TEST REPORT

Applicant Name:	SHENZHEN STARWAVE INDUSTRIAL TECHNOLOGY CO.,LTD
Address:	1505 Floor 15,Huaide International Building,No.73, Fuyong Section,Guangshen Road,Huaide Community,Fuyong Street, Bao'an District, Shenzhen, China
Report Number:	SZ3231226-78343E-RF-00B
FCC ID:	2BDOP-UPT-1448

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Wireless keyboard
Model No.:	UPT-1448
Multiple Model(s) No.:	UPT-1446
Trade Mark:	N/A
Date Received:	2024/01/17
Report Date:	2024/01/26

Test Result:	Pass▲

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

Prepared and Checked By:

Michelle Zeng

Michelle Zeng
RF Engineer

Approved By:

Nancy Wang

Nancy Wang
RF Supervisor

Note: The information marked# is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "▼".

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZ3231226-78343E-RF-00B	Original Report	2024/01/26

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Wireless keyboard
Tested Model	UPT-1448
Multiple Model(s)	UPT-1446 (Please refer to the DoS# provided by the applicant)
Frequency Range	BLE: 2402-2480MHz
Maximum Conducted Peak Output Power	BLE: -6.59dBm
Modulation Technique	BLE: GFSK
Antenna Specification#	2.34dBi (provided by the applicant)
Voltage Range	1*1.5V AA Alkaline Battery
Sample serial number	2FSJ-1 for RF Conducted Test 2FSJ-2 for Radiated Emissions (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A

Objective

This report is in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.247 rules.

Test Methodology

All tests and measurements indicated in this document were performed in accordance ANSI C63.10-2013.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Frequency		213.55 Hz(k=2, 95% level of confidence)
RF output power, conducted		0.72 dB(k=2, 95% level of confidence)
Unwanted Emission, conducted		1.75 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz-150kHz	3.94dB(k=2, 95% level of confidence)
	150kHz-30MHz	3.84dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 30MHz	3.30dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	4.48dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	4.55dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	4.85dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.05dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.35dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.44dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.16dB(k=2, 95% level of confidence)
Temperature		±1℃
Humidity		±1%
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 Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

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.

Equipment Modifications

No modification was made to the EUT tested.

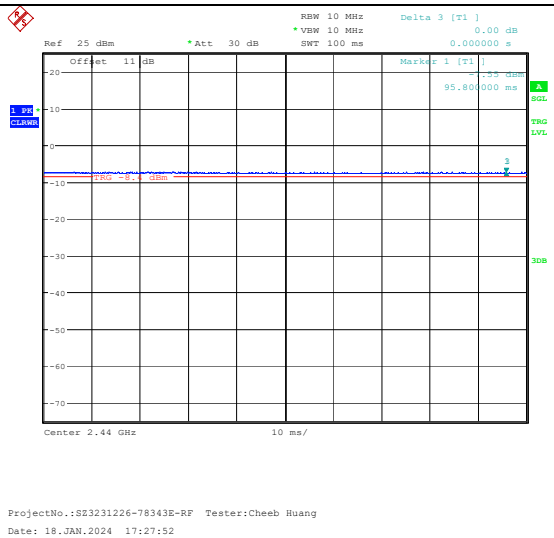
EUT Exercise Software

"FCC_test_tool V2.3.2.exe"[#] exercise software was used and the power level is -5[#]. The software and power level was provided by the applicant.

Duty cycle

Test Modes	Ton (ms)	Ton+off (ms)	Duty Cycle (%)	1/T (Hz)	VBW Setting (Hz)
BLE	100	100	100	/	10

Duty cycle



Support Equipment List and Details

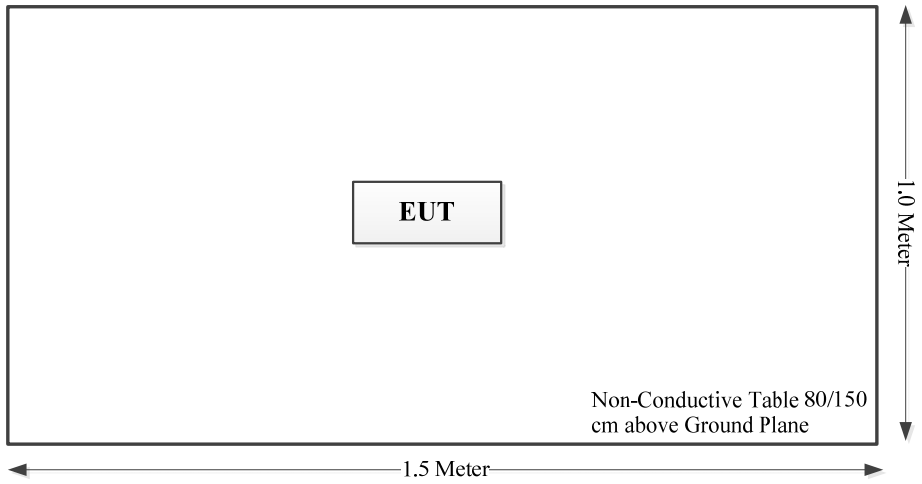
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

Spurious emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	99% Occupied Bandwidth & 6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant

Not Applicable, the device was powered by battery when operating.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2024/07/19
ETS	Passive Loop Antenna	6512	29604	2023/07/07	2024/07/06
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2023/04/18	2024/04/17
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Anetenna	BBHA9120D(120 1)	1143	2023/07/26	2024/07/25
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
Unknown	RF Cable	XH750A-N	J-10M	2023/10/08	2024/10/07
SNSD	2.4G Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
A.H.System	Pre-amplifier	PAM-1840VH	190	2023/08/03	2024/08/02
Electro-Mechanics Co	Horn Antenna	3116	9510-2270	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2023/08/03	2024/08/02
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200982	2023/12/18	2024/12/17
MARCONI	10dB Attenuator	6534/3	2942	2023/07/04	2024/07/03

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) 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) (1) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Measurement Result

For worst case:

Mode	Frequency (MHz)	Max tune-up conducted power# (dBm)	Max tune-up conducted power# (mW)	Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
BLE	2402-2480	-6.0	0.25	5	0.1	3.0	Yes

Result: Compliant

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

According to FCC § 15.203, 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.

Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached and the maximum antenna gain[#] is 2.34dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna type	Antenna Gain[#]	Impedance	Frequency Range
PCB	2.34dBi	50Ω	2.4~2.5GHz

Result: Compliant

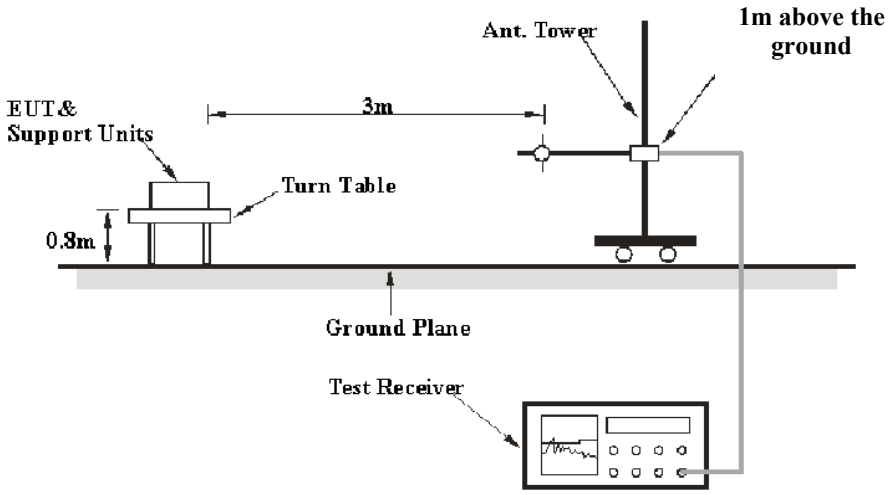
FCC §15.209, §15.205 & §15.247(D) – UNWANTED EMISSION FREQUENCIES AND RESTRICTED BANDS

Applicable Standard

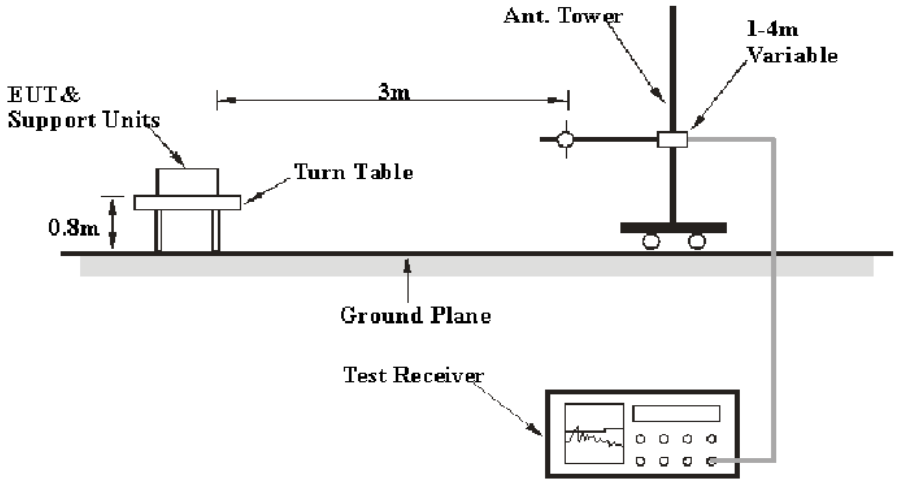
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

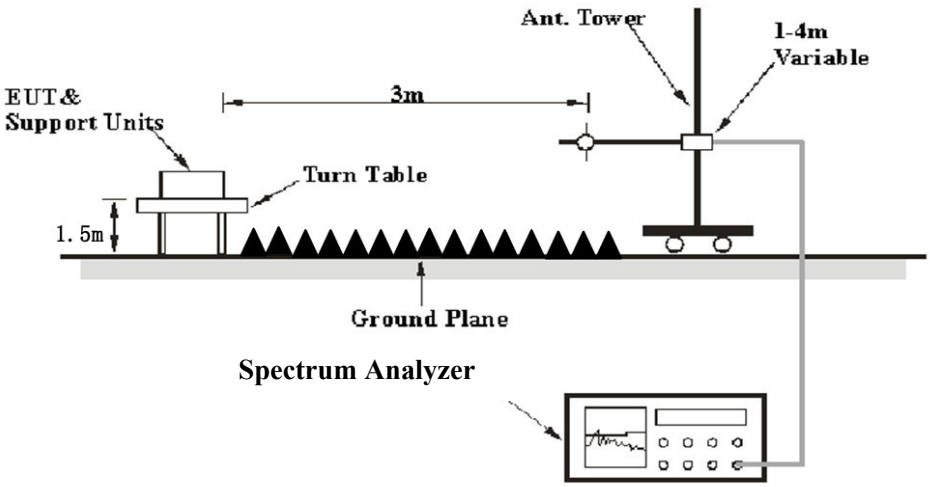
9 kHz-30MHz:



30MHz-1GHz:



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 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 9 kHz 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
9 kHz – 150 kHz	200 Hz	1 kHz	/	QP
150 kHz – 30 MHz	9 kHz	30 kHz	/	QP
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 & Over Limit/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.

Test Data

Environmental Conditions

Temperature:	22~25.1℃
Relative Humidity:	50~55 %
ATM Pressure:	101 kPa

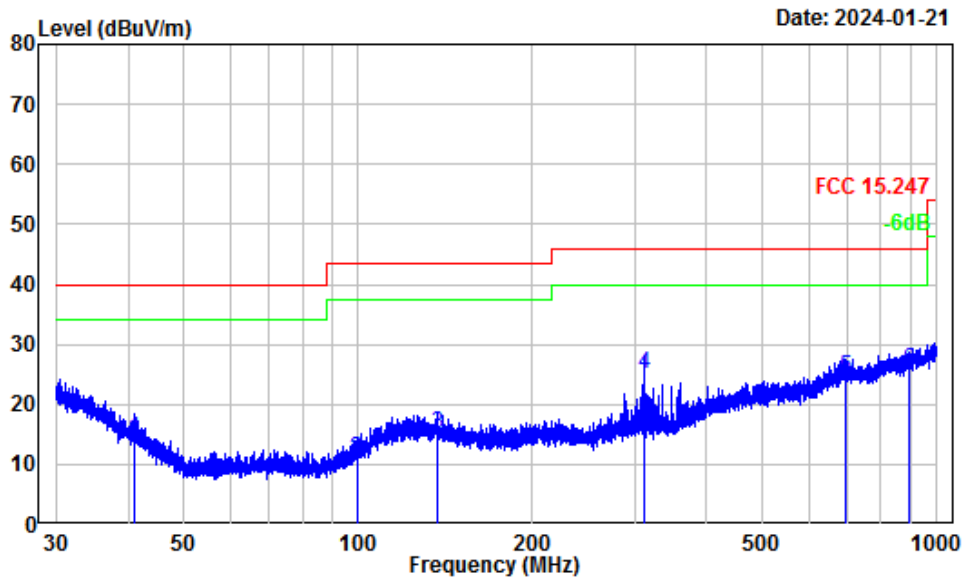
The testing was performed by Warren Huang on 2024-01-21for below 1GHz and Tyler Wu from 2024-01-17 to 2024-01-25 for above 1GHz.

EUT operation mode: Transmitting

Note: For 9 kHz-30MHz, The amplitude of spurious emissions attenuated more than 20 dB below the limit was not be recorded.

30MHz-1GHz: *(Maximum output power mode BLE 1M, Low Channel)*

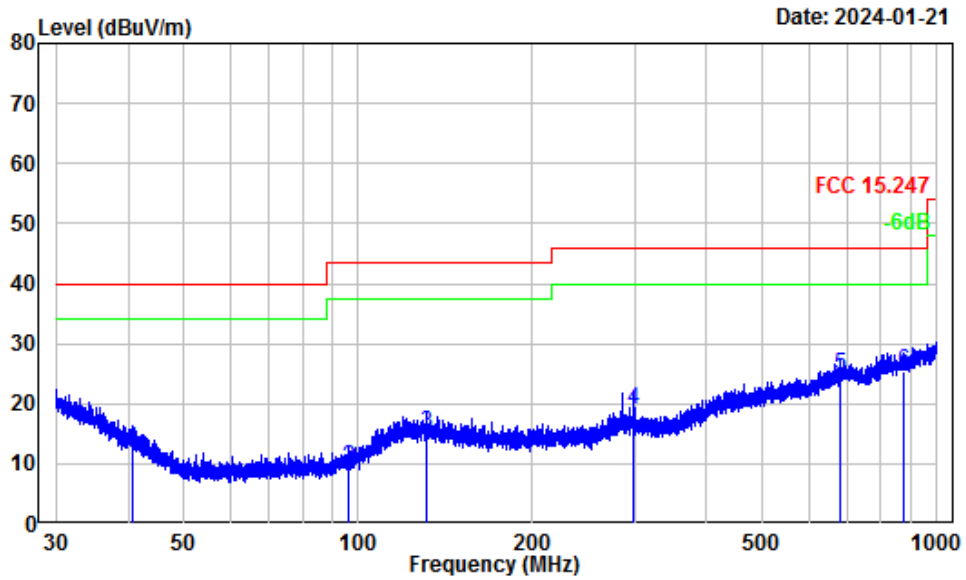
Horizontal



Site : chamber
Condition : 3m Horizontal
Project Number: SZ3231226-78343E-RF
Note : BLE
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	41.06	-11.07	25.32	14.25	40.00	-25.75	QP
2	99.35	-13.91	24.85	10.94	43.50	-32.56	QP
3	137.12	-10.60	25.83	15.23	43.50	-28.27	QP
4	312.04	-9.93	34.89	24.96	46.00	-21.04	QP
5	693.81	-1.63	26.22	24.59	46.00	-21.41	QP
6	896.60	0.96	24.70	25.66	46.00	-20.34	QP

Vertical



Site : chamber
Condition : 3m Vertical
Project Number: SZ3231226-78343E-RF
Note : BLE
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.59	-12.22	24.57	12.35	40.00	-27.65	QP
2	96.27	-16.03	25.31	9.28	43.50	-34.22	QP
3	130.84	-10.83	26.04	15.21	43.50	-28.29	QP
4	298.01	-10.43	29.39	18.96	46.00	-27.04	QP
5	682.65	-2.24	26.86	24.62	46.00	-21.38	QP
6	877.94	0.29	25.06	25.35	46.00	-20.65	QP

1-25 GHz:

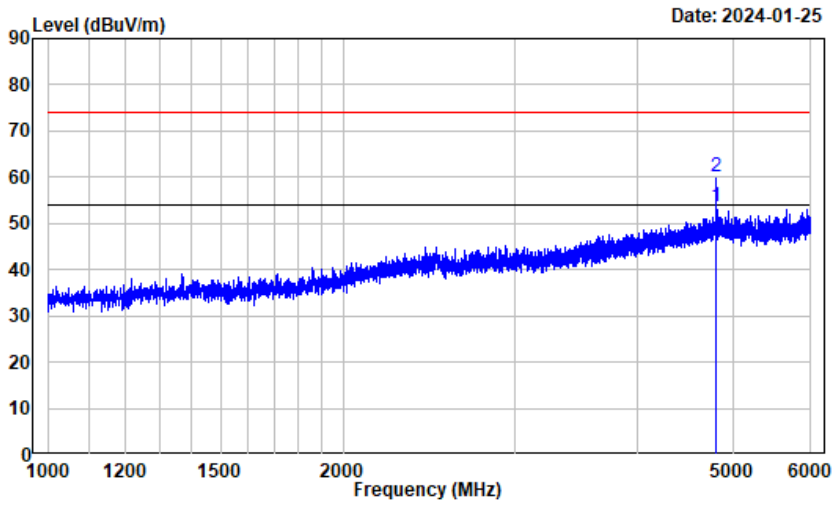
BLE 1M

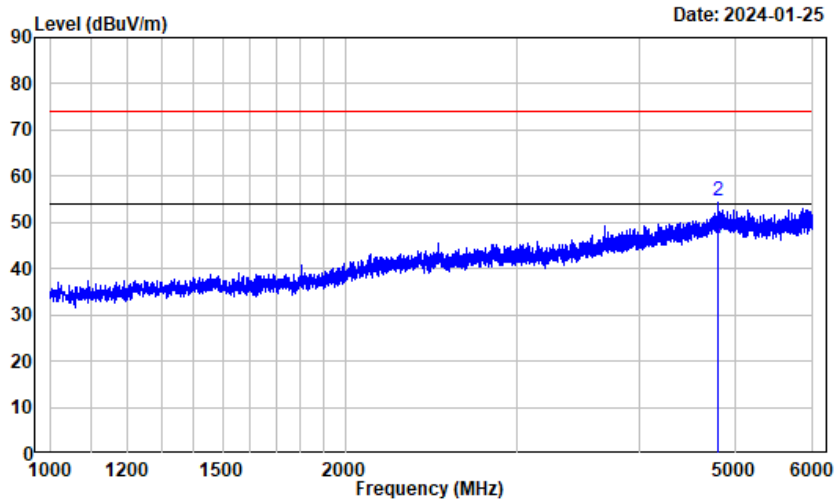
Frequency (MHz)	Receiver		Rx Antenna	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave	Polar (H/V)				
Low Channel 2402MHz							
4804.00	57.53	PK	H	2.42	59.95	74	-14.05
4804.00	51.28	AV	H	2.42	53.70	54	-0.30
4804.00	52.32	PK	V	2.42	54.74	74	-19.26
4804.00	44.15	AV	V	2.42	46.57	54	-7.43
Middle Channel 2440MHz							
4880.00	56.93	PK	H	2.68	59.61	74	-14.39
4880.00	50.64	AV	H	2.68	53.32	54	-0.68
4880.00	50.89	PK	V	2.68	53.57	74	-20.43
4880.00	41.95	AV	V	2.68	44.63	54	-9.37
High Channel 2480MHz							
4960.00	56.39	PK	H	2.68	59.07	74	-14.93
4960.00	50.18	AV	H	2.68	52.86	54	-1.14
4960.00	50.33	PK	V	2.68	53.01	74	-20.99
4960.00	40.91	AV	V	2.68	43.59	54	-10.41

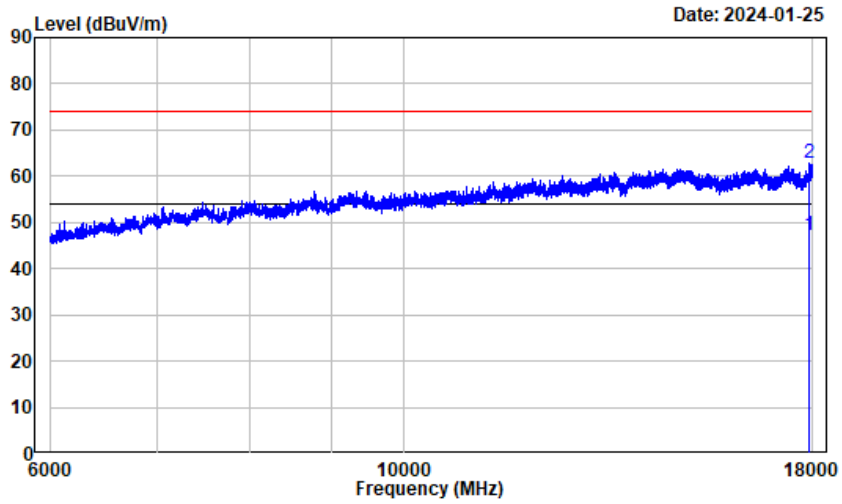
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is in the noise floor level was not recorded.

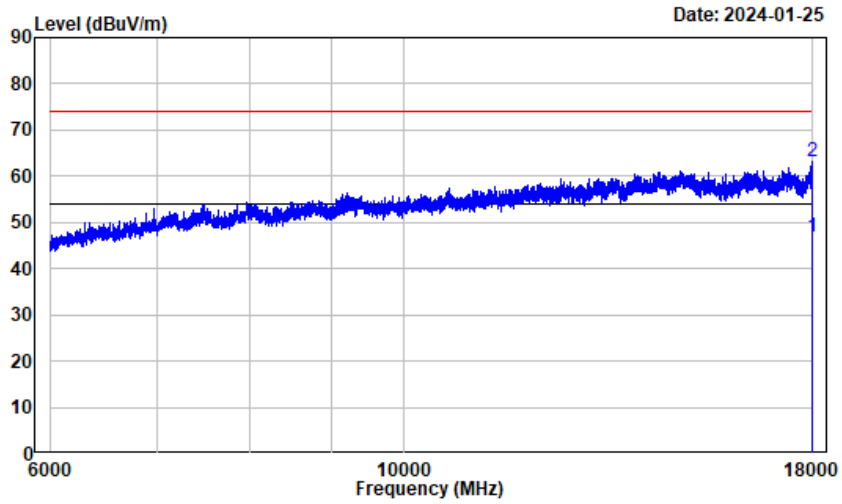
Listed with the worst harmonic margin test plot:

Pre-scan, Low Channel (worst case)

Horizontal	
1-6GHz	 Project No. : SZ3231226-78343E Tester : Tyler Polarization: Horizontal Note : BLE1M | | Freq | Factor | Read Level | Limit Level | Limit Line | Remark | Over Limit | | | MHz | dB/m | dBuV | dBuV/m | dBuV/m | | dB | | 1 | 4804.000 | 2.42 | 51.28 | 53.70 | 54.00 | Average | -0.30 | | 2 | 4804.000 | 2.42 | 57.53 | 59.95 | 74.00 | Peak | -14.05 |

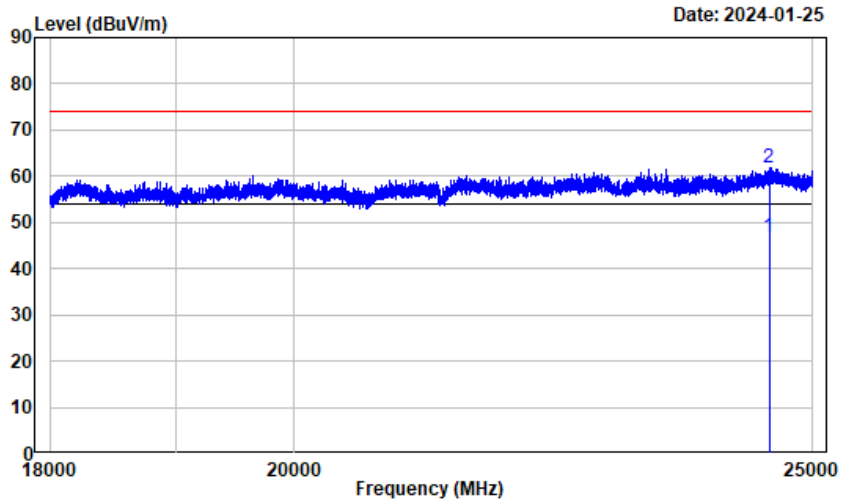
Vertical	
1-6GHz	 Project No. : SZ3231226-78343E Tester : Tyler Polarization: Vertical Note : BLE1M | | Freq | Factor | Read Level | Level | Limit Line | Remark | Over Limit | | | MHz | dB/m | dBuV | dBuV/m | dBuV/m | | dB | | 1 | 4804.000 | 2.42 | 44.15 | 46.57 | 54.00 | Average | -7.43 | | 2 | 4804.000 | 2.42 | 52.32 | 54.74 | 74.00 | Peak | -19.26 |

Horizontal	
6-18GHz	 Project No. : SZ3231226-78343E Tester : Tyler Polarization: Horizontal Note : BLE1M Freq / Factor / Read Level / Limit Level / Limit Line / Remark / Over Limit MHz / dB/m / dBuV / dBuV/m / dBuV/m / / dB 1 17905.500 23.95 23.28 47.23 74.00 Average -26.77 2 17905.500 23.95 38.76 62.71 74.00 Peak -11.29

Vertical	
6-18GHz	 Project No. : SZ3231226-78343E Tester : Tyler Polarization: Vertical Note : BLE1M Freq / Factor / Read Level / Limit Level / Limit Line / Remark / Over Limit MHz / dB/m / dBuV / dBuV/m / dBuV/m / / dB 1 17998.500 24.61 22.37 46.98 54.00 Average -7.02 2 17998.500 24.61 38.42 63.03 74.00 Peak -10.97

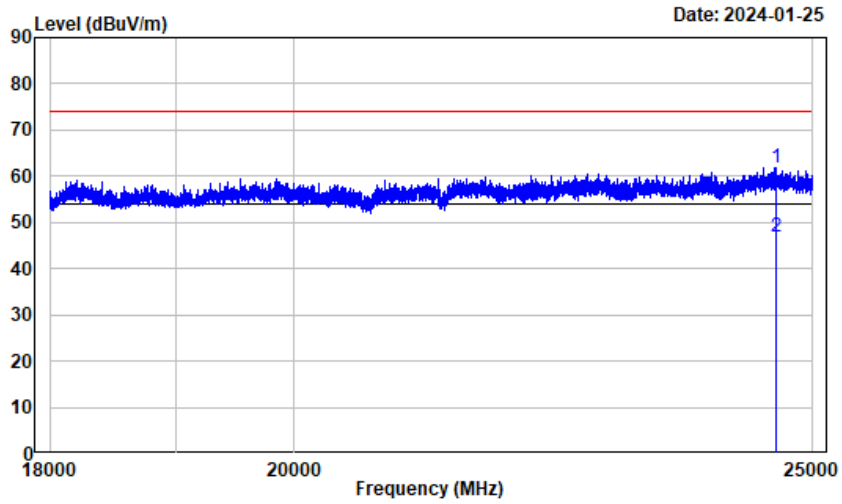
Horizontal

18-25GHz



Project No. : SZ3231226-78343E
Tester : Tyler
Polarization: Horizontal
Note : BLE1M

	Freq	Factor	Read Level	Level	Limit Line	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	24534.500	18.96	28.06	47.02	54.00	Average	-6.98
2	24534.500	18.96	42.88	61.84	74.00	Peak	-12.16

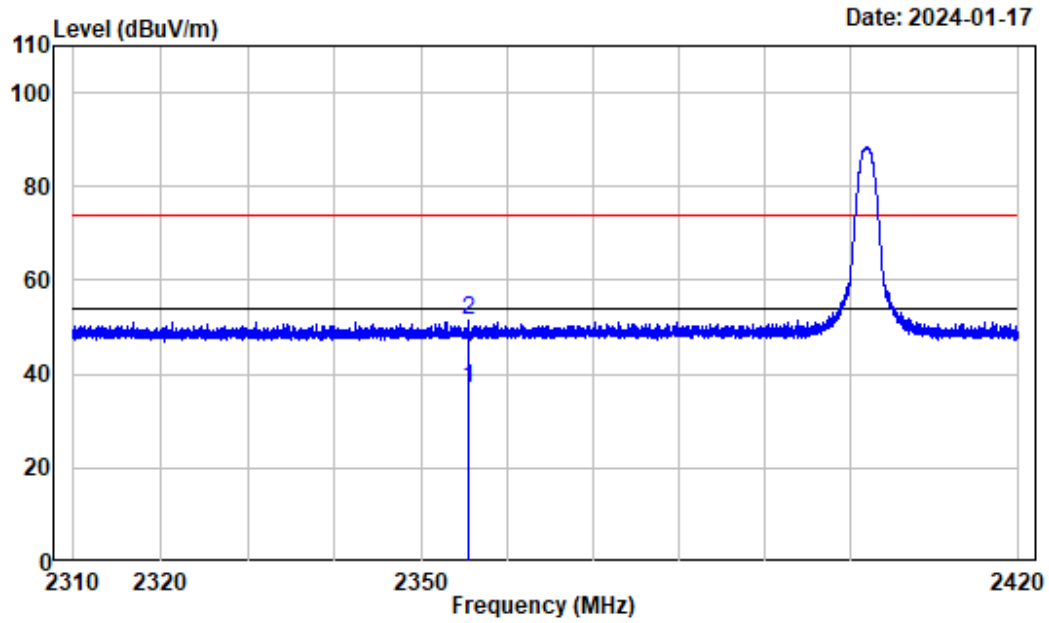
Vertical	
18-25GHz	

Project No. : SZ3231226-78343E
Tester : Tyler
Polarization: Vertical
Note : BLE1M

	Freq	Factor	Read Level	Level	Limit Line	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	24614.130	18.85	43.00	61.85	74.00	Peak	-12.15
2	24614.130	18.85	28.04	46.89	54.00	Average	-7.11

Test plots for Band Edge Measurements (Radiated):

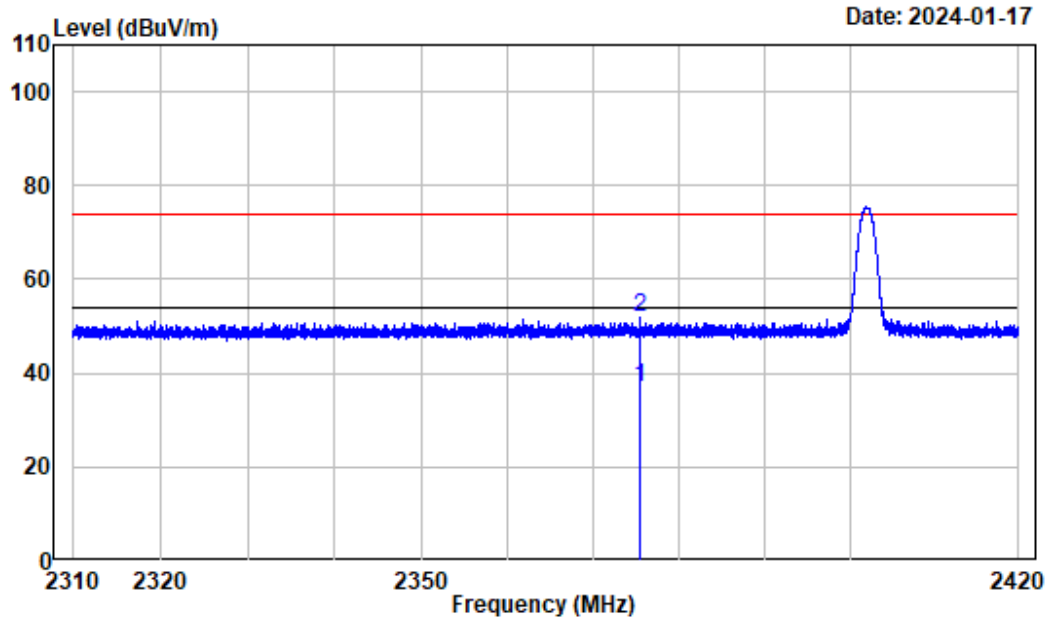
BLE 1M			
Test Channel:	**2402MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: SZ3231226-78343E
Tester : Tyler
Note : BLE1M

	Freq	Factor	Read Level	Limit Line	Level	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2355.347	-3.15	40.26	54.00	37.11	Average	-16.89
2	2355.347	-3.15	54.45	74.00	51.30	peak	-22.70

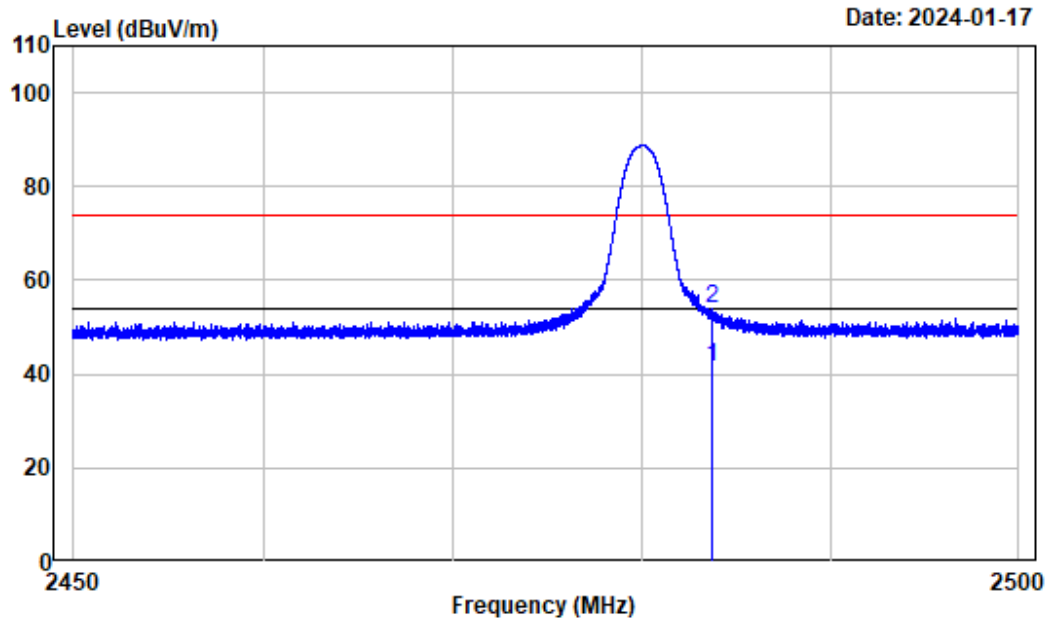
BLE 1M			
Test Channel:	**2402MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: SZ3231226-78343E
Tester : Tyler
Note : BLE1M

	Freq	Factor	Read Level	Limit Line	Level	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2375.367	-3.18	40.32	54.00	37.14	Average	-16.86
2	2375.367	-3.18	54.91	74.00	51.73	peak	-22.27

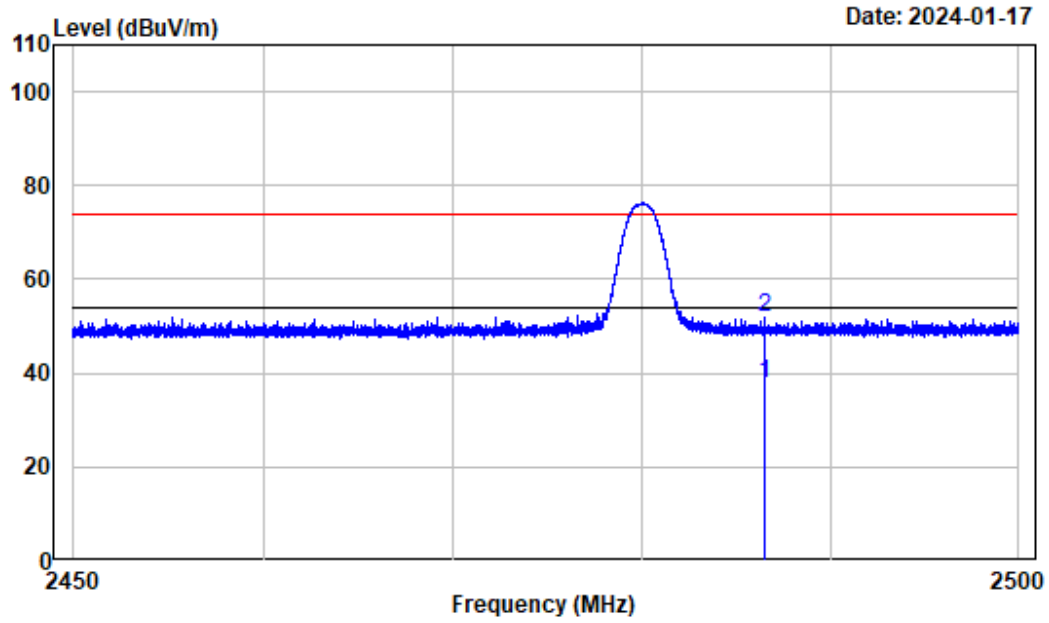
BLE 1M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: SZ3231226-78343E
Tester : Tyler
Note : BLE1M

	Freq	Factor	Read Level	Limit Line	Level	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2483.706	-3.17	44.82	54.00	41.65	Average	-12.35
2	2483.706	-3.17	57.13	74.00	53.96	peak	-20.04

BLE 1M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: SZ3231226-78343E
Tester : Tyler
Note : BLE1M

	Freq	Factor	Read Level	Limit Line	Level	Remark	Over Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2486.525	-3.17	40.82	54.00	37.65	Average	-16.35
2	2486.525	-3.17	55.10	74.00	51.93	peak	-22.07

FCC §15.247(a) (2) – 99% OCCUPIED BANDWIDTH & 6 dB EMISSON BANDWIDTH

Standard Applicable

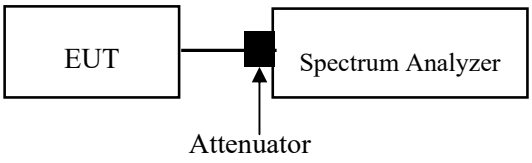
According to FCC §15.247(a) (2)
Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 6.9.3

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:	26.1 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

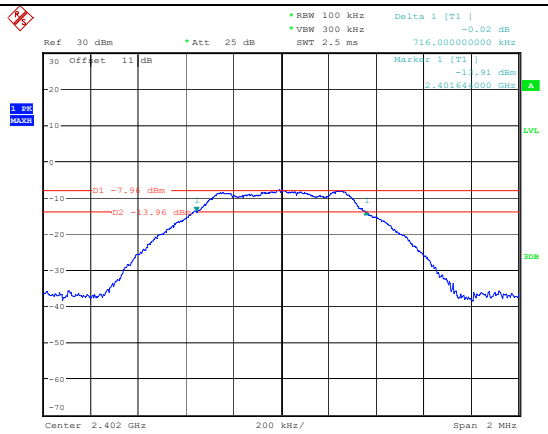
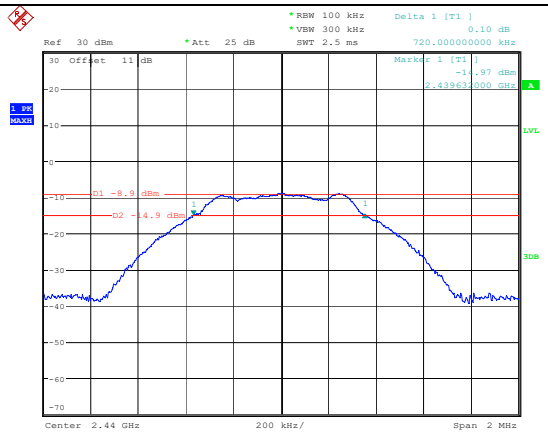
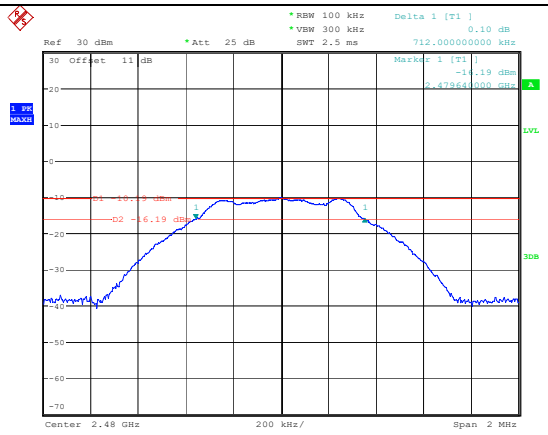
The testing was performed by Cheeb Huang on 2024-01-18.

EUT operation mode: Transmitting

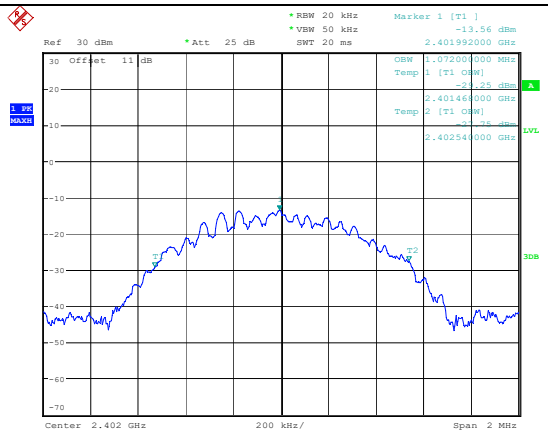
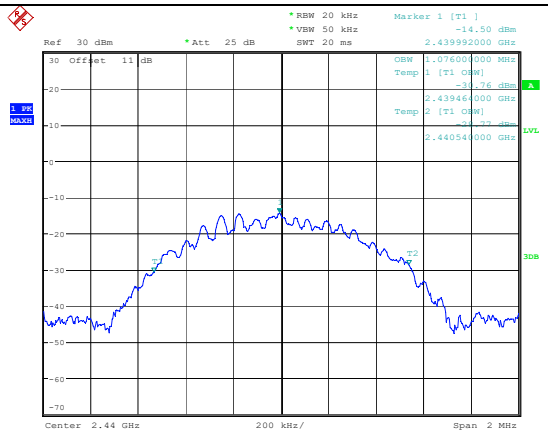
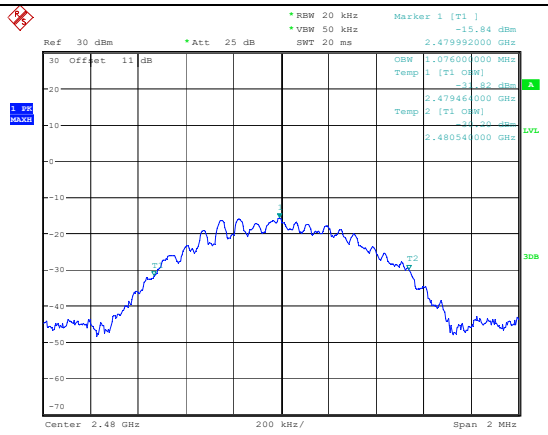
Test Result: Compliant.

Test Channel	Test Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)
Lowest	2402	0.716	1.072	≥0.5
Middle	2440	0.720	1.076	≥0.5
Highest	2480	0.712	1.076	≥0.5

6 dB Bandwidth

BLE 1M	
Low Channel	
Middle Channel	
High Channel	

99% Occupied Bandwidth

BLE 1M	
Low Channel	
Middle Channel	
High Channel	

FCC §15.247(b) (3)- PEAK OUTPUT POWER MEASUREMENT

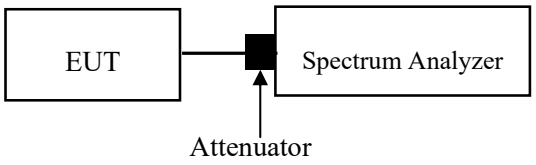
Applicable Standard

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.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.9.1.1

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

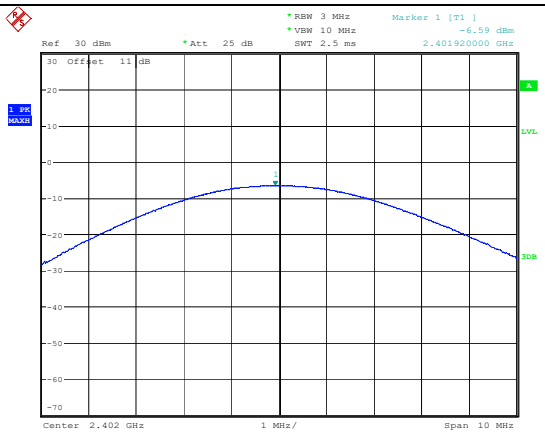
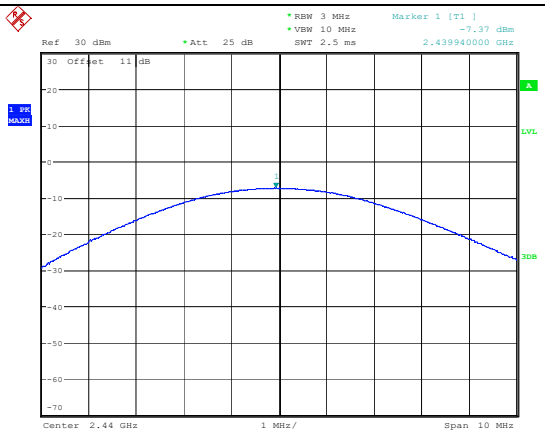
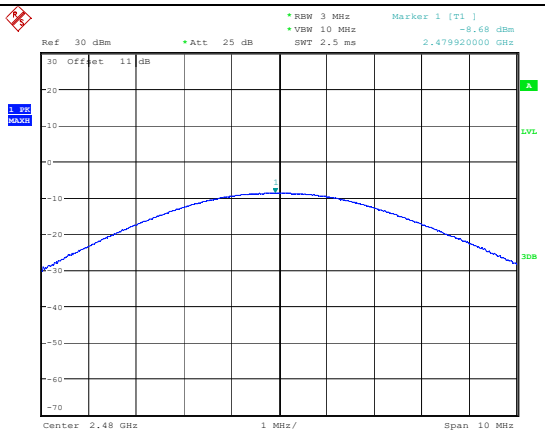
Temperature:	26.1 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-18.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
BLE 1M	2402	-6.59	≤30
	2440	-7.37	≤30
	2480	-8.68	≤30

BLE 1M	
Low Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:15:50
Middle Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:17:18
High Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:18:15

FCC §15.247(e) – POWER SPECTRAL DENSITY

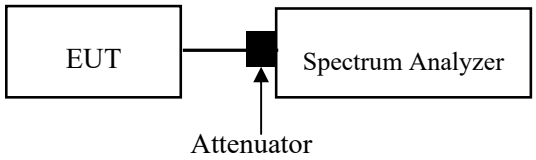
Applicable Standard

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.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.2

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

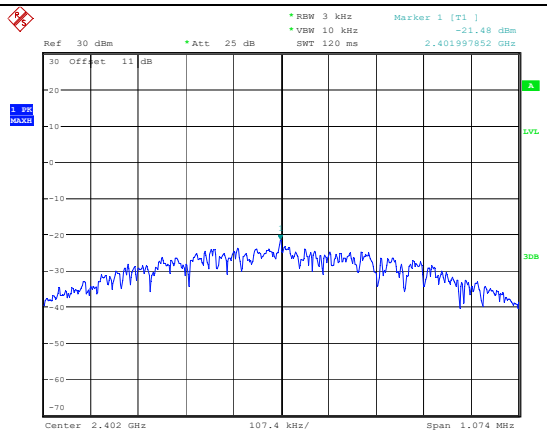
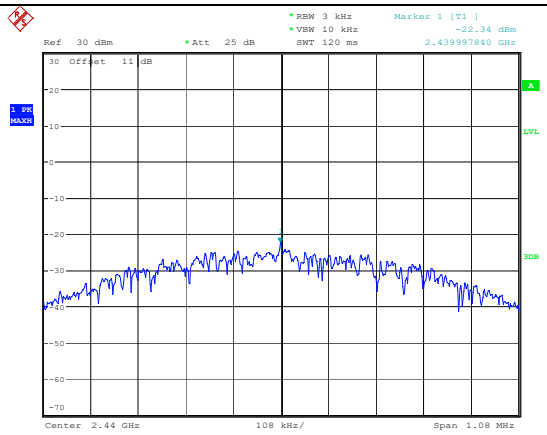
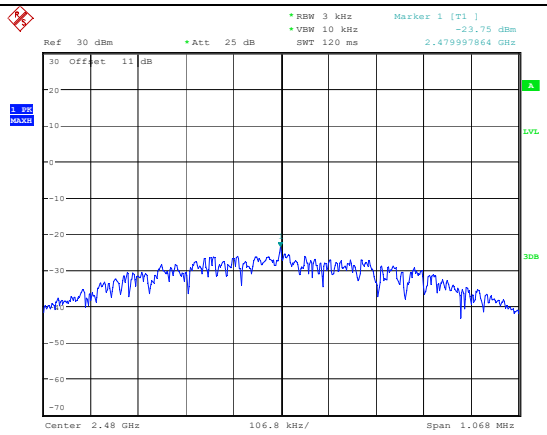
Temperature:	26.1 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-18.

Test Mode: Transmitting

Test Result: Compliant.

Test Modes	Test Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1M	2402	-21.48	≤8.00
	2440	-22.34	≤8.00
	2480	-23.75	≤8.00

BLE 1M	
Low Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:15:59
Middle Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:17:25
High Channel	 ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang Date: 18.JAN.2024 17:18:22

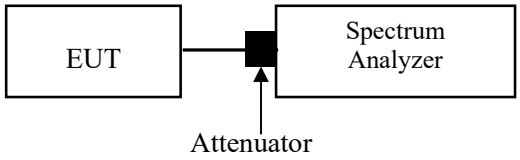
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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)).

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required

Test Procedure



Test Method: ANSI C63.10-2013 Clause 11.11

1. Set the RBW =100 kHz.
2. Set the VBW ≥ 3×RBW.
3. Detector = peak
4. Sweep time = auto couple.
5. Trace mode=max hold
6. All trace to fully stabilize
7. Use the peak marker function to determine the maximum amplitude level.
   Ensure that amplitude of all unwanted emissions outside of the authorized frequency band(excluding restricted frequency bands) is attenuated by at least the minimum requirement specified in 11.11.
   Report the three highest emissions relative to the limit.

Test Data

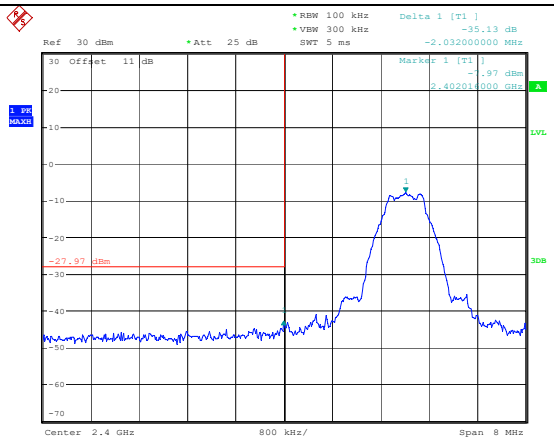
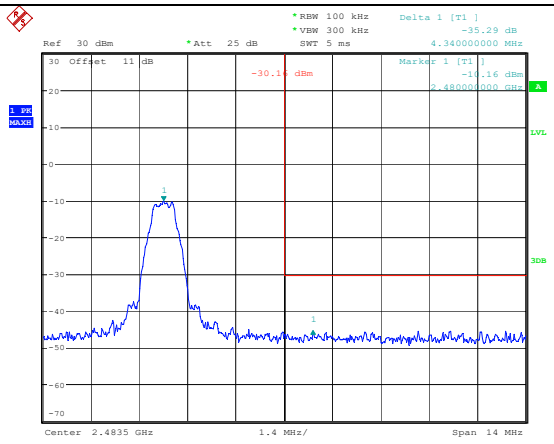
Environmental Conditions

Temperature:	26.1 ℃
Relative Humidity:	50 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-18.

EUT operation mode: Transmitting

Test Result: Compliant.

Band Edge, Single Channel	
BLE 1M, Left Side	
BLE 1M, Right Side	

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