TEST REPORT

Applicant Name :	SHENZHEN TOPFLYtech CO., LIMITED
Address :	Rm409 Scientific Research Building Tsinghua, Hi-tech Park Hi-tech Industrial Nanshan District, shenzhen, China
Report Number :	SZNS220623-28255E-RF
FCC ID:	2ASWYSOLARGUARDX100
IC:	27469-SOGUARDX100

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2; RSS-247, ISSUE 2, FEBRUARY 2017

Sample Description

Product Type:	SolarPowered GPS Elock
Model No.:	SolarGuardX 100
Multiple Model(s) No.:	N/A
Trade Mark:	TOPFLYtech
Date Received:	2022/06/23
Report Date:	2022/07/24

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Andy Yu
EMC Engineer

Approved By:

Candy Li
EMC Engineer

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	SolarGuardX 100
FVIN	V2.1
Frequency Range	BLE: 2402-2480MHz
Maximum Conducted Peak Output Power	BLE 1M: 6.13dBm BLE 2M: -0.79dBm
Modulation Technique	BLE: GFSK
Antenna Specification*	1.1dBi(provided by the applicant)
Voltage Range	DC 3.6V From Battery or DC 5V From Adapter
Sample serial number	RF: SZNS220623-28255E-RF-S2 RE&CE: SZNS220623-28255E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This report is in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209, 15.247 rules and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada rules.

Test Methodology

All tests and measurements indicated in this document were performed in accordance ANSI C63.10-2013, RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

EUT Exercise Software

“nRF_DTM”* exercise software was used and the power level is 0*. The software and power level was provided by the manufacturer.

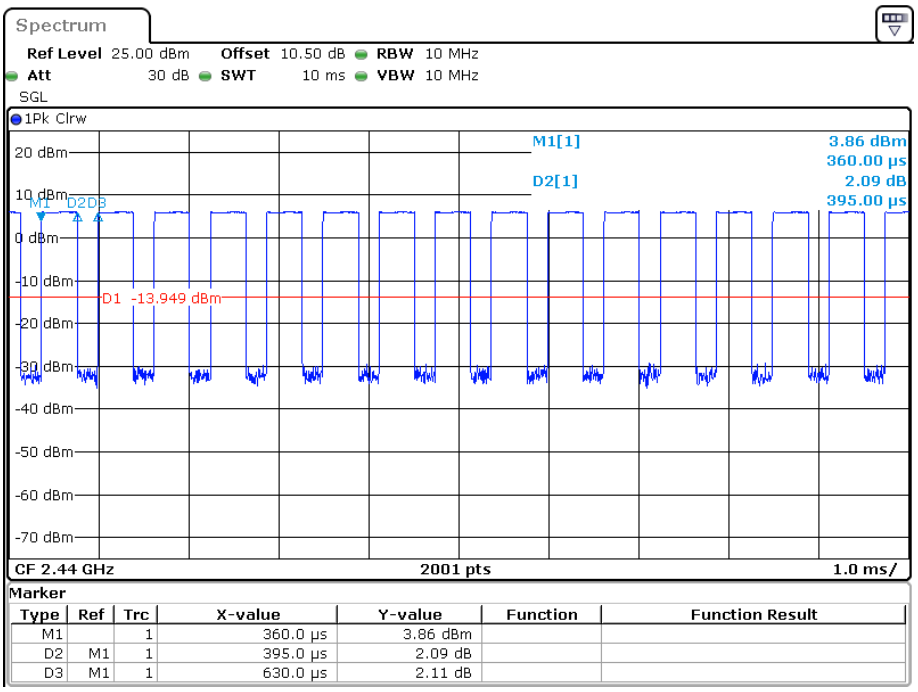
Equipment Modifications

No modification was made to the EUT tested.

Duty cycle

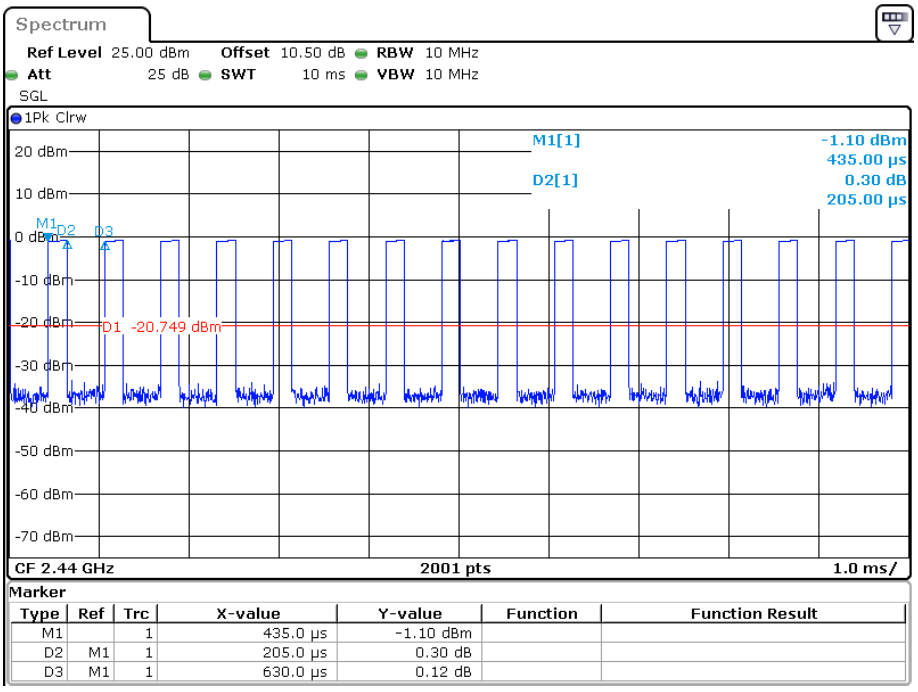
Mode	Ton (ms)	Ton+off (ms)	Duty Cycle (%)
BLE 1M	0.395	0.630	62.70
BLE 2M	0.205	0.630	32.54

BLE-1M:



Date: 8.JUL.2022 23:17:04

BLE-2M:



Date: 8.JUL.2022 23:55:57

Support Equipment List and Details

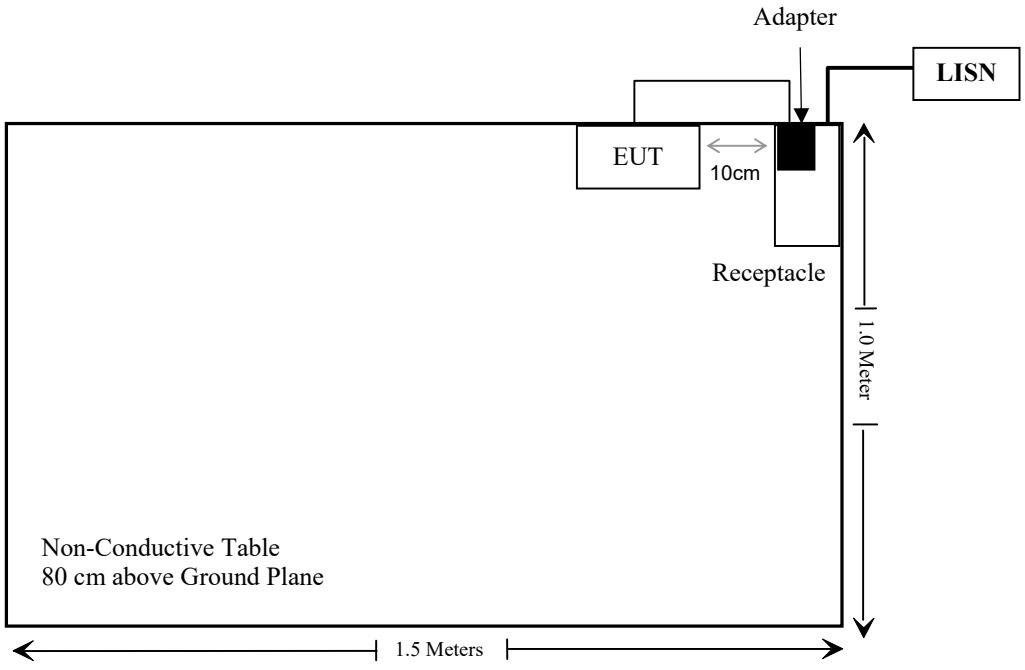
Manufacturer	Description	Model	Serial Number
TECNO	Adapter	U050TSA	AH07015321906

External I/O Cable

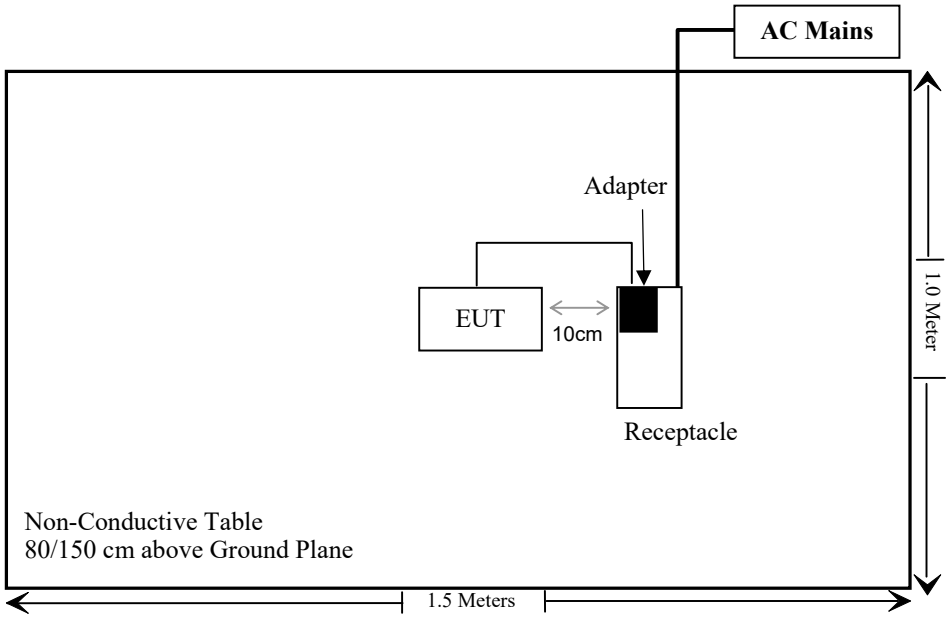
Cable Description	Length (m)	From Port	To
Unshield detachable DC cable	1.0	Adapter	EUT

Block Diagram of Test Setup

For conducted emission:



For radiated emission:



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (3) &§2.1091 RSS-102 §4	Maximum Permissible Exposure(MPE) & RF Exposure	Compliant
FCC §15.203, RSS-GEN Clause 6.8	Antenna Requirement	Compliant
FCC §15.207 (a); RSS-Gen Clause 8.8	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d); RSS-247 Clause 5.5 RSS-Gen Clause 8.10	Spurious Emissions	Compliant
FCC §15.247 (a)(2); RSS-247 Clause 5.2 a) RSS-Gen Clause 6.7	6 dB Bandwidth and 99% Occupied Bandwidth	Compliant
FCC §15.247(b)(3); RSS-247 Clause 5.4 d)	Maximum Conducted Output Power	Compliant
FCC §15.247(d); RSS-247 Clause 5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) RSS-247 Clause 5.2 b)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2021/12/14	2022/12/13
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Cable	Unknown	3	Each time	/

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}}+\sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}}+\sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k}\leq 1$$

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (W)
		(dBm)	(dBi)	(dBd)	(dBm)	(W)		
BLE	2402-2480	6.5	1.1	-1.05	5.45	0.004	0.2	0.768
NFC	13.56	/	/	/	/	0.00045	0.2	0.751
GSM850	824-849	25.97	1.0	-1.15	24.82	0.303	0.2	0.422
GSM1900	1850-1910	22.97	1.5	-0.65	22.32	0.171	0.2	0.768
Cat-M B2	1850-1910	22.0	1.5	-0.65	21.35	0.136	0.2	0.768
Cat-M B4	1710-1755	22.0	1.7	-0.45	21.55	0.143	0.2	0.768
Cat-M B5	824-849	22.0	1.0	-1.15	20.85	0.122	0.2	0.422
Cat-M B12	699-716	22.0	0.8	-1.35	20.65	0.116	0.2	0.358
Cat-M B13	777-787	22.0	0.8	-1.35	20.65	0.116	0.2	0.398
Cat-M B25	1850-1915	22.0	1.5	-0.65	21.35	0.136	0.2	0.768
Cat-M B26	814-849	22.0	1.0	-1.15	20.85	0.122	0.2	0.417
Cat-M B66	1710-1780	22.0	1.7	-0.45	21.55	0.143	0.2	0.768
Cat-M B85	698-716	22.0	0.8	-1.35	20.65	0.116	0.2	0.357
NB-IOT B2	1850-1910	22.0	1.5	-0.65	21.35	0.136	0.2	0.768
NB-IOT B4	1710-1755	22.0	1.7	-0.45	21.55	0.143	0.2	0.768
NB-IOT B5	824-849	22.0	1.0	-1.15	20.85	0.122	0.2	0.422
NB-IOT B12	699-716	22.0	0.8	-1.35	20.65	0.116	0.2	0.358
NB-IOT B13	777-787	22.0	0.8	-1.35	20.65	0.116	0.2	0.398
NB-IOT B25	1850-1915	22.0	1.5	-0.65	21.35	0.136	0.2	0.768
NB-IOT B66	1710-1780	22.0	1.7	-0.45	21.55	0.143	0.2	0.768
NB-IOT B71	663-698	22.0	0.8	-1.35	20.65	0.116	0.2	0.339
NB-IOT B85	698-716	22.0	0.8	-1.35	20.65	0.116	0.2	0.357

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The device contain a WWAN module (FCC ID: XMR201910BG95M3) granted on 07/17/2020.
3. The BLE, NFC and WWAN can transmit at same time.
4. For NFC, the max E-field strength is 93.64dBuV/m@3m

$$EIRP = p_t \times g_t = (E \times d)^2 / 30$$

where

p_t is the transmitter output power in watts
g_t is the numeric gain of the transmitting antenna (dimensionless)
E is the electric field strength in V/m
d is the measurement distance in meters (m)

$$ERP = EIRP/1.64 = (E \times d)^2 / (30 \times 1.64) = (E \times d)^2 / 49.2$$

So, ERP = (0.048*3)2/49.2=0.00042W=0.42mW

The tune-up ERP=0.45mW

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BLE}/limit+ ERP_{NFC}/limit +ERP_{WWAN}/limit
=0.004/0.768+0.00045/0.751+0.303/0.422=0.724＜1.0, so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

RSS-102 § 4 –EXPOSURE LIMITS

Applicable Standard

According to RSS-102 §4:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000/$f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

Result

Mode	Frequency (MHz)	Antenna Gain		Turn up Power		Evaluation Distance (m)	Power Density (W/m^2)	MPE Limit (W/m^2)
		(dBi)	(numeric)	(dBm)	(W)			
BLE	2402-2480	1.1	1.29	6.5	0.004	0.2	0.010	5.35
NFC	13.56	/	/	/	0.00045	0.2	0.001	2
GSM850	824-849	1.0	1.26	25.97	0.395	0.2	0.991	2.58
GSM1900	1850-1910	1.5	1.41	22.97	0.198	0.2	0.556	4.48
Cat-M B2	1850-1910	1.5	1.41	22.0	0.158	0.2	0.443	4.48
Cat-M B4	1710-1755	1.7	1.48	22.0	0.158	0.2	0.465	4.24
Cat-M B5	824-849	1.0	1.26	22.0	0.158	0.2	0.396	2.58
Cat-M B12	699-716	0.8	1.20	22.0	0.158	0.2	0.377	2.30
Cat-M B13	777-787	0.8	1.20	22.0	0.158	0.2	0.377	2.47
Cat-M B25	1850-1915	1.5	1.41	22.0	0.158	0.2	0.443	4.48
Cat-M B26	824-849	1.0	1.26	22.0	0.158	0.2	0.396	2.58
Cat-M B66	1710-1780	1.7	1.48	22.0	0.158	0.2	0.465	4.24
Cat-M B85	698-716	0.8	1.20	22.0	0.158	0.2	0.377	2.30
NB-IOT B2	1850-1910	1.5	1.41	22.0	0.158	0.2	0.443	4.48
NB-IOT B4	1710-1755	1.7	1.48	22.0	0.158	0.2	0.465	4.24
NB-IOT B5	824-849	1.0	1.26	22.0	0.158	0.2	0.396	2.58
NB-IOT B12	699-716	0.8	1.20	22.0	0.158	0.2	0.377	2.30
NB-IOT B13	777-787	0.8	1.20	22.0	0.158	0.2	0.377	2.47
NB-IOT B25	1850-1915	1.5	1.41	22.0	0.158	0.2	0.443	4.48
NB-IOT B66	1710-1780	1.7	1.48	22.0	0.158	0.2	0.465	4.24
NB-IOT B71	663-698	0.8	1.20	22.0	0.158	0.2	0.377	2.22
NB-IOT B85	698-716	0.8	1.20	22.0	0.158	0.2	0.377	2.30

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The device contain a WWAN module (IC: 10224A-2019BG95M3).
3. The BLE, NFC and WWAN can transmit at same time.
4. For NFC, the max E-field strength is 93.64dBuV/m@3m

$$EIRP = p_t \times g_t = (E \times d)^2 / 30$$

where

p_t is the transmitter output power in watts
g_t is the numeric gain of the transmitting antenna (dimensionless)
E is the electric field strength in V/m
d is the measurement distance in meters (m)

$$ERP = EIRP/1.64 = (E \times d)^2 / (30 \times 1.64) = (E \times d)^2 / 49.2$$

So, ERP = (0.048*3)2/49.2=0.00042W=0.42mW

The tune-up ERP=0.45mW

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BLE}/limit+MPE_{NFC}/limit+MPE_{WWAN}/limit =0.010/5.37+0.001/2+0.991/2.58=0.386＜1.0, so simultaneous exposure is compliant.

To maintain compliance with the ISEDC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203, RSS-GEN CLAUSE 6.8 - ANTENNA REQUIREMENT

Applicable Standard

According to § 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to RSS-Gen §6.8, The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).
When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.
For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has one internal antenna permanently attached to the unit for BLE, fulfill the requirement of this section. The antenna gain is 1.1 dBi. Please refer to the EUT photos.

Antenna	Type	Antenna Gain	Impedance
	PCB	1.1dBi	50 Ω

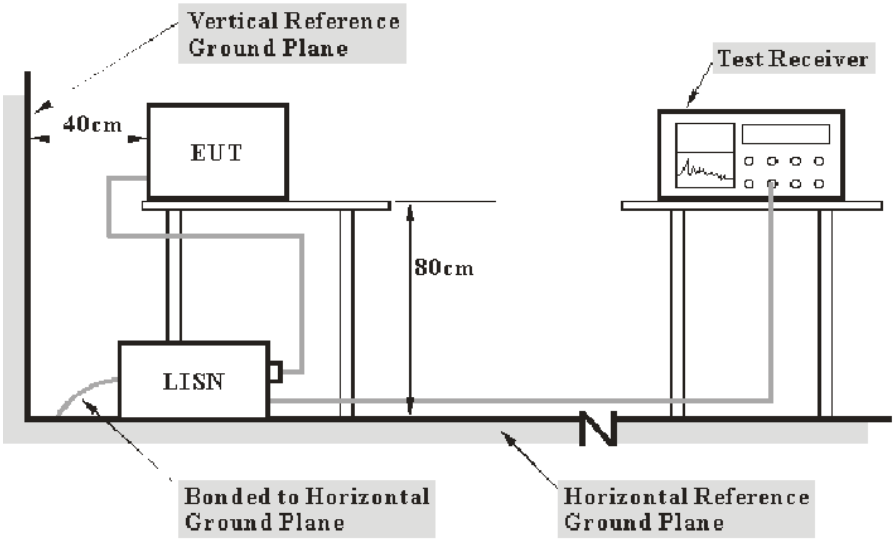
Result: Compliant.

FCC §15.207 (a)，RSS-GEN §8.8 - AC Power Line Conducted Emissions

Applicable Standard

FCC§15.207(a). RSS-Gen§8.8.

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits and RSS-Gen limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

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

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Test Results Summary

According to the EUT complied with the FCC 15.207/RSS-Gen.

Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Transd Factor = LISN VDF + Cable Loss

The "**Over limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

Environmental Conditions

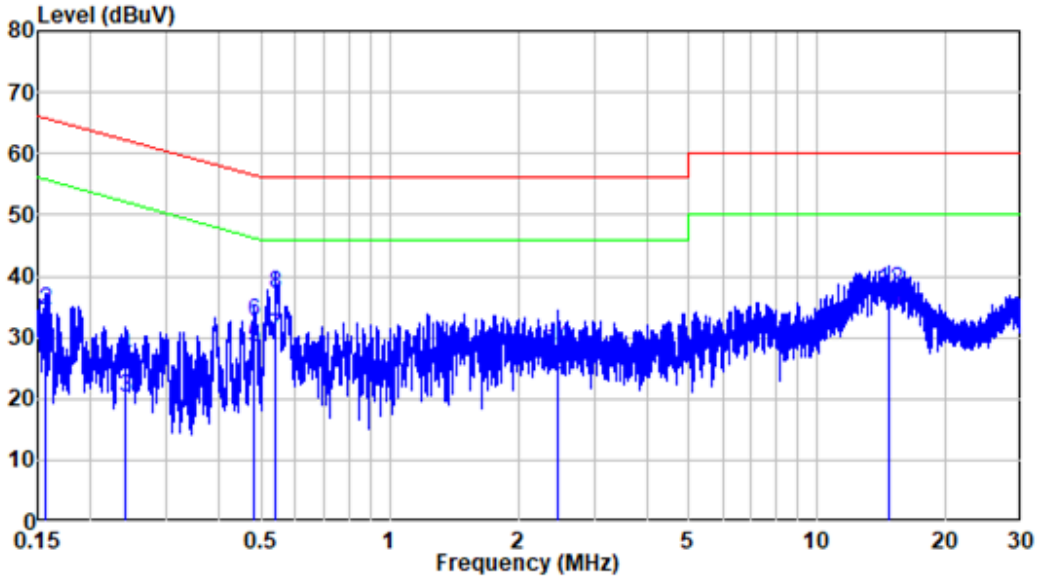
Temperature:	24 ℃
Relative Humidity:	42 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason on 2022-07-13

EUT operation mode: Transmitting(worst case high channel)

BLE 1M:

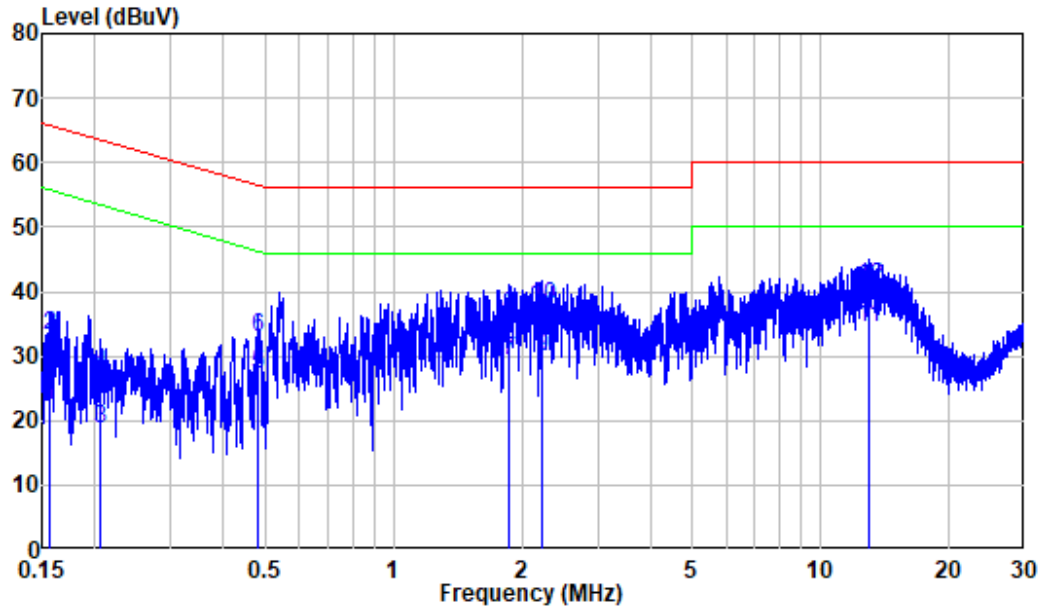
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : BLE 1MHz
Model : SolarGuardX 100
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.156	9.80	15.60	25.40	55.65	-30.25	Average
2	0.156	9.80	24.67	34.47	65.65	-31.18	QP
3	0.241	9.80	10.45	20.25	52.04	-31.79	Average
4	0.241	9.80	17.16	26.96	62.04	-35.08	QP
5	0.480	9.80	18.52	28.32	46.35	-18.03	Average
6	0.480	9.80	22.74	32.54	56.35	-23.81	QP
7	0.540	9.81	20.42	30.23	46.00	-15.77	Average
8	0.540	9.81	27.35	37.16	56.00	-18.84	QP
9	2.464	9.82	14.09	23.91	46.00	-22.09	Average
10	2.464	9.82	18.29	28.11	56.00	-27.89	QP
11	14.759	9.95	24.48	34.43	50.00	-15.57	Average
12	14.759	9.95	27.82	37.77	60.00	-22.23	QP

AC 120V/60 Hz, Neutral

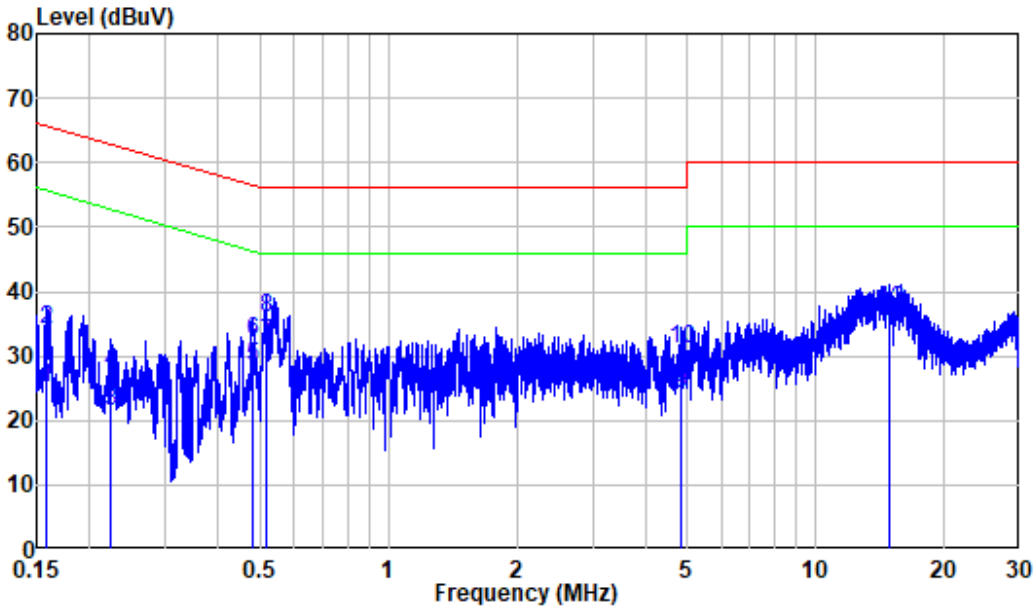


Site : Shielding Room
Condition: Neutral
Mode : BLE 1MHz
Model : SolarGuardX 100
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.156	9.80	12.43	22.23	55.66	-33.43	Average
2	0.156	9.80	23.35	33.15	65.66	-32.51	QP
3	0.206	9.80	8.91	18.71	53.37	-34.66	Average
4	0.206	9.80	17.25	27.05	63.37	-36.32	QP
5	0.479	9.80	17.50	27.30	46.35	-19.05	Average
6	0.479	9.80	23.03	32.83	56.35	-23.52	QP
7	1.867	9.82	19.39	29.21	46.00	-16.79	Average
8	1.867	9.82	26.35	36.17	56.00	-19.83	QP
9	2.232	9.82	20.13	29.95	46.00	-16.05	Average
10	2.232	9.82	27.87	37.69	56.00	-18.31	QP
11	12.954	10.03	24.37	34.40	50.00	-15.60	Average
12	12.954	10.03	30.79	40.82	60.00	-19.18	QP

BLE 2M:

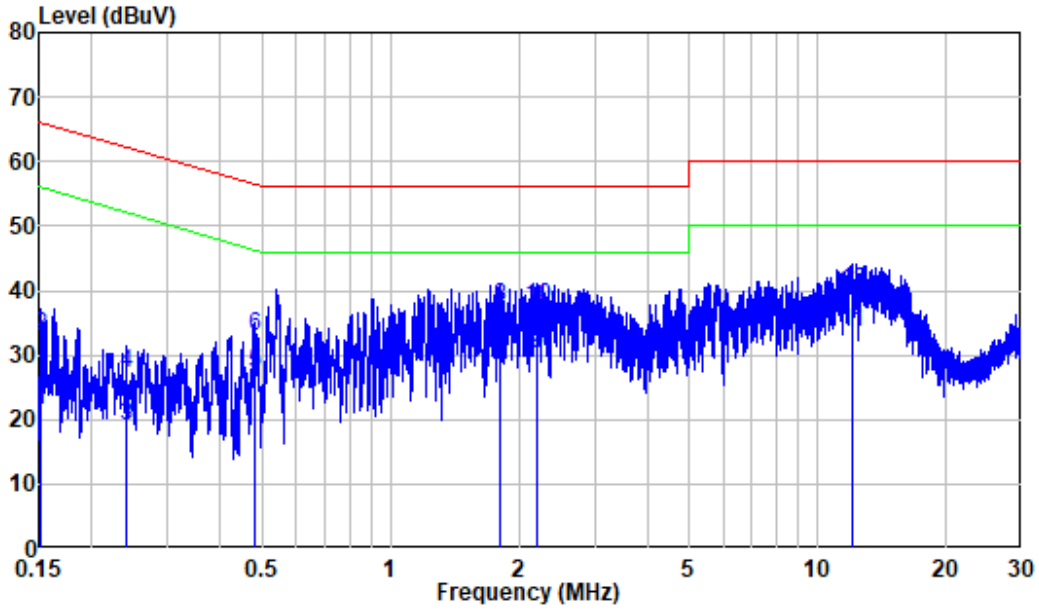
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : BLE 2MHz
Model : SolarGuardX 100
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.158	9.80	15.20	25.00	55.54	-30.54	Average
2	0.158	9.80	24.24	34.04	65.54	-31.50	QP
3	0.224	9.80	11.72	21.52	52.67	-31.15	Average
4	0.224	9.80	17.74	27.54	62.67	-35.13	QP
5	0.479	9.80	18.67	28.47	46.36	-17.89	Average
6	0.479	9.80	22.44	32.24	56.36	-24.12	QP
7	0.516	9.81	22.23	32.04	46.00	-13.96	Average
8	0.516	9.81	26.16	35.97	56.00	-20.03	QP
9	4.826	9.85	14.20	24.05	46.00	-21.95	Average
10	4.826	9.85	21.33	31.18	56.00	-24.82	QP
11	14.799	9.95	24.63	34.58	50.00	-15.42	Average
12	14.799	9.95	27.12	37.07	60.00	-22.93	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : BLE 2MHz
Model : SolarGuardX 100
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.152	9.80	11.58	21.38	55.91	-34.53	Average
2	0.152	9.80	23.08	32.88	65.91	-33.03	QP
3	0.240	9.80	9.23	19.03	52.10	-33.07	Average
4	0.240	9.80	17.29	27.09	62.10	-35.01	QP
5	0.479	9.80	17.49	27.29	46.35	-19.06	Average
6	0.479	9.80	22.96	32.76	56.35	-23.59	QP
7	1.806	9.82	20.39	30.21	46.00	-15.79	Average
8	1.806	9.82	27.48	37.30	56.00	-18.70	QP
9	2.200	9.82	20.25	30.07	46.00	-15.93	Average
10	2.200	9.82	27.73	37.55	56.00	-18.45	QP
11	12.020	10.02	23.35	33.37	50.00	-16.63	Average
12	12.020	10.02	29.70	39.72	60.00	-20.28	QP

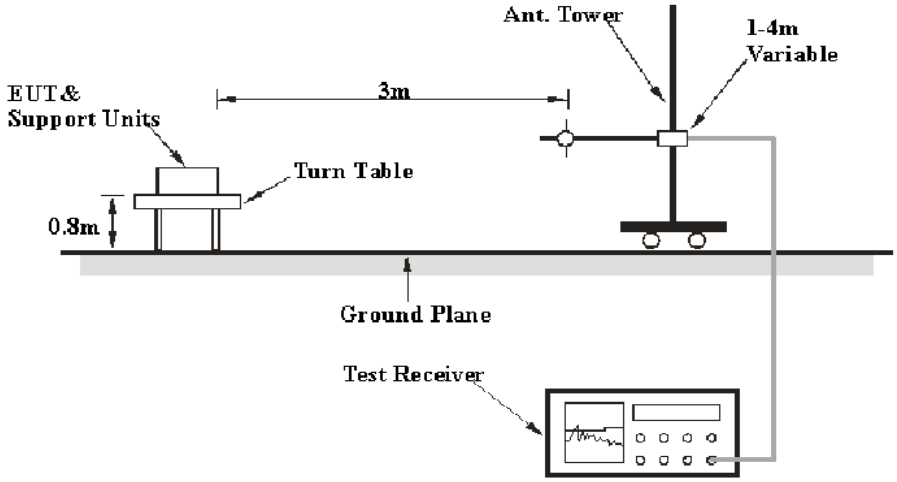
FCC §15.209, §15.205 & §15.247(D), RSS-GEN § 8.10 & RSS-247 § 5.5 – UNWANTED EMISSION FREQUENCIES AND RESTRICTED BANDS

Applicable Standard

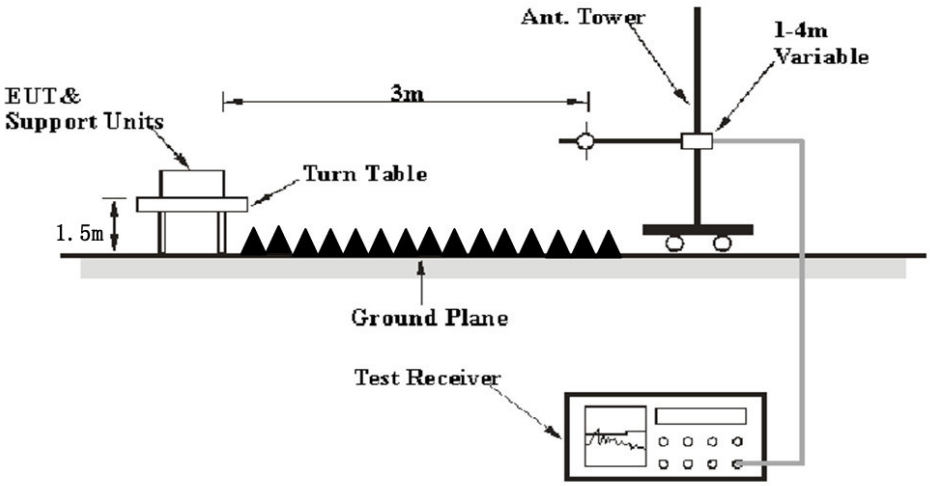
FCC §15.247 (d); §15.209; §15.205; RSS-247 §5.5, RSS-GEN §8.10.

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.205, FCC 15.209, FCC 15.247, RSS-Gen and RSS-247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30MHz – 1000 MHz	100 kHz	300 kHz	120kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.

Repeat above procedures until all measured frequencies were complete.

Factor & Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Results Summary

According to the data in the following table, the EUT complied with the FCC 15.205, FCC 15.209, FCC 15.247, RSS-Gen and RSS-247.

Test Data

Environmental Conditions

Temperature:	25.6~28 ℃
Relative Humidity:	50~56 %
ATM Pressure:	101.0 kPa

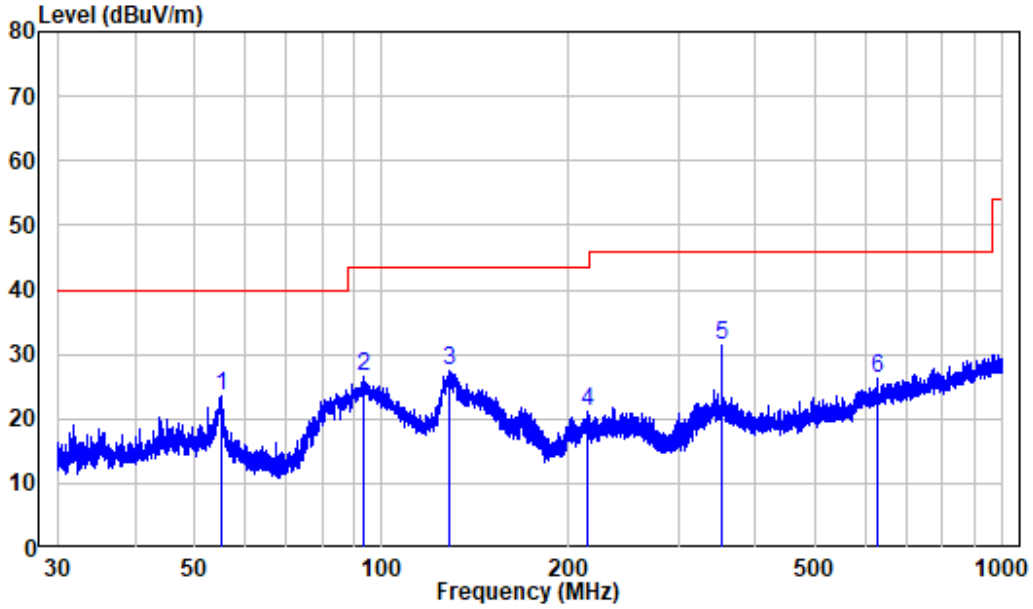
The testing was performed by Level on 2022-07-14 for below 1GHz and Level Li on 2022-07-09 for above 1GHz.

EUT operation mode: Transmitting(Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

30MHz-1GHz: *(worst case is BLE 1M, High channel)*

Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.

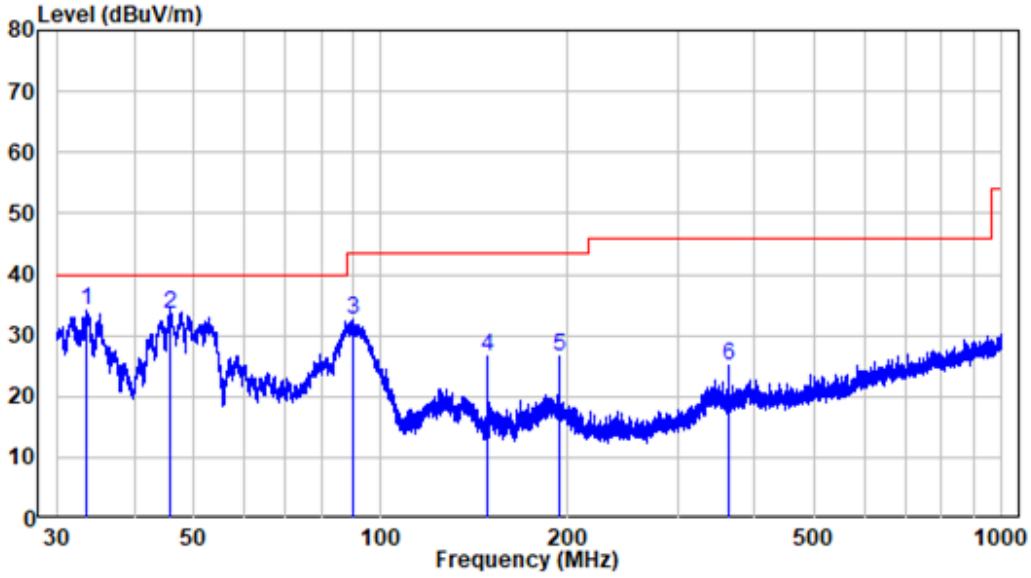
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : S2NS220623-28255E-RF
Test Mode: BLE

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	55.027	-10.28	33.72	23.44	40.00	-16.56	Peak
2	93.236	-12.93	39.37	26.44	43.50	-17.06	Peak
3	128.732	-14.77	42.24	27.47	43.50	-16.03	Peak
4	214.139	-11.71	32.95	21.24	43.50	-22.26	Peak
5	351.708	-7.37	38.76	31.39	46.00	-14.61	Peak
6	630.306	-2.07	28.25	26.18	46.00	-19.82	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : S2NS220623-28255E-RF
Test Mode: BLE

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	33.621	-11.91	45.89	33.98	40.00	-6.02	Peak
2	45.835	-9.98	43.42	33.44	40.00	-6.56	QP
3	90.023	-14.01	46.66	32.65	43.50	-10.85	Peak
4	148.376	-15.36	41.81	26.45	43.50	-17.05	Peak
5	193.179	-11.29	37.72	26.43	43.50	-17.07	Peak
6	363.462	-7.58	32.68	25.10	46.00	-20.90	Peak

Above 1GHz:

BLE 1M:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/AV		Height (m)	Polar (H/V)				
Low Channel 2402 MHz									
2310	67.47	PK	210	1.7	H	-7.24	60.23	74	-13.77
2310	55.20	AV	210	1.7	H	-7.24	47.96	54	-6.04
2310	67.57	PK	172	2	V	-7.24	60.33	74	-13.67
2310	54.63	AV	172	2	V	-7.24	47.39	54	-6.61
2390	68.16	PK	77	2.5	H	-7.22	60.94	74	-13.06
2390	55.59	AV	77	2.5	H	-7.22	48.37	54	-5.63
2390	68.19	PK	209	1.6	V	-7.22	60.97	74	-13.03
2390	55.62	AV	209	1.6	V	-7.22	48.40	54	-5.60
4804	52.88	PK	27	1.1	H	-3.51	49.37	74	-24.63
4804	53.13	PK	14	2.1	V	-3.51	49.62	74	-24.38
Middle Channel 2440MHz									
4880	53.49	PK	146	2.4	H	-3.36	50.13	74	-23.87
4880	53.67	PK	235	2	V	-3.36	50.31	74	-23.69
High Channel 2480MHz									
2483.5	68.74	PK	289	1.3	H	-7.20	61.54	74	-12.46
2483.5	55.56	AV	289	1.3	H	-7.20	48.36	54	-5.64
2483.5	68.29	PK	356	1.5	V	-7.20	61.09	74	-12.91
2483.5	55.47	AV	356	1.5	V	-7.20	48.27	54	-5.73
2500	67.48	PK	310	1.4	H	-7.18	60.3	74	-13.70
2500	55.17	AV	310	1.4	H	-7.18	47.99	54	-6.01
2500	67.86	PK	115	1.4	V	-7.18	60.68	74	-13.32
2500	55.18	AV	115	1.4	V	-7.18	48	54	-6.00
4960	53.06	PK	205	2.4	H	-3.01	50.05	74	-23.95
4960	53.48	PK	26	1.6	V	-3.01	50.47	74	-23.53

BLE 2M:

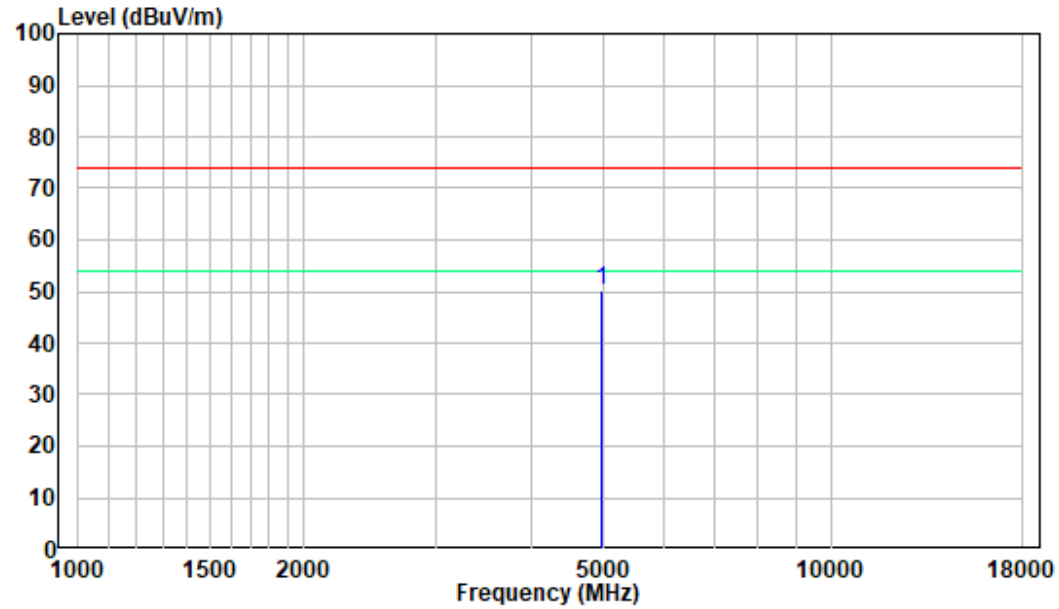
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/AV		Height (m)	Polar (H/V)				
Low Channel 2402 MHz									
2310	67.39	PK	299	1.3	H	-7.24	60.15	74	-13.85
2310	55.75	AV	299	1.3	H	-7.24	48.51	54	-5.49
2310	67.76	PK	1	2.1	V	-7.24	60.52	74	-13.48
2310	55.00	AV	1	2.1	V	-7.24	47.76	54	-6.24
2390	68.36	PK	10	2.5	H	-7.22	61.14	74	-12.86
2390	56.16	AV	10	2.5	H	-7.22	48.94	54	-5.06
2390	68.15	PK	35	1.3	V	-7.22	60.93	74	-13.07
2390	56.04	AV	35	1.3	V	-7.22	48.82	54	-5.18
4804	53.24	PK	211	1.5	H	-3.51	49.73	74	-24.27
4804	53.47	PK	341	1.5	V	-3.51	49.96	74	-24.04
Middle Channel 2440MHz									
4880	53.40	PK	122	1	H	-3.36	50.04	74	-23.96
4880	53.29	PK	59	1	V	-3.36	49.93	74	-24.07
High Channel 2480MHz									
2483.5	69.09	PK	181	1.6	H	-7.20	61.89	74	-12.11
2483.5	56.94	AV	181	1.6	H	-7.20	49.74	54	-4.26
2483.5	69.48	PK	246	1.4	V	-7.20	62.28	74	-11.72
2483.5	56.83	AV	246	1.4	V	-7.20	49.63	54	-4.37
2500	68.60	PK	91	2.2	H	-7.18	61.42	74	-12.58
2500	56.44	AV	91	2.2	H	-7.18	49.26	54	-4.74
2500	69.21	PK	334	2.2	V	-7.18	62.03	74	-11.97
2500	56.22	AV	334	2.2	V	-7.18	49.04	54	-4.96
4960	52.86	PK	80	1.7	H	-3.01	49.85	74	-24.15
4960	52.52	PK	37	1.7	V	-3.01	49.51	74	-24.49

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is 20dB to the limit or in noise floor was not recorded.
The test result of peak was less than the limit of average, so just peak value were recorded.

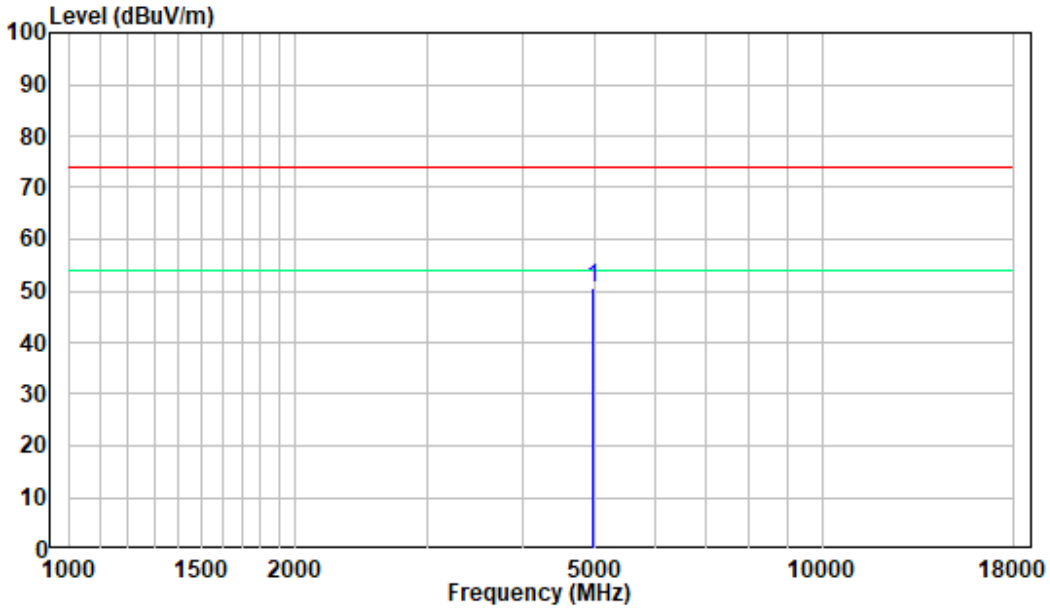
1-18GHz

Pre-scan for BLE 1M, High channel

Horizontal:



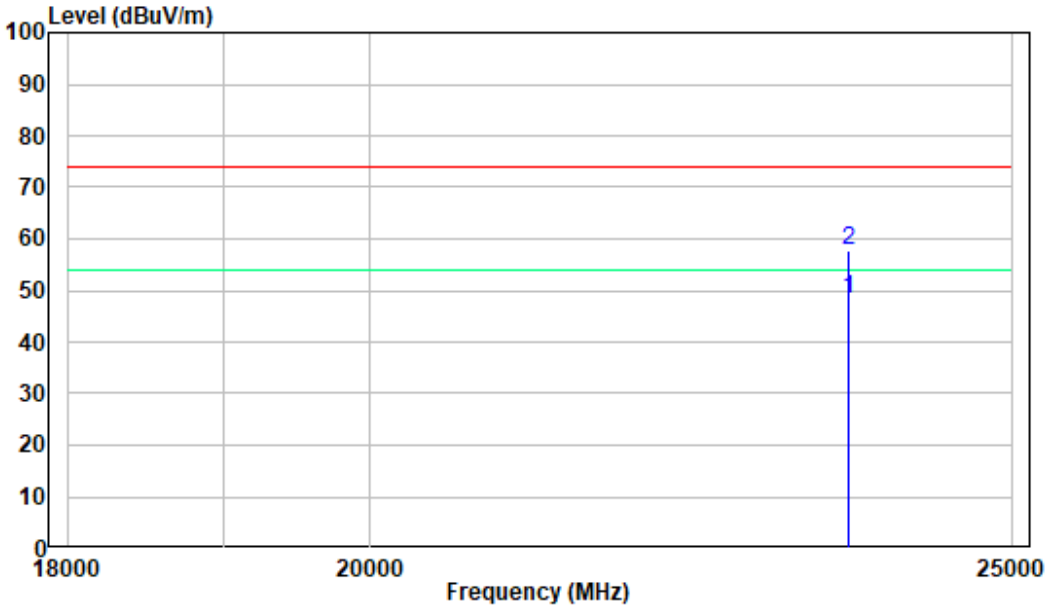
Vertical:



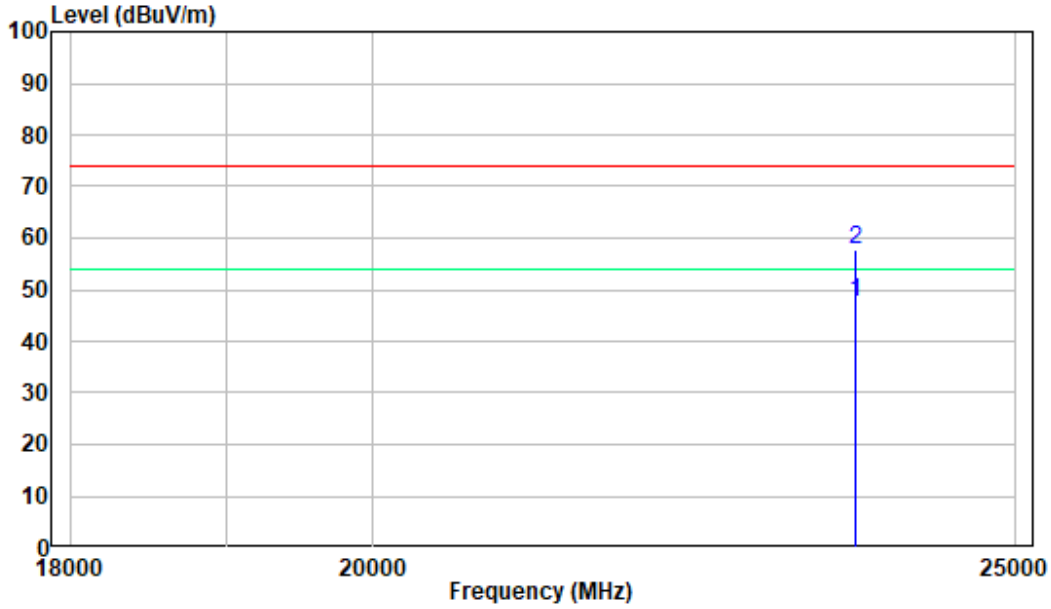
18-25GHz

Pre-scan for BLE 1M, High channel

Horizontal:



Vertical:



FCC §15.247(a) (2), RSS-GEN § 6.7 & RSS-247 § 5.2 (a) – 99% OCCUPIED BANDWIDTH & 6 dB EMISSON BANDWIDTH

Standard Applicable

According to FCC §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.

According to RSS-247 §5.2 a)
The minimum 6 dB bandwidth shall be 500 kHz.

According to RSS-Gen §6.7
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.
In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

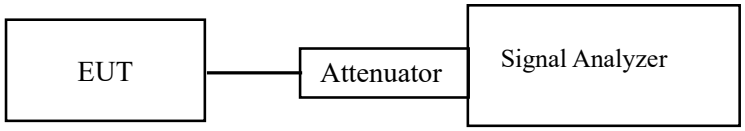
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

99% Occupied bandwidth test:
Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling from 2022-07-08 to 2022-07-09.

Test Mode: Transmitting

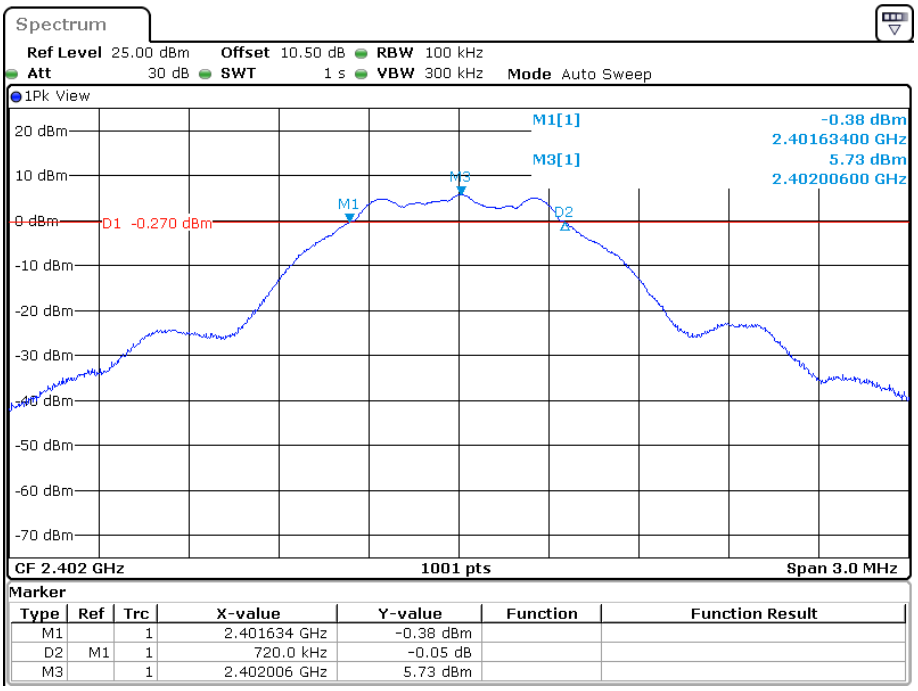
Test Result: Pass.

Please refer to the following tables and plots.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	6dB Bandwidth Limit (kHz)
BLE 1M				
Low	2402	0.720	1.046	≥500
Middle	2440	0.717	1.049	≥500
High	2480	0.729	1.049	≥500
BLE 2M				
Low	2402	1.158	2.038	≥500
Middle	2440	1.158	2.044	≥500
High	2480	1.152	2.044	≥500

BLE 1M:

6dB Bandwidth, Low Channel

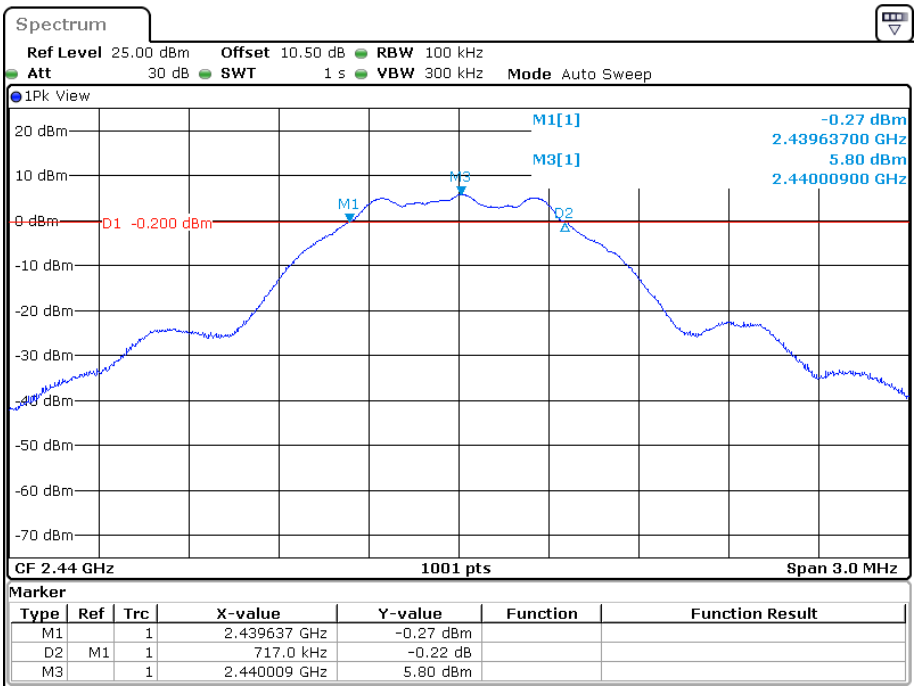


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401634 GHz	-0.38 dBm		
D2	M1	1	720.0 kHz	-0.05 dB		
M3		1	2.402006 GHz	5.73 dBm		

Date: 8.JUL.2022 23:15:01

6dB Bandwidth, Middle Channel

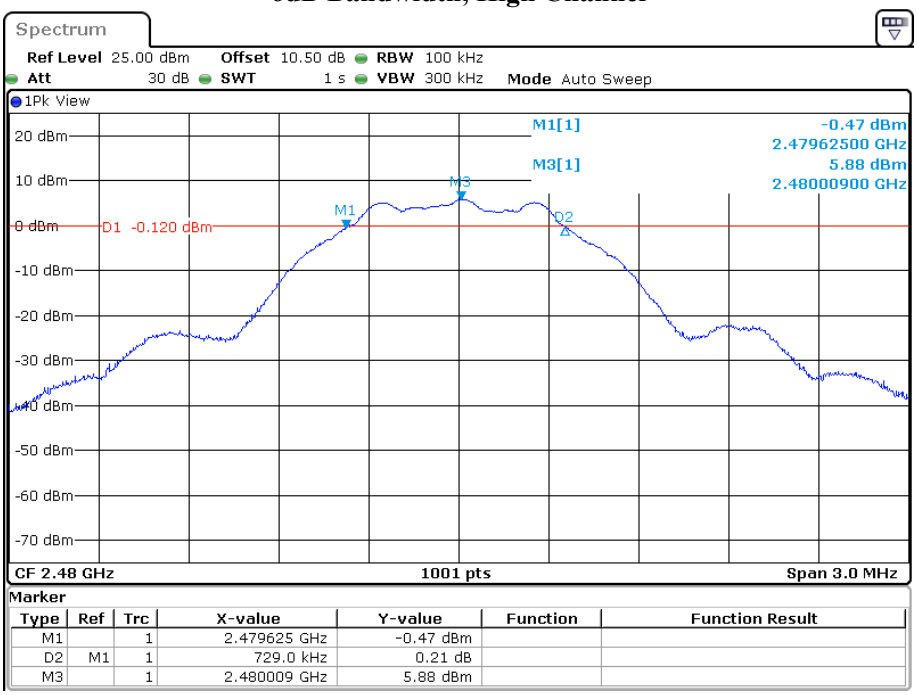


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.439637 GHz	-0.27 dBm		
D2	M1	1	717.0 kHz	-0.22 dB		
M3		1	2.440009 GHz	5.80 dBm		

Date: 8.JUL.2022 23:18:34

6dB Bandwidth, High Channel

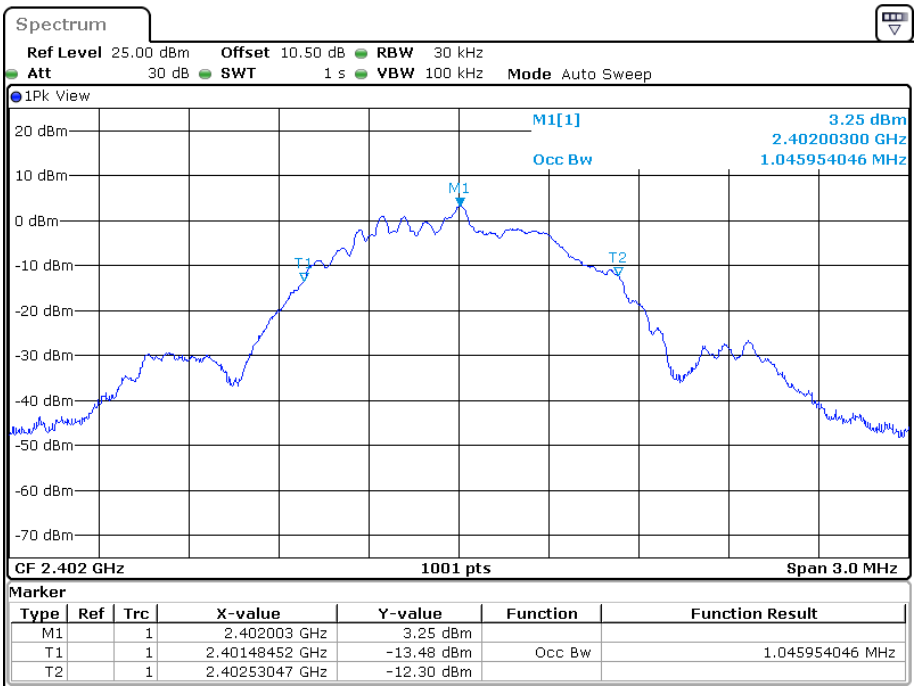


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479625 GHz	-0.47 dBm		
D2	M1	1	729.0 kHz	0.21 dB		
M3		1	2.480009 GHz	5.88 dBm		

Date: 8.JUL.2022 23:32:36

99% Emission Bandwidth, Low Channel

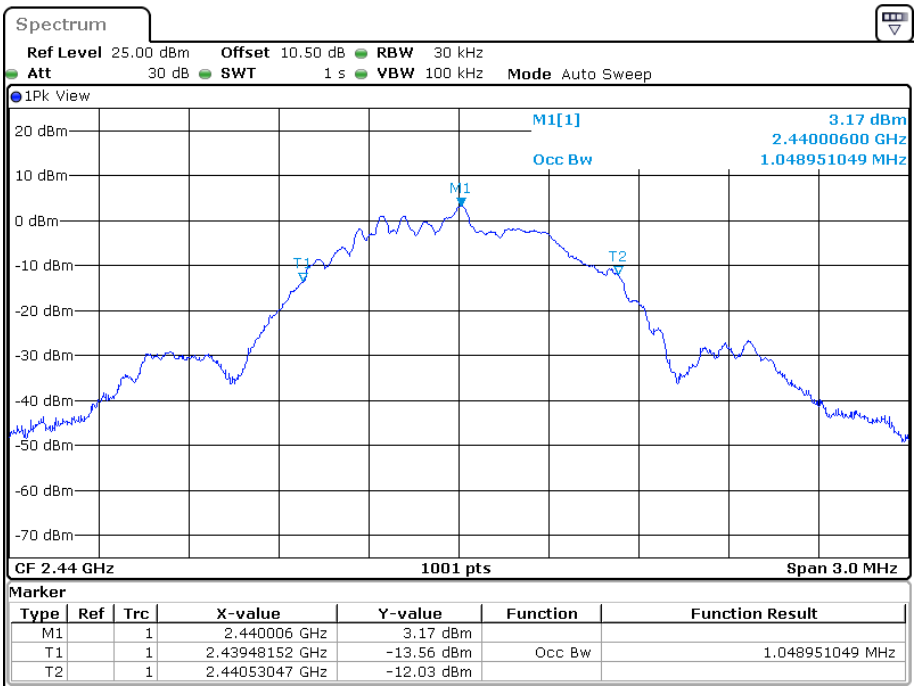


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402003 GHz	3.25 dBm		
T1		1	2.40148452 GHz	-13.48 dBm	Occ Bw	1.045954046 MHz
T2		1	2.40253047 GHz	-12.30 dBm		

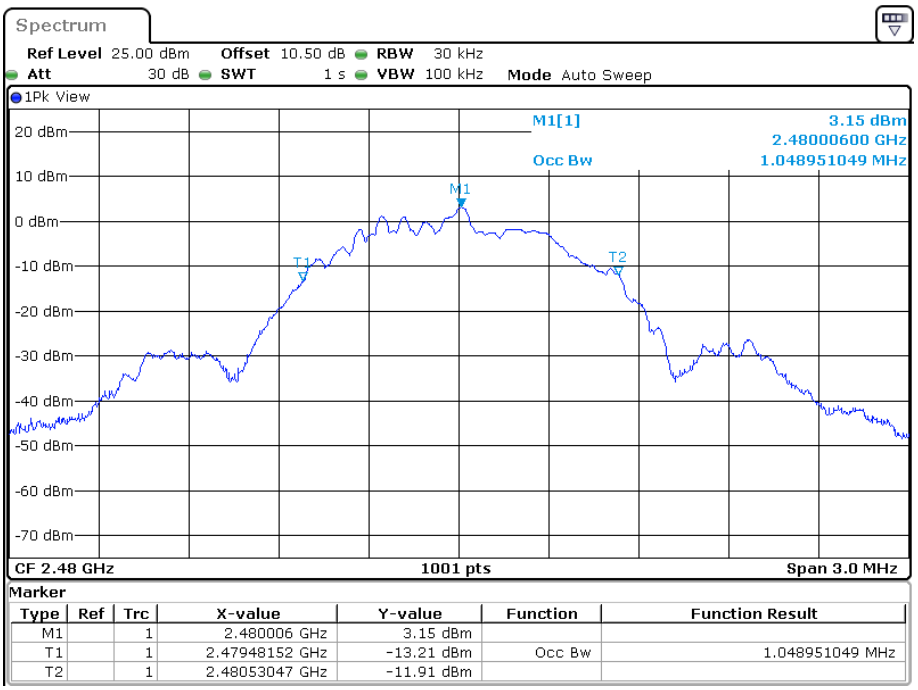
Date: 8.JUL.2022 23:14:32

99% Emission Bandwidth, Middle Channel



Date: 8.JUL.2022 23:18:04

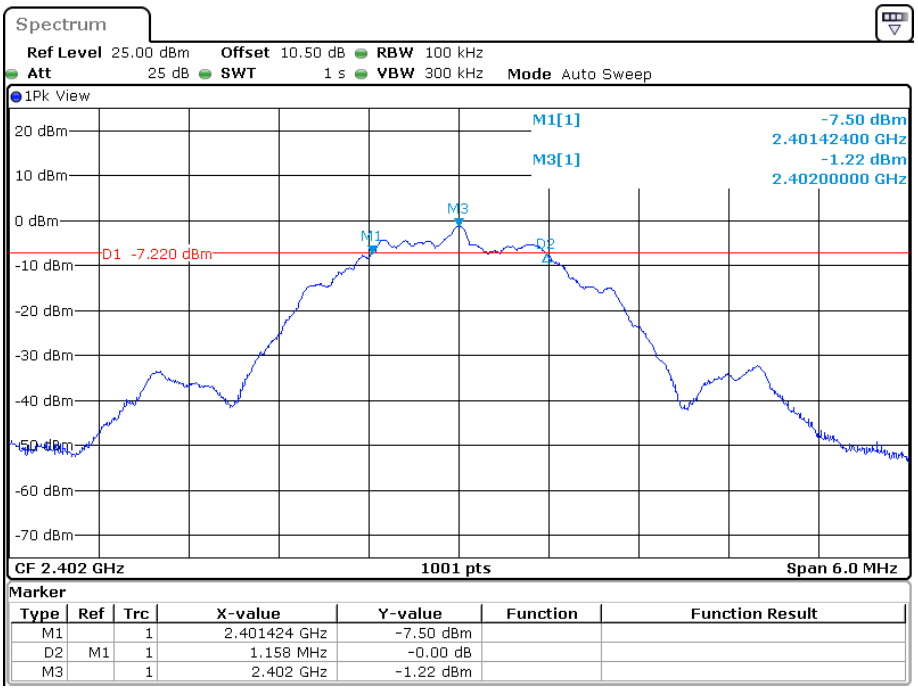
99% Emission Bandwidth, High Channel



Date: 8.JUL.2022 23:32:06

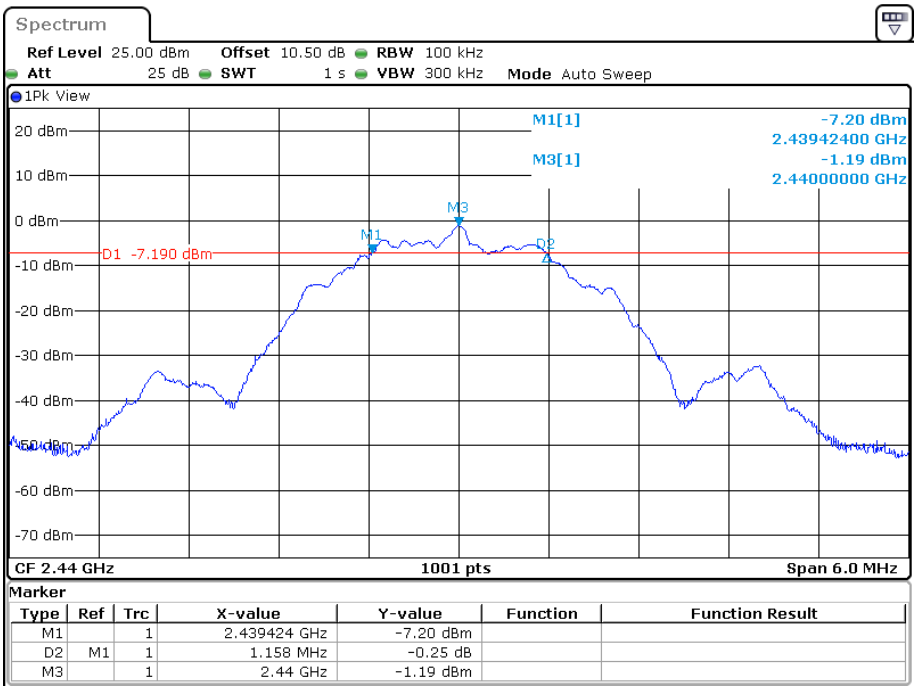
BLE 2M:

6dB Bandwidth, Low Channel



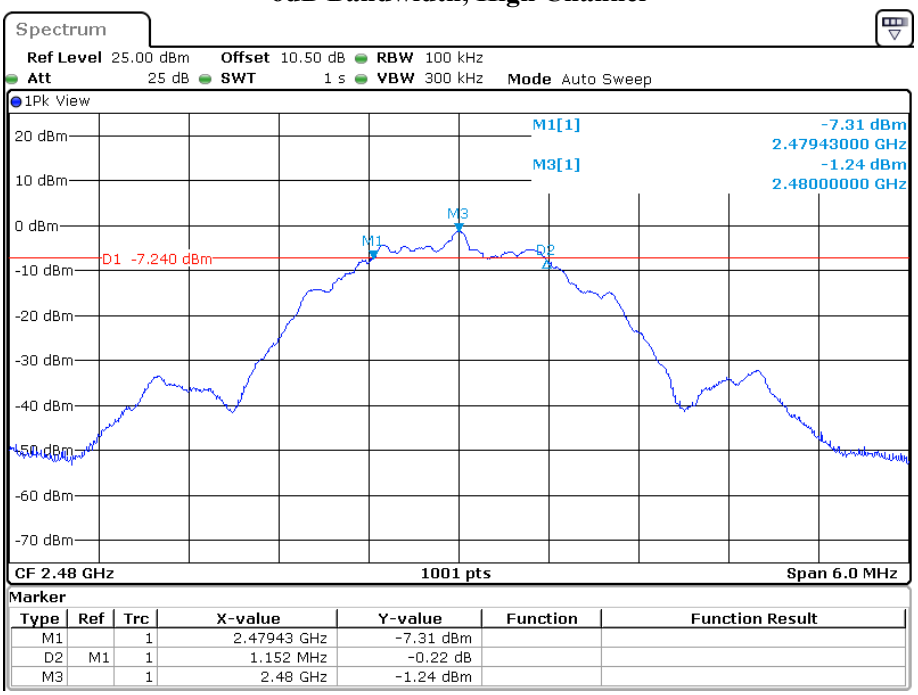
Date: 9.JUL.2022 00:02:51

6dB Bandwidth, Middle Channel



Date: 8.JUL.2022 23:57:27

6dB Bandwidth, High Channel

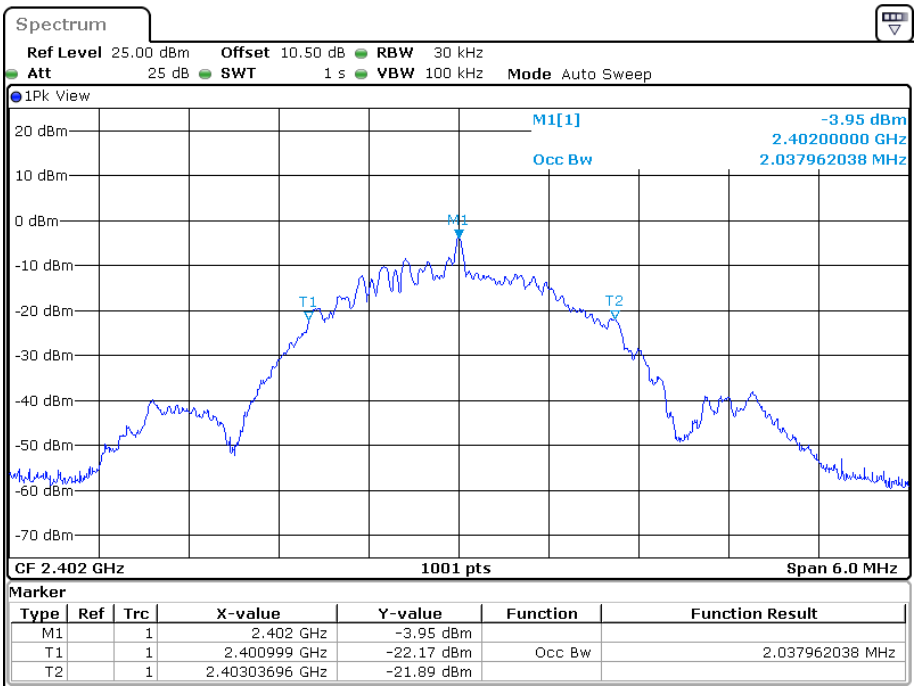


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47943 GHz	-7.31 dBm		
D2	M1	1	1.152 MHz	-0.22 dB		
M3		1	2.48 GHz	-1.24 dBm		

Date: 8.JUL.2022 23:53:48

99% Emission Bandwidth, Low Channel

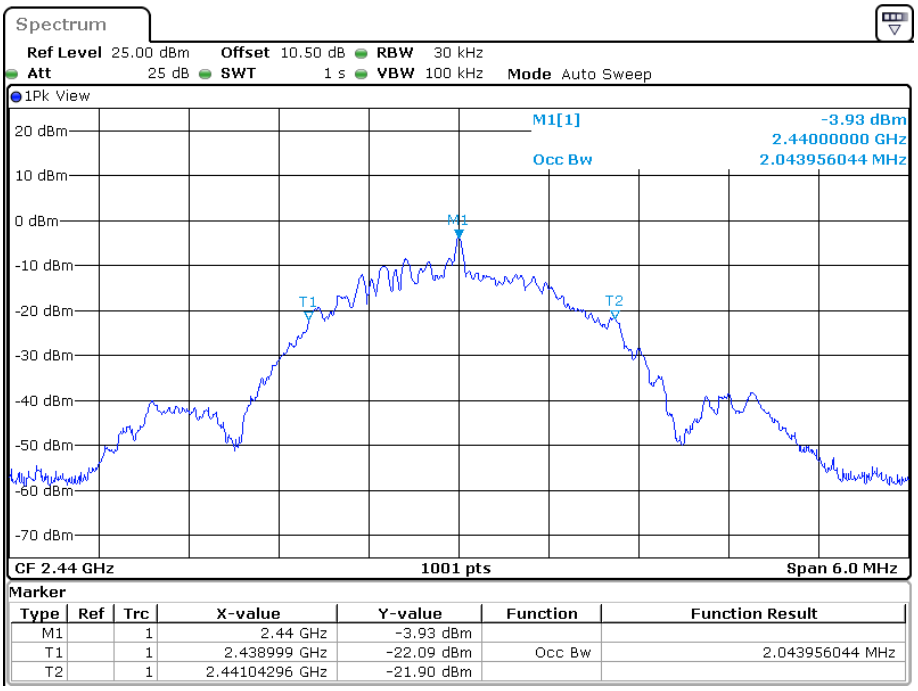


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402 GHz	-3.95 dBm		
T1		1	2.400999 GHz	-22.17 dBm	Occ Bw	2.037962038 MHz
T2		1	2.40303696 GHz	-21.89 dBm		

Date: 9.JUL.2022 00:02:21

99% Emission Bandwidth, Middle Channel

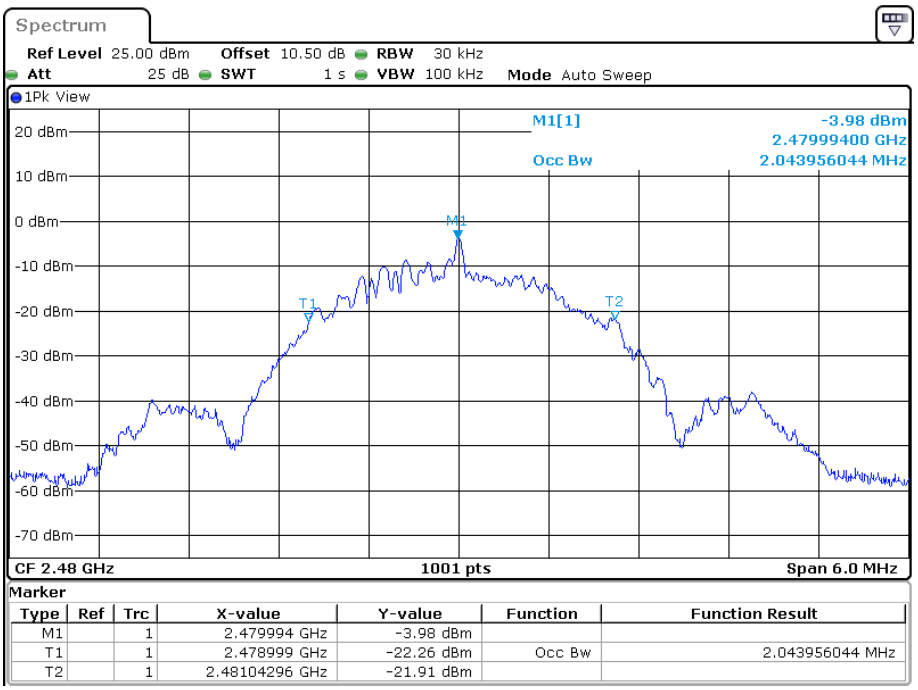


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44 GHz	-3.93 dBm		
T1		1	2.438999 GHz	-22.09 dBm	Occ Bw	2.043956044 MHz
T2		1	2.44104296 GHz	-21.90 dBm		

Date: 8.JUL.2022 23:56:57

99% Emission Bandwidth, High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479994 GHz	-3.98 dBm		
T1		1	2.478999 GHz	-22.26 dBm	Occ Bw	2.043956044 MHz
T2		1	2.48104296 GHz	-21.91 dBm		

Date: 8.JUL.2022 23:53:18

FCC §15.247(b) (3), RSS-247 §5.4 (d) - PEAK OUTPUT POWER MEASUREMENT

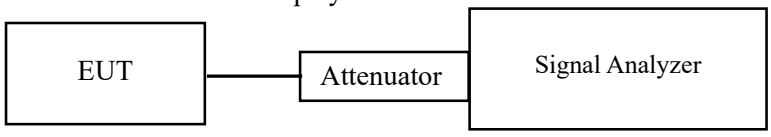
Applicable Standard

According to FCC §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. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to RSS-247§5.4 d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(e), the e.i.r.p. shall not exceed 4 W.
As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-07-08 and 2022-07-09.

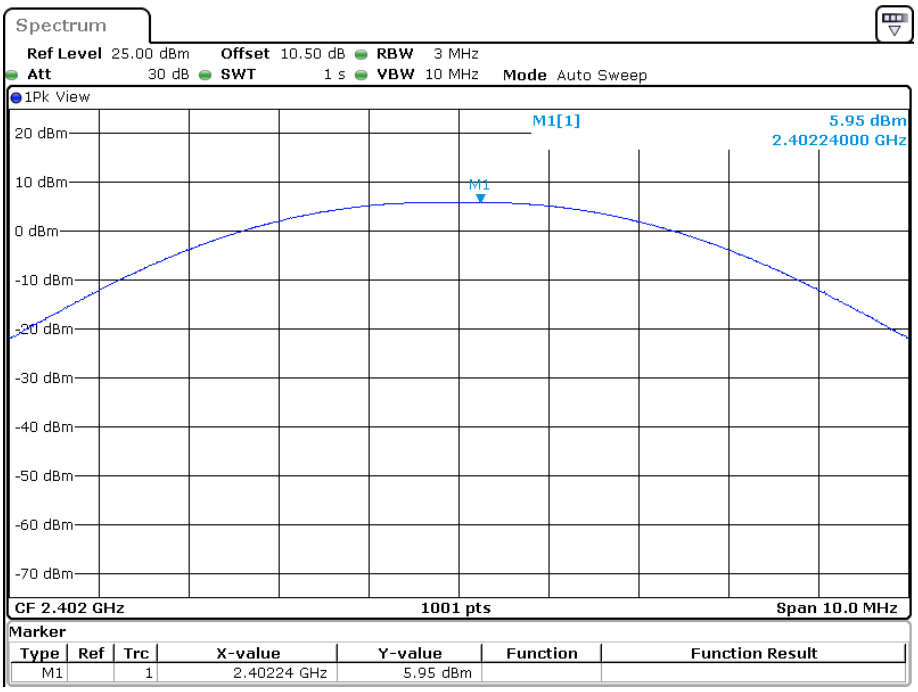
Test Result: Compliant

EUT operation mode: Transmitting

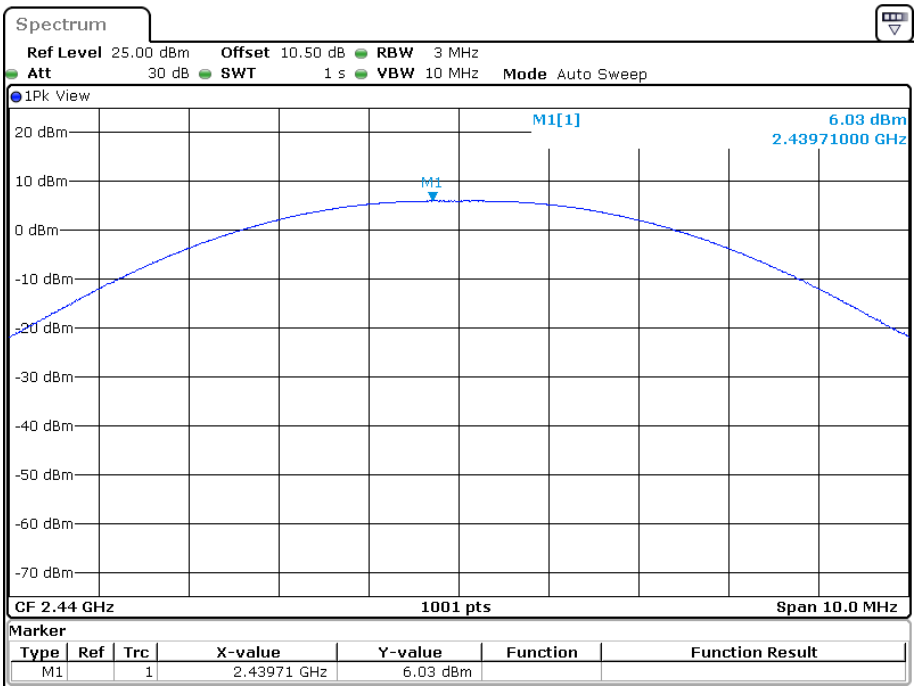
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1M			
Low	2402	5.95	30
Middle	2440	6.03	30
High	2480	6.13	30
BLE 2M			
Low	2402	-0.83	30
Middle	2440	-0.79	30
High	2480	-0.84	30
Note: the antenna gain is 1.1dBi, the maximum EIRP=7.23dBm<36dBm			

BLE 1M:

Low Channel

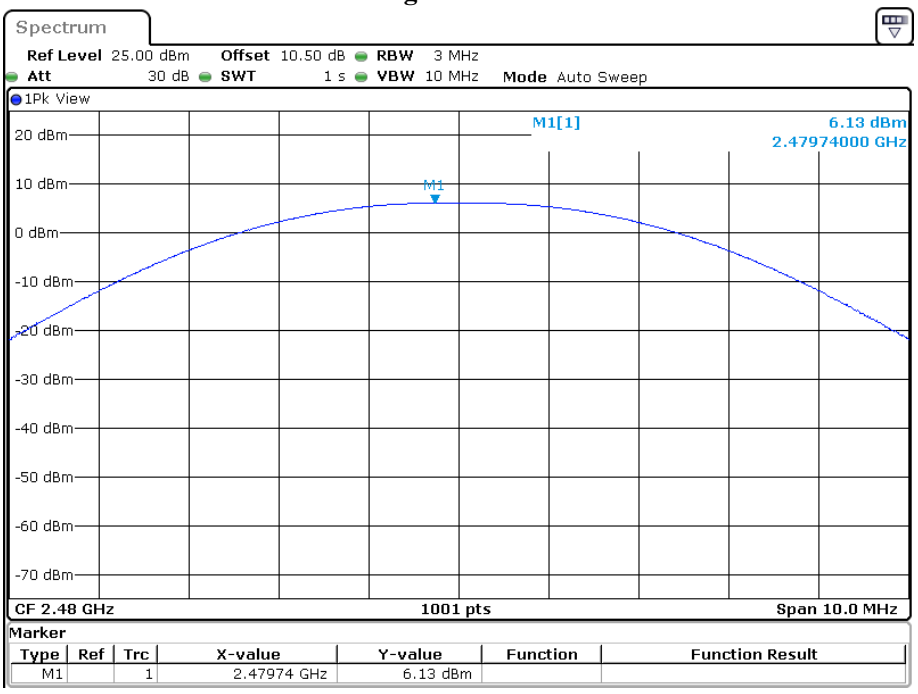


Middle Channel



Date: 8.JUL.2022 23:17:35

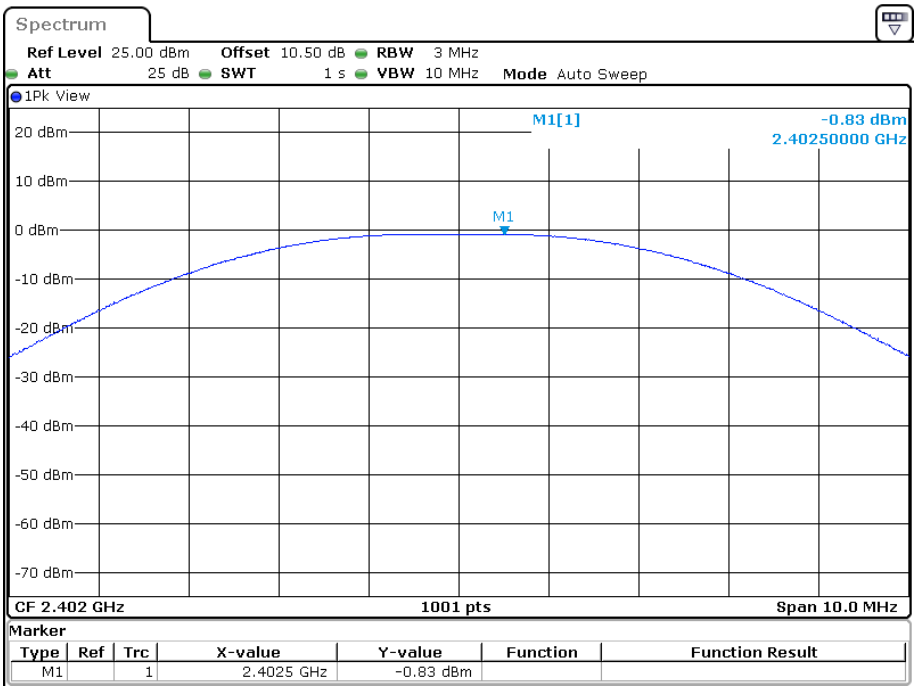
High Channel



Date: 8.JUL.2022 23:31:37

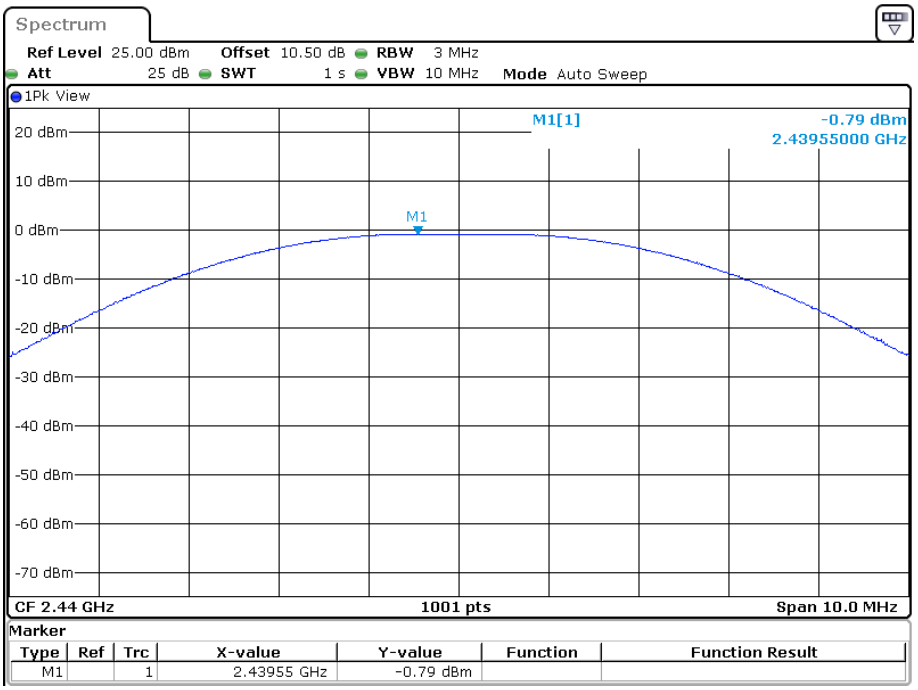
BLE 2M:

Low Channel



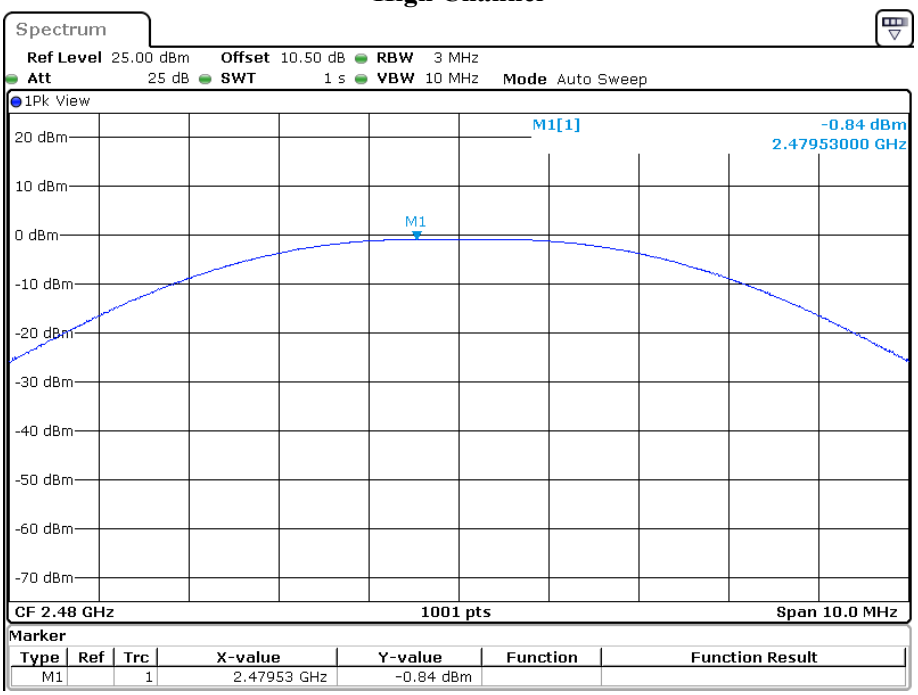
Date: 9.JUL.2022 00:01:52

Middle Channel



Date: 8.JUL.2022 23:56:28

High Channel



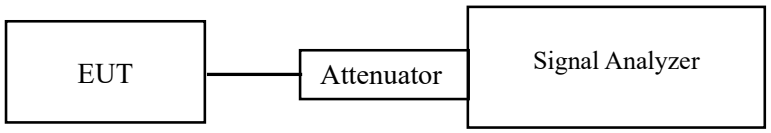
§ 15.247(d) & RSS-247 § 5.5 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

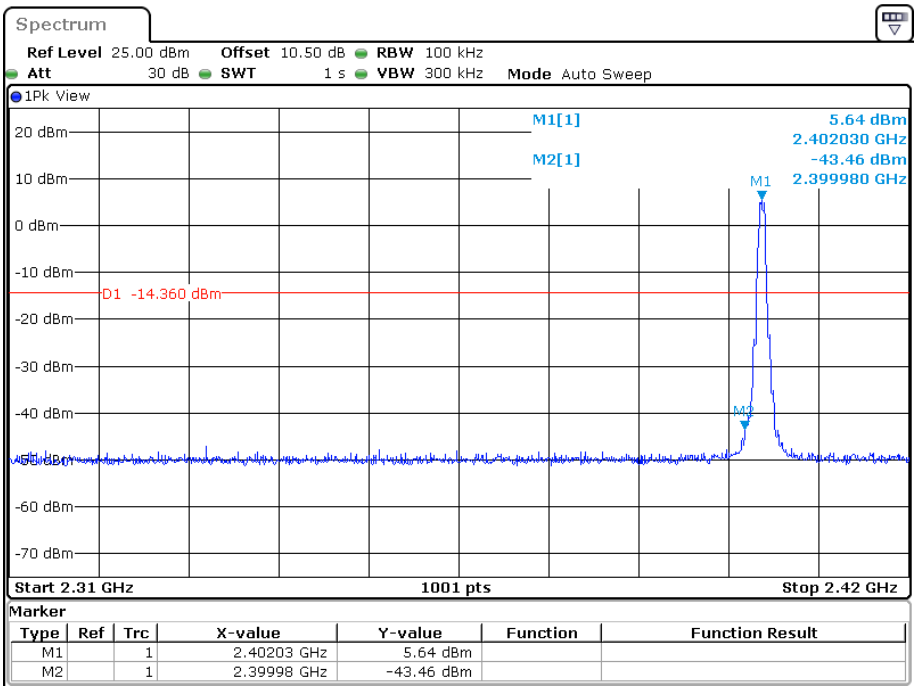
The testing was performed by Roger Ling from 2022-07-08 to 2022-07-09.

EUT operation mode: Transmitting

Test Result Compliant.

BLE 1M:

Band Edge, Left Side

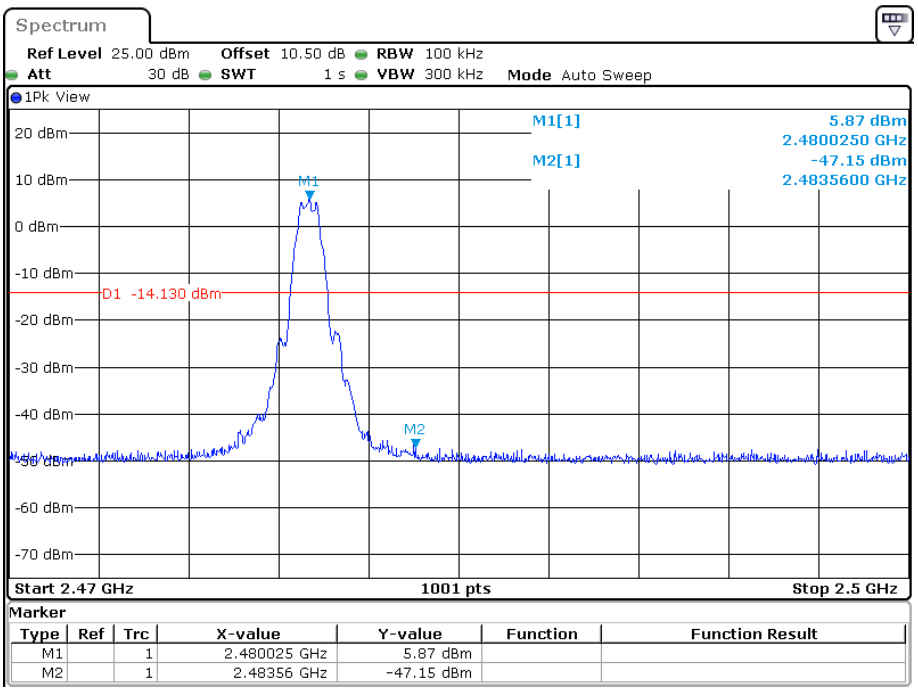


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40203 GHz	5.64 dBm		
M2		1	2.39998 GHz	-43.46 dBm		

Date: 8.JUL.2022 23:16:01

Band Edge, Right Side



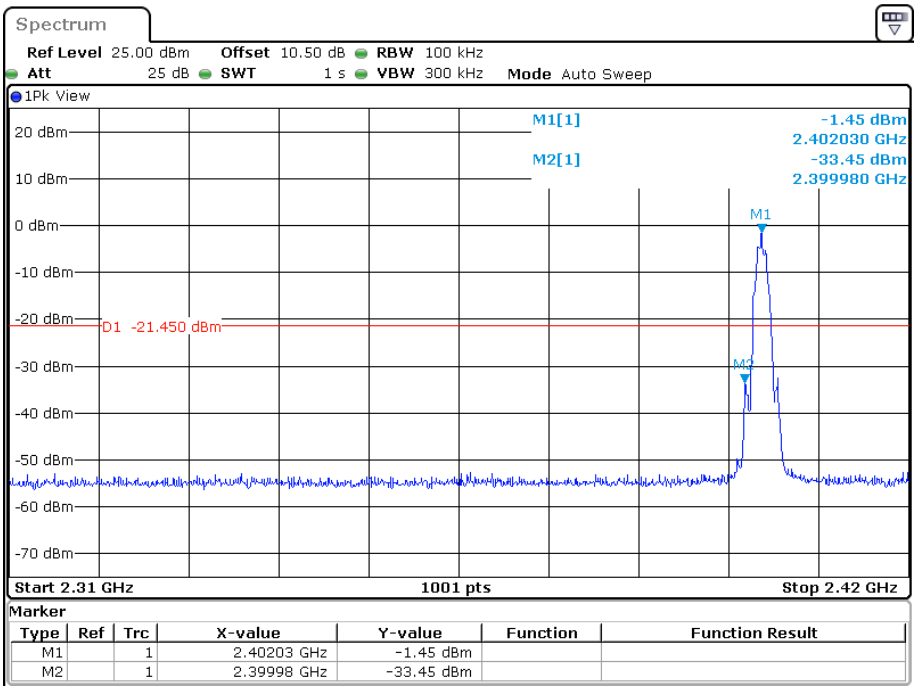
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480025 GHz	5.87 dBm		
M2		1	2.48356 GHz	-47.15 dBm		

Date: 8.JUL.2022 23:33:36

BLE 2M:

Band Edge, Left Side

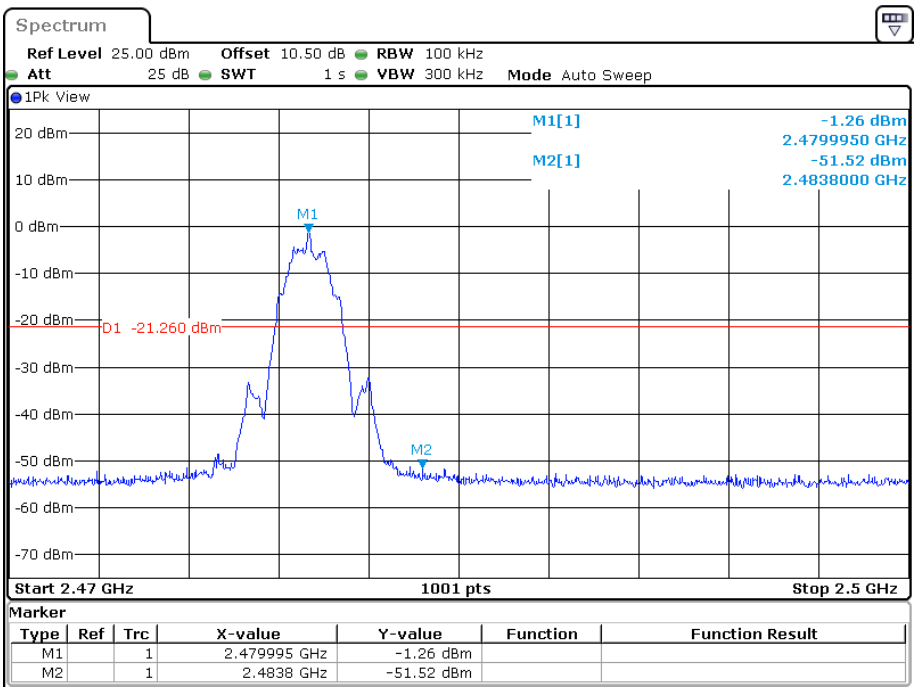


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40203 GHz	-1.45 dBm		
M2		1	2.39998 GHz	-33.45 dBm		

Date: 9.JUL.2022 00:03:50

Band Edge, Right Side



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479995 GHz	-1.26 dBm		
M2		1	2.4838 GHz	-51.52 dBm		

Date: 8.JUL.2022 23:54:47

FCC §15.247(e), RSS-247 §5.2 (b) – POWER SPECTRAL DENSITY

Applicable Standard

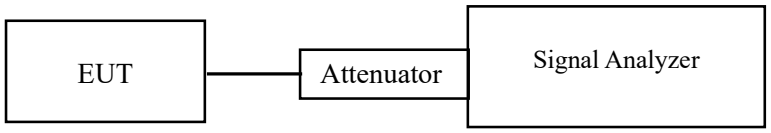
According to FCC §15.247(e):
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

According to RSS-247 §5.2 b):

b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling from 2022-07-08 to 2022-07-09.

Test Mode: Transmitting

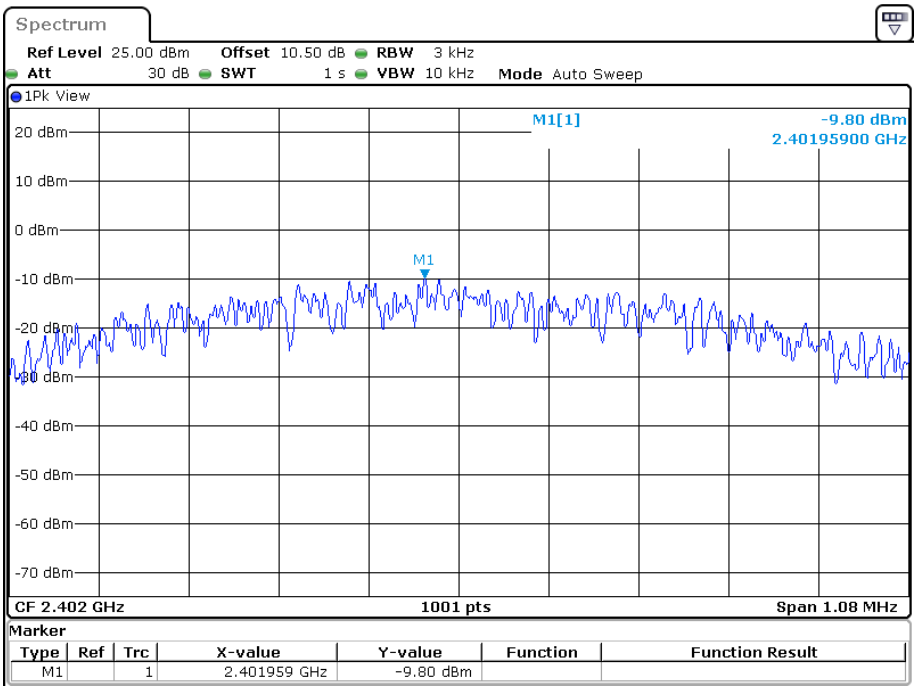
Test Result: Pass

Please refer to the following table and plots:

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1M			
Low	2402	-9.80	≤8
Middle	2440	-9.89	≤8
High	2480	-9.75	≤8
BLE 2M			
Low	2402	-18.95	≤8
Middle	2440	-19.02	≤8
High	2480	-19.03	≤8

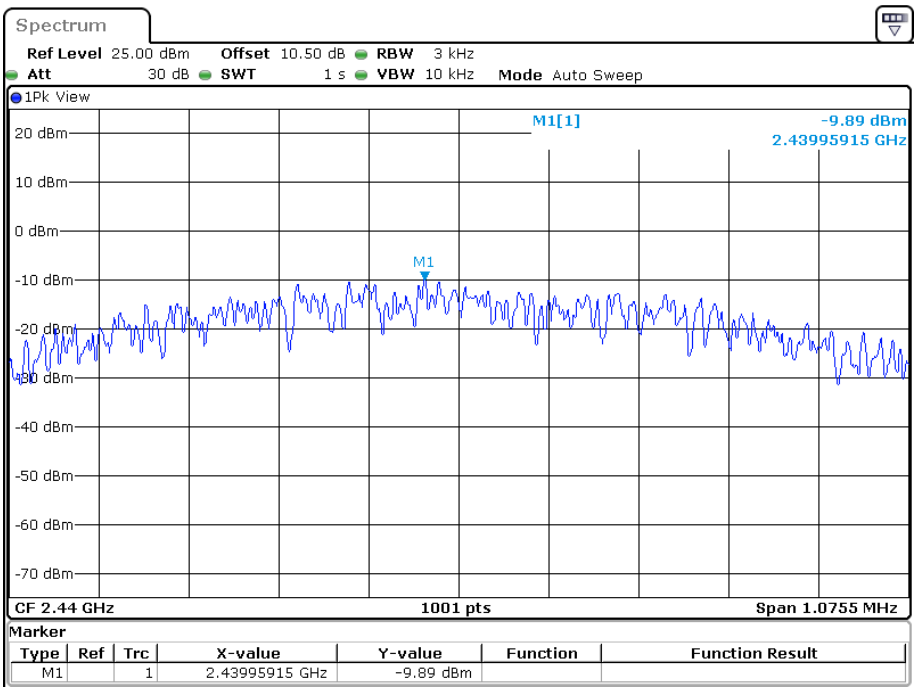
BLE 1M:

Power Spectral Density, Low Channel



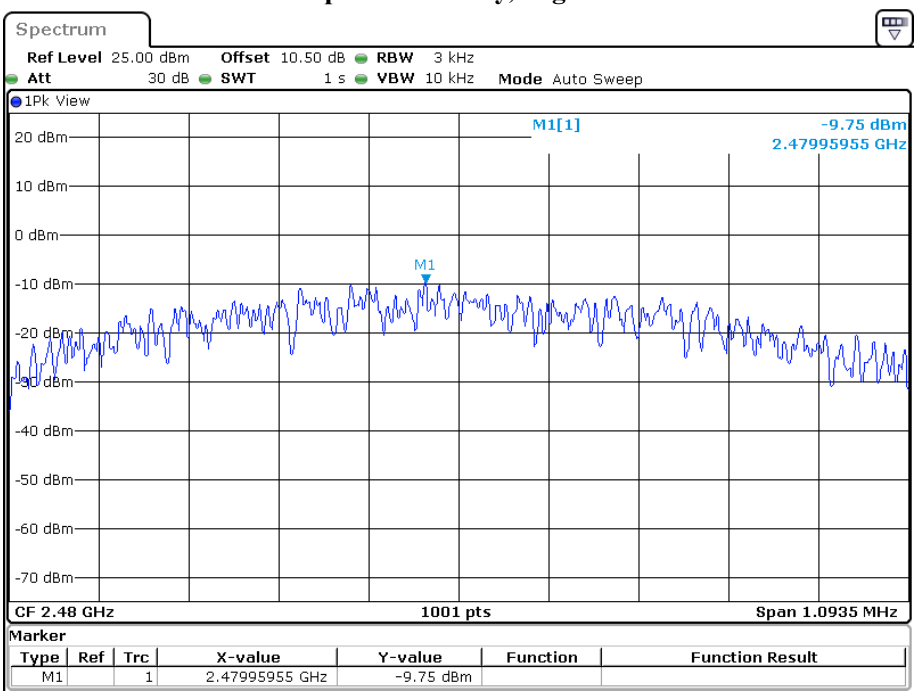
Date: 8.JUL.2022 23:15:31

Power Spectral Density, Middle Channel



Date: 8.JUL.2022 23:19:03

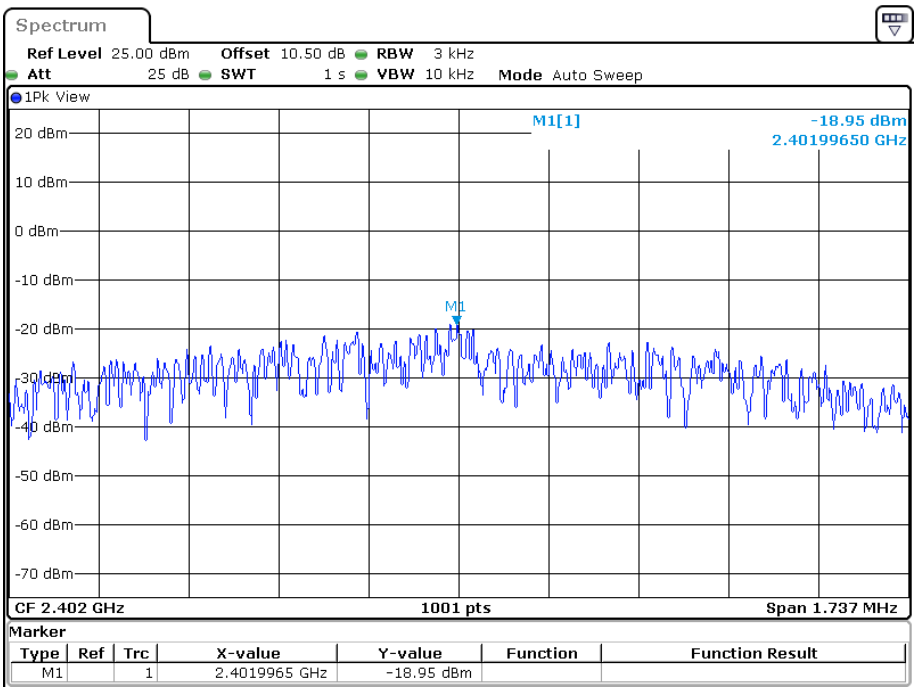
Power Spectral Density, High Channel



Date: 8.JUL.2022 23:33:06

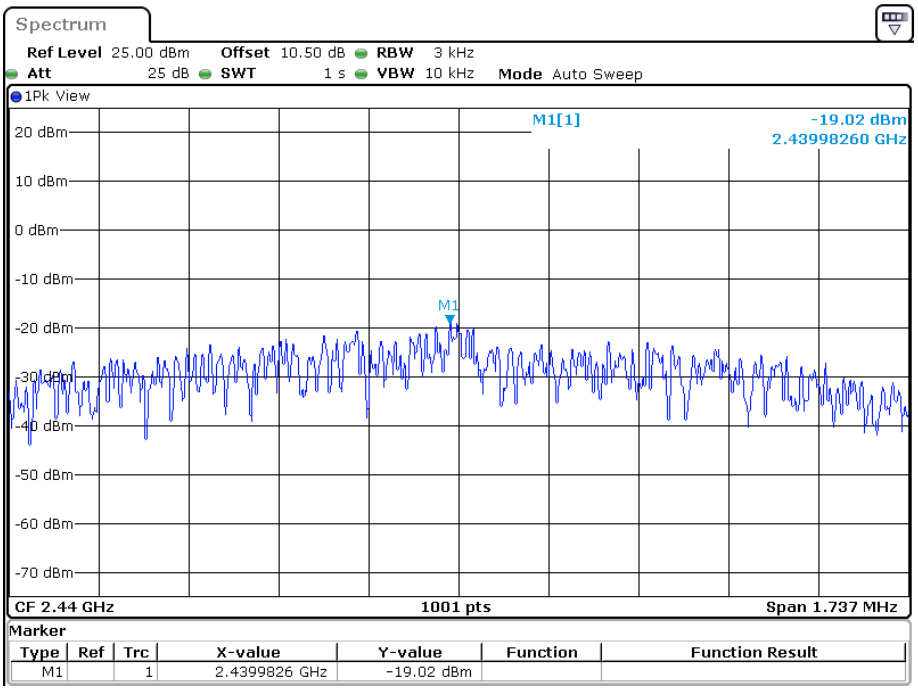
BLE 2M:

Power Spectral Density, Low Channel



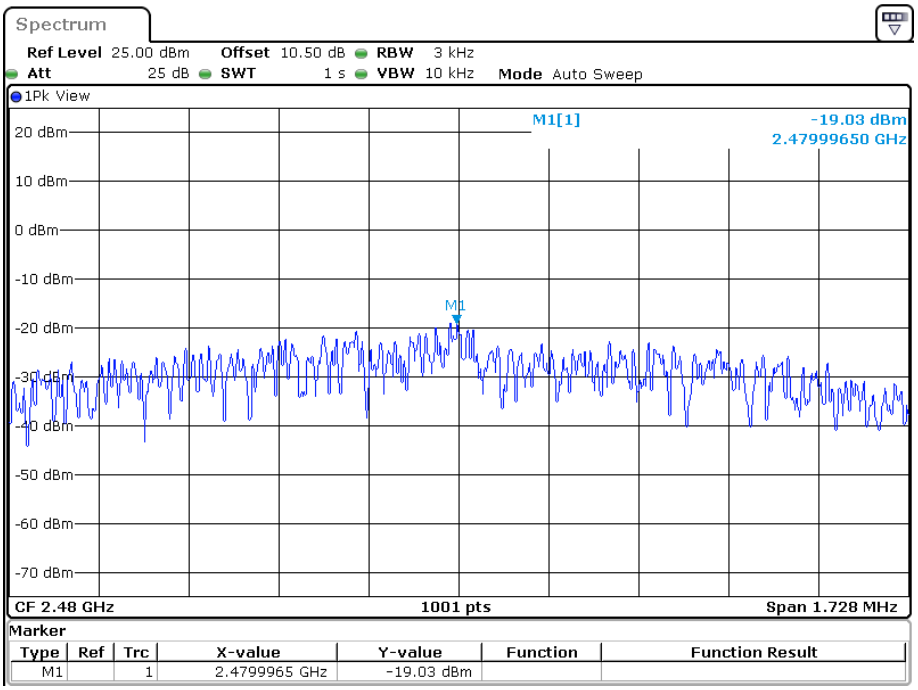
Date: 9.JUL.2022 00:03:21

Power Spectral Density, Middle Channel



Date: 8.JUL.2022 23:57:57

Power Spectral Density, High Channel



Date: 8.JUL.2022 23:54:17

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