**Shenzhen Global Test Service Co.,Ltd.**
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

# TEST REPORT

## FCC PART 15 SUBPART C 15.247 & RSS-247

| | |
|---|---|
| **Report Reference No.....:** | **GTS20210531015-1-1** |
| **FCC ID..... :** | **2AU6S-RRD8400SB** |
| **IC ..... :** | **25701-RRD8400SB** |
| Compiled by ( position+printed name+signature)..: | File administrators Jimmy Wang |
| Supervised by ( position+printed name+signature)..: | Test Engineer Aaron Tan |
| Approved by ( position+printed name+signature)..: | Manager Jason Hu |
| Date of issue.....: | May 20, 2021 |
| **Representative Laboratory Name .:** | **Shenzhen Global Test Service Co., Ltd.** |
| Address.....: | No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong |
| **Applicant's name.....:** | **LUCID AUDIO** |
| Address .....: | 14301 Faa Blvd, Ft Worth, TX 76155 United States of America |
| **Test specification .....:** | |
| Standard .....: | **47 CFR FCC Part 15 Subpart C 15.247 & RSS-247 Issue 2, February 2017** |
| TRF Originator.....: | Shenzhen Global Test Service Co.,Ltd. |
| Master TRF.....: | Dated 2014-12 |

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| | |
|---|---|
| **Test item description .....:** | Hearmuff Bluetooth |
| Trade Mark .....: | Lucid |
| **Manufacturer.....:** | **LUCID AUDIO** |
| Model/Type reference(HVIN) .....: | BT HEARMUFFS |
| Listed Models(HVIN) .....: | N/A |
| Ratings .....: | DC 3.7V from battery |
| Modulation .....: | GFSK, Π/4DQPSK, 8DPSK |
| Hardware version .....: | RRD-8400S-B V1.1 |
| Software version .....: | V1.0 |
| Test Software version .....: | V1.0.2.2 |
| Frequency.....: | From 2402MHz to 2480MHz |
| Result.....: | **PASS** |

# TEST REPORT

| Test Report No. : | GTS20210531015-1-1 | May 31, 2021<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | Hearmuff Bluetooth |
| Model /Type(HVIN) | : | BT HEARMUFFS |
| Listed Models(HVIN) | : | N/A |
| **Applicant** | : | **LUCID AUDIO** |
| Address | : | 14301 Faa Blvd, Ft Worth, TX 76155 United States of America |
| **Manufacturer** | : | **LUCID AUDIO** |
| Address | : | 14301 Faa Blvd, Ft Worth, TX 76155 United States of America |

| **Test Result**: | **PASS** |
|---|---|

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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# 1 TEST STANDARDS

The tests were performed according to following standards:

RSS-247-Issue 2: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

RSS-Gen Issue 5: — General Requirements for Compliance of Radio Apparatus
FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

# 2 SUMMARY

## 2.1 General Remarks

| | | |
|---|---|---|
| Date of receipt of test sample | : | Apr. 28, 2021 |
| | | |
| | | |
| Testing commenced on | : | Apr. 29, 2021 |
| | | |
| | | |
| Testing concluded on | : | May 14, 2021 |

## 2.2 Product Description

| | |
|---|---|
| Product Name: | Hearmuff Bluetooth |
| Model(HVIN): | BT HEARMUFFS |
| Power supply: | DC 3.7V from battery |
| Sample ID: | GTS20210531015-1-1#/ GTS20210531015-1-2# |
| **Bluetooth :** | |
| Supported Type: | Bluetooth BR/EDR |
| Modulation: | GFSK, π/4DQPSK, 8DPSK |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 79 |
| Channel separation: | 1MHz |
| Antenna type: | PCB antenna |
| Antenna gain: | 0 dBi |

## 2.3 Test Sample

The application provides 2 samples to meet requirement.

| Sample Number | Description |
|---|---|
| GTS20210531015-1-1# | Engineer sample – continuous transmit |
| GTS20210531015-1-2# | Normal sample – Intermittent transmit |

## 2.4 Equipment Under Test

### Power supply system utilised

| | | | | | |
|---|---|---|---|---|---|
| Power supply voltage | : | ○ | 230V / 50 Hz | ○ | 120V / 60Hz |
| | | ○ | 12 V DC | ○ | 24 V DC |
| | | ● | Other (specified in blank below) | | |

DC 3.7V from battery

## 2.5 Short description of the Equipment under Test (EUT)

This is a Hearmuff Bluetooth.

For more details, refer to the user's manual of the EUT.

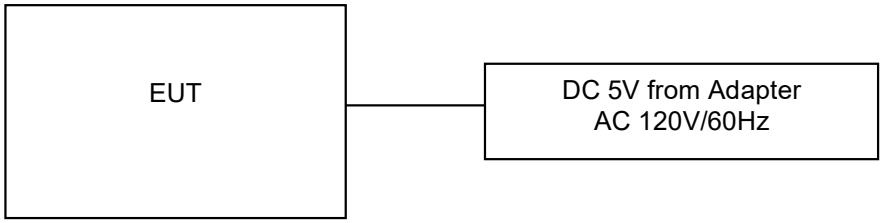
## 2.6 EUT operation mode

The Applicant provides communication tools software(FCC_assist_1.0.2.2) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

**Operation Frequency：**

| Channel | Frequency (MHz) |
|---|---|
| 00 | 2402 |
| 01 | 2403 |
| ⋮ | ⋮ |
| 38 | 2440 |
| 39 | 2441 |
| 40 | 2442 |
| ⋮ | ⋮ |
| 77 | 2479 |
| 78 | 2480 |

## 2.7 Block Diagram of Test Setup




## 2.8 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

| Description | Manufacturer | Model | Technical Parameters | Certificate | Provided by |
|---|---|---|---|---|---|
| AC-DC Adapter | MOSO | EP-TA10CBC | Input:AC100-240V-50/60Hz，0.5A Output:DC 5V,1A | FCC | Laboratory |
| / | / | / | / | / | / |
| / | / | / | / | / | / |
| / | / | / | / | / | / |

## 2.9 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for cerfication filing to comply with the rules of FCC Part 15 Subpart C and RSS-247.

## 2.10 Modifications

No modifications were implemented to meet testing criteria.

# 3 TEST ENVIRONMENT

## 3.1 Address of the test laboratory

**Shenzhen Global Test Service Co.,Ltd.**
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

## 3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

### A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

### CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

### IC Registration

The 3m alternate test site of Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 24189 and CAB identifier: CN0082.

### FCC-Registration

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been registered to test radio equipmentto meet the requirements for (FCC) Federal Communications Commission with the Registration No.165725.and Designation Number: CN1234.

## 3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
AC Conducted emission

| | |
|---|---|
| Temperature: | 25.6 ° C |
| | |
| Humidity: | 52.1 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

Radiation emission

| | |
|---|---|
| Temperature: | 24.6 ° C |
| | |
| Humidity: | 49.1 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

RF Conducted Testing

| | |
|---|---|
| Temperature: | 25.4 ° C |
| | |
| Humidity: | 51.6% |
| | |
| Atmospheric pressure: | 950-1050mbar |

## 3.4 Summary of measurement results

| FCC PART 15.247 & RSS 247 | | |
|---|---|---|
| FCC Part 15.207<br>RSS-Gen 8.8 | AC Power Conducted Emission | PASS |
| FCC Part 15.247(a)(1)(i)<br>RSS 247 5.1 (a)<br>RSS-Gen 6.7 | 20dB Bandwidth& 99% Bandwidth | PASS |
| FCC Part 15.247(d)<br>RSS 247 5.5 | Spurious RF Conducted Emission | PASS |
| FCC Part 15.247(b)<br>RSS 247 5.4 (b) | Maximum Peak Output Power | PASS |
| FCC Part 15.247(b)<br>RSS 247 5.1 (a) | Pseudorandom Frequency Hopping Sequence | PASS |
| FCC Part 15.247(a)(1)(iii)<br>RSS 247 5.1 (d) | Number of hopping frequency& Time of Occupancy | PASS |
| FCC Part 15.247(a)(1)<br>RSS 247 5.1 (b) | Frequency Separation | PASS |
| FCC Part 15.205/15.209<br>RSS-Gen 8.9 | Radiated Emissions | PASS |
| FCC Part 15.247(d)<br>RSS-Gen 8.10 | Band Edge Compliance of RF Emission | PASS |

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report

## 3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

| Test | Range | Measurement Uncertainty | Notes |
|---|---|---|---|
| Radiated Emission | 30~1000MHz | 4.10 dB | (1) |
| Radiated Emission | 1~18GHz | 4.32 dB | (1) |
| Radiated Emission | 18-40GHz | 5.54 dB | (1) |
| Conducted Disturbance | 0.15~30MHz | 3.12 dB | (1) |

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

## 3.6 Equipments Used during the Test

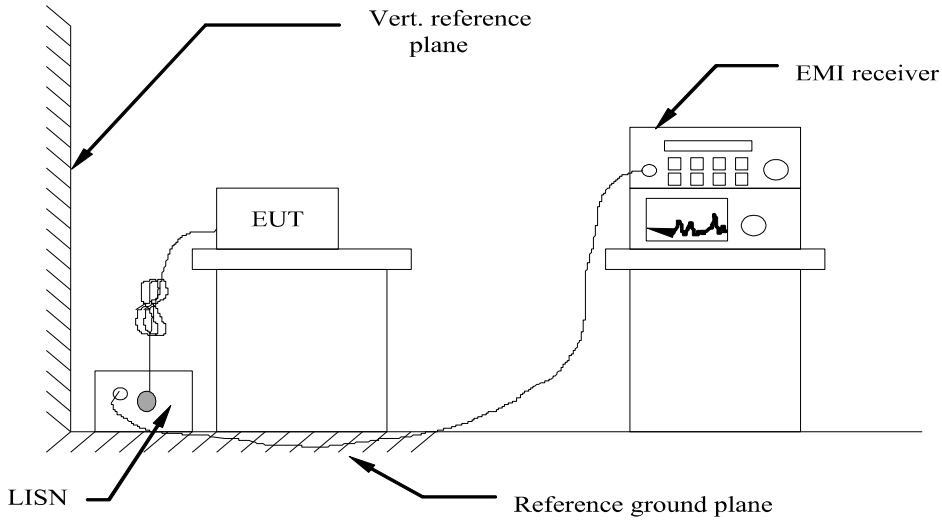
| Test Equipment | Manufacturer | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| LISN | R&S | ENV216 | 3560.6550.08 | 2020/09/19 | 2021/09/18 |
| LISN | R&S | ESH2-Z5 | 893606/008 | 2020/09/19 | 2021/09/18 |
| EMI Test Receiver | R&S | ESPI3 | 101841-cd | 2020/09/19 | 2021/09/18 |
| EMI Test Receiver | R&S | ESCI7 | 101102 | 2020/09/19 | 2021/09/18 |
| Spectrum Analyzer | Agilent | N9020A | MY48010425 | 2020/09/19 | 2021/09/18 |
| Spectrum Analyzer | Agilent | E4407B | MY45132751 | 2020/09/19 | 2021/09/18 |
| Spectrum Analyzer | R&S | FSV40 | 100019 | 2020/09/19 | 2021/09/18 |
| Vector Signal generator | Agilent | N5181A | MY49060502 | 2020/09/19 | 2021/09/18 |
| Spectrum Analyzer | Agilent | E4421B | 3610AO1069 | 2020/09/19 | 2021/09/18 |
| Climate Chamber | ESPEC | EL-10KA | A20120523 | 2020/09/19 | 2021/09/18 |
| Controller | EM Electronics | Controller EM 1000 | N/A | N/A | N/A |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 01622 | 2020/09/19 | 2021/09/18 |
| Active Loop Antenna | Beijing Da Ze Technology Co.,Ltd. | ZN30900C | 15006 | 2020/10/11 | 2021/10/10 |
| Bilog Antenna | Schwarzbeck | VULB9163 | 000976 | 2020/05/26 | 2021/05/25 |
| Broadband Horn Antenna | SCHWARZBECK | BBHA 9170 | 791 | 2020/09/19 | 2021/09/18 |
| Amplifier | Schwarzbeck | BBV 9743 | #202 | 2020/09/19 | 2021/09/18 |
| Amplifier | Schwarzbeck | BBV9179 | 9719-025 | 2020/09/19 | 2021/09/18 |
| Amplifier | EMCI | EMC051845B | 980355 | 2020/09/19 | 2021/09/18 |
| Temperature/Humidity Meter | Gangxing | CTH-608 | 02 | 2020/09/19 | 2021/09/18 |
| High-Pass Filter | K&L | 9SH10-2700/X12750-O/O | KL142031 | 2020/09/19 | 2021/09/18 |
| High-Pass Filter | K&L | 41H10-1375/U12750-O/O | KL142032 | 2020/09/19 | 2021/09/18 |
| RF Cable(below 1GHz) | HUBER+SUHNER | RG214 | RE01 | 2020/09/19 | 2021/09/18 |
| RF Cable(above 1GHz) | HUBER+SUHNER | RG214 | RE02 | 2020/09/19 | 2021/09/18 |
| Data acquisition card | Agilent | U2531A | TW53323507 | 2020/09/19 | 2021/09/18 |
| Power Sensor | Agilent | U2021XA | MY5365004 | 2020/09/19 | 2021/09/18 |
| Test Control Unit | Tonscend | JS0806-1 | 178060067 | 2020/06/19 | 2021/06/18 |
| Automated filter bank | Tonscend | JS0806-F | 19F8060177 | 2020/06/19 | 2021/06/18 |
| EMI Test Software | Tonscend | JS1120-1 | Ver 2.6.8.0518 | / | / |
| EMI Test Software | Tonscend | JS1120-3 | Ver 2.5.77.0418 | / | / |
| EMI Test Software | Tonscend | JS32-CE | Ver 2.5 | / | / |
| EMI Test Software | Tonscend | JS32-RE | Ver 2.5.1.8 | / | / |

Note: The Cal.Interval was one year.

# 4 TEST CONDITIONS AND RESULTS

## 4.1 AC Power Conducted Emission

**TEST CONFIGURATION**




**TEST PROCEDURE**

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4 The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm bad; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

**AC Power Conducted Emission Limit**

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207 and RSS Gen 8.8, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| * Decreases with the logarithm of the frequency. | | |

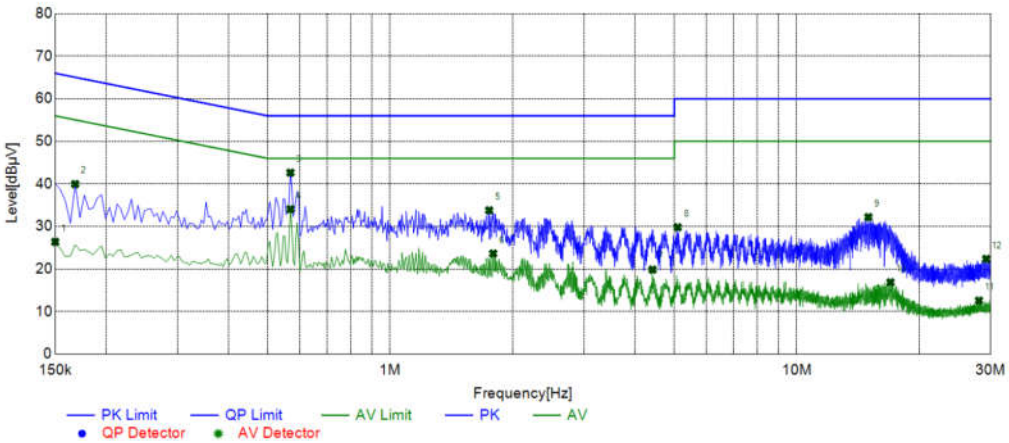
## TEST RESULTS

Remark:

1. All modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

| Power supply: | AC 120V/60Hz(adapter) | Polarization | L |
|---|---|---|---|

**Test Graph**



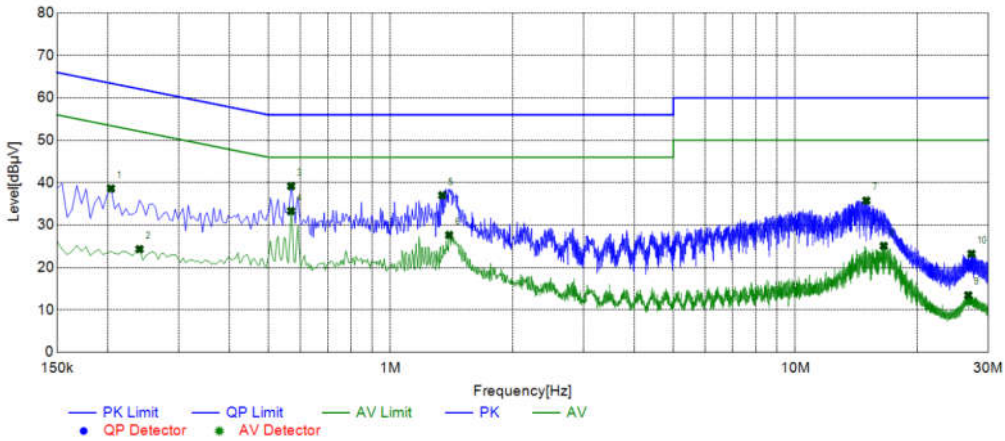

| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Frequency [MHz] | Reading [dBμV] | Factor [dB] | Result [dBμV] | Limit [dBμV] | Margin [dB] | Detector | Line | Remark |
| 1 | 0.1500 | 16.34 | 10.05 | 26.39 | 56.00 | 29.61 | AV | L1 | PASS |
| 2 | 0.1680 | 29.92 | 10.05 | 39.97 | 65.06 | 25.09 | PK | L1 | PASS |
| 3 | 0.5685 | 32.59 | 10.06 | 42.65 | 56.00 | 13.35 | PK | L1 | PASS |
| 4 | 0.5685 | 24.03 | 10.06 | 34.09 | 46.00 | 11.91 | AV | L1 | PASS |
| 5 | 1.7520 | 23.66 | 10.13 | 33.79 | 56.00 | 22.21 | PK | L1 | PASS |
| 6 | 1.7925 | 13.52 | 10.13 | 23.65 | 46.00 | 22.35 | AV | L1 | PASS |
| 7 | 4.4205 | 9.43 | 10.44 | 19.87 | 46.00 | 26.13 | AV | L1 | PASS |
| 8 | 5.0955 | 19.31 | 10.50 | 29.81 | 60.00 | 30.19 | PK | L1 | PASS |
| 9 | 15.0045 | 21.14 | 11.06 | 32.20 | 60.00 | 27.80 | PK | L1 | PASS |
| 10 | 17.0025 | 5.65 | 11.23 | 16.88 | 50.00 | 33.12 | AV | L1 | PASS |
| 11 | 28.0635 | 0.83 | 11.76 | 12.59 | 50.00 | 37.41 | AV | L1 | PASS |
| 12 | 29.2425 | 10.59 | 11.79 | 22.38 | 60.00 | 37.62 | PK | L1 | PASS |

Note:1. Result (dBμV) = Reading (dBμV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

| Power supply: | AC 120V/60Hz(adapter) | Polarization | N |
|---|---|---|---|

**Test Graph**




**Suspected List**

| NO. | Frequency [MHz] | Reading [dBµV] | Factor [dB] | Result [dBµV] | Limit [dBµV] | Margin [dB] | Detector | Line | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.2040 | 28.56 | 10.06 | 38.62 | 63.45 | 24.83 | PK | N | PASS |
| 2 | 0.2400 | 14.30 | 10.03 | 24.33 | 52.10 | 27.77 | AV | N | PASS |
| 3 | 0.5685 | 29.14 | 10.06 | 39.20 | 56.00 | 16.80 | PK | N | PASS |
| 4 | 0.5685 | 23.27 | 10.06 | 33.33 | 46.00 | 12.67 | AV | N | PASS |
| 5 | 1.3425 | 26.93 | 10.09 | 37.02 | 56.00 | 18.98 | PK | N | PASS |
| 6 | 1.3965 | 17.56 | 10.10 | 27.66 | 46.00 | 18.34 | AV | N | PASS |
| 7 | 14.9820 | 24.71 | 11.06 | 35.77 | 60.00 | 24.23 | PK | N | PASS |
| 8 | 16.5435 | 13.94 | 11.17 | 25.11 | 50.00 | 24.89 | AV | N | PASS |
| 9 | 26.7540 | 1.78 | 11.69 | 13.47 | 50.00 | 36.53 | AV | N | PASS |
| 10 | 27.2445 | 11.54 | 11.71 | 23.25 | 60.00 | 36.75 | PK | N | PASS |

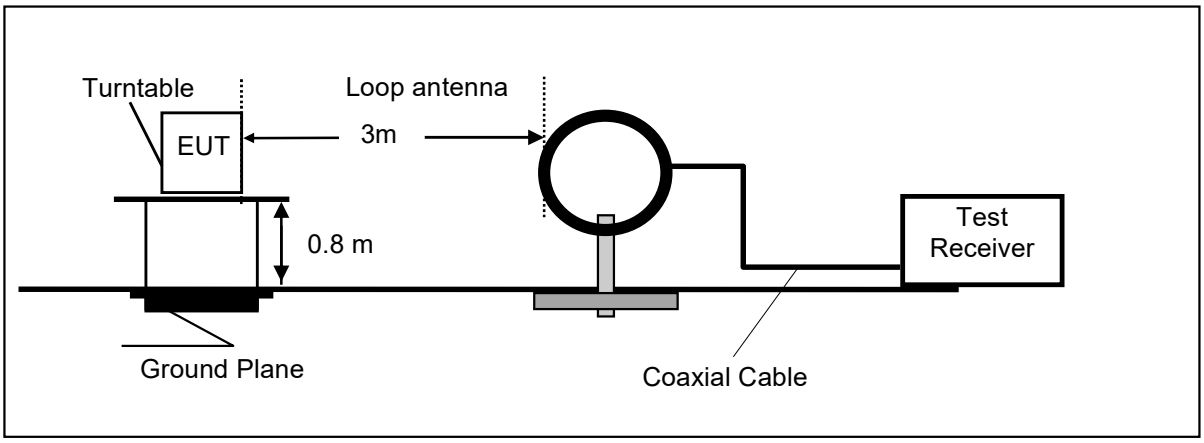
Note:1. Result (dBµV) = Reading (dBµV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

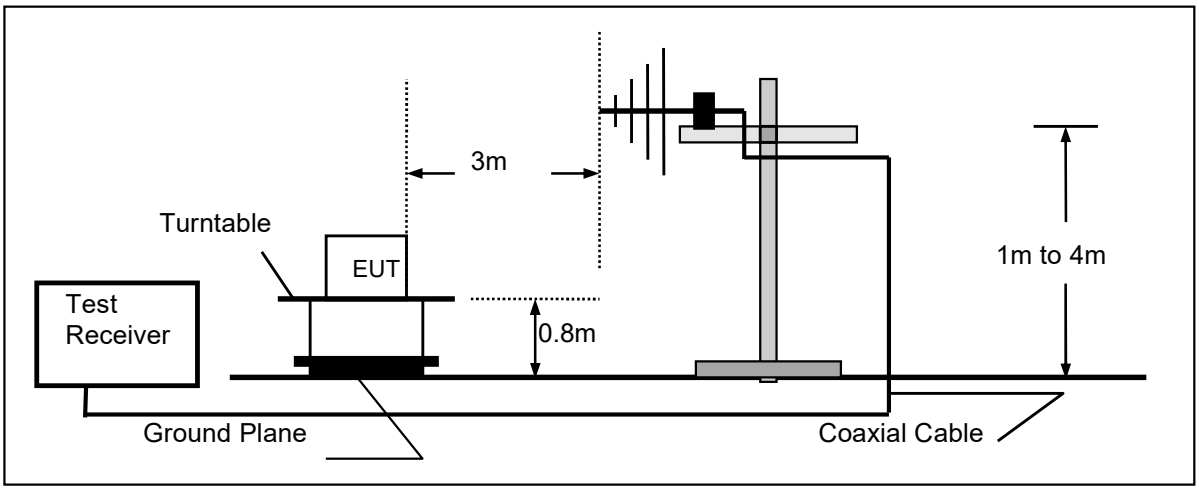
## 4.2 Radiated Emission

**TEST CONFIGURATION**

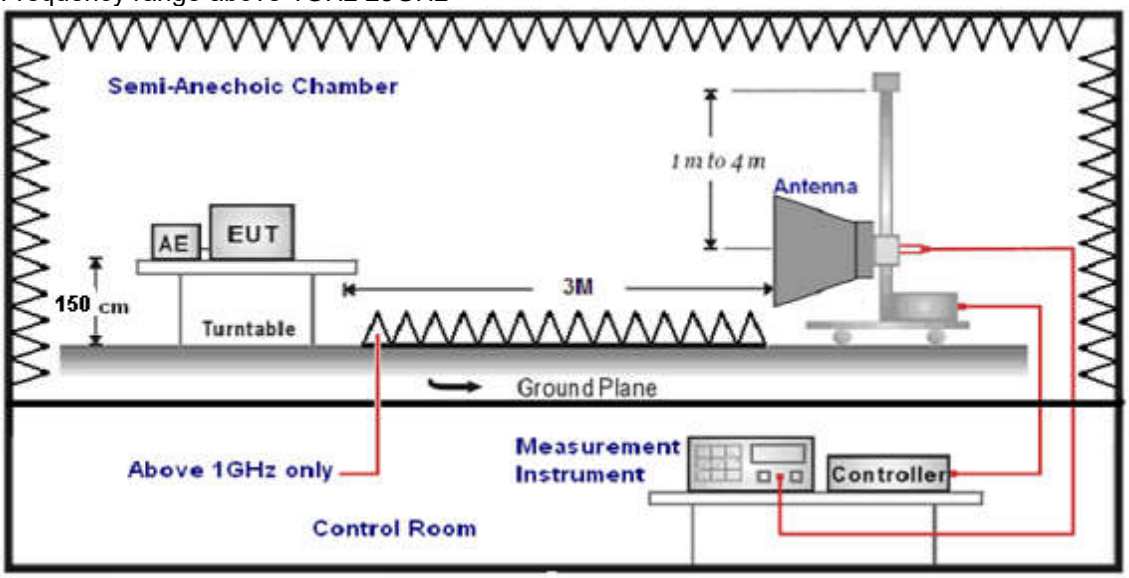
Frequency range 9 KHz – 30MHz




Frequency range 30MHz – 1000MHz




Frequency range above 1GHz-25GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type | Test Distance |
|---|---|---|
| 9KHz-30MHz | Active Loop Antenna | 3 |
| 30MHz-1GHz | Ultra-Broadband Antenna | 3 |
| 1GHz-18GHz | Double Ridged Horn Antenna | 3 |
| 18GHz-25GHz | Horn Anternna | 1 |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|---|---|---|
| 9KHz-150KHz | RBW=200Hz/VBW=3KHz,Sweep time=Auto | QP |
| 150KHz-30MHz | RBW=9KHz/VBW=100KHz,Sweep time=Auto | QP |
| 30MHz-1GHz | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP |
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

**RADIATION LIMIT**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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)

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

Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

## TEST RESULTS

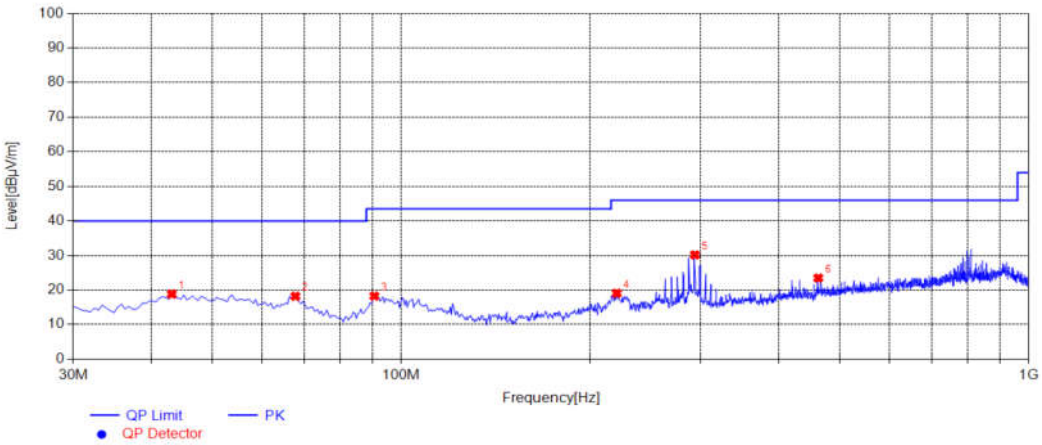
Remark:

1. We measured Radiated Emission at GFSK, π/4 DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
2. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

**For 30MHz-1GHz**

Horizontal

**Test Graph**



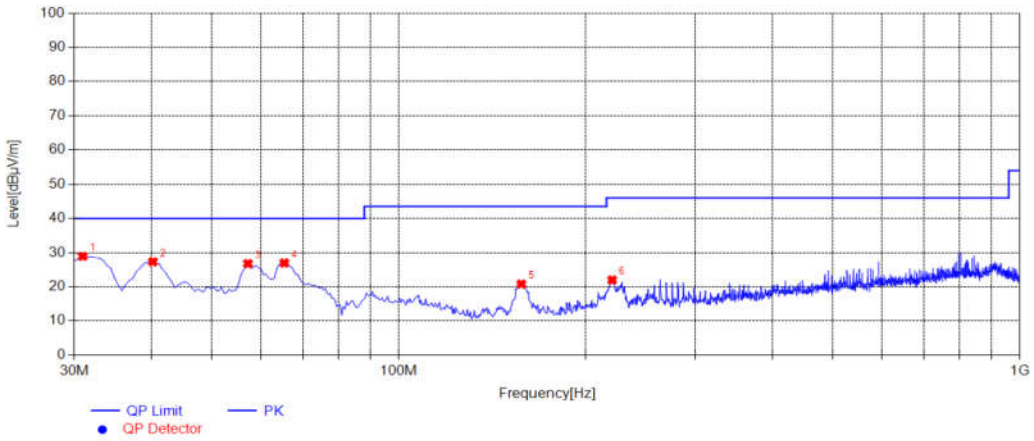

| Suspected List | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity | Remark |
| 1 | 43.0950 | 25.65 | -6.84 | 18.81 | 40.00 | 21.19 | 100 | 140 | PK | Horizonta | PASS |
| 2 | 67.8300 | 27.60 | -9.41 | 18.19 | 40.00 | 21.81 | 100 | 240 | PK | Horizonta | PASS |
| 3 | 90.6250 | 28.50 | -10.26 | 18.24 | 43.50 | 25.26 | 100 | 160 | PK | Horizonta | PASS |
| 4 | 220.6050 | 28.34 | -9.29 | 19.05 | 46.00 | 26.95 | 100 | 260 | PK | Horizonta | PASS |
| 5 | 293.8400 | 37.61 | -7.46 | 30.15 | 46.00 | 15.85 | 100 | 80 | PK | Horizonta | PASS |
| 6 | 462.1350 | 27.65 | -4.20 | 23.45 | 46.00 | 22.55 | 100 | 330 | PK | Horizonta | PASS |

Note:1. Result (dBμV/m) = Reading(dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

Vertical

**Test Graph**




| Suspected List | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity | Remark |
| 1 | 30.9700 | 38.47 | -9.58 | 28.89 | 40.00 | 11.11 | 100 | 140 | PK | Vertical | PASS |
| 2 | 40.1850 | 34.92 | -7.66 | 27.26 | 40.00 | 12.74 | 100 | 320 | PK | Vertical | PASS |
| 3 | 57.1600 | 33.82 | -7.08 | 26.74 | 40.00 | 13.26 | 100 | 110 | PK | Vertical | PASS |
| 4 | 65.4050 | 36.47 | -9.55 | 26.92 | 40.00 | 13.08 | 100 | 280 | PK | Vertical | PASS |
| 5 | 157.5550 | 32.88 | -12.13 | 20.75 | 43.50 | 22.75 | 100 | 140 | PK | Vertical | PASS |
| 6 | 220.6050 | 31.24 | -9.29 | 21.95 | 46.00 | 24.05 | 100 | 360 | PK | Vertical | PASS |

Note:1. Result (dBμV/m) = Reading(dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

**For 1GHz to 25GHz**

*Note: GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.*

***GFSK (above 1GHz)***

| Frequency(MHz): | | | 2402 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 55.24 | PK | 74 | 18.76 | 53.34 | 31.42 | 6.98 | 36.50 | 1.90 |
| 4804.00 | 46.25 | AV | 54 | 7.75 | 44.35 | 31.42 | 6.98 | 36.50 | 1.90 |
| 7206.00 | 48.53 | PK | 74 | 25.47 | 37.93 | 37.03 | 8.87 | 35.30 | 10.60 |
| 7206.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

| Frequency(MHz): | | | 2402 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 55.84 | PK | 74 | 18.16 | 53.94 | 31.42 | 6.98 | 36.50 | 1.90 |
| 4804.00 | 47.05 | AV | 54 | 6.95 | 45.15 | 31.42 | 6.98 | 36.50 | 1.90 |
| 7206.00 | 49.43 | PK | 74 | 24.57 | 38.83 | 37.03 | 8.87 | 35.30 | 10.60 |
| 7206.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

| Frequency(MHz): | | | 2441 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4882.00 | 54.83 | PK | 74 | 19.17 | 52.77 | 30.98 | 7.58 | 36.50 | 2.06 |
| 4882.00 | 46.70 | AV | 54 | 7.30 | 44.64 | 30.98 | 7.58 | 36.50 | 2.06 |
| 7323.00 | 49.10 | PK | 74 | 24.90 | 38.18 | 37.66 | 8.56 | 35.30 | 10.92 |
| 7323.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

| Frequency(MHz): | | | 2441 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4882.00 | 55.43 | PK | 74 | 18.57 | 53.37 | 30.98 | 7.58 | 36.50 | 2.06 |
| 4882.00 | 48.20 | AV | 54 | 5.80 | 46.14 | 30.98 | 7.58 | 36.50 | 2.06 |
| 7323.00 | 50.20 | PK | 74 | 23.80 | 39.28 | 37.66 | 8.56 | 35.30 | 10.92 |
| 7323.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

| Frequency(MHz): | | | 2480 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 56.00 | PK | 74 | 18.00 | 52.93 | 31.47 | 7.80 | 36.20 | 3.07 |
| 4960.00 | 46.68 | AV | 54 | 7.32 | 43.61 | 31.47 | 7.80 | 36.20 | 3.07 |
| 7440.00 | 48.99 | PK | 74 | 25.01 | 37.25 | 38.32 | 8.72 | 35.30 | 11.74 |
| 7440.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

| Frequency(MHz): | | | 2480 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 57.10 | PK | 74 | 16.90 | 54.03 | 31.47 | 7.80 | 36.20 | 3.07 |
| 4960.00 | 47.28 | AV | 54 | 6.72 | 44.21 | 31.47 | 7.80 | 36.20 | 3.07 |
| 7440.00 | 49.89 | PK | 74 | 24.11 | 38.15 | 38.32 | 8.72 | 35.30 | 11.74 |
| 7440.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier

3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

***Results of Band Edges Test (Radiated)***

*Note: GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported.*

**GFSK**

| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **HORIZONTAL** | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 49.52 | PK | 74.00 | 24.48 | 54.93 | 27.49 | 3.32 | 36.22 | -5.41 |
| 2390.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |
| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 50.72 | PK | 74.00 | 23.28 | 56.13 | 27.49 | 3.32 | 36.22 | -5.41 |
| 2390.00 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **HORIZONTAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 48.77 | PK | 74.00 | 25.23 | 54.28 | 27.45 | 3.38 | 36.34 | -5.51 |
| 2483.50 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 51.27 | PK | 74.00 | 22.73 | 56.78 | 27.45 | 3.38 | 36.34 | -5.51 |
| 2483.50 | -- | AV | 54 | -- | -- | -- | -- | -- | -- |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.

## 4.3 Maximum Peak Output Power

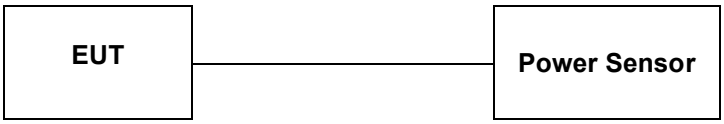
**Limit**

The Maximum Peak Output Power Measurement is 125mW (20.97).

**Test Procedure**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the powersensor.

**Test Configuration**




**Test Results**

| Type | Channel | Output power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| GFSK | 00 | -0.86 | 20.97 | Pass |
| | 39 | -0.57 | | |
| | 78 | -0.86 | | |
| π/4DQPSK | 00 | -0.12 | 20.97 | Pass |
| | 39 | 0.17 | | |
| | 78 | -0.12 | | |
| 8DPSK | 00 | 0.28 | 20.97 | Pass |
| | 39 | 0.20 | | |
| | 78 | 0.24 | | |

Note: 1.The test results including the cable lose.

## 4.4 20dB Bandwidth

**Limit**

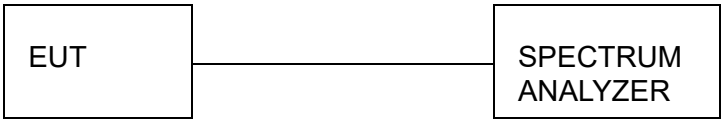
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

**Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

**Test Configuration**

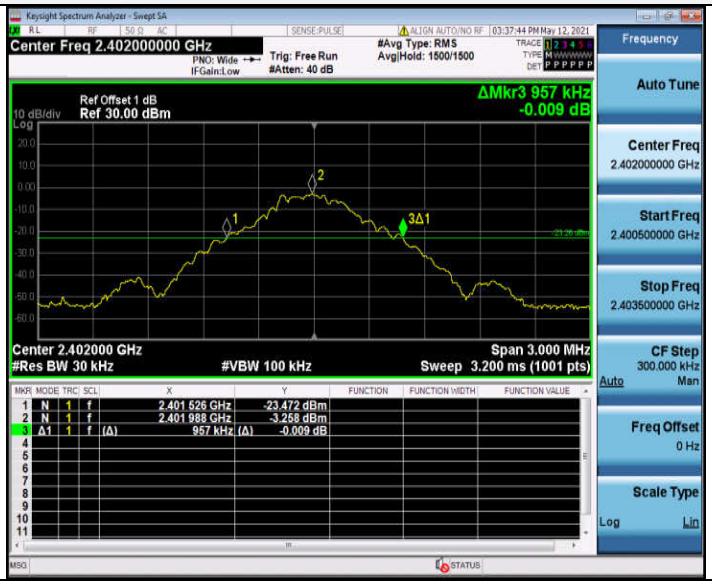



**Test Results**

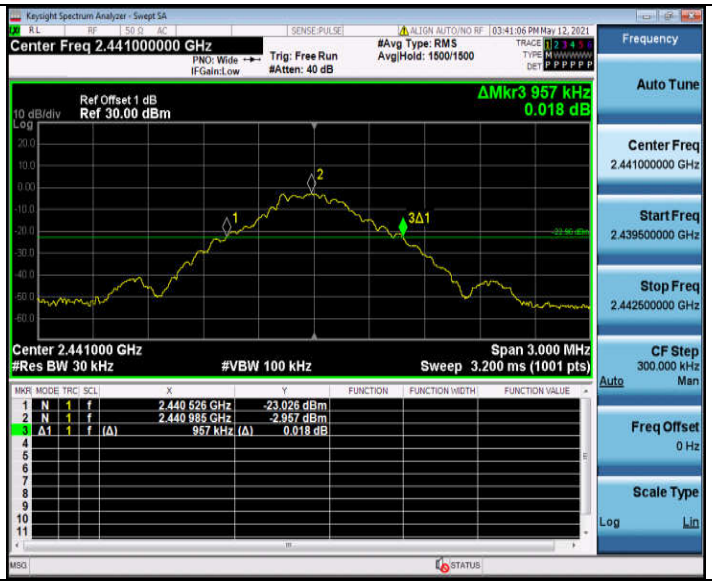
| Modulation | Channel | 20dB bandwidth (MHz) | Result |
|---|---|---|---|
| GFSK | CH00 | 0.957 | Pass |
| | CH39 | 0.957 | |
| | CH78 | 0.960 | |
| π/4DQPSK | CH00 | 1.311 | |
| | CH39 | 1.314 | |
| | CH78 | 1.314 | |
| 8DPSK | CH00 | 1.302 | |
| | CH39 | 1.305 | |
| | CH78 | 1.305 | |

**Test plot as follows:**

*GFSK Modulation*




*CH00*




*CH39*

*CH78*

*π/4DQPSK Modulation*

*CH00*

*CH39*

*CH78*

*8DPSK Modulation*

*CH00*

*CH39*

*CH78*

## 4.5 99% Occupied Bandwidth

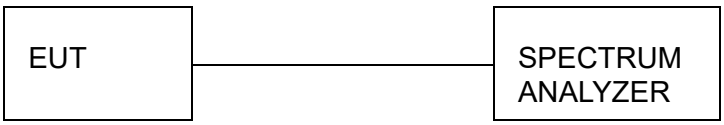
**Limit**

N/A

**Test Procedure**

1. The testing follows ANSI C63.10:2013.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 1%~5% OBW. Set the Video bandwidth (VBW) = 3*RBW. In order to make an accurate measurement.
4. 4Use the 99% power bandwidth function of the spectrum analyzer to measure and record the results in the test report.

**Test Configuration**




**Test Results**

| Modulation | Channel | 99% OBW (MHz) | Result |
|---|---|---|---|
| GFSK | CH00 | 0.84554 | Pass |
| | CH39 | 0.84931 | |
| | CH78 | 0.85082 | |
| π/4DQPSK | CH00 | 1.1706 | |
| | CH39 | 1.1711 | |
| | CH78 | 1.1726 | |
| 8DPSK | CH00 | 1.1840 | |
| | CH39 | 1.1861 | |
| | CH78 | 1.1867 | |

**Test plot as follows:**

*GFSK Modulation*

*CH00*

*CH39*

*CH78*

*π/4DQPSK Modulation*

*CH00*

*CH39*

*CH78*

*8DPSK Modulation*

*CH00*

*CH39*

*CH78*

## 4.6 Frequency Separation

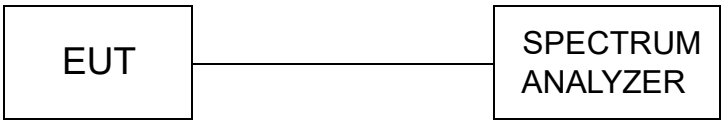
**LIMIT**

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

**TEST PROCEDURE**

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with100 KHz RBW and 300 KHz VBW.

**TEST CONFIGURATION**




**TEST RESULTS**

| Modulation | Channel | Channel Separation (MHz) | Limit(MHz) | Result |
|---|---|---|---|---|
| GFSK | CH39 | 1.012 | 25KHz or 2/3*20dB bandwidth | Pass |
| | CH40 | | | |
| π/4DQPSK | CH39 | 1.008 | 25KHz or 2/3*20dB bandwidth | Pass |
| | CH40 | | | |
| 8DPSK | CH39 | 1.002 | 25KHz or 2/3*20dB bandwidth | Pass |
| | CH40 | | | |

Note:
We have tested all mode at high, middle and low channel, and recorded worst case at middle

**Test plot as follows:**

*GFSK*

*8DPSK*

*π/4DQPSK*

## 4.7 Number of hopping frequency

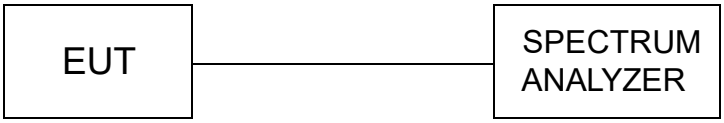
**Limit**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

**Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

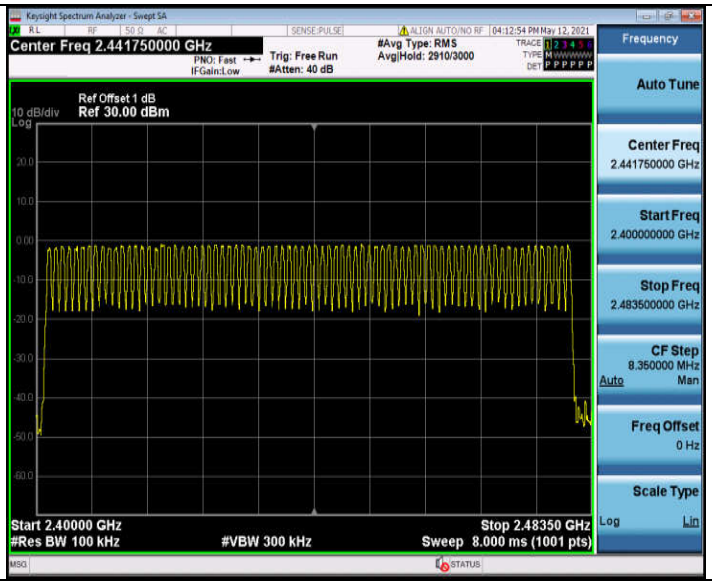
**Test Configuration**



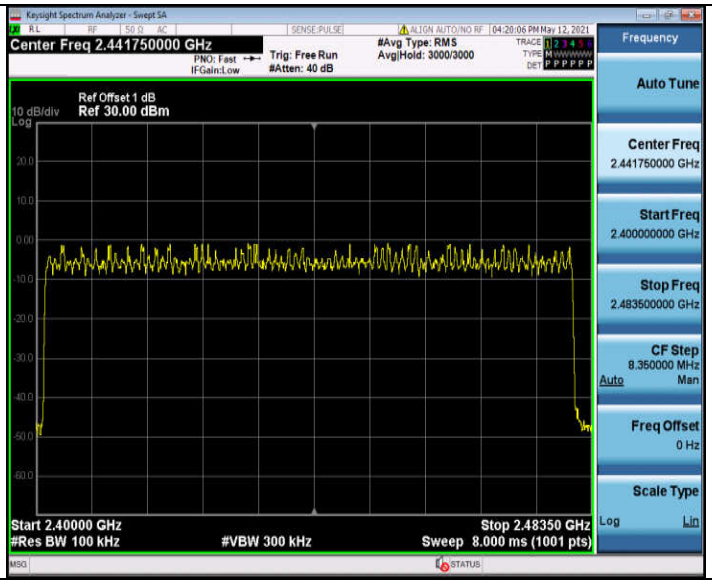

**Test Results**

| Modulation | Number of Hopping Channel | Limit | Result |
|---|---|---|---|
| GFSK | 79 | ≥15 | Pass |
| π/4DQPSK | 79 | | |
| 8DPSK | 79 | | |

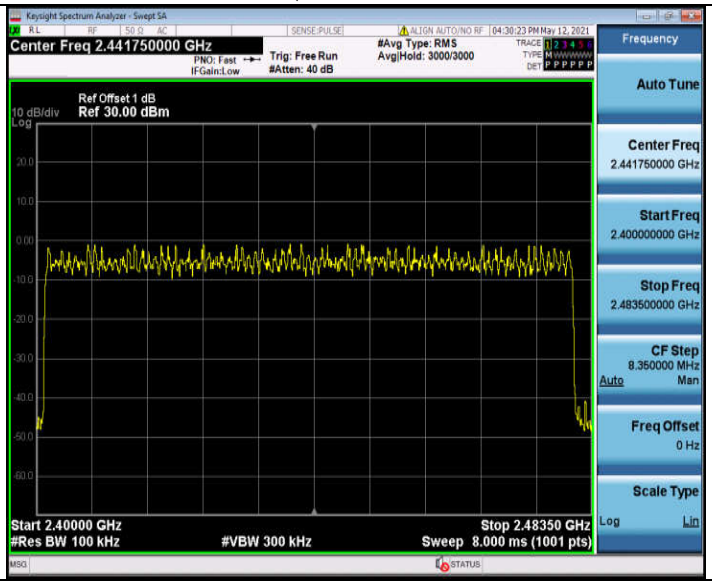
**Test plot as follows:**




*GFSK Modulation*




*π/4DQPSK Modulation*




*8DPSK Modulation*

## 4.8 Time of Occupancy (Dwell Time)

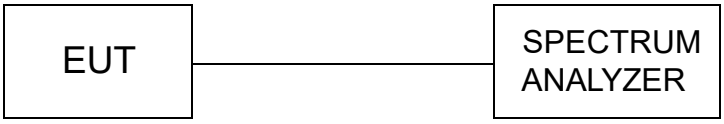
**Limit**

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

**Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

**Test Configuration**

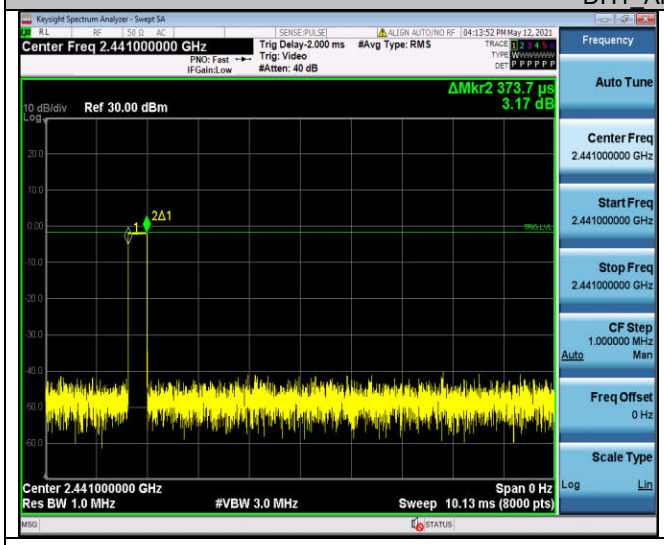


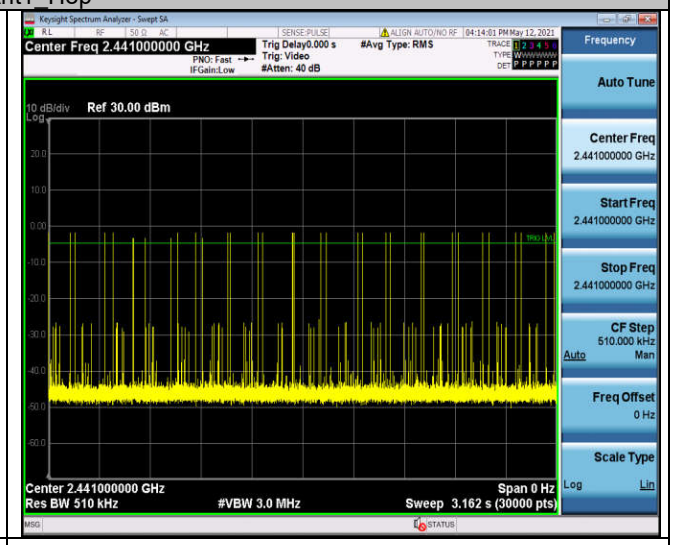

**Test Results**

| TestMode | Channel | BurstWidth [ms] | TotalHops [Num] | Result[s] | Limit[s] | Verdict |
|---|---|---|---|---|---|---|
| DH1 | Hop | 0.37 | 330 | 0.123 | <=0.4 | PASS |
| DH3 | Hop | 1.63 | 160 | 0.261 | <=0.4 | PASS |
| DH5 | Hop | 2.88 | 100 | 0.288 | <=0.4 | PASS |
| 2DH1 | Hop | 0.38 | 330 | 0.127 | <=0.4 | PASS |
| 2DH3 | Hop | 1.64 | 180 | 0.295 | <=0.4 | PASS |
| 2DH5 | Hop | 2.88 | 90 | 0.260 | <=0.4 | PASS |
| 3DH1 | Hop | 0.39 | 330 | 0.127 | <=0.4 | PASS |
| 3DH3 | Hop | 1.64 | 200 | 0.327 | <=0.4 | PASS |
| 3DH5 | Hop | 2.88 | 100 | 0.288 | <=0.4 | PASS |

**Test plot as follows:**

DH1_Ant1_Hop

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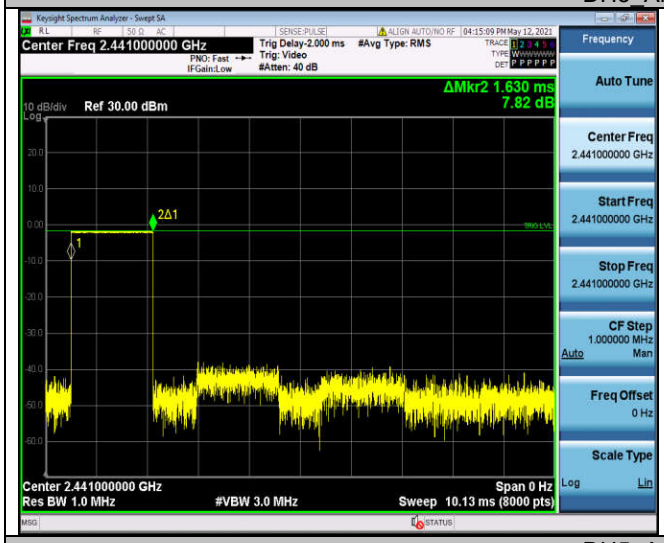
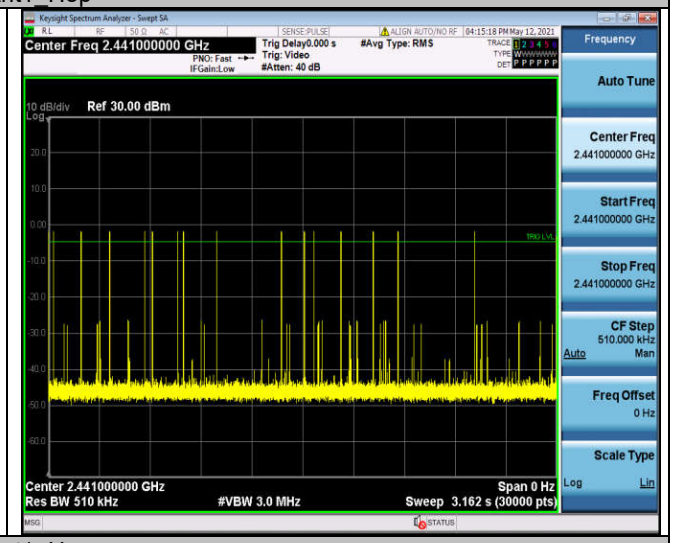
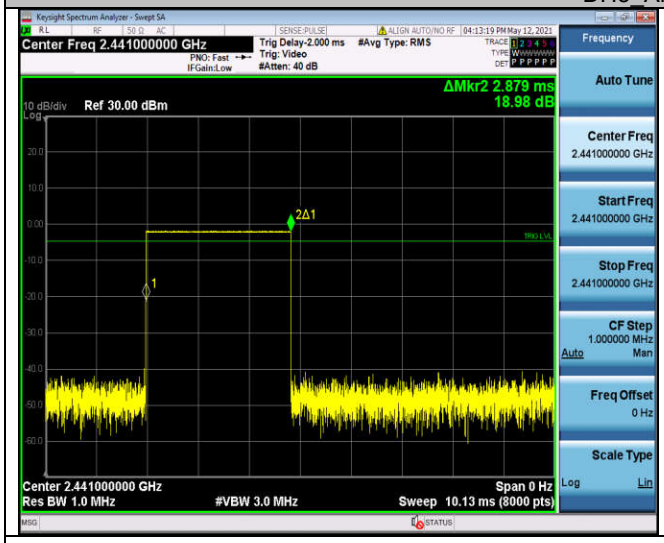
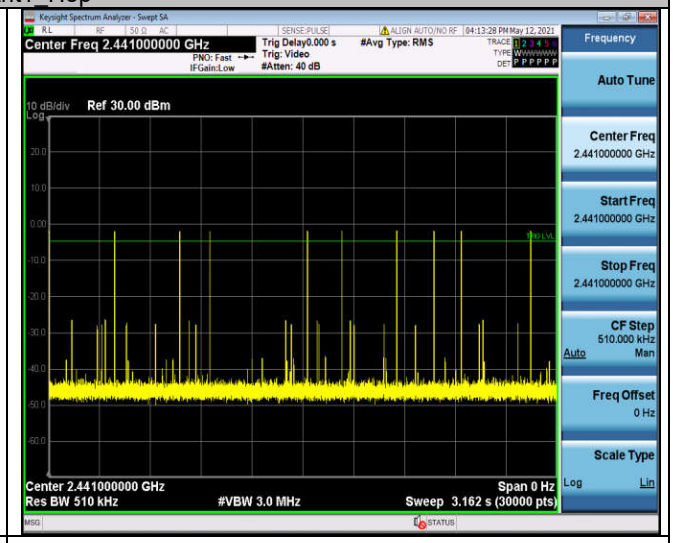


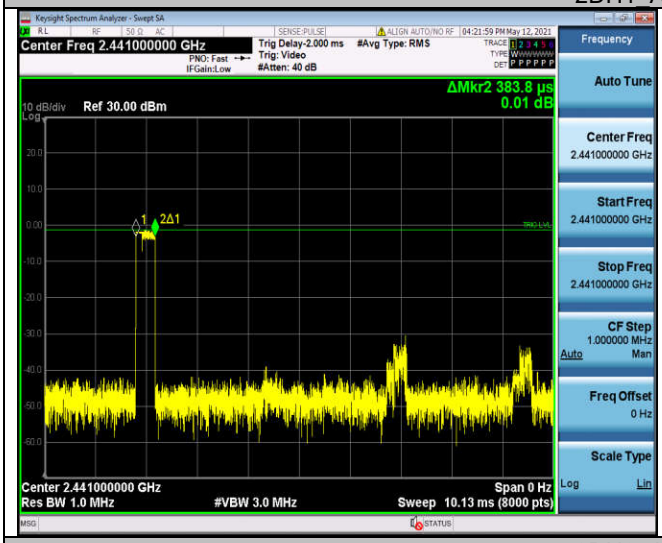



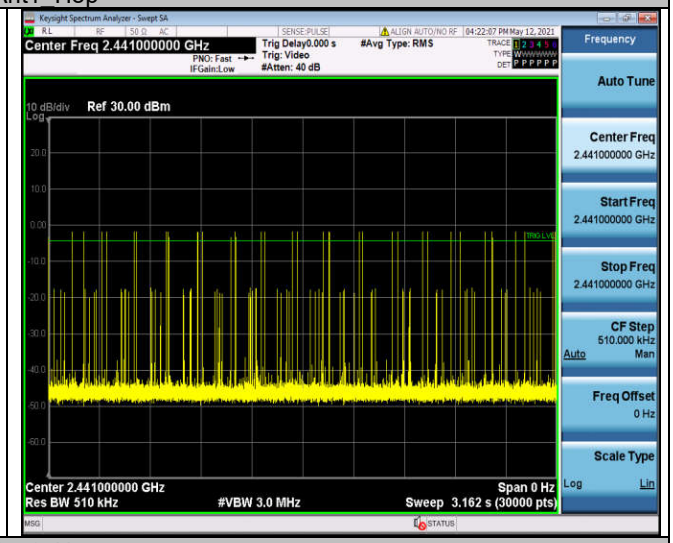

DH5_Ant1_Hop



2DH1_Ant1_Hop

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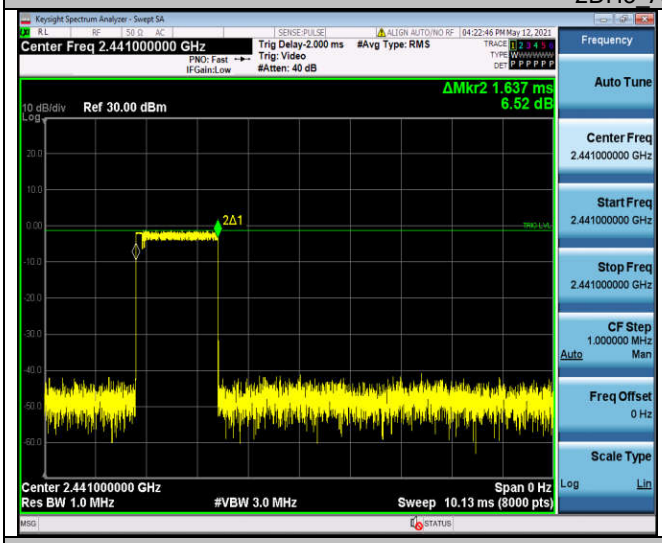
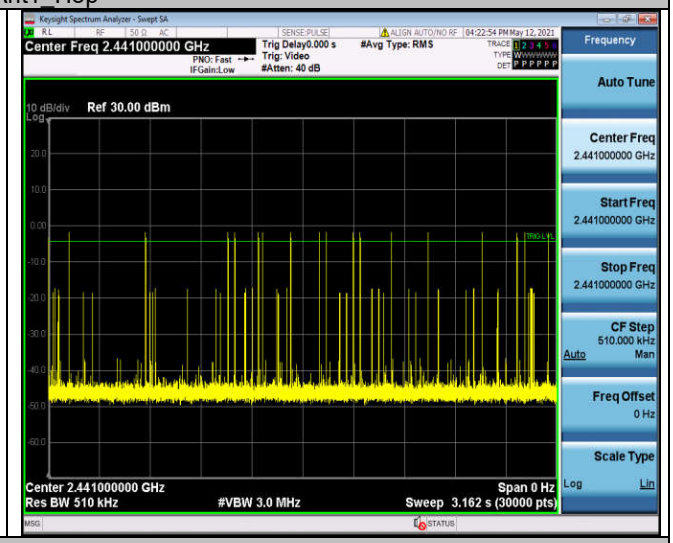
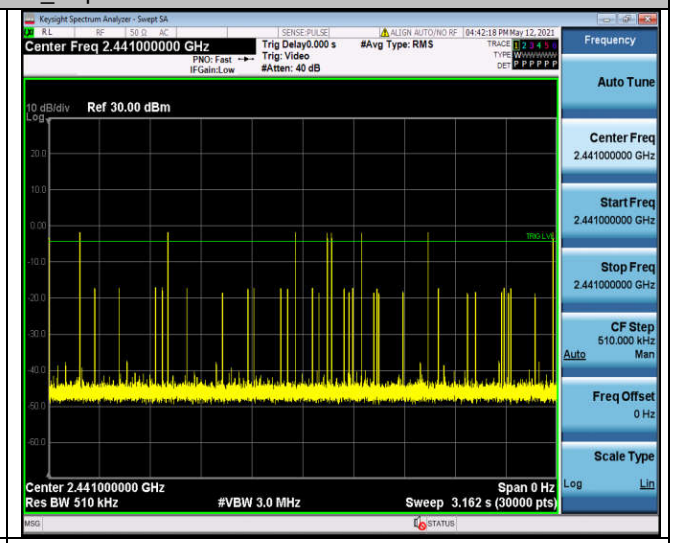
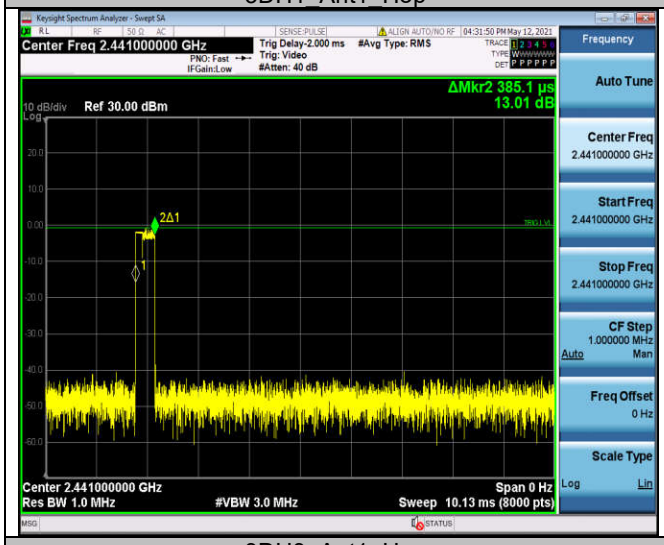


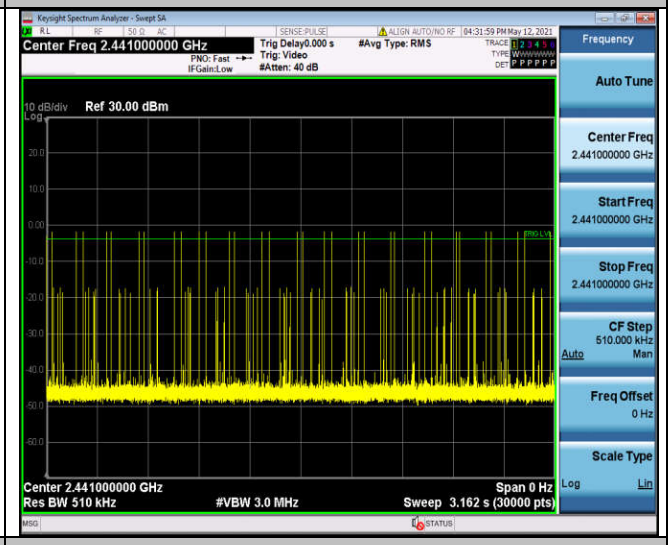




2DH5_Ant1_Hop

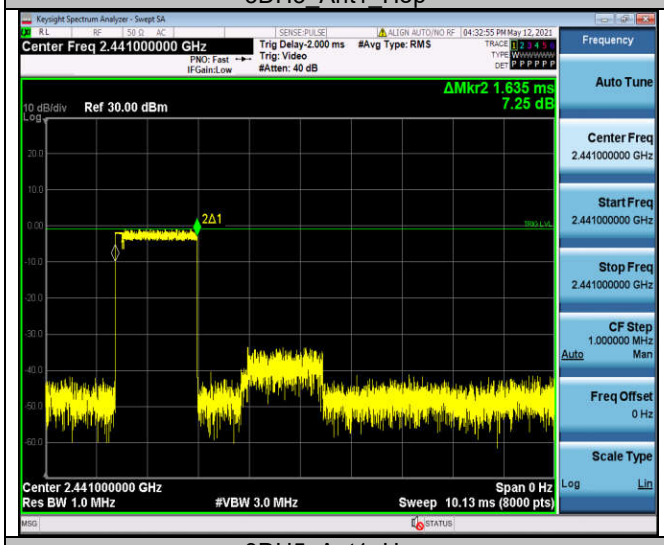


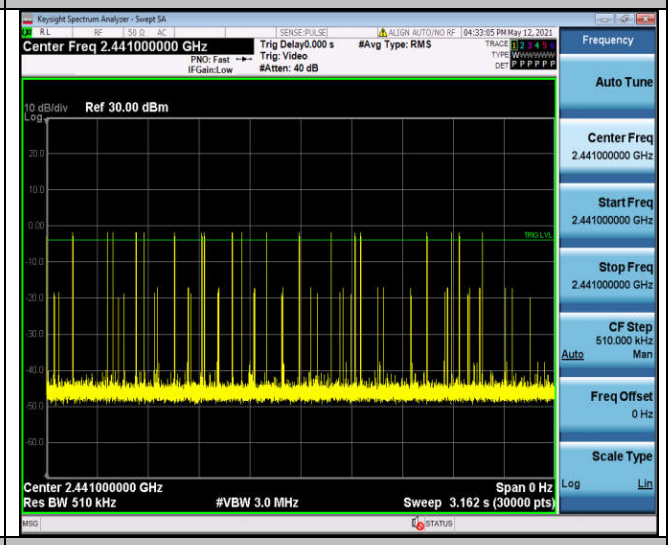
3DH1_Ant1_Hop



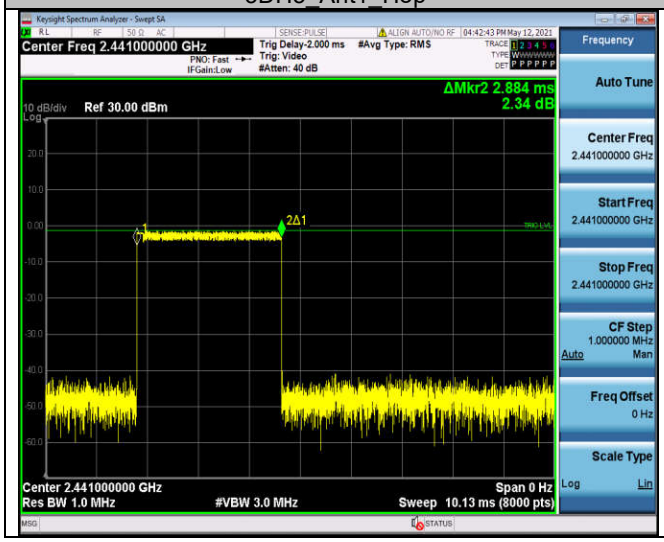



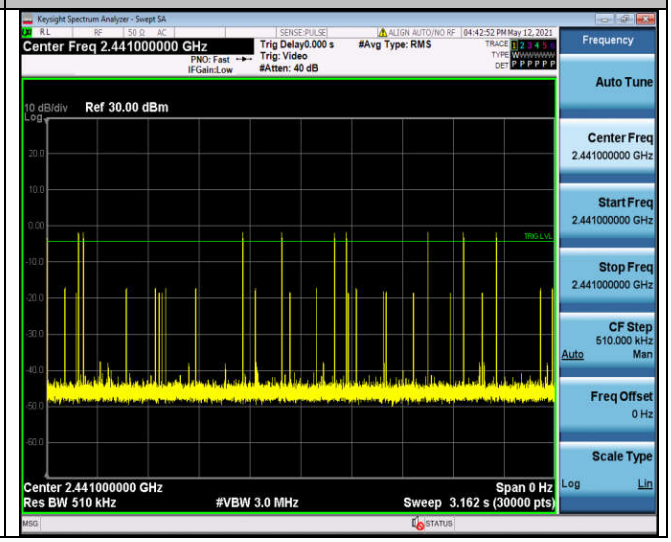

3DH3_Ant1_Hop




3DH5_Ant1_Hop



## 4.9 Out-of-band Emissions

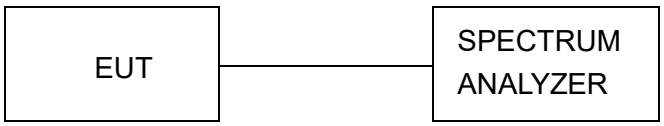
**Limit**

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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.

**Test Procedure**

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

**Test Configuration**




**Test Results**

Remark: 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 and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5

Test plot as follows: