	21.94	100	40	Vertical	/
2	2380.1375	60.87	55.42	-5.45	74.00	18.58	200	87	Vertical	/
3	2390.0000	57.77	52.36	-5.41	74.00	21.64	200	243	Vertical	/
4	2404.5750	107.24	101.89	-5.35	---	---	100	221	Vertical	N/A

Lowest Channel
Channel 2405MHz
Detector mode: Average Polarity: Horizontal

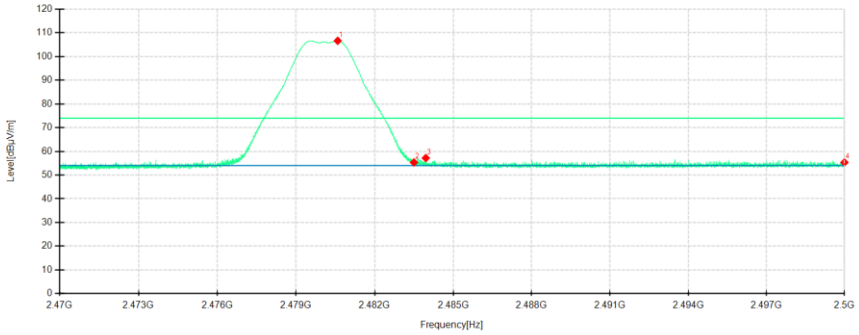


Detector mode: Average Polarity: Vertical

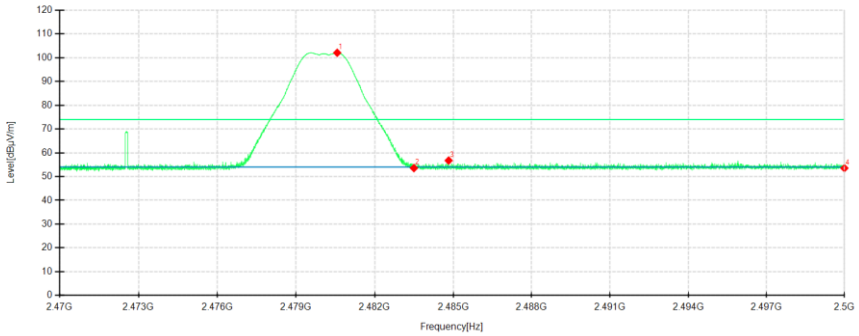


No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2310.0000	47.59	42.63	-4.96	54.00	11.37	200	300	Horizontal	/
2	2344.4250	48.93	43.36	-5.57	54.00	10.64	200	340	Horizontal	/
3	2390.0000	48.53	42.70	-5.83	54.00	11.30	200	326	Horizontal	/
4	2405.1375	109.65	103.79	-5.86	---	---	100	307	Horizontal	N/A
1	2310.0000	47.45	41.79	-5.66	54.00	12.21	100	117	Vertical	/
2	2371.0750	49.70	44.21	-5.49	54.00	9.79	100	338	Vertical	/
3	2390.0000	48.68	43.27	-5.41	54.00	10.73	100	326	Vertical	/
4	2405.2250	104.75	99.40	-5.35	---	---	100	235	Vertical	N/A

Highest Channel
Channel 2480MHz
Detector mode: Peak Polarity: Horizontal

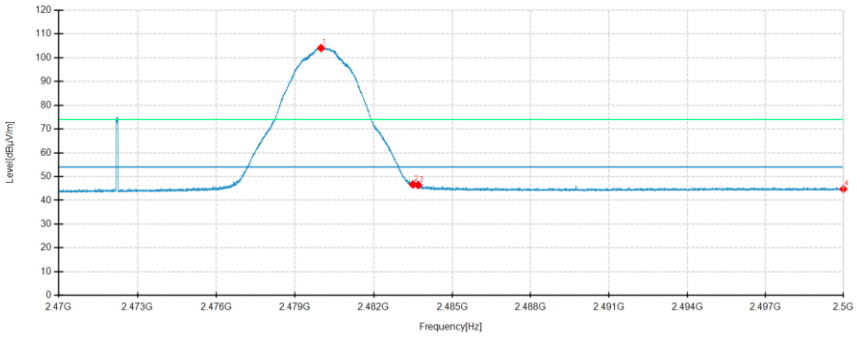


Detector mode: Peak Polarity: Vertical

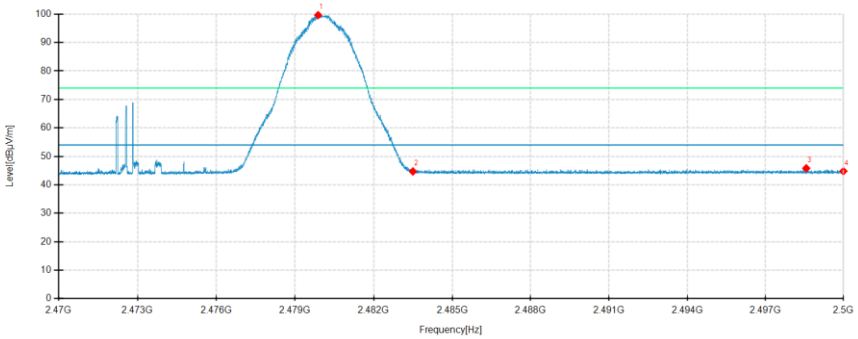


No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2480.5900	111.78	106.62	-5.16	---	---	100	308	Horizontal	N/A
2	2483.5000	60.43	55.33	-5.10	74.00	18.67	200	0	Horizontal	/
3	2483.9538	62.28	57.19	-5.09	74.00	16.81	100	308	Horizontal	/
4	2500.0000	60.13	55.34	-4.79	74.00	18.66	100	46	Horizontal	/
1	2480.5713	107.12	102.07	-5.05	---	---	100	235	Vertical	N/A
2	2483.5000	58.60	53.57	-5.03	74.00	20.43	200	235	Vertical	/
3	2484.8275	61.78	56.75	-5.03	74.00	17.25	200	48	Vertical	/
4	2500.0000	58.53	53.54	-4.99	74.00	20.46	200	247	Vertical	/

Highest Channel
Channel 2480MHz
Detector mode: Average Polarity: Horizontal



Detector mode: Average Polarity: Vertical



No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2479.9938	109.21	104.04	-5.17	---	---	100	308	Horizontal	N/A
2	2483.5000	51.77	46.67	-5.10	54.00	7.33	100	308	Horizontal	/
3	2483.7063	51.51	46.42	-5.09	54.00	7.58	100	308	Horizontal	/
4	2500.0000	49.53	44.74	-4.79	54.00	9.26	100	150	Horizontal	/
1	2479.8813	104.67	99.62	-5.05	---	---	100	235	Vertical	N/A
2	2483.5000	49.73	44.70	-5.03	54.00	9.30	100	235	Vertical	/
3	2498.5713	50.80	45.81	-4.99	54.00	8.19	200	177	Vertical	/
4	2500.0000	49.79	44.80	-4.99	54.00	9.20	100	157	Vertical	/

Remark: Max field strength in 3m distance. No any other emission which falls in restricted bands can be detected and be reported.

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E20240506136401-test setup photo-FCC+IC.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E20240506136401-EUT photo.

---------- End of Report ----------