# CFR 47 FCC PART 15 SUBPART C
# ISED RSS-247 ISSUE 2

# TEST REPORT

**2K 4ch 1HDD wireless Recorder**

**MODEL NUMBER: W2K4NVR**

**PROJECT NUMBER: 4788689317**

**REPORT NUMBER: 4788689317-1**

**FCC ID: SMHW2K4NVR**

**IC: 4593A-W2K4NVR**

**ISSUE DATE: Nov. 17, 2018**

*Prepared for*

**Circus World Displays Limited**

*Prepared by*

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Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V0 | 11/17/2018 | Initial Issue | |

| Summary of Test Results | | | |
|---|---|---|---|
| **Clause** | **Test Items** | FCC/IC Rules | Test Results |
| 1 | 6dB Bandwidth and 99% Occupied Bandwidth | FCC Part 15.247 (a) (2)<br>RSS-247 Clause 5.2 (a)<br>ISED RSS-Gen Clause 6.7 | Pass |
| 2 | Peak Conducted Output Power | FCC Part 15.247 (b) (3)<br>RSS-247 Clause 5.4 (e) | Pass |
| 3 | Power Spectral Density | FCC Part 15.247 (e)<br>RSS-247 Clause 5.2 (b) | Pass |
| 4 | Conducted Bandedge and Spurious Emission | FCC Part 15.247 (d)<br>RSS-247 Clause 5.5 | Pass |
| 5 | Radiated Bandedge and Spurious Emission | FCC Part 15.247 (d)<br>FCC Part 15.209<br>FCC Part 15.205<br>RSS-247 Clause 5.5<br>RSS-GEN Clause 8.9 | Pass |
| 6 | Conducted Emission Test For AC Power Port | FCC Part 15.207<br>RSS-GEN Clause 8.8 | Pass |
| 7 | Antenna Requirement | FCC Part 15.203<br>RSS-GEN Clause 8.3 | Pass |
| Remark:<br>1) For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.<br>2) Pre-testing Antenna 1 and Antenna2, and pre-testing SISO and MIMO modes, only the data of the worse case is shown in this test repot. | | | |

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# 1. ATTESTATION OF TEST RESULTS

**Applicant Information**

| | |
|---|---|
| Company Name: | Circus World Displays Limited |
| Address: | 4080 Montrose Rd., Niagara Falls, ON, L2H1J9, Canada |

**Manufacturer Information**

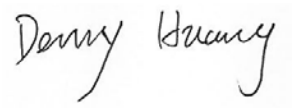
| | |
|---|---|
| Company Name: | Circus World Displays Limited |
| Address: | 4080 Montrose Rd., Niagara Falls, ON, L2H1J9, Canada |

**EUT Description**

| | |
|---|---|
| Product Name | 2K 4ch 1HDD wireless Recorder |
| Model Name | W2K4NVR |
| Trademark | DEFENDER |
| Sample Number | 1830071 |
| Data of Receipt Sample | Sep 26, 2018 |
| Date Tested | Sep 26, 2018~ Nov. 16, 2018 |

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 FCC PART 15 SUBPART C | PASS |
| ISED RSS-247 Issue 2 | PASS |
| ISED RSS-GEN Issue 5 | PASS |

Tested By:



Denny Huang
Engineer Project Associate

Check By:

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo

Laboratory Manager

# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 558074 D01 DTS Meas Guidance v05, KDB 414788 D01 Radiated Test Site v01r01, KDB 662911 D01 Multiple Transmitter Output v02r01, CFR 47 FCC Part 2, CFR 47 FCC Part 15, ANSI C63.10-2013, ISED RSS-247 Issue 2 and ISED RSS-GEN Issue 5.

# 3. FACILITIES AND ACCREDITATION

| | |
|---|---|
| Accreditation Certificate | **A2LA (Certificate No.: 4102.01)**<br>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA.<br>**FCC (FCC Designation No.: CN1187)**<br>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Delcaration of Conformity (DoC) and Certification rules<br>**IC(Company No.: 21320)**<br>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320.<br>**VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)**<br>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793.<br>Facility Name:<br>Chamber D, the VCCI registration No. is G-20019 and R-20004<br>Shielding Room B , the VCCI registration No. is C-20012 and T-20011 |

Note 1: All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

Note 2 : For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. These measurements below 30MHz had been correlated to measurements performed on an OATS.

Note 3 : The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognize national standards.

## 4.2. CMEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| Test Item | Uncertainty |
|---|---|
| Conduction emission | 3.62dB |
| Radiation Emission test(include Fundamental emission) (9KHz-30MHz) | 2.2dB |
| Radiation Emission test(include Fundamental emission) (30MHz-1GHz) | 4.00dB |
| Radiation Emission test (1GHz to 26GHz)( include Fundamental emission) | 5.78dB (1GHz-18Gz) |
| | 5.23dB (18GHz-26Gz) |
| Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. | |

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

| | | |
|---|---|---|
| Product Name: | 2K 4ch 1HDD wireless Recorder | |
| Model No.: | W2K4NVR | |
| Operating Frequency: | IEEE 802.11B SISO/g/n(HT20): 2412MHz to 2462MHz | |
| 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: OFDM (64QAM, 16QAM, QPSK, BPSK) | |
| Channel Number: | IEEE 802.11b, 802.11g, IEEE 802.11n(HT20): 11 Channels | |
| Channels Step: | Channels with 5MHz step | |
| Sample Type: | Fixed production | |
| Test power grade: | 11B:9 (manufacturer declare)<br>11G:7 (manufacturer declare)<br>11N(HT20):7 (manufacturer declare) | |
| Test software of EUT: | Artgui (manufacturer declare) | |
| Antenna Type: | Dipole Antenna | |
| Antenna Gain: | Antenna 1: | 5 dBi |
| | Antenna 2: | 5 dBi |
| Power Supply | Adapter | Model:EUSA+24120-2000<br>INPUT:100-240V~,50/60Hz, 0.6A<br>OUTPUT:12V ⎓2A |

## 5.2. MAXIMUM OUTPUT POWER

| Frequency Range (MHz) | Number of Transmit Chains (NTX) | IEE Std. 802.11 | Channel Number | Max PK Conducted Power-Antenna 1 (dBm) | Max PK Conducted Power-Antenna 2 (dBm) | Max PK Conducted Power-Antenna1+2 (dBm) |
|---|---|---|---|---|---|---|
| 2412-2462 | 1/2 | IEEE 802.11B SISO | 1-11[11] | 9.77 | 9.24 | 12.55 |
| 2412-2462 | 1/2 | IEEE 802.11G SISO | 1-11[11] | 13.70 | 12.78 | 16.27 |
| 2412-2462 | 1/2 | IEEE 802.11nHT20 MIMO | 1-11[11] | 13.29 | 12.47 | 15.80 |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under those modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

## 5.3. CHANNEL LIST

| Channel List for 802.11b/g/n (20 MHz) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 1 | 2412 | 4 | 2427 | 7 | 2442 | 10 | 2457 |
| 2 | 2417 | 5 | 2432 | 8 | 2447 | 11 | 2462 |
| 3 | 2422 | 6 | 2437 | 9 | 2452 | / | / |

## 5.4. TEST CHANNEL CONFIGURATION

| Test Mode | Test Channel | Frequency |
|---|---|---|
| WiFi TX(802.11b) | CH 1, CH 6, CH 11 | 2412MHz, 2437MHz, 2462MHz |
| WiFi TX(802.11g) | CH 1, CH 6, CH 11 | 2412MHz, 2437MHz, 2462MHz |
| WiFi TX(802.11n HT20) | CH 1, CH 6, CH 11 | 2412MHz, 2437MHz, 2462MHz |

## 5.5. THE WORSE CASE CONFIGURATIONS

**1TX Mode**

| The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test Software | | cart | | | | | |
| Modulation Mode | Transmit Antenna Number | Test Channel | | | | | |
| | | NCB: 20MHz | | | NCB: 40MHz | | |
| | | CH 1 | CH 6 | CH 11 | CH 3 | CH 6 | CH 9 |
| 802.11b | 1 | 9 | 9 | 9 | N/A | | |
| 802.11g | 1 | 7 | 7 | 7 | | | |
| 802.11n HT20 | 1 | 7 | 7 | 7 | | | |
| 802.11n HT40 | 1 | N/A | N/A | N/A | N/A | N/A | N/A |

**2TX Mode**

| The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test Software | | cart | | | | | |
| Modulation Mode | Transmit Antenna Number | Test Channel | | | | | |
| | | NCB: 20MHz | | | NCB: 40MHz | | |
| | | CH 1 | CH 6 | CH 11 | CH 3 | CH 6 | CH 9 |
| 802.11b | 1&2 | 9 | 9 | 9 | N/A | | |
| 802.11g | 1&2 | 7 | 7 | 7 | | | |
| 802.11n HT20 | 1&2 | 7 | 7 | 7 | | | |
| 802.11n HT40 | 1&2 | N/A | N/A | N/A | N/A | N/A | N/A |

## 5.6. DESCRIPTION OF AVAILABLE ANTENNAS

| Ant. | Frequency (MHz) | Antenna Type | Antenna Gain (dBi) | Directional gain(dBi) |
|---|---|---|---|---|
| 1 | 2400-2483.5 | Dipole Antenna | 5 | 8.01 |
| 2 | 2400-2483.5 | Dipole Antenna | 5 | |

Note:

1） Directional gain= 10log $[(10^{G1/20}+10^{G2/20})^2/N_{ANT}]$ =8.01 dBi

2） $N_{ANT}$: the number of Antenna

| Test Mode | Transmit and Receive Mode | Description |
|---|---|---|
| IEEE 802.11b | ☒1TX, 1RX | Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently. |
| IEEE 802.11g | ☒1TX, 1RX | Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently. |
| IEEE 802.11N (HT20) SISO | ☒1TX, 1RX | Antenna1 or Antenna2 can be used as transmitting/receiving antenna independently. |
| IEEE 802.11N (HT20) MIMO | ☒2TX, 2RX | Both antennas can be used as transmitting/receiving antenna. |

## 5.7. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Item | Equipment | Brand Name | Model Name | FCC ID |
|---|---|---|---|---|
| 1 | Laptop | ThinkPad | T410 | N/A |

**I/O CABLES**

| Cable No | Port | Connector Type | Cable Type | Cable Length(m) | Remarks |
|---|---|---|---|---|---|
| 1 | LAN | LAN | N/A | N/A | N/A |

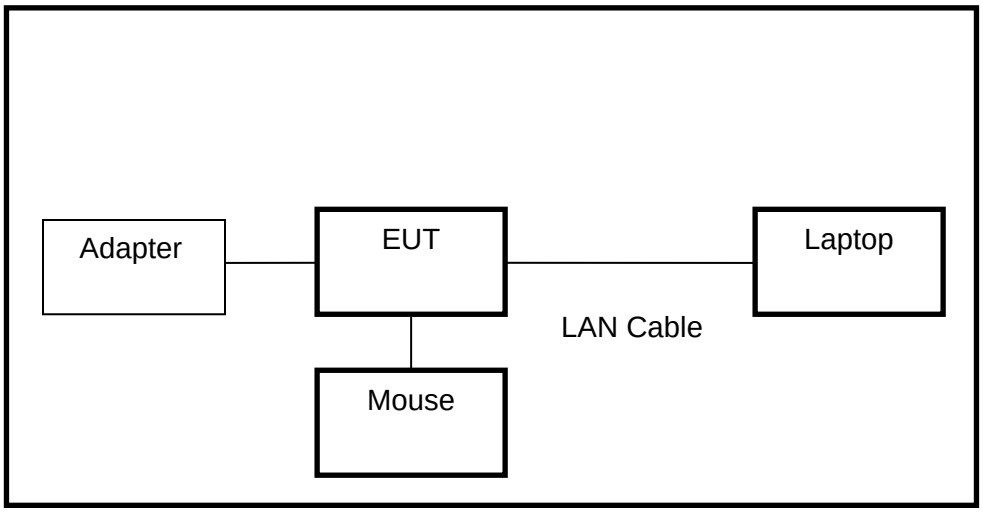
**ACCESSORIES**

| Item | Accessory | Brand Name | Model Name | Description |
|---|---|---|---|---|
| 1 | Mouse | / | RTM 019 | / |

**TEST SETUP**

The EUT can work in engineering mode with a software through a Laptop.

**SETUP DIAGRAM FOR TESTS**



# 6. MEASURING INSTRUMENT AND SOFTWARE USED

| **Conducted Emissions(**Instrument**)** | | | | | | |
|---|---|---|---|---|---|---|
| Used | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Next Cal. |
| ☑ | EMI Test Receiver | R&S | ESR3 | 101961 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | Two-Line V-Network | R&S | ENV216 | 101983 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | Artificial Mains Networks | Schwarzbeck | NSLK 8126 | 8126465 | Dec.12, 2017 | Dec.11, 2018 |
| Software | | | | | | |
| Used | Description | | Manufacturer | Name | Version | |
| ☑ | Test Software for Conducted disturbance | | UL | Antenna port | Ver. 7.2 | |
| **Radiated Emissions(**Instrument**)** | | | | | | |
| Used | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Next Cal. |
| ☑ | MXE EMI Receiver | KESIGHT | N9038A | MY56400036 | Dec. 12, 2017 | Dec. 11, 2018 |
| ☑ | Hybrid Log Periodic Antenna | TDK | HLP-3003C | 130960 | Jan.09, 2016 | Jan.09, 2019 |
| ☑ | Preamplifier | HP | 8447D | 2944A09099 | Dec. 12, 2017 | Dec. 11, 2018 |
| ☑ | EMI Measurement Receiver | R&S | ESR26 | 101377 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | Horn Antenna | TDK | HRN-0118 | 130939 | Jan. 09, 2016 | Jan. 09, 2019 |
| ☑ | High Gain Horn Antenna | Schwarzbeck | BBHA-9170 | 691 | Jan.06, 2016 | Jan.06, 2019 |
| ☑ | Preamplifier | TDK | PA-02-0118 | TRS-305-00066 | Dec. 12, 2017 | Dec. 11, 2018 |
| ☑ | Preamplifier | TDK | PA-02-2 | TRS-307-00003 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | Loop antenna | Schwarzbeck | 1519B | 00008 | Mar. 26, 2016 | Mar. 26, 2019 |
| ☑ | Band Reject Filter | Wainwright | WRCJV8-2350-2400-2483.5-2533.5-40SS | 4 | Dec.12, 2017 | Dec.11, 2018 |
| Software | | | | | | |
| Used | Description | | Manufacturer | Name | Version | |
| ☑ | Test Software for Radiated disturbance | | Farad | EZ-EMC | Ver. UL-3A1 | |
| **Other instruments** | | | | | | |
| Used | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Next Cal. |
| ☑ | Spectrum Analyzer | Keysight | N9030A | MY55410512 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | Power Meter | Keysight | N9031A | MY55416024 | Dec.12, 2017 | Dec.11, 2018 |

| | | | | | | |
|---|---|---|---|---|---|---|
| ☑ | Power Sensor | Keysight | N9323A | MY55440013 | Dec.12, 2017 | Dec.11, 2018 |

## 7. MEASUREMENT METHODS

| No. | Test Item | KDB Name | Section |
|---|---|---|---|
| 1 | 6dB Bandwidth | KDB 558074 D01 DTS Meas Guidance v05 | 8.2 |
| 2 | Peak Output Power | KDB 558074 D01 DTS Meas Guidance v05 | 8.3.1.3/8.3.2.3 |
| 3 | Power Spectral Density | KDB 558074 D01 DTS Meas Guidance v05 | 8.4 |
| 4 | Out-of-band emissions in non-restricted bands | KDB 558074 D01 DTS Meas Guidance v05 | 8.5 |
| 5 | Out-of-band emissions in restricted bands | KDB 558074 D01 DTS Meas Guidance v05 | 8.6 |
| 6 | Band-edge | KDB 558074 D01 DTS Meas Guidance v05 | 8.7 |
| 7 | Conducted Emission Test For AC Power Port | ANSI C63.10-2013 | 6.2 |

# 8. ANTENNA PORT TEST RESULTS

## 8.1. ON TIME AND DUTY CYCLE

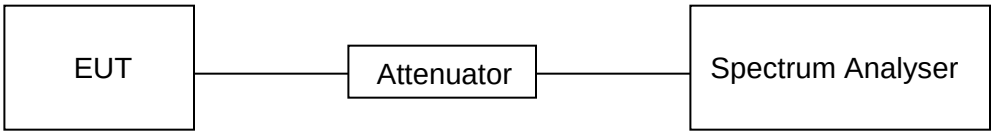
**LIMITS**

None; for reporting purposes only

**PROCEDURE**

KDB 558074 Zero-Span Spectrum Analyzer Method

**TEST SETUP**




**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 25°C | Relative Humidity | 58% |
| Atmosphere Pressure | 101kPa | Test Voltage | DC 12.0V |

**RESULTS**

| Mode | On Time (msec) | Period (msec) | Duty Cycle x (Linear) | Duty Cycle | Duty Cycle Correction Factor (db) | 1/T Minimum VBW (KHz) |
|---|---|---|---|---|---|---|
| 11B SISOSISO | 12.19 | 12.235 | 1 | 0.9963 | 0.016 | 0.082 |
| 11G SISOSISO | 2.019 | 2.074 | 1 | 0.9735 | 0.117 | 0.495 |
| 11N20MIMO | 1.882 | 1.938 | 1 | 0.9711 | 0.127 | 0.531 |

Note: 1) Duty Cycle Correction Factor=10log(1/x).
2) Where: x is Duty Cycle(Linear)
3) Where: T is On Time (transmit duration)
4) Pre-testing Antenna 1 and Antenna2, and pre-testing SISO and MIMO modes, only the data of worse case is shown in this test repot.

11B SISO ON TIME AND DUTY CYCLE MID CH


11G SISO ON TIME AND DUTY CYCLE MID CH

11n HT20 ON TIME AND DUTY CYCLE MID CH


Remark:

1) For the period time=N(the end time of the burst)-F(the start time of the burst)

## 8.2. 6 dB DTS BANDWIDTH AND 99% OCCUPIED BANDWIDTH

**LIMITS**

| CFR 47 FCC Part15 (15.247) Subpart C<br>ISED RSS-247 ISSUE 2 | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| CFR 47 FCC 15.247(a)(2)<br>ISED RSS-247 5.2 (a) | 6 dB Bandwidth | ≥ 500KHz | 2400-2483.5 |
| ISED RSS-Gen Clause 6.7 | 99% Occupied Bandwidth | For reporting purposes only. | 2400-2483.5 |

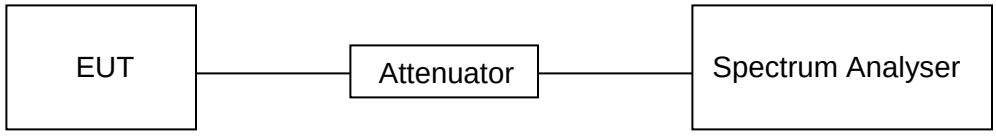
**TEST PROCEDURE**

Connect the UUT to the spectrum analyser and use the following settings:

| | |
|---|---|
| Center Frequency | The centre frequency of the channel under test |
| Detector | Peak |
| RBW | For 6dB Bandwidth :100K<br>For 99% Occupied Bandwidth :1% to 5% of the occupied bandwidth |
| VBW | For 6dB Bandwidth : ≥3 × RBW<br>For 99% Occupied Bandwidth : approximately 3×RBW |
| Trace | Max hold |
| Sweep | Auto couple |

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

**TEST SETUP**



**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 25°C | Relative Humidity | 58% |
| Atmosphere Pressure | 101kPa | Test Voltage | DC 12.0V |

**RESULTS**

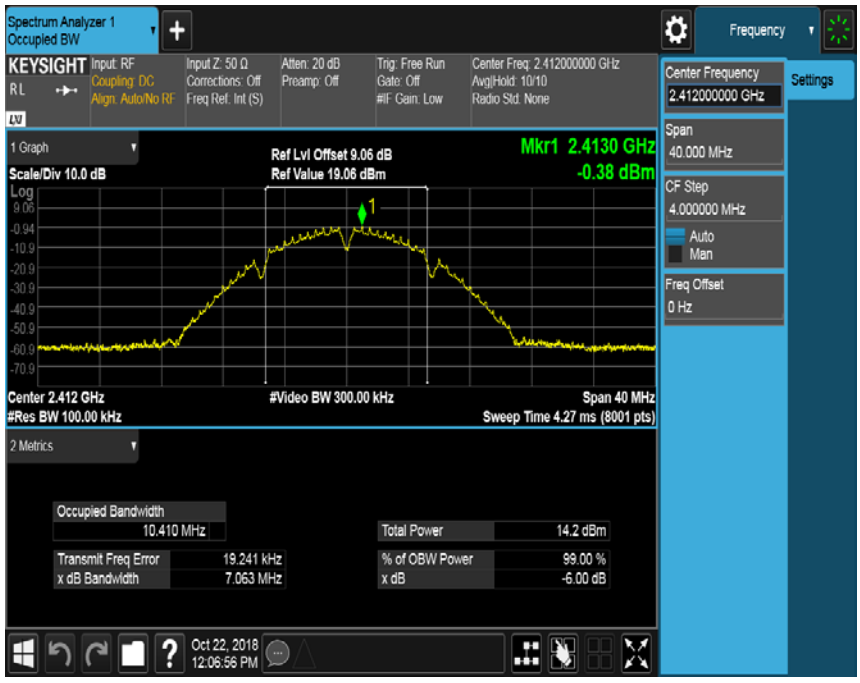
### 8.2.1. 802.11b MODE

**ANTENNA 1**

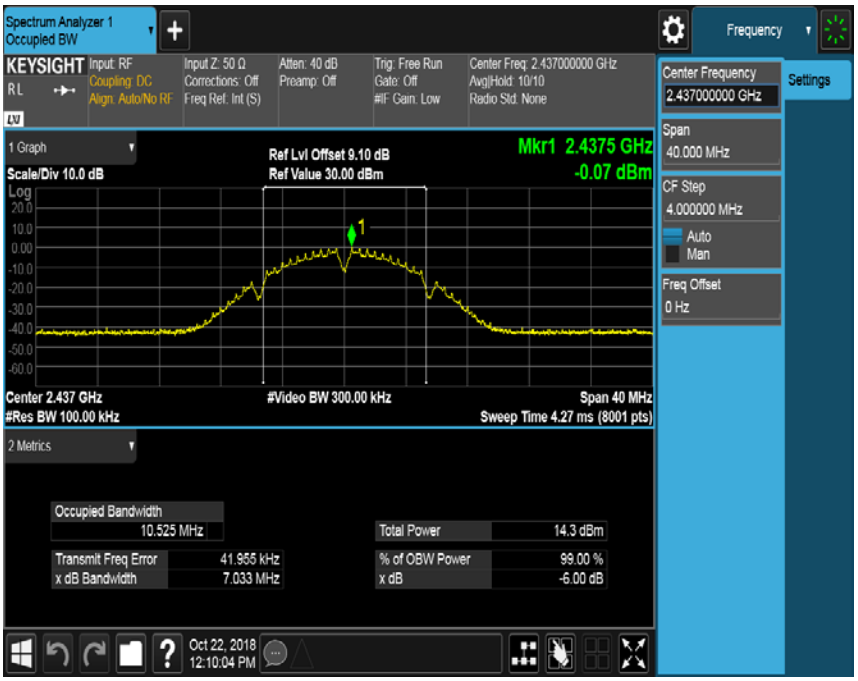
| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 7.063 | 10.41 | ≥500 | Pass |
| Middle | 7.033 | 10.53 | ≥500 | Pass |
| High | 6.577 | 10.76 | ≥500 | Pass |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

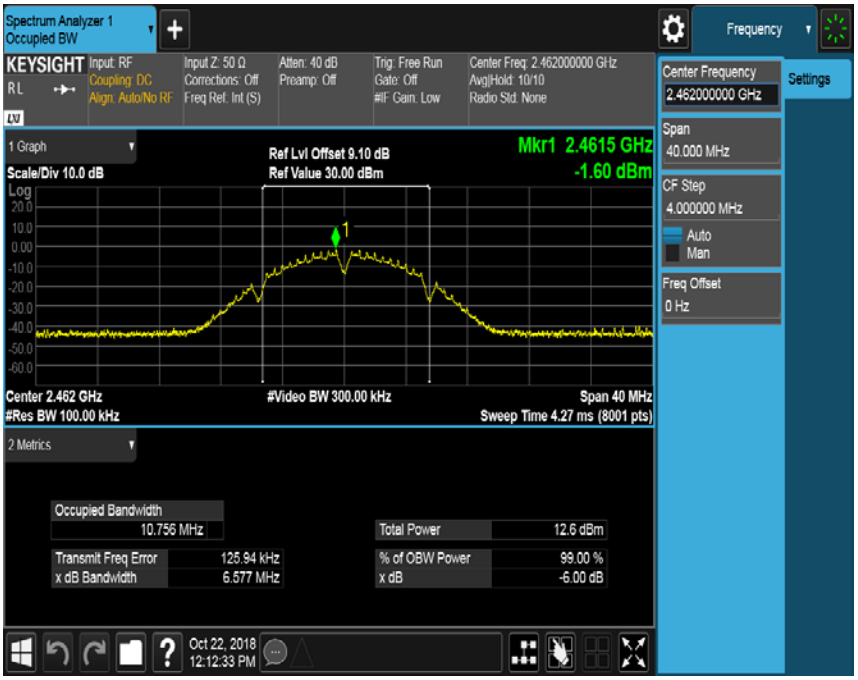
6 dB AND 99% BANDWIDTH LOW CH



6 dB AND 99% BANDWIDTH MID CH




6 dB AND 99% BANDWIDTH HIGH CH

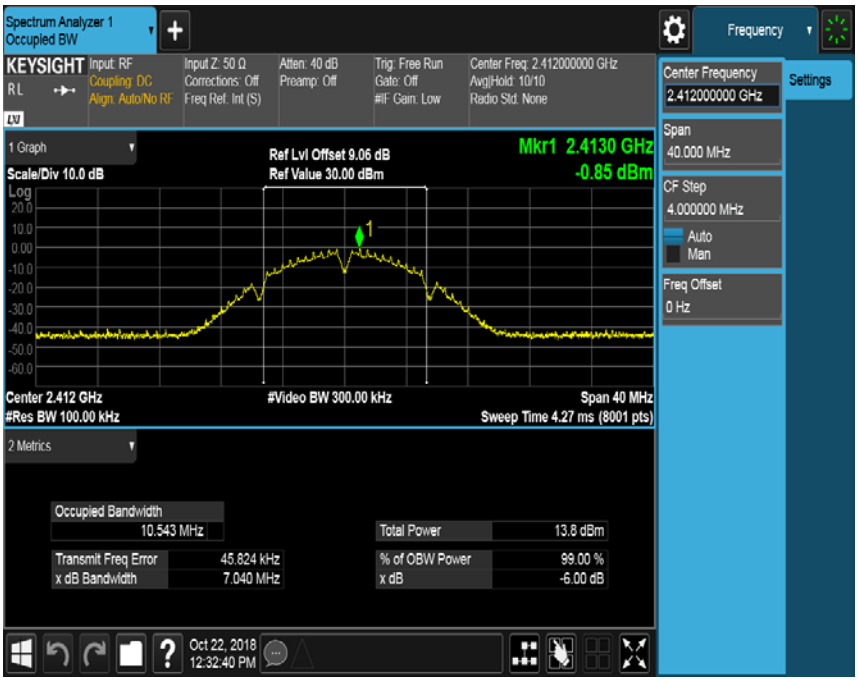


**ANTENNA 2**

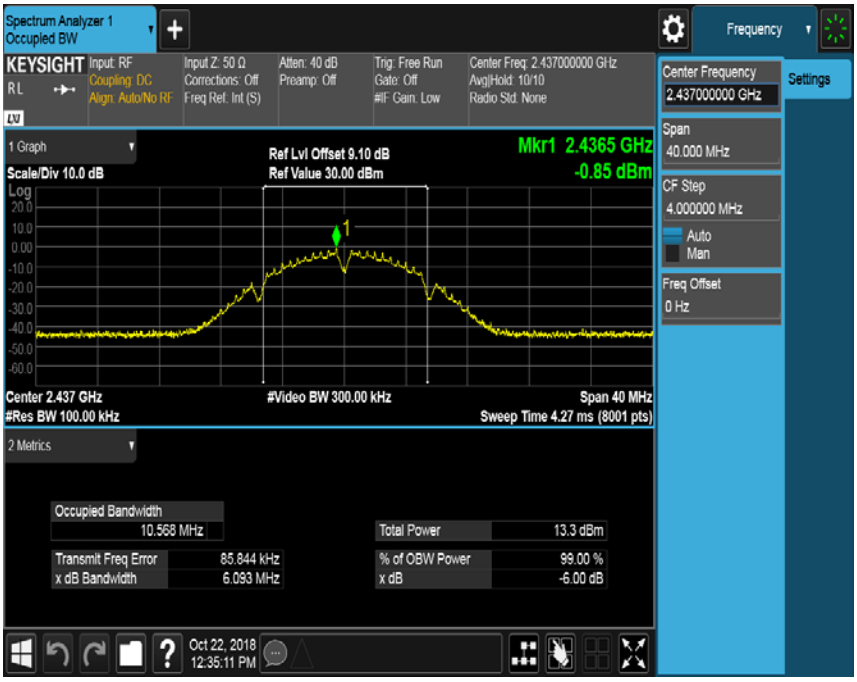
| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 7.040 | 10.54 | ≥500 | Pass |
| Middle | 6.093 | 10.57 | ≥500 | Pass |
| High | 7.049 | 10.89 | ≥500 | Pass |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

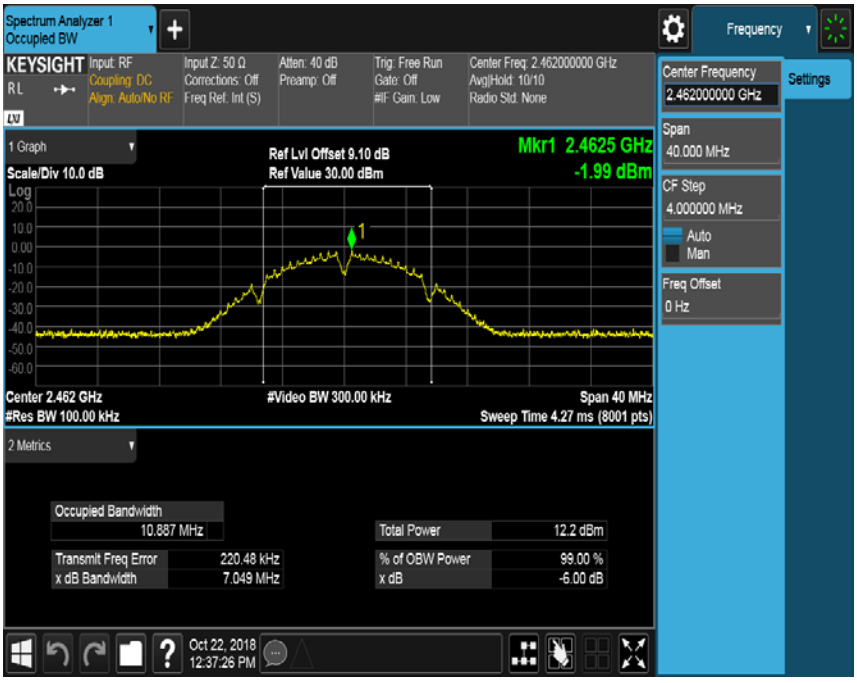
6 dB AND 99% BANDWIDTH LOW CH



6 dB AND 99% BANDWIDTH MID CH




6 dB AND 99% BANDWIDTH HIG CH



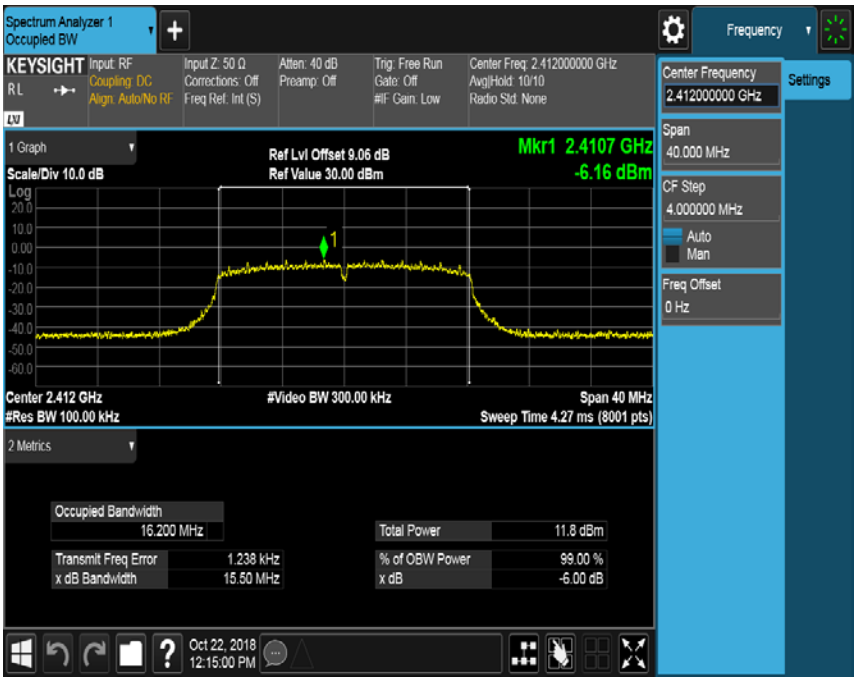
### 8.2.2. 802.11g MODE

**ANTENNA 1**

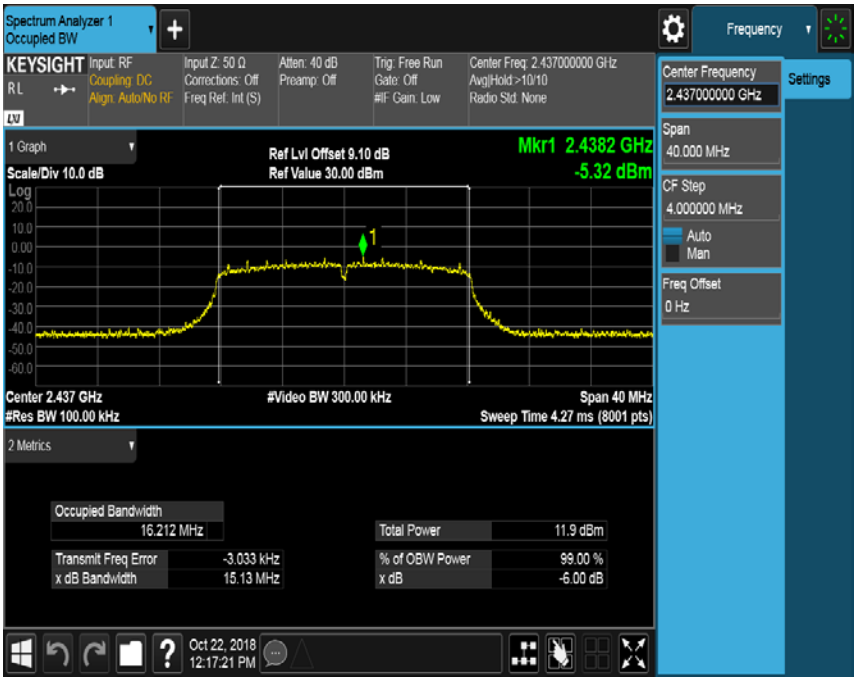
| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 15.50 | 16.20 | ≥500 | Pass |
| Middle | 15.13 | 16.21 | ≥500 | Pass |
| High | 15.11 | 16.23 | ≥500 | Pass |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

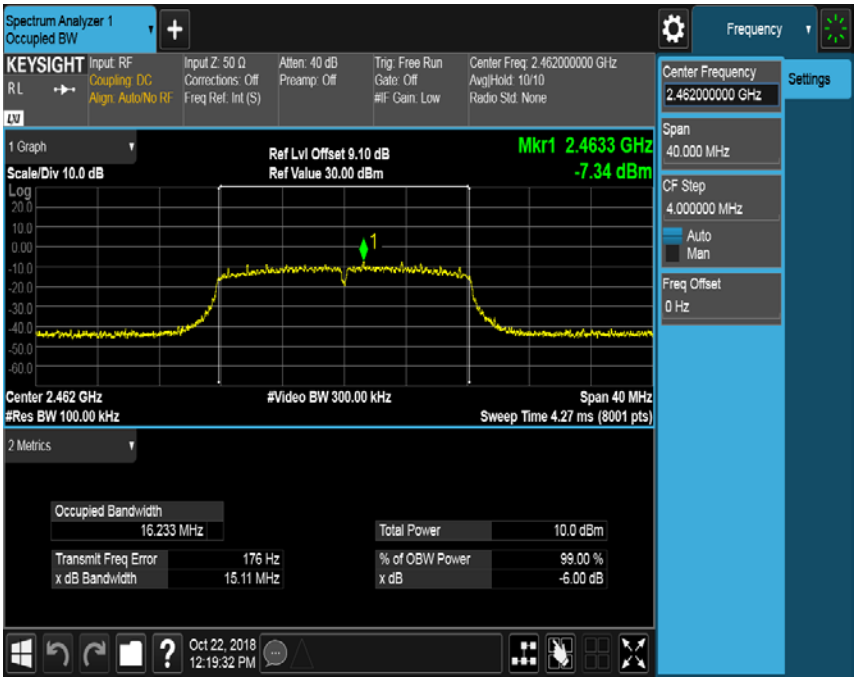
6 dB AND 99% BANDWIDTH LOW CH



6 dB AND 99% BANDWIDTH MID CH




6 dB AND 99% BANDWIDTH HIGH CH

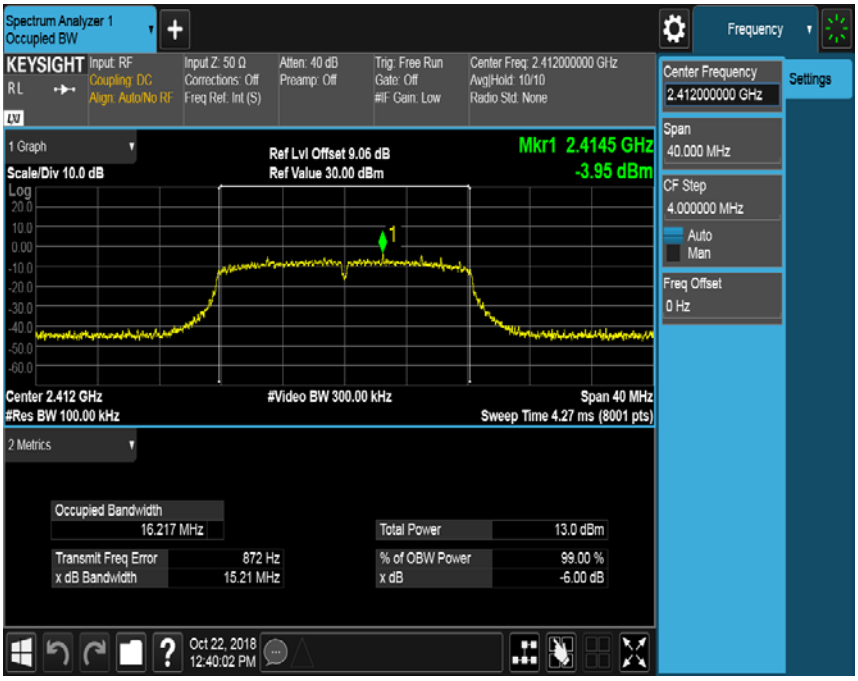


**ANTENNA 2**

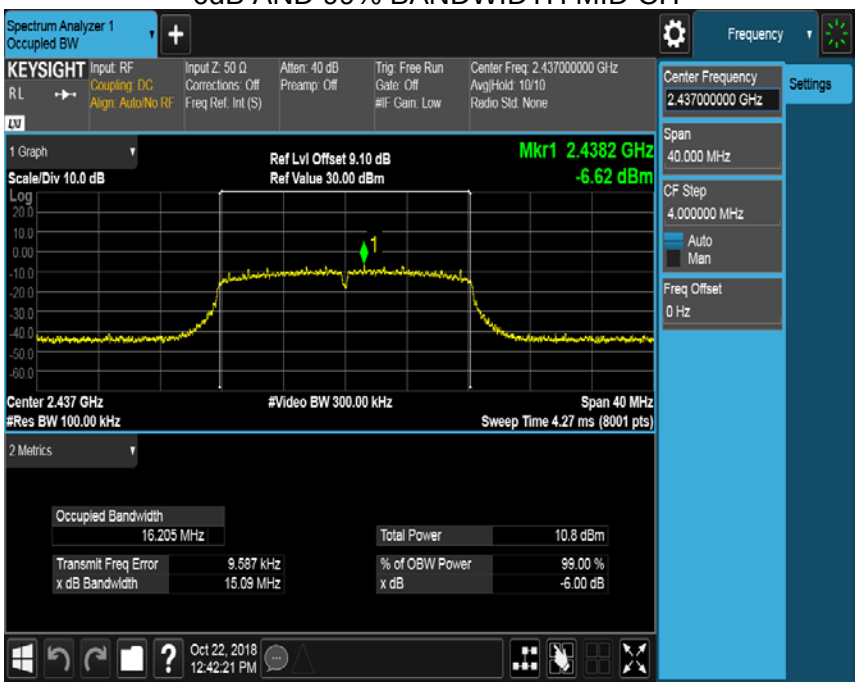
| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 15.50 | 16.20 | ≥500 | Pass |
| Middle | 15.13 | 16.21 | ≥500 | Pass |
| High | 15.11 | 16.23 | ≥500 | Pass |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

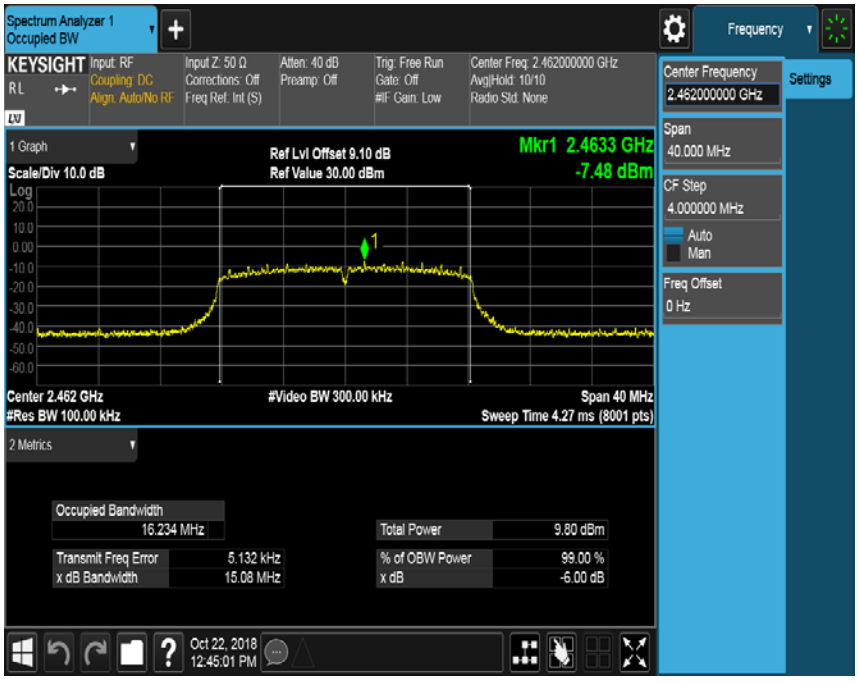
6dB AND 99%BANDWIDTH LOW CH



6dB AND 99% BANDWIDTH MID CH




6dB AND 99% BANDWIDTH HIGH CH



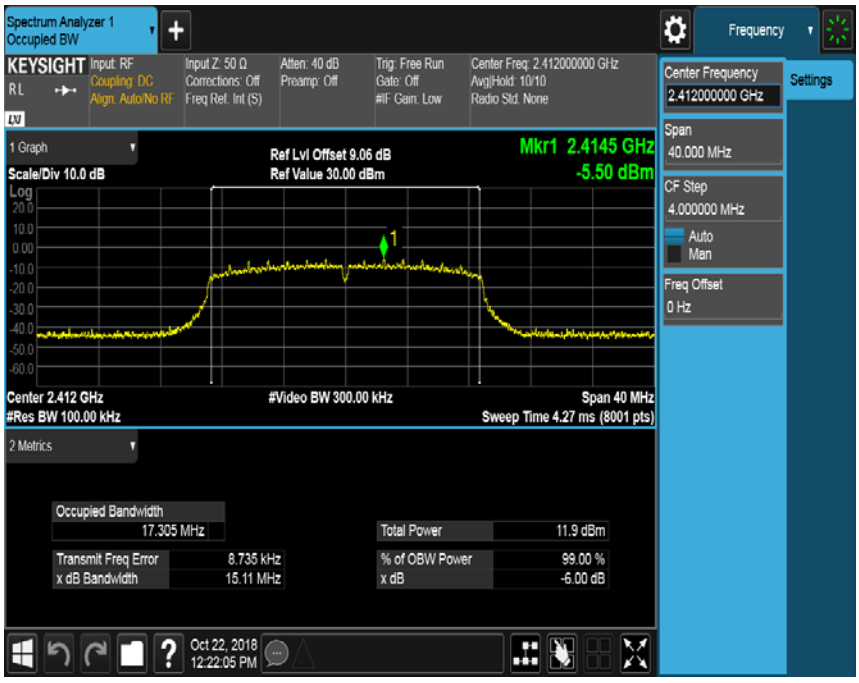
### 8.2.3. 802.11n HT20 MODE

**ANTENNA 1**

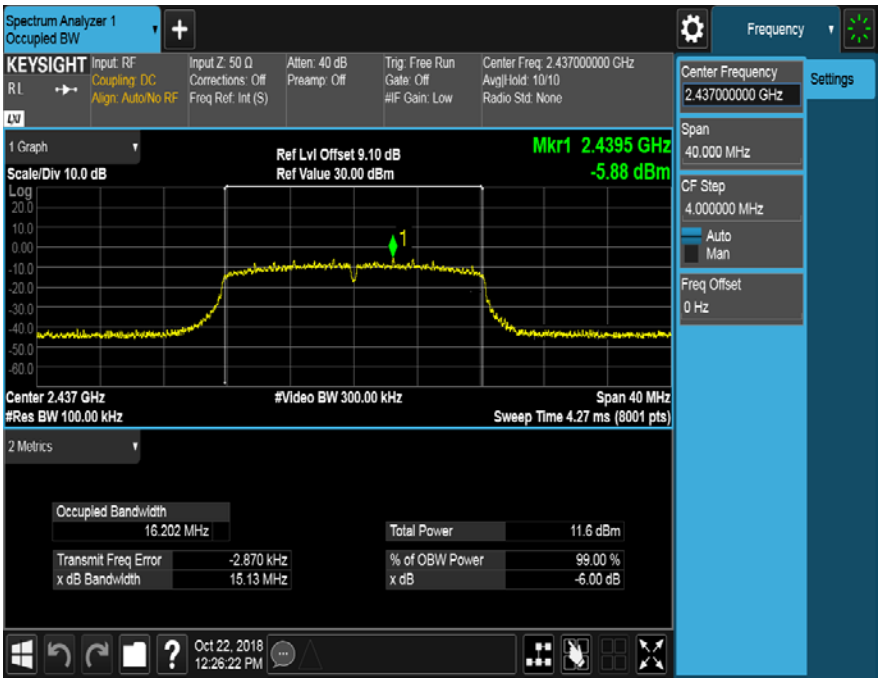
| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 15.11 | 17.31 | ≥500 | Pass |
| Middle | 15.13 | 16.20 | ≥500 | Pass |
| High | 14.70 | 17.34 | ≥500 | Pass |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

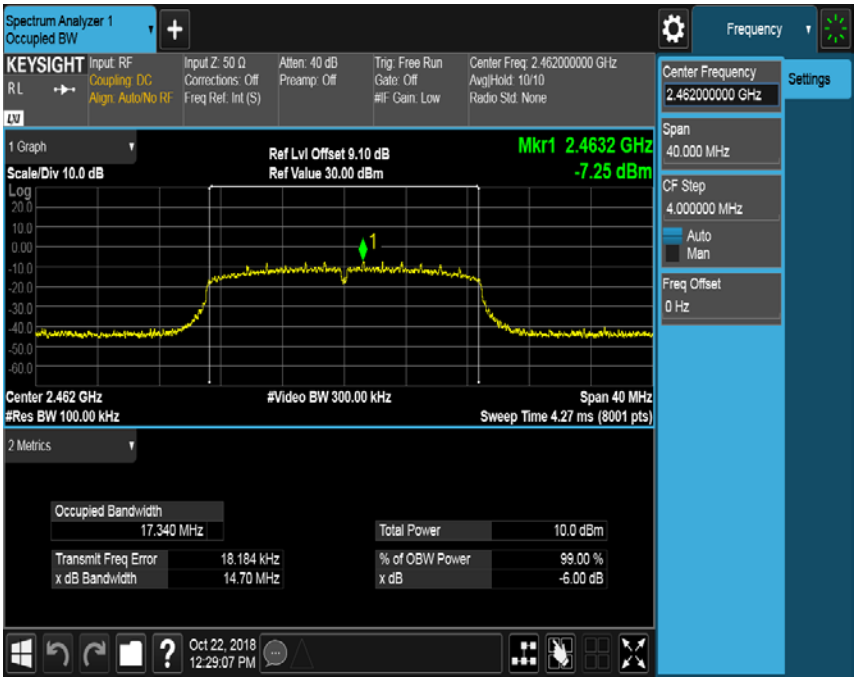
6dB AND 99% BANDWIDTH LOW CH



6dB AND 99% BANDWIDTH MID CH




6dB AND 99% BANDWIDTH HIGH CH



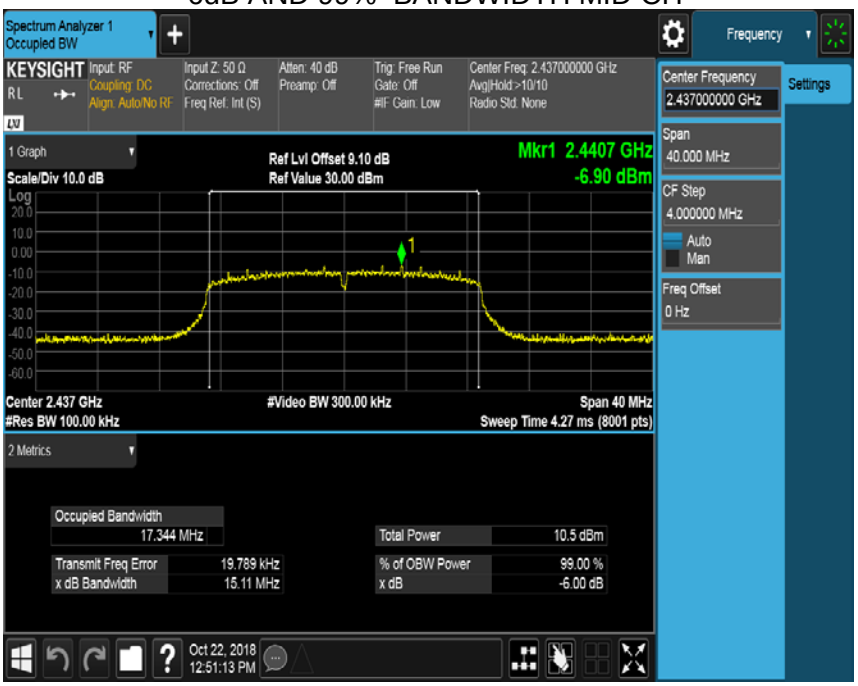
**ANTENNA 2**

| Channel | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| Low | 15.11 | 17.33 | ≥500 | Pass |
| Middle | 15.11 | 17.34 | ≥500 | Pass |
| High | 15.11 | 17.36 | ≥500 | Pass |

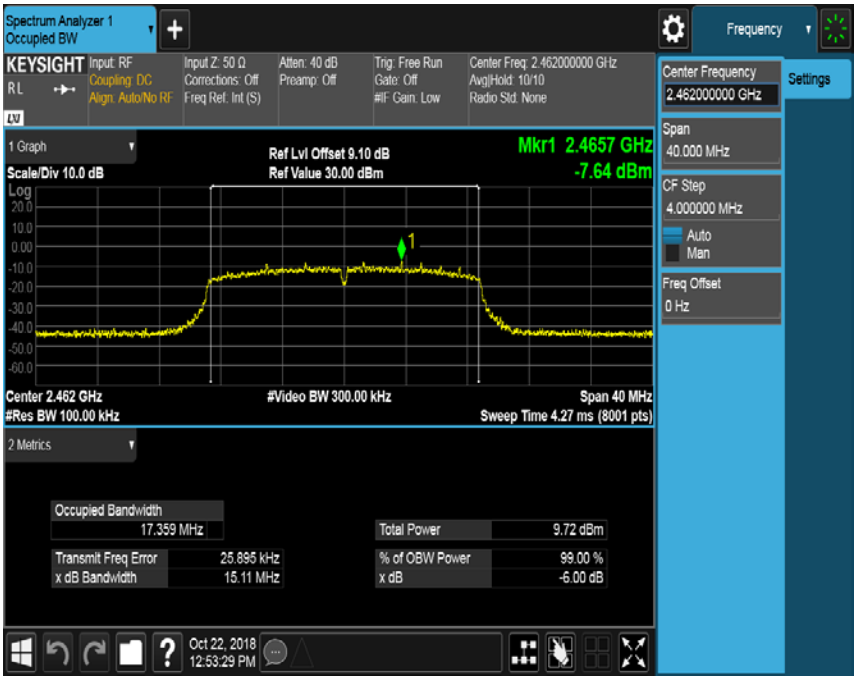
Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

6dB AND 99% BANDWIDTH LOW CH

6dB AND 99% BANDWIDTH MID CH




6dB AND 99% BANDWIDTH HIGH CH




Note: All modes and antennas had been tested, but only the worst data recorded in the report.

## 8.3. PEAK CONDUCTED OUTPUT POWER

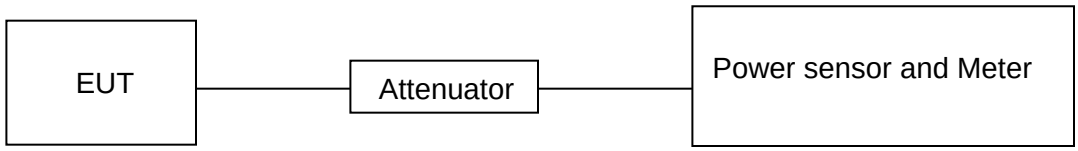
**LIMITS**

| CFR 47 FCC Part15 (15.247) Subpart C<br>ISED RSS-247 ISSUE 2 | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| CFR 47 FCC 15.247(b)(3)<br>ISED RSS-247 5.4 (e) | Peak Output Power | 1 watt or 30dBm<br>(See Note 1/2) | 2400-2483.5 |
| 1. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.<br>2. Limit=30dBm – (Directional gain -6)dBi<br>Directional gain = $10\log[(10^{G1/20}+10^{G2/20})^2/N_{ANT}] = 8.01 > 6$dBi,where the $N_{ANT}$ is the numbers of antenna. So, the power limit shall be reduced to 30 – (8.01-6) = 27.99 dBm | | | |

**TEST PROCEDURE**

Place the EUT on the table and set it in the transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
Measure peak power each channel.
Peak Detector use for Peak result.
AVG Detector use for AVG result.

**TEST SETUP**




**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 25°C | Relative Humidity | 58% |
| Atmosphere Pressure | 101kPa | Test Voltage | DC 12.0V |

**RESULTS**

### 8.3.1. 802.11b MODE-SISO

**SISO MODE**

| Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 9.77 | 12.52 | PASS |
| | 2 | 9.24 | | |
| Middle | 1 | 9.72 | 12.14 | |
| | 2 | 8.45 | | |
| High | 1 | 8.03 | 10.88 | |
| | 2 | 7.71 | | |

| Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 7.25 | 10.09 | PASS |
| | 2 | 6.91 | | |
| Middle | 1 | 7.24 | 9.82 | |
| | 2 | 6.34 | | |
| High | 1 | 5.59 | 8.47 | |
| | 2 | 5.33 | | |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

### 8.3.2. 802.11g MODE-SISO

**SISO MODE**

| Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 13.70 | 16.27 | PASS |
| | 2 | 12.78 | | |
| Middle | 1 | 13.40 | 15.86 | |
| | 2 | 12.21 | | |
| High | 1 | 11.89 | 14.58 | |
| | 2 | 11.23 | | |

| Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 5.54 | 9.41 | PASS |
| | 2 | 7.12 | | |
| Middle | 1 | 5.09 | 8.94 | |
| | 2 | 6.64 | | |
| High | 1 | 3.55 | 7.49 | |
| | 2 | 5.24 | | |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

### 8.3.3. 802.11n HT20 MODE-MIMO

**MIMO MODE**

| Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 13.09 | 15.80 | PASS |
| | 2 | 12.47 | | |
| Middle | 1 | 13.29 | 15.75 | |
| | 2 | 12.12 | | |
| High | 1 | 11.13 | 14.06 | |
| | 2 | 10.96 | | |

| Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | 5.27 | 9.18 | PASS |
| | 2 | 6.92 | | |
| Middle | 1 | 4.86 | 8.76 | |
| | 2 | 6.48 | | |
| High | 1 | 3.34 | 7.30 | |
| | 2 | 5.07 | | |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical.

## 8.4. POWER SPECTRAL DENSITY

**LIMITS**

| CFR 47 FCC Part15 (15.247) Subpart C<br>ISED RSS-247 ISSUE 2 | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| CFR 47 FCC §15.247 (e)<br>ISED RSS-247 5.2 (b) | Power Spectral Density | 8 dBm/3 kHz<br>(See Note 1/2) | 2400-2483.5 |
| 1. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.<br>2. Limit=8dBm – (Directional gain -6)dBi<br>Directional gain = 10log[(10G1/20GANT + 10 log(NANT) dBi, where NANT is the number of outputs, GANT is the Antenna gain.<br>Directional gain = 10log $[(10^{G1/20}+10^{G2/20})^2/N_{ANT}]$ =8.01＞6dBi,where the NANT is the numbers of antenna. So, the power density limit shall be reduced to 8 – (8.01-6) = 5.99 dBm in any 3KHz band. | | | |

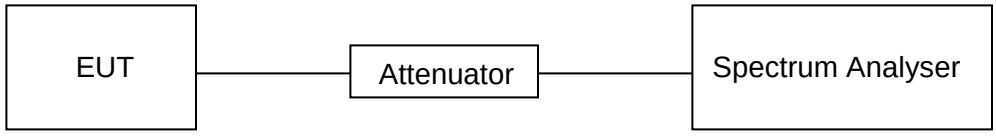
**TEST PROCEDURE**

Connect the UUT to the spectrum analyser and use the following settings:

| | |
|---|---|
| Center Frequency | The centre frequency of the channel under test |
| Detector | Peak |
| RBW | 3 kHz ≤ RBW ≤100 kHz |
| VBW | ≥3 × RBW |
| Span | 1.5 x DTS bandwidth |
| Trace | Max hold |
| Sweep time | Auto couple. |

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.
If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

**TEST SETUP**



**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 25°C | Relative Humidity | 58% |
| Atmosphere Pressure | 101kPa | Test Voltage | DC 12.0V |

**RESULTS**

### 8.4.1. 802.11b MODE

**SISO MODE**

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | -4.89 | -1.93 | 8 |
| | 2 | -4.99 | | |
| Middle | 1 | -4.41 | -1.89 | |
| | 2 | -5.46 | | |
| High | 1 | -5.97 | -3.41 | |
| | 2 | -6.92 | | |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.

**ANTENNA 1**

PSD LOW CH


PSD MID CH

PSD HIGH CH


**ANTENNA 2**

PSD LOW CH

PSD MID CH


PSD HIGH CH

### 8.4.1. 802.11g MODE

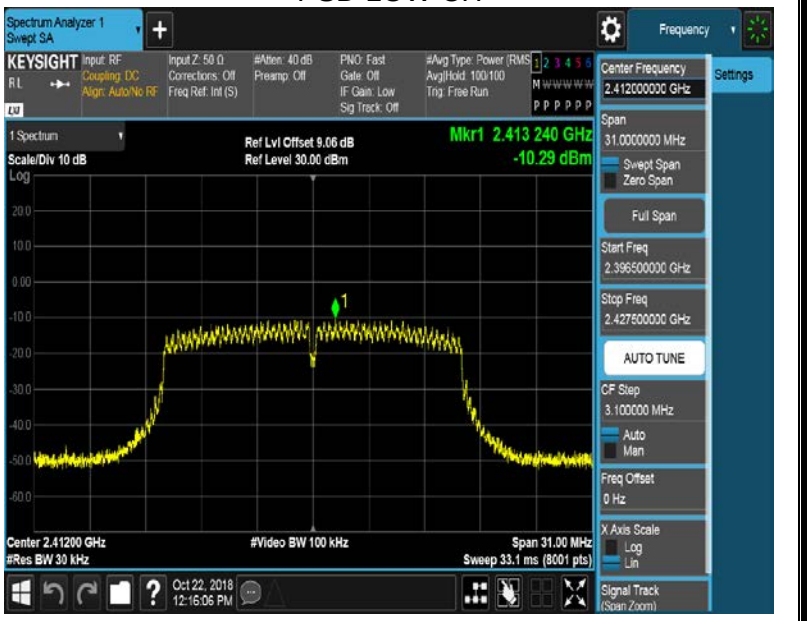
**SISO MODE**

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | -10.29 | -7.42 | 8 |
| | 2 | -10.57 | | |
| Middle | 1 | -9.94 | -7.43 | |
| | 2 | -11.00 | | |
| High | 1 | -10.88 | -8.61 | |
| | 2 | -12.51 | | |

Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.

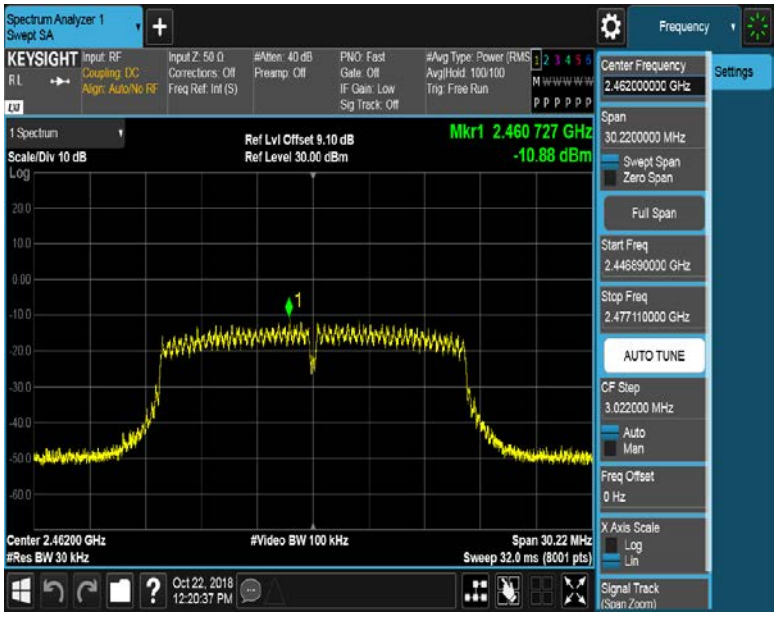
**ANTENNA 1**

PSD LOW CH



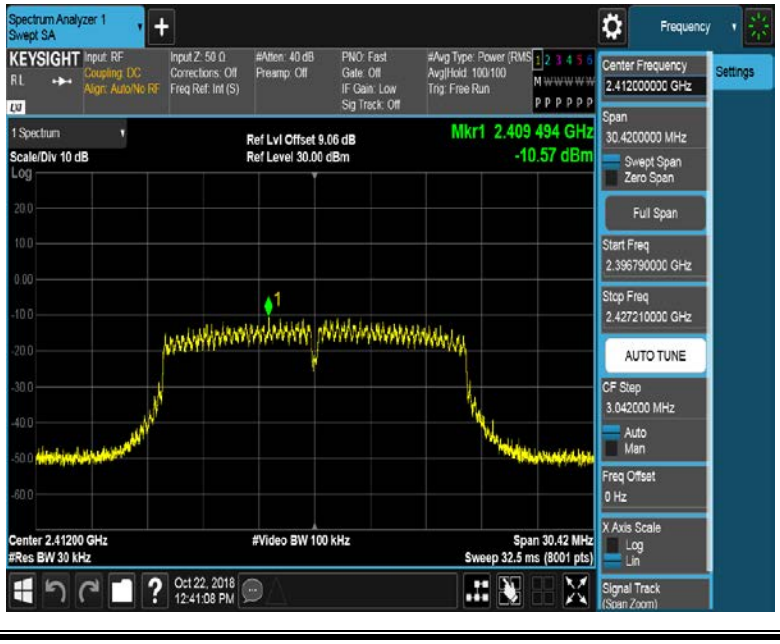

PSD MID CH

PSD HIGH CH

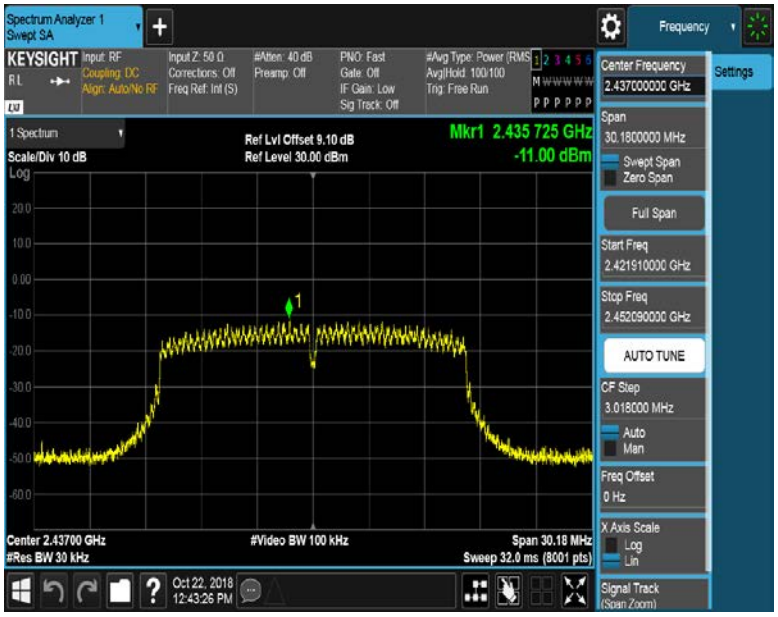



**ANTENNA 2**

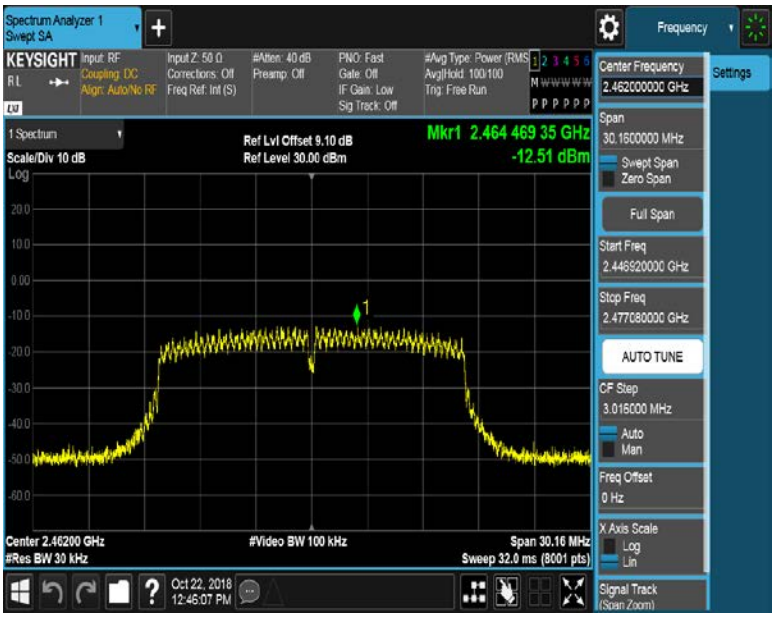
PSD LOW CH



PSD MID CH




PSD HIGH CH



### 8.4.2. 802.11n HT20 MODE

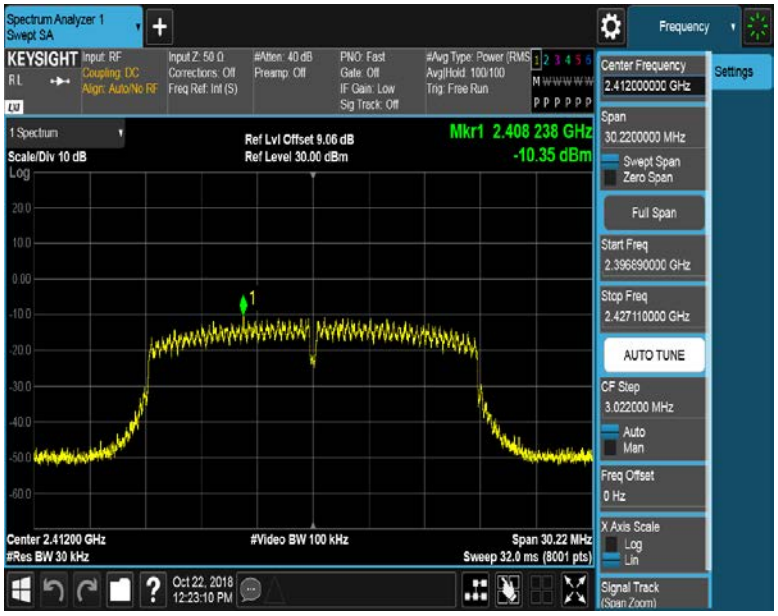
**MIMO MODE**

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| Low | 1 | -10.35 | -7.73 | 5.99 |
| | 2 | -11.16 | | |
| Middle | 1 | -9.96 | -7.59 | |
| | 2 | -11.34 | | |
| High | 1 | -12.08 | -9.32 | |
| | 2 | -12.60 | | |

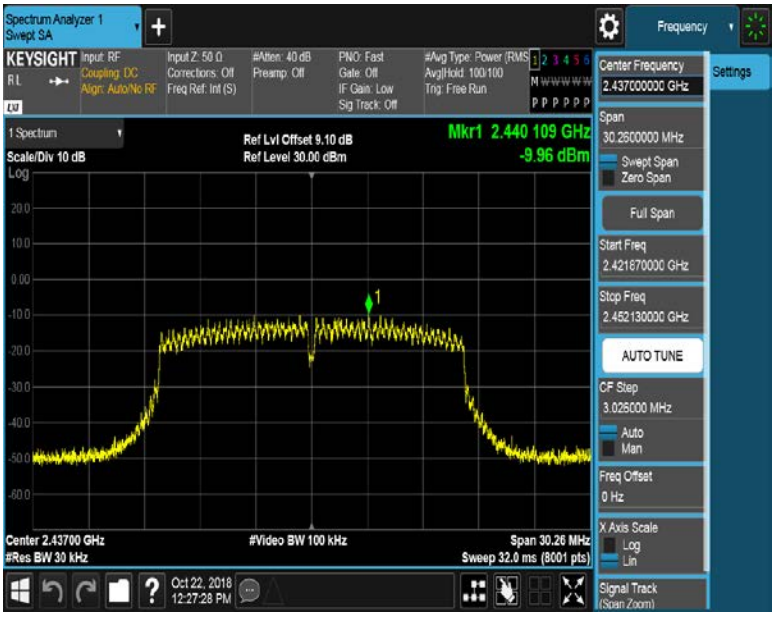
Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report.

**ANTENNA 1**

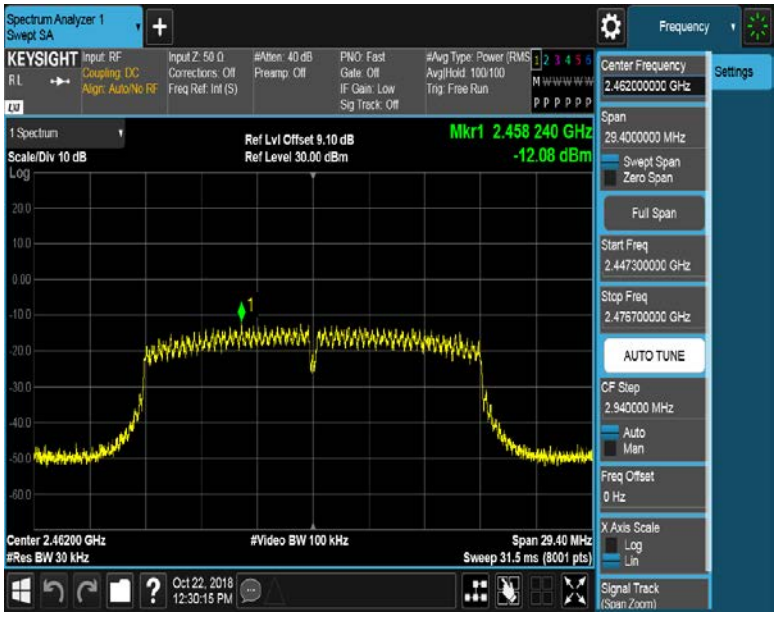
PSD LOW CH




PSD MID CH

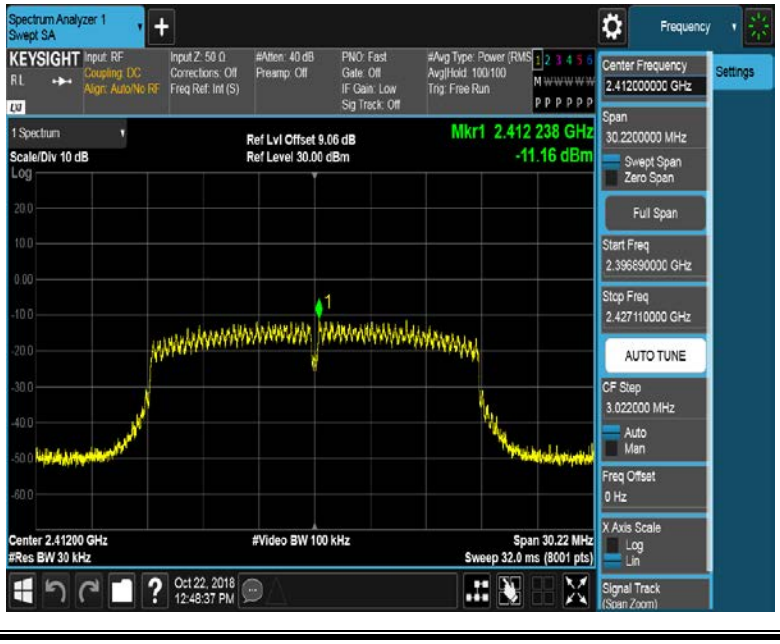


PSD HIGH CH

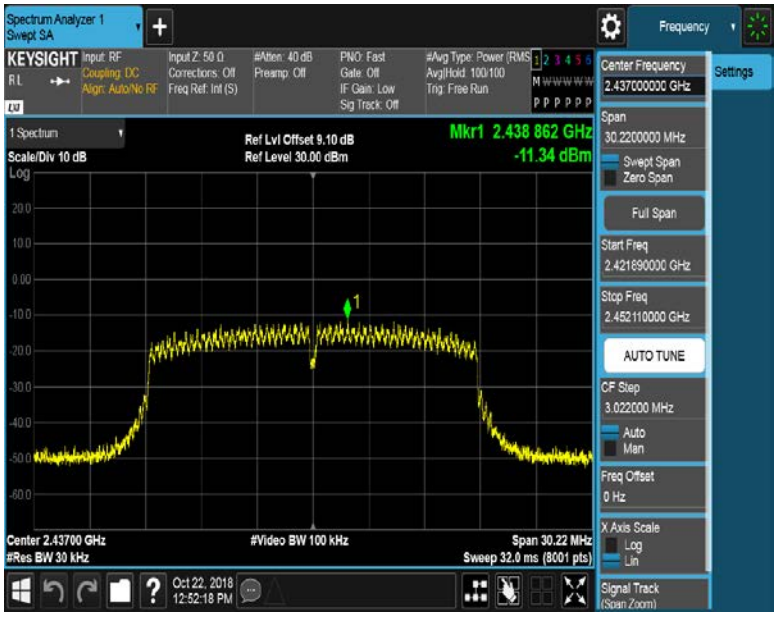



**ANTENNA 2**

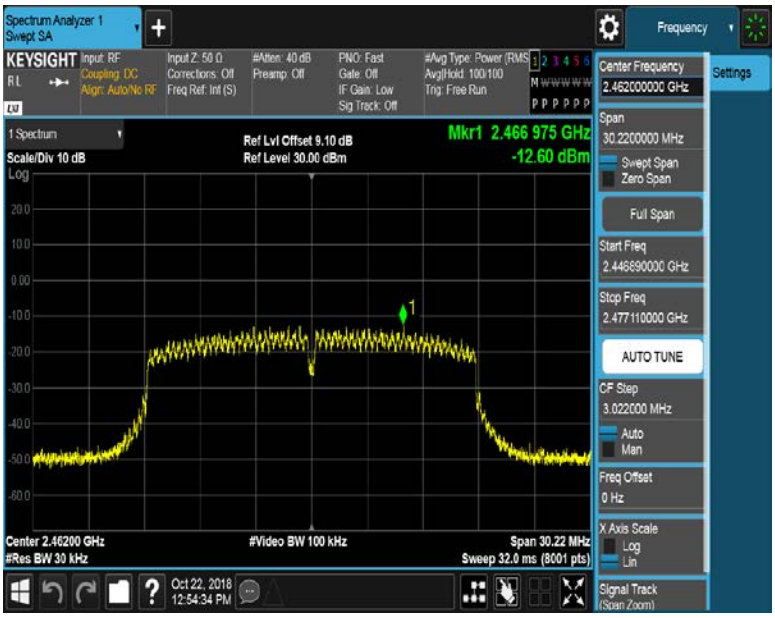
PSD LOW CH



PSD MID CH




PSD HIGH CH



## 8.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

**LIMITS**

| CFR 47 FCC Part15 (15.247) Subpart C<br>ISED RSS-247 ISSUE 2 | | |
|---|---|---|
| Section | Test Item | Limit |
| CFR 47 FCC §15.247 (d)<br>ISED RSS-247 5.5 | Conducted Bandedge and Spurious Emissions | at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power |
| Remark: For this product, it has two antennas, antenna1 and antenna2, the 802.11B SISO&802.11G SISO modes are use the SISO technical, but the ant1 and ant2 can transmitter in the same time under these modes. The 802.11N(HT20) is use both the SISO and MIMO technical, pre-testing both the SISO and MIMO modes, only the data of worse case is shown in this report. | | |

**TEST PROCEDURE**

Connect the UUT to the spectrum analyser and use the following settings:

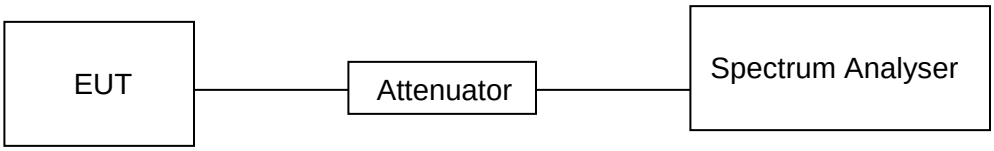
| | |
|---|---|
| Center Frequency | The centre frequency of the channel under test |
| Detector | Peak |
| RBW | 100K |
| VBW | ≥3 × RBW |
| Span | 1.5 x DTS bandwidth |
| Trace | Max hold |
| Sweep time | Auto couple. |

Use the peak marker function to determine the maximum PSD level.

| | |
|---|---|
| Span | Set the center frequency and span to encompass frequency range to be measured |
| Detector | Peak |
| RBW | 100K |
| VBW | ≥3 × RBW |
| measurement points | ≥span/RBW |
| Trace | Max hold |
| Sweep time | Auto couple. |

Use the peak marker function to determine the maximum amplitude level**.**

**TEST SETUP**




**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 25°C | Relative Humidity | 58% |
| Atmosphere Pressure | 101kPa | Test Voltage | DC 12.0V |

**RESULTS**

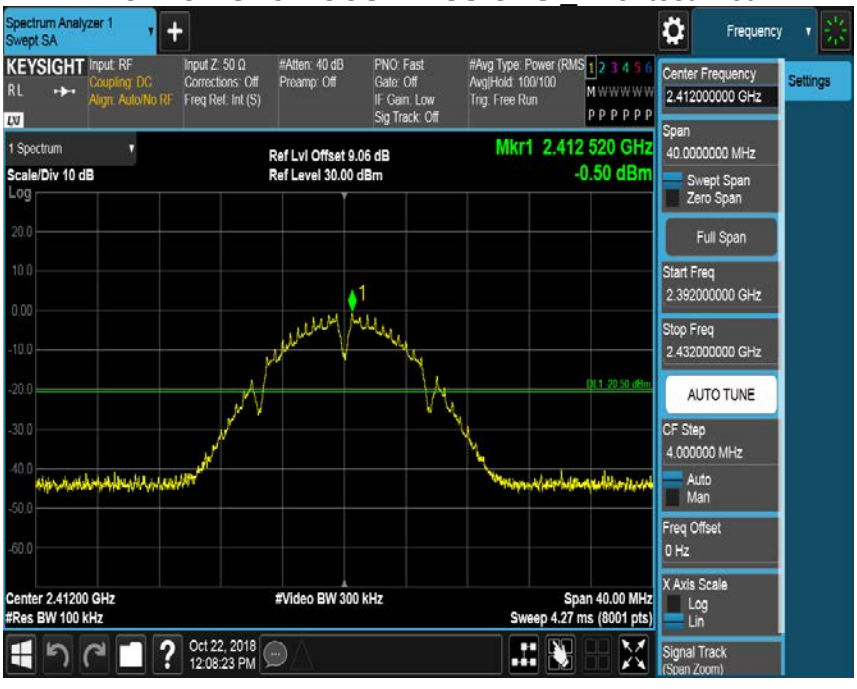
### 8.5.1. 802.11b MODE

**SISO MODE**

**ANTENNA 1**

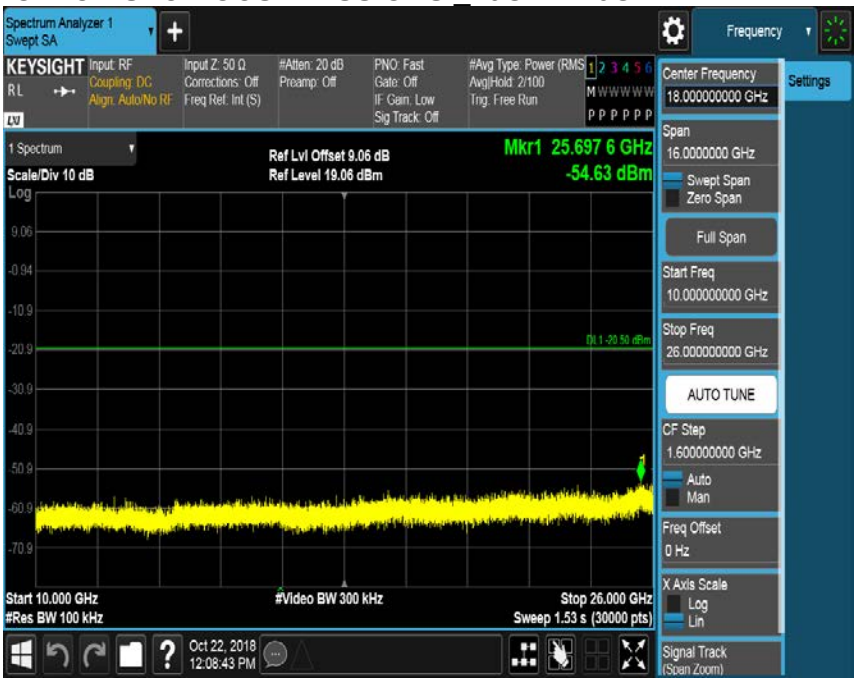
LOW CH BANDEDAGE


LOW CH SPURIOUS EMISSIONS _ Pref test Plot



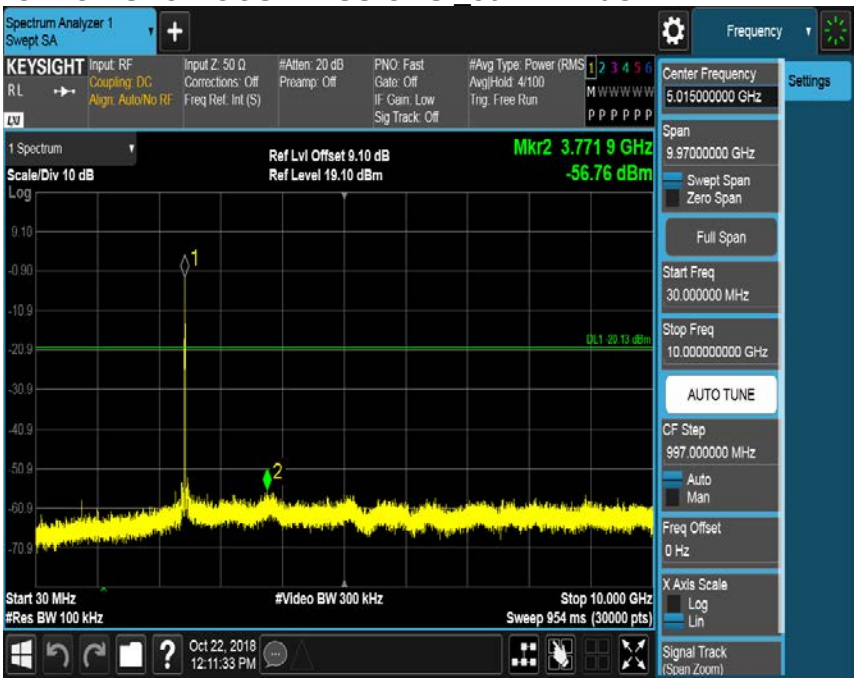
LOW CH SPURIOUS EMISSIONS _30MHz~10GHz


LOW CH SPURIOUS EMISSIONS _10GHz~26GHz

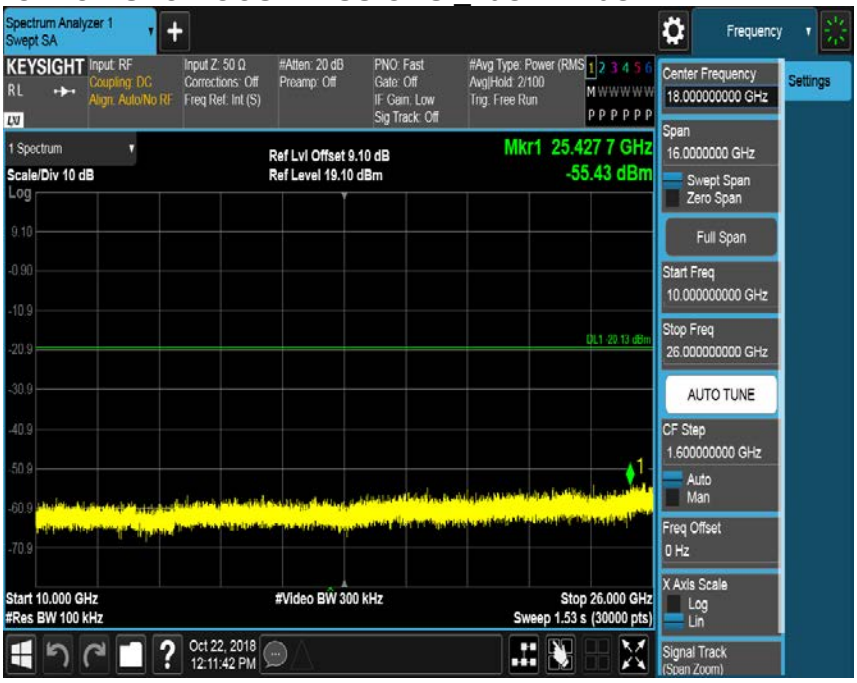


MID CH SPURIOUS EMISSIONS _ Pref test Plot

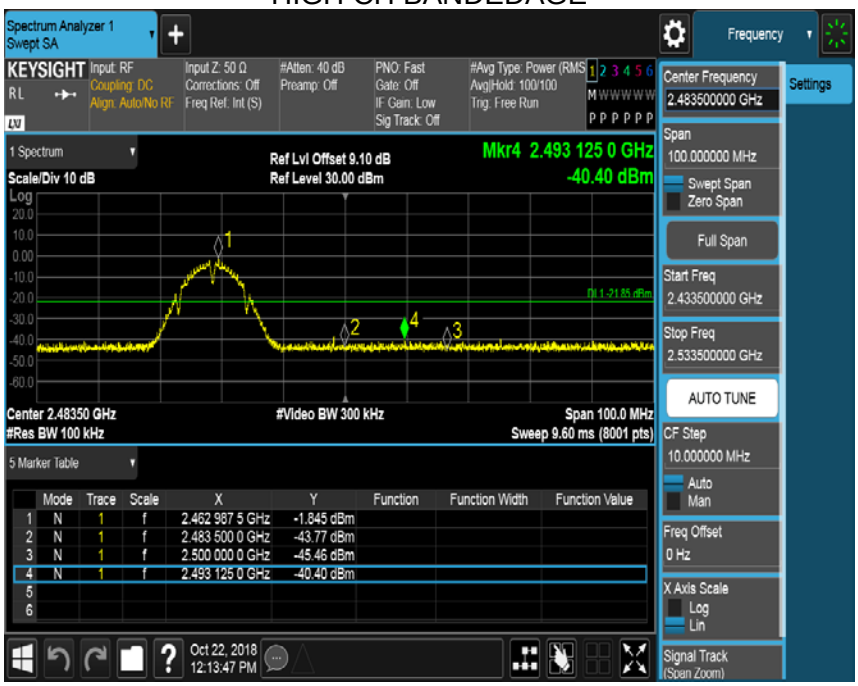

LOW CH SPURIOUS EMISSIONS _ 30MHz~10GHz



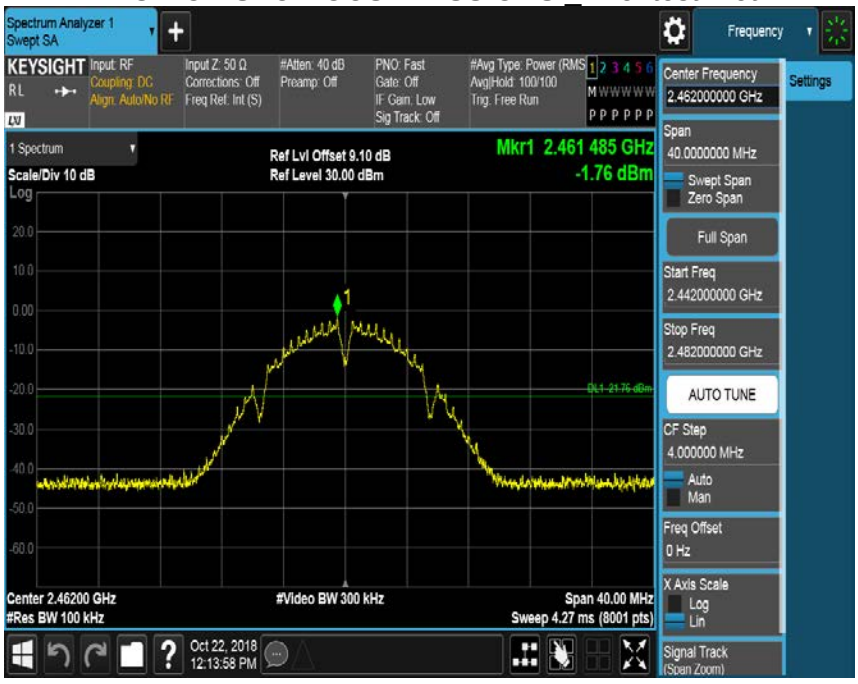
LOW CH SPURIOUS EMISSIONS _10GHz~26GHz



HIGH CH BANDEDAGE

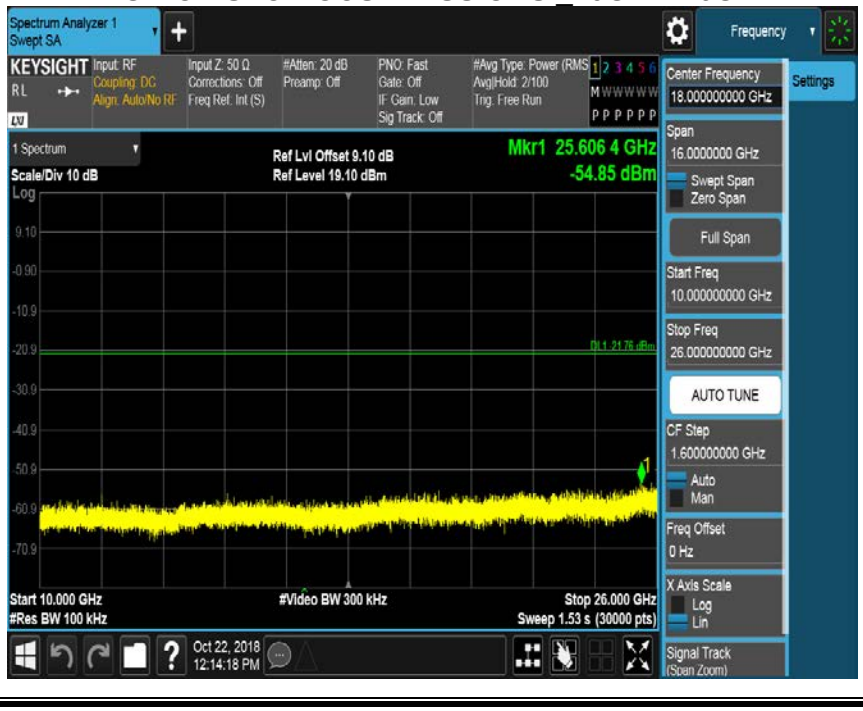



HIGH CH SPURIOUS EMISSIONS _ Pref test Plot



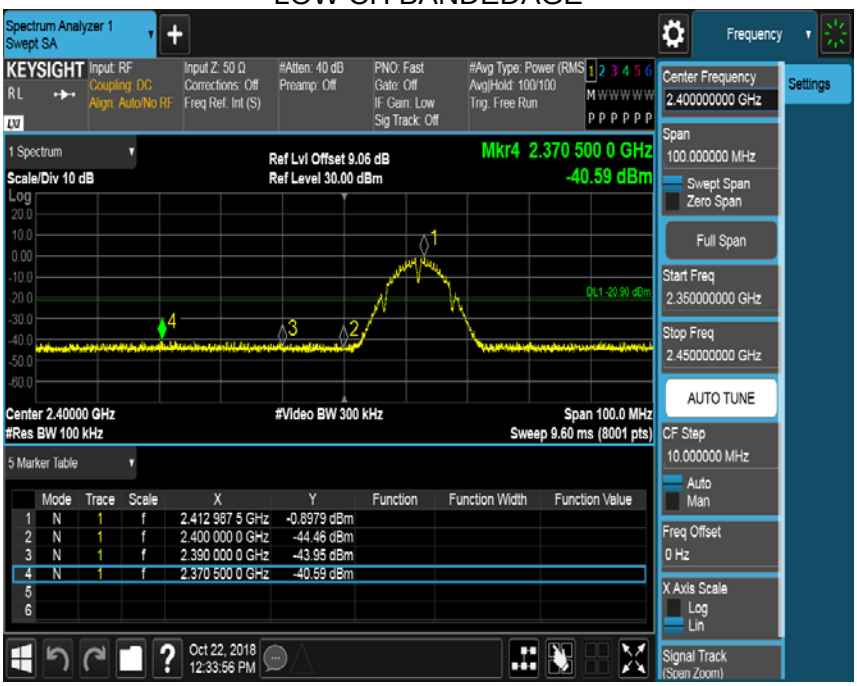
HIGH CH SPURIOUS EMISSIONS _30MHz~10GHz


HIGH CH SPURIOUS EMISSIONS _10GHz~26GHz



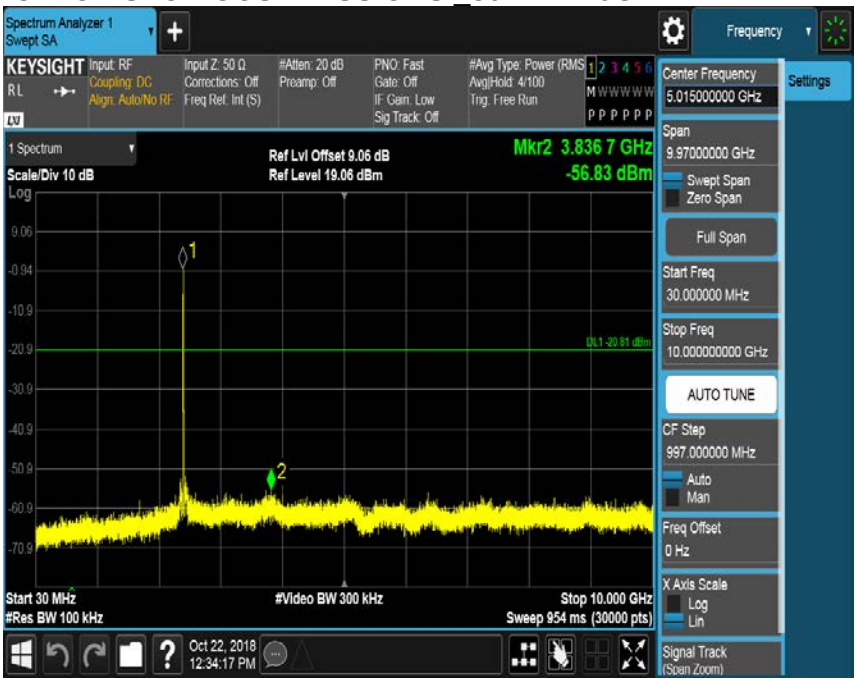
**ANTENNA 2**

LOW CH BANDEDAGE



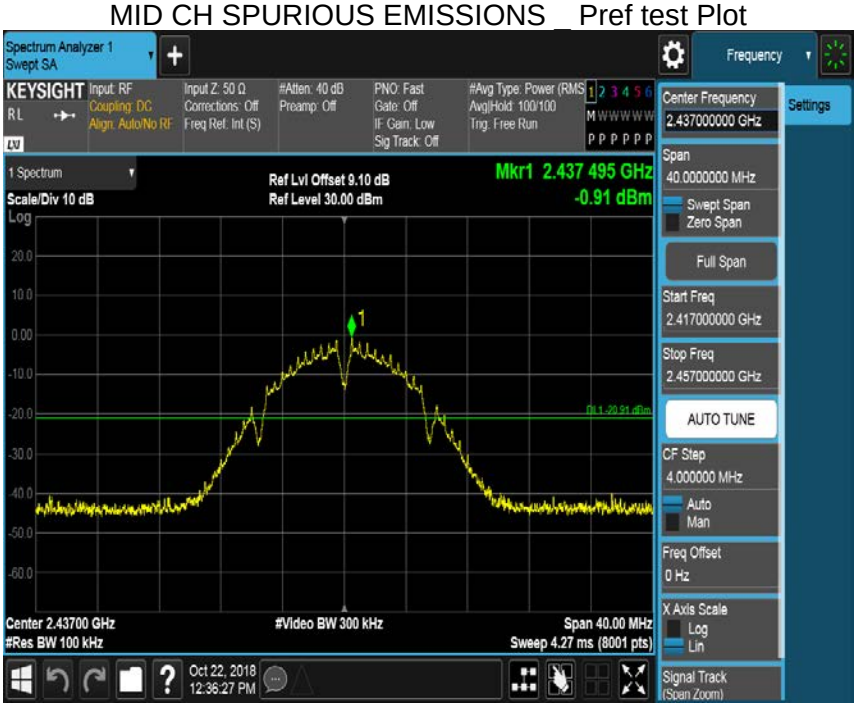
LOW CH SPURIOUS EMISSIONS _ Pref test Plot


LOW CH SPURIOUS EMISSIONS _ 30MHz~10GHz

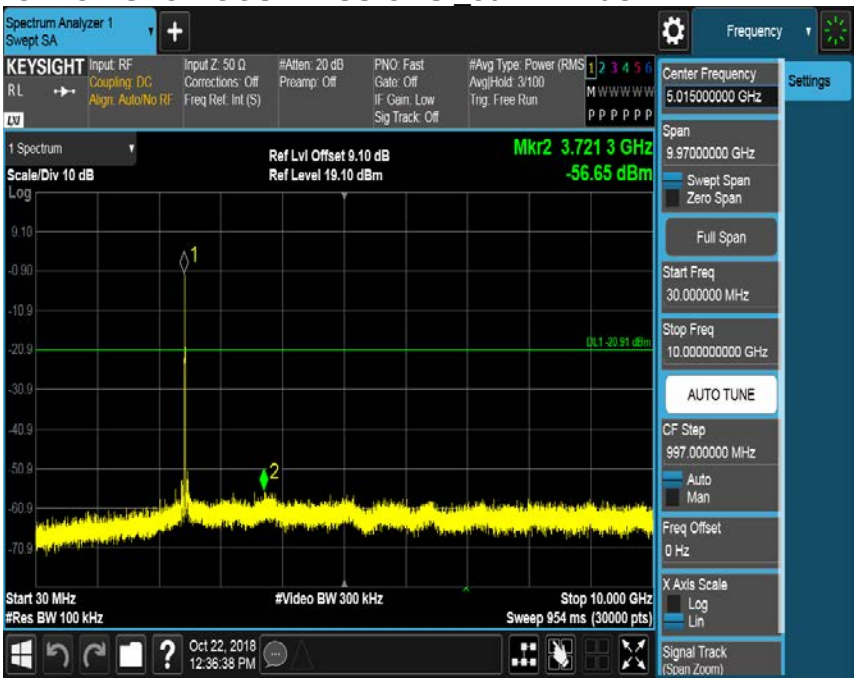


LOW CH SPURIOUS EMISSIONS _10GHz~26GHz

MID CH SPURIOUS EMISSIONS _ Pref test Plot

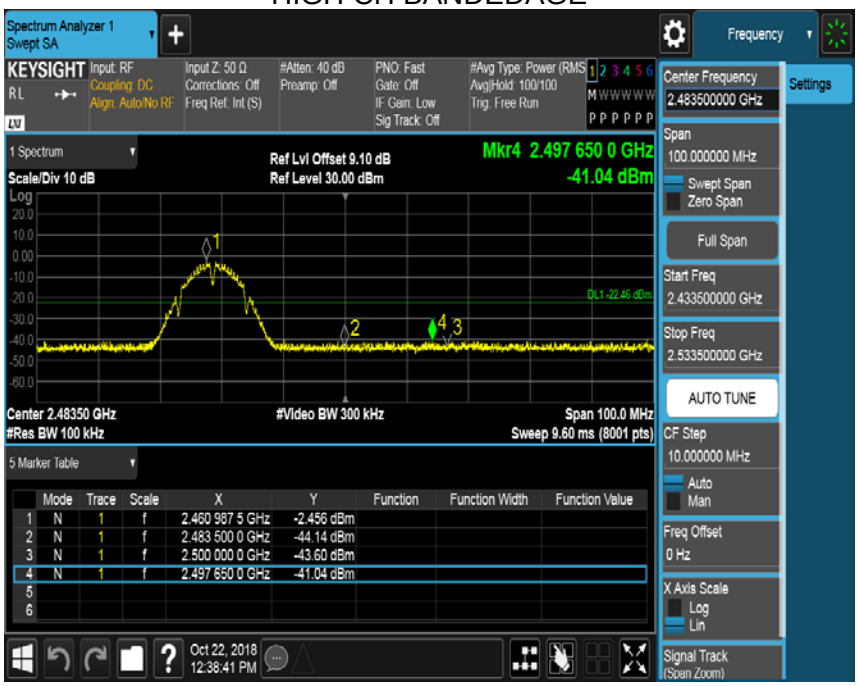



LOW CH SPURIOUS EMISSIONS _ 30MHz~10GHz

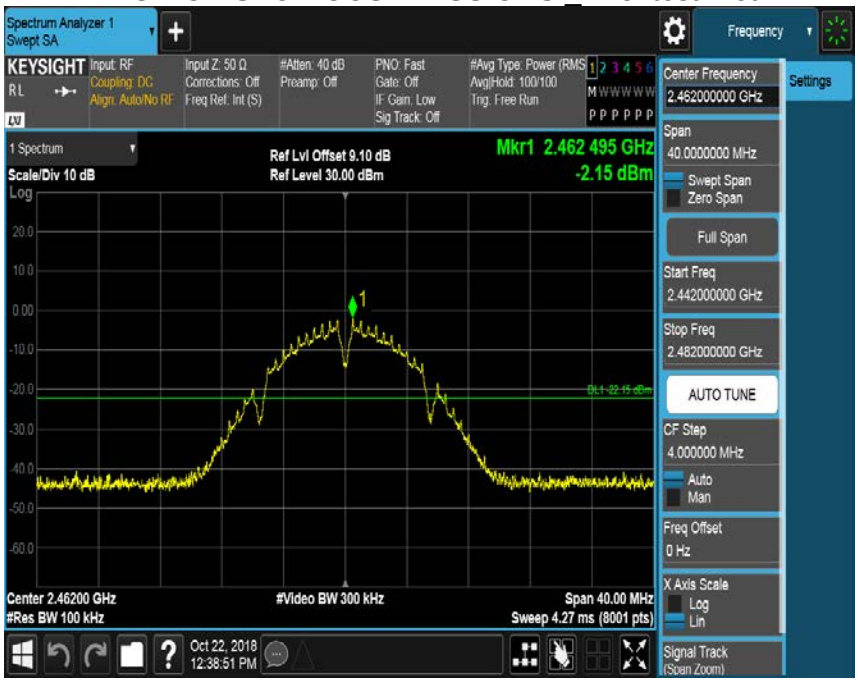


LOW CH SPURIOUS EMISSIONS _10GHz~26GHz

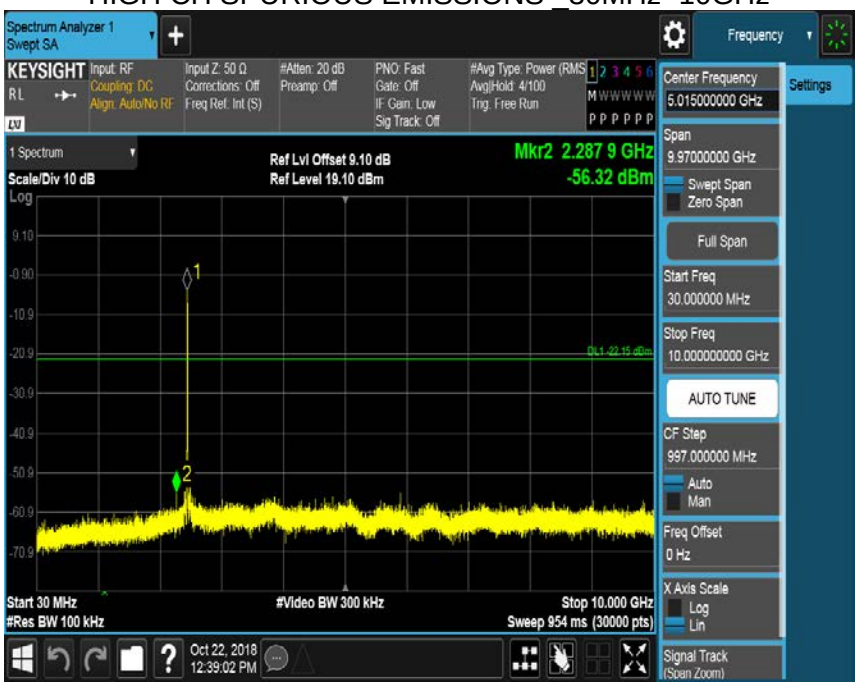
HIGH CH BANDEDAGE



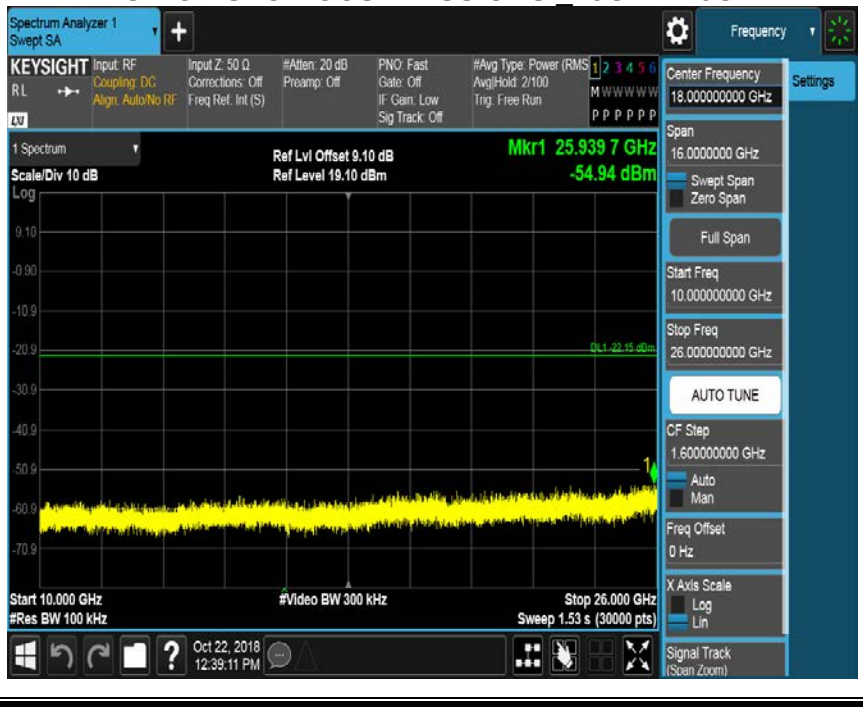

HIGH CH SPURIOUS EMISSIONS _ Pref test Plot



HIGH CH SPURIOUS EMISSIONS _30MHz~10GHz




HIGH CH SPURIOUS EMISSIONS _10GHz~26GHz

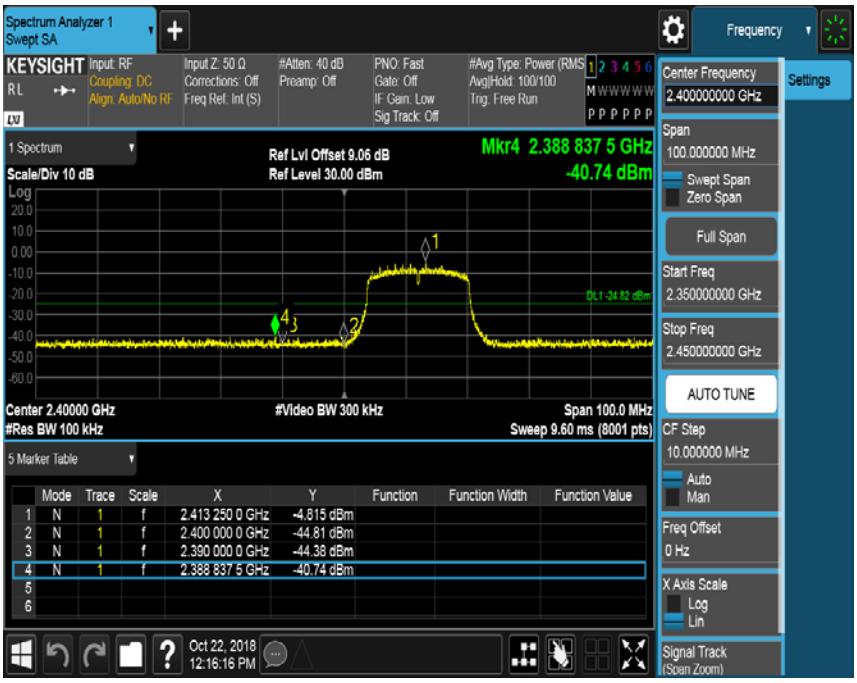


### 8.5.1. 802.11g MODE

**SISO MODE**

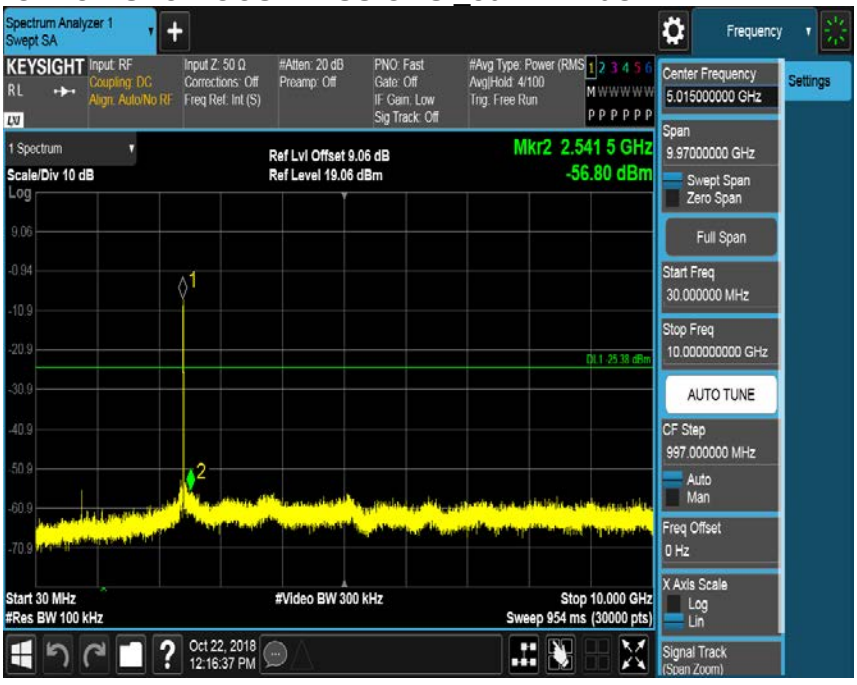
**ANTENNA 1**

LOW CH BANDEDAGE



LOW CH SPURIOUS EMISSIONS _ Pref test Plot

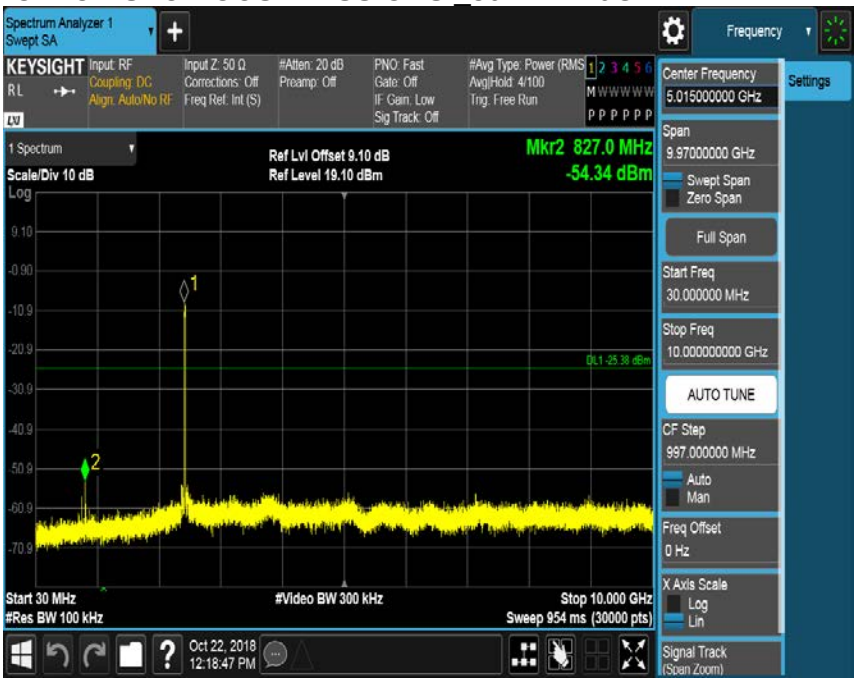

LOW CH SPURIOUS EMISSIONS _ 30MHz~10GHz



LOW CH SPURIOUS EMISSIONS _10GHz~26GHz

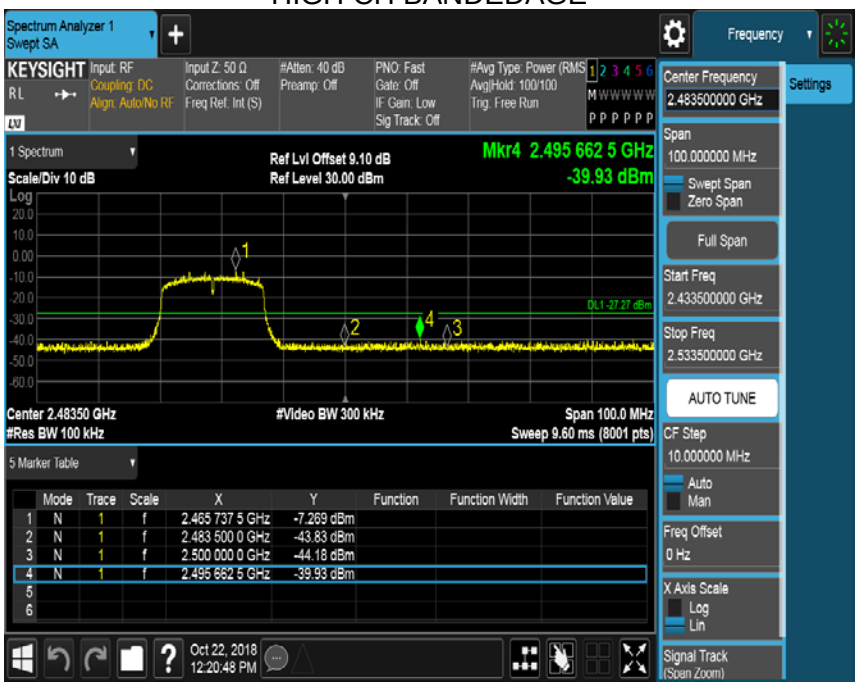
MID CH SPURIOUS EMISSIONS _ Pref test Plot


LOW CH SPURIOUS EMISSIONS _ 30MHz~10GHz



LOW CH SPURIOUS EMISSIONS _10GHz~26GHz

HIGH CH BANDEDAGE




HIGH CH SPURIOUS EMISSIONS _ Pref test Plot

HIGH CH SPURIOUS EMISSIONS _30MHz~10GHz


HIGH CH SPURIOUS EMISSIONS _10GHz~26GHz