Microtest
微 测 检 测

Test Report

Report No.: MTi220530014-06E2

Date of issue: 2022-09-20

Applicant: Robosen Robotics (ShenZhen) Co., Ltd.

Product: robosen AI base

Model(s): ZNJD

FCC ID: 2ATNWZNJDT1

Shenzhen Microtest Co., Ltd.

http://www.mtitest.com

Address: 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Tel: (86-755)88850135 Fax: (86-755) 88850136 Web: www.mtitest.com E-mail: mti@51mti.com

Instructions

1. This test report shall not be partially reproduced without the written consent of the laboratory.

2. The test results in this test report are only responsible for the samples submitted

3. This test report is invalid without the seal and signature of the laboratory.

4. This test report is invalid if transferred, altered, or tampered with in any form without authorization.

5. Any objection to this test report shall be submitted to the laboratory within 15 days from the date of receipt of the report.

Contents

Test Result Certification	
Applicant:	**Robosen Robotics (ShenZhen) Co., Ltd.**
Address:	A3703, Bldg 11, Shenzhen Bay ECO-Tech Park, No.16,Gaoxin South Science and Tech Rd., Nanshan Dist., Shenzhen, Guangdong, China
Manufacturer:	**Robosen Robotics (ShenZhen) Co., Ltd.**
Address:	A3703, Bldg 11, Shenzhen Bay ECO-Tech Park, No.16,Gaoxin South Science and Tech Rd., Nanshan Dist., Shenzhen, Guangdong, China
Factory:	**Dongguan Jonter Digital Co., Ltd.**
Address:	Building 1, No. 5, Daguizi East Street, Tangjiao Village, Chashan Town, Dongguan, China
Product description	
Product name:	robosen AI base
Trademark:	robosen
Model name:	ZNJD
Serial Model:	N/A
Standards:	FCC 47 CFR Part 15 Subpart C
Test method:	ANSI C63.10-2013
Date of Test	
Date of test:	2022-08-26 ~ 2022-09-20
Test result:	Pass

Test Engineer : Cindy Qin

(Cindy Qin)

Reviewed By: Leon Chen

(Leon Chen)

Approved By: Tom Xue

(Tom Xue)

1 General Description

1.1 Description of EUT

Product name:	robosen AI base
Model name:	ZNJD
Series Model:	N/A
Model difference:	N/A
Electrical rating:	Input: DC 15V/2.4A
Hardware version:	V2.0
Software version:	V3.0
Accessories:	Adapter: Model: MD42A-1500240-U Input: 100-240V 50/60Hz 0.8A Output: 15V⎓2.4A 36.0W USB-C to USB-C cable: 95cm
EUT serial number:	MTi220530014-06-S0001
RF specification:	
Bluetooth version:	V4.2
Operation frequency:	2402 MHz ~ 2480 MHz
Modulation type:	GFSK
Antenna designation:	Chip antenna, antenna Gain: 2.85 dBi
Max. peak conducted output power:	-1.36 dBm

1.2 Description of test modes

1.2.1 Operation channel list

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

1.2.2 Test channels

Chanel	Frequency
Lowest (CH0)	2402MHz
Middle (CH19)	2440MHz
Highest (CH39)	2480MHz

Note: The test software has been used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

1.2.3 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
/	/	/	/

1.3 Measurement uncertainty

Parameter	Measurement uncertainty
AC power line conducted emission (9 kHz~30 MHz)	±2.5 dB
Occupied Bandwidth	±3 %
Conducted RF output power	±0.16 dB
Conducted spurious emissions	±0.21 dB
Radiated emission (9 kHz ~ 30 MHz)	±4.0 dB
Radiated emission (30 MHz~1 GHz)	±4.2 dB
Radiated emission (above 1 GHz)	±4.3 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2 Summary of Test Result

No.	FCC reference	Description of test	Result
1	§ 15.203	Antenna requirement	Pass
2	§ 15.207	AC power line conducted emissions	Pass
3	15.247(a)(2)	6dB occupied bandwidth	Pass
4	15.247(b)(3)	Conducted peak output power	Pass
5	15.247(e)	Power Spectral Density	Pass
6	15.247(d)	Conducted emission at the band edge	Pass
7	15.247(d)	Conducted spurious emissions	Pass
8	/	Duty Cycle	Pass
9	15.247(d)	Radiated spurious emissions	Pass

Note: N/A means not applicable.

3 Test Facilities and Accreditations

3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573

4 Equipment List

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTi-E002	EMI Test Receiver	R&S	ESCI3	101368	2022/05/05	2023/05/04
MTi-E023	Artificial power network	Schwarzbeck	NSLK8127	NSLK8127# 841	2022/05/05	2023/05/04
MTi-E025	Artificial power network	Schwarzbeck	NSLK8127	8127183	2022/05/05	2023/05/04
MTI-E043	EMI test receiver	R&S	ESCI7	101166	2022/05/05	2023/05/04
MTI-E046	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00044	2021/05/30	2023/05/29
MTI-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTI-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTI-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2022/05/05	2023/05/04
MTI-E048	Pre-amplifier	Agilent	8449B	3008A01120	2022/05/05	2023/05/04
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2022/04/15	2023/04/14
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2022/05/05	2023/05/04
MTi-E135	Horn antenna	Schwarzbeck	BBHA 9170	00987	2021/05/30	2023/05/29
MTi-E136	Pre-amplifier	Space-Dtronics	EWLAN1840G -G45	210405001	2022/05/05	2023/05/04
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2022/05/05	2023/05/04
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2022/05/05	2023/05/04
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2022/05/05	2023/05/04
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2022/05/05	2023/05/04
MTI-E010S	EMI Measurement Software	Farad	EZ-EMC Ver. EMEC-3A1	/	/	/
MTI-E014S	RF Test System	Tonscend	TS®JS1120 V2.6.88.0330	/	/	/

5 Test Result

5.1 Antenna requirement

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 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Description of the antenna of EUT

The antenna of EUT is Chip antenna (Antenna Gain: 2.85 dBi). which is no consideration of replacement.

5.2 AC power line conducted emissions

5.2.1 Limits

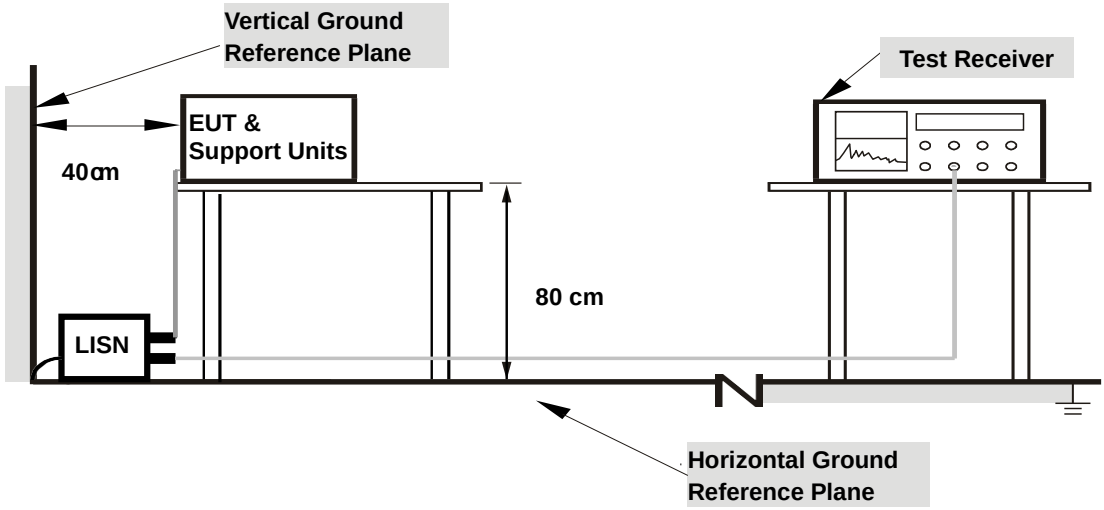
Frequency (MHz)	Detector type / Bandwidth	Limit-Quasi-peak dBµV	Limit-Average dBµV
0.15 -0.5	Average / 9 kHz	66 to 56	56 to 46
0.5 -5		56	46
5 -30		60	50

Note 1: the limit decreases with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz.

5.2.2 Test Procedures

a) The test setup is refer to the standard ANSI C63.10-2013.
b) The EUT is connected to the main power through a line impedance stabilization network (LISN). All support equipment is powered from additional LISN(s).
c) Emissions were measured on each current carrying line of the EUT using an EMI test receiver connected to the LISN powering the EUT.
d) The test receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes described in Item 1.2.
e) The test data of the worst-case condition(s) was recorded.

5.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the test setup.

5.2.4 Test Result

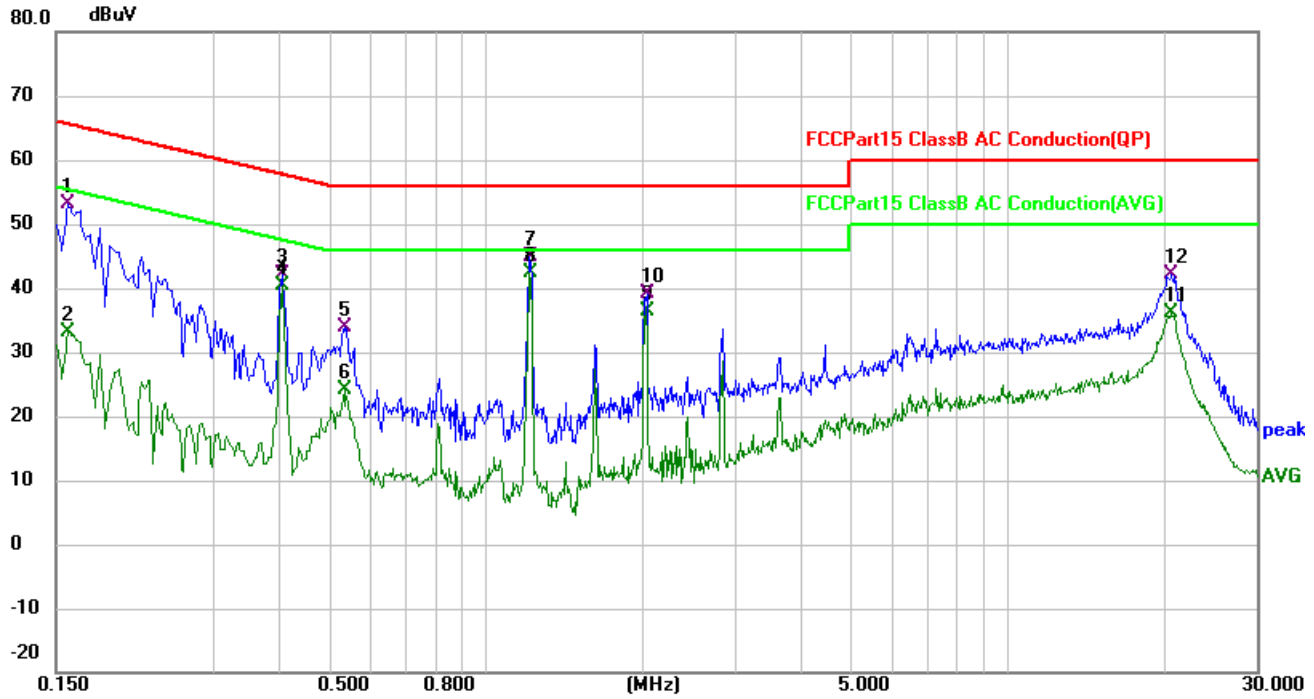
Notes:

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

Calculation formula:

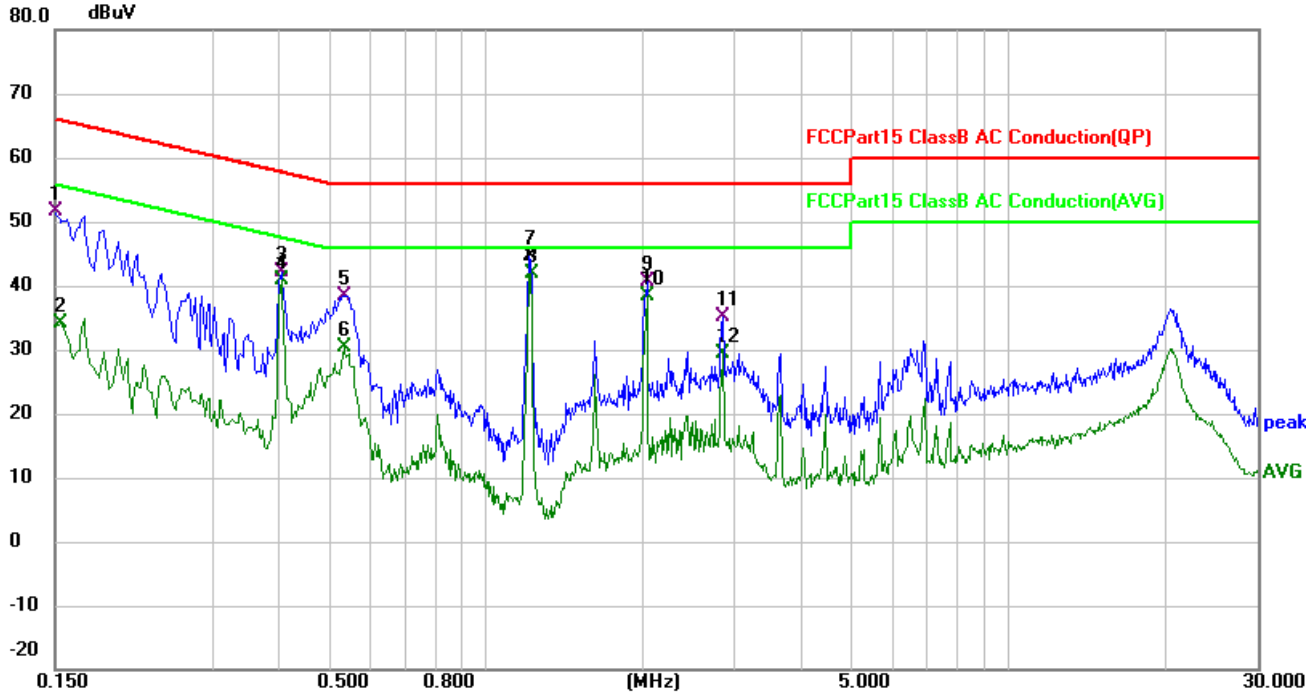
Measurement (dBµV) = Reading Level (dBµV) + Correct Factor (dB)
Over (dB) = Measurement (dBµV) – Limit (dBµV)

Test mode:	TX-2440MHz	Phase:	L
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	CE chamber 1



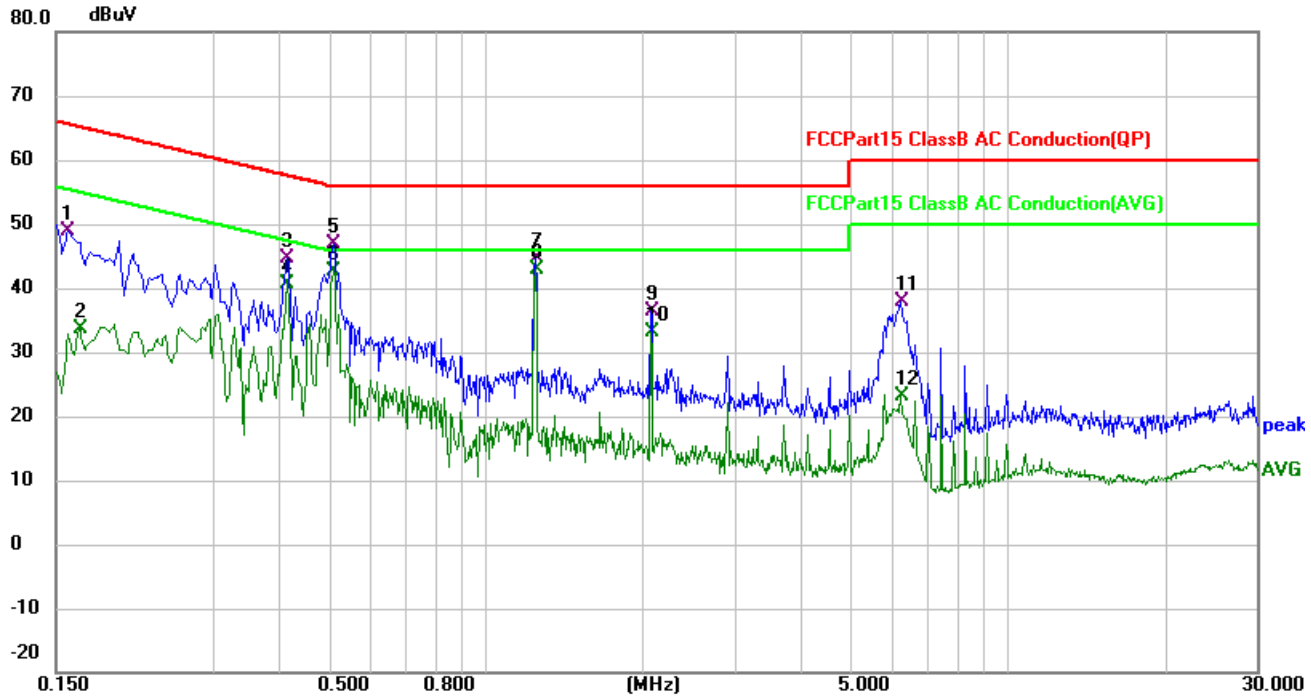
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1580	42.75	10.28	53.03	65.57	-12.54	QP
2	0.1580	22.91	10.28	33.19	55.57	-22.38	AVG
3	0.4060	30.93	11.12	42.05	57.73	-15.68	QP
4	0.4060	29.27	11.12	40.39	47.73	-7.34	AVG
5	0.5340	22.39	11.39	33.78	56.00	-22.22	QP
6	0.5340	12.62	11.39	24.01	46.00	-21.99	AVG
7	1.2139	32.06	12.74	44.80	56.00	-11.20	QP
8 *	1.2139	29.63	12.74	42.37	46.00	-3.63	AVG
9	2.0260	26.44	10.01	36.45	46.00	-9.55	AVG
10	2.0340	29.20	10.01	39.21	56.00	-16.79	QP
11	20.4980	25.53	10.66	36.19	50.00	-13.81	AVG
12	20.6100	31.37	10.66	42.03	60.00	-17.97	QP

Test mode:	TX-2440MHz	Phase:	N
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	CE chamber 1



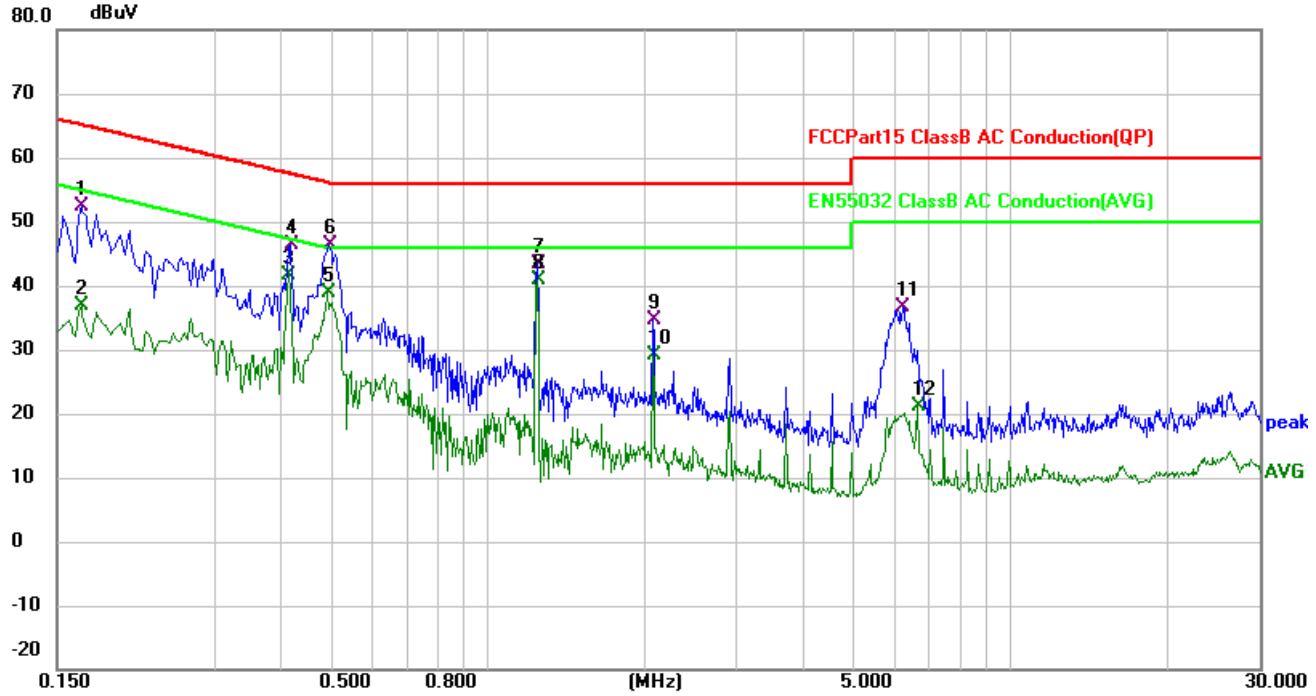
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1500	41.31	10.29	51.60	66.00	-14.40	QP
2	0.1539	23.96	10.28	34.24	55.79	-21.55	AVG
3	0.4060	31.12	11.06	42.18	57.73	-15.55	QP
4	0.4060	29.70	11.06	40.76	47.73	-6.97	AVG
5	0.5340	27.11	11.39	38.50	56.00	-17.50	QP
6	0.5340	18.87	11.39	30.26	46.00	-15.74	AVG
7	1.2139	31.87	12.78	44.65	56.00	-11.35	peak
8 *	1.2179	29.20	12.80	42.00	46.00	-4.00	AVG
9	2.0340	30.08	10.46	40.54	56.00	-15.46	QP
10	2.0340	27.95	10.46	38.41	46.00	-7.59	AVG
11	2.8500	24.71	10.32	35.03	56.00	-20.97	QP
12	2.8500	19.03	10.32	29.35	46.00	-16.65	AVG

Test mode:	TX-2440MHz	Phase:	L
Power supply:	Power by AC/DC adapter (AC 240V/60Hz)	Test site:	CE chamber 1



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1580	38.66	10.28	48.94	65.57	-16.63	QP
2	0.1660	23.39	10.28	33.67	55.16	-21.49	AVG
3	0.4138	33.58	11.12	44.70	57.57	-12.87	QP
4	0.4140	29.43	11.12	40.55	47.57	-7.02	AVG
5	0.5100	35.49	11.34	46.83	56.00	-9.17	QP
6	0.5100	31.25	11.34	42.59	46.00	-3.41	AVG
7	1.2460	31.87	12.81	44.68	56.00	-11.32	QP
8 *	1.2460	30.00	12.81	42.81	46.00	-3.19	AVG
9	2.0740	26.42	10.02	36.44	56.00	-19.56	QP
10	2.0740	23.14	10.02	33.16	46.00	-12.84	AVG
11	6.2260	27.65	10.27	37.92	60.00	-22.08	QP
12	6.2260	12.80	10.27	23.07	50.00	-26.93	AVG

Test mode:	TX-2440MHz	Phase:	N
Power supply:	Power by AC/DC adapter (AC 240V/60Hz)	Test site:	CE chamber 1



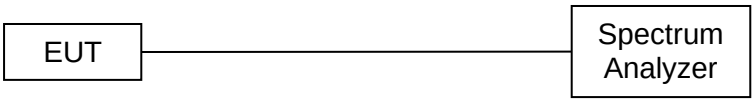
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1660	42.21	10.28	52.49	65.16	-12.67	QP
2	0.1660	26.56	10.28	36.84	55.16	-18.32	AVG
3	0.4140	30.58	11.12	41.70	47.57	-5.87	AVG
4	0.4180	35.16	11.14	46.30	57.49	-11.19	QP
5	0.4940	27.47	11.30	38.77	46.10	-7.33	AVG
6	0.4980	35.09	11.32	46.41	56.03	-9.62	QP
7	1.2460	30.50	12.81	43.31	56.00	-12.69	QP
8 *	1.2460	27.99	12.81	40.80	46.00	-5.20	AVG
9	2.0740	24.55	10.02	34.57	56.00	-21.43	QP
10	2.0740	19.09	10.02	29.11	46.00	-16.89	AVG
11	6.2300	26.38	10.27	36.65	60.00	-23.35	QP
12	6.6340	10.86	10.28	21.14	50.00	-28.86	AVG

5.3 6dB occupied bandwidth

5.3.1 Limits

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.

5.3.2 Test setup



5.3.3 Test procedures

a) Test method: ANSI C63.10-2013 Section 11.8.2.
b) The transmitter output of EUT is connected to the spectrum analyzer.
c) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, detector = Peak

5.3.4 Test results

Mode	Test channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
BLE 1Mbps	CH0	2402	0.6925	≥ 0.5
	CH19	2440	0.6995	≥ 0.5
	CH39	2480	0.7051	≥ 0.5

6dB occupied bandwidth

CH0

CH19

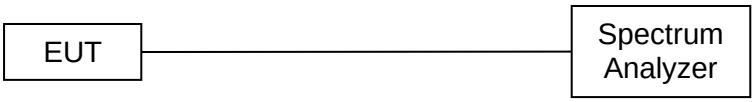
CH39

5.4 Conducted peak output power

5.4.1 Limits

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.4.2 Test setup



5.4.3 Test procedure

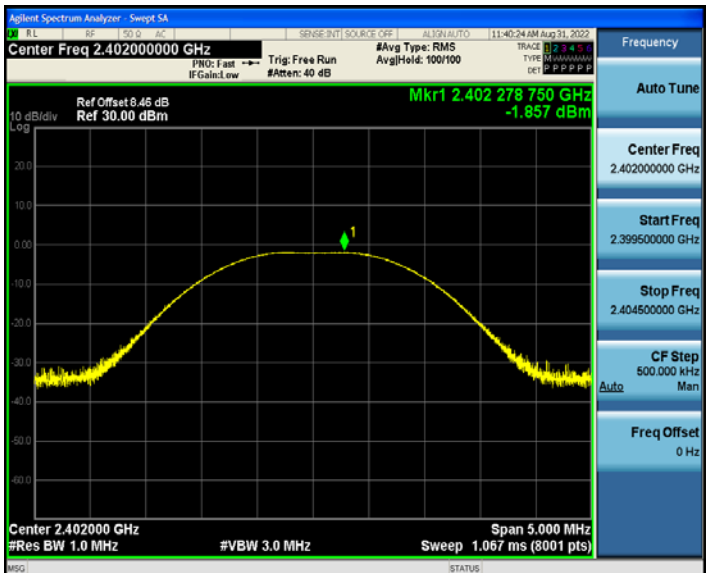
a) Test method: ANSI C63.10-2013 Section 11.9.1.1.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW ≥ 6dB occupied bandwidth, VBW ≥ 3 × RBW, detector = Peak

5.4.4 Test results

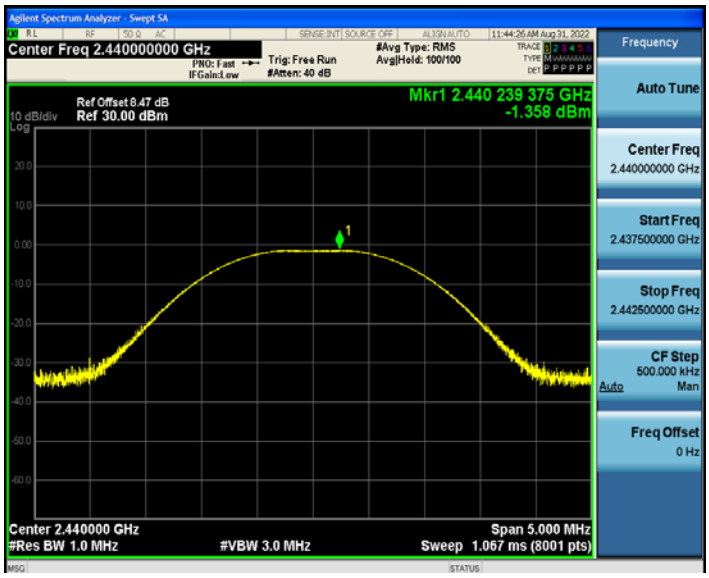
Mode	Test channel	Frequency (MHz)	Conducted peak output power (dBm)	Limit (dBm)
BLE 1Mbps	CH0	2402	-1.86	≤ 30
	CH19	2440	-1.36	≤ 30
	CH39	2480	-1.76	≤ 30

Peak conducted output power

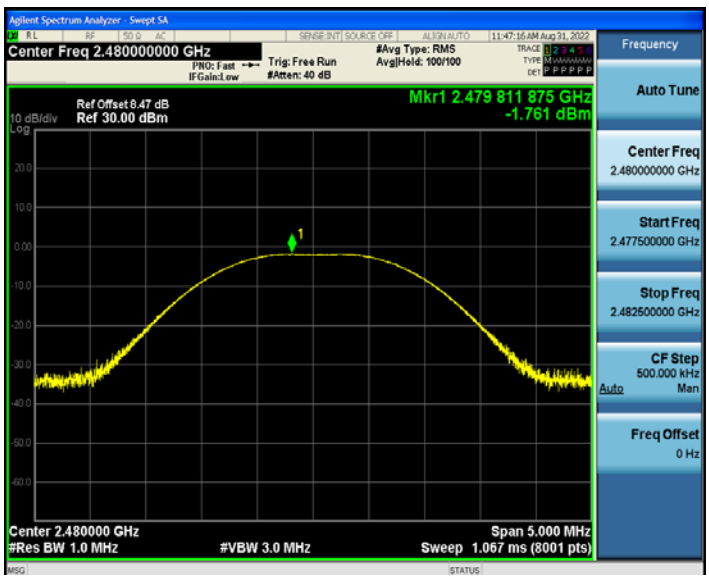
CH0



CH19



CH39

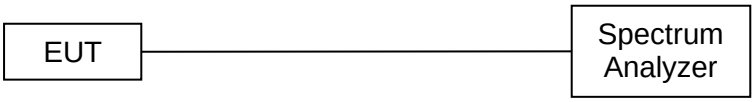


5.5 Power spectral density test

5.5.1 Limit

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.

5.5.2 Test setup



5.5.3 Test Procedure

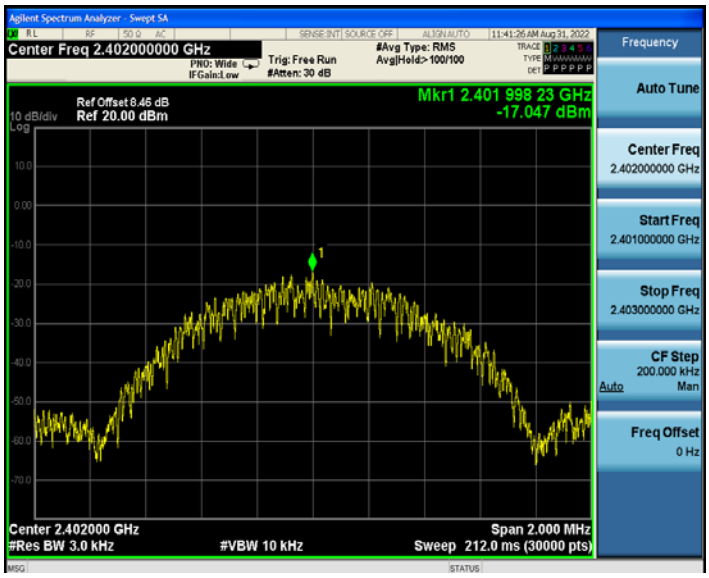
a) Test method: ANSI C63.10-2013 Section 11.10.2.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 3 kHz, VBW = 10 kHz, detector = Peak

5.5.4 Test Results

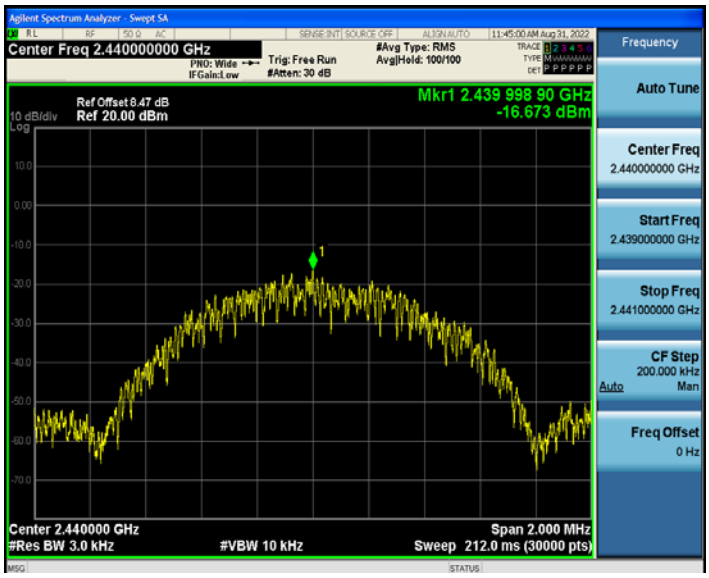
Mode	Test channel	Frequency (MHz)	Power spectral density (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1Mbps	CH0	2402	-17.05	≤ 8
	CH19	2440	-16.67	≤ 8
	CH39	2480	-17.09	≤ 8

Power spectral density

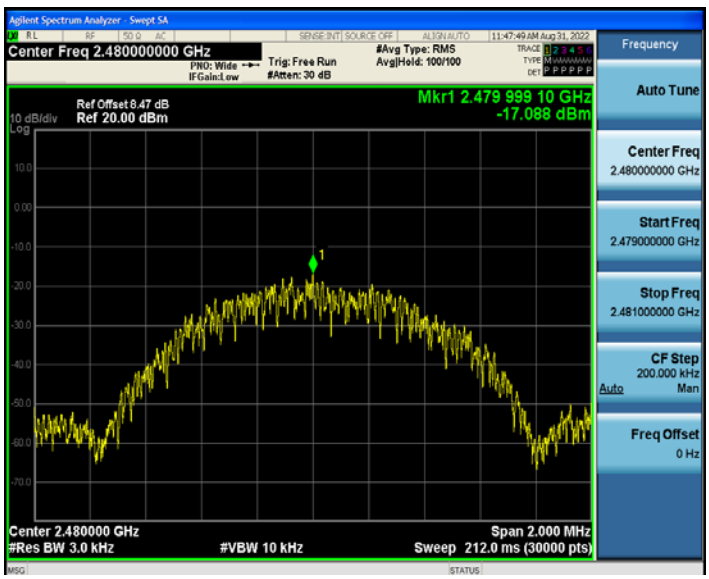
CH0



CH19



CH39

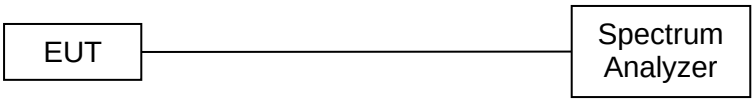


5.6 Conducted emissions at the band edge

5.6.1 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 (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)).

5.6.2 Test setup



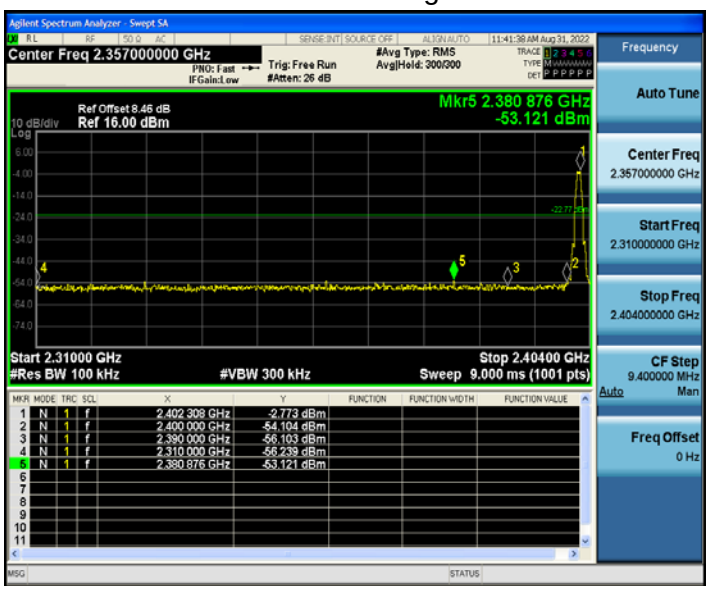
5.6.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 11.13
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

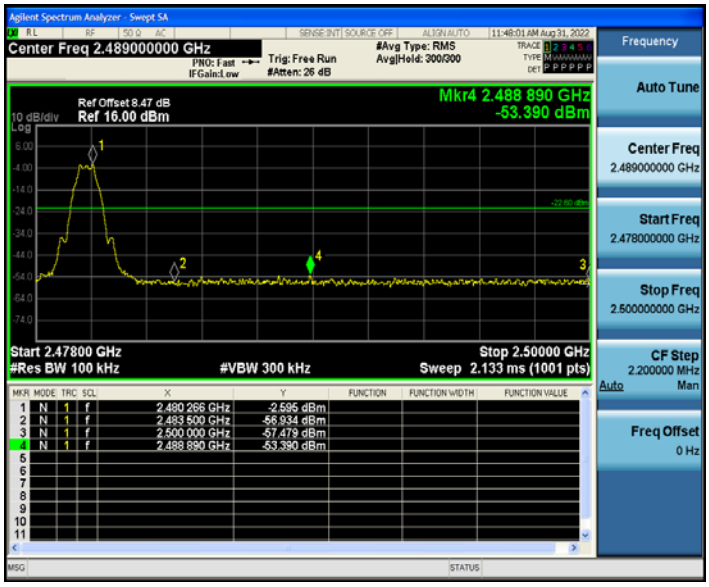
5.6.4 Test results

BLE 1Mbps - conducted emissions at the band edge

Low band-edge



High band-edge

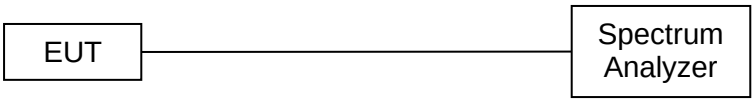


5.7 Conducted spurious emissions

5.7.1 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 (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)).

5.7.2 Test setup



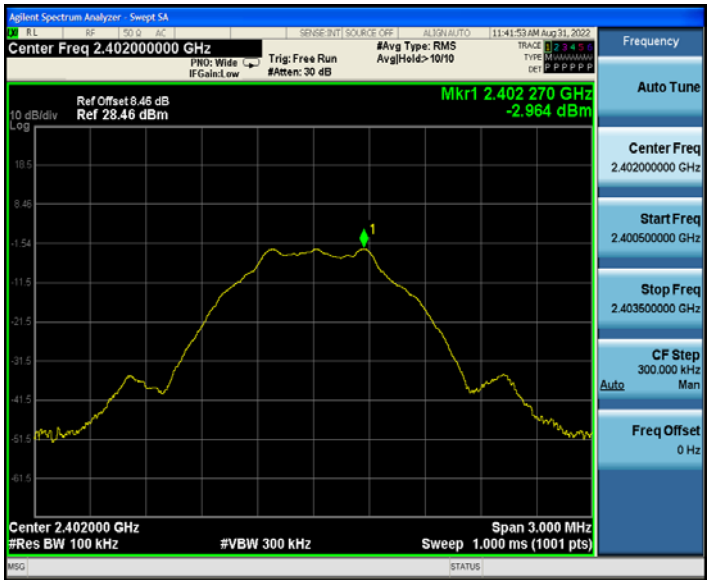
5.7.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 11.11 & 11.12.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

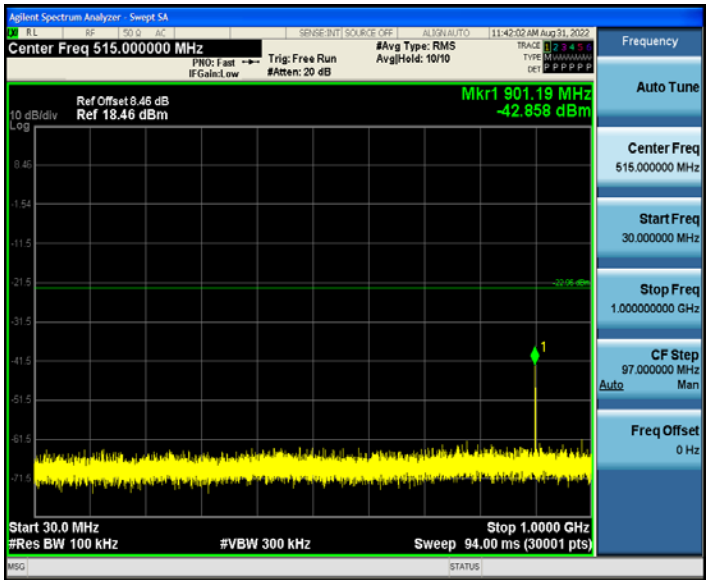
5.7.4 Test results

BLE 1Mbps - conducted spurious emissions

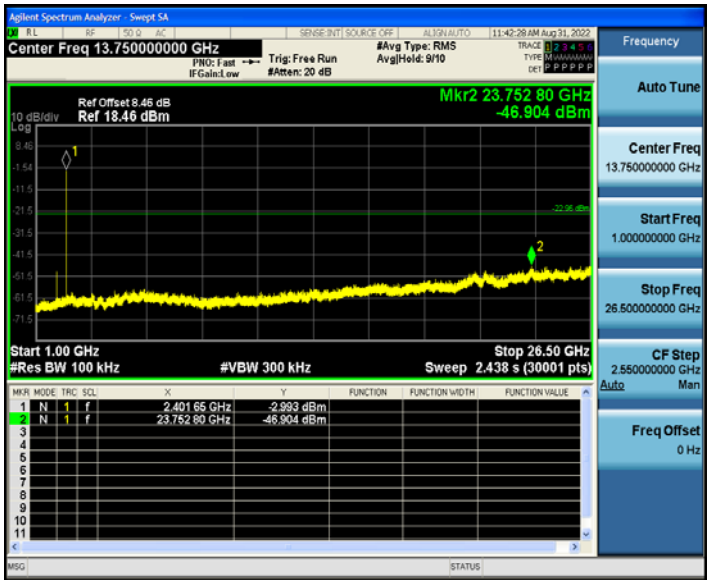
CH0



CH0

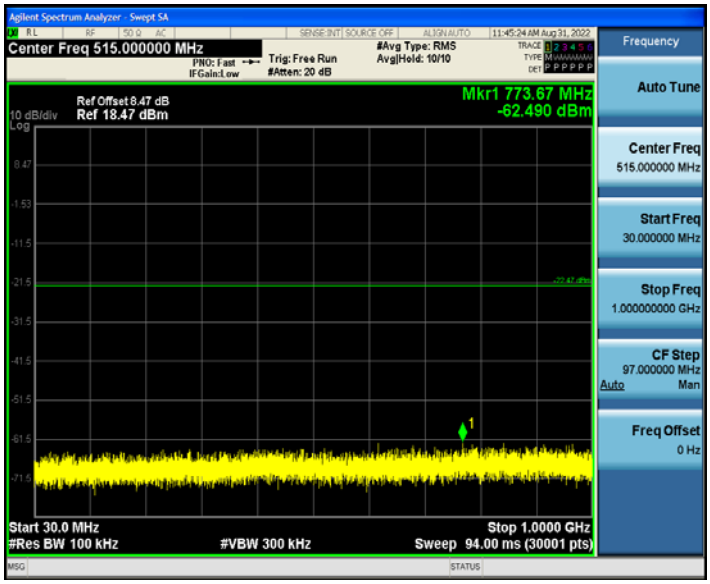


CH0

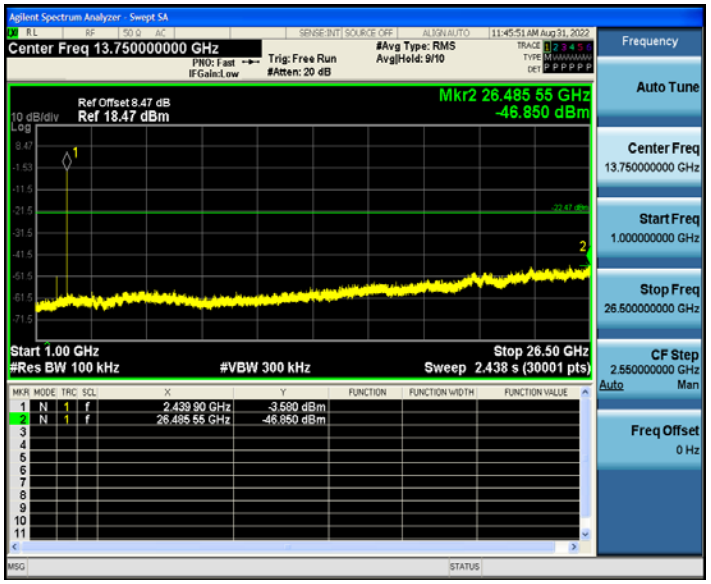


CH19

CH19

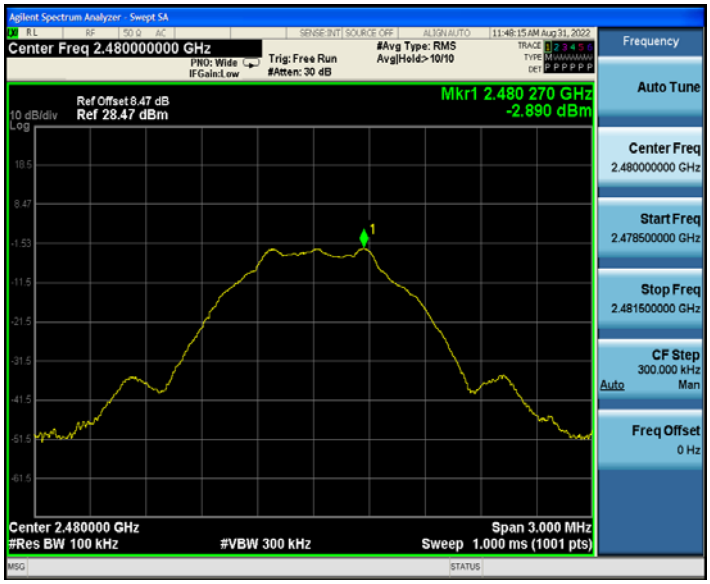


CH19

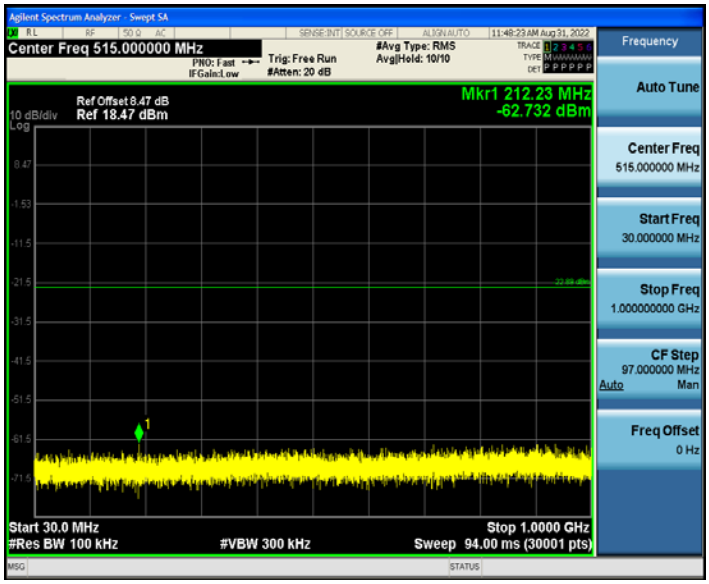


BLE 1Mbps - conducted spurious emissions

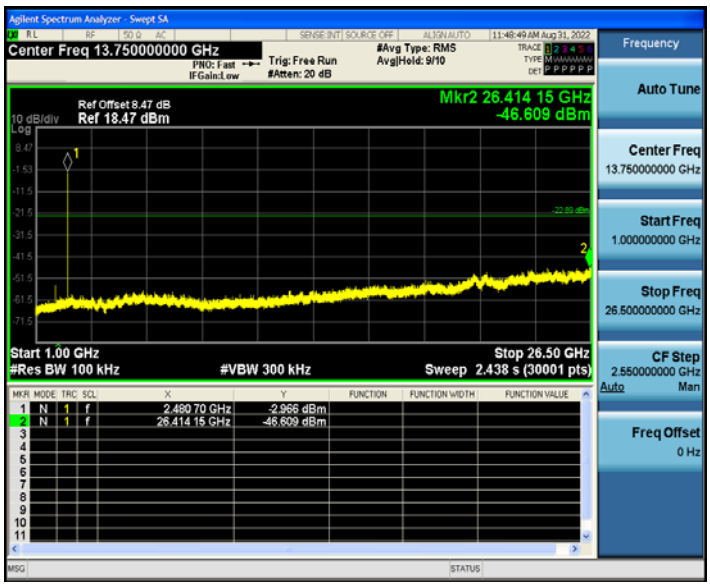
CH39



CH39



CH39

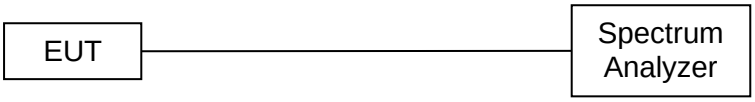


5.8 Duty Cycle

5.8.1 Conformance Limit

None, for reporting purposes only.

5.8.2 Test setup



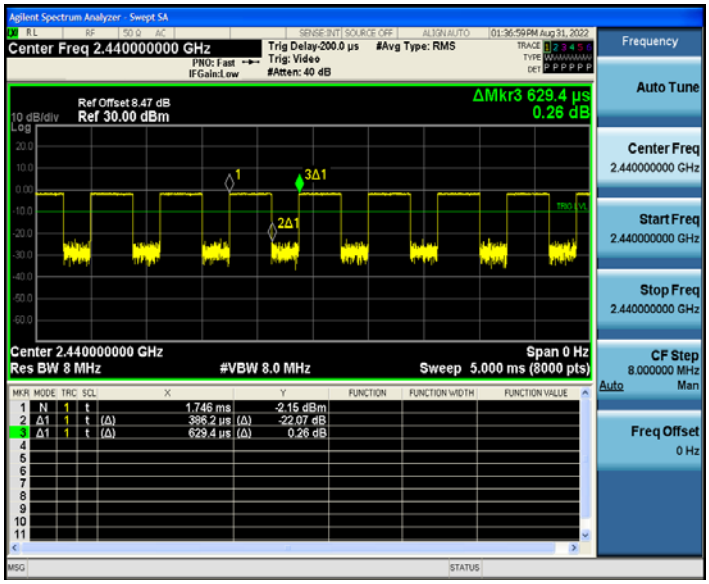
5.8.3 Test procedure

a) Test method: KDB 558074 Zero-span spectrum analyzer method.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

5.8.4 Test Results

TestMode	Transmission Duration (ms]	Transmission Period (ms]	Duty Cycle (%)
BLE 1Mbps	0.39	0.63	61.90

BLE 1Mbps



5.9 Radiated spurious emission

5.9.1 Limits

§ 15.247 (d) 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)).

§ 15.209 Radiated emission limits at restricted bands:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note 1: the tighter limit applies at the band edges.
Note 2: 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

§ 15.35 (b) requirements:
When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

According to ANSI C63.10-2013, the tests shall be performed in the frequency range shown in the following table:

Frequency range of measurements for unlicensed wireless device

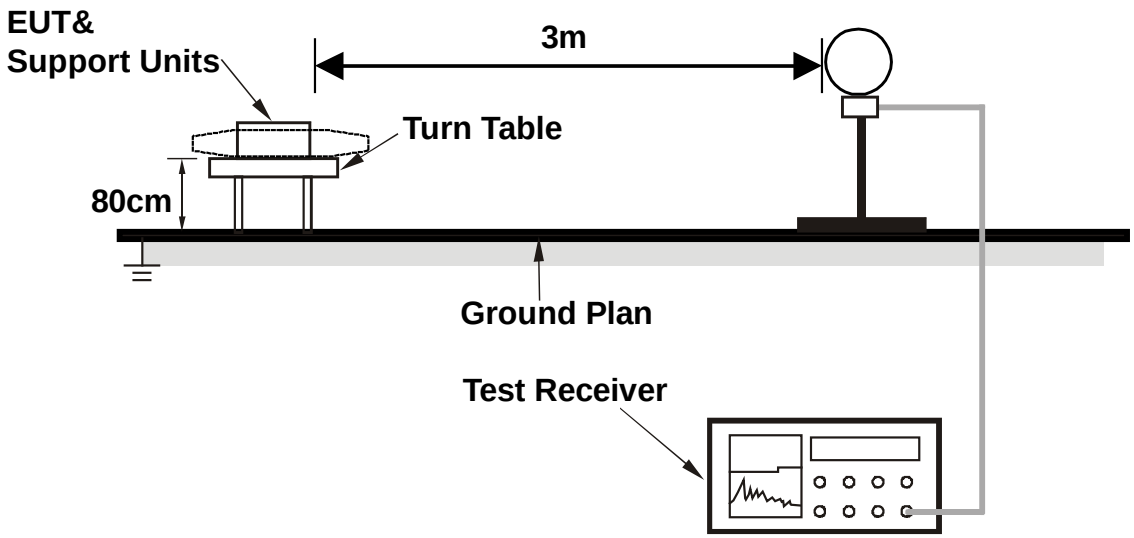
Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Frequency range of measurements for unlicensed wireless device with digital device

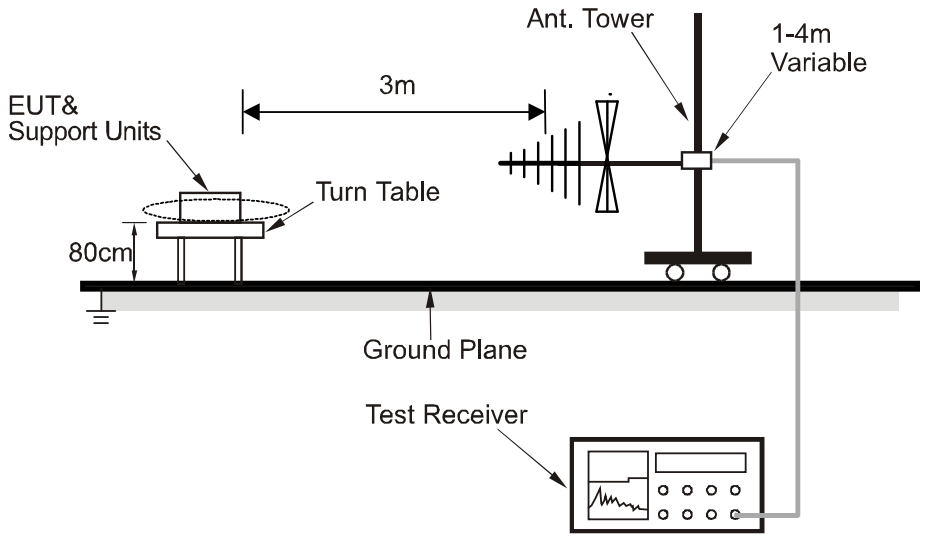
Highest frequency generated or used in the device or on which the device operates or tunes	Upper frequency range of measurement
Below 1.705 MHz	30 MHz
1.705 MHz to 108 MHz	1000 MHz
108 MHz to 500 MHz	2000 MHz
500 MHz to 1000 MHz	5000 MHz
Above 1000 MHz	5th harmonic of the highest frequency or 40 GHz, whichever is lower

5.9.2 Test setup

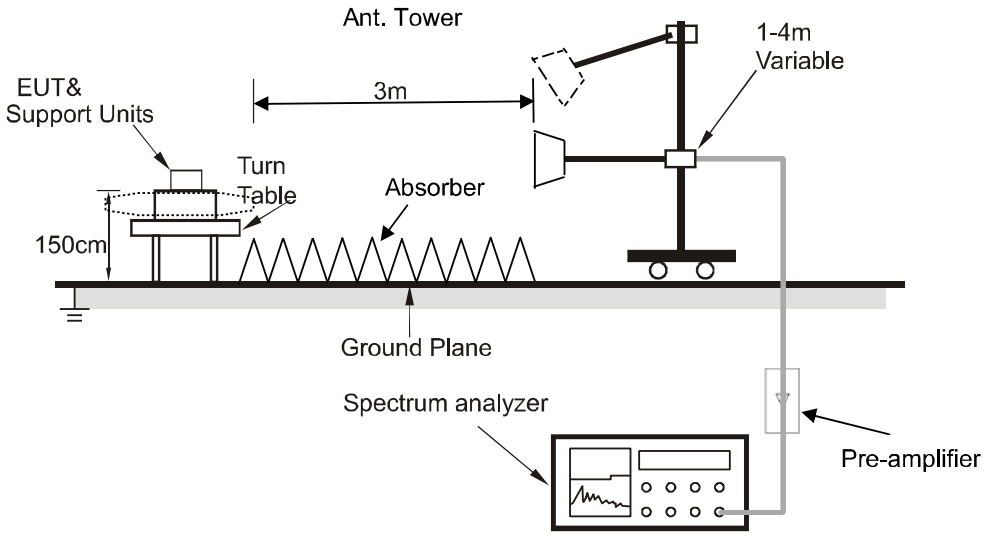
Below 30MHz:



30MHz~1GHz:



Above 1GHz:



For the actual test configuration, please refer to the related item – Photographs of the test setup.

5.9.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 6.3, 6.4, 6.5, 6.6, 11.11, 11.12, 11.13.
b) The EUT is placed on an on-conducting table 0.8 meters above the ground plane for measurement below 1GHz, 1.5 meters above the ground plane for measurement above 1GHz.
c) Emission blew 18 GHz were measured at a 3 meters test distance, above 18 GHz were measured at 1-meter test distance with the application of a distance correction factor
d) The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Test instrument setup

Frequency	Test receiver / Spectrum analyzer setting
9 kHz ~ 150 kHz	Quasi Peak / RBW: 200 Hz
150 kHz ~ 30 MHz	Quasi Peak / RBW: 9 kHz
30 MHz ~ 1 GHz	Quasi Peak / RBW: 120 kHz
Above 1 GHz	Peak / RBW: 1 MHz, VBW: 3MHz, Peak detector AVG / RBW: 1 MHz, VBW: 3MHz, Average detector

5.9.4 Test results

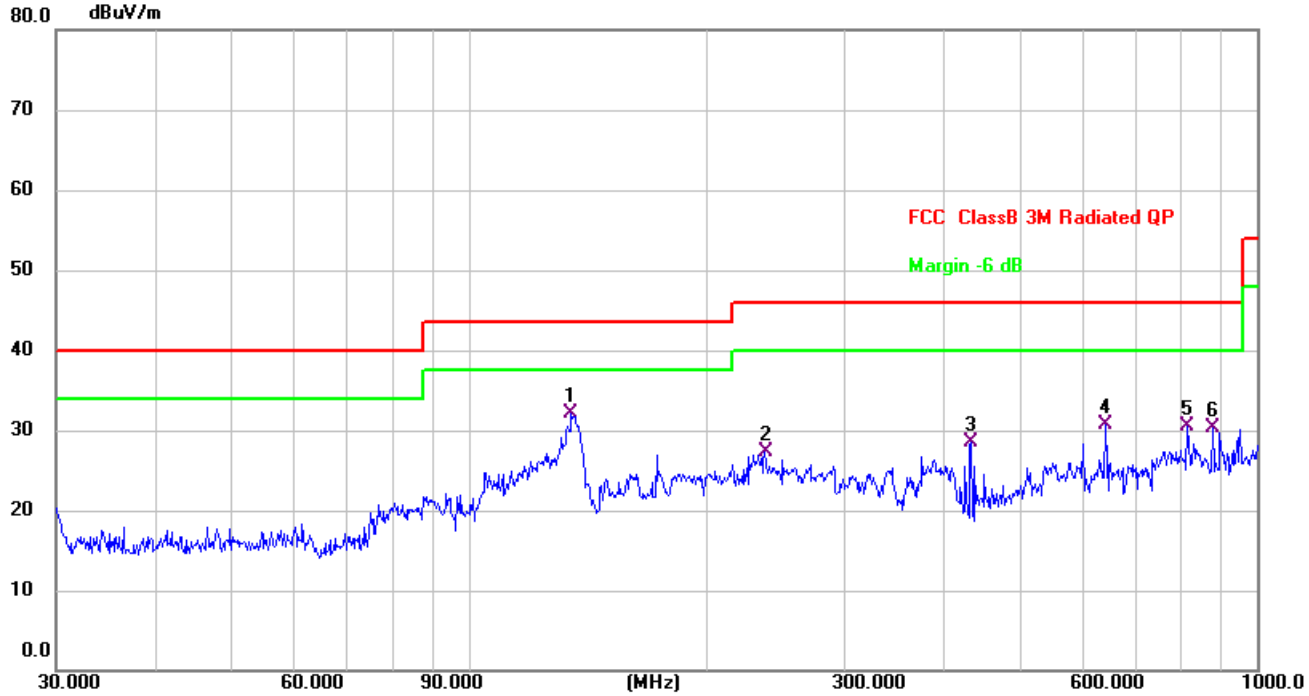
Notes:

The amplitude of spurious emissions which are attenuated more than 20 dB below the limits are not reported.
All modes of operation of the EUT were investigated, and only the worst-case results are reported.
There were no emissions found below 30MHz within 20dB of the limit.

Calculation formula:
Measurement (dBμV/m) = Reading Level (dBμV) + Correct Factor (dB/m)
Over (dB) = Measurement (dBμV/m) – Limit (dBμV/m)

Radiated emissions between 30MHz – 1GHz

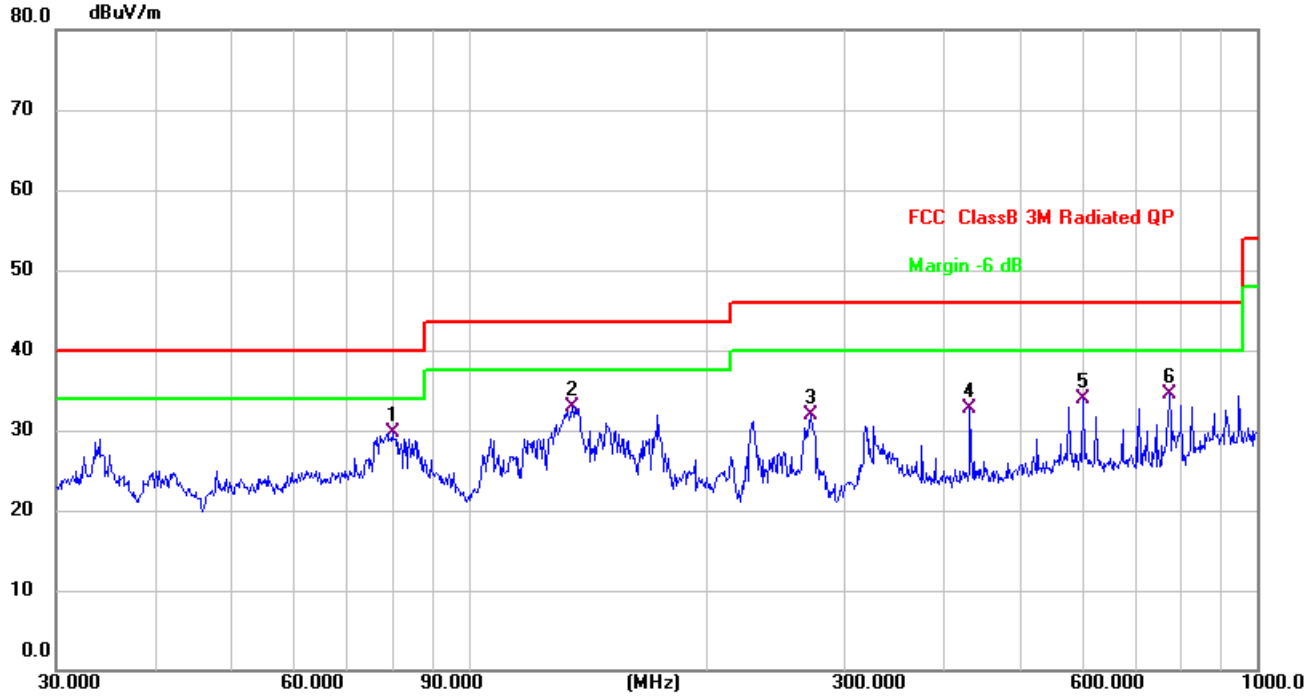
Test mode:	BLE 1Mbps – 2402 MHz TX mode	Polarization:	Horizontal
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	RE chamber 2



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	135.0318	44.89	-12.82	32.07	43.50	-11.43	QP
2	237.4757	35.91	-8.63	27.28	46.00	-18.72	QP
3	434.0649	34.52	-5.95	28.57	46.00	-17.43	QP
4	642.8612	33.84	-3.19	30.65	46.00	-15.35	QP
5	815.9678	32.14	-1.62	30.52	46.00	-15.48	QP
6	878.3214	30.69	-0.46	30.23	46.00	-15.77	QP

Radiated emissions between 30MHz – 1GHz

Test mode:	BLE 1Mbps – 2402 MHz TX mode	Polarization:	Vertical
Power supply:	Power by AC/DC adapter (AC 120V/60Hz)	Test site:	RE chamber 2



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	80.0805	41.37	-11.72	29.65	40.00	-10.35	QP
2	135.5061	45.73	-12.83	32.90	43.50	-10.60	QP
3	271.3245	39.78	-7.94	31.84	46.00	-14.16	QP
4	432.5455	38.54	-5.92	32.62	46.00	-13.38	QP
5	601.4265	36.54	-2.73	33.81	46.00	-12.19	QP
6	774.1584	36.73	-2.15	34.58	46.00	-11.42	QP

Radiated emissions 1 GHz ~ 25 GHz

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
BLE 1Mbps - 2402 MHz TX mode							
4804.000	39.67	0.81	40.48	74.00	-33.52	Peak	V
4804.000	33.41	0.81	34.22	54.00	-19.78	AVG	V
7206.000	38.17	5.86	44.03	74.00	-29.97	Peak	V
7206.000	32.15	5.86	38.01	54.00	-15.99	AVG	V
9608.000	41.25	6.32	47.57	74.00	-26.43	Peak	V
9608.000	34.93	6.32	41.25	54.00	-12.75	AVG	V
4804.000	41.15	0.81	41.96	74.00	-32.04	Peak	H
4804.000	34.58	0.81	35.39	54.00	-18.61	AVG	H
7206.000	40.44	5.86	46.30	74.00	-27.70	Peak	H
7206.000	34.29	5.86	40.15	54.00	-13.85	AVG	H
9608.000	41.80	6.32	48.12	74.00	-25.88	Peak	H
9608.000	35.74	6.32	42.06	54.00	-11.94	AVG	H
BLE 1Mbps - 2440 MHz TX mode							
4880.000	40.86	1.17	42.03	74.00	-31.97	Peak	V
4880.000	34.93	1.17	36.10	54.00	-17.90	AVG	V
7320.000	40.93	5.52	46.45	74.00	-27.55	Peak	V
7320.000	34.74	5.52	40.26	54.00	-13.74	AVG	V
9760.000	41.50	6.21	47.71	74.00	-26.29	Peak	V
9760.000	35.12	6.21	41.33	54.00	-12.67	AVG	V
4880.000	40.96	1.17	42.13	74.00	-31.87	Peak	H
4880.000	34.94	1.17	36.11	54.00	-17.89	AVG	H
7320.000	41.02	5.52	46.54	74.00	-27.46	Peak	H
7320.000	34.71	5.52	40.23	54.00	-13.77	AVG	H
9760.000	42.00	6.21	48.21	74.00	-25.79	Peak	H
9760.000	35.94	6.21	42.15	54.00	-11.85	AVG	H

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
BLE 1Mbps - 2480 MHz TX mode							
4960.000	41.22	1.53	42.75	74.00	-31.25	Peak	V
4960.000	34.72	1.53	36.25	54.00	-17.75	AVG	V
7440.000	39.78	5.16	44.94	74.00	-29.06	Peak	V
7440.000	33.23	5.16	38.39	54.00	-15.61	AVG	V
9920.000	41.83	6.09	47.92	74.00	-26.08	Peak	V
9920.000	35.47	6.09	41.56	54.00	-12.44	AVG	V
4960.000	40.92	1.53	42.45	74.00	-31.55	Peak	H
4960.000	34.82	1.53	36.35	54.00	-17.65	AVG	H
7440.000	39.41	5.16	44.57	74.00	-29.43	Peak	H
7440.000	33.21	5.16	38.37	54.00	-15.63	AVG	H
9920.000	39.82	6.09	45.91	74.00	-28.09	Peak	H
9920.000	33.53	6.09	39.62	54.00	-14.38	AVG	H

Radiated emissions at band edge

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
BLE 1Mbps – Low band-edge							
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
2310.000	46.30	-8.20	38.10	74.00	-35.90	Peak	V
2310.000	37.43	-8.20	29.23	54.00	-24.77	AVG	V
2390.000	47.34	-7.83	39.51	74.00	-34.49	Peak	V
2390.000	37.55	-7.83	29.72	54.00	-24.28	AVG	V
2310.000	37.29	-8.20	29.09	54.00	-24.91	Peak	H
2390.000	47.13	-7.83	39.30	74.00	-34.70	AVG	H
2390.000	37.60	-7.83	29.77	54.00	-24.23	Peak	H
2310.000	47.11	-8.20	38.91	74.00	-35.09	AVG	H
BLE 1Mbps – High band-edge							
2483.500	47.22	-7.39	39.83	74.00	-34.17	Peak	V
2483.500	37.86	-7.39	30.47	54.00	-23.53	AVG	V
2500.000	47.16	-7.32	39.84	74.00	-34.16	Peak	V
2500.000	37.62	-7.32	30.30	54.00	-23.70	AVG	V
2483.500	47.49	-7.39	40.10	74.00	-33.90	Peak	H
2483.500	38.07	-7.39	30.68	54.00	-23.32	AVG	H
2500.000	48.60	-7.32	41.28	74.00	-32.72	Peak	H
2500.000	37.58	-7.32	30.26	54.00	-23.74	AVG	H

Photographs of the Test Setup

See the appendix – Test Setup Photos.

Photographs of the EUT

See the appendix - EUT Photos.

----End of Report----