TEST REPORT

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.: CTK-2024-00851

1. Applicant

◦ Name : SOLUM CO.,LTD.

◦ Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea (Zip 16914)

◦ Date of Receipt : 2023-12-26

2. Manufacturer

◦ Name : SOLUM CO.,LTD.

◦ Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea (Zip 16914)

3. Factory

◦ Name : DONGGUAN SOLUM ELECTRONICS CO., LTD.

◦ Address : Building 2/4/6, No.35, Tongzhen Road, Tongsha, Dongcheng District, Dongguan City, Guangdong Province, 523127 People's Republic of China

4. Use of Report : For FCC Conformance

5. Test Sample / Model : Signage / WC37FAPBDU0/SM

6. Date of Test : 2024-02-27 to 2024-03-27

7. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

8. Testing Environment: Temp.: (23 ± 1) ℃, Humidity: (36 ± 3) % R.H.

9. Test Results : Compliance

10. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
(Address : 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Republic of Korea)

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This report cannot be reproduced or copied without the written consent of CTK

Approval	Tested by	Technical Manager
	Bong-seok Kim: (Signature)	Young-taek Lee: (Signature)

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2024-03-27

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REPORT REVISION HISTORY

Date	Revision	Page No
2024-03-27	Issued (CTK-2024-00851)	all

CONTENTS

1. General Product Description

1.1 Applicant Information

Company	SOLUM CO.,LTD.
Contact Point	4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea (Zip 16914)
Contact Person	Name : Ki Dong Lee E-mail : kdlee007@solu-m.com Tel : +82-31-8006-7677 Fax : -

1.2 Product Information

FCC ID	2AFWN-WC37FAPBDW0
Product Description	Signage
Model name	WC37FAPBDU0/SM
Variant Model name	-
Operating Frequency	2 402 MHz - 2 480 MHz
RF Output Power	BLE_PHY 1M : 1.090 dBm (1.285 mW) BLE_PHY 2M : 1.204 dBm (1.319 mW) BLE_PHY Coded(S=2) : 1.235 dBm (1.329 mW) BLE_PHY Coded(S=8) : 1.124 dBm (1.295 mW)
Antenna Specification	Antenna type : PCB Antenna Peak Gain : 3.59 dBi
Number of channels	40
Channel Spacing	2 MHz
Type of Modulation	GFSK
Power Source	DC 19 V
RF Power setting in Test SW	Initial value

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Notebook	HP Inc.	HP Probook 455 G7	5CD0234DWM
AC Adapter	HP Inc.	PPP012D-S	677777-003

1.4 Model Differences

Not applicable

2. Accreditations

2.1 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	CN : 8737A CAB ID : KR0025
KOREA	NRRA	KR0025

2.2 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	C	Conducted
15.247(b)	Maximum Output Power	C	
15.247(d)	Conducted Spurious emission	C	
15.247(d)	Unwanted Emission(Conducted)	C	
15.247(e)	Transmitter Power Spectral Density	C	
15.209	Radiated Emissions	C	Radiated
15.207	AC Conducted Emissions	C	Line Conducted
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
Note 2: The data in this test report are traceable to the national or international standards.			
Note 3: The sample was tested according to the following specification: FCC Part 15.247			
Note 4: The tests were performed according to the method of measurements prescribed in KDB No.558074, ANSI C63.10-2013			

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.
The results are only attached worst cases.

Test Frequency

Lowest channel	Middle channel	Highest channel
2 402 MHz	2 440 MHz	2 480 MHz

Test mode

Mode	Duty Cycle	Duty Cycle Factor
BLE_PHY 1M	85.47	0.68
BLE_PHY 2M	57.60	2.40
BLE_PHY Coded(S=2)	57.12	2.43
BLE_PHY Coded(S=8)	82.80	0.82

3.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

3.4 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor k = 2, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	1.5 dB (C.L.: Approx. 95 %, k = 2)
Power Spectral Density	1.5 dB (C.L.: Approx. 95 %, k = 2)
Occupied Bandwidth	0.1 MHz (C.L.: Approx. 95 %, k = 2)
Unwanted Emission(conducted)	3.0 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f ≤ 1 GHz)	3.88 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f > 1 GHz)	4.50 dB (C.L.: Approx. 95 %, k = 2)
Line Conducted Emission	2.08 dB (C.L.: Approx. 95 %, k = 2)

3.5 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	EP5RE Ver. 6.0.1.0, ES10 Ver. 10.001
Line Conducted Test	EMC32 Ver. 10.50.0

4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

KDB 558074 - Section 8.2
ANSI C63.10-2013 - Section 11.8.2

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 - Section 6.9

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.
Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

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

Minimum Standard :

6 dB Bandwidth > 500kHz

Test Data :

Test mode: BLE_PHY 1M

Frequency (MHz)	6dB Bandwidth (MHz)	Result
2 402	0.669	Complies
2 440	0.666	Complies
2 480	0.664	Complies

Test mode: BLE_PHY 2M

Frequency (MHz)	6dB Bandwidth (MHz)	Result
2 402	1.146	Complies
2 440	1.157	Complies
2 480	1.166	Complies

Test mode: BLE_PHY Coded(S=2)

Frequency (MHz)	6dB Bandwidth (MHz)	Result
2 402	0.653	Complies
2 440	0.659	Complies
2 480	0.659	Complies

Test mode: BLE_PHY Coded(S=8)

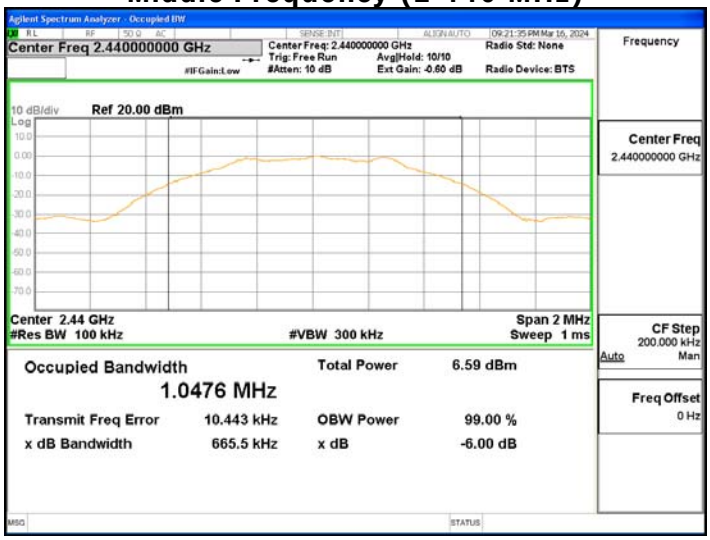
Frequency (MHz)	6dB Bandwidth (MHz)	Result
2 402	0.600	Complies
2 440	0.601	Complies
2 480	0.599	Complies

See next pages for actual measured spectrum plots.

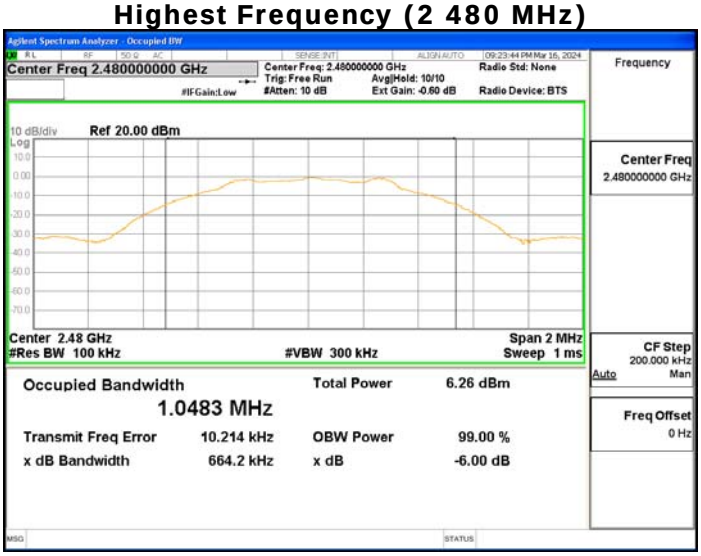
Test mode: BLE_PHY 1M

Lowest Frequency (2 402 MHz)

Middle Frequency (2 440 MHz)

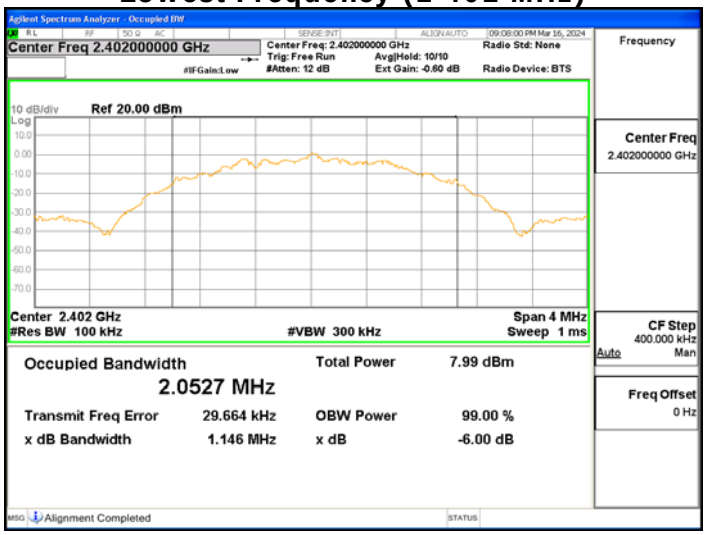


Highest Frequency (2 480 MHz)



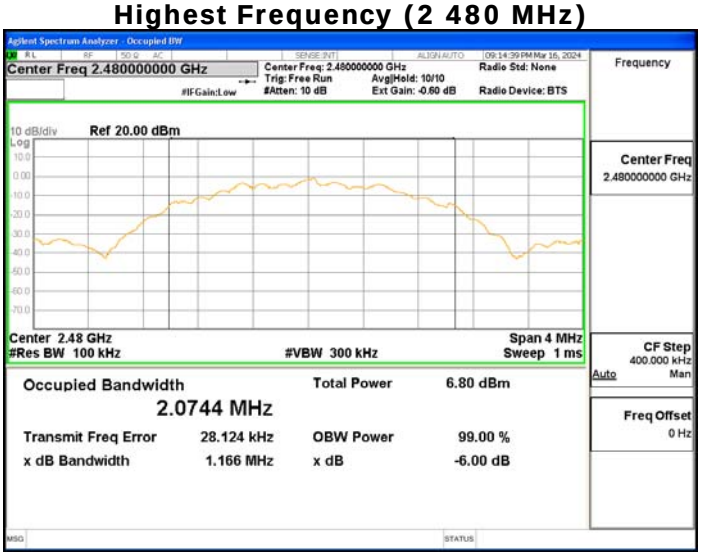
Test mode: BLE_PHY 2M

Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

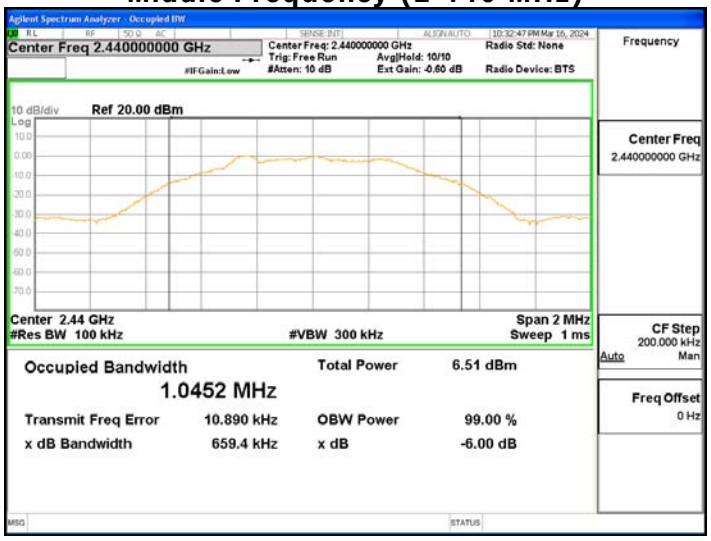
Highest Frequency (2 480 MHz)



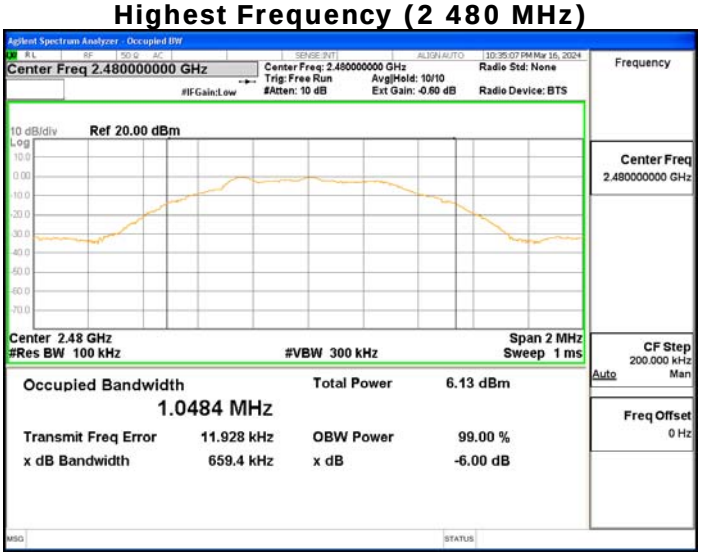
Test mode: BLE_PHY Coded(S=2)

Lowest Frequency (2 402 MHz)

Middle Frequency (2 440 MHz)



Highest Frequency (2 480 MHz)

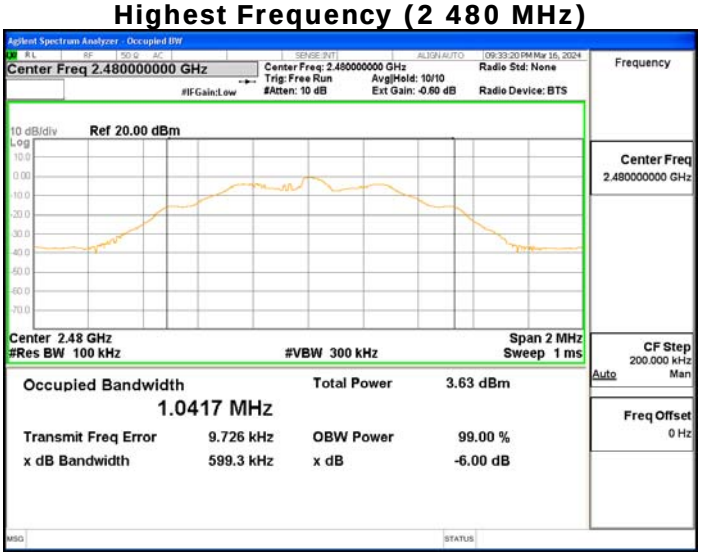


Test mode: BLE_PHY Coded(S=8)

Lowest Frequency (2 402 MHz)

Middle Frequency (2 440 MHz)

Highest Frequency (2 480 MHz)



4.2 Maximum peak Conducted Output Power

Test Procedures

KDB 558074 - Section 8.3.1.1
ANSI C63.10-2013 - Section 11.9.1.1

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW ≥ DTS bandwidth

b) VBW ≥ 3 x RBW

c) span ≥ 3 x RBW

d) Sweep time = auto couple

e) Detector = peak

f) Trace mode= max hold

g) Allow trace to fully stabilize

h) Use peak marker function to determine the peak amplitude level.

Limit :

Maximum Output Power < 1 W (30 dBm)

Test Data :

Test mode: BLE_PHY 1M

Frequency (MHz)	Maximum peak Conducted Output Power		Result
	(dBm)	(mW)	
2 402	1.090	1.285	Complies
2 440	0.049	1.011	Complies
2 480	-0.146	0.967	Complies

Test mode: BLE_PHY 2M

Frequency (MHz)	Maximum peak Conducted Output Power		Result
	(dBm)	(mW)	
2 402	1.204	1.319	Complies
2 440	0.140	1.033	Complies
2 480	-0.061	0.986	Complies

Test mode: BLE_PHY Coded(S=2)

Frequency (MHz)	Maximum peak Conducted Output Power		Result
	(dBm)	(mW)	
2 402	1.235	1.329	Complies
2 440	0.169	1.040	Complies
2 480	-0.073	0.983	Complies

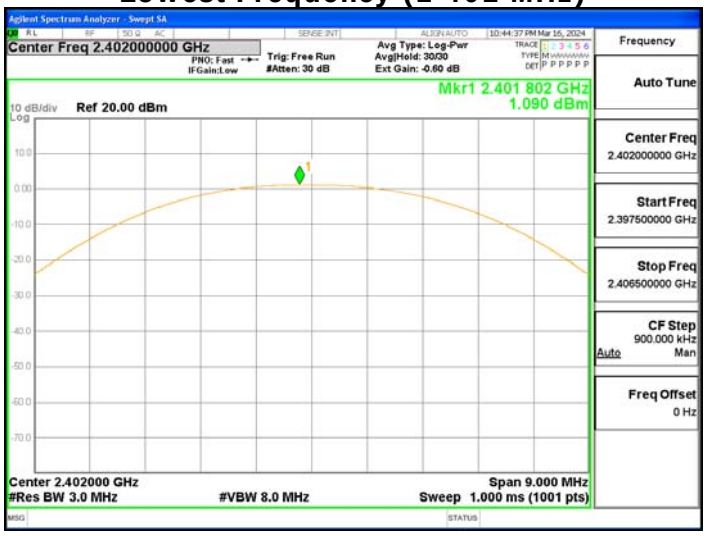
Test mode: BLE_PHY Coded(S=8)

Frequency (MHz)	Maximum peak Conducted Output Power		Result
	(dBm)	(mW)	
2 402	1.124	1.295	Complies
2 440	0.263	1.062	Complies
2 480	-0.160	0.964	Complies

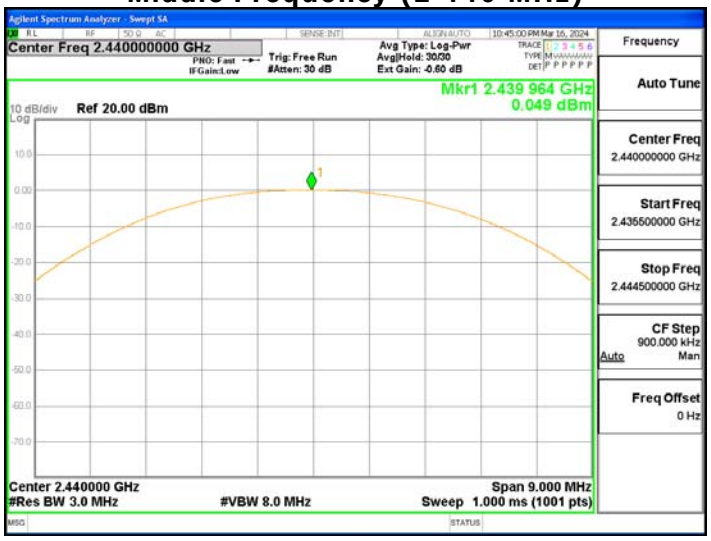
See next pages for actual measured spectrum plots.

Test mode: BLE_PHY 1M

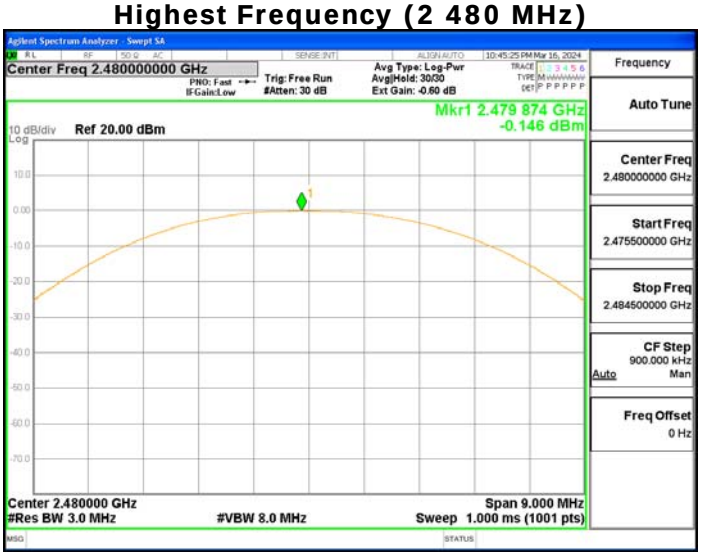
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

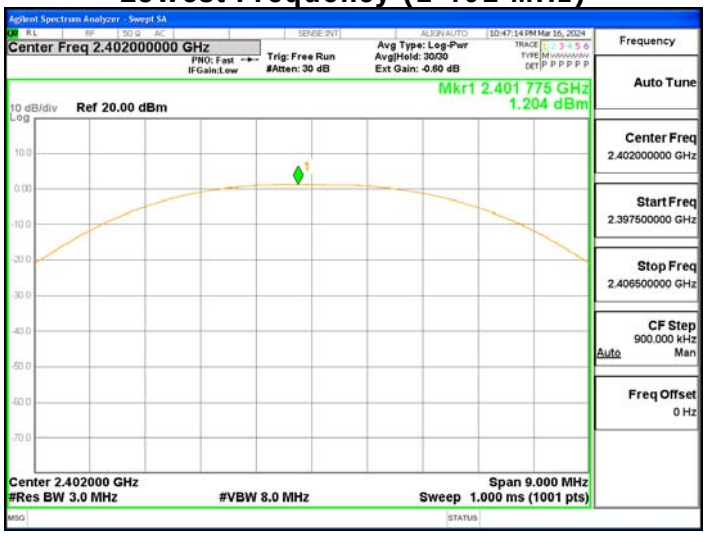


Highest Frequency (2 480 MHz)

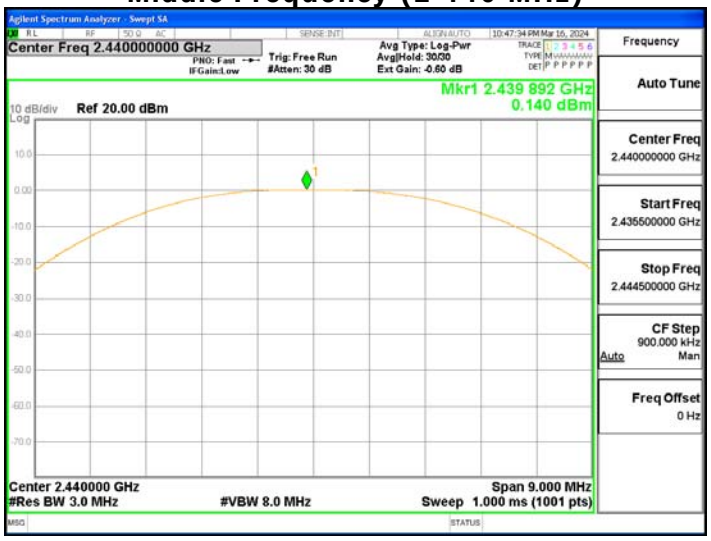


Test mode: BLE_PHY 2M

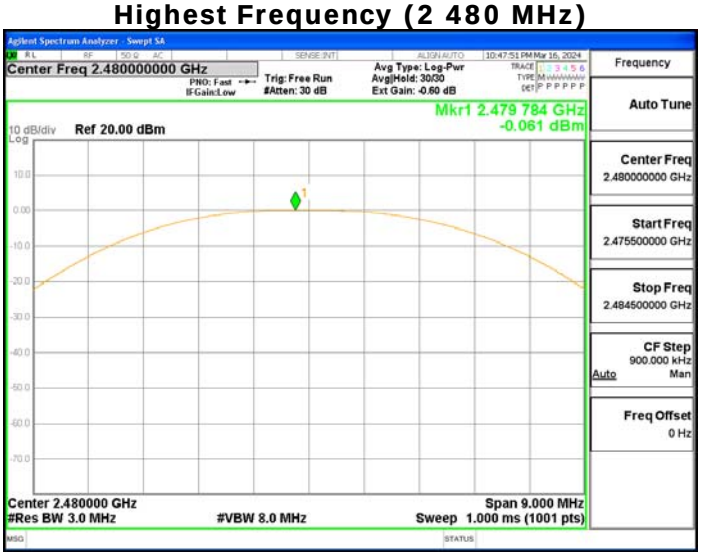
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

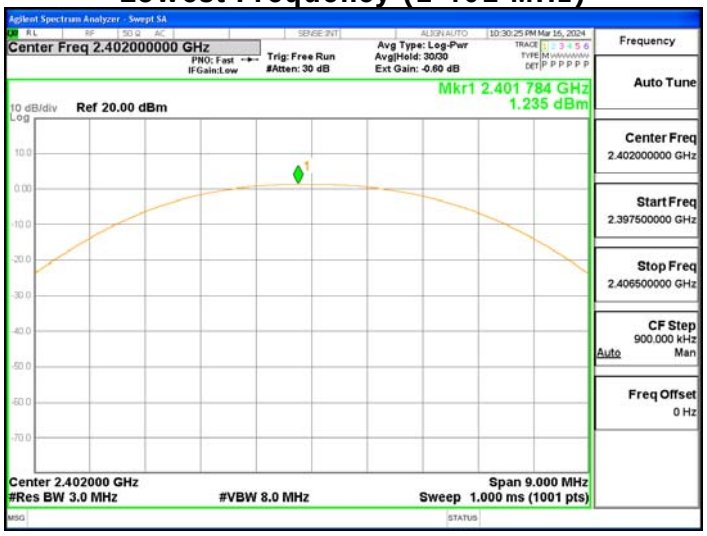


Highest Frequency (2 480 MHz)

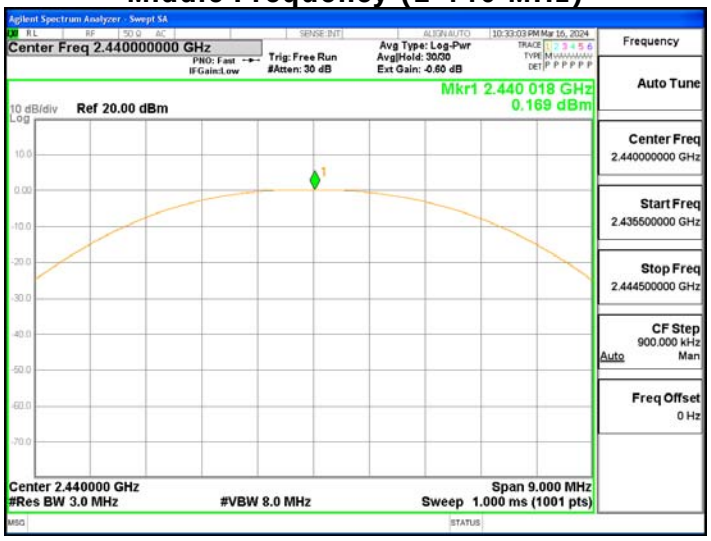


Test mode: BLE_PHY Coded(S=2)

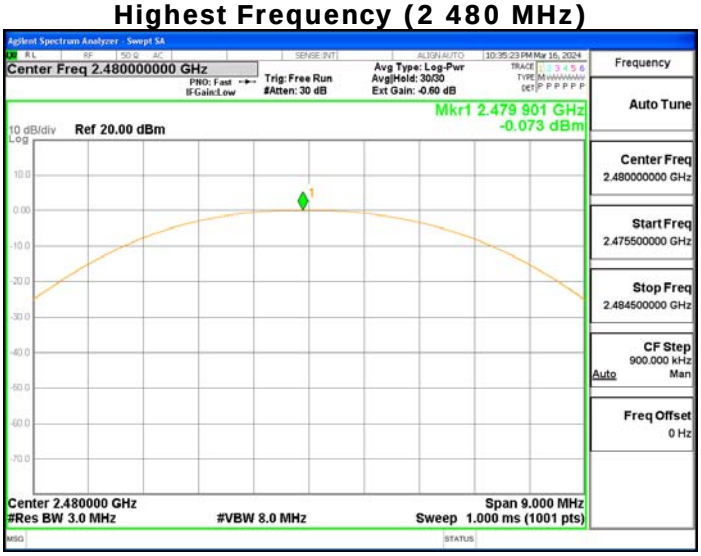
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

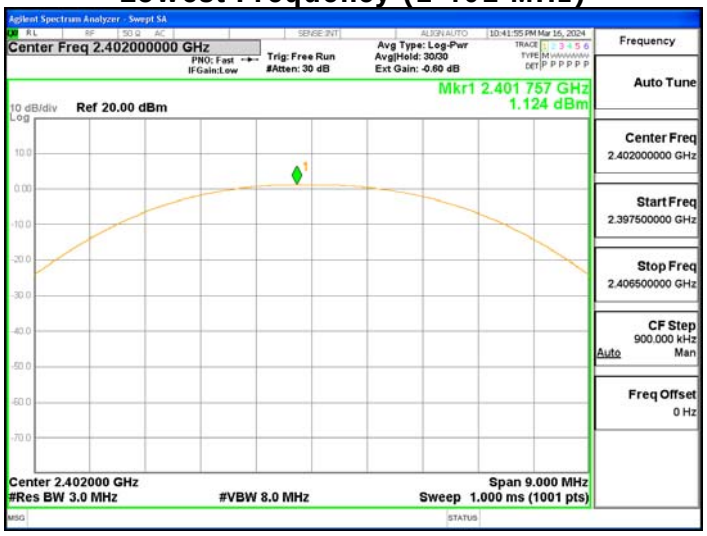


Highest Frequency (2 480 MHz)

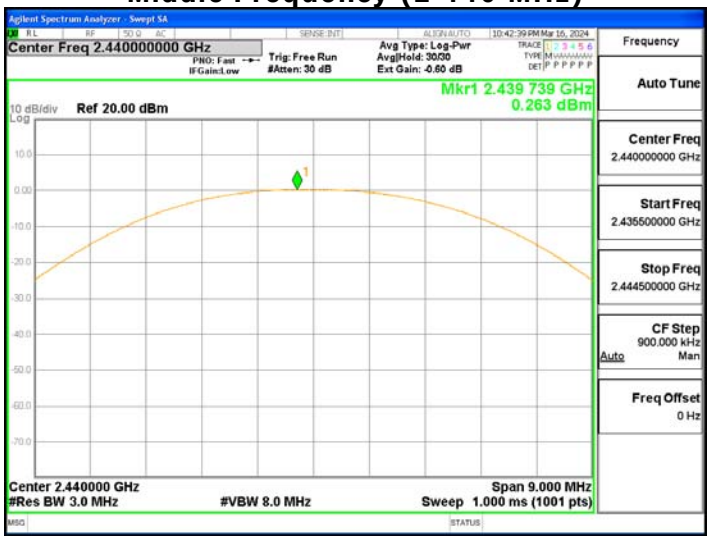


Test mode: BLE_PHY Coded(S=8)

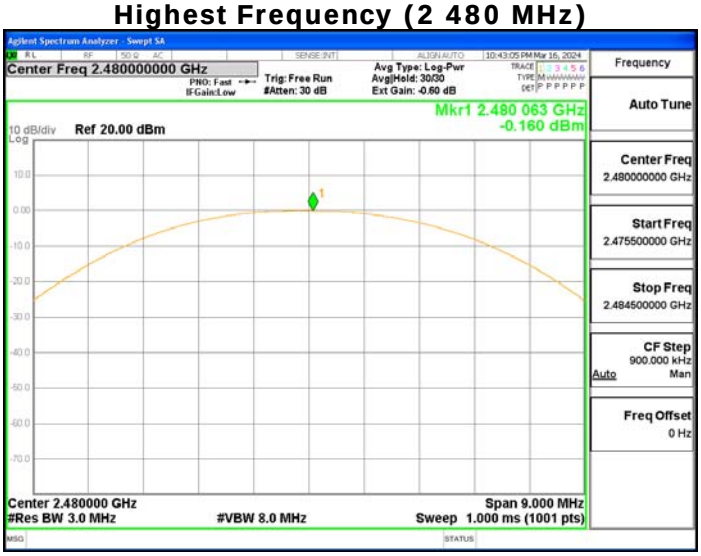
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)



Highest Frequency (2 480 MHz)



4.3 Transmitter Power Spectral Density

Test Procedures

KDB 558074 - Section 8.4
ANSI C63.10-2013 - Section 11.10.2

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW : 3 kHz ≤ RBW ≤ 100 kHz
b) VBW ≥ 3 x RBW
c) span ≥ 1.5 x DTS bandwidth
d) Sweep time = auto couple
e) Detector = peak
f) Trace mode= max hold
g) Allow trace to fully stabilize
h) Use the peak marker function to determine the maximum amplitude level within the RBW.

Limit :

Power Spectral Density < 8dBm @ 3 kHz BW

Test Data:

Test mode: BLE_PHY 1M

Frequency (MHz)	Power Spectral Density (dBm)	Result
2 402	-14.901	Complies
2 440	-15.771	Complies
2 480	-16.562	Complies

Test mode: BLE_PHY 2M

Frequency (MHz)	Power Spectral Density (dBm)	Result
2 402	-16.013	Complies
2 440	-17.820	Complies
2 480	-18.434	Complies

Test mode: BLE_PHY Coded(S=2)

Frequency (MHz)	Power Spectral Density (dBm)	Result
2 402	-6.013	Complies
2 440	-6.140	Complies
2 480	-6.541	Complies

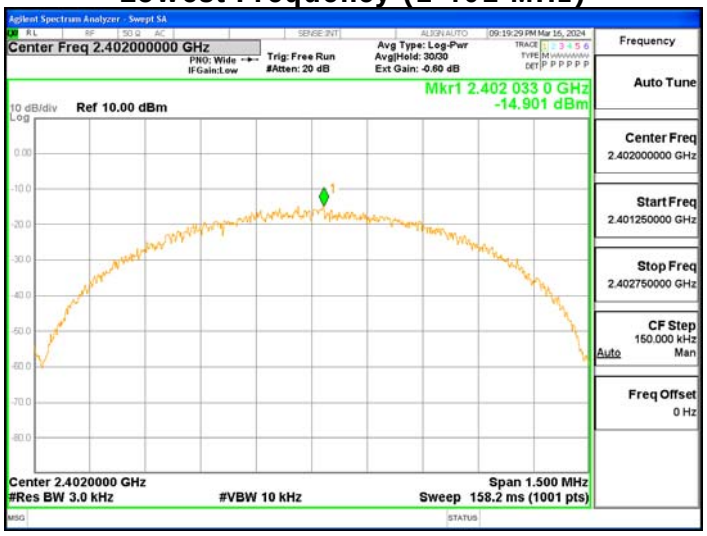
Test mode: BLE_PHY Coded(S=8)

Frequency (MHz)	Power Spectral Density (dBm)	Result
2 402	-5.286	Complies
2 440	-6.127	Complies
2 480	-6.464	Complies

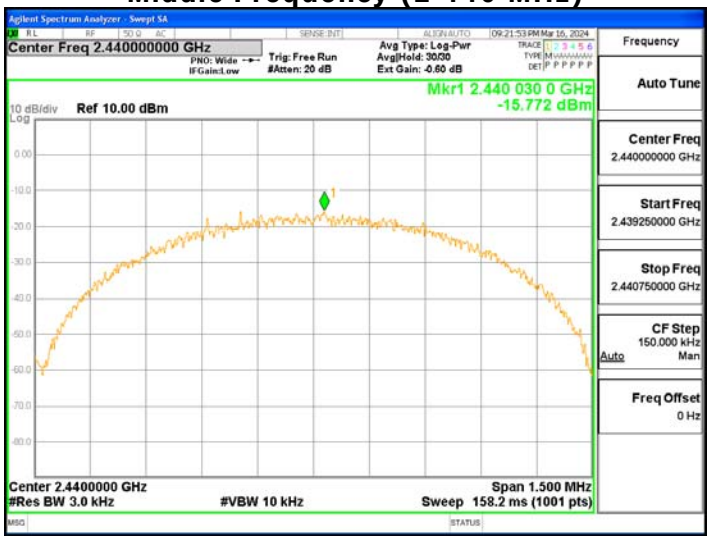
See next pages for actual measured spectrum plots.

Test mode: BLE_PHY 1M

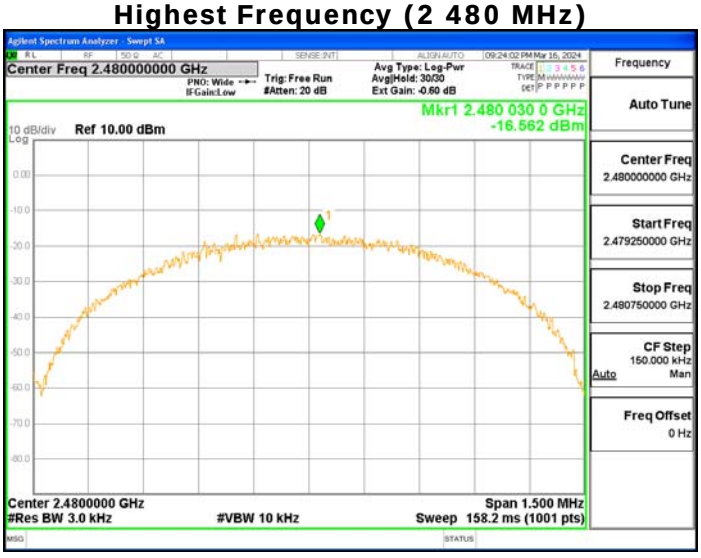
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

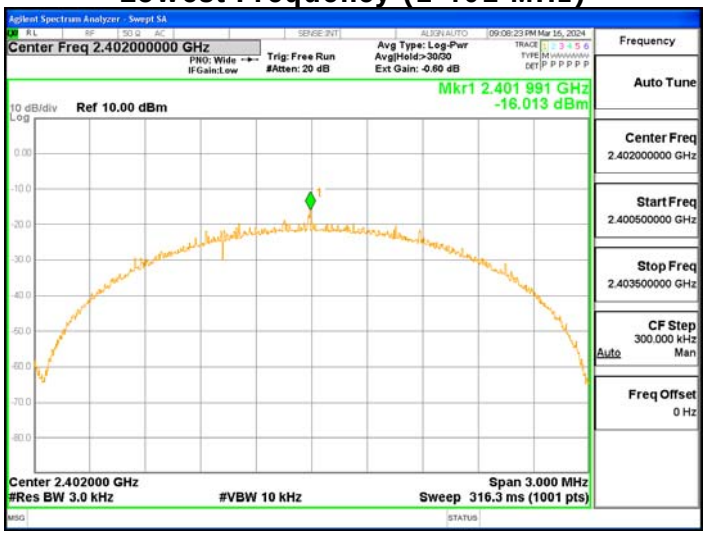


Highest Frequency (2 480 MHz)

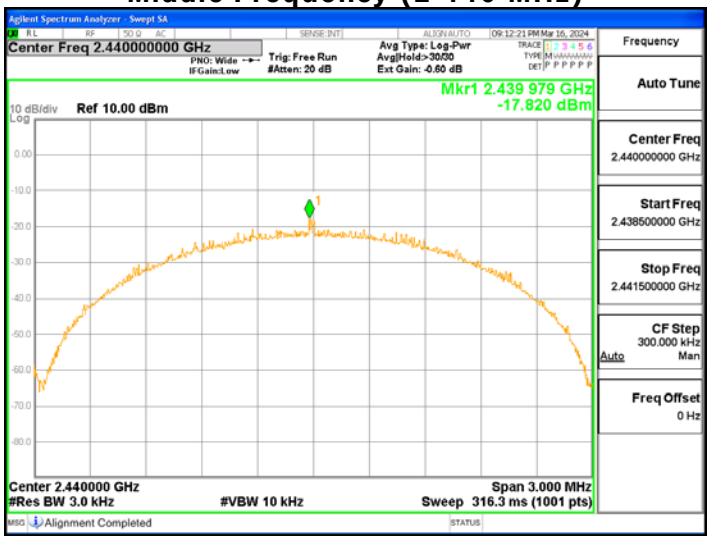


Test mode: BLE_PHY 2M

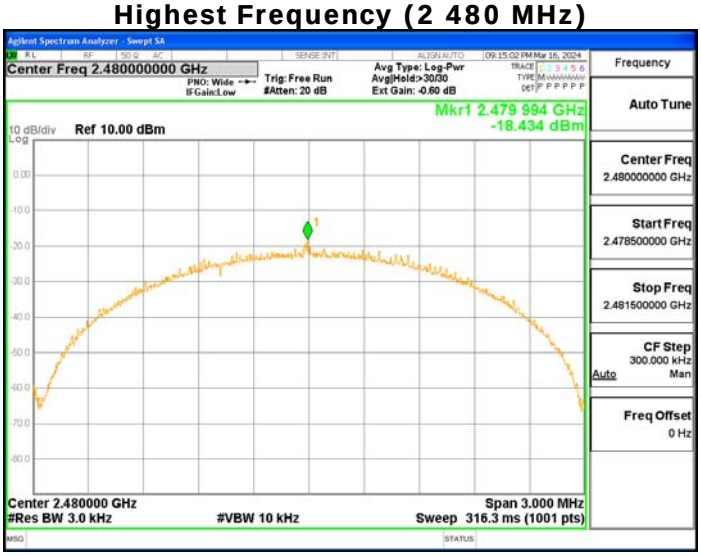
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

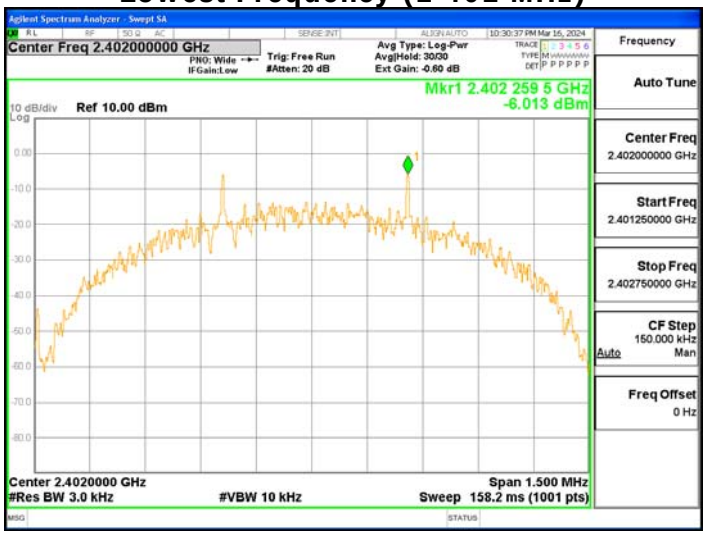


Highest Frequency (2 480 MHz)

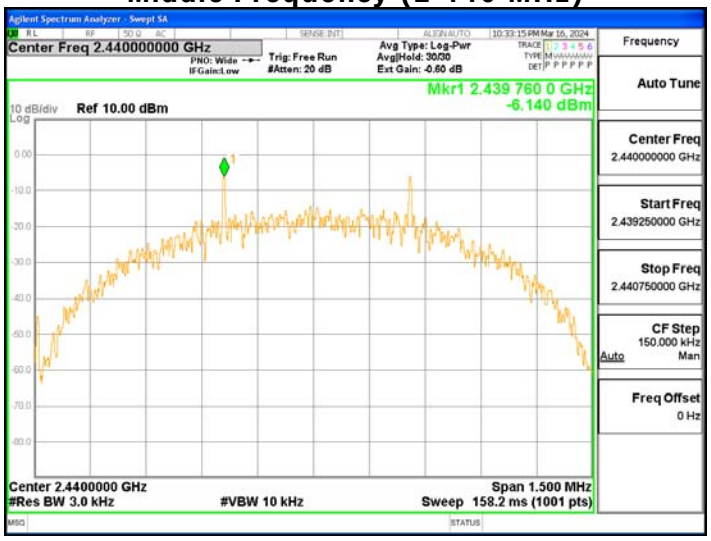


Test mode: BLE_PHY Coded(S=2)

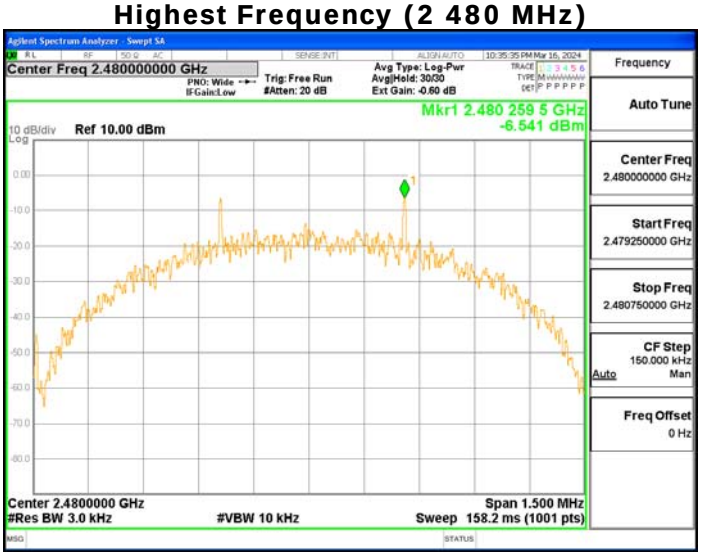
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)

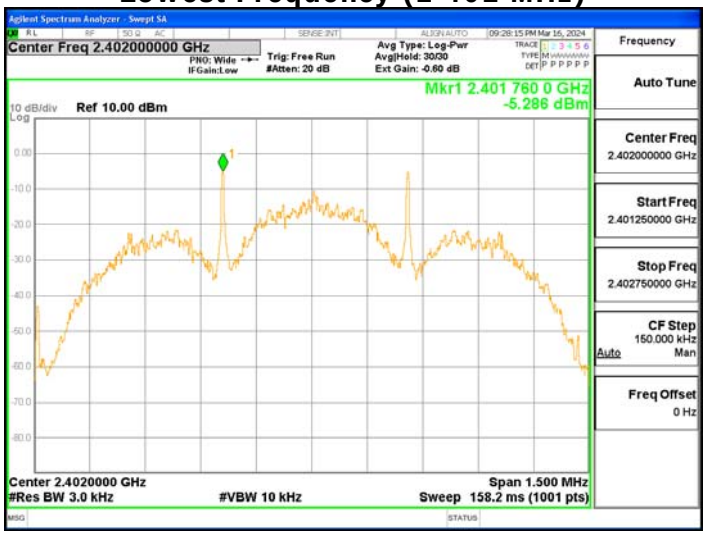


Highest Frequency (2 480 MHz)

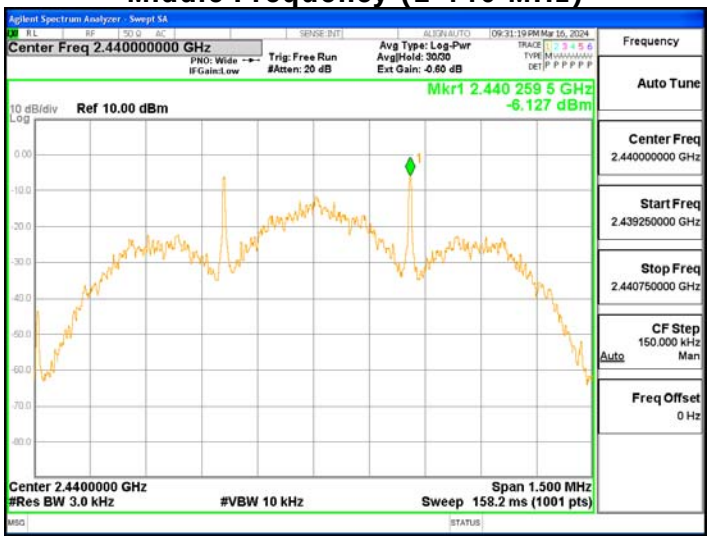


Test mode: BLE_PHY Coded(S=8)

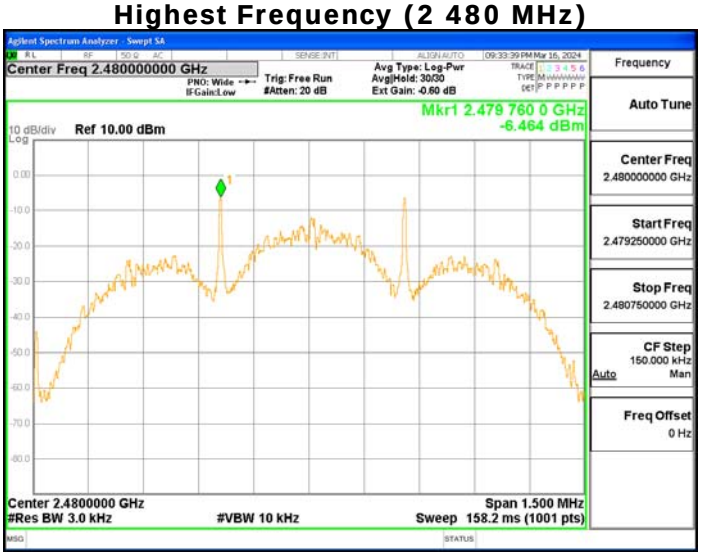
Lowest Frequency (2 402 MHz)



Middle Frequency (2 440 MHz)



Highest Frequency (2 480 MHz)



4.4 Conducted Spurious emission

Test Procedures

KDB 558074 - Section 8.5
ANSI C63.10-2013 - Section 11.11.3

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

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(4), 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 Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz
b) VBW ≥ 3 x RBW
c) Detector = peak
d) Sweep time = auto couple
e) Trace mode= max hold
f) Allow trace to fully stabilize
g) Use the peak marker function to determine the maximum amplitude level.

Limit :

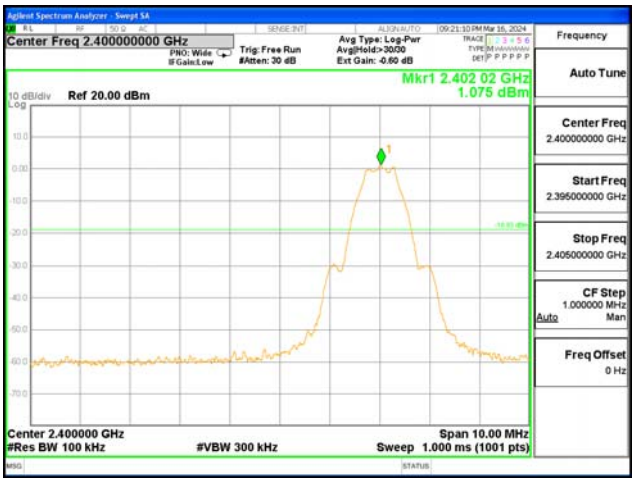
Emission level < 20 dBc

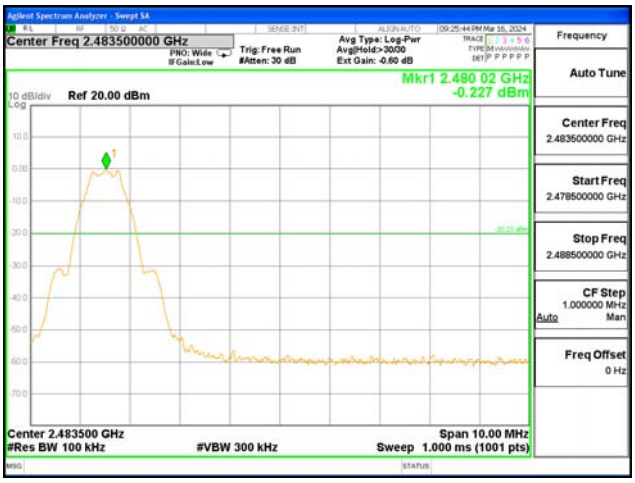
Test results: Complies

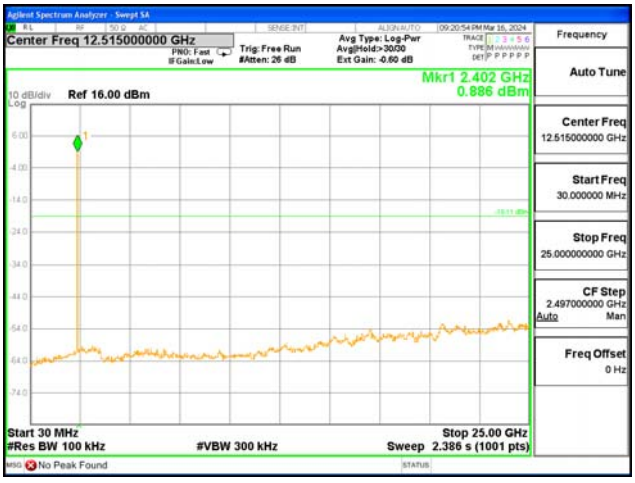
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest in-band spectral density. Therefore the applying equipment meets the requirement.

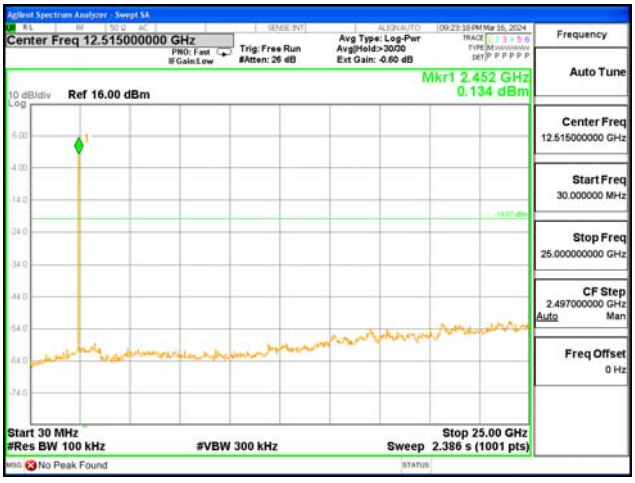
See next pages for actual measured spectrum plots.

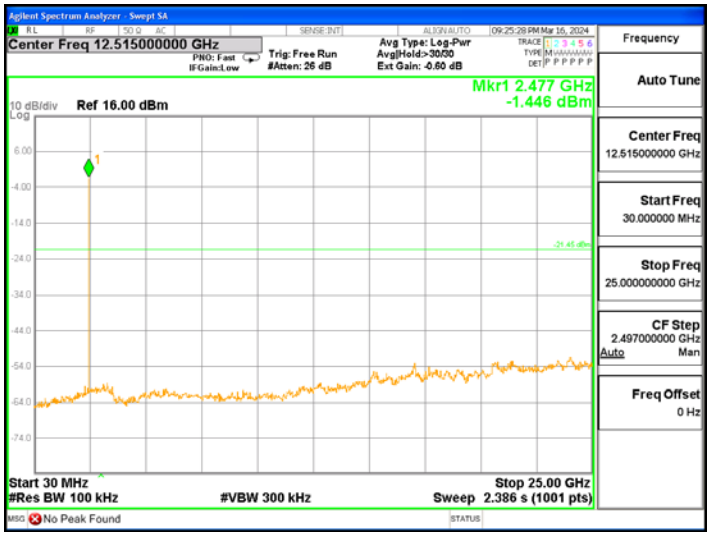
Test Data:
Test Mode: BLE_PHY 1M



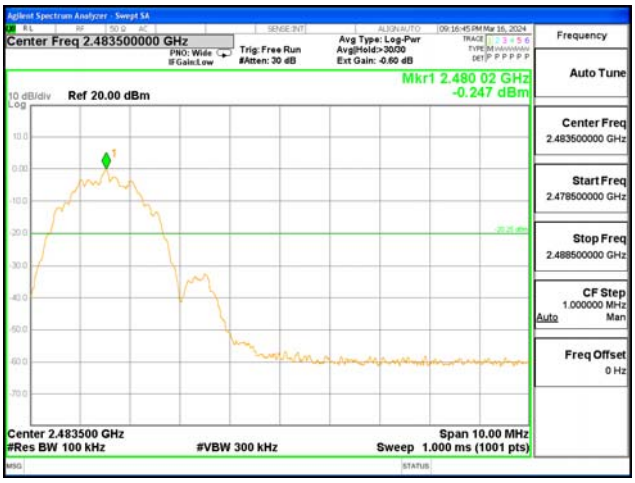


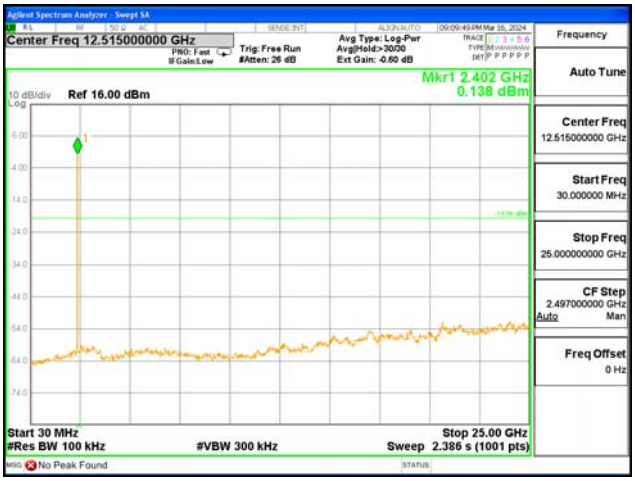


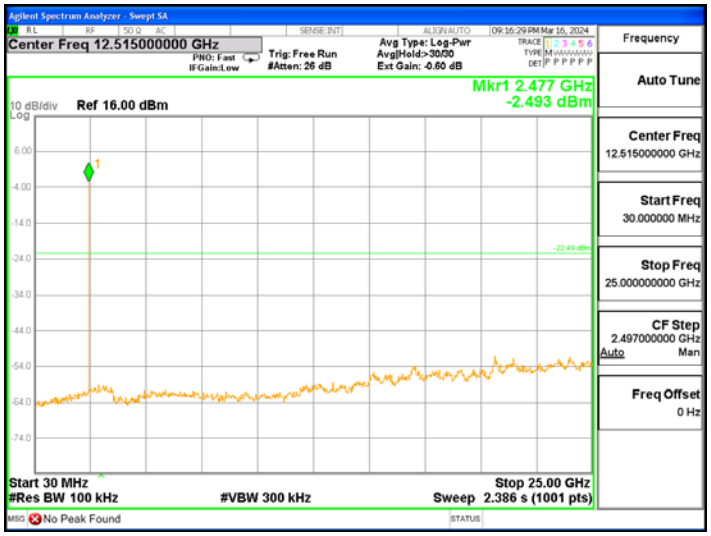




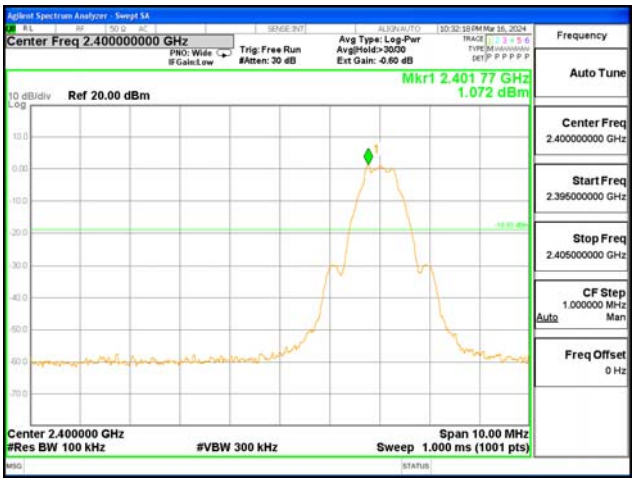
Test Mode: BLE_PHY 2M

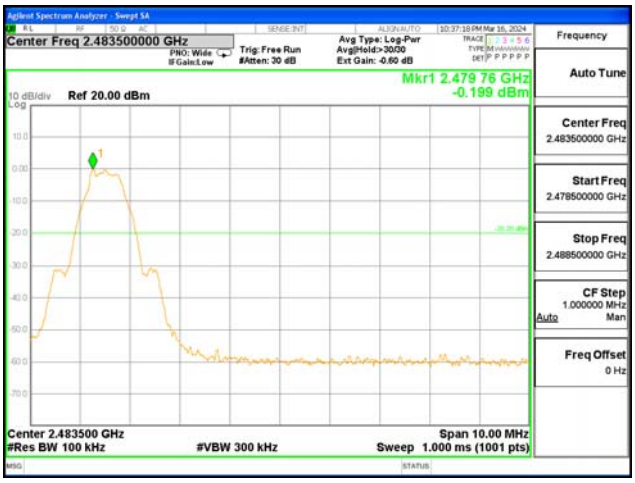


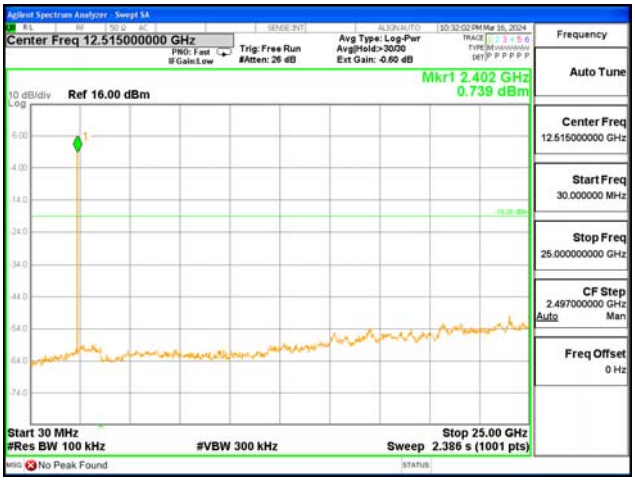


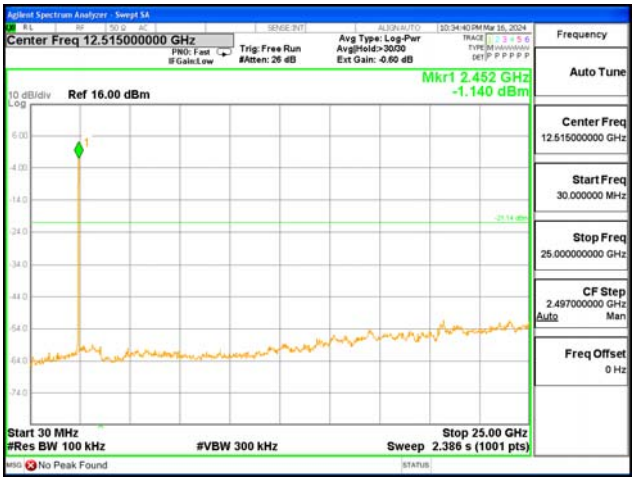


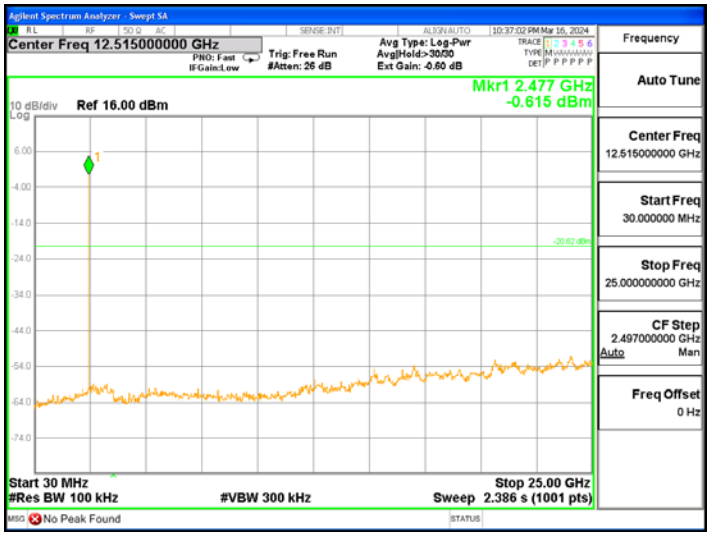
Test Mode: BLE_PHY Coded(S=2)



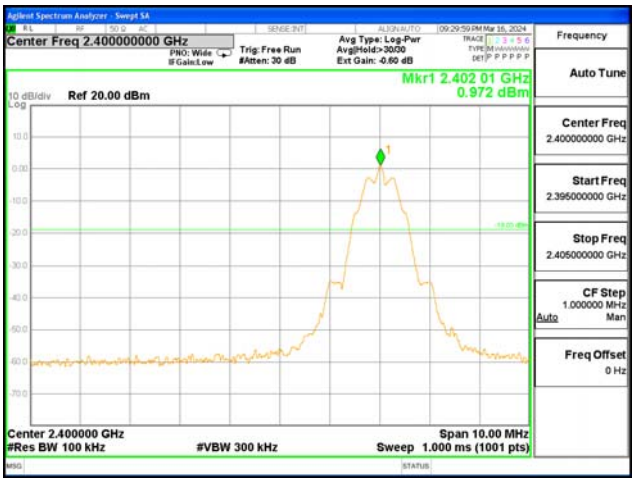


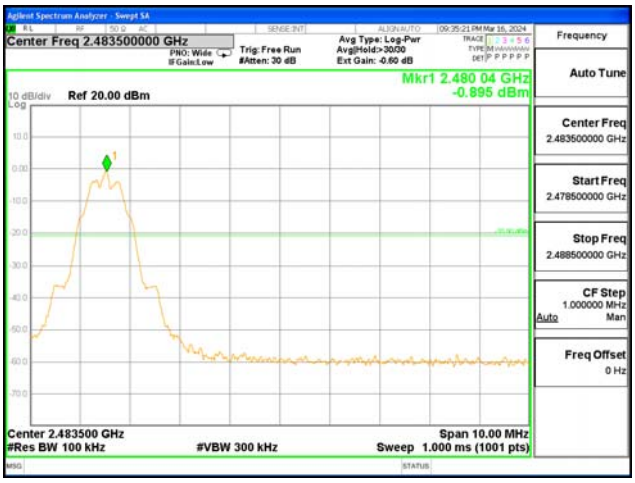


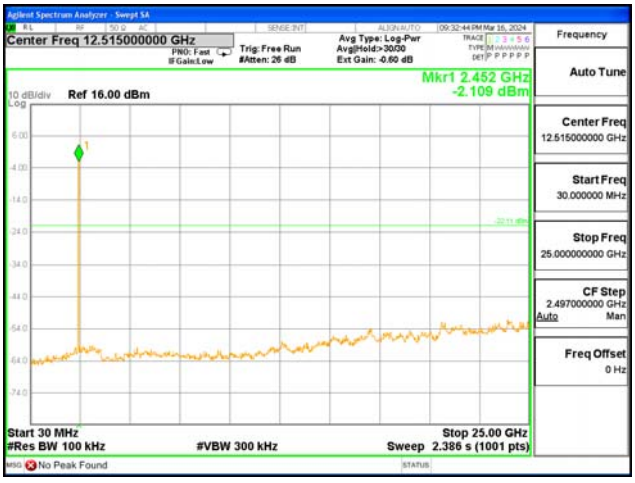


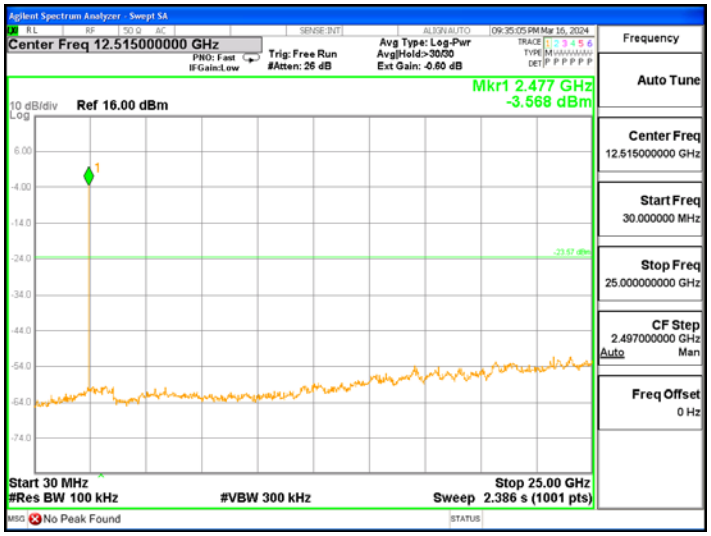


Test Mode: BLE_PHY Coded(S=8)









4.5 Radiated Emission

Test Location

☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

KDB 558074 - Section 8.5, 8.6
ANSI C63.10-2013 - Section 11.11, 11.12

1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
2) In the frequency rage above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings:

Frequency Range = 9 kHz ~ 1 GHz

a) RBW = 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz

b) VBW ≥ RBW

c) Detector = CISPR Quasi-peak

d) Sweep time = auto couple

- Peak

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10^{th} harmonic)

a) RBW = 1 MHz

b) VBW ≥ 3 x RBW

c) Detector = Peak

d) Sweep time = auto

e) Trace mode = max hold

- Average (duty cycle ≥ 98%)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10^{th} harmonic)

a) RBW = 1 MHz

b) VBW ≥ 3 x RBW

c) Detector = RMS

d) Sweep time = auto

e) Averaging type = power (i.e., RMS)

f) Trace mode = average (at least 100 traces)

- Average (duty cycle < 98%, duty cycle variations are less than ±2%)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

a) RBW = 1 MHz

b) VBW ≥ 3 x RBW

c) Detector = RMS

d) Sweep time = auto

e) Averaging type = power (i.e., RMS)

f) Trace mode = average (at least 100 traces)

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.
If power averaging (RMS) mode, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

Mode	Duty Cycle	Duty Cycle Factor
BLE_PHY 1M	85.47	0.68
BLE_PHY 2M	57.60	2.40
BLE_PHY Coded(S=2)	57.12	2.43
BLE_PHY Coded(S=8)	82.80	0.82

Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
[1]0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	[2]Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2 Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 2. General Field Strength Limits for Licence-Exempt Transmitters

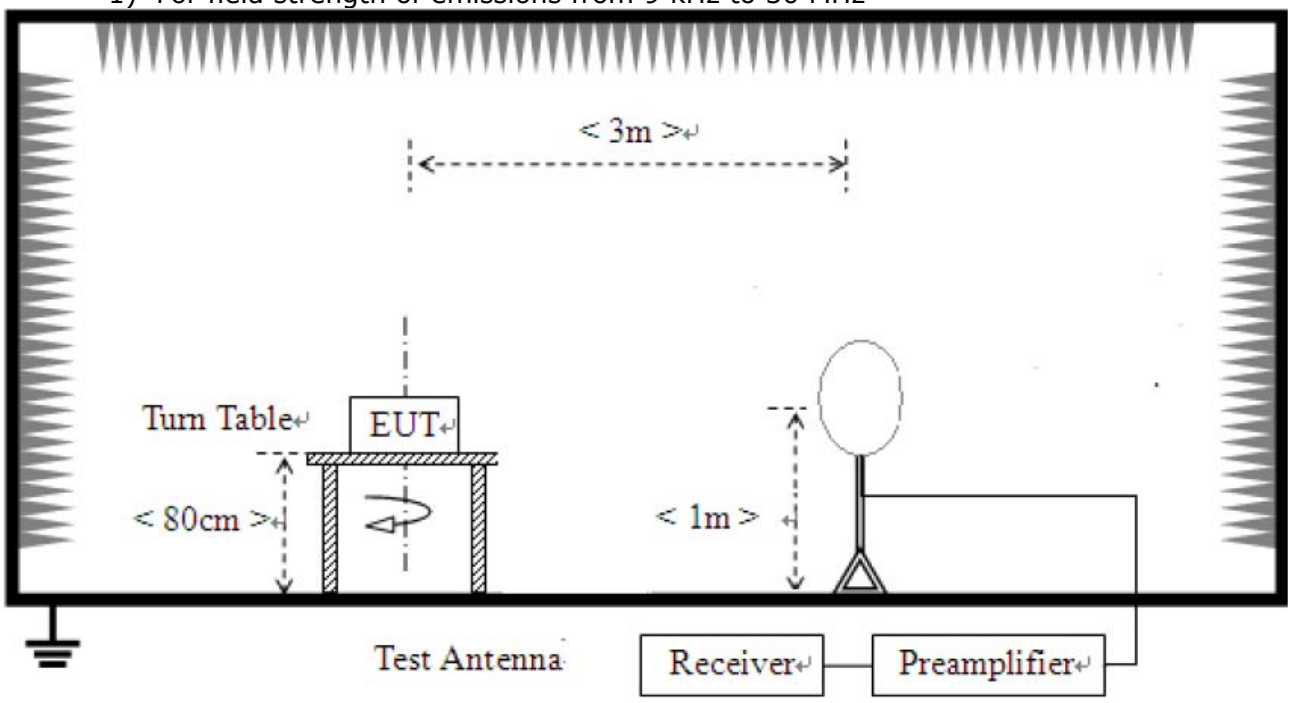
Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

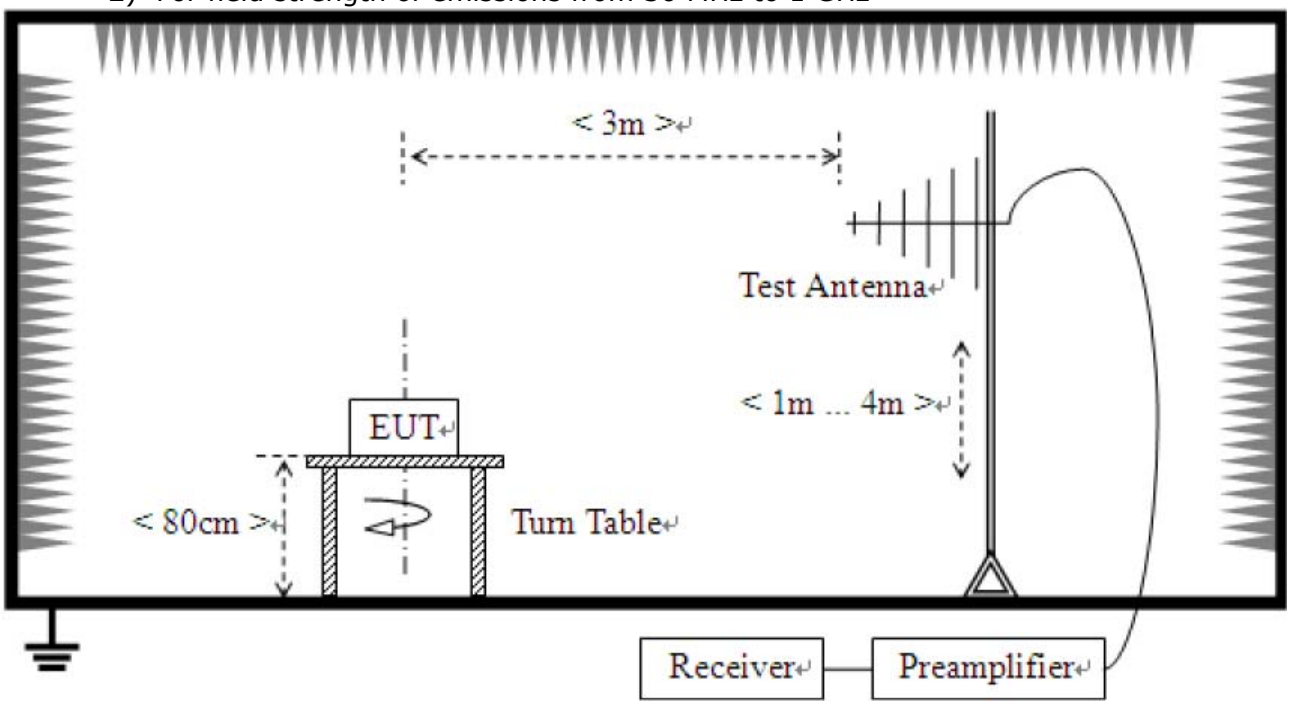
Note :
1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

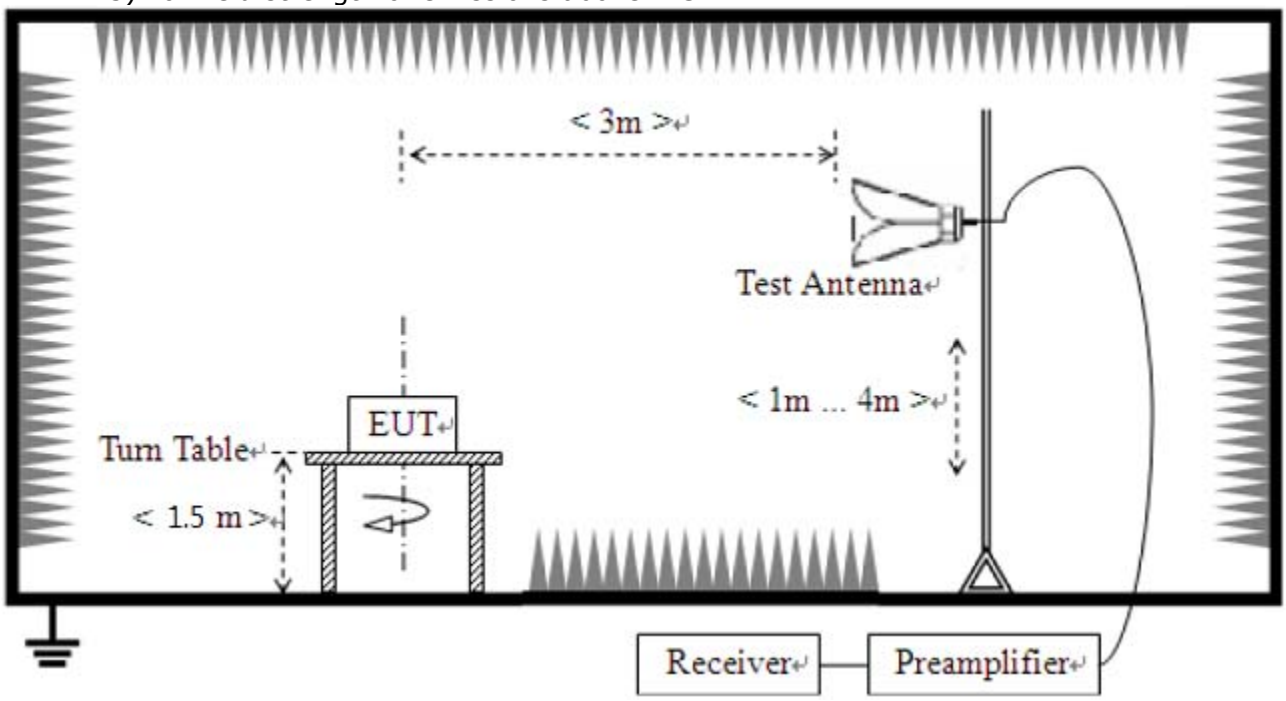
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



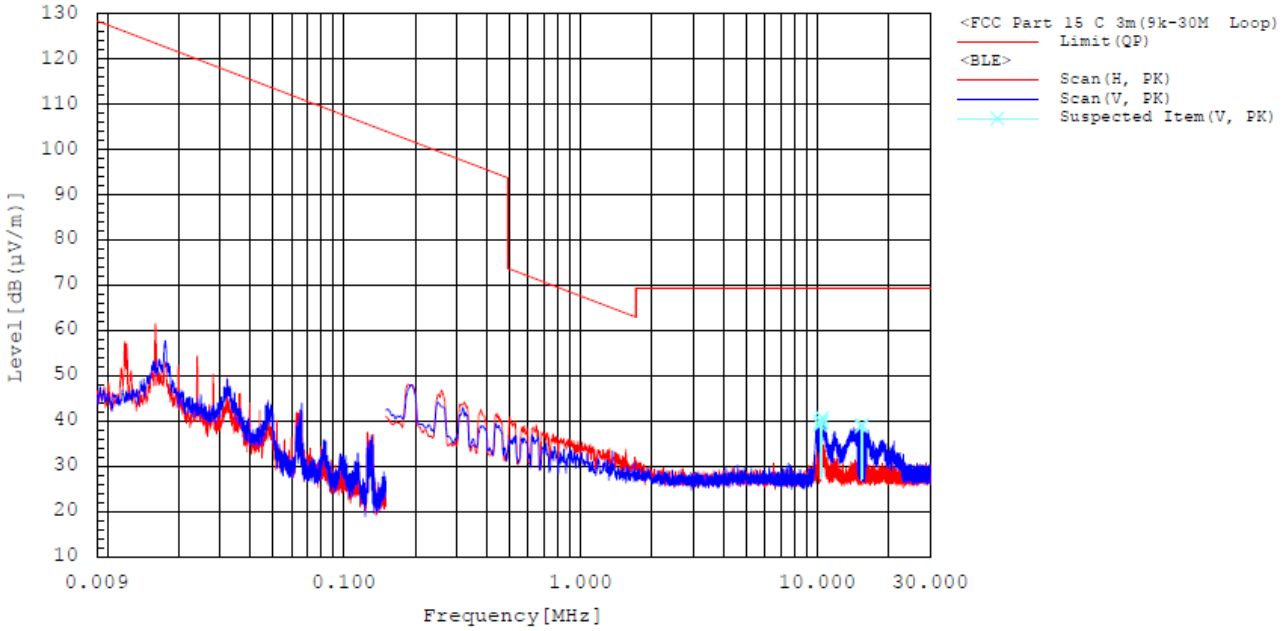
Test results

1) 9 kHz to 30 MHz

Test mode : BLE_PHY Coded(S=8)_Lowest channel(Worst Case)

The requirements are:
☒ Complies

Test Data



Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 9 kHz to 30 MHz were 20 dB lower than the limit.						

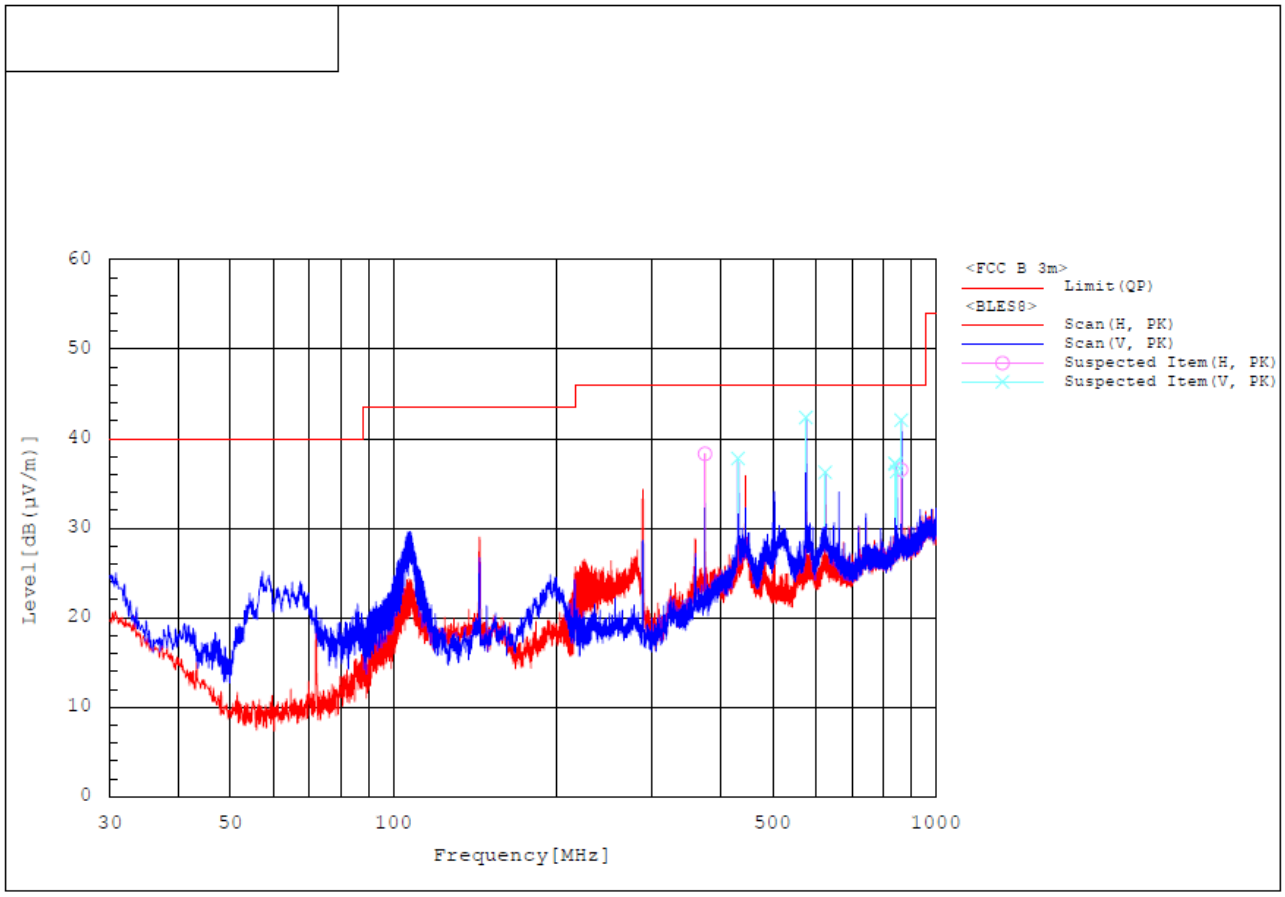
Remark :
1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down positon(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
4. This data is the Peak(PK) value.

2) 30 MHz to 1 GHz

Test mode : BLE_PHY Coded(S=8)_Lowest channel(Worst Case)

The requirements are:
☒ Complies

Test Data



Spectrum Selection

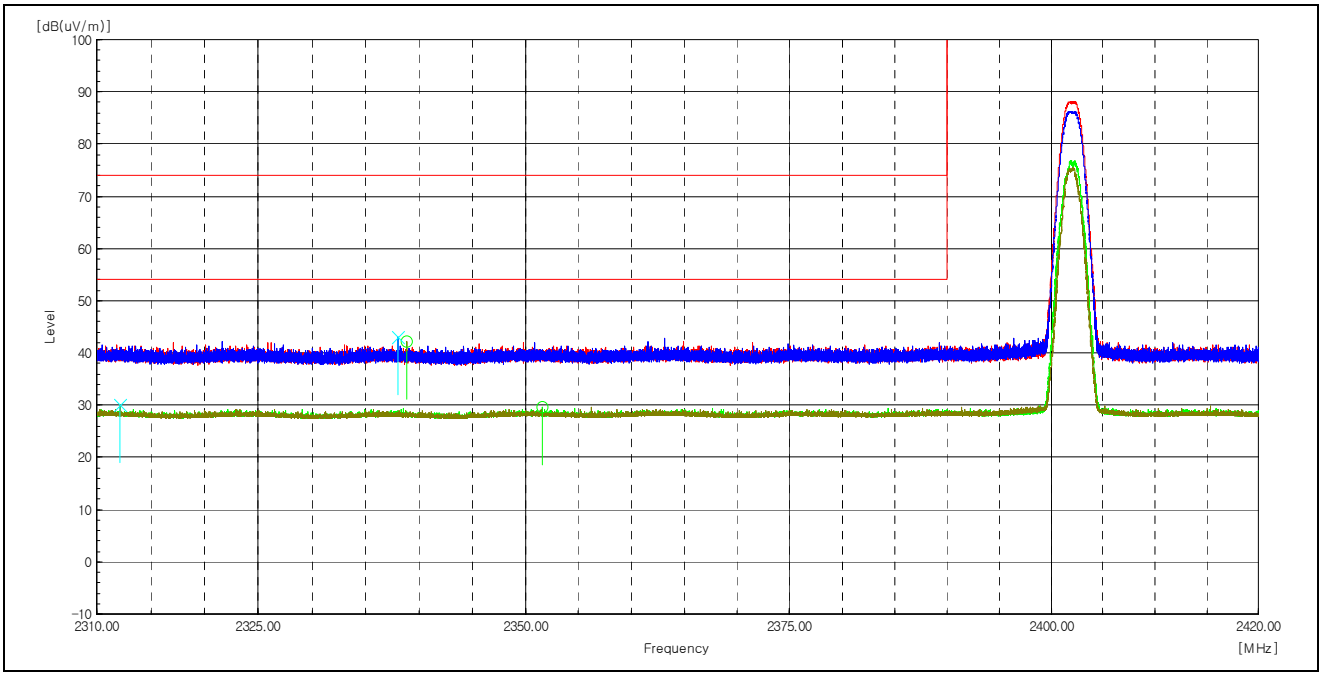
No.	Frequency [MHz]	Pol	Reading PK [dB(μV)]	c.f [dB(1/m)]	Result PK [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP-PK [dB]	Height [cm]	Angle [deg]	Remark
1	375.029	H	46.3	-8.0	38.3	46.0	7.7	99.9	117.0	
2	431.483	V	43.7	-5.9	37.8	46.0	8.2	99.9	359.6	
3	575.625	V	44.6	-2.2	42.4	46.0	3.6	99.9	31.9	
4	624.998	V	38.3	-2.1	36.2	46.0	9.8	99.9	357.1	
5	840.338	V	35.1	2.1	37.2	46.0	8.8	99.9	357.9	
6	842.957	V	34.9	2.3	37.2	46.0	8.8	99.9	359.6	
7	846.934	V	33.7	2.6	36.3	46.0	9.7	99.9	211.5	
8	862.551	H	33.5	3.0	36.5	46.0	9.5	399.9	93.2	
9	862.842	V	39.1	3.0	42.1	46.0	3.9	99.9	357.2	

Remark :
1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down positon(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

3) 2 310 MHz to 2 390 MHz

The requirements are:
☒ Complies

Test DATA : BLE_PHY 1M Lowest channel



Test mode : BLE_PHY 1M Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 310 MHz to 2 390 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY 2M Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 310 MHz to 2 390 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY Coded(S=2) Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 310 MHz to 2 390 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY Coded(S=8) Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 310 MHz to 2 390 MHz were 20 dB lower than the limit.						

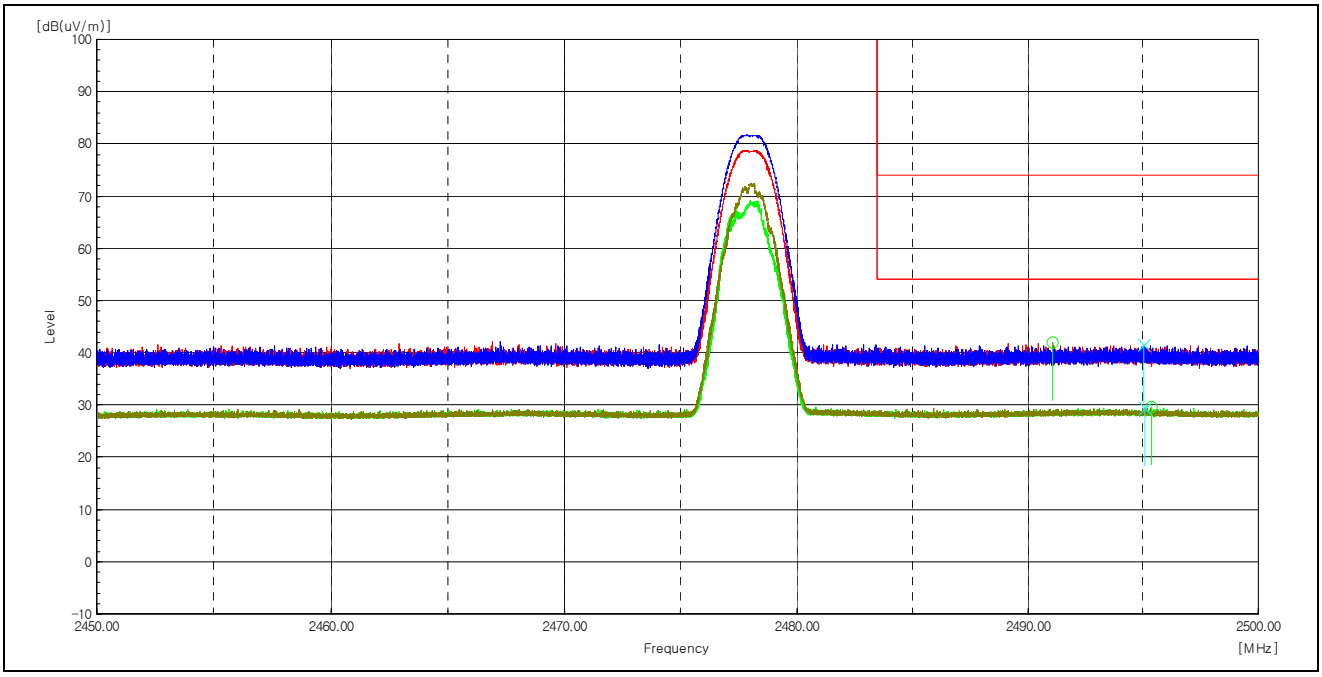
Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. Tested at 100% duty cycle.

4) 2 483.5 MHz – 2 500 MHz

The requirements are:
☒ Complies

Test DATA : BLE_PHY 1M Highest channel



Test mode : BLE_PHY 1M Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 483.5 MHz to 2 500 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY 2M Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 483.5 MHz to 2 500 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY Coded(S=2) Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 2 483.5 MHz to 2 500 MHz were 20 dB lower than the limit.						

Test mode : BLE_PHY Coded(S=8) Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]

The emissions 2 483.5 MHz to 2 500 MHz were 20 dB lower than the limit.

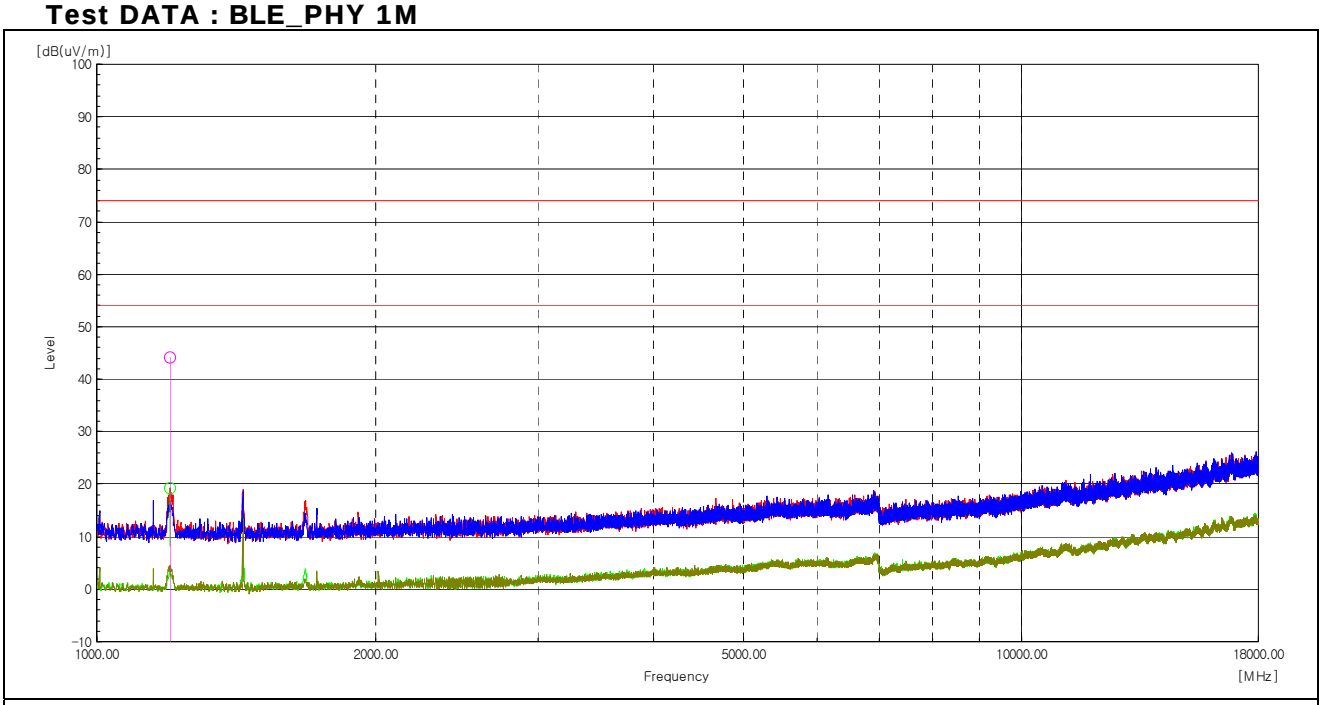
Remarks

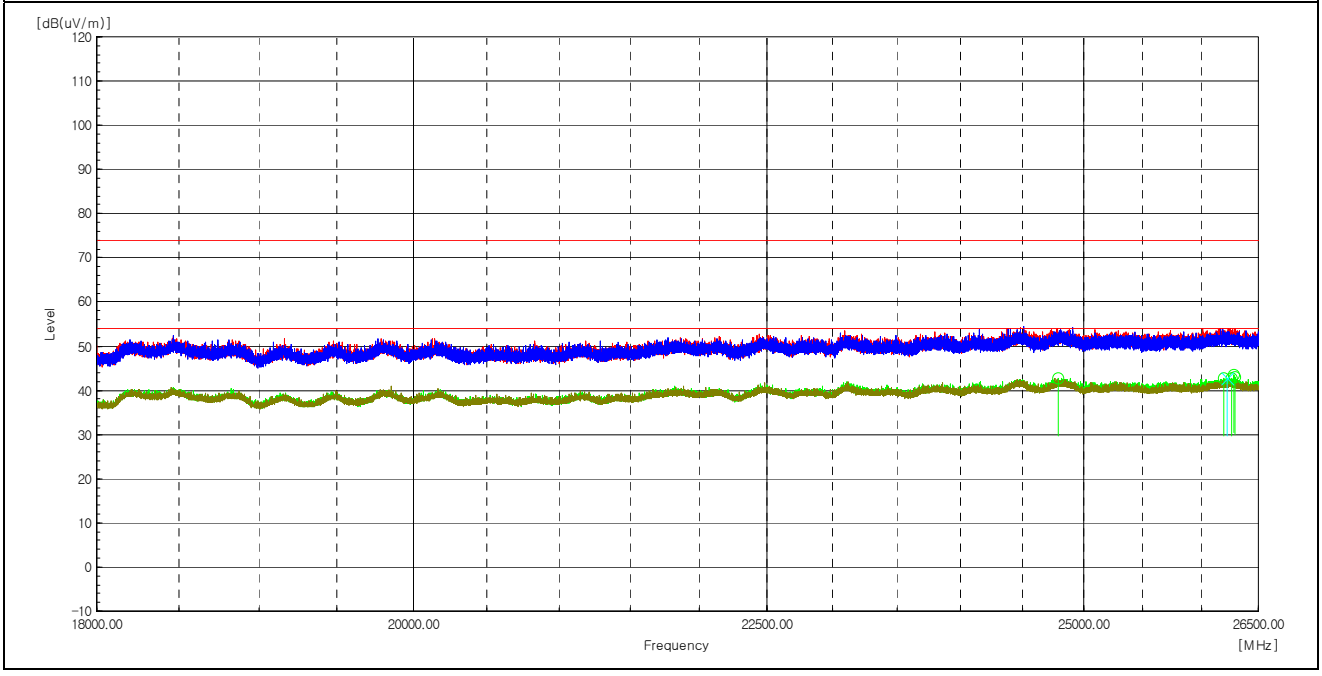
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. Tested at 100% duty cycle.

5) 1 GHz to 26.5 GHz

The requirements are:
☒ Complies

Test DATA : BLE_PHY 1M





Test mode : BLE_PHY 1M

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 200.6	H	55.1	-11.0	44.1	74.0	29.9	Peak

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	54.4	-9.9	44.5	74.0	29.5	Peak

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	H	56.8	-9.9	46.9	74.0	27.1	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. The 18 GHz end had no signal detected. As can be seen from the conducted spurious emission test, no signal was detected in the section.
5. Tested at 100% duty cycle.

Test mode : BLE_PHY 2M

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.7	V	54.4	-9.9	44.5	74.0	29.5	Peak

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 199.9	V	53.8	-11.0	42.8	74.0	31.2	Peak

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	54.1	-9.9	44.2	74.0	29.8	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. The 18 GHz end had no signal detected. As can be seen from the conducted spurious emission test, no signal was detected in the section.
5. Tested at 100% duty cycle.

Test mode : BLE_PHY Coded(S=2)

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	54.0	-9.9	44.1	74.0	29.9	Peak

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	53.9	-9.9	44.0	74.0	30.0	Peak

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	53.5	-9.9	43.6	74.0	30.4	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. The 18 GHz end had no signal detected. As can be seen from the conducted spurious emission test, no signal was detected in the section.
5. Tested at 100% duty cycle.

Test mode : BLE_PHY Coded(S=8)

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 439.3	V	53.5	-9.9	43.6	74.0	30.4	Peak

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 199.9	V	53.6	-11.0	42.6	74.0	31.4	Peak

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Note
1 440.0	V	53.1	-9.9	43.2	74.0	30.8	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. The 18 GHz end had no signal detected. As can be seen from the conducted spurious emission test, no signal was detected in the section.
5. Tested at 100% duty cycle.

4.6 AC Conducted Emissions

Frequency Range of Measurement
150 kHz to 30 MHz

Instrument Settings
IF Band Width: 9 kHz

Test Procedures

ANSI C63.10-2013 - Section 6.2

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit
- **15.207(a)**

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

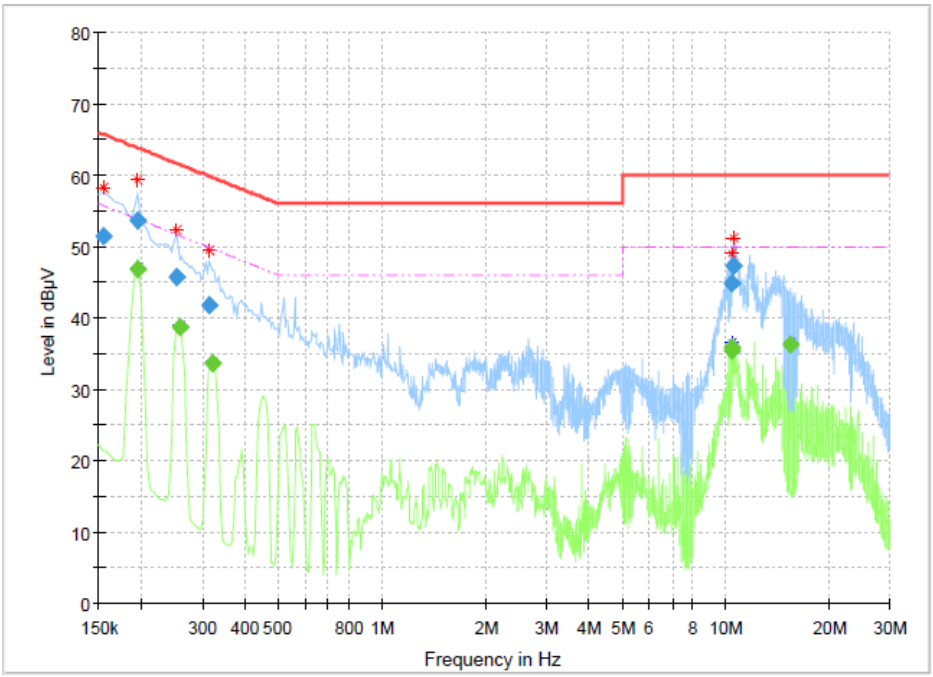
* The level decreases linearly with the logarithm of the frequency.
** A linear average detector is required.

Test Results

The requirements are:
☒ Complies

Test Data

BLE_PHY Coded(S=8)_Lowest channel(Worst case)



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.154500	51.37	---	65.75	14.38	15000.0	9.000	N	ON	9.8
0.195000	---	46.75	53.82	7.07	15000.0	9.000	N	ON	9.8
0.195000	53.60	---	63.82	10.22	15000.0	9.000	N	ON	9.8
0.253500	45.74	---	61.64	15.90	15000.0	9.000	N	ON	9.6
0.258000	---	38.70	51.50	12.79	15000.0	9.000	N	ON	9.6
0.316500	41.85	---	59.80	17.95	15000.0	9.000	N	ON	9.8
0.321000	---	33.57	49.68	16.11	15000.0	9.000	N	ON	9.8
10.365000	---	35.80	50.00	14.20	15000.0	9.000	N	ON	9.9
10.383000	44.92	---	60.00	15.08	15000.0	9.000	L1	ON	9.8
10.428000	---	35.44	50.00	14.56	15000.0	9.000	N	ON	9.9
10.540500	47.29	---	60.00	12.71	15000.0	9.000	N	ON	9.9
15.355500	---	36.23	50.00	13.77	15000.0	9.000	N	ON	10.0

APPENDIX A – Test Equipment Used For Tests

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY50510324	2023-12-05	2024-12-05
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2023-03-22 2024-03-21	2024-03-22 2025-03-21
3	EMI TEST RECEIVER	Rohde & Schwarz	ESW44	102039	2023-05-03	2024-05-03
4	BILOG ANTENNA	TESEQ	CBL6111D	60654	2023-08-21	2025-08-21
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2023-04-15	2025-04-15
6	6dB Attenuator	PASTERNACK	PE7AP006-06	L20210504000023	2023-08-04	2024-08-04
7	AMPLIFIER	SONOMA INSTRUMENT	310N	411011	2023-08-04	2024-08-04
8	Spectrum Analyzer	R&S	FSV40	101574	2024-01-15	2025-01-15
9	PRE AMPLIFIER	HP	8449B	3008A00620	2023-04-21	2024-04-21
10	Double Ridged Guide Antenna	ETS-Lindgren	3115	00078895	2023-04-13	2024-04-13
11	HORN ANTENNA	SCHWARZBECK	BBHA9170	1153	2023-10-19	2024-10-19
12	LOW NOISE AMPLIFIER	TESTEK	TK-PA1840H	210124-L	2023-10-23	2024-10-23
13	Band Reject Filter	Micro Tronics	BRM50702	G233	2023-12-04	2024-12-04
14	EMI Test Receiver	R&S	ESR3	102826	2023-05-03	2024-05-03
15	LISN	R&S	ENV216	102698	2023-05-03	2024-05-03
16	6dB Attenuator	NONE	6dB	190557	2023-09-25	2024-09-25

No.	Cable	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable (Conducted)	Junkosha Inc.	MWX221	1512S151	2023-08-21
2	RF Cable (Conducted)	Junkosha Inc.	MWX221	1512S148	2023-08-21
3	RF Cable (Line Conducted)	Canare Corporation	L-5D2W	N/A	2024-03-06
4	RF Cable (9kHz-30MHz Radiated)	Canare Corporation	L-5D2W	N/A	2024-03-06
5	RF Cable (9kHz-1GHz Radiated)	Canare Corporation	L-5D2W	N/A	2023-08-23
6	RF Cable (9kHz-1GHz Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2023-08-23
7	RF Cable (1GHz-18GHz Radiated)	Junkosha Inc.	MWX221	2008S246	2023-06-28
8	RF Cable (1GHz-18GHz Radiated)	Rosenberger	NONE	1520.9927.00	2023-06-28
9	RF Cable (1GHz-18GHz Radiated)	Sensorview Co., LTD	9S18	TPC2204060007	2023-06-28
10	RF Cable (18 GHz - 40 GHz Radiated)	Sensorview Co., LTD	9S40	TPC2204060009	2023-06-28
11	RF Cable (18 GHz - 40 GHz Radiated)	Sensorview Co., LTD	9A40	TP210713-001	2023-06-28

-END-