# TEST REPORT

| | | |
|---|---|---|
| **APPLICANT** | : | Anker Innovations Limited |
| **PRODUCT NAME** | : | Nebula Cosmos |
| **MODEL NAME** | : | D2140 |
| **BRAND NAME** | : | NEBULA |
| **FCC ID** | : | 2AOKB-D2140 |
| **STANDARD(S)** | : | 47 CFR Part 15 Subpart C |
| **RECEIPT DATE** | : | 2019-12-23 |
| **TEST DATE** | : | 2020-04-27 to 2020-05-05 |
| **ISSUE DATE** | : | 2020-05-15 |

Edited by: Peng Mi (Rapporteur)

Approved by: Peng Huarui ( Supervisor )

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MORLAB

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| Change History | | |
|---|---|---|
| **Version** | **Date** | **Reason for change** |
| 1.0 | 2020-05-15 | First edition |
| | | |

# 1. Technical Information

**Note:** Provide by applicant.

## 1.1. Applicant and Manufacturer Information

| | |
|---|---|
| **Applicant:** | Anker Innovations Limited |
| **Applicant Address:** | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |
| **Manufacturer:** | Anker Innovations Limited |
| **Manufacturer Address:** | Room 1318-19,Hollywood Plaza,610 Nathan Road, Mongkok, Kowloon, Hong Kong |

## 1.2. Equipment Under Test (EUT) Description

| | | |
|---|---|---|
| **Product Name:** | Nebula Cosmos | |
| **Serial No:** | (N/A, marked #1 by test site) | |
| **Hardware Version:** | V0.4 | |
| **Software Version:** | ATV9.0.2 | |
| **Equipment Type:** | Bluetooth LE | |
| **Bluetooth Version:** | 4.2 | |
| **Modulation Type:** | GFSK | |
| **Operating Frequency Range:** | 2402MHz - 2480MHz | |
| **Antenna Type:** | FPC Antenna | |
| **Antenna Gain:** | 1.2dBi | |
| **Accessory Information:** | Adaptor | |
| | Brand Name: | N/A |
| | Model No.: | NSA120EC-19063200 |
| | Serial No.: | (N/A, marked #1 by test site) |
| | Rated Output: | 19V⎓6.32A |
| | Rated Input: | 100-240V~2A 50/60Hz |

**Note 1:** We use the dedicated software to control the EUT continuous transmission.

**Note 2:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

## 1.3. The Channel Number and Frequency

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | 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** |

**Note:** The lowest channel 0, middle 19 and highest 39 were selected for test in the report.

## 1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

| No. | Identity | Document Title |
|---|---|---|
| 1 | 47 CFR Part 15 | Radio Frequency Devices |

Test detailed items/section required by FCC rules and results are as below:

| No. | Section | Description | Test Date | Test Engineer | Result | Method determination /Remark |
|---|---|---|---|---|---|---|
| 1 | 15.203 | Antenna Requirement | N/A | N/A | N/A | N/A |
| 2 | N/A | Duty Cycle of Test Signal | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 3 | 15.247(b) | Maximum Peak Conducted Output Power | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 4 | 15.247(b) | Maximum Average Conducted Output Power | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 5 | 15.247(a) | Bandwidth | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 6 | 15.247(d) | Conducted Spurious Emission and Band Edge | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 7 | 15.247(e) | Power spectral density (PSD) | May 05, 2020 | Tu Yanan | PASS | No deviation |
| 8 | 15.207 | Conducted Emission | Apr 27, 2020 | Huang Zhiye | PASS | No deviation |
| 9 | 15.247(d) | Restricted Frequency Bands | Apr 27, 2020 | Peng Xuewei | PASS | No deviation |
| 10 | 15.209, 15.247(d) | Radiated Emission | Apr 27, 2020 | Peng Xuewei | PASS | No deviation |
| **Note 1:** The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013 and KDB558074 D01 v05r02. | | | | | | |

| |
|---|
| **Note 2:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The Ref offset 1.5dB means the cable loss is 1.5dB.<br>**Note 3:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table. |

## 1.5. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature (°C): | 15-35 |
| Relative Humidity (%): | 30-60 |
| Atmospheric Pressure (kPa): | 86-106 |

# 2. 47 CFR Part 15C Requirements

## 2.1. Antenna Requirement

### 2.1.1.Applicable Standard

According to FCC 15.203, 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.

### 2.1.2.Test Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

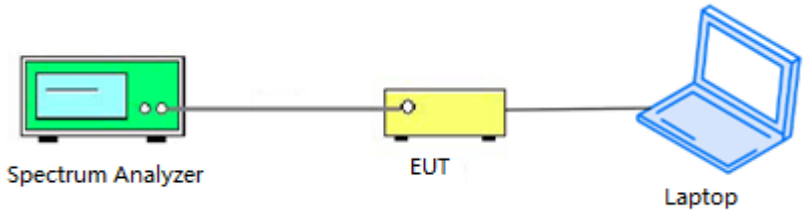
## 2.2. Duty Cycle of Test Signal

### 2.2.1.Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).
When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this subclause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than ±2%; otherwise, the duty cycle is considered to be nonconstant.

### 2.2.2.Test Description

**Test Setup:**




ANSI C63.10 2013 Clause 11.6 was used in order to prove compliance.

### 2.2.3.Test Result

| Test Mode | Duty Cycle (%) (D) | Duty Factor (10*lg[1/D]) |
|---|---|---|
| GFSK | 62.20 | 2.06 |

## 2.3. Maximum Peak Conducted Output Power

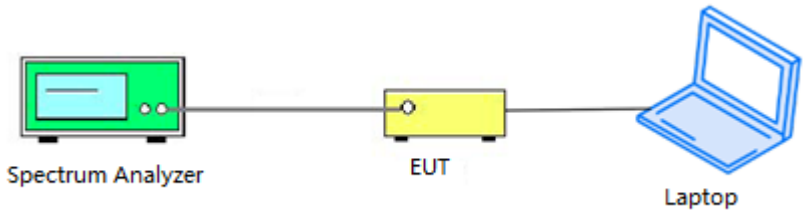
### 2.3.1.Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

### 2.3.2.Test Description

The measured output power was calculated by the reading of the spectrum analyzer and calibration.

**Test Setup:**




The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

### 2.3.3.Test Procedure

The measured output power was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for Peak Output Power test on the spectrum analyzer:
a) Set analyzer center frequency to channel center frequency
b) Set RBW to1 MHz
c) Set VBW to 3 MHz
d) Set span to 3 MHz
e) Sweep time = auto couple
f) Detector = peak
g) Trace mode = max hold
h) Allow trace to fully stabilize
i) Use peak marker function to determine the peak amplitude level

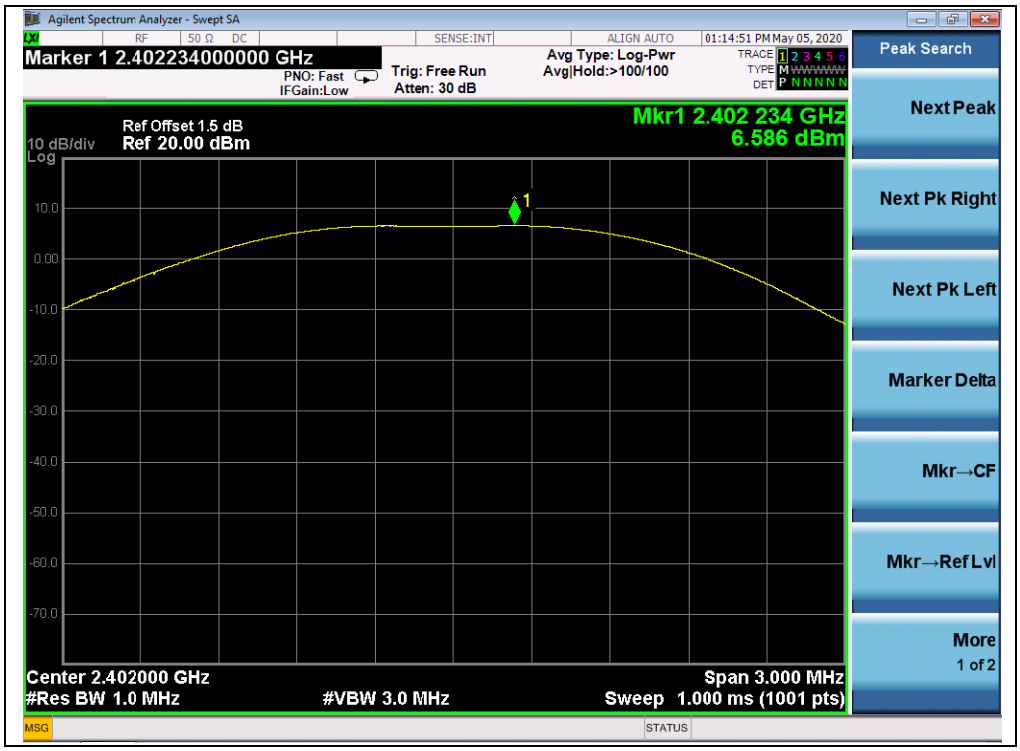
### 2.3.4.Test Result

The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

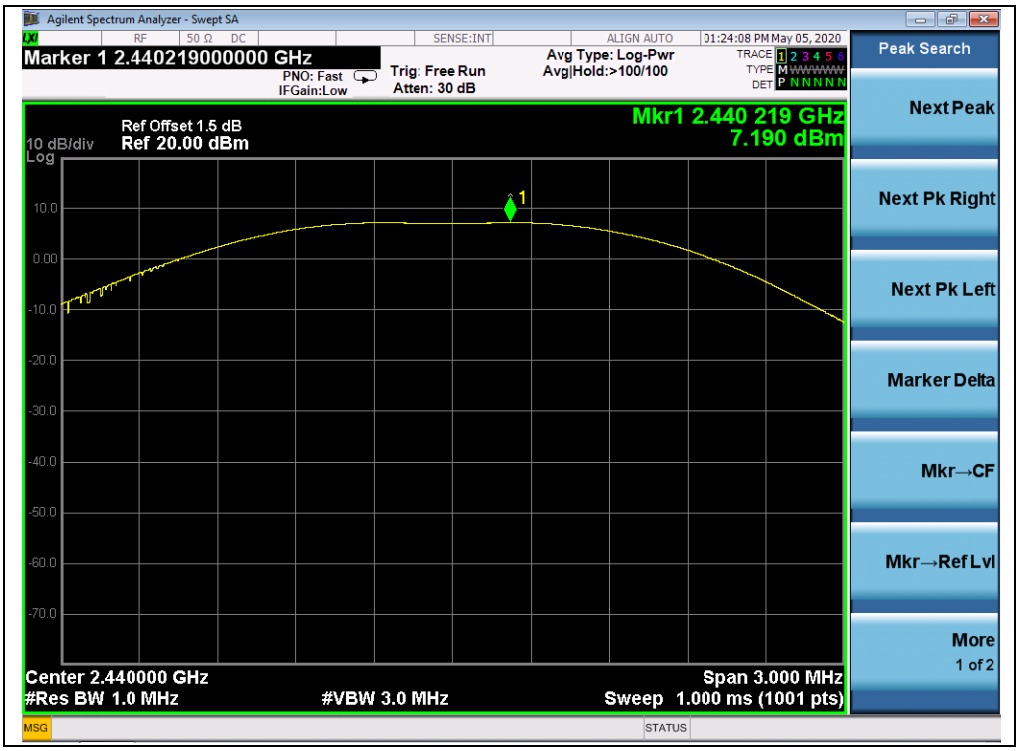
**A.Test Verdict:**

| Channel | Frequency (MHz) | Measured Output Peak Power | | Limit | | Verdict |
|---|---|---|---|---|---|---|
| | | dBm | W | dBm | W | |
| 0 | 2402 | 6.59 | 0.0046 | 30 | 1 | PASS |
| 19 | 2440 | **7.19** | **0.0052** | | | PASS |
| 39 | 2480 | 6.93 | 0.0049 | | | PASS |

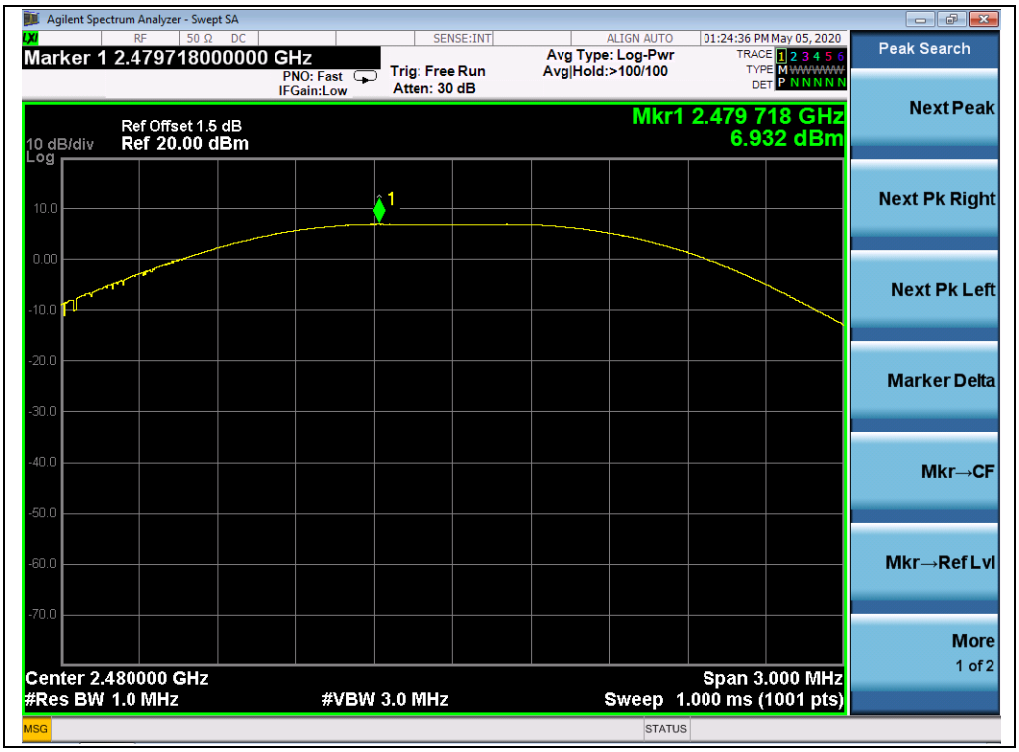
**B.Test Plot:**




(Channel 0, 2402MHz)




(Channel 19, 2440MHz)




(Channel 39, 2480MHz)

# 2.4. Maximum Average Conducted Output Power

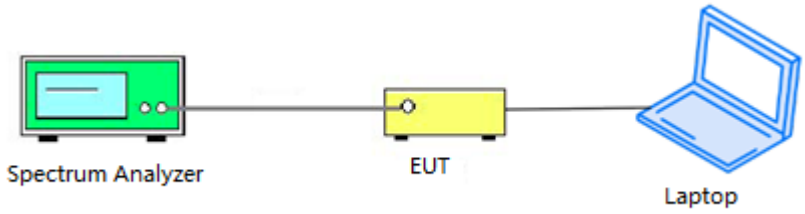
### 2.4.1.Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum average conducted output power of the intentional radiator shall not exceed 1 Watt.

### 2.4.2.Test Description

The measured output power was calculated by the reading of the spectrum analyzer and calibration.

**Test Setup:**




The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

### 2.4.3.Test Procedure

KDB 558074 Section 8.3.2 was used in order to prove compliance.

### 2.4.4.Test Result

| Channel | Frequency (MHz) | Average Power | | | | Limit | | Verdict |
|---|---|---|---|---|---|---|---|---|
| | | Measured | Duty Factor | Duty factor Calculated | | | | |
| | | dBm | | dBm | W | dBm | W | |
| 0 | 2402 | 4.27 | 2.06 | 6.33 | 0.0043 | 30 | 1 | PASS |
| 19 | 2440 | 4.53 | | **6.59** | **0.0046** | | | PASS |
| 39 | 2480 | 4.24 | | 6.30 | 0.0043 | | | PASS |

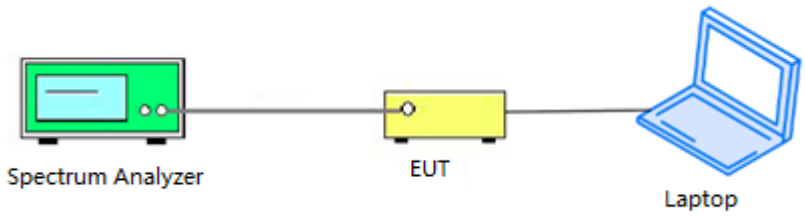
# 2.5.6 dB Bandwidth

### 2.5.1.Requirement

According to FCC section 15.247(a) (2), 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.

### 2.5.2.Test Description

**Test Setup:**




The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.
Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

### 2.5.3.Test Procedure

The steps for the first option are as follows:
a) Set analyzer center frequency to channel center frequency
b) Set RBW to 100 kHz
c) Set VBW to 300 kHz
d) Detector = peak.
e) Trace mode = max hold
f) Sweep time = auto couple
g) Allow the trace to fully stabilize
h) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1 (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 dB.

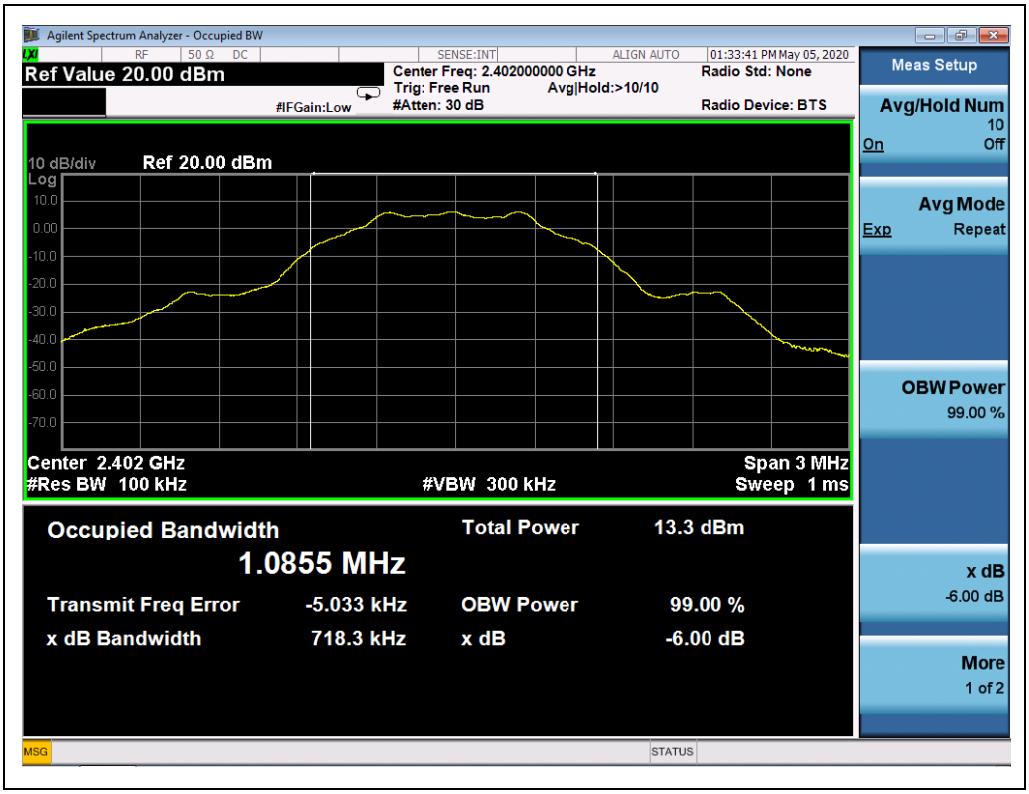
### 2.5.4.Test Result

The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the module.

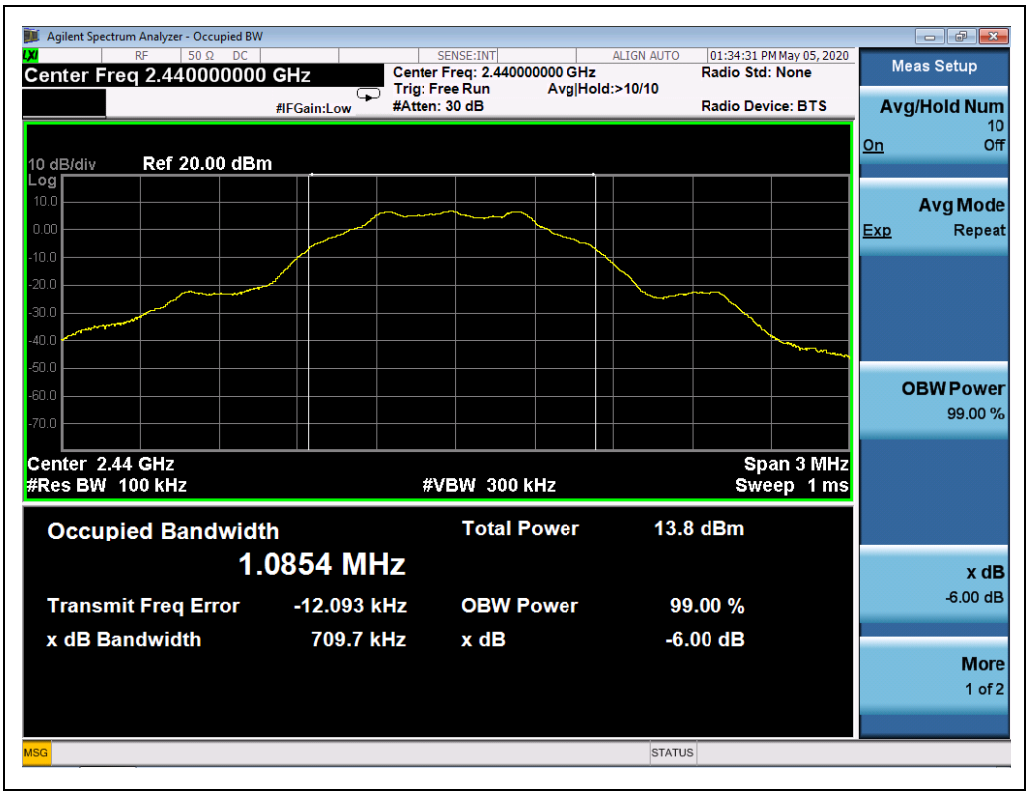
**A. Test Verdict:**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Limits(kHz) | Result |
|---|---|---|---|---|
| 0 | 2402 | 0.718 | ≥500 | PASS |
| 19 | 2440 | 0.710 | ≥500 | PASS |
| 39 | 2480 | 0.701 | ≥500 | PASS |

**B. Test Plot:**




(Channel 0, 2402MHz)




(Channel 19, 2440 MHz)

(Channel 39, 2480MHz)

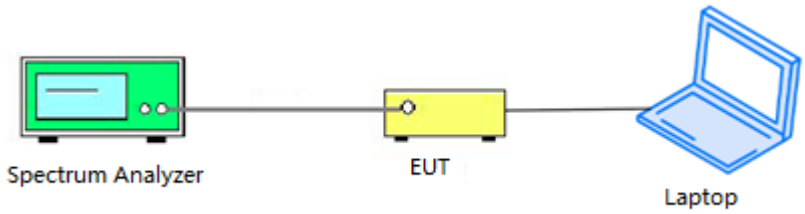
# 2.6. Conducted Spurious Emissions and Band Edge

## 2.6.1.Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

## 2.6.2.Test Description

**Test Setup:**




The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.
Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

## 2.6.3.Test Procedure

KDB 558074 Section 8.5 and 8.7 was used in order to prove compliance.

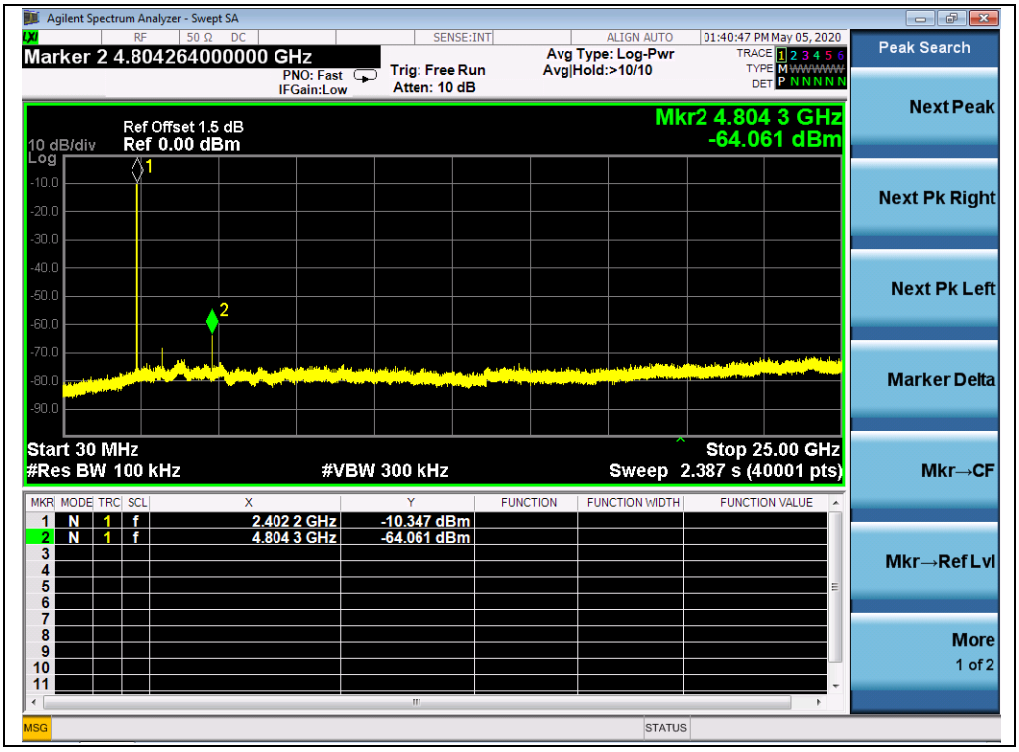
### 2.6.4.Test Result

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

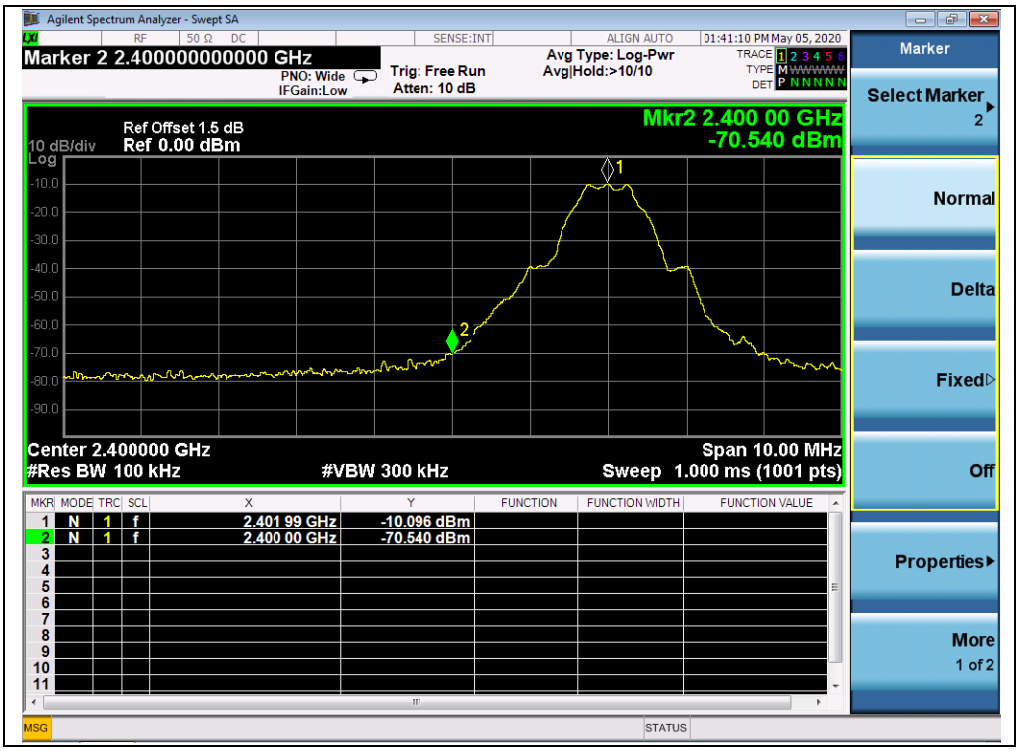
**A.Test Verdict:**

| Channel | Frequency (MHz) | Measured Max. Out of Band Emission (dBm) | Limit (dBm) | | Verdict |
|---|---|---|---|---|---|
| | | | Carrier Level | Calculated -20dBc Limit | |
| 0 | 2402 | -64.06 | -10.35 | -30.35 | PASS |
| 19 | 2440 | -64.74 | -10.06 | -30.06 | PASS |
| 39 | 2480 | -64.98 | -11.04 | -31.04 | PASS |

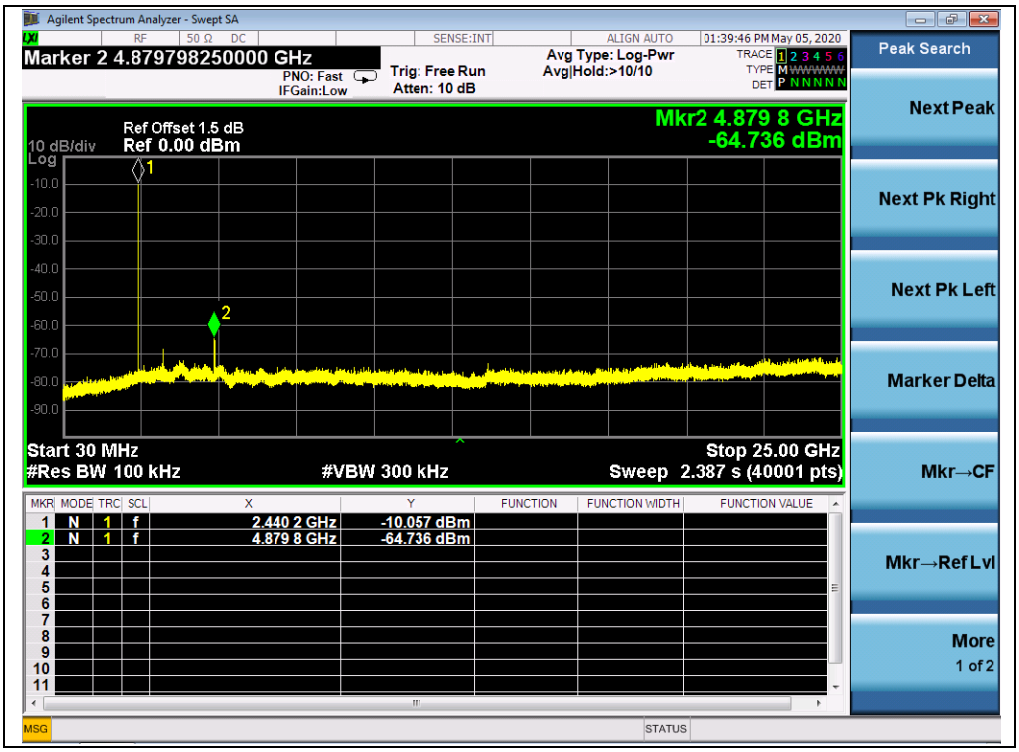
**B.Test Plot:**



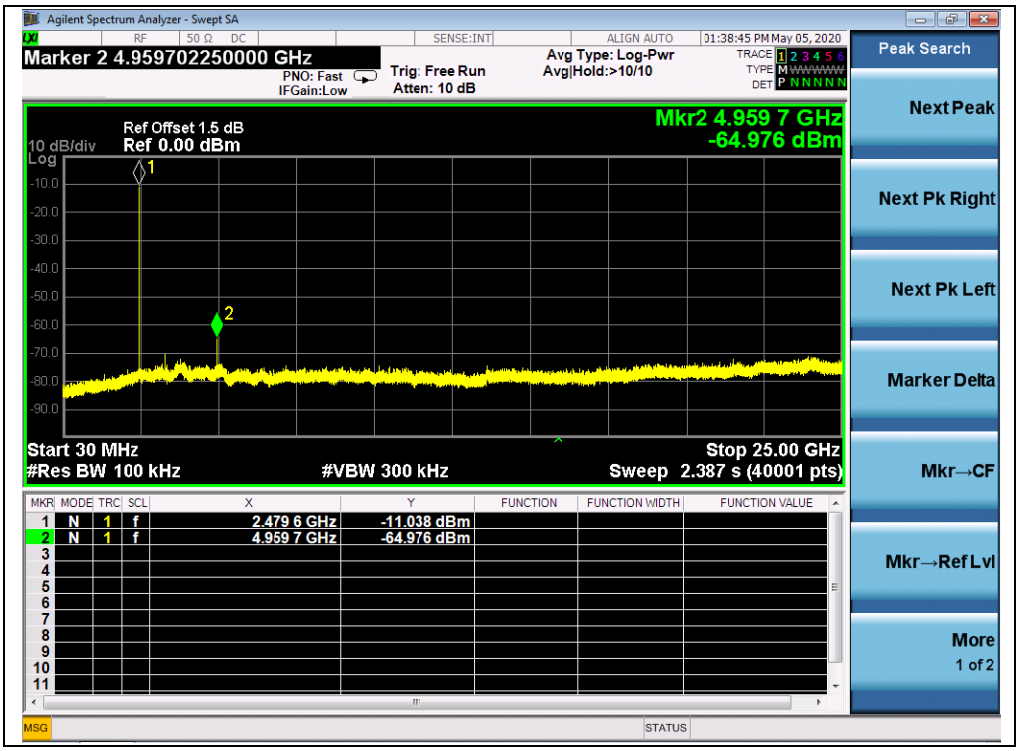

(Channel = 0, 30MHz to 25GHz)



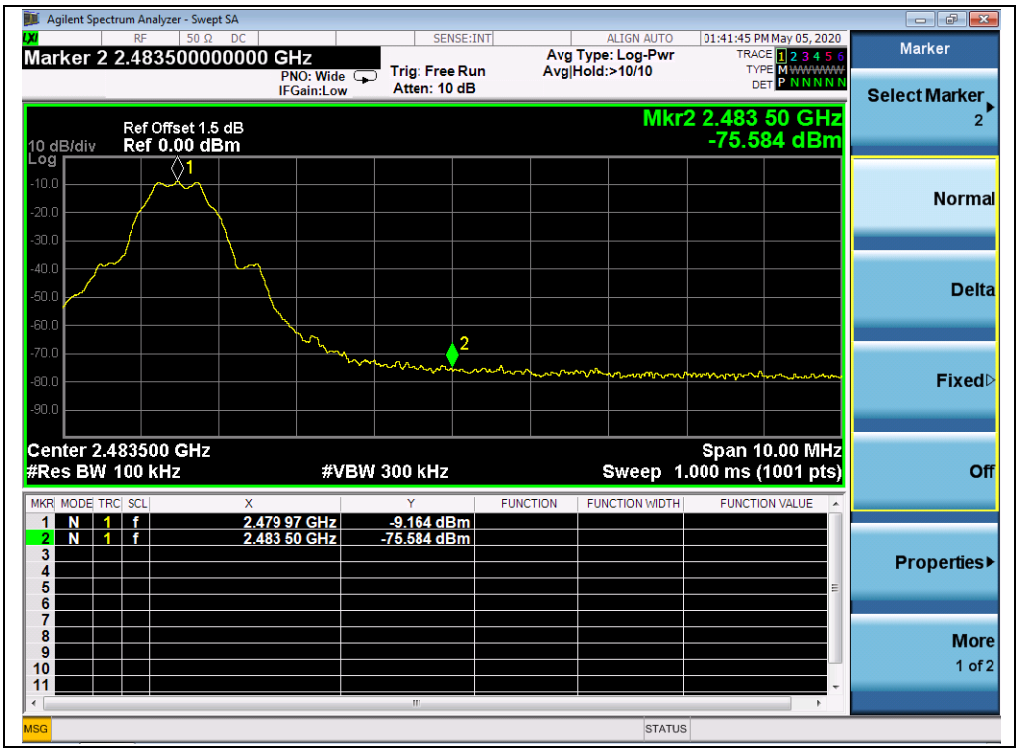

(Band Edge, Channel = 0)




(Channel = 19, 30MHz to 25GHz)




(Channel = 39, 30MHz to 25GHz)




(Band Edge, Channel = 39)

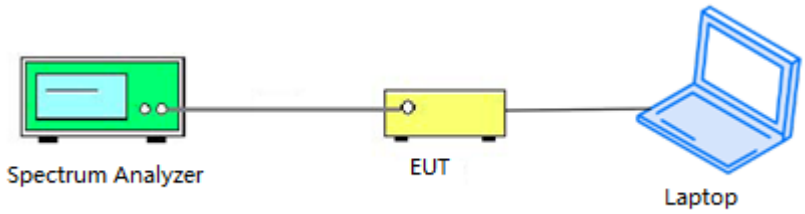
# 2.7. Power Spectral Density (PSD)

### 2.7.1.Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 2.7.2.Test Description

**Test Setup:**




The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.7.3.Test Procedure

The measured power spectral density was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for PSD test:

a) Set analyzer center frequency to channel center frequency
b) Set span to 1.5 times DTS
c) Set RBW to 3 kHz
d) Set VBW to 10 kHz
e) Detector = peak
f) Sweep time = auto couple
g) Trace mode = max hold
h) Allow trace to fully stabilize
i) Use the peak marker function to determine the maximum amplitude level within the RBW

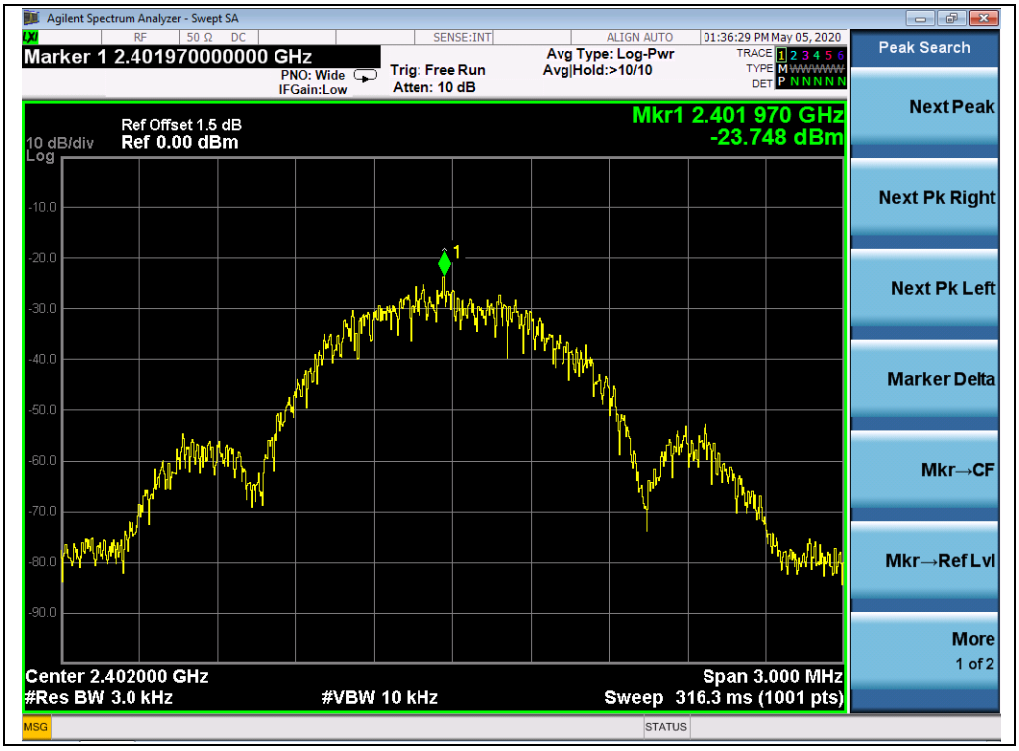
### 2.7.4.Test Result

The lowest, middle and highest channels are tested.

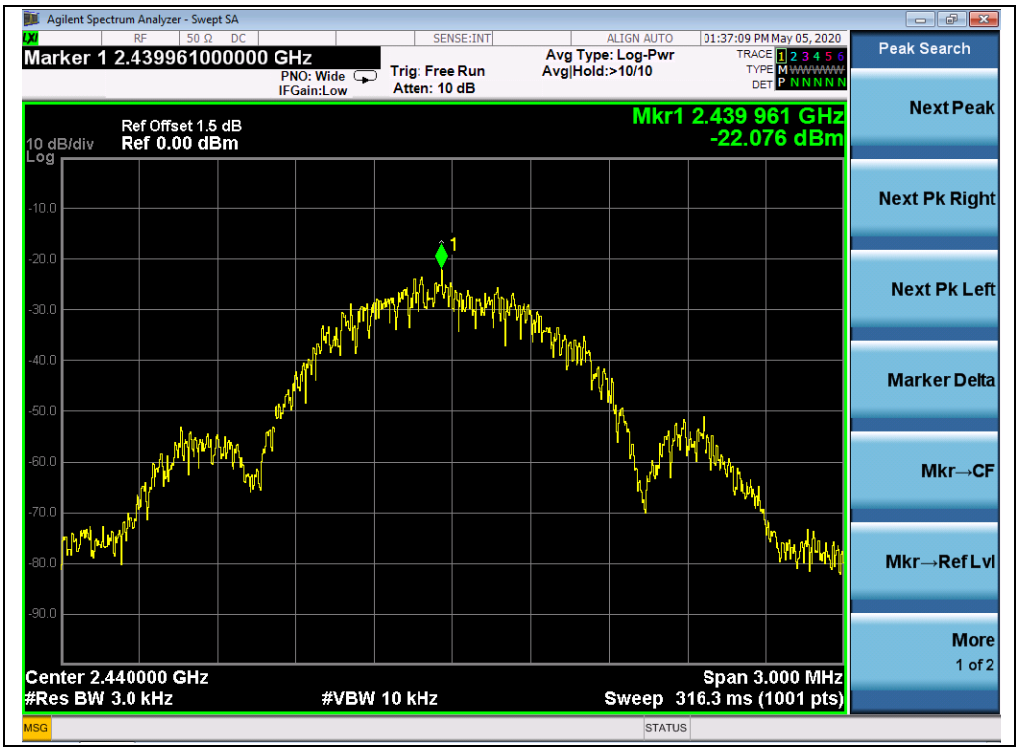
**A.Test Verdict:**

| Spectral power density (dBm/3kHz) | | | | |
|---|---|---|---|---|
| Channel | Frequency (MHz) | Measured PSD (dBm/3kHz) | Limit (dBm/3kHz) | Verdict |
| 0 | 2402 | -23.75 | 8 | PASS |
| 19 | 2440 | -22.08 | 8 | PASS |
| 39 | 2480 | -22.82 | 8 | PASS |

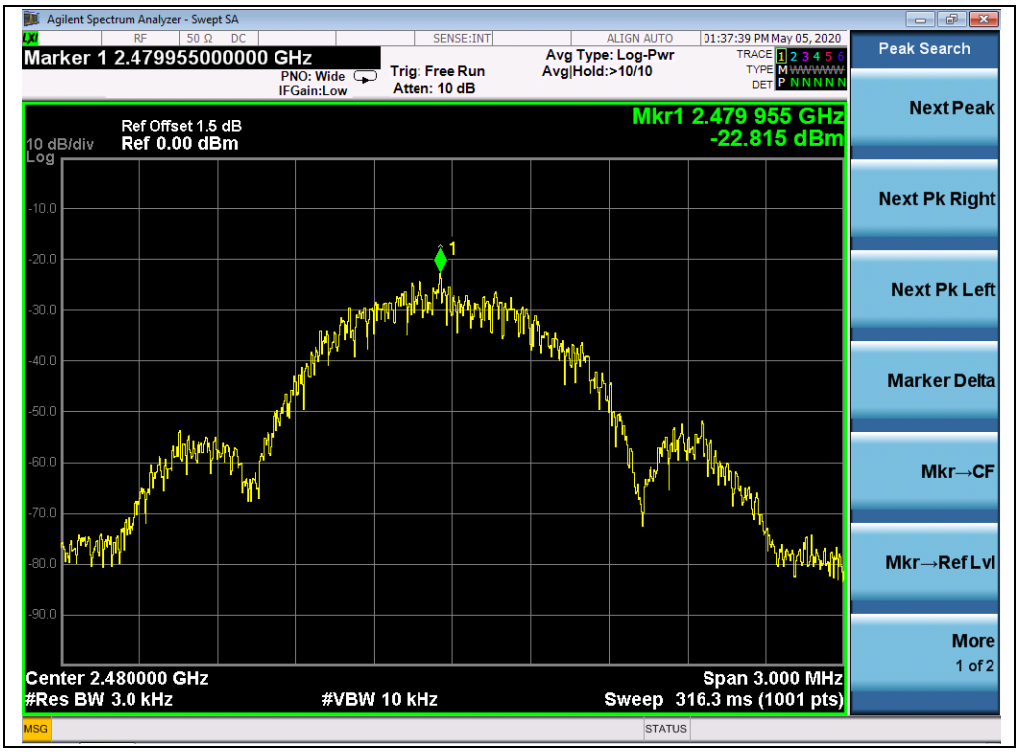
**B.Test Plot:**




(Channel = 0, 2402MHz)




(Channel = 19, 2440MHz)




(Channel = 39, 2480MHz)

## 2.8. Conducted Emission

### 2.8.1.Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quai-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

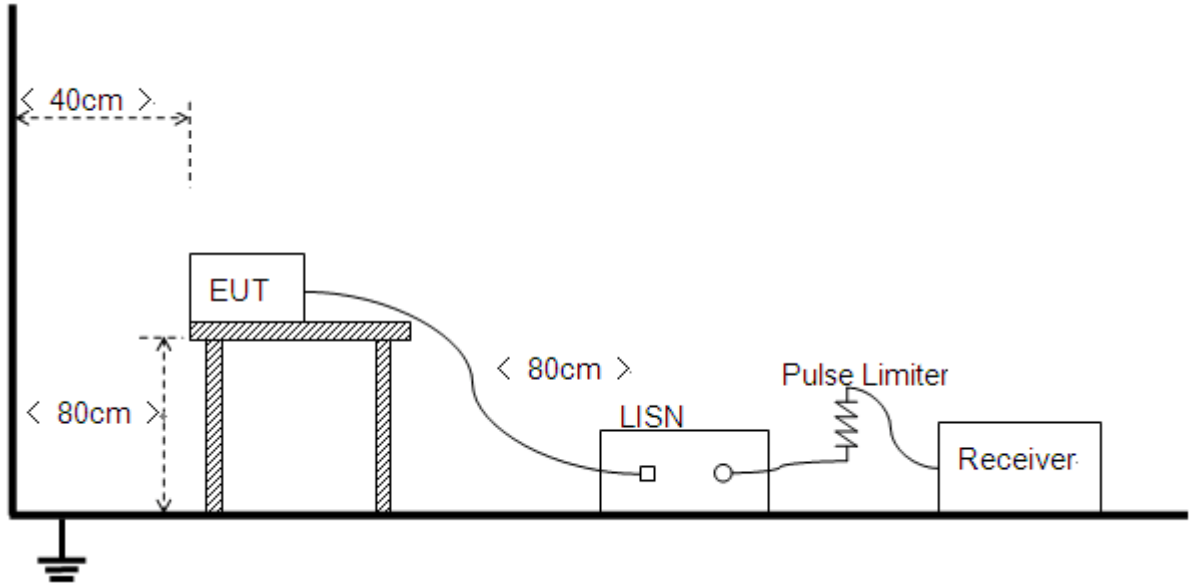
NOTE:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

### 2.8.2.Test Description

**Test Setup:**




The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

### 2.8.3.Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

**Note:** Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

**A.Test Setup:**

Test Mode: EUT+ADAPTER + BT TX

Test voltage: AC 120V/60Hz

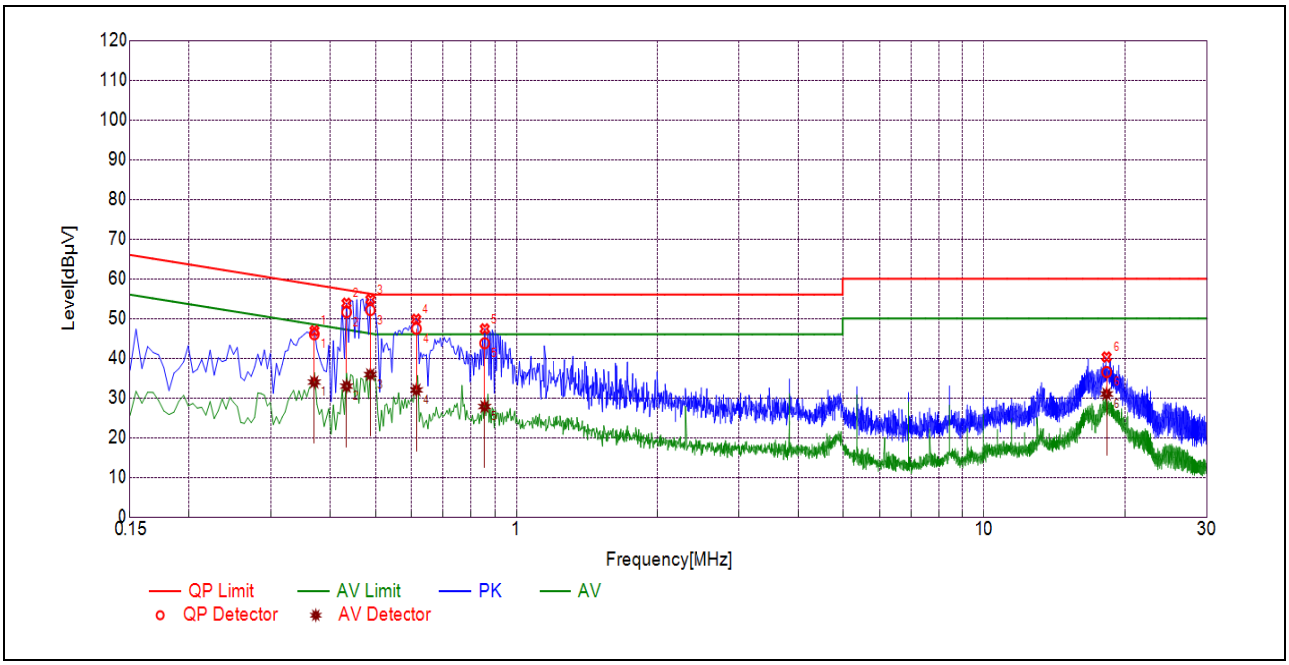
The measurement results are obtained as below:

E [dBμV] $=U_R + L_{Cable\ loss}$ [dB] + $A_{Factor}$

$U_R$: Receiver Reading

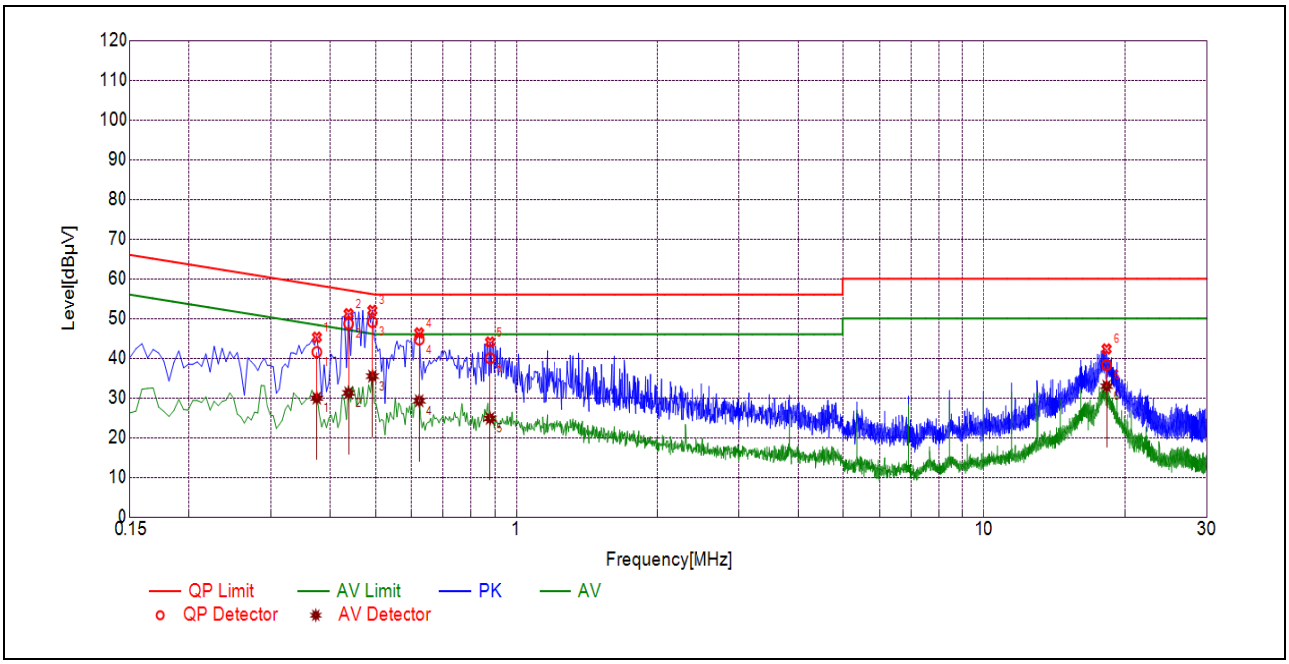
$A_{Factor}$: Voltage division factor of LISN

**B.Test Plots:**




(L Phase)

| NO. | Fre. (MHz) | Emission Level (dBµV) | | Limit (dBµV) | | Power-line | Verdict |
|---|---|---|---|---|---|---|---|
| | | Quai-peak | Average | Quai-peak | Average | | |
| 1 | 0.3702 | 46.02 | 33.99 | 58.50 | 48.50 | Line | PASS |
| 2 | 0.4337 | 51.58 | 32.96 | 57.18 | 47.18 | | PASS |
| 3 | 0.4872 | 52.12 | 35.87 | 56.22 | 46.22 | | PASS |
| 4 | 0.6141 | 47.42 | 32.00 | 56.00 | 46.00 | | PASS |
| 5 | 0.8559 | 43.76 | 27.83 | 56.00 | 46.00 | | PASS |
| 6 | 18.2452 | 36.51 | 31.00 | 60.00 | 50.00 | | PASS |




(N Phase)

| NO. | Fre. (MHz) | Emission Level (dBµV) | | Limit (dBµV) | | Power-line | Verdict |
|---|---|---|---|---|---|---|---|
| | | Quai-peak | Average | Quai-peak | Average | | |
| 1 | 0.3748 | 41.55 | 29.94 | 58.39 | 48.39 | Neutral | PASS |
| 2 | 0.4379 | 48.67 | 31.26 | 57.10 | 47.10 | | PASS |
| 3 | 0.4921 | 49.12 | 35.48 | 56.13 | 46.13 | | PASS |
| 4 | 0.6227 | 44.71 | 29.28 | 56.00 | 46.00 | | PASS |
| 5 | 0.8787 | 39.98 | 24.83 | 56.00 | 46.00 | | PASS |
| 6 | 18.2463 | 38.29 | 32.95 | 60.00 | 50.00 | | PASS |

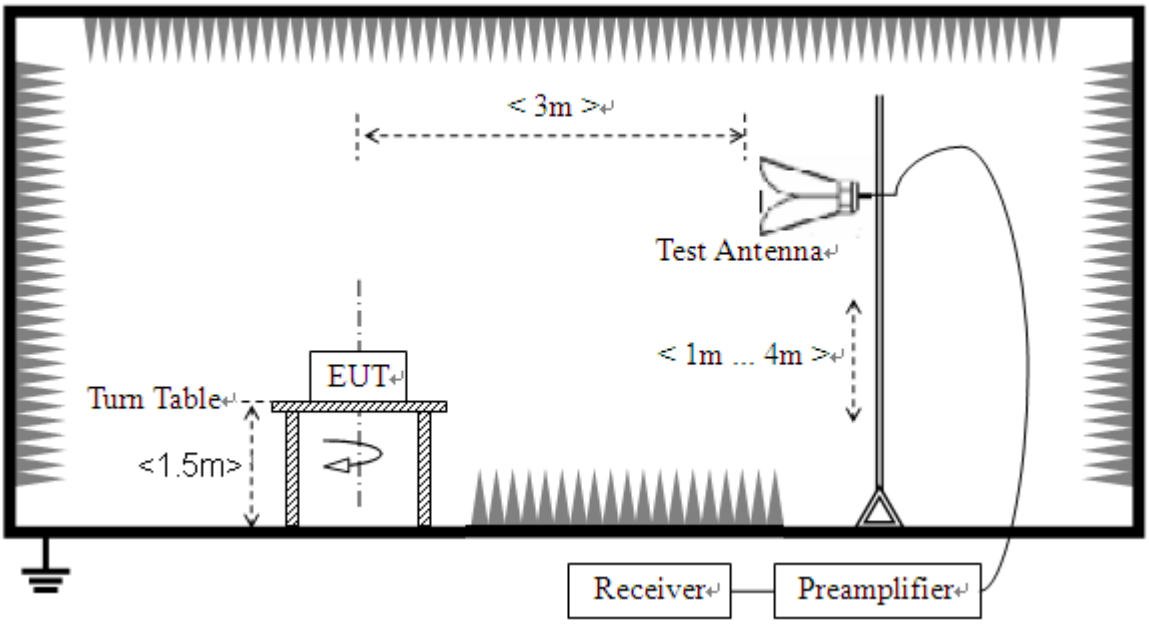
## 2.9. Restricted Frequency Bands

### 2.9.1.Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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).

### 2.9.2.Test Description

**Test Setup**




The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:
Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

### 2.9.3.Test Result

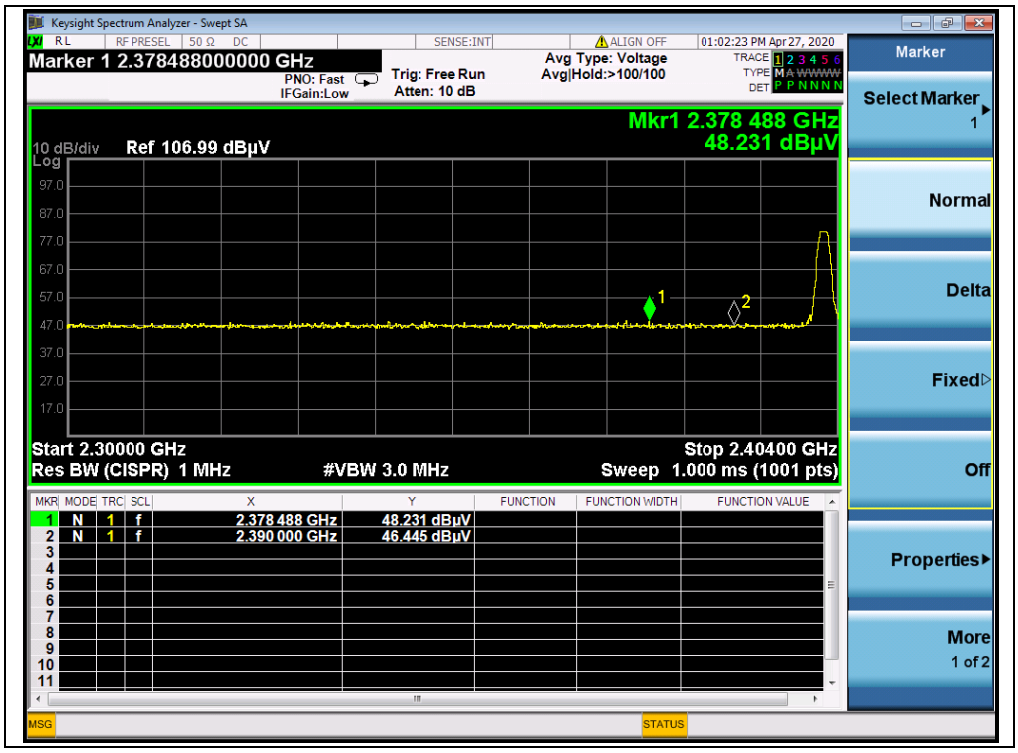
The lowest and highest channels are tested to verify the Restricted Frequency Bands.
The measurement results are obtained as below:
E [dBμV/m] $=U_R + A_T + A_{Factor}$ [dB]; $A_T = L_{Cable\ loss}$ [dB]-$G_{preamp}$ [dB]
$A_T$: Total correction Factor except Antenna
$U_R$: Receiver Reading
$G_{preamp}$: Preamplifier Gain
$A_{Factor}$: Antenna Factor at 3m

Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

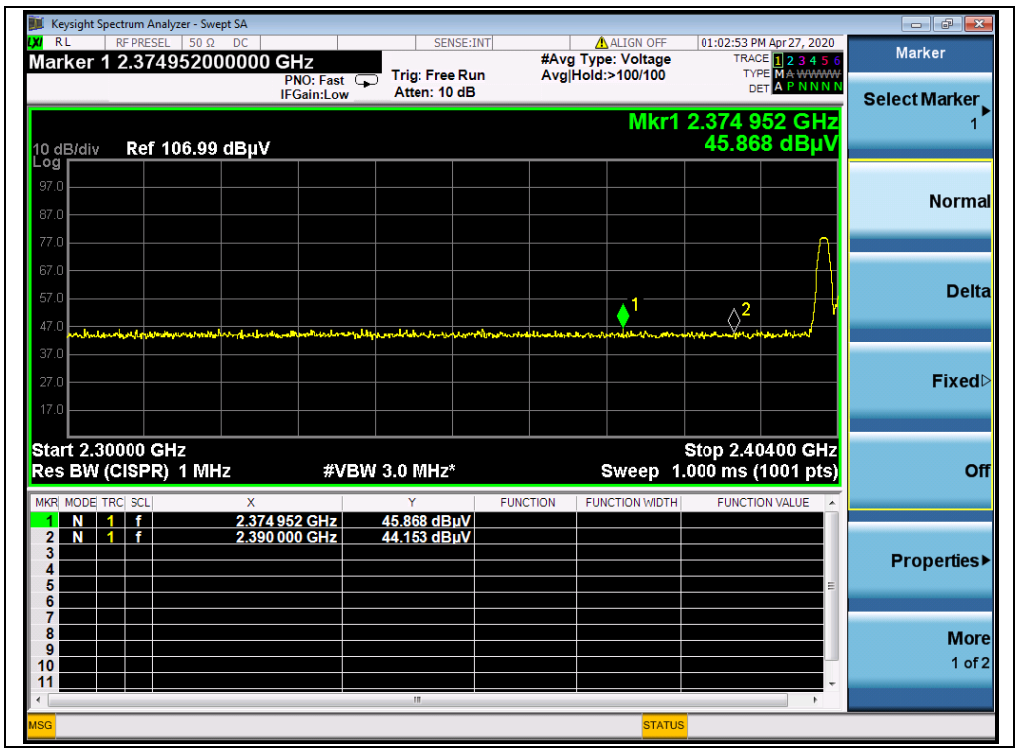
**A.Test Verdict:**

| Channel | Frequency (MHz) | Detector PK/ AV | Receiver Reading $U_R$ (dBuV) | $A_T$ (dB) | $A_{Factor}$ (dB@3m) | Max. Emission E (dBμV/m) | Limit (dBμV/m) | Verdict |
|---|---|---|---|---|---|---|---|---|
| 0 | 2378.49 | PK | 48.23 | -29.67 | 32.56 | 51.12 | 74 | PASS |
| 0 | 2374.95 | AV | 45.87 | -29.67 | 32.56 | 48.76 | 54 | PASS |
| 39 | 2485.61 | PK | 48.38 | -29.67 | 32.56 | 51.27 | 74 | PASS |
| 39 | 2484.35 | AV | 45.98 | -29.67 | 32.56 | 48.87 | 54 | PASS |

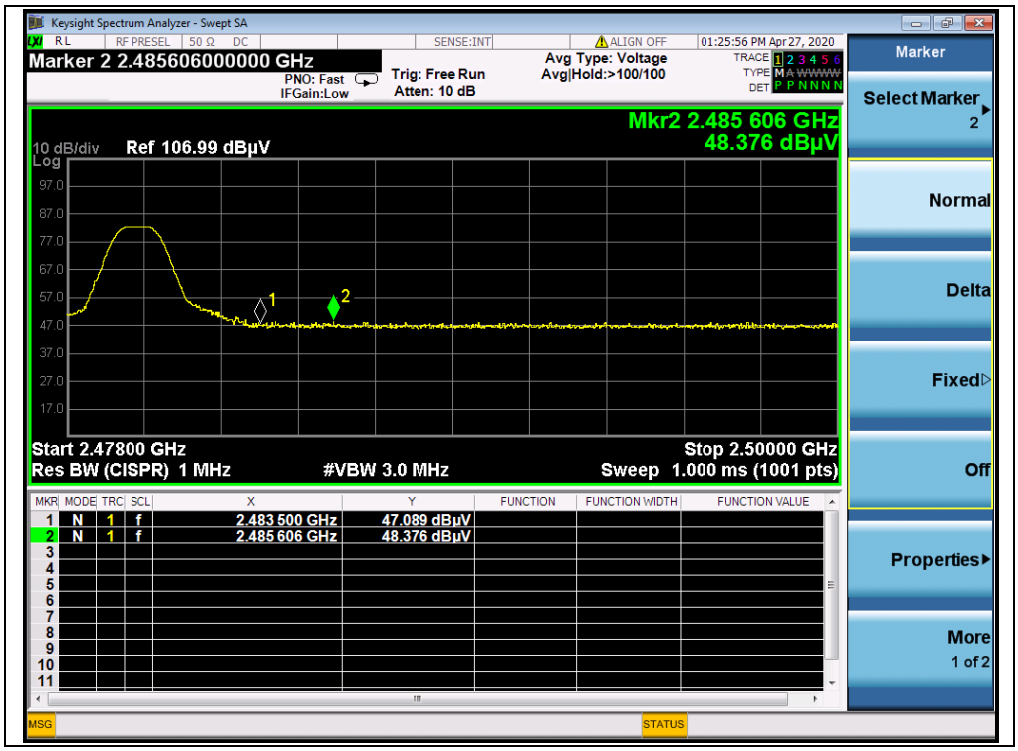
**B.Test Plot:**



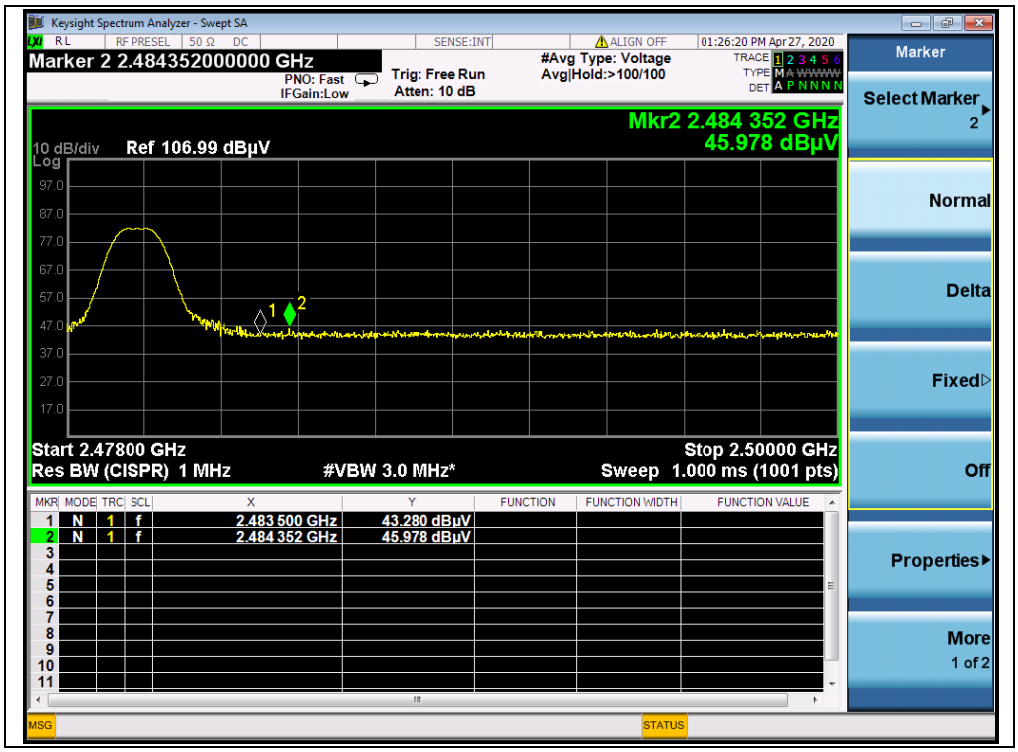

(PEAK, Channel = 0)




(AVG, Channel = 0)




(PEAK, Channel = 39)




(AVG, Channel = 39)

# 2.10. Radiated Emission

### 2.10.1.Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

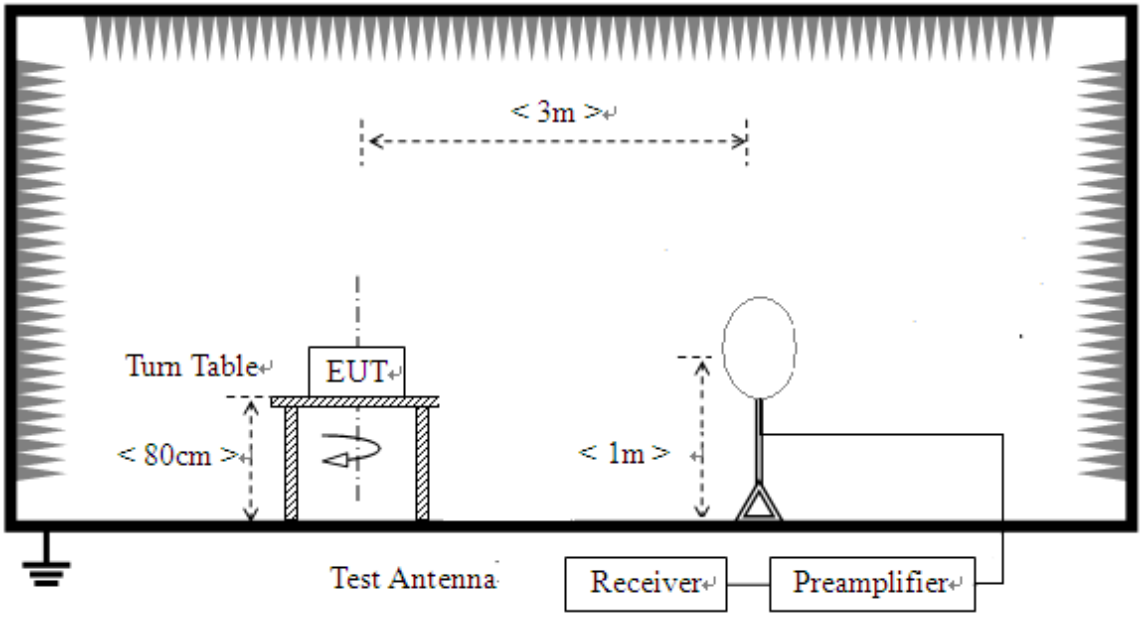
| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Note1:** For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
**Note2:** For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK). In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

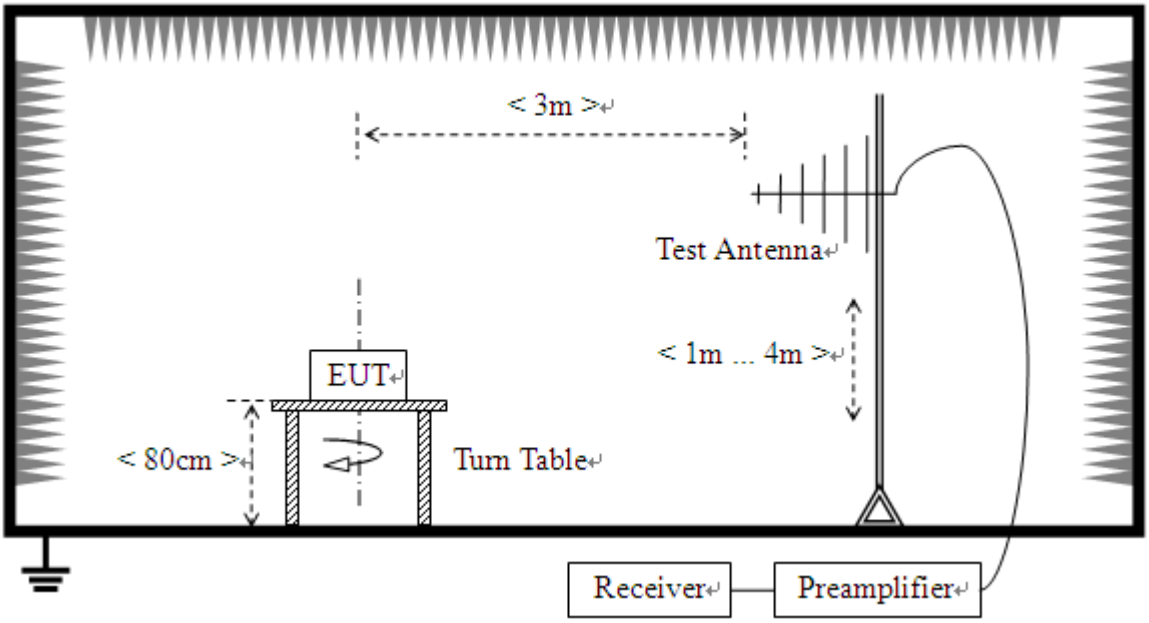
### 2.10.2.Test Description

**Test Setup:**

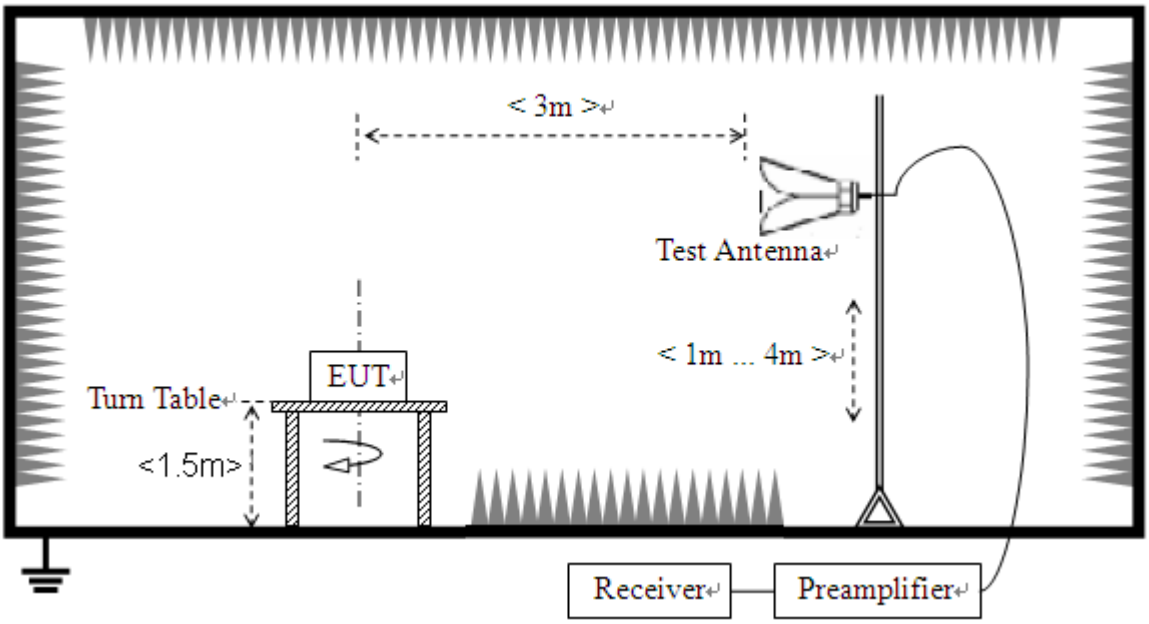
1) For radiated emissions from 9kHz to 30MHz




2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz




The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10:2013. For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10:2013.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

(a) In the frequency range of 9 kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant

emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

### 2.10.3.Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:
E [dBμV/m] $=U_R + A_T + A_{Factor}$ [dB]; $A_T = L_{Cable\ loss}$ [dB]$-G_{preamp}$ [dB]
$A_T$: Total correction Factor except Antenna
$U_R$: Receiver Reading
$G_{preamp}$: Preamplifier Gain
$A_{Factor}$: Antenna Factor at 3m

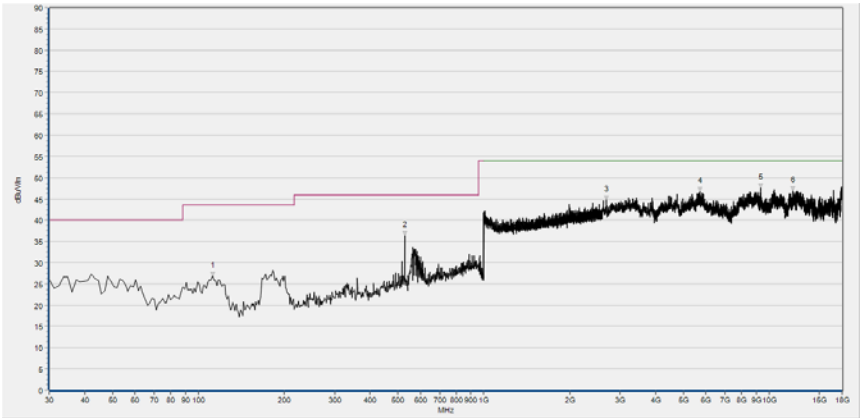
During the test, the total correction Factor $A_T$ and $A_{Factor}$ were built in test software.

**Note1:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

**Note2:** For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

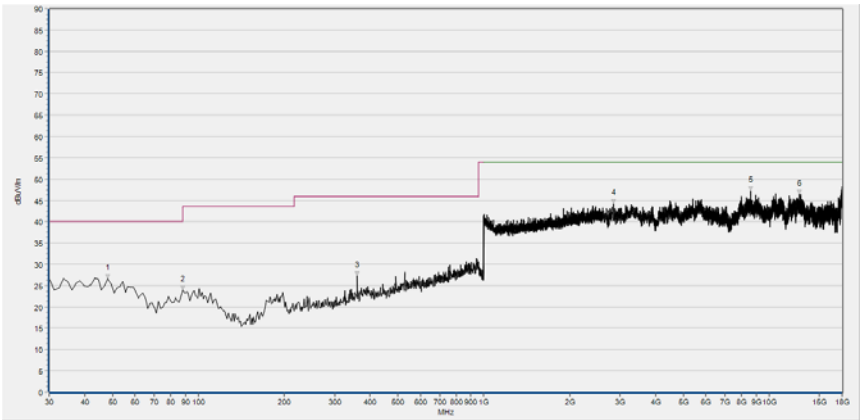
**Note3:** For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

**Plot for Channel = 0**



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 112.553 | 26.76 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 527.747 | 36.39 | N/A | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 2689.616 | 44.75 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 5730.969 | 46.81 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 9352.028 | 47.67 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 12121.731 | 46.87 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |

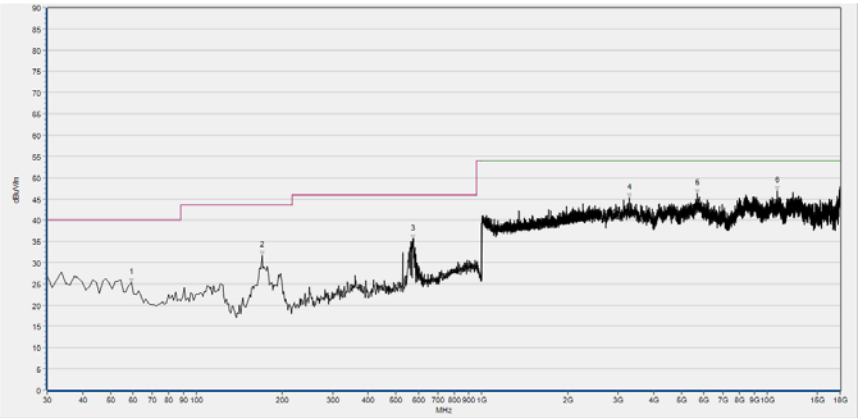
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 48.210 | 26.60 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 88.273 | 23.95 | N/A | N/A | N/A | 43.50 | N/A | Vertical | PASS |
| 360.213 | 27.39 | N/A | N/A | N/A | 46.00 | N/A | Vertical | PASS |
| 2849.245 | 44.23 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 8626.696 | 47.27 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 12737.843 | 46.47 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |

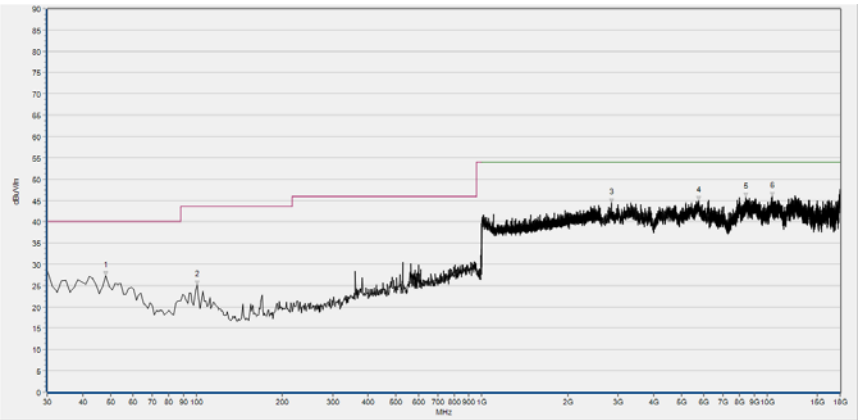
(Antenna Vertical, 30MHz to 18GHz)

**Plot for Channel = 19**



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 59.136 | 25.23 | N/A | N/A | N/A | 40.00 | N/A | Horizontal | PASS |
| 169.612 | 31.69 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 572.666 | 35.45 | N/A | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 3283.324 | 45.26 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 5683.361 | 46.30 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 10813.893 | 46.90 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |

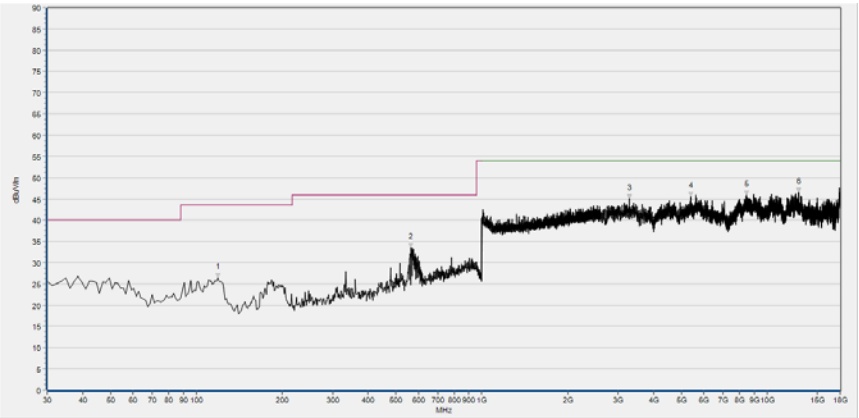
(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 48.210 | 27.26 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 100.413 | 25.08 | N/A | N/A | N/A | 43.50 | N/A | Vertical | PASS |
| 2843.644 | 44.38 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 5753.373 | 44.94 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 8419.458 | 45.79 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 10419.022 | 45.96 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |

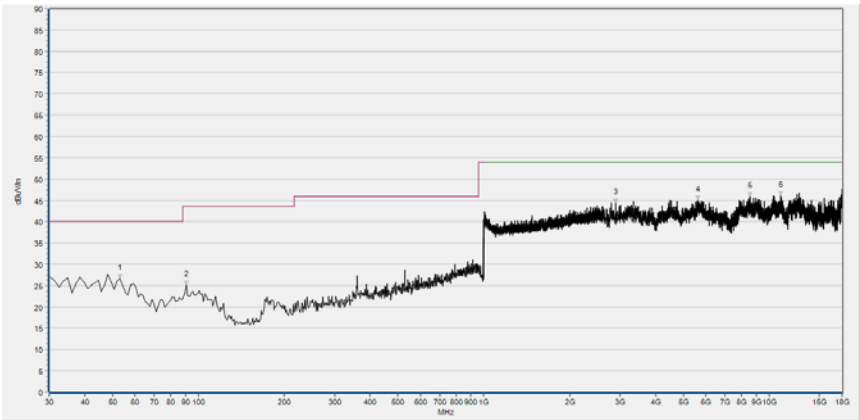
(Antenna Vertical, 30MHz to 18GHz)

**Plot for Channel = 39**



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 118.623 | 26.51 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 564.168 | 33.55 | N/A | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 3280.524 | 45.02 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 5383.706 | 45.66 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 8467.067 | 45.90 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |
| 12891.871 | 46.54 | N/A | N/A | 74.00 | N/A | 54.00 | Horizontal | PASS |

(Antenna Horizontal, 30MHz to 18GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 53.066 | 26.65 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 90.701 | 25.09 | N/A | N/A | N/A | 43.50 | N/A | Vertical | PASS |
| 2896.854 | 44.36 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 5627.350 | 45.13 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 8573.486 | 45.95 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |
| 10984.724 | 46.05 | N/A | N/A | 74.00 | N/A | 54.00 | Vertical | PASS |

(Antenna Vertical, 30MHz to 18GHz)

# Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

| Test items | Uncertainty |
|---|---|
| Peak Output Power | ±2.22dB |
| Power spectral density (PSD) | ±2.22dB |
| Bandwidth | ±5% |
| Conducted Spurious Emission | ±2.77dB |
| Restricted Frequency Bands | ±5% |
| Radiated Emission | ±2.95dB |
| Conducted Emission | ±2.44dB |

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

# Annex B Testing Laboratory Information

## 1. Identification of the Responsible Testing Laboratory

| | |
|---|---|
| **Laboratory Name:** | Shenzhen Morlab Communications Technology Co., Ltd.<br>Morlab Laboratory |
| **Laboratory Address:** | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |
| **Telephone:** | +86 755 36698555 |
| **Facsimile:** | +86 755 36698525 |

## 2. Identification of the Responsible Testing Location

| | |
|---|---|
| **Name:** | Shenzhen Morlab Communications Technology Co., Ltd.<br>Morlab Laboratory |
| **Address:** | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China |

## 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.

## 4. Test Equipments Utilized

### 4.1 Conducted Test Equipments

| Equipment Name | Serial No. | Type | Manufacturer | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EXA Signal Analzyer | MY53470836 | N9010A | Agilent | 2020.04.01 | 2021.03.31 |
| RF cable (30MHz-26GHz) | CB01 | RF01 | Morlab | N/A | N/A |
| Coaxial cable | CB02 | RF02 | Morlab | N/A | N/A |
| SMA connector | CN01 | RF03 | HUBER-SUHNER | N/A | N/A |
| Computer | T430i | Think Pad | Lenovo | N/A | N/A |

### 4.2 Conducted Emission Test Equipments

| Equipment Name | Serial No. | Type | Manufacturer | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| Receiver | MY56400093 | N9038A | KEYSIGHT | 2020.03.26 | 2021.03.25 |
| LISN | 812744 | NSLK 8127 | Schwarzbeck | 2020.03.26 | 2021.03.25 |
| Pulse Limiter (10dB) | VTSD 9561 F-B #206 | VTSD 9561-F | Schwarzbeck | 2019.08.13 | 2020.08.12 |
| Coaxial cable(BNC) (30MHz-26GHz) | CB01 | EMC01 | Morlab | N/A | N/A |
| Adapter | NA | HA-19050100UU | HONGGUANGDE | N/A | N/A |

### 4.3 List of Software Used

| Description | Manufacturer | Software Version |
|---|---|---|
| Test system | Tonscend | V2.6 |
| Power Panel | Agilent | V3.8 |
| MORLAB EMCR V1.2 | MORLAB | V1.0 |

### 4.4 Radiated Test Equipments

| Equipment Name | Serial No. | Type | Manufacturer | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| Receiver | MY54130016 | N9038A | Agilent | 2019.07.29 | 2020.07.28 |
| Test Antenna - Bi-Log | 9163-520 | VULB 9163 | Schwarzbeck | 2019.05.24 | 2022.05.23 |
| Test Antenna - Loop | 1520-022 | FMZB1520 | Schwarzbeck | 2019.02.14 | 2022.02.13 |
| Test Antenna – Horn | 01774 | BBHA 9120D | Schwarzbeck | 2019.07.26 | 2022.07.25 |
| Test Antenna – Horn | BBHA9170 #774 | BBHA9170 | Schwarzbeck | 2019.07.26 | 2022.07.25 |
| Coaxial cable (N male) (9KHz-30MHz) | CB04 | EMC04 | Morlab | N/A | N/A |
| Coaxial cable (N male) (30MHz-26GHz) | CB02 | EMC02 | Morlab | N/A | N/A |
| Coaxial cable (N male) (30MHz-26GHz) | CB03 | EMC03 | Morlab | N/A | N/A |
| 1-18GHz pre-Amplifier | 61171/61172 | S020180L3203 | Tonscend | 2019.07.29 | 2020.07.28 |
| 18-26.5GHz pre-Amplifier | 46732 | S10M100L3802 | Tonscend | 2019.07.29 | 2020.07.28 |
| Notch Filter | N/A | WRCG-2400-2483.5-60SS | Wainwright | 2019.12.01 | 2020.12.01 |
| Anechoic Chamber | N/A | 9m*6m*6m | CRT | 2020.01.06 | 2023.01.05 |

END OF REPORT