

## RF Test Report

Issued Date: Nov. 01, 2021

Applicant : LEXON  
Product Type : OSLO ENERGY+  
Trade Name : LEXON  
Model Number : LL141  
FCC ID : 2ARD3-LL141  
EUT Rated Voltage : DC 9V, 2A  
Test Voltage : 120 Vac / 60 Hz  
Receive Date : Oct. 08, 2021  
Test Period : Oct. 19 ~ Oct. 20, 2021  
Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Test Result : Complied

### Testing Laboratory

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Certificate #3464.02

American Association for Laboratory Accreditation number: 3464.02

Test Firm MRA designation number: CN1168

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**Revision History**

| Rev. | Issue Date    | Revisions     |
|------|---------------|---------------|
| 00   | Nov. 01, 2021 | Initial Issue |
|      |               |               |
|      |               |               |
|      |               |               |

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# 1 General Information

## 1.1. Summary of Test Result

| FCC Standard      | Item                                    | Result | Remark |
|-------------------|-----------------------------------------|--------|--------|
| 15.207            | AC Power Conducted Emission             | PASS   | -----  |
| 15.203            | Antenna Requirement                     | PASS   | -----  |
| 15.247(b)(1)      | Max. Output Power                       | PASS   | -----  |
| 15.247(d)         | Transmitter Radiated Emissions          | PASS   | -----  |
| 15.247(a)(1)      | 20dB RF Bandwidth                       | PASS   | -----  |
| 15.247(a)(1)      | Carrier Frequency Separation            | PASS   | -----  |
| 15.247(a)(1)(iii) | Number of Hopping                       | PASS   | -----  |
| 15.247(a)(1)(iii) | Time of Occupancy (Dwell Time)          | PASS   | -----  |
| 15.247(d)         | Out of Band Conducted Spurious Emission | PASS   | -----  |

| Standard                          | Description                                                                                                                                                           |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CFR47, Part 15, Subpart C §15.247 | Intentional Radiators                                                                                                                                                 |
| ANSI C63. 10: 2013                | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices                                                                        |
| ANSI C63. 4: 2014                 | American National Standard for methods of measurement of radio – noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz |
| DA 00-705                         | Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems                                                                                       |
| KDB558074 D01 v05r02              | GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES                              |

The test results of this report relate only to the tested sample(s) identified in this report. Manufacturer or whom it may concern should recognize the pass or fail of the test result.

### Decision Rule

☒ Uncertainty is not included.

☐ Uncertainty is included.

A Test Lab Techno Corp. tested the above equipment under the requirements outlined in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. Based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

A Test Lab Techno Corp. will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## 1.2. Measurement Uncertainty

| Test Item              | Frequency Range     | Uncertainty (dB) |
|------------------------|---------------------|------------------|
| Conducted Emission     | 9kHz ~ 150kHz       | 2.7              |
|                        | 150kHz ~ 30MHz      | 2.7              |
| Radiated Emission      | 9kHz ~ 30MHz        | 1.7              |
|                        | 30MHz ~ 1000MHz     | 5.7              |
|                        | 1000MHz ~ 18000MHz  | 5.5              |
|                        | 18000MHz ~ 26500MHz | 4.8              |
|                        | 26500MHz ~ 40000MHz | 4.8              |
| Conducted Output Power | +0.27 dB / -0.28 dB |                  |
| RF Bandwidth           | 4.96%               |                  |
| Power Spectral Density | +0.71 dB / -0.77 dB |                  |

## 2 EUT Description

### 2.1. EUT description

|                                |                                                           |       |                                                                                              |
|--------------------------------|-----------------------------------------------------------|-------|----------------------------------------------------------------------------------------------|
| Applicant                      | LEXON<br>125 avenue des Champs Elysées 75008 Paris France |       |                                                                                              |
| Manufacturer                   | LEXON<br>125 avenue des Champs Elysées 75008 Paris France |       |                                                                                              |
| Product                        | OSLO ENERGY+                                              |       |                                                                                              |
| Trade Name                     | LEXON                                                     |       |                                                                                              |
| Model Number                   | LL141                                                     |       |                                                                                              |
| FCC ID                         | 2ARD3-LL141                                               |       |                                                                                              |
| Frequency Range                | 2402 ~ 2480 MHz                                           |       |                                                                                              |
| Modulation Type                | GFSK for 1Mbps                                            |       |                                                                                              |
|                                | $\pi/4$ -DQPSK for 2Mbps                                  |       |                                                                                              |
|                                | 8DPSK for 3Mbps                                           |       |                                                                                              |
| Operate Temp. Range            | 0 ~ +35 °C                                                |       |                                                                                              |
| Antenna information            | Type                                                      |       | Max. Gain (dBi)                                                                              |
|                                | PCB Antenna                                               |       | -0.58                                                                                        |
| RF Cable information           | Cable Loss(dB)                                            |       | Provided by                                                                                  |
|                                | 0.5                                                       |       | <input checked="" type="checkbox"/> Manufacturer <input type="checkbox"/> Testing Laboratory |
| RF Output Power<br>(Conducted) | GFSK for 1Mbps                                            | 0.001 | W                                                                                            |
|                                | $\pi/4$ -DQPSK for 2Mbps                                  | 0.001 | W                                                                                            |
|                                | 8DPSK for 3Mbps                                           | 0.001 | W                                                                                            |

## 2.2. Channel numbers and channel list

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
| 0           | 2402            | 20          | 2422            | 40          | 2442            | 60          | 2462            |
| 1           | 2403            | 21          | 2423            | 41          | 2443            | 61          | 2463            |
| 2           | 2404            | 22          | 2424            | 42          | 2444            | 62          | 2464            |
| 3           | 2405            | 23          | 2425            | 43          | 2445            | 63          | 2465            |
| 4           | 2406            | 24          | 2426            | 44          | 2446            | 64          | 2466            |
| 5           | 2407            | 25          | 2427            | 45          | 2447            | 65          | 2467            |
| 6           | 2408            | 26          | 2428            | 46          | 2448            | 66          | 2468            |
| 7           | 2409            | 27          | 2429            | 47          | 2449            | 67          | 2469            |
| 8           | 2410            | 28          | 2430            | 48          | 2450            | 68          | 2470            |
| 9           | 2411            | 29          | 2431            | 49          | 2451            | 69          | 2471            |
| 10          | 2412            | 30          | 2432            | 50          | 2452            | 70          | 2472            |
| 11          | 2413            | 31          | 2433            | 51          | 2453            | 71          | 2473            |
| 12          | 2414            | 32          | 2434            | 52          | 2454            | 72          | 2474            |
| 13          | 2415            | 33          | 2435            | 53          | 2455            | 73          | 2475            |
| 14          | 2416            | 34          | 2436            | 54          | 2456            | 74          | 2476            |
| 15          | 2417            | 35          | 2437            | 55          | 2457            | 75          | 2477            |
| 16          | 2418            | 36          | 2438            | 56          | 2458            | 76          | 2478            |
| 17          | 2419            | 37          | 2439            | 57          | 2459            | 77          | 2479            |
| 18          | 2420            | 38          | 2440            | 58          | 2460            | 78          | 2480            |
| 19          | 2421            | 39          | 2441            | 59          | 2461            |             |                 |

### 3 Test Methodology

#### 3.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

| Pre-Test Mode                             |
|-------------------------------------------|
| Mode 1: Transmit mode                     |
| Mode 2: GFSK Continuous TX mode           |
| Mode 3: $\pi/4$ -DQPSK Continuous TX mode |
| Mode 4: 8DPSK Continuous TX mode          |

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in TX mode only. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "X axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

| Final-Test Mode                           |
|-------------------------------------------|
| Mode 1: Transmit mode                     |
| Mode 2: GFSK Continuous TX mode           |
| Mode 3: $\pi/4$ -DQPSK Continuous TX mode |
| Mode 4: 8DPSK Continuous TX mode          |

#### Description of Test Modes

Preliminary tests were performed in different modulation to find the worst case. The modulation has shown the worst-case in section 4.5. Investigation has been done on all the possible configurations for searching the worst cases.

#### Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

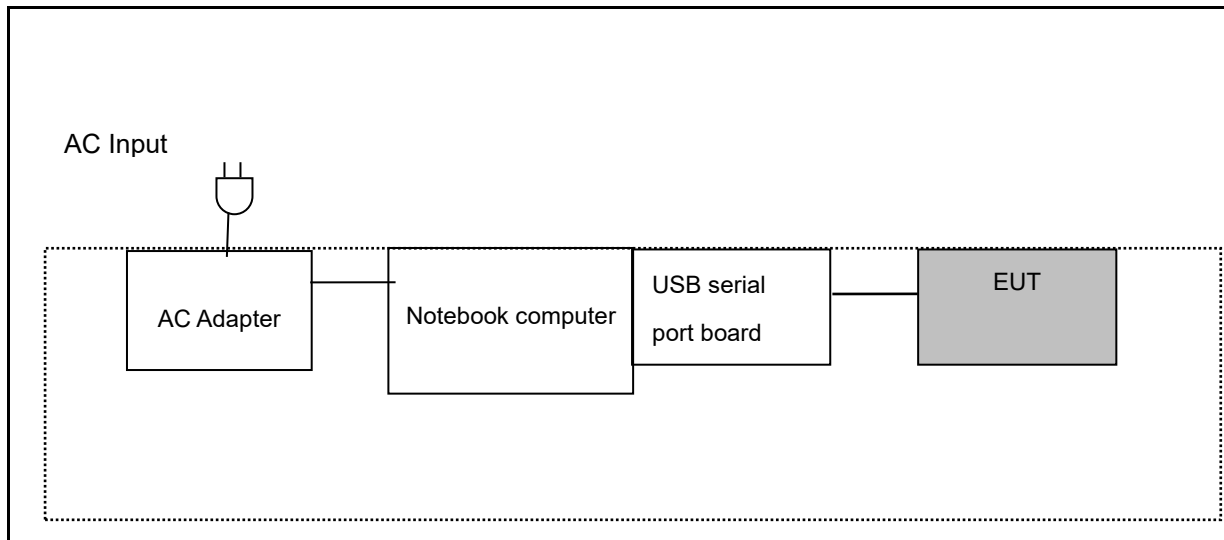
|    | Product                      | Manufacturer | Model Number | Serial Number | Power Cord |
|----|------------------------------|--------------|--------------|---------------|------------|
| 1. | Wireless Connectivity Tester | R & S        | CMW270       | 101185        | NA         |

### 3.2. EUT Test Step

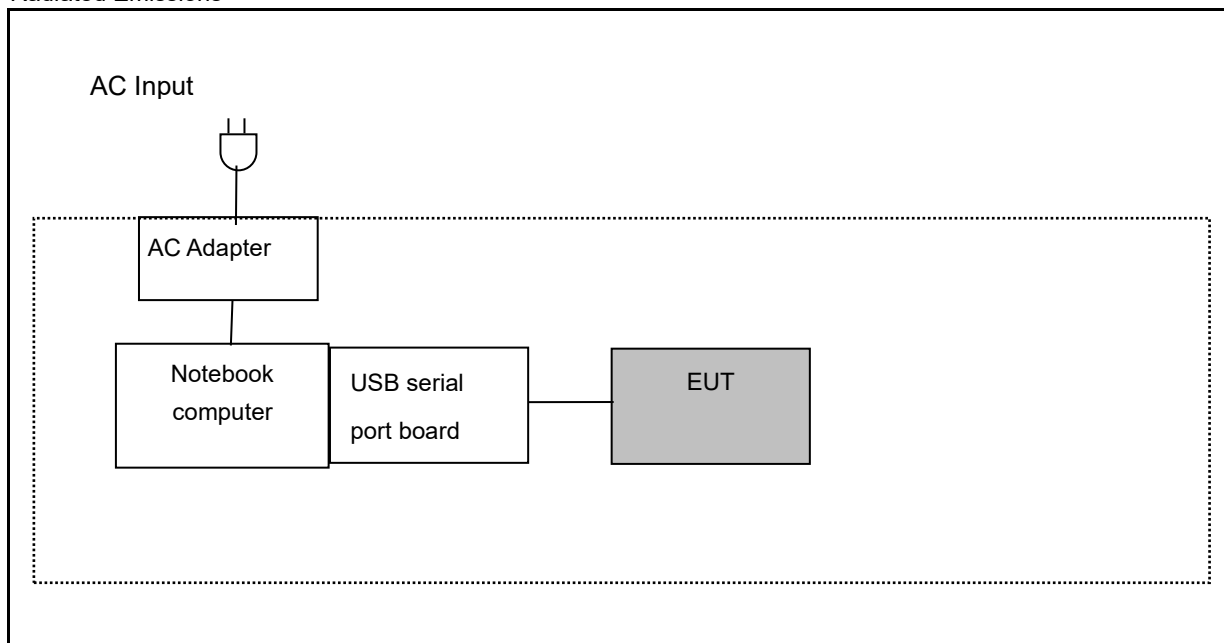
|   |                                                                |
|---|----------------------------------------------------------------|
| 1 | Setup the EUT shown on "Configuration of Test System Details." |
| 2 | Turn on the power of all equipment.                            |
| 3 | Turn on TX function                                            |
| 4 | EUT run test program.                                          |

### 3.3. Configuration of Test System Details

#### Conducted Emission



#### Radiated Emissions



| Devices Description |                       |              |              |                             |                    |
|---------------------|-----------------------|--------------|--------------|-----------------------------|--------------------|
|                     | Product               | Manufacturer | Model Number | Serial Number               | Power Cord         |
| (1)                 | AC Adapter            | LENOVO       | ADLX65YCCD   | 8SSA10R16874C1SG0<br>5F12AM | Non-Shielded, 1m   |
| (2)                 | Notebook computer     | LENOVO       | 14ARE 2020   | MP1SJVAC                    | Non-Shielded, 2m   |
| (3)                 | USB serial port board | -            | -            | -                           | Non-Shielded, 0.1m |

### 3.4. Test Instruments

For Conducted Emission

Test Period: Oct. 19, 2021

| Equipment     | Manufacturer | Model Number | Serial Number | Cal. Date  | Cal. Period |
|---------------|--------------|--------------|---------------|------------|-------------|
| Test Receiver | R&S          | ESR3         | 101923        | 09/01/2021 | 1 year      |
| LISN          | R&S          | ENV216       | 101942        | 09/01/2021 | 1 year      |
| ISN           | TESEQ        | ISN T800     | 39216         | 09/01/2021 | 1 year      |
| RF Cable      | EMCI         | EMCCFD400    | 433LFC        | 09/01/2021 | 1 year      |
| Test Site     | ATL          | CE           | CE            | N.C.R.     | -----       |

For Radiated Emissions

Test Period: Oct. 19 ~ Oct. 20, 2021

| Equipment     | Manufacturer | Model Number | Serial Number | Cal. Date  | Cal. Period |
|---------------|--------------|--------------|---------------|------------|-------------|
| Preamplifier  | EMCI         | EMC001330    | 980300        | 09/01/2021 | 1 year      |
| Preamplifier  | EMCI         | EMC012645SE  | 980318        | 09/01/2021 | 1 year      |
| Bilog Antenna | Schwarzbeck  | VULB 9168    | 672           | 10/15/2021 | 1 year      |
| Horn Antenna  | ETS          | 3117         | 00204949      | 10/15/2021 | 1 year      |
| Receiver      | Keysight     | N9038A       | MY51210179    | 09/01/2021 | 1 year      |
| Cable         | EMCI         | N/A          | 1066LFC       | 09/01/2021 | 1 year      |
| Cable         | EMCI         | N/A          | 160719        | 09/01/2021 | 1 year      |
| Test Site     | OuHeng       | MFAC3M       | RE-026        | 02/23/2021 | 1 year      |

Note: N.C.R. = No Calibration Request.

|                      |                                                   |
|----------------------|---------------------------------------------------|
| Measurement Software |                                                   |
| CE                   | EZ-EMC Ver. ATL-03A1-1                            |
| RE                   | EZ-EMC Ver ATL-ITC-3A1-1 (for Conducted Emission) |

For Conducted

Test Period: Oct. 19 ~ Oct. 20, 2021

| Equipment                             | Manufacturer | Model Number          | Serial Number | Cal. Date  | Cal. Period |
|---------------------------------------|--------------|-----------------------|---------------|------------|-------------|
| Power Sensor                          | Anritsu      | MA2411B               | 1126022       | 09/01/2021 | 1 year      |
| Power Meter                           | Anritsu      | ML2495A               | 1135009       | 09/01/2021 | 1 year      |
| Spectrum Analyzer<br>(3 Hz~13.2 GHz)  | Agilent      | E4445A                | MY45300744    | 10/24/2021 | 1 year      |
| Microwave Cable                       | EMCI         | EMC104-SM-SM-1<br>500 | 140303        | 09/01/2021 | 1 year      |
| Spectrum Analyzer<br>(9 kHz~26.5 GHz) | Agilent      | E4408B                | MY45107753    | 10/24/2021 | 1 year      |
| Test Site                             | ATL          | TE05                  | TE05          | N.C.R.     | -----       |

Note: N.C.R. = No Calibration Request.

### 3.5. Test Site Environment

| Items                      | Required (IEC 60068-1) | Actual |
|----------------------------|------------------------|--------|
| Temperature (°C)           | 15-35                  | 26     |
| Humidity (%RH)             | 25-75                  | 60     |
| Barometric pressure (mbar) | 860-1060               | 950    |

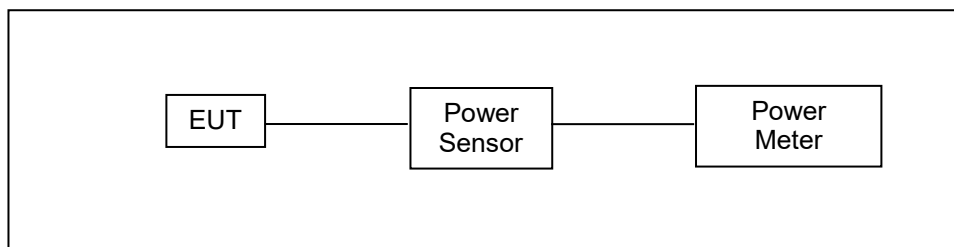
## 4 Measurement Procedure

### 4.1. Maximum Conducted Output Power Measurement

#### ■ Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels < 0.125 watt.

#### ■ Test Setup



#### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor. The maximum peak output power shall not exceed 1 watt.

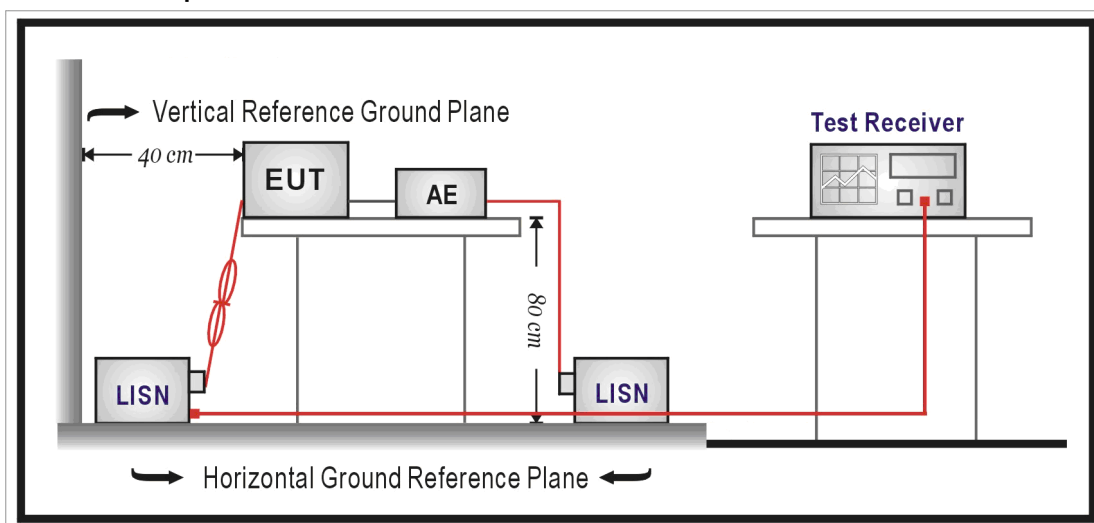
Use a direct connection between the antenna port of transmitter and the power sensor, for prevent the power sensor input attenuation 40-50 dB. Set the RBW Bandwidth of the emission or use a channel power meter mode. For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6)/3 dBm. The antenna port of the EUT was connected to the input of a power sensor. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

## 4.2. AC Power Line Conducted Emission Measurement

### ■ Limit

| Frequency (MHz) | Quasi-peak | Average  |
|-----------------|------------|----------|
| 0.15 - 0.5      | 66 to 56   | 56 to 46 |
| 0.50 - 5.0      | 56         | 46       |
| 5.0 - 30.0      | 60         | 50       |

### ■ Test Setup



### ■ Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a  $50\Omega//50\mu\text{H}$  coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a  $50\Omega//50\mu\text{H}$  coupling impedance with  $50\Omega$  termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150kHz to 30MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0,8 m from the AMN. If the mains power cable is longer than 1m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4m. All of interconnecting cables that hang closer than 40cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1m. All  $50\Omega$  ports of the LISN shall be resistively terminated into  $50\Omega$  loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

### 4.3. Radiated Emission Measurement

#### ■ Limit

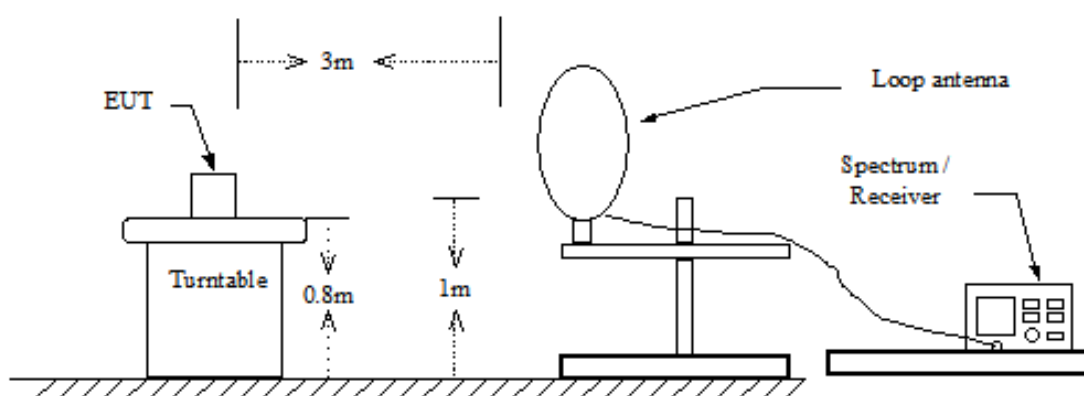
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency<br>(MHz) | Field Strength<br>( $\mu\text{V/m}$ at meter) | Measurement Distance<br>(meters) |
|--------------------|-----------------------------------------------|----------------------------------|
| 0.009 – 0.490      | $2400 / F$ (kHz)                              | 300                              |
| 0.490 – 1.705      | $24000 / F$ (kHz)                             | 30                               |
| 1.705 – 30.0       | 30                                            | 30                               |
| 30 - 88            | $100^{**}$                                    | 3                                |
| 88-216             | $150^{**}$                                    | 3                                |
| 216-960            | $200^{**}$                                    | 3                                |
| Above 960          | 500                                           | 3                                |

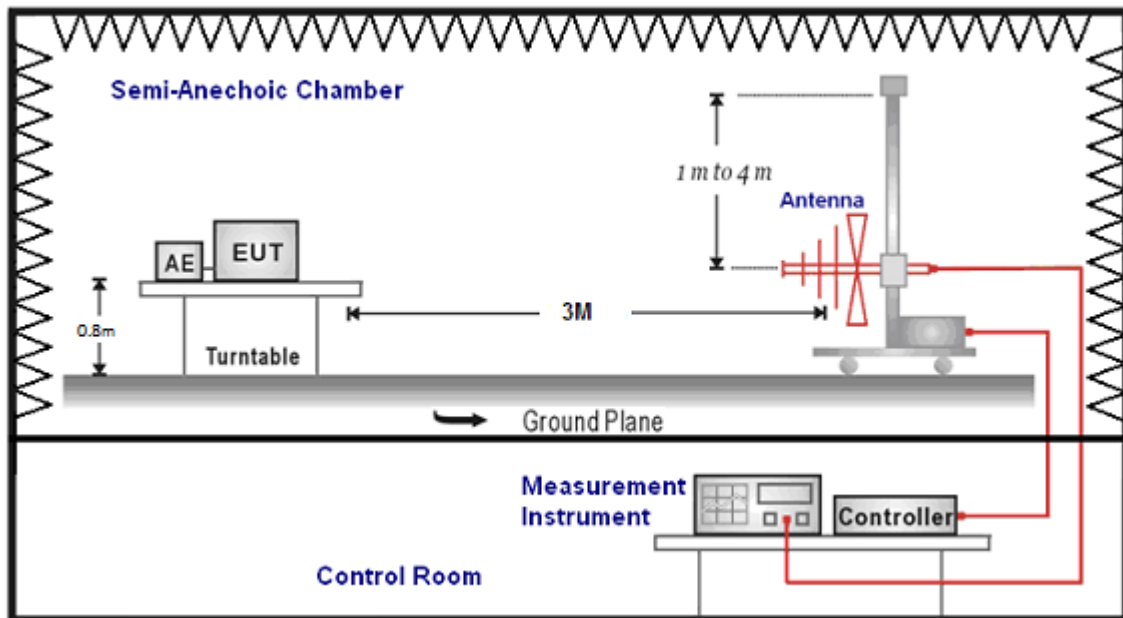
**\*\*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

#### ■ Setup

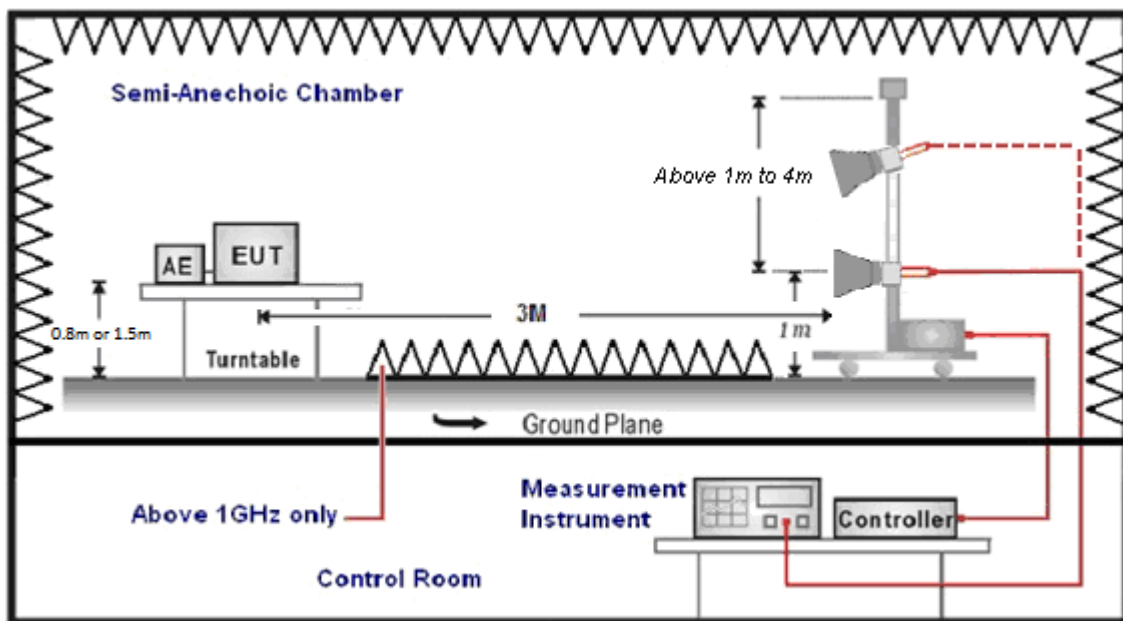
9kHz ~ 30MHz



Below 1GHz



Above 1GHz



## ■ Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 – 26.5 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20dB/decade).

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts per meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro volts per meter (dBuV/m).

The actual field intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

$$(1) \text{ Amplitude (dBuV/m) = FI (dBuV) + AF (dBuV) + CL (dBuV) - Gain (dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dBuV/m) = Amplitude (dBuV) - Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

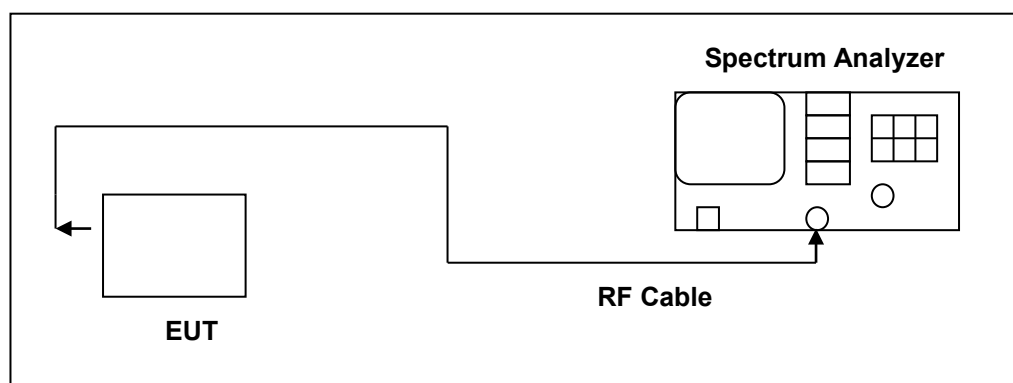
Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

#### 4.4. 20dB RF Bandwidth Measurement

##### ■ Limit

N/A

##### ■ Test Setup



##### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer used the following settings:

1. Span = approx. 2 to 3 times the 20dB bandwidth, centered on a hopping frequency
2. RBW  $\geq$  1% of the 20dB span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

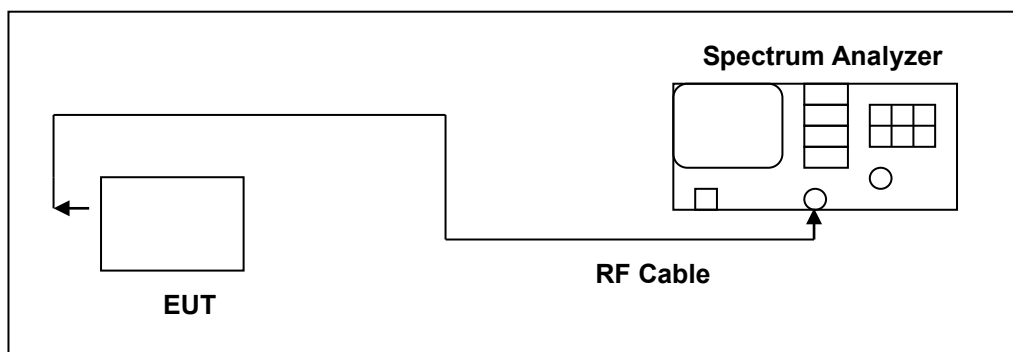
The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20dB down one side of the emission. The marker-delta function and marker was moved to the other side of the emission until it was even with the reference marker. The marker-delta reading at this point was the 20dB bandwidth of the emission.

## 4.5. Carrier Frequency Separation Measurement

### ■ Limit

Title 47 of the CFR, Part 15 Subpart (c) 15.247(a)(1) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel spacing shall be a minimum of 25 kHz or the 20 dB bandwidth, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel.

### ■ Test Setup



### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. The following spectrum analyzer settings were used:

1. Span = wide enough to capture the peaks of two adjacent channels
2. Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span
3. Video (or Average) Bandwidth (VBW)  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

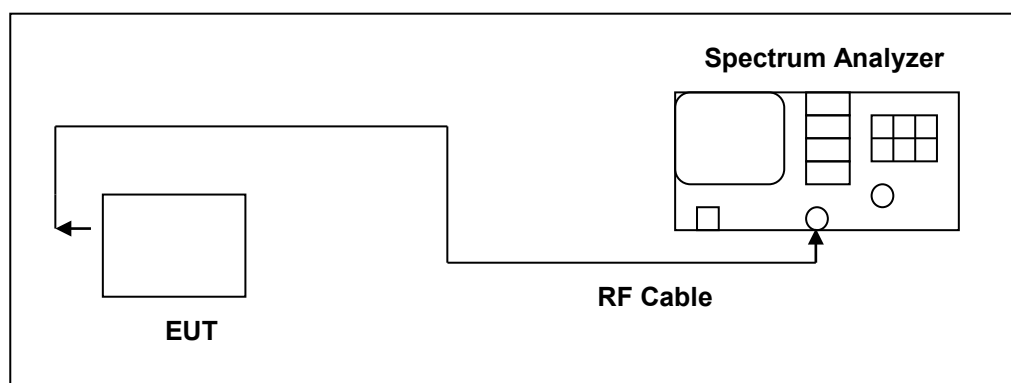
The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

## 4.6. Number of Hopping Measurement

### ■ Limit

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

### ■ Test Setup



### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer used the following settings:

1. Span = the frequency band of operation
2. RBW  $\geq$  1% of the span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

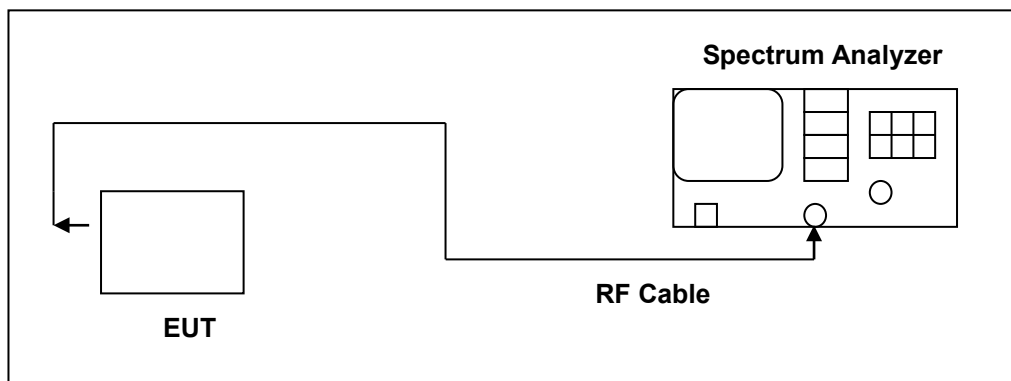
The trace was allowed to stabilize.

## 4.7. Time of Occupancy (Dwell Time) Measurement

### ■ 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 Setup



### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the spectrum through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth hopping function of the EUT was enabled. The following spectrum analyzer settings were used:

1. Span = zero span, centered on a hopping channel
2. RBW = 1 MHz
3. VBW  $\geq$  RBW
4. Sweep = as necessary to capture the entire dwell time per hopping channel
5. Detector function = peak
6. Trace = max hold

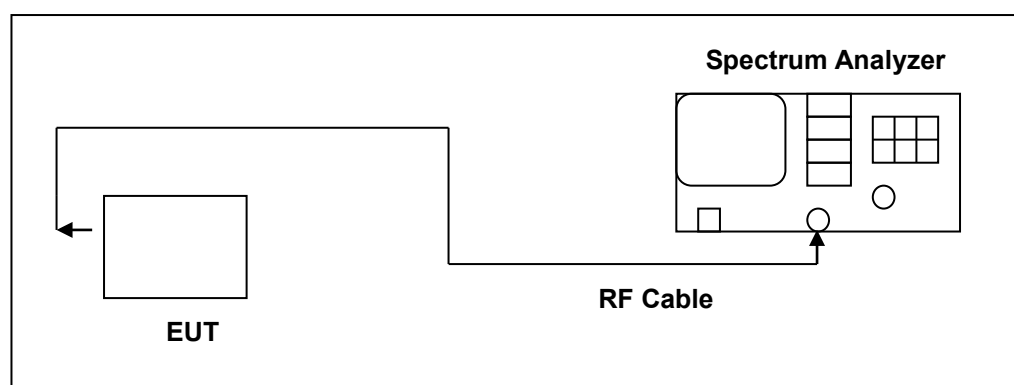
The marker-delta function was used to determine the dwell time.

## 4.8. Out of Band Conducted Emissions Measurement

### ■ 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

### ■ Test Setup



### ■ Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function. All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels (Channel 0, 39, 78)

## 4.9. Antenna Measurement

### ■ Limit

For intentional device, according to 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.

And According to 15.247 (b)(4), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

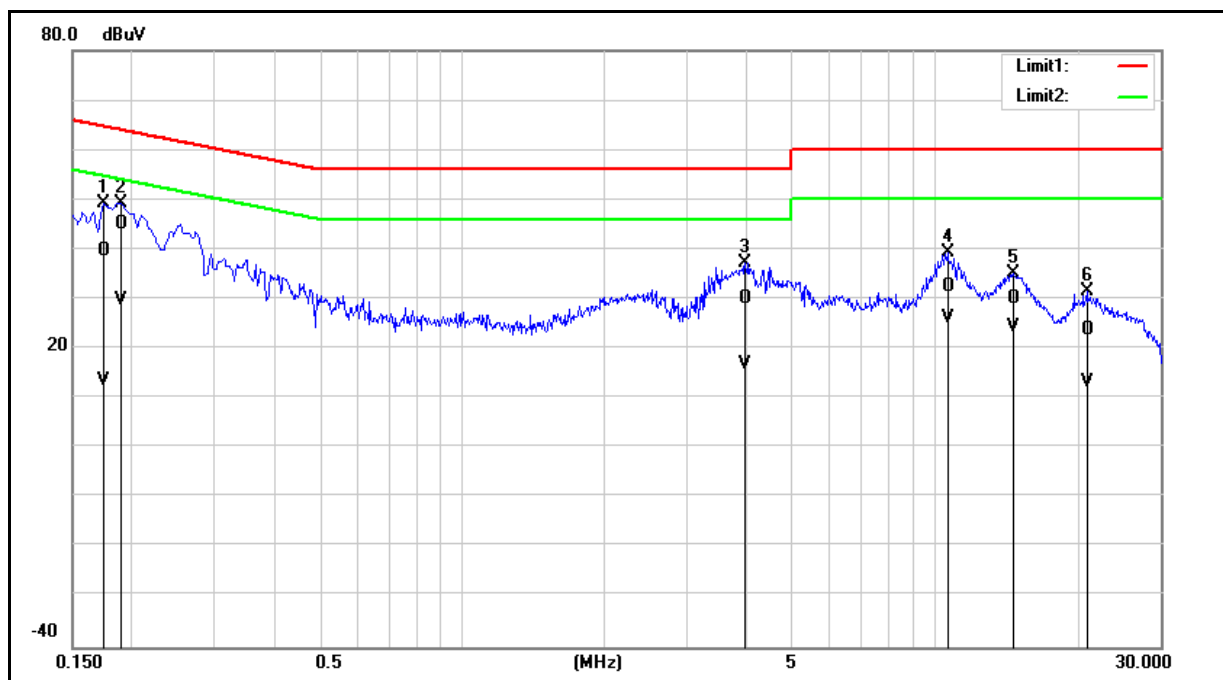
### ■ Antenna Connector Construction

See section 2 – antenna information.

## 5 Test Results

### Annex A. Conducted Emission

|              |                    |                       |                |
|--------------|--------------------|-----------------------|----------------|
| Standard:    | FCC Part 15.247    | Line:                 | L1             |
| Test item:   | Conducted Emission | Power:                | AC 120 V/60 Hz |
| Test Mode:   | Mode 1             | Temp.(°C)/Hum.(% RH): | 26(°C)/60 % RH |
| Description: |                    |                       |                |



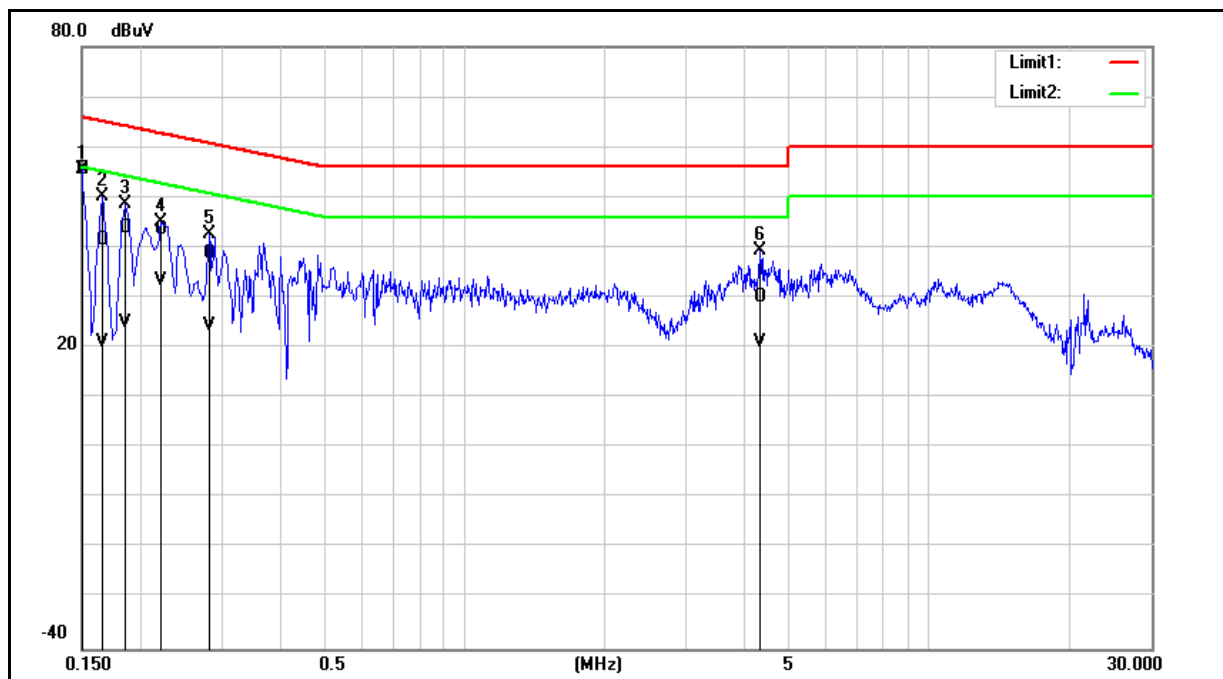
| No. | Frequency<br>(MHz) | QP<br>reading<br>(dBuV) | AVG<br>reading<br>(dBuV) | Correction<br>factor<br>(dB) | QP<br>result<br>(dBuV) | AVG<br>result<br>(dBuV) | QP<br>limit<br>(dBuV) | AVG<br>limit<br>(dBuV) | QP<br>margin<br>(dB) | AVG<br>margin<br>(dB) | Remark |
|-----|--------------------|-------------------------|--------------------------|------------------------------|------------------------|-------------------------|-----------------------|------------------------|----------------------|-----------------------|--------|
| 1   | 0.1740             | 30.07                   | 3.79                     | 9.68                         | 39.75                  | 13.47                   | 64.77                 | 54.77                  | -25.02               | -41.30                | Pass   |
| 2   | 0.1900             | 35.31                   | 19.98                    | 9.69                         | 45.00                  | 29.67                   | 64.04                 | 54.04                  | -19.04               | -24.37                | Pass   |
| 3   | 3.9820             | 20.13                   | 6.94                     | 9.82                         | 29.95                  | 16.76                   | 56.00                 | 46.00                  | -26.05               | -29.24                | Pass   |
| 4   | 10.6420            | 22.50                   | 16.17                    | 9.84                         | 32.34                  | 26.01                   | 60.00                 | 50.00                  | -27.66               | -23.99                | Pass   |
| 5   | 14.6620            | 19.80                   | 14.33                    | 10.12                        | 29.92                  | 24.45                   | 60.00                 | 50.00                  | -30.08               | -25.55                | Pass   |
| 6   | 20.9620            | 13.77                   | 3.09                     | 10.11                        | 23.88                  | 13.20                   | 60.00                 | 50.00                  | -36.12               | -36.80                | Pass   |

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

Example: 39.75=9.68+30.07

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

|              |                    |                       |                |
|--------------|--------------------|-----------------------|----------------|
| Standard:    | FCC Part 15.247    | Line:                 | N              |
| Test item:   | Conducted Emission | Power:                | AC 120 V/60 Hz |
| Test Mode:   | Mode 1             | Temp.(°C)/Hum.(% RH): | 26(°C)/60 %RH  |
| Description: |                    |                       |                |



| No. | Frequency<br>(MHz) | QP<br>reading<br>(dBuV) | AVG<br>reading<br>(dBuV) | Correction<br>factor<br>(dB) | QP<br>result<br>(dBuV) | AVG<br>result<br>(dBuV) | QP<br>limit<br>(dBuV) | AVG<br>limit<br>(dBuV) | QP<br>margin<br>(dB) | AVG<br>margin<br>(dB) | Remark |
|-----|--------------------|-------------------------|--------------------------|------------------------------|------------------------|-------------------------|-----------------------|------------------------|----------------------|-----------------------|--------|
| 1   | 0.1500             | 45.78                   | 45.78                    | 9.67                         | 55.45                  | 55.45                   | 66.00                 | 56.00                  | -10.55               | -0.55                 | Pass   |
| 2   | 0.1660             | 31.79                   | 11.45                    | 9.67                         | 41.46                  | 21.12                   | 65.16                 | 55.16                  | -23.70               | -34.04                | Pass   |
| 3   | 0.1860             | 34.11                   | 15.28                    | 9.68                         | 43.79                  | 24.96                   | 64.21                 | 54.21                  | -20.42               | -29.25                | Pass   |
| 4   | 0.2220             | 33.76                   | 23.52                    | 9.68                         | 43.44                  | 33.20                   | 62.74                 | 52.74                  | -19.30               | -19.54                | Pass   |
| 5   | 0.2820             | 28.92                   | 14.56                    | 9.70                         | 38.62                  | 24.26                   | 60.76                 | 50.76                  | -22.14               | -26.50                | Pass   |
| 6   | 4.3180             | 20.14                   | 11.20                    | 9.83                         | 29.97                  | 21.03                   | 56.00                 | 46.00                  | -26.03               | -24.97                | Pass   |

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

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

## Annex B. Conducted Test Results

### Maximum Conducted Output Power Measurement

| Test Mode | Antenna | Channel | Result[dBm] | Result[mW]  | Limit[W] | Limit[mW] | Verdict |
|-----------|---------|---------|-------------|-------------|----------|-----------|---------|
| DH1       | Ant1    | 2402    | 1.13        | <b>1.30</b> | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.69       | 0.85        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.95       | 0.51        | ≤20.97   | ≤125      | PASS    |
| DH3       | Ant1    | 2402    | 0.69        | 1.17        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.78       | 0.84        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.91       | 0.51        | ≤20.97   | ≤125      | PASS    |
| DH5       | Ant1    | 2402    | 0.77        | 1.19        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.73       | 0.85        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.85       | 0.52        | ≤20.97   | ≤125      | PASS    |
| 2DH1      | Ant1    | 2402    | 0.84        | <b>1.21</b> | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.74       | 0.84        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.96       | 0.51        | ≤20.97   | ≤125      | PASS    |
| 2DH3      | Ant1    | 2402    | 0.64        | 1.16        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.91       | 0.81        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -3.08       | 0.49        | ≤20.97   | ≤125      | PASS    |
| 2DH5      | Ant1    | 2402    | 0.8         | 1.20        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.72       | 0.85        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.96       | 0.51        | ≤20.97   | ≤125      | PASS    |
| 3DH1      | Ant1    | 2402    | 0.63        | 1.16        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.99       | 0.80        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -3.15       | 0.48        | ≤20.97   | ≤125      | PASS    |
| 3DH3      | Ant1    | 2402    | 0.72        | <b>1.18</b> | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.78       | 0.84        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -3.05       | 0.50        | ≤20.97   | ≤125      | PASS    |
| 3DH5      | Ant1    | 2402    | 0.7         | 1.17        | ≤20.97   | ≤125      | PASS    |
|           |         | 2441    | -0.84       | 0.82        | ≤20.97   | ≤125      | PASS    |
|           |         | 2480    | -2.98       | 0.50        | ≤20.97   | ≤125      | PASS    |

Note: The relevant measured result has the offset with cable loss already.

**20dB RF Bandwidth Measurement**

| Test Mode | Antenna | Channel | 20dB<br>EBW[MHz] | Verdict |
|-----------|---------|---------|------------------|---------|
| DH5       | Ant1    | 2402    | 0.963            | PASS    |
|           |         | 2441    | 0.918            | PASS    |
|           |         | 2480    | 1.023            | PASS    |
| 2DH5      | Ant1    | 2402    | 1.239            | PASS    |
|           |         | 2441    | 1.251            | PASS    |
|           |         | 2480    | 1.260            | PASS    |
| 3DH5      | Ant1    | 2402    | 1.284            | PASS    |
|           |         | 2441    | 1.254            | PASS    |
|           |         | 2480    | 1.290            | PASS    |

## ■ Test Graphs

DH5\_Ant1\_2402



DH5\_Ant1\_2441



### DH5\_Ant1\_2480



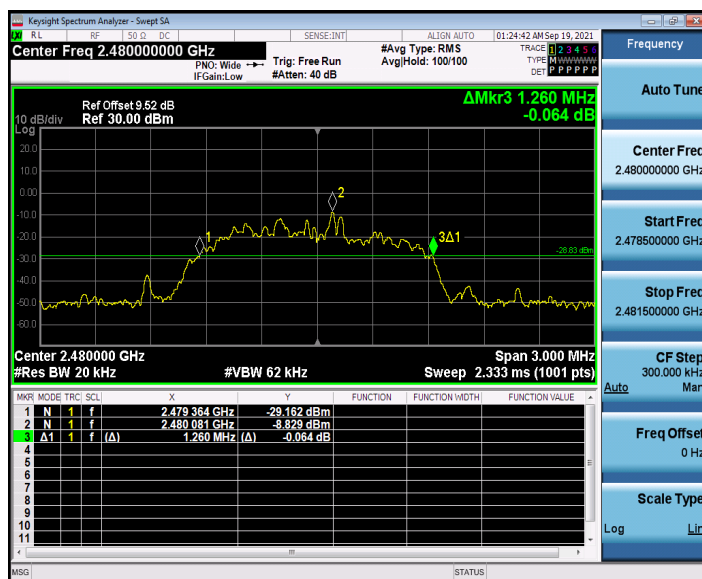
### 2DH5\_Ant1\_2402



## 2DH5\_Ant1\_2441



## 2DH5\_Ant1\_2480



### 3DH5\_Ant1\_2402



### 3DH5\_Ant1\_2441



## 3DH5\_Ant1\_2480

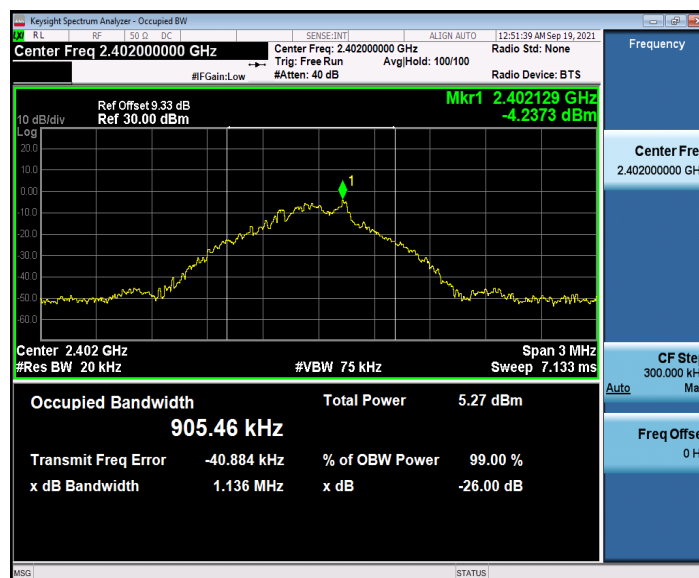


### Occupied Channel Bandwidth

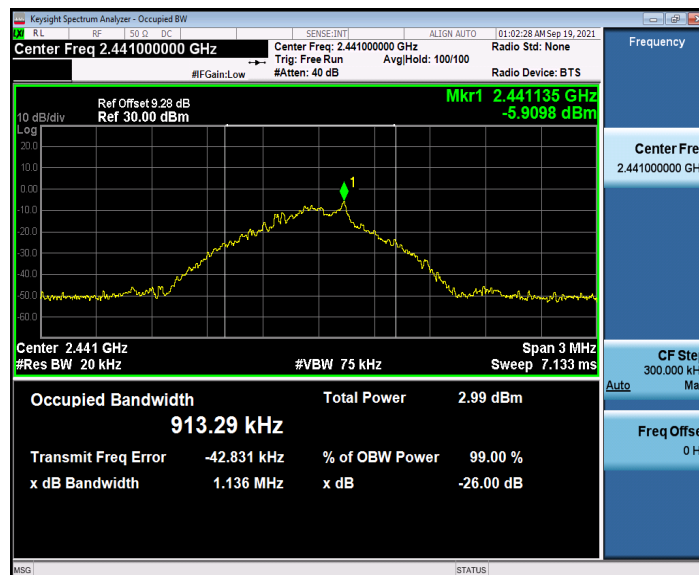
| Test Mode | Antenna | Channel | OCB [MHz] | Limit[MHz]   | Verdict |
|-----------|---------|---------|-----------|--------------|---------|
| DH5       | Ant1    | 2402    | 0.90546   | $\geq 0.642$ | PASS    |
|           |         | 2441    | 0.91329   | $\geq 0.612$ | PASS    |
|           |         | 2480    | 0.91979   | $\geq 0.682$ | PASS    |
| 2DH5      | Ant1    | 2402    | 1.1992    | $\geq 0.826$ | PASS    |
|           |         | 2441    | 1.1904    | $\geq 0.834$ | PASS    |
|           |         | 2480    | 1.1963    | $\geq 0.840$ | PASS    |
| 3DH5      | Ant1    | 2402    | 1.2028    | $\geq 0.856$ | PASS    |
|           |         | 2441    | 1.2040    | $\geq 0.836$ | PASS    |
|           |         | 2480    | 1.2199    | $\geq 0.860$ | PASS    |

## ■ Test Graphs

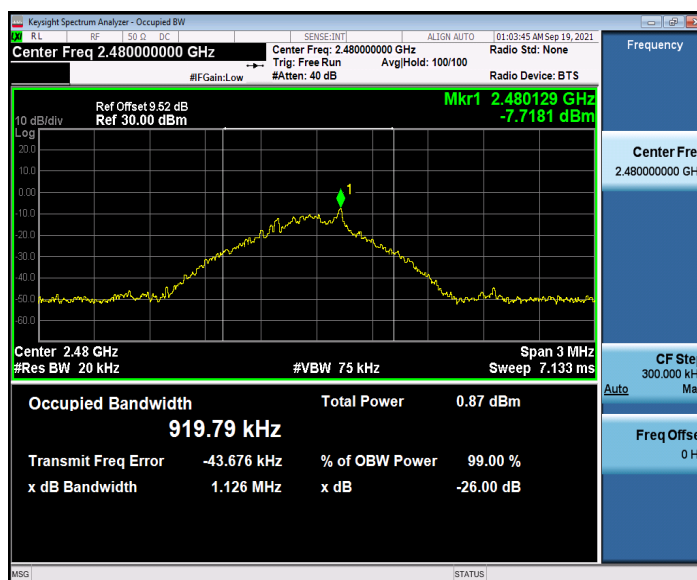
DH5\_Ant1\_2402



DH5\_Ant1\_2441



## DH5\_Ant1\_2480



## 2DH5\_Ant1\_2402



## 2DH5\_Ant1\_2441



## 2DH5\_Ant1\_2480

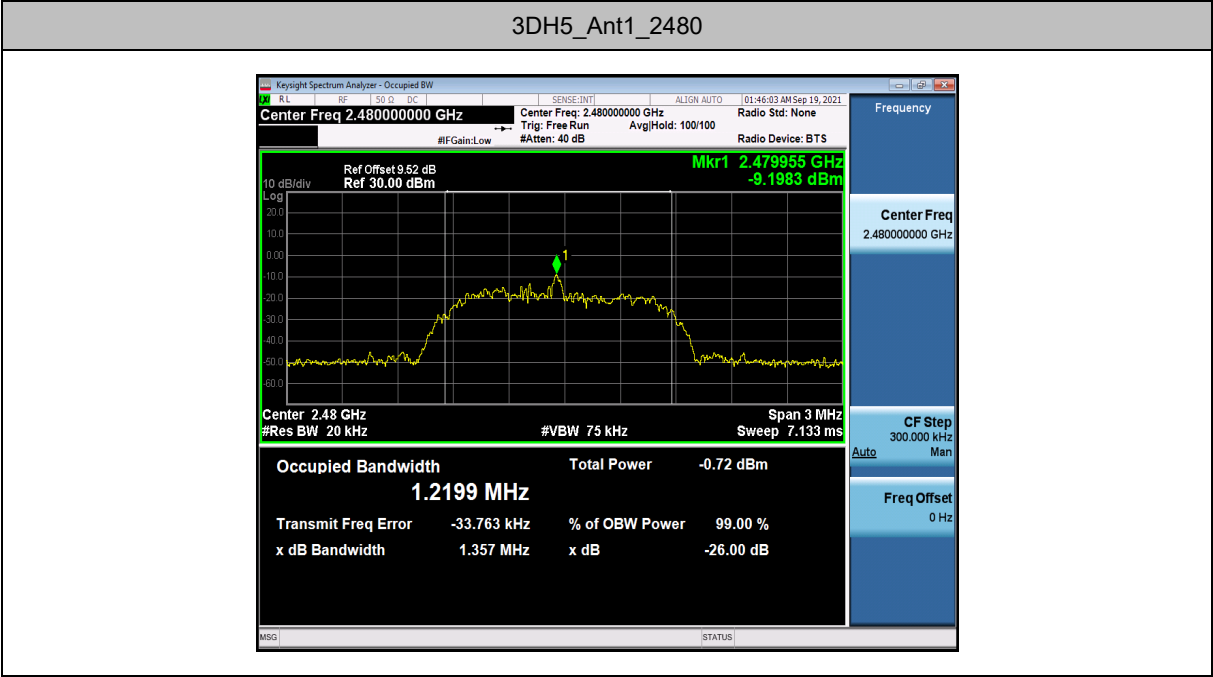


## 3DH5\_Ant1\_2402



## 3DH5\_Ant1\_2441





## Carrier Frequency Separation Measurement

| Test Mode | Antenna | Channel | Result[dBm] | Limit[dBm]   | Verdict |
|-----------|---------|---------|-------------|--------------|---------|
| DH5       | Ant1    | Hop     | 1.018       | $\geq 0.682$ | PASS    |
| 2DH5      | Ant1    | Hop     | 1.008       | $\geq 0.840$ | PASS    |
| 3DH5      | Ant1    | Hop     | 1.002       | $\geq 0.860$ | PASS    |

## Test Graphs

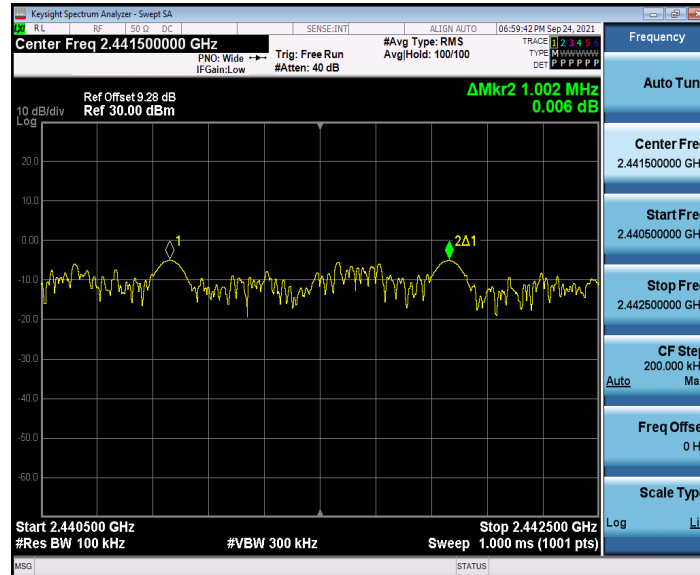
DH5\_Ant1\_Hop



2DH5\_Ant1\_Hop



### 3DH5\_Ant1\_Hop

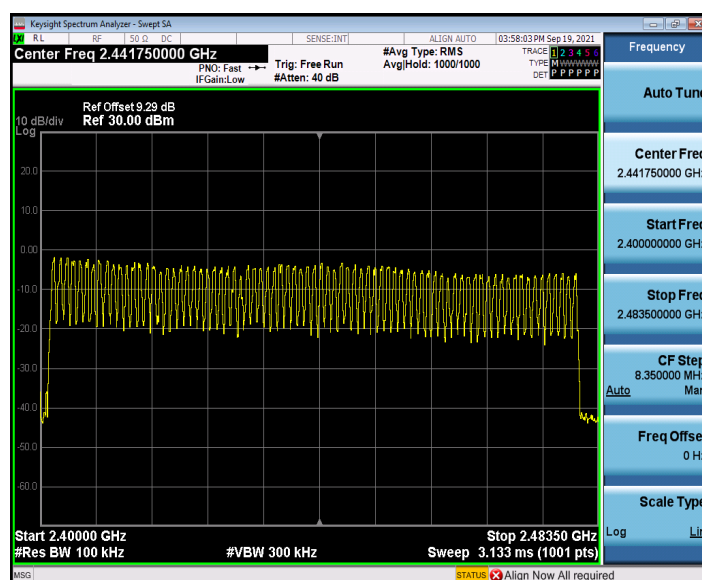


## Number of Hopping Measurement

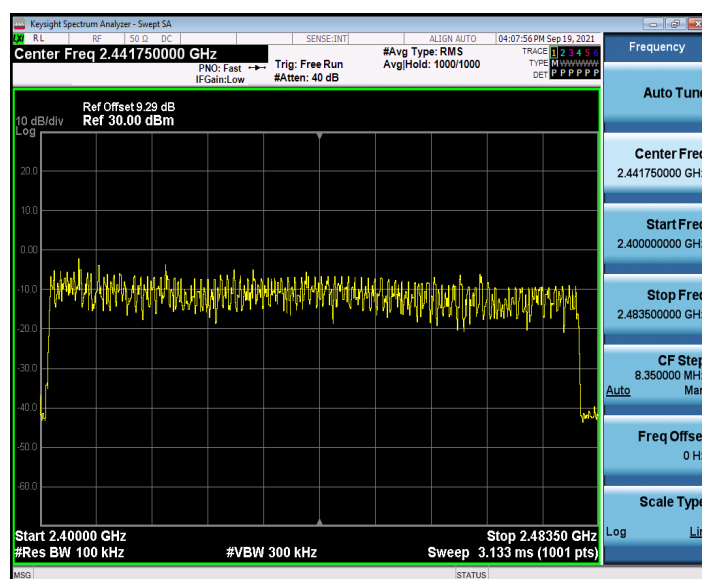
| Test Mode | Frequency Range (MHz) | Measurement Results (Ch) | Limit (ch) |
|-----------|-----------------------|--------------------------|------------|
| Mode 2    | 2402 - 2480           | 79                       | > 15       |
| Mode 3    | 2402 - 2480           | 79                       | > 15       |
| Mode 4    | 2402 - 2480           | 79                       | > 15       |

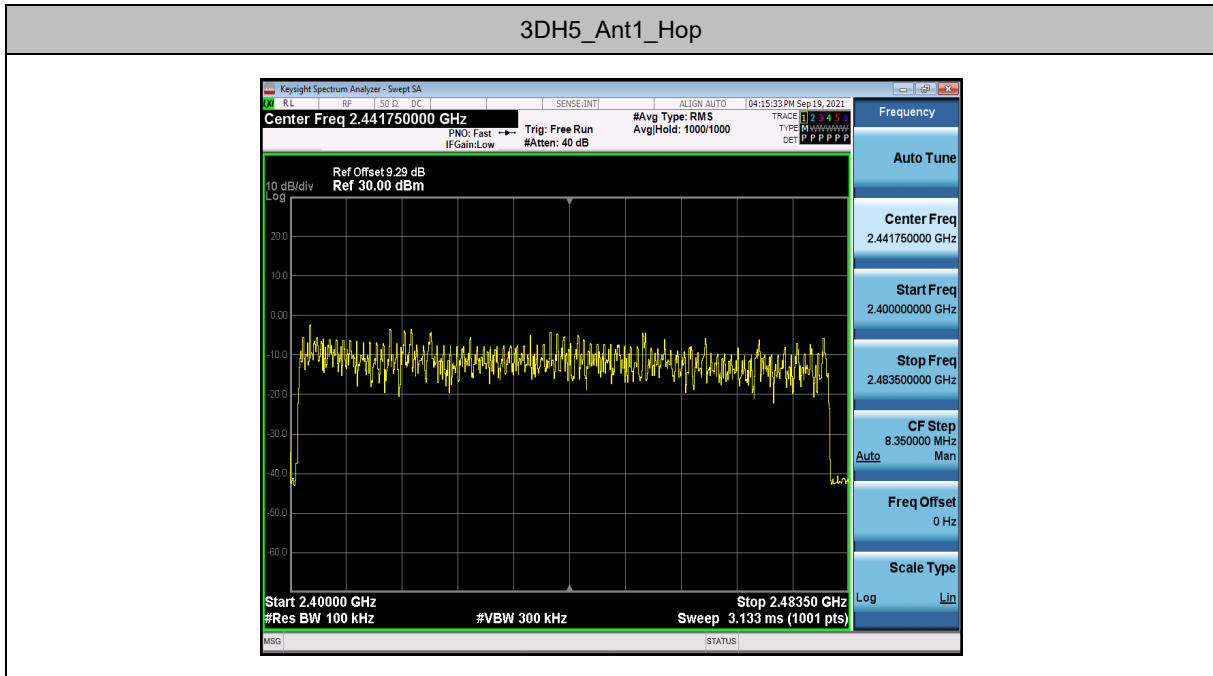
## ■ Test Graphs

DH5\_Ant1\_Hop



2DH5\_Ant1\_Hop



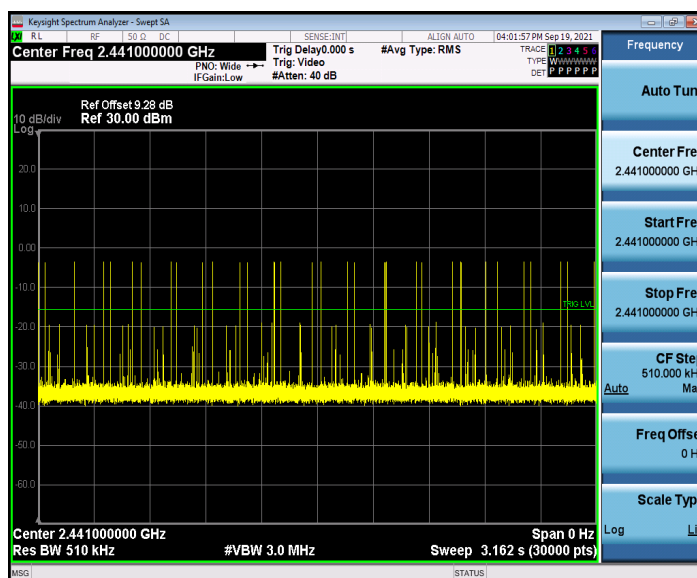
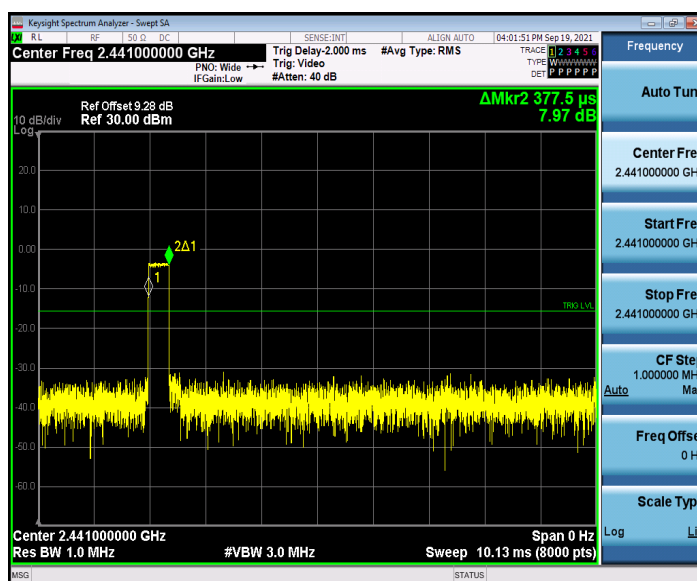


### Time of Occupancy (Dwell Time) Measurement

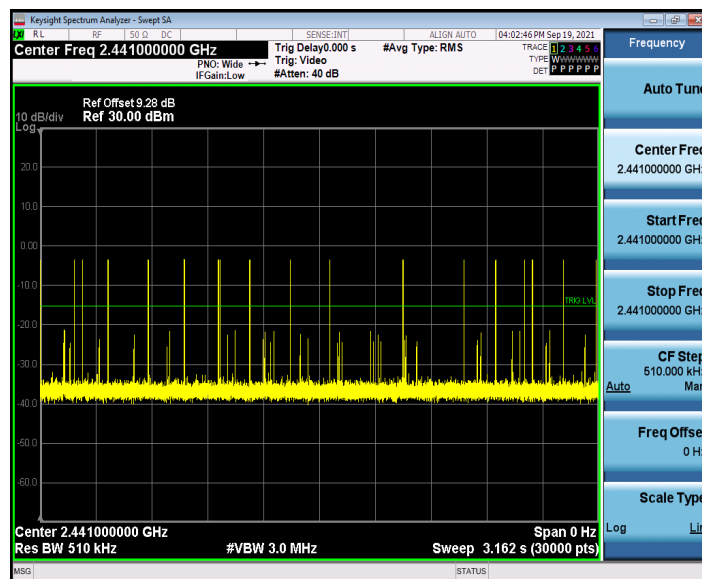
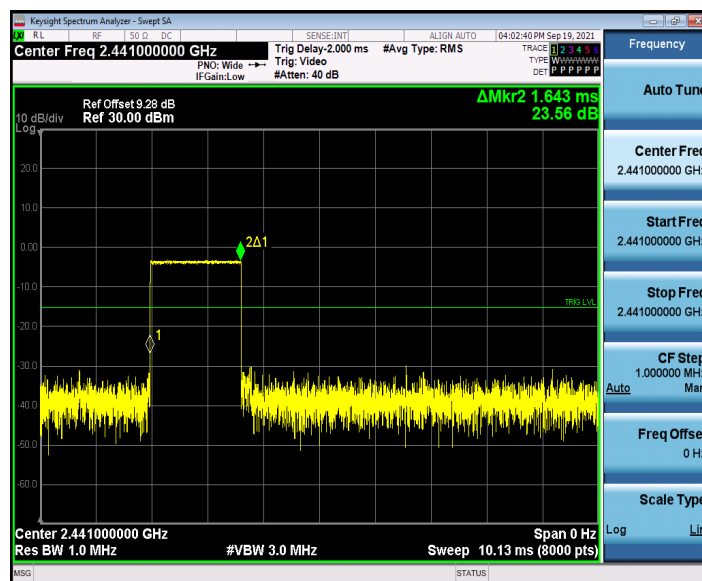
| TestMode | Antenna | Channel | BurstWidth<br>[ms] | TotalHops<br>[Num] | Result[s] | Limit[s] | Verdict |
|----------|---------|---------|--------------------|--------------------|-----------|----------|---------|
| DH1      | Ant1    | Hop     | 0.38               | 330                | 0.125     | ≤0.4     | PASS    |
| DH3      | Ant1    | Hop     | 1.64               | 180                | 0.296     | ≤0.4     | PASS    |
| DH5      | Ant1    | Hop     | 2.89               | 120                | 0.347     | ≤0.4     | PASS    |
| 2DH1     | Ant1    | Hop     | 0.39               | 330                | 0.127     | ≤0.4     | PASS    |
| 2DH3     | Ant1    | Hop     | 1.64               | 170                | 0.278     | ≤0.4     | PASS    |
| 2DH5     | Ant1    | Hop     | 2.89               | 80                 | 0.231     | ≤0.4     | PASS    |
| 3DH1     | Ant1    | Hop     | 0.39               | 320                | 0.124     | ≤0.4     | PASS    |
| 3DH3     | Ant1    | Hop     | 1.64               | 170                | 0.278     | ≤0.4     | PASS    |
| 3DH5     | Ant1    | Hop     | 2.89               | 110                | 0.318     | ≤0.4     | PASS    |

# ■ Test Graphs

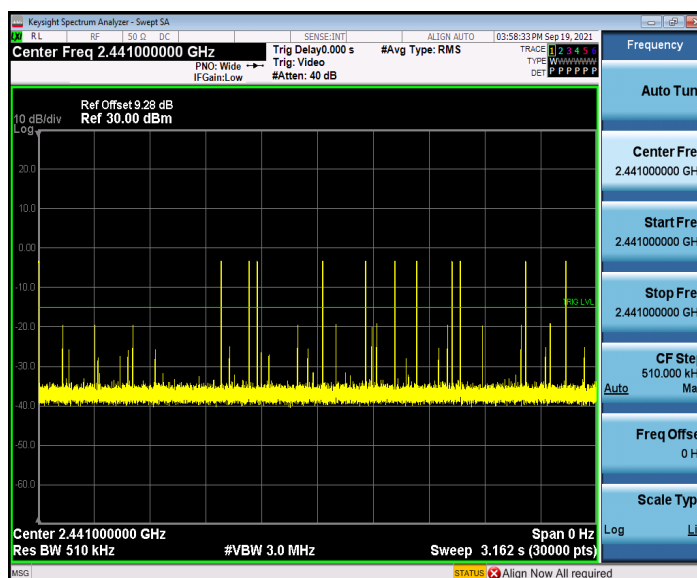
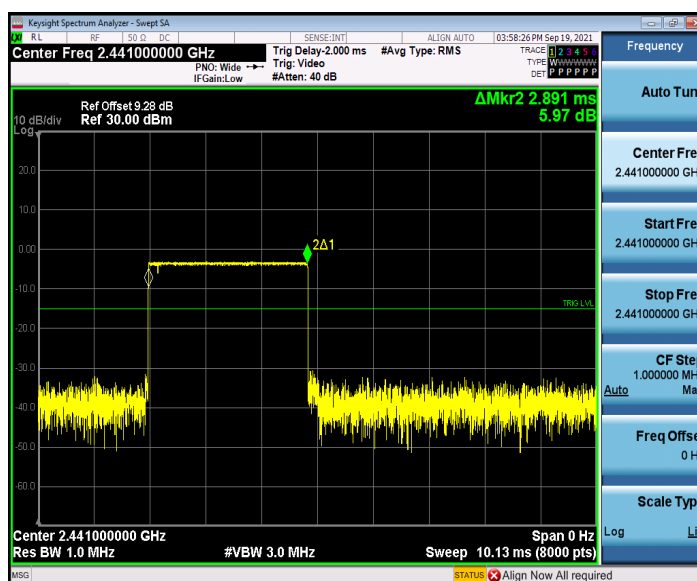
DH1\_Ant1\_Hop



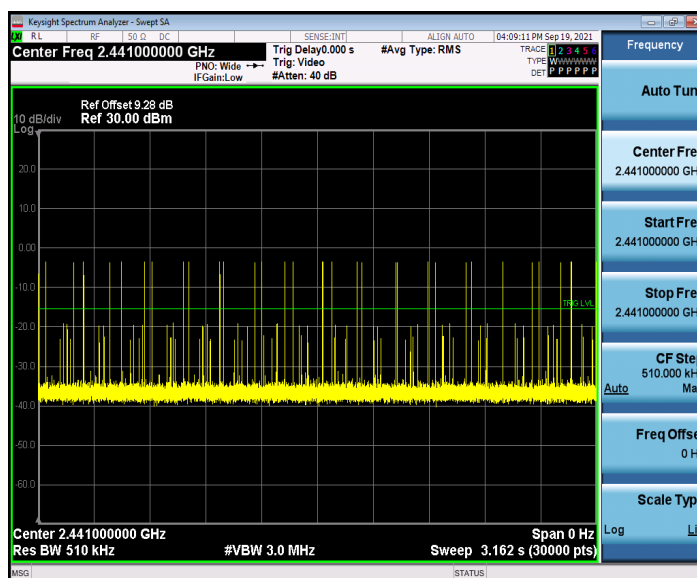
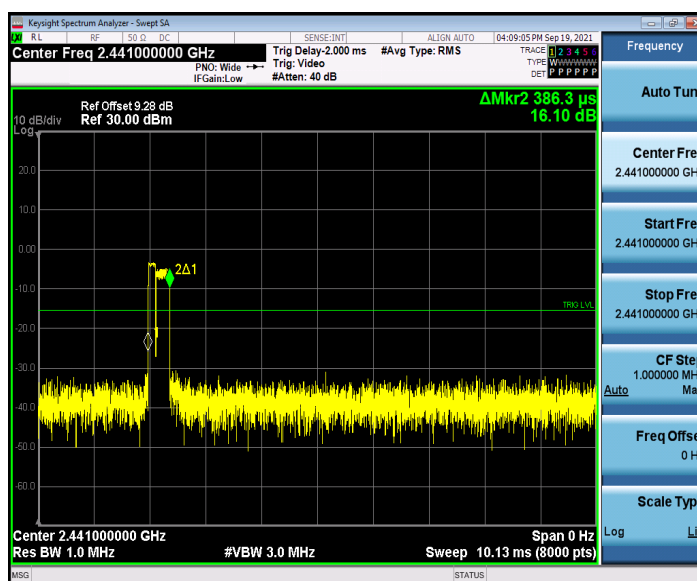
### DH3\_Ant1\_Hop



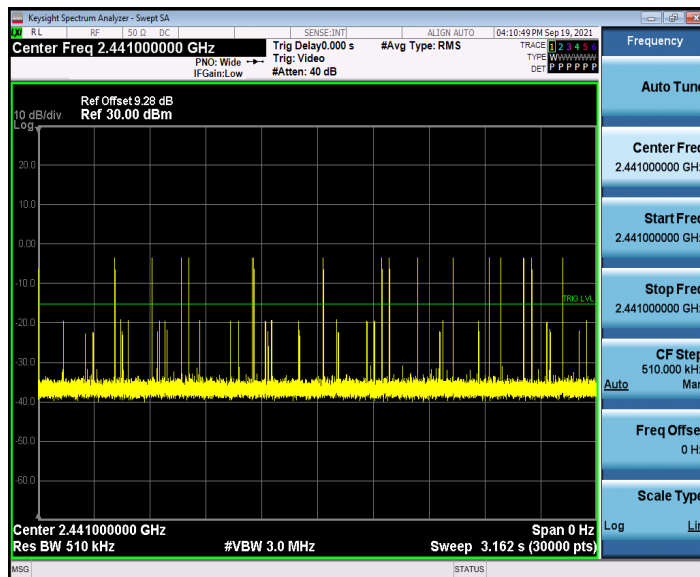
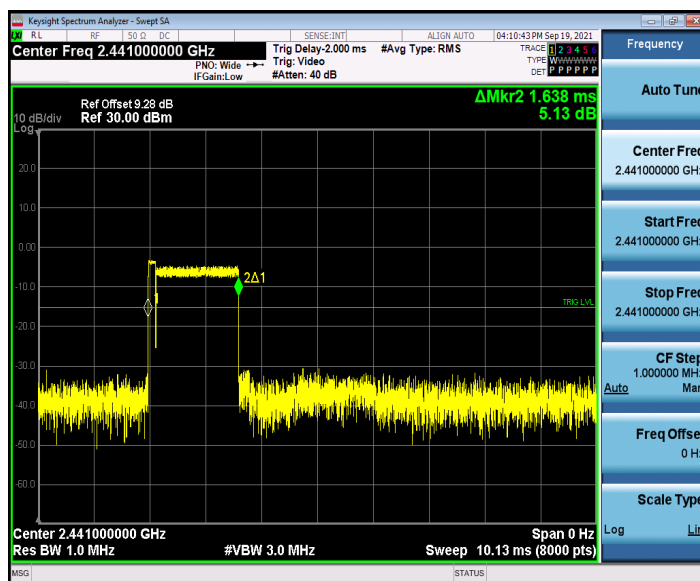
### DH5\_Ant1\_Hop



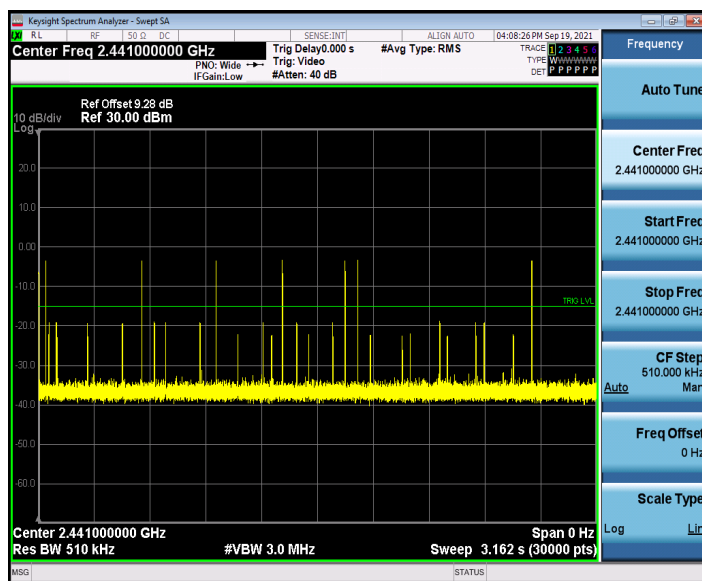
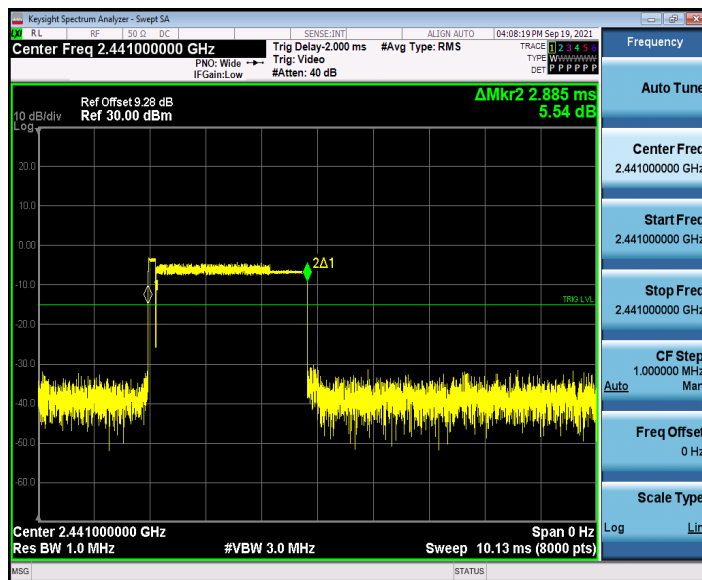
## 2DH1\_Ant1\_Hop



2DH3\_Ant1\_Hop



### 2DH5\_Ant1\_Hop



3DH1\_Ant1\_Hop

