FCC TEST REPORT

FOR

Dygma Lab SL

Raise 2 - Keyboard LEFT side

Test Model: R2 1.0

Additional Model No.: KS-L

Prepared for	:	Dygma Lab SL
Address	:	Calle Convento Jerusalen 53-3, Valencia, Spain
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	May 22, 2024
Number of tested samples	:	2
Sample No.	:	A05204149E-1, A05204149E-2
Sample number	:	Prototype
Date of Test	:	May 22, 2024 ~ June 04, 2024
Date of Report	:	June 04, 2024

FCC TEST REPORT

FCC CFR 47 PART 15 C (15.249)

Report Reference No.	**:**	**LCSA05204149EA**
Date of Issue.....	:	June 04, 2024
Testing Laboratory Name	**:**	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name	**:**	**Dygma Lab SL**
Address.....	:	Calle Convento Jerusalen 53-3, Valencia, Spain
Test Specification		
Standard	:	FCC CFR 47 PART 15 C(15.249) / ANSI C63.10: 2013
Test Report Form No.....	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

Shenzhen LCS Compliance Testing Laboratory Ltd. All rights reserved.
This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen LCS Compliance Testing Laboratory Ltd. is acknowledged as copyright owner and source of the material. Shenzhen LCS Compliance Testing Laboratory Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Test Item Description.	**:**	**Raise 2 - Keyboard LEFT side**
Trade Mark	:	DYGMA
Test Model	:	R2 1.0
Ratings.....	:	Input: DC 5V, 1000mA DC 3.7V by Rechargeable Li-ion Battery, 2370mAh
Result	**:**	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Jack Liu	Cary Luo	Gavin Liang
Jack Liu/ Administrator	Cary Luo/ Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : **LCSA05204149EA**	June 04, 2024 Date of issue

Test Model.....	: R2 1.0
EUT.....	: Raise 2 - Keyboard LEFT side
Applicant.....	**: Dygma Lab SL**
Address.....	: Calle Convento Jerusalen 53-3, Valencia, Spain
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen Poshton Technology Co.,Ltd**
Address.....	: 601, Block A, Building 2, Changxing Science and Technology Park, Shayi Community, SHAJING TOWN, Baoan District, Shenzhen, 518104, P.R.CHINA
Telephone.....	: /
Fax.....	: /
Factory.....	**: Shenzhen Poshton Technology Co.,Ltd**
Address.....	: 601, Block A, Building 2, Changxing Science and Technology Park, Shayi Community, SHAJING TOWN, Baoan District, Shenzhen, 518104, P.R.CHINA
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Report Version	Issue Date	Revision Content	Revised By
000	June 04, 2024	Initial Issue	--

TABLE OF CONTENTS

1. GENERAL INFORMATION 6
1.1 Description of Device (EUT) 6
1.2. Support Equipment List 7
1.3. External I/O 7
1.4. Description of Test Facility 7
1.5. Statement of the measurement uncertainty 7
1.6. Measurement Uncertainty 7
1.7. Description of Test Modes 8
2. TEST METHODOLOGY 9
2.1. EUT Configuration 9
2.2. EUT Exercise 9
2.3. General Test Procedures 9
3. CONNECTION DIAGRAM OF TEST SYSTEM 10
3.1. Justification 10
3.2. EUT Exercise Software 10
3.3. Special Accessories 10
3.4. Block Diagram/Schematics 10
3.5. Equipment Modifications 10
3.6. Test Setup 10
4. SUMMARY OF TEST RESULTS 11
5. ANTENNA REQUIREMENT 12
6. POWER LINE CONDUCTED EMISSIONS 13
7. RADIATED EMISSION MEASUREMENT 16
8. RESULTS FOR BAND EDGE TESTING 26
9. 20 DB BANDWIDTH MEASUREMENT 32
10. LIST OF MEASURING EQUIPMENT 34
11. TEST SETUP PHOTOGRAPHS OF THE EUT 35
12. EXTERIOR PHOTOGRAPHS OF THE EUT 35
13. INTERIOR PHOTOGRAPHS OF THE EUT 35

1. GENERAL INFORMATION

1.1 Description of Device (EUT)

EUT	:	Raise 2 - Keyboard LEFT side
Test Model	:	R2 1.0
Additional Model No.	:	KS-L
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	:	Input: DC 5V, 1000mA DC 3.7V by Rechargeable Li-ion Battery, 2370mAh
Hardware Version	:	/
Software Version	:	/
2.4G		
Frequency Range		2402MHz-2480MHz
Channel Number	:	79
Modulation Type	:	GFSK
Antenna Description	:	PCB Antenna, 1.0dBi(max.)

1.2. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Lenovo	ADAPTER for Notebook	ADP-90DD B	36001941	FCC
Lenovo	Notebook	B470	WB05067151	FCC

Note: Auxiliary equipment is provided by the laboratory.

1.3. External I/O

I/O Port Description	Quantity	Cable
Type-C USB Port	2	USB Cable: 1.5m, unshielded

1.4. Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

Test Firm Registration Number: 254912.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
		30MHz~200MHz	±2.96dB	(1)
		200MHz~1000MHz	±3.10dB	(1)
		1GHz~26.5GHz	±3.80dB	(1)
		26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)
Occupied Channel Bandwidth	:	1GHz-40GHz	±5%	(1)

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

1.7. Description of Test Modes

Operates in the unlicensed ISM Band at 2.4GHz. With basic data rate feature, the data rates can be up to 1 Mb/s by modulating the RF carrier using GFSK techniques. The EUT works in the X-axis, Y-axis, Z-axis. The following operating modes were applied for the related test items. All test modes were tested, only the result of the worst case was recorded in the report.

Mode of Operations	Frequency Range (MHz)	Data Rate (Mbps)
GFSK	2402	/
	2442	/
	2480	/
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case at AC 120V/60Hz.

AC conducted emission pre-test at power adapter and PC modes, recorded worst case at PC mode.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be TX.

Channel List:

Frequency Band	Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
2402~2480MHz	1	2402	40	2441
	2	2403	41	2442
	---	---	42	2443
	38	2439	---	---
	39	2440	79	2480

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10: 2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.249 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane.According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz and 1.5 m above ground plane above 1GHz.The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

3. CONNECTION DIAGRAM OF TEST SYSTEM

3.1. Justification

The system was configured for testing in a continuous transmit condition. Continuous transmitting was pre-programmed. It'll keep transmitting with modulated signal at the lowest channel by installing the batter. When press the "up" button, it'll move to the next channel. Repeat press "up" button, it'll transmitting at each of the channel used.

3.2. EUT Exercise Software

Press the corresponding button, and change the channel.

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C §15.249		
FCC Rules	**Description Of Test**	**Result**
§15.203	Antenna Requirement	Compliant
§15.207(a)	Power Line Conducted Emissions	Compliant
§15.205(a), §15.209(a), §15.249(a), §15.249(c)	Radiated Emissions Measurement	Compliant
§15.249 (d)	Band Edges Measurement	Compliant
§15.215(c)	20 dB Bandwidth	Compliant

Remark:
N/A - Not Applicable for this device!!!*

5. ANTENNA REQUIREMENT

5.1. Standard Applicable

According to § 15.203 and RSS-Gen, 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.

5.2. Antenna Connected Construction

The EUT use PCB Antenna and maximum antenna gain is 1.0dBi, antenna cannot replacement, meets FCC Part §15.203 antenna requirement. Please see EUT photo for details.

5.3. Results

Compliance

6. POWER LINE CONDUCTED EMISSIONS

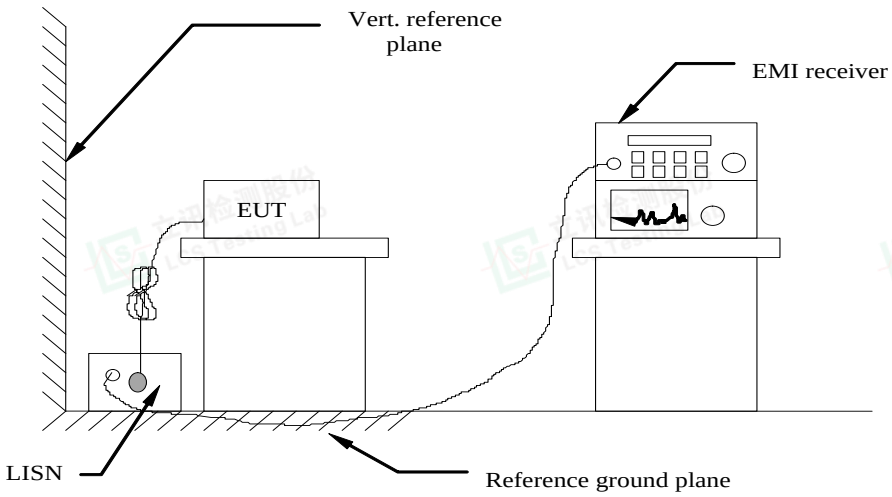
6.1. Standard Applicable

According to §15.207 (a) & RSS-Gen § 8.8: For an intentional radiator which 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 or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

6.2. Block Diagram of Test Setup



6.3. Test Results

The AC mains conducted disturbance is calculated by adding the 10dB Pulse Limiter and Cable Factor and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

CD (dBuV) = RA (dBuV) + PL (dB) + CL (dB)

Where CD = Conducted Disturbance	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	PL = 10 dB Pulse Limiter Factor

6.4. Test Results

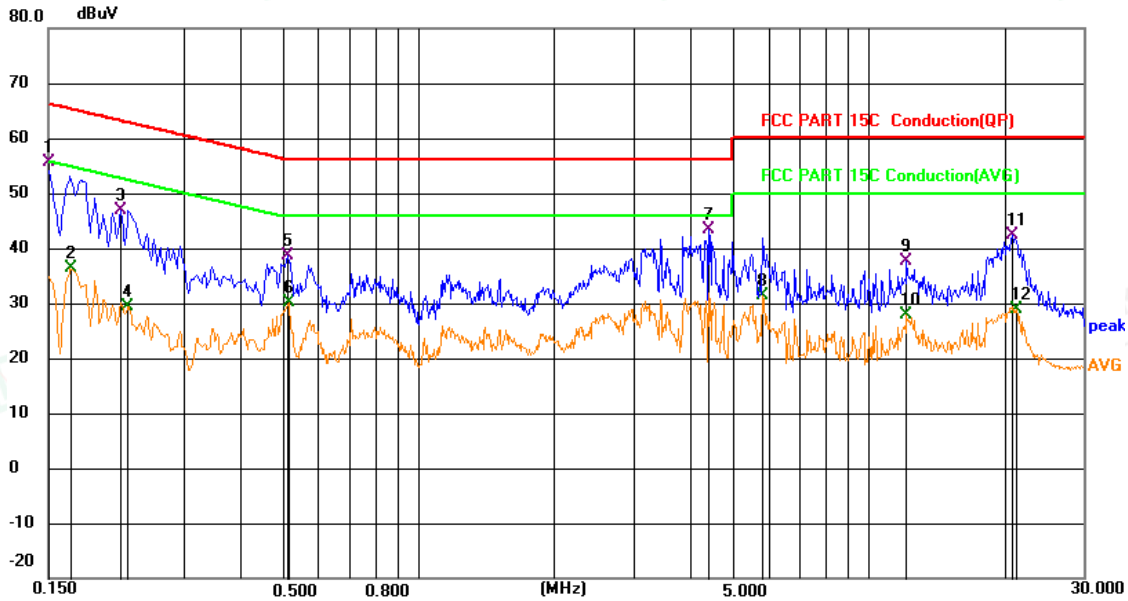
Temperature	24.4℃	Humidity	53.0%
Test Engineer	Paddi Chen	Configurations	2.4G

PASS.

The test data please refer to following page.

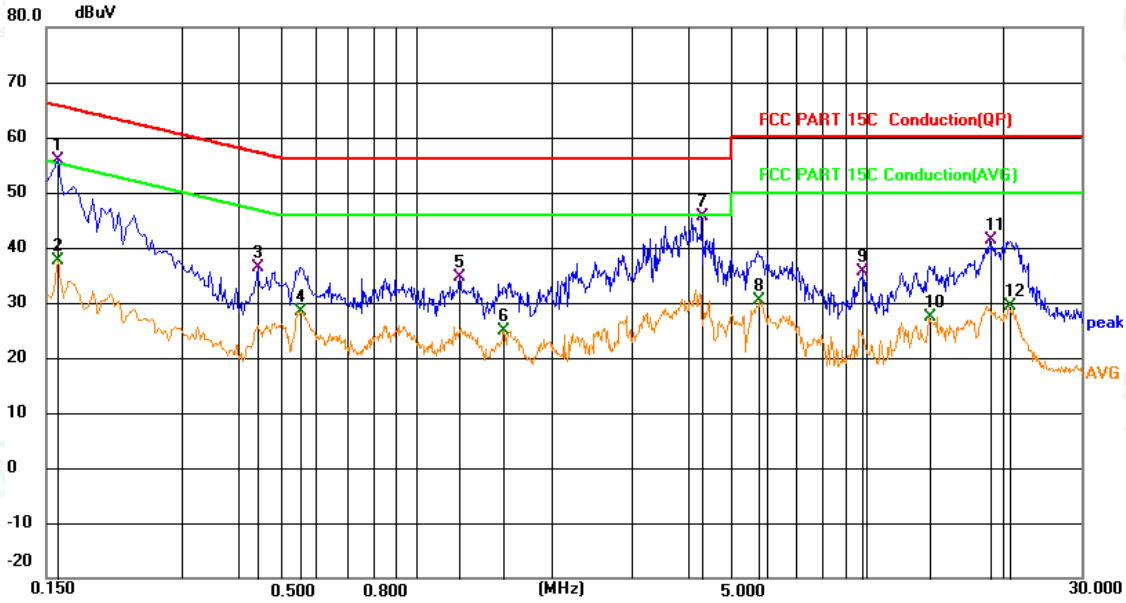
AC Conducted Emission @ AC 120V/60Hz (worst case)

Line



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1500	35.89	19.63	55.52	66.00	-10.48	QP
2		0.1681	16.69	19.63	36.32	55.05	-18.73	AVG
3		0.2176	27.25	19.63	46.88	62.91	-16.03	QP
4		0.2266	9.76	19.63	29.39	52.57	-23.18	AVG
5		0.5101	19.05	19.65	38.70	56.00	-17.30	QP
6		0.5146	10.46	19.65	30.11	46.00	-15.89	AVG
7		4.4206	23.69	19.70	43.39	56.00	-12.61	QP
8		5.8201	11.65	19.70	31.35	50.00	-18.65	AVG
9		12.1606	17.70	19.84	37.54	60.00	-22.46	QP
10		12.1606	8.10	19.84	27.94	50.00	-22.06	AVG
11		20.8186	22.32	20.16	42.48	60.00	-17.52	QP
12		21.2911	8.80	20.13	28.93	50.00	-21.07	AVG

Neutral



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1590	36.23	19.63	55.86	65.52	-9.66	QP
2		0.1590	17.97	19.63	37.60	55.52	-17.92	AVG
3		0.4426	16.78	19.64	36.42	57.01	-20.59	QP
4		0.5505	8.77	19.65	28.42	46.00	-17.58	AVG
5		1.2435	14.99	19.66	34.65	56.00	-21.35	QP
6		1.5585	5.24	19.67	24.91	46.00	-21.09	AVG
7		4.3081	25.76	19.80	45.56	56.00	-10.44	QP
8		5.8021	10.62	19.80	30.42	50.00	-19.58	AVG
9		9.8251	15.87	19.85	35.72	60.00	-24.28	QP
10		13.8256	7.53	19.84	27.37	50.00	-22.63	AVG
11		18.7306	21.31	20.17	41.48	60.00	-18.52	QP
12		20.7736	9.22	20.16	29.38	50.00	-20.62	AVG

****Note: 1).Pre-scan all modes and recorded the worst case results in this report 2.4G mode (High Channel)*

2). Measurement = Reading + Correct Factor, Margin = Measurement – Limit, Correct Factor=Lisn Factor+Cable Factor+Insertion loss of Pulse Limiter.

7. RADIATED EMISSION MEASUREMENT

7.1. Standard Applicable

According to FCC § 15.249: Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) and 15.249 limit in the table below has to be followed.

Fundamental Frequency	Field Strength of fundamental (millivolts/meter)	Field Strength of harmonics (microvolts/meter)
902-928MHz	50	500
2400-2483.5MHz	50	500
5725-5875MHz	50	500
24.0-24.25GHz	250	2500

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

According to RSS-210 B.10:

The field strength of fundamental and harmonic emissions, measured at 3 m, shall not exceed 50 mV/m and 0.5 mV/m respectively.

The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

7.2. Instruments Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

7.3. Test Procedure

1) Sequence of testing 9 kHz to 30 MHz

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 0.8 m 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 normal operation 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.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 1.0 meter.

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

Final measurement:

--- Identified emissions during the premeasurement 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 QPK 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 premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

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 0.8 m 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 normal operation 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.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 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 premeasurement the software maximize the peaks by changing turntable position (± 45°) 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 premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

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 normal operation 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.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 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 premeasurement the software maximize the peaks by changing turntable position (± 45°) 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 premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

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 normal operation 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.

Premeasurement:

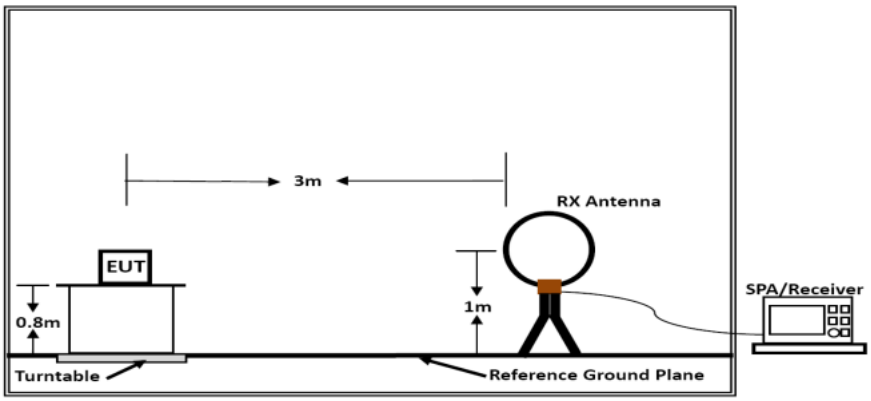
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

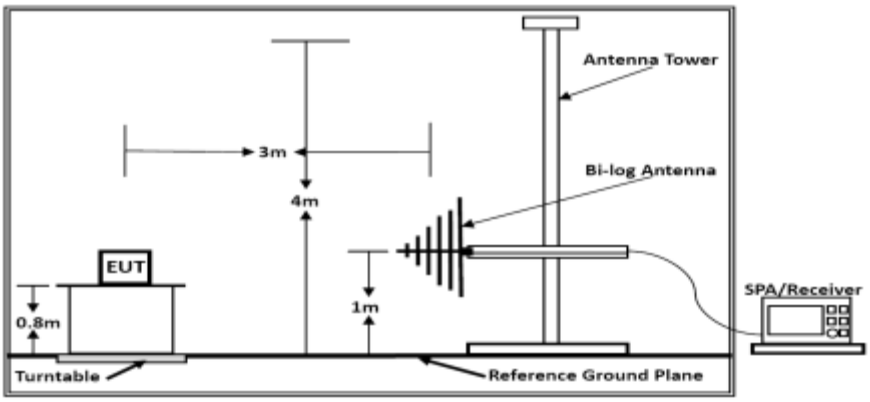
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

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

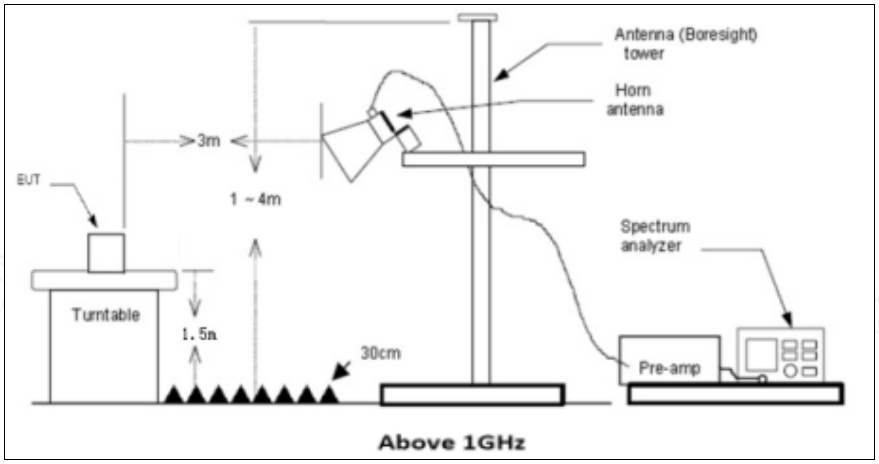
7.4. Block Diagram of Test Setup



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

7.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

7.6. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS (dBuV/m) = RA (dBuV) + AF (dB/m) + CL (dB) – AG (dB)

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

7.7. Test Results of Radiated Emissions (9 KHz~30 MHz)

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen		

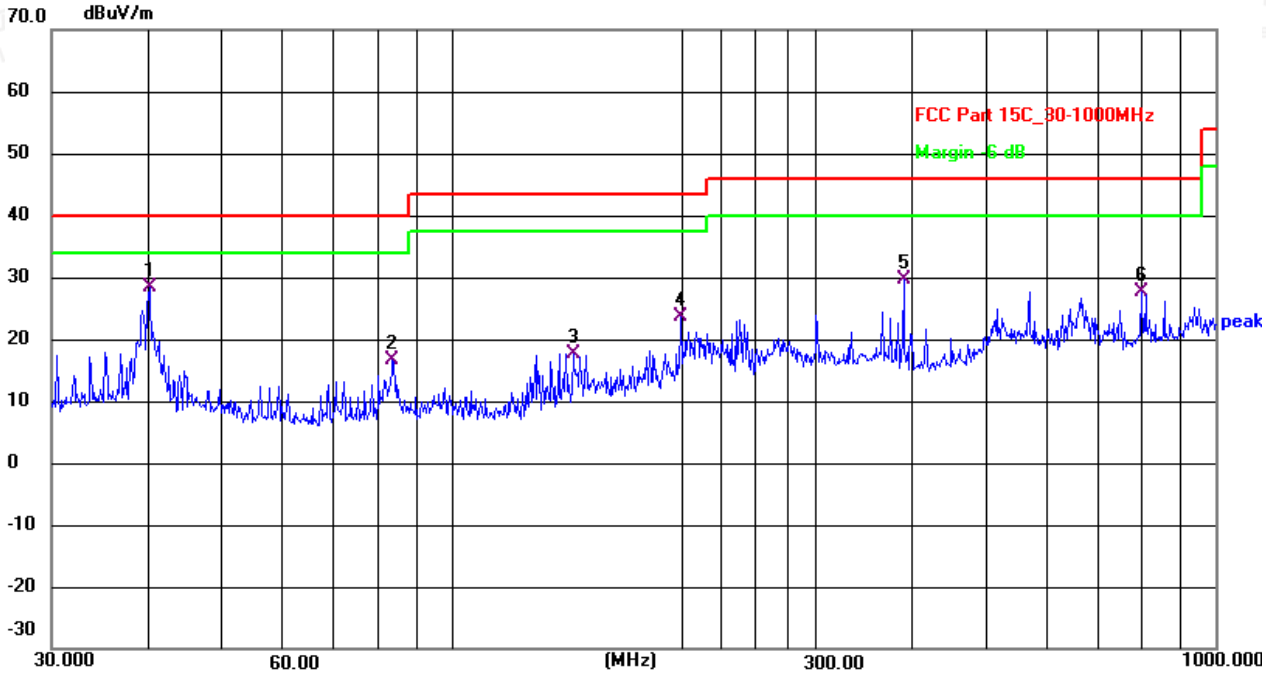
Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:
The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

7.8. Test Results of Radiated Emissions (30 MHz – 1000 MHz)

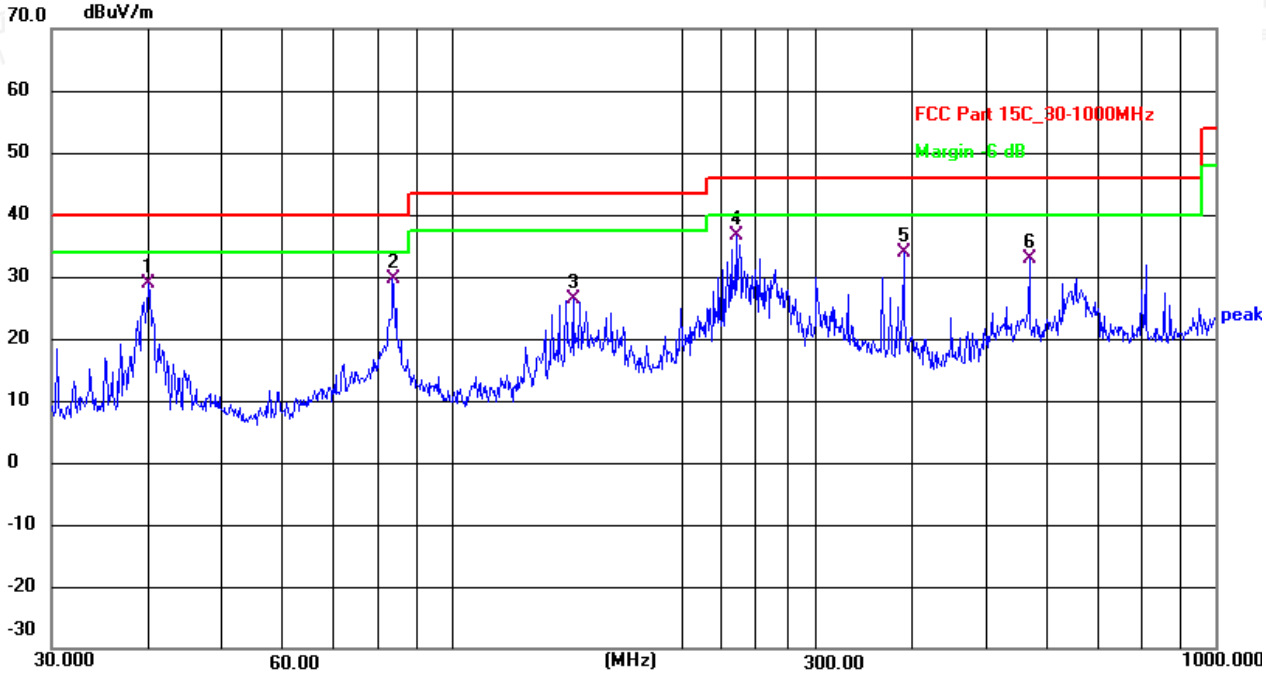
Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen		

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	40.2756	45.83	-17.51	28.32	40.00	-11.68	QP
2	83.8155	36.07	-19.50	16.57	40.00	-23.43	QP
3	144.3347	38.16	-20.43	17.73	43.50	-25.77	QP
4	199.9855	41.09	-17.39	23.70	43.50	-19.80	QP
5	390.7225	44.13	-14.54	29.59	46.00	-16.41	QP
6	798.9797	37.57	-9.96	27.61	46.00	-18.39	QP

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	40.1347	46.41	-17.52	28.89	40.00	-11.11	QP
2	83.8156	49.09	-19.50	29.59	40.00	-10.41	QP
3	144.3348	46.73	-20.43	26.30	43.50	-17.20	QP
4	235.8164	52.76	-16.25	36.51	46.00	-9.49	QP
5	390.7226	48.53	-14.53	34.00	46.00	-12.00	QP
6	570.6100	43.92	-11.03	32.89	46.00	-13.11	QP

Note:
1). Pre-scan all modes and recorded the worst case results in this report (GFSK-2480MHz).
2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
3). Level = Reading + Factor, Margin = Level – Limit,
Factor = Antenna Factor + Cable Loss - Preamp Factor

7.8. Results for Radiated Emissions (1 – 26 GHz)

Field Strength of Fundamental (TX-2402 MHz)					
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2402	H	86.72	114	94	Pass
2402	V	86.60	114	94	Pass

Channel 1 / 2402 MHz

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measure d dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4804.00	53.78	33.06	35.04	3.94	55.74	74.00	-18.26	Peak	Horizontal
4804.00	43.61	33.06	35.04	3.94	45.57	54.00	-8.43	Average	Horizontal
4804.00	57.81	33.06	35.04	3.94	59.77	74.00	-14.23	Peak	Vertical
4804.00	44.44	33.06	35.04	3.94	46.40	54.00	-7.60	Average	Vertical

Field Strength of Fundamental (TX-2442 MHz)					
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2442	H	82.93	114	94	Pass
2442	V	83.29	114	94	Pass

Channel 41/ 2442 MHz

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4884.00	54.50	33.16	35.15	3.96	56.47	74.00	-17.53	Peak	Horizontal
4884.00	43.36	33.16	35.15	3.96	45.33	54.00	-8.67	Average	Horizontal
4884.00	61.65	33.16	35.15	3.96	63.62	74.00	-10.38	Peak	Vertical
4884.00	45.19	33.16	35.15	3.96	47.16	54.00	-6.84	Average	Vertical

Field Strength of Fundamental (TX-2480 MHz)					
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2480	H	89.60	114	94	Pass
2480	V	87.79	114	94	Pass

Channel 79/ 2480 MHz

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4960.00	60.84	33.26	35.14	3.98	62.94	74.00	-11.06	Peak	Horizontal
4960.00	44.24	33.26	35.14	3.98	46.34	54.00	-7.66	Average	Horizontal
4960.00	53.62	33.26	35.14	3.98	55.72	74.00	-18.28	Peak	Vertical
4960.00	43.76	33.26	35.14	3.98	45.86	54.00	-8.14	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz - 10th harmonic (ex. 26GHz), at least have 20dB margin found between lowest internal used/generated frequency to 30 MHz.

2). Radiated emissions measured in frequency range from 9 KHz - 10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.

3). 18~25 GHz at least have 20dB margin. No recording in the test report.

4). Measured Level = Reading Level + Factor, Margin = Measured Level – Limit, Factor = Antenna Factor + Cable Loss - Preamp Factor

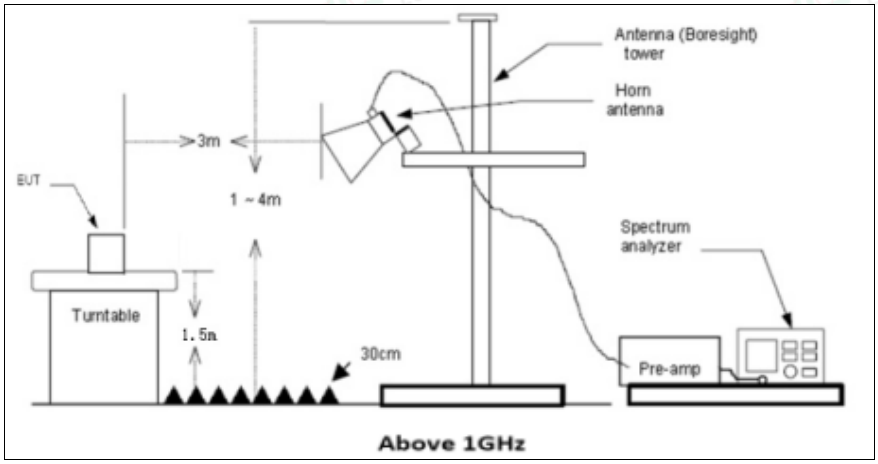
8. RESULTS FOR BAND EDGE TESTING

8.1. Standard Applicable

According to FCC §15.249 (d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to RSS-210 B.10 (b): Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

8.2. Test Setup Layout



8.3. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

8.4. Test Procedures

3) Sequence of testing 1 GHz to 18 GHz

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 normal operation 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.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 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 premeasurement the software maximize the peaks by changing turntable position (± 45°) 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 premeasurement with marked maximum final measurements and the limit will be stored.

8.5. Measuring Instruments and Setting

Temperature	23.5℃	Humidity	52.1%
Test Engineer	Paddi Chen		

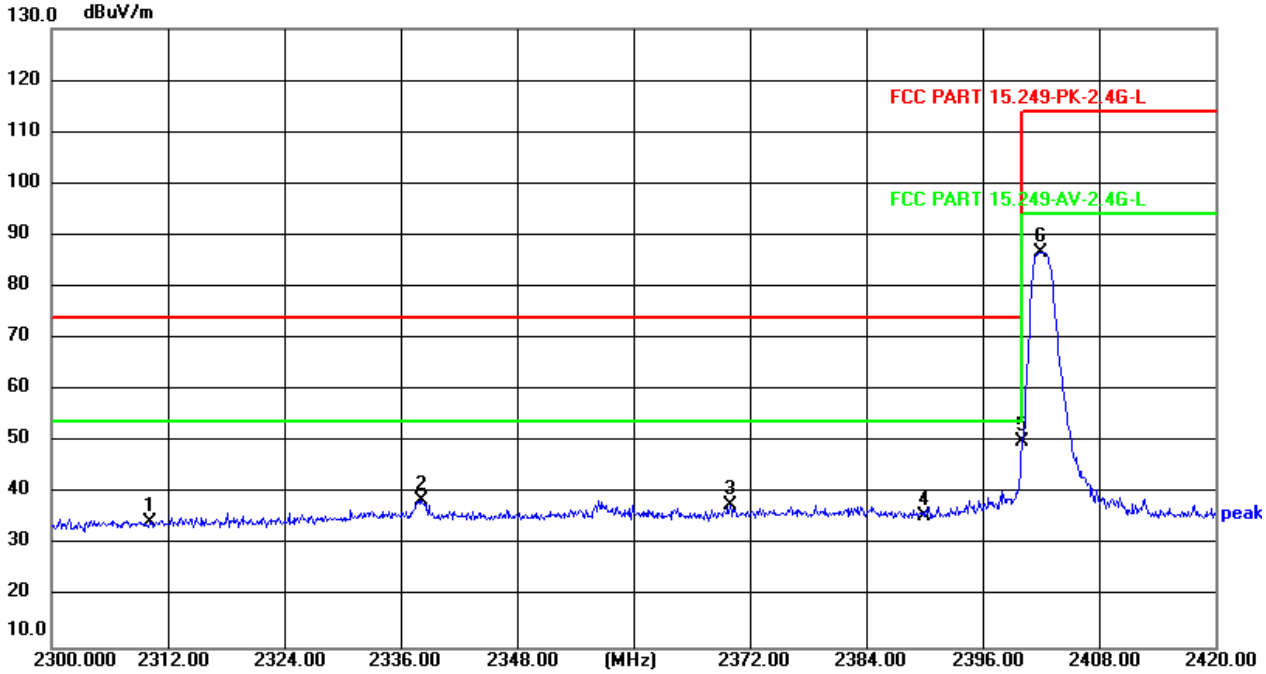
PASS

Remark:

1. *The other emission levels were very low against the limit.*
2. *The average measurement was not performed when the peak measured data under the limit of average detection.*
3. *Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330Hz/Sweep time=Auto/Detector=Peak;*
4. *Please refer to following test plots;*

Channel 1 / 2402 MHz

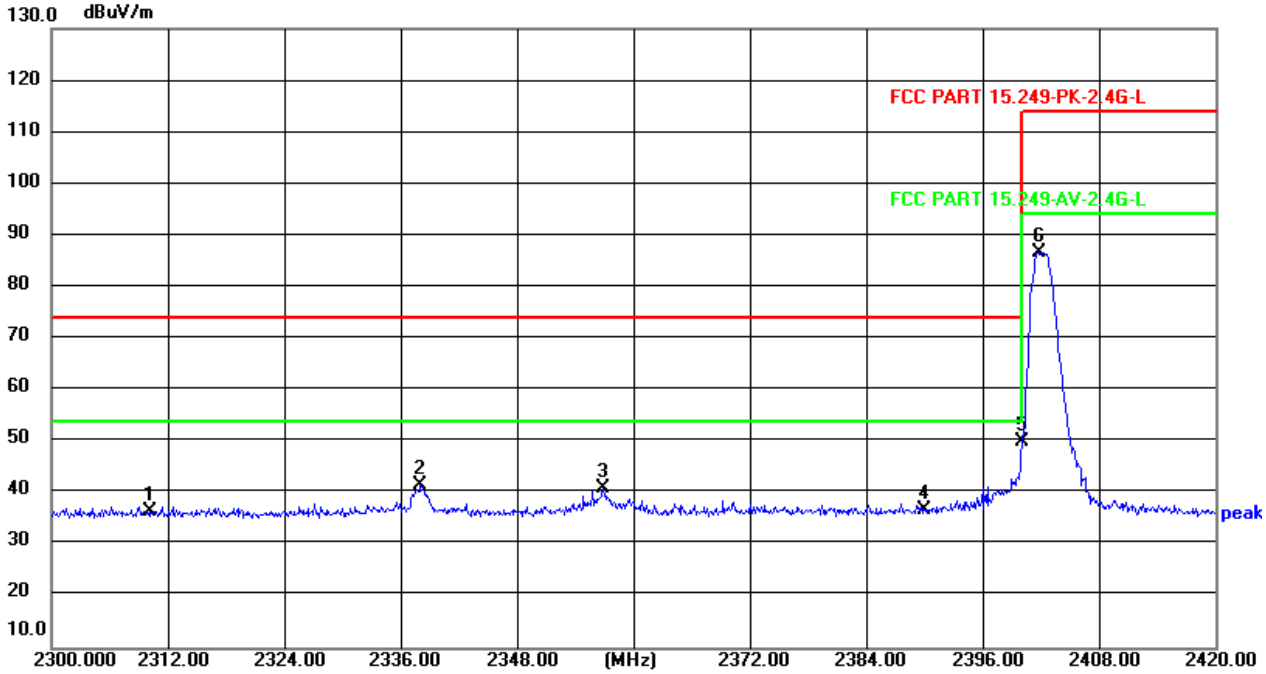
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2310.000	46.33	-12.02	34.31	74.00	-39.69	peak
2	2338.160	50.63	-11.91	38.72	74.00	-35.28	peak
3	2369.960	49.69	-11.80	37.89	74.00	-36.11	peak
4	2390.000	47.51	-11.73	35.78	74.00	-38.22	peak
5	2400.000	61.61	-11.70	49.91	74.00	-24.09	peak
6	2402.000	98.42	-11.70	86.72	114.00	-27.28	peak

Channel 1 / 2402 MHz

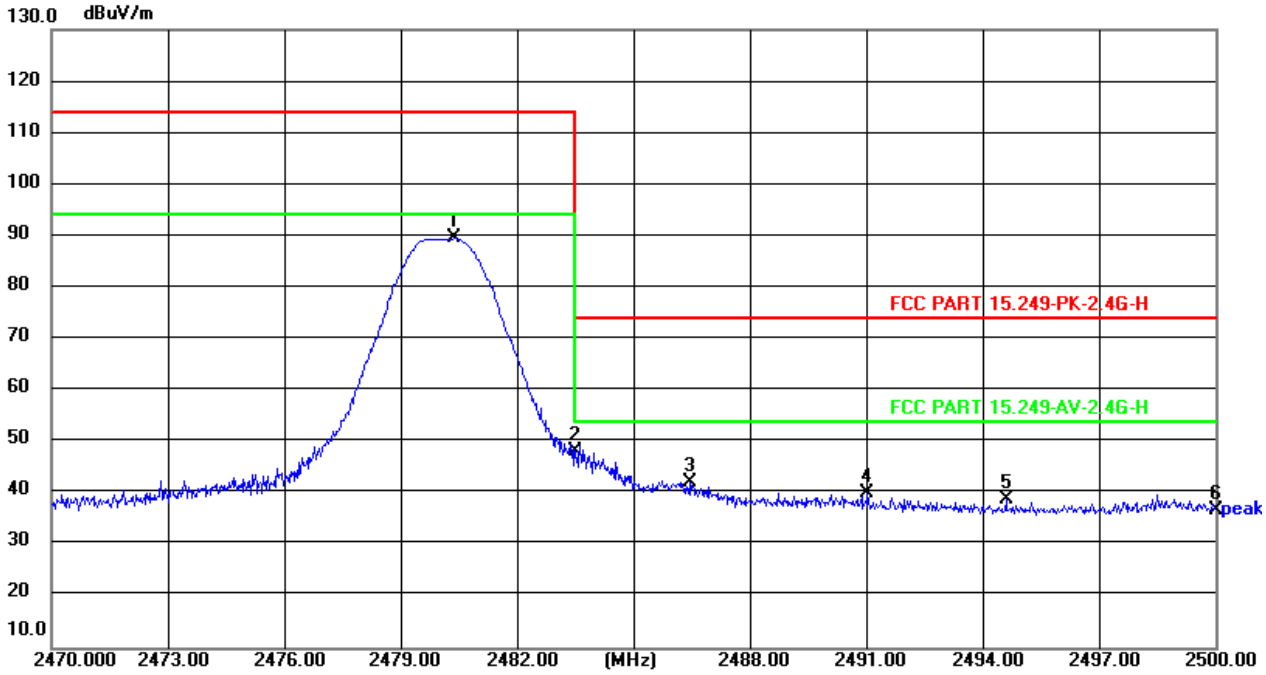
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2310.000	48.45	-12.02	36.43	74.00	-37.57	peak
2	2338.040	53.60	-11.91	41.69	74.00	-32.31	peak
3	2356.880	52.84	-11.84	41.00	74.00	-33.00	peak
4	2390.000	48.72	-11.73	36.99	74.00	-37.01	peak
5	2400.000	61.80	-11.70	50.10	74.00	-23.90	peak
6	2401.760	98.30	-11.70	86.60	114.00	-27.40	peak

Channel 79/ 2480 MHz

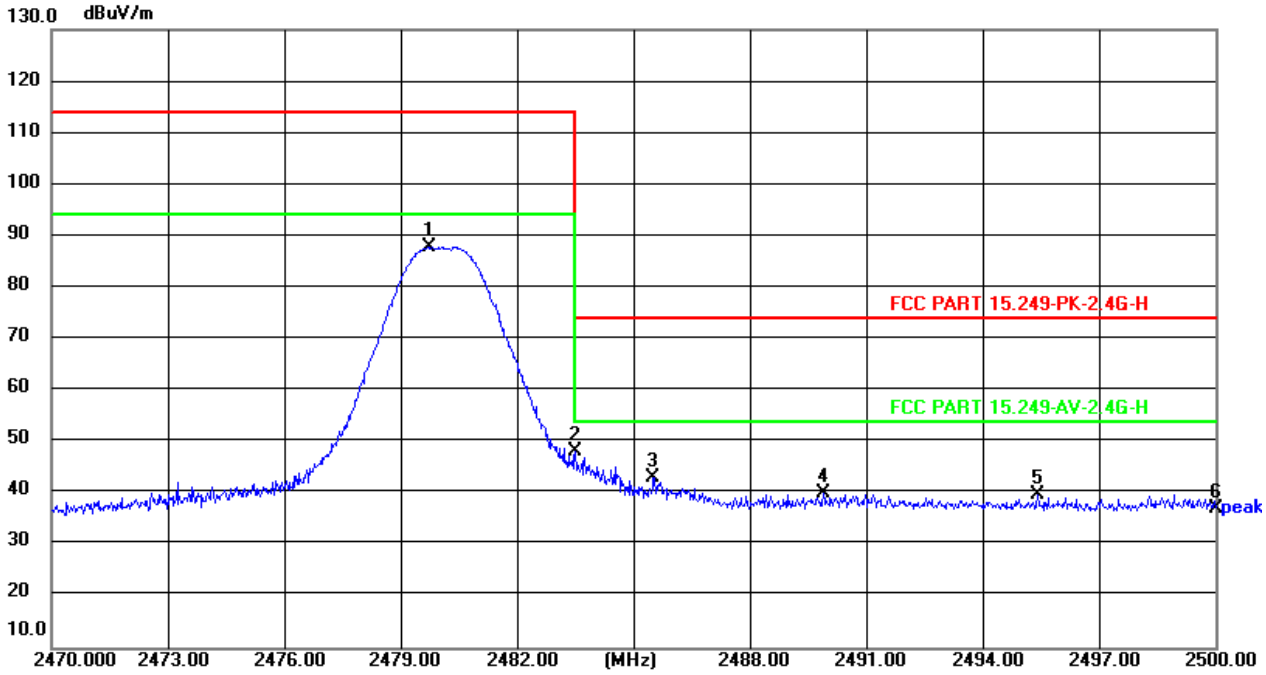
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2480.380	101.02	-11.42	89.60	114.00	-24.40	peak
2	2483.500	59.74	-11.40	48.34	74.00	-25.66	peak
3	2486.440	53.65	-11.39	42.26	74.00	-31.74	peak
4	2491.030	51.44	-11.37	40.07	74.00	-33.93	peak
5	2494.600	50.24	-11.36	38.88	74.00	-35.12	peak
6	2500.000	48.24	-11.34	36.90	74.00	-37.10	peak

Channel 79/ 2480 MHz

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2479.750	99.21	-11.42	87.79	114.00	-26.21	peak
2	2483.500	59.50	-11.40	48.10	74.00	-25.90	peak
3	2485.510	54.60	-11.40	43.20	74.00	-30.80	peak
4	2489.890	51.62	-11.38	40.24	74.00	-33.76	peak
5	2495.410	51.26	-11.36	39.90	74.00	-34.10	peak
6	2500.000	48.55	-11.34	37.21	74.00	-36.79	peak

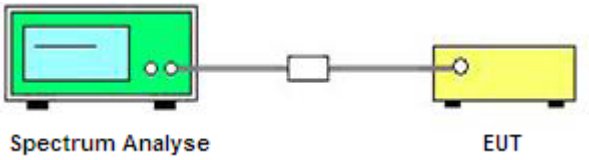
Note: Due to the measure PK emission level less than the AV limit value. No necessary to take down the AV emission level.

9. 20 DB BANDWIDTH MEASUREMENT

9.1. Standard Applicable

§15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

9.2. Block Diagram of Test Setup



9.3. Test Procedure

Use the following spectrum analyzer settings:

Span = 3MHz

RBW = 30 KHz

VBW = 100 KHz

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

9.4. Test Results

Temperature	23.5℃	Humidity	52.1%
Test Engineer	Paddi Chen		

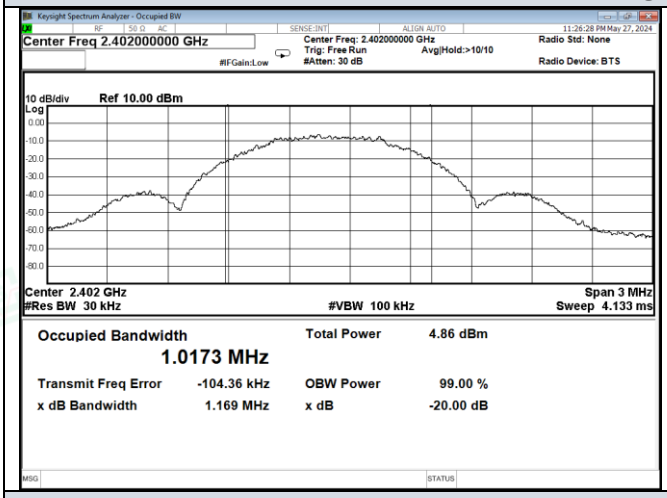
Test Result of 20dB Bandwidth Measurement		
Test Frequency (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
2402	1.169	Non-Specified
2442	1.180	Non-Specified
2480	1.182	Non-Specified

Remark:

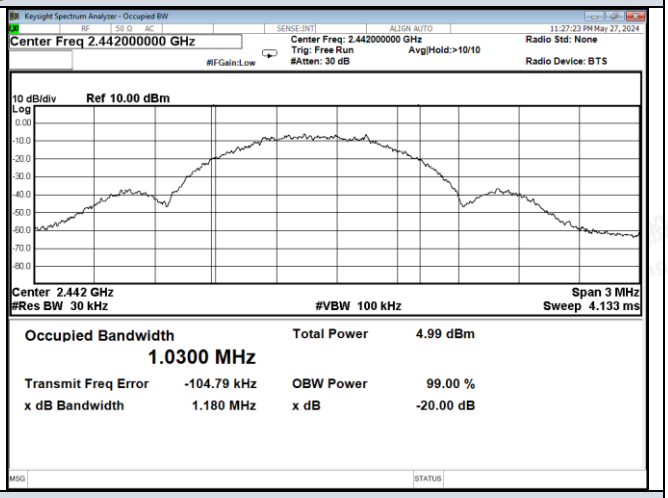
1. *Test results including cable loss;*
2. *Please refer following test plots;*

20dB Bandwidth

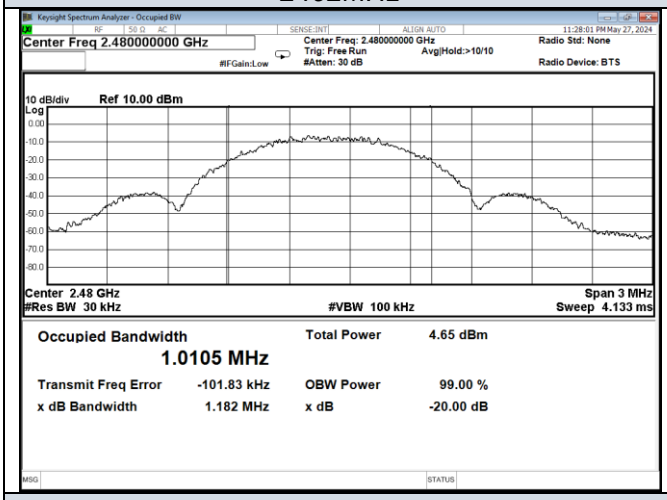
GFSK



2402MHz



2442MHz



2480MHz

10. LIST OF MEASURING EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2023-10-18	2024-10-17
2	DC Power Supply	Agilent	E3642A	N/A	2023-10-18	2024-10-17
3	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2023-10-05	2024-10-04
4	EMI Test Software	AUDIX	E3	/	N/A	N/A
5	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2023-06-09	2024-06-08
6	Positioning Controller	Max-Full	MF7802BS	MF780208586	N/A	N/A
7	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2021-08-29	2024-08-28
8	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2021-09-12	2024-09-11
9	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2021-09-05	2024-09-04
10	EMI Test Receiver	R&S	ESR 7	101181	2023-08-15	2024-08-14
11	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2023-07-17	2024-07-16
12	Low-frequency amplifier	SchwarzZBECK	BBV9745	00253	2023-10-18	2024-10-17
13	High-frequency amplifier	JS Denki Pte	PA0118-43	JSPA21009	2023-10-18	2024-10-17
14	EMI Test Receiver	R&S	ESPI	101940	2023-08-15	2024-08-14
15	Artificial Mains	R&S	ENV216	101288	2023-06-09	2024-06-08
16	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2023-06-09	2024-06-08
17	EMI Test Software	Farad	EZ	/	N/A	N/A
18	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2021-08-29	2024-08-28
19	Broadband Preamplifier	SCHWARZBECK	BBV9719	9719-025	2023-06-16	2024-06-15
20	Antenna Mast	Max-Full	MFA-515BSN	1308572	N/A	N/A
21	Pulse Limiter	R&S	ESH3-Z2	102750-NB	2023-08-15	2024-08-14

11. TEST SETUP PHOTOGRAPHS OF THE EUT

Please refer to separated files for Test Setup Photos of the EUT.

12. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

13. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

----------THE END OF REPORT----------