FCC Part 15C
Measurement and Test Report

For

CHENGDU HIZIMA TECHNOLOGY CO.,LTD

FCC ID: 2AP29-ZMK3-1U

FCC Rule(s):	FCC Part 15.247
Product Description:	Smart Electronic Key
Tested Model:	ZMK3-1U
Report No.:	BSL1804838010001Y-ER-2
Tested Date:	May 28~30, 2018
Issued Date:	May 30,2018
Tested By:	Lisa. Li / Engineer
Reviewed By:	arno. Liu / EMC Manager
Approved & Authorized By:	Mike mo / PSQ Manager

Prepared By:

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TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	CHENGDU HIZIMA TECHNOLOGY CO.,LTD
Address of applicant:	D2-2F,MOJU INDUSTRIAL PARK,#199,XIQU AVENUE,HI-TECH ZONE WEST,CHENGDU,SICHUAN,CHINA
Manufacturer:	CHENGDU HIZIMA TECHNOLOGY CO.,LTD
Address of manufacturer:	D2-2F,MOJU INDUSTRIAL PARK,#199,XIQU AVENUE,HI-TECH ZONE WEST,CHENGDU,SICHUAN,CHINA

General Description of EUT	
Product Name:	Smart Electronic Key
Brand Name:	
Model No.:	ZMK3-1U,ZMK3-1B,ZMK3-2B,ZMK3-2U,ZMK3-3B, ZMK3-3U
Rated Voltage:	DC 3.7V by battery
Note: The test data is gathered from a production sample provided by the manufacturer.	

Technical Characteristics of EUT	
Bluetooth Version:	V4.0 (BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	1.73dBm(Conducted)
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	PCB Antenna
Antenna Gain:	0dBi
Lowest Internal Frequency:	32.768KHz

1.2 Test Standards

The following report is prepared on behalf of the CHENGDU HIZIMA TECHNOLOGY CO.,LTD. in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide KDB 558074 D01 v04 for digital transmission systems shall be performed also.

1.4 Test Facility

BSL Testing Co.,LTD.
NO. 24, ZH Park, Nantou, Shenzhen, 518000 China
Designation Number : CN1217
Test Firm Registration Number: 866035
Tel: 86- 755-26508703
Fax: 86- 755-26508703

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	GFSK(BLE)	2402MHz, 2442MHz, 2480MHz

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E23	EB12648265
USB	ESR	Shielded	Without Core
Adapter	Capshi	C01	2689458

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	±2.88dB
Transmitter Spurious Emissions	Radiated	±5.1dB

1.7 Test Equipment List and Details

Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
Communication Tester	Rohde & Schwarz	CMW500	100358	2017-10-21	2018-10-20
Spectrum Analyzer	R&S	FSP40	100550	2017-10-21	2018-10-20
Test Receiver	R&S	ESCI7	US47140102	2017-10-21	2018-10-20
Signal Generator	HP	83630B	3844A01028	2017-10-22	2018-10-21
Test Receiver	R&S	ESPI-3	100180	2017-10-21	2018-10-20
Amplifier	Agilent	8449B	4035A00116	2017-10-22	2018-10-21
Amplifier	HP	8447E	2945A02770	2017-10-22	2018-10-21
Signal Generator	IFR	2023A	202307/242	2017-10-22	2018-10-21
Broadband Antenna	SCHAFFNER	2774	2774	2017-10-17	2018-10-16
Biconical and log periodic antennas	ELECTRO-METRICS	EM-6917B-1	171	2017-10-17	2018-10-16
Horn Antenna	R&S	HF906	100253	2017-10-17	2018-10-16
Horn Antenna	EM	EM-6961	6462	2017-10-17	2018-10-16
LISN	R&S	ESH3-Z5	100196	2017-10-17	2018-10-16
LISN	COM-POWER	LI-115	02027	2017-10-17	2018-10-16
3m Semi-Anechoic Chamber	Chengyu Electron	9 (L)*6 (W)* 6 (H)	BSL086	2017-10-21	2018-10-20
Horn Antenna	A-INFOMW	LB-180400KF	BSL088	2017-10-21	2018-10-20

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 2.1093	RF Exposure	PASS
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	PASS
§15.205	Restricted Band of Operation	PASS
§ 15.207(a)	Conducted Emission	PASS
§ 15.247(e)	Power Spectral Density	PASS
§ 15.247(a)(2)	6 dB Bandwidth	PASS
§ 15.247(b)(3)	RF Output Power	PASS
§ 15.209(a)	Radiated Emission	PASS
§ 15.247(d)	Band Edge (Out of Band Emissions)	PASS

Note: PASS: applicable, N/A: not applicable.

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

This product has a PCB antenna, fulfill the requirement of this section.

5. Power Spectral Density

5.1 Standard Applicable

According to 15.247(a)(1)(iii), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 Test Procedure

According to the KDB 558074 D01 v04, the test method of power spectral density as below:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 × RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3 Environmental Conditions

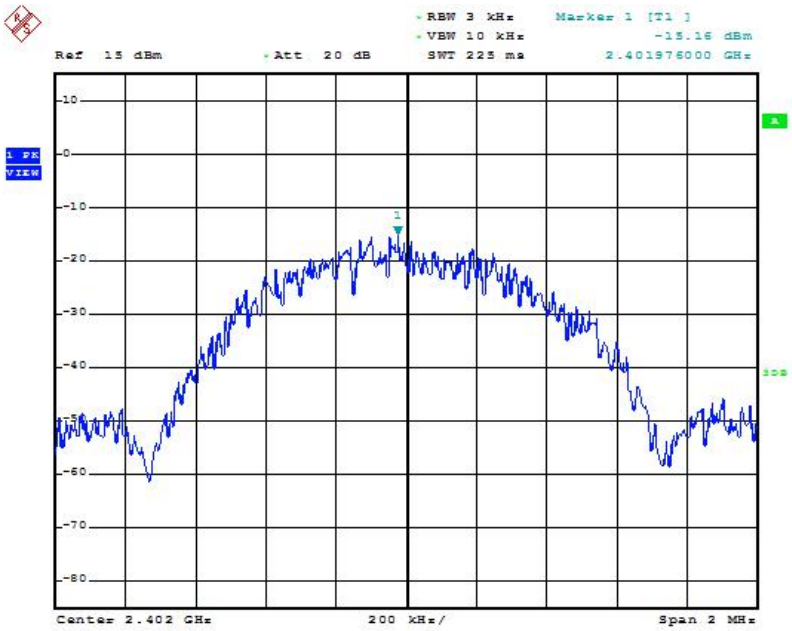
Temperature:	26° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

5.4 Summary of Test Results/Plots

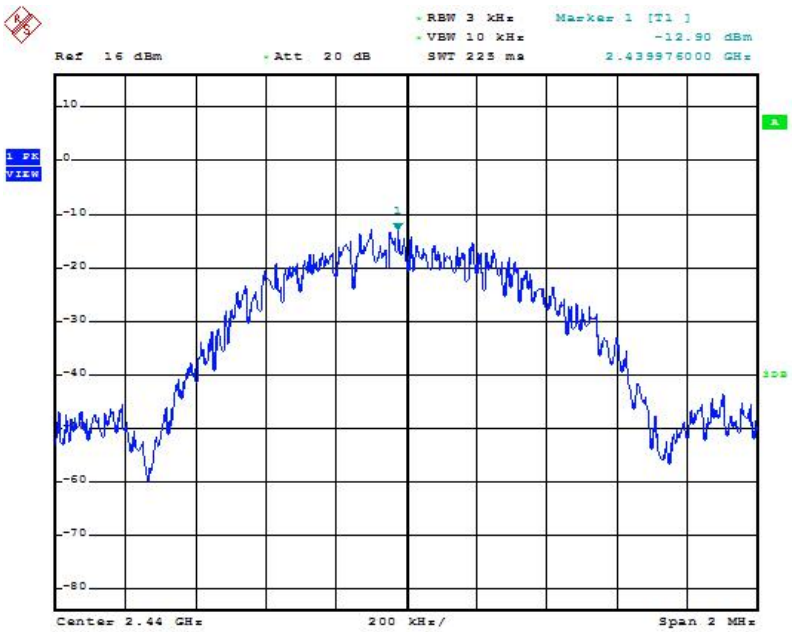
Test Mode	Test Channel MHz	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
GFSK(BLE)	2402	-13.16	8
	2442	-12.90	8
	2480	-13.31	8

Please refer to the following test plots:

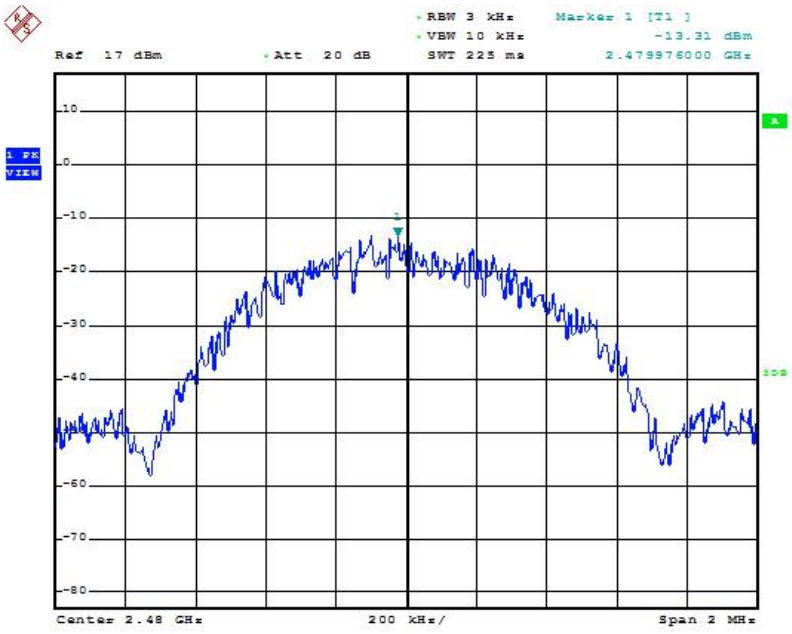
Low Channel



Middle Channel



High Channel



6. 6dB Bandwidth

6.1 Standard Applicable

According to 15.247(a)(2). Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Test Procedure

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3 Environmental Conditions

Temperature:	25° C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

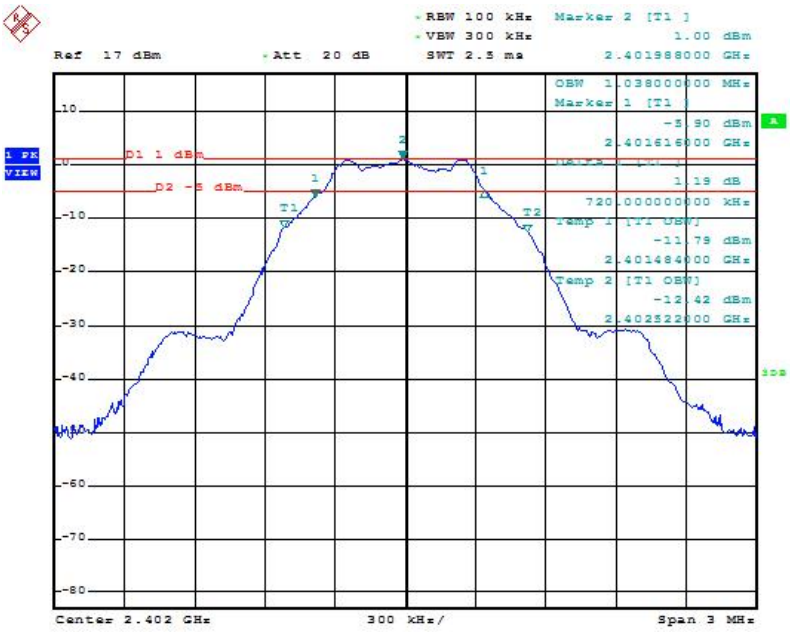
6.4 Summary of Test Results/Plots

Test Mode	Test Channel MHz	6 dB Bandwidth kHz	Limit kHz
GFSK(BLE)	2402	720	≥500
	2442	732	≥500
	2480	720	≥500

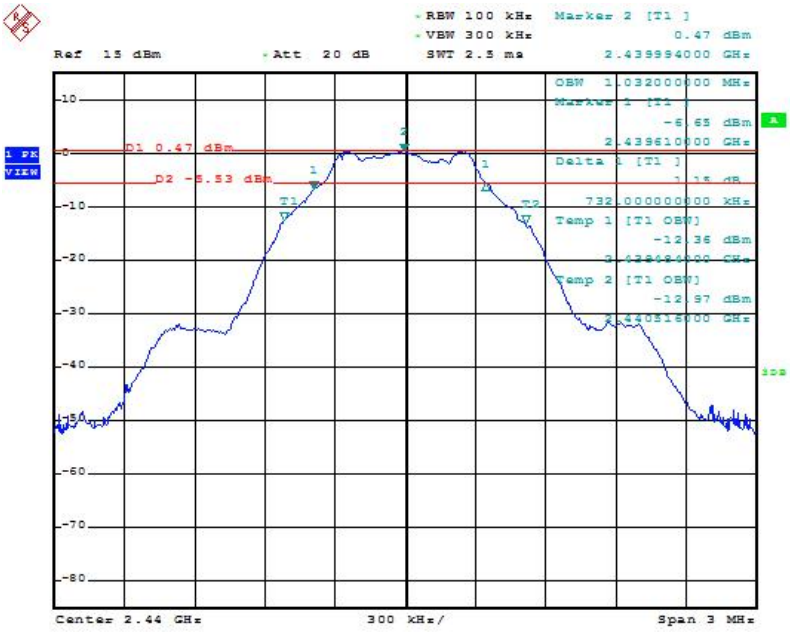
Please refer to the following test plots:

For BLE

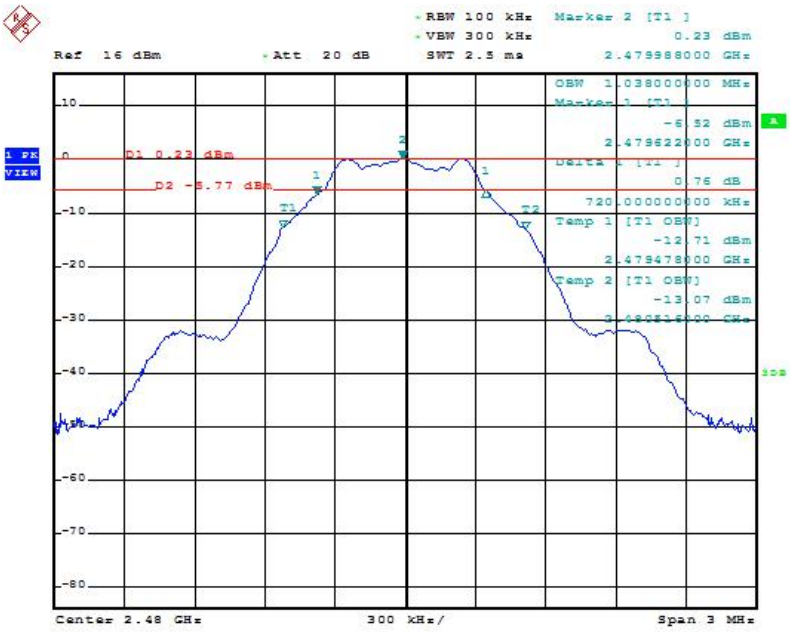
Low Channel:



Middle Channel:



High Channel:



7. RF Output Power

7.1 Standard Applicable

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

7.2 Test Procedure

According to section KDB-558074 D01 v04 section 9.1.1, this procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ⩾ DTS bandwidth.
b) Set VBW ⩾ 3 × RBW.
c) Set span ⩾ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

7.3 Environmental Conditions

Temperature:	26° C
Relative Humidity:	57%
ATM Pressure:	1011 mbar

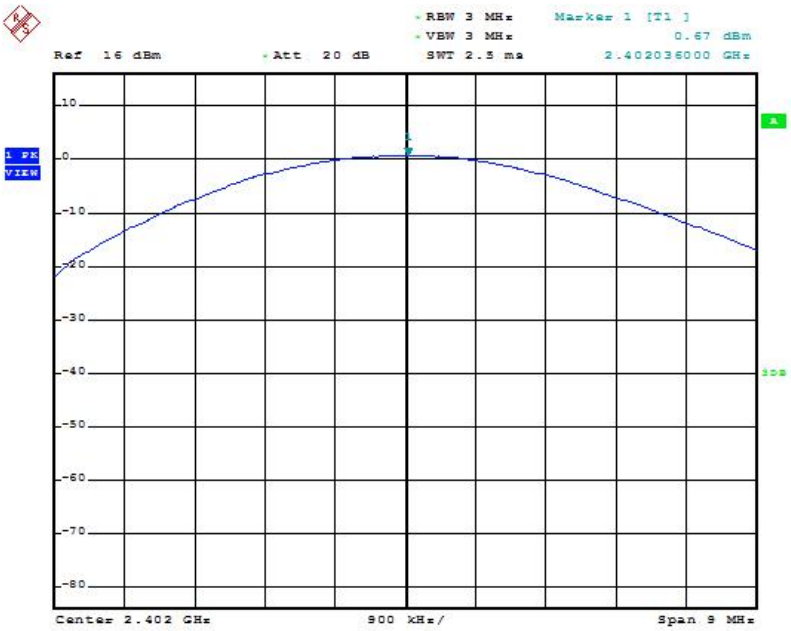
7.4 Summary of Test Results/Plots

Test Mode	Frequency MHz	Reading dBm	Output Power mW	Limit mW
GFSK(BLE)	2402	0.67	1.17	1000
	2442	0.27	1.06	1000
	2480	1.73	1.49	1000

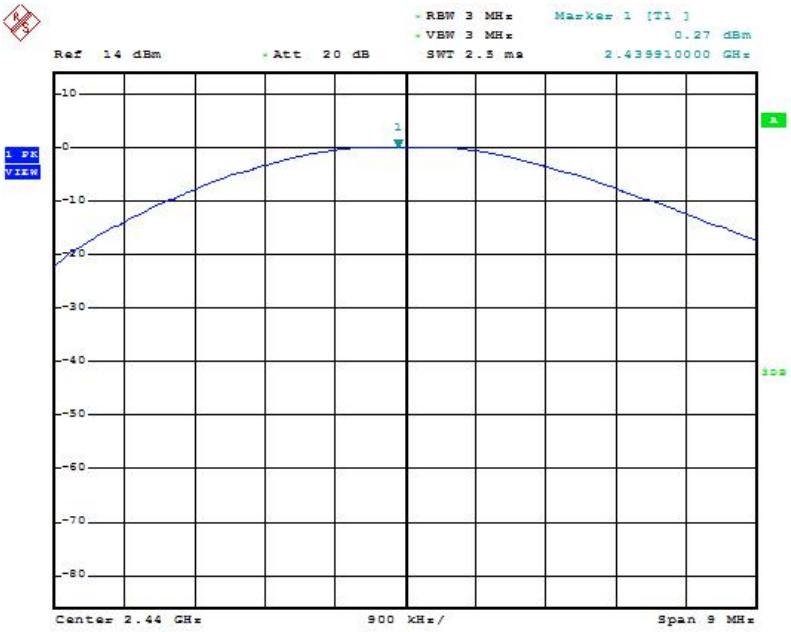
Note: the antenna gain of 0dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

For BLE:

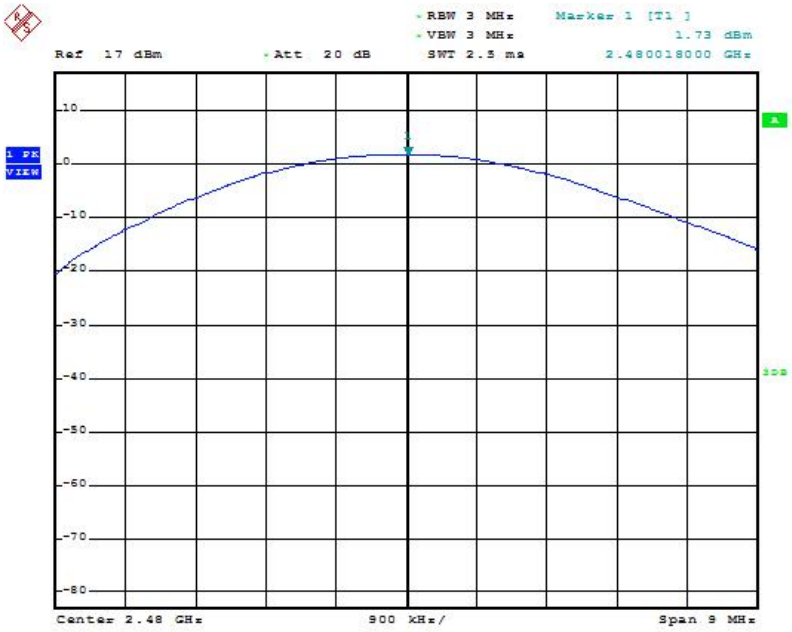
Low Channel:



Middle Channel:



High Channel:



8. Field Strength of Spurious Emissions

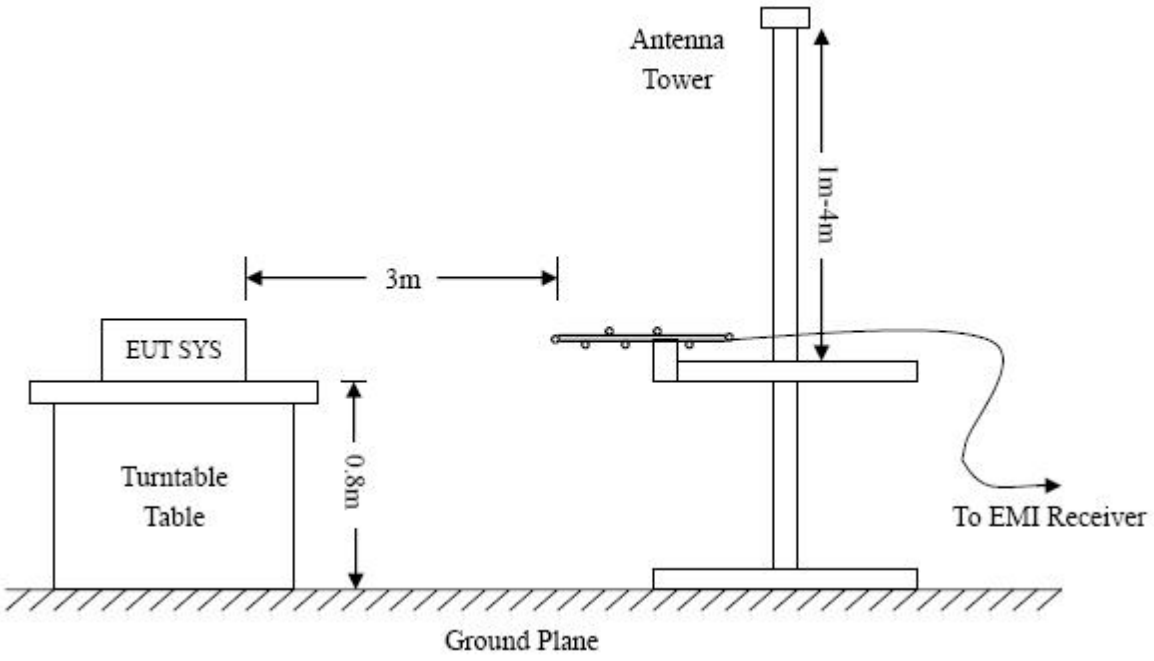
8.1 Standard Applicable

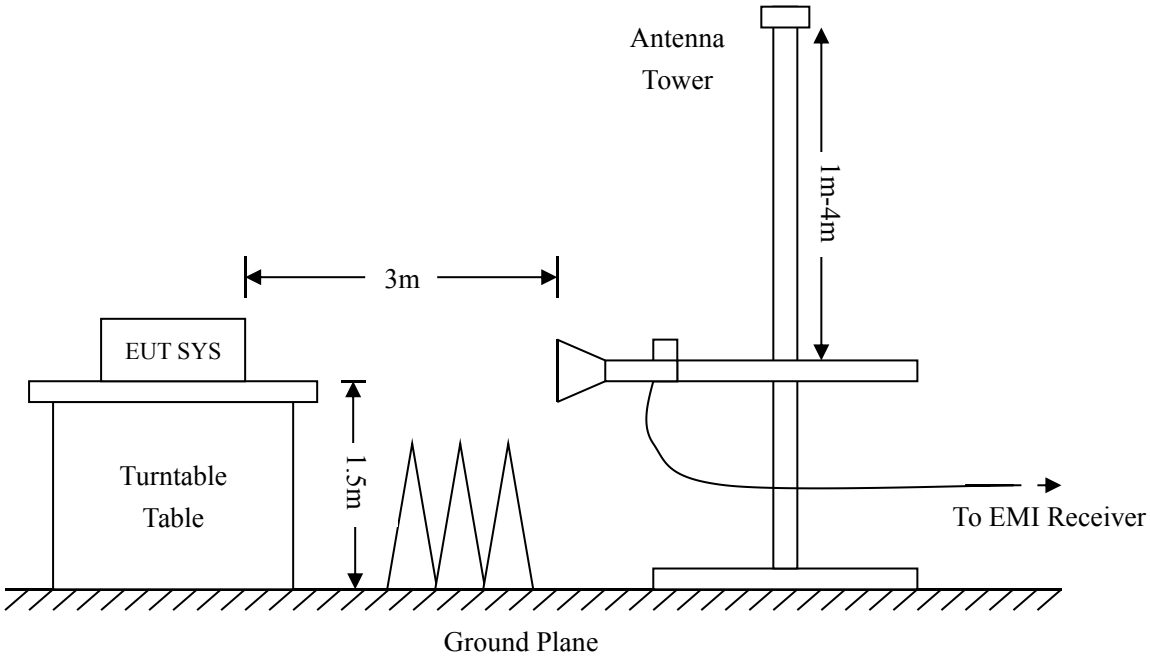
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

8.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.





Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

8.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15 Limit

8.4 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

8.5 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst cases:

Note:

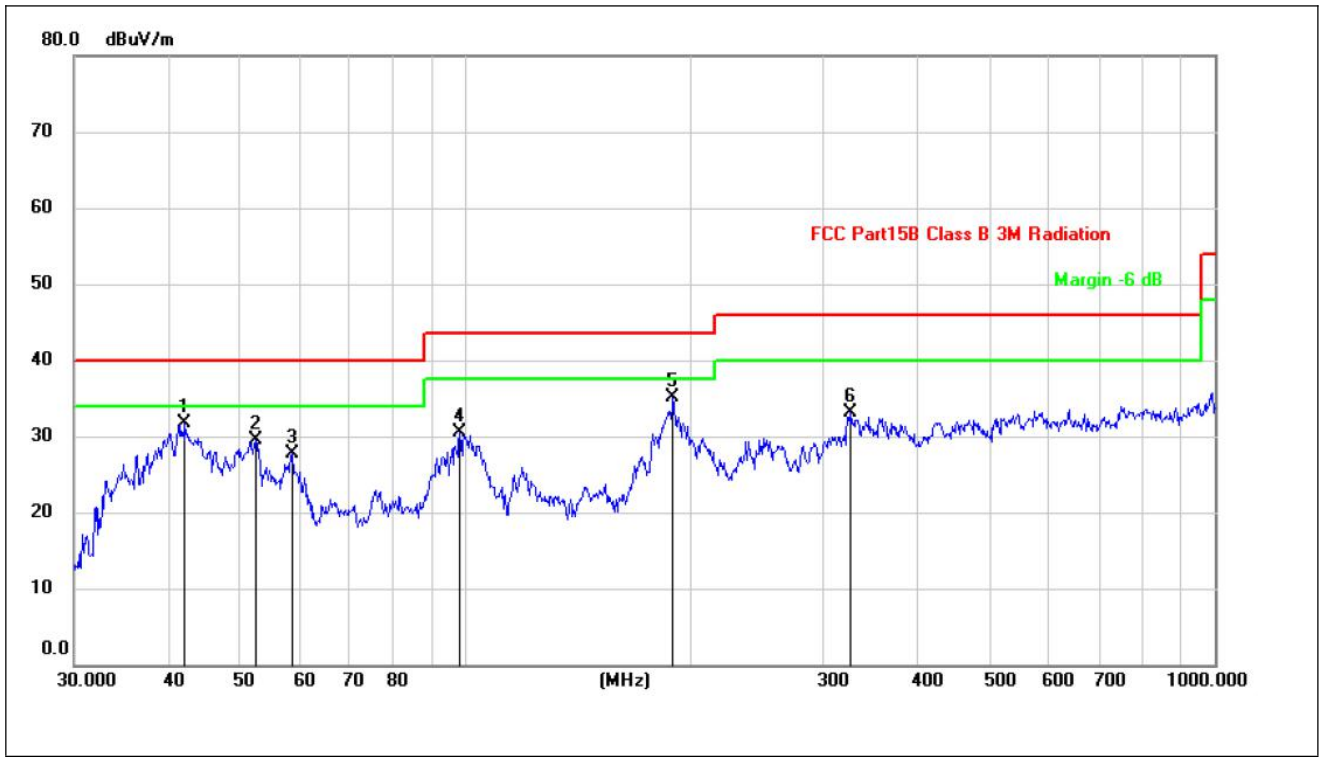
1. Worst-case radiated emission below 1GHz is GFSK (CH Low) mode.

2. Worst-case radiated emission above 1GHz is GFSK (CH Low, Middle, High) mode.

The Worst Test Data Below 1GHz GFSK (CH Low) mode:

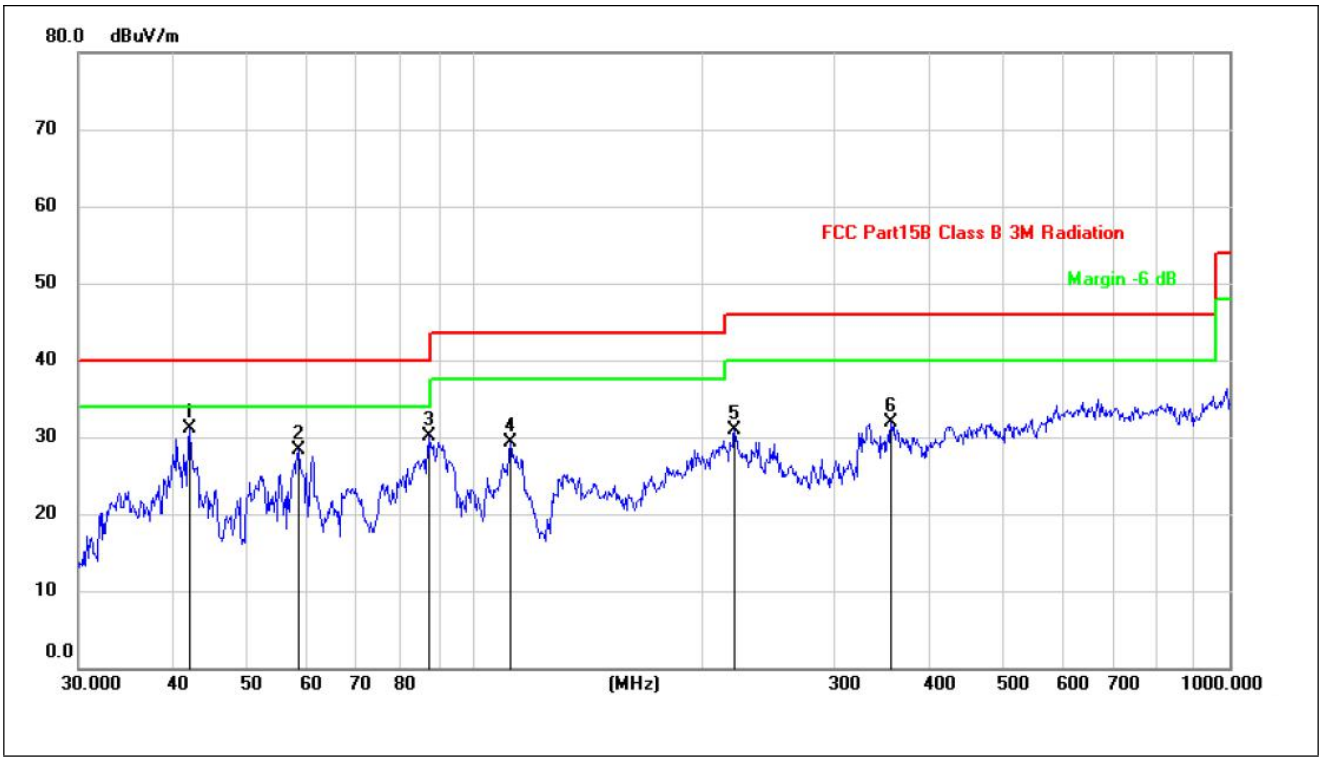
Plot of Radiated Emissions

Test Specification: Horizontal



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	42.1542	31.64	40.00	-8.36	QP			
2		52.3912	29.42	40.00	-10.58	QP			
3		58.6126	27.80	40.00	-12.20	QP			
4		98.1419	30.50	43.50	-13.00	QP			
5		189.0740	35.11	43.50	-8.39	QP			
6		326.7395	33.09	46.00	-12.91	QP			

Test Specification: *Vertical*



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	42.1542	31.14	40.00	-8.86	QP			
2		58.6126	28.30	40.00	-11.70	QP			
3		87.4175	30.14	40.00	-9.86	QP			
4		111.7377	29.36	43.50	-14.14	QP			
5		221.3916	30.95	46.00	-15.05	QP			
6		356.6757	31.84	46.00	-14.16	QP			

The Worst Spurious Emissions Above 1GHz

Transmitting: BLE mode:

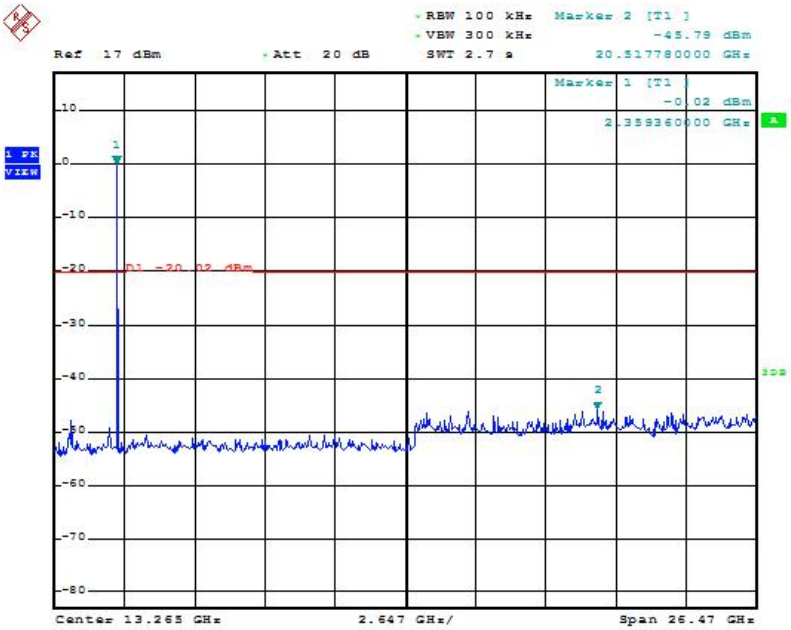
Frequency (MHz)	Reading (dBuV/m)	Correct dB	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar H/V	Detector
Low Channel-2402MHz							
4804	65.25	-3.61	61.64	74	-12.36	H	PK
4804	46.62	-3.61	43.01	54	-10.99	H	AV
7206	58.95	-0.54	58.41	74	-15.59	H	PK
7206	44.35	-0.54	43.81	54	-10.19	H	AV
4804	55.51	-3.61	51.9	74	-22.1	V	PK
4804	49.24	-3.61	45.63	54	-8.37	V	AV
7206	51.62	-0.54	51.08	74	-22.92	V	PK
7206	46.34	-0.54	45.8	54	-8.2	V	AV
Middle Channel-2442MHz							
4884	56.95	-3.61	53.34	74	-20.66	H	PK
4884	48.62	-3.61	45.01	54	-8.99	H	AV
7326	54.34	-0.54	53.8	74	-20.2	H	PK
7326	42.12	-0.54	41.58	54	-12.42	H	AV
4884	54.25	-3.61	50.64	74	-23.36	V	PK
4884	47.54	-3.61	43.93	54	-10.07	V	AV
7326	58.62	-0.54	58.08	74	-15.92	V	PK
7326	46.84	-0.54	46.3	54	-7.7	V	AV
High Channel-2480MHz							
4960	62.95	-3.61	59.34	74	-14.66	H	PK
4960	41.35	-3.61	37.74	54	-16.26	H	AV
7440	52.15	-0.54	51.61	74	-22.39	H	PK
7440	45.02	-0.54	44.48	54	-9.52	H	AV
4960	58.54	-3.61	54.93	74	-19.07	V	PK
4960	44.52	-3.61	40.91	54	-13.09	V	AV
7440	55.51	-0.54	54.97	74	-19.03	V	PK
7440	47.84	-0.54	47.3	54	-6.7	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

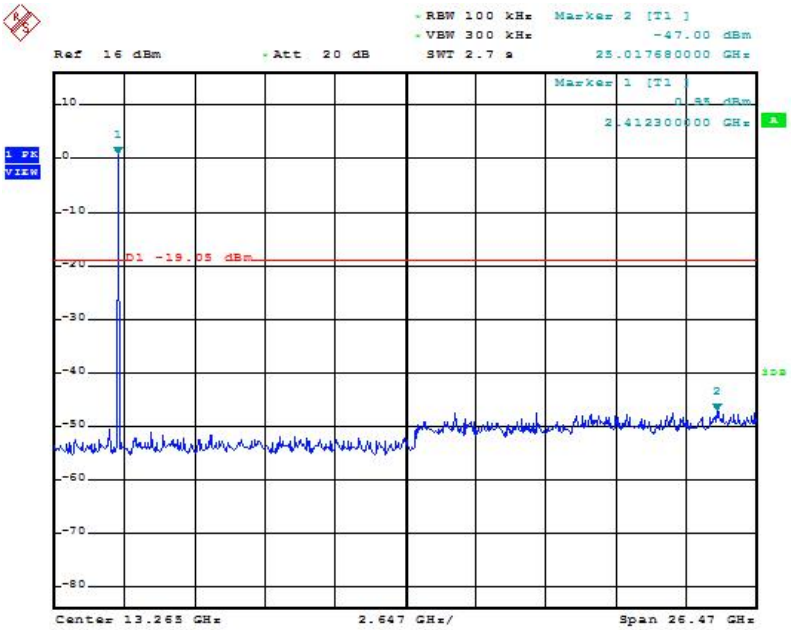
Spurious Emission(Conducted)

For BLE

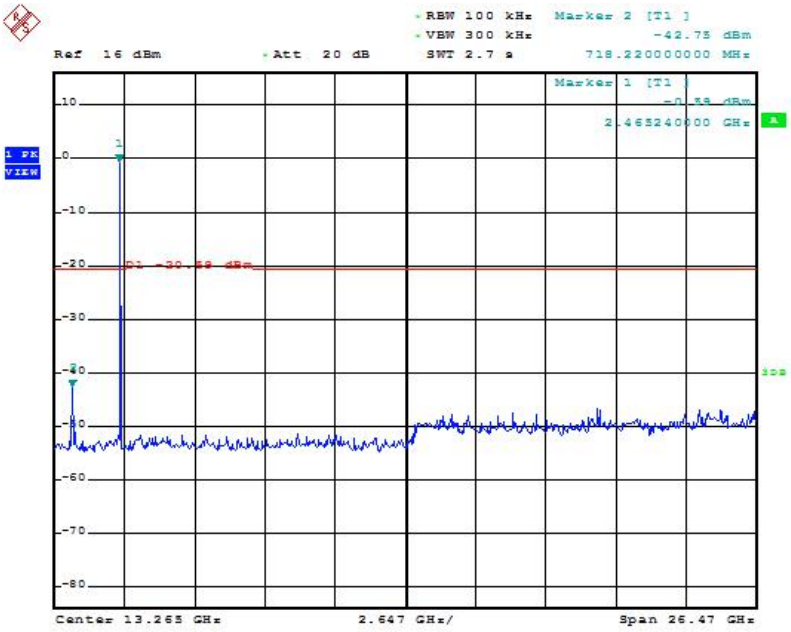
Low channel:



Middle channel:



High channel:



9. Out of Band Emissions

9.1 Standard Applicable

According to §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

9.2 Test Procedure

According to the KDB 558074 D01 v04, the band-edge radiated test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)
RBW = 1MHz, VBW = 1MHz for peak value measured
RBW = 1MHz, VBW = 10Hz for average value measured
Sweep = auto; Detector function = peak/average; Trace = max hold
All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the KDB 558074 D01 v04, the conducted spurious emissions test method as follows:
1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW ≥ 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

9.3 Environmental Conditions

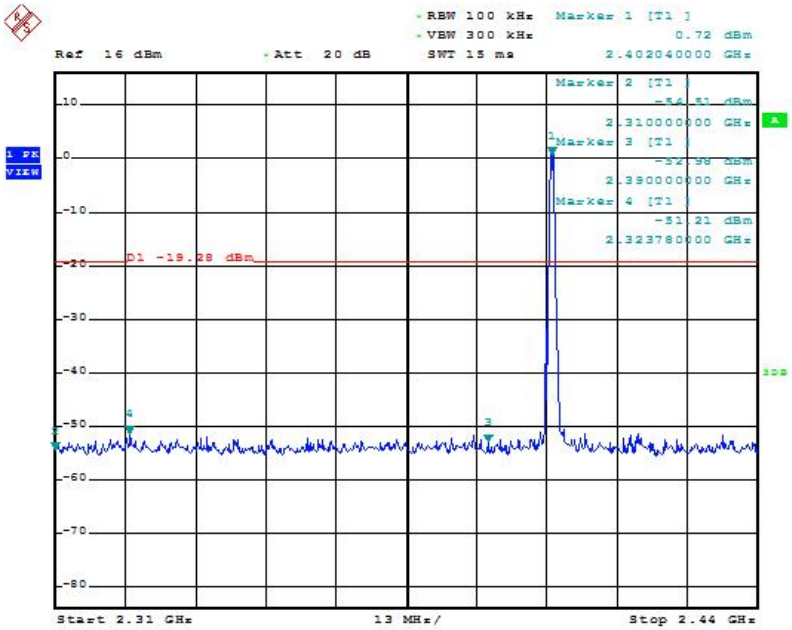
Temperature:	23°C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

9.4 Summary of Test Results/Plots

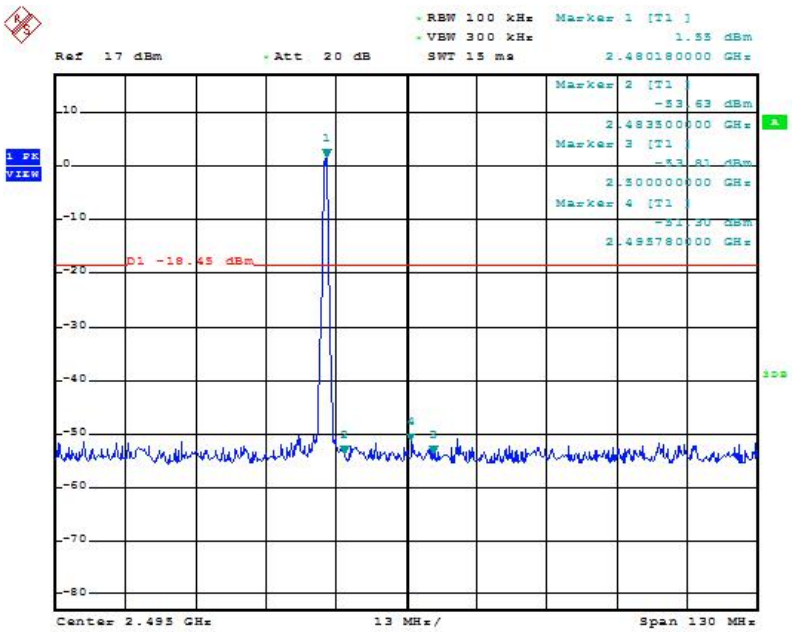
Bandedge (Radiated)
Lowest Bandedge-BLE

Channel	Freq.(MHz)	Level(dBuV)	Limit(dBuV)	Margin(dB)	Detector
	2400	55.85	74	-18.15	Peak
LOW	2400	34.62	54	-19.38	Average
	2483.5	49.02	74	-24.98	Peak
HIGH	2483.5	34.24	54	-19.76	Average

Bandedge (Conducted)
Lowest



High Channel:

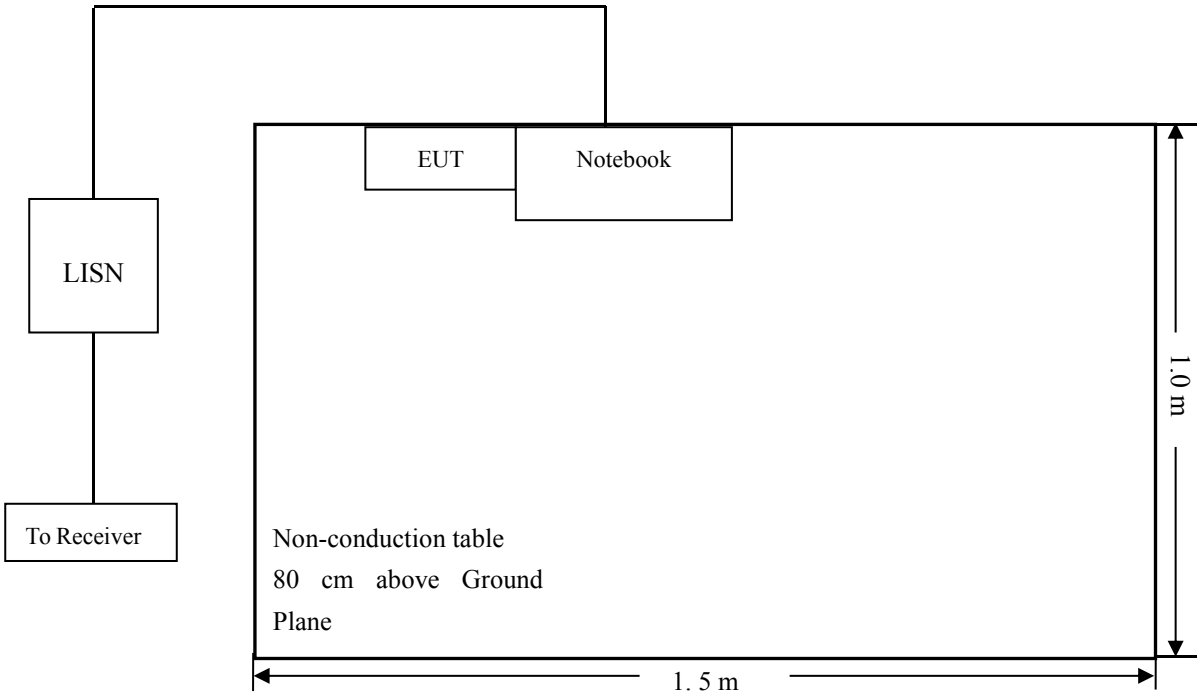


10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

10.2 Basic Test Setup Block Diagram



10.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

10.4 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency..... 150 kHz
Stop Frequency..... 30 MHz
Sweep Speed..... Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth..... 9 kHz
Quasi-Peak Adapter Mode.....Normal

10.5 Summary of Test Results/Plots

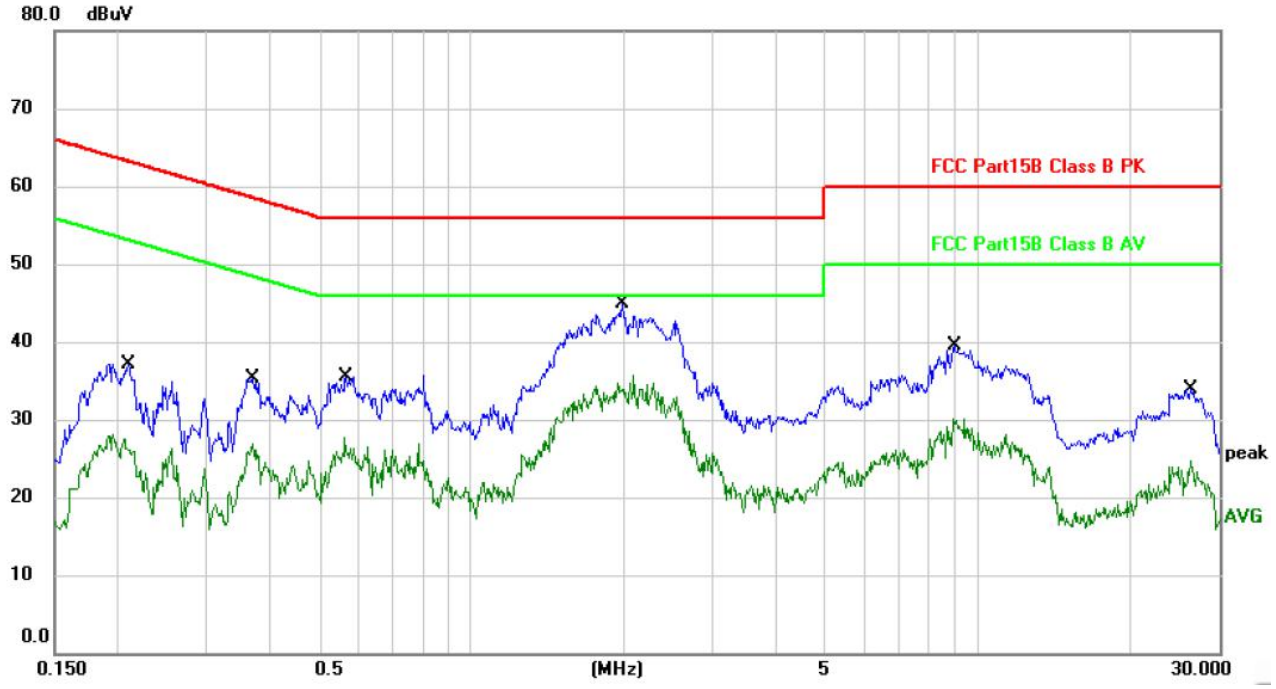
According to the data in section 10.6, the EUT complied with the FCC Part 15.207 Conducted margin for this device

10.6 Conducted Emissions Test Data

Note: We pre-scan all mode, the worst data is GFSK (Low channel).

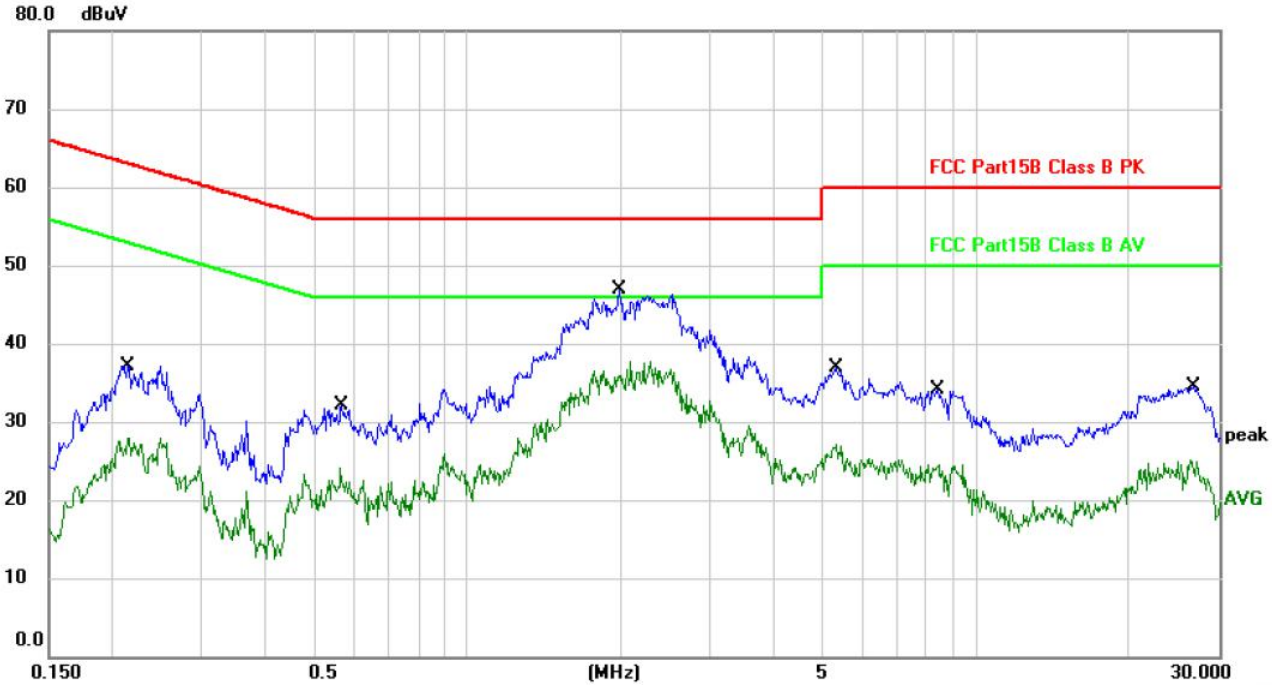
Plot of Conducted Emissions The Worst Test Data GFSK (Low channel):

Test Specification: *Neutral*



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1		0.2099	37.16	63.21	-26.05	QP	
2		0.2099	17.94	53.21	-35.27	AVG	
3		0.3699	35.28	58.50	-23.22	QP	
4		0.3699	21.02	48.50	-27.48	AVG	
5		0.5655	35.50	56.00	-20.50	QP	
6		0.5655	23.59	46.00	-22.41	AVG	
7	*	1.9899	44.92	56.00	-11.08	QP	
8		1.9899	28.45	46.00	-17.55	AVG	
9		8.9778	39.43	60.00	-20.57	QP	
10		8.9778	26.33	50.00	-23.67	AVG	
11		26.2896	33.82	60.00	-26.18	QP	
12		26.2896	20.42	50.00	-29.58	AVG	

Test Specification: *Line*



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1		0.2139	37.16	63.05	-25.89	QP	
2		0.2139	25.85	53.05	-27.20	AVG	
3		0.5655	32.00	56.00	-24.00	QP	
4		0.5655	20.83	46.00	-25.17	AVG	
5	*	1.9899	46.92	56.00	-9.08	QP	
6		1.9899	34.86	46.00	-11.14	AVG	
7		5.2899	36.89	60.00	-23.11	QP	
8		5.2899	24.23	50.00	-25.77	AVG	
9		8.3978	34.17	60.00	-25.83	QP	
10		8.3978	17.82	50.00	-32.18	AVG	
11		26.8180	34.42	60.00	-25.58	QP	
12		26.8180	18.08	50.00	-31.92	AVG	

******* END OF REPORT *******