TEST REPORT

Reference No.	:	WTX23X04091251W001
FCC ID	:	2AUV5-IMM2
Applicant	:	Prevent Biometrics
Address	:	4600 W 77th St., Suite 275, Edina, MN, 55435
Manufacturer	:	The same as Applicant
Address	:	The same as Applicant
Product Name	:	Prevent Impact Monitor Mouthguard 2.0
Model No.	:	9020-HBPXFERG
Standards	:	FCC Part 15.247
Date of Receipt sample	:	2023-04-26
Date of Test	:	2023-04-26 to 2023-09-13
Date of Issue	:	2023-09-13
Test Report Form No.	:	WTX_Part 15_247W
Test Result	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of approver.

Prepared By:

Waltek Testing Group (Shenzhen) Co., Ltd.

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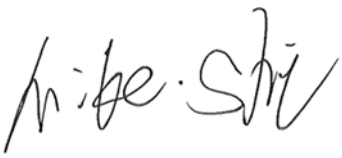
Tested by:



Mike Shi

Approved by:

Silin Chen

TABLE OF CONTENTS

Report version

Version No.	Date of issue	Description
Rev.00	2023-09-13	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

General Description of EUT	
Product Name:	Prevent Impact Monitor Mouthguard 2.0
Trade Name	/
Model No.:	9020-HBPXFERG
Adding Model(s):	/
Rated Voltage:	Battery:DC3.7 V
Battery Capacity:	20mAh
Power Adapter:	/
Software Version:	2.0.20
Hardware Version:	1.0
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Bluetooth Version:	V5.0(BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	1Mbps: -0.60dBm (Conducted) 2Mbps: -0.88dBm (Conducted)
Data Rate:	1Mbps, 2Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	PCB Antenna
Antenna Gain:	1.95dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.
558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under section 15.247 of the Fcc rules.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

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, KDB 558074 D01 15.247 Meas Guidance v05r02.
The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory
Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.
Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990
Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is mai ntained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A
The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A and the CAB identifier is CN0057.

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, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low	2402MHz
TM2	Middle	2440MHz
TM3	High	2480MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	45~55 %
ATM Pressure:	1019 mbar

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
USB Cable	0.5	Shielded	With Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Prevent Solo Case 2.0	Prevent Biometrics	7013ICC-0002	/

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	9-150kHz ±3.74dB
		0.15-30MHz ±3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ±4.52dB
		0.2-1GHz ±5.56dB
		1-6GHz ±3.84dB
		6-26GHz ±3.92dB

1.7 Test Equipment List and Details

Fixed asset Number	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
WTXE1041A1001	Communication Tester	Rohde & Schwarz	CMW500	148650	2023-02-25	2024-02-24
WTXE1005A1005	Spectrum Analyzer	Agilent	N9020A	US47140102	2023-02-25	2024-02-24
WTXE1084A1001	Spectrum Analyzer	Agilent	N9020A	MY54320548	2023-02-25	2024-02-24
WTXE1004A1-001	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2023-02-25	2024-02-24
☐Chamber A: Below 1GHz						
WTXE1005A1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1007A1001	Amplifier	HP	8447F	2805A03475	2023-02-25	2024-02-24
WTXE1010A1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1010A1006	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2023-03-20	2026-03-19
☐Chamber A: Above 1GHz						
WTXE1005A1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1065A1001	Amplifier	C&D	PAP-1G18	14918	2023-02-25	2024-02-24
WTXE1010A1005	Horn Antenna	ETS	3117	00086197	2021-03-19	2024-03-18
WTXE1010A1010	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2021-03-19	2024-03-18
WTXE1003A1001	Pre-amplifier	Schwarzbeck	BBV 9721	9721-031	2023-02-25	2024-02-24
☐Chamber B:Below 1GHz						
WTXE1010A1006	Trilog Broadband Antenna	Schwarz beck	VULB9163(B)	9163-635	2021-04-09	2024-04-08
WTXE1038A1001	Amplifier	Agilent	8447D	2944A10179	2023-02-25	2024-02-24

WTXE1001A 1002	EMI Test Receiver	Rohde & Schwarz	ESPI	101391	2023-02-25	2024-02-24
☒Chamber C:Below 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1010A 1013-1	Trilog Broadband Antenna	Schwarz beck	VULB 9168	1194	2021-05-28	2024-05-27
WTXE1010A 1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1007A 1002	Amplifier	HP	8447F	2944A038 69	2023-02-25	2024-02-24
☒Chamber C: Above 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1103A 1005	Horn Antenna	POAM	RTF-11A	LP228060 221	2023-03-10	2026-03-09
WTXE1103A 1006	Amplifier	Tonscend	TAP01018050	AP22E806 235	2023-02-25	2024-02-24
WTXE1010A 1010	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2021-03-19	2024-03-18
WTXE1003A 1001	Pre-amplifier	Schwarzbeck	BBV 9721	9721-031	2023-02-25	2024-02-24
☒Conducted Room 1#						
WTXE1001A 1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2023-02-25	2024-02-24
WTXE1002A 1001	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2023-02-25	2024-02-24
WTXE1003A 1001	AC LISN	Schwarz beck	NSLK8126	8126-224	2023-02-25	2024-02-24
☐Conducted Room 2#						
WTXE1001A 1004	EMI Test Receiver	Rohde & Schwarz	ESPI	101259	2023-02-25	2024-02-24
WTXE1003A 1003	LISN	Rohde & Schwarz	ENV 216	100097	2023-02-25	2024-02-24

Software List			
Description	**Manufacturer**	**Model**	**Version**
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

*Remark: indicates software version used in the compliance certification testing.

2. SUMMARY OF TEST RESULTS

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

N/A: Not applicable.

3. Antenna Requirement

3.1 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.

3.2 Evaluation Information

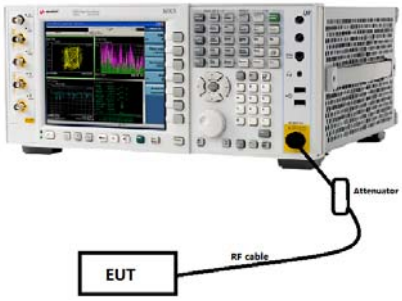
This product has a PCB antenna, fulfill the requirement of this section.

4. Power Spectral Density

4.1 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 8dBm in any 3kHz band during any time interval of continuous transmission.

4.2 Test Setup Block Diagram



4.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, 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: 3kHz ≤ RBW ≤ 100kHz.
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 3kHz) and repeat.

4.4 Summary of Test Results/Plots

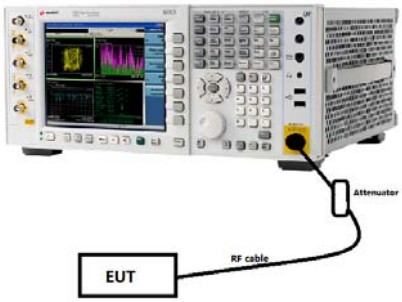
Please refer to Appendix A

5. DTS Bandwidth

5.1 Standard Applicable

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

5.2 Test Setup Block Diagram



5.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

a) Set RBW = 100kHz.
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 6dB relative to the maximum level measured in the fundamental emission.

5.4 Summary of Test Results/Plots

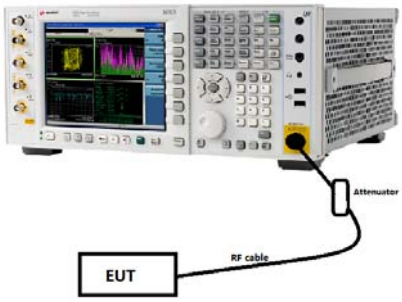
Please refer to Appendix B

6. RF Output Power

6.1 Standard Applicable

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

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.1.1 and ANSI C63.10-2013 Subclause 11.9.1.1, 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.

6.4 Summary of Test Results/Plots

Please refer to Appendix C

7. Field Strength of Spurious Emissions

7.1 Standard Applicable

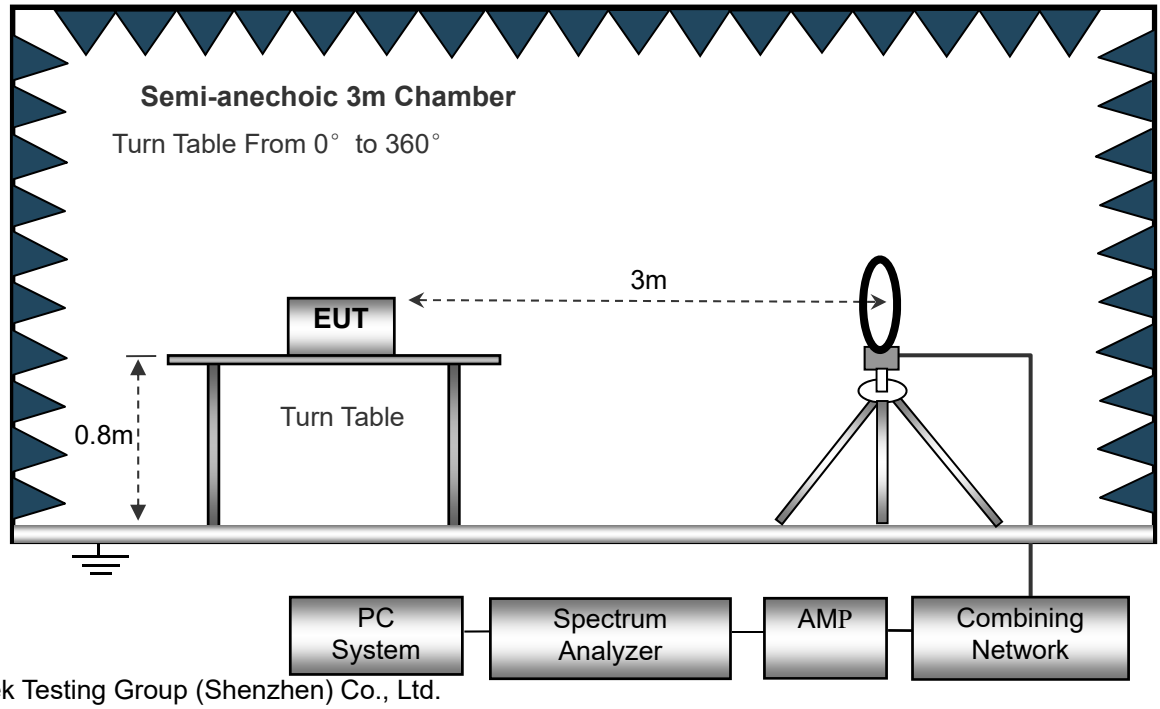
According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the 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 30dB instead of 20dB. 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.

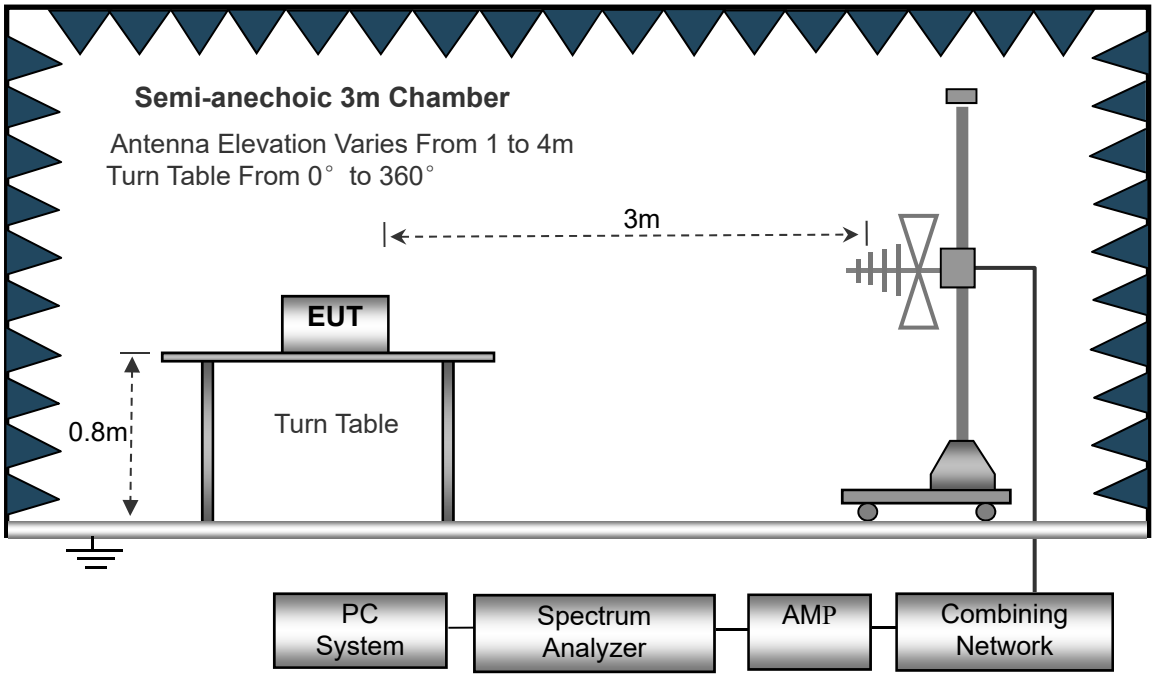
7.2 Test Procedure

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 40cm long in the middle. The spacing between the peripherals was 10cm.

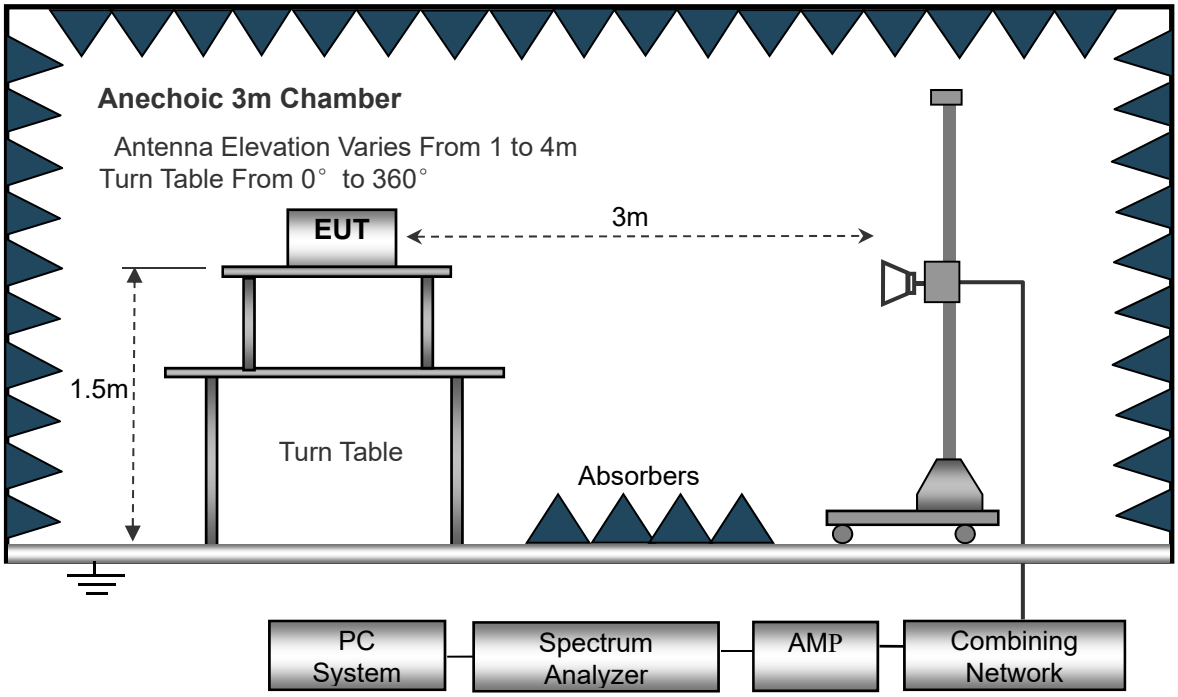
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1GHz.



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

7.3 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:

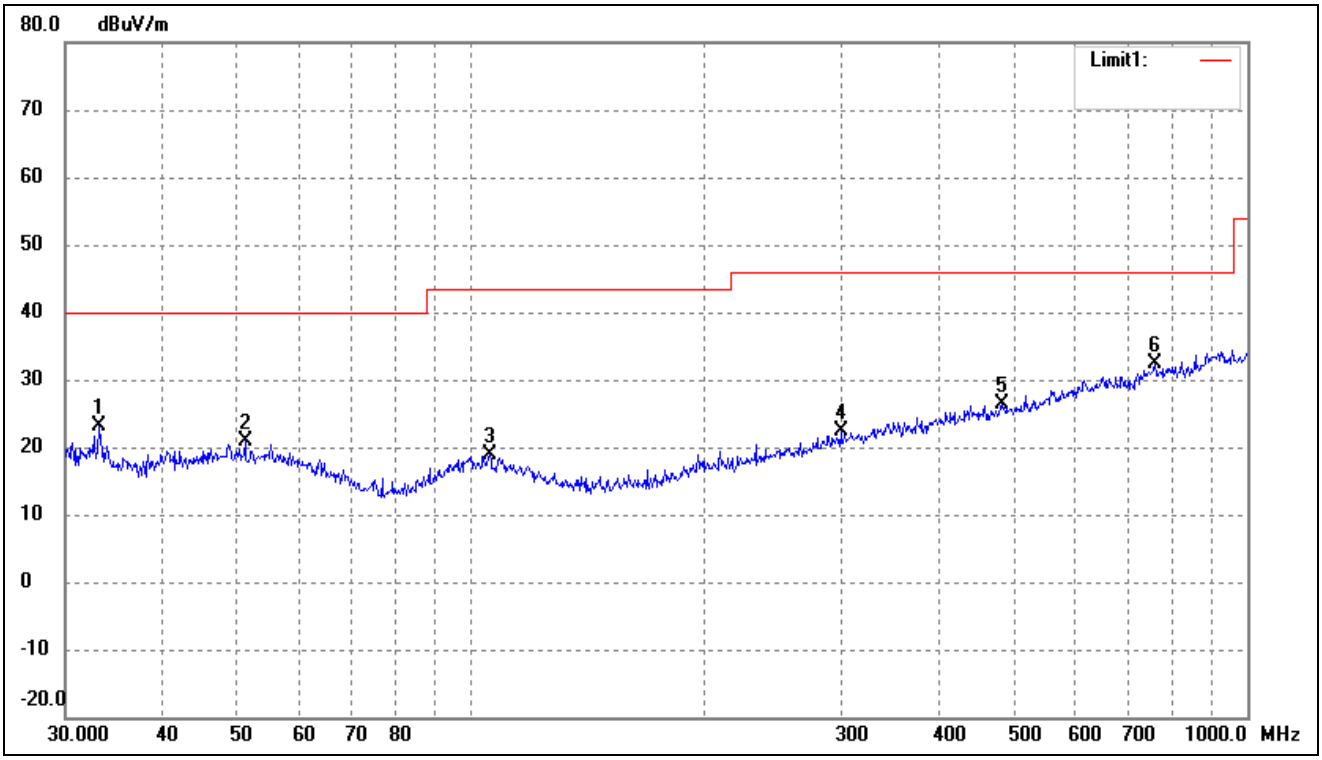
Margin = Corr. Ampl. – FCC Part 15 Limit

7.4 Summary of Test Results/Plots

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

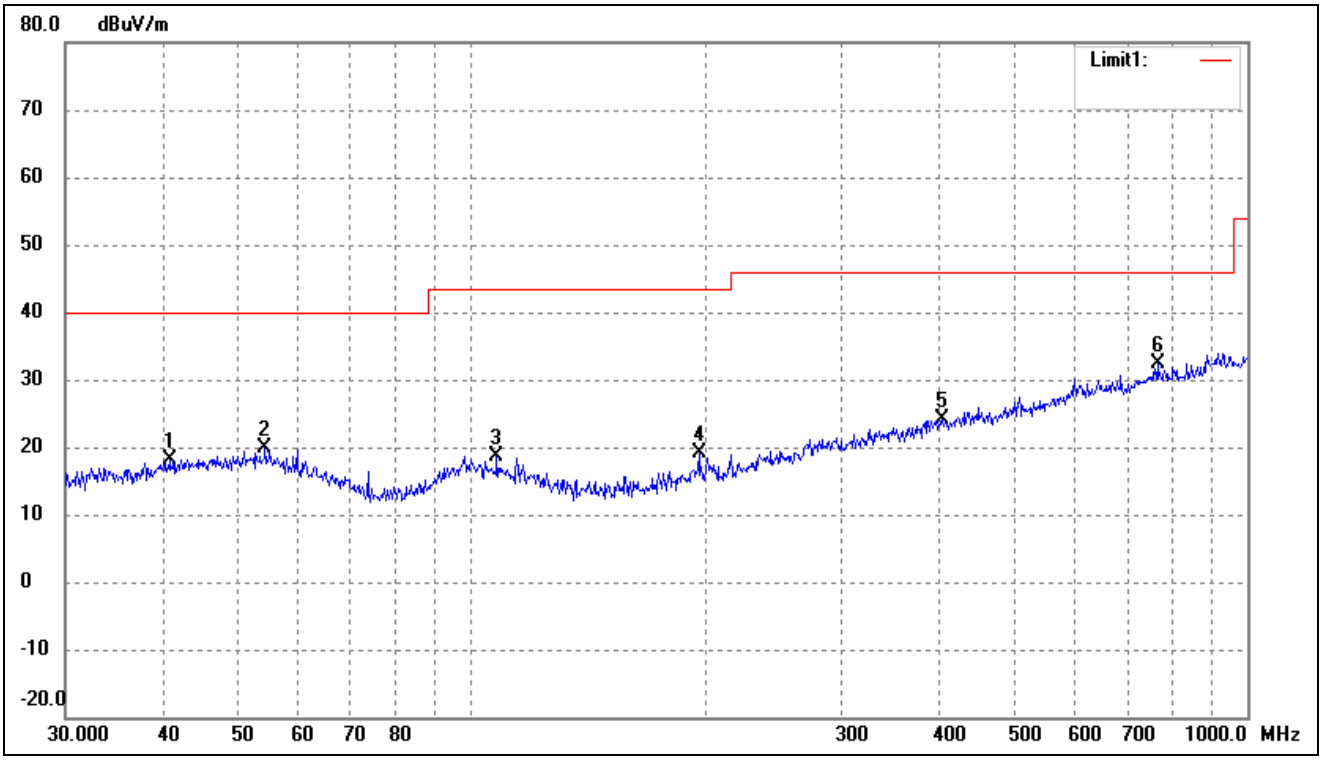
- Spurious Emissions Below 1GHz
- BLE 1Mbps

Test Channel	Low(worst case)	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	33.2112	33.20	-10.11	23.09	40.00	-16.91	-	-	peak
2	51.1209	28.24	-7.36	20.88	40.00	-19.12	-	-	peak
3	105.6415	27.36	-8.45	18.91	43.50	-24.59	-	-	peak
4	299.3158	26.98	-4.72	22.26	46.00	-23.74	-	-	peak
5	483.9094	27.77	-1.42	26.35	46.00	-19.65	-	-	peak
6	760.7036	28.50	3.89	32.39	46.00	-13.61	-	-	peak

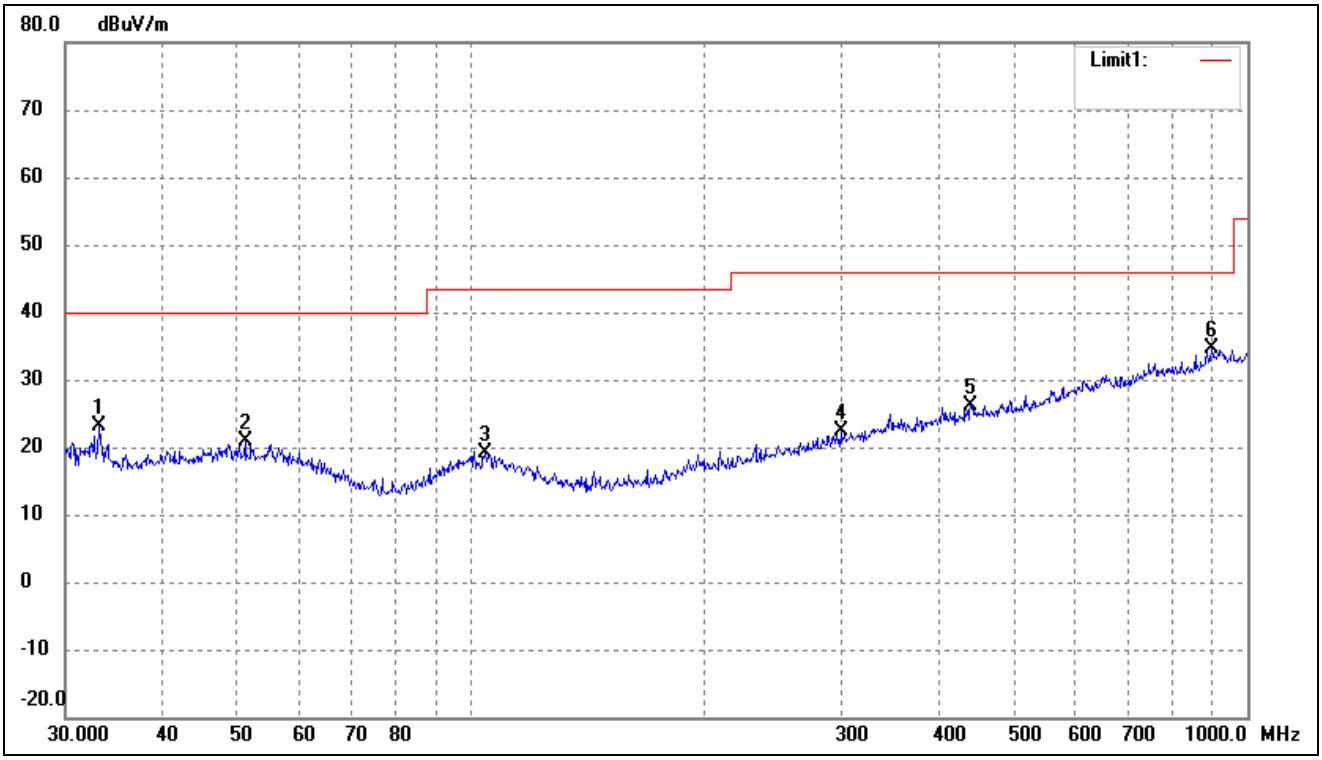
Test Channel	Low(worst case)	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	40.8446	26.45	-8.43	18.02	40.00	-21.98	-	-	peak
2	54.2610	27.47	-7.53	19.94	40.00	-20.06	-	-	peak
3	107.8877	27.15	-8.57	18.58	43.50	-24.92	-	-	peak
4	196.5098	27.23	-8.13	19.10	43.50	-24.40	-	-	peak
5	404.6665	26.58	-2.42	24.16	46.00	-21.84	-	-	peak
6	766.0572	28.47	3.90	32.37	46.00	-13.63	-	-	peak

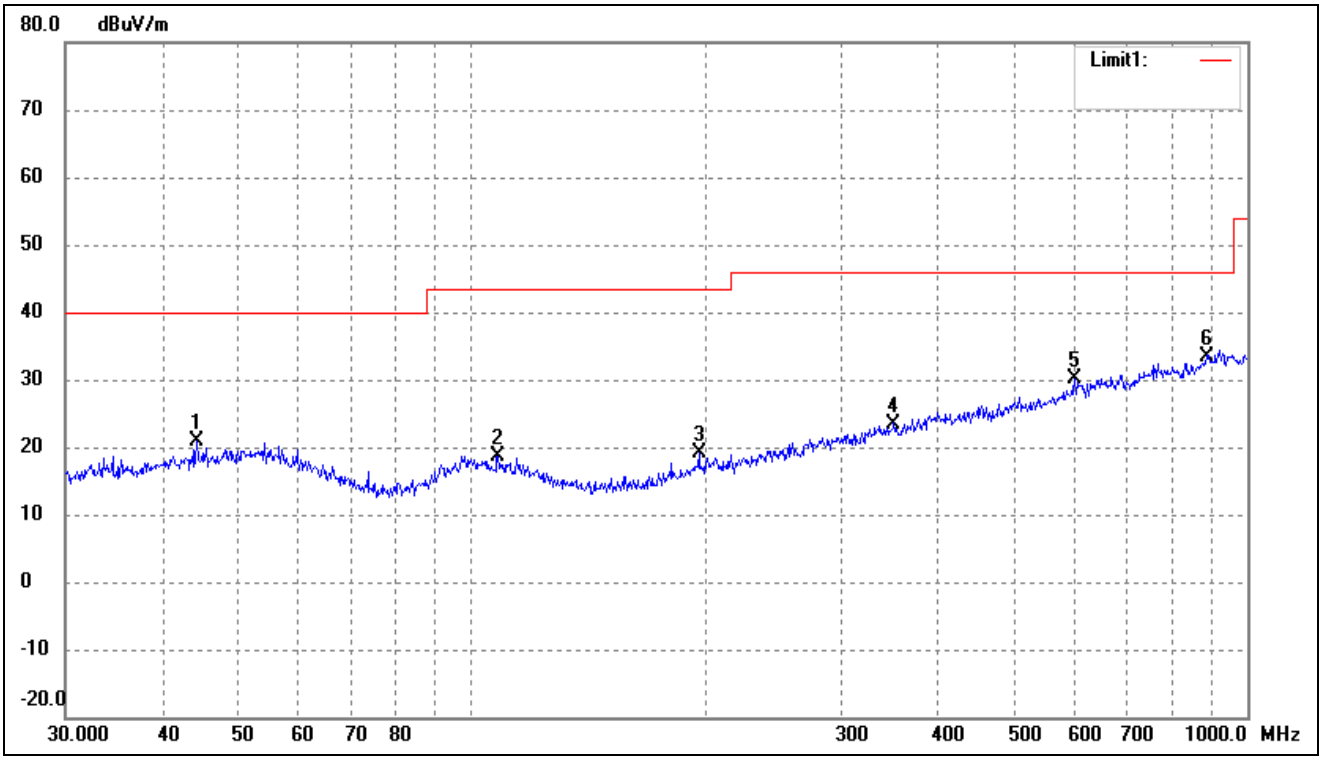
➢ BLE 2Mbps

Test Channel	Low(worst case)	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	33.2112	33.20	-10.11	23.09	40.00	-16.91	-	-	peak
2	51.1209	28.24	-7.36	20.88	40.00	-19.12	-	-	peak
3	104.1701	27.50	-8.43	19.07	43.50	-24.43	-	-	peak
4	299.3158	26.98	-4.72	22.26	46.00	-23.74	-	-	peak
5	440.1963	28.33	-2.09	26.24	46.00	-19.76	-	-	peak
6	900.1474	28.54	6.07	34.61	46.00	-11.39	-	-	peak

Test Channel	Low(worst case)	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	44.2752	28.73	-7.82	20.91	40.00	-19.09	-	-	peak
2	108.2667	27.21	-8.59	18.62	43.50	-24.88	-	-	peak
3	196.5098	27.23	-8.13	19.10	43.50	-24.40	-	-	peak
4	350.4768	26.89	-3.39	23.50	46.00	-22.50	-	-	peak
5	599.3213	28.78	1.38	30.16	46.00	-15.84	-	-	peak
6	887.6099	27.84	5.66	33.50	46.00	-12.50	-	-	peak

Remark: '-'Means' the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

➢ Spurious Emissions Above 1GHz

BLE 1Mbps

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
4804	58.30	-3.59	54.71	74	-19.29	H	PK
4804	55.19	-3.59	51.60	54	-2.40	H	AV
7206	53.63	-0.52	53.11	74	-20.89	H	PK
7206	47.20	-0.52	46.68	54	-7.32	H	AV
4804	53.20	-3.59	49.61	74	-24.39	V	PK
4804	51.80	-3.59	48.21	54	-5.79	V	AV
7206	47.52	-0.52	47.00	74	-27.00	V	PK
7206	44.83	-0.52	44.31	54	-9.69	V	AV
Middle Channel-2440MHz							
4880	58.20	-3.49	54.71	74	-19.29	H	PK
4880	55.44	-3.49	51.95	54	-2.05	H	AV
7320	53.80	-0.47	53.33	74	-20.67	H	PK
7320	46.48	-0.47	46.01	54	-7.99	H	AV
4880	53.82	-3.49	50.33	74	-23.67	V	PK
4880	51.77	-3.49	48.28	54	-5.72	V	AV
7320	47.07	-0.47	46.60	74	-27.40	V	PK
7320	43.64	-0.47	43.17	54	-10.83	V	AV
High Channel-2480MHz							
4960	58.97	-3.41	55.56	74	-18.44	H	PK
4960	55.59	-3.41	52.18	54	-1.82	H	AV
7440	54.67	-0.42	54.25	74	-19.75	H	PK
7440	47.93	-0.42	47.51	54	-6.49	H	AV
4960	53.50	-3.41	50.09	74	-23.91	V	PK
4960	50.69	-3.41	47.28	54	-6.72	V	AV
7440	46.48	-0.42	46.06	74	-27.94	V	PK
7440	45.18	-0.42	44.76	54	-9.24	V	AV

BLE 2Mbps

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
4804	58.84	-3.59	55.25	74	-18.75	H	PK
4804	55.50	-3.59	51.91	54	-2.09	H	AV
7206	55.45	-0.52	54.93	74	-19.07	H	PK
7206	46.98	-0.52	46.46	54	-7.54	H	AV
4804	53.38	-3.59	49.79	74	-24.21	V	PK
4804	51.01	-3.59	47.42	54	-6.58	V	AV
7206	47.80	-0.52	47.28	74	-26.72	V	PK
7206	43.69	-0.52	43.17	54	-10.83	V	AV
Middle Channel-2440MHz							
4880	57.92	-3.49	54.43	74	-19.57	H	PK
4880	54.85	-3.49	51.36	54	-2.64	H	AV
7320	53.62	-0.47	53.15	74	-20.85	H	PK
7320	46.30	-0.47	45.83	54	-8.17	H	AV
4880	54.19	-3.49	50.70	74	-23.30	V	PK
4880	51.94	-3.49	48.45	54	-5.55	V	AV
7320	47.43	-0.47	46.96	74	-27.04	V	PK
7320	44.25	-0.47	43.78	54	-10.22	V	AV
High Channel-2480MHz							
4960	57.41	-3.41	54.00	74	-20.00	H	PK
4960	54.84	-3.41	51.43	54	-2.57	H	AV
7440	54.95	-0.42	54.53	74	-19.47	H	PK
7440	47.49	-0.42	47.07	54	-6.93	H	AV
4960	52.41	-3.41	49.00	74	-25.00	V	PK
4960	51.46	-3.41	48.05	54	-5.95	V	AV
7440	47.80	-0.42	47.38	74	-26.62	V	PK
7440	43.36	-0.42	42.94	54	-11.06	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.

8. Out of Band Emissions

8.1 Standard Applicable

According to §15.247(d), in any 100kHz 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 20dB below that in the 100kHz 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 30dB instead of 20dB. 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).

8.2 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:
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.

B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 9.

b) VBW ≥ [3 × RBW].

c) Detector = peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

RBW as a function of frequency

Frequency	RBW
9kHz to 150kHz	200Hz to 300Hz
0.15MHz to 30MHz	9kHz to 10kHz
30MHz to 1000MHz	100kHz to 120kHz
>1000MHz	1MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

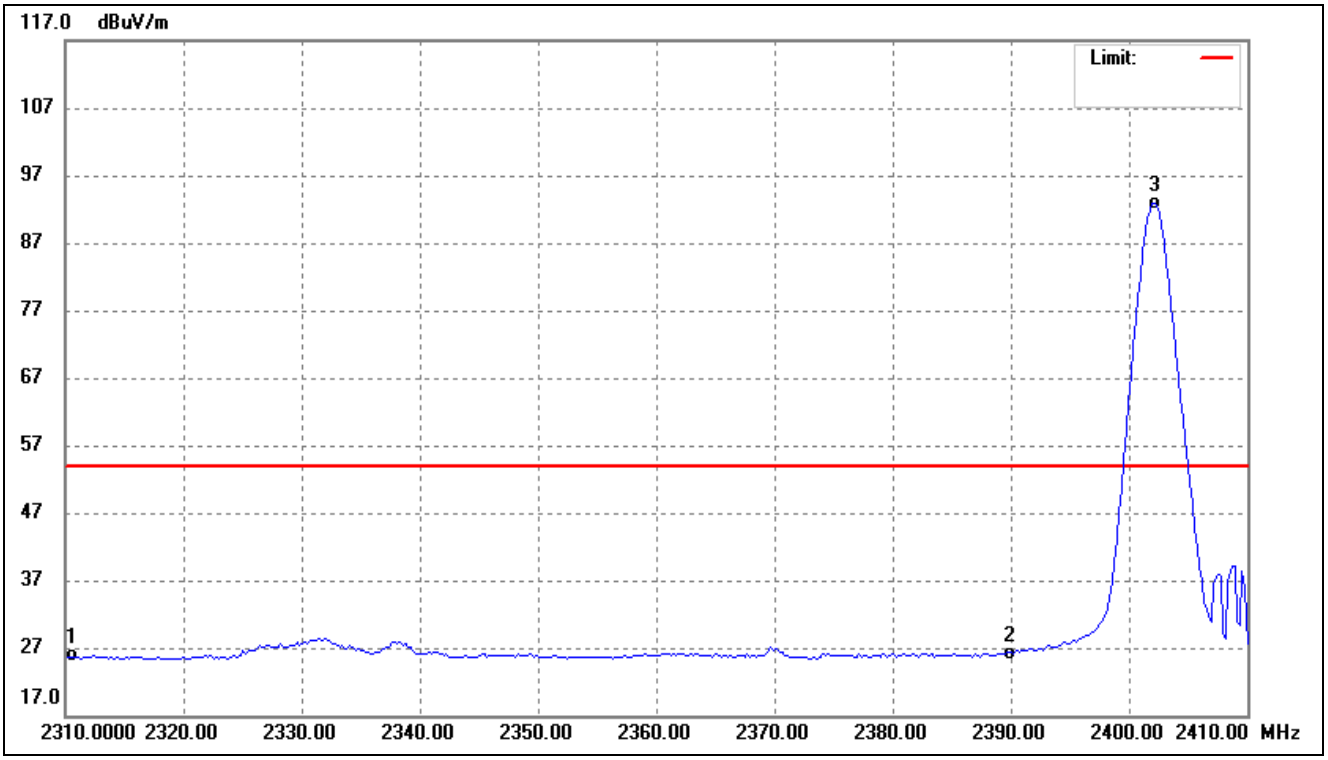
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

8.3 Summary of Test Results/Plots

➢ Radiated test

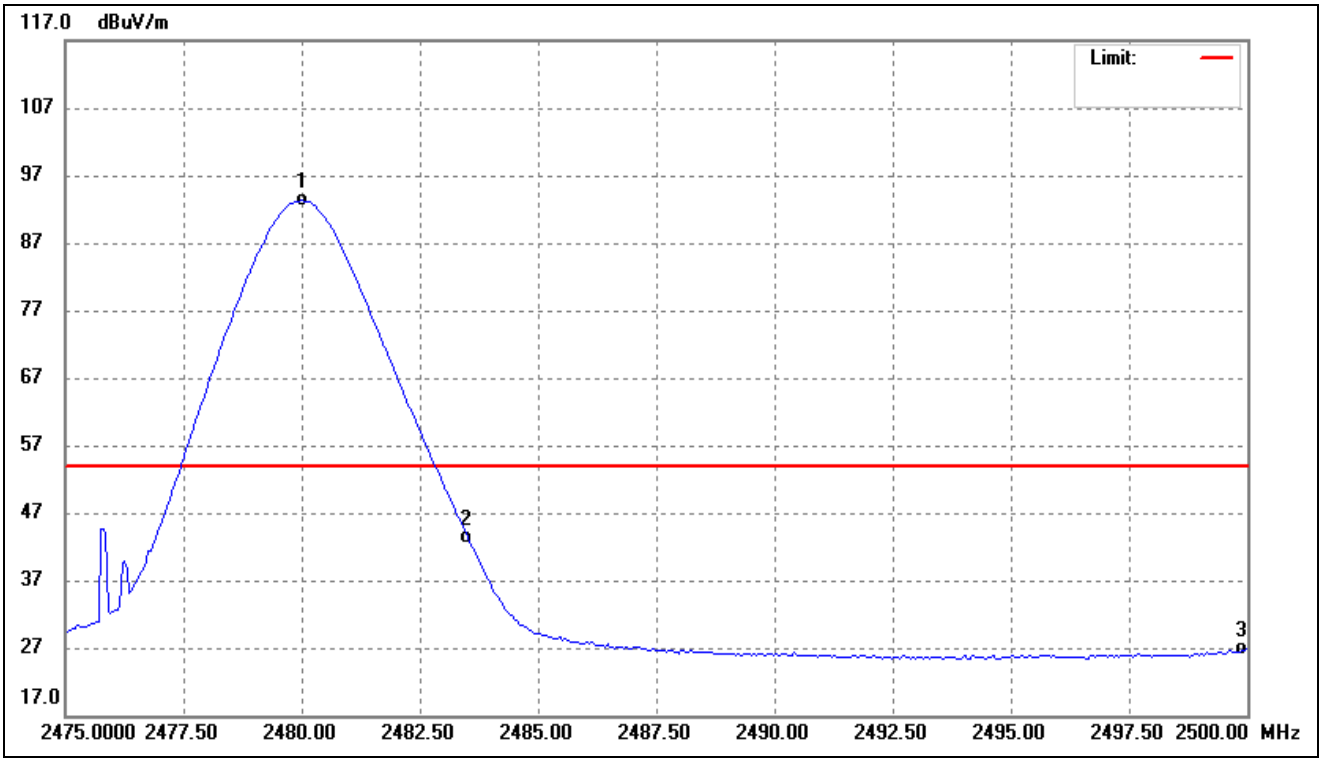
BLE 1Mbps

Test Channel	Low	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.79	-19.02	25.77	54.00	-28.23	Average Detector
	2310.000	56.79	-19.02	37.77	74.00	-36.23	Peak Detector
2	2390.000	45.06	-18.87	26.19	54.00	-27.81	Average Detector
	2390.000	56.89	-18.87	38.02	74.00	-35.98	Peak Detector
3	2402.184	111.75	-18.85	92.90	/	/	Average Detector
	2401.784	112.40	-18.85	93.55	/	/	Peak Detector

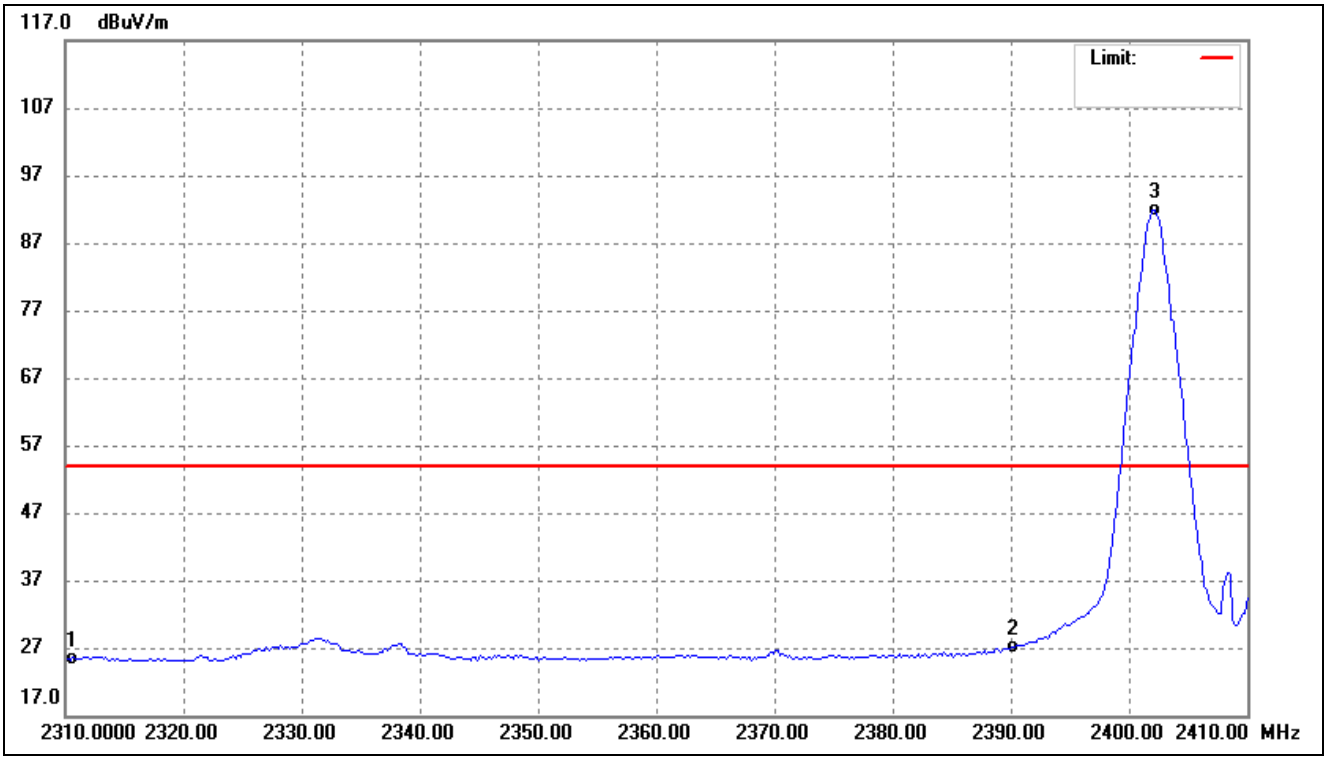
Test Channel	High	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.010	111.94	-18.68	93.26	/	/	Average Detector
	2479.709	112.56	-18.68	93.88	/	/	Peak Detector
2	2483.500	62.08	-18.68	43.40	54.00	-10.60	Average Detector
	2483.500	70.86	-18.68	52.18	74.00	-21.82	Peak Detector
3	2500.000	45.48	-18.65	26.83	54.00	-27.17	Average Detector
	2500.000	58.06	-18.65	39.41	74.00	-34.59	Peak Detector

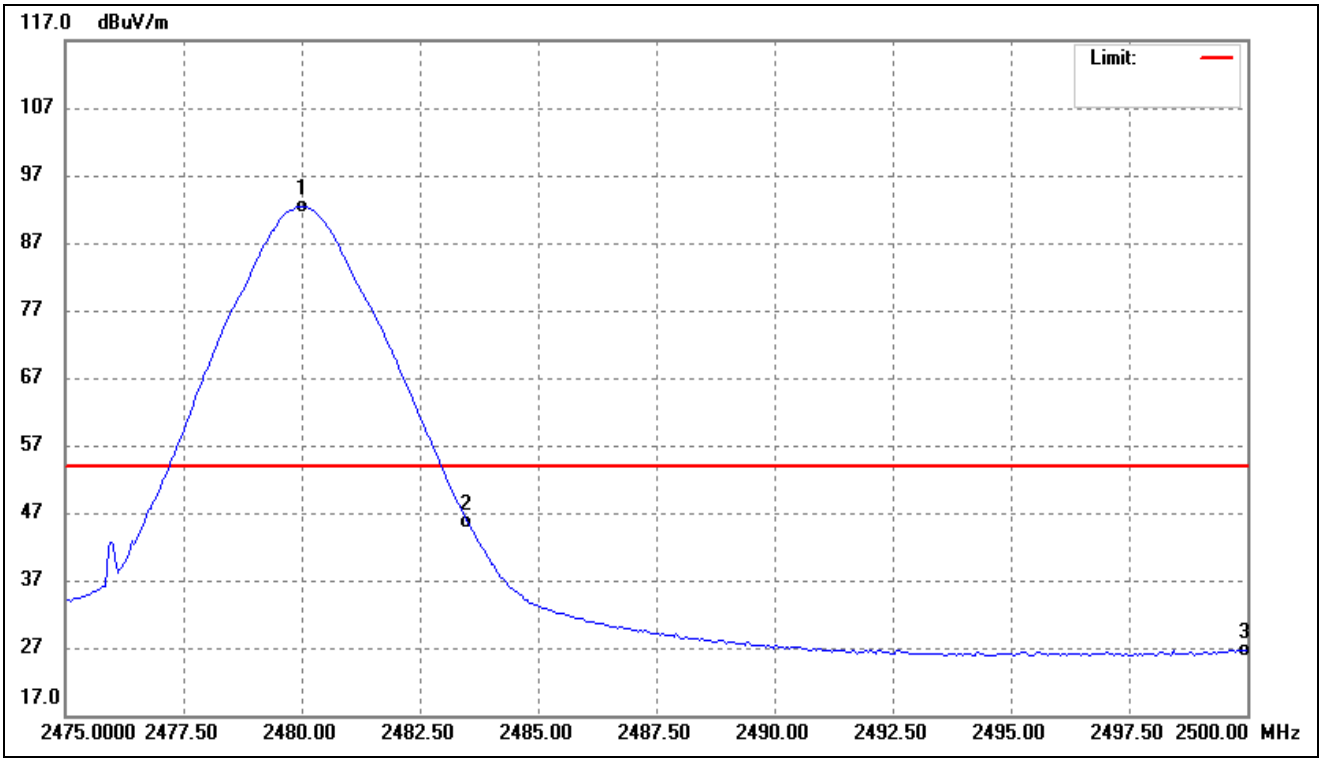
BLE 2Mbps

Test Channel	Low	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.48	-19.02	25.46	54.00	-28.54	Average Detector
	2310.000	56.68	-19.02	37.66	74.00	-36.34	Peak Detector
2	2390.000	45.99	-18.87	27.12	54.00	-26.88	Average Detector
	2390.000	58.18	-18.87	39.31	74.00	-34.69	Peak Detector
3	2402.184	110.71	-18.85	91.86	/	/	Average Detector
	2401.583	112.45	-18.85	93.60	/	/	Peak Detector

Test Channel	High	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.010	111.07	-18.68	92.39	/	/	Average Detector
	2479.459	112.89	-18.69	94.20	/	/	Peak Detector
2	2483.500	64.20	-18.68	45.52	54.00	-8.48	Average Detector
	2483.500	74.82	-18.68	56.14	74.00	-17.86	Peak Detector
3	2500.000	45.40	-18.65	26.75	54.00	-27.25	Average Detector
	2500.000	57.50	-18.65	38.85	74.00	-35.15	Peak Detector

➢ Conducted test

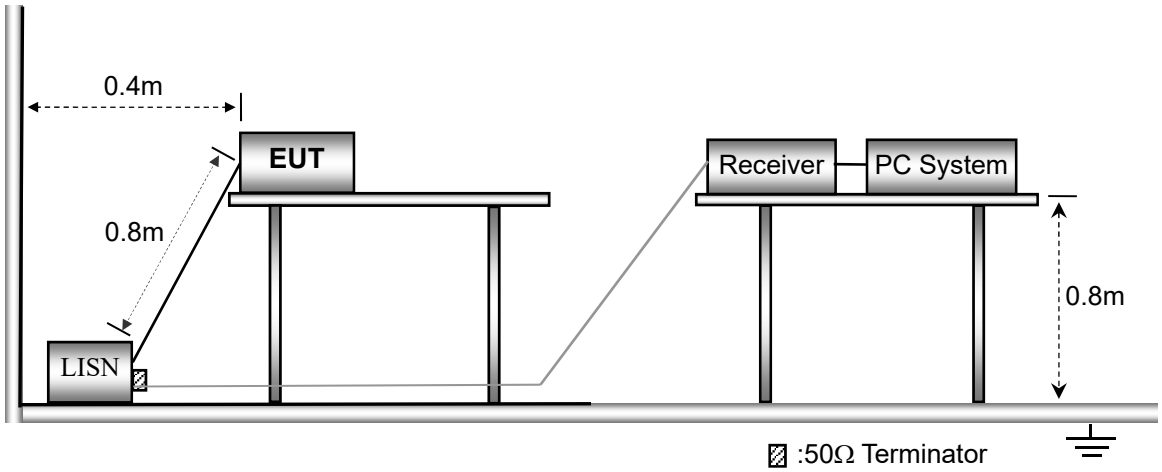
Please refer to Appendix D

9. Conducted Emissions

9.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

9.2 Basic Test Setup Block Diagram



9.3 Test Receiver Setup

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

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

9.4 Summary of Test Results/Plots

Not applicable

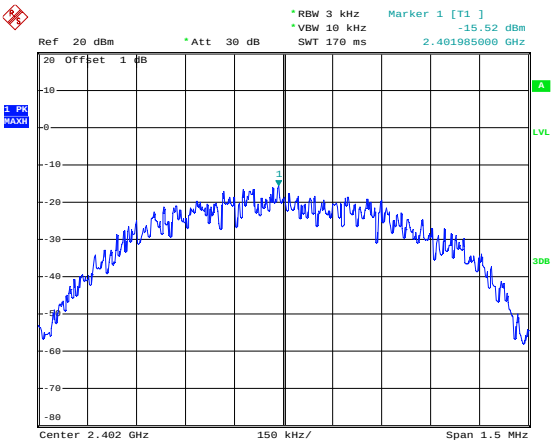
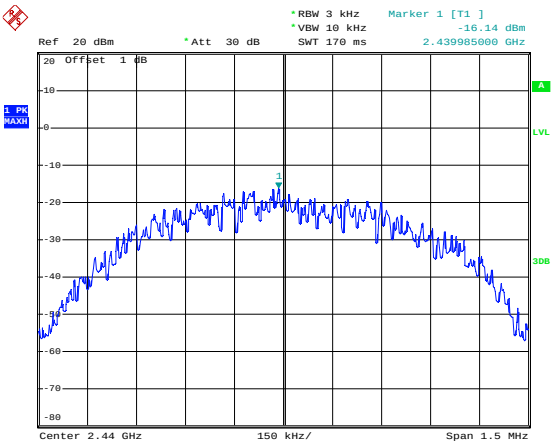
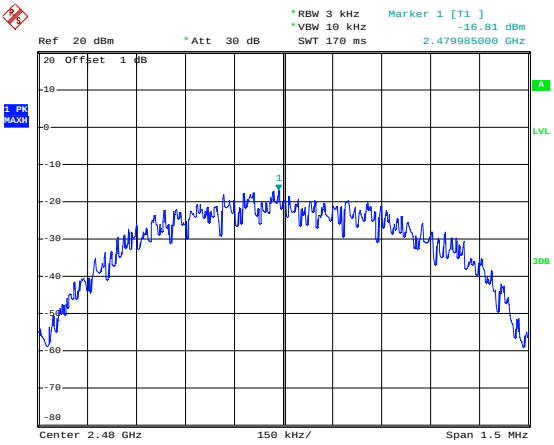
APPENDIX SUMMARY

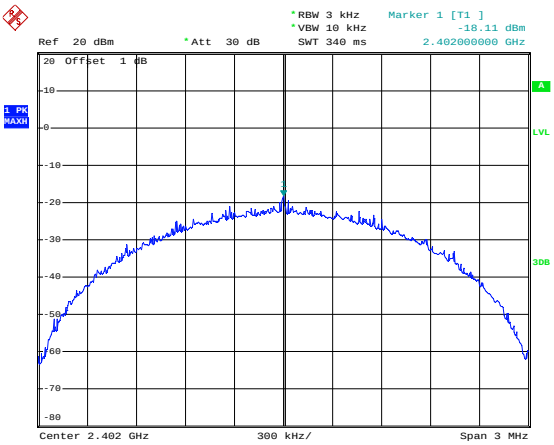
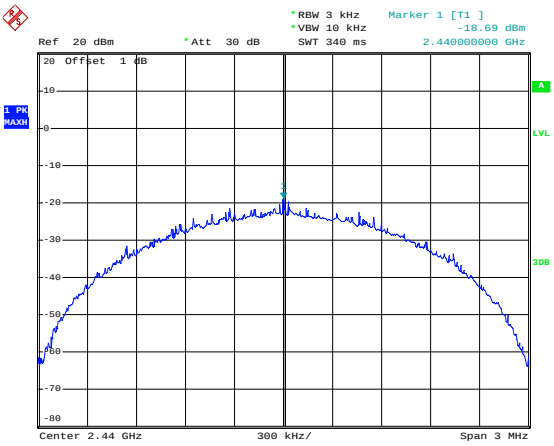
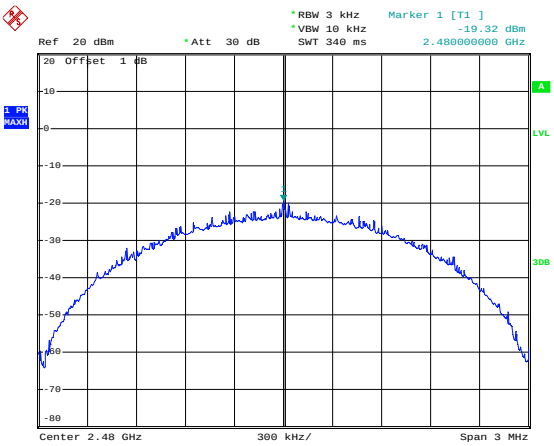
Project No.	WTX23X04091281W	Test Engineer	Elin Su
Start date	2023/5/5	Finish date	22023/5/5
Temperature	23℃	Humidity	59%

APPENDIX	Description of Test Item	Result
A	Power Spectral Density	Compliant
B	DTS Bandwidth	Compliant
C	RF Output Power	Compliant
D	Conducted Out of Band Emissions	Compliant

APPENDIX A

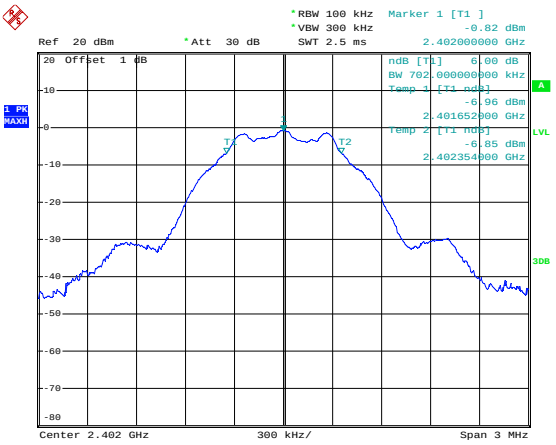
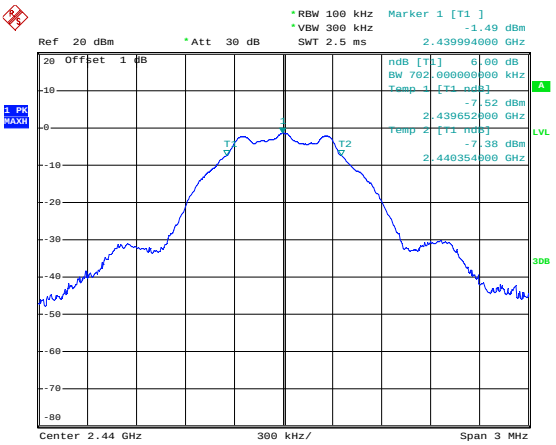
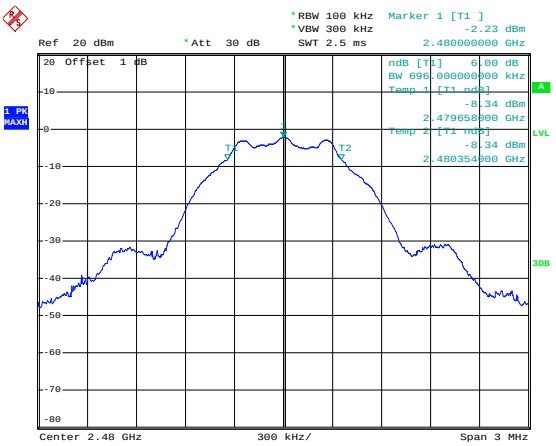
Power Spectral Density			
Test Mode	Test Channel	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
GFSK(BLE)-1Mbps	Low	-15.52	8
	Middle	-16.14	8
	High	-16.81	8
GFSK(BLE)-2Mbps	Low	-18.11	8
	Middle	-18.69	8
	High	-19.32	8

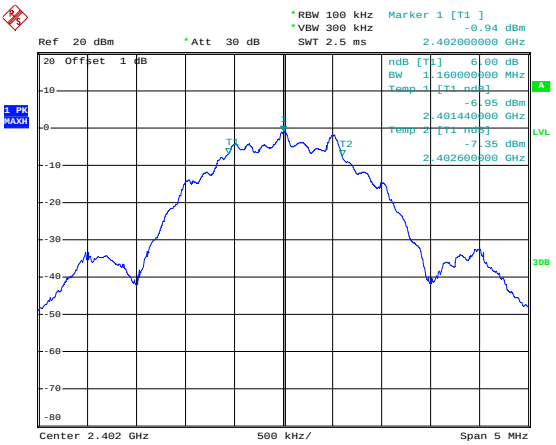
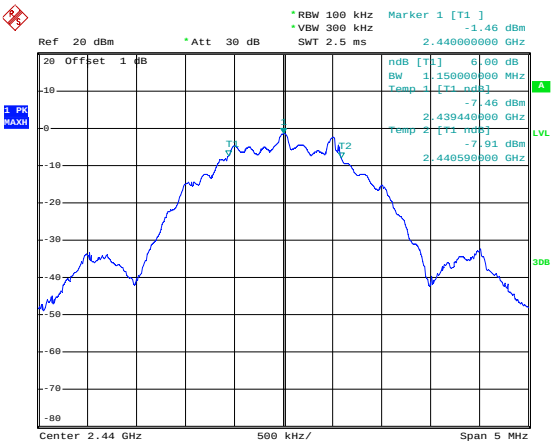
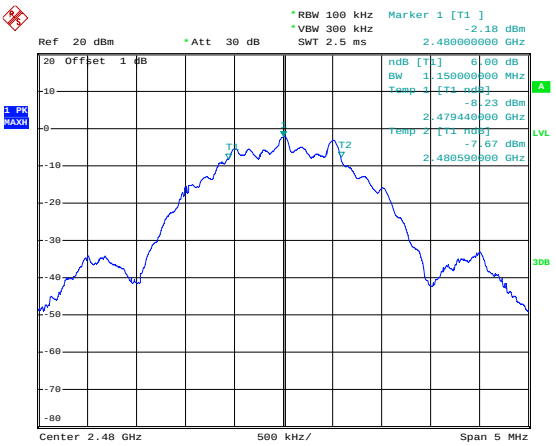
Low(1Mbps)	
Middle(1Mbps)	
High(1Mbps)	

Low(2Mbps)	 Date: 5.MAY.2023 15:24:42
Middle(2Mbps)	 Date: 5.MAY.2023 15:24:59
High(2Mbps)	 Date: 5.MAY.2023 15:25:18

APPENDIX B

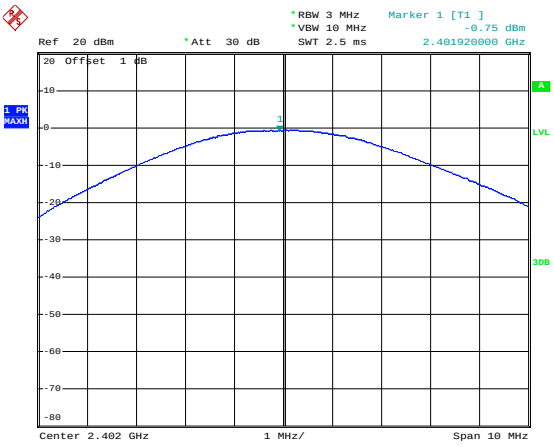
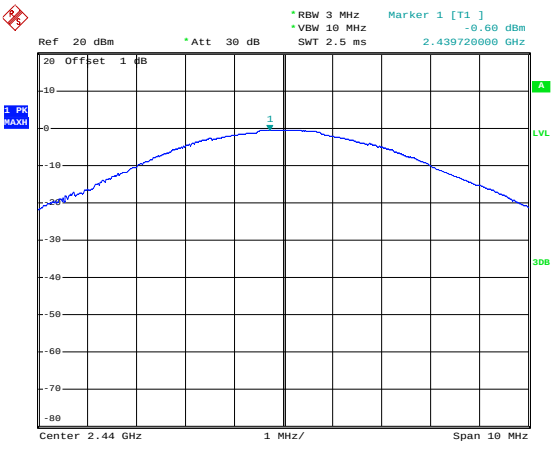
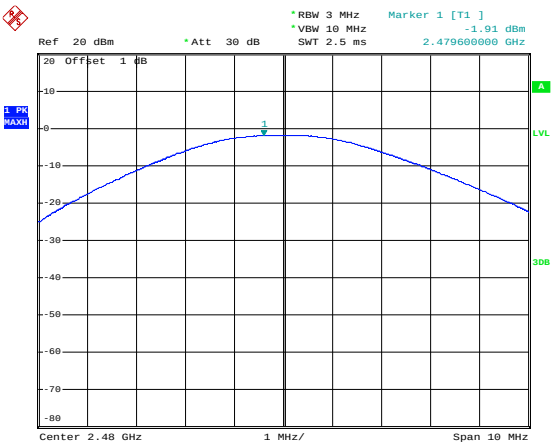
Test Mode	Test Channel	6 dB Bandwidth kHz	Limit kHz
GFSK(BLE)1Mbps	Low	702	≥500
	Middle	702	≥500
	High	696	≥500
GFSK(BLE)2Mbps	Low	1160	≥500
	Middle	1150	≥500
	High	1150	≥500

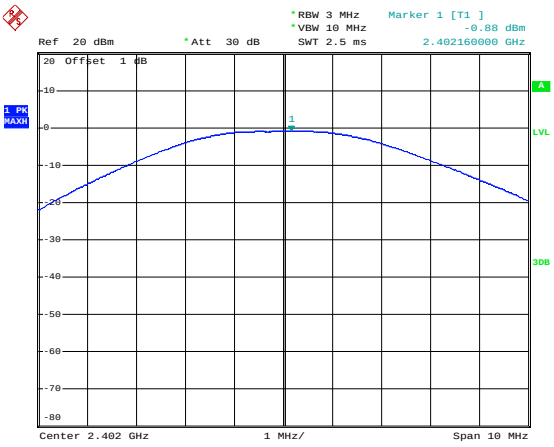
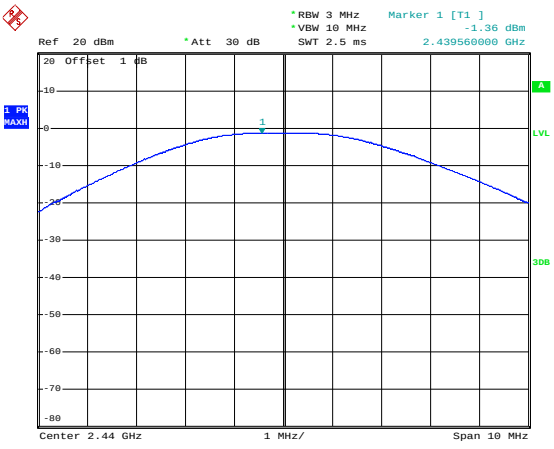
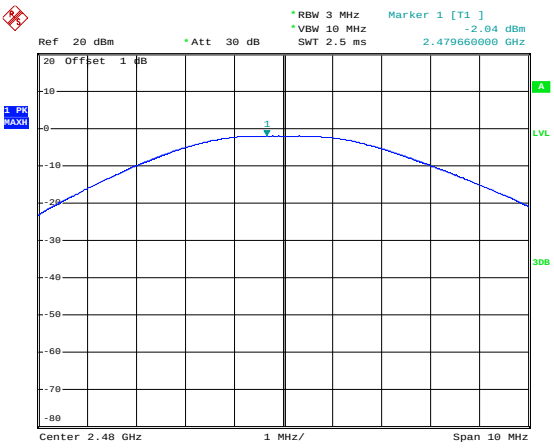
Low(1Mbps)	 Date: 5.MAY.2023 15:31:28
Middle(1Mbps)	 Date: 5.MAY.2023 15:31:51
High(1Mbps)	 Date: 5.MAY.2023 15:32:11

Low(2Mbps)	 Date: 5.MAY.2023 15:32:40
Middle(2Mbps)	 Date: 5.MAY.2023 15:33:07
High(2Mbps)	 Date: 5.MAY.2023 15:33:31

APPENDIX C

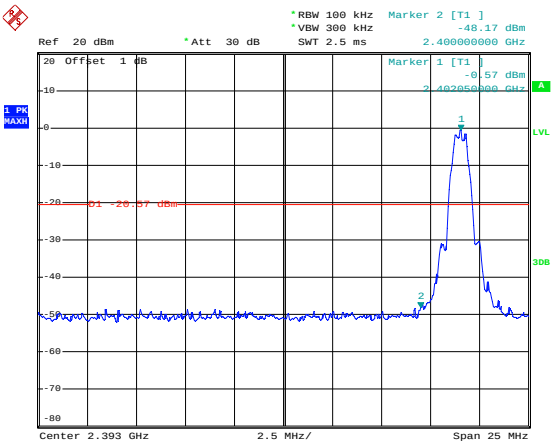
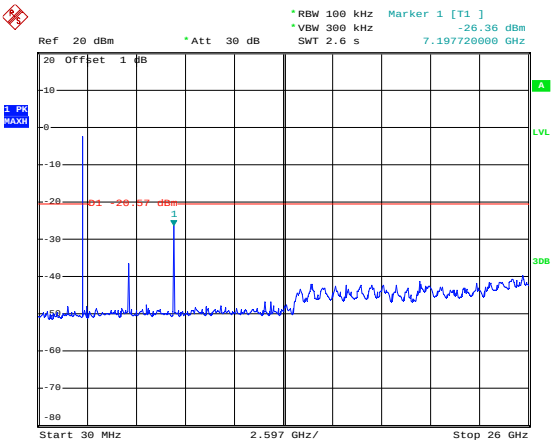
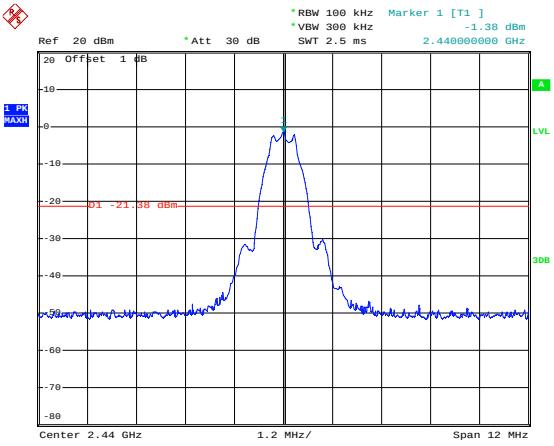
RF Output Power			
Test Mode	Test Channel	Reading dBm	Limit dBm
GFSK(BLE)-1Mbps	Low	-0.75	30.00
	Middle	-0.60	30.00
	High	-1.91	30.00
GFSK(BLE)-2Mbps	Low	-0.88	30.00
	Middle	-1.36	30.00
	High	-2.04	30.00

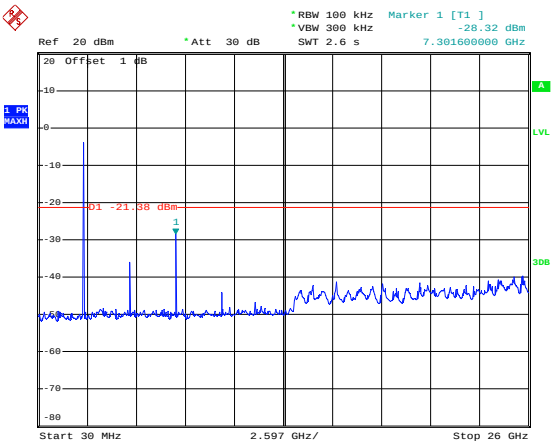
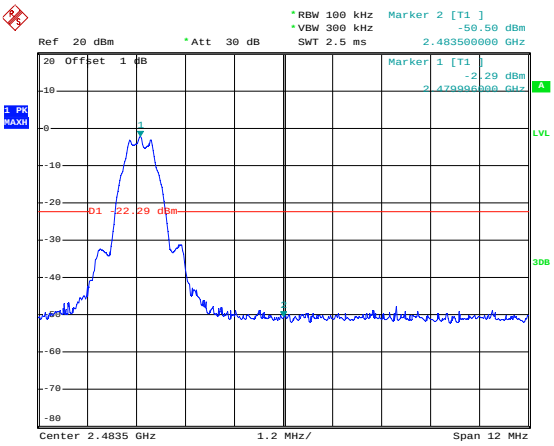
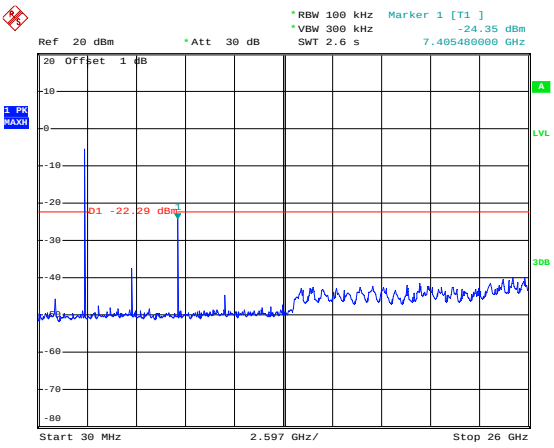
Low(1Mbps)	 Date: 5.MAY.2023 15:19:21
Middle(1Mbps)	 Date: 5.MAY.2023 15:20:06
High(1Mbps)	 Date: 5.MAY.2023 15:20:31

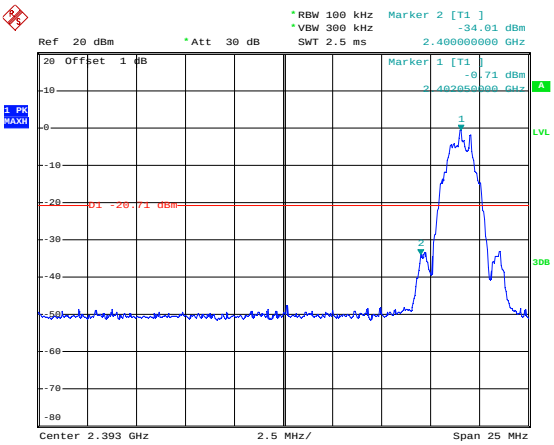
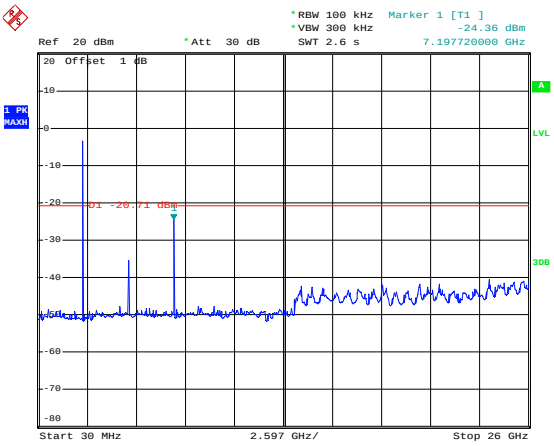
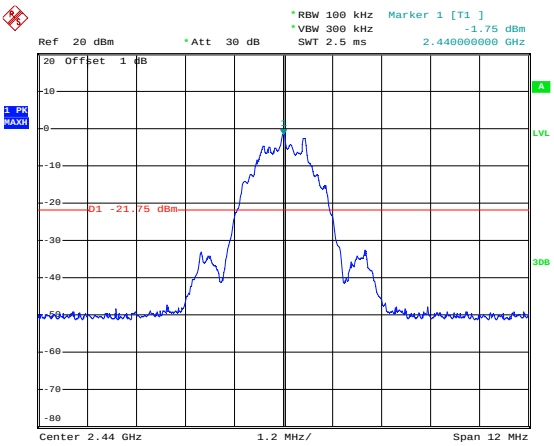
Low(2Mbps)	 Date: 5.MAY.2023 15:20:59
Middle(2Mbps)	 Date: 5.MAY.2023 15:21:21
High(2Mbps)	 Date: 5.MAY.2023 15:21:36

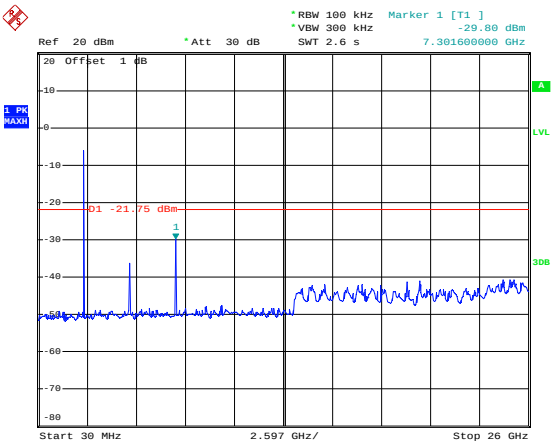
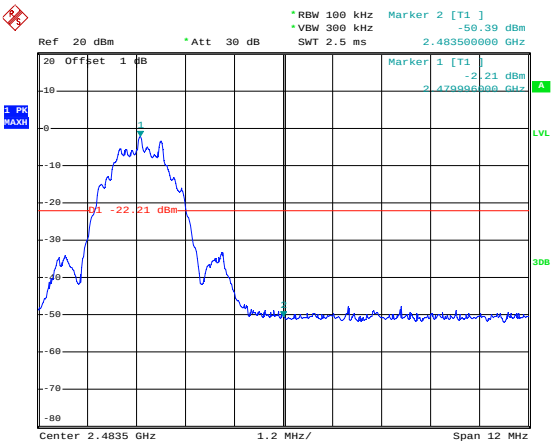
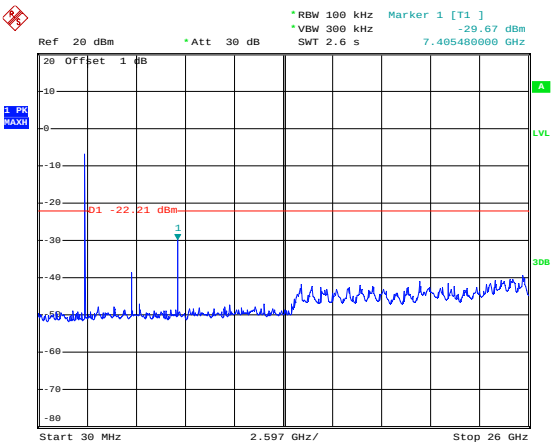
APPENDIX D

Conducted Out of Band Emissions

Low1Mbps	 Date: 5.MAY.2023 15:36:27
	 Date: 5.MAY.2023 15:36:49
Middle1Mbps	 Date: 5.MAY.2023 15:37:38

	 Date: 5.MAY.2023 15:37:52
High1Mbps	 Date: 5.MAY.2023 15:38:40
	 Date: 5.MAY.2023 15:38:54

Low2Mbps	 Date: 5.MAY.2023 15:39:50
	 Date: 5.MAY.2023 15:40:03
Middle2Mbps	 Date: 5.MAY.2023 15:40:37

	 Date: 5.MAY.2023 15:40:50
High2Mbps	 Date: 5.MAY.2023 15:41:23
	 Date: 5.MAY.2023 15:41:39

APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

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