# TEST REPORT

| | | |
|---|---|---|
| **Product** | : | Portable Monitor |
| **Trade mark** | : | OWLENZ |
| **Model/Type reference** | : | SPD20,SPD30,SPD40,SPD50,SPD60, SPD70,SPD80,SPD90,SPD100, SPD150,SPD200,SPD300,SPD10. |
| **Serial Number** | : | N/A |
| **Report Number** | : | EED32M00266502 |
| **FCC ID** | : | 2AXJJ-STAR-2020 |
| **Date of Issue** | : | Nov. 02, 2020 |
| **Test Standards** | : | 47 CFR Part 15Subpart C |
| **Test result** | : | PASS |

Prepared for:

**Shenzhen Star Audio-Visual Equipment Co., Ltd**
**RM 102,1st FL, Building 8, 2rd Industry Zone,**
**Shajing Street, Baoan District, Shenzhen**

Prepared by:

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Date: Nov. 02, 2020

Check No : 4538210931

CENTRE TESTING INTERNATIONAL GROUP CO.,LTD. CTI Report Seal

# 2 Version

| Version No. | Date | Description |
|---|---|---|
| 00 | Nov. 02, 2020 | Original |
| | | |
| | | |

# 3 Test Summary

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

Remark:
Test according to ANSI C63.4-2014 & ANSI C63.10-2013.
Company Name and Address shown on Report, the sample(s) and sample Information was/ were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified.
Model No.:SPD20,SPD30,SPD40,SPD50,SPD60,SPD70,SPD80,SPD90,SPD100,SPD150,SPD200, SPD300,SPD10.
Only the model SPD10 was tested, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, with difference being color and the product model .

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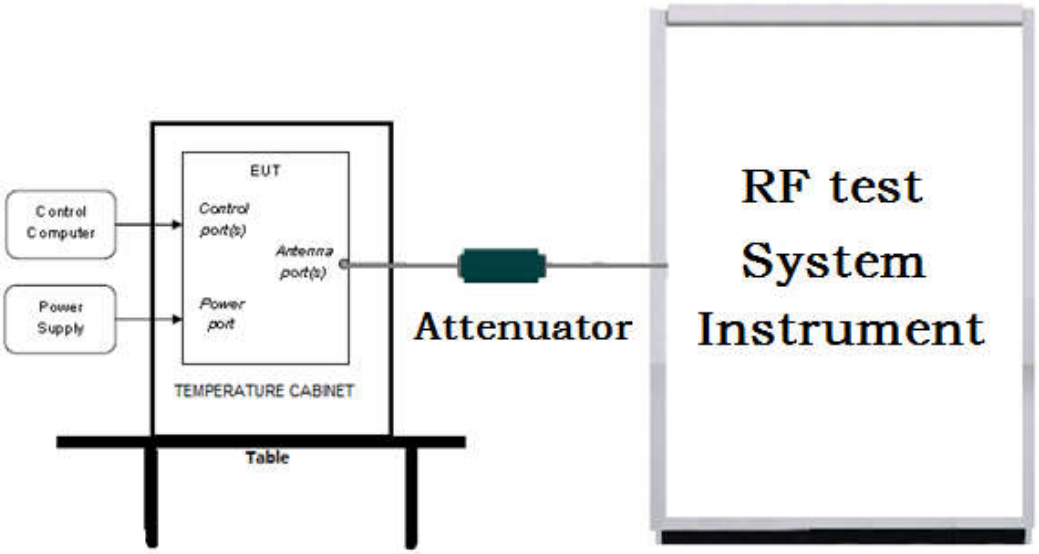
# 5 Test Requirement

## 5.1 Test setup

### 5.1.1 For Conducted test setup




### 5.1.2 For Radiated Emissions test setup

**Radiated Emissions setup:**

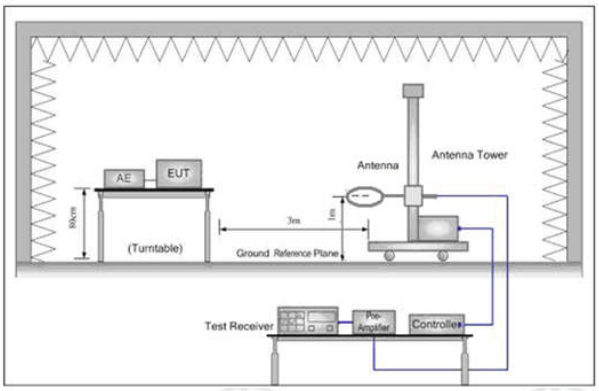



Figure 1. Below 30MHz

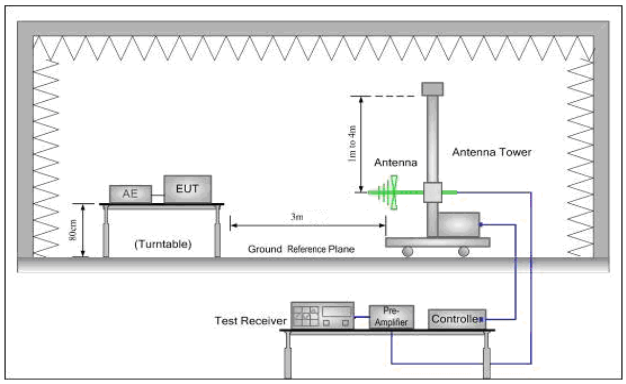



Figure 2. 30MHz to 1GHz

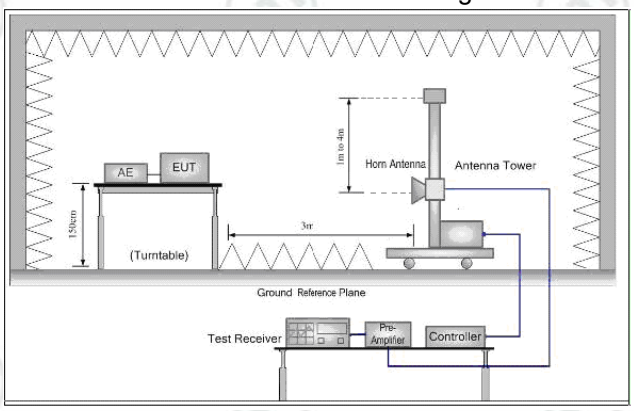
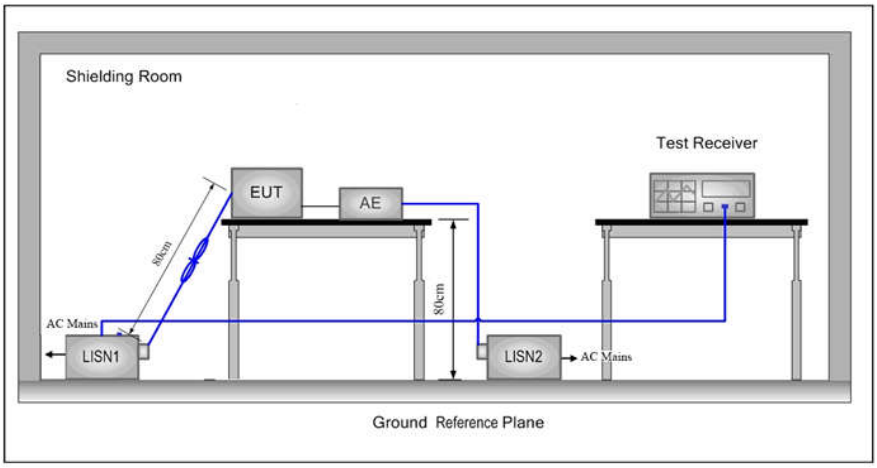



Figure 3. Above 1GHz

### 5.1.3 For Conducted Emissions test setup

**Conducted Emissions setup**




## 5.2 Test Environment

| **Operating Environment:** | |
|---|---|
| Temperature: | 24.0 °C |
| Humidity: | 54 % RH |
| Atmospheric Pressure: | 1010mbar |

## 5.3 Test Condition

Test channel:

| Test Mode | Tx/Rx | RF Channel | | |
|---|---|---|---|---|
| | | Low(L) | Middle(M) | High(H) |
| 802.11b/g/n(HT20) | 2412MHz ~2462 MHz | Channel 1 | Channel 6 | Channel11 |
| | | 2412MHz | 2437MHz | 2462MHz |
| 802.11n(HT40) | 2422MHz ~2452 MHz | Channel 3 | Channel 6 | Channel 9 |
| | | 2422MHz | 2437MHz | 2452MHz |
| Transmitting mode: | Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate. | | | |

Test mode:

**Pre-scan under all rate at lowest channel**

| **Mode** | **802.11b** | | | |
|---|---|---|---|---|
| **Data Rate** | **1Mbps** | **2Mbps** | **5.5Mbps** | **11Mbps** |
| Power(dBm) | 6.21 | 6.18 | 6.16 | 6.13 |

| **Mode** | **802.11g** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Data Rate** | **6Mbps** | **9Mbps** | **12Mbps** | **18Mbps** | **24Mbps** | **36Mbps** | **48Mbps** | **54Mbps** |
| Power(dBm) | 6.11 | 6.09 | 6.06 | 6.05 | 6.03 | 6.01 | 5.98 | 5.95 |

| **Mode** | **802.11n (HT20)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Data Rate** | **6.5Mbps** | **13Mbps** | **19.5Mbps** | **26Mbps** | **39Mbps** | **52Mbps** | **58.5Mbps** | **65Mbps** |
| Power(dBm) | 6.34 | 6.31 | 6.28 | 6.25 | 6.23 | 6.22 | 6.2 | 6.18 |
| **Mode** | **802.11n (HT40)** | | | | | | | |
| **Data Rate** | **13.5Mbps** | **27Mbps** | **40.5Mbps** | **54Mbps** | **81Mbps** | **108Mbps** | **121.5Mbps** | **135Mbps** |
| Power(dBm) | 6.32 | 6.30 | 6.28 | 6.25 | 6.23 | 6.21 | 6.18 | 6.16 |

Through Pre-scan, 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20); 13.5Mbps of rate is the worst case of802.11n(HT40).

# 6 General Information

## 6.1 Client Information

| | |
|---|---|
| Applicant: | Shenzhen Star Audio-Visual Equipment Co., Ltd |
| Address of Applicant: | RM 102,1st FL, Building 8, 2rd Industry Zone, Shajing Street, Baoan District, Shenzhen |
| Manufacturer: | Shenzhen Star Audio-Visual Equipment Co., Ltd |
| Address of Manufacturer: | RM 102,1st FL, Building 8, 2rd Industry Zone, Shajing Street, Baoan District, Shenzhen |
| Factory: | Shenzhen Zhengtongrenhe Technology Co., Ltd. |
| Address of Factory: | Room 201, Building E, Weihuada Industrial Park, No. 65, Huaning West Road, Xinwei, Xinshi Community, Dalang Street, Longhua District, Shenzhen |

## 6.2 General Description of EUT

| | | |
|---|---|---|
| Product Name: | Portable Monitor | |
| Model No.(EUT): | SPD20,SPD30,SPD40,SPD50,SPD60, SPD70,SPD80,SPD90,SPD100, SPD150,SPD200,SPD300,SPD10. | |
| Test Model No: | SPD10 | |
| Trade mark: | OWLENZ | |
| Frequency Range of Operation: | IEEE 802.11b/g/n(HT20)(HT40): 2400MHz to 2483.5MHz | |
| Power Supply: | Adapter | MODEL:FJ-SW618H-1E<br>INPUT:100-240V~50/60Hz 0.6A Max<br>OUTPUT:5.0V⎓3.0A,15.0W Max or<br>9.0V⎓2.0A,18.0W Max or<br>12.0V⎓1.5A,18.0W Max<br>OUTPUT POWER:18.0W Max |
| | Battery | DQ30100115/2S 7.6V<br>5000mAh 38Wh |
| Sample Received Date: | Aug. 28, 2020 | |
| Sample tested Date: | Aug. 28, 2020 to Oct.16, 2020 | |

## 6.3 Product Specification subjective to this standard

| | |
|---|---|
| Operation Frequency: | IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz<br>IEEE 802.11n(HT40): 2422MHz to 2452MHz |
| Channel Numbers: | IEEE 802.11b/g, IEEE 802.11n HT20: 11 Channels<br>IEEE 802.11n HT40: 7 Channels |
| Channel Separation: | 5MHz |
| Type of Modulation: | IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK)<br>IEEE for 802.11g :OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE for 802.11n(HT20 and HT40) : OFDM (64QAM, 16QAM,QPSK, BPSK) |
| Test Power Grade: | Default |
| Test Software of EUT: | REALTEK |
| Antenna Type and Gain: | Type: Built-in dual-band antenna<br>Gain:3.0 dBi |
| Test Voltage: | Battery 7.6V |

Operation Frequency each of channel(802.11b/g/n HT20)

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| 1 | 2412MHz | 4 | 2427MHz | 7 | 2442MHz | 10 | 2457MHz |
| 2 | 2417MHz | 5 | 2432MHz | 8 | 2447MHz | 11 | 2462MHz |
| 3 | 2422MHz | 6 | 2437MHz | 9 | 2452MHz | | |

Operation Frequency each of channel(802.11n HT40)

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 3 | 2422MHz | 6 | 2437MHz | 9 | 2452MHz |
| 4 | 2427MHz | 7 | 2442MHz | | |
| 5 | 2432MHz | 8 | 2447MHz | | |

## 6.4 Description of Support Units

The EUT has been tested with associated equipment below

| Associated equipment name | | Manufacture | model | S/N serial number | Supplied by | Certification |
|---|---|---|---|---|---|---|
| AE1 | Notebook | DELL | DELL 3490 | D245DX2 | DELL | CE&FCC |
| | | | | | | |
| | | | | | | |

## 6.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd
Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China
Telephone: +86 (0) 755 33683668 Fax:+86 (0) 755 33683385
No tests were sub-contracted.
FCC Designation No.: CN1164

## 6.6 Deviation from Standards

None.

## 6.7 Abnormalities from Standard Conditions

None.

## 6.8 Other Information Requested by the Customer

None.

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

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

# 7 Equipment List

| RF test system | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Mode No.** | **Serial Number** | **Cal. Date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Spectrum Analyzer | Keysight | N9010A | MY54510339 | 02-17-2020 | 02-16-2021 |
| Signal Generator | Keysight | N5182B | MY53051549 | 02-17-2020 | 02-16-2021 |
| Temperature/ Humidity Indicator | biaozhi | HM10 | 1804186 | 06-29-2020 | 06-28-2021 |
| High-pass filter | Sinoscite | FL3CX03WG18N M12-0398-002 | --- | --- | --- |
| High-pass filter | MICRO-TRONICS | SPA-F-63029-4 | --- | --- | --- |
| DC Power | Keysight | E3642A | MY56376072 | 02-17-2020 | 02-16-2021 |
| PC-1 | Lenovo | R4960d | --- | --- | --- |
| BT&WI-FI Automatic control | R&S | OSP120 | 101374 | 02-17-2020 | 02-16-2021 |
| RF control unit | JS Tonscend | JS0806-2 | 158060006 | 02-17-2020 | 02-16-2021 |
| BT&WI-FI Automatic test software | JS Tonscend | JS1120-3 | --- | --- | --- |

| Conducted disturbance Test | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Receiver | R&S | ESCI | 100435 | 04-28-2020 | 04-27-2021 |
| Temperature/ Humidity Indicator | Defu | TH128 | / | --- | --- |
| LISN | R&S | ENV216 | 100098 | 03-05-2020 | 03-04-2021 |
| Barometer | changchun | DYM3 | 1188 | --- | --- |

| 3M Semi/full-anechoic Chamber | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| 3M Chamber & Accessory Equipment | TDK | SAC-3 | --- | 05-24-2019 | 05-23-2022 |
| TRILOG Broadband Antenna | Schwarzbeck | VULB9163 | 9163-618 | 05-16-2020 | 05-15-2021 |
| Loop Antenna | Schwarzbeck | FMZB 1519B | 1519B-076 | 04-25-2018 | 04-24-2021 |
| Receiver | R&S | ESCI7 | 100938-003 | 10-21-2019 | 10-20-2020 |
| Multi device Controller | maturo | NCD/070/107 11112 | --- | --- | --- |
| Temperature/ Humidity Indicator | Shanghai qixiang | HM10 | 1804298 | 06-29-2020 | 06-28-2021 |
| Cable line | Fulai(7M) | SF106 | 5219/6A | --- | --- |
| Cable line | Fulai(6M) | SF106 | 5220/6A | --- | --- |
| Cable line | Fulai(3M) | SF106 | 5216/6A | --- | --- |
| Cable line | Fulai(3M) | SF106 | 5217/6A | --- | --- |

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

# 8 Radio Technical Requirements Specification

**Reference documents for testing:**

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

**Test Results List:**

| Test Requirement | Test method | Test item | Verdict | Note |
|---|---|---|---|---|
| Part15C Section 15.247 (b)(3) | ANSI C63.10 | Conducted Peak Output Power | PASS | Appendix A) |
| Part15C Section 15.247 (a)(2) | ANSI C63.10 | 6dB Occupied Bandwidth | PASS | Appendix B) |
| Part15C Section 15.247(d) | ANSI C63.10 | Band-edge for RF Conducted Emissions | PASS | Appendix C) |
| Part15C Section 15.247(d) | ANSI C63.10 | RF Conducted Spurious Emissions | PASS | Appendix D) |
| Part15C Section 15.247 (e) | ANSI C63.10 | Power Spectral Density | PASS | Appendix E) |
| Part15C Section 15.203/15.247 (c) | ANSI C63.10 | Antenna Requirement | PASS | Appendix F) |
| Part15C Section 15.207 | ANSI C63.10 | AC Power Line Conducted Emission | PASS | Appendix G) |
| Part15C Section 15.205/15.209 | ANSI C63.10 | Restricted bands around fundamental frequency (Radiated Emission) | PASS | Appendix H) |
| Part15C Section 15.205/15.209 | ANSI C63.10 | Radiated Spurious Emissions | PASS | Appendix I) |

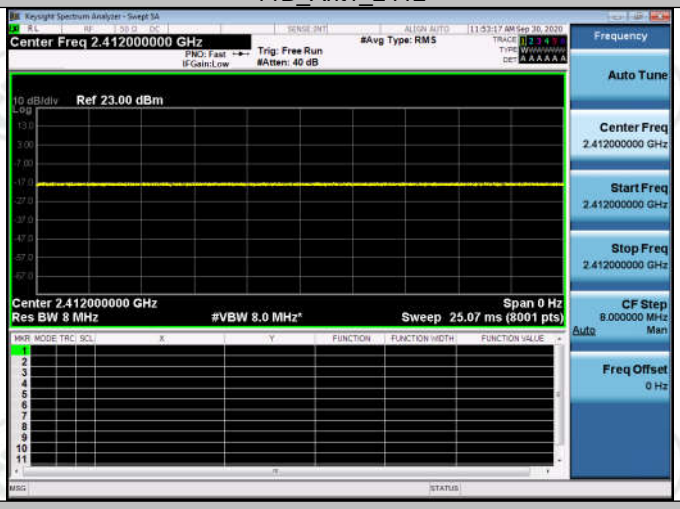
## EUT DUTY CYCLE

### Result Table

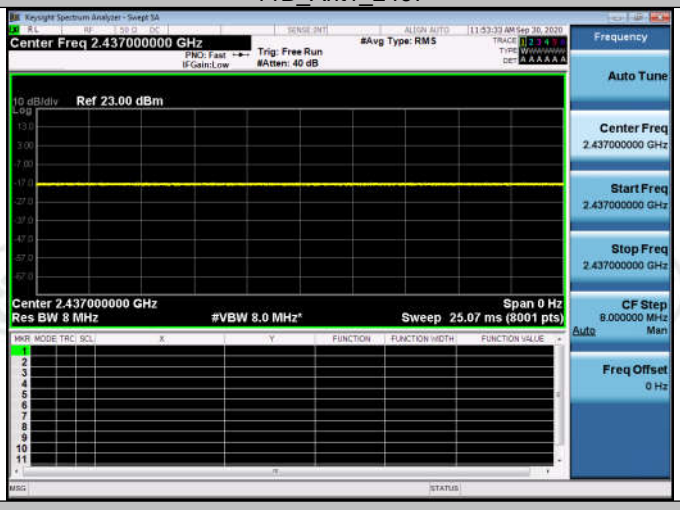
| Test Mode | Antenna | Channel | Duty Cycle [%] | Limit | Verdict |
|---|---|---|---|---|---|
| 11B | Ant1 | 2412 | 100 | --- | PASS |
| | Ant1 | 2437 | 100 | --- | PASS |
| | Ant1 | 2462 | 100 | --- | PASS |
| 11G | Ant1 | 2412 | 100 | --- | PASS |
| | Ant1 | 2437 | 100 | --- | PASS |
| | Ant1 | 2462 | 100 | --- | PASS |
| 11N20SISO | Ant1 | 2412 | 100 | --- | PASS |
| | Ant1 | 2437 | 100 | --- | PASS |
| | Ant1 | 2462 | 100 | --- | PASS |
| 11N40SISO | Ant1 | 2422 | 100 | --- | PASS |
| | Ant1 | 2437 | 100 | --- | PASS |
| | Ant1 | 2452 | 100 | --- | PASS |

**Test Graph**

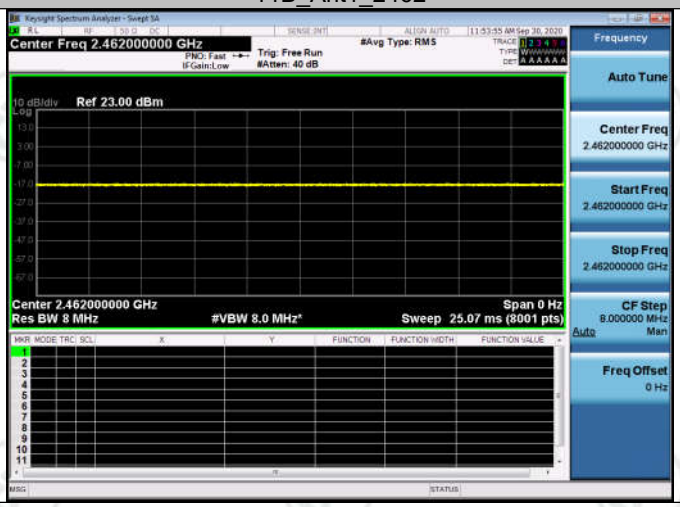
11B_Ant1_2412



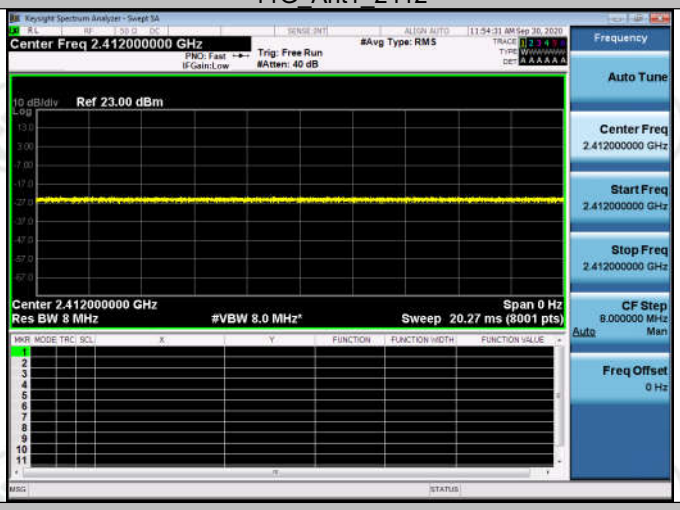

11B_Ant1_2437



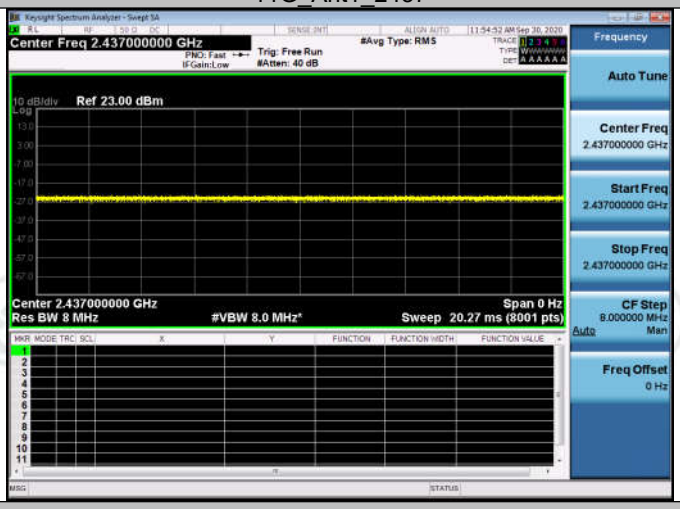

11B_Ant1_2462



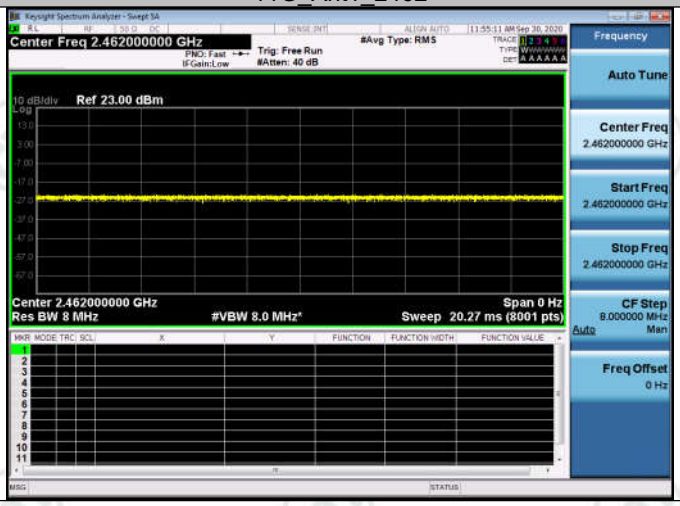
11G_Ant1_2412



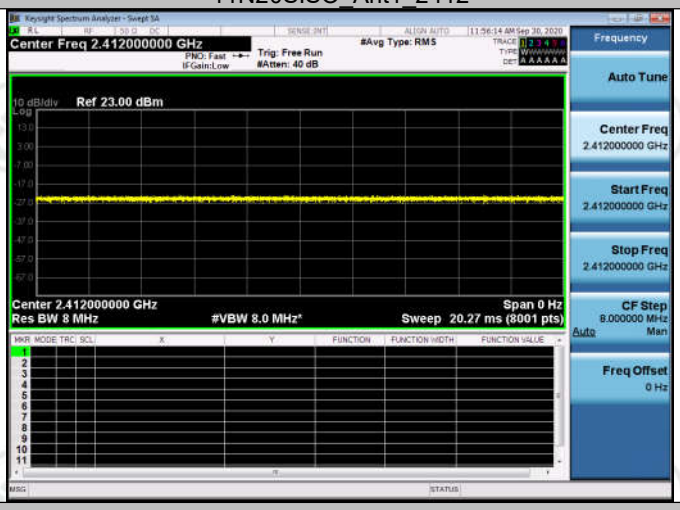

11G_Ant1_2437



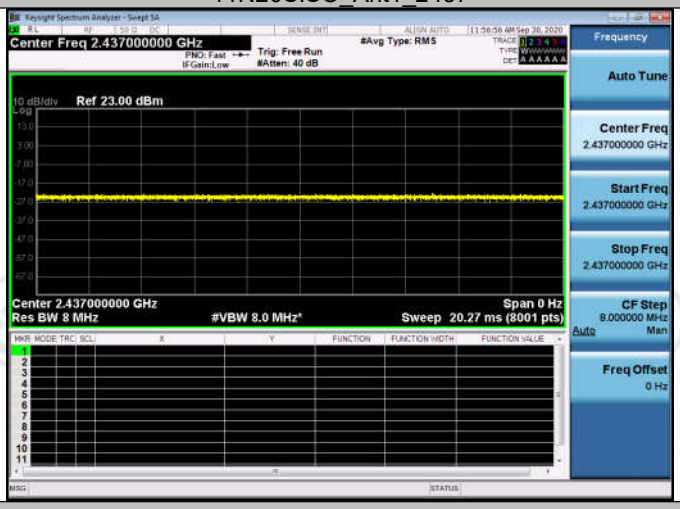

11G_Ant1_2462



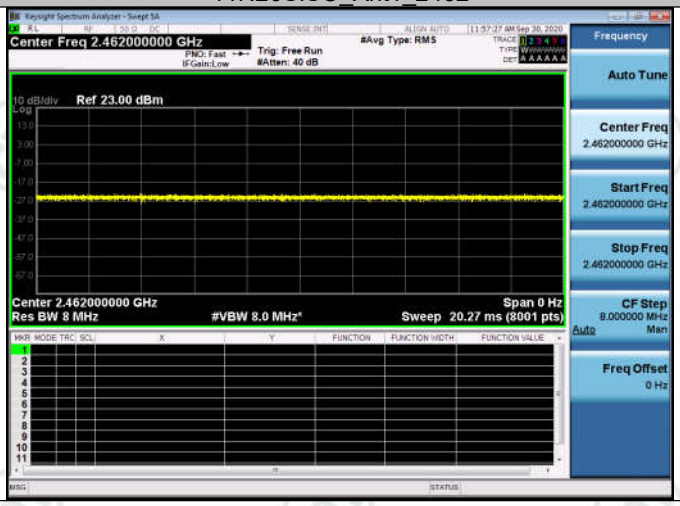
11N20SISO_Ant1_2412



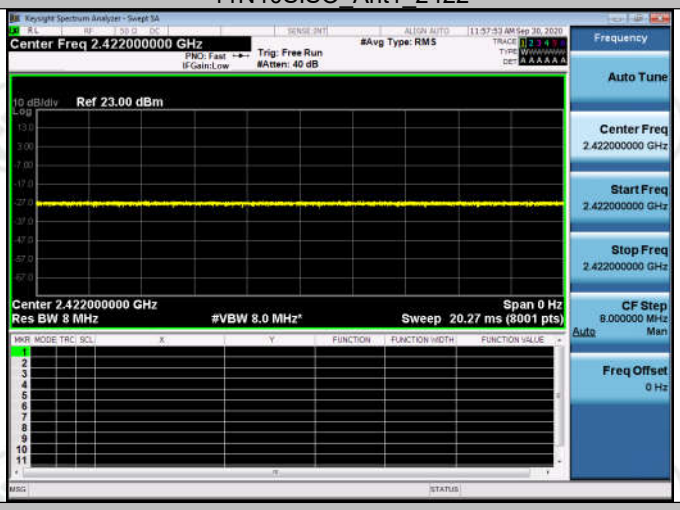

11N20SISO_Ant1_2437



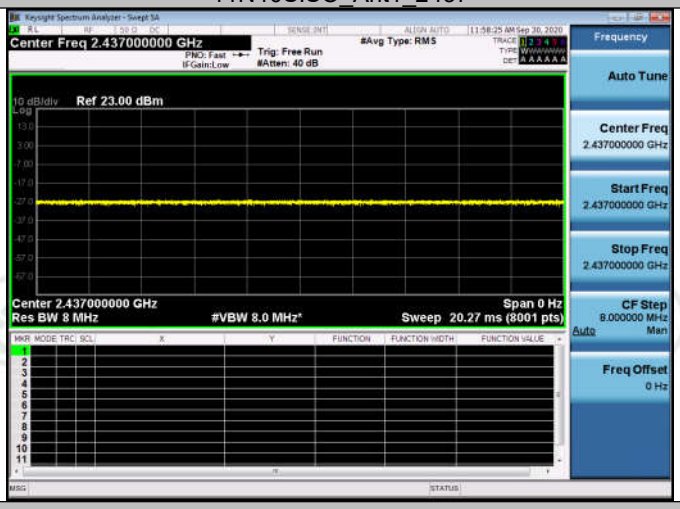

11N20SISO_Ant1_2462



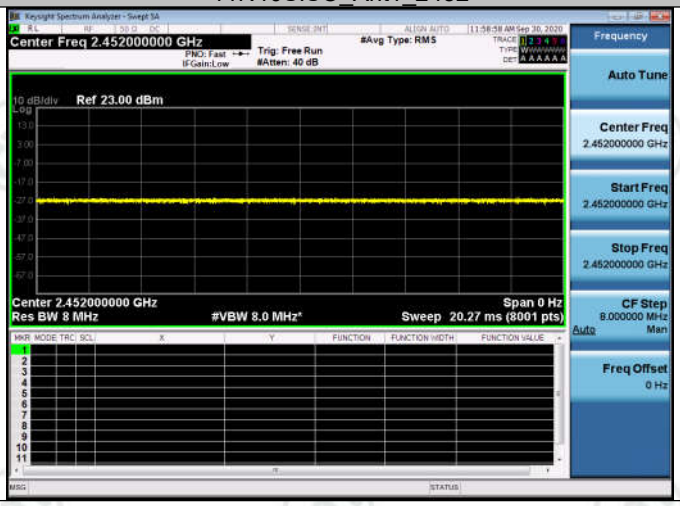
11N40SISO_Ant1_2422




11N40SISO_Ant1_2437




11N40SISO_Ant1_2452



# Appendix A): Conducted Peak Output Power

**Test Limit**
According to §15.247(b)(3),

**Peak output power**：

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

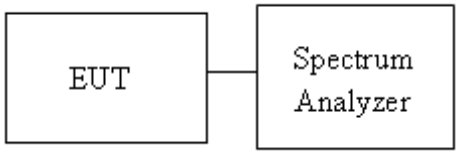
| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：30dBm<br>☐ Antenna with DG greater than 6 dBi：<br>[Limit = 30 – (DG – 6)]<br>☐ Point-to-point operation： |

**Average output power**：For reporting purposes only.

**Test Procedure**
Test method Refer as KDB 558074 D01.

1. The EUT RF output connected to spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT.
3. Spectrum analyzer settings are as follows：
   a) Set the RBW = 1 MHz.
   b) Set the VBW ≥ [3 × RBW].
   c) Set the span ≥ [1.5 × DTS bandwidth].
   d) Detector = peak.
   e) Sweep time = auto couple.
   f) Trace mode = max hold.
   g) Allow trace to fully stabilize.
   h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges
4. Measure and record the result in the test report.

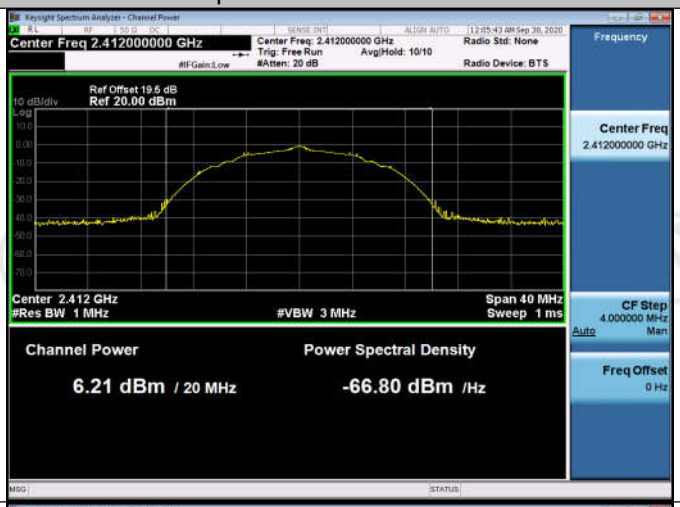
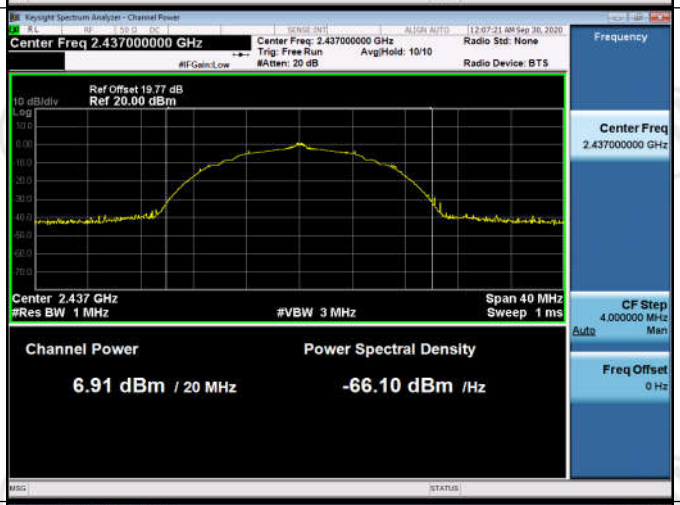
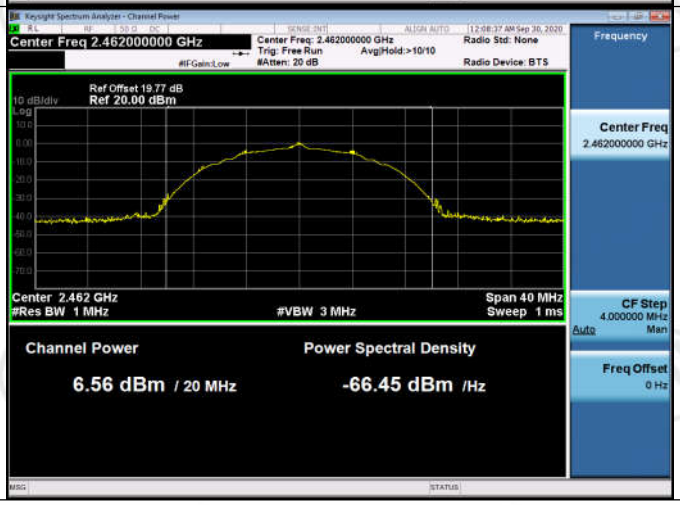
**Test Setup**

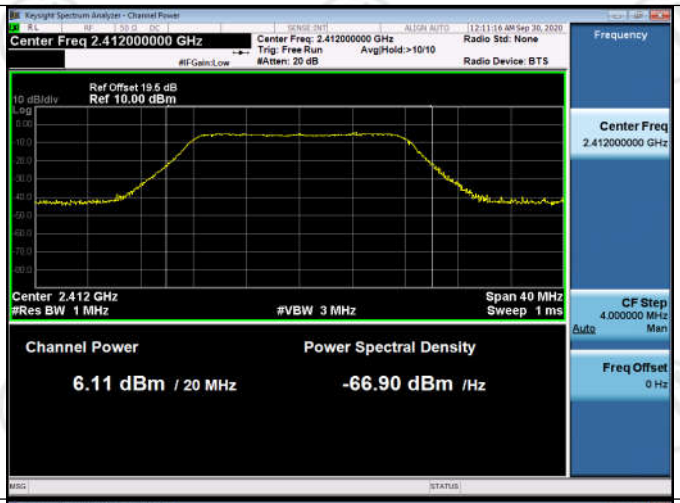
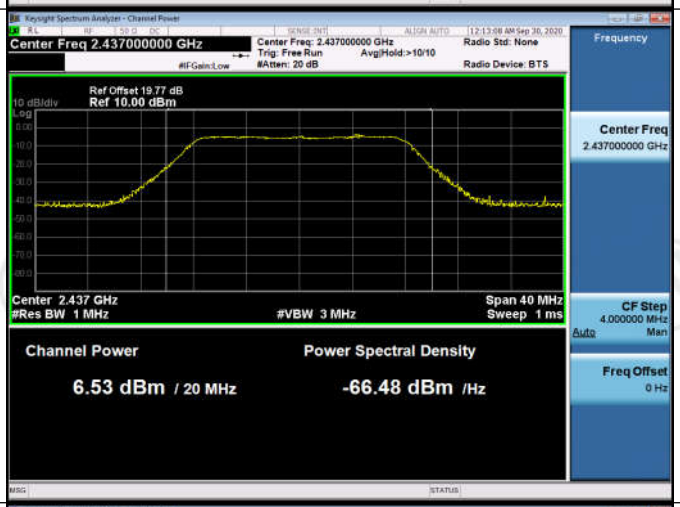
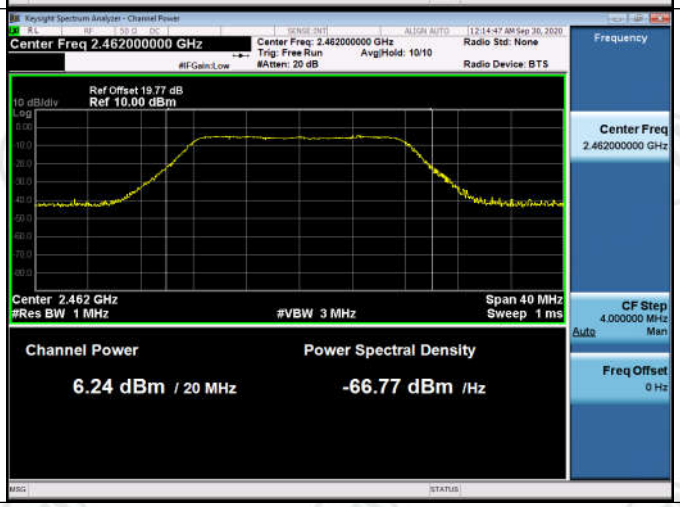


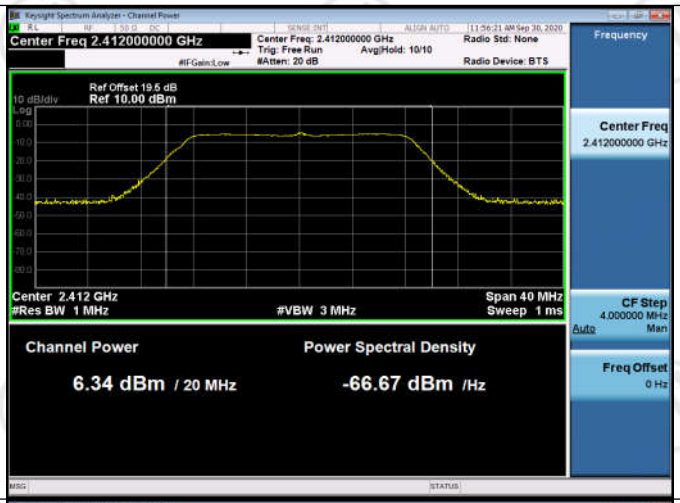
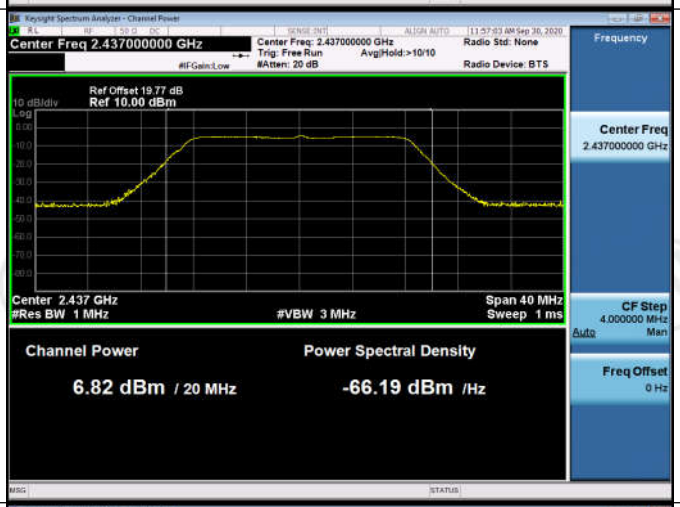
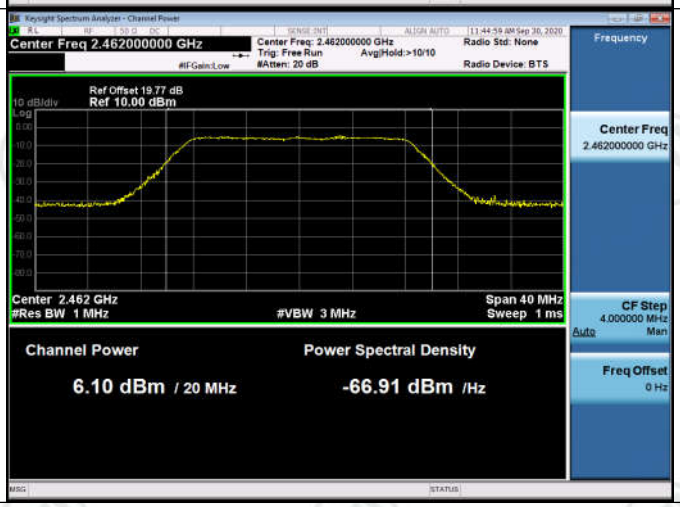
## Test Result

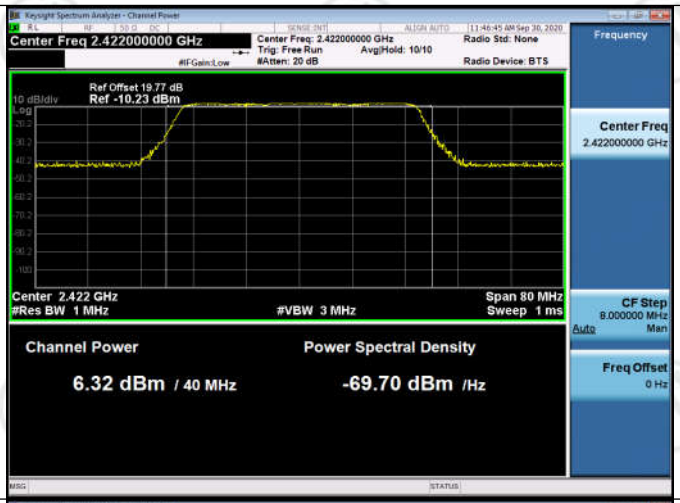
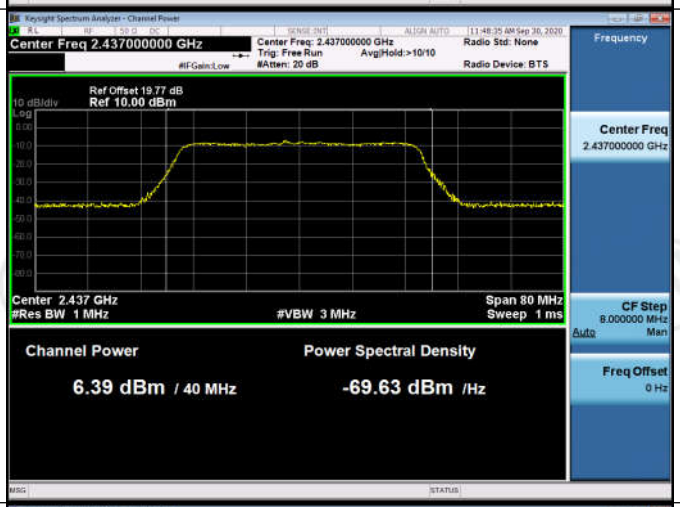
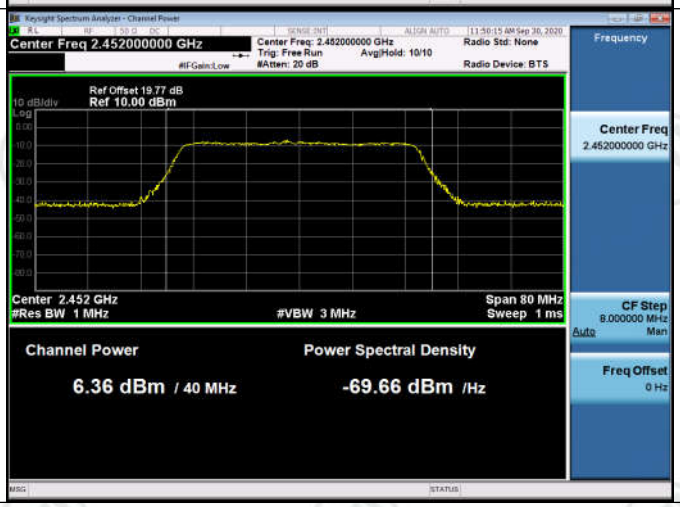
| Mode | Channel | Conducted Peak Output Power [dBm] | Verdict |
|---|---|---|---|
| 11B | LCH | 6.21 | PASS |
| 11B | MCH | 6.91 | PASS |
| 11B | HCH | 6.56 | PASS |
| 11G | LCH | 6.11 | PASS |
| 11G | MCH | 6.53 | PASS |
| 11G | HCH | 6.24 | PASS |
| 11N20SISO | LCH | 6.34 | PASS |
| 11N20SISO | MCH | 6.82 | PASS |
| 11N20SISO | HCH | 6.1 | PASS |
| 11N40SISO | LCH | 6.32 | PASS |
| 11N40SISO | MCH | 6.39 | PASS |
| 11N40SISO | HCH | 6.36 | PASS |

**Test Graph**

| Graphs | | | |
|---|---|---|---|
| 11B/LCH | |  | |
| 11B/MCH | |  | |
| 11B/HCH | |  | |

| | | | |
|---|---|---|---|
| 11G/LCH | |  | |
| 11G/MCH | |  | |
| 11G/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N20SISO/LCH | |  | |
| 11N20SISO/MCH | |  | |
| 11N20SISO/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N40SISO/LCH | |  | |
| 11N40SISO/MCH | |  | |
| 11N40SISO/HCH | |  | |

# Appendix B): 6dB Occupied Bandwidth

**Test Limit**

According to §15.247(a)(2),

**6 dB Bandwidth** :

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

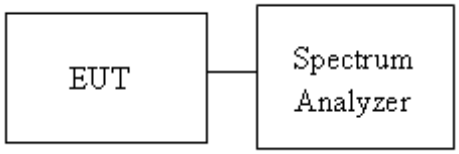
**Occupied Bandwidth(99%)** : For reporting purposes only.

**Test Procedure**

Test method Refer as KDB 558074 D01 and ANSI C63.10: 2013 clause 6.9.2,

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

**Test Setup**

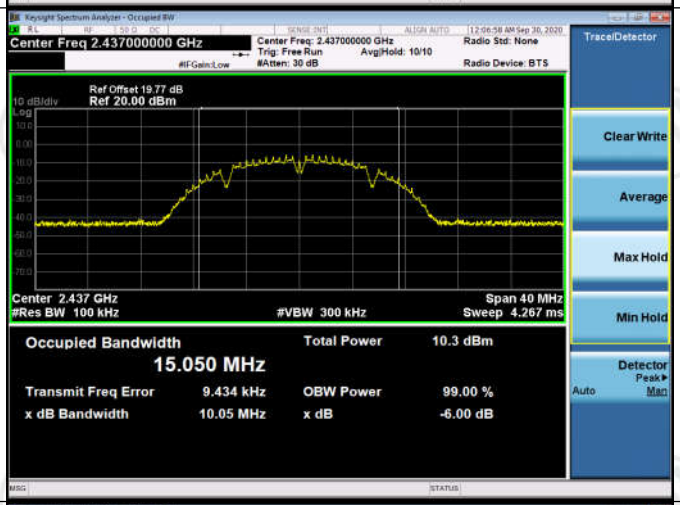
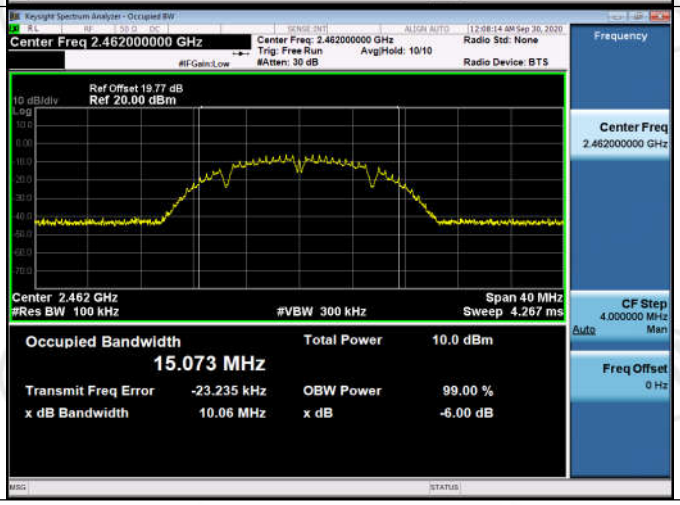


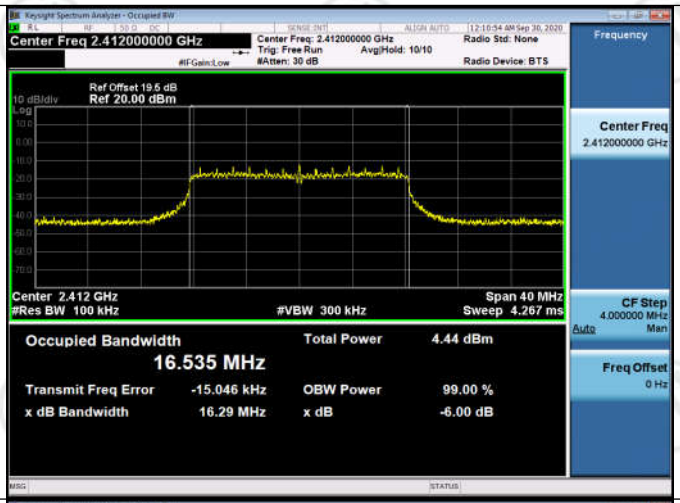
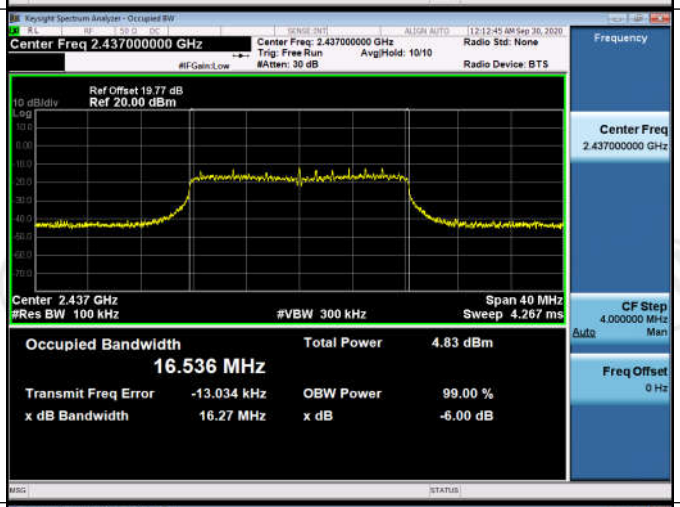
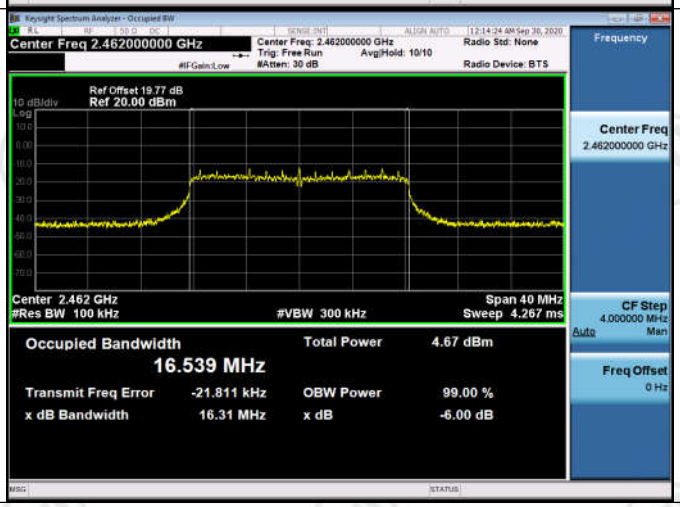
## Test Result

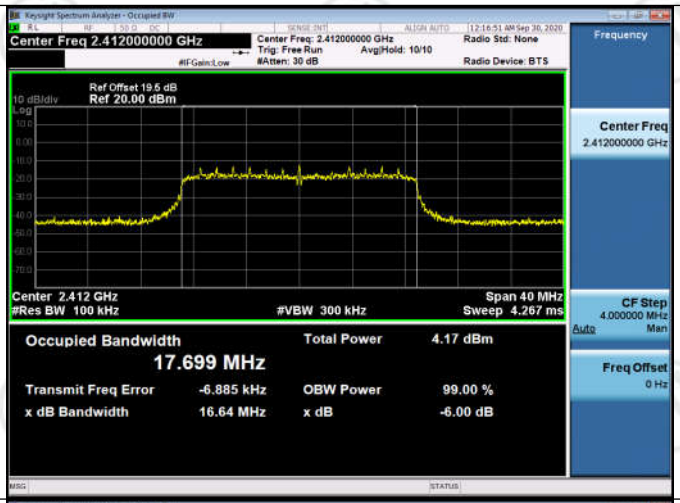
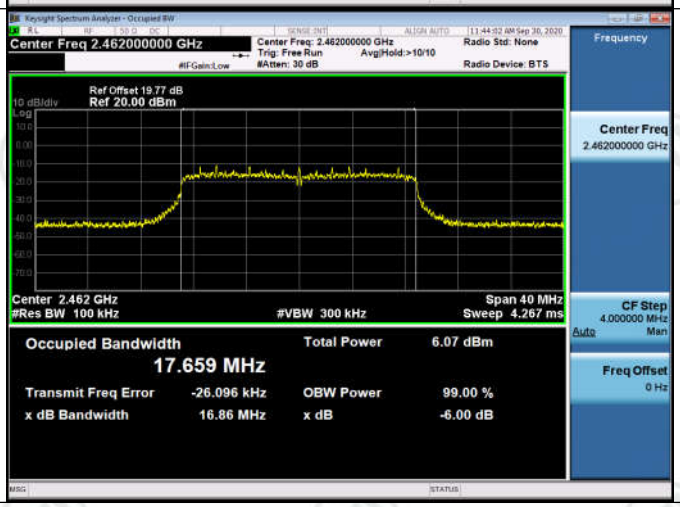
| Mode | Channel | 6dB Bandwidth [MHz] | 99% OBW [MHz] | Verdict |
|---|---|---|---|---|
| 11B | LCH | 10.07 | 15.470 | PASS |
| 11B | MCH | 10.05 | 15.394 | PASS |
| 11B | HCH | 10.06 | 15.485 | PASS |
| 11G | LCH | 16.29 | 17.022 | PASS |
| 11G | MCH | 16.27 | 16.994 | PASS |
| 11G | HCH | 16.31 | 17.045 | PASS |
| 11N20SISO | LCH | 16.64 | 18.038 | PASS |
| 11N20SISO | MCH | 16.74 | 18.045 | PASS |
| 11N20SISO | HCH | 16.86 | 17.934 | PASS |
| 11N40SISO | LCH | 33.87 | 37.041 | PASS |
| 11N40SISO | MCH | 35.06 | 36.981 | PASS |
| 11N40SISO | HCH | 35.07 | 36.973 | PASS |

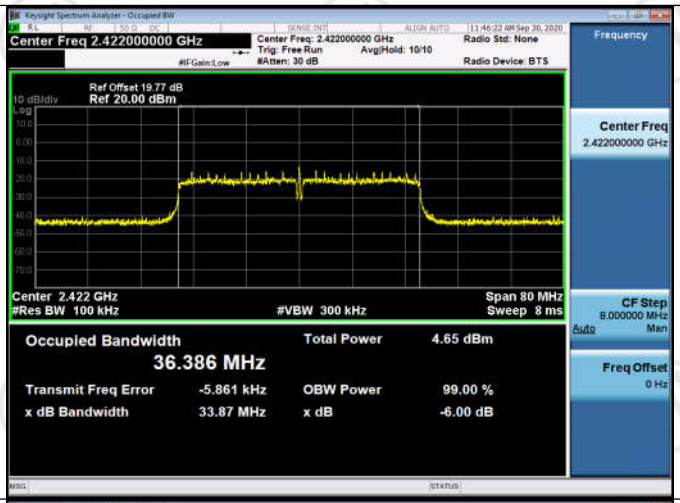
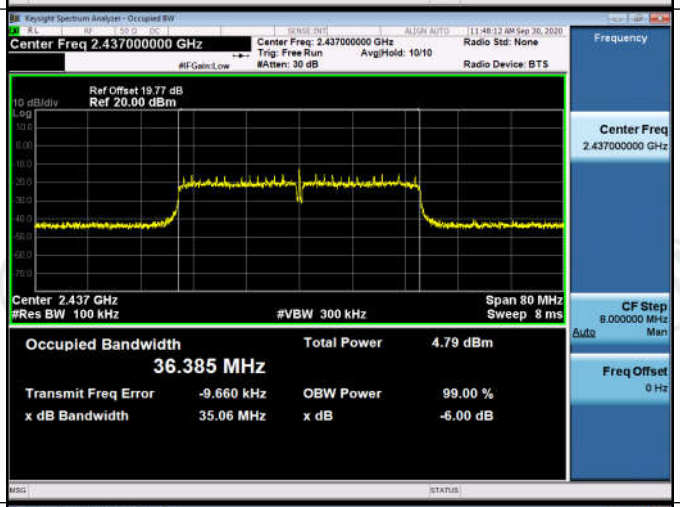
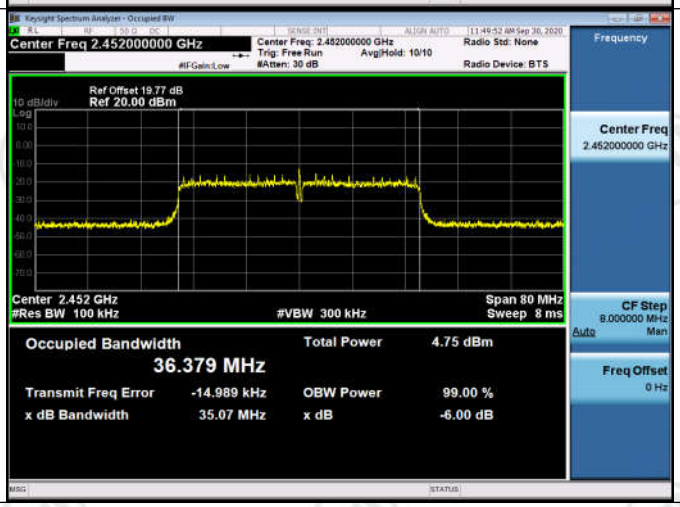
**Test Graph**

**6 dB Bandwidth**

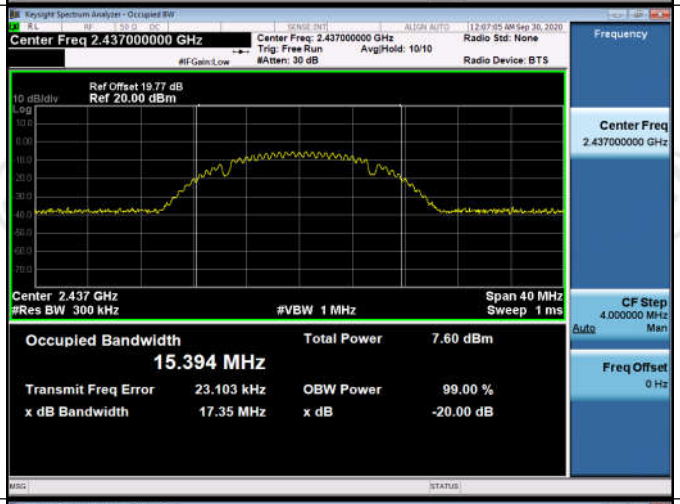
| Graphs | | | |
|---|---|---|---|
| 11B/LCH | | | |
| 11B/MCH | |  | |
| 11B/HCH | |  | |

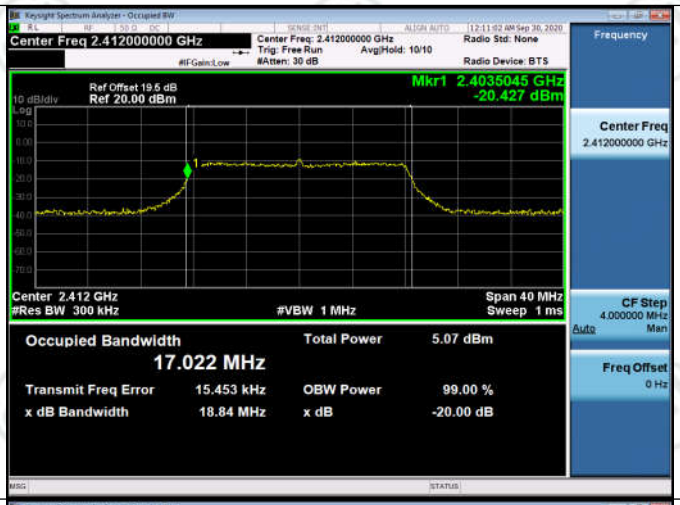
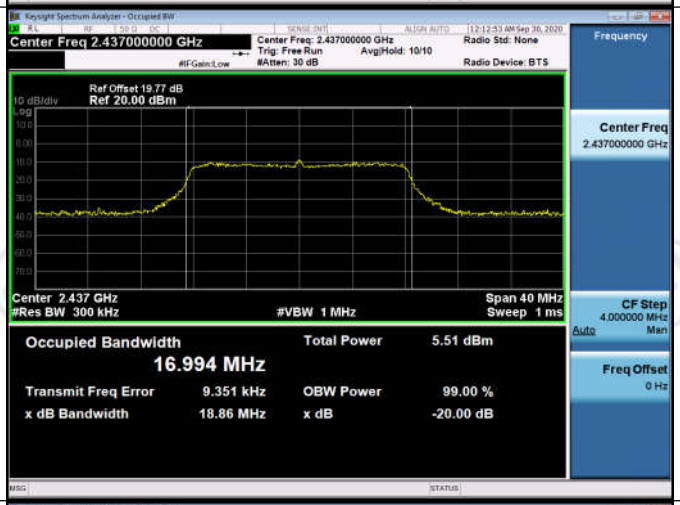
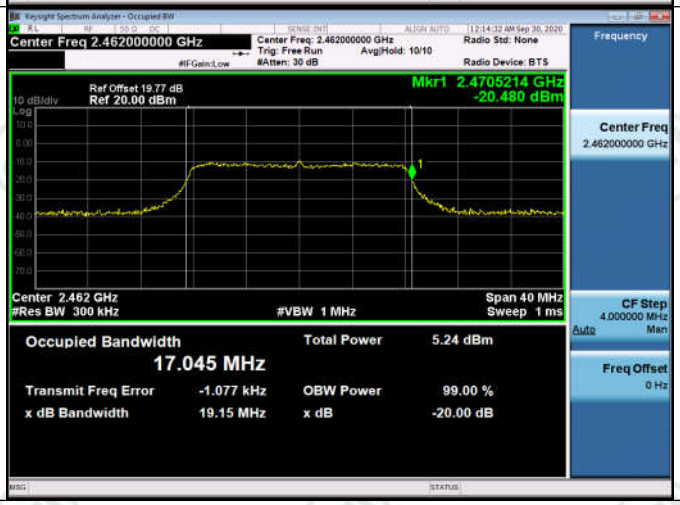
| | | | |
|---|---|---|---|
| 11G/LCH | |  | |
| 11G/MCH | |  | |
| 11G/HCH | |  | |

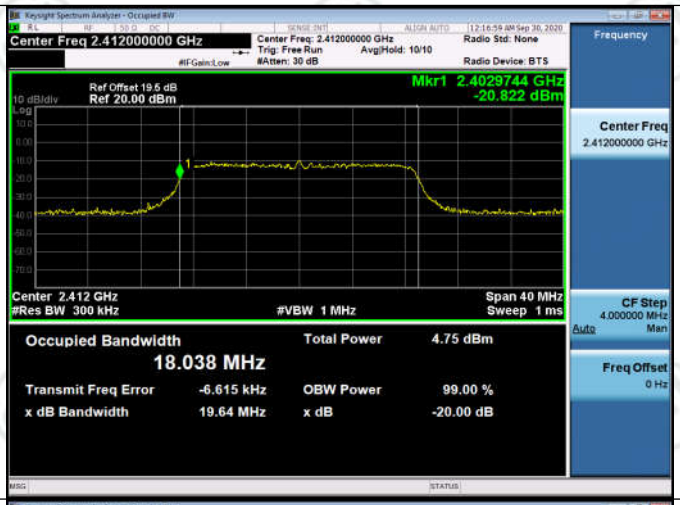
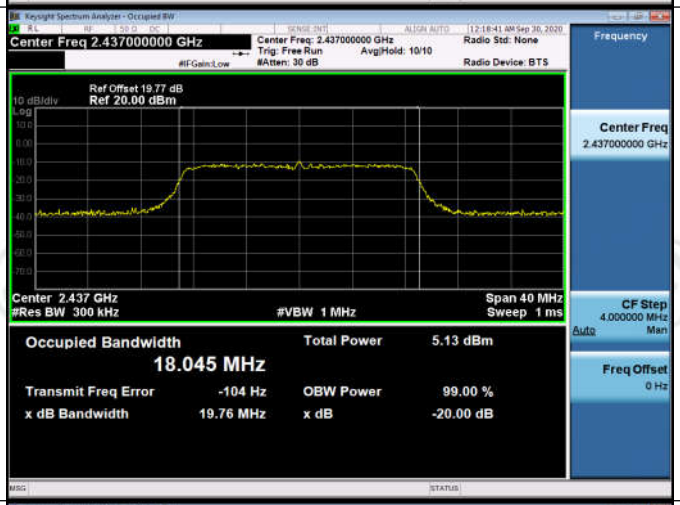
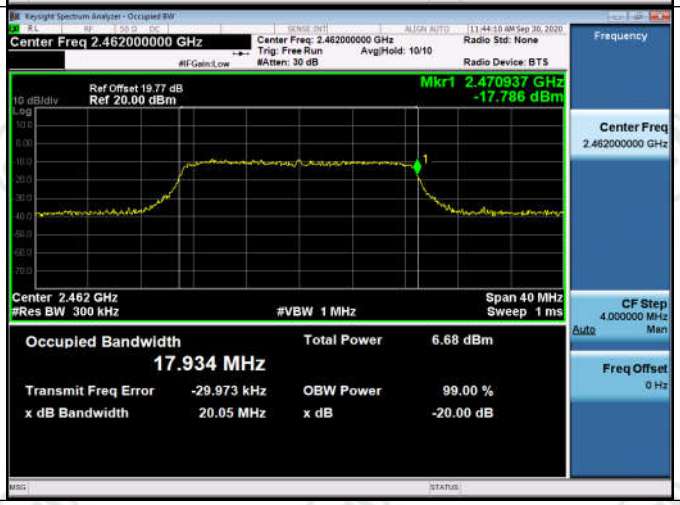
| | | | |
|---|---|---|---|
| 11N20SISO/LCH | |  | |
| 11N20SISO/MCH | | | |
| 11N20SISO/HCH | |  | |

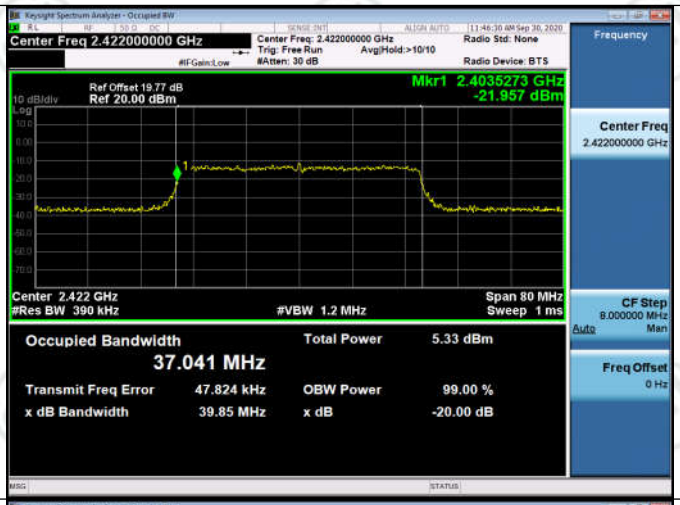
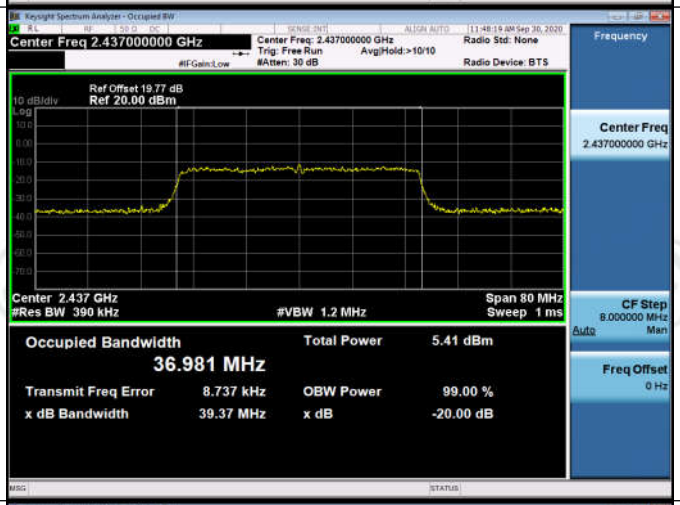
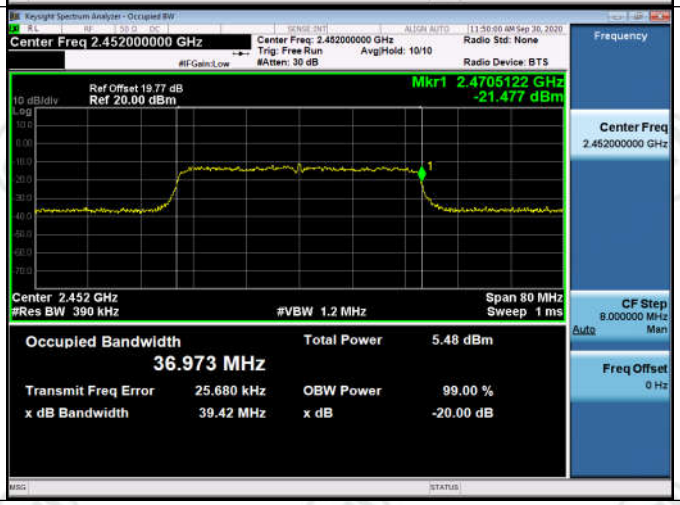
| | | | |
|---|---|---|---|
| 11N40SISO/LCH | |  | |
| 11N40SISO/MCH | |  | |
| 11N40SISO/HCH | |  | |

## Occupied Bandwidth(99%)

| Graphs | | | |
|---|---|---|---|
| 11B/LCH | | | |
| 11B/MCH | |  | |
| 11B/HCH | | | |

| | | | |
|---|---|---|---|
| 11G/LCH | |  | |
| 11G/MCH | |  | |
| 11G/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N20SISO/LCH | |  | |
| 11N20SISO/MCH | |  | |
| 11N20SISO/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N40SISO/LCH | |  | |
| 11N40SISO/MCH | |  | |
| 11N40SISO/HCH | |  | |

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

**Test Limit**

According to §15.247(d),

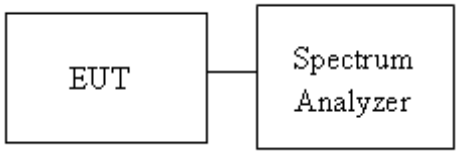
In any 100 kHz bandwidth outside the authorized frequency band,
Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

**Test Procedure**

Test method Refer as KDB 558074 D01.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. f the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

**Test Setup**

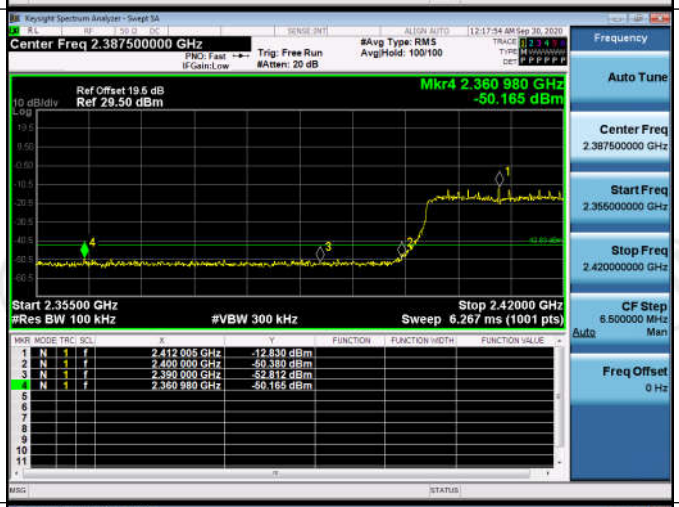
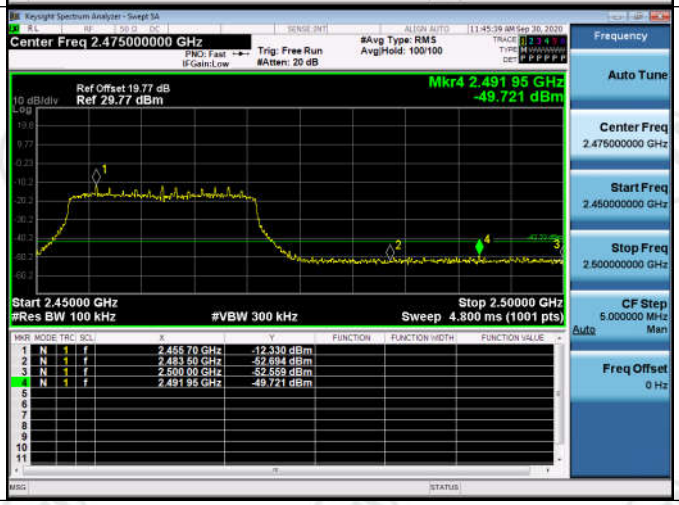


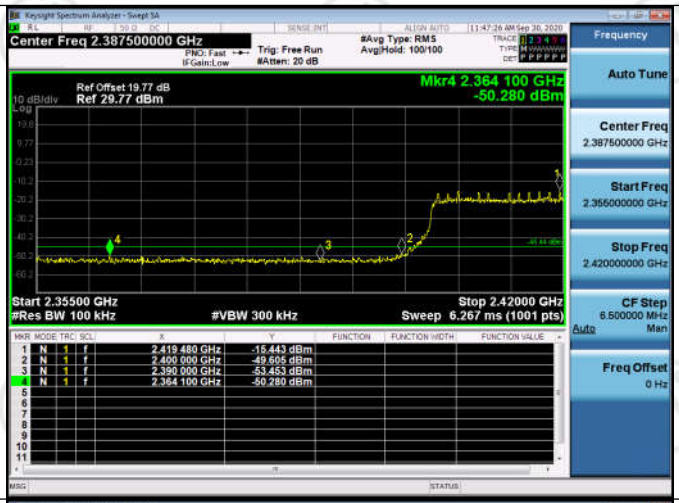
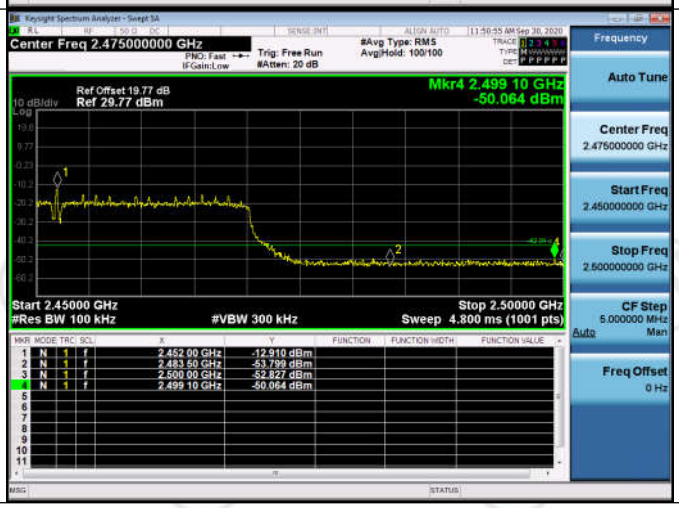
**Result Table**

| Mode | Channel | Carrier Power[dBm] | Max.Spurious Level [dBm] | Limit [dBm] | Verdict |
|---|---|---|---|---|---|
| 11B | LCH | -7.050 | -50.267 | -37.05 | PASS |
| 11B | HCH | -6.293 | -49.809 | -36.29 | PASS |
| 11G | LCH | -12.508 | -49.966 | -42.51 | PASS |
| 11G | HCH | -12.281 | -49.090 | -42.28 | PASS |
| 11N20SISO | LCH | -12.830 | -50.165 | -42.83 | PASS |
| 11N20SISO | HCH | -12.330 | -49.721 | -42.33 | PASS |
| 11N40SISO | LCH | -15.443 | -50.280 | -45.44 | PASS |
| 11N40SISO | HCH | -12.910 | -50.064 | -42.91 | PASS |

**Test Graph**

| Graphs | | |
|---|---|---|
| 11B/LCH | | |
| 11B/HCH | | |
| 11G/LCH | | |

| | | | |
|---|---|---|---|
| 11G/HCH | | | |
| 11N20SISO/LCH | |  | |
| 11N20SISO/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N40SISO/LCH | |  | |
| 11N40SISO/HCH | |  | |

# Appendix D): RF Conducted Spurious Emissions

**Test Limit**

According to §15.247(d),

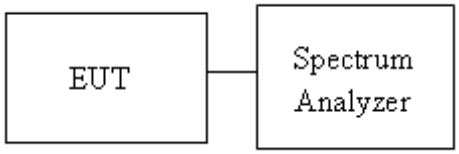
In any 100 kHz bandwidth outside the authorized frequency band,
Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

**Test Procedure**

Test method Refer as KDB 558074 D01.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. f the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

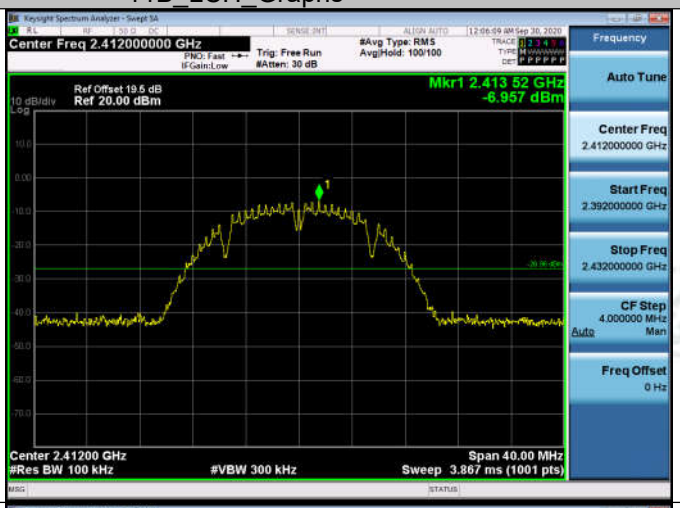
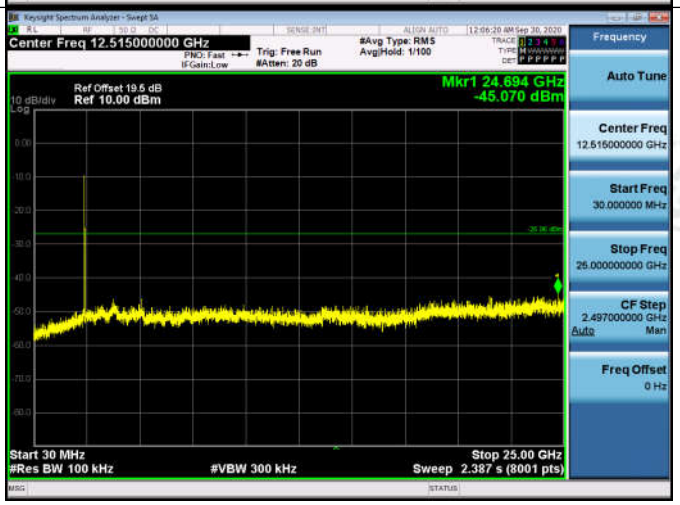
**Test Setup**

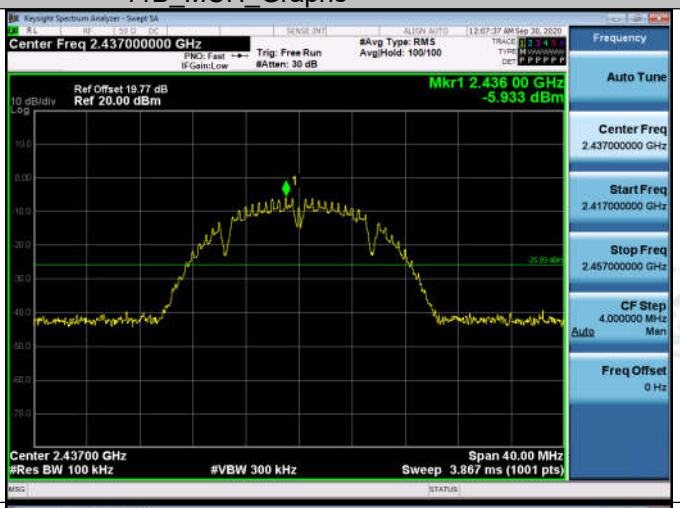
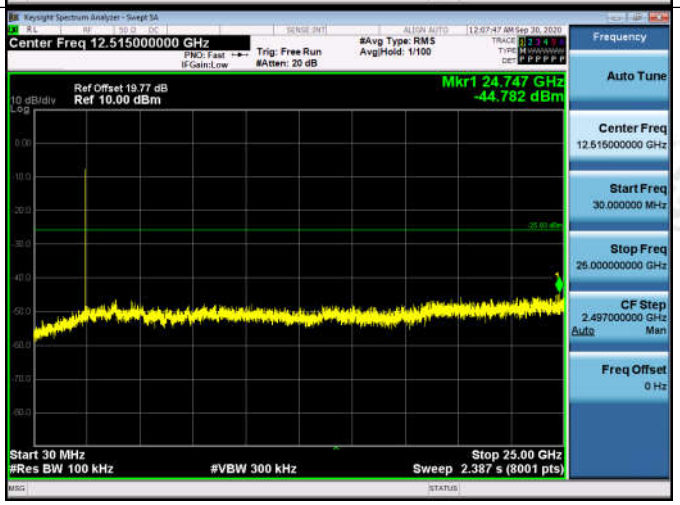


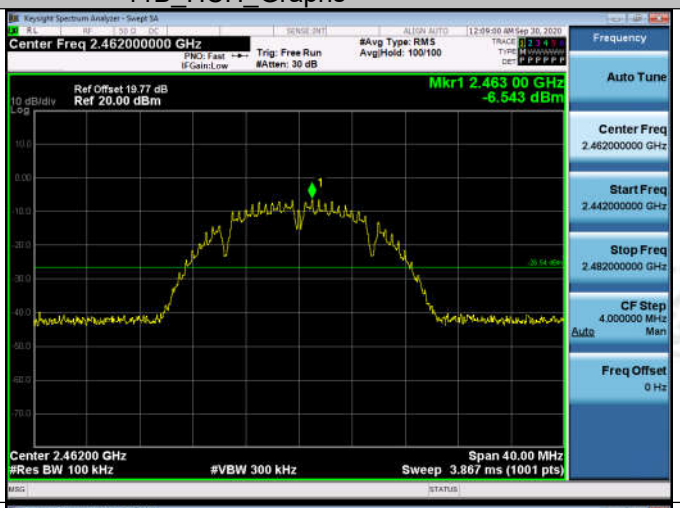
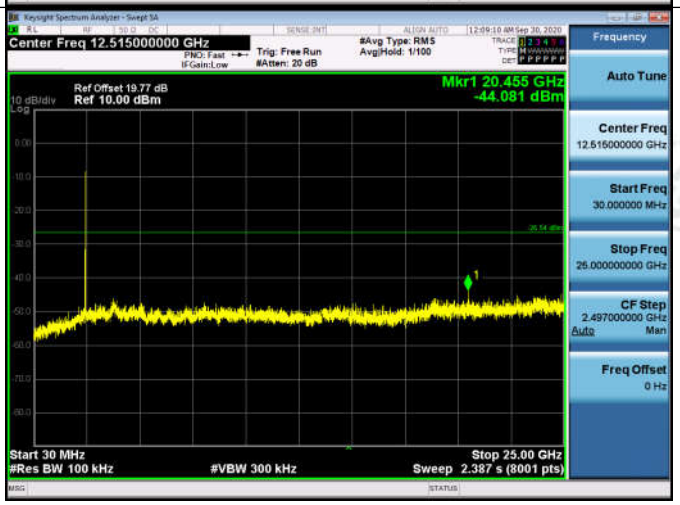
**Result Table**

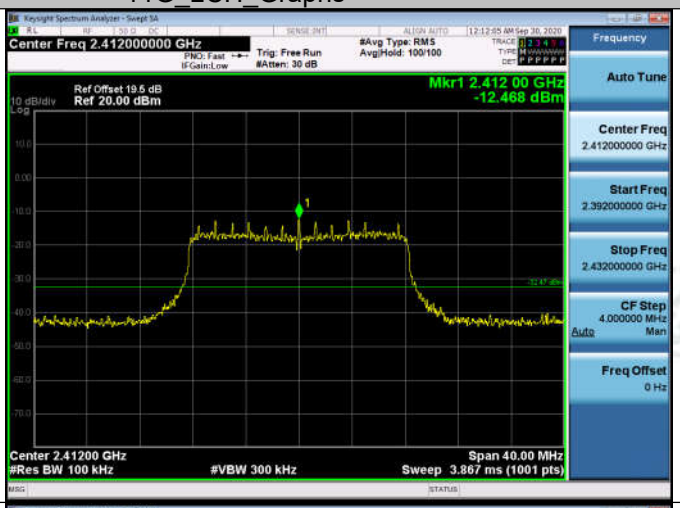
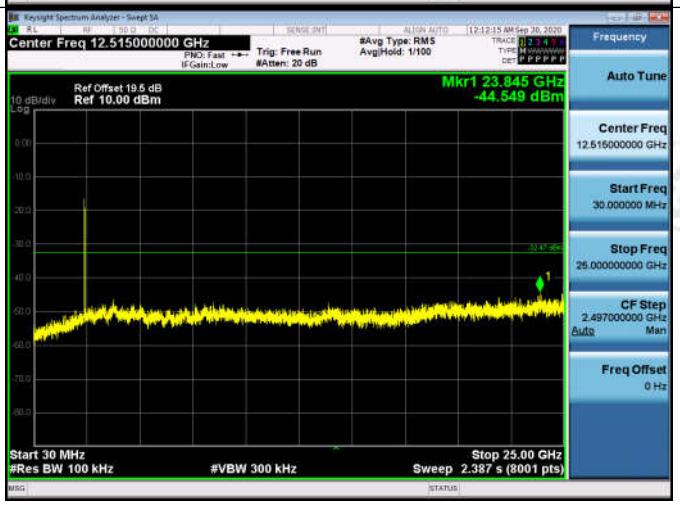
| Mode | Channel | Pref [dBm] | Puw[dBm] | Verdict |
|---|---|---|---|---|
| 11B | LCH | -6.957 | <Limit | PASS |
| 11B | MCH | -5.933 | <Limit | PASS |
| 11B | HCH | -6.543 | <Limit | PASS |
| 11G | LCH | -12.468 | <Limit | PASS |
| 11G | MCH | -12.094 | <Limit | PASS |
| 11G | HCH | -12.499 | <Limit | PASS |
| 11N20SISO | LCH | -12.871 | <Limit | PASS |
| 11N20SISO | MCH | -12.331 | <Limit | PASS |
| 11N20SISO | HCH | -12.586 | <Limit | PASS |
| 11N40SISO | LCH | -13.317 | <Limit | PASS |
| 11N40SISO | MCH | -12.97 | <Limit | PASS |
| 11N40SISO | HCH | -13.071 | <Limit | PASS |

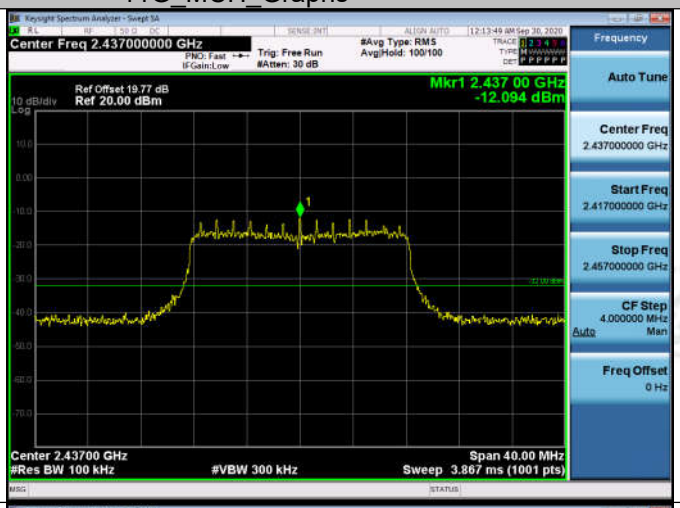
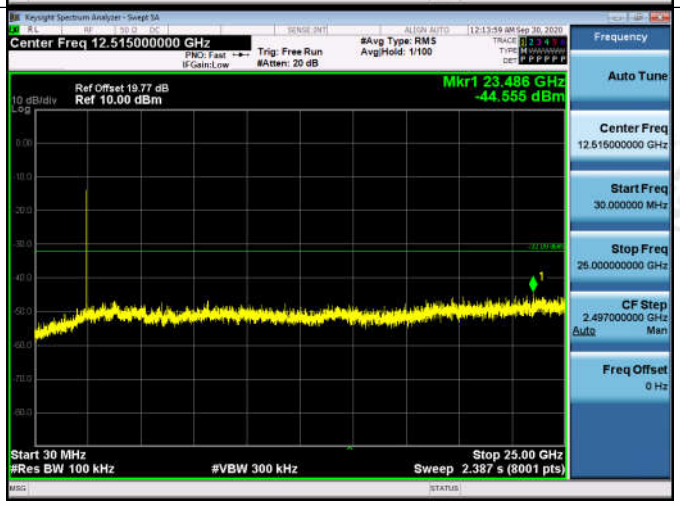
**Test Graph**

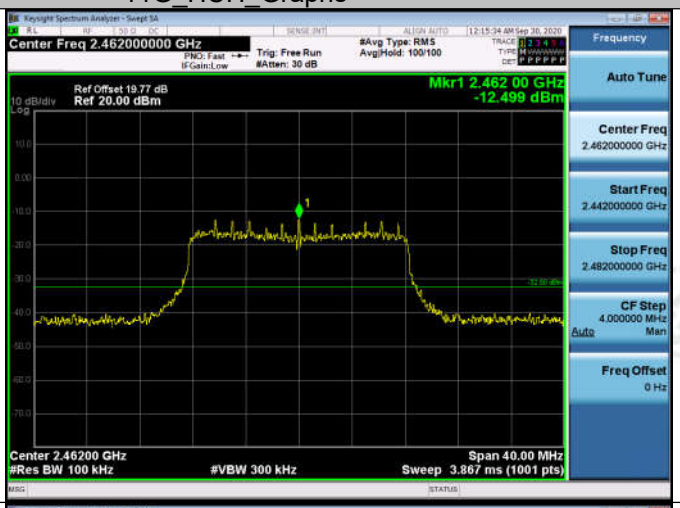
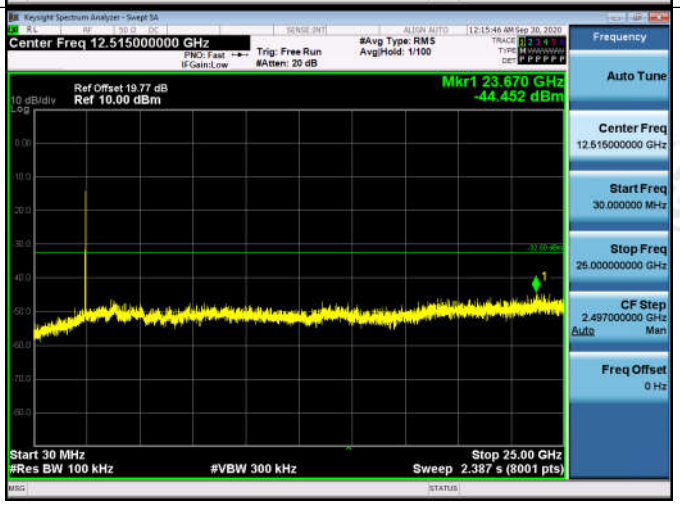
| 11B_LCH_Graphs | | |
|---|---|---|
| Pref/11B/LCH | |  |
| Puw/11B/LCH | |  |

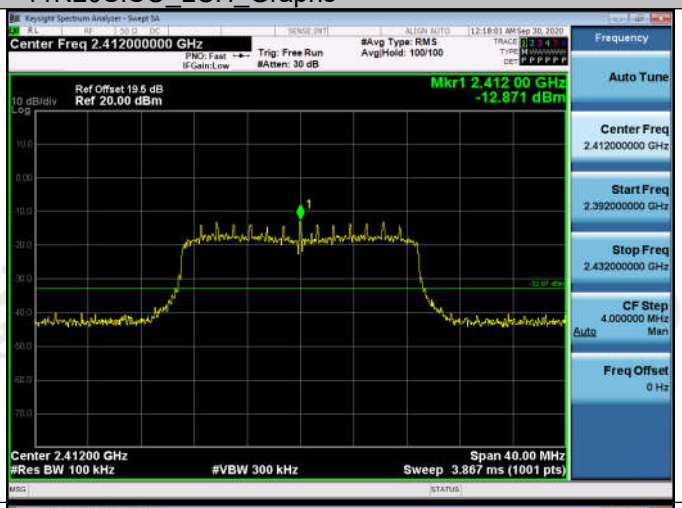
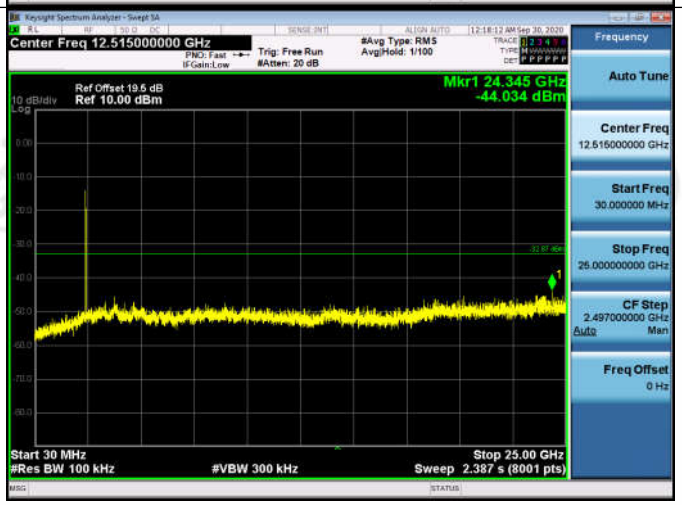
| 11B_MCH_Graphs | | |
|---|---|---|
| Pref/11B/MCH | |  |
| Puw/11B/MCH | |  |

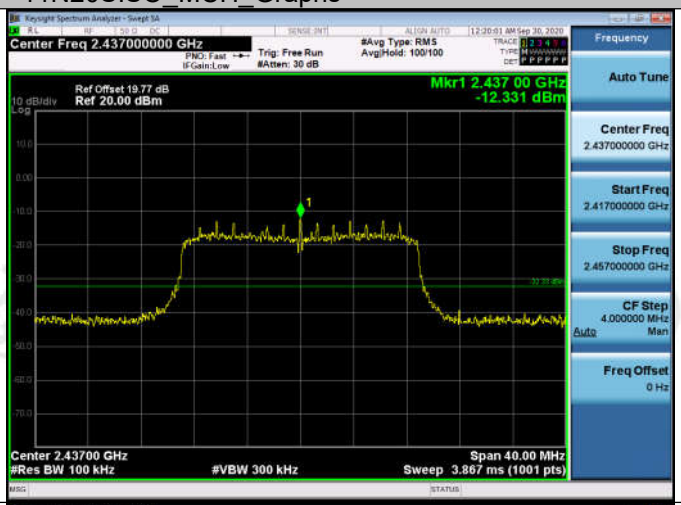
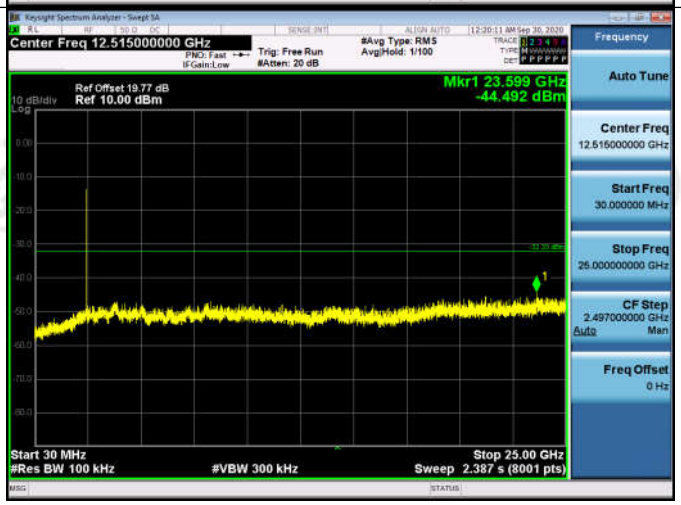
| 11B_HCH_Graphs | | |
|---|---|---|
| Pref/11B/HCH | |  |
| Puw/11B/HCH | |  |

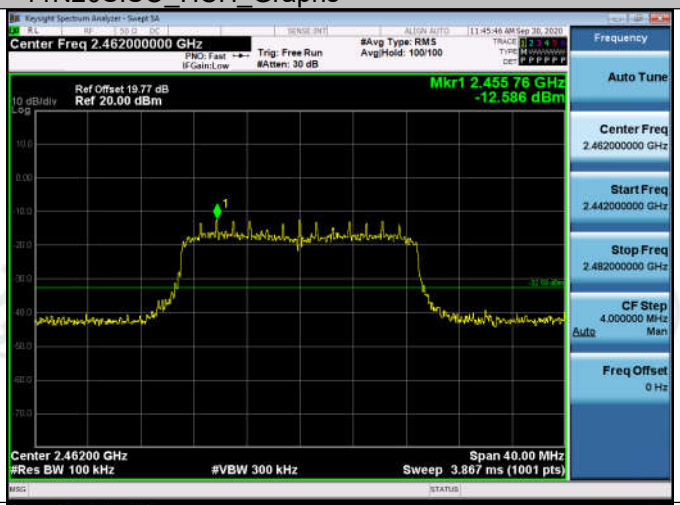
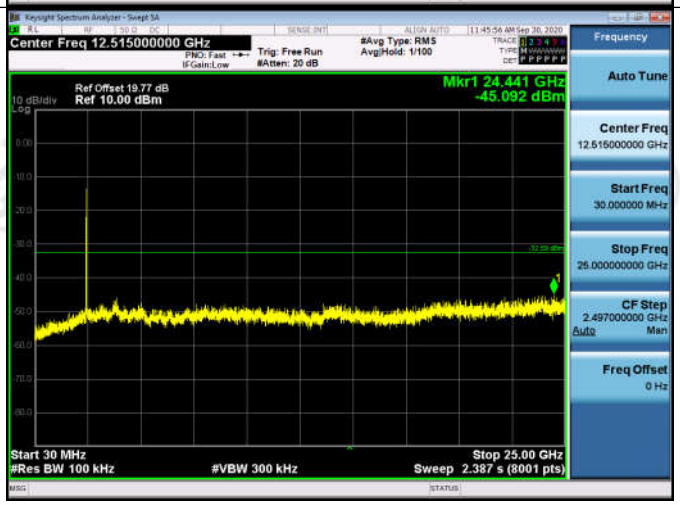
| 11G_LCH_Graphs | | |
|---|---|---|
| Pref/11G/LCH | |  |
| Puw/11G/LCH | |  |

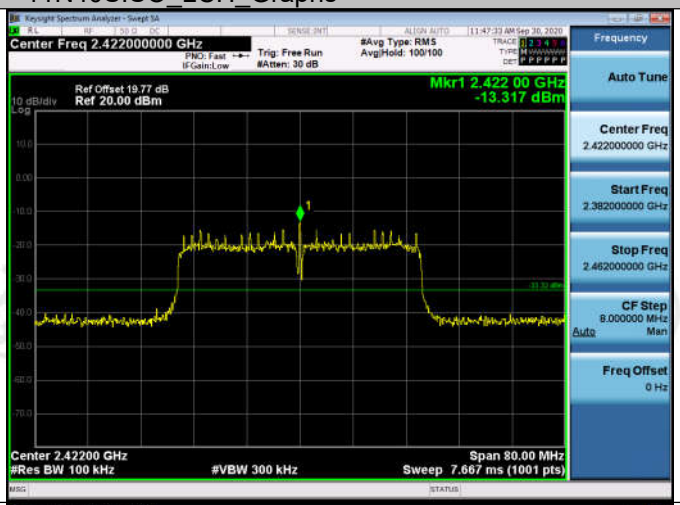
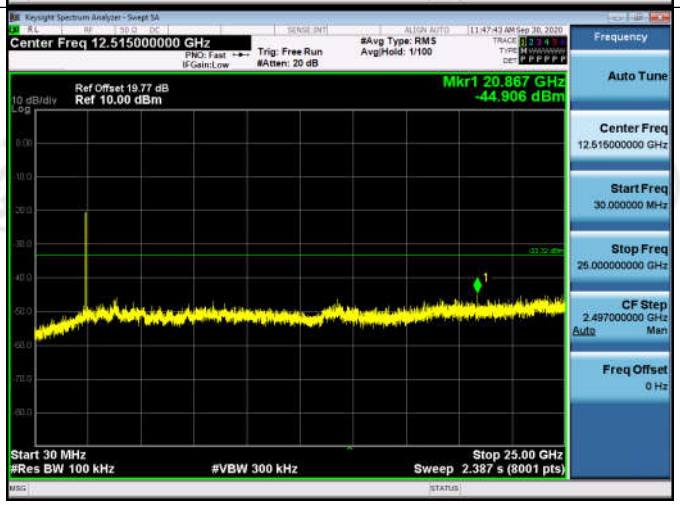
| 11G_MCH_Graphs | | |
|---|---|---|
| Pref/11G/MCH | |  |
| Puw/11G/MCH | |  |

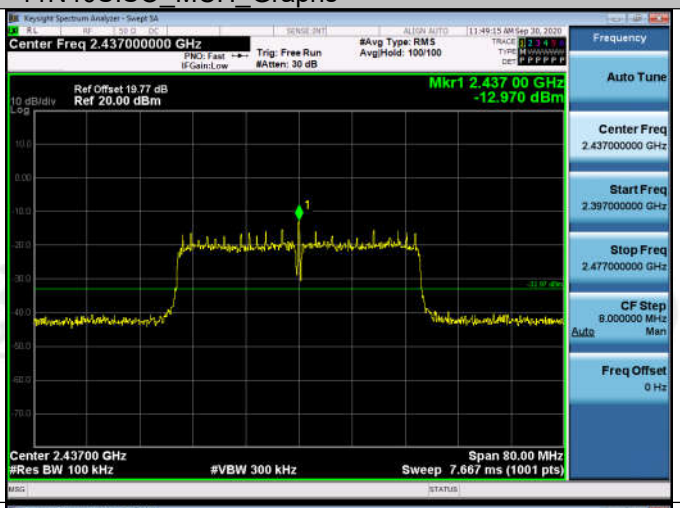
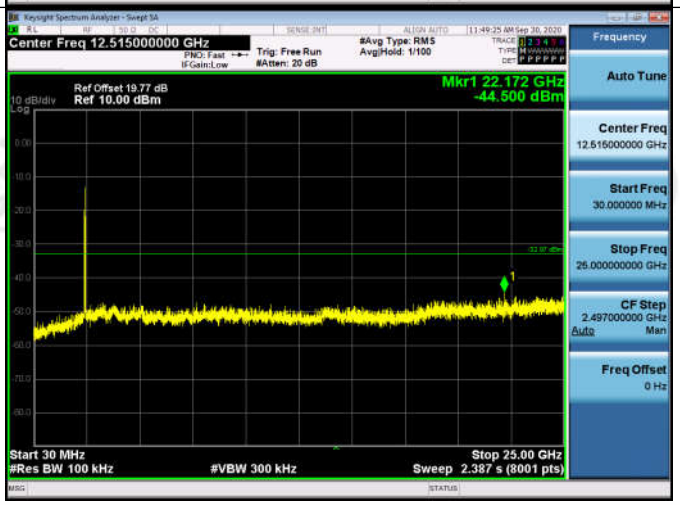
| 11G_HCH_Graphs | | |
|---|---|---|
| Pref/11G/HCH | |  |
| Puw/11G/HCH | |  |

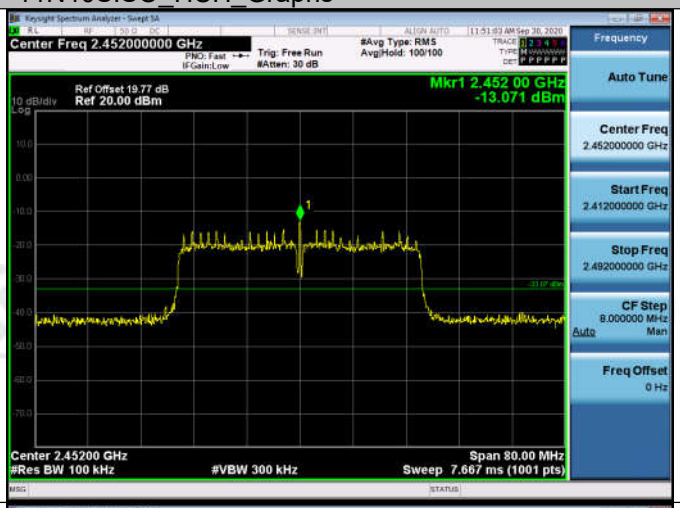
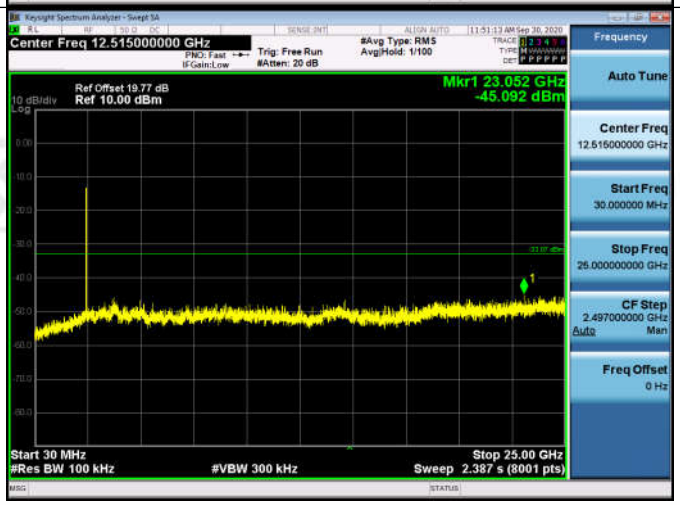
| 11N20SISO_LCH_Graphs | | |
|---|---|---|
| Pref/11N20SISO/LCH | |  |
| /11N20SISO/LCH | |  |

| 11N20SISO_MCH_Graphs | | |
|---|---|---|
| Pref/11N20SISO/MCH | |  |
| Puw/11N20SISO/MCH | |  |

| 11N20SISO_HCH_Graphs | | |
|---|---|---|
| Pref/11N20SISO/HCH | |  |
| Puw/11N20SISO/HCH | |  |

| 11N40SISO_LCH_Graphs | | |
|---|---|---|
| Pref/11N40SISO/LCH | |  |
| Puw/11N40SISO/LCH | |  |

| 11N40SISO_MCH_Graphs | | |
|---|---|---|
| Pref/11N40SISO/MCH | |  |
| Puw/11N40SISO/MCH | |  |

| 11N40SISO_HCH_Graphs | | |
|---|---|---|
| Pref/11N40SISO/HCH | |  |
| Puw/11N40SISO/HCH | |  |

## Appendix E): Power Spectral Density

**Test Limit**

According to §15.247(e),

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

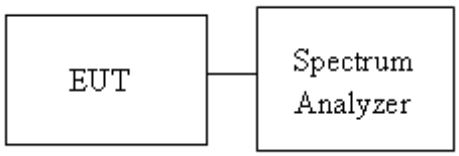
| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：8dBm<br>☐ Antenna with DG greater than 6 dBi：<br>[ Limit = 8 – (DG – 6) ]<br>☐ Point-to-point operation： |

**Test Procedure**

Test method Refer as KDB 558074 D01.

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

**Test Setup**

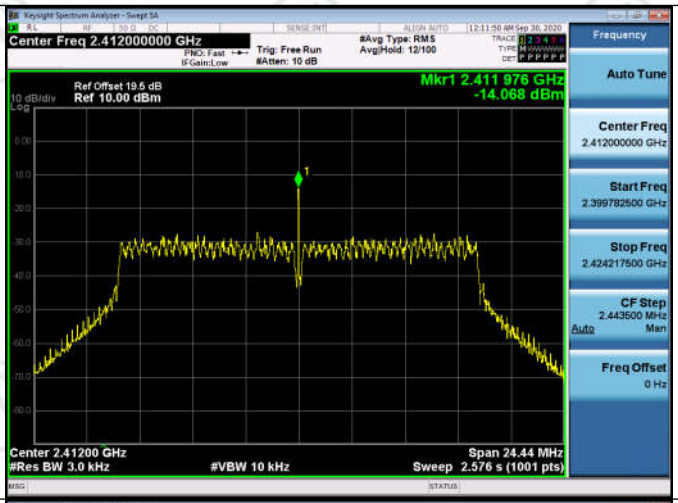
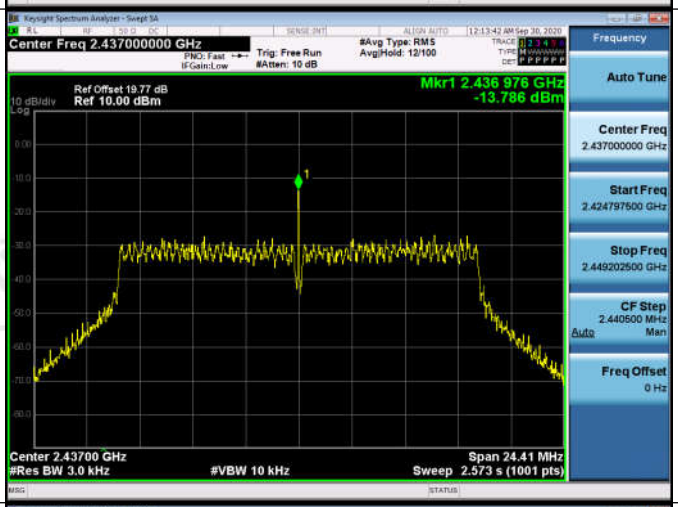
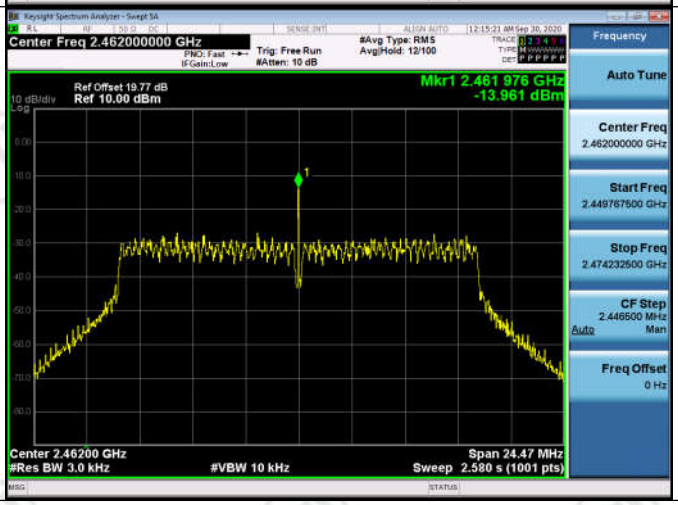


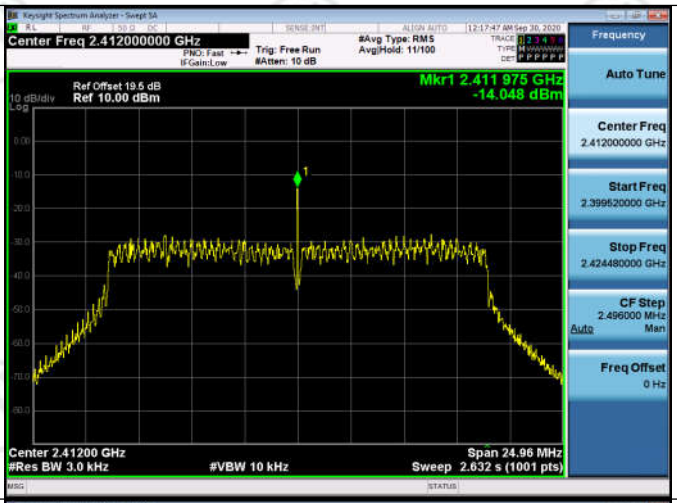
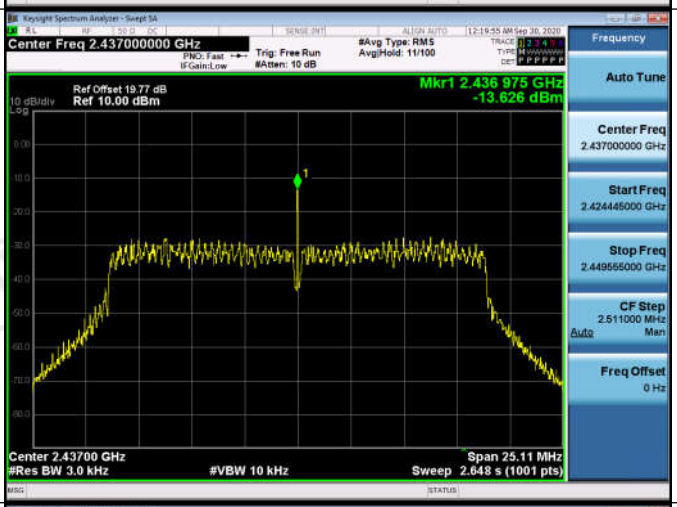
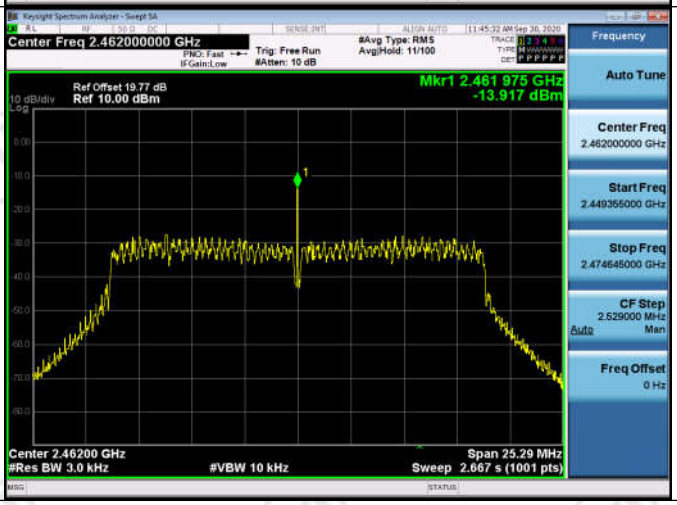
**Result Table**

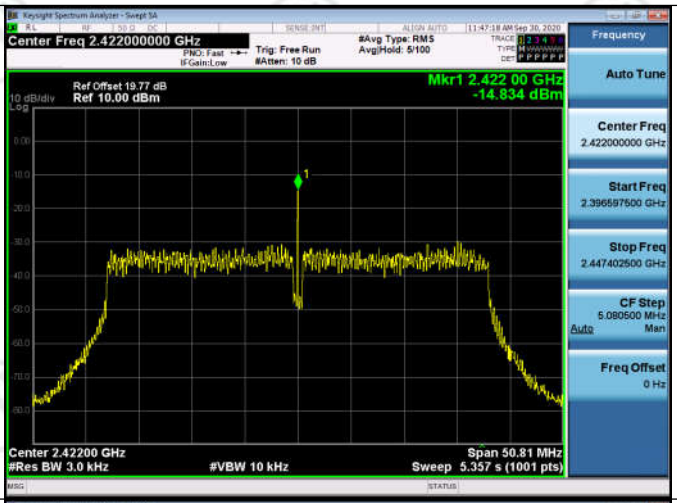
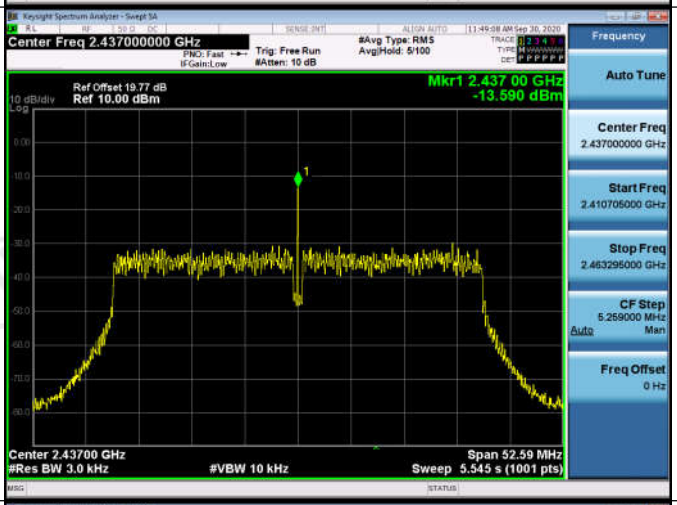
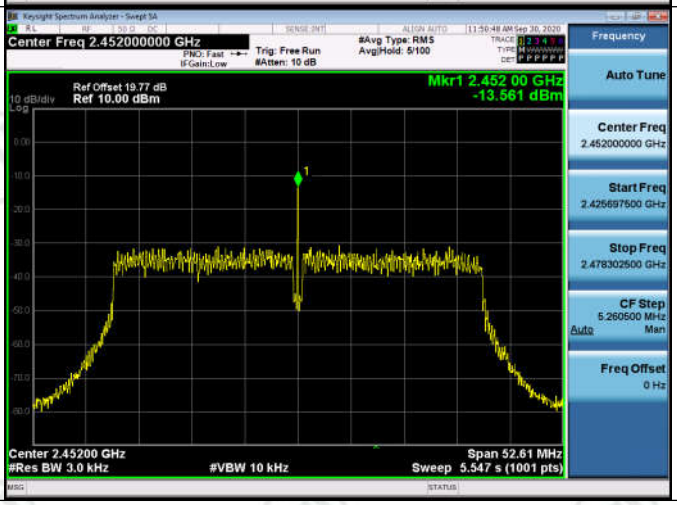
| Mode | Channel | Power Spectral Density [dBm] | Verdict |
|---|---|---|---|
| 11B | LCH | -13.265 | PASS |
| 11B | MCH | -12.860 | PASS |
| 11B | HCH | -13.193 | PASS |
| 11G | LCH | -14.068 | PASS |
| 11G | MCH | -13.786 | PASS |
| 11G | HCH | -13.961 | PASS |
| 11N20SISO | LCH | -14.048 | PASS |
| 11N20SISO | MCH | -13.626 | PASS |
| 11N20SISO | HCH | -13.917 | PASS |
| 11N40SISO | LCH | -14.834 | PASS |
| 11N40SISO | MCH | -13.590 | PASS |
| 11N40SISO | HCH | -13.561 | PASS |

**Test Graph**

| Graphs | | | |
|---|---|---|---|
| 11B/LCH | | | |
| 11B/MCH | | | |
| 11B/HCH | | | |

| | | | |
|---|---|---|---|
| 11G/LCH | |  | |
| 11G/MCH | |  | |
| 11G/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N20SISO/LCH | |  | |
| 11N20SISO/MCH | |  | |
| 11N20SISO/HCH | |  | |

| | | | |
|---|---|---|---|
| 11N40SISO/LCH | |  | |
| 11N40SISO/MCH | |  | |
| 11N40SISO/HCH | |  | |

# Appendix F): Antenna Requirement

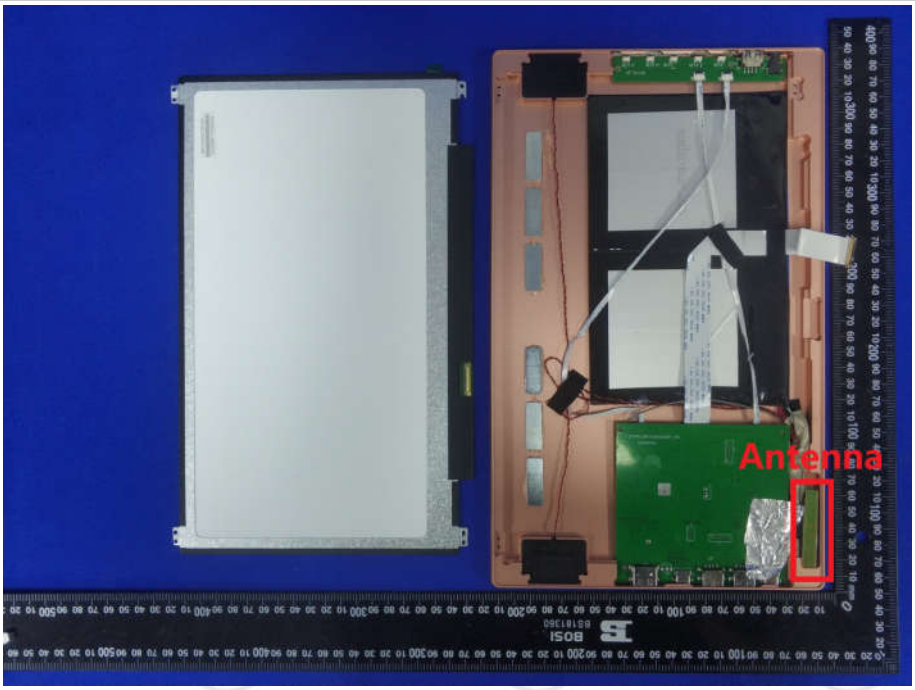
**15.203 requirement:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

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

**EUT Antenna:**




The antenna is Built-in dual-band antenna. The best case gain of the antenna is 3.0 dBi.

# Appendix G): AC Power Line Conducted Emission

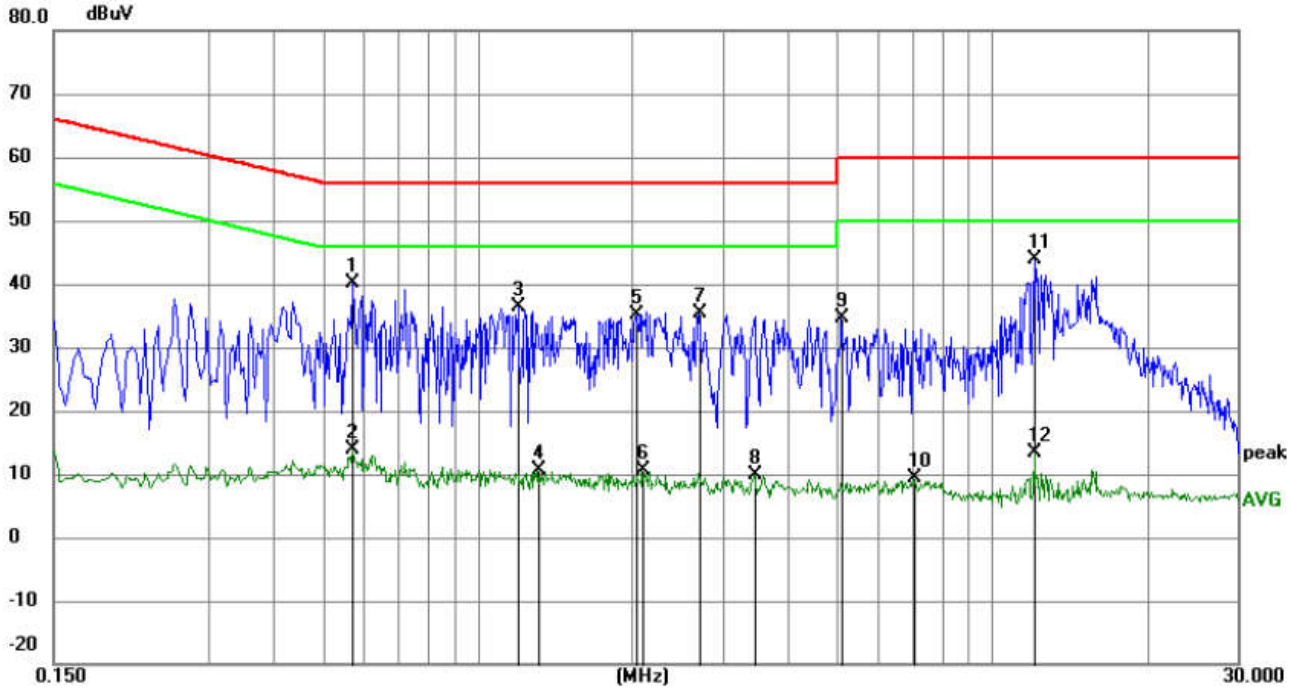
<table>
<tr><td>Test Procedure:</td><td>Test frequency range :150KHz-30MHz<br>1) The mains terminal disturbance voltage test was conducted in a shielded room.<br>2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.<br>3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,<br>4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.<br>5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBμV)</th></tr>
<tr><th>Quasi-peak</th><th>Average</th></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
* The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.<br>NOTE : The lower limit is applicable at the transition frequency</td></tr>
</table>

**Measurement Data**

An initial pre-scan was performed on the live and neutral lines with peak detector.

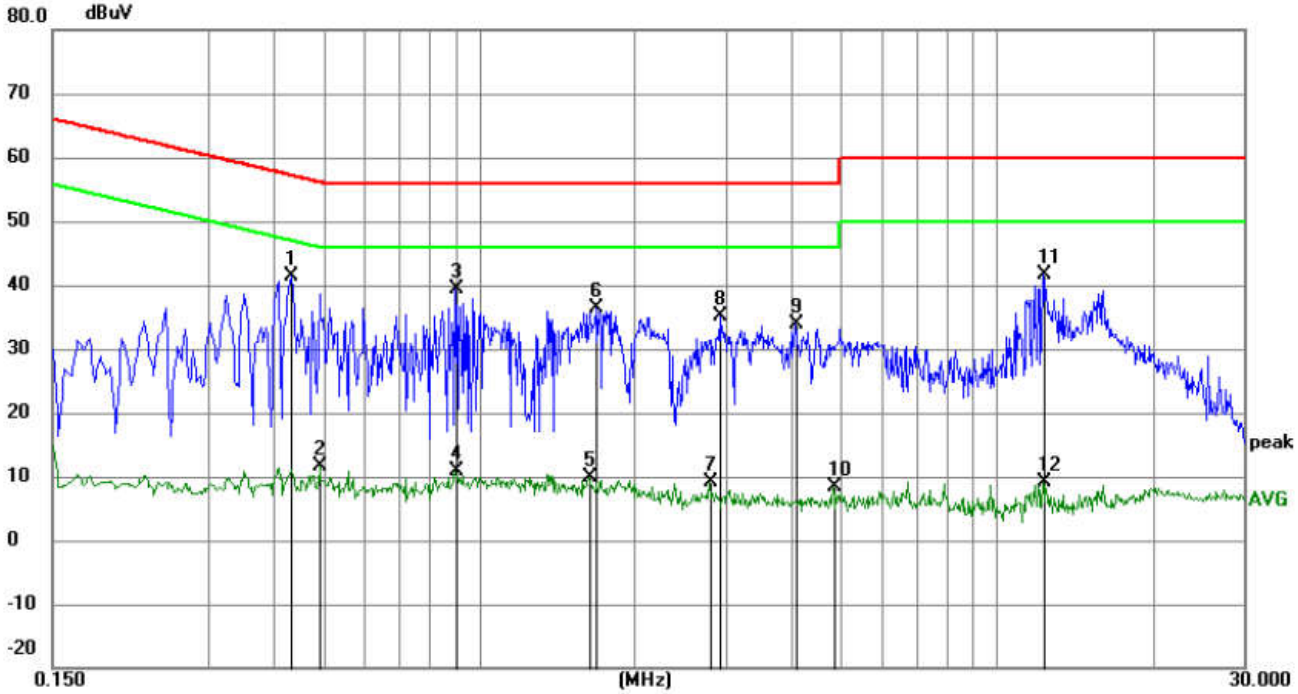
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | * | 0.5725 | 30.04 | 10.04 | 40.08 | 56.00 | -15.92 | QP | |
| 2 | | 0.5725 | 3.85 | 10.04 | 13.89 | 46.00 | -32.11 | AVG | |
| 3 | | 1.1979 | 26.64 | 9.82 | 36.46 | 56.00 | -19.54 | QP | |
| 4 | | 1.3149 | 0.93 | 9.82 | 10.75 | 46.00 | -35.25 | AVG | |
| 5 | | 2.0354 | 25.33 | 9.79 | 35.12 | 56.00 | -20.88 | QP | |
| 6 | | 2.0939 | 0.85 | 9.79 | 10.64 | 46.00 | -35.36 | AVG | |
| 7 | | 2.6970 | 25.60 | 9.79 | 35.39 | 56.00 | -20.61 | QP | |
| 8 | | 3.4620 | 0.16 | 9.78 | 9.94 | 46.00 | -36.06 | AVG | |
| 9 | | 5.1089 | 24.78 | 9.78 | 34.56 | 60.00 | -25.44 | QP | |
| 10 | | 7.0438 | -0.36 | 9.79 | 9.43 | 50.00 | -40.57 | AVG | |
| 11 | | 12.0615 | 34.07 | 9.84 | 43.91 | 60.00 | -16.09 | QP | |
| 12 | | 12.0615 | 3.54 | 9.84 | 13.38 | 50.00 | -36.62 | AVG | |

Neutral line:




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | * | 0.4334 | 31.44 | 9.96 | 41.40 | 57.19 | -15.79 | QP | |
| 2 | | 0.4919 | 1.76 | 9.95 | 11.71 | 46.14 | -34.43 | AVG | |
| 3 | | 0.9012 | 29.43 | 9.85 | 39.28 | 56.00 | -16.72 | QP | |
| 4 | | 0.9012 | 1.11 | 9.85 | 10.96 | 46.00 | -35.04 | AVG | |
| 5 | | 1.6304 | 0.11 | 9.80 | 9.91 | 46.00 | -36.09 | AVG | |
| 6 | | 1.6839 | 26.46 | 9.80 | 36.26 | 56.00 | -19.74 | QP | |
| 7 | | 2.7915 | -0.58 | 9.79 | 9.21 | 46.00 | -36.79 | AVG | |
| 8 | | 2.9264 | 25.44 | 9.79 | 35.23 | 56.00 | -20.77 | QP | |
| 9 | | 4.0739 | 24.20 | 9.78 | 33.98 | 56.00 | -22.02 | QP | |
| 10 | | 4.8300 | -1.31 | 9.78 | 8.47 | 46.00 | -37.53 | AVG | |
| 11 | | 12.2728 | 31.66 | 9.85 | 41.51 | 60.00 | -18.49 | QP | |
| 12 | | 12.2728 | -0.77 | 9.85 | 9.08 | 50.00 | -40.92 | AVG | |

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

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

Receiver Setup:

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

Test Procedure:

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

Test method Refer as KDB 558074 D01

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

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

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

Limit:

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