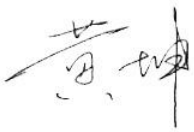
TEST REPORT

Applicant:	inMusic Brands, Inc
EUT Description:	PORTABLE COLUMNAR ARRAY LOUDSPEAKER
Model:	TSA2, TS112C, TS******* (* can be “0-9”, “A-Z”, “a-z”, blank, “-”, “+” or any character, symbol, alphanumeric)
Brand:	ALTO
FCC ID:	Y4O-TSA2
Standards:	FCC 47 CFR Part 15 Subpart C
Date of Receipt:	2024/12/23
Date of Test:	2024/12/23 to 2025/01/22
Date of Issue:	2025/02/11

TOWE. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

the results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of the model are manufactured with identical electrical and mechanical components. All sample tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise. without written approval of TOWE, the test report shall not be reproduced except in full.



Huangkun
Approved By:

ChenChengfu
Reviewed By:

Revision History

Rev.	Issue Date	Description	Revised by
01	2025/02/11	Original	Chen Chengfu

Product Differentiation Statement

These models are identical, and all models have the same RF module and antenna, PCB layout, schematics and component. Only the models name are different.

Production name	Trademark	FCC ID	Model no.
PORTABLE COLUMNAR ARRAY LOUDSPEAKER	ALTO	Y4O-TSA2	TSA2, TS112C, TS******* (* can be “0-9”, “A-Z”, “a-z”, blank, “-”, “+” or any character, symbol, alphanumeric)

So, only the test data for Model No.(TS112C) was presented in the report.

Summary of Test Results

Clause	FCC Part	Test Items	Result
4.1	§15.203/15.247(b)	Antenna Requirement	PASS
4.2	§15.207	AC Power Line Conducted Emission	PASS
4.3	§15.247 (b)(3)	Output Power	PASS
4.4	§15.247 (a)(2)	Occupied Bandwidth	Reporting purposes only
4.5	§15.247 (e)	Power Spectral Density	PASS
4.6	§15.247(d)	Band Edge for Conducted Emissions	PASS
4.7	§15.247(d)	Spurious RF Conducted Emissions	PASS
4.8	§15.205 §15.209	Radiated Spurious emissions and Band Edge	PASS
Test Method: ANSI C63.10:2020, KDB 558074 D01 15.247 Mesa Guidance v05r02. Remark: Pass is EUT meets standard requirements.			

Table of Contents

1 General Description

1.1 Lab Information

1.1.1 Testing Location

These measurements tests were conducted at the Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. facility located at F401 and F101, Building E, Hongwei Industrial Zone, Liuxian 3rd Road, Bao'an District, Shenzhen, China. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014
Tel.: +86-755-27212361
Contact Email: info@towewireless.com

1.1.2 Test Facility / Accreditations

A2LA (Certificate Number: 7088.01)
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

FCC Designation No.: CN1353
Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. has been recognized as an accredited testing laboratory. Designation Number: CN1353.

ISED CAB identifier: CN0152
Sushi TOWE Wireless Testing(Shenzhen) Co., Ltd. has been recognized by ISED as an accredited testing laboratory.
CAB identifier: CN0152
Company Number: 31000

1.2 Client Information

1.2.1 Applicant

Applicant:	inMusic Brands, Inc
Address:	200 SCENIC VIEW DRIVE, SUITE 201.CUMBERLAND. Rhode Island, United States,02864

1.2.2 Manufacturer

Manufacturer:	inMusic Brands, Inc
Address:	200 SCENIC VIEW DRIVE, SUITE 201.CUMBERLAND. Rhode Island, United States,02864

1.3 Product Information

EUT Description:	PORTABLE COLUMNAR ARRAY LOUDSPEAKER
Model No.:	TSA2, TS112C, TS******* (* can be “0-9”, “A-Z”, “a-z”, blank, “-”, “+” or any character, symbol, alphanumeric)
Brand:	ALTO
Hardware Version:	V1.0
Software Version:	N/A
Bluetooth version:	Bluetooth V5.3
Support Mode:	☒LE 1M PHY:1Mbps
Modulation Type:	GFSK
Frequency Range:	2400 ~ 2483.5MHz
Channel Frequency:	2402 ~ 2480MHz
Channel Number:	40
Antenna Type:	☐ External, ☒ Integrated
Antenna Gain:	Ant (dBi)
	2.81
Remark: The above EUT's information was declared by applicant, please refer to the specifications or user's manual for more detailed description.	

2 Test Configuration

2.1 Test Channel

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

Remark:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Test Channel	Test Frequency
The Lowest channel(CH0)	2402MHz
The Middle channel(CH19)	2440MHz
The Highest channel(CH39)	2480MHz

2.2 Worst-case configuration and Mode

Modulation Type	LE 1M PHY
Transmitting mode	Keep the EUT was programmed to be in continuously transmitting mode
Normal Link	Keep the EUT operation to normal function.

2.3 Support Unit used in test

Description	Manufacturer	Model	Serial Number
Laptop	Lenovo	Thinkbook 14 G4+IAP	YX05AZ13

2.4 Test Environment

Temperature:	Normal: 15℃ ~ 35℃
Humidity:	45-56 % RH Ambient
Voltage:	AC 110V AC 120V/60Hz for Conducted Emissions
Remark: The testing environment is within the scope of the EUT user manual and meets the requirements of the standard testing environment.	

2.5 Test RF Cable

For all conducted test items: The offset level is set spectrum analyzer to compensate the RF cable loss and attenuator factor between RF conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level will be exactly the RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

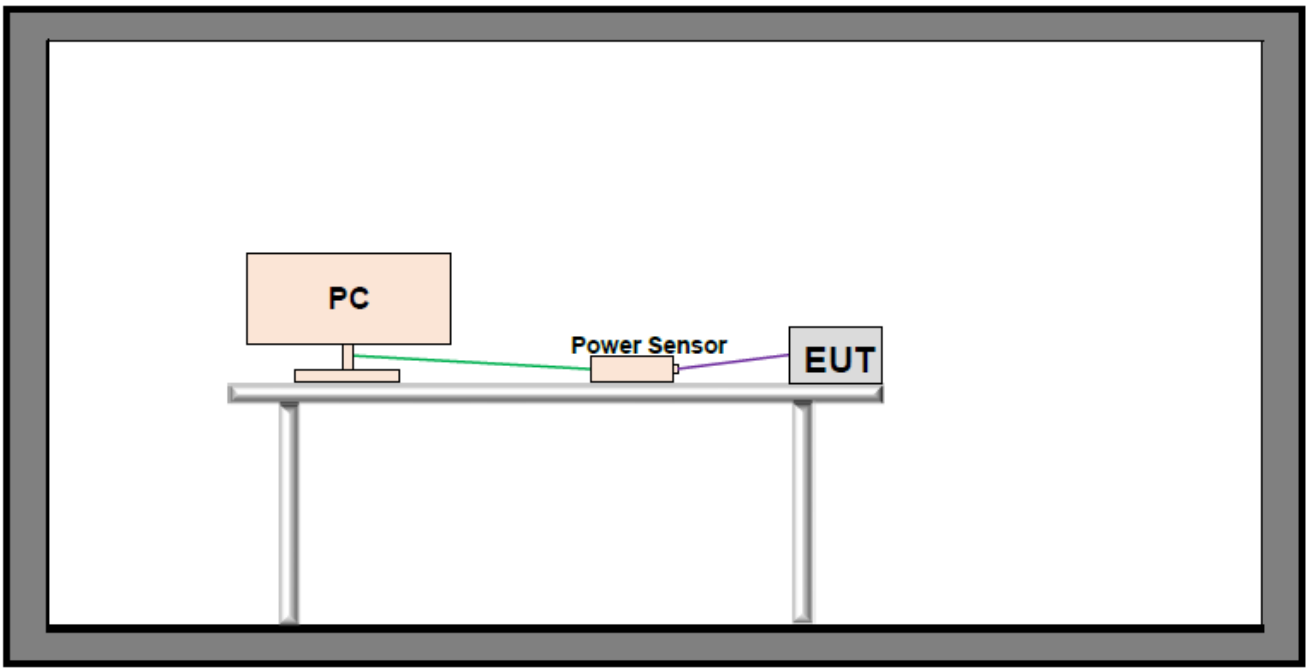
2.6 Modifications

No modifications were made during testing.

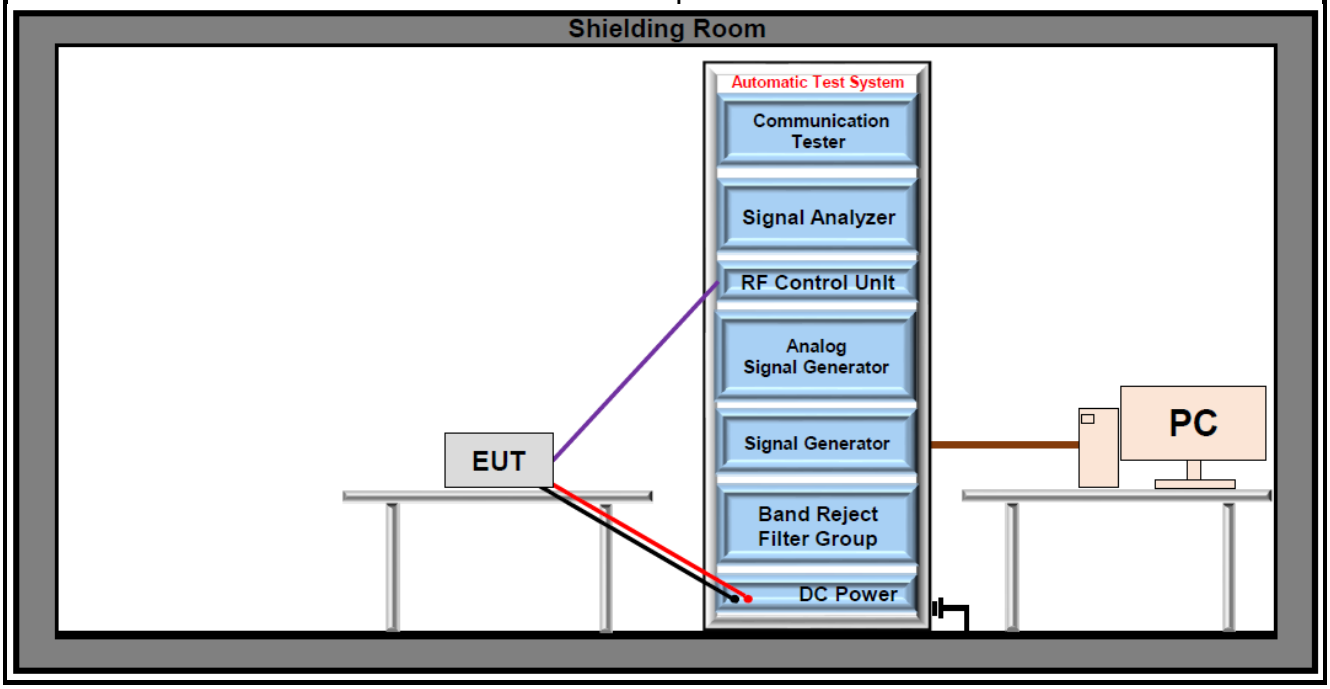
2.7 Test Setup Diagram

2.7.1 Conducted Configuration

Setup 1

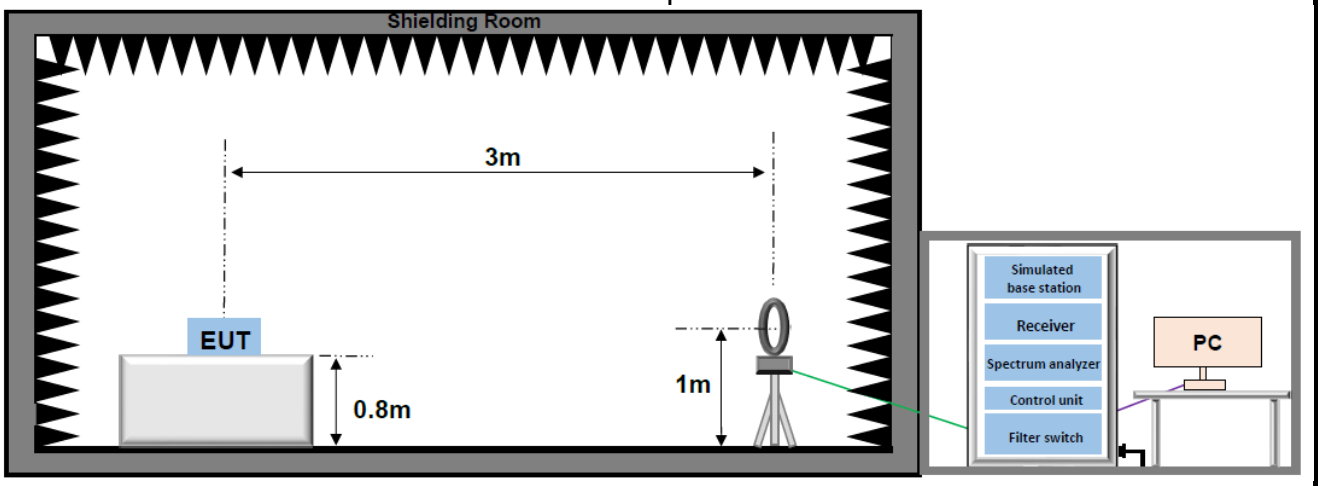


Setup 2

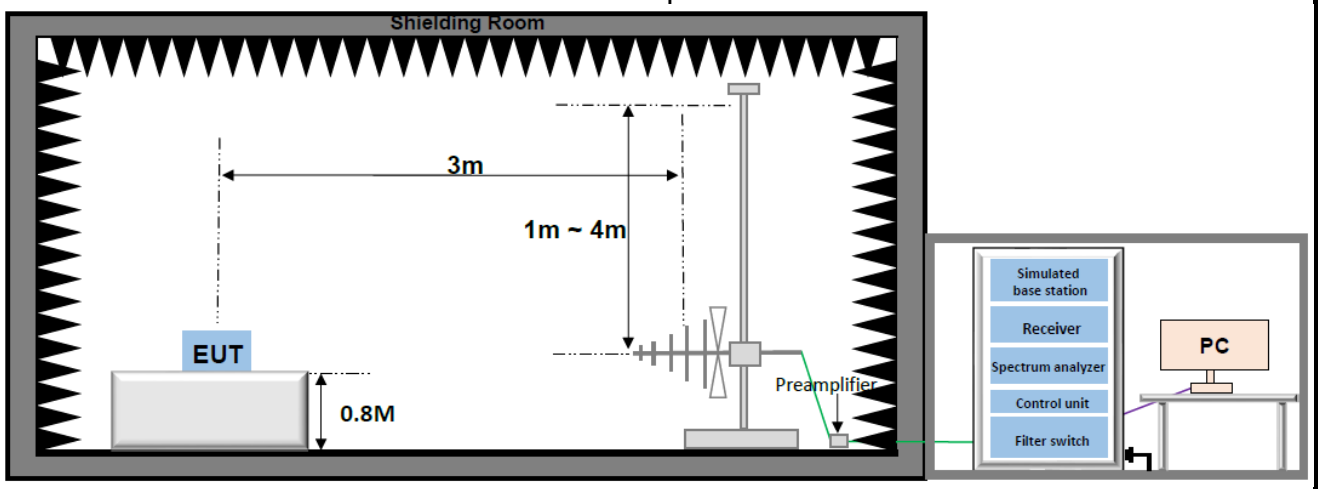


2.7.2 Radiated Configuration

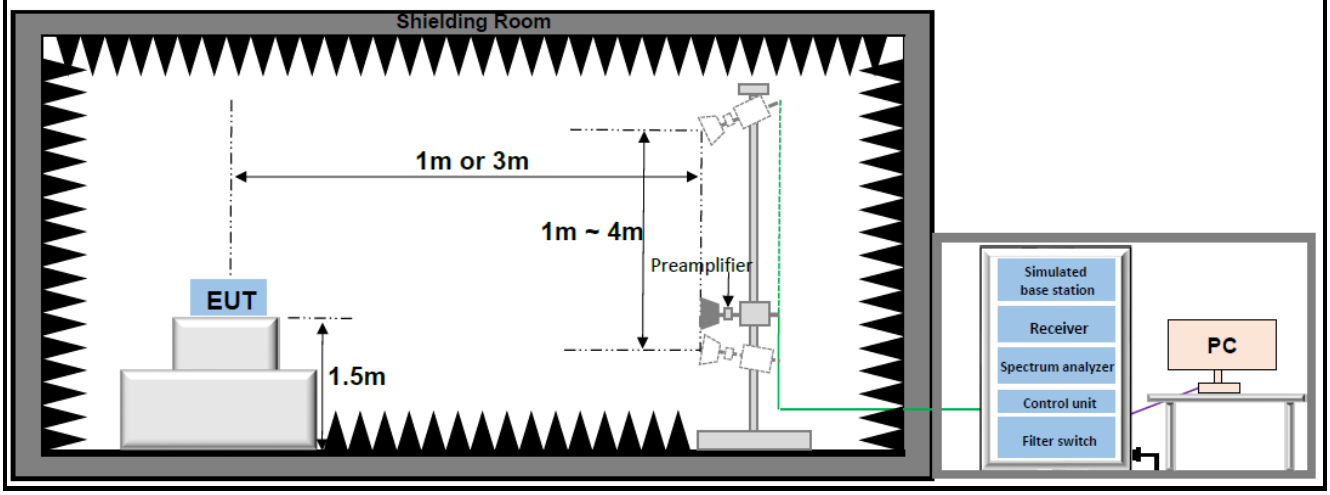
Setup 1



Setup 2



Setup 3



3 Equipment and Measurement Uncertainty

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, whichever is less, and where applicable is traceable to recognized national standards.

3.1 Test Equipment List

RF					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
Signal Analyzer	Keysight	N9020A	US46470429	2024/03/25	2025/03/24
Signal Generator	R&S	SMR20	101027	2024/03/25	2025/03/24
Vector Signal Generator	R&S	SMM100A	549353	2024/05/30	2025/05/29
Power Sensor	Anritsu	MA24408A	12520	2024/05/30	2025/05/29
RF Control Unit	Tonscend	JS0806-2	23C80620671	2024/05/30	2025/05/29
Measurement Software	Tonscend	TS1120-3	10659	N/A	N/A

Radiated Emission					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
Biconic Logarithmic Periodic Antennas	Schwarzbeck	VULB9163	1643	2023/06/25	2025/06/24
Double-Ridged Horn Antennas	Schwarzbeck	BBHA 9120D	2809	2023/06/25	2025/06/24
Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	1290	2023/06/25	2025/06/24
Loop Antenna	Schwarzbeck	FMZB 1519C	1519C-028	2023/06/29	2025/06/28
Signal Analyzer	Keysight	N9020A	MY49100252	2024/03/25	2025/03/24
EXA Signal Analyzer, Multi-touch	Keysight	N9010B	MY63440541	2024/05/30	2025/05/29
Wideband Radio Communication Tester	R&S	CMW500	150645	2024/03/25	2025/03/24
Low Noise Amplifier	Tonscend	TAP9K3G40	AP23A8060273	2023/04/08	2025/04/07
Low Noise Amplifier	Tonscend	TAP01018050	AP22G806258	2023/04/08	2025/04/07
Low Noise Amplifier	Tonscend	TAP18040048	AP22G806247	2023/04/08	2025/04/07
Hygrometer	BINGYU	HTC-1	N/A	2023/06/01	2025/05/31
Band Reject Filter Group	Townshend	JS0806-F	23A806F0652	N/A	N/A
Test Software	Tonscend	TS+	Version: 5.0.0	N/A	N/A

Conducted Emission					
Description	**Manufacturer**	**Model**	**S.N.**	**Last Due**	**Cal Due**
EMI Tester Receiver	Rohde & Schwarz	ESR3	103108	2024/05/31	2025/05/30
LISN	Rohde & Schwarz	ENV 216	102836	2024/01/10	2025/01/09
				2025/01/04	2026/01/03
Test software	Rohde & Schwarz	ELEKTRA V4.61	N/A	N/A	N/A

3.2 Measurement Uncertainty

Parameter	U_{lab}
Frequency Error	679.98Hz
Output Power	0.76dB
Conducted Spurious Emissions	2.22dB
Conducted Emissions(150kHz~30MHz)	2.43dB
Radiated Emissions(9kHz~30MHz)	2.40dB
Radiated Emissions(30MHz~1000MHz)	4.66dB
Radiated Emissions(1GHz~18GHz)	5.42dB
Radiated Emissions(18GHz~40GHz)	5.46dB

Uncertainty figures are valid to a confidence level of 95%

4 Test Results

4.1 Antenna Requirement

Standard Applicable:	47 CFR Part 15C Section 15.203 /247(b)
15.203 requirement: 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, 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. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
The antenna gain and type as provided by the manufacturer are as follows: The antenna Type is Integrated. With maximum gain is 2.81dBi. Antenna Anti-Replacement Construction: An embedded-in antenna design is used.	

4.2 AC Power Line Conducted Emissions

Limits

Frequency range (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

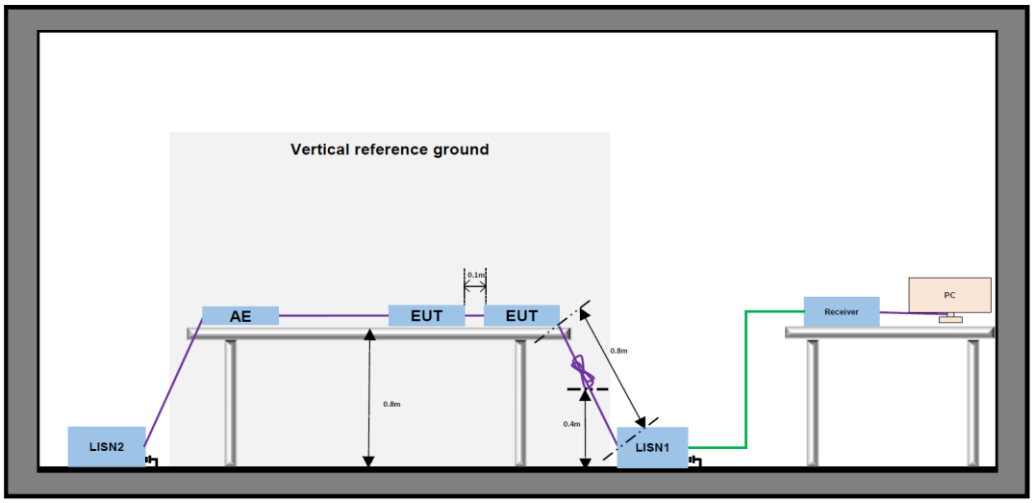
Test Procedure

ANSI C63.10:2020, Section 6.2.

Test Settings

1. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
2. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
3. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
4. The receiver is set to a resolution bandwidth of 9kHz. Peak detection s used netless otherwise noted as quasi-peak or average.
5. AC Power Line Conducted Emissions, the channel with the highest output power was tested.
6. Both sides of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Test Setup

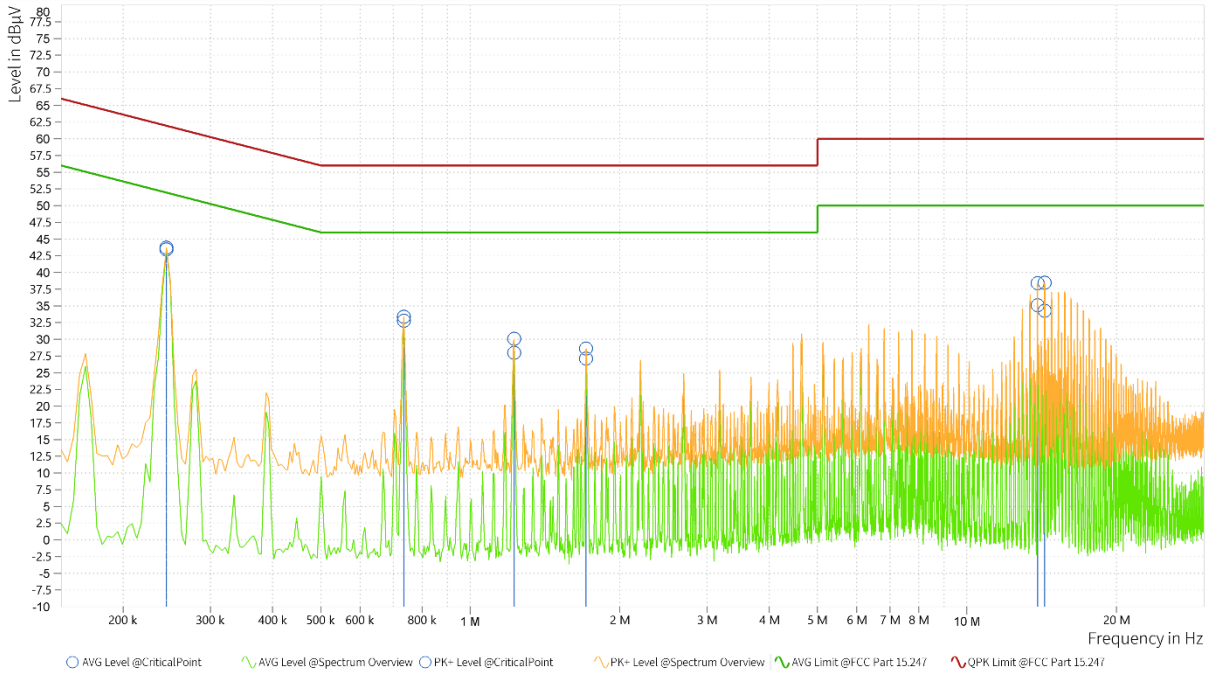


Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result:

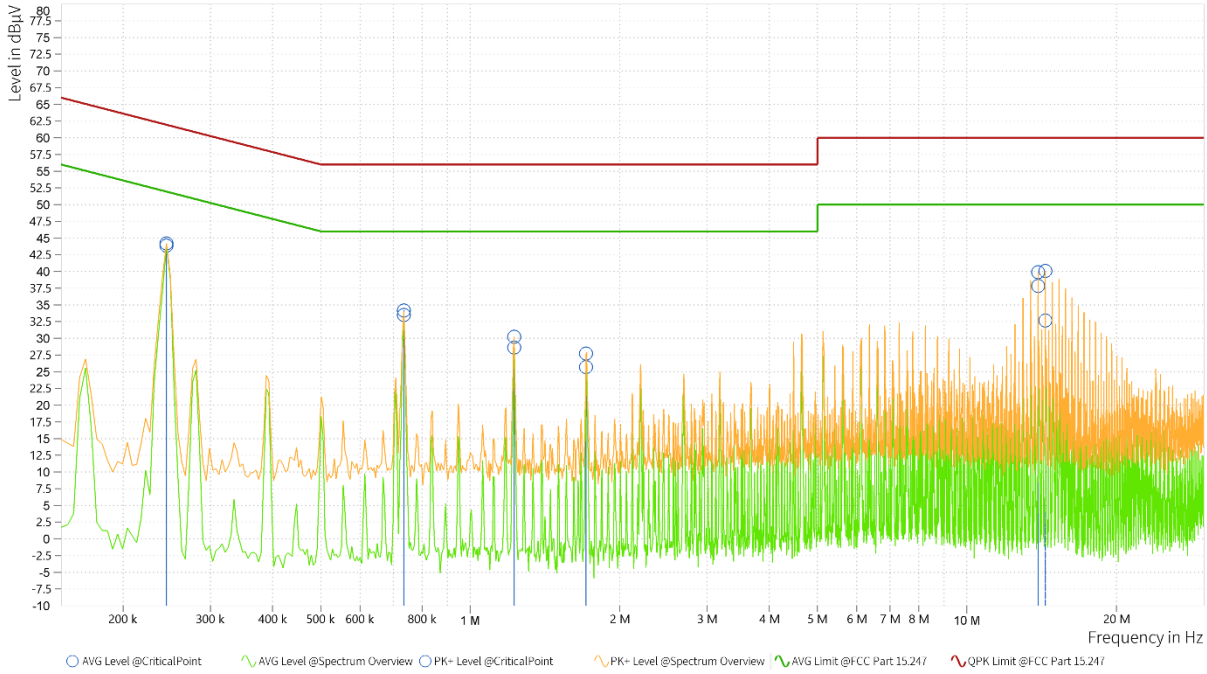
Test mode:	BLE		
Test Voltage:	AC 120V / 60Hz	Phase:	Line



Rg	Frequency [MHz]	PK+ Level [dBµV]	PK+: QPK Limit [dBµV]	PK+ Margin [dB]	AVG Level [dBµV]	AVG Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line
1	0.245	43.72	61.94	18.22	43.46	51.94	8.48	9.71	L1
1	0.735	33.38	56.00	22.62	32.77	46.00	13.23	9.59	L1
1	1.226	30.06	56.00	25.94	27.99	46.00	18.01	9.86	L1
1	1.712	28.63	56.00	27.37	27.10	46.00	18.90	9.86	L1
1	13.880	38.39	60.00	21.61	35.09	50.00	14.91	9.57	L1
1	14.352	38.45	60.00	21.55	34.27	50.00	15.73	9.55	L1

Note:
1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Margin[dB] = Limit[dBµV] - Level[dBµV]

Test mode:	BLE		
Test Voltage:	AC 120V / 60Hz	Phase:	Neutral



Rg	Frequency [MHz]	PK+ Level [dBµV]	PK+: QPK Limit [dBµV]	PK+ Margin [dB]	AVG Level [dBµV]	AVG Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line
1	0.245	44.20	61.94	17.75	43.84	51.94	8.10	9.55	N
1	0.735	34.15	56.00	21.85	33.50	46.00	12.50	9.64	N
1	1.226	30.23	56.00	25.77	28.61	46.00	17.39	9.68	N
1	1.712	27.72	56.00	28.28	25.70	46.00	20.30	9.69	N
1	13.916	39.90	60.00	20.10	37.81	50.00	12.19	9.74	N
1	14.388	40.06	60.00	19.94	32.67	50.00	17.33	9.75	N

Note:
1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Margin[dB] = Limit[dBµV] - Level[dBµV]

4.3 Output Power

Limits

If With directional antenna gains less than 6 dBi, the limit is 30dBm.

Test Procedure

ANSI C63.10:2020 Section 11.9.1.2(PKPM1) or 11.9.2.3.2(AVGPM-G)

Test Settings

1. Set to the maximum power setting and enable the EUT transmit continuously.
2. The power output was measured on the EUT antenna port using RF Cable with attenuator connected to a power meter via wideband power sensor. Peak output power was read directly from power meter.
3. Measure and record the results in the test report.

Test Setup

Refer to section 2.7.1- Setup 1 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

4.4 Occupied Bandwidth

Limits

DTSBW: The minimum 6 dB bandwidth shall be at least 500 kHz.
99%BW: None, for reporting purposes only.

Test Procedure

ANSI C63.10:2020 Section 11.8.2 and 6.9.3

Test Settings

1. Set to the maximum power setting and enable the EUT transmit continuously.
2. The transmitter output is connected to a spectrum analyzer:
3. RBW = 100kHz(DTS)
4. RBW = 1% - 5%(99%BW)
5. VBW = 3 times the RBW
6. Sweep = Auto
7. Detector = Peak
8. Trace = Max hold
9. The trace was allowed to stabilize
10. Measure and record the results in the test report.

Test Notes

DTS: The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X= 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.

Test Setup

Refer to section 2.7.1- Setup 2 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

4.5 Power Spectral Density

Limits

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.

Test Procedure

ANSI C63.10:2020 Section 11.10.2(PKPSD)

Test Settings

1. Set to the maximum power setting and enable the EUT transmit continuously
2. The transmitter output is connected to a spectrum analyzer
3. 3kHz ≤ RBW ≤ 100 kHz
   (If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.)
4. VBW ≥ 3 times RBW
5. Span = 1.5 times the DTS bandwidth
6. Sweep = Auto
7. Detector = Peak
8. Trace = Max hold
9. The trace was allowed to stabilize
10. Measure and record the results in the test report.

Test Setup

Refer to section 2.7.1- Setup 2 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

4.6 Band Edge for Conducted Emissions

Limits

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 15.247(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure

ANSI C63.10:2020 Section 11.11.3

Test Settings

1. Set to the maximum power setting and enable the EUT transmit continuously
2. The transmitter output is connected to a spectrum analyzer
3. RBW = 100kHz
4. VBW = 300kHz
5. Point ≥ 2 x span/RBW
6. Sweep = Auto
7. Detector = Peak
8. Trace = Max hold
9. The trace was allowed to stabilize
10. Measure and record the results in the test report

Test Setup

Refer to section 2.7.1- Setup 2 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

4.7 Spurious RF Conducted Emissions

Limits

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 15.247(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure

ANSI C63.10:2020 Section 11.11.3

Test Settings

1. Set to the maximum power setting and enable the EUT transmit continuously.
2. Activate frequency hopping function if necessary.
3. The transmitter output is connected to a spectrum analyzer
4. The spectrum from 30MHz - 26.5GHz
5. RBW = 100kHz
6. VBW = 300kHz
7. Sweep = Auto
8. Detector = Peak
9. Trace = Max hold
10. The trace was allowed to stabilize
11. Measure and record the results in the test report

Test Setup

Refer to section 2.7.1- Setup 2 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

4.8 Radiated Spurious Emissions and Band Edge

Limits

Spurious emissions are permitted in an of the frequency bands:

MHz	MHz	MHz	MHz	GHz	GHz
0.090 - 0.110	12.29 - 12.293	149.9 - 150.05	1660 - 1710	4.5 - 5.15	14.47 - 14.5
0.495 - 0.505	12.51975 - 1252025	156.52475 - 156.52525	1718.8 - 1722.2	5.35 - 5.46	15.35 - 16.2
2.1735 - 2.1905	12.5767 - 12.57725	156.7 - 156.9	2200 - 2300	7.25 - 7.75	17.7 - 21.4
4.125 - 128	13.36 - 13.41	162.0125 - 167.17	2310 - 2390	8.025 - 8.5	22.01 - 23.12
4.17725 - 4.17775	16.42 - 16.423	167.72 - 173.2	2483.5 - 2500	9.0 - 9.2	23.6 - 24.0
4.20725 - 4.20775	16.69475 - 16.69525	240 - 285	2655 - 2900	9.3 - 9.5	31.2 - 31.8
6.215 - 6.218	1680425 - 1680475	322 - 335.4	3260 - 3267	10.6 - 12.7	36.43 - 36.5
6.26775 - 6.26825	25.5 - 25.67	399.9 - 410	3332 - 3339	13.25 - 13.4	
6.31175 - 6.31225	37.5 - 38.25	608 - 614	3345.8 - 3358		
8.291 - 8.294	73 - 74.6	960 - 1240	3600 - 4400		
8.362 - 8.366	74.8 - 75.2	1300 - 1427			
8.37625 - 8.38675	108 - 121.94	1435 - 1626.5			
8.41425 - 8.41475	123 - 138	1645.5 - 1646.5			

Radiated disturbance of an intentional radiator:

Frequency	Field strength (μV/m)	Limit (dBμV/m	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	74.0	Peak	3
		54.0	Average	

Test Procedure

ANSI C63.10:2020 Section 6.4 & 6.5 & 6.6

Test Settings

1. For radiated emissions measurements performed at frequencies less than or equal to 1GHz, the EUT shall be placed on a RF-transparent table or support at a nominal height of 80cm above the reference ground plane.
2. For radiated emissions measurements performed at frequencies above 1GHz, the EUT shall be placed on a RF-transparent table or support at a nominal height of 80cm above the ground plane.
3. Radiated measurements shall be made with the measurement antenna positioned in both horizontal and vertical polarization. The measurement antenna shall be varied from 1m to 4m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level (i.e, field strength or received power), when orienting the measurement antenna in vertical polarization, the minimum height of the lowest element of the antenna shall clear the site reference ground plane by at least 25cm.
4. For each suspected emission, the EUT was ranged its worst case and then tune the antenna tower(from 1~4m) and turntable(from 0~360°) find the maximum reading. Preamplifier and a high pass filter are used for the test in order get better signal level comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
7. spectrum analyzer setting:

   Measurements Below 1000MHz: RBW = 120 kHz; VBW ≥ 300 kHz; Detector = Peak

   Measurements Above 1000MHz: RBW = 1 MHz; VBW ≥ 3 MHz; Detector = Peak

Average Measurements Above 1000MHz:

RBW = 1 MHz, VBW ≥ 1/T, with peak detector for average measurements.

8. The field strength is calculated by adding the Antenna Factor, Cable Factor. The basic equation with a sample calculation is as follows:

   Level = Reading(dBμV) + AF(dB/m) + Factor(dB):

   AF = Antenna Factor(dB/m)

   Factor = Cable Factor(dB) - Preamplifier gain(dB)

   Margin = Limit(dBμV/m) – Level(dBμV/m)

9. Repeat above procedures until all frequencies measured was complete.
10. Measure and record the results in the test report.

Test Notes

1. Emissions below 18GHz were measured at a 3-meter test distance while emissions above 18GHz were measured at a 1-meter test distance with the application of a distance correction factor.
2. Radiated spurious emissions were investigated from 9kHz to 30MHz, 30MHz-1GHz and above 1GHz. the disturbance between 9kHz to 30MHz, 30MHz-1GHz and 18GHz to 40GHz was very low. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be recorded, so only the harmonics had been displayed.
3. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Test Setup

Refer to section 2.7.2 for details.

Measuring Instruments

The measuring equipment is listed in the section 3.1 of this test report.

Test Result

The detailed test data see: **Appendix.**

5 Test Setup Photos

The detailed test data see: **Appendix A - BT Setup Photos**

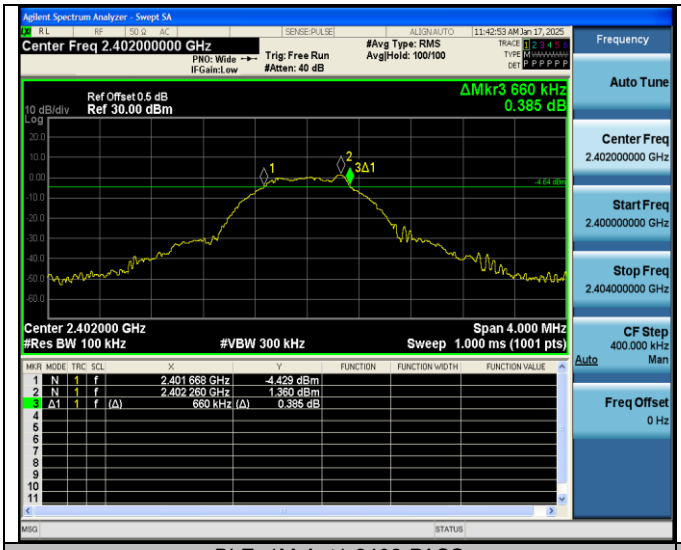
Appendix

DTS Bandwidth

Test Result

TestMode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.660	2401.668	2402.328	0.5	PASS
BLE_1M	Ant1	2440	0.660	2439.664	2440.324	0.5	PASS
BLE_1M	Ant1	2480	0.668	2479.656	2480.324	0.5	PASS

Test Graphs



BLE_1M-Ant1-2402-PASS

BLE_1M-Ant1-2440-PASS

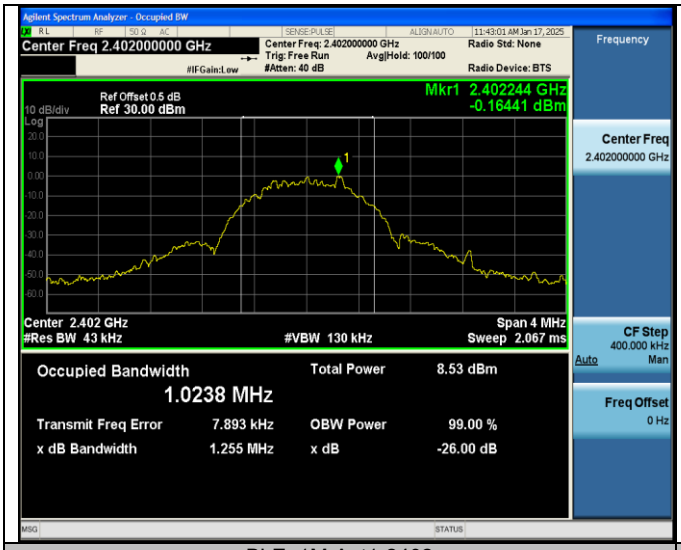
BLE_1M-Ant1-2480-PASS

Occupied Channel Bandwidth

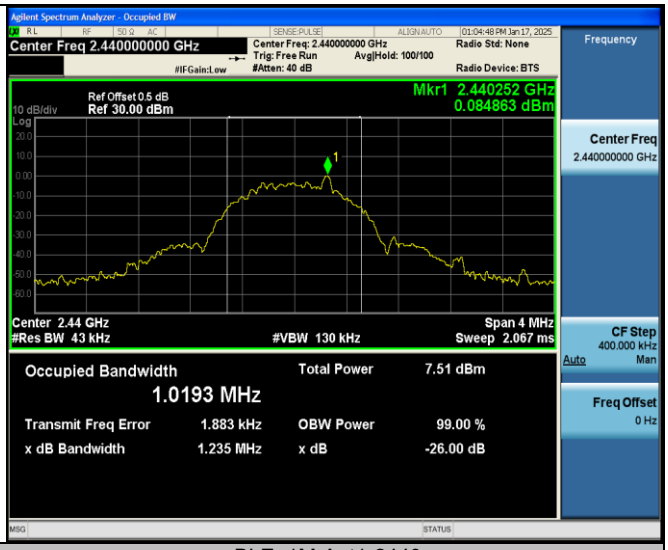
Test Result

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0238	2401.4960	2402.5198	---	---
BLE_1M	Ant1	2440	1.0193	2439.4922	2440.5115	---	---
BLE_1M	Ant1	2480	1.0307	2479.4847	2480.5154	---	---

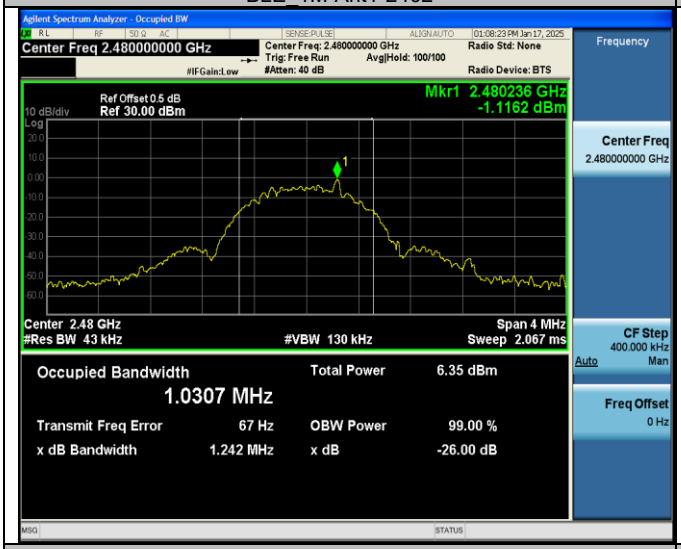
Test Graphs



BLE_1M-Ant1-2402



BLE_1M-Ant1-2440



BLE_1M-Ant1-2480

Maximum conducted output power

Test Result Peak

TestMode	Antenna	Frequency[MHz]	Conducted Peak Power[dBm]	Conducted Limit[dBm]	Verdict
BLE_1M	Ant1	2402	2.631	≤30	PASS
BLE_1M	Ant1	2440	1.846	≤30	PASS
BLE_1M	Ant1	2480	0.815	≤30	PASS

Test Result Average

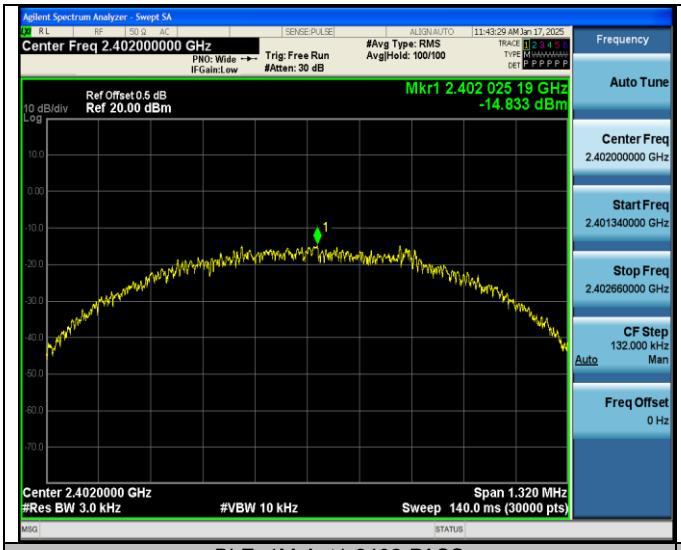
TestMode	Antenna	Frequency[MHz]	Conducted Average Power[dBm]	Conducted Limit[dBm]	Verdict
BLE_1M	Ant1	2402	1.912	≤30	PASS
BLE_1M	Ant1	2440	1.173	≤30	PASS
BLE_1M	Ant1	2480	0.124	≤30	PASS

Maximum power spectral density

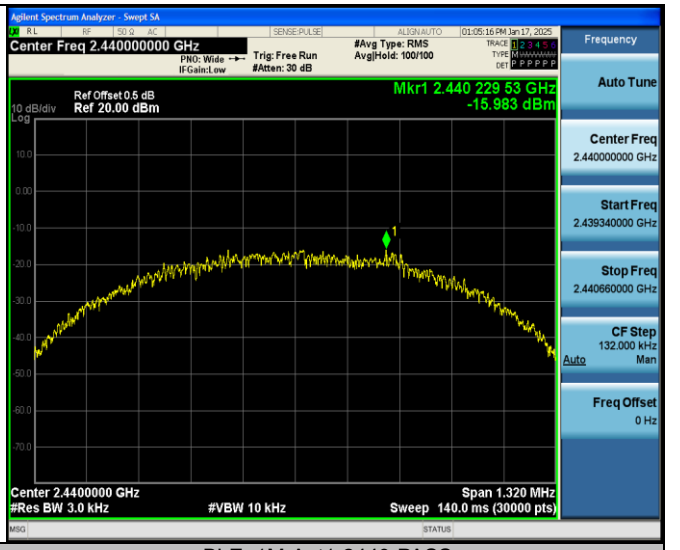
Test Result

TestMode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-14.83	≤8.00	PASS
BLE_1M	Ant1	2440	-15.98	≤8.00	PASS
BLE_1M	Ant1	2480	-16.69	≤8.00	PASS

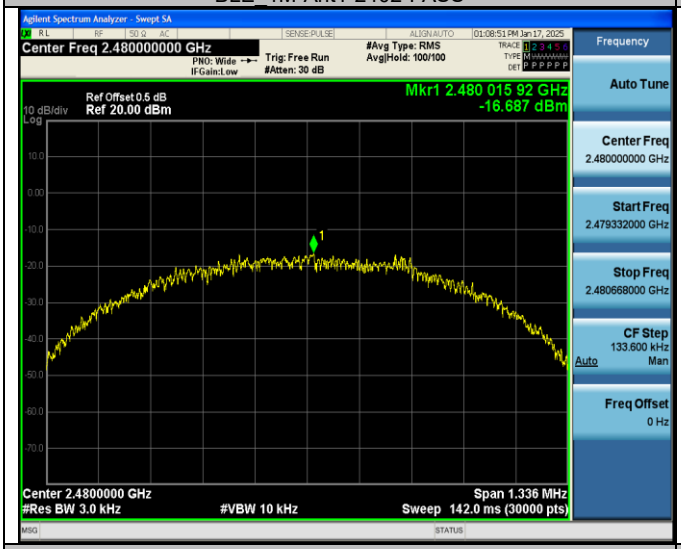
Test Graphs



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2440-PASS



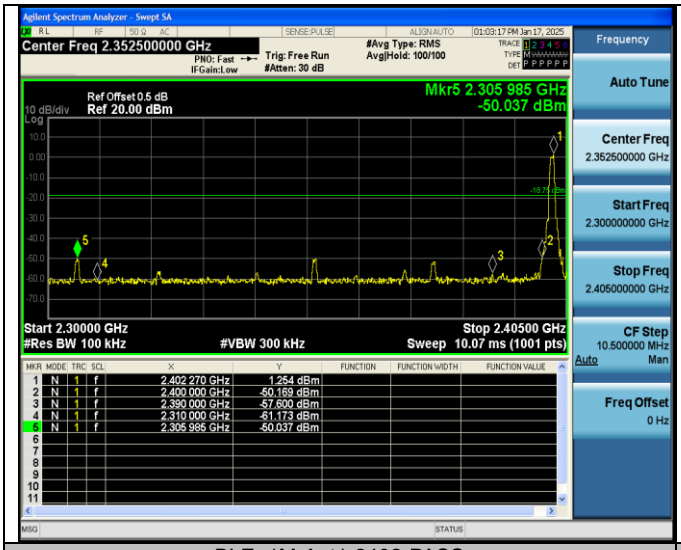
BLE_1M-Ant1-2480-PASS

Band edge measurements

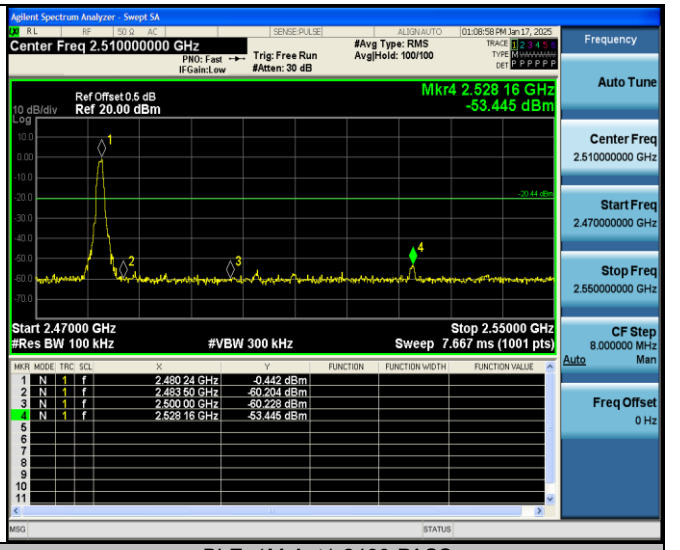
Test Result

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	1.25	-50.04	≤-18.75	PASS
BLE_1M	Ant1	High	2480	-0.44	-53.45	≤-20.44	PASS

Test Graphs



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2480-PASS

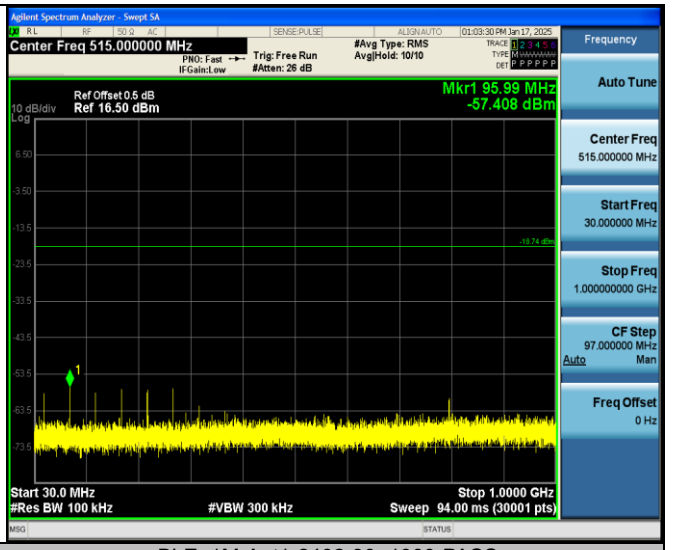
Conducted Spurious Emission

Test Result

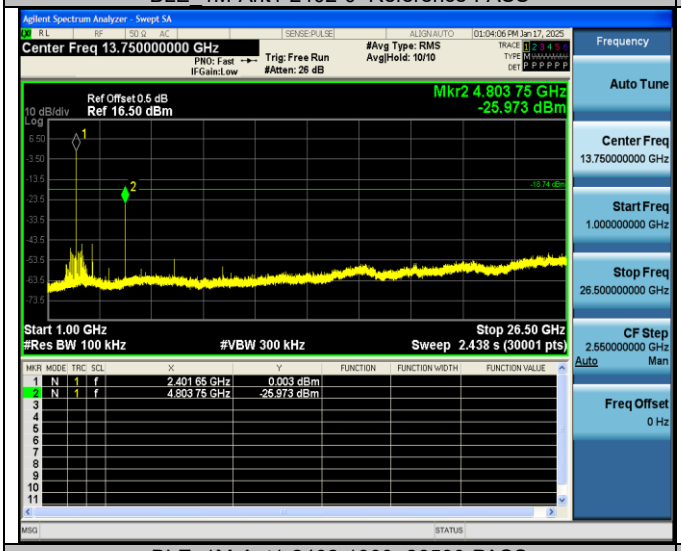
TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	0~Reference	1.26	1.26	---	PASS
BLE_1M	Ant1	2402	30~1000	1.26	-57.41	≤-18.74	PASS
BLE_1M	Ant1	2402	1000~26500	1.26	-25.97	≤-18.74	PASS
BLE_1M	Ant1	2440	0~Reference	0.26	0.26	---	PASS
BLE_1M	Ant1	2440	30~1000	0.26	-56.54	≤-19.74	PASS
BLE_1M	Ant1	2440	1000~26500	0.26	-26.96	≤-19.74	PASS
BLE_1M	Ant1	2480	0~Reference	-1.17	-1.17	---	PASS
BLE_1M	Ant1	2480	30~1000	-1.17	-56.69	≤-21.17	PASS
BLE_1M	Ant1	2480	1000~26500	-1.17	-30.33	≤-21.17	PASS

Test Graphs

BLE_1M-Ant1-2402-0~Reference-PASS

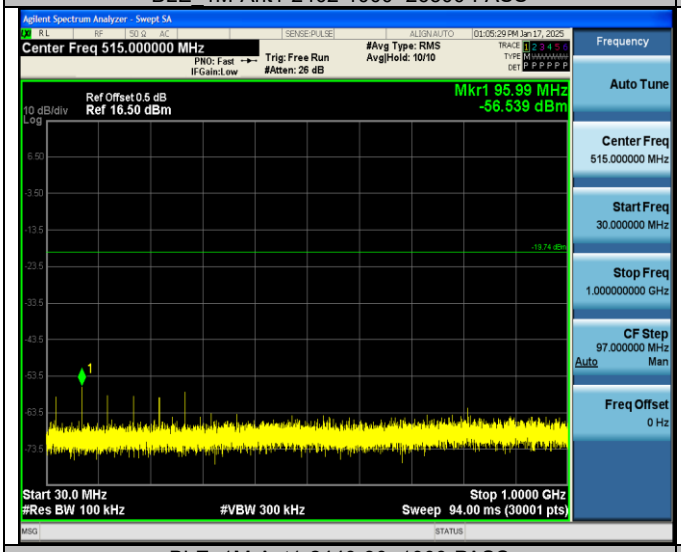


BLE_1M-Ant1-2402-30~1000-PASS

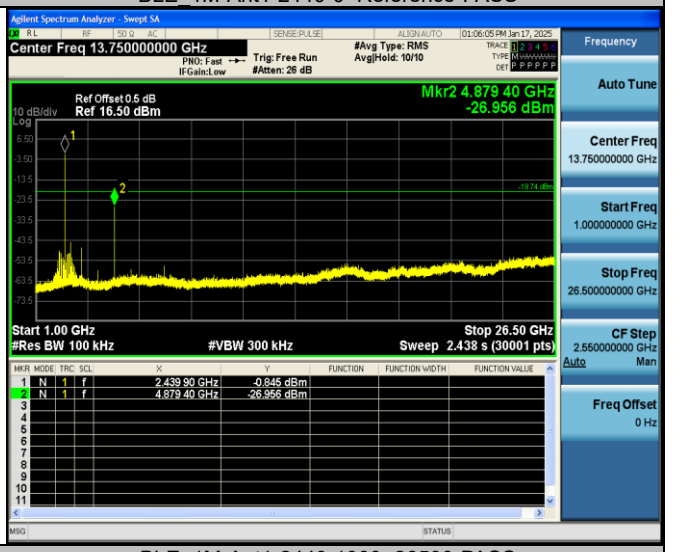


BLE_1M-Ant1-2402-1000~26500-PASS

BLE_1M-Ant1-2440-0~Reference-PASS

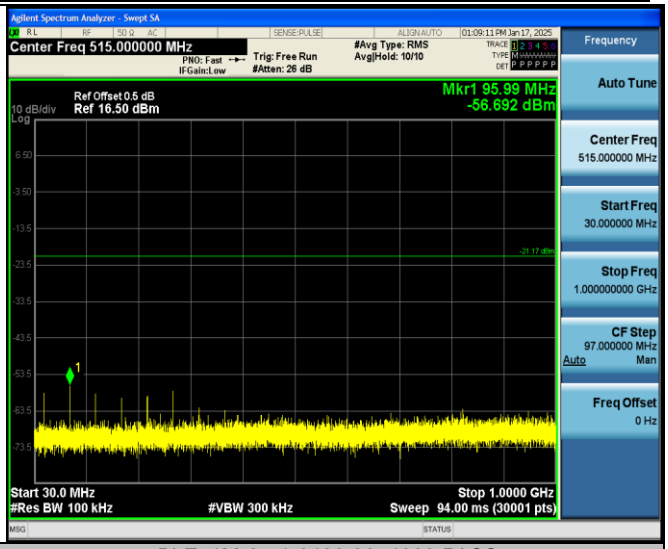


BLE_1M-Ant1-2440-30~1000-PASS

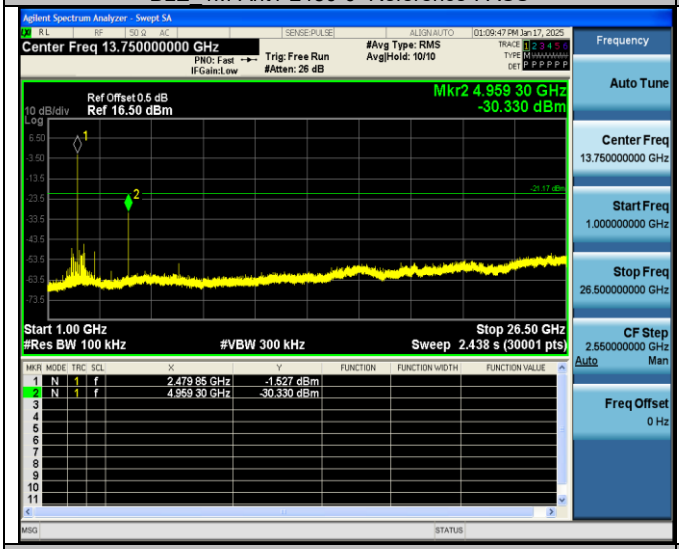


BLE_1M-Ant1-2440-1000~26500-PASS

BLE_1M-Ant1-2480-0~Reference-PASS



BLE_1M-Ant1-2480-30~1000-PASS



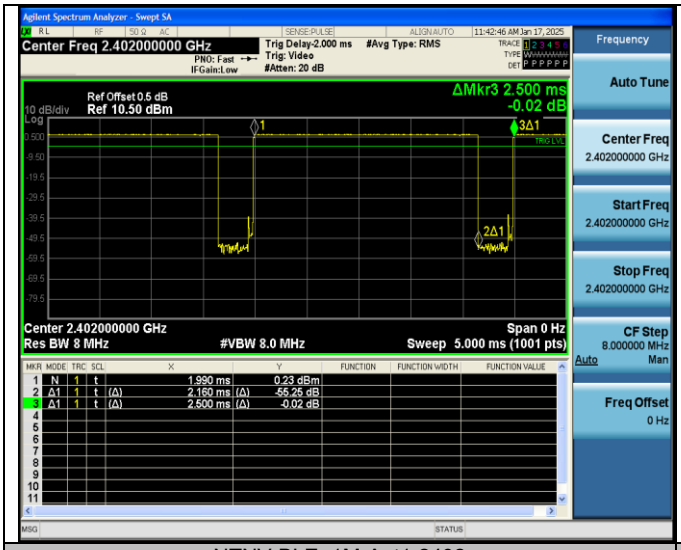
BLE_1M-Ant1-2480-1000~26500-PASS

Duty Cycle

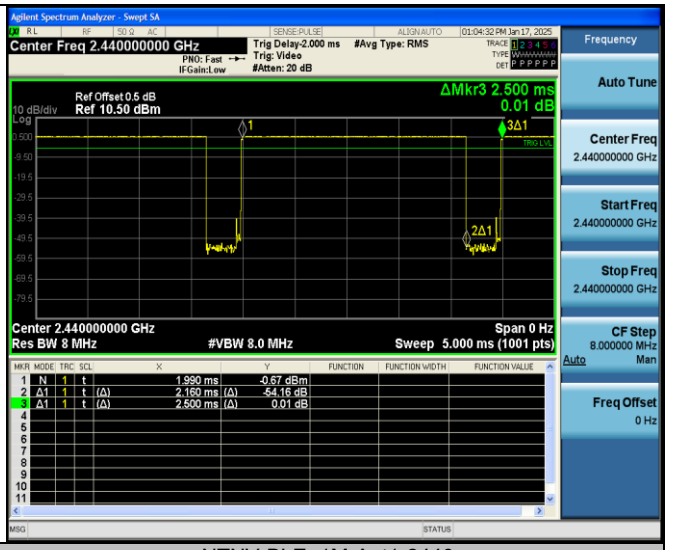
Test Result

TestMode	Antenna	Frequency[MHz]	ON Time [ms]	Period [ms]	Duty Cycle [%]	Duty Cycle Factor[dB]
BLE_1M	Ant1	2402	2.16	2.50	86.40	0.63
BLE_1M	Ant1	2440	2.16	2.50	86.40	0.63
BLE_1M	Ant1	2480	2.16	2.50	86.40	0.63

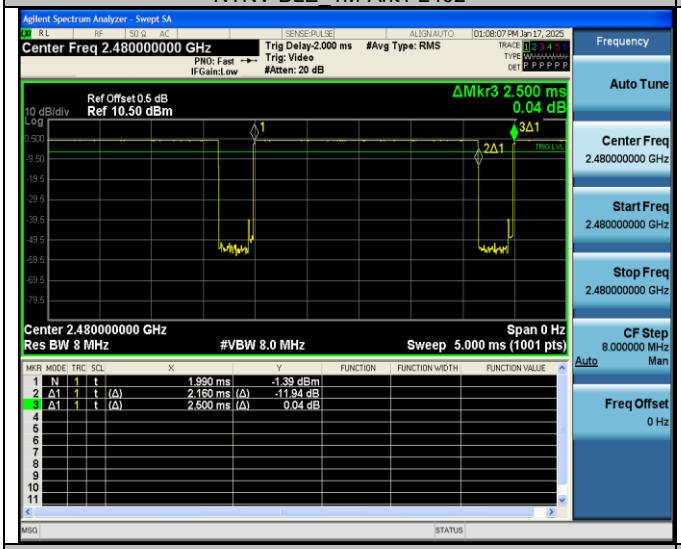
Test Graphs



NTNV-BLE_1M-Ant1-2402



NTNV-BLE_1M-Ant1-2440



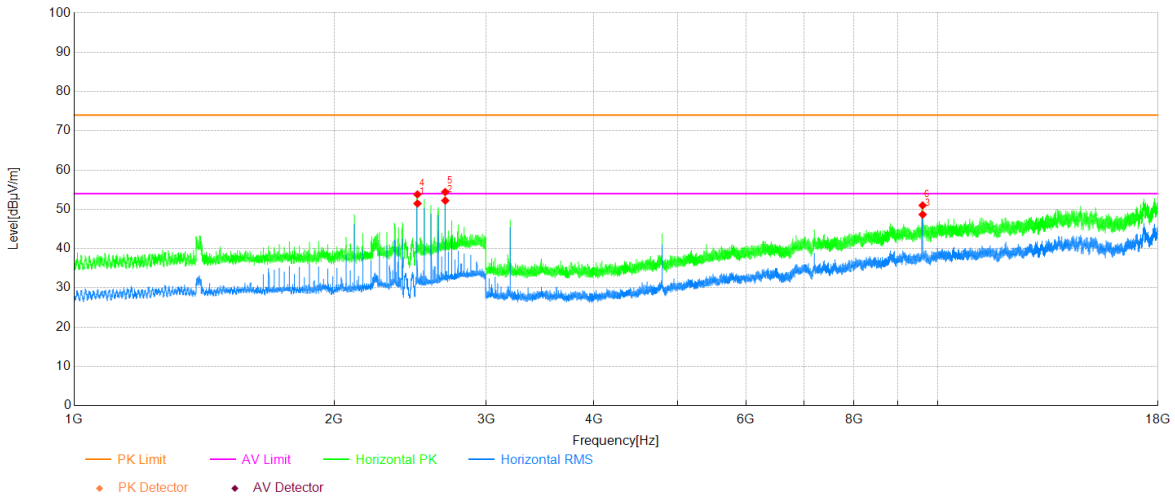
NTNV-BLE_1M-Ant1-2480

Radiated Spurious Emissions

Test Result

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Low
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

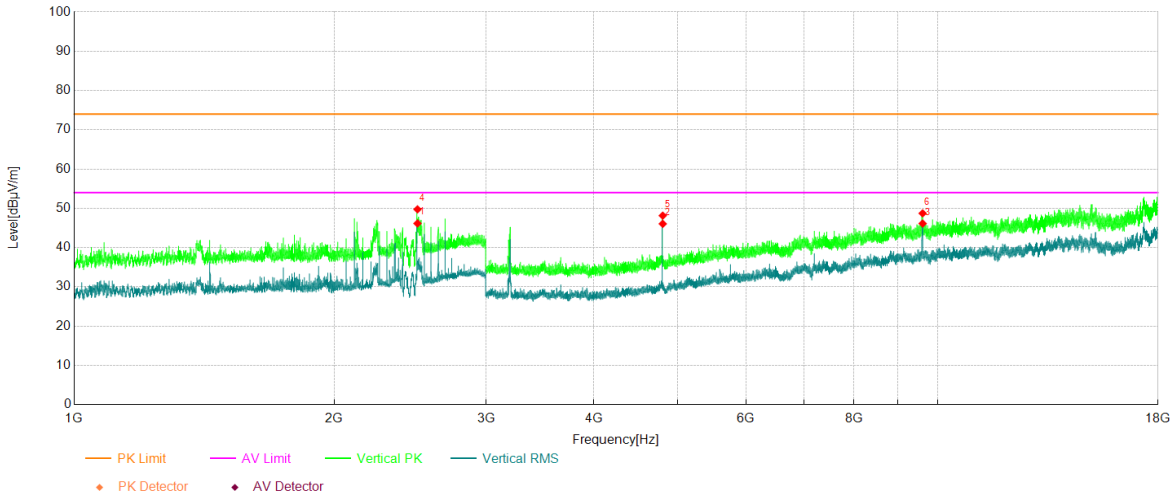


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2498.20	49.08	2.40	51.48	54.00	2.52	Horizontal	PASS
2	2690.20	48.35	3.87	52.22	54.00	1.78	Horizontal	PASS
3	9608.50	45.82	2.85	48.67	54.00	5.33	Horizontal	PASS
4	2497.80	51.40	2.40	53.80	74.00	20.20	Horizontal	PASS
5	2689.80	50.53	3.87	54.40	74.00	19.60	Horizontal	PASS
6	9608.00	48.16	2.84	51.00	74.00	23.00	Horizontal	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Low
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

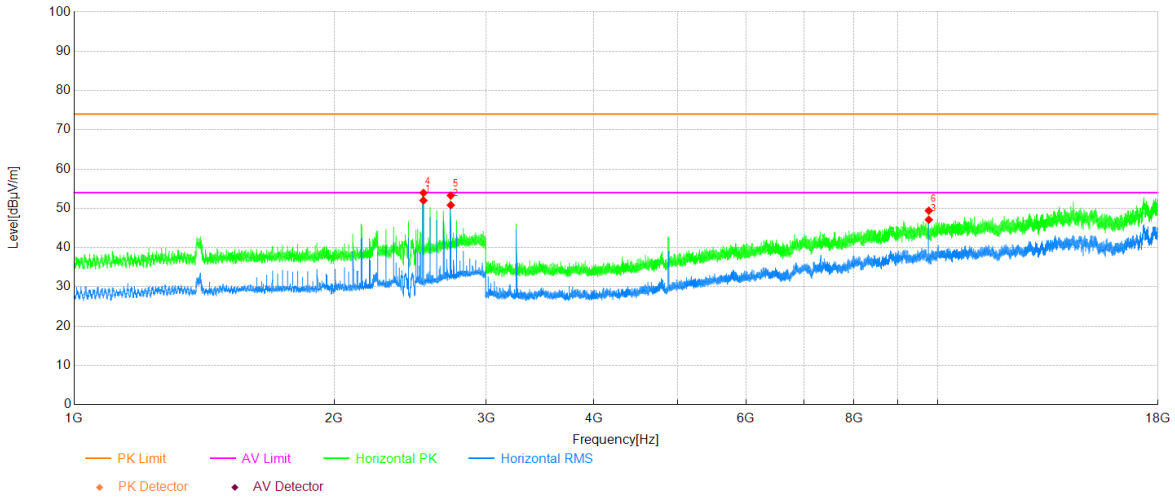


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2498.20	43.75	2.40	46.15	54.00	7.85	Vertical	PASS
2	4805.00	53.65	-7.60	46.05	54.00	7.95	Vertical	PASS
3	9608.50	43.28	2.85	46.13	54.00	7.87	Vertical	PASS
4	2498.20	47.34	2.40	49.74	74.00	24.26	Vertical	PASS
5	4804.50	55.73	-7.59	48.14	74.00	25.86	Vertical	PASS
6	9608.00	45.88	2.84	48.72	74.00	25.28	Vertical	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Mid
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

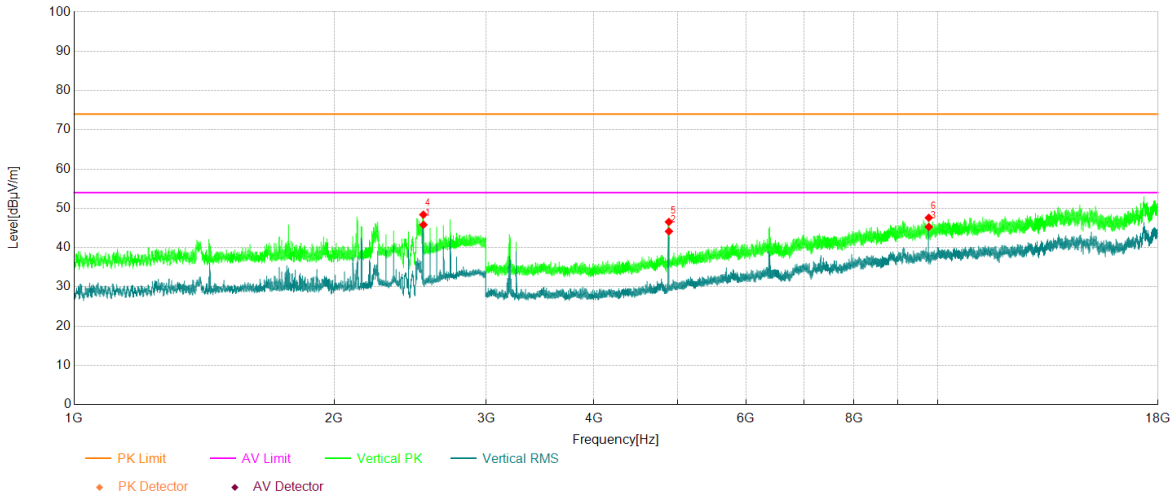


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2538.20	49.61	2.40	52.01	54.00	1.99	Horizontal	PASS
2	2730.20	46.78	4.03	50.81	54.00	3.19	Horizontal	PASS
3	9768.50	44.40	2.70	47.10	54.00	6.90	Horizontal	PASS
4	2538.40	51.53	2.40	53.93	74.00	20.07	Horizontal	PASS
5	2730.00	49.23	4.03	53.26	74.00	20.74	Horizontal	PASS
6	9768.00	46.70	2.70	49.40	74.00	24.60	Horizontal	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Mid
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

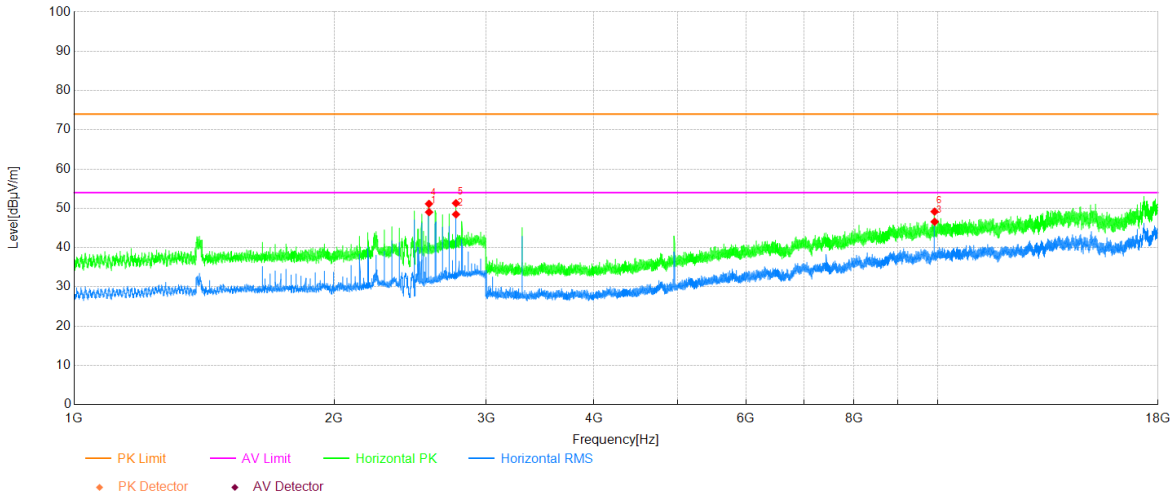


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2538.20	43.41	2.40	45.81	54.00	8.19	Vertical	PASS
2	4885.00	52.17	-8.03	44.14	54.00	9.86	Vertical	PASS
3	9768.50	42.57	2.70	45.27	54.00	8.73	Vertical	PASS
4	2537.60	45.97	2.41	48.38	74.00	25.62	Vertical	PASS
5	4884.00	54.57	-8.03	46.54	74.00	27.46	Vertical	PASS
6	9768.00	44.90	2.70	47.60	74.00	26.40	Vertical	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	High
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

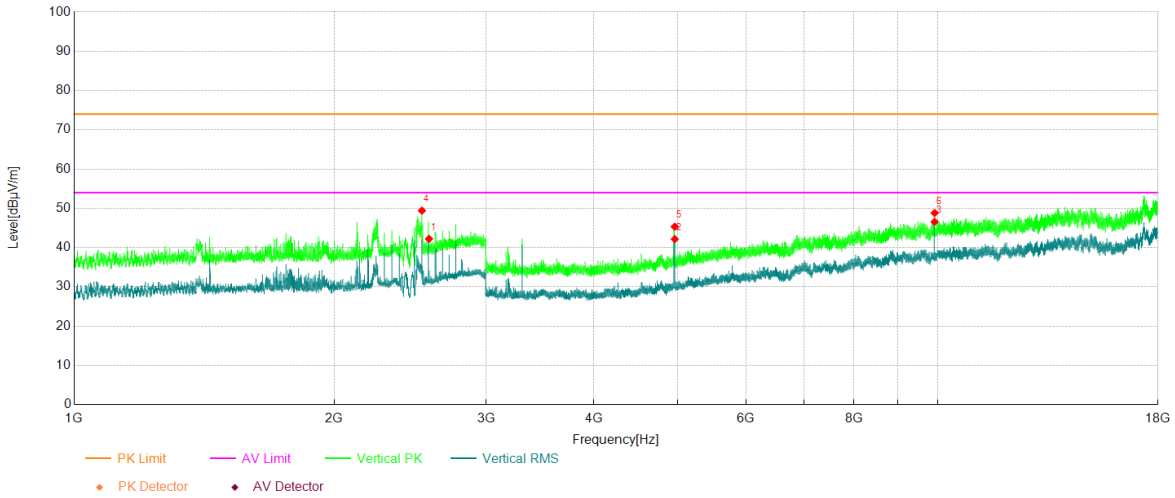


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2576.60	46.49	2.54	49.03	54.00	4.97	Horizontal	PASS
2	2768.40	44.12	4.33	48.45	54.00	5.55	Horizontal	PASS
3	9920.50	43.41	3.17	46.58	54.00	7.42	Horizontal	PASS
4	2576.00	48.61	2.54	51.15	74.00	22.85	Horizontal	PASS
5	2768.00	46.99	4.32	51.31	74.00	22.69	Horizontal	PASS
6	9920.00	46.00	3.17	49.17	74.00	24.83	Horizontal	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	High
SN:	-	Engineer:	申状
Remark:	-		

Test Graph



Data List

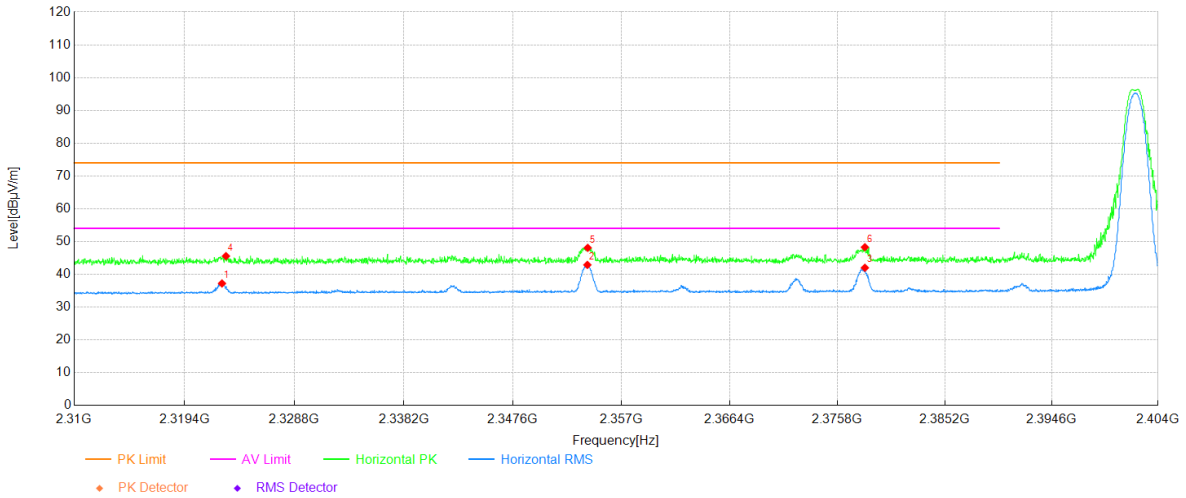
NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2576.20	39.67	2.54	42.21	54.00	11.79	Vertical	PASS
2	4960.50	49.71	-7.55	42.16	54.00	11.84	Vertical	PASS
3	9920.50	43.39	3.17	46.56	54.00	7.44	Vertical	PASS
4	2528.00	47.01	2.41	49.42	74.00	24.58	Vertical	PASS
5	4960.00	52.88	-7.55	45.33	74.00	28.67	Vertical	PASS
6	9920.00	45.64	3.17	48.81	74.00	25.19	Vertical	PASS

Radiated Band Edge

Test Result

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Low
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

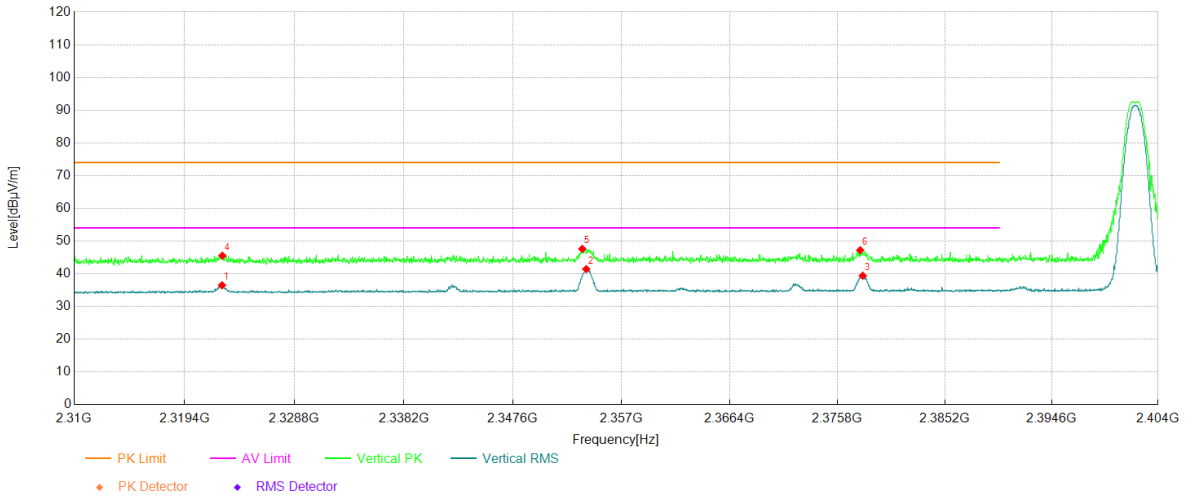


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2322.60	36.01	1.21	37.22	54.00	16.78	Horizontal	PASS
2	2354.04	41.43	1.45	42.88	54.00	11.12	Horizontal	PASS
3	2378.20	40.56	1.44	42.00	54.00	12.00	Horizontal	PASS
4	2322.94	44.34	1.22	45.56	74.00	28.44	Horizontal	PASS
5	2354.07	46.63	1.45	48.08	74.00	25.92	Horizontal	PASS
6	2378.20	46.84	1.44	48.28	74.00	25.72	Horizontal	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	Low
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

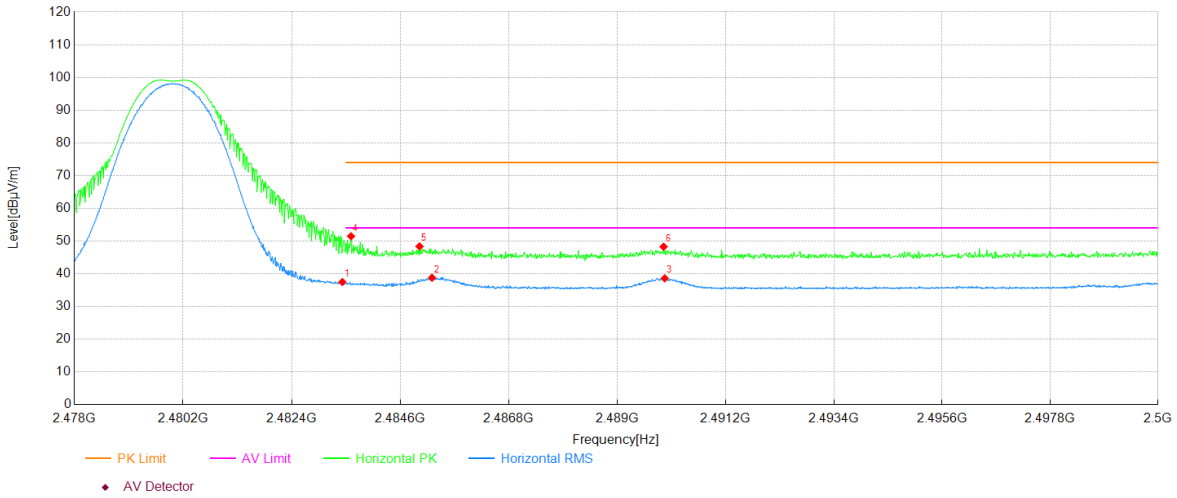


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2322.60	35.27	1.21	36.48	54.00	17.52	Vertical	PASS
2	2353.94	39.98	1.45	41.43	54.00	12.57	Vertical	PASS
3	2378.02	37.97	1.44	39.41	54.00	14.59	Vertical	PASS
4	2322.63	44.30	1.21	45.51	74.00	28.49	Vertical	PASS
5	2353.60	46.15	1.45	47.60	74.00	26.40	Vertical	PASS
6	2377.80	45.77	1.44	47.21	74.00	26.79	Vertical	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	High
SN:	-	Engineer:	申状
Remark:	-		

Test Graph

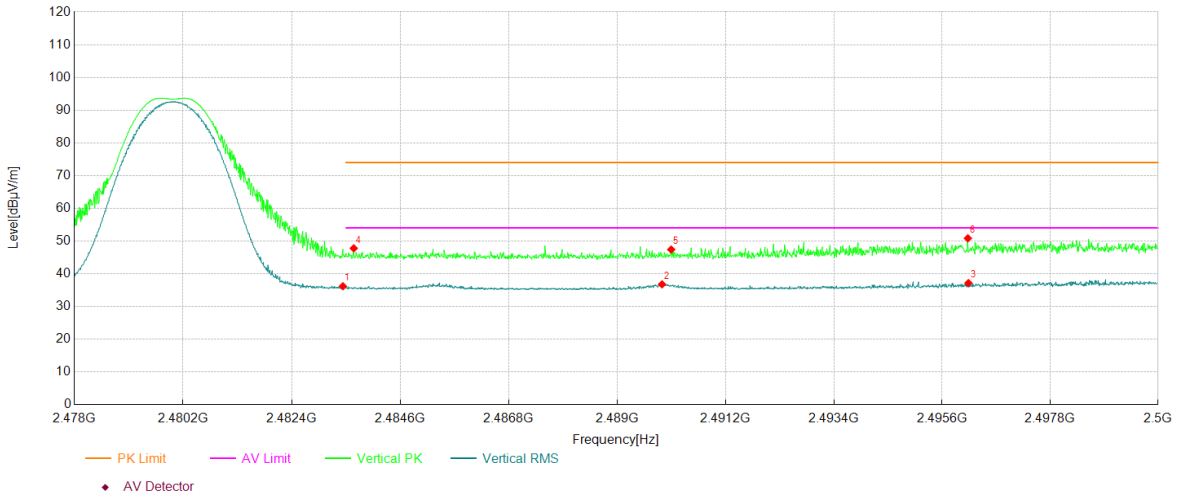


Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2483.43	35.62	1.85	37.47	-	-	Horizontal	NA
2	2485.24	36.89	1.88	38.77	54.00	15.23	Horizontal	PASS
3	2489.96	36.68	1.93	38.61	54.00	15.39	Horizontal	PASS
4	2483.60	49.61	1.86	51.47	74.00	22.53	Horizontal	PASS
5	2484.99	46.49	1.87	48.36	74.00	25.64	Horizontal	PASS
6	2489.94	46.34	1.93	48.27	74.00	25.73	Horizontal	PASS

Project Information			
Mode:	BLE	Band:	-
Bandwidth	-	Channel	High
SN:	-	Engineer:	申状
Remark:	-		

Test Graph



Data List

NO.	Freq. [MHz]	Reading [dBuV]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Verdict
1	2483.44	34.34	1.85	36.19	-	-	Vertical	NA
2	2489.91	34.85	1.93	36.78	54.00	17.22	Vertical	PASS
3	2496.14	35.18	1.99	37.17	54.00	16.83	Vertical	PASS
4	2483.66	45.92	1.86	47.78	74.00	26.22	Vertical	PASS
5	2490.10	45.47	1.93	47.40	74.00	26.60	Vertical	PASS
6	2496.13	48.85	1.99	50.84	74.00	23.16	Vertical	PASS

~The End~