FCC RF Test Report

APPLICANT	:	Zhejiang Rexense IoT Technology Co., Ltd.
EQUIPMENT	:	2.4G Zigbee Module
BRAND NAME	:	REXENSE
MODEL NAME	:	REX3P212
FCC ID	:	2AOE2REX3P212
STANDARD	:	47 CFR Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Jul. 03, 2023 ~ Jul. 31, 2023

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.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.02

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
FR351809	Rev. 01	Initial issue of report	Aug. 25, 2023

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	-	Pass	-
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 0.64 dB at 7440.000 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 8.32 dB at 0.169 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	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

Zhejiang Rexense IoT Technology Co., Ltd.
6th Floor, Building 4, No.6, Longzhou Road, Yuhang District, Hangzhou, Zhejiang Province 310051 PRC

1.2 Manufacturer

Zhejiang Rexense IoT Technology Co., Ltd.
6th Floor, Building 4, No.6, Longzhou Road, Yuhang District, Hangzhou, Zhejiang Province 310051 PRC

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	2.4G Zigbee Module
Brand Name	REXENSE
Model Name	REX3P212
FCC ID	2AOE2REX3P212
HW Version	V1
SW Version	V1
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	2405 MHz ~ 2480 MHz
Number of Channels	16
Channel Spacing	5 MHz
Carrier Frequency of Each Channel	2405 MHz, 2410MHz, …, 2480MHz
Maximum Output Power to Antenna	19.36 dBm (0.0863 W)
Antenna Type / Gain	PCB Antenna type with gain 1.27 dBi
Type of Modulation	O-QPSK

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		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH06-KS	AUDIX	E3	6.2009-8-24al
2.	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 v05
- 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)
2400-2483.5 MHz	11	2405	19	2445
	12	2410	20	2450
	13	2415	21	2455
	14	2420	22	2460
	15	2425	23	2465
	16	2430	24	2470
	17	2435	25	2475
	18	2440	26	2480

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 (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). Pre-scanned tests, X, Y, Z in three orthogonal panels to determine the final configuration (X plane as worst plane) from all possible combinations.

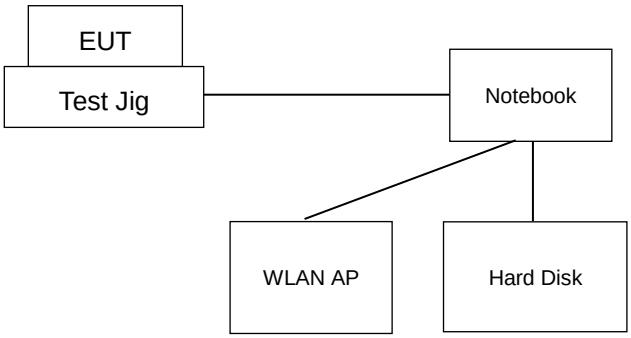
b. AC power line Conducted Emission was tested under maximum output power.

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**
	250kbps / Zigbee
Conducted TCs	Mode 1: Zigbee Tx CH11_2405 MHz Mode 2: Zigbee Tx CH19_2445 MHz Mode 3: Zigbee Tx CH26_2480 MHz
Radiated TCs	Mode 1: Zigbee Tx CH11_2405 MHz Mode 2: Zigbee Tx CH19_2445 MHz Mode 3: Zigbee Tx CH26_2480 MHz
AC Conducted Emission	Mode 1: Zigbee Tx + Charging from Test Jig

2.3 Connection Diagram of Test System

Conducted Emission:



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

Radiated Emission:

This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

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.	Hard DISK	WD	C6B	N/A	N/A	N/A
4.	Test Jig	N/A	N/A	N/A	N/A	N/A
5.	Antenna	N/A	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

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

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 5.5 dB.

Offset(dB) = RF cable loss(dB).

= 5.5(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.

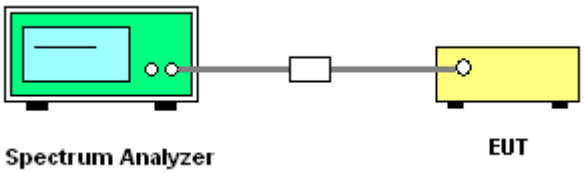
3.1.2 Measuring Instruments

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.
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 30kHz and set the Video bandwidth (VBW) = 100kHz.
6. Measure and record the results in the test report.

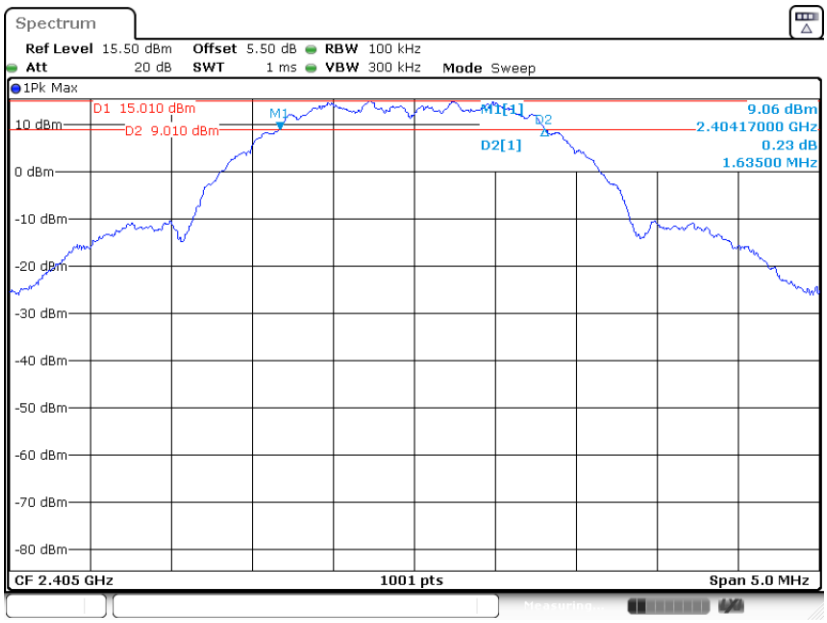
3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

Test data refer to Appendix A.

6 dB Bandwidth Plot on Channel 11



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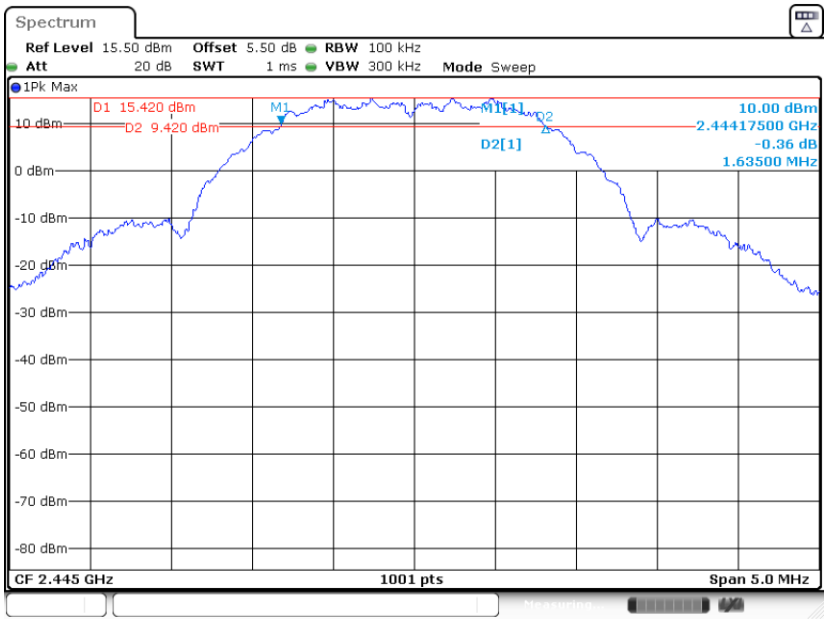
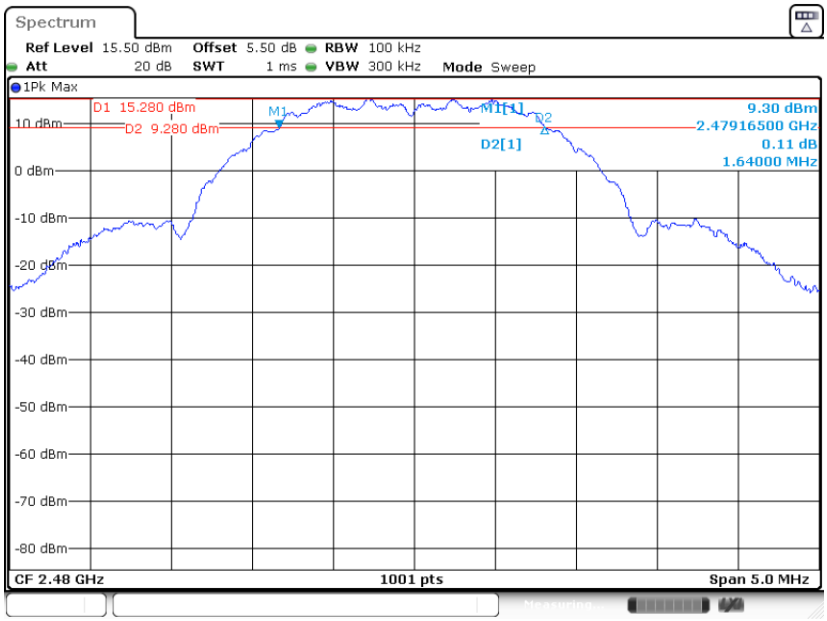
6 dB Bandwidth Plot on Channel 19



Date: 4.JUL.2023 14:27:05

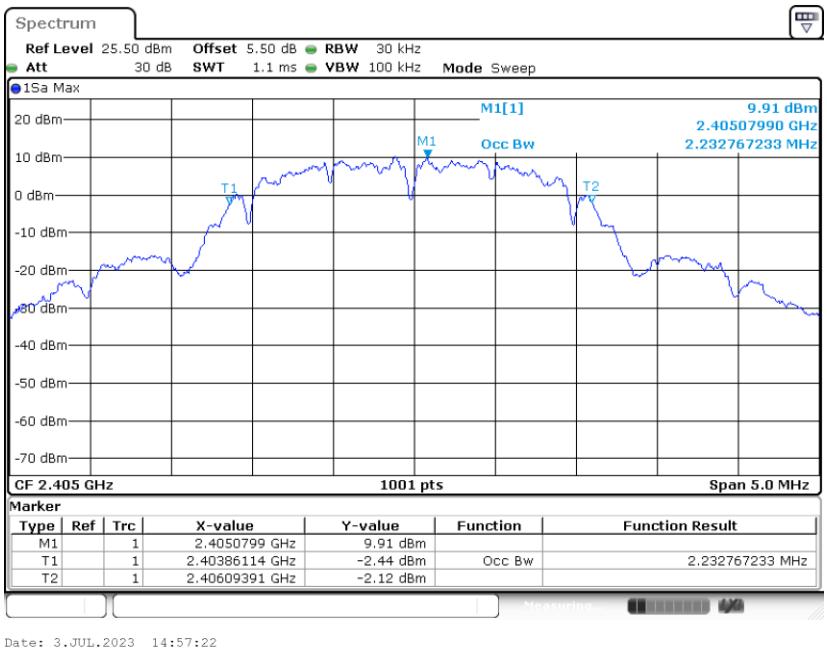
6 dB Bandwidth Plot on Channel 26



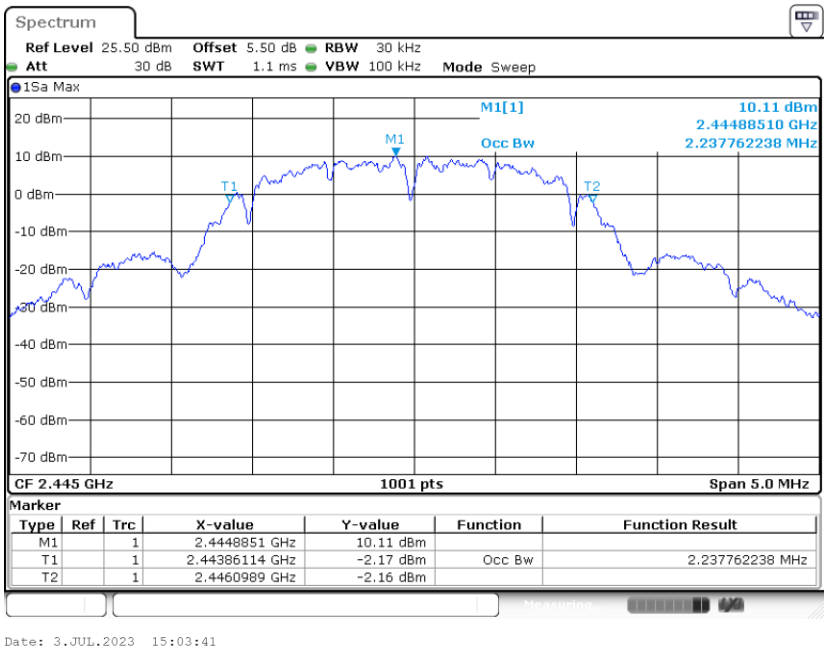
3.1.6 Test Result of 99% Occupied Bandwidth

Test data refer to Appendix A.

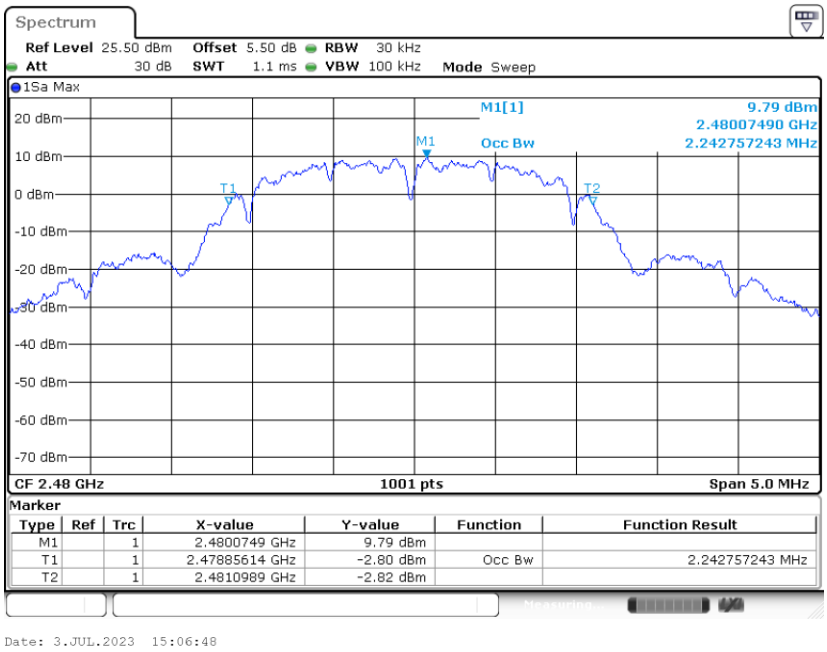
99% Bandwidth Plot on Channel 11



99% Occupied Bandwidth Plot on Channel 19



99% Occupied Bandwidth Plot on Channel 26



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

3.2 Peak Output Power Measurement

3.2.1 Limit of Peak 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.

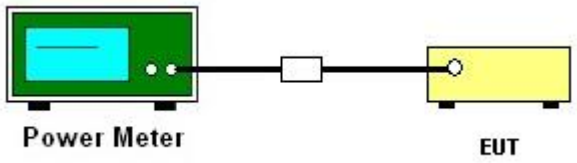
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

1. 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

Test data refers to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Test data refers 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.

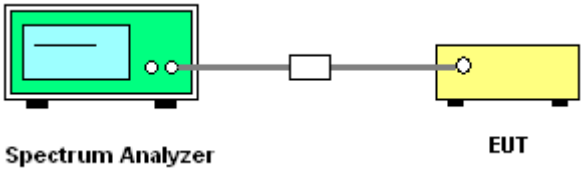
3.3.2 Measuring Instruments

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.
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

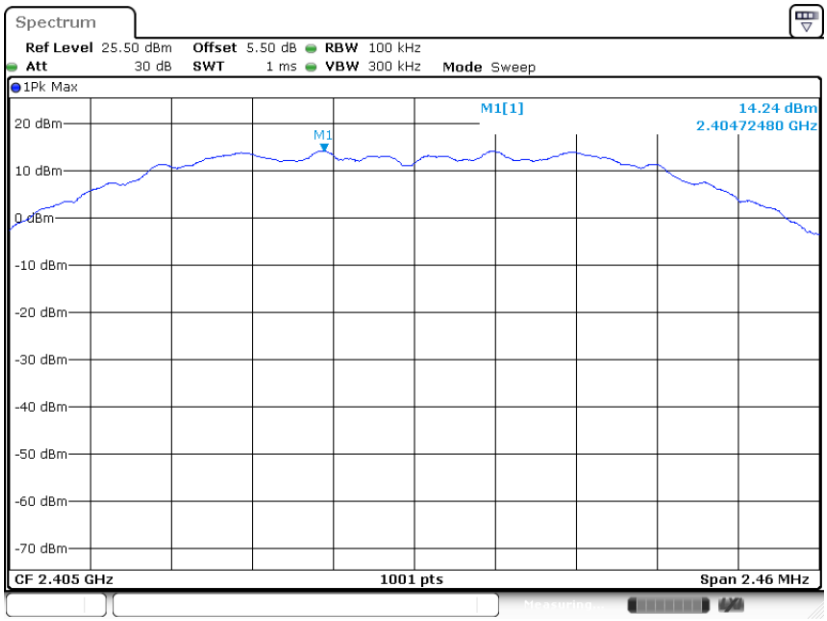


3.3.5 Test Result of Power Spectral Density

Test data refers to Appendix A.

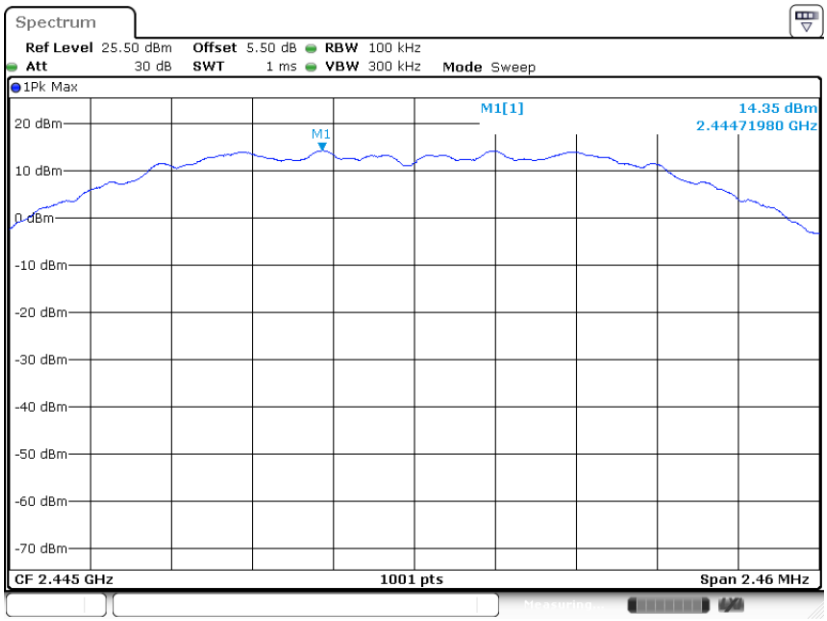
3.3.6 Test Result of Power Spectral Density Plots (100kHz)

PSD 100kHz Plot on Channel 11



Date: 3.JUL.2023 14:56:12

PSD 100kHz Plot on Channel 19



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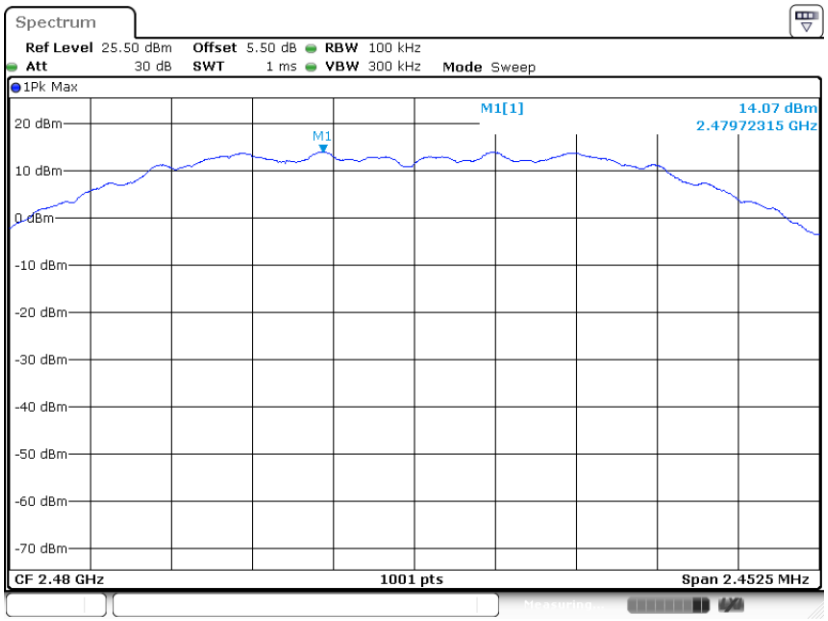
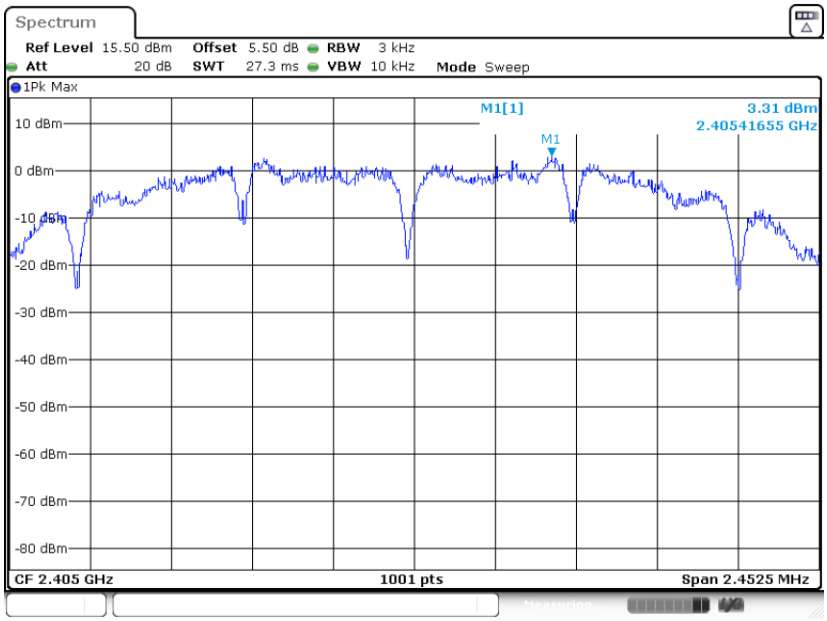
PSD 100kHz Plot on Channel 26



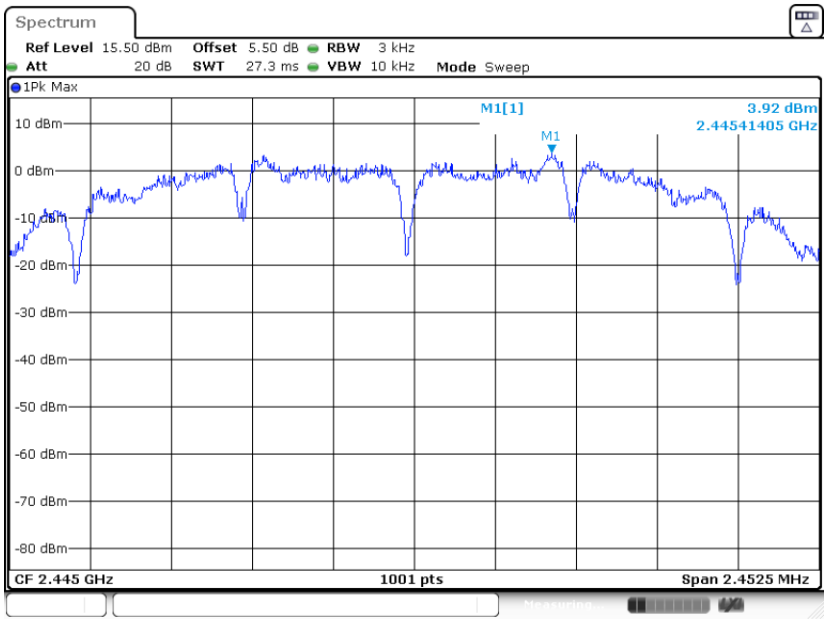
3.3.7 Test Result of Power Spectral Density Plots (3kHz)

PSD 3kHz Plot on Channel 11



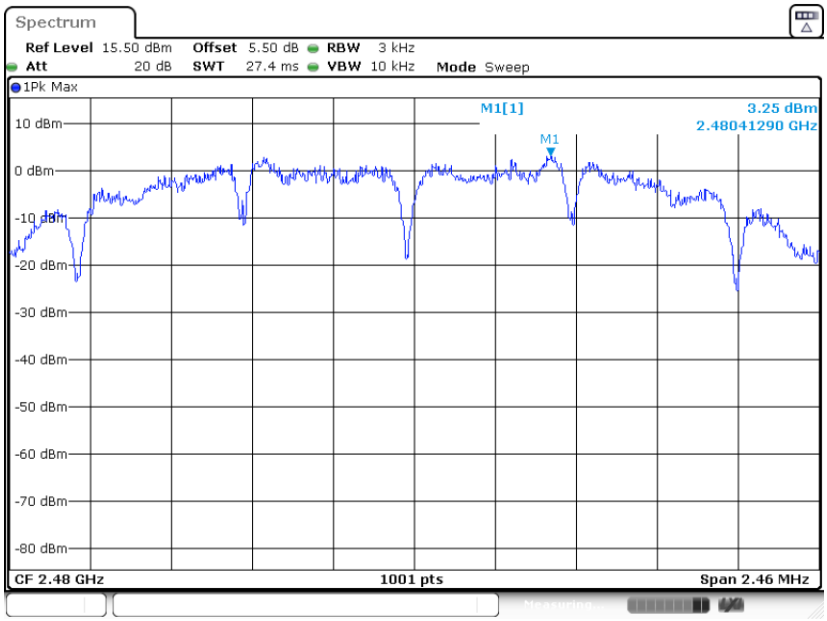
Date: 4.JUL.2023 14:24:54

PSD 3kHz Plot on Channel 19



Date: 4.JUL.2023 14:27:24

PSD 3kHz Plot on Channel 26



Date: 4.JUL.2023 14:28:51

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.

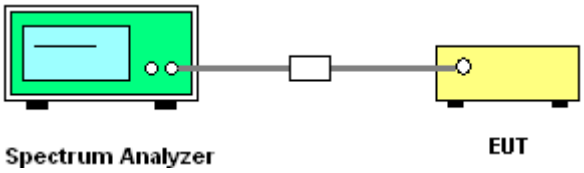
3.4.2 Measuring Instruments

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

3.4.3 Test Procedure

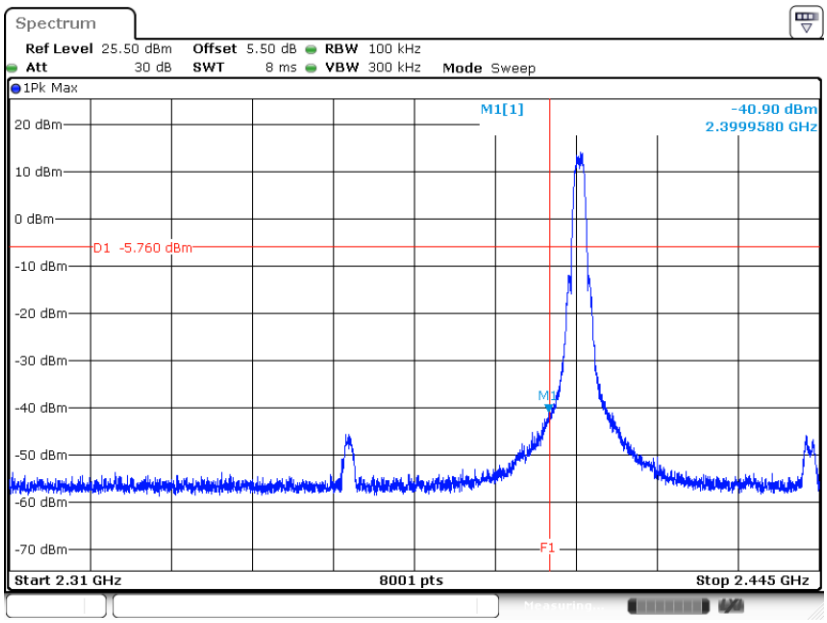
1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 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



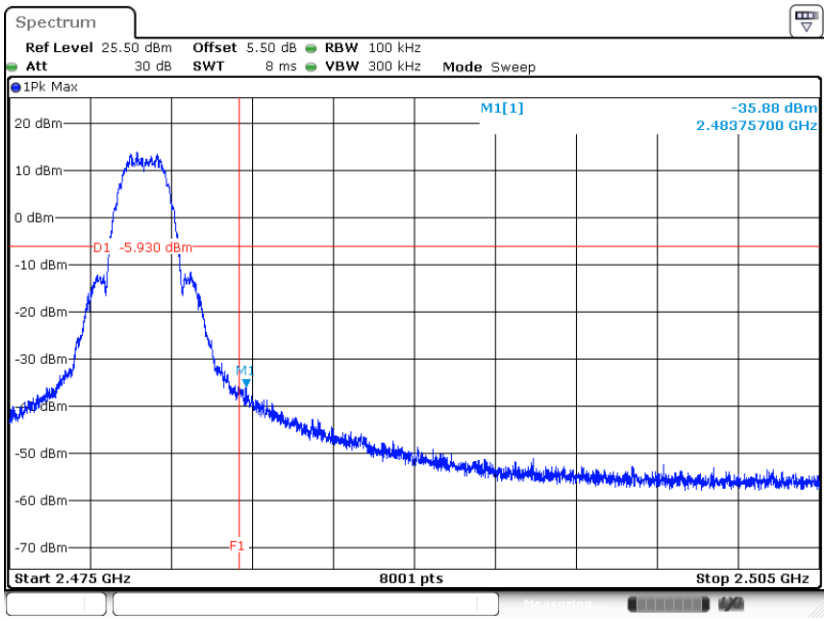
3.4.5 Test Result of Conducted Band Edges Plots

Low Band Edge Plot on Channel 11



Date: 3.JUL.2023 14:59:20

High Band Edge Plot on Channel 26

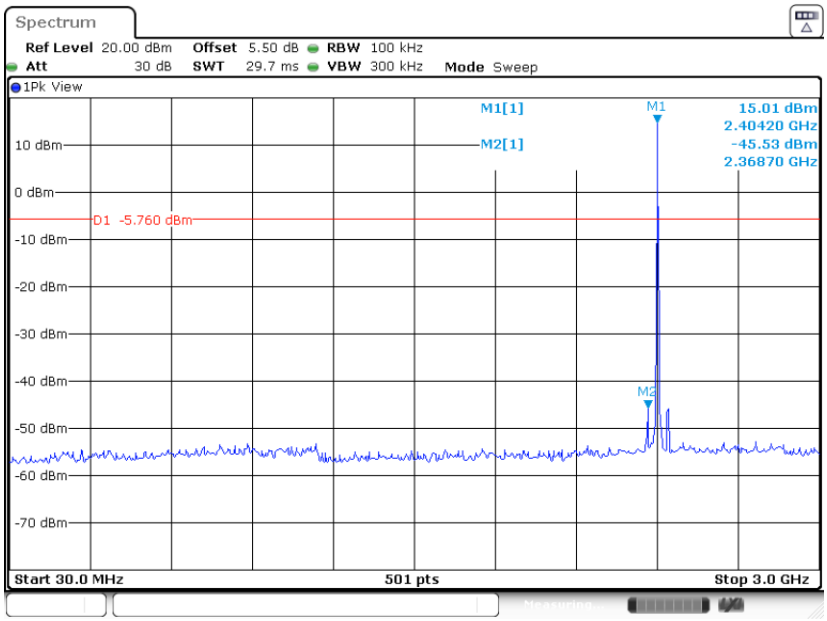


Date: 3.JUL.2023 15:09:00

3.4.6 Test Result of Conducted Spurious Emission Plots

Conducted Spurious Emission Plot on

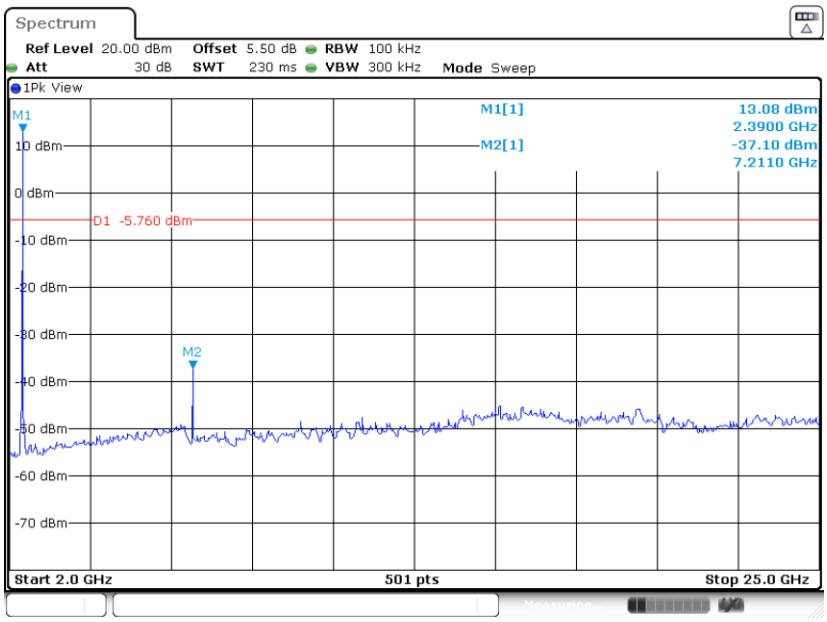
Zigbee Channel 11



Date: 4.JUL.2023 14:50:56

Conducted Spurious Emission Plot on

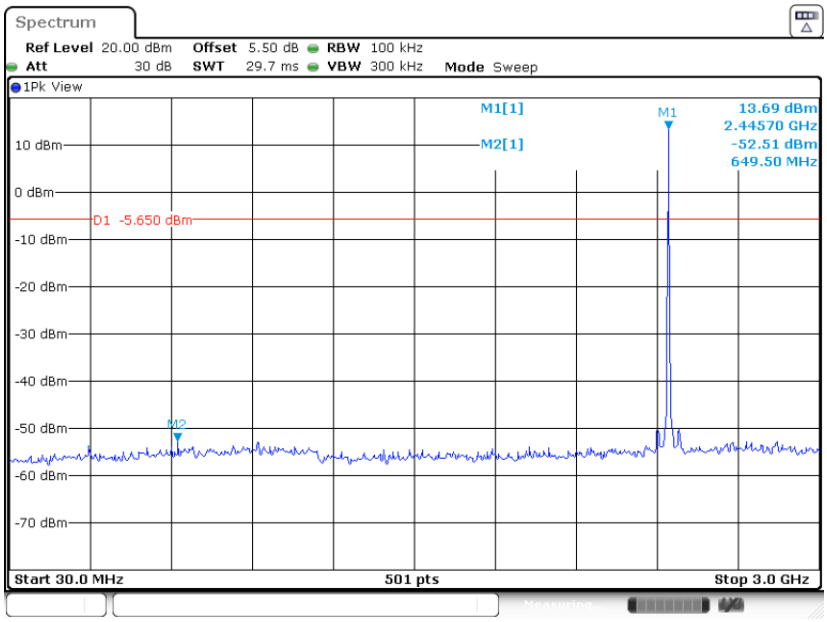
Zigbee Channel 11



Date: 4.JUL.2023 14:51:09

Conducted Spurious Emission Plot on

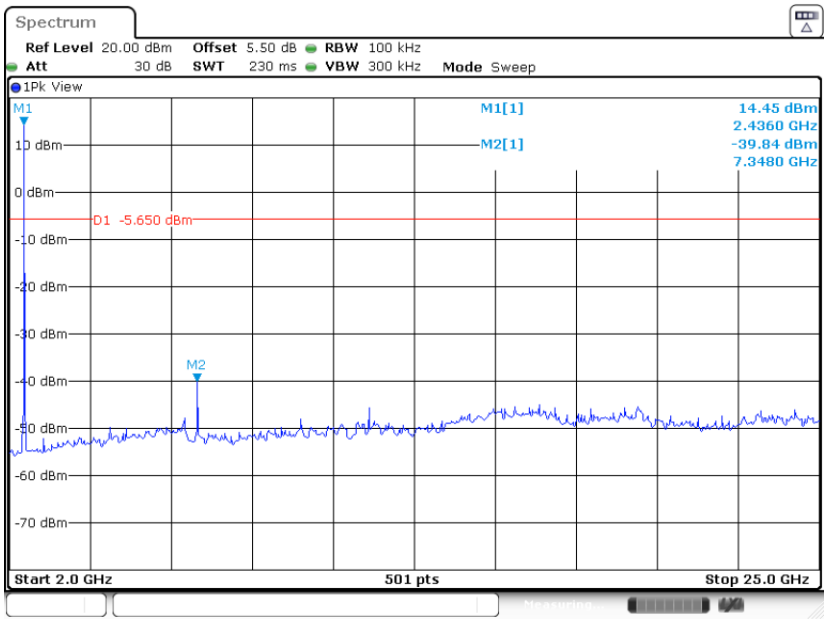
Zigbee Channel 19



Date: 4.JUL.2023 14:53:05

Conducted Spurious Emission Plot on

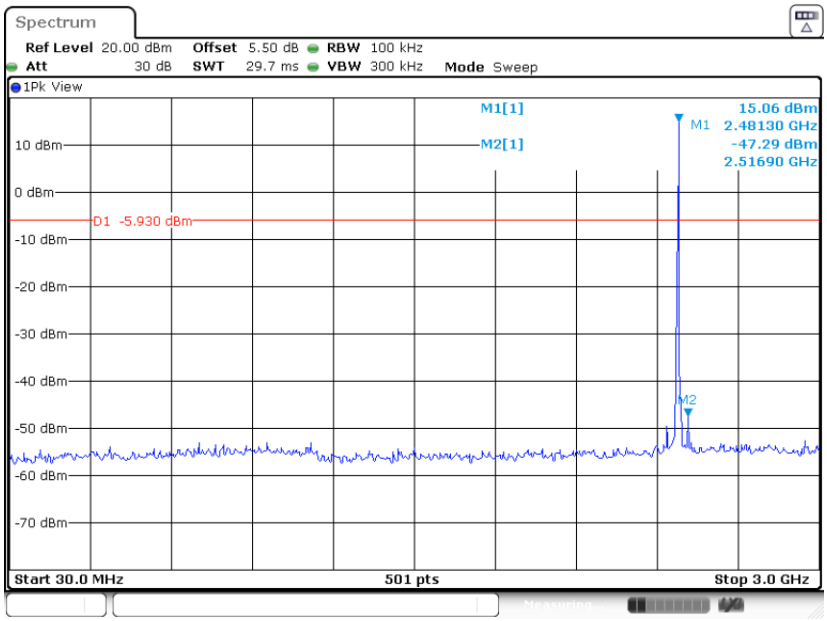
Zigbee Channel 19



Date: 4.JUL.2023 14:53:16

Conducted Spurious Emission Plot on

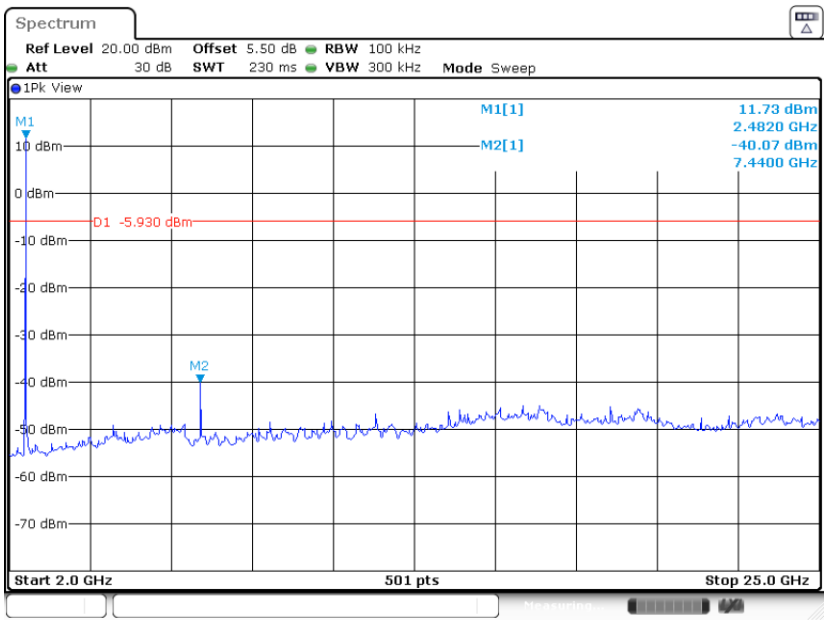
Zigbee Channel 26



Date: 4.JUL.2023 14:59:20

Conducted Spurious Emission Plot on

Zigbee Channel 26



Date: 4.JUL.2023 14:57:33

3.5 Spurious Emission Measurement in the Restricted Band

3.5.1 Limit of Spurious Emission Measurement in the Restricted Band

Emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

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 conducted spurious emission measurement in the restricted band, 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.
7. For measurement below 1GHz, if the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector 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;

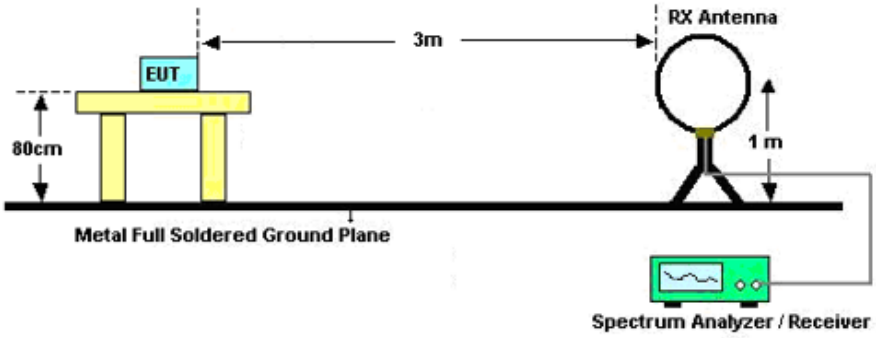
(3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.

For average measurement:

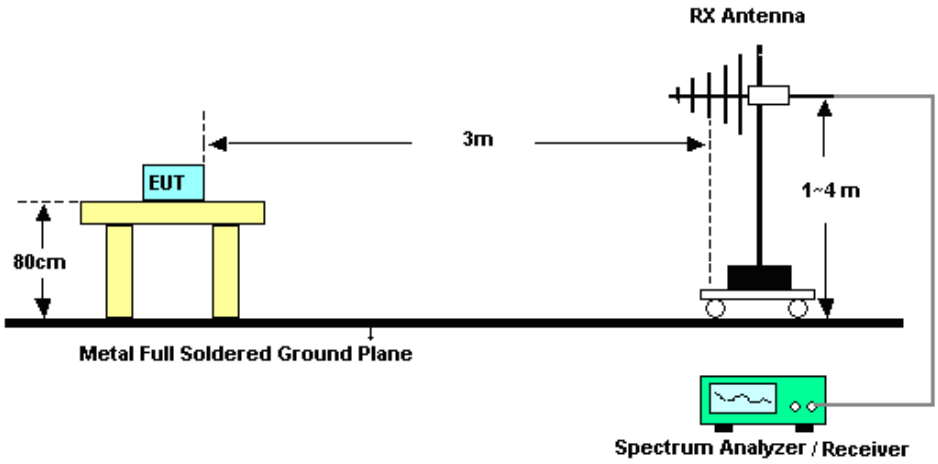
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

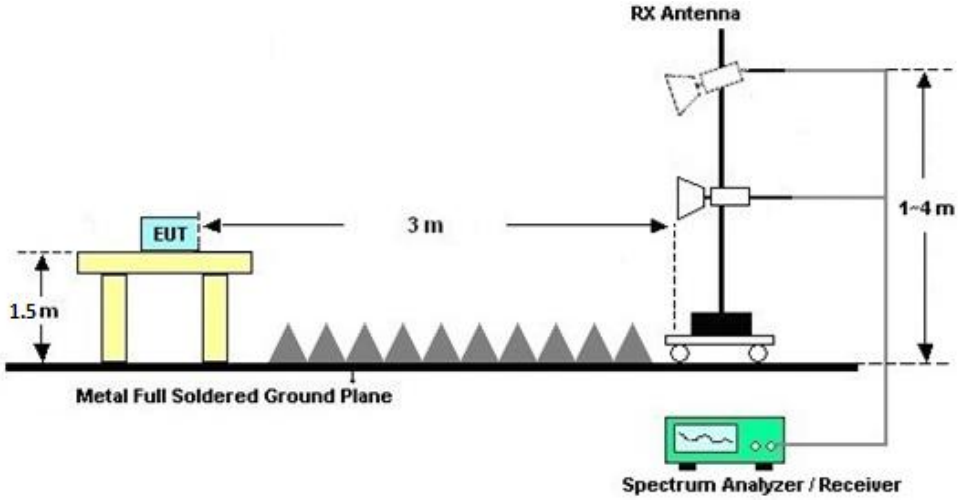
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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.

3.5.6 Test Results of Radiated Spurious at Band Edges

Please refer to Appendix C.

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

Please refer to Appendix C.

3.5.8 Duty Cycle

Please refer to Appendix D.

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)	
	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.

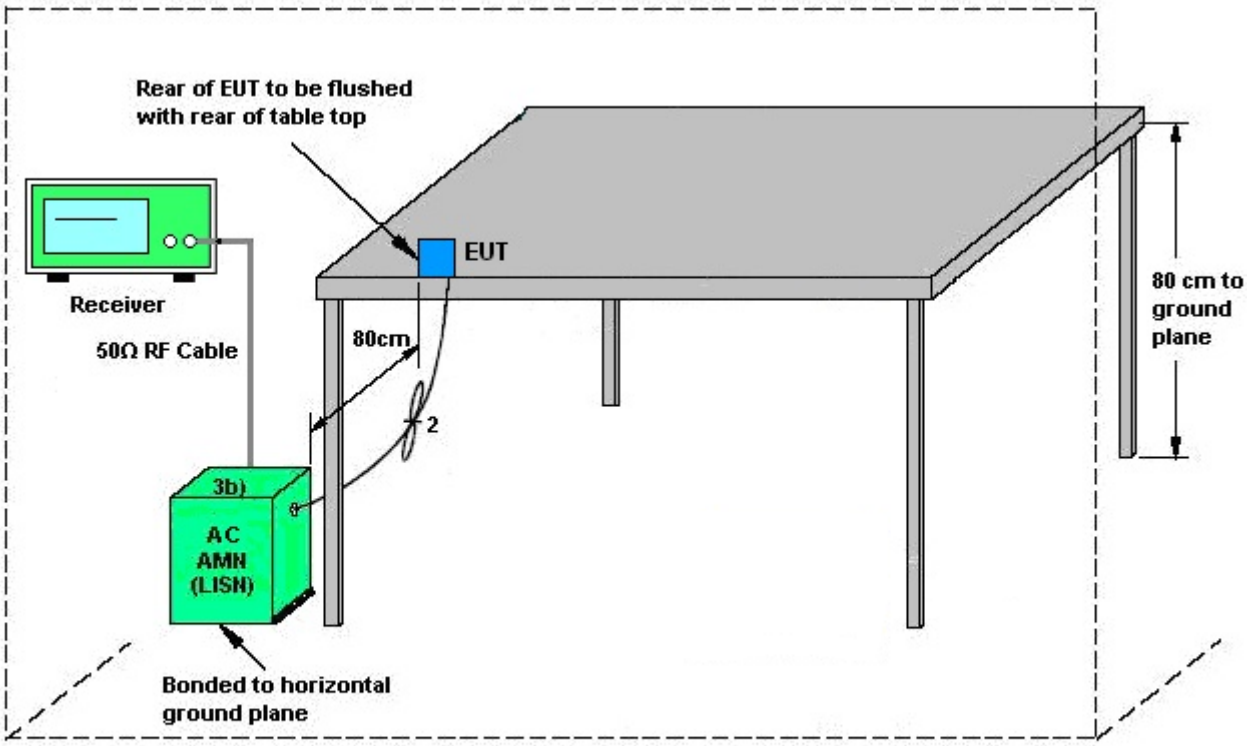
3.6.2 Measuring Instruments

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.
8. 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



AMN = Artificial mains network (LISN)
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.

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

Non-standard antenna connector 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	Jul. 03, 2023~ Jul. 04, 2023	Oct. 11, 2023	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 04, 2023	Jul. 03, 2023~ Jul. 04, 2023	Jan. 03, 2024	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 04, 2023	Jul. 03, 2023~ Jul. 04, 2023	Jan. 03, 2024	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 13, 2022	Jul. 31, 2023	Oct. 12, 2023	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz-44GHz	Oct. 13, 2022	Jul. 31, 2023	Oct. 12, 2023	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	Jul. 31, 2023	Oct. 15, 2023	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	Apr. 09, 2023	Jul. 31, 2023	Apr. 08, 2024	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 06, 2023	Jul. 31, 2023	Apr. 05, 2024	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 08, 2023	Jul. 31, 2023	Jan. 07, 2024	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz ~1GHZ	Jul. 06, 2023	Jul. 31, 2023	Jul. 05, 2024	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 04, 2023	Jul. 31, 2023	Jan. 03, 2024	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2082395	1Ghz-18Ghz	Jan. 04, 2023	Jul. 31, 2023	Jan. 03, 2024	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 12, 2022	Jul. 31, 2023	Oct. 11, 2023	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jul. 31, 2023	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jul. 31, 2023	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jul. 31, 2023	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 16, 2023	Jul. 18, 2023	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2022	Jul. 18, 2023	Oct. 12, 2023	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Jul. 18, 2023	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2022	Jul. 18, 2023	Oct. 11, 2023	Conduction (CO01-KS)

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	±0.46 dB
Conducted Emissions	±2.26 dB
Occupied Channel Bandwidth	±0.1 %
Conducted Power Spectral Density	±0.88 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.94dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.26dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.02dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.26dB

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

Appendix A. Conducted Test Results

Report Number : FR351809

Bluetooth Low Energy

Test Engineer:	Jacob Zhang	Temperature:	20~26	°C
Test Date:	2023/7/3~2023/7/4	Relative Humidity:	40~51	%

Zigbee

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
Zigbee	250K	1	11	2405	2.23	1.64	0.50	Pass
Zigbee	250K	1	19	2445	2.24	1.64	0.50	Pass
Zigbee	250K	1	26	2480	2.24	1.64	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
Zigbee	250K	1	11	2405	19.36	30.00	1.27	20.63	36.00	Pass
Zigbee	250K	1	19	2445	18.87	30.00	1.27	20.14	36.00	Pass
Zigbee	250K	1	26	2480	19.35	30.00	1.27	20.62	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)
Zigbee	250K	1	11	2405	0.00	19.34
Zigbee	250K	1	19	2445	0.00	18.85
Zigbee	250K	1	26	2480	0.00	19.32

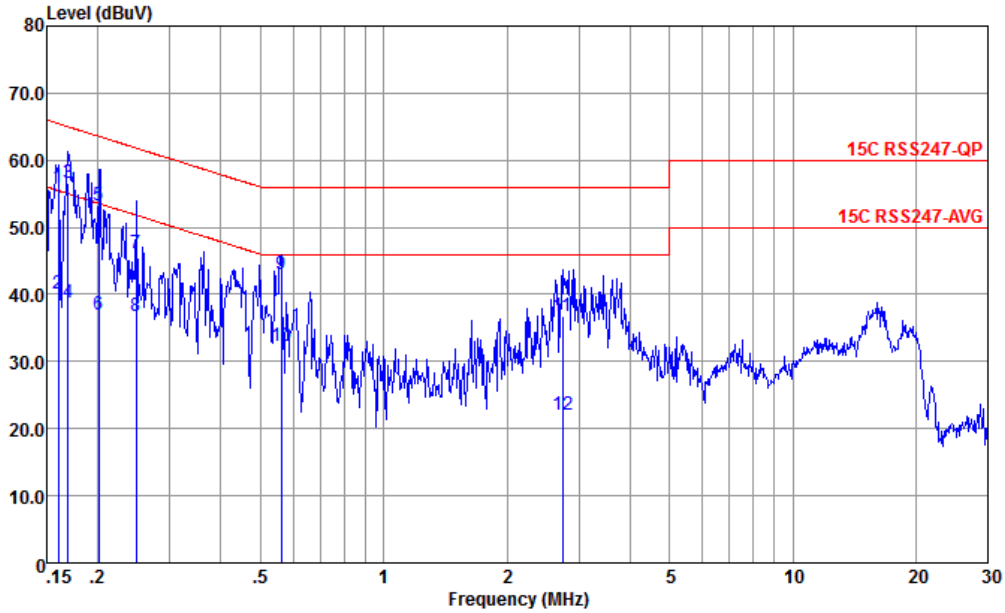
TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
Zigbee	250K	1	11	2405	14.24	3.31	1.27	8.00	Pass
Zigbee	250K	1	19	2445	14.35	3.92	1.27	8.00	Pass
Zigbee	250K	1	26	2480	14.07	3.25	1.27	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

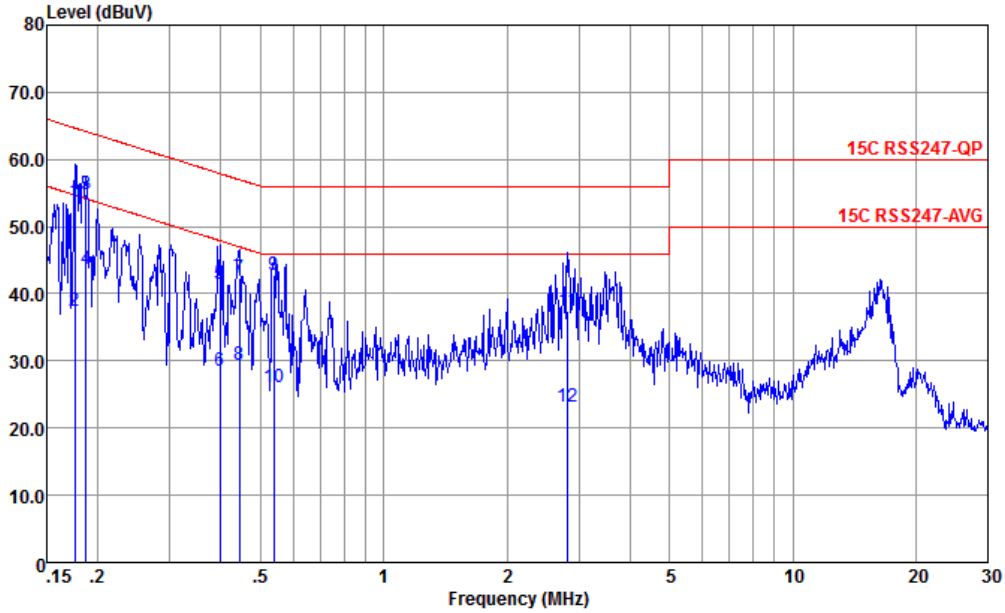
Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-L 2023 LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.160	55.97	-9.50	65.47	45.49	0.05	10.43	QP
2		0.160	40.07	-15.40	55.47	29.59	0.05	10.43	Average
3	*	0.169	56.67	-8.32	64.99	46.20	0.04	10.43	QP
4		0.169	38.77	-16.22	54.99	28.30	0.04	10.43	Average
5		0.201	53.35	-10.23	63.58	42.90	0.03	10.42	QP
6		0.201	37.05	-16.53	53.58	26.60	0.03	10.42	Average
7		0.248	46.22	-15.60	61.82	35.80	0.04	10.38	QP
8		0.248	36.72	-15.10	51.82	26.30	0.04	10.38	Average
9		0.561	42.95	-13.05	56.00	32.80	-0.04	10.19	QP
10		0.561	32.35	-13.65	46.00	22.20	-0.04	10.19	Average
11		2.736	36.77	-19.23	56.00	26.80	-0.09	10.06	QP
12		2.736	22.17	-23.83	46.00	12.20	-0.09	10.06	Average

Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-N 2023 NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.176	53.77	-10.91	64.68	43.30	0.05	10.42	QP
2		0.176	37.37	-17.31	54.68	26.90	0.05	10.42	Average
3	*	0.187	54.87	-9.28	64.15	44.40	0.05	10.42	QP
4		0.187	43.67	-10.48	54.15	33.20	0.05	10.42	Average
5		0.398	41.44	-16.46	57.90	31.20	-0.06	10.30	QP
6		0.398	28.54	-19.36	47.90	18.30	-0.06	10.30	Average
7		0.444	42.39	-14.59	56.98	32.19	-0.06	10.26	QP
8		0.444	29.39	-17.59	46.98	19.19	-0.06	10.26	Average
9		0.538	42.73	-13.27	56.00	32.60	-0.07	10.20	QP
10		0.538	26.03	-19.97	46.00	15.90	-0.07	10.20	Average
11		2.824	37.53	-18.47	56.00	27.60	-0.13	10.06	QP
12		2.824	23.23	-22.77	46.00	13.30	-0.13	10.06	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix C. Radiated Spurious Emission Test Data

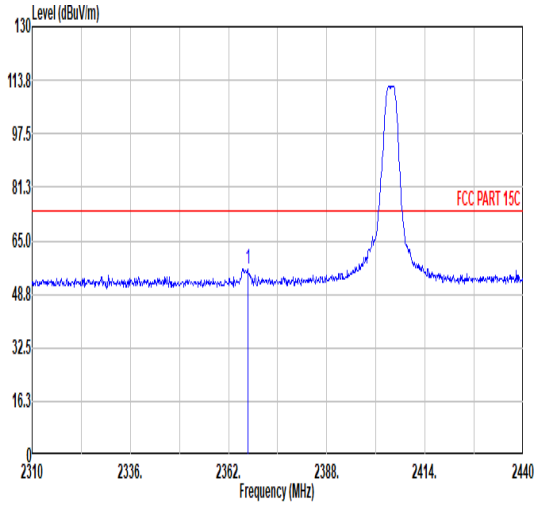
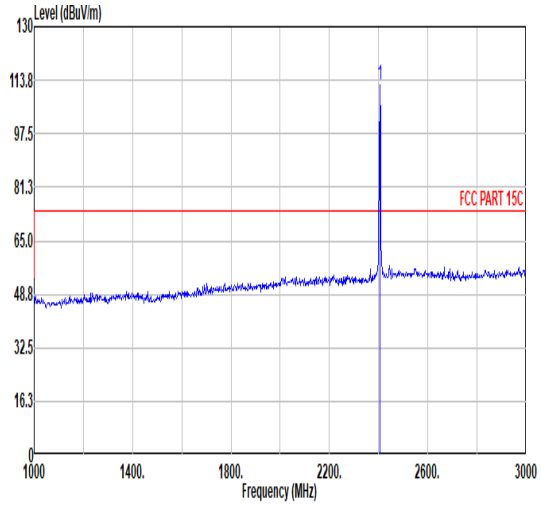
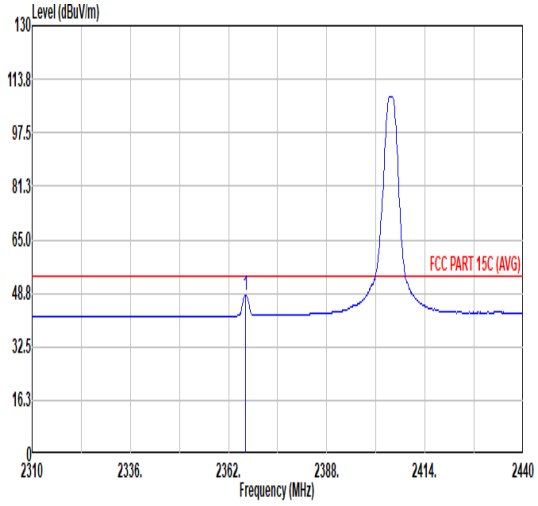
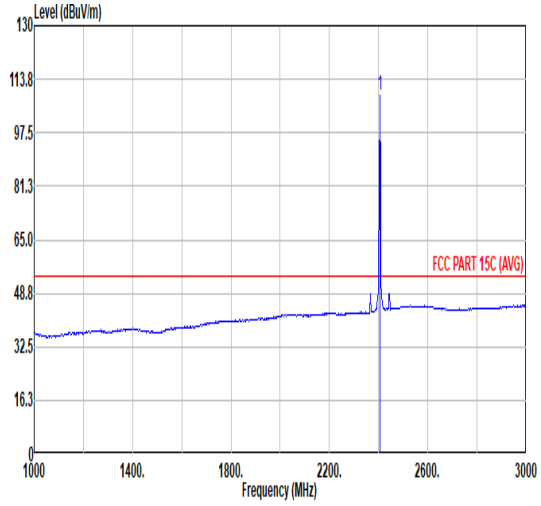
Test Engineer :	Carry Xu	Relative Humidity :	41~42％
		Temperature :	22~23℃

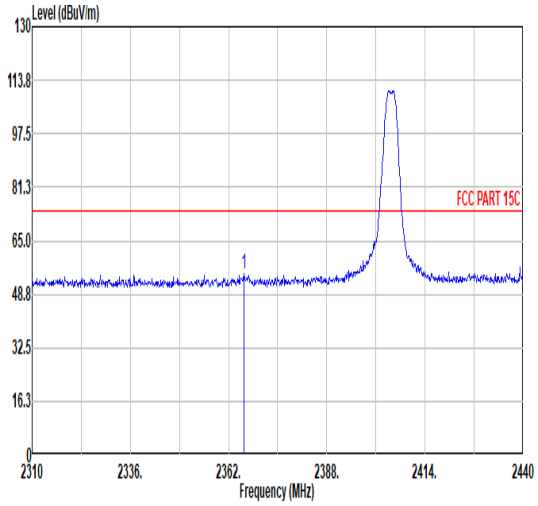
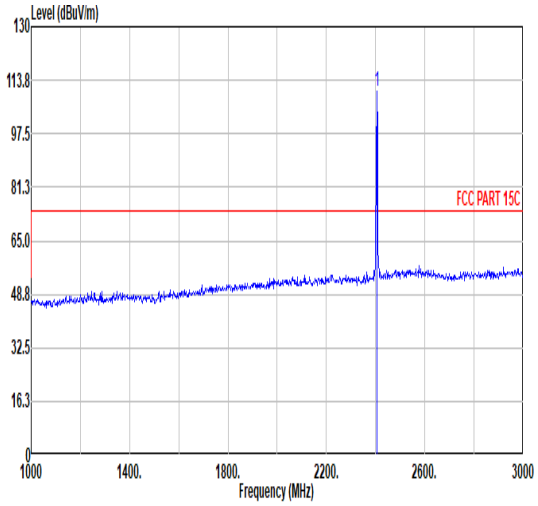
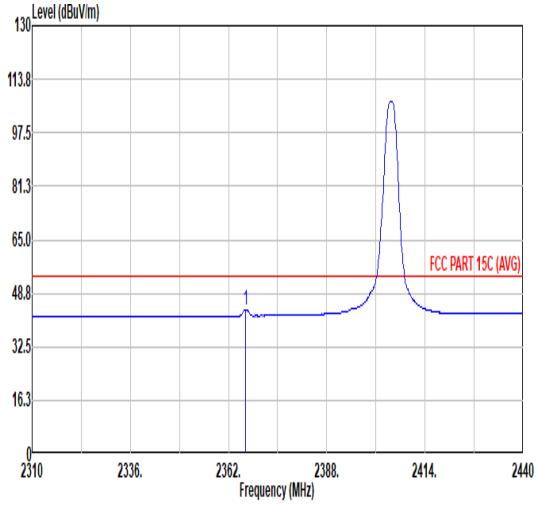
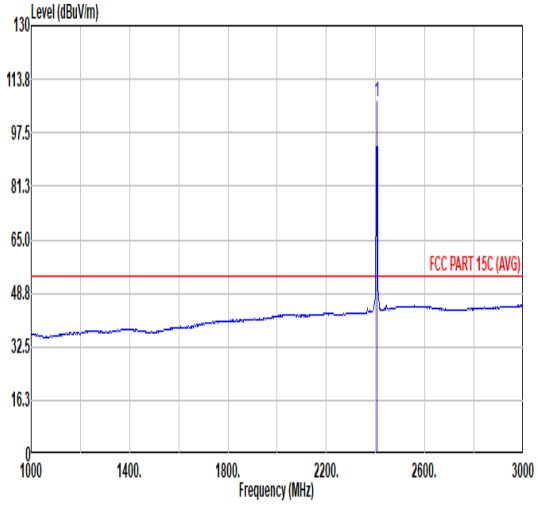
Radiated Spurious Emission Test Modes

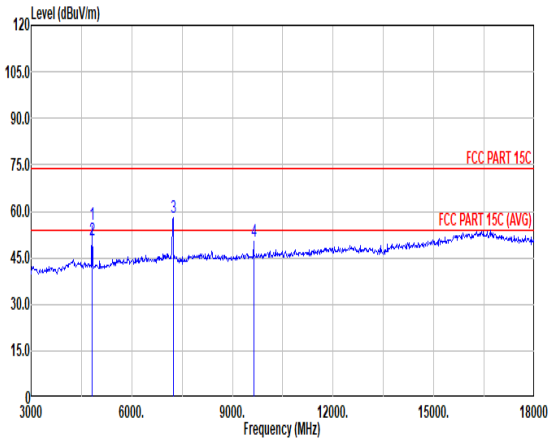
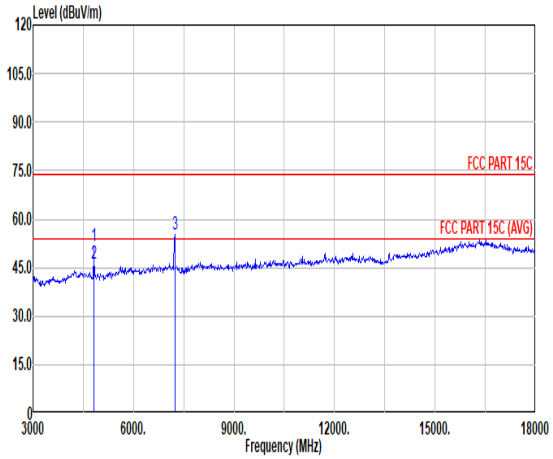
Mode	Band (MHz)	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2405-2480	O-QPSK	11	2405	250Kbps	-	-
Mode 2	2405-2480	O-QPSK	19	2445	250Kbps	-	-
Mode 3	2405-2480	O-QPSK	26	2480	250Kbps	-	-
	2405-2480	O-QPSK	26	2480	250Kbps	-	LF

Summary of each worse mode

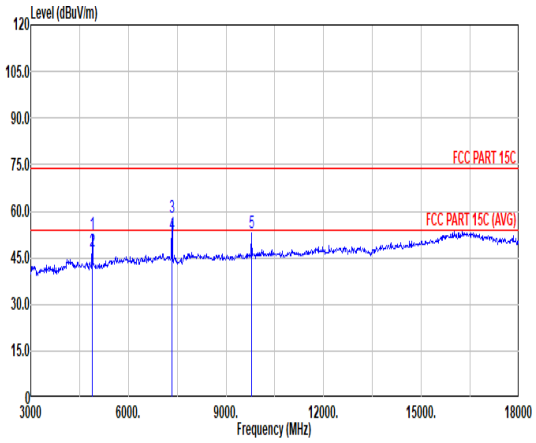
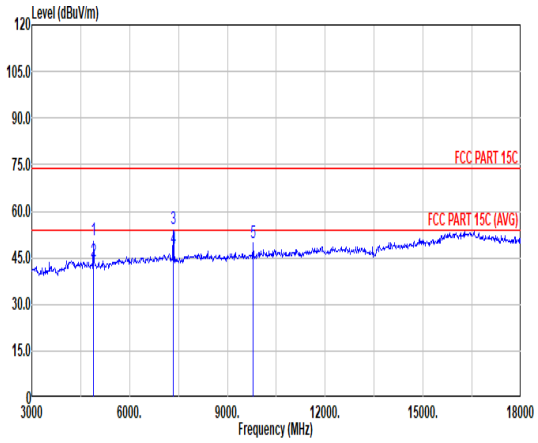
Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	O-QPSK	11	2366.55	47.97	54.00	-6.03	H	AVERAGE	Pass	Band Edge
1	O-QPSK	11	4810.00	50.66	54.00	-3.34	H	AVERAGE	Pass	Harmonic
2	O-QPSK	19	-	-	-	-	-	-	-	Band Edge
2	O-QPSK	19	7335.00	52.63	54.00	-1.37	H	AVERAGE	Pass	Harmonic
3	O-QPSK	26	2483.50	47.77	54.00	-6.23	H	AVERAGE	Pass	Band Edge
3	O-QPSK	26	7440.00	53.36	54.00	-0.64	H	AVERAGE	Pass	Harmonic
3	O-QPSK	26	480.08	32.16	46.00	-13.84	H	Peak	Pass	LF

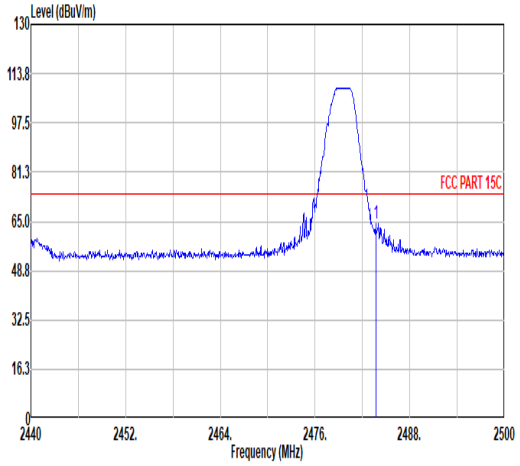
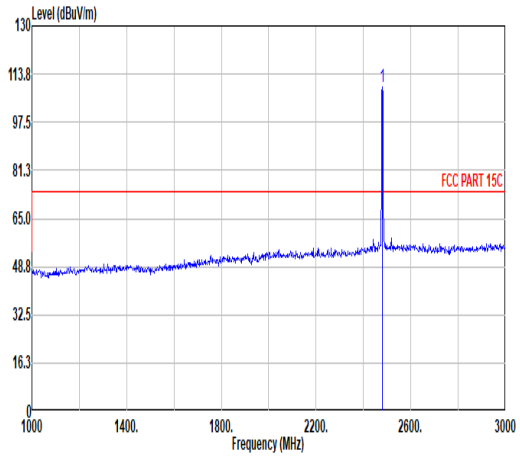
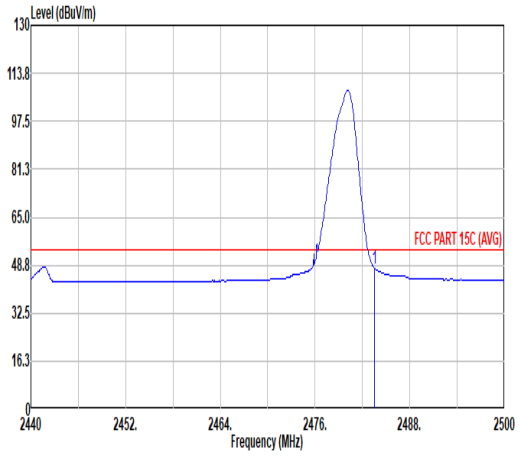
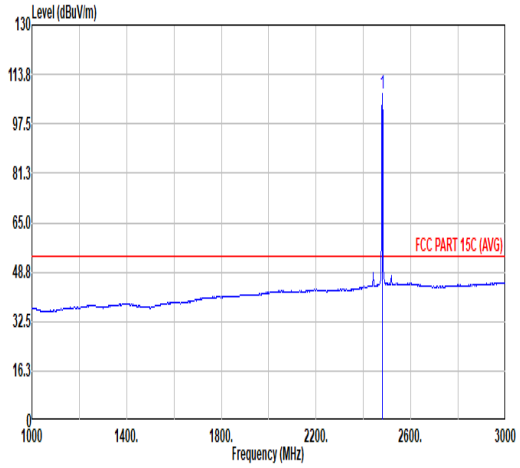
Mode	1	
	Band Edge	
	2405-2480_ Zigbee _CH11_2405MHz	
Pol.	Horizontal	Fundamental
Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2367.07 56.59 74.00 -17.41 45.18 31.74 6.57 32.90 6.00 147 330 PEAK	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2405.00 112.17 ------ ------ 100.13 32.24 6.63 32.83 6.00 147 330 PEAK
Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2366.55 47.97 54.00 -6.03 36.57 31.73 6.57 32.90 6.00 147 330 AVERAGE	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2405.00 108.86 ------ ------ 96.82 32.24 6.63 32.83 6.00 147 330 AVERAGE

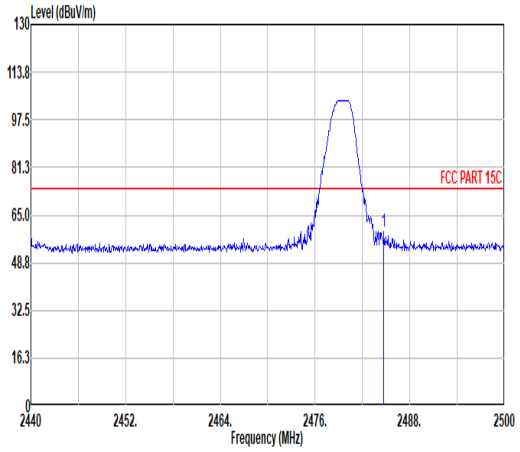
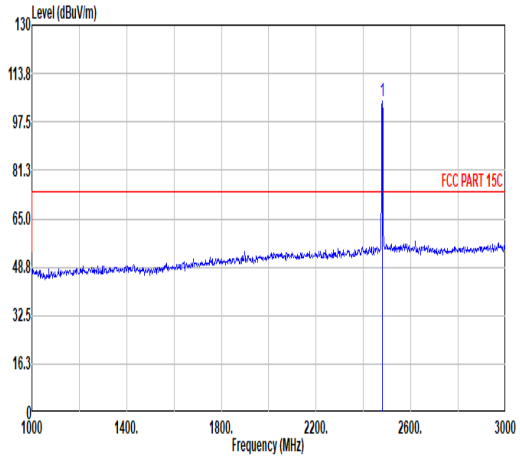
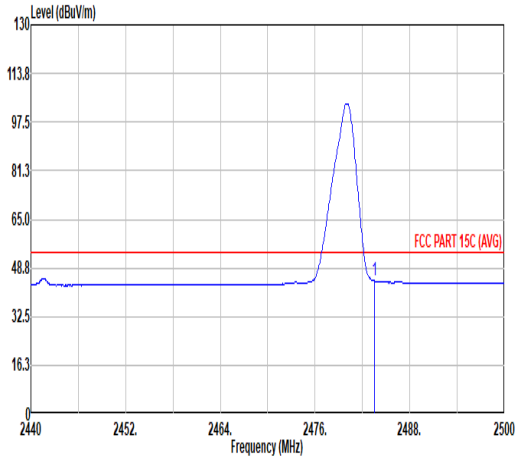
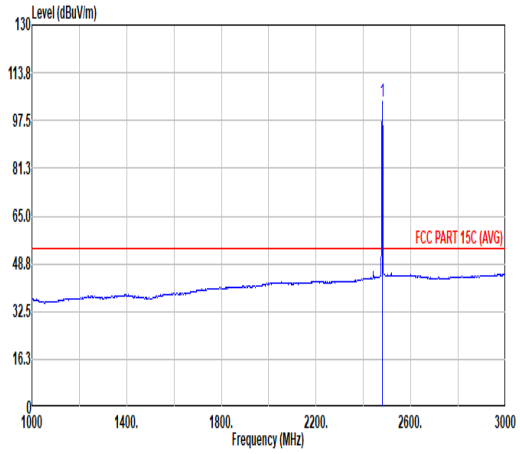
Mode	1	
	Band Edge	
	2405-2480_ Zigbee _CH11_2405MHz	
Pol.	Vertical	Fundamental
Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2366.03 54.88 74.00 -19.12 43.49 31.72 6.57 32.90 6.00 386 85 PEAK	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2405.00 110.57 ------ ------ 98.53 32.24 6.63 32.83 6.00 386 85 PEAK
Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2366.55 43.88 54.00 -10.12 32.48 31.73 6.57 32.90 6.00 386 85 AVERAGE	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2405.00 107.17 ------ ------ 95.13 32.24 6.63 32.83 6.00 386 85 AVERAGE

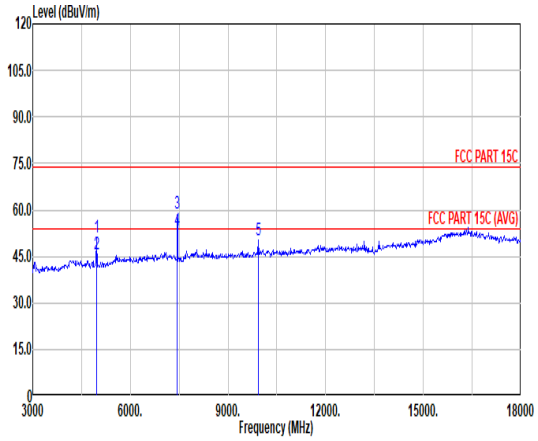
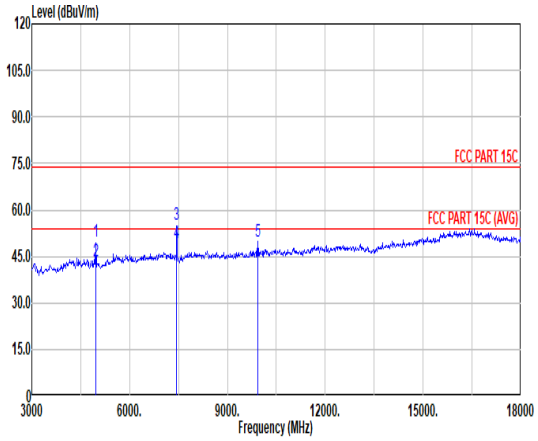
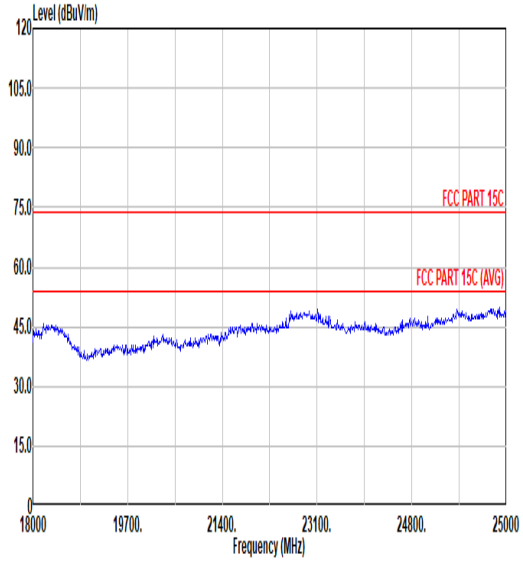
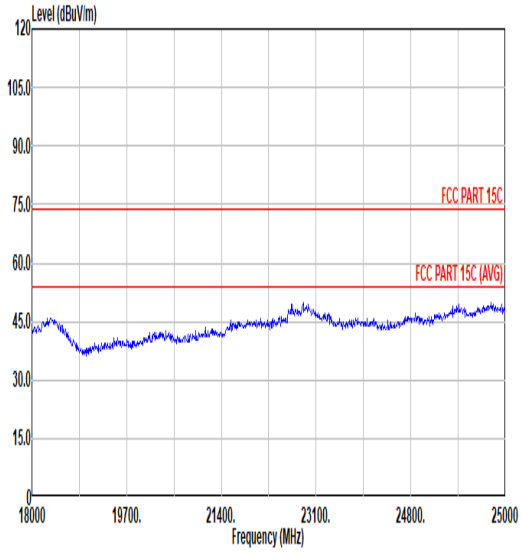
Mode	1	
	Harmonic	
	2405-2480_ Zigbee _CH11_2405MHz	
Pol.	Horizontal	Vertical
Peak Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 4810.00 55.74 74.00 -18.26 73.01 34.20 9.45 60.92 0.00 104 8 PEAK 2 4810.00 50.66 54.00 -3.34 67.93 34.20 9.45 60.92 0.00 104 8 AVERAGE 3 7230.00 57.79 89.17 -31.38 70.56 35.72 11.66 60.15 0.00 --- --- Peak 4 9630.00 50.32 89.17 -38.85 60.64 36.90 13.57 60.79 0.00 --- --- Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 4810.00 51.79 74.00 -22.21 69.06 34.20 9.45 60.92 0.00 349 94 PEAK 2 4810.00 46.16 54.00 -7.84 63.43 34.20 9.45 60.92 0.00 349 94 AVERAGE 3 7230.00 55.42 89.17 -33.75 68.19 35.72 11.66 60.15 0.00 --- --- Peak

Note: The Remark #3 & #4 are non-restricted frequency which limit is 100kHz-PSD down 20dB

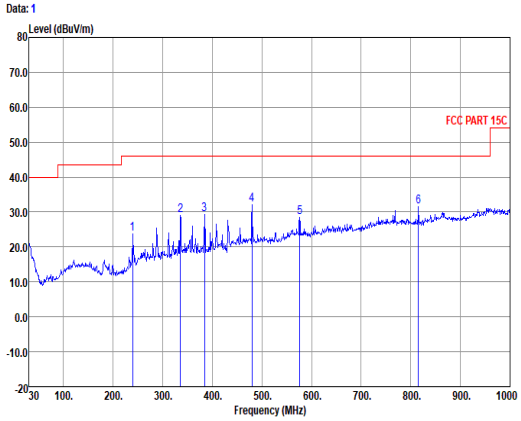
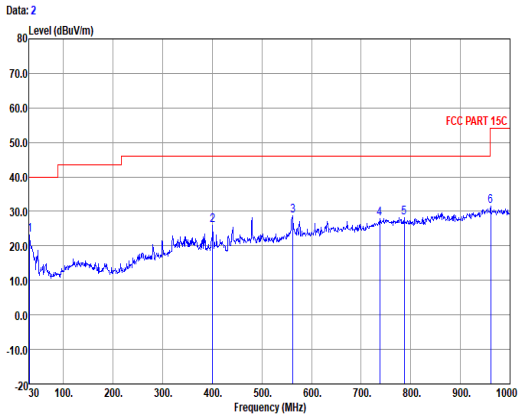
Mode	2	
	Harmonic	
	2405-2480_ Zigbee _CH19_2445MHz	
Pol.	Horizontal	Vertical
Peak Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 4890.00 52.72 74.00 -21.28 69.84 34.20 9.54 60.86 0.00 100 8 PEAK 2 4890.00 47.20 54.00 -6.80 64.32 34.20 9.54 60.86 0.00 100 8 AVERAGE 3 7335.00 58.11 74.00 -15.89 71.05 35.74 11.70 60.38 0.00 117 172 PEAK 4 7335.00 52.63 54.00 -1.37 65.58 35.73 11.70 60.38 0.00 117 172 AVERAGE 5 9780.00 52.86 79.11 -26.25 62.95 37.16 13.59 60.84 0.00 --- --- Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 4890.00 50.63 74.00 -23.37 67.75 34.20 9.54 60.86 0.00 358 94 PEAK 2 4890.00 44.15 54.00 -9.85 61.27 34.20 9.54 60.86 0.00 358 94 AVERAGE 3 7335.00 54.12 74.00 -19.88 67.06 35.74 11.70 60.38 0.00 102 117 PEAK 4 7335.00 48.12 54.00 -5.88 61.07 35.73 11.70 60.38 0.00 102 117 AVERAGE 5 9795.00 49.87 76.41 -26.54 59.92 37.19 13.60 60.84 0.00 --- --- Peak

Mode	3	
	Band Edge	
	2405-2480_ Zigbee _CH26_2480MHz	
Pol.	Horizontal	Fundamental
Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2483.68 64.28 74.00 -9.72 51.41 32.77 6.73 32.63 6.00 152 329 PEAK	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2480.00 109.46 ------ ------ 96.62 32.74 6.73 32.63 6.00 152 329 PEAK
Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2483.50 47.77 54.00 -6.23 34.90 32.77 6.73 32.63 6.00 152 329 AVERAGE	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2480.00 107.61 ------ ------ 94.77 32.74 6.73 32.63 6.00 152 329 AVERAGE

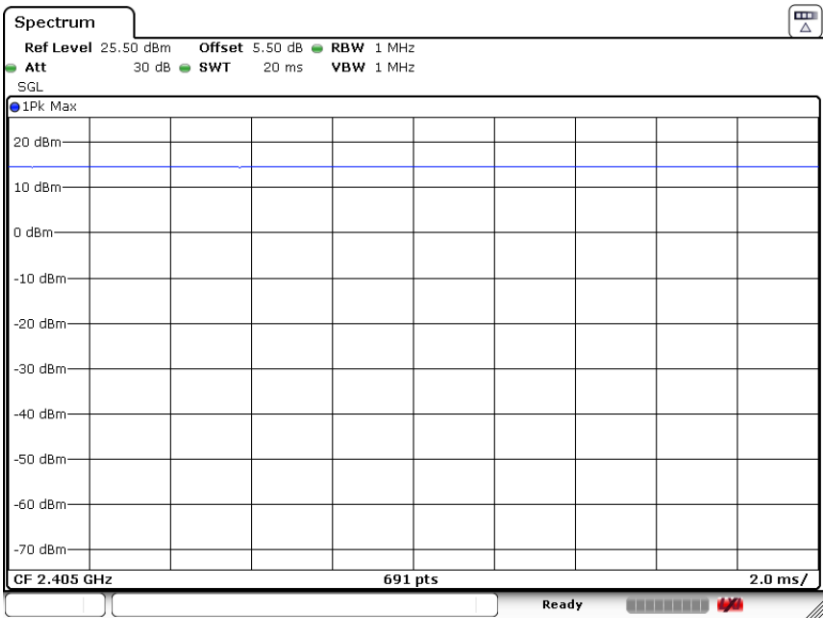
Mode	3	
	Band Edge	
	2405-2480_ Zigbee _CH26_2480MHz	
Pol.	Vertical	Fundamental
Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2484.70 59.57 74.00 -14.43 46.68 32.78 6.73 32.62 6.00 100 256 PEAK	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2480.00 104.45 ------ ------ 91.61 32.74 6.73 32.63 6.00 100 256 PEAK
Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2483.50 44.44 54.00 -9.56 31.57 32.77 6.73 32.63 6.00 100 256 AVERAGE	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2480.00 103.88 ------ ------ 91.04 32.74 6.73 32.63 6.00 100 256 AVERAGE

Mode	3	
	Harmonic	
	2405-2480_ Zigbee _CH26_2480MHz	
Pol.	Horizontal	Vertical
Peak Avg	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark 1 4960.00 51.39 74.00 -22.61 68.40 34.18 9.61 60.80 0.00 128 61 PEAK 2 4960.00 45.83 54.00 -8.17 62.84 34.18 9.61 60.80 0.00 128 61 AVERAGE 3 7440.00 58.76 74.00 -15.24 71.91 35.70 11.77 60.62 0.00 113 259 PEAK 4 7440.00 53.36 54.00 -0.64 66.50 35.70 11.78 60.62 0.00 113 259 AVERAGE 5 9930.00 50.42 88.42 -38.00 60.16 37.36 13.79 60.89 0.00 --- --- Peak	 Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark 1 4960.00 49.90 74.00 -24.10 66.91 34.18 9.61 60.80 0.00 370 94 PEAK 2 4960.00 43.42 54.00 -10.58 60.43 34.18 9.61 60.80 0.00 370 94 AVERAGE 3 7440.00 55.08 74.00 -18.92 68.23 35.70 11.77 60.62 0.00 254 101 PEAK 4 7440.00 49.30 54.00 -4.70 62.44 35.70 11.77 60.61 0.00 254 101 AVERAGE 5 9930.00 49.89 83.41 -33.52 59.63 37.36 13.79 60.89 0.00 --- --- Peak
	 	

Note: Only the worst case has assessed 18G ~25GHz to test.

Mode	3	
	LF	
	2405-2480_ Zigbee _CH26_2480MHz	
Pol.	Horizontal	Vertical
Peak QP	 Site : 03CH06-KS Condition : FCC PART 15C 3m LF 6111D SN44483 HORIZONTAL |	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark
---	---	---	---	---	---	---	---	---	---	---	---
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB/m	dB	cm	deg	
1	239.52	23.84	-22.16	46.00	36.42	2.09	17.50	32.17	---	---	Peak
2	335.55	29.16	-16.84	46.00	38.83	2.47	20.06	32.20	---	---	Peak
3	384.05	29.30	-16.70	46.00	37.56	2.64	21.34	32.24	---	---	Peak
4	480.08	32.16	-13.84	46.00	38.21	2.96	23.64	32.65	---	---	Peak
5	576.11	28.55	-17.45	46.00	32.13	3.24	25.61	32.43	---	---	Peak
6	815.70	31.51	-14.49	46.00	31.08	3.86	28.55	31.98	---	---	Peak
	 Site : 03CH06-KS Condition : FCC PART 15C 3m LF 6111D SN44483 VERTICAL |	Freq	Level	Over Limit	Limit Line	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark
---	---	---	---	---	---	---	---	---	---	---	---
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB	dB/m	dB	cm	deg	
1	31.94	23.06	-16.94	40.00	30.85	0.48	24.04	32.31	---	---	Peak
2	400.54	26.08	-19.92	46.00	33.71	2.70	21.92	32.25	---	---	Peak
3	562.53	28.69	-17.31	46.00	32.45	3.20	25.50	32.46	---	---	Peak
4	737.13	27.83	-18.17	46.00	28.53	3.67	27.82	32.19	---	---	Peak
5	786.60	28.23	-17.77	46.00	28.34	3.79	28.20	32.10	---	---	Peak
6	961.20	31.53	-22.47	54.00	27.31	4.18	30.91	30.87	---	---	Peak

Appendix D. Duty Cycle Plots

Mode	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Zigbee	100	-	-	10Hz

Zigbee mode