

FCC RF Test Report

APPLICANT	: Xiaomi Communications Co., Ltd.
EQUIPMENT	: Mobile Phone
BRAND NAME	: Redmi
MODEL NAME	: 23028RA60L
FCC ID	: 2AFZZA60L
STANDARD	: FCC Part 15 Subpart C §15.247
CLASSIFICATION	: (DTS) Digital Transmission System
TEST DATE(S)	: Nov. 17, 2022 ~ Dec. 07, 2022

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.

This report contains data that were produced under subcontract by Sporton International Inc. (Shenzhen).

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



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



TABLE OF CONTENTS

		N HISTORY	
SUI	MMAR	<pre>XY OF TEST RESULT</pre>	4
1	GENE	ERAL DESCRIPTION	5
	1.1	Applicant	5
	1.2	Manufacturer	5
	1.3	Product Feature of Equipment Under Test	5
	1.4	Product Specification of Equipment Under Test	5
	1.5	Modification of EUT	5
	1.6	Testing Location	6
	1.7	Test Software	6
	1.8	Applicable Standards	6
2	TEST	CONFIGURATION OF EQUIPMENT UNDER TEST	7
	2.1	Carrier Frequency Channel	7
	2.2	Test Mode	8
	2.3	Connection Diagram of Test System	9
	2.4	Support Unit used in test configuration and system	10
	2.5	EUT Operation Test Setup	10
	2.6	Measurement Results Explanation Example	10
3	TEST	RESULT	11
	3.1	6dB and 99% Bandwidth Measurement	11
	3.2	Output Power Measurement	16
	3.3	Power Spectral Density Measurement	17
	3.4	Conducted Band Edges and Spurious Emission Measurement	22
	3.5	Radiated Band Edges and Spurious Emission Measurement	27
	3.6	AC Conducted Emission Measurement	31
	3.7	Antenna Requirements	33
4	LIST	OF MEASURING EQUIPMENT	34
5	UNCE	ERTAINTY OF EVALUATION	35
AP	PEND	IX A. CONDUCTED TEST RESULTS	
AP	PENDI	IX B. AC CONDUCTED EMISSION TEST RESULT	
API	PENDI	IX C. RADIATED SPURIOUS EMISSION	
AP	PENDI	IX D. DUTY CYCLE PLOTS	

APPENDIX E. SETUP PHOTOGRAPHS



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR2O2911B	Rev. 01	Initial issue of report	Dec. 12, 2022



SUMMARY OF TE	ST 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 Emission15.209(a) & 15.247(d)Pass		Under limit 8.82 dB at 48.430 MHz	
3.6	15.207	AC Conducted Emission 15.207(a) Pass		Under limit 14.84 dB at 0.160 MHz	
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1 General Description

1.1 Applicant

Xiaomi Communications Co., Ltd.

#019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085

1.2 Manufacturer

Xiaomi Communications Co., Ltd.

#019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085

1.3 Product Feature of Equipment Under Test

Product Feature			
Equipment	Mobile Phone		
Brand Name	Redmi		
Model Name	23028RA60L		
FCC ID 2AFZZA60L			
IMEI Code	Conducted: 861736060059026/861736060059034 Conduction: 861736060056501/861736060056519 Radiation: 861736060060461/861736060060479		
HW Version	P1.1		
SW Version MIUI14			
EUT Stage Identical Prototype			

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	-1.19 dBm (0.0008 W)			
99% Occupied Bandwidth	1.031MHz			
Antenna Type / Gain	PIFA Antenna with gain 0.1 dBi			
Type of Modulation	Bluetooth LE : GFSK			

1.5 Modification of EUT

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



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.

Test Firm	Sporton International Inc. (Kunshan)				
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958				
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.		
Test Site NO.	03CH04-KS TH01-KS	CN1257	314309		

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International Inc. (Shenzhen)				
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595				
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.		
	CO01-SZ	CN1256	421272		

Test data subcontracted: Conduction test items in section 3.6 of this report.

1.7 Test Software

ltem	Site	Manufacturer	Name	Version
1.	03CH04-KS	AUDIX	E3	6.2009-8-24al
2.	CO01-SZ	AUDIX	E3	6.120613b

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 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	-	-



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 feller de la company de la		o demonstrate in compliance wi	المسطلة منصفه مطلقيها
I he following summary fable i	e enowing all test modes to) demonstrate in compliance wi	in the standard
			in the standard.

Summary table of Test Cases				
Test Item	Data Rate / Modulation			
Test item	Bluetooth LE / GFSK			
Conducted	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps			
TCs	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps			
105	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps			
	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps			
Radiated	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps			
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps			
TCs	Mode 4: Bluetooth Tx CH39_2480 MHz_1Mbps (LF)			
	Mode 5: LTE Band 13 Link + BLE CH39_TX (RSE Co-location)			
AC	Made 1, CSN850 Idle + Divetaath Link + M/LAN Link (2,40) + USB Cable 2(Charging			
Conducted	Mode 1: GSM850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable 2(Charging			
Emission	from Adapter) + Rarphone			

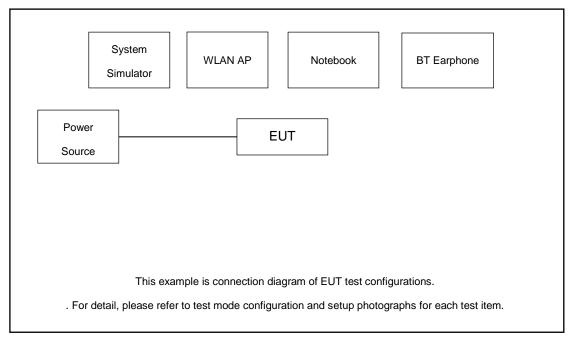
Remark:

- 1. For Radiated Test Cases, The tests were performance with Adapter, Earphone and USB Cable 1.
- 2. The RSE Co-location mode are assessed from the worst WWAN Link + Bluetooth TX mode.

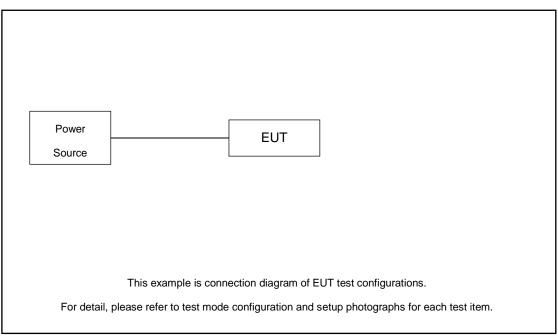


2.3 Connection Diagram of Test System

AC Conducted Emission:



Radiated Emission:



2.4 Support Unit used in test configuration and system

ltem	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded,1.8m
2.	WLAN AP	Dlink	DIR-820L	KA2IR820LA1	N/A	Unshielded,1.8m
3.	Notebook	Lenovo	E540	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Bluetooth Earphone	Samsung	EO-MG900	PYAHS-107W	N/A	N/A
5.	Earphone	MI	EM023	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 WLAN AP 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 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.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 6.0 dB.

 $Offset(dB) = RF \ cable \ loss(dB).$ = 6.0 (dB)



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.
- 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



Spectrum Analyzer



3.1.5 Test Result of 6dB Bandwidth

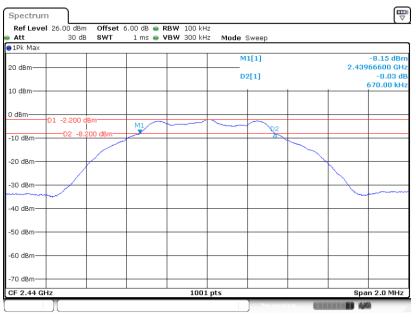
Please refer to Appendix A.



6 dB Bandwidth Plot on Channel 00

Date: 17.NOV.2022 08:43:25

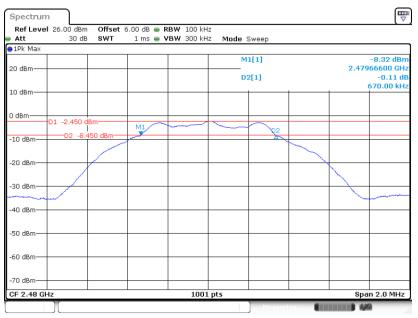




6 dB Bandwidth Plot on Channel 19

Date: 17.NOV.2022 09:11:19

6 dB Bandwidth Plot on Channel 39

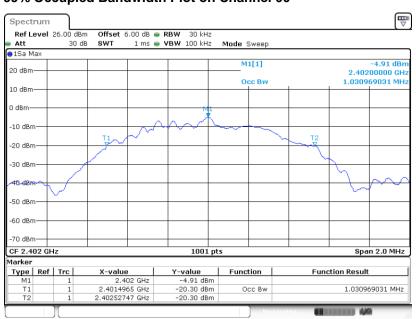


Date: 17.NOV.2022 08:59:13



3.1.6 Test Result of 99% Occupied Bandwidth

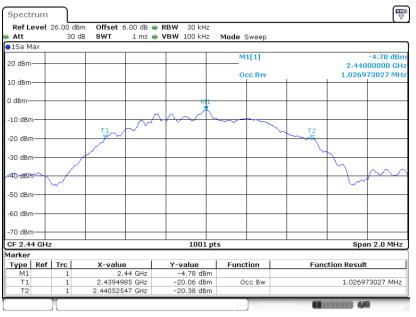
Please refer to Appendix A.



99% Occupied Bandwidth Plot on Channel 00

Date: 17.NOV.2022 08:45:10

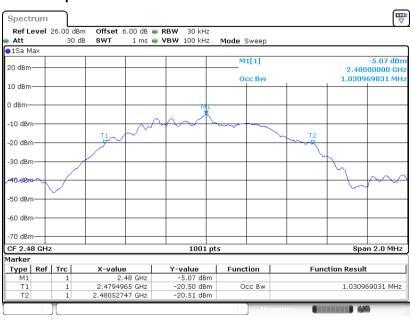




99% Occupied Bandwidth Plot on Channel 19

Date: 17.NOV.2022 09:12:46

99% Occupied Bandwidth Plot on Channel 39



Date: 17.NOV.2022 09:00:59

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



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 6 dBi.

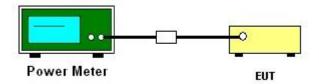
3.2.2 Measuring Instruments

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.



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.

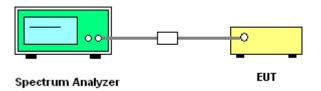
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

- 1. 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.
- 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

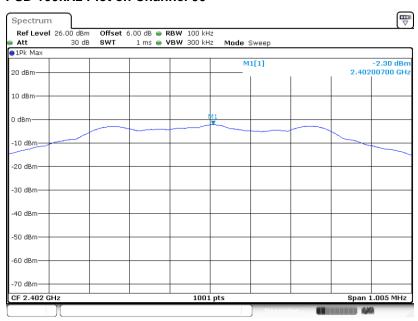


3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



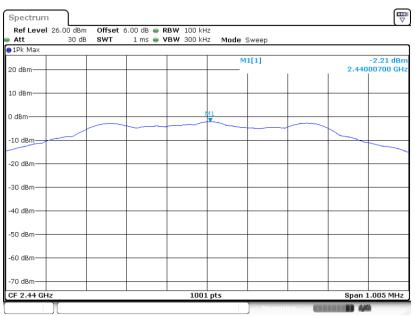
3.3.6 Test Result of Power Spectral Density Plots (100kHz)



PSD 100kHz Plot on Channel 00

Date: 17.NOV.2022 08:44:02

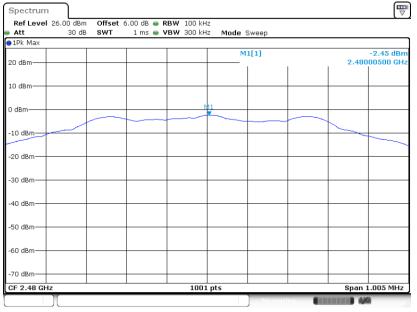
PSD 100kHz Plot on Channel 19



Date: 17.NOV.2022 09:11:57



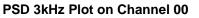
PSD 100kHz Plot on Channel 39

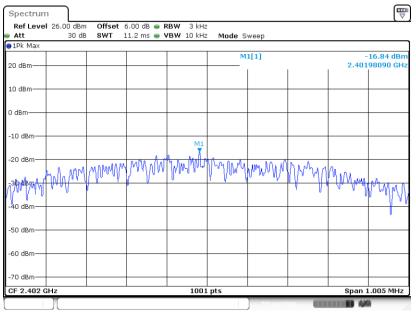


Date: 17.NOV.2022 08:59:51

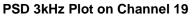


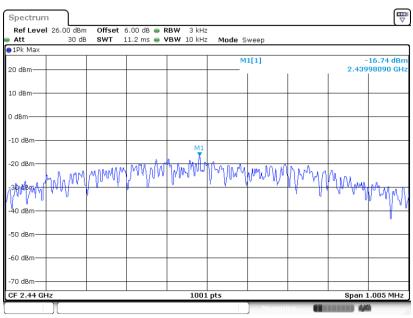
3.3.7 Test Result of Power Spectral Density Plots (3kHz)





Date: 17.NOV.2022 08:43:43

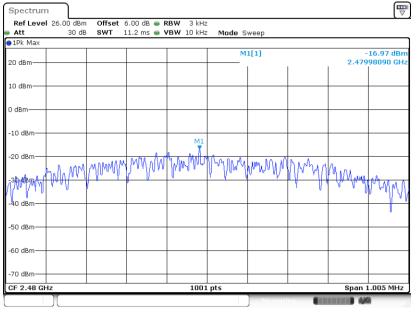




Date: 17.NOV.2022 09:11:38



PSD 3kHz Plot on Channel 39



Date: 17.NOV.2022 08:59:32



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.

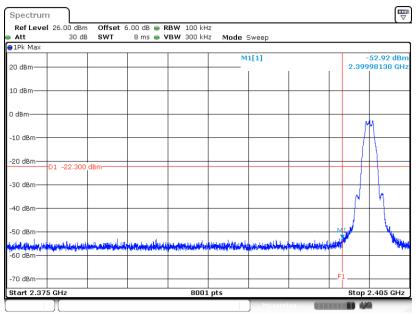
3.4.4 Test Setup





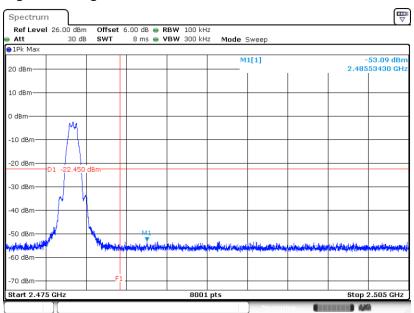
3.4.5 Test Result of Conducted Band Edges Plots





Date: 17.NOV.2022 08:44:21

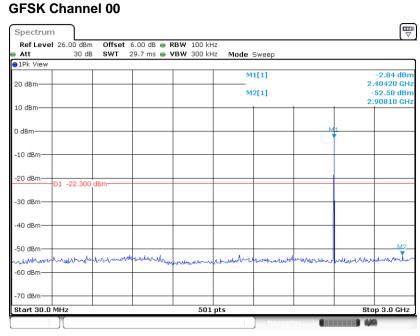
High Band Edge Plot on Channel 39



Date: 17.NOV.2022 09:00:09

3.4.6 Test Result of Conducted Spurious Emission Plots

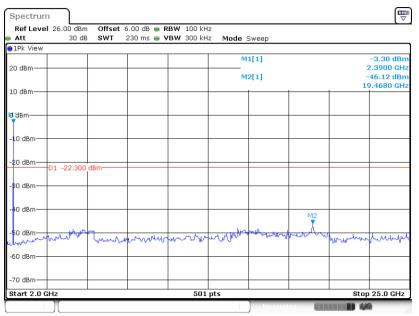
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 17.NOV.2022 08:44:42

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

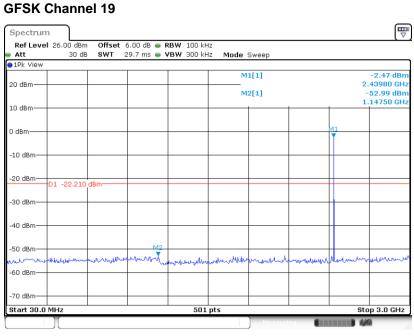
GFSK Channel 00



Date: 17.NOV.2022 08:45:02

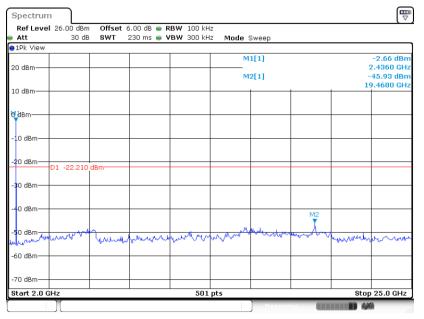


Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 17.NOV.2022 09:12:17

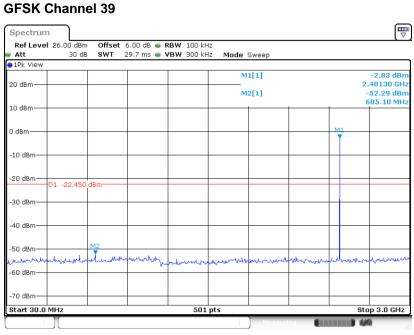
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



Date: 17.NOV.2022 09:12:37

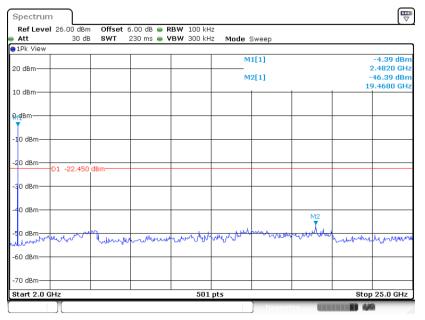


Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 17.NOV.2022 09:13:40

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



Date: 17.NOV.2022 09:14:14



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.



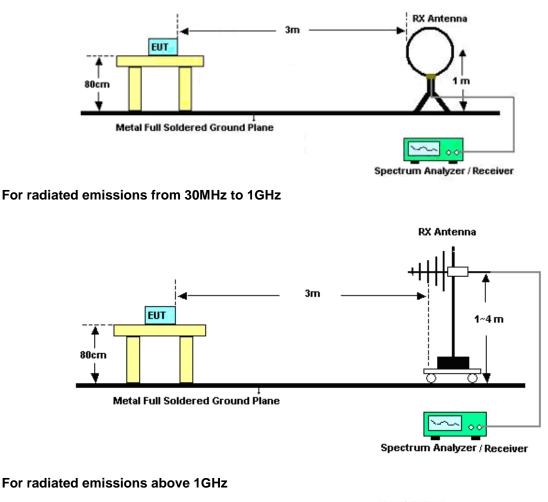
3.5.3 Test Procedures

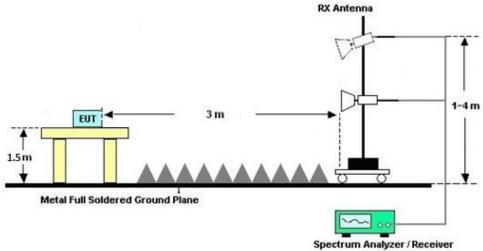
- 1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get 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.



3.5.4 Test Setup

For radiated emissions below 30MHz





Sporton International Inc. (Kunshan) TEL : +86-512-57900158 FAX : +86-512-57900958 FCC ID: 2AFZZA60L



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.

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.



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.

Frequency of emission (MHz)	Conducted limit (dBµV)		
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

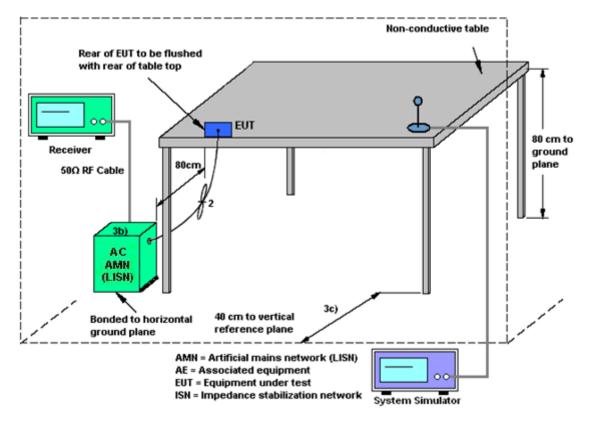
The section 4.0 of List of Measuring Equipment of this test report is used for test.

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.



3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



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.



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. 12, 2022	Nov. 17, 2022	Oct. 11, 2023	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GH z	Jan. 05, 2022	Nov. 17, 2022	Jan. 04, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2022	Nov. 17, 2022	Jan. 04, 2023	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY564000 04	3Hz~8.5GHz;M ax 30dBm	Oct. 13, 2022	Dec. 07, 2022	Oct. 12, 2023	Radiation (03CH04-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY574710 79	10Hz-44G,MAX 30dB	Oct. 12, 2022	Dec. 07, 2022	Oct. 11, 2023	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	Dec. 07, 2022	Oct. 15, 2023	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 24, 2022	Dec. 07, 2022	May 23, 2023	Radiation (03CH05-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1284	1GHz~18GHz	Jan. 05, 2022	Dec. 07, 2022	Jan. 04, 2023	Radiation (03CH04-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2022	Dec. 07, 2022	Jan. 04, 2023	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	Jan. 05, 2022	Dec. 07, 2022	Jan. 04, 2023	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GG A	060728	18~40GHz	Jan. 05, 2022	Dec. 07, 2022	Jan. 04, 2023	Radiation (03CH04-KS)
high gain Amplifier	EM	EM01G18GA	060840	1Ghz-18Ghz	Oct. 12, 2022	Dec. 07, 2022	Oct. 11, 2023	Radiation (03CH04-KS)
Amplifier	Agilent	8449B	3008A023 70	1Ghz-18Ghz	Oct. 12, 2022	Dec. 07, 2022	Oct. 11, 2023	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F1040900 04	N/A	NCR	Dec. 07, 2022	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Dec. 07, 2022	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Dec. 07, 2022	NCR	Radiation (03CH04-KS)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Jul. 07, 2022	Nov. 25, 2022	Jul. 06, 2023	Conduction (CO01-SZ)
AC LISN	R&S	ENV216	100063	9kHz~30MHz	Sep. 15, 2022	Nov. 25, 2022	Sep. 14, 2023	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	EMCO	3816/2SH	00103892	9kHz~30MHz	Oct. 17, 2022	Nov. 25, 2022	Oct. 16, 2023	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000 891	100Vac~250Vac	Jul. 07, 2022	Nov. 25, 2022	Jul. 06, 2023	Conduction (CO01-SZ)

NCR: No Calibration Required



5 Uncertainty of Evaluation

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

Test Item	Uncertainty
Conducted Power	±0.56 dB
Conducted Emissions	±0.92 dB
Occupied Channel Bandwidth	±0.03 %
Conducted Power Spectral Density	±0.54 dB

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence	2.2dB
of 95% (U = 2Uc(y))	2.208

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

Measuring Uncertainty for a Level of Confidence	5.0dB
of 95% (U = 2Uc(y))	3.00B

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

Measuring Uncertainty for a Level of Confidence	5.1dB
of 95% (U = 2Uc(y))	5.108

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

Measuring Uncertainty for a Level of Confidence	5.1dB
of 95% (U = 2Uc(y))	5.106

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



Appendix A. Conducted Test Results

Report Number : FR2O2911B

Bluetooth Low Energy

Test Engineer:	Jacob Zhang	Temperature:	20~26	°C
Test Date:	2022/11/17	Relative Humidity:	40~51	%

		<u>TEST RESULTS DATA</u> 6dB and 99% Occupied Bandwidth										
Mc	od.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail			
BL	.E	1Mbps	1	0	2402	1.031	0.670	0.50	Pass			
BL	.E	1Mbps	1	19	2440	1.027	0.670	0.50	Pass			
BL	.E	1Mbps	1	39	2480	1.031	0.670	0.50	Pass			

	<u>TEST RESULTS DATA</u> <u>Peak Power Table</u>										
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	-1.32	30.00	0.10	-1.22	36.00	Pass	
BLE	1Mbps	1	19	2440	-1.19	30.00	0.10	-1.09	36.00	Pass	
BLE	1Mbps	1	39	2480	-1.48	30.00	0.10	-1.38	36.00	Pass	

	<u>TEST RESULTS DATA</u> <u>Average Power Table</u> <u>(Reporting Only)</u>									
Мо	d. Dai Rai		Ntx	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)			
BL	E 1Mb	ps	1	0	2402	2.04	-1.58			
BL	E 1Mb	ps	1	19	2440	2.04	-1.63			
BL	E 1Mb	ps	1	39	2480	2.04	-1.82			

	<u>TEST RESULTS DATA</u> <u>Peak Power Density</u>										
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	-2.30	-16.84	0.10	8.00	Pass		
BLE	1Mbps	1	19	2440	-2.21	-16.74	0.10	8.00	Pass		
BLE	1Mbps	1	39	2480	-2.45	-16.97	0.10	8.00	Pass		

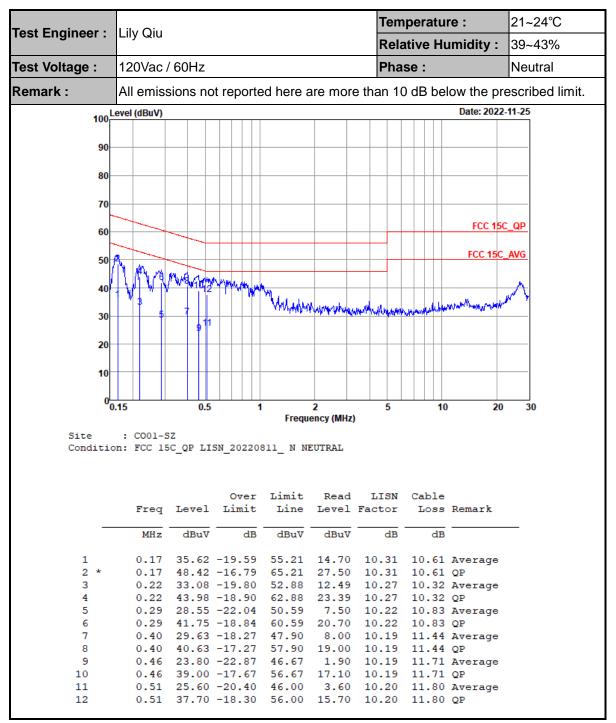
Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.



Appendix B. AC Conducted Emission Test Results

Test Engineer :	Lily Qiu					Tem	peratu	re :	21~24°C		
rest Engineer .						Rela	ative Hu	umidity :	39~43%		
Test Voltage :	120Vac /	/ 60Hz				Pha	se :		Line		
Remark :	All emiss	sions no	t reporte	ed here a	are more	e than 10	nan 10 dB below the prescribed limit.				
100	Level (dBuV)						Date: 2022-11-25				
90											
80											
70											
•								500 450			
60								FCC 150	: <u>_QP</u>		
-	A				+ +						
50	n A.							FCC 15C	AVG		
	I WITHOUT	8 V-10 mm									
40	<u> </u>	° 10 12	WHAT I AND A	White					$-\Lambda$		
	3			N N N N	Ander an In	ولمدين لجرادعا فالمحاصرين	n and a server	HAMPANAMALANAM	Not A		
30	5			WWWWWWWW	- AND AND AND A	A					
		9 11									
20											
					1						
10											
10											
0	0.15	0.5			2	5	10	20			
0	0.15	0.5	1		2 ency (MHz)	5	10	20	30		
0			1		-	-	10	20	30		
0 Site	: CO01-S	SZ		Frequ	ency (MHz)	-	10	20	30		
0 Site		SZ		Frequ	ency (MHz)	-	10	20	30		
0 Site	: CO01-S	SZ		Frequ	ency (MHz)	-	10	20	30		
0 Site	: CO01-S	SZ	SN_20220	Frequ	ency (MHz) INE			20	30		
0 Site	: CO01-5 on: FCC 15	SZ SC_QP LI:	SN_202200 Over	Frequ B11_ L L: Limit	ency (MHz) INE Read	LISN	Cable		30		
0 Site	: CO01-5 on: FCC 15	SZ	SN_202200 Over	Frequ B11_ L L: Limit	ency (MHz) INE Read		Cable	20 Remark	30		
0 Site	: COOL-S on: FCC 15 Freq	GZ GC_QP LI: Level	SN_202208 Over Limit	Frequ Bll_ L L Limit Line	INE Read Level	LISN Factor	Cable Loss		30		
0 Site	: CO01-5 on: FCC 15	SZ SC_QP LI:	SN_202200 Over	Frequ B11_ L L: Limit	ency (MHz) INE Read	LISN	Cable		30		
0 Site	: COO1-S on: FCC 15 Freq MHz	SZ SC_QP LI: Level 	SN_202208 Over Limit	Freque B11_ L L: Limit Line dBuV	Read Level dBuV	LISN Factor dB	Cable Loss 		30		
0 Site Conditio	: CO01-S on: FCC 15 Freq MHz 0.16	SZ GC_QP LI: Level dBuV 37.19	SN_202200 Over Limit dB	Freque B11_ L L: Limit Line dBuV 55.43	Read Level dBuV 16.30	LISN Factor dB 10.20	Cable Loss dB 10.69	Remark 	30		
0 Site Conditio	: CO01-S on: FCC 15 Freq MHz 0.16 0.16	52 50_QP LI: 	Over Limit dB -18.24	Freque B11_ L L: Limit Line dBuV 55.43	Read Level dBuV 16.30 29.70	LISN Factor dB 10.20 10.20	Cable Loss dB 10.69 10.69	Remark 	30		
Site Condition 1 2 * 3 4	: CO01-S on: FCC 15 Freq MHz 0.16 0.22 0.22	2 5C_QP LI: 	Over Limit 	Freque B11_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79	Read Level dBuV 16.30 29.70 11.90 25.50	LISN Factor dB 10.20 10.20 10.19 10.19	Cable Loss dB 10.69 10.69 10.35 10.35	Remark Average QP Average QP	30		
0 Site Condition 1 2 * 3 4 5	: CO01-S on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27	2 5C_QP LI: Level dBuV 37.19 50.59 32.44 46.04 28.85	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25	Read Level dBuV 16.30 29.70 11.90 25.50 8.00	LISN Factor dB 10.20 10.20 10.19 10.19 10.17	Cable Loss dB 10.69 10.35 10.35 10.35	Remark Average QP Average QP Average	30		
0 Site Condition 1 2 * 3 4 5 6	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27 0.27	2 5C_QP LI: Level dBuV 37.19 50.59 32.44 46.04 28.85 41.35	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50	LISN Factor dB 10.20 10.19 10.19 10.17 10.17	Cable Loss dB 10.69 10.35 10.35 10.35 10.68 10.68	Remark Average QP Average QP Average QP	30		
0 Site Condition 1 2 * 3 4 5 6 7	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27 0.27 0.32	2 5C_QP LI: dBuV 37.19 50.59 32.44 46.04 28.85 41.35 28.87	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90 -20.79	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25 49.66	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50 7.71	LISN Factor dB 10.20 10.19 10.19 10.17 10.17 10.12	Cable Loss dB 10.69 10.35 10.35 10.35 10.68 10.68 11.04	Remark Average QP Average QP Average QP Average	30		
0 Site Condition 1 2 * 3 4 5 6 7 8	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.22 0.27 0.27 0.32 0.32	2 5C_QP LI: dBuV 37.19 50.59 32.44 46.04 28.85 41.35 28.87 40.77	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90 -20.79 -18.89	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25 49.66 59.66	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50 7.71 19.61	LISN Factor dB 10.20 10.19 10.19 10.17 10.17 10.17 10.12 10.12	Cable Loss dB 10.69 10.35 10.35 10.35 10.68 10.68 11.04 11.04	Remark Average QP Average QP Average QP Average QP	30		
0 Site Condition 1 2 * 3 4 5 6 7 8 9	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27 0.27 0.27 0.32 0.32 0.32 0.40	2 5C_QP LI: dBuV 37.19 50.59 32.44 46.04 28.85 41.35 28.87 40.77 25.54	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90 -20.79 -18.89 -22.36	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25 49.66 59.66 47.90	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50 7.71 19.61 4.00	LISN Factor dB 10.20 10.19 10.19 10.17 10.17 10.17 10.12 10.12 10.10	Cable Loss dB 10.69 10.35 10.35 10.35 10.68 10.68 11.04 11.04	Remark Average QP Average QP Average QP Average QP Average			
0 Site Condition 1 2 * 3 4 5 6 7 8 9 10	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27 0.27 0.27 0.32 0.32 0.40 0.40	2 2 2 2 2 2 2 2 2 2 2 2 2 2	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90 -20.79 -18.89 -22.36 -18.06	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25 49.66 59.66 47.90 57.90	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50 7.71 19.61 4.00 18.30	LISN Factor dB 10.20 10.19 10.19 10.17 10.17 10.12 10.12 10.12 10.10 10.10	Cable Loss dB 10.69 10.35 10.35 10.68 10.68 11.04 11.04 11.44	Remark Average QP Average QP Average QP Average QP Average QP			
0 Site Condition 1 2 * 3 4 5 6 7 8 9	: CO01-5 on: FCC 15 Freq MHz 0.16 0.22 0.22 0.27 0.27 0.27 0.32 0.32 0.40 0.40 0.49	22 25 26 27 29 20 20 20 20 20 20 20 20 20 20	Over Limit dB -18.24 -14.84 -20.35 -16.75 -22.40 -19.90 -20.79 -18.89 -22.36 -18.06	Freque Bill_ L L: Limit Line dBuV 55.43 65.43 52.79 62.79 51.25 61.25 49.66 59.66 47.90 57.90 46.10	Read Level dBuV 16.30 29.70 11.90 25.50 8.00 20.50 7.71 19.61 4.00 18.30 3.20	LISN Factor dB 10.20 10.19 10.19 10.17 10.17 10.12 10.12 10.10 10.10 10.10	Cable Loss dB 10.69 10.35 10.35 10.68 10.68 11.04 11.04 11.44	Remark Average QP Average QP Average QP Average QP Average QP 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 Data

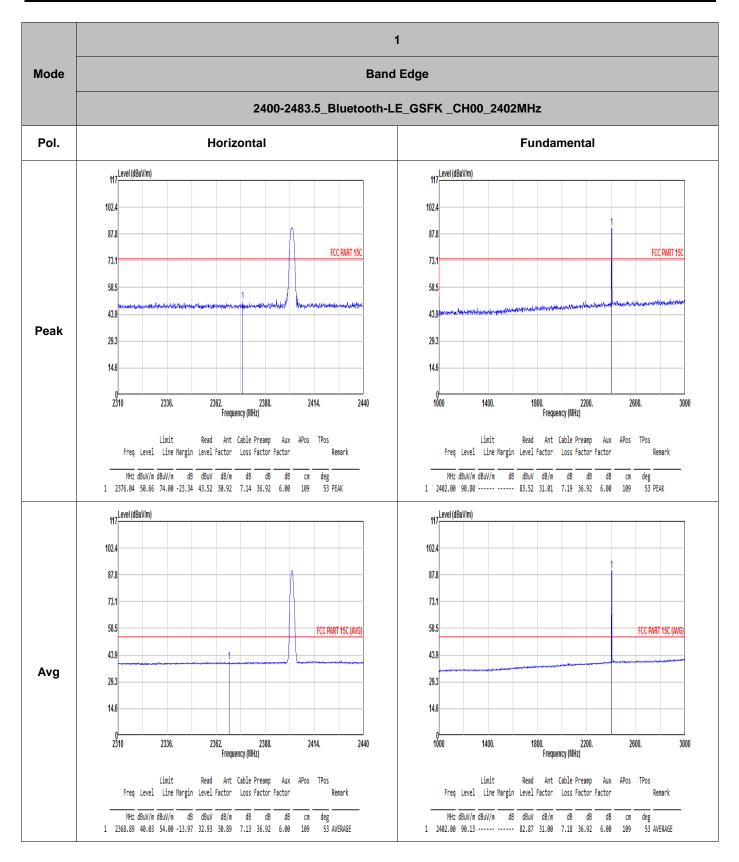
Mode	Band (MHz)	Modulation	Channel	Frequency	Data Rate	Remark
Mode 1	2400-2483.5	Bluetooth-LE_GSFK	CH00	2402	1Mbps	-
Mode 2	2400-2483.5	Bluetooth-LE_GSFK	CH19	2440	1Mbps	-
Mode 3	2400-2483.5	Bluetooth-LE_GSFK	CH39	2480	1Mbps	-
Mode 4	2400-2483.5	Bluetooth-LE_GSFK	CH39	2480	1Mbps	LF
Mada 5	0.400 0.400 5	Bluetooth-LE_GSFK	CH39	2480	1Mbps	On In anti-
Mode 5	2400-2483.5	LTE Band 13- BW 5M	Mid	-	-	Co-location



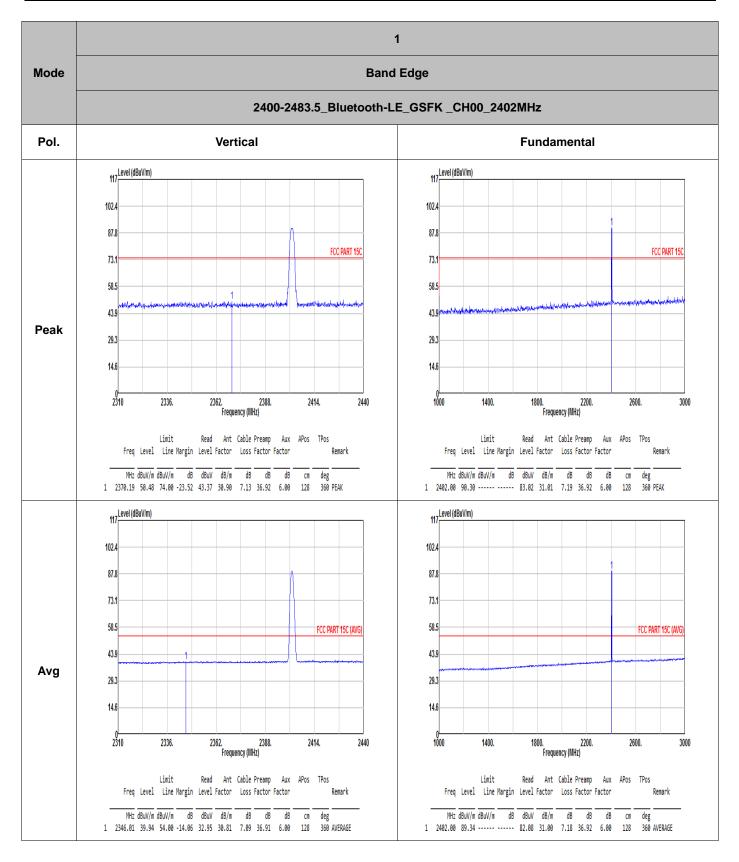
Summary of each worse mode

Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	Bluetooth-LE_GSFK	CH00	2368.89	40.03	54.00	-13.97	Н	AVERAGE	Pass	Band Edge
	Bluetooth-LE_GSFK	CH00	4804.00	44.28	74.00	-29.72	Н	PEAK	Pass	Harmonic
	Bluetooth-LE_GSFK	CH19	-	-	-	-	-	-	-	Band Edge
2	Bluetooth-LE_GSFK	CH19	7320.00	44.80	74.00	-29.20	V	PEAK	Pass	Harmonic
	Bluetooth-LE_GSFK	CH39	2486.80	40.44	54.00	-13.56	Н	AVERAGE	Pass	Band Edge
3	Bluetooth-LE_GSFK	CH39	4960.00	45.03	74.00	-28.97	Н	PEAK	Pass	Harmonic
4	Bluetooth-LE_GSFK	CH39	48.43	31.18	40	-8.82	V	PEAK	Pass	LF
5	Bluetooth-LE_GSFK	CH39	2484.46	41.02	54.00	-12.98	Н	AVERAGE	Pass	Band Edge
5	Bluetooth-LE_GSFK	CH39	7440.00	44.37	74.00	-29.63	V	PEAK	Pass	Harmonic

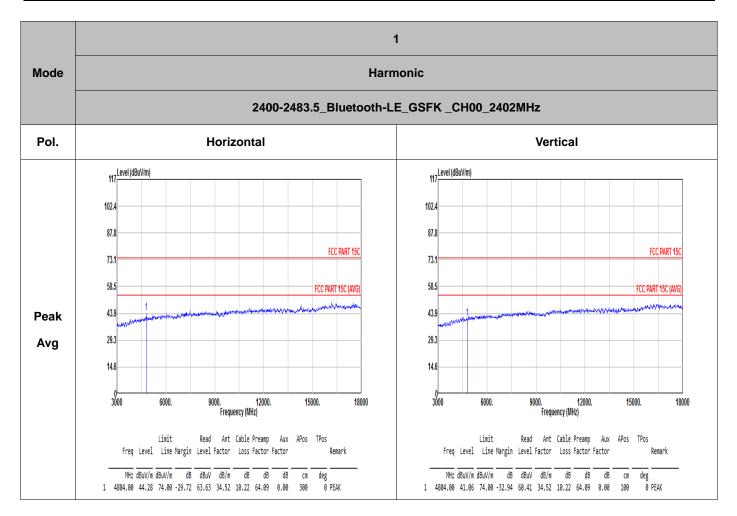




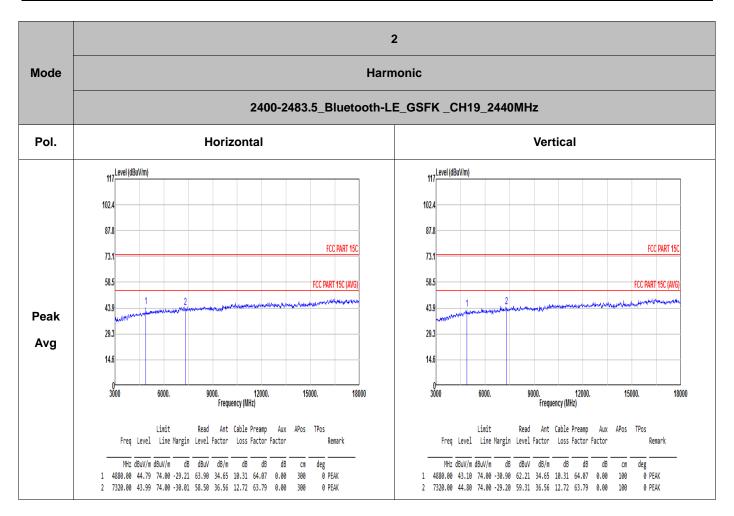




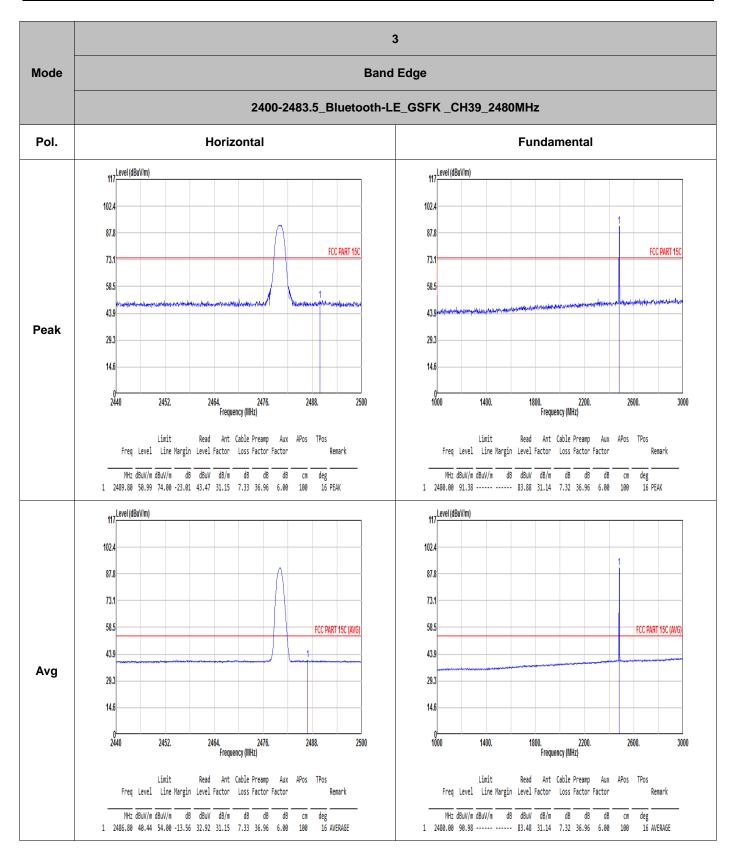




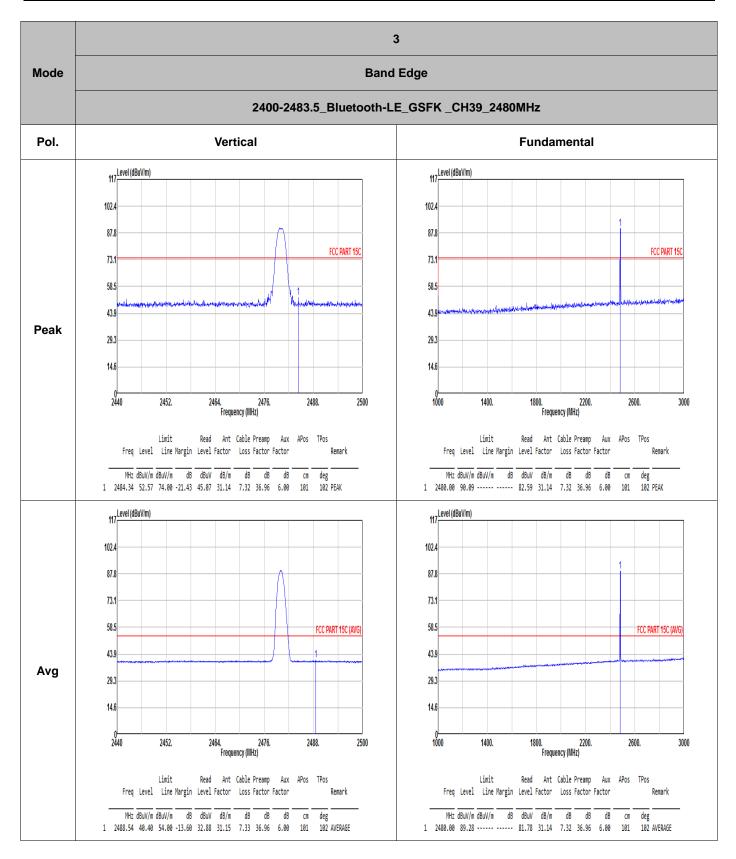




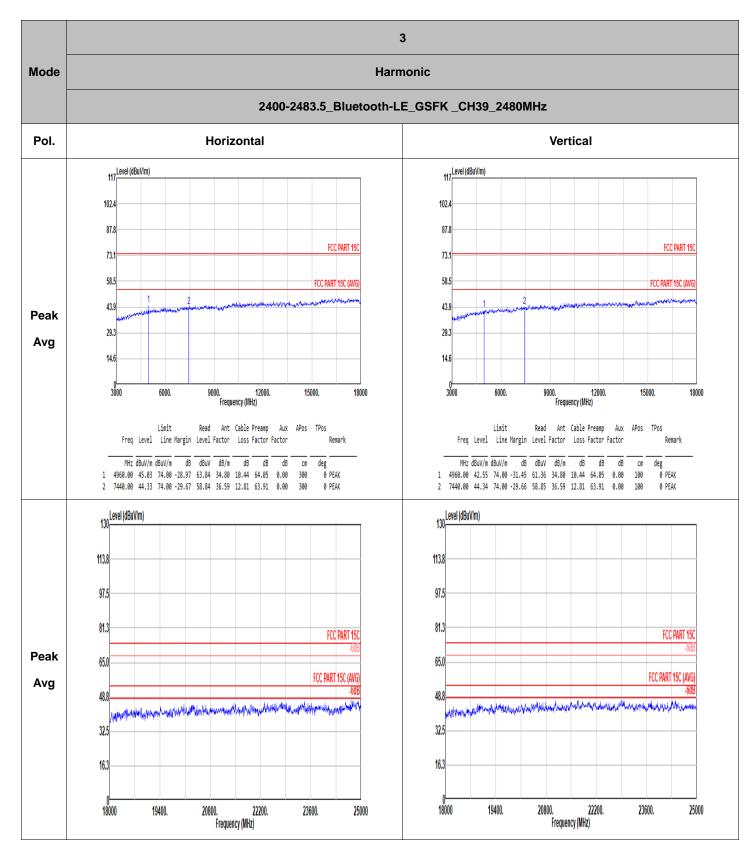




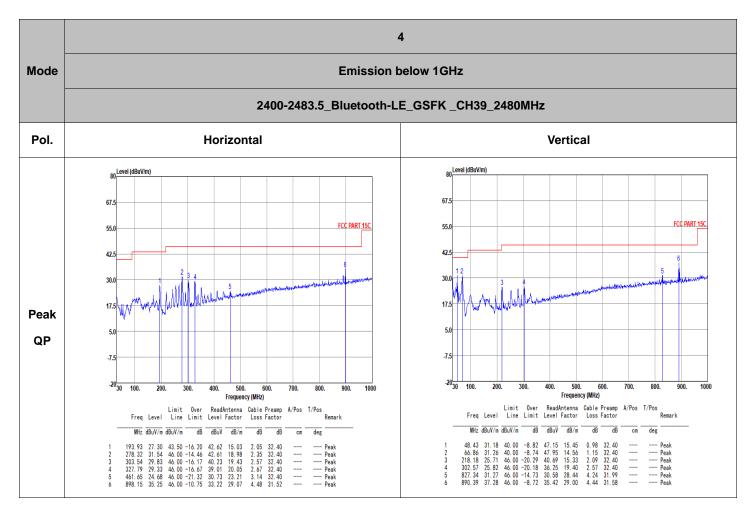




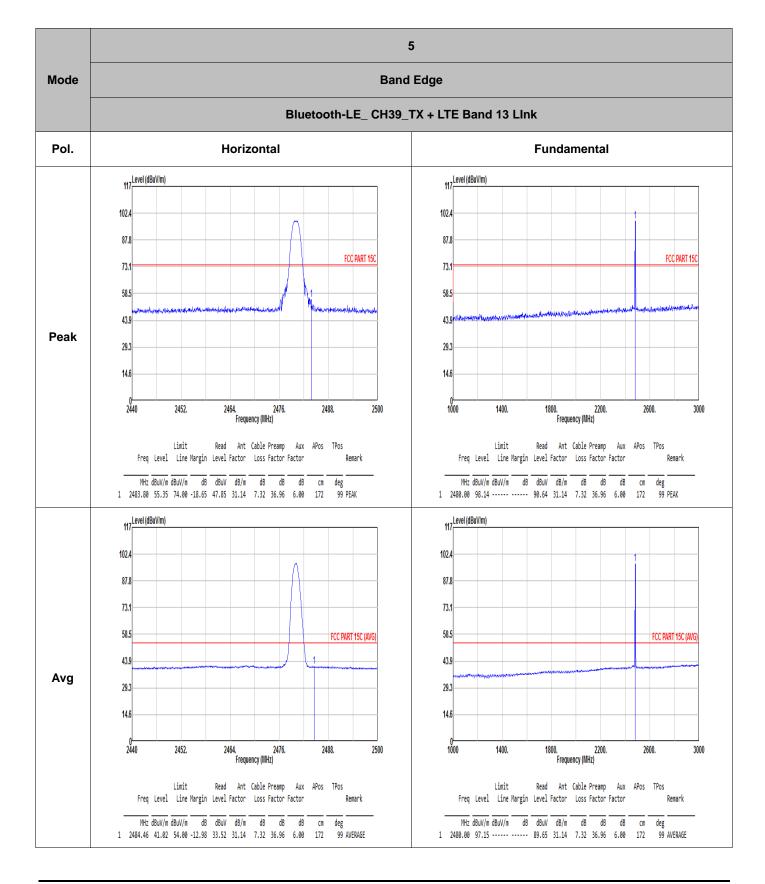






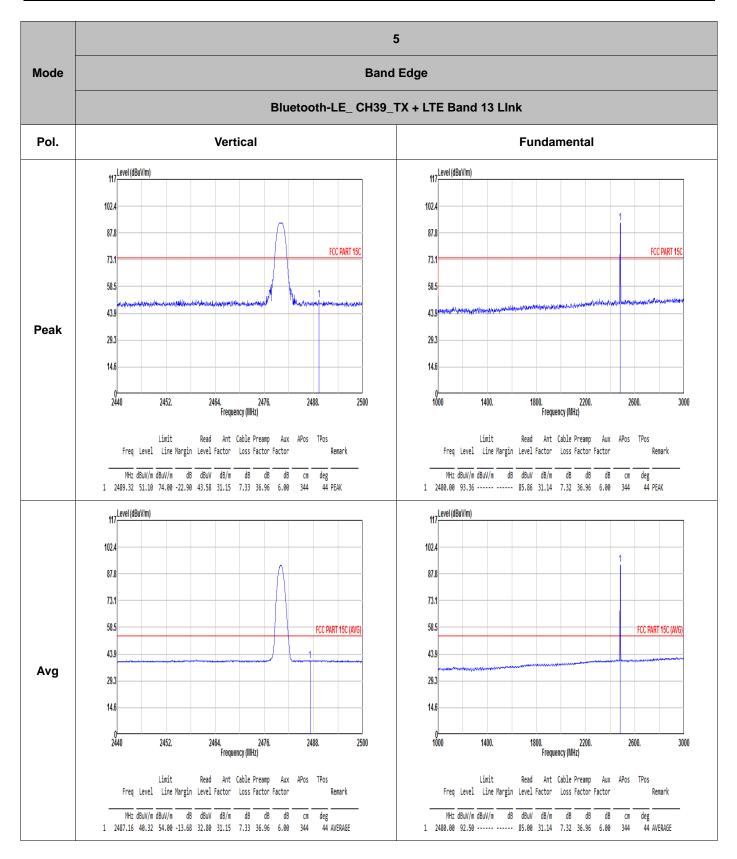




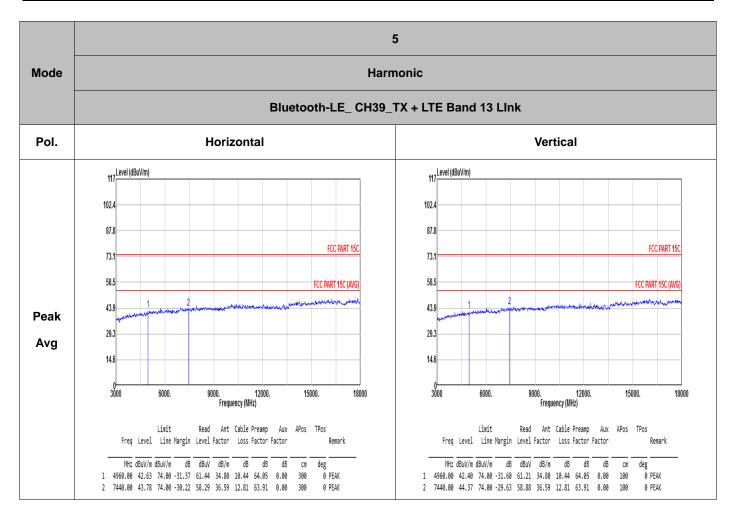


Sporton International Inc. (Kunshan) TEL : +86-512-57900158 FAX : +86-512-57900958 FCC ID: 2AFZZA60L













Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting	
Bluetooth LE	62.50	0.391	2.556	2.7KHz	

Bluetooth LE

Spectr	um								
Ref Le	vel 3			🖷 RBW 1 MHz					
Att		30) dB 🖷 SWT 2 ms	😑 VBW 1 MHz					
SGL									
1Pk Ma	x								
20 dBm-	_				Da	8[1]			0.02 dE 626.09 μ
					M	1[1]			5.13 dBn
101dBm-	-		D2 D3						43.48 µ
0 dBm—		·····			1				
-10 dBm	_								
-20 dBm	+								
-30 dBm									
-30 00111									
- <mark>4</mark> 0 dBm	+								
L					1	L.			1
50 dBm	-				halphape	74h)		- U	Apply have
-60 dBm			1. 1			. Ka			
-70 dBm	+							_	
CF 2.44	GHz			691 pt	s				200.0 µs/
1arker									
	Ref		X-value	Y-value	Funct	ion	F	unction Re	sult
M1 D2	M1	1	43.48 µs	5.13 dBm 0.12 dB					
D2	M1 M1	1	391.3 µs 626.09 µs	0.12 dB					
		-	020.09 p3	0.02 00			Ready		