FCC RF Test Report

APPLICANT : Zhejiang Lingzhu Technology Co., Ltd.

EQUIPMENT: Smart Control Panel L

MODEL NAME : TPP05-Z(US) FCC ID : 2BEWX-TPP05

STANDARD : FCC Part 15 Subpart C §15.247

CLASSIFICATION : (DTS) Digital Transmission System

TEST DATE(S) : Mar. 23, 2024 ~ Apr. 15, 2024

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

JasonJia

Approved by: Jason Jia





Report No.: FR372501-02E

Sporton International Inc. (Kunshan)

No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR372501-02E	Rev. 01	Initial issue of report	Jul. 23, 2024

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SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Report only	-
3.2	15.247(b)(3)	Peak Output Power	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 2.29 dB at 324.880 MHz for Quasi-peak
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.27 dB at 0.532 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Note: This is a change FCC ID report. Since no changes have been made to this device, therefore, all test cases were leveraged from original report (FCC ID: 2A789-TPP05, report number FR372501-01)

Conformity Assessment Condition:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- 2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

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1 General Description

1.1 Applicant

Zhejiang Lingzhu Technology Co., Ltd.

Room 302, No 1 Building Huace Center, Xihu District, Hangzhou City, Zhejiang Province, China

1.2 Manufacturer

Zhejiang Lingzhu Technology Co., Ltd.

Room 302,No 1 Building Huace Center,Xihu District, Hangzhou City, Zhejiang Province,China

1.3 Product Feature of Equipment Under Test

Product Feature				
Equipment	Smart Control Panel L			
Model Name	TPP05-Z(US)			
FCC ID	2BEWX-TPP05			

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification			
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz		
Number of Channels	40		
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)		
Maximum Output Power to Antenna	BLE 1Mbps: 7.56 dBm (0.0057 W)		
Maximum Output Fower to Antenna	BLE 2Mbps: 7.83 dBm (0.0061 W)		
99% Occupied Bandwidth	BLE 1Mbps:1.020MHz		
39 % Occupied Bandwidth	BLE 2Mbps:2.040MHz		
Antenna Type / Gain IPEX Antenna with gain -2.07 dBi			
Type of Modulation Bluetooth LE : GFSK			

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

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1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

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Test Firm	Sporton International Inc. (Kunshan)				
	No. 1098, Pengxi North Road, Kunshan Economic Development Zone				
Test Site Location	Jiangsu Province 215300 People's Republic of China				
	TEL: +86-512-57900158				
	Sporton Sito No	ECC Designation No.	FCC Test Firm		
Test Site No.	Sporton Site No.	FCC Designation No.	Registration No.		
rest one NO.	CO01-KS 03CH07-KS TH01-KS	CN1257	314309		

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	SPORTON	FCC 15C-15E Test Tools Ver10.0_210607	10.0
2.	03CH07-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

- All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

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2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
2400-2483.5 MHz	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
[15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
[18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

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2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

	Summary table of Test Cases					
Test Item	Data Rate / Modulation					
rest item	Bluetooth – LE / GFSK					
	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps					
	Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps					
Conducted	Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps					
TCs	Mode 4: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps					
	Mode 5: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps					
	Mode 6: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps					
	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps					
	Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps					
Radiated	Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps					
TCs	Mode 4: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps					
	Mode 5: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps					
	Mode 6: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps					
AC						
Conducted	Mode 1: BT Link + WLAN Link(2.4G) + L1+L2 light link + RS485 Link + AC Power					
Emission						

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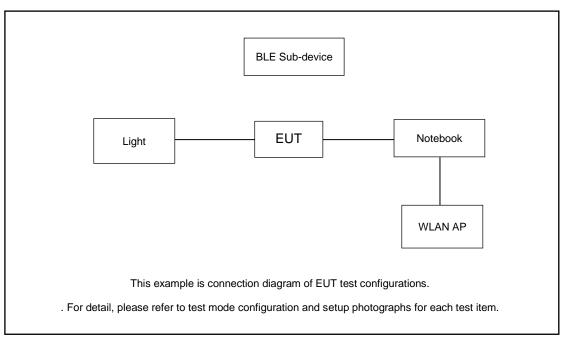
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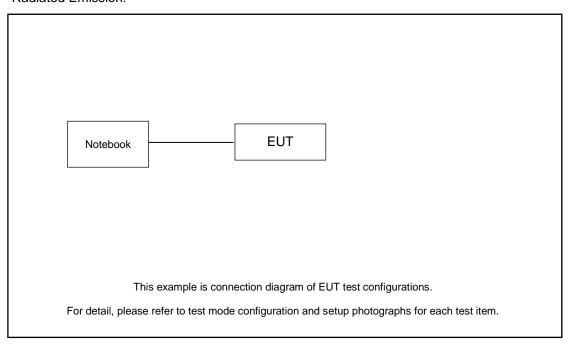
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2.3 Connection Diagram of Test System

Conducted Emission:



Radiated Emission:



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2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
2.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	Shielded cable DC O/P 1.8m, Unshielded AC I/P cable 1.8m
3.	Light	N/A	N/A	N/A	N/A	N/A
4.	AC Power	N/A	N/A	N/A	N/A	N/A
5.	BLE Sub-device	N/A	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the BLE Sub-device under large package sizes transmission.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example:

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

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5.80 dB

 $Offset(dB) = RF \ cable \ loss(dB)$ = 5.80(dB)

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3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

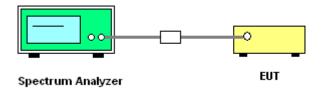
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 11.8
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
- 5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1% to 5% of the 99% OBW and the VBW is set to 3 times of the RBW.
- 6. Measure and record the results in the test report.

3.1.4 Test Setup



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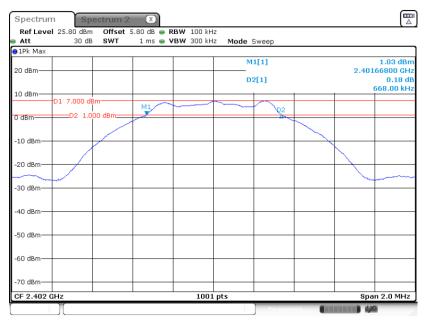
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3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

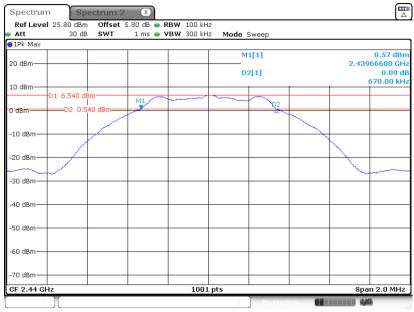
BLE 1Mbps

6 dB Bandwidth Plot on Channel 00



Date: 23.MAR.2024 04:33:52

6 dB Bandwidth Plot on Channel 19



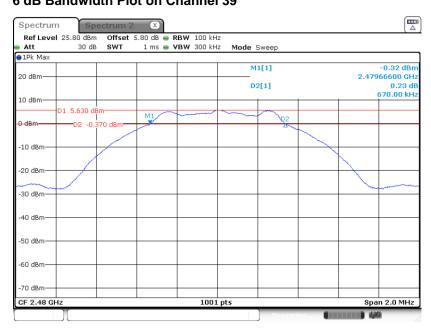
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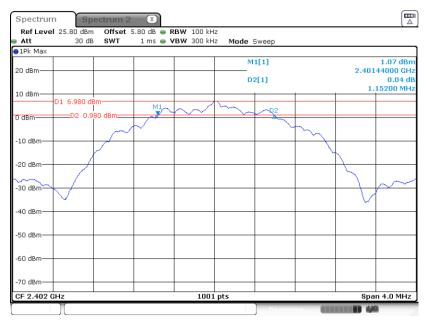
6 dB Bandwidth Plot on Channel 39



Date: 23.MAR.2024 04:42:20

BLE 2Mbps

6 dB Bandwidth Plot on Channel 00



Date: 23.MAR.2024 04:46:50

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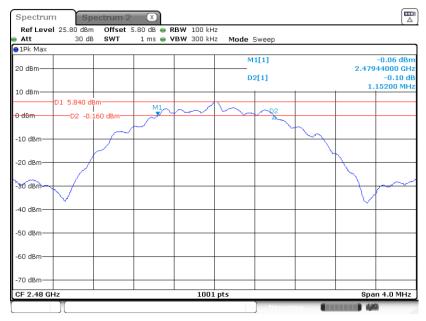
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6 dB Bandwidth Plot on Channel 19



Date: 23.MAR.2024 05:26:20

6 dB Bandwidth Plot on Channel 39



Date: 23.MAR.2024 05:30:29

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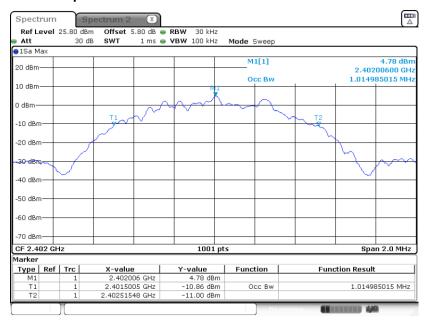
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3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

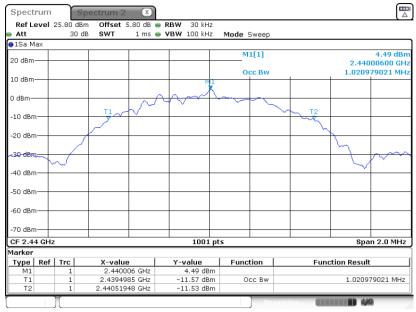
BLE 1Mbps

99% Occupied Bandwidth Plot on Channel 00



Date: 23.MAR.2024 04:35:39

99% Occupied Bandwidth Plot on Channel 19



Date: 23.MAR.2024 04:38:36

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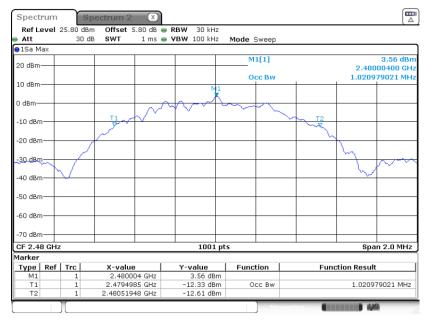
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PORTON LAB. FCC RF Test Report

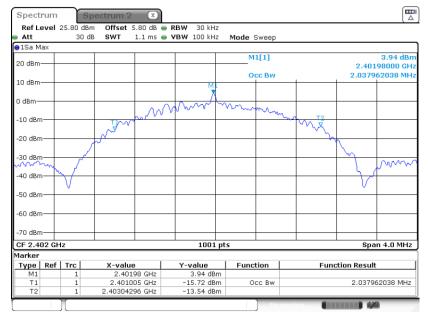
99% Occupied Bandwidth Plot on Channel 39



Date: 23.MAR.2024 04:44:07

BLE 2Mbps

99% Occupied Bandwidth Plot on Channel 00



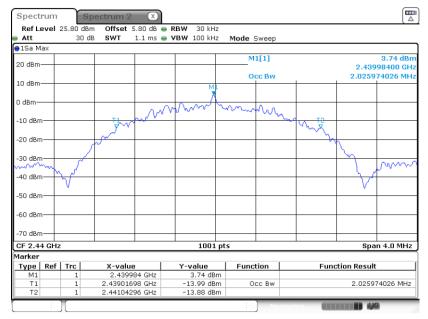
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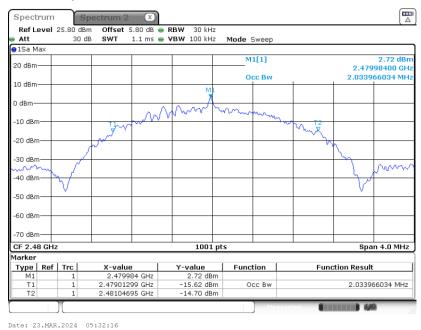
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99% Occupied Bandwidth Plot on Channel 19



Date: 23.MAR.2024 05:27:48

99% Occupied Bandwidth Plot on Channel 39



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

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3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

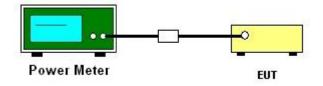
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

- The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
- 2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

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3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

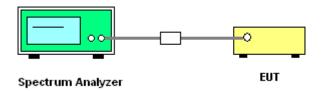
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

- The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
- 5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
- 6. Measure and record the results in the test report.
- 7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

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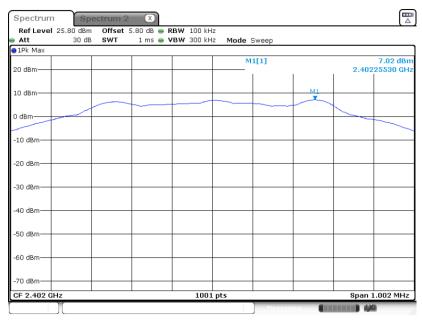
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3.3.6 Test Result of Power Spectral Density Plots (100kHz)

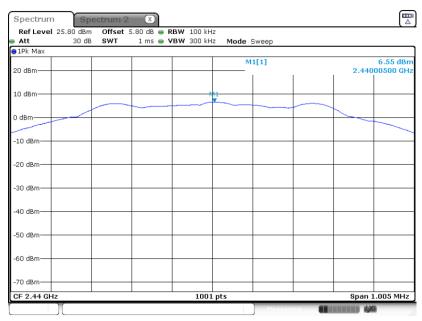
BLE 1Mbps

PSD 100kHz Plot on Channel 00



Date: 23.MAR.2024 04:34:30

PSD 100kHz Plot on Channel 19



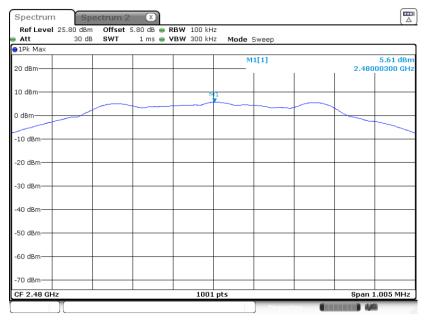
Date: 23.MAR.2024 04:37:46

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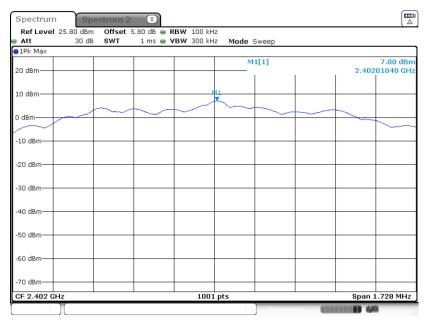
PSD 100kHz Plot on Channel 39



Date: 23.MAR.2024 04:42:58

BLE 2Mbps

PSD 100kHz Plot on Channel 00



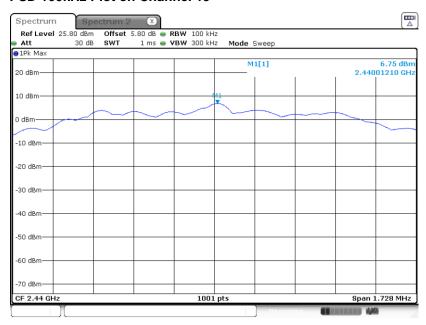
Date: 23.MAR.2024 04:47:28

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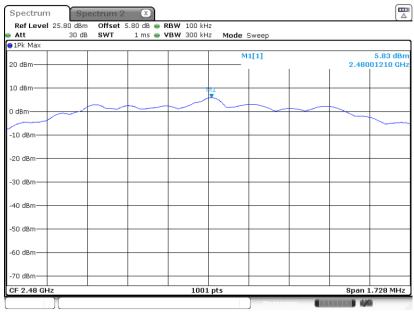
CRF Test Report No.: FR372501-02E

PSD 100kHz Plot on Channel 19



Date: 23.MAR.2024 05:26:58

PSD 100kHz Plot on Channel 39



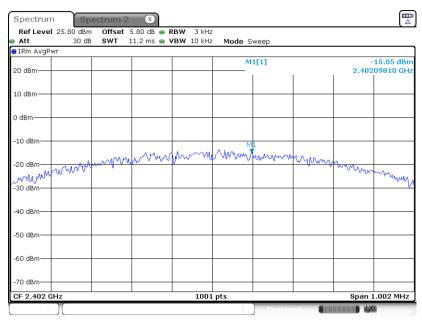
Date: 23.MAR.2024 05:31:07

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3.3.7 Test Result of Power Spectral Density Plots (3kHz)

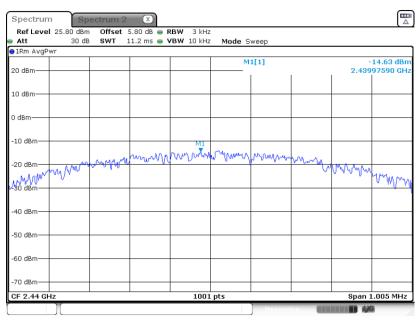
BLE 1Mbps

PSD 3kHz Plot on Channel 00



Date: 23.MAR.2024 04:34:11

PSD 3kHz Plot on Channel 19



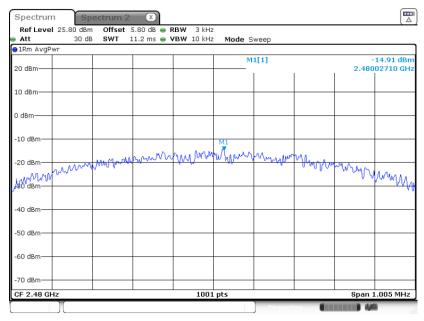
Date: 23.MAR.2024 04:37:27

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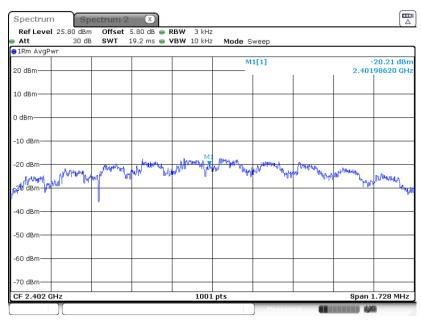
PSD 3kHz Plot on Channel 39



Date: 23.MAR.2024 04:42:39

BLE 2Mbps

PSD 3kHz Plot on Channel 00



Date: 23.MAR.2024 04:47:09

Sporton International Inc. (Kunshan)

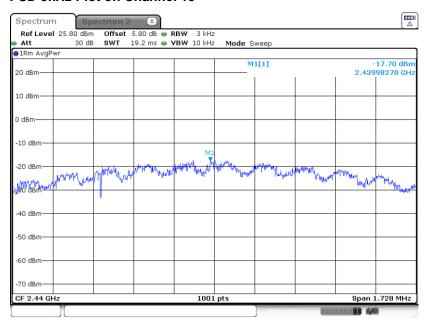
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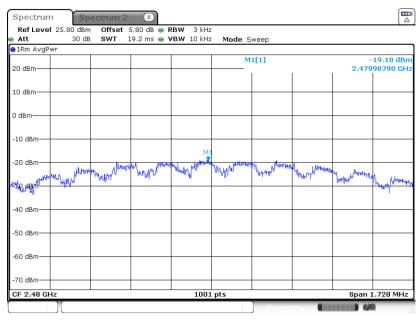
FCC RF Test Report

PSD 3kHz Plot on Channel 19



Date: 23.MAR.2024 05:26:39

PSD 3kHz Plot on Channel 39



Date: 23.MAR.2024 05:30:48

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3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

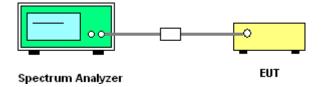
3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

- 1. The testing follows ANSI C63.10-2013 clause 11.13
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
- 5. Measure and record the results in the test report.
- 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



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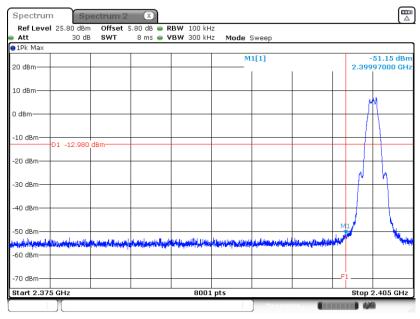
 FCC ID: 2BEWX-TPP05
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Report Template No.: BU5-FR15CBT4.0 Version 2.0

3.4.5 Test Result of Conducted Band Edges Plots

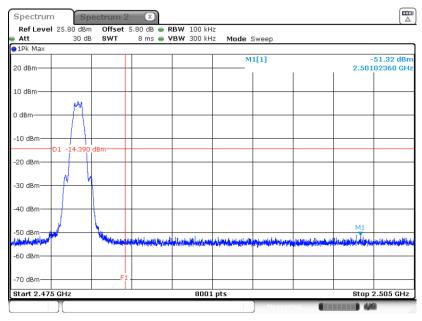
BLE 1Mbps

Low Band Edge Plot on Channel 00



Date: 23.MAR.2024 04:34:49

High Band Edge Plot on Channel 39



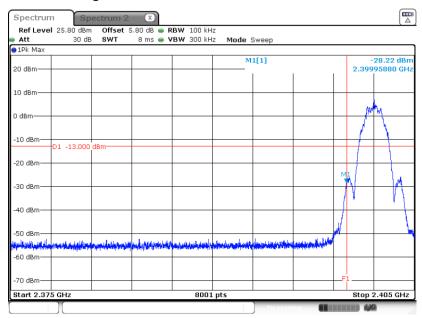
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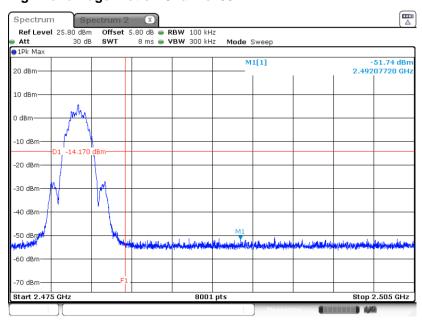
BLE 2Mbps

Low Band Edge Plot on Channel 00



Date: 23.MAR.2024 04:47:47

High Band Edge Plot on Channel 39



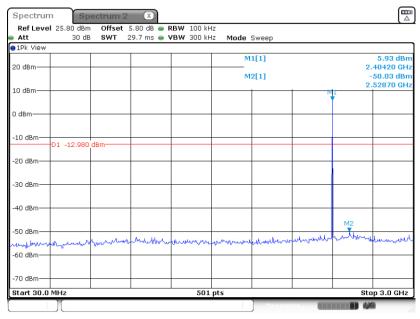
Date: 23.MAR.2024 05:31:26

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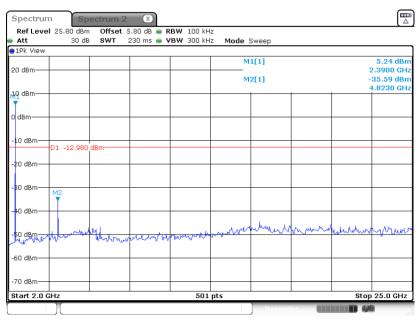
3.4.6 Test Result of Conducted Spurious Emission Plots

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00



Date: 23.MAR.2024 04:35:10

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00



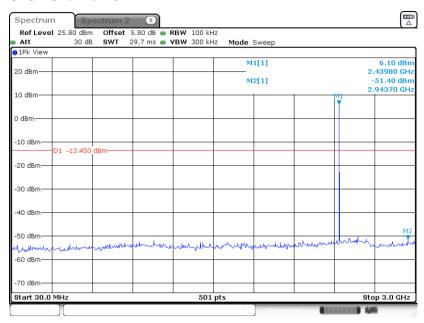
Date: 23.MAR.2024 04:35:30

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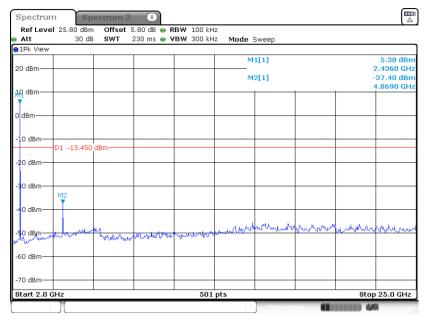
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Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



Date: 23.MAR.2024 04:38:07

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



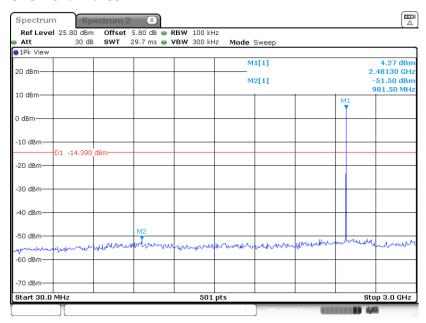
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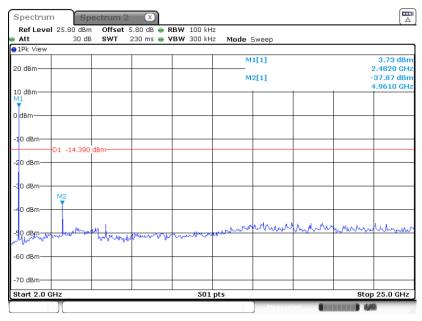
Report No.: FR372501-02E

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 23.MAR.2024 04:43:38

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



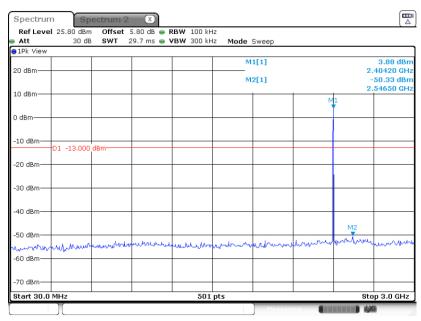
Date: 23.MAR.2024 04:43:58

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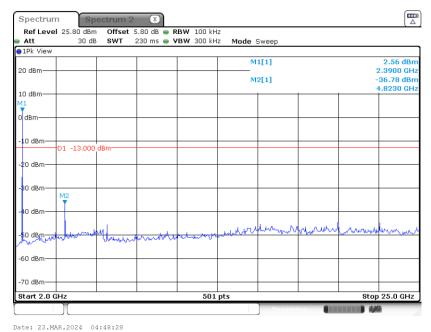
Report No.: FR372501-02E

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00



Date: 23.MAR.2024 04:48:08

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00

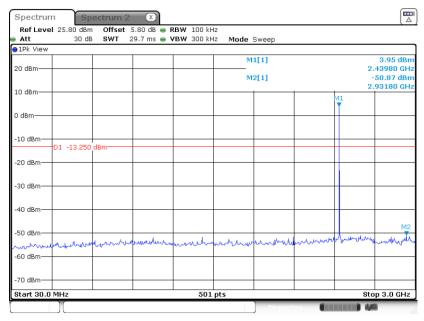


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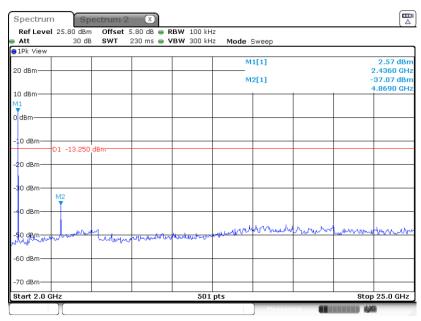
Report No.: FR372501-02E

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



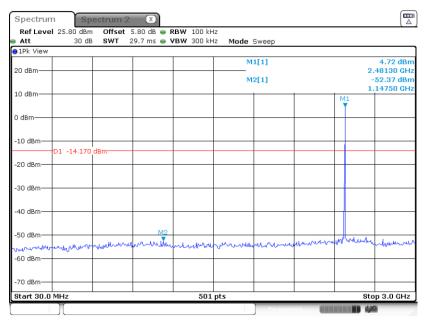
Date: 23.MAR.2024 05:27:19

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



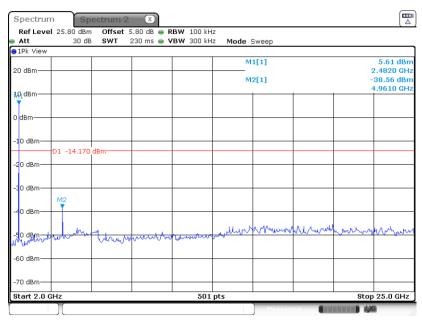
Date: 23.MAR.2024 05:27:39

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39



Date: 23.MAR.2024 05:31:47

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39



Date: 23.MAR.2024 05:32:07

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3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(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

3.5.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

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3.5.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
- 7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- 8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \ge 1$ GHz for peak measurement. For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

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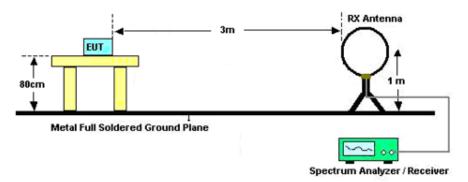
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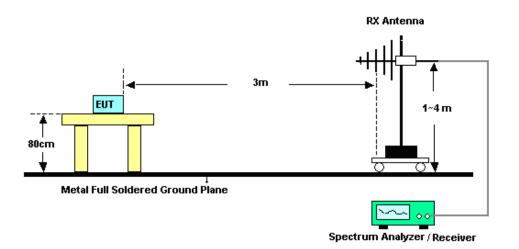
Report Template No.: BU5-FR15CBT4.0 Version 2.0

3.5.4 Test Setup

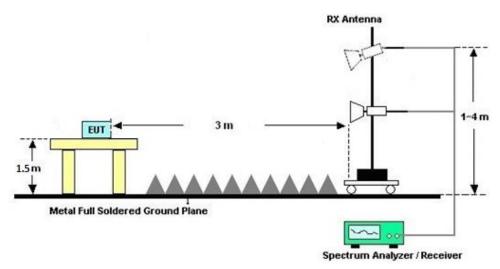
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

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

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There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C

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3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Eroquency of emission (MUz)	Conducted	limit (dΒμV)
Frequency of emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

^{*}Decreases with the logarithm of the frequency.

3.6.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.6.3 Test Procedures

- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

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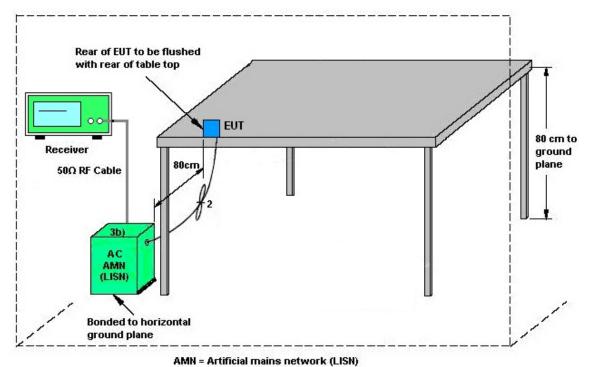
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3.6.4 Test Setup



AE = Associated equipment

EUT = Equipment under test

ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

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3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

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

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4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S FSV40		101040	10Hz~40GHz	Oct. 11, 2023	Mar. 23, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GH z	Jan. 02, 2024	Mar. 23, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Mar. 23, 2024	Jan. 01, 2025	Conducted (TH01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz;Ma x 30dBm	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY553705 28	10Hz-44G,MAX 30dB	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
Bilog Antenna	TeseQ	CBL6111D	59913	30MHz-1GHz	Aug. 12, 2023	Apr. 15, 2024	Aug. 11, 2024	Radiation (03CH07-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218642	1GHz~18GHz	Apr. 06, 2023	Apr. 15, 2024	Apr. 05, 2024	Radiation (03CH07-KS)
high gain Amplifier	EM	EM01G18GA	060840	1Ghz-18Ghz	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
Amplifier	SONOMA	310N	413740	9KHz-1GHz	Jan. 04, 2024	Apr. 15, 2024	Jan. 03, 2025	Radiation (03CH07-KS)
Amplifier	EM	EM01G18GA	060834	1Ghz-18Ghz	Oct. 10, 2023	Apr. 15, 2024	Oct. 09, 2024	Radiation (03CH07-KS)
Amplifier	EM	EM18G40GG A	060851	18~40GHz	Jan. 04, 2024	Apr. 15, 2024	Jan. 03, 2025	Radiation (03CH07-KS)
AC Power Source	Chroma	61601	616010002 473	N/A	NCR	Apr. 15, 2024	NCR	Radiation (03CH07-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Apr. 15, 2024	NCR	Radiation (03CH07-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Apr. 15, 2024	NCR	Radiation (03CH07-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Mar. 27, 2024	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Mar. 27, 2024	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Mar. 27, 2024	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000 0811	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Mar. 27, 2024	Oct. 10, 2024	Conduction (CO01-KS)

NCR: No Calibration Required

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5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. 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.

Uncertainty of Conducted Measurement

Conducted Spurious Emission & Bandedge	±2.26 dB
Occupied Channel Bandwidth	±0.1%
Conducted Power	±0.46 dB
Conducted Power Spectral Density	±0.88 dB
Frequency	±0.4 Hz

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence	2.84dB
of 95% (U = 2Uc(y))	2.84uB

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

- 1		
	Measuring Uncertainty for a Level of Confidence	3.30dB
	of 95% (U = 2Uc(y))	3.30UB

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.20dB
---------------------------------------------------------------------	--------

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence	4.86dB
of 95% (U = 2Uc(y))	4.00UB

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence	5.24dB
of 95% (U = 2Uc(y))	5.24 u B

----- THE END -----

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Appendix A. Conducted Test Results

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Bluetooth Low Energy

Test Engineer:	Jiang Jun	Temperature:	20~26	ç
Test Date:	2024/3/23	Relative Humidity:	40~51	%

BLE1M

TEST RESULTS DATA 6dB and 99% Occupied Bandwidth

Mod.	Data Rate	N TX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.010	0.67	0.50	Pass
BLE	1Mbps	1	19	2440	1.020	0.67	0.50	Pass
BIE	1Mhne	1	30	2/180	1 020	0.67	0.50	Dacc

TEST RESULTS DATA

Peak Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	7.56	30.00	-2.07	5.49	36.00	Pass
BLE	1Mbps	1	19	2440	7.28	30.00	-2.07	5.21	36.00	Pass
BLE	1Mbps	1	39	2480	6.35	30.00	-2.07	4.28	36.00	Pass

TEST RESULTS DATA

Average Power Table

(Reporting Only)

Mod.	Data Rate	N⊤x	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
BLE	1Mbps	1	0	2402	0.68	7.50
BLE	1Mbps	1	19	2440	0.68	7.25
BLE	1Mbps	1	39	2480	0.68	6.23

TEST RESULTS DATA

Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	7.02	-15.05	-2.07	8.00	Pass
BLE	1Mbps	1	19	2440	6.55	-14.63	-2.07	8.00	Pass
BLE	1Mbps	1	39	2480	5.61	-14.91	-2.07	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Report Number : FR372501-02E

Bluetooth Low Energy

Test Engineer:	Jiang Jun	Temperature:	20~26	°C
Test Date:	2024/3/23	Relative Humidity:	40~51	%

BLE2M

TEST RESULTS DATA 6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	2Mbps	1	0	1000	2.040	1.15	0.50	Pass
BLE	2Mbps	1	19	2440	2.025	1.15	0.50	Pass
BLE	2Mbps	1	39	2480	2.030	1.15	0.50	Pass

TEST RESULTS DATA

Peak Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	2Mbps	1	0	2402	7.83	30.00	-2.07	5.76	36.00	Pass
BLE	2Mbps	1	19	2440	7.69	30.00	-2.07	5.62	36.00	Pass
BLE	2Mbps	1	39	2480	6.69	30.00	-2.07	4.62	36.00	Pass

TEST RESULTS DATA

Average Power Table (Reporting Only)

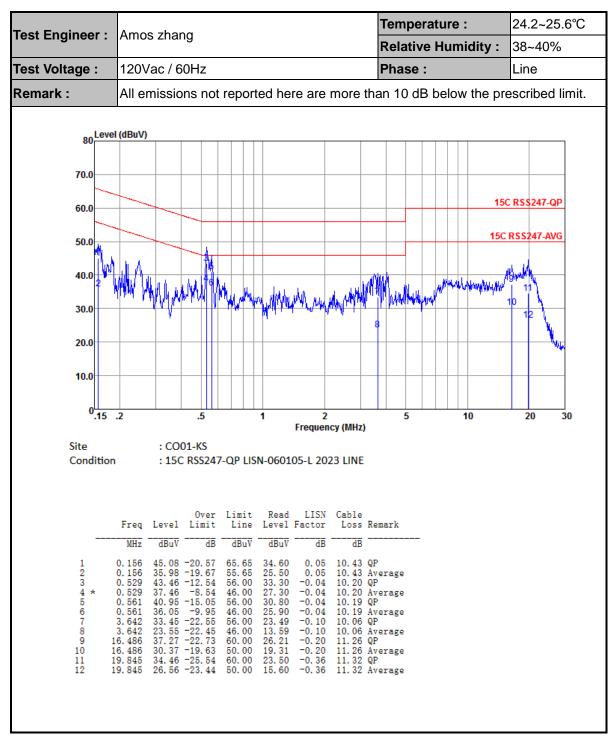
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
BLE	2Mbps	1	0	2402	2.40	7.25
BLE	2Mbps	1	19	2440	2.40	7.23
BLE	2Mbps	1	39	2480	2.40	6.52

TEST RESULTS DATA Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	2Mbps	1	0	2402	7.00	-20.21	-2.07	8.00	Pass
BLE	2Mbps	1	19	2440	6.75	-17.70	-2.07	8.00	Pass
BLE	2Mbps	1	39	2480	5.83	-19.18	-2.07	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

Appendix B. AC Conducted Emission Test Results



TEL: +86-512-57900158 FCC ID: 2BEWX-TPP05 Report No.: FR372501-02E

Foot Funings	A		Temperature :	24.2~25.6°C
est Engineer :	Amos zhang		Relative Humidity	: 38~40%
est Voltage :	120Vac / 60Hz		Phase :	Neutral
Remark :	All emissions not	reported here are me	ore than 10 dB below the I	prescribed limit
Louis	(dData)			
80 Level	(dBuV)			
70.0				
				15C RS\$247-QP
60.0				
50.0	1		1	5C RSS247-AVG
40.0	dry			Marily
Total Pile	'Y 'Y\J]VyU,,,YVXYY]W	ومال المراجعة والمحال المالية	March Control of the	MM 9' 1/1/1/
30.0	 	isad the Arabita altra days a bear h	Y WALL TO THE PARTY OF THE PART	10 12
20.0			6 9	A AMANA
40.0				
10.0				
0.15	.2 .5	1 2	5 10	20 30
611	CO04 KG	Frequency	(MHz)	
Site Condition	: CO01-KS : 15C RSS247	7-QP LISN-060105-N 2023	NEUTRAL	
	0ver	Limit Read LISN C	able	
	Freq Level Limit	Line Level Factor	Loss Remark	
	MHz dBuV dB	dBuV dBuV dB	dB	
2 *	0.532 45.63 -10.37 0.532 39.73 -6.27	46.00 29.60 -0.07 1	0.20 QP 0.20 Average	
4	0.564 41.62 -14.38 0.564 37.62 -8.38 3.241 32.13 -23.87		0.19 QP 0.19 Average 0.06 QP	
6	3. 241 32. 13 23. 67 3. 241 22. 53 -23. 47 3. 642 33. 13 -22. 87	46.00 12.60 -0.13 1		
8	3. 642 23. 13 -22. 87 6. 055 36. 32 -23. 68	46.00 13.20 -0.13 16 60.00 25.20 -0.14 1	0.06 Average	
10 1	6. 055 27. 02 -22. 98 0. 162 35. 66 -24. 34	50.00 15.90 -0.14 1	1.26 Average 1.33 QP	
	0.162 27.66 -22.34		1.33 Average	

Note:

- 1. Level(dB μ V) = Read Level(dB μ V) + LISN Factor(dB) + Cable Loss(dB)
- 2. Over Limit(dB) = Level(dB μ V) Limit Line(dB μ V)

Appendix C. Radiated Spurious Emission

Test Engineer :	Jako Zhou	Relative Humidity :	41 ~ 42 %
rest Engineer.	Jake Zhou	Temperature :	22 ~ 23 ℃

Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2400-2483.5	Bluetooth-LE_GSFK	00	2402	1Mbps	-	-
Mode 2	2400-2483.5	Bluetooth-LE_GSFK	19	2440	1Mbps	-	-
Mode 3	2400-2483.5	Bluetooth-LE_GSFK	39	2480	1Mbps	-	-
Mode 4	2400-2483.5	Bluetooth-LE_GSFK	00	2402	2Mbps	-	-
Mode 5	2400-2483.5	Bluetooth-LE_GSFK	19	2440	2Mbps	-	-
Mode 6	2400-2483.5	Bluetooth-LE_GSFK	39	2480	2Mbps	-	-
Co-Location	2400-2483.5	Bluetooth-LE_GSFK	00	2402	1Mbps	-	-
Co-Location	2400-2483.5	Zigbee	26	2480	250Kbps	-	-

Summary of each worse mode

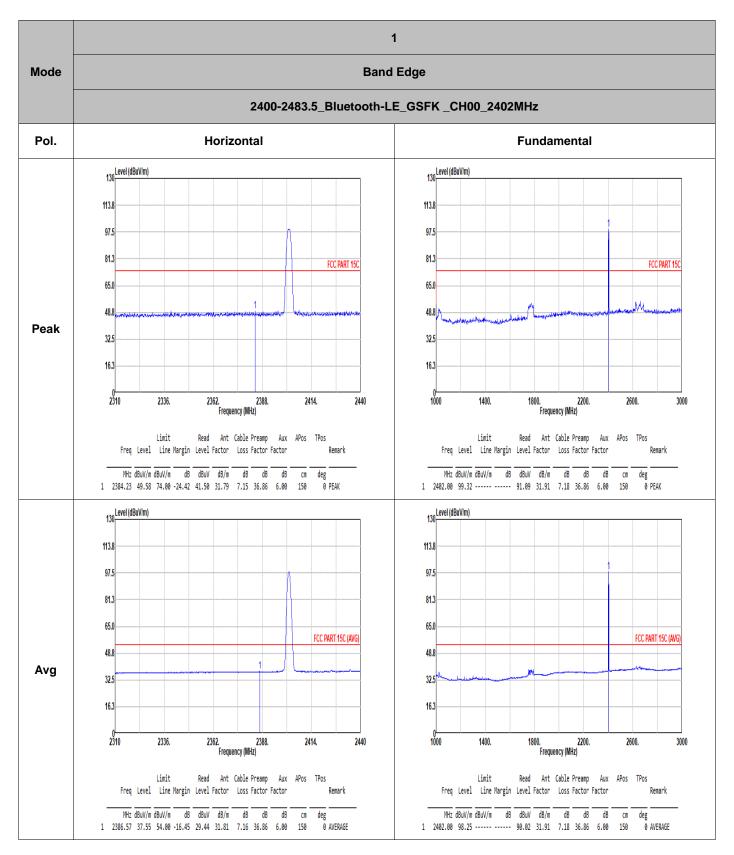
Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	Bluetooth-LE_GSFK	00	2386.57	37.55	54.00	-16.45	Н	AVERAGE	Pass	Band Edge
1	Bluetooth-LE_GSFK	00	4804.00	47.92	54.00	-6.08	Н	AVERAGE	Pass	Harmonic
2	Bluetooth-LE_GSFK	19	-	-	-	-	-	-	-	Band Edge
2	Bluetooth-LE_GSFK	19	5371.00	41.21	54.00	-12.79	V	Average	Pass	Harmonic
3	Bluetooth-LE_GSFK	39	2483.50	39.20	54.00	-14.80	Н	AVERAGE	Pass	Band Edge
3	Bluetooth-LE_GSFK	39	5073.00	41.85	54.00	-12.15	V	Average	Pass	Harmonic
4	Bluetooth-LE_GSFK	00	2369.28	37.84	54.00	-16.16	Н	AVERAGE	Pass	Band Edge
4	Bluetooth-LE_GSFK	00	4954.00	41.44	54.00	-12.56	V	Average	Pass	Harmonic
5	Bluetooth-LE_GSFK	19	-	-	-	-	-	-	-	Band Edge
5	Bluetooth-LE_GSFK	19	5073.00	41.85	54.00	-12.15	Н	Average	Pass	Harmonic
6	Bluetooth-LE_GSFK	39	2483.50	42.28	54.00	-11.72	Н	AVERAGE	Pass	Band Edge
6	Bluetooth-LE_GSFK	39	5071.00	41.14	54.00	-12.86	Н	Average	Pass	Harmonic
	Bluetooth-LE_GSFK	00	2480.00	100.63	54.00	46.63	V	Average	Fail	Band Edge
Co-Location	Zighaa	26	2483.50	47.47	54.00	-6.53	Н	AVERAGE	Pass	Band Edge
	Zigbee	26	5367.00	41.29	54.00	-12.71	V	Average	Pass	Harmonic

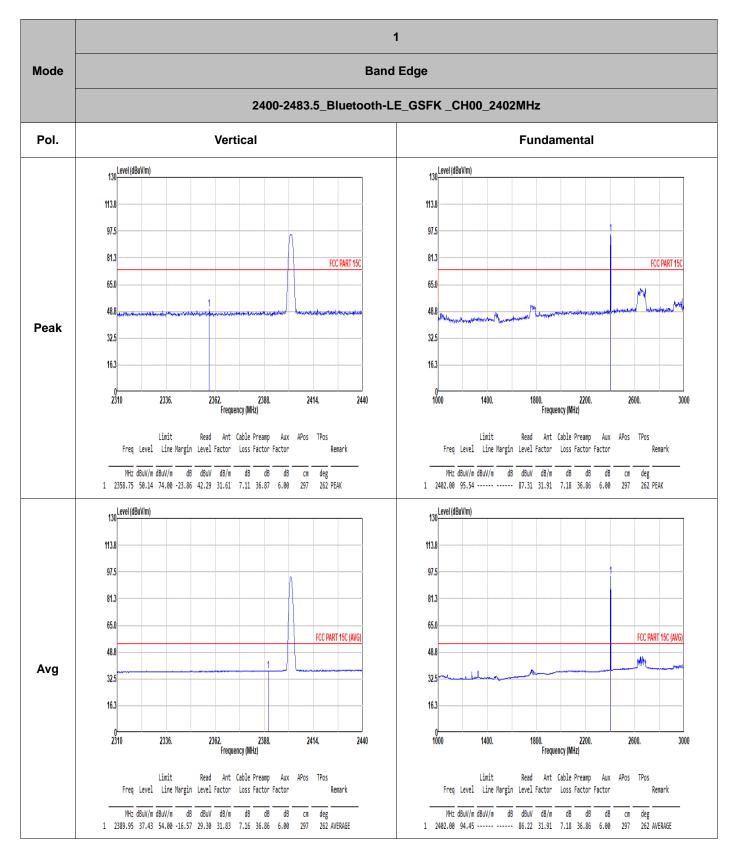
Note: The following frequencies of Harmonic which fall in the non-restricted frequency band, the limit is 100kHz-PSD down 20dB.

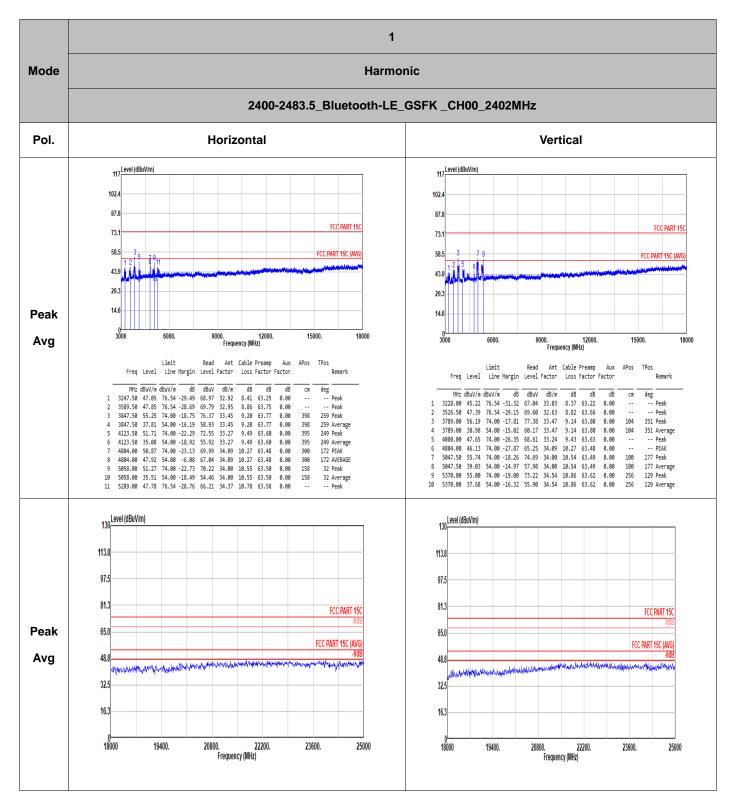
Sporton International Inc. (Kunshan) TEL: +86-512-57900158

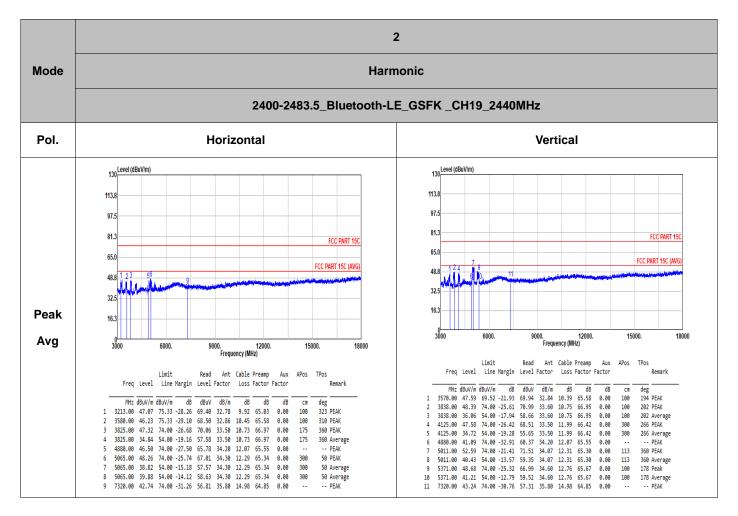
FCC ID: 2BEWX-TPP05

Report No.:FR372501-02E

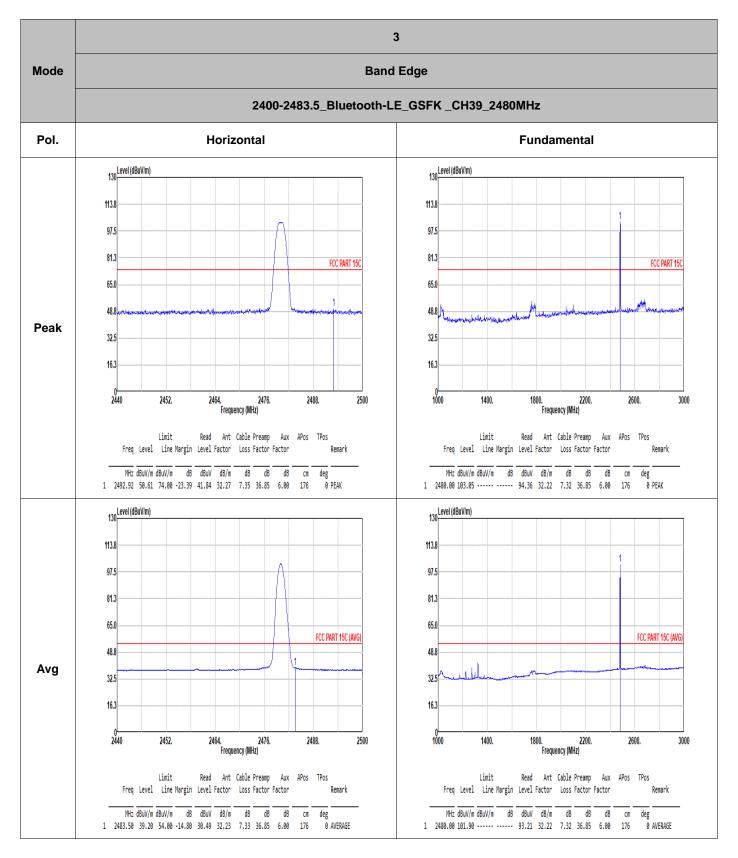


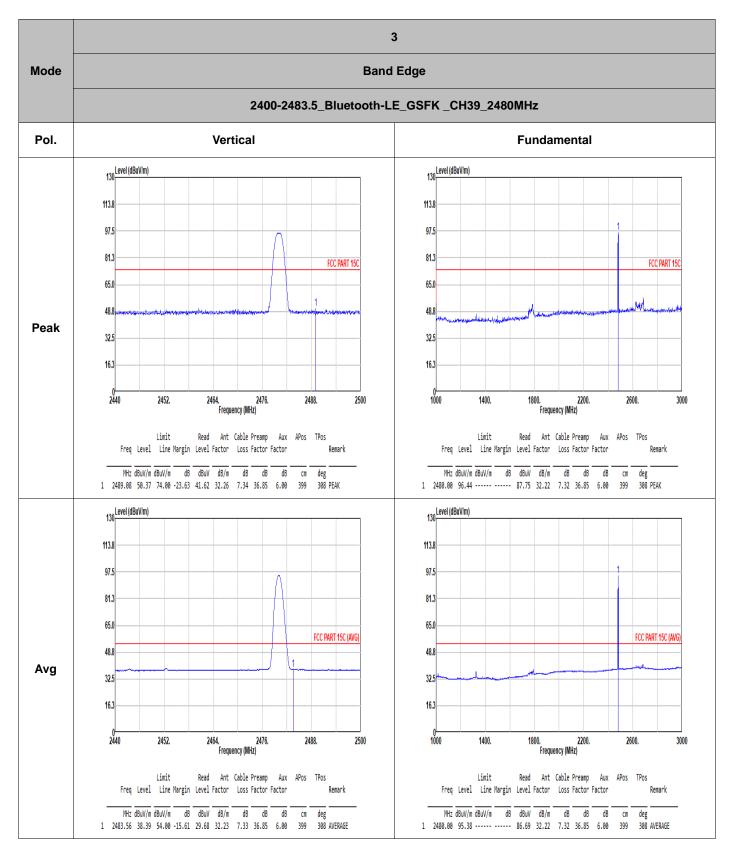


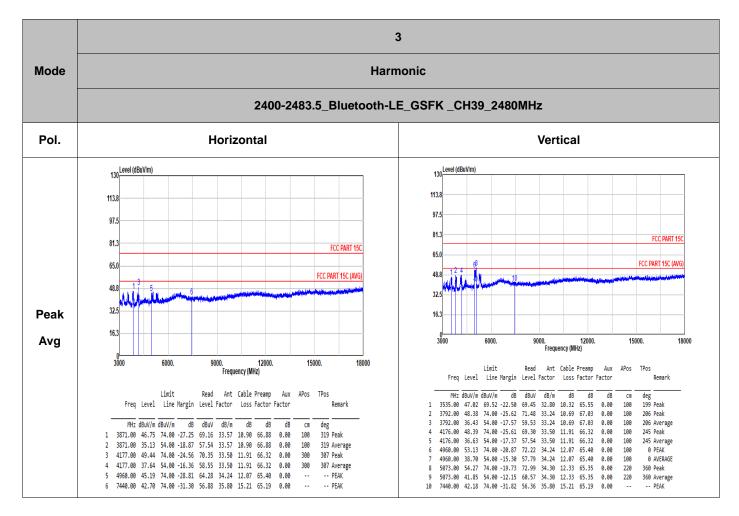


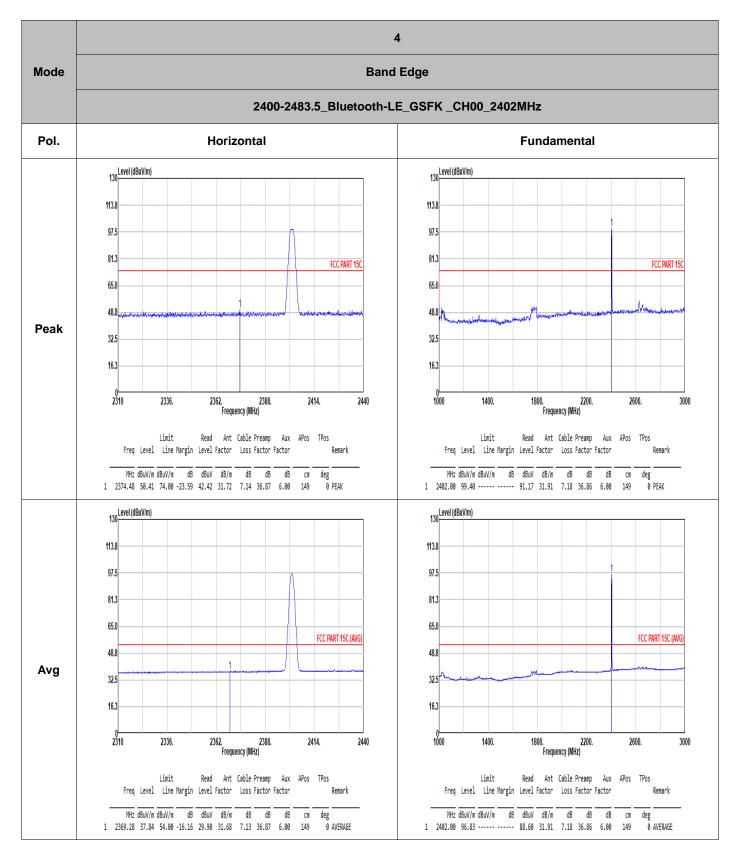


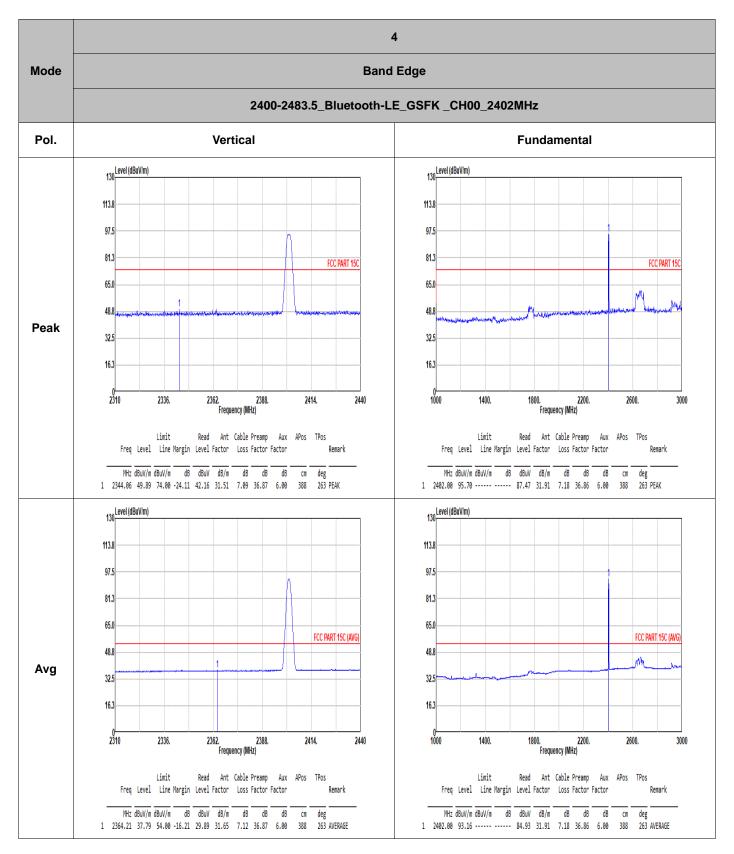
CC RF Test Report Report No.:FR372501-02E

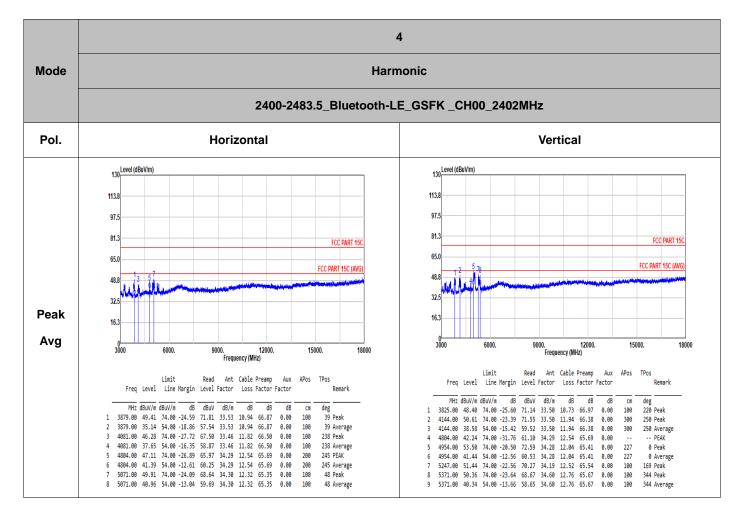


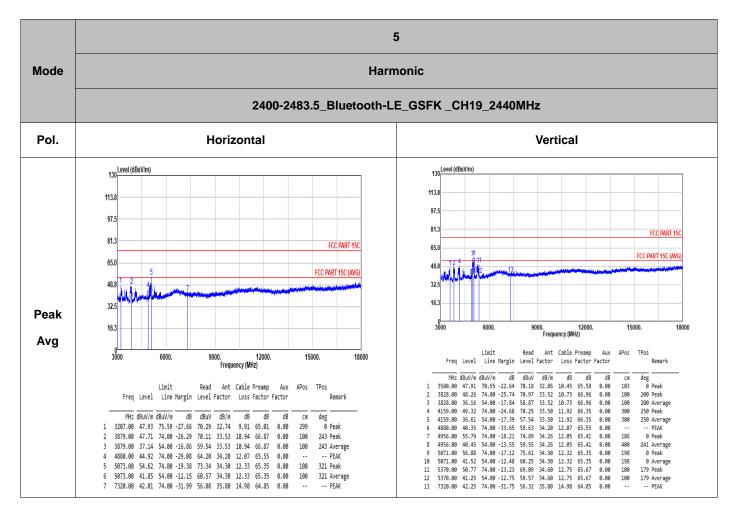


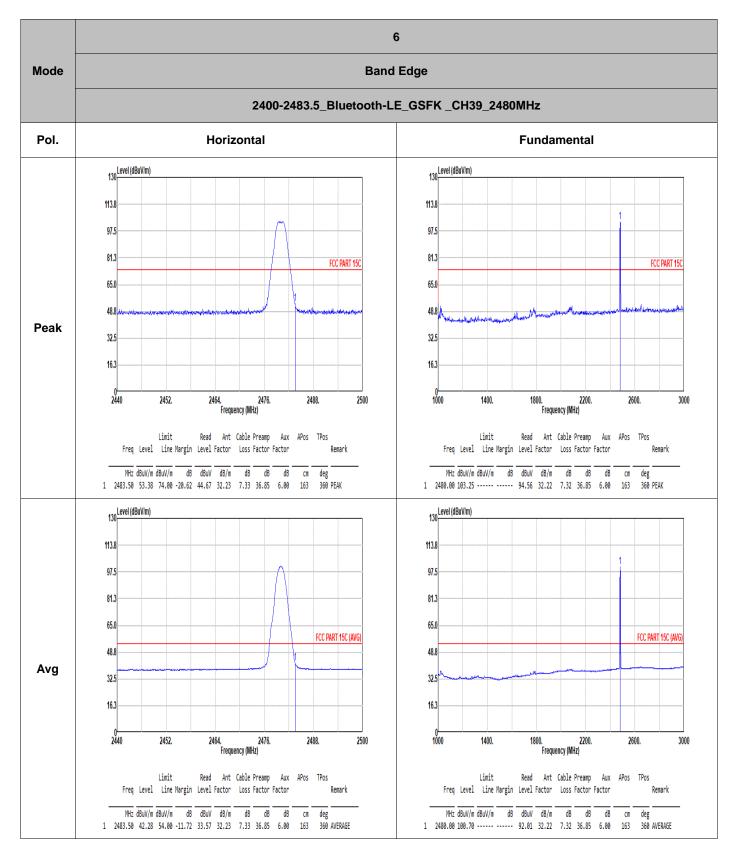


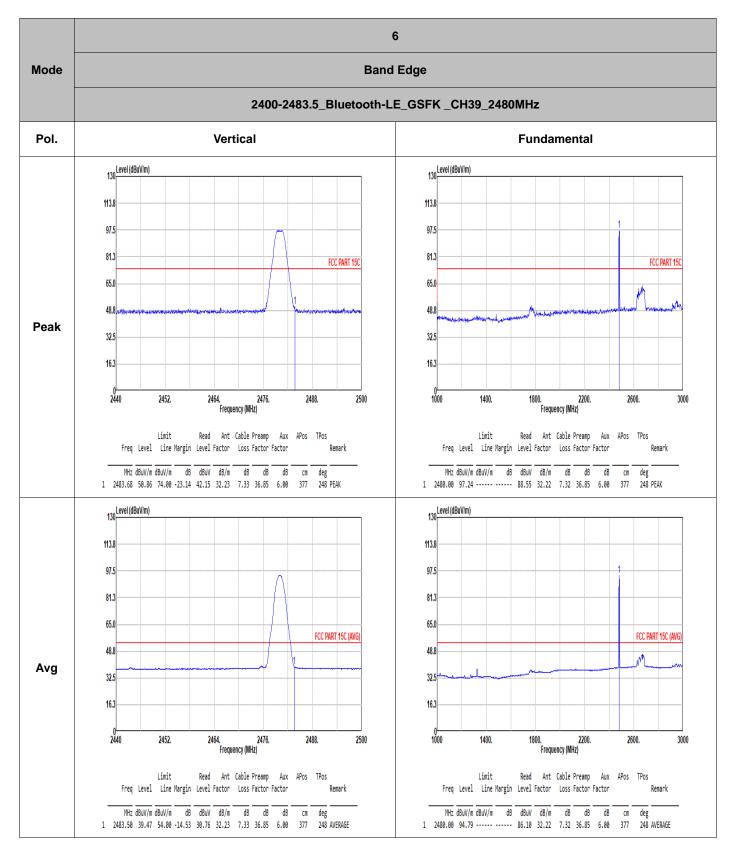


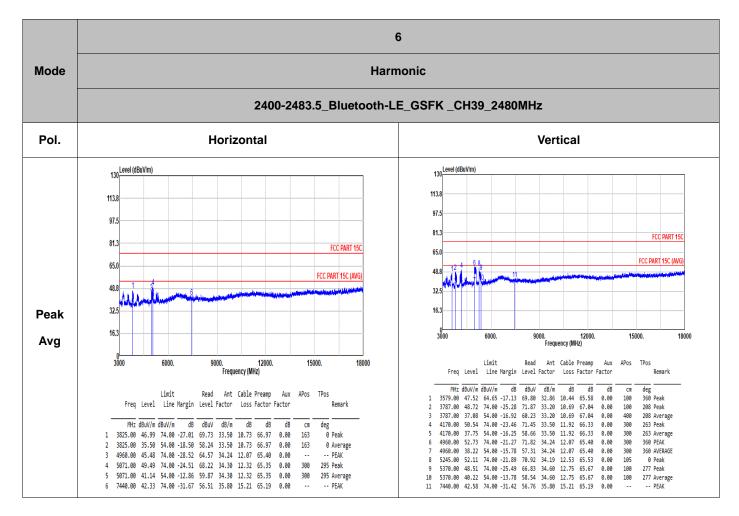


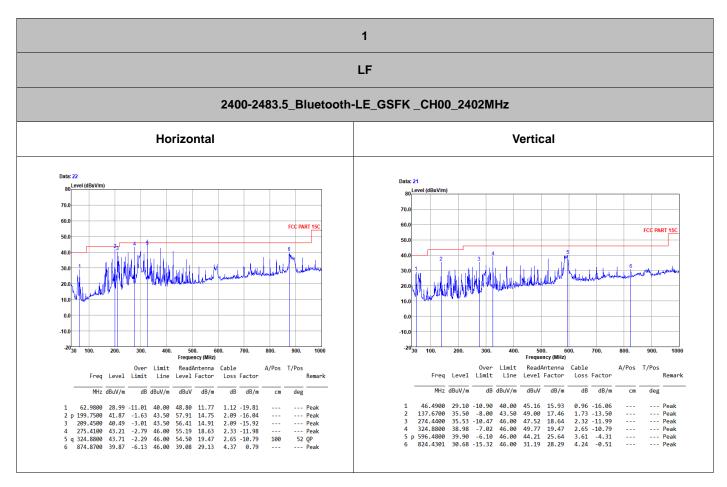


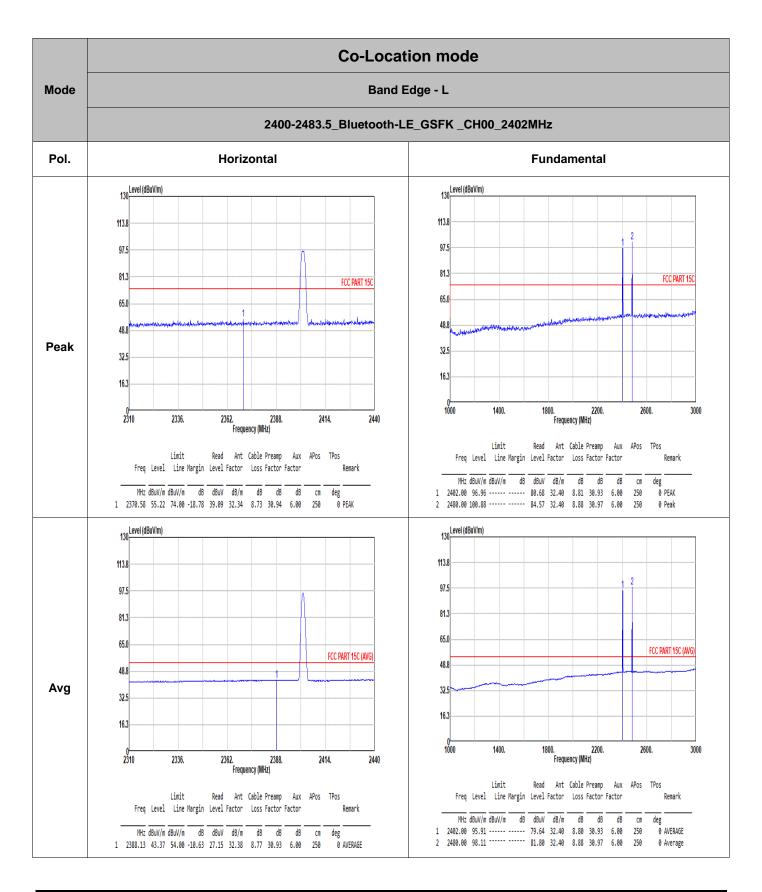


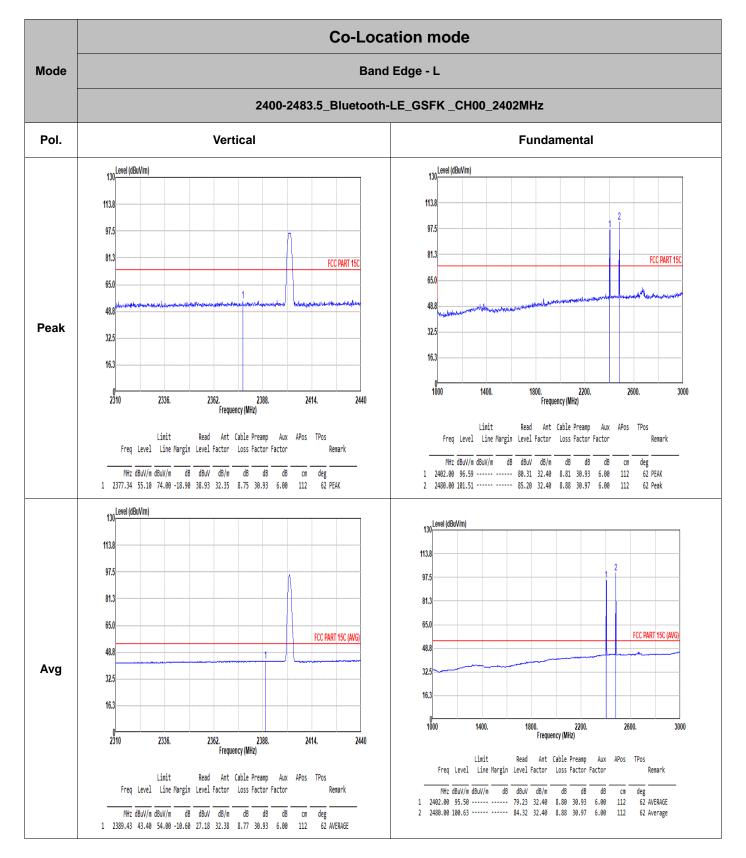


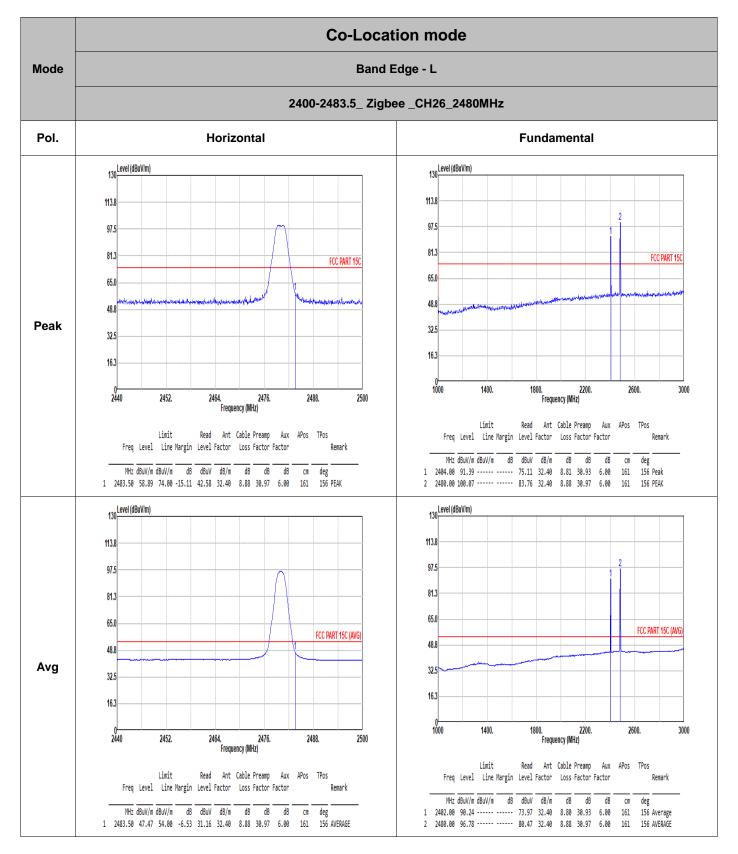




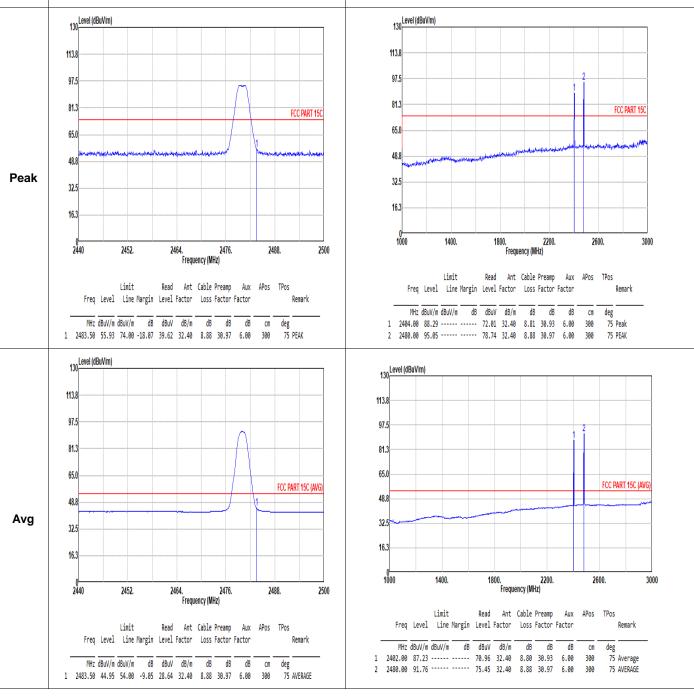








Report No.:FR372501-02E Co-Location mode Band Edge - L Mode 2400-2483.5_ Zigbee _CH26_2480MHz Pol. Vertical **Fundamental** 130 Level (dBuV/m) 130 Level (dBuV/m) 113.8 113.8 97.5 97.5 81.3 81.3 65.0 65.0 48.8 48.8 **Peak** 32.5 32.5 16.3 16.3 0 1000 1400. 2600. 3000 2440 2464. 2476. Frequency (MHz) Frequency (MHz) 2452. 2488. 2500 Limit Read Ant Cable Preamp Aux APos TPos Read Ant Cable Preamp Aux APos TPos Limit Freq Level Line Margin Level Factor Loss Factor Factor Freq Level Line Margin Level Factor Loss Factor Factor MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2404.00 88.29 ----- 72.01 32.40 8.81 30.93 6.00 300 75 Peak 2 2480.00 95.05 ----- 78.74 32.40 8.88 30.97 6.00 300 1 2483.50 55.93 74.00 -18.07 39.62 32.40 8.88 30.97 6.00 300 130 Level (dBuV/m) 130 Level (dBuV/m) 113.8 113.8 97.5 97.5 81.3 81.3 65.0 65.0 FCC PART 15C (AVG FCC PART 15C (AVG) 48.8 48.8 Avg 32.5 32.5 16.3



Co-Location mode Mode Harmonic 2400-2483.5_ Zigbee _CH26_2480MHz Pol. Horizontal Vertical 130 Level (dBuV/m) 130 Level (dBuV/m) 113.8 113.8 97.5 97.5 81.3 FCC PART 150 81.3 FCC PART 15C 65.0 FCC PART 15C (AVG FCC PART 15C (AVG) 32.5 Peak Avg 3000 15000. 6000. 9000. 12000. 18000 Frequency (MHz) 3000 6000. 12000. 15000. 18000 Frequency (MHz) Limit Read Ant Cable Preamp Aux APos TPos Freq Level Line Margin Level Factor Loss Factor Factor Limit Read Ant Cable Preamp Aux APos TPos deg 250 Peak -- PEAK dBuV dB/m Freq Level Line Margin Level Factor Loss Factor Factor Remark 4804.00 50.70 74.00 -23.30 69.79 34.24 12.07 65.40 0.00 MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 271 Peak 4960.00 40.46 54.00 -13.54 59.55 34.24 12.07 65.40 0.00 5071.00 53.21 74.00 -20.79 71.94 34.30 12.32 65.35 0.00 100 246 205 Average 360 Peak 3789.00 45.37 74.00 -28.63 68.51 33.21 10.69 67.04 0.00 100

271 Average

-- PEAK

-- PEAK

3789.00 34.51 54.00 -19.49 57.65 33.21 10.69 67.04 0.00

4804.00 46.65 74.00 -27.35 65.51 34.29 12.54 65.69 0.00 4960.00 43.87 74.00 -30.13 62.96 34.24 12.07 65.40 0.00

7440.00 42.49 74.00 -31.51 56.67 35.80 15.21 65.19 0.00

TEL: +86-512-57900158 FCC ID: 2BEWX-TPP05 5071.00 40.95 54.00 -13.05 59.68 34.30 12.32 65.35 0.00 5367.00 50.57 74.00 -23.43 68.92 34.60 12.72 65.67 0.00

5367.00 41.29 54.00 -12.71 59.64 34.60 12.72 65.67

8 7440.00 44.56 74.00 -29.44 58.74 35.80 15.21 65.19 0.00

246 100 360 Average 73 Peak

73 Average

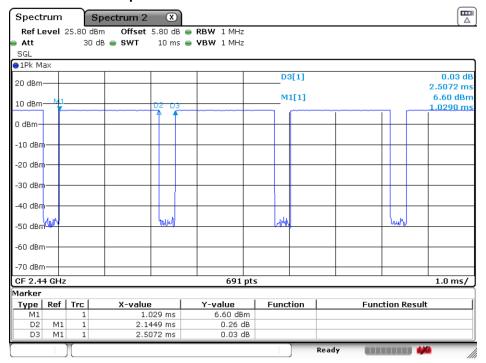
-- PEAK

Report No.:FR372501-02E

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE 1Mbps	85.55	2.145	0.466	0.47kHz
Bluetooth LE 2Mbps	57.53	1.080	0.926	1kHz

Bluetooth LE 1Mbps



: D1 of D2

Report No.:FR372501-02E

Bluetooth LE 2Mbps

