# TEST REPORT

| | | |
|---|---|---|
| **Product** | : | Zigbee Pro Temp tag |
| **Trade mark** | : | V-MARK |
| **Model/Type reference** | : | VTS04W02 |
| **Serial Number** | : | N/A |
| **Report Number** | : | EED32M00045601 |
| **FCC ID** | : | 2AQ7V-VTSCFGPROTT |
| **Date of Issue** | : | Jun. 08, 2020 |
| **Test Standards** | : | 47 CFR Part 15 Subpart C |
| **Test result** | : | PASS |

Prepared for:

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**400-601 West Broadway, Vancouver,**
**British Columbia, Canada**

Prepared by:

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Date: Jun. 08, 2020

Check No.:3970366270

# 2 Version

| Version No. | Date | Description |
|---|---|---|
| 00 | Jun. 08, 2020 | Original |
| | | |
| | | |

# 3 Test Summary

| Test Item | Test Requirement | Test method | Result |
|---|---|---|---|
| **Antenna Requirement** | 47 CFR Part 15 Subpart C Section 15.203/15.247 (c) | ANSI C63.10-2013 | PASS |
| **AC Power Line Conducted Emission** | 47 CFR Part 15 Subpart C Section 15.207 | ANSI C63.10-2013 | N/A |
| **Conducted Peak Output Power** | 47 CFR Part 15 Subpart C Section 15.247 (b)(3) | ANSI C63.10-2013 | PASS |
| **6dB Occupied Bandwidth** | 47 CFR Part 15 Subpart C Section 15.247 (a)(2) | ANSI C63.10-2013 | PASS |
| **Power Spectral Density** | 47 CFR Part 15 Subpart C Section 15.247 (e) | ANSI C63.10-2013 | PASS |
| **Band-edge for RF Conducted Emissions** | 47 CFR Part 15 Subpart C Section 15.247(d) | ANSI C63.10-2013 | PASS |
| **RF Conducted Spurious Emissions** | 47 CFR Part 15 Subpart C Section 15.247(d) | ANSI C63.10-2013 | PASS |
| **Radiated Spurious Emissions** | 47 CFR Part 15 Subpart C Section 15.205/15.209 | ANSI C63.10-2013 | PASS |
| **Restricted bands around fundamental frequency (Radiated Emission)** | 47 CFR Part 15 Subpart C Section 15.205/15.209 | ANSI C63.10-2013 | PASS |
| **Duty Cycle** | ANSI C63.10-2013 | ANSI C63.10-2013 | PASS |

Remark:

Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

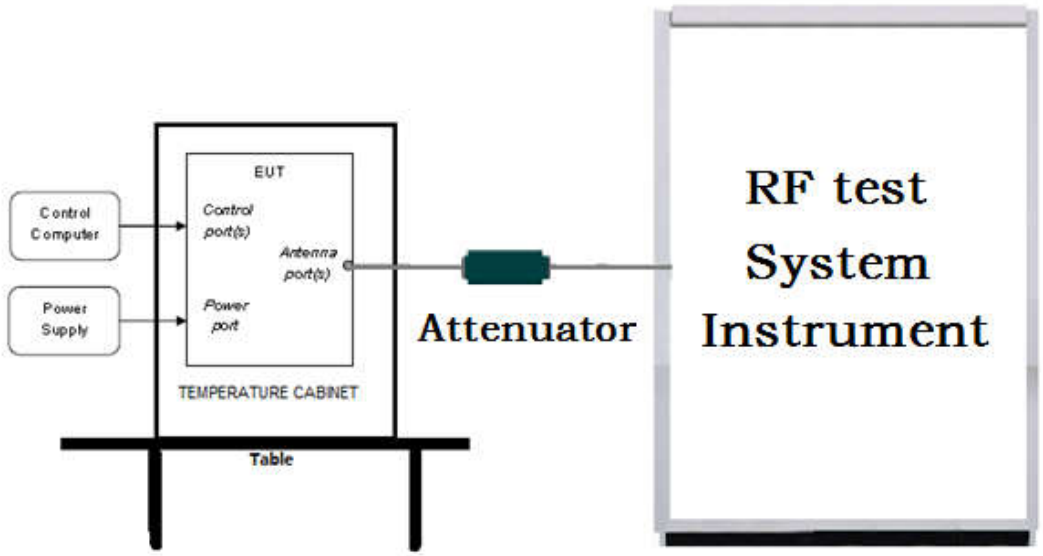
The tested sample(s) and the sample information are provided by the client.

# 4 Content

# 5 Test Requirement

## 5.1 Test setup

### 5.1.1 For Conducted test setup




### 5.1.2 For Radiated Emissions test setup

**Radiated Emissions setup:**

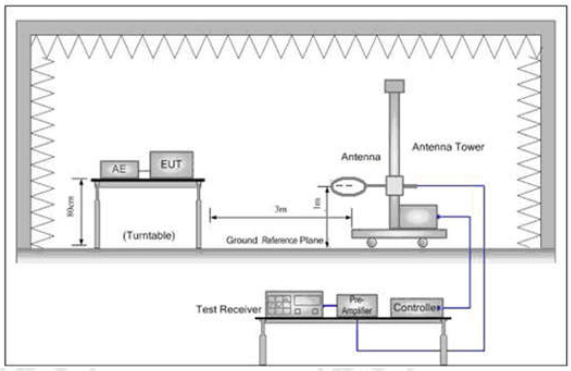



Figure 1. Below 30MHz

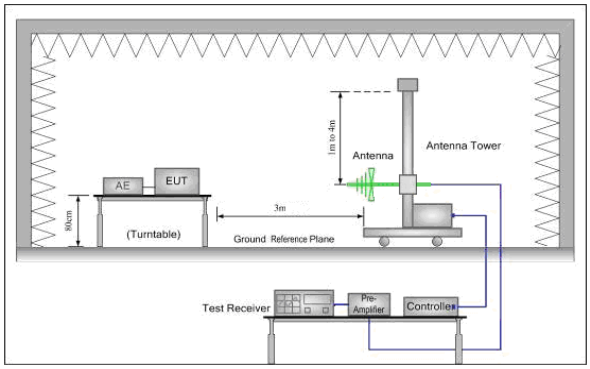



Figure 2. 30MHz to 1GHz

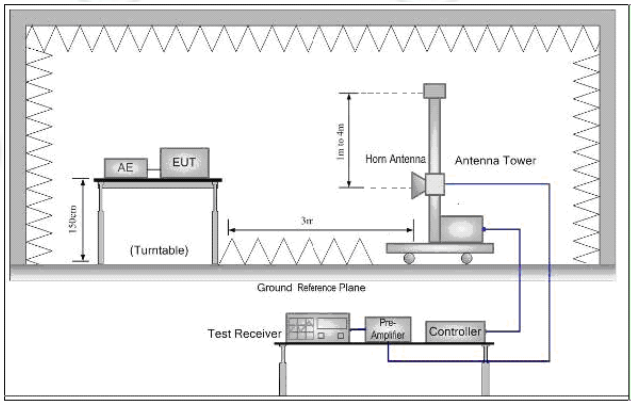



Figure 3. Above 1GHz

### 5.1.3 For Conducted Emissions test setup

**Conducted Emissions setup**

N/A

## 5.2 Test Environment

| **Operating Environment:** | |
|---|---|
| Temperature: | 24.0 °C |
| Humidity: | 53 % RH |
| Atmospheric Pressure: | 1010mbar |

## 5.3 Test Condition

| Test Mode | Tx | RF Channel | | |
|---|---|---|---|---|
| | | Low(L) | Middle(M) | High(H) |
| OQPSK | 2405MHz ~2480MHz | Channel 1 | Channel 8 | Channel 16 |
| | | 2405MHz | 2440MHz | 2480MHz |

# 6 General Information

## 6.1 Client Information

| | |
|---|---|
| Applicant: | V-MARK Enterprises Ltd. |
| Address of Applicant: | 400-601 West Broadway, Vancouver, British Columbia, Canada |
| Manufacturer: | Senpu Fishing Tackle Co., Ltd. |
| Address of Manufacturer: | Floor 2 No 2 Building Fucheng Industrial Park, 82nd Shilian lu, Shiji Town, Panyu District, GuangZhou |

## 6.2 General Description of EUT

| | | |
|---|---|---|
| Product Name: | Zigbee Pro Temp tag | |
| Model No.(EUT): | VTS04W02 | |
| Trade Mark: | V-MARK | |
| EUT Supports Radios application: | 2405-2480MHz (2405MHz/2440MHz/2480MHz) | |
| Power Supply: | Battery | ER14335 3.6V 1600mAh |
| Sample Received Date: | Mar. 16, 2020 | |
| Sample tested Date: | Mar. 16, 2020 to May 28, 2020 | |

## 6.3 Product Specification subjective to this standard

| | |
|---|---|
| Operation Frequency: | 2405MHz to 2480MHz |
| Channel Numbers: | 16 |
| Type of Modulation: | OQPSK |
| Test Power Grade: | Default |
| Test Software of EUT: | Default |
| Antenna Type and Gain: | Type: PCB Antenna<br>Gain:2dBi |
| Test Voltage: | DC 3.6V |

Operation Frequency each of channel

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 1 | 2405 | 7 | 2435 | 13 | 2465 |
| 2 | 2410 | 8 | 2440 | 14 | 2470 |
| 3 | 2415 | 9 | 2445 | 15 | 2475 |
| 4 | 2420 | 10 | 2450 | 16 | 2480 |
| 5 | 2425 | 11 | 2455 | | |
| 6 | 2430 | 12 | 2460 | | |

## 6.4 Description of Support Units

The EUT has been tested independently

## 6.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd

Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China

Telephone: +86 (0) 755 33683668 Fax:+86 (0) 755 33683385

No tests were sub-contracted.

FCC Designation No.: CN1164

## 6.6 Deviation from Standards

None.

## 6.7 Abnormalities from Standard Conditions

None.

## 6.8 Other Information Requested by the Customer

None.

## 6.9 Measurement Uncertainty (95% confidence levels, k=2)

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Radio Frequency | $7.9 \times 10^{-8}$ |
| 2 | RF power, conducted | 0.46dB (30MHz-1GHz) |
| | | 0.55dB (1GHz-18GHz) |
| 3 | Radiated Spurious emission test | 4.3dB (30MHz-1GHz) |
| | | 4.5dB (1GHz-12.75GHz) |
| 4 | Conduction emission | 3.5dB (9kHz to 150kHz) |
| | | 3.1dB (150kHz to 30MHz) |
| 5 | Temperature test | 0.64°C |
| 6 | Humidity test | 3.8% |
| 7 | DC power voltages | 0.026% |

# 7 Equipment List

| RF test system | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Mode No.** | **Serial Number** | **Cal. Date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Spectrum Analyzer | Keysight | N9010A | MY54510339 | 02-17-2020 | 02-16-2021 |
| Signal Generator | Keysight | N5182B | MY53051549 | 02-17-2020 | 02-16-2021 |
| Temperature/ Humidity Indicator | biaozhi | HM10 | 1804186 | 07-26-2019 | 07-25-2020 |
| High-pass filter | Sinoscite | FL3CX03WG18N M12-0398-002 | --- | --- | --- |
| High-pass filter | MICRO-TRONICS | SPA-F-63029-4 | --- | --- | --- |
| DC Power | Keysight | E3642A | MY56376072 | 02-17-2020 | 02-16-2021 |
| PC-1 | Lenovo | R4960d | --- | --- | --- |
| BT&WI-FI Automatic control | R&S | OSP120 | 101374 | 02-17-2020 | 02-16-2021 |
| RF control unit | JS Tonscend | JS0806-2 | 158060006 | 02-17-2020 | 02-16-2021 |
| BT&WI-FI Automatic test software | JS Tonscend | JS1120-3 | --- | --- | --- |

| 3M Semi/full-anechoic Chamber | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| 3M Chamber & Accessory Equipment | TDK | SAC-3 | --- | 05-24-2019 | 05-23-2022 |
| TRILOG Broadband Antenna | Schwarzbeck | VULB9163 | 9163-618 | 07-26-2019 | 07-25-2020 |
| Loop Antenna | Schwarzbeck | FMZB 1519B | 1519B-076 | 04-25-2018 | 04-24-2021 |
| Receiver | R&S | ESCI7 | 100938-003 | 10-21-2019 | 10-20-2020 |
| Multi device Controller | maturo | NCD/070/10711112 | --- | --- | --- |
| Temperature/ Humidity Indicator | Shanghai qixiang | HM10 | 1804298 | 07-26-2019 | 07-25-2020 |
| Cable line | Fulai(7M) | SF106 | 5219/6A | --- | --- |
| Cable line | Fulai(6M) | SF106 | 5220/6A | --- | --- |
| Cable line | Fulai(3M) | SF106 | 5216/6A | --- | --- |
| Cable line | Fulai(3M) | SF106 | 5217/6A | --- | --- |

| 3M full-anechoic Chamber | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| RSE Automatic test software | JS Tonscend | JS36-RSE | 10166 | 06-19-2019 | 06-18-2020 |
| Receiver | Keysight | N9038A | MY57290136 | 03-05-2020 | 03-04-2021 |
| Spectrum Analyzer | Keysight | N9020B | MY57111112 | 03-05-2020 | 03-04-2021 |
| Spectrum Analyzer | Keysight | N9030B | MY57140871 | 03-05-2020 | 03-04-2021 |
| TRILOG Broadband Antenna | Schwarzbeck | VULB 9163 | 9163-1148 | 04-25-2018 | 04-24-2021 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | 9170-832 | 04-25-2018 | 04-24-2021 |
| Horn Antenna | ETS-LINDGREN | 3117 | 00057407 | 07-10-2018 | 07-09-2021 |
| Preamplifier | EMCI | EMC184055SE | 980596 | 05-22-2019<br>05-20-2020 | 05-21-2020<br>05-19-2021 |
| Preamplifier | EMCI | EMC001330 | 980563 | 05-08-2019<br>04-22-2020 | 05-07-2020<br>04-21-2021 |
| Preamplifier | JS Tonscend | 980380 | EMC051845 SE | 01-09-2020 | 01-08-2021 |
| Temperature/ Humidity Indicator | biaozhi | GM1360 | EE1186631 | 04-30-2019<br>04-27-2020 | 04-29-2020<br>04-26-2021 |
| Fully Anechoic Chamber | TDK | FAC-3 | --- | 01-17-2018 | 01-16-2021 |
| Filter bank | JS Tonscend | JS0806-F | 188060094 | 04-10-2018 | 04-09-2021 |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0001 | --- | --- |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0002 | --- | --- |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0003 | --- | --- |
| Cable line | Times | SFT205-NMSM-2.50M | 393495-0001 | --- | --- |
| Cable line | Times | EMC104-NMNM-1000 | SN160710 | --- | --- |
| Cable line | Times | SFT205-NMSM-3.00M | 394813-0001 | --- | --- |
| Cable line | Times | SFT205-NMNM-1.50M | 381964-0001 | --- | --- |
| Cable line | Times | SFT205-NMSM-7.00M | 394815-0001 | --- | --- |
| Cable line | Times | HF160-KMKM-3.00M | 393493-0001 | --- | --- |

# 8 Radio Technical Requirements Specification

**Reference documents for testing:**

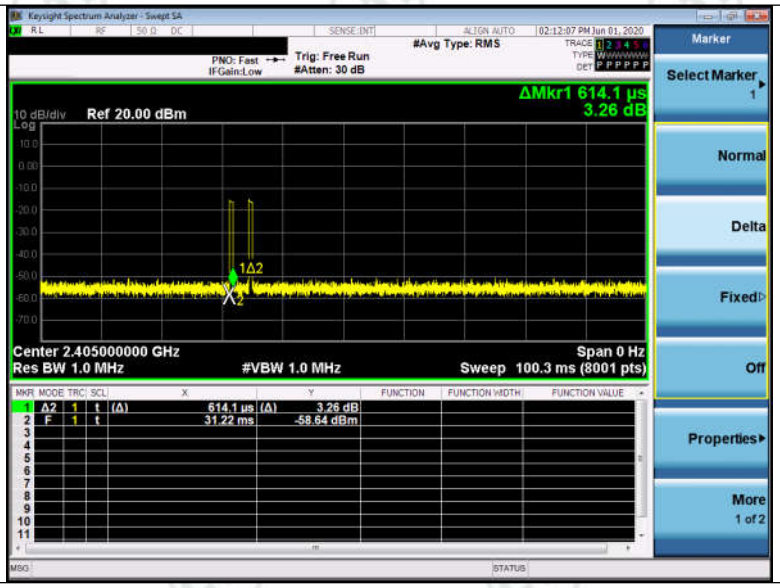
| No. | Identity | Document Title |
|---|---|---|
| 1 | FCC Part15C (2015) | Subpart C-Intentional Radiators |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicesed Wireless Devices |

**Test Results List:**

| Test Requirement | Test method | Test item | Verdict | Note |
|---|---|---|---|---|
| Part15C Section 15.247 (a)(2) | ANSI 63.10 | 6dB Occupied Bandwidth | PASS | Appendix A) |
| Part15C Section 15.247 (b)(3) | ANSI 63.10 | Conducted Peak Output Power | PASS | Appendix B) |
| Part15C Section 15.247(d) | ANSI 63.10 | Band-edge for RF Conducted Emissions | PASS | Appendix C) |
| Part15C Section 15.247(d) | ANSI 63.10 | RF Conducted Spurious Emissions | PASS | Appendix D) |
| Part15C Section 15.247 (e) | ANSI 63.10 | Power Spectral Density | PASS | Appendix E) |
| Part15C Section 15.203/15.247 (c) | ANSI 63.10 | Antenna Requirement | PASS | Appendix F) |
| Part15C Section 15.207 | ANSI 63.10 | AC Power Line Conducted Emission | N/A | N/A |
| Part15C Section 15.205/15.209 | ANSI 63.10 | Restricted bands around fundamental frequency (Radiated Emission) | PASS | Appendix G) |
| Part15C Section 15.205/15.209 | ANSI 63.10 | Radiated Spurious Emissions | PASS | Appendix H) |

## EUT DUTY CYCLE

| Duty Cycle | | | |
|---|---|---|---|
| Configuration | TX ON(ms) | TX ALL(ms) | Duty Cycle(%) |
| OQPSK | 1.23 | 100 | 1.23% |



# Appendix A): 6dB Occupied Bandwidth

**Test Limit**

According to §15.247(a)(2) and RSS-247 section 5.2(a)

**6 dB Bandwidth** :

| | |
|---|---|
| Limit | Shall be at least 500kHz |

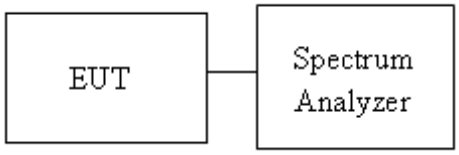
**Occupied Bandwidth(99%)** : For reporting purposes only.

**Test Procedure**

Test method Refer as KDB 558074 D01 , section 8.1 and ANSI 63.10:2013 clause 6.9.2 & 6.9.3.

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 100kHz, VBW = 300kHz and Detector = Peak, to measurement 6 dB Bandwidth.
4. SA set RBW = 30kHz, VBW = 100kHz and Detector = Peak, to measurement 99% Bandwidth
5. Measure and record the result of 6 dB Bandwidth and 99% Bandwidth. in the test report.

**Test Setup**



## Test Result

### 6dB Bandwidth

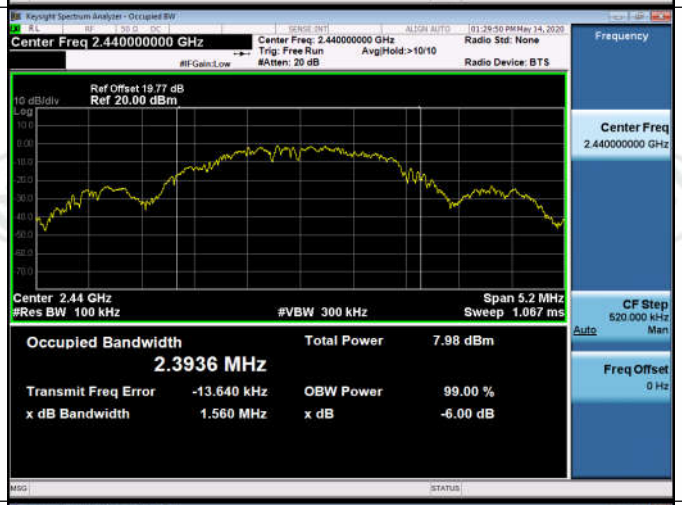
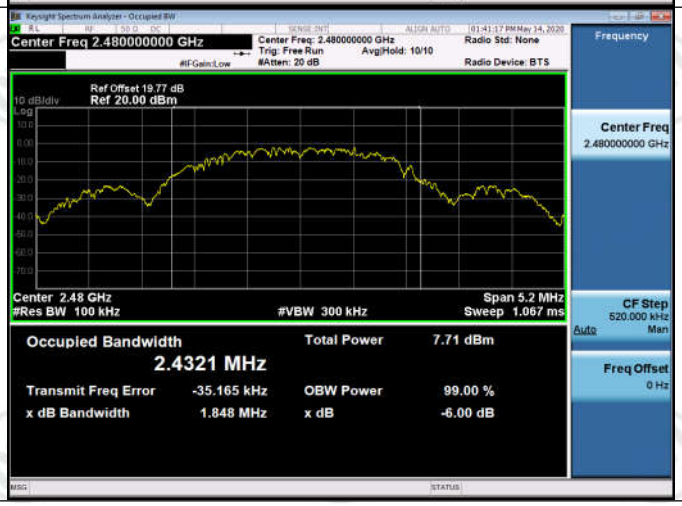
| Mode | Channel | 6dB Bandwidth [MHz] | Verdict |
|---|---|---|---|
| OQPSK | LCH | 1.564 | PASS |
| OQPSK | MCH | 1.560 | PASS |
| OQPSK | HCH | 1.848 | PASS |

### 99%OBW

| Mode | Channel | 99% OBW[MHz] | Verdict |
|---|---|---|---|
| OQPSK | LCH | 2.3545 | PASS |
| OQPSK | MCH | 2.3938 | PASS |
| OQPSK | HCH | 2.4529 | PASS |

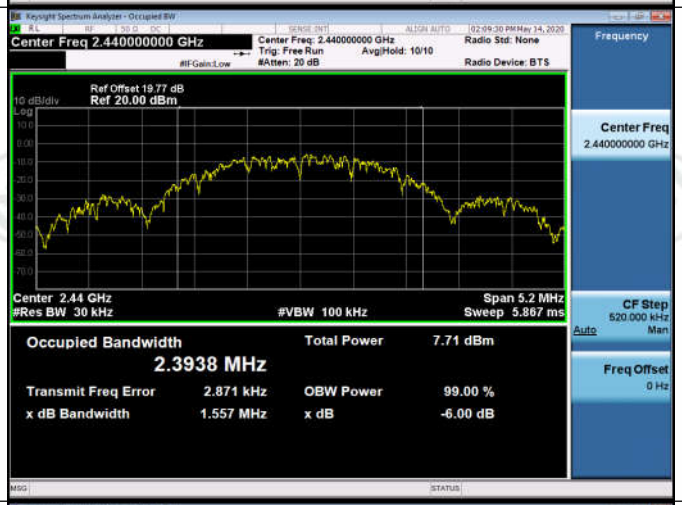
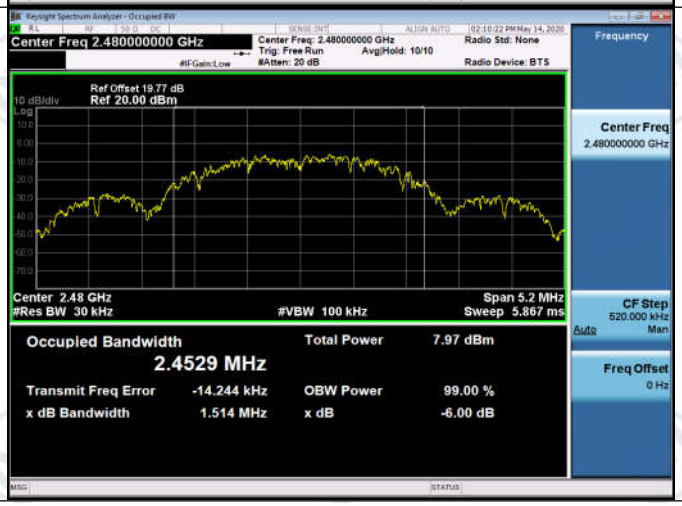
## 6dB Bandwidth

### Test Graphs

| Graphs | | |
|---|---|---|
| LCH | |  |
| MCH | |  |
| HCH | |  |

**99%OBW**

**Test Graphs**

| Graphs | | |
|---|---|---|
| LCH | |  |
| MCH | |  |
| HCH | |  |

# Appendix B): Conducted Peak Output Power

**Test Limit**

According to §15.247(b) and RSS-247 section 5.4(d)

**Peak output power** :

For systems using digital modulation in the 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt(30 dBm), base on the use of antennas with directional gain not exceed 6 dBi If transmitting antennas of directional gain greater than 6dBi are used the peak output power the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

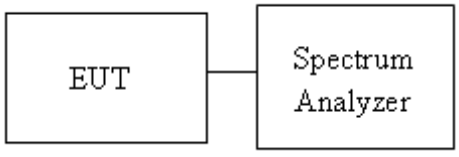
| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：30dBm<br>☐ Antenna with DG greater than 6 dBi<br>[ Limit = 30 – (DG – 6) ]<br>☐ Point-to-point operation |

**Test Procedure**

Test method Refer as KDB 558074 D01 , section 9.1.2.

1. The EUT RF output connected to spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT.
3. Spectrum analyzer settings are as follows：
   a) Set the RBW≥DTS bandwidth.
   b) Set VBW≥[3×RBW].
   c) Set span≥[3×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
4. Measure and record the result in the test report.

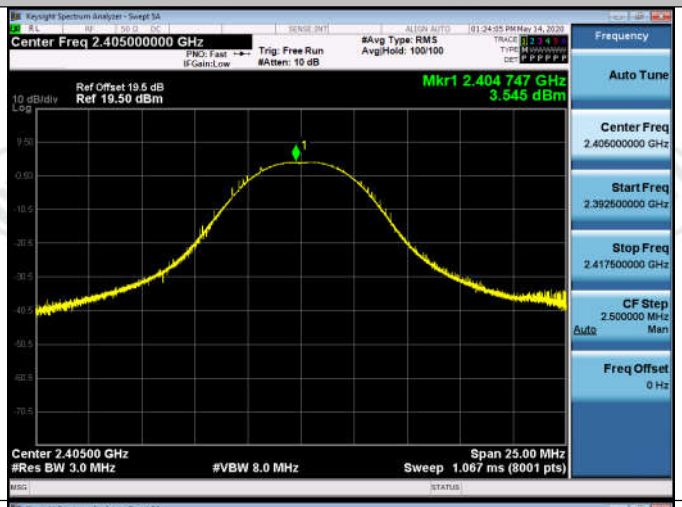
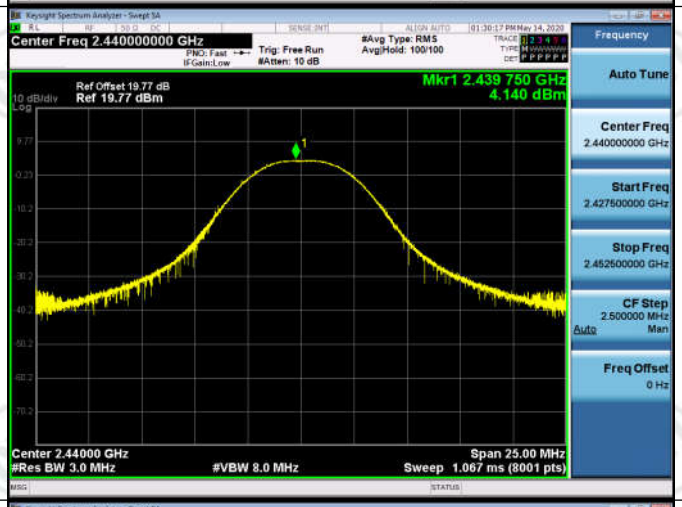
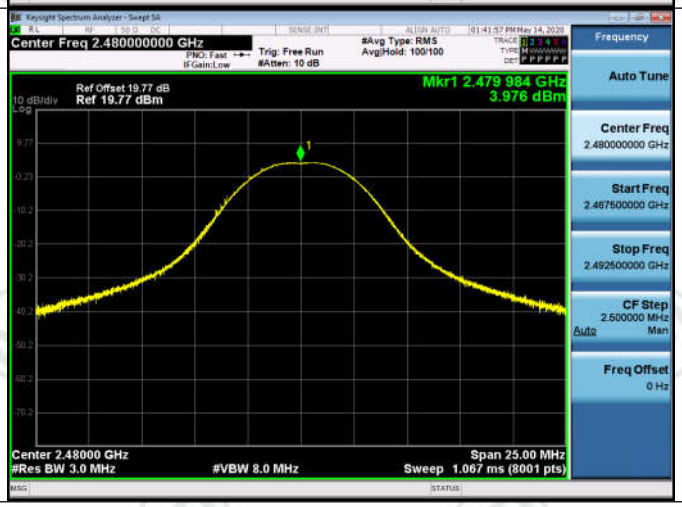
**Test Setup**



## Test Result

| Mode | Channel | Conduct Peak Power[dBm] | Verdict |
|---|---|---|---|
| OQPSK | LCH | 3.545 | PASS |
| OQPSK | MCH | 4.14 | PASS |
| OQPSK | HCH | 3.976 | PASS |

## Test Graphs

| Graphs | | | |
|---|---|---|---|
| LCH | |  | |
| MCH | |  | |
| HCH | |  | |

# Appendix C): Band-edge for RF Conducted Emissions

**Test Limit**

According to §15.247(d) and RSS-247 section 5.5

In any 100 kHz bandwidth outside the authorized frequency band,

Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement 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).

**Test Procedure**

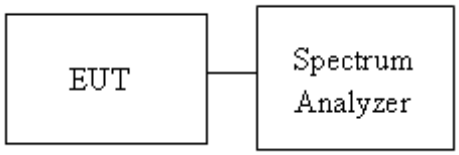
Test method Refer as KDB 558074 D01 , Section 11.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

**Test Setup**



## Result Table

| Mode | Channel | Carrier Power[dBm] | Max.Spurious Level [dBm] | Limit [dBm] | Verdict |
|---|---|---|---|---|---|
| OQPSK | LCH | -1.655 | -56.934 | -21.66 | PASS |
| OQPSK | HCH | -1.855 | -36.562 | -21.86 | PASS |

## Test Graphs

| Graphs | | |
|---|---|---|
| LCH | |  |
| HCH | |  |

# Appendix D): RF Conducted Spurious Emissions

## Test Limit

According to §15.247(d) and RSS-247 section 5.5

In any 100 kHz bandwidth outside the authorized frequency band,

Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement 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).

## Test Procedure

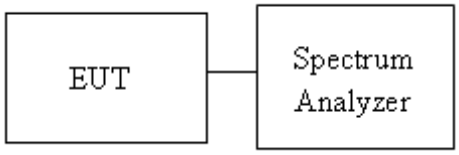
Test method Refer as KDB 558074 D01 , Section 11.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

## Test Setup



## Result Table

| Mode | Channel | Pref [dBm] | Puw[dBm] | Verdict |
|---|---|---|---|---|
| OQPSK | LCH | -1.812 | <Limit | PASS |
| OQPSK | MCH | -1.188 | <Limit | PASS |
| OQPSK | HCH | -1.823 | <Limit | PASS |

## Test Graphs

| OQPSK_LCH_Graphs | | | |
|---|---|---|---|
| Pref/LCH | |  | |
| Puw/LCH | |  | |

| OQPSK_MCH_Graphs | | | |
|---|---|---|---|
| Pref/MCH | |  | |
| Puw/MCH | |  | |

| OQPSK_HCH_Graphs | | |
|---|---|---|
| Pref/HCH | |  |
| Puw/HCH | |  |

# Appendix E): Power Spectral Density

## Test Limit

According to §15.247(e) and RSS-247 section 5.2(b)

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.

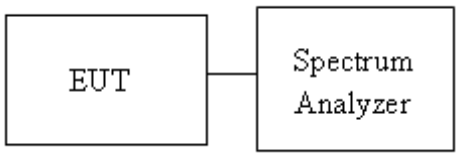
| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：8dBm<br>☐ Antenna with DG greater than 6 dBi<br>[ Limit = 8 – (DG – 6) ]<br>☐ Point-to-point operation： |

## Test Procedure

Test method Refer as KDB 558074 D01 , Section 10.2

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 10kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss and Duty Factor were compensated to the results for each measurement by SA.
5. Mark the maximum level.
   Measure and record the result of power spectral density. in the test report.

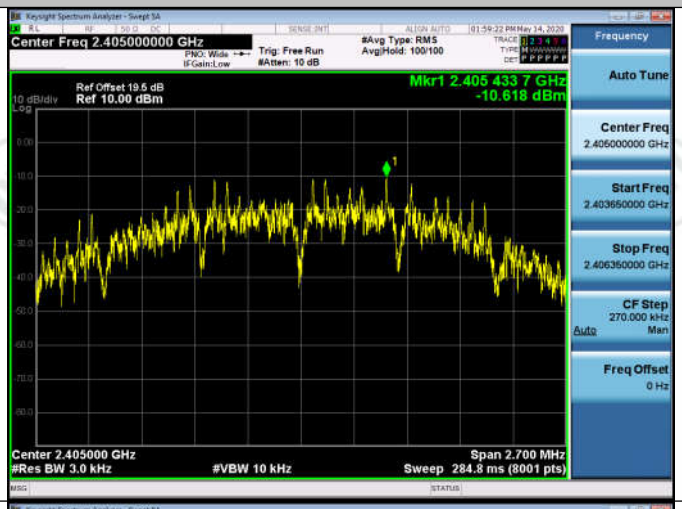
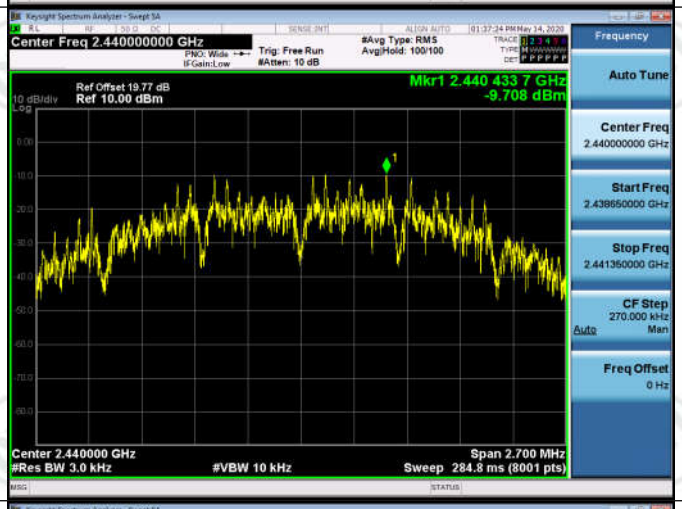
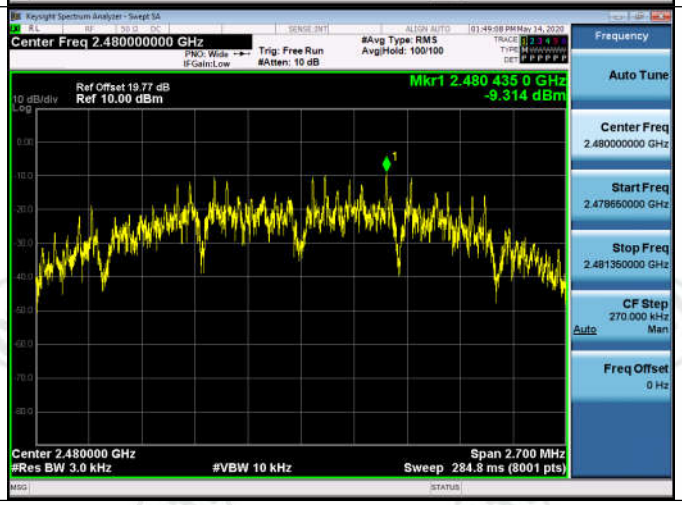
## Test Setup



## Result Table

| Mode | Channel | PSD [dBm] | Verdict |
|---|---|---|---|
| OQPSK | LCH | -10.618 | PASS |
| OQPSK | MCH | -9.708 | PASS |
| OQPSK | HCH | -9.314 | PASS |

## Test Graphs

| Graphs | | | |
|---|---|---|---|
| LCH | |  | |
| MCH | |  | |
| HCH | |  | |

# Appendix F): 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

**15.247(b) (4) requirement:**

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**EUT Antenna:**


The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 2 dBi.

# Appendix G): Restricted bands around fundamental frequency (Radiated)

Receiver Setup:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 30MHz-1GHz | Quasi-peak | 120kHz | 300kHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

Test Procedure:

**Below 1GHz test procedure as below:**

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

**Above 1GHz test procedure as below:**

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).
h. Test the EUT in the lowest channel , the Highest channel
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

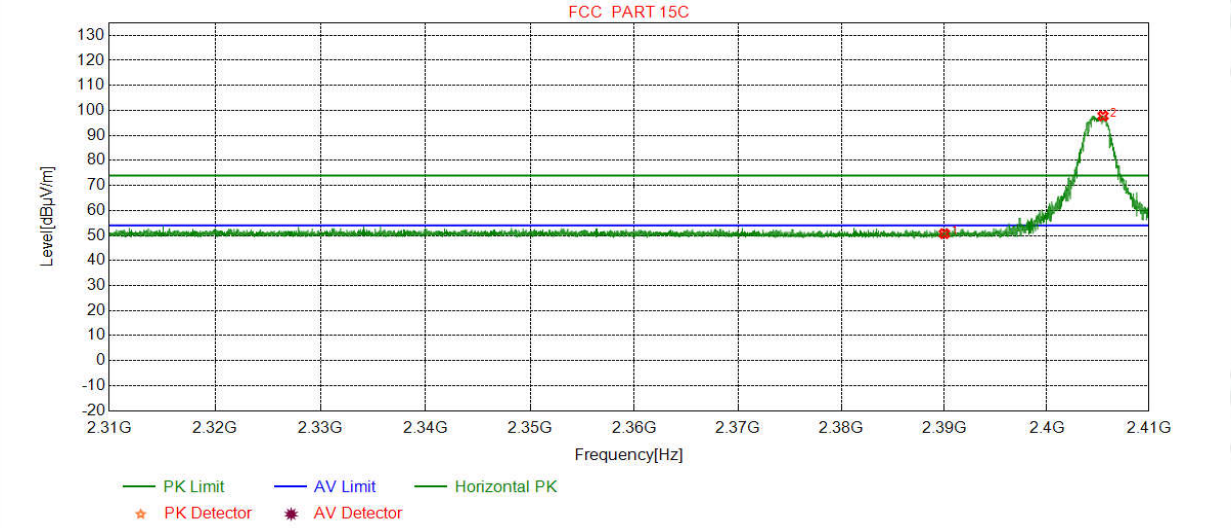
Limit:

| Frequency | Limit (dBμV/m @3m) | Remark |
|---|---|---|
| 30MHz-88MHz | 40.0 | Quasi-peak Value |
| 88MHz-216MHz | 43.5 | Quasi-peak Value |
| 216MHz-960MHz | 46.0 | Quasi-peak Value |
| 960MHz-1GHz | 54.0 | Quasi-peak Value |
| Above 1GHz | 54.0 | Average Value |
| | 74.0 | Peak Value |

**Test plot as follows:**

| Mode: | OQPSK | Channel: | 2405 |
|---|---|---|---|
| Remark: | PK | | |

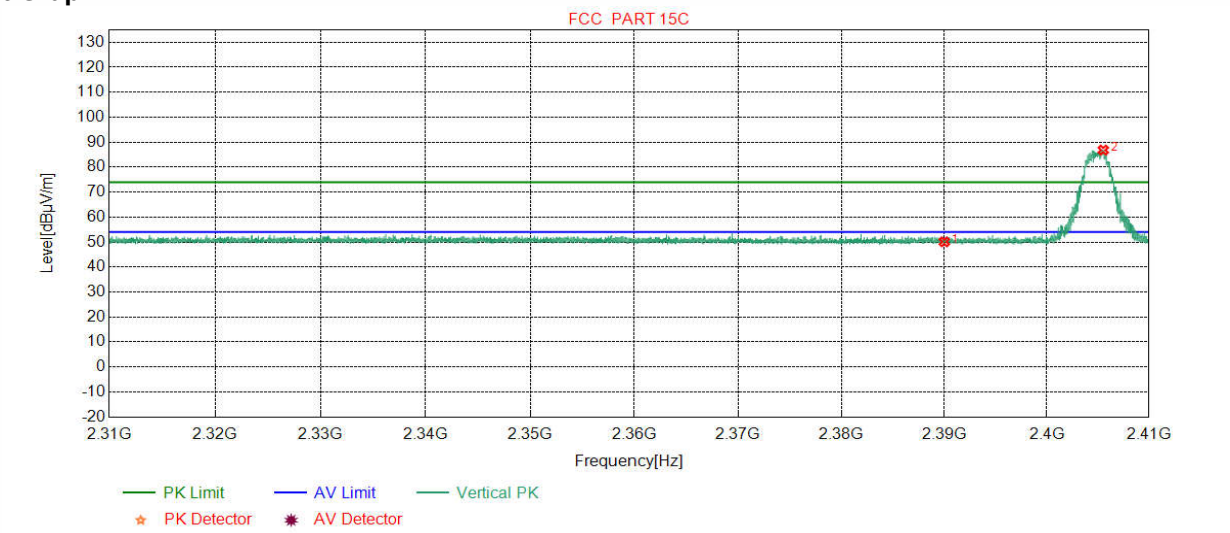
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.0000 | 32.25 | 13.37 | -43.12 | 48.23 | 50.73 | 74.00 | 23.27 | Pass | Horizontal |
| 2 | 2405.5130 | 32.27 | 13.33 | -43.13 | 95.30 | 97.77 | 74.00 | -23.77 | Pass | Horizontal |

| Mode: | OQPSK | Channel: | 2405 |
|---|---|---|---|
| Remark: | PK | | |

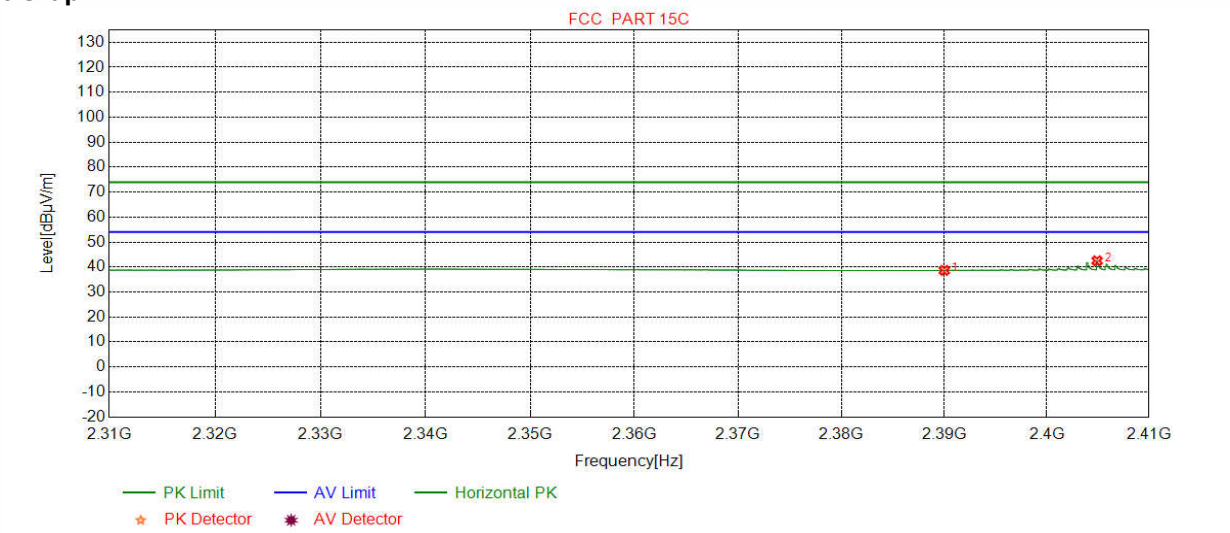
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.0000 | 32.25 | 13.37 | -43.12 | 47.59 | 50.09 | 74.00 | 23.91 | Pass | Vertical |
| 2 | 2405.5330 | 32.27 | 13.33 | -43.13 | 84.36 | 86.83 | 74.00 | -12.83 | Pass | Vertical |

| Mode: | OQPSK | Channel: | 2405 |
|---|---|---|---|
| Remark: | AV | | |

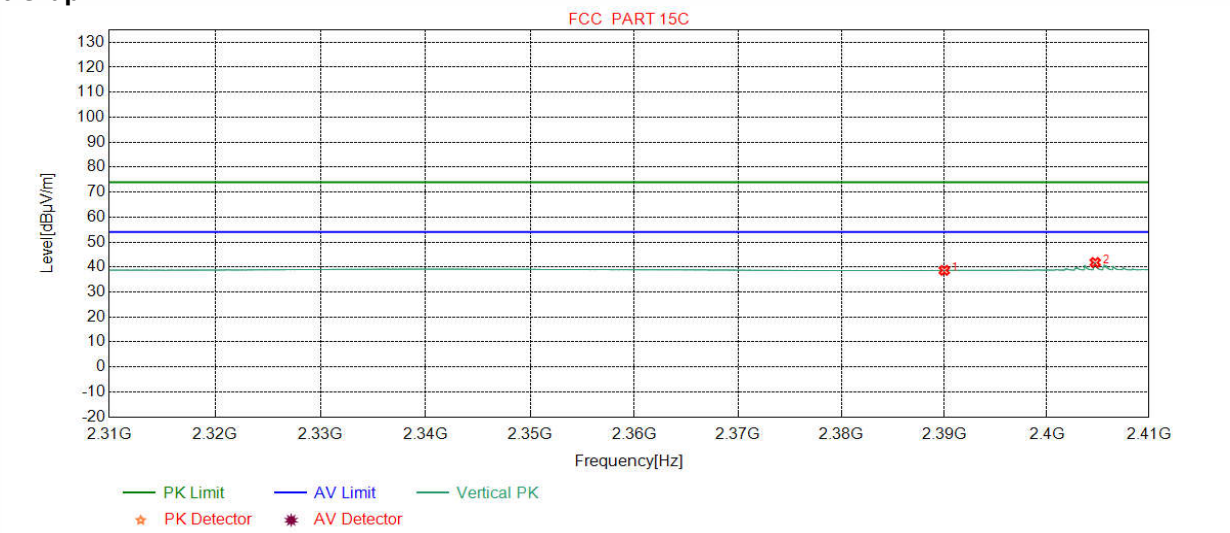
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.0000 | 32.25 | 13.37 | -43.12 | 36.16 | 38.66 | 54.00 | 15.34 | Pass | Horizontal |
| 2 | 2404.9330 | 32.27 | 13.32 | -43.12 | 40.04 | 42.51 | 54.00 | 11.49 | Pass | Horizontal |

| Mode: | OQPSK | Channel: | 2405 |
|---|---|---|---|
| Remark: | AV | | |

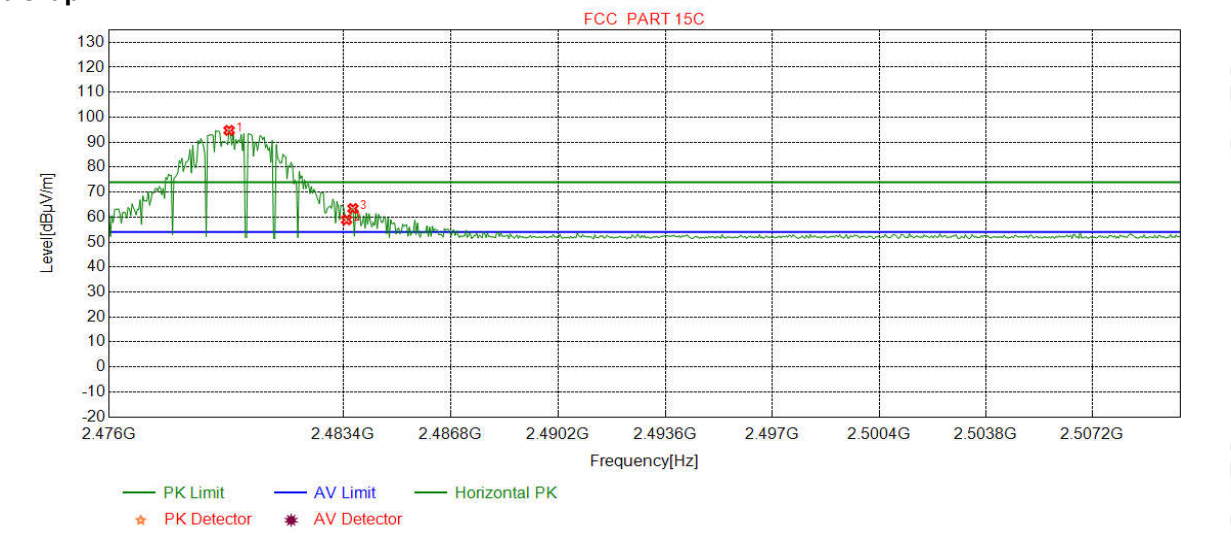
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.0000 | 32.25 | 13.37 | -43.12 | 36.16 | 38.66 | 54.00 | 15.34 | Pass | Vertical |
| 2 | 2404.7463 | 32.27 | 13.32 | -43.12 | 39.34 | 41.81 | 54.00 | 12.19 | Pass | Vertical |

| Mode: | OQPSK | Channel: | 2480 |
|---|---|---|---|
| Remark: | PK | | |

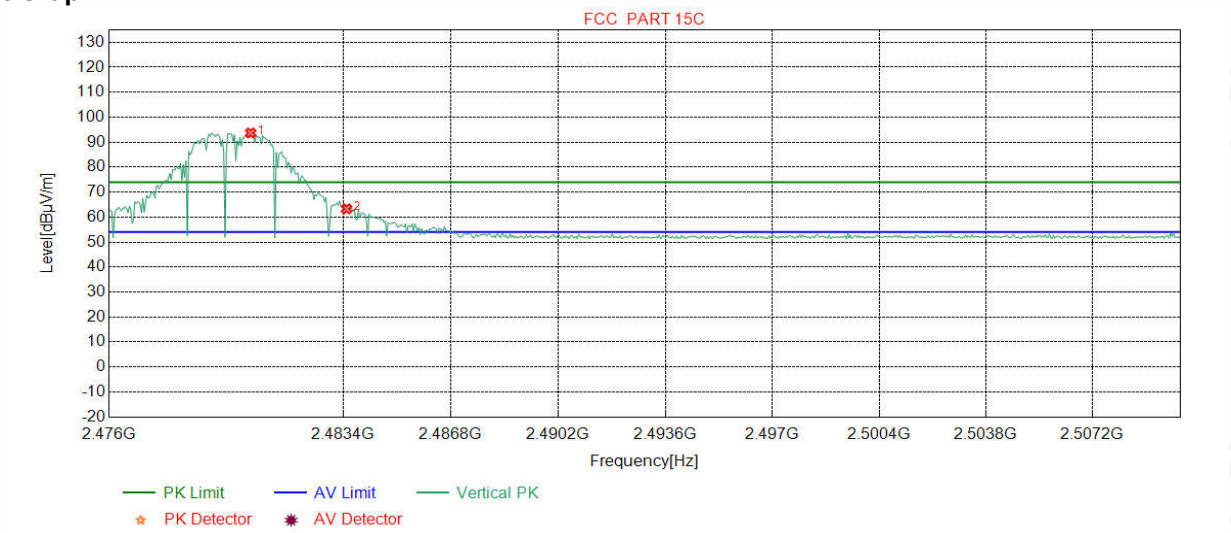
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2479.7872 | 32.37 | 13.39 | -43.10 | 92.05 | 94.71 | 74.00 | -20.71 | Pass | Horizontal |
| 2 | 2483.5000 | 32.38 | 13.38 | -43.11 | 56.24 | 58.89 | 74.00 | 15.11 | Pass | Horizontal |
| 3 | 2483.7021 | 32.38 | 13.37 | -43.10 | 60.78 | 63.43 | 74.00 | 10.57 | Pass | Horizontal |

| Mode: | OQPSK | Channel: | 2480 |
|---|---|---|---|
| Remark: | PK | | |

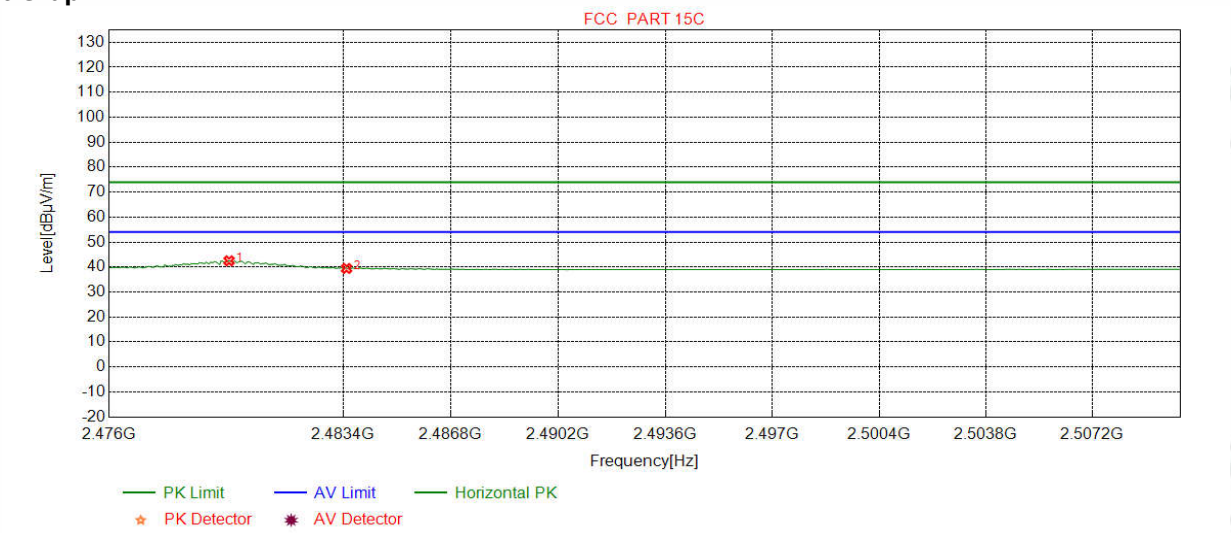
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2480.4681 | 32.37 | 13.39 | -43.10 | 91.01 | 93.67 | 74.00 | -19.67 | Pass | Vertical |
| 2 | 2483.5000 | 32.38 | 13.38 | -43.11 | 60.64 | 63.29 | 74.00 | 10.71 | Pass | Vertical |

| Mode: | OQPSK | Channel: | 2480 |
|---|---|---|---|
| Remark: | AV | | |

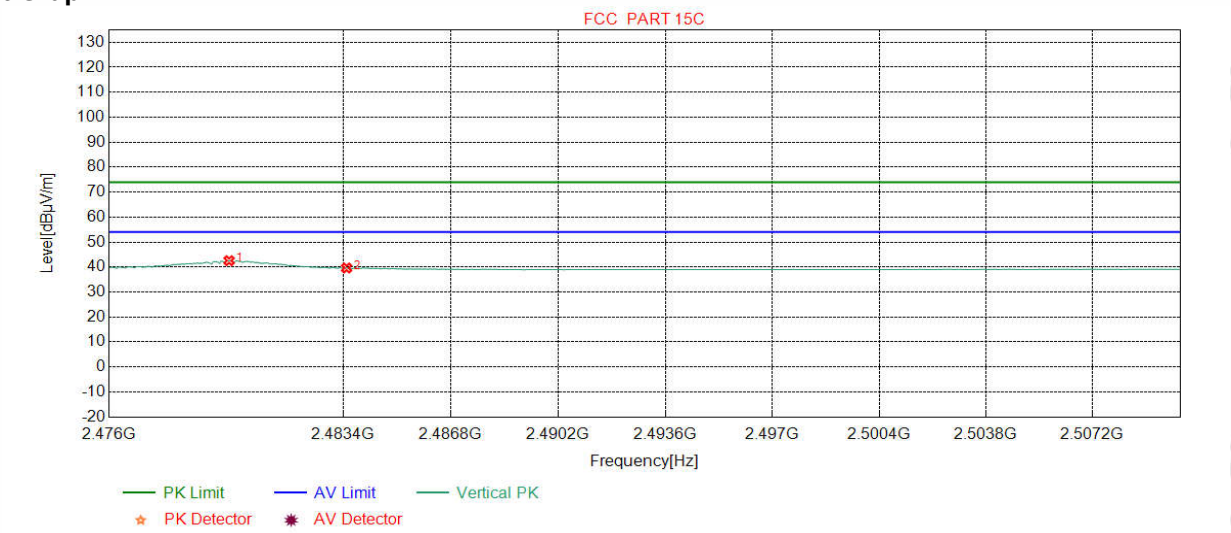
**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2479.7872 | 32.37 | 13.39 | -43.10 | 39.83 | 42.49 | 54.00 | 11.51 | Pass | Horizontal |
| 2 | 2483.5000 | 32.38 | 13.38 | -43.11 | 36.78 | 39.43 | 54.00 | 14.57 | Pass | Horizontal |

| Mode: | OQPSK | Channel: | 2480 |
|---|---|---|---|
| Remark: | AV | | |

**Test Graph**




| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2479.7872 | 32.37 | 13.39 | -43.10 | 39.89 | 42.55 | 54.00 | 11.45 | Pass | Vertical |
| 2 | 2483.5000 | 32.38 | 13.38 | -43.11 | 36.96 | 39.61 | 54.00 | 14.39 | Pass | Vertical |

Note:
1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading -Correct Factor

Correct Factor = Preamplifier Factor– Antenna Factor–Cable Factor

# Appendix H): Radiated Spurious Emissions

**Receiver Setup:**

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 0.009MHz-0.090MHz | Peak | 10kHz | 30kHz | Peak |
| 0.009MHz-0.090MHz | Average | 10kHz | 30kHz | Average |
| 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 0.110MHz-0.490MHz | Peak | 10kHz | 30kHz | Peak |
| 0.110MHz-0.490MHz | Average | 10kHz | 30kHz | Average |
| 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 120kHz | 300kHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

**Test Procedure:**

**Below 1GHz test procedure as below:**

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

**Above 1GHz test procedure as below:**

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).;
h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

Limit:

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

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

# Radiated Spurious Emissions test Data:

## Radiated Emission below 1GHz

| Mode: | | | OQPSK | | | | | Channel: | | 2440 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 36.5967 | 11.21 | 0.67 | -31.38 | 41.35 | 21.85 | 40.00 | 18.15 | Pass | H | PK |
| 2 | 71.2291 | 8.77 | 0.96 | -32.03 | 34.03 | 11.73 | 40.00 | 28.27 | Pass | H | PK |
| 3 | 195.0135 | 10.43 | 1.64 | -31.94 | 41.25 | 21.38 | 43.50 | 22.12 | Pass | H | PK |
| 4 | 360.0270 | 14.52 | 2.27 | -31.84 | 40.89 | 25.84 | 46.00 | 20.16 | Pass | H | PK |
| 5 | 649.9890 | 19.40 | 3.10 | -32.07 | 44.42 | 34.85 | 46.00 | 11.15 | Pass | H | PK |
| 6 | 844.9785 | 21.44 | 3.50 | -31.82 | 40.65 | 33.77 | 46.00 | 12.23 | Pass | H | PK |
| 7 | 150.0010 | 7.55 | 1.45 | -32.01 | 48.03 | 25.02 | 43.50 | 18.48 | Pass | V | PK |
| 8 | 195.0135 | 10.43 | 1.64 | -31.94 | 44.80 | 24.93 | 43.50 | 18.57 | Pass | V | PK |
| 9 | 304.0524 | 13.29 | 2.07 | -31.60 | 41.37 | 25.13 | 46.00 | 20.87 | Pass | V | PK |
| 10 | 433.2693 | 15.93 | 2.46 | -31.84 | 39.43 | 25.98 | 46.00 | 20.02 | Pass | V | PK |
| 11 | 649.9890 | 19.40 | 3.10 | -32.07 | 43.66 | 34.09 | 46.00 | 11.91 | Pass | V | PK |
| 12 | 844.9785 | 21.44 | 3.50 | -31.82 | 41.55 | 34.67 | 46.00 | 11.33 | Pass | V | PK |

**Transmitter Emission above 1GHz**

| Mode: | | | OQPSK | | | | | Channel: | | 2405 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 3204.0136 | 33.28 | 4.63 | -43.09 | 50.71 | 45.53 | 74.00 | 28.47 | Pass | H | PK |
| 2 | 3927.0618 | 33.74 | 4.34 | -43.01 | 50.50 | 45.57 | 74.00 | 28.43 | Pass | H | PK |
| 3 | 5011.1341 | 34.51 | 4.83 | -42.79 | 50.74 | 47.29 | 74.00 | 26.71 | Pass | H | PK |
| 4 | 5509.1673 | 35.01 | 5.16 | -42.60 | 50.41 | 47.98 | 74.00 | 26.02 | Pass | H | PK |
| 5 | 7442.2962 | 36.54 | 5.85 | -42.11 | 49.40 | 49.68 | 74.00 | 24.32 | Pass | H | PK |
| 6 | 9210.4140 | 37.66 | 6.47 | -42.04 | 49.32 | 51.41 | 74.00 | 22.59 | Pass | H | PK |
| 7 | 3208.0139 | 33.28 | 4.62 | -43.10 | 50.20 | 45.00 | 74.00 | 29.00 | Pass | V | PK |
| 8 | 4070.0713 | 33.90 | 4.33 | -42.98 | 49.80 | 45.05 | 74.00 | 28.95 | Pass | V | PK |
| 9 | 5076.1384 | 34.58 | 4.83 | -42.78 | 51.41 | 48.04 | 74.00 | 25.96 | Pass | V | PK |
| 10 | 5880.1920 | 35.61 | 5.07 | -42.60 | 49.28 | 47.36 | 74.00 | 26.64 | Pass | V | PK |
| 11 | 6898.2599 | 36.06 | 5.87 | -42.27 | 49.62 | 49.28 | 74.00 | 24.72 | Pass | V | PK |
| 12 | 9698.4466 | 37.68 | 6.59 | -42.10 | 49.24 | 51.41 | 74.00 | 22.59 | Pass | V | PK |

| Mode: | | | OQPSK | | | | | Channel: | | 2440 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 3752.0501 | 33.60 | 4.35 | -43.05 | 49.63 | 44.53 | 74.00 | 29.47 | Pass | H | PK |
| 2 | 4985.1323 | 34.50 | 4.82 | -42.80 | 50.86 | 47.38 | 74.00 | 26.62 | Pass | H | PK |
| 3 | 5934.1956 | 35.69 | 5.24 | -42.60 | 49.55 | 47.88 | 74.00 | 26.12 | Pass | H | PK |
| 4 | 7672.3115 | 36.53 | 6.20 | -42.13 | 49.02 | 49.62 | 74.00 | 24.38 | Pass | H | PK |
| 5 | 9295.4197 | 37.64 | 6.64 | -42.06 | 49.91 | 52.13 | 74.00 | 21.87 | Pass | H | PK |
| 6 | 10488.499 | 38.48 | 7.06 | -42.00 | 49.39 | 52.93 | 74.00 | 21.07 | Pass | H | PK |
| 7 | 2921.1921 | 33.07 | 4.39 | -43.10 | 51.47 | 45.83 | 74.00 | 28.17 | Pass | V | PK |
| 8 | 3834.0556 | 33.67 | 4.36 | -43.03 | 50.04 | 45.04 | 74.00 | 28.96 | Pass | V | PK |
| 9 | 4996.1331 | 34.50 | 4.82 | -42.80 | 51.50 | 48.02 | 74.00 | 25.98 | Pass | V | PK |
| 10 | 6365.2243 | 35.87 | 5.41 | -42.52 | 49.40 | 48.16 | 74.00 | 25.84 | Pass | V | PK |
| 11 | 7600.3067 | 36.56 | 6.10 | -42.12 | 49.20 | 49.74 | 74.00 | 24.26 | Pass | V | PK |
| 12 | 9209.4140 | 37.66 | 6.47 | -42.04 | 49.60 | 51.69 | 74.00 | 22.31 | Pass | V | PK |

| Mode: | | | OQPSK | | | | | Channel: | | 2480 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Ant Factor [dB] | Cable loss [dB] | Pream gain [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 3469.0313 | 33.39 | 4.45 | -43.10 | 50.22 | 44.96 | 74.00 | 29.04 | Pass | H | PK |
| 2 | 4529.1019 | 34.50 | 4.70 | -42.80 | 50.03 | 46.43 | 74.00 | 27.57 | Pass | H | PK |
| 3 | 5021.1347 | 34.52 | 4.85 | -42.80 | 51.05 | 47.62 | 74.00 | 26.38 | Pass | H | PK |
| 4 | 6452.2301 | 35.89 | 5.52 | -42.51 | 49.34 | 48.24 | 74.00 | 25.76 | Pass | H | PK |
| 5 | 7444.2963 | 36.54 | 5.85 | -42.11 | 49.19 | 49.47 | 74.00 | 24.53 | Pass | H | PK |
| 6 | 9772.4515 | 37.71 | 6.67 | -42.10 | 49.43 | 51.71 | 74.00 | 22.29 | Pass | H | PK |
| 7 | 3925.0617 | 33.74 | 4.34 | -43.01 | 49.97 | 45.04 | 74.00 | 28.96 | Pass | V | PK |
| 8 | 4635.1090 | 34.50 | 4.90 | -42.80 | 50.11 | 46.71 | 74.00 | 27.29 | Pass | V | PK |
| 9 | 5532.1688 | 35.05 | 5.16 | -42.60 | 50.45 | 48.06 | 74.00 | 25.94 | Pass | V | PK |
| 10 | 6614.2409 | 35.95 | 5.50 | -42.43 | 49.08 | 48.10 | 74.00 | 25.90 | Pass | V | PK |
| 11 | 7503.3002 | 36.60 | 5.95 | -42.10 | 49.09 | 49.54 | 74.00 | 24.46 | Pass | V | PK |
| 12 | 9190.4127 | 37.66 | 6.44 | -42.03 | 49.94 | 52.01 | 74.00 | 21.99 | Pass | V | PK |

Note:

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

Final Test Level =Receiver Reading -Correct Factor

Correct Factor = Preamplifier Factor– Antenna Factor–Cable Factor

3) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.