RF Test Report

FCC ID: 2BF5R-VHKP1

Report No.	:	TBR-C-202511-0122-1
Applicant	:	Photon Sail Technologies Pte. Ltd.
Equipment Under Test (EUT)		
EUT Name	:	Keypad
Model No.	:	VHKP1
Series Model No.	:	----
Brand Name	:	
Sample ID	:	HC-C-202511-0122-01-01-1#&HC-C-202511-0122-01-01-2#
Receipt Date	:	2025-11-21
Test Date	:	2025-11-21 to 2025-12-31
Issue Date	:	2025-12-31
Standards	:	FCC Part 15 Subpart C 15.247
Test Method	:	ANSI C63.10:2020+Cor.1:2023 KDB 558074 D01 15.247 Meas Guidance v05r02
Conclusions	:	**PASS** In the configuration tested, the EUT complied with the standards specified above.
Tested By	:	Lily. zhang Lily. zhang
Reviewed By	:	Wade. Lv Wade. Lv
Approved By	:	IVAN SU Ivan Su

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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Revision History

Report No.	Version	Description	Issued Date
TBR-C-202511-0122-1	Rev.01	Initial issue of report	2025-12-31

1. General Information about EUT

1.1 Client Information

Applicant	:	Photon Sail Technologies Pte. Ltd.
Address	:	182 Cecil Street, #23-02 Frasers Tower, Singapore
Manufacturer	:	Photon Sail Technologies Pte. Ltd.
Address	:	182 Cecil Street, #23-02 Frasers Tower, Singapore

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	Keypad	
Models No.	:	VHKP1	
Model Difference	:	----	
Product Description	:	Operation Frequency:	Bluetooth LE 4.2: 2402MHz~2480MHz
		Number of Channel:	40 channels
		Modulation Type:	GFSK
		Bit Rate of Transmitter:	1Mbps&2Mbps
		Antenna Type:	0.79dBi FPC Antenna
Power Rating	:	AC Adapter(TPA-418G050100UU01) Input: 100-240V~50/60Hz 0.3A Output: 5.0V/1.0A 5.0W DC 6V(LR03 AAA 1.5V*4)	
Software Version	:	V0.1.0	
Hardware Version	:	CS_KP1_C01_V5	

Remark:

(1) The antenna gain and adapter provided by the applicant, the verified for the RF conduction test provided by TOBY test lab.

(2) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

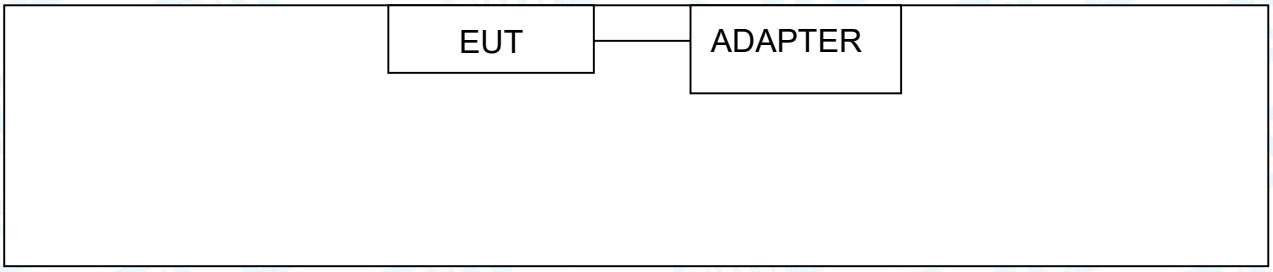
(3) The above antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

(4)Channel List:

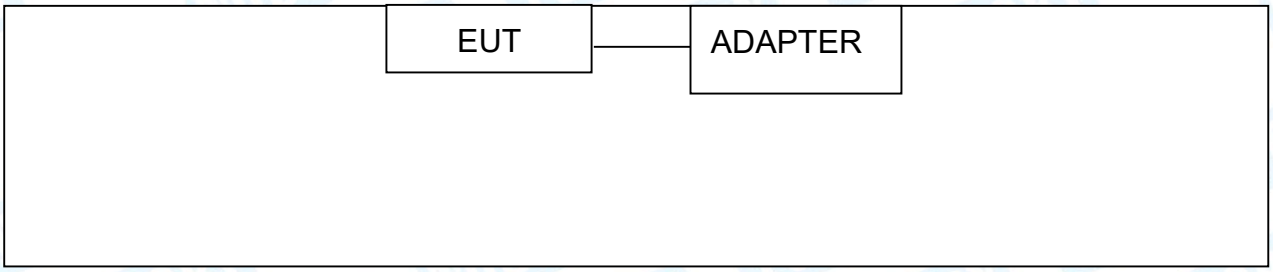
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	14	2430	28	2458
01	2404	15	2432	29	2460
02	2406	16	2434	30	2462
03	2408	17	2436	31	2464
04	2410	18	2438	32	2466
05	2412	19	2440	33	2468
06	2414	20	2442	34	2470
07	2416	21	2444	35	2472
08	2418	22	2446	36	2474
09	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454		
13	2428	27	2456		

1.3 Block Diagram Showing the Configuration of System Tested

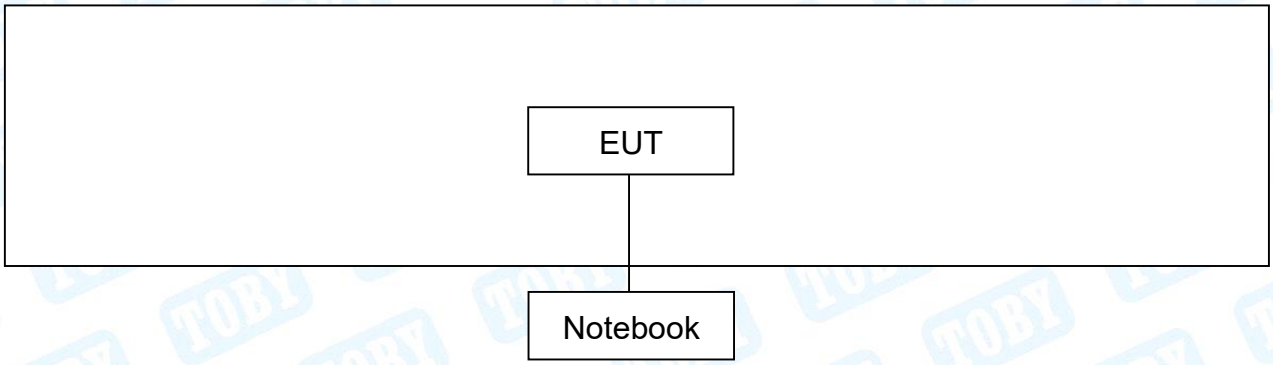
Conducted Test



Radiated Test



Conducted Measurements Test



1.4 Description of Support Units

Equipment Information				
Name	**Model**	**FCC ID/SDOC**	**Manufacturer**	**Used "√"**
Notebook	inspiron 5509	----	DELL	√
Adapter	TPA-418G050100UU01	-----	TIANYIN	√
Cable Information				
Number	**Shielded Type**	**Ferrite Core**	**Length**	**Note**
Cable 1	-----	-----	0.8M	Accessory
Note: The Notebook is provided by Toby test lab. The adapter and cable is provided by Applicant.				

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

For Conducted Test	
Final Test Mode	**Description**
Mode 1	TX Mode
For Radiated Test	
Final Test Mode	**Description**
Mode 2	TX 1Mbps Mode (Channel 00/19/39)
Mode 3	TX 2Mbps Mode (Channel 00/19/39)

Note:

(1) For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate.

According to ANSI C63.10 standards, the measurements are performed at the highest, middle, lowest available channels, and the worst case data rate as follows:

BLE Mode: GFSK Modulation Transmitting mode.

(2) During the testing procedure, the continuously transmitting with the maximum power mode was programmed by the customer.

(3) The EUT is considered a Mobile unit; in normal use it was positioned on X-plane. The worst case was found positioned on X-plane. The refore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

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 power parameters of RF setting.

Test Software Version	**SecureCRT.exe**		
Frequency	2402MHz	2440MHz	2480MHz
BLE 1M	30	30	30
BLE 2M	30	30	30

1.7 Measurement Uncertainty

The reported uncertainty of measurement y±U，where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2，providing a level of confidence of approximately 95 %.

Test Item	Parameters	Expanded Uncertainty (U_{Lab})
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	±3.50 dB ±3.10 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	±4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	±4.50 dB
Radiated Emission	Level Accuracy: Above 1000MHz	±4.20 dB
RF Power-Conducted	Level Accuracy: Above 1000MHz	±0.95 dB
Power Spectral Density-Conducted	Level Accuracy: Above 1000MHz	±3dB
Occupied Bandwidth	Level Accuracy: 30MHz to 1000 MHz Above 1000MHz	±3.8%
Unwanted Emission-Conducted	Level Accuracy: 30MHz to 1000 MHz Above 1000MHz	±2.72 dB
Temperature	/	±0.6℃
Humidity	/	±4%
Supply voltages	/	±2%
Time	/	±4%

1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1/F., Building 6, Rundongsheng Industrial Zone, Longzhu, Xixiang, Bao'an District, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

A2LA Certificate No.: 4750.01

The laboratory has been accredited by American Association for Laboratory Accreditation(A2LA) to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the technical competence in the field of Electrical Testing. And the A2LA Certificate No.: 4750.01.FCC Accredited Test Site Number: 854351. Designation Number: CN1223.

IC Registration No.: (11950A)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A. CAB identifier: CN0056.

2. Test Summary

Standard Section FCC	Test Item	Test Sample(s)	Judgment	Remark
FCC 15.207(a)	Conducted Emission	HC-C-202511-0122-01-01-1#	PASS	N/A
FCC 15.209 & 15.247(d)	Radiated Unwanted Emissions	HC-C-202511-0122-01-01-1#	PASS	N/A
FCC 15.203	Antenna Requirement	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.247(a)(2)	6dB Bandwidth	HC-C-202511-0122-01-01-2#	PASS	N/A
/	99% Occupied bandwidth	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.247(b)(3)	Peak Output Power and E.I.R.P	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.247(e)	Power Spectral Density	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.247(d)	Band Edge Measurements	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.207	Conducted Unwanted Emissions	HC-C-202511-0122-01-01-2#	PASS	N/A
FCC 15.247(d)	Emissions in Restricted Bands	HC-C-202511-0122-01-01-2#	PASS	N/A
/	On Time and Duty Cycle	HC-C-202511-0122-01-01-2#	/	N/A

Note: N/A is an abbreviation for Not Applicable.

3. Test Software

Test Item	Test Software	Manufacturer	Version No.
Conducted Emission	EZ-EMC	EZ	CDI-03A2
Radiation Emission	EZ-EMC	EZ	FA-03A2RE
Radiation Emission	EZ-EMC	EZ	FA-03A2RE+
RF Conducted Measurement	MTS-8310	MWRFtest	V2.0.0.0
RF Test System	JS1120	Tonscend	V3.2.22

4. Test Equipment and Test Site

Test Site				
No.	**Test Site**	**Manufacturer**	**Specification**	**Used**
TB-EMCSR001	Shielding Chamber #1	YIHENG	7.5*4.0*3.0 (m)	√
TB-EMCSR002	Shielding Chamber #2	YIHENG	8.0*4.0*3.0 (m)	√
TB-EMCCA001	3m Anechoic Chamber #A	ETS	9.0*6.0*6.0 (m)	X
TB-EMCCB002	3m Anechoic Chamber #B	YIHENG	9.0*6.0*6.0 (m)	√

Conducted Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jun. 16, 2025	Jun. 15, 2026
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jun. 16, 2025	Jun. 15, 2026
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jun. 16, 2025	Jun. 15, 2026
LISN	Rohde & Schwarz	ENV216	101131	Jun. 16, 2025	Jun. 15, 2026
Radiation Emission Test (B Site)					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 27, 2025	Aug. 26, 2026
Spectrum Analyzer	Rohde & Schwarz	FSV40-N	102197	Jun. 16, 2025	Jun. 15, 2026
EMI Test Receiver	Rohde & Schwarz	ESU-8	100472/008	Feb. 20, 2025	Feb. 19, 2026
Bilog Antenna	SCHWARZBECK	VULB 9168	1225	Oct. 18, 2025	Oct. 17, 2027
Horn Antenna	SCHWARZBECK	BBHA 9120 D	2463	Jun. 14, 2024	Jun. 13, 2026
Horn Antenna	SCHWARZBECK	BBHA 9170	1118	Feb. 27, 2024	Feb. 26, 2026
Loop Antenna	SCHWARZBECK	FMZB 1519 B	1519B-059	Jun. 14, 2024	Jun. 13, 2026
HF Amplifier	Tonscend	TAP9E6343	AP21C806117	Aug. 27, 2025	Aug. 26, 2026
HF Amplifier	Tonscend	TAP051845	AP21C806141	Aug. 27, 2025	Aug. 26, 2026
HF Amplifier	Tonscend	TAP0184050	AP21C806129	Aug. 27, 2025	Aug. 26, 2026
Highpass Filter	CD	HPM-6.4/18G	---	N/A	N/A
Highpass Filter	CD	HPM-2.8/18G	---	N/A	N/A
Highpass Filter	XINBO	XBLBQ-HTA67(8-25G)	22052702-1	N/A	N/A
Antenna Conducted Emission					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Rohde & Schwarz	FSV40-N	102197	Jun. 16, 2025	Jun. 15, 2026
MXA Signal Analyzer	KEYSIGHT	N9020B	MY60110172	Aug. 27, 2025	Aug. 26, 2026
MXA Signal Analyzer	Agilent	N9020A	MY47380425	Aug. 27, 2025	Aug. 26, 2026
Vector Signal Generator	Agilent	N5182A	MY50141294	Aug. 27, 2025	Aug. 26, 2026

Analog Signal Generator	Agilent	N5181A	MY48180463	Aug. 27, 2025	Aug. 26, 2026
Vector Signal Generator	KEYSIGHT	N5182B	MY59101429	Aug. 27, 2025	Aug. 26, 2026
Analog Signal Generator	KEYSIGHT	N5173B	MY61252685	Aug. 27, 2025	Aug. 26, 2026
RF Power Sensor	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO26	Aug. 27, 2025	Aug. 26, 2026
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO29	Aug. 27, 2025	Aug. 26, 2026
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO31	Aug. 27, 2025	Aug. 26, 2026
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO33	Aug. 27, 2025	Aug. 26, 2026
RF Control Unit	Tonsced	JS0806-1	21C8060380	N/A	N/A
RF Control Unit	Tonsced	JS0806-2	21F8060439	Aug. 27, 2025	Aug. 26, 2026
Power Control Box	Tonsced	JS0806-4ADC	21C8060387	N/A	N/A
Attenuator	YINSAIGE	DC-18G 3dB	DC18G	N/A	N/A
Attenuator	YINSAIGE	DC-40G 3dB	DC40G	N/A	N/A

5. Conducted Emission

5.1 Test Standard and Limit

5.1.1 Test Standard

FCC Part 15.207

5.1.2 Test Limit

Frequency	Maximum RF Line Voltage (dBμV)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

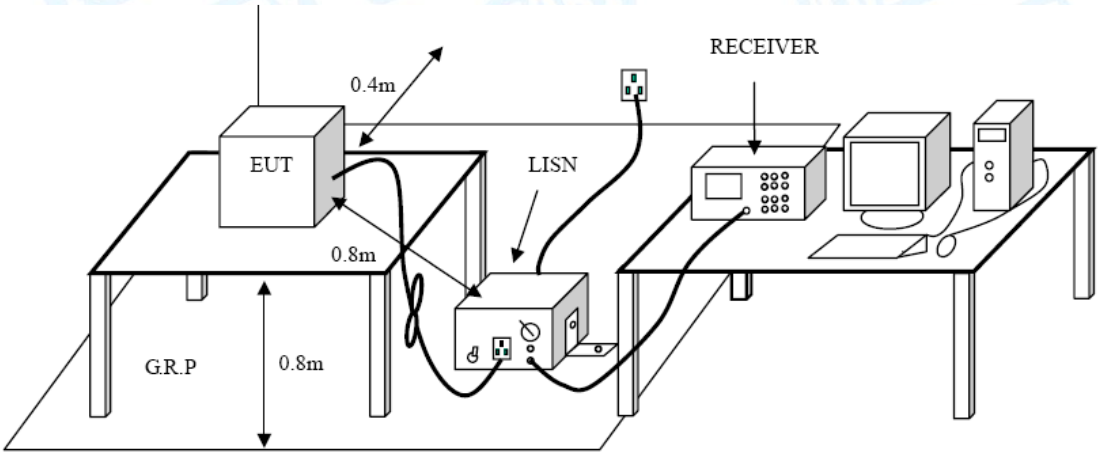
Notes:

(1) *Decreasing linearly with logarithm of the frequency.

(2) The lower limit shall apply at the transition frequencies.

(3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

5.2 Test Setup



5.3 Test Procedure

- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.

●The bandwidth of EMI test receiver is set at 9 kHz, and the test frequency band is from 0.15MHz to 30MHz.

5.4 Deviation From Test Standard

No deviation

5.5 EUT Operating Mode

Please refer to the description of test mode.

5.6 Test Data

Please refer to the Attachment A inside test report.

6. Radiated and Conducted Unwanted Emissions

6.1 Test Standard and Limit

6.1.1 Test Standard

FCC Part 15.209 & FCC Part 15.247(d)

6.1.2 Test Limit

General field strength limits at frequencies Below 30MHz		
Frequency (MHz)	**Field Strength (microvolt/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
Note: 1, The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.		

General field strength limits at frequencies above 30 MHz		
Frequency (MHz)	**Field strength (μV/m at 3 m)**	**Measurement Distance (meters)**
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

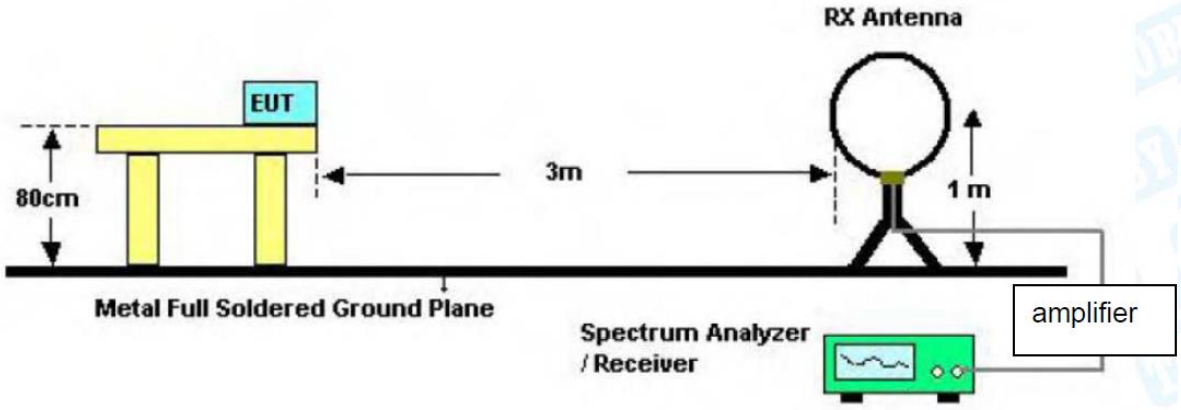
General field strength limits at frequencies Above 1000MHz		
Frequency (MHz)	**Distance of 3m (dBuV/m)**	
	Peak	**Average**
Above 1000	74	54
Note: (1) The tighter limit applies at the band edges. (2) Emission Level(dBuV/m)=20log Emission Level(uV/m)		

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum device, digitally modulated device, or hybrid system is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the

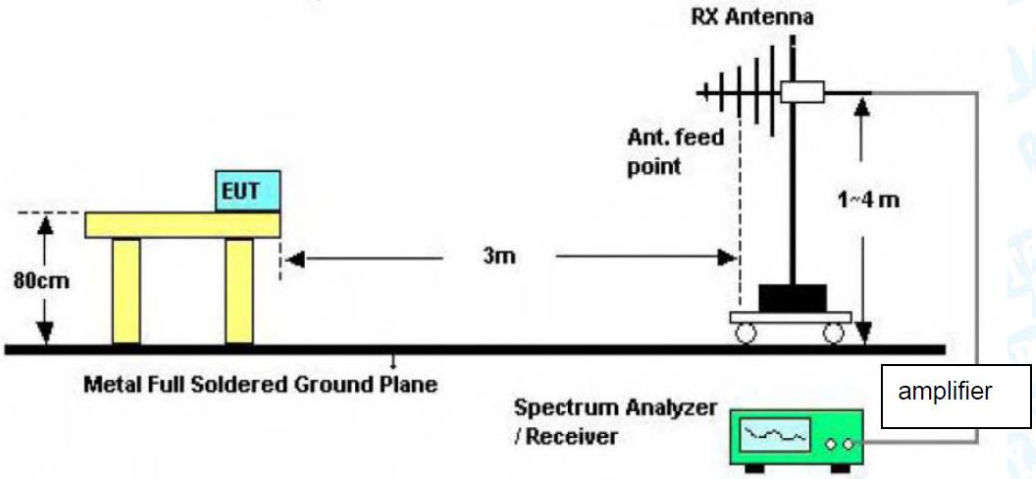
peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6.2 Test Setup

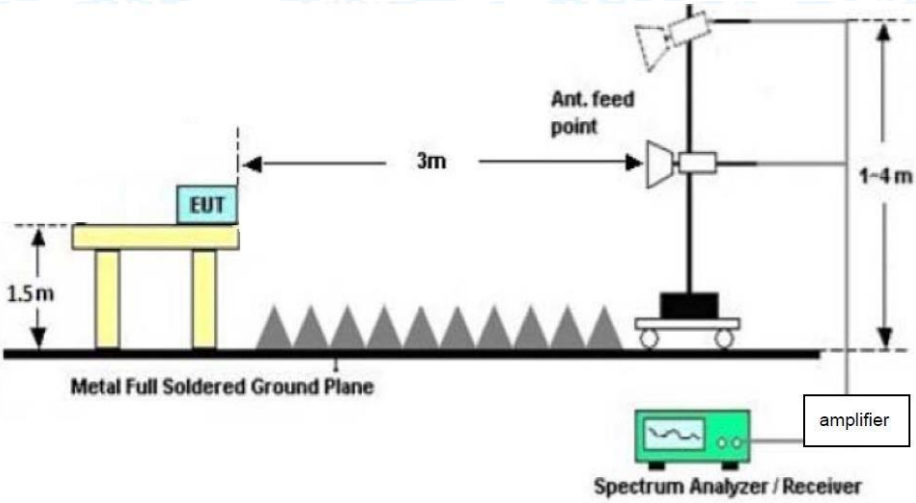
Radiated measurement



Below 30MHz Test Setup

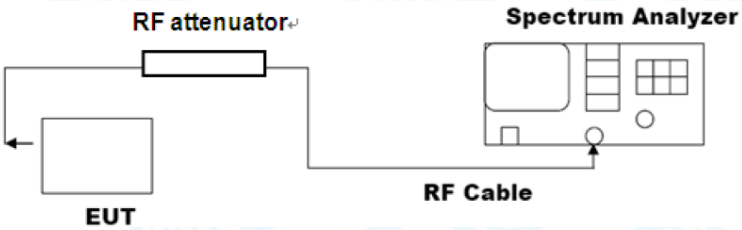


Below 1000MHz Test Setup



Above 1GHz Test Setup

Conducted measurement



6.3 Test Procedure

---Radiated measurement

●The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.

● Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

● The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.

●The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

●If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Below 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.

●Testing frequency range 30MHz-1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection. Testing frequency range 9KHz-150Hz the measuring instrument use VBW=200Hz with Quasi-peak detection. Testing frequency range 9KHz-30MHz the measuring instrument use VBW=9kHz with Quasi-peak detection.

●Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

●For the actual test configuration, please see the test setup photo.

--- Conducted measurement

●Reference level measurement

Establish a reference level by using the following procedure:

a) Set instrument center frequency to DTS channel center frequency.

b) Set the span to≥1.5 times the DTS bandwidth.

c) Set the RBW = 100 kHz.

d) Set the VBW≥[3*RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

●Emission level measurement

Establish an emission level by using the following procedure:

a) Set the center frequency and span to encompass frequency range to be measured.

b) Set the RBW = 100 kHz.

c) Set the VBW≥[3*RBW].

d) Detector = peak.

e) Sweep time = auto couple.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

6.4 Deviation From Test Standard

No deviation

6.5 EUT Operating Mode

Please refer to the description of test mode.

6.6 Test Data

Radiated measurement please refer to the Attachment B inside test report.

Conducted measurement please refer to the external appendix report of BLE.

7. Restricted Bands and Band Edge Requirement

7.1 Test Standard and Limit

7.1.1 Test Standard

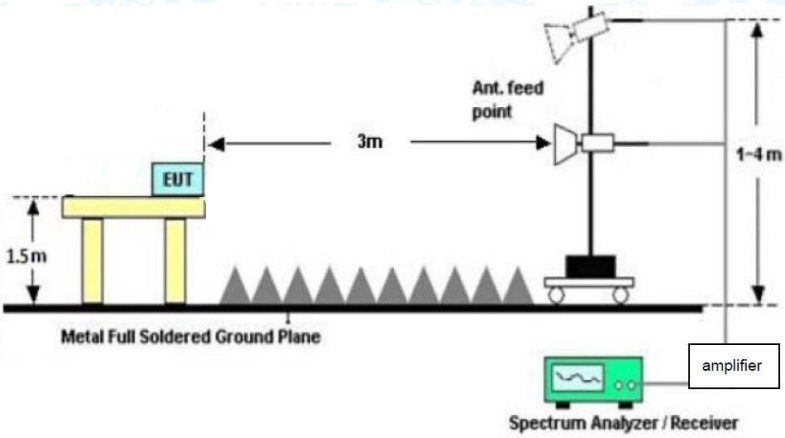
FCC Part 15.205 & FCC Part 15.247(d)

7.1.2 Test Limit

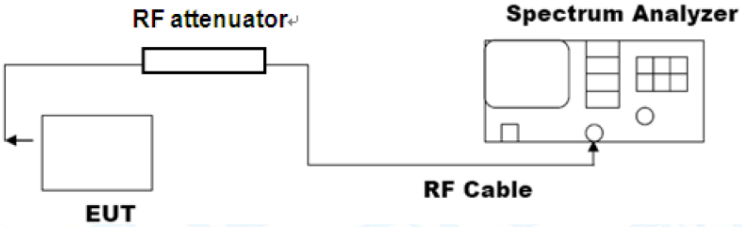
Restricted Frequency Band (MHz)	**Distance Meters(at 3m)**	
	Peak (dBuV/m)	**Average (dBuV/m)**
2310 ~2390	74	54
2483.5 ~2500	74	54
	Peak (dBm)see 7.3 e)	**Average (dBm)** see 7.3 e)
2310 ~2390	-21.20	-41.20
2483.5 ~2500	-21.20	-41.20
Note: According the ANSI C63.10 11.12.2 antenna-port conducted measurements may also be used as an alternative to radiated measurements for determining compliance in the restricted frequency bands requirements. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test forcabinet/case emissions is required.		

7.2 Test Setup

Radiated measurement



Conducted measurement



7.3 Test Procedure

---Radiated measurement

● Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

● The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.

●The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

●The Peak Value and average value both need to comply with applicable limit above 1 GHz.

●Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

●For the actual test configuration, please see the test setup photo.

--- Conducted measurement

a) Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 11.12.2.3 through 11.12.2.5 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to

determine the EIRP (see 11.12.2.6 for guidance on determining the applicable antenna gain).

c) Add the appropriate maximum ground reflection factor to the EIRP (6 dB for frequencies

≤30 MHz; 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and 0 dB for

frequencies > 1000 MHz).

d) For MIMO devices, measure the power of each chain and sum the EIRP of all chains in linear terms (i.e., watts and mW).

e) Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20 \log d + 104.8$$

where

E is the electric field strength in dBuV/m

EIRP is the equivalent isotropically radiated power in dBm

d is the specified measurement distance in m

f) Compare the resultant electric field strength level with the applicable regulatory limit.

g) Perform the radiated spurious emission test.

7.4 Deviation From Test Standard

No deviation

7.5 EUT Operating Mode

Please refer to the description of test mode.

7.6 Test Data

Remark: The test uses antenna-port conducted measurements as an alternative to radiated measurements for determining compliance in the restricted frequency bands requirements.

Please refer to the external appendix report of BLE.

8. Bandwidth Test

8.1 Test Standard and Limit

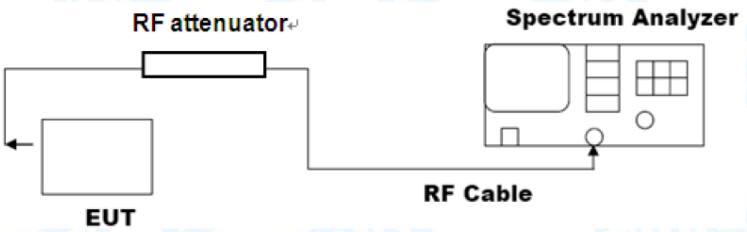
8.1.1 Test Standard

FCC Part 15.205 & FCC Part 15.247(d)

8.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
-6dB bandwidth (DTS bandwidth)	>=500 KHz	2400~2483.5
99% occupied bandwidth	/	2400~2483.5

8.2 Test Setup



8.3 Test Procedure

---DTS bandwidth

●The steps for the first option are as follows:

a) Set RBW = shall be in the range of 1% to 5% of the OBW but not less than 100 kHz.

b) Set the VBW ≥ [3 × RBW].

c) Detector = peak.

d) Trace mode = max-hold.

e) Sweep = No faster than coupled (auto) time.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission by placing two markers, one at the lowest frequency

and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “−6 dB down amplitude”. If a marker is below this “−6 dB down amplitude” value, then it shall be as close as possible to this value.

---occupied bandwidth

●The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency.

The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

8.4 Deviation From Test Standard

No deviation

8.5 EUT Operating Mode

Please refer to the description of test mode.

8.6 Test Data

Please refer to the external appendix report of BLE.

9. Peak Output Power

9.1 Test Standard and Limit

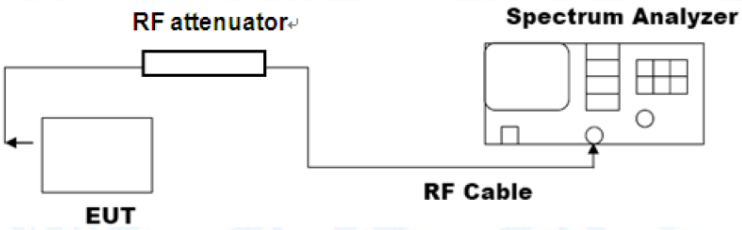
9.1.1 Test Standard

FCC Part 15.247(b)(3)

9.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	not exceed 1 W or 30dBm	2400~2483.5

9.2 Test Setup



9.3 Test Procedure

---RBW≥DTS bandwidth

●The following procedure shall be used when an instrument with a resolution bandwidth that is greater than

the DTS bandwidth is available to perform the measurement:

a) Set the RBW≥DTS bandwidth.

b) Set VBW≥[3*RBW].

c) Set span≥[3*RBW].

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

9.4 Deviation From Test Standard

No deviation

9.5 EUT Operating Mode

Please refer to the description of test mode.

9.6 Test Data

Please refer to the external appendix report of BLE.

10. Power Spectral Density

10.1 Test Standard and Limit

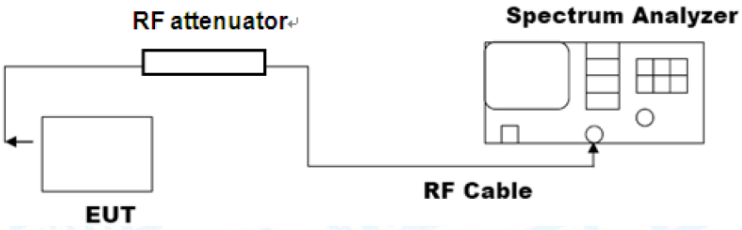
10.1.1 Test Standard

FCC Part 15.247(e)

10.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Power Spectral Density	8dBm(in any 3 kHz)	2400~2483.5

10.2 Test Setup



10.3 Test Procedure

●The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz≤RBW≤100 kHz.

d) Set the VBW ≥[3*RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

10.4 Deviation From Test Standard

No deviation

10.5 Antenna Connected Construction

Please refer to the description of test mode.

10.6 Test Data

Please refer to the external appendix report of BLE.

11. Antenna Requirement

11.1 Test Standard and Limit

11.1.1 Test Standard

FCC Part 15.203

11.1.2 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 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.

11.2 Deviation From Test Standard

No deviation

11.3 Antenna Connected Construction

The gains of the antenna used for transmitting is 0.79dBi, and the antenna de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

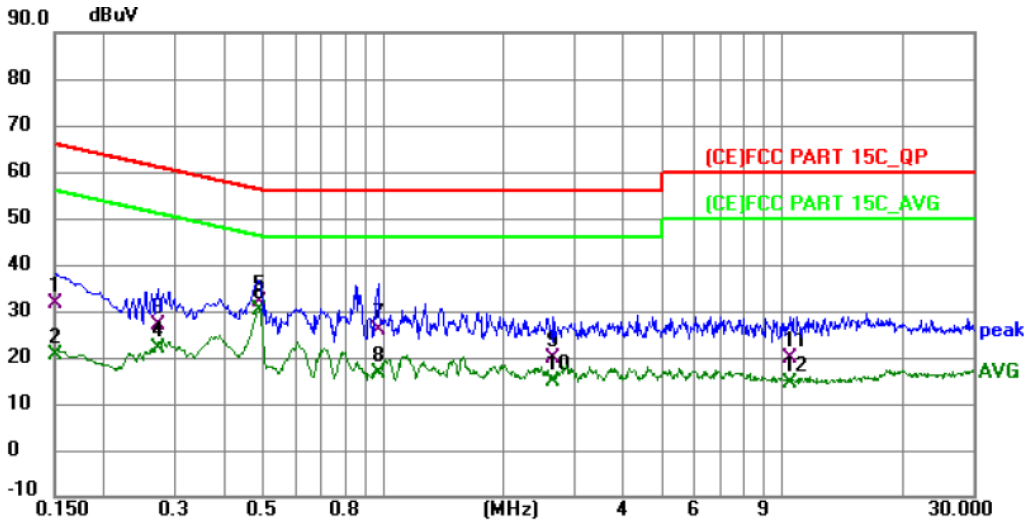
11.4 Test Data

The EUT antenna is a FPC Antenna. It complies with the standard requirement.

Antenna Type
☒Permanent attached antenna
☐Unique connector antenna
☐Professional installation antenna

Attachment A-- Conducted Emission Test Data

Test Voltage:	AC 120V/60Hz
Terminal:	Line
Test Mode:	Mode 1
Remark:	Only showed the worst mode test data.

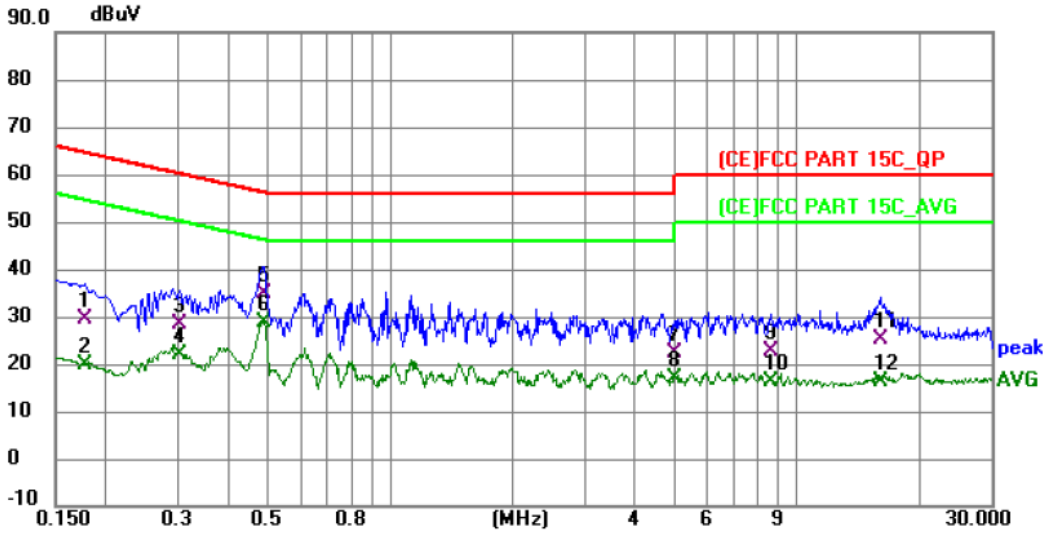


Temperature: 23.4 ℃ Humidity: 47 %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.150	22.17	9.49	31.66	66.00	-34.34	QP
2		0.150	10.91	9.49	20.40	56.00	-35.60	AVG
3		0.272	17.38	9.58	26.96	61.06	-34.10	QP
4		0.272	12.52	9.58	22.10	51.06	-28.96	AVG
5		0.487	22.49	9.40	31.89	56.22	-24.33	QP
6	*	0.487	20.88	9.40	30.28	46.22	-15.94	AVG
7		0.974	16.67	9.36	26.03	56.00	-29.97	QP
8		0.974	7.40	9.36	16.76	46.00	-29.24	AVG
9		2.666	10.42	9.51	19.93	56.00	-36.07	QP
10		2.666	5.43	9.51	14.94	46.00	-31.06	AVG
11		10.486	10.08	9.68	19.76	60.00	-40.24	QP
12		10.486	4.68	9.68	14.36	50.00	-35.64	AVG

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) =QuasiPeak/Average (dBuV)-Limit (dBuV)

Test Voltage:	AC 120V/60Hz
Terminal:	Neutral
Test Mode:	Mode 1
Remark:	Only showed the worst mode test data.



Temperature: 23.4 ℃ Humidity: 47 %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.177	19.86	9.58	29.44	64.63	-35.19	QP
2		0.177	10.14	9.58	19.72	54.63	-34.91	AVG
3		0.303	18.75	9.62	28.37	60.16	-31.79	QP
4		0.303	12.48	9.62	22.10	50.16	-28.06	AVG
5		0.487	25.53	9.36	34.89	56.22	-21.33	QP
6	*	0.487	19.46	9.36	28.82	46.22	-17.40	AVG
7		4.979	13.07	9.42	22.49	56.00	-33.51	QP
8		4.979	7.39	9.42	16.81	46.00	-29.19	AVG
9		8.601	12.98	9.77	22.75	60.00	-37.25	QP
10		8.601	6.48	9.77	16.25	50.00	-33.75	AVG
11		16.008	15.02	10.05	25.07	60.00	-34.93	QP
12		16.008	6.24	10.05	16.29	50.00	-33.71	AVG

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) =QuasiPeak/Average (dBuV)-Limit (dBuV)

Attachment B--Unwanted Emissions Data

---Radiated Unwanted Emissions

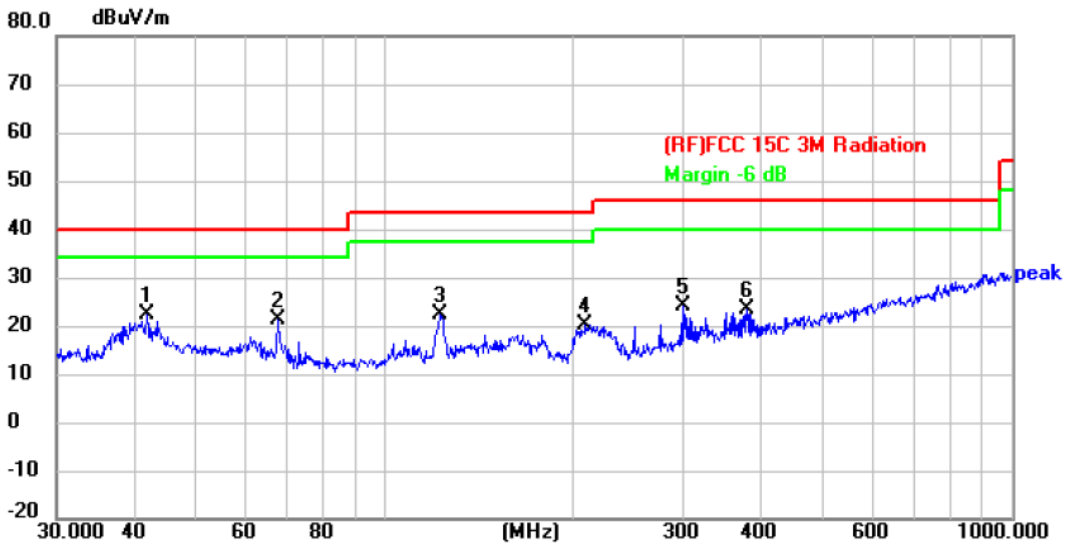
9 KHz~30 MHz

From 9 KHz to 30 MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB Below the permissible value has no need to be reported.

30MHz~1GHz

Test Voltage:	AC 120V/60Hz
Ant. Pol.	Horizontal
Test Mode:	Mode 2 TX 1Mbps Mode Channel 00
Remark:	Only showed the worst mode test data.



Temperature: 23.9 ℃ Humidity: 48 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	41.7129	45.33	-23.15	22.18	40.00	-17.82	peak	P
2	67.6751	45.49	-24.25	21.24	40.00	-18.76	peak	P
3	122.8340	45.24	-22.77	22.47	43.50	-21.03	peak	P
4	209.3129	45.10	-24.75	20.35	43.50	-23.15	peak	P
5	300.3672	45.74	-21.49	24.25	46.00	-21.75	peak	P
6	378.5843	43.17	-19.76	23.41	46.00	-22.59	peak	P

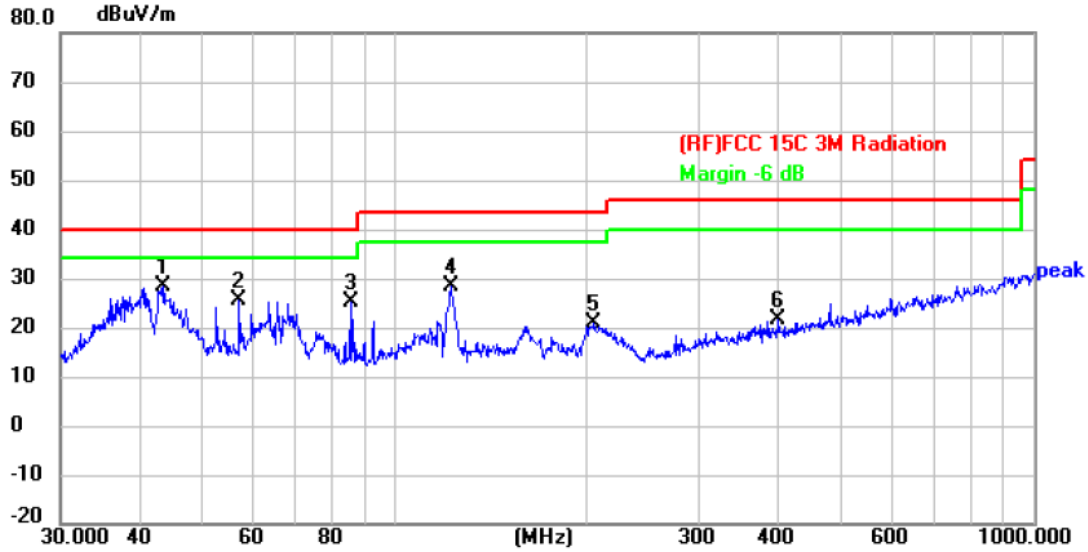
Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)

2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)

3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Test Voltage:	AC 120V/60Hz
Ant. Pol.	Vertical
Test Mode:	Mode 2 TX 1Mbps Mode Channel 00
Remark:	Only showed the worst mode test data.



Temperature: 23.9 ℃ Humidity: 48 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	43.3534	51.32	-22.84	28.48	40.00	-11.52	peak	P
2	57.1914	49.04	-23.51	25.53	40.00	-14.47	peak	P
3	85.2980	51.49	-26.36	25.13	40.00	-14.87	peak	P
4	122.4040	51.12	-22.90	28.22	43.50	-15.28	peak	P
5	204.9551	44.99	-24.11	20.88	43.50	-22.62	peak	P
6	399.0302	40.99	-19.37	21.62	46.00	-24.38	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Above 1GHz

Only showed the worst mode test data.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	BLE(1Mbps) Mode TX 2402MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	9491.5000	43.81	4.50	48.31	74.00	-25.69	peak	P
2	14795.5000	38.76	8.70	47.46	74.00	-26.54	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	BLE(1Mbps) Mode TX 2402MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	7222.0000	51.22	-3.33	47.89	74.00	-26.11	peak	P
2	9797.5000	44.18	3.69	47.87	74.00	-26.13	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	BLE(1Mbps) Mode TX 2440MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	9466.0000	43.76	4.38	48.14	74.00	-25.86	peak	P
2	13342.0000	41.41	5.49	46.90	74.00	-27.10	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	BLE(1Mbps) Mode TX 2440MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	9466.0000	43.67	4.38	48.05	74.00	-25.95	peak	P
2	11761.0000	39.53	6.44	45.97	74.00	-28.03	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	BLE(1Mbps) Mode TX 2480MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	9440.5000	43.57	4.13	47.70	74.00	-26.30	peak	P
2 *	14770.0000	39.84	8.49	48.33	74.00	-25.67	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

Temperature:	24.6℃	**Relative Humidity:**	53%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	BLE(1Mbps) Mode TX 2480MHz		

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	10843.0000	43.74	4.32	48.06	74.00	-25.94	peak	P
2 *	14795.5000	39.64	8.70	48.34	74.00	-25.66	peak	P

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)-AMP(dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency. Test with highpass filter (Pass Frequency: 2.8-18G and 8-25G), and 18GHz-26.5GHz is the noise, No other signals were detected.
5. Results below the limit by 20 dB were not recorded in the table.
6. The peak value＜average limit, So only show the peak value.

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