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# FCC&IC TEST REPORT

Report No.....: AB25060001FW01  
FCC ID.....: **2BQHD-DGEN1**  
IC ID.....: **34121-DGEN1**  
Applicant.....: Freedom Factory Inc  
Address.....: 4 Peddlers Row 295, Newark, Delaware 19702 USA  
Manufacturer.....: Freedom Factory Inc  
Address.....: 4 Peddlers Row 295, Newark, Delaware 19702 USA  
Product Name.....: dGEN1  
Trade Mark.....: Freedom Factory  
Test Model.....: dGEN1  
Additional Model(s).....: /  
Standard.....: FCC 47 CFR Part 15 Subpart C (Part 15.247)  
RSS-Gen Issue 5  
RSS-247 Issue 3  
Date of Receipt.....: 2025.04.15  
Date of Test Date.....: 2025.04.15-2025.06.19  
Date of Issue.....: 2025.07.07  
Test Result.....: Pass

Compiled by:  
(Printed Name + Signature)      Huaijie Li

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Approved by:  
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Testing Laboratory Name.....: Aibo Standard Technology (Shenzhen) Co., Ltd.

Address.....: 101, Building B, Tuori New Energy Industrial Park, High-tech Park,  
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## FCC&IC TEST REPORT

<b>Test Report No.:</b> AB25060001FW01	<u>2025.07.07</u> Date of issue
--	------------------------------------

EUT.....	: dGEN1
Test Model.....	: dGEN1
<b>Applicant.....</b>	<b>: Freedom Factory Inc</b>
Address.....	: 4 Peddlers Row 295, Newark, Delaware 19702 USA
Telephone.....	: +1(726)842-5475
Fax.....	: /
<b>Manufacturer.....</b>	<b>: Freedom Factory Inc</b>
Address.....	: 4 Peddlers Row 295, Newark, Delaware 19702 USA
Telephone.....	: +1(726)842-5475
Fax.....	: /

<b>Test Result</b>	<b>Positive</b>
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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.

**REPORT VERSION**

Version No.	Issue Date	Description
01	2025.07.07	Initial Issue

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# 1. GENERAL INFORMATION

## 1.1. GENERAL DESCRIPTION OF EUT

Product Name:	dGEN1	
Trade Mark:	Freedom Factory	
Test Model:	dGEN1	
Additional Model(s):	/	
Model Difference:	/	
Hardware Version:	S891_MB_V2	
Software Version:	/	
Power Supply:	DC 3.87V by battery(4500mAh) or DC 5V 1A from AC/DC adapter	
EUT Supports Function: (Provided by the customer)	2.4GHz ISM Bands:	Bluetooth V5. 2
Test Sample(s) Number:	AB25060001-01 (Engineer Sample) AB25060001-02 (Normal Sample)	
Radio Specification Subject to this Report		
Bluetooth Version:	Bluetooth BDR + EDR	
Frequency Range:	2402MHz~2480MHz	
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK	
Channel Spacing:	1MHz	
Channel Number(s):	79	
Antenna Type:	PIFA Antenna	
Antenna Gain:	-0.53dBi(Max.)	

**1.2. DESCRIPTION OF SUPPORT EQUIPMENT**

Description	Manufacturer	Model	Serial Number	Supplied by
AC/DC Adapter	Xiaomi	MDY-11-EX	SA62212LA04358J	Applicant

**1.3. DESCRIPTION OF EXTERNAL I/O**

I/O Port Description	Quantity	Cable
USB Type-C Interface	1	0.8m, unshielded
Earphone Jack	1	N/A

#### 1.4. GENERAL DESCRIPTION OF APPLIED STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#) - Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2013](#) - American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

[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.

[RSS-Gen Issue 5](#)-General Requirements for Compliance of Radio Apparatus

[RSS-247 Issue 3](#)-Digital Transmission Systems (DTSs),Frequency Hopping Systems (FHSs)and Licence-Exempt Local Area Network(LE-LAN) Devices

#### 1.5. DESCRIPTION OF TEST FACILITY

**Test Lab:** Aibo Standard Technology (Shenzhen) Co., Ltd.

**Address:** 101, Building B, Tuori New Energy Industrial Park, High-tech Park, Tianliao Community, Yutang Street, Guangming District, Shenzhen City, Guangdong Province, China

Tel.: +(86) 0755 85250797

E-mail: Aibonorm@aibonorm.com

Website: www.Aibonorm.com

The test facility is recognized, certified, or accredited by the following organizations:

**A2LA-Lab Certificate No.: 7514.01**

Aibo Standard Technology (Shenzhen) Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**FCC Accredited Lab.**

Designation Number: CN1411

Test Firm Registration Number: 567066

**ISED Wireless Device Testing Laboratories**

CAB identifier: CN0185



## 1.6. MEASUREMENT UNCERTAINTY

The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Items	Measurement Uncertainty
Power Line Conducted Emission (9kHz~150kHz)	±3.62dB
Power Line Conducted Emission (150kHz~30MHz)	±3.38dB
Radiated Emission (9kHz~30MHz)	±3.10dB
Radiated Emission (30MHz~1GHz)	±4.90dB
Radiated Emission (1GHz~18GHz)	±3.88dB
Radiated Emission (8GHz~40GHz)	±5.32dB
RF Conducted Power	±0.57dB
Conducted Spurious Emissions	±1.60dB
RF Frequency	±6.0 x 10 <sup>-7</sup>

Note: All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

## 1.7. ENVIRONMENTAL CONDITIONS

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

Normal Temperature:	+15°C ~ +35°C
Relative Humidity	20 % ~ 75 %
Air Pressure	98KPa ~ 101KPa

## 1.8. DESCRIPTION OF TEST MODES

Operation Frequency List	
Channel Number	Frequency (MHz)
<b>00</b>	<b>2402</b>
01	2403
⋮	⋮
38	2440
<b>39</b>	<b>2441</b>
40	2442
⋮	⋮
77	2479
<b>78</b>	<b>2480</b>

For portable device, radiated emission was verified over X, Y, Z Axis, and shown the worst case in this report. The following operating modes were applied for the related test items. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data packets and antenna ports (if EUT with antenna diversity architecture), only the result of the worst case was recorded in the report.

List of Test Modes	
Test Mode(s)	Description
TM1	Keep the EUT works in continuously transmitting mode (non-hopping) with GFSK Modulation
TM2	Keep the EUT works in continuously transmitting mode (non-hopping) with $\pi/4$ DQPSK Modulation
TM3	Keep the EUT works in continuously transmitting mode (non-hopping) with 8DPSK Modulation
TM4	Keep the EUT works in continuously transmitting mode (hopping) with GFSK Modulation
TM5	Keep the EUT works in continuously transmitting mode (hopping) with $\pi/4$ DQPSK Modulation
TM6	Keep the EUT works in continuously transmitting mode (hopping) with 8DPSK Modulation

### Power setting during the test:

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software Version	#*#*3646633#*#*		
Frequency	2402MHz	2441MHz	2480MHz
RF Power Parameter(s)	Default	Default	Default

## 2. SUMMARY OF TEST RESULT

Test Cases			
FCC&IC Rule	Description of Test Item(s)	Result	Test Engineer
Part 15.203	Antenna Requirement	Pass	Jacey Fu
Part 15.247(b)(1) RSS-247 5.4(b)	Maximum Peak Conducted Output Power	Pass	Jacey Fu
Part 15.247(a)(1) RSS-247 5.1(a) RSS-Gen 6.7	20dB Bandwidth & Occupied Bandwidth	Pass	Jacey Fu
Part 15.247(a)(1) RSS-247 5.1(b)	Carrier Frequencies Separation	Pass	Jacey Fu
Part 15.247(a)(1)(iii) RSS-247 5.1(d)	Number of Hopping Channel	Pass	Jacey Fu
Part 15.247(a)(1)(iii) RSS-247 5.1(d)	Time Of Occupancy (Dwell Time)	Pass	Jacey Fu
Part 15.247(d) RSS-Gen 8.9, 8.10 RSS-247 5.5	Conducted Spurious Emissions and Conducted Band Edges Measurement	Pass	Jacey Fu
Part 15.205, 15.209, 15.247(d) RSS-Gen 8.9, 8.10 RSS-247 5.5	Radiated Emissions and Radiated Band Edges Measurement	Pass	Jacey Fu
Part 15.207 RSS-Gen 8.8	Power Line Conducted Emissions	Pass	Jacey Fu

### 3. MEASUREMENT INSTRUMENTS LIST

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Until
1	Loop Antenna	Schwarzbeck	FMZB 1519	1519-025	02/19/2025	02/18/2026
2	Power Amplifier	HZEMC	HPA-9K0133	HYP A23029	02/19/2025	02/18/2026
3	Broadband Antenna	Schwarzbeck	VULB 9168	01763	02/19/2025	02/18/2026
4	Attenuator	PRM	ATT50-6-3	ATT50-6-3	01/20/2025	01/19/2026
5	Spectrum Analyzer	R&S	FSV40-N	101365	01/20/2025	01/19/2026
6	Horn Antenna	Schwarzbeck	BBHA 9120 D	02786	02/19/2025	02/18/2026
7	Horn Antenna	Schwarzbeck	ZLB7-18-40G-77	072410839	02/19/2025	02/18/2026
8	Power Amplifier	HZEMC	PA0118-43	HYP A23030	02/19/2025	02/18/2026
9	Power Amplifier	HZEMC	PA01840-45	HYP A23031	02/19/2025	02/18/2026
10	EMI Test Receiver	R&S	ESCI	101196	01/20/2025	01/19/2026
11	LISN	R&S	ENV216	102374	01/20/2025	01/19/2026
12	Pulse Limiter	Schwarzbeck	ESH3-Z2	0357.8810.54	01/20/2025	01/19/2026
13	MXA Signal Analyzer	Keysight	N9020A	MY52091389	01/20/2025	01/19/2026
14	Power Sensor	Agilent	U2021XA	MY54110007	01/31/2025	01/30/2026
15	Power Sensor	Agilent	U2021XA	MY54110009	01/31/2025	01/30/2026
16	MXG Vector Signal Generator	Agilent	N5182A	MY47070153	01/20/2025	01/19/2026
17	Analog Signal Source	Keysight	N5173B	MY60403029	01/20/2025	01/19/2026
18	Vector Signal Generator	R&S	SMCV100B	106103	01/20/2025	01/19/2026
19	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW500	118780	01/20/2025	01/19/2026
20	DC POWER SUPPLY	MAISHENG	MT-305DS	2021040016	02/28/2025	02/27/2026
21	Const Temp. & Humidity Chamber	GRT	GR-HWX-150L	GR25010601	01/20/2025	01/19/2026

Test Software		
Software name	Model	Version
Conducted Emission Measurement Software	FASLAB	V4.1
Radiated Emission Measurement Software	FASLAB	V4.1
Bluetooth and WIFI Test System	MTS 8310	V3.0.0.0

## 4. ANTENNA REQUIREMENT

### 1) Standard Requirement

#### 15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

#### 15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 2) Conclusion

Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is -0.53dBi (Max.). It complies with the standard requirement.

## 5. PSEUDORANDOM FREQUENCY HOPPING SEQUENCE

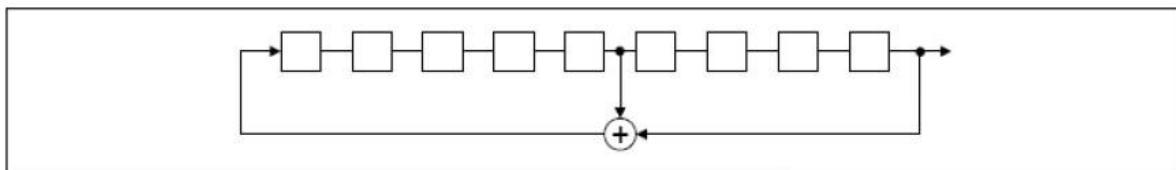
### For 47 CFR Part 15C section 15.247(a)(1),(g),(h) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### EUT Pseudorandom Frequency Hopping Sequence Requirement

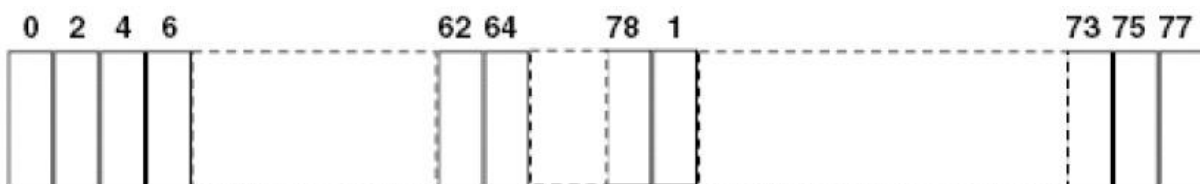
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- a) Number of shift register stages: 9
- b) Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits
- c) Longest sequence of zeros: 8(non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

The system receiver has input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

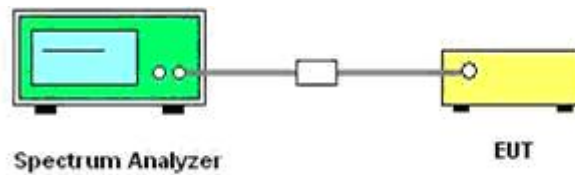
## 6. CONDUCTED OUTPUT POWER

### 6.1. LIMIT

According to 15.247(b)(1) and RSS-247 5.4(b). For frequency hopping systems operating in the 2400–2483.5MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5MHz band: 0.125watts.

### 6.2. TEST SETUP

#### ☒ Using a Spectrum Analyzer for Testing:



#### ☐ Using a Broadband Power Meter for Testing:



### 6.3. TEST PROCEDURE

#### ☒ Using a Spectrum Analyzer for Testing:

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

a) Use the following spectrum analyzer settings:

- 1) Span: Approximately five times the 20dB bandwidth, centered on a hopping channel.
- 2) RBW > 20dB bandwidth of the emission being measured.
- 3) VBW  $\geq$  RBW.
- 4) Sweep: Auto.
- 5) Detector function: Peak.
- 6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

e) A plot of the test results and setup description shall be included in the test report.

#### ☐ Using a Broadband Power Meter for Testing:

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the broadband power meter.

#### 6.4. TEST RESULT

**Pass.**

Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

Note: The test results including the cable lose.

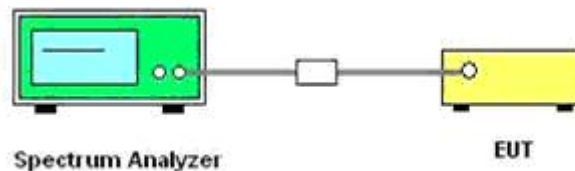


## 7. 20DB BANDWIDTH AND OCCUPIED BANDWIDTH

### 7.1. LIMIT

None; for reporting purposes only.

### 7.2. TEST SETUP



### 7.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

#### For 20dB Bandwidth Measurement:

- Span = approximately 2 to 5 times the OBW, centered on a hopping channel.
- RBW = 1% to 5% of the OBW.
- VBW  $\geq 3 \times$  RBW
- Sweep = auto;
- Detector function = peak
- Trace = max hold
- All 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 and record the 20dB down bandwidth of the emission.

#### For 99% Occupied Bandwidth Measurement:

- Span = approximately 1.5 to 5 times the OBW, centered on a hopping channel.
- RBW = 1% to 5% of the OBW.
- VBW  $\geq 3 \times$  RBW
- Sweep = auto;
- Detector function = peak
- Trace = max hold
- Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recoded.

### 7.4. TEST RESULT

Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

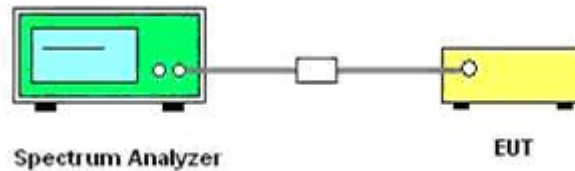
## 8. CARRIER FREQUENCIES SEPARATION

### 8.1. LIMIT

According to 15.247(a)(1) and RSS-247 5.1(b), Frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

### 8.2. TEST SETUP



### 8.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- Span: Wide enough to capture the peaks of two adjacent channels.
- RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- 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.

### 8.4. TEST RESULT

**Pass.**

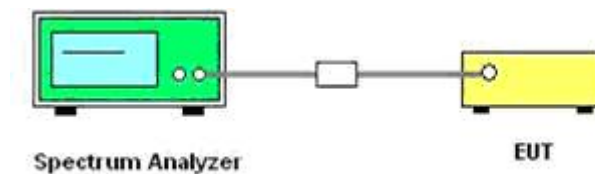
Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

## 9. NUMBER OF HOPPING CHANNEL

### 9.1. LIMIT

According to 15.247(a)(1)(iii) and RSS-247 5.1(d), Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 non-overlapping channels.

### 9.2. TEST SETUP



### 9.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) VBW  $\geq$  RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.

### 9.4. TEST RESULT

**Pass.**

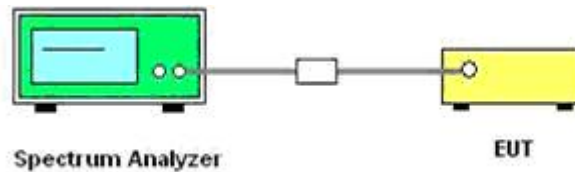
Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

## 10. TIME OF OCCUPANCY (DWELL TIME)

### 10.1. LIMIT

According to 15.247(a)(1)(iii) and RSS-247 5.1(d), Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 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.

### 10.2. TEST SETUP



### 10.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- Set center frequency of Spectrum Analyzer = operating frequency. Spectrum Setting: RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak.
- Use video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for packet transmitting.
- Measure the maximum time duration of one single pulse.
- The EUT was set to the Hopping Mode for Dwell Time Test.

### 10.4. TEST RESULT

**Pass.**

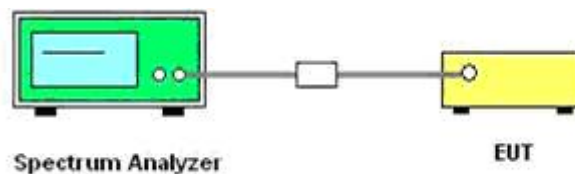
Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

## 11. CONDUCTED SPURIOUS EMISSIONS AND CONDUCTED BAND EDGES MEASUREMENT

### 11.1. LIMIT

According to §15.247(d) and RSS-247 5.5, In any 100kHz 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 20dB below that in the 100kHz 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 30dB instead of 20dB. Attenuation below the general limits specified in § 15.209(a) is not required. 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)).

### 11.2. TEST SETUP



### 11.3. TEST PROCEDURE

- Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- Set the spectrum analyzer to any one measured frequency within its operating range.
- Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
- Measure the highest amplitude appearing on spectral display and set it as a reference level.
- Set a convenient frequency span including 100 kHz bandwidth from band edge. Measure the emission and marking the edge frequency.
- Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.

### 11.4. TEST RESULT

**Pass.**

Please refer to the Appendix for Bluetooth (BDR/EDR) RF Conducted Test Data.

## 12. RADIATED EMISSIONS AND RADIATED BAND EDGES MEASUREMENT

### 12.1. LIMIT

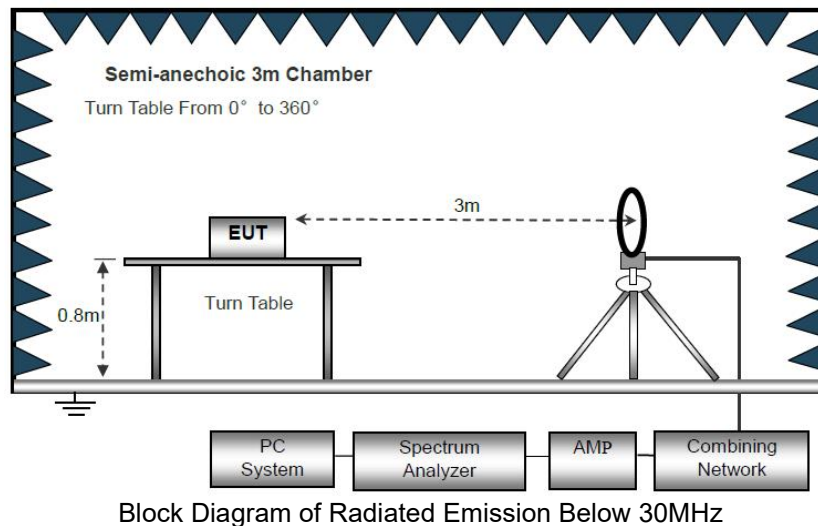
According to §15.247(d) and RSS-247 5.5, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

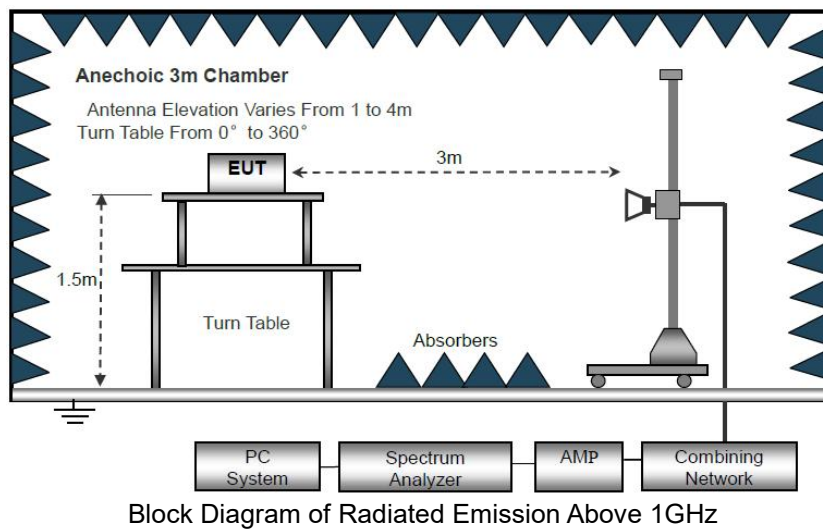
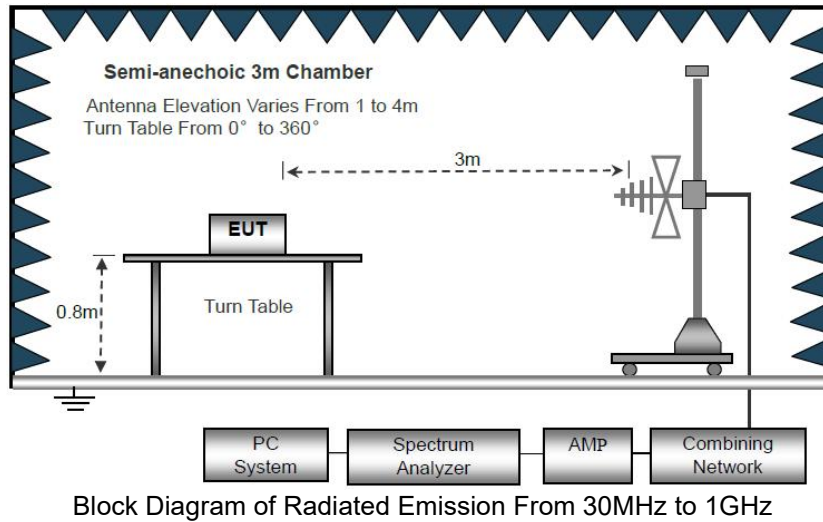
Limits of Spurious Emissions				
Frequency	Field strength (microvolt/meter)	Limit (dB $\mu$ V/m)	Remark	Measurement distance (m)
0.009MHz~0.490MHz	2400/F(kHz)	---	---	300
0.490MHz~1.705MHz	24000/F(kHz)	---	---	30
1.705MHz~30MHz	30	---	---	30
30MHz~88MHz	100	40.0	Quasi-peak	3
88MHz~216MHz	150	43.5	Quasi-peak	3
216MHz~960MHz	200	46.0	Quasi-peak	3
960MHz~1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

**Remark:**

- The lower limit shall apply at the transition frequencies.
- Emission level (dB $\mu$ V/m) = 20\*log Emission level (uV/m).
- For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
- Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

### 12.2. TEST SETUP





### 12.3. TEST PROCEDURE

- Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
- Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0 degree to 360 degree to acquire the highest emissions from EUT.
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until all frequency measurements have been completed.
- Radiated emission test frequency band from 9KHz to 25GHz.
- The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and record the worst case in this report.

g) The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz~30MHz	Active Loop Antenna	3
30MHz~1GHz	Bilog Antenna	3
1GHz~18GHz	Horn Antenna	3
18GHz~25GHz	Horn Antenna	1

h) Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz~150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz~30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz~1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz~40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

## 12.4. TEST RESULT

**Pass.**

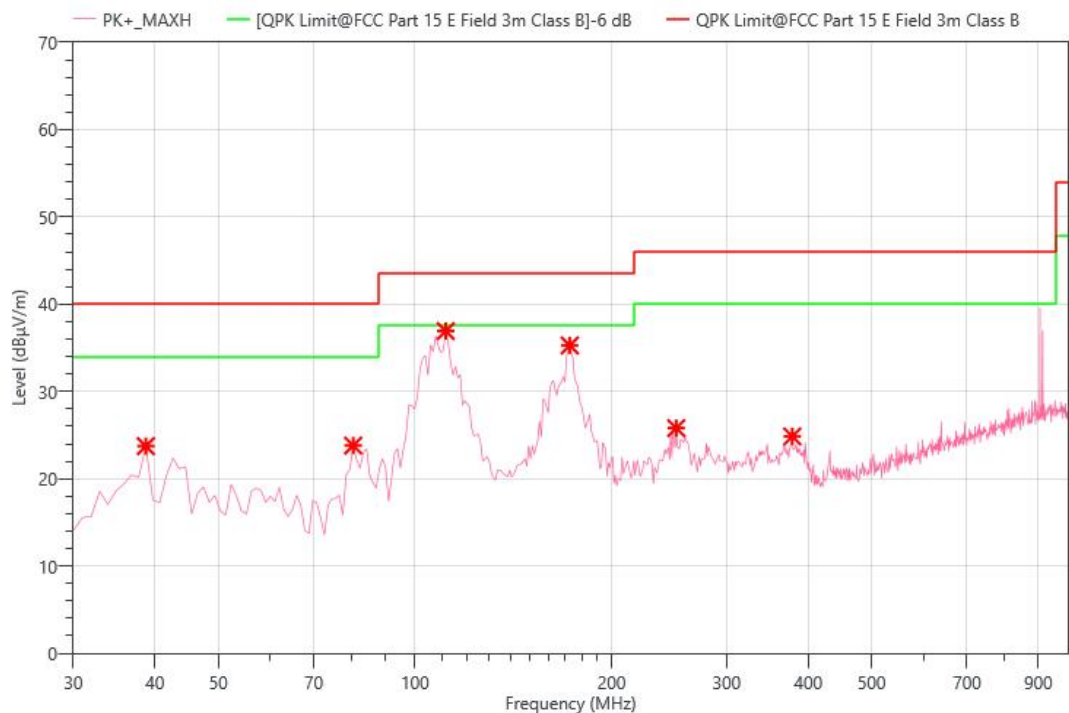
Remark:

- Pre-scan all modes and recorded the worst case in this report.
- Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and the emission levels from 9kHz to 30MHz are attenuated 20dB below the limit and not recorded in report.



## Radiated Emission Test Data (30MHz to 1GHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	Jacey Fu
Worst Test Mode:	TM1(GFSK_2402MHz)	Polarity:	Horizontal



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Pol.
1	38.730	36.71	-12.97	23.74	40.00	16.26	PK+	H
2	80.440	41.05	-17.25	23.80	40.00	16.20	PK+	H
3	111.480	52.02	-15.1	36.92	43.50	6.58	PK+	H
4	172.590	48.48	-13.21	35.27	43.50	8.23	PK+	H
5	251.160	39.37	-13.57	25.80	46.00	20.20	PK+	H
6	378.230	35.14	-10.29	24.85	46.00	21.15	PK+	H

Remark:

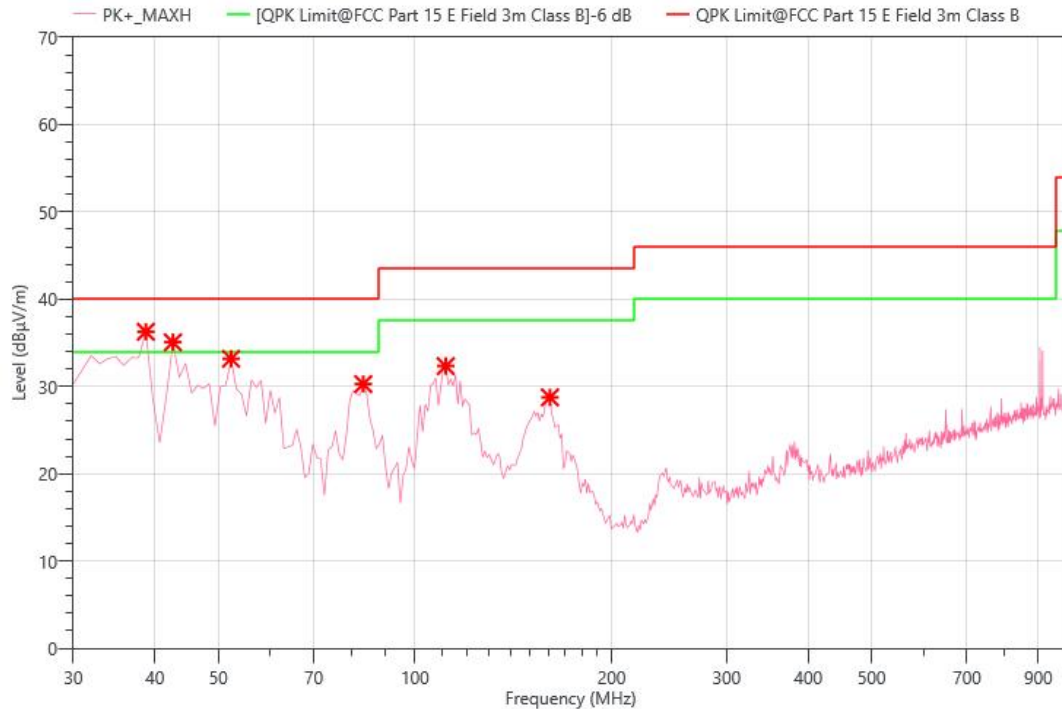
Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

## Radiated Emission Test Data (30MHz to 1GHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	Jacey Fu
Worst Test Mode:	TM1(GFSK_2402MHz)	Polarity:	Vertical



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Pol.
1	38.730	49.24	-12.97	36.27	40.00	3.73	PK+	V
2	42.610	48.16	-13.1	35.06	40.00	4.94	PK+	V
3	52.310	46.61	-13.44	33.17	40.00	6.83	PK+	V
4	83.350	47.58	-17.31	30.27	40.00	9.73	PK+	V
5	111.480	47.43	-15.1	32.33	43.50	11.17	PK+	V
6	160.950	40.85	-12.1	28.75	43.50	14.75	PK+	V

## Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

Radiated Emission Test Data (Above 1GHz)							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		Jacey Fu	
Lowest Channel (Worst Case: GFSK_2402MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
4804	63.33	-6.54	56.79	74	-17.21	PEAK	H
4804	47.49	-6.54	40.95	54	-13.05	AVG	H
7206	56.28	-1.6	54.68	74	-19.32	PEAK	H
7206	46.27	-1.6	44.67	54	-9.33	AVG	H
4804	57.71	-7.36	50.35	74	-23.65	PEAK	V
4804	51.72	-7.36	44.36	54	-9.64	AVG	V
7206	52.15	-2.06	50.09	74	-23.91	PEAK	V
7206	36.42	-2.06	34.36	54	-19.64	AVG	V
Middle Channel (Worst Case: GFSK_2441MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
4882	61.71	-7.72	53.99	74	-20.01	PEAK	H
4882	52.86	-7.72	45.14	54	-8.86	AVG	H
7206	50.6	-2.21	48.39	74	-25.61	PEAK	H
7323	40.8	-2.21	38.59	54	-15.41	AVG	H
4882	57.71	-7.58	50.13	74	-23.87	PEAK	V
4882	47.39	-7.58	39.81	54	-14.19	AVG	V
7323	56.1	-2.17	53.93	74	-20.07	PEAK	V
7323	38.12	-2.17	35.95	54	-18.05	AVG	V
Highest Channel (Worst Case: GFSK_2480MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
4960	63.99	-7.72	56.27	74	-17.73	PEAK	H
4960	50.88	-7.72	43.16	54	-10.84	AVG	H
7206	52.76	-2.06	50.7	74	-23.3	PEAK	H
7440	40.36	-2.06	38.3	54	-15.7	AVG	H
4960	58.51	-7.66	50.85	74	-23.15	PEAK	V
4960	51.15	-7.66	43.49	54	-10.51	AVG	V
7440	54.14	-1.63	52.51	74	-21.49	PEAK	V
7440	41.43	-1.63	39.8	54	-14.2	AVG	V
Remark:							
Emission Level = Reading + Factor;							
Factor = Antenna Factor + Cable Loss – Pre-amplifier;							
Margin= Emission Level - Limit.							

Radiated Band Edges Test Data							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		Jacey Fu	
Lowest Channel (Worst Case: GFSK_2402MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2310	57.52	-13.61	45.23	74	-28.77	PEAK	H
2310	43.4	-13.61	34.60	54	-19.4	AVG	H
2390	59.63	-13.48	50.84	74	-23.16	PEAK	H
2390	42.65	-13.48	33.33	54	-20.67	AVG	H
2400	64.77	-13.4	52.63	74	-21.37	PEAK	H
2400	50.83	-13.4	33.86	54	-20.14	AVG	H
2310	57.1	-13.61	44.65	74	-29.35	PEAK	V
2310	45.76	-13.61	34.02	54	-19.98	AVG	V
2390	63.44	-13.48	49.17	74	-24.83	PEAK	V
2390	38.44	-13.48	26.47	54	-27.53	AVG	V
2400	60.22	-13.4	42.27	74	-31.73	PEAK	V
2400	44.91	-13.4	27.56	54	-26.44	AVG	V
Highest Channel (Worst Case: GFSK_2480MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2483.5	68.6	-13.36	58.92	74	-15.08	PEAK	H
2483.5	46.74	-13.36	29.83	54	-24.17	AVG	H
2500	59.31	-12.45	45.00	74	-29	PEAK	H
2500	42.82	-12.45	27.45	54	-26.55	AVG	H
2483.5	63.47	-13.36	53.19	74	-20.81	PEAK	V
2483.5	50.29	-13.36	40.82	54	-13.18	AVG	V
2500	59.18	-12.45	43.65	74	-30.35	PEAK	V
2500	41.31	-12.45	29.83	54	-24.17	AVG	V
Remark: Emission Level = Reading + Factor; Factor = Antenna Factor + Cable Loss – Pre-amplifier; Margin= Emission Level - Limit.							

## 13. POWER LINE CONDUCTED EMISSIONS

### 13.1. LIMIT

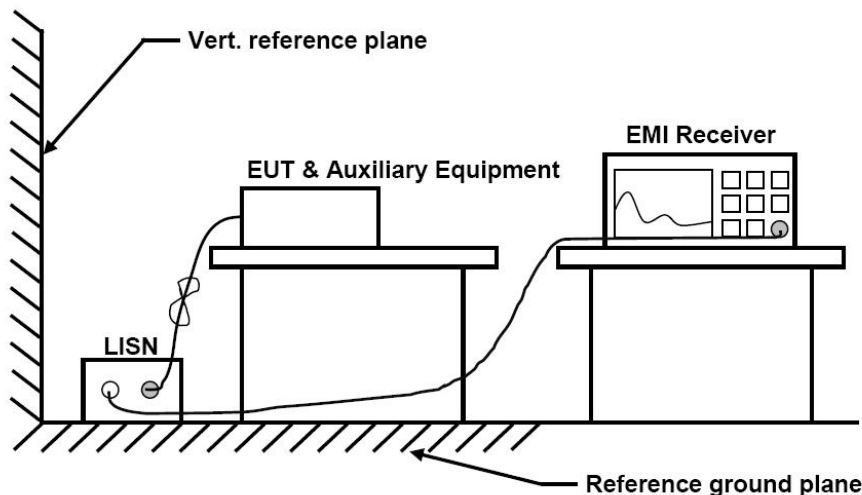
According to the rule FCC Part 15.207 and RSS-Gen 8.8, Conducted emissions limit, the limit for a wireless device as below:

Frequency Range (MHz)	Conducted emissions (dBuV)	
	Quasi-peak	Average
0.15~0.5	66 to 56	56 to 46
0.5~5	56	46
5~30	60	50

Remark:

- The lower limit shall apply at the transition frequencies.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50MHz.

### 13.2. TEST SETUP



### 13.3. TEST PROCEDURE

Test frequency range :150KHz-30MHz

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

associated equipment was at least 0.8 m from the LISN 2.

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

#### **13.4. TEST RESULT**

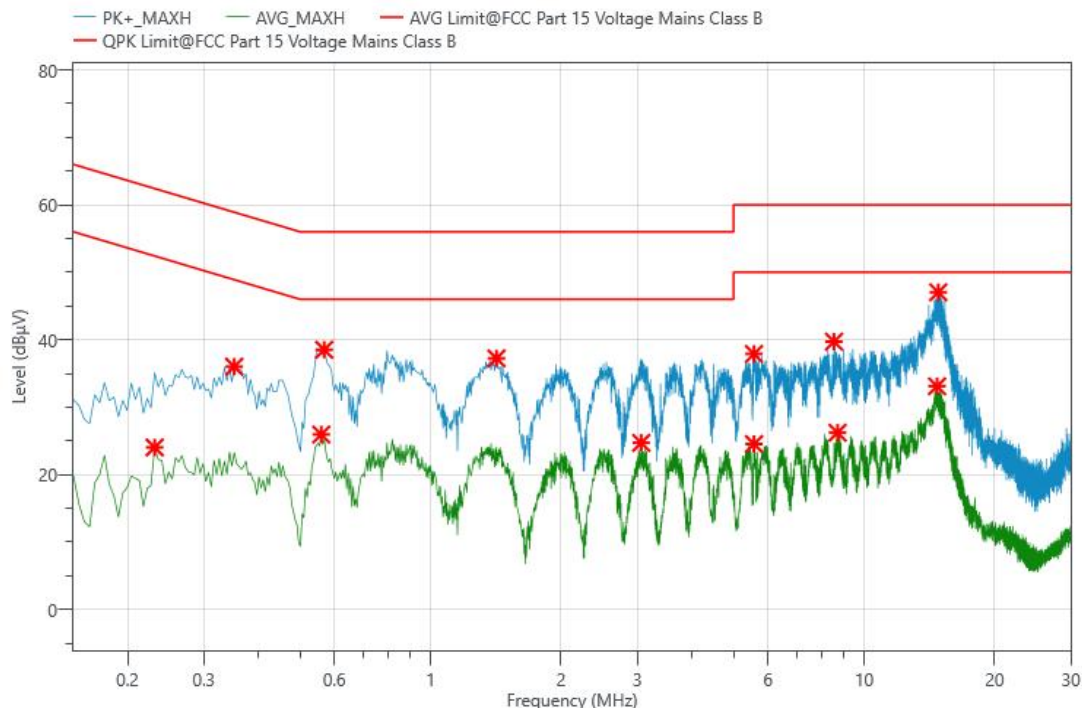
**Pass.**

Remark:

- a) AC Power line conducted emissions pre-test both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case.
- b) Worst-case mode and channel used for 150KHz~30MHz power line conducted emissions was determined to be Hopping mode (GFSK).

## Test Plots and Data of Conducted Emissions (Worst Case: Hopping Mode-GFSK)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	Jacey Fu
Test Voltage:	AC 120V/60Hz	Test Power Line:	Live



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.231	14.04	9.99	24.03	52.41	28.38	AVG	L1	GND
2	0.353	26.02	9.99	36.01	58.90	22.89	PK+	L1	GND
3	0.560	15.95	9.99	25.94	46.00	20.06	AVG	L1	GND
4	0.569	28.53	9.99	38.52	56.00	17.48	PK+	L1	GND
5	1.419	27.23	10.01	37.24	56.00	18.76	PK+	L1	GND
6	3.062	14.67	10.04	24.71	46.00	21.29	AVG	L1	GND
7	5.573	27.81	10.08	37.89	60.00	22.11	PK+	L1	GND
8	5.573	14.45	10.08	24.53	50.00	25.47	AVG	L1	GND
9	8.520	28.89	10.83	39.72	60.00	20.28	PK+	L1	GND
10	8.682	15.31	10.91	26.22	50.00	23.78	AVG	L1	GND
11	14.730	19.58	13.52	33.10	50.00	16.90	AVG	L1	GND
12	14.825	33.48	13.56	47.04	60.00	12.96	PK+	L1	GND

## Remark:

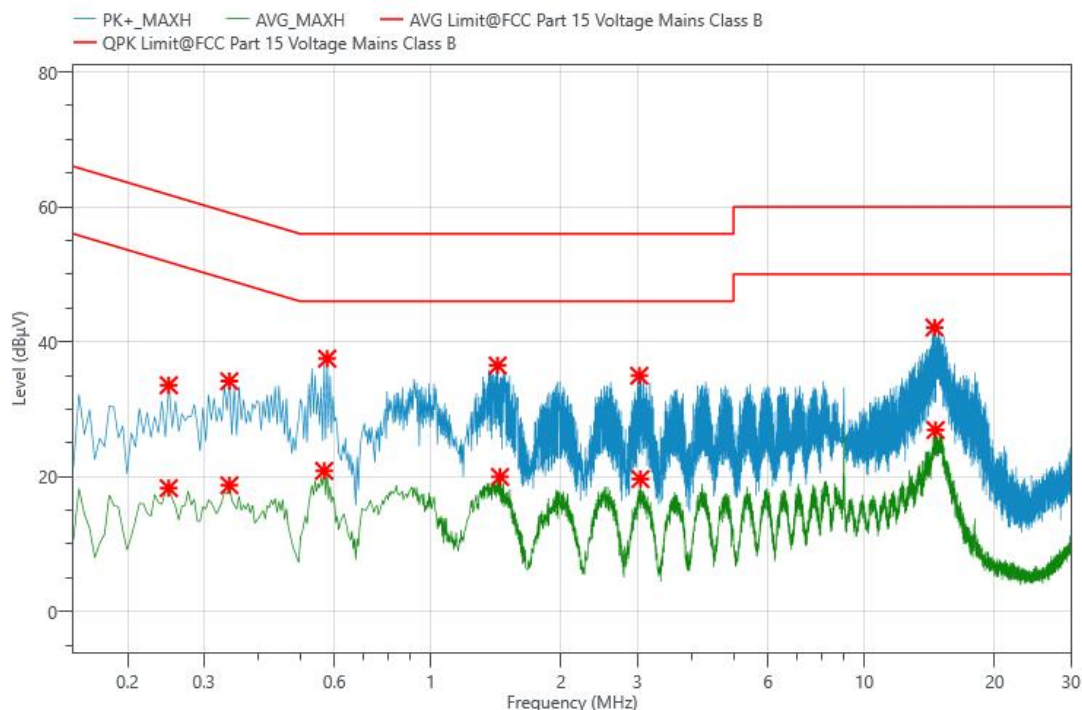
Emission Level = Reading + Correct Factor;

Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Emission Level - Limit.

## Test Plots and Data of Conducted Emissions (Worst Case: Hopping Mode-GFSK)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	Jacey Fu
Test Voltage:	AC 120V/60Hz	Test Power Line:	Neutral



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.249	23.56	9.99	33.55	61.79	28.24	PK+	N	GND
2	0.249	8.30	9.99	18.29	51.79	33.50	AVG	N	GND
3	0.344	24.16	9.99	34.15	59.12	24.97	PK+	N	GND
4	0.344	8.72	9.99	18.71	49.12	30.41	AVG	N	GND
5	0.569	10.85	9.99	20.84	46.00	25.16	AVG	N	GND
6	0.578	27.49	10	37.49	56.00	18.51	PK+	N	GND
7	1.428	26.46	10.01	36.47	56.00	19.53	PK+	N	GND
8	1.446	9.94	10.01	19.95	46.00	26.05	AVG	N	GND
9	3.030	24.92	10.04	34.96	56.00	21.04	PK+	N	GND
10	3.048	9.59	10.04	19.63	46.00	26.37	AVG	N	GND
11	14.537	28.65	13.44	42.09	60.00	17.91	PK+	N	GND
12	14.613	13.43	13.47	26.90	50.00	23.10	AVG	N	GND

Remark:

Emission Level = Reading + Correct Factor;

Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Emission Level - Limit.



## **14. PHOTOGRAPHS OF TEST SETUP**

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

## **15. EXTERNAL PHOTOGRAPHS OF THE EUT**

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

## **16. INTERNAL PHOTOGRAPHS OF THE EUT**

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

\*\*\*\*\*THE END\*\*\*\*\*