Microtest
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# Test Report

| | |
|---|---|
| **Report No.:** | MTi220302017-01E2 |
| **Date of issue:** | May 07, 2022 |
| **Applicant:** | Xiamen Paperang Technology Co., Ltd. |
| **Product:** | Thermal Printer |
| **Model(s):** | P1A1, P1, PAPERANG-P1, P1S, P1C, P1L, DL-P1C, DL-P1S, DL-P1L, MZ-P1C, MZ-P1S, MZ-P1L, PAPERANG-P1B |
| **FCC ID:** | 2APWO-P1A1 |

Shenzhen Microtest Co., Ltd.

http://www.mtitest.com

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# 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:** | **Xiamen Paperang Technology Co., Ltd.** |
| Address: | Room 3124, Xuanye Building, Pioneer Park, Xiamen Torch High-tech Zone, Fujian, China |
| **Manufacturer:** | **Xiamen Paperang Technology Co., Ltd.** |
| Address: | Room 3124, Xuanye Building, Pioneer Park, Xiamen Torch High-tech Zone, Fujian, China |
| **Factory:** | **Xiamen Hanin Electronic Technology Co., Ltd.** |
| Address: | 96# Rongyuan Road, Tong'an District, Xiamen |
| **Product description** | |
| Product name: | Thermal Printer |
| Trademark: | Paperang |
| Model name: | P1A1 |
| Serial Model: | P1, PAPERANG-P1, P1S, P1C, P1L, DL-P1C, DL-P1S, DL-P1L, MZ-P1C, MZ-P1S, MZ-P1L, PAPERANG-P1B |
| Standards: | FCC 47 CFR Part 15 Subpart C |
| Test method: | ANSI C63.10-2013 |
| **Date of Test** | |
| Date of test: | 2022-03-20 ~ 2022-04-28 |
| Test result: | Pass |

**Test Engineer :** Yanice Xie

(Yanice Xie)

**Reviewed By:** : Leon Chen

(Leon Chen)

**Approved By:** : Tom Xue

(Tom Xue)

# 1 General Description

## 1.1 Description of EUT

| | |
|---|---|
| Product name: | Thermal Printer |
| Model name: | P1A1 |
| Series Model: | P1, PAPERANG-P1, P1S, P1C, P1L, DL-P1C, DL-P1S, DL-P1L, MZ-P1C, MZ-P1S, MZ-P1L, PAPERANG-P1B |
| Model difference: | All the models are the same circuit and module, except the model's name and color of appearance. |
| Electrical rating: | Input: 5V 1A or DC 3.7V from battery |
| Battery: | DC 3.7V 1100mAh |
| Hardware version: | HM-E210CMB |
| Software version: | HME210C_V1 |
| Accessories: | Cable: USB-A to USB-C cable (Length: 0.50m) |
| EUT serial number: | MTi220302017-01-S0001 |
| **RF specification:** | |
| Bluetooth version: | V4.2 |
| Operation frequency: | 2402 MHz ~ 2480 MHz |
| Modulation type: | GFSK |
| Antenna designation: | PCB antenna, antenna Gain: 0 dBi |
| Max. peak conducted output power: | -2.08 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 |
| Adapter | HW-090200CH0 | / | Huizhou BYD Electronics Co., Ltd. |
| / | / | / | / |

### 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 | 2021/06/02 | 2022/06/01 |
| MTi-E023 | Artificial power network | Schwarzbeck | NSLK8127 | NSLK8127# 841 | 2021/06/02 | 2022/06/01 |
| MTi-E025 | Artificial power network | Schwarzbeck | NSLK8127 | 8127183 | 2021/06/02 | 2022/06/01 |
| MTI-E043 | EMI test receiver | R&S | ESCI7 | 101166 | 2021/06/02 | 2022/06/01 |
| 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 | 2021/06/02 | 2022/06/01 |
| MTI-E048 | Pre-amplifier | Agilent | 8449B | 3008A01120 | 2021/06/02 | 2022/06/01 |
| 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 | 2021/05/06 | 2022/05/05 |
| MTi-E135 | Horn antenna | Schwarzbeck | BBHA 9170 | 00987 | 2021/05/30 | 2023/05/29 |
| MTi-E136 | Pre-amplifier | Space-Dtronics | EWLAN1840G -G45 | 210405001 | 2021/06/02 | 2022/06/01 |
| MTi-E062 | PXA Signal Analyzer | Agilent | N9030A | MY51350296 | 2021/06/23 | 2022/06/22 |
| MTi-E067 | RF Control Unit | Tonscend | JS0806-1 | 19D8060152 | 2021/06/02 | 2022/06/01 |
| MTi-E068 | RF Control Unit | Tonscend | JS0806-2 | 19D8060153 | 2021/06/02 | 2022/06/01 |
| MTi-E069 | Band Reject Filter Group | Tonscend | JS0806-F | 19D8060160 | 2021/06/02 | 2022/06/01 |
| 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 PCB antenna (Antenna Gain: 0dBi), which is no consideration of replacement.

## 5.2 AC power line conducted emissions

### 5.2.1 Limits

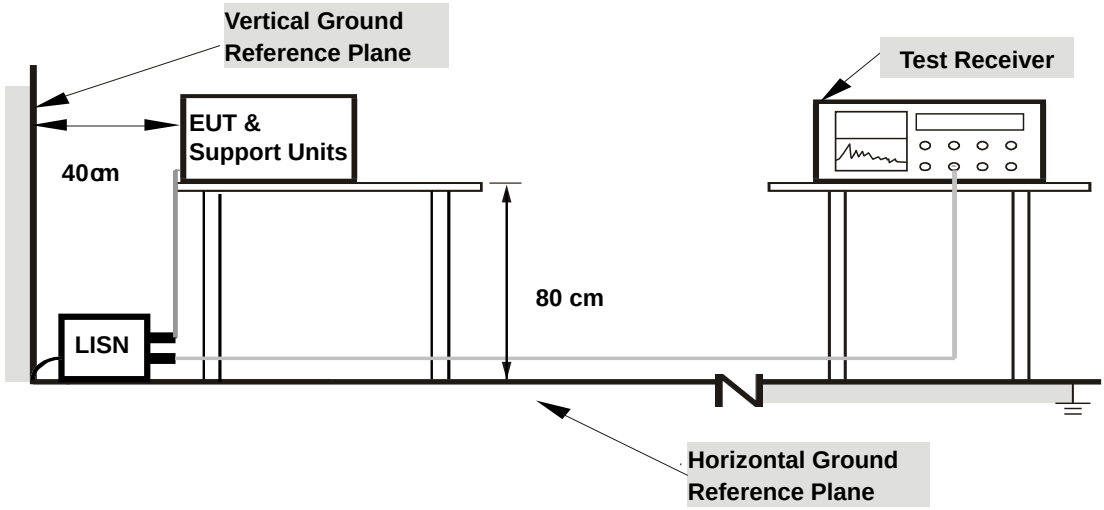
| Frequency (MHz) | Detector type / Bandwidth | Limit-Quasi-peak dBµV | Limit-Average dBµV |
|---|---|---|---|
| 0.15 -0.5 | Average / 9 kHz | 66 to 56 | 56 to 46 |
| 0.5 -5 | | 56 | 46 |
| 5 -30 | | 60 | 50 |

**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

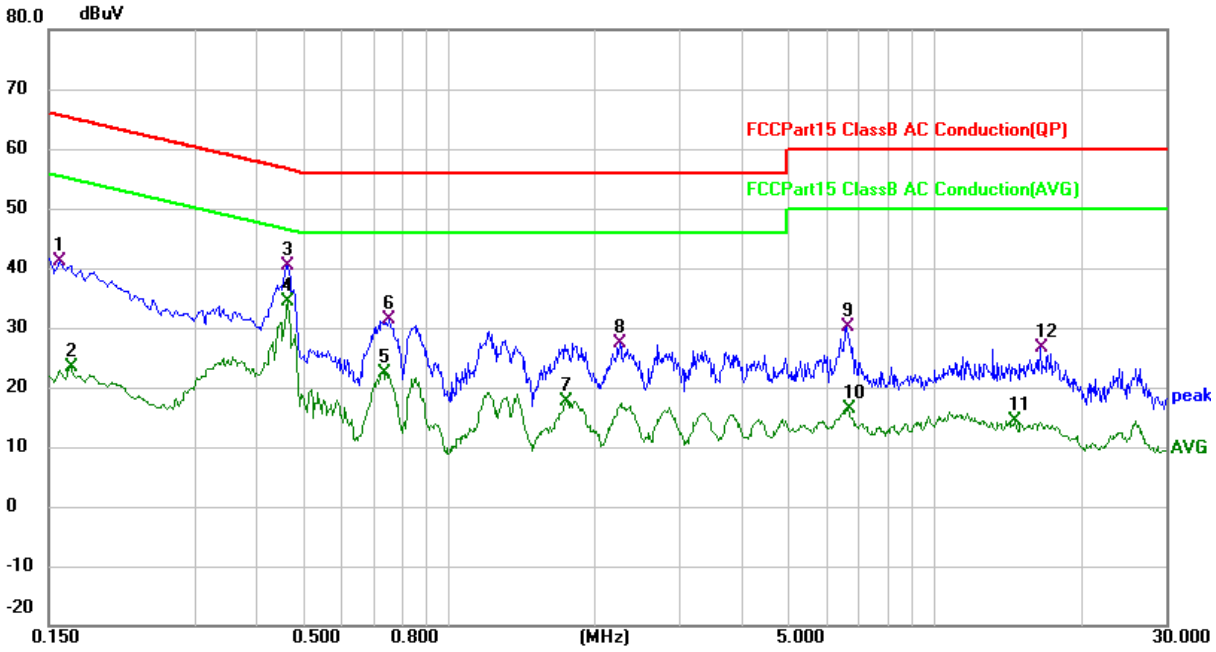
**Notes:**

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

**Calculation formula:**

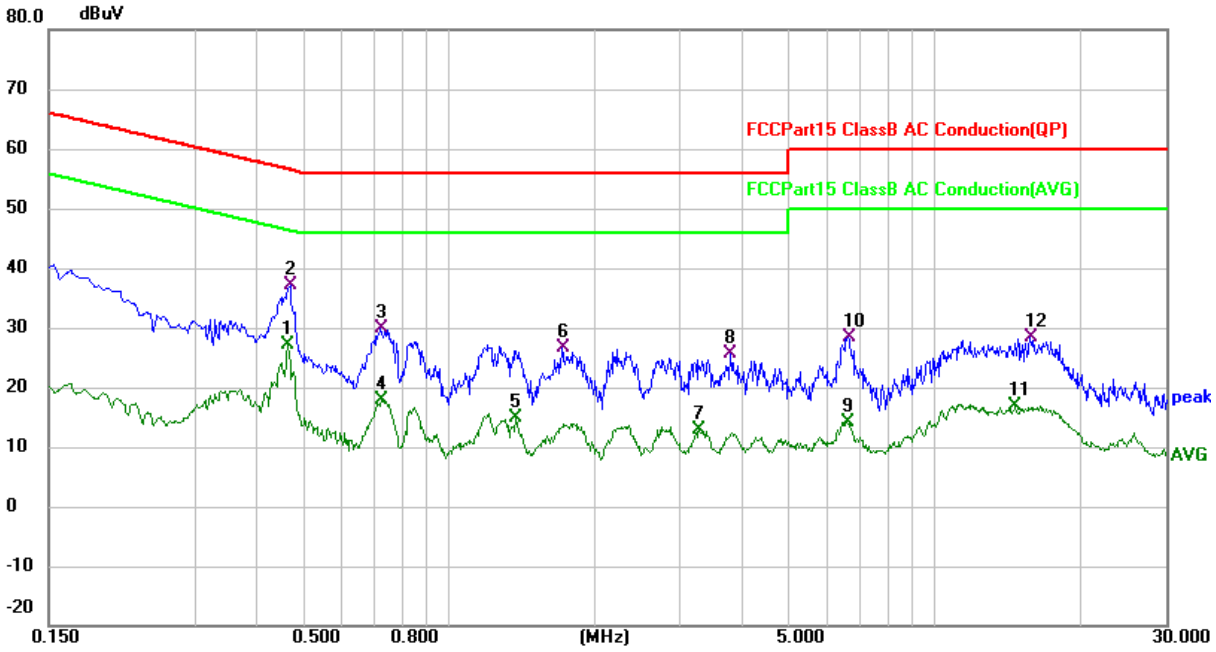
Measurement (dBµV) = Reading Level (dBµV) + Correct Factor (dB)
Over (dB) = Measurement (dBµV) – Limit (dBµV)

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




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1580 | 30.11 | 10.99 | 41.10 | 65.57 | -24.47 | QP |
| 2 | | 0.1660 | 12.44 | 10.99 | 23.43 | 55.16 | -31.73 | AVG |
| 3 | | 0.4660 | 29.38 | 11.03 | 40.41 | 56.58 | -16.17 | QP |
| 4 | * | 0.4660 | 23.33 | 11.03 | 34.36 | 46.58 | -12.22 | AVG |
| 5 | | 0.7380 | 11.35 | 11.11 | 22.46 | 46.00 | -23.54 | AVG |
| 6 | | 0.7580 | 20.28 | 11.12 | 31.40 | 56.00 | -24.60 | QP |
| 7 | | 1.7500 | 2.87 | 14.88 | 17.75 | 46.00 | -28.25 | AVG |
| 8 | | 2.2540 | 11.54 | 15.91 | 27.45 | 56.00 | -28.55 | QP |
| 9 | | 6.6260 | 18.63 | 11.59 | 30.22 | 60.00 | -29.78 | QP |
| 10 | | 6.6340 | 4.68 | 11.59 | 16.27 | 50.00 | -33.73 | AVG |
| 11 | | 14.6100 | 2.69 | 11.71 | 14.40 | 50.00 | -35.60 | AVG |
| 12 | | 16.5620 | 14.93 | 11.76 | 26.69 | 60.00 | -33.31 | QP |

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



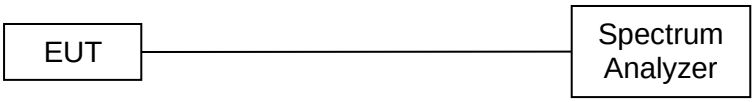

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.4660 | 16.27 | 10.89 | 27.16 | 46.58 | -19.42 | AVG |
| 2 | * | 0.4700 | 26.19 | 10.90 | 37.09 | 56.51 | -19.42 | QP |
| 3 | | 0.7260 | 18.79 | 11.09 | 29.88 | 56.00 | -26.12 | QP |
| 4 | | 0.7300 | 6.75 | 11.09 | 17.84 | 46.00 | -28.16 | AVG |
| 5 | | 1.3740 | 0.86 | 14.02 | 14.88 | 46.00 | -31.12 | AVG |
| 6 | | 1.7140 | 11.75 | 14.76 | 26.51 | 56.00 | -29.49 | QP |
| 7 | | 3.2780 | 1.54 | 11.37 | 12.91 | 46.00 | -33.09 | AVG |
| 8 | | 3.8180 | 14.15 | 11.37 | 25.52 | 56.00 | -30.48 | QP |
| 9 | | 6.6020 | 2.82 | 11.39 | 14.21 | 50.00 | -35.79 | AVG |
| 10 | | 6.6460 | 16.95 | 11.39 | 28.34 | 60.00 | -31.66 | QP |
| 11 | | 14.7300 | 5.19 | 11.70 | 16.89 | 50.00 | -33.11 | AVG |
| 12 | | 15.7460 | 16.71 | 11.73 | 28.44 | 60.00 | -31.56 | QP |

## 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

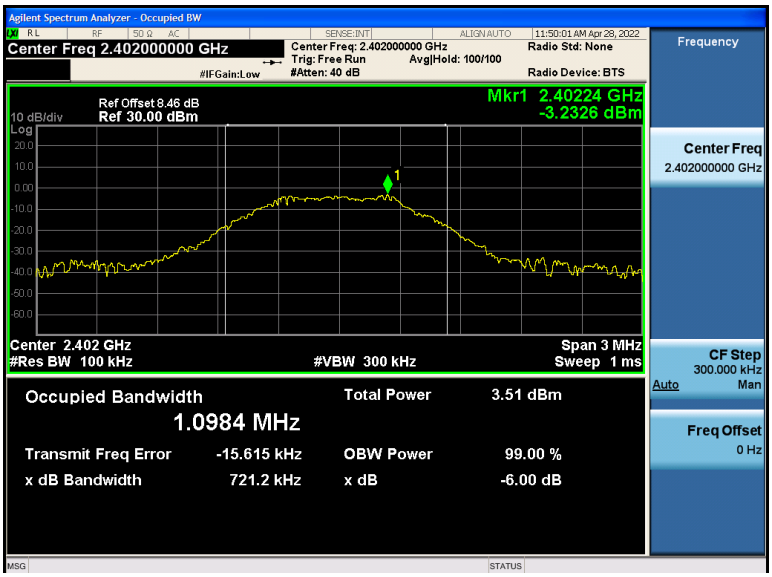
a) Test method: ANSI C63.10-2013 Section 11.8.2.
b) The transmitter output of EUT is connected to the spectrum analyzer.
c) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, detector = Peak

### 5.3.4 Test results

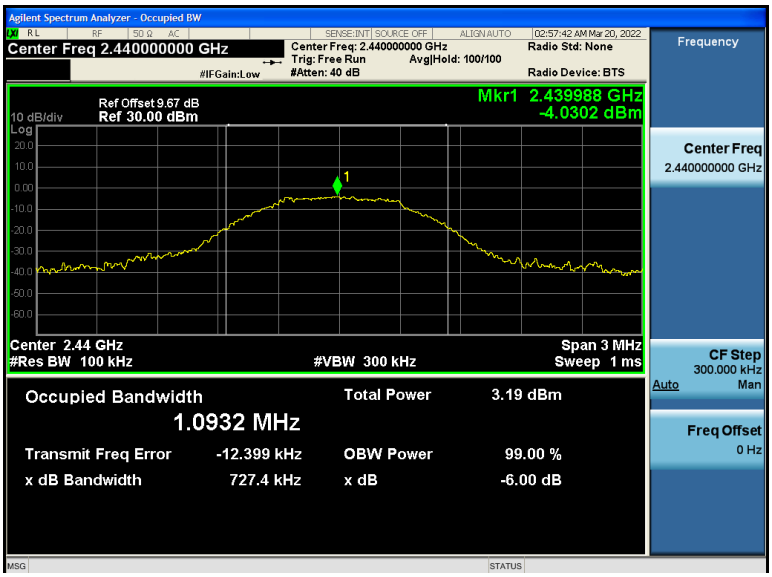
| Mode | Test channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) |
|---|---|---|---|---|
| BLE 1Mbps | CH0 | 2402 | 0.7212 | ≥ 0.5 |
| | CH19 | 2440 | 0.7274 | ≥ 0.5 |
| | CH39 | 2480 | 0.7056 | ≥ 0.5 |

## 6dB occupied bandwidth

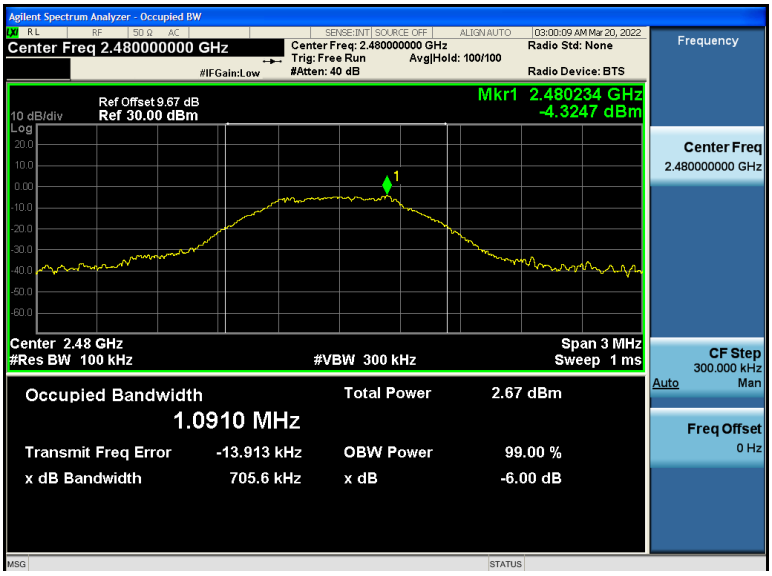
### CH0




### CH19




### CH39

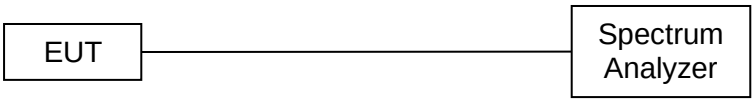


## 5.4 Conducted peak output power

### 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

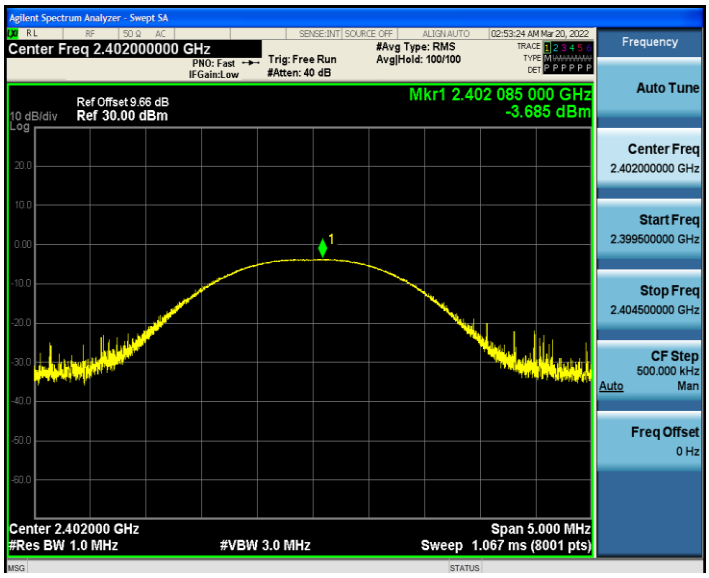
a) Test method: ANSI C63.10-2013 Section 11.9.1.1.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW ≥ 6dB occupied bandwidth, VBW ≥ 3 × RBW, detector = Peak

### 5.4.4 Test results

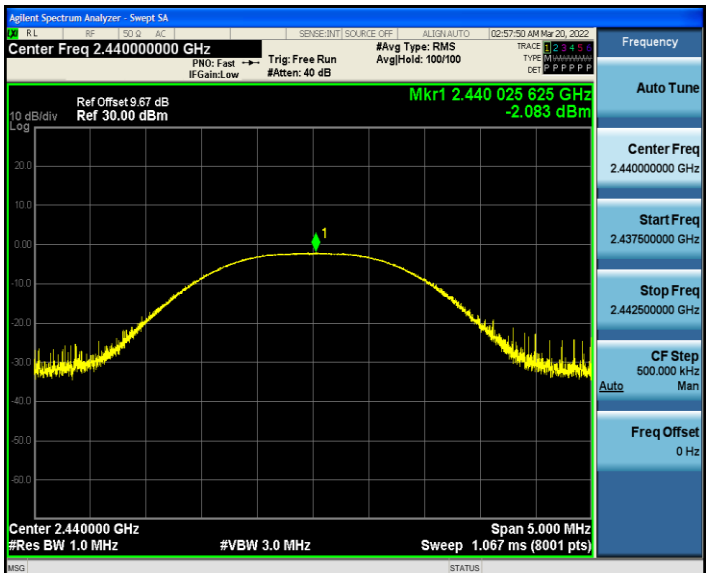
| Mode | Test channel | Frequency (MHz) | Conducted peak output power (dBm) | Limit (dBm) |
|---|---|---|---|---|
| BLE 1Mbps | CH0 | 2402 | -3.69 | ≤ 30 |
| | CH19 | 2440 | -2.08 | ≤ 30 |
| | CH39 | 2480 | -2.73 | ≤ 30 |

## Peak conducted output power

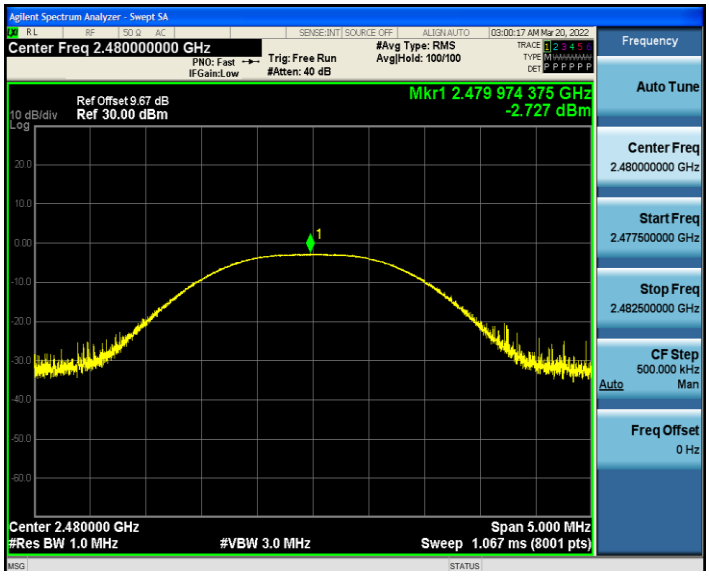
**CH0**




**CH19**




**CH39**

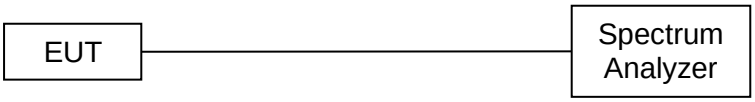


## 5.5 Power spectral density test

### 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

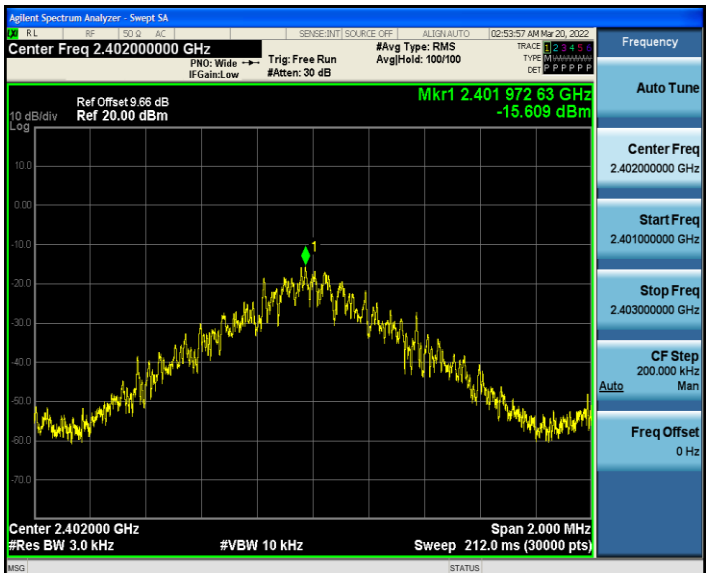
a) Test method: ANSI C63.10-2013 Section 11.10.2.
b) The EUT was set to continuously transmitting in the max power during the test.
c) The transmitter output of EUT is connected to the spectrum analyzer.
d) Spectrum analyzer setting: RBW = 3 kHz, VBW = 10 kHz, detector = Peak

### 5.5.4 Test Results

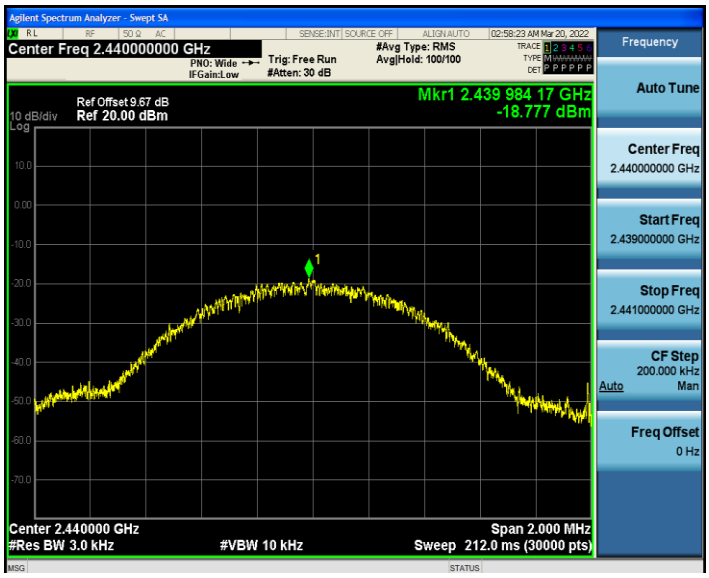
| Mode | Test channel | Frequency (MHz) | Power spectral density (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|---|---|
| BLE 1Mbps | CH0 | 2402 | -15.61 | ≤ 8 |
| | CH19 | 2440 | -18.78 | ≤ 8 |
| | CH39 | 2480 | -19.64 | ≤ 8 |

## Power spectral density

**CH0**




**CH19**



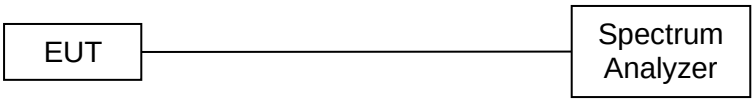

**CH39**

## 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



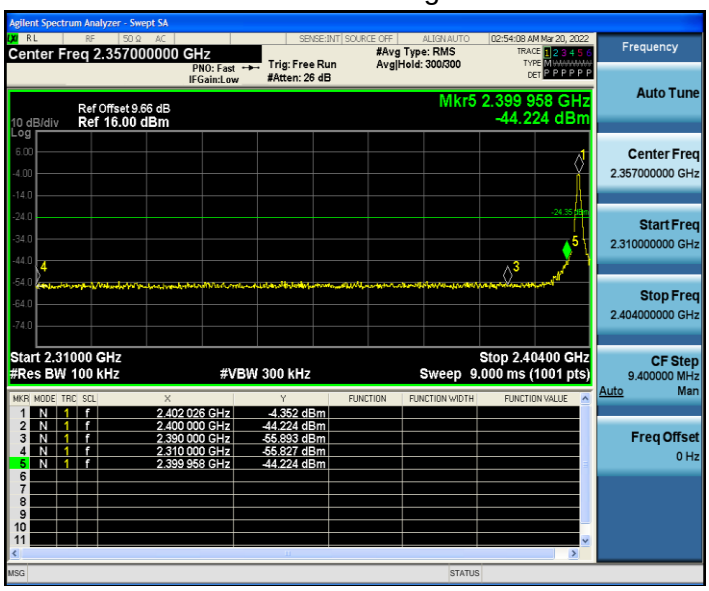

### 5.6.3 Test procedure

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.

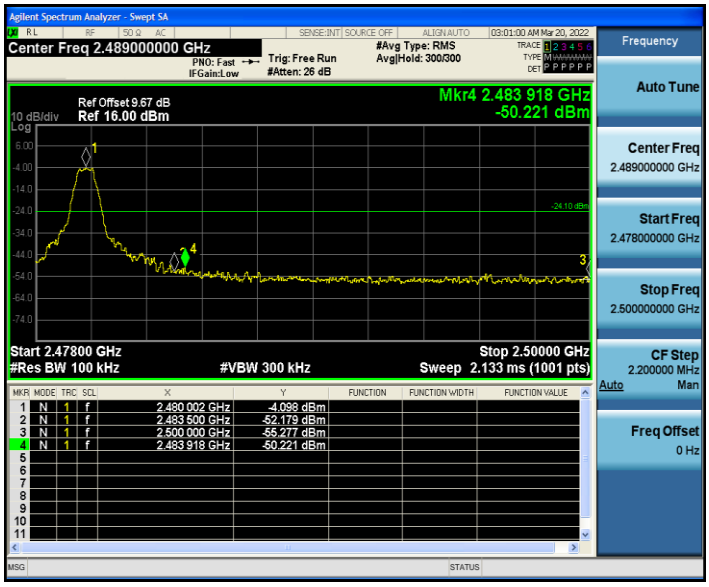
### 5.6.4 Test results

## BLE 1Mbps - conducted emissions at the band edge

Low band-edge




High band-edge

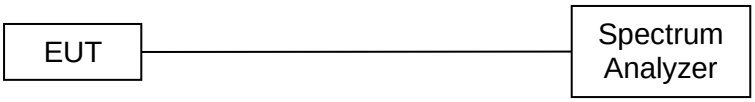


## 5.7 Conducted spurious emissions

### 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



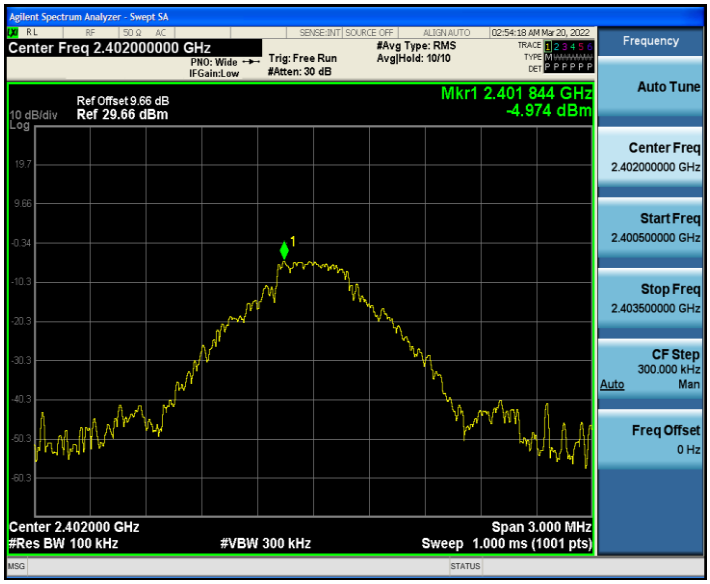

### 5.7.3 Test procedure

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.

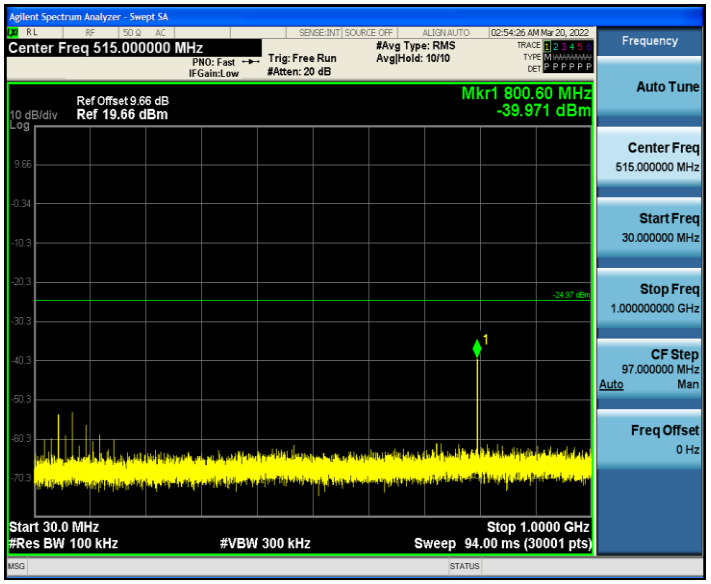
### 5.7.4 Test results

## BLE 1Mbps - conducted spurious emissions

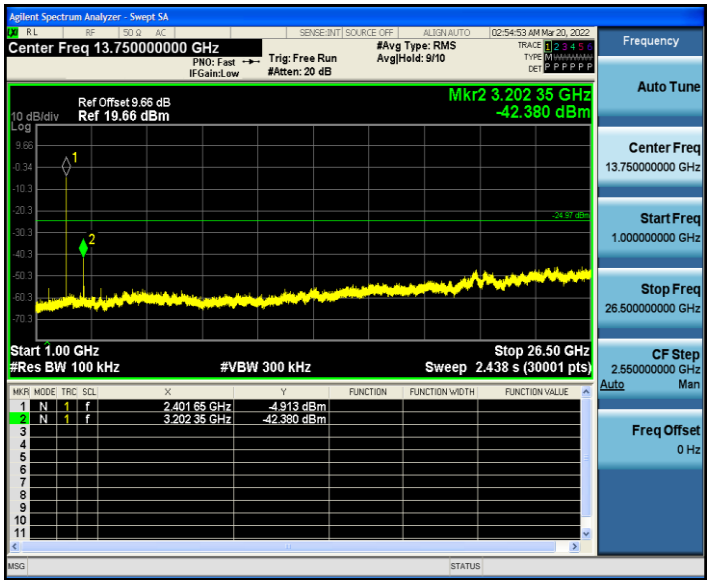
CH0




CH0

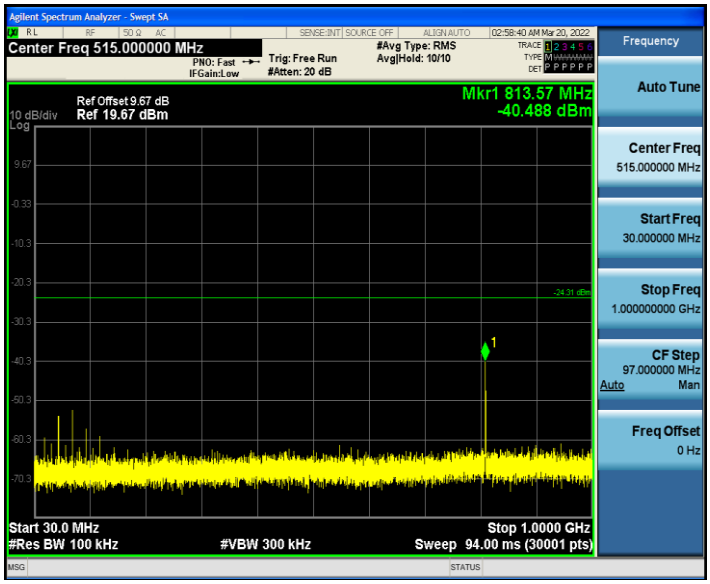



CH0

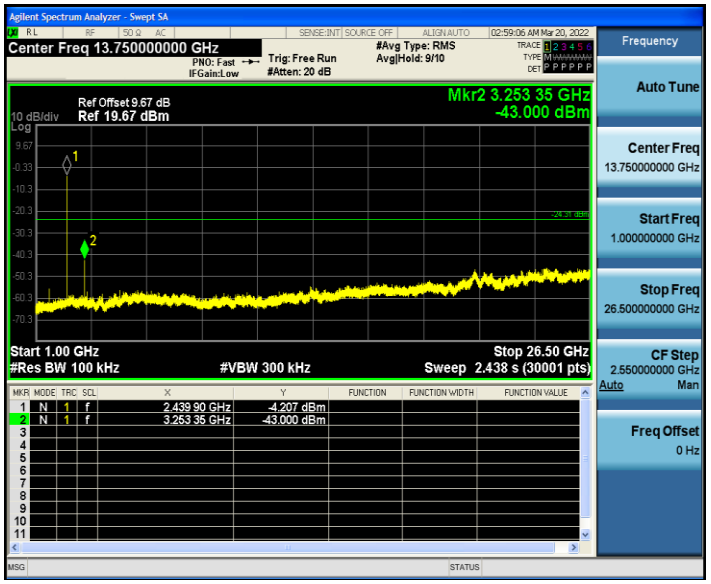



CH19


CH19



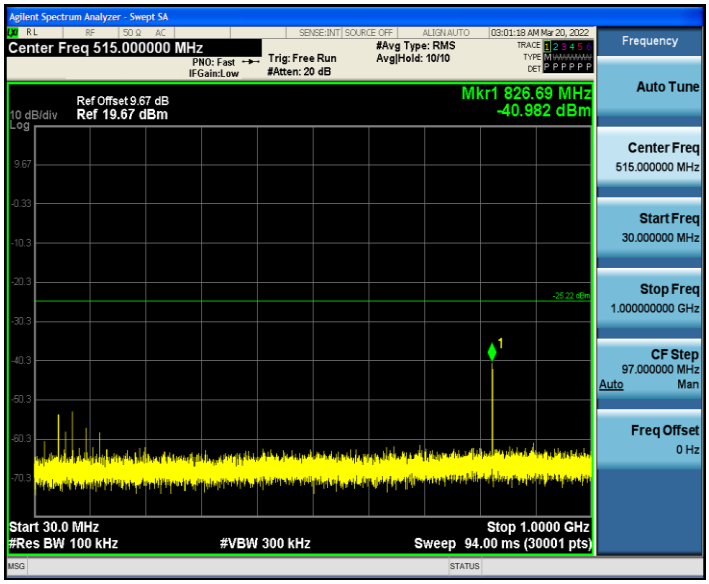

CH19



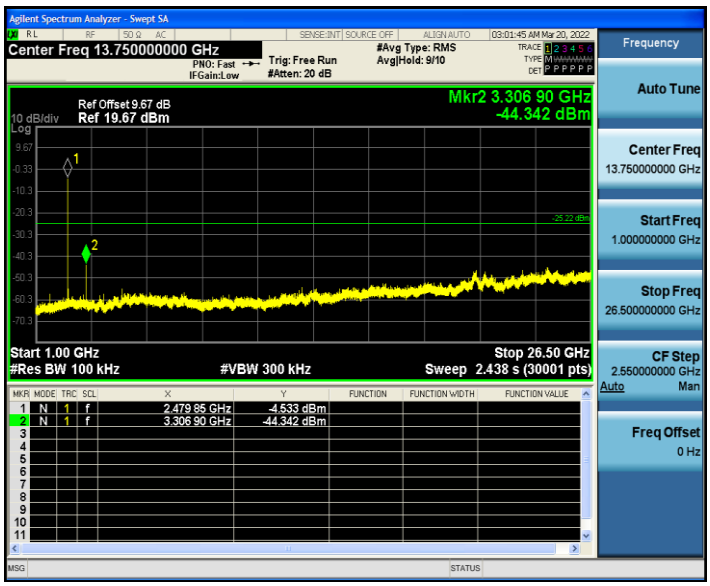
## BLE 1Mbps - conducted spurious emissions

CH39


CH39




CH39

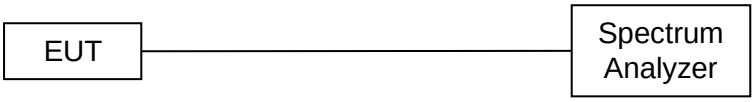


## 5.8 Duty Cycle

### 5.8.1 Conformance Limit

None, for reporting purposes only.

### 5.8.2 Test setup



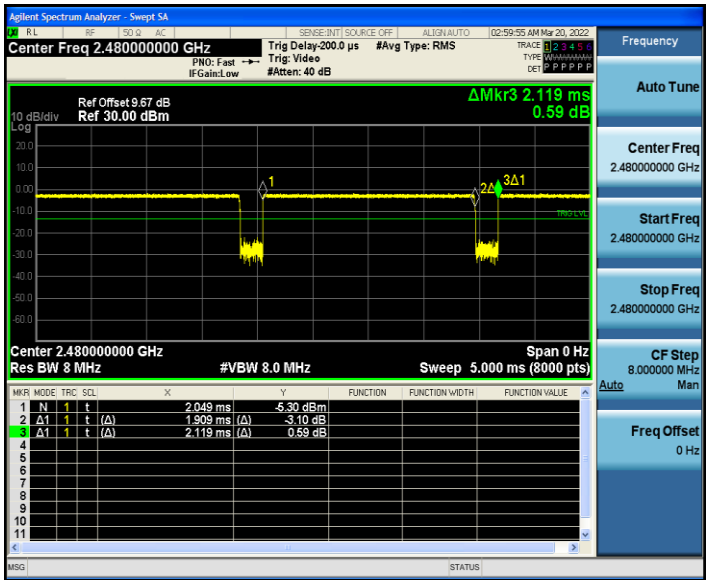

### 5.8.3 Test procedure

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 | 1.909 | 2.119 | 90.09 |

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**

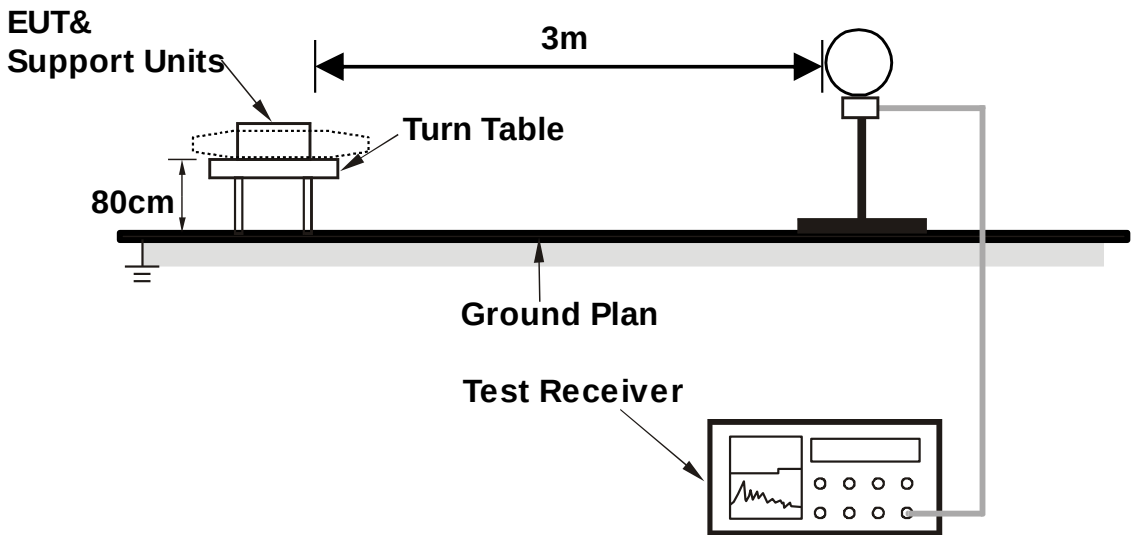
| Lowest frequency generated in the device | Upper frequency range of measurement |
|---|---|
| 9 kHz to below 10 GHz | 10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower |
| At or above 10 GHz to below 30 GHz | 5th harmonic of highest fundamental frequency or to 100 GHz,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

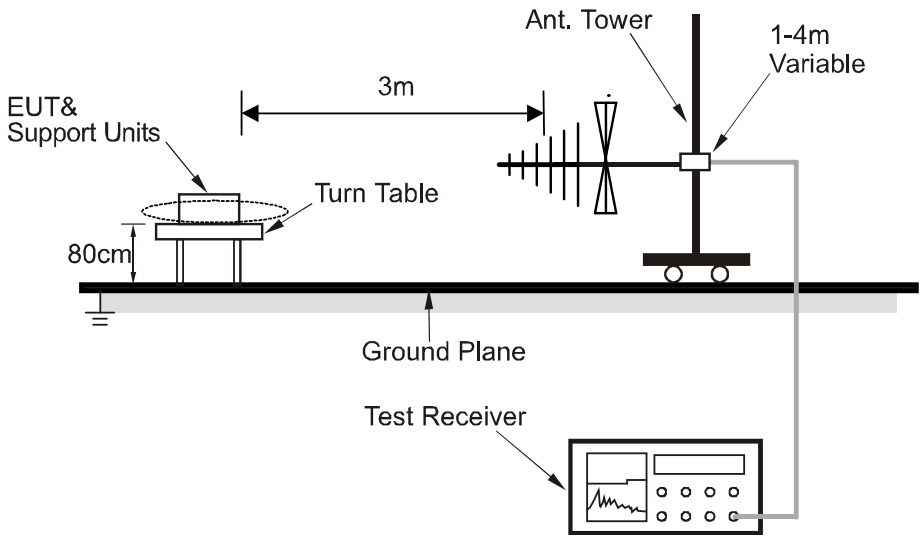
| Highest frequency generated or used in the device or on which the device operates or tunes | Upper frequency range of measurement |
|---|---|
| Below 1.705 MHz | 30 MHz |
| 1.705 MHz to 108 MHz | 1000 MHz |
| 108 MHz to 500 MHz | 2000 MHz |
| 500 MHz to 1000 MHz | 5000 MHz |
| Above 1000 MHz | 5th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

### 5.9.2 Test setup

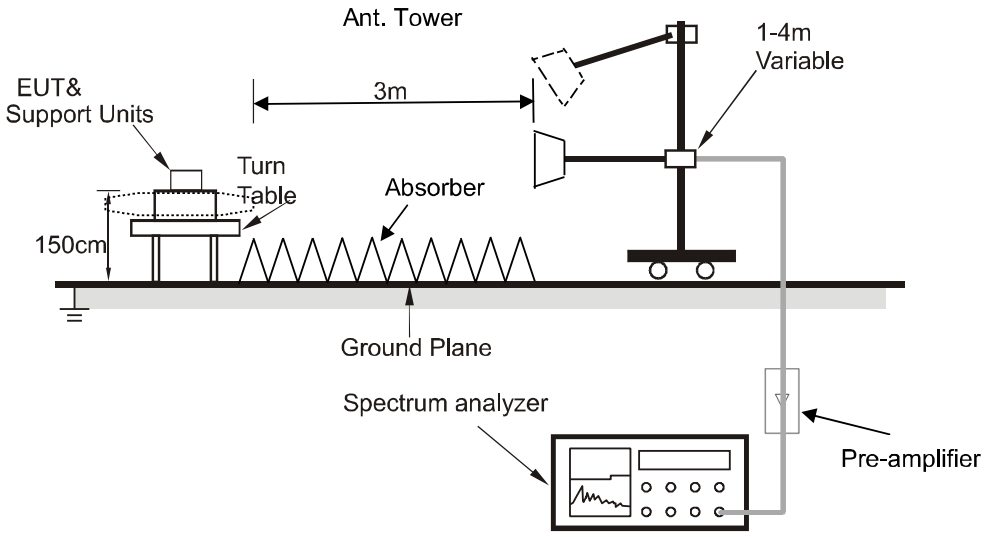
Below 30MHz:




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<br>AVG / RBW: 1 MHz, VBW: 3MHz, Average detector |

### 5.9.4 Test results

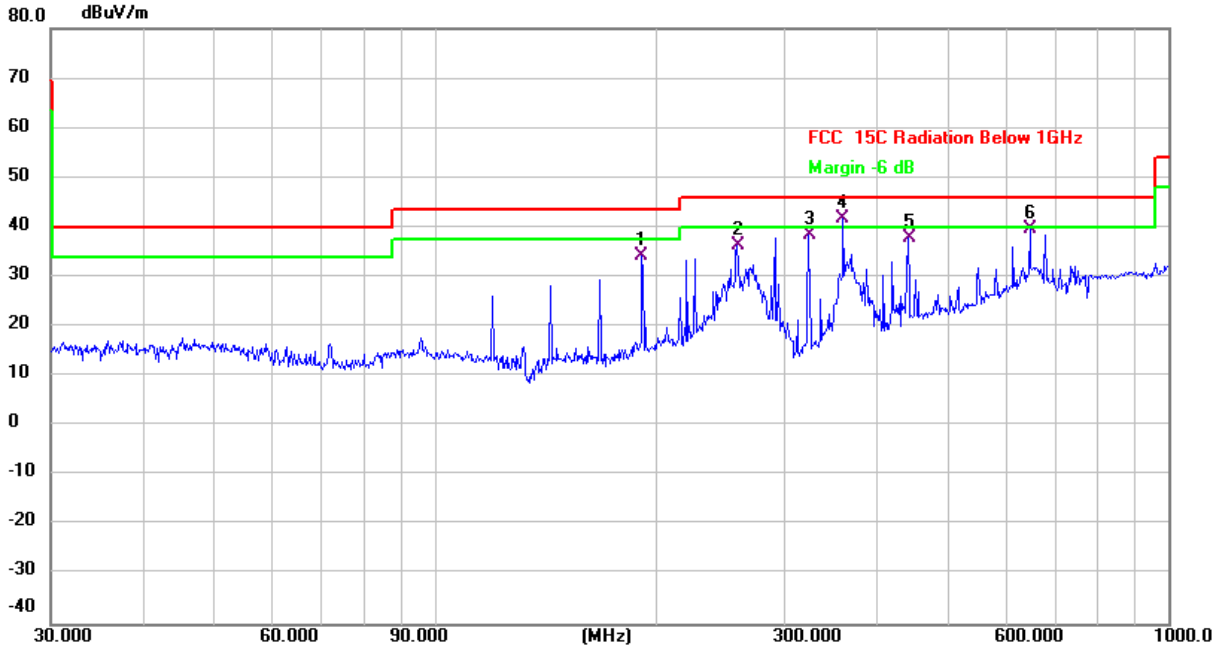
**Notes:**

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**

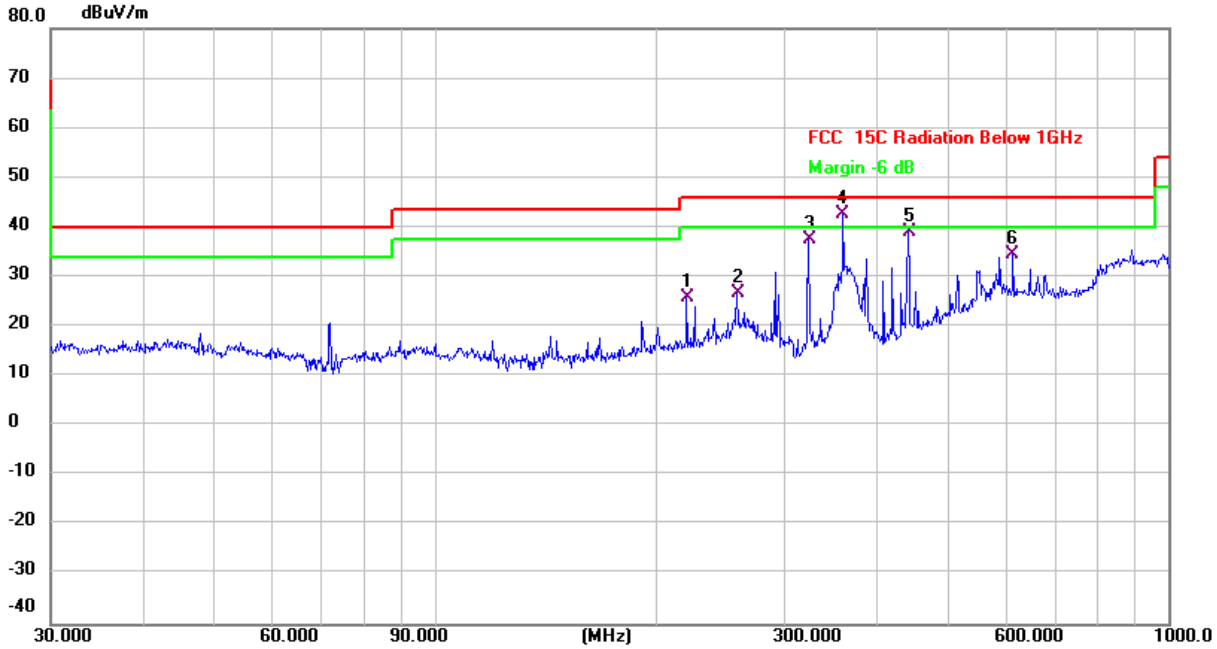
| | | | |
|---|---|---|---|
| Test mode: | BLE 1Mbps – 2402 MHz TX mode | Polarization: | Horizontal |
| Power supply: | DC 5V | Test site: | RE chamber 2 |




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector |
| 1 | | 191.7450 | 42.74 | -8.40 | 34.34 | 43.50 | -9.16 | QP |
| 2 | | 258.3264 | 42.22 | -5.76 | 36.46 | 46.00 | -9.54 | QP |
| 3 | | 323.3204 | 43.04 | -4.60 | 38.44 | 46.00 | -7.56 | QP |
| 4 | * | 360.4476 | 46.42 | -4.58 | 41.84 | 46.00 | -4.16 | QP |
| 5 | | 441.7426 | 41.31 | -3.41 | 37.90 | 46.00 | -8.10 | QP |
| 6 | | 647.3856 | 39.91 | -0.28 | 39.63 | 46.00 | -6.37 | QP |

**Radiated emissions between 30MHz – 1GHz**

| | | | |
|---|---|---|---|
| Test mode: | BLE 1Mbps – 2402 MHz TX mode | Polarization: | Vertical |
| Power supply: | DC 5V | Test site: | RE chamber 2 |




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector |
| 1 | | 220.6171 | 33.01 | -7.12 | 25.89 | 46.00 | -20.11 | QP |
| 2 | | 258.3264 | 32.54 | -5.76 | 26.78 | 46.00 | -19.22 | QP |
| 3 | | 323.3204 | 42.21 | -4.60 | 37.61 | 46.00 | -8.39 | QP |
| 4 | * | 360.4476 | 47.18 | -4.58 | 42.60 | 46.00 | -3.40 | QP |
| 5 | | 441.7426 | 42.53 | -3.41 | 39.12 | 46.00 | -6.88 | QP |
| 6 | | 614.2142 | 34.67 | 0.00 | 34.67 | 46.00 | -11.33 | 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 | 39.37 | 1.52 | 40.89 | 74 | -33.11 | Peak | V |
| 4804 | 33.17 | 1.52 | 34.69 | 54 | -19.31 | AVG | V |
| 7206 | 38.62 | 5.46 | 44.08 | 74 | -29.92 | Peak | V |
| 7206 | 32.6 | 5.46 | 38.06 | 54 | -15.94 | AVG | V |
| 9608 | 40 | 6.33 | 46.33 | 74 | -27.67 | Peak | V |
| 9608 | 33.9 | 6.33 | 40.23 | 54 | -13.77 | AVG | V |
| 4804 | 40.88 | 1.52 | 42.4 | 74 | -31.6 | Peak | H |
| 4804 | 34.8 | 1.52 | 36.32 | 54 | -17.68 | AVG | H |
| 7206 | 38.67 | 5.46 | 44.13 | 74 | -29.87 | Peak | H |
| 7206 | 32.67 | 5.46 | 38.13 | 54 | -15.87 | AVG | H |
| 9608 | 39.84 | 6.33 | 46.17 | 74 | -27.83 | Peak | H |
| 9608 | 33.85 | 6.33 | 40.18 | 54 | -13.82 | AVG | H |
| **BLE 1Mbps - 2440 MHz TX mode** | | | | | | | |
| 4880 | 39.14 | 1.68 | 40.82 | 74 | -33.18 | Peak | V |
| 4880 | 33.18 | 1.68 | 34.86 | 54 | -19.14 | AVG | V |
| 7320 | 39.06 | 5.45 | 44.51 | 74 | -29.49 | Peak | V |
| 7320 | 32.89 | 5.45 | 38.34 | 54 | -15.66 | AVG | V |
| 9760 | 39.6 | 6.37 | 45.97 | 74 | -28.03 | Peak | V |
| 9760 | 33.27 | 6.37 | 39.64 | 54 | -14.36 | AVG | V |
| 4880 | 39.26 | 1.68 | 40.94 | 74 | -33.06 | Peak | H |
| 4880 | 32.9 | 1.68 | 34.58 | 54 | -19.42 | AVG | H |
| 7320 | 39.54 | 5.45 | 44.99 | 74 | -29.01 | Peak | H |
| 7320 | 33.23 | 5.45 | 38.68 | 54 | -15.32 | AVG | H |
| 9760 | 39.98 | 6.37 | 46.35 | 74 | -27.65 | Peak | H |
| 9760 | 33.88 | 6.37 | 40.25 | 54 | -13.75 | 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 | 40.12 | 1.83 | 41.95 | 74 | -32.05 | Peak | V |
| 4960 | 33.86 | 1.83 | 35.69 | 54 | -18.31 | AVG | V |
| 7440 | 40.39 | 5.43 | 45.82 | 74 | -28.18 | Peak | V |
| 7440 | 33.83 | 5.43 | 39.26 | 54 | -14.74 | AVG | V |
| 9920 | 38.39 | 6.41 | 44.8 | 74 | -29.2 | Peak | V |
| 9920 | 32.24 | 6.41 | 38.65 | 54 | -15.35 | AVG | V |
| 4960 | 41.81 | 1.83 | 43.64 | 74 | -30.36 | Peak | H |
| 4960 | 35.82 | 1.83 | 37.65 | 54 | -16.35 | AVG | H |
| 7440 | 40.21 | 5.43 | 45.64 | 74 | -28.36 | Peak | H |
| 7440 | 34.03 | 5.43 | 39.46 | 54 | -14.54 | AVG | H |
| 9920 | 38.79 | 6.41 | 45.2 | 74 | -28.8 | Peak | H |
| 9920 | 32.71 | 6.41 | 39.12 | 54 | -14.88 | 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 | 48.77 | -6.6 | 42.17 | 74 | -31.83 | Peak | V |
| 2310 | 38.71 | -6.6 | 32.11 | 54 | -21.89 | AVG | V |
| 2390 | 49.93 | -6.23 | 43.7 | 74 | -30.3 | Peak | V |
| 2390 | 38.92 | -6.23 | 32.69 | 54 | -21.31 | AVG | V |
| 2310 | 49.06 | -6.6 | 42.46 | 74 | -31.54 | Peak | H |
| 2310 | 38.9 | -6.6 | 32.3 | 54 | -21.7 | AVG | H |
| 2390 | 51.82 | -6.23 | 45.59 | 74 | -28.41 | Peak | H |
| 2390 | 39.28 | -6.23 | 33.05 | 54 | -20.95 | AVG | H |
| **BLE 1Mbps – High band-edge** | | | | | | | |
| 2483.5 | 62.63 | -5.79 | 56.84 | 74 | -17.16 | Peak | V |
| 2483.5 | 44.55 | -5.79 | 38.76 | 54 | -15.24 | AVG | V |
| 2500 | 49.25 | -5.72 | 43.53 | 74 | -30.47 | Peak | V |
| 2500 | 39.37 | -5.72 | 33.65 | 54 | -20.35 | AVG | V |
| 2483.5 | 69.37 | -5.79 | 63.58 | 74 | -10.42 | Peak | H |
| 2483.5 | 50.77 | -5.79 | 44.98 | 54 | -9.02 | AVG | H |
| 2500 | 50.59 | -5.72 | 44.87 | 74 | -29.13 | Peak | H |
| 2500 | 39.56 | -5.72 | 33.84 | 54 | -20.16 | 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----**