# FCC 47 CFR PART 15 SUBPART C

# CERTIFICATION TEST REPORT

*For*

**Network Video Recorder**

**MODEL NUMBER: DHI-NVR2108HS-W-4KS2**

**FCC ID: SVNDHNVR21HSW**

**REPORT NUMBER: 4788560194.2-4**

**ISSUE DATE: September 12, 2018**

*Prepared for*

**ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD.**
**No.1199, Bin'an Road, Binjiang District, Hangzhou, P.R. China**

*Prepared by*

**UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch**
**Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake Hi-Tech Development Zone Dongguan, 523808, People's Republic of China**

**Tel: +86 769 22038881**
**Fax: +86 769 33244054**
**Website: www.ul.com**

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Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 09/12/2018 | Initial Issue | |


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| Summary of Test Results | | | |
|---|---|---|---|
| **Clause** | **Test Items** | FCC Rules | Test Results |
| 1 | 6dB Bandwidth | FCC 15.247 (a) (2) | PASS |
| 2 | Peak Conducted Output Power | FCC 15.247 (b) (3) | PASS |
| 3 | Power Spectral Density | FCC 15.247 (e) | PASS |
| 4 | Conducted Bandedge and Spurious Emission | FCC 15.247 (d) | PASS |
| 5 | Radiated Bandedge and Spurious Emission | FCC 15.247 (d)<br>FCC 15.209<br>FCC 15.205 | PASS |
| 6 | Conducted Emission Test For AC Power Port | FCC 15.207 | PASS |
| 7 | Antenna Requirement | FCC 15.203 | PASS |


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# 1. ATTESTATION OF TEST RESULTS

**Applicant Information**

| | |
|---|---|
| Company Name: | ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD. |
| Address: | No.1199, Bin'an Road, Binjiang District, Hangzhou, P.R. China |

**Manufacturer Information**

| | |
|---|---|
| Company Name: | ZHEJIANG DAHUA VISION TECHNOLOGY CO.,LTD. |
| Address: | No.1199, Bin'an Road, Binjiang District, Hangzhou, P.R. China |

**EUT Description**

| | |
|---|---|
| Product Name | Network Video Recorder |
| Model Name | DHI-NVR2108HS-W-4KS2 |
| Sample Status | Good |
| Sample Received date | August 13, 2018 |
| Date Tested | August 15~September 10, 2018 |

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | PASS |

Tested By:

Kebo Zhang
Engineer

Checked By:

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo

Laboratory Manager


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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB558074 D01 DTS Meas Guidance v05, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

# 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: 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.

Note 3: For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OATS.

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# 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. MEASUREMENT UNCERTAINTY

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

| Test Item | Uncertainty |
|---|---|
| Uncertainty for Conduction emission test | 2.90dB |
| Uncertainty for Radiation Emission test(include Fundamental emission) (9KHz-30MHz) | 2.2dB |
| Uncertainty for Radiation Emission test(include Fundamental emission) (30MHz-1GHz) | 4.52dB |
| Uncertainty for Radiation Emission test (1GHz to 26GHz)( include Fundamental emission) | 5.04dB(1-6GHz) |
| | 5.30dB (6GHz-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. | |


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# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

| | |
|---|---|
| Equipment | Network Video Recorder |
| Model Name | DHI-NVR2108HS-W-4KS2 |
| Series model | DHI-NVR2108HS-W-4KS2,DHI-NVR2104HS-W-4KS2 N41B1W,DHI-NVR21XYHS-W-4KSZ,DH-NVR21XYHS-W-4KSZ, NVR21XYHS-W-4KSZ, N41BZW |
| Model difference | Different: only the name and the number of channels for audio, video input and output are different (different ways are supported by software functions, the hardware structure is the same), 04 stands for 4 channels, 08 stands for 8 channels; XY can be 04,08,16,32,64. Z can be 0~9 (only the version number of different product models of the same product is different, no hardware information is involved); the structure of the product is the same as that of the power supply. The electrical principle and key components are identical and do not affect the safety and electromagnetic compatibility of the product. |
| Radio Technology | IEEE802.11b/g/n HT20 |
| Operation frequency | IEEE 802.11b: 2412MHz—2462MHz<br>IEEE 802.11g: 2412MHz—2462MHz<br>IEEE 802.11n HT20: 2412MHz—2462MHz |
| Modulation | IEEE 802.11b: DSSS(CCK)<br>IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) |
| Power Supply | AC120V/60Hz |

## 5.2. MAXIMUM OUTPUT POWER

| Frequency Range (MHz) | Number of Transmit ANTs (NTX) | IEE Std. 802.11 | Channel Number | Max Conducted PEAK Power (dBm) |
|---|---|---|---|---|
| 2412-2462 | 2 | b | 1-11[11] | 10.25 |
| 2412-2462 | 2 | g | 1-11[11] | 17.67 |
| 2412-2462 | 2 | n HT20 | 1-11[11] | 17.51 |

Note: All mode support MIMO mode.


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## 5.3. CHANNEL LIST

| Channel List for 802.11b/g/n (20 MHz) | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency(MHz) | Channel | Frequency (MHz) |
| 1 | 2412 | 5 | 2432 | 9 | 2452 |
| 2 | 2417 | 6 | 2437 | 10 | 2457 |
| 3 | 2422 | 7 | 2442 | 11 | 2462 |
| 4 | 2427 | 8 | 2447 | 12 | / |

## 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 POWER SETTING PARAMETER

| The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band | | | | |
|---|---|---|---|---|
| Test Software | | Tera Term | | |
| Modulation Mode | Transmit Antenna Number | Test Channel | | |
| | | NCB: 20MHz | | |
| | | CH 1 | CH 6 | CH 11 |
| 802.11b | 1 | 4 | 4 | 4 |
| 802.11g | 1 | 6.5 | 6.5 | 6.5 |
| 802.11n HT20 | 1 | 6.5 | 6.5 | 6.5 |
| 802.11b | 2 | 4 | 4 | 4 |
| 802.11g | 2 | 6.5 | 6.5 | 6.5 |
| 802.11n HT20 | 2 | 6.5 | 6.5 | 6.5 |

## 5.6. TEST ENVIRONMENT

| Environment Parameter | Selected Values During Tests | |
|---|---|---|
| Relative Humidity | 55 ~ 65% | |
| Atmospheric Pressure: | 1025Pa | |
| Temperature | TN | 23 ~ 28°C |
| Voltage : | VL | N/A |
| | VN | AC 120V/60Hz |
| | VH | N/A |

Note: VL= Lower Extreme Test Voltage
VN= Nominal Voltage
VH= Upper Extreme Test Voltage
TN= Normal Temperature


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## 5.7. DESCRIPTION OF AVAILABLE ANTENNAS

| Antenna | Frequency (MHz) | Antenna Type | Antenna Gain (dBi) |
|---|---|---|---|
| 1 | 2412-2462 | Omni-directional | 4.44 |
| 2 | 2412-2462 | Omni-directional | 3.74 |

Note: Directional gain= $10\log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}] = 7.11 > 6dBi$

$N_{ANT}$: the number of Antenna

| Test Mode | Transmit and Receive Mode | Description |
|---|---|---|
| IEEE 802.11b | ☒2TX, 2RX | ANT 1, 2 can be used as transmitting/receiving antenna. |
| IEEE 802.11g | ☒2TX, 2RX | ANT 1, 2 can be used as transmitting/receiving antenna. |
| IEEE 802.11n HT20 | ☒2TX, 2RX | ANT 1, 2 can be used as transmitting/receiving antenna. |

Note: All mode support MIMO mode.

## 5.8. WORST-CASE CONFIGURATIONS

| IEE Std. 802.11 | Modulation Technology | Modulation Type | Data Rate (Mbps) | Worst Case (Mbps) |
|---|---|---|---|---|
| b | DSSS | CCK | 11/5.5/2/1 | 1 |
| g | OFDM | BPSK, QPSK, 16QAM, 64QAM | 54/48/36/24/18/12/9/6 | 6 |
| n HT20 | OFDM | BPSK, QPSK, 16QAM, 64QAM | MCS0~MCS15 | MCS0 |

Note: 1.All mode support MIMO mode.
2.SISO mode and MIMO mode have the same power setting, so only the worst case MOMI mode will be record in the report.


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## 5.9. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Item | Equipment | Brand Name | Model Name | P/N |
|---|---|---|---|---|
| 1 | PC | Dell | Vostro 3902 | 8KNDDB2 |
| 2 | USB TO RS232 | N/A | N/A | N/A |

**I/O CABLES**

| Cable No | Port | Connector Type | Cable Type | Cable Length(m) | Remarks |
|---|---|---|---|---|---|
| 1 | USB | N/A | N/A | 0.5 | N/A |
| 2 | Network Line | N/A | N/A | 0.8 | N/A |

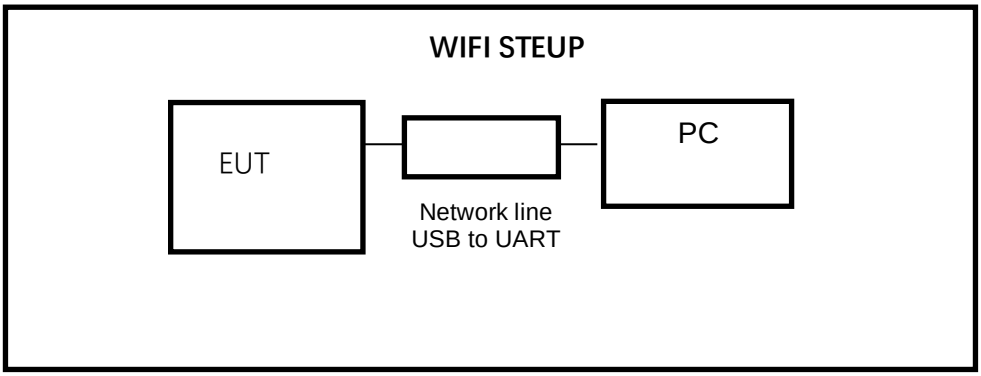
**ACCESSORY**

| Item | Accessory | Brand Name | Model Name | Description |
|---|---|---|---|---|
| 1 | Adapter | HONOR | ADS-26FSG-12 | Input: AC 100-240, 50/60Hz, 0.6A Output: 12V 2A |
| 2 | Adapter | MASS | S024-1A120200 | Input: AC 100-240, 50/60Hz, 0.6A Output: 12V 2A |
| Note: Both adapters have been pre-tested and only the worst case adapter data(MASS) is recorded in the report. | | | | |

**TEST SETUP**

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

**SETUP DIAGRAM FOR TESTS**





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## 5.10. 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 | Farad | EZ-EMC | Ver. UL-3A1 |

| 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. 25, 2019 |
| ☑ | Band Reject Filter | Wainwright | WRCJV8-2350-2400-2483.5-2533.5-40SS | 4 | Dec.12, 2017 | Dec.11, 2018 |
| ☑ | High Pass Filter | Wi | WHKX10-2700-3000-18000-40SS | 23 | Dec.12, 2017 | Dec.11, 2018 |

| Software | | | | |
|---|---|---|---|---|
| Used | Description | Manufacturer | Name | Version |
| ☑ | Test Software for Radiated disturbance | Farad | EZ-EMC | Ver. UL-3A1 |


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| 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 | N1911A | MY55416024 | Dec.12,2017 | Dec.11,2018 |
| ☑ | Power Sensor | Keysight | N1921A | MY51100041 | Dec.12,2017 | Dec.11,2018 |

# 6. MEASUREMENT METHODS

| No. | Test Item | KDB Name | Section |
|---|---|---|---|
| 1 | 6dB Bandwidth | KDB 558074 D01 DTS Meas Guidance v05 | 8.0 |
| 2 | Peak Output Power | KDB 558074 D01 DTS Meas Guidance v05 | 9.1.1 |
| 3 | Power Spectral Density | KDB 558074 D01 DTS Meas Guidance v05 | 10.2 |
| 4 | Out-of-band emissions in non-restricted bands | KDB 558074 D01 DTS Meas Guidance v05 | 11.0 |
| 5 | Out-of-band emissions in restricted bands | KDB 558074 D01 DTS Meas Guidance v05 | 12.1 |
| 6 | Band-edge | KDB 558074 D01 DTS Meas Guidance v05 | 13.3.2 |
| 7 | Conducted Emission Test For AC Power Port | ANSI C63.10-2013 | 7.3 |
| 8 | 99% Occupied bandwidth | ANSI C63.10-2013 | 6.9.3 |


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# 7. ANTENNA PORT TEST RESULTS

## 7.1. ON TIME AND DUTY CYCLE

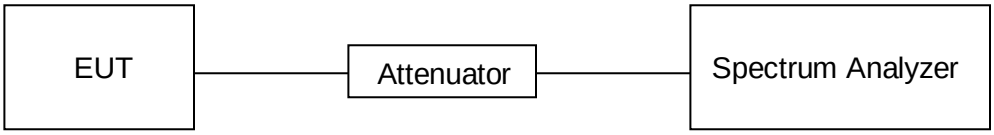
**LIMITS**

None; for reporting purposes only

**PROCEDURE**

KDB 558074 Zero-Span Spectrum Analyzer Method

**TEST SETUP**




**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24.5°C | Relative Humidity | 59% |
| Atmosphere Pressure | 101kPa | Test Voltage | AC 120V |

**RESULTS**

**ANTENNA1**

| Mode | On Time (msec) | Period (msec) | Duty Cycle x (Linear) | Duty Cycle (%) | Duty Cycle Correction Factor (db) | 1/B Minimum VBW (KHz) |
|---|---|---|---|---|---|---|
| 11b | 127.8 | 127.8 | 1 | 100 | 0 | 0.01 |
| 11g | 2.01 | 2.08 | 0.97 | 97 | 0.13 | 0.50 |
| 11n20 | 1.88 | 1.93 | 0.97 | 97 | 0.13 | 1.00 |

Note: Duty Cycle Correction Factor=10log(1/x).
Where: x is Duty Cycle (Linear)
Where: B is On Time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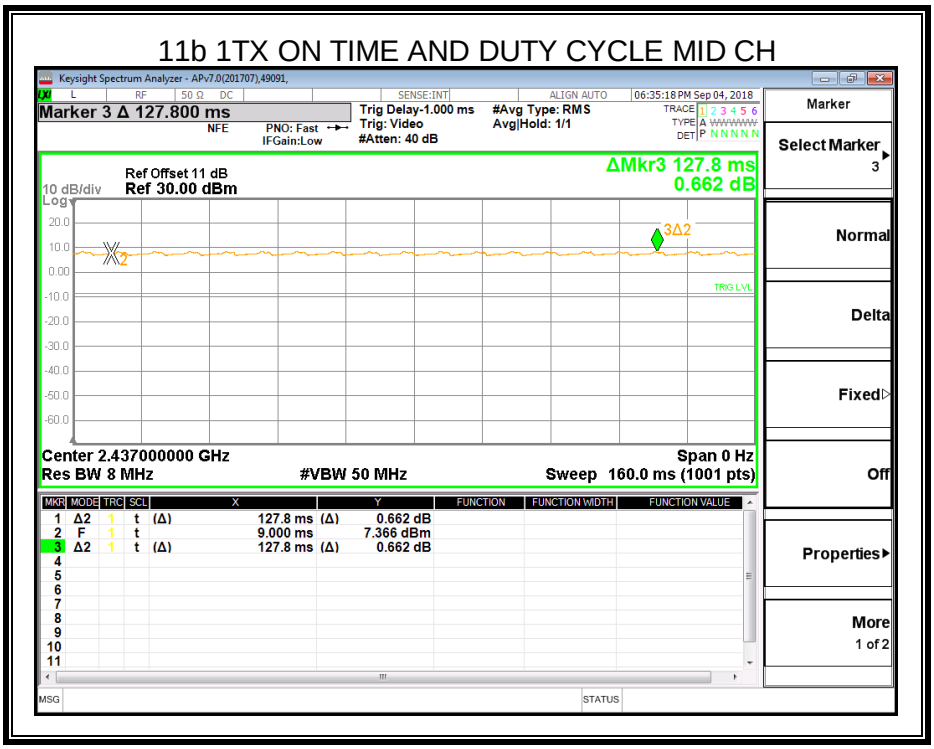
Antenna 1 and Antenna 2 has the same duty cycle, only Antenna 1 data show here.





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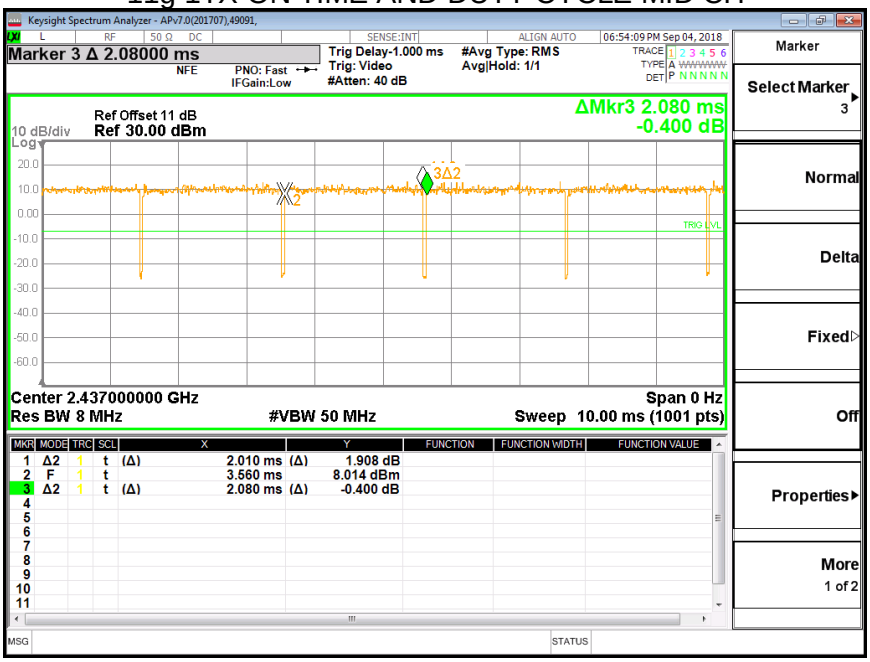
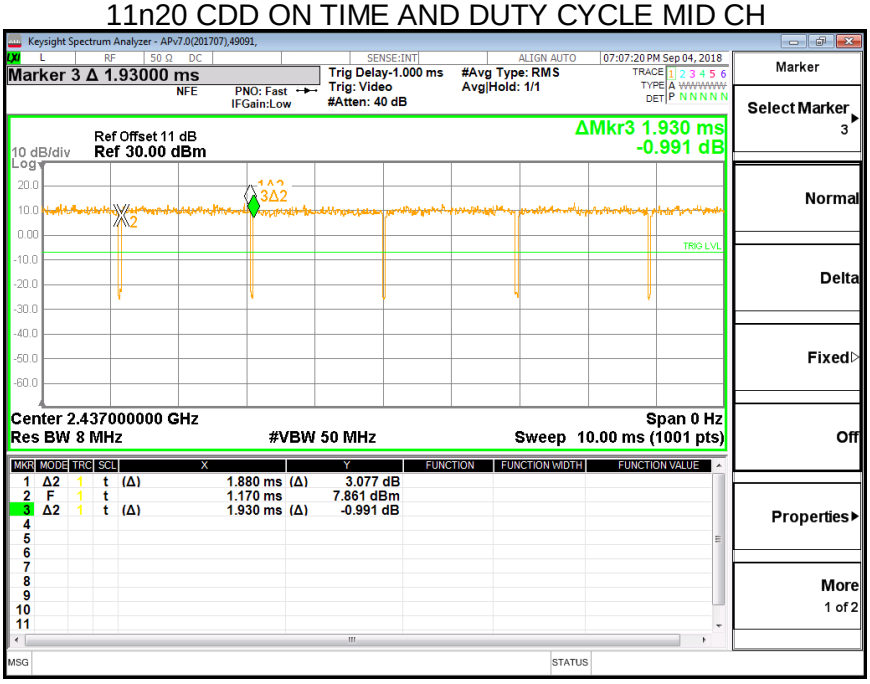
11g 1TX ON TIME AND DUTY CYCLE MID CH




11n20 CDD ON TIME AND DUTY CYCLE MID CH





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## 7.2. 6 dB DTS BANDWIDTH AND 99% BANDWIDTH

**LIMITS**

| FCC Part15 (15.247) Subpart C | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| FCC 15.247(a)(2) RSS-247 5.1 (a) | 6 dB Bandwidth | >= 500KHz | 2400-2483.5 |
| C63.10 Clause 6.9.3 | 99% Bandwidth | For reporting purposes only. | 2400-2483.5 |

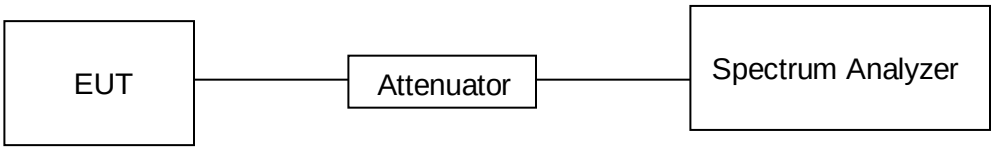
**TEST PROCEDURE**

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

| | |
|---|---|
| Center Frequency | The center frequency of the channel under test |
| Detector | Peak |
| RBW | For 6dB Bandwidth :100K<br>For 99% Bandwidth :1% to 5% of the occupied bandwidth |
| VBW | For 6dB Bandwidth : ≥3 × RBW<br>For 99% 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**





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**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24.5°C | Relative Humidity | 59% |
| Atmosphere Pressure | 101kPa | Test Voltage | AC 120V |

**RESULTS**


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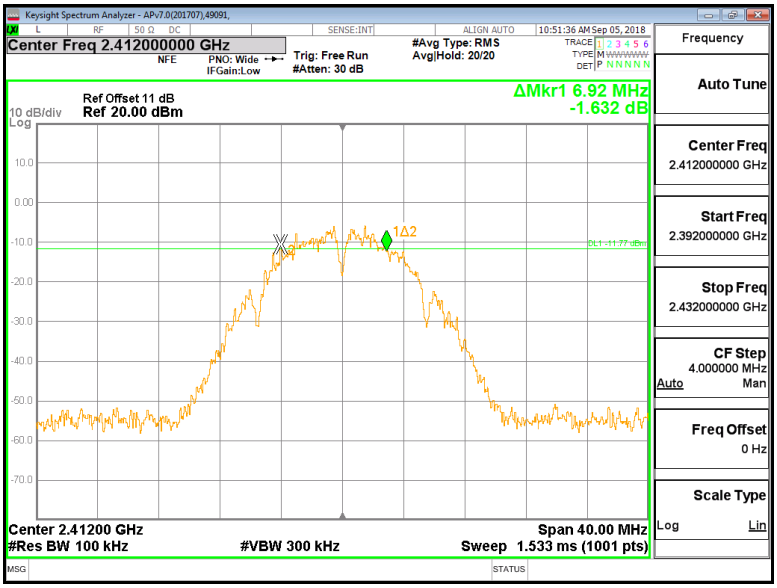
### 7.2.1. 802.11b MIMO MODE

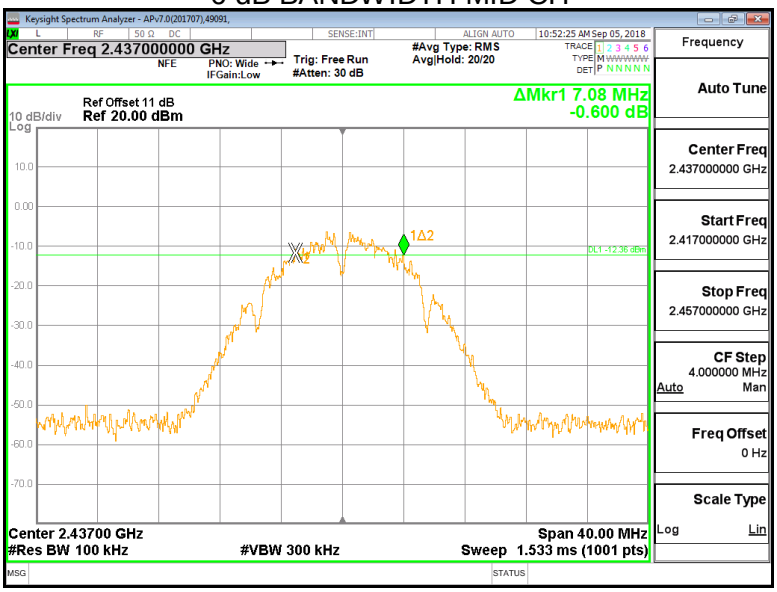
**ANTENNA1**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 6.92 | 11.393 | 500 | Pass |
| 2437 | 7.08 | 11.228 | 500 | Pass |
| 2462 | 6.28 | 11.001 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH







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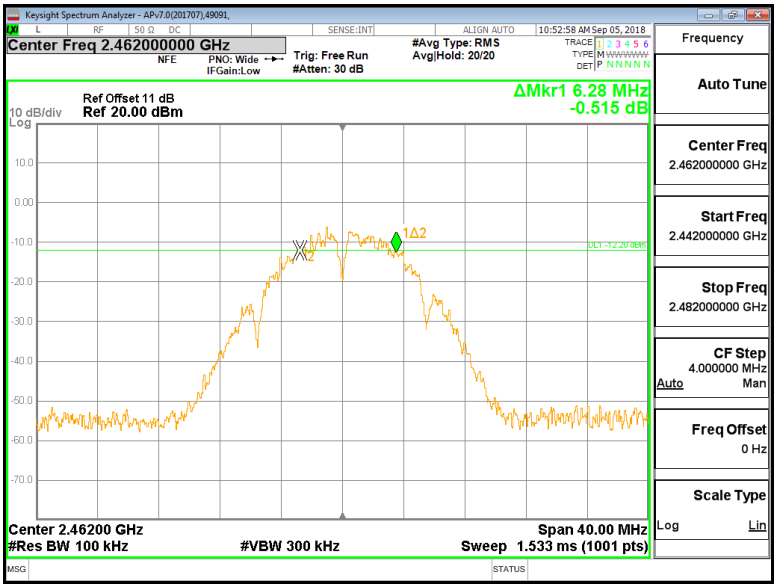
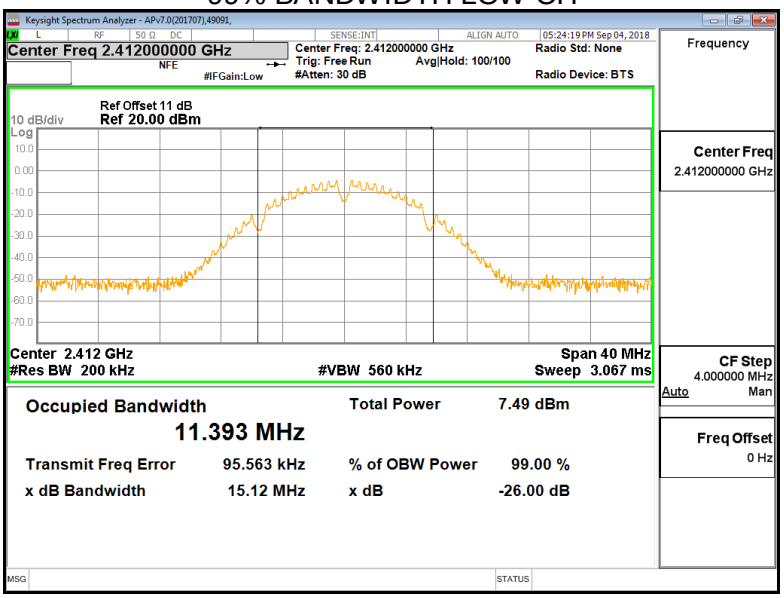
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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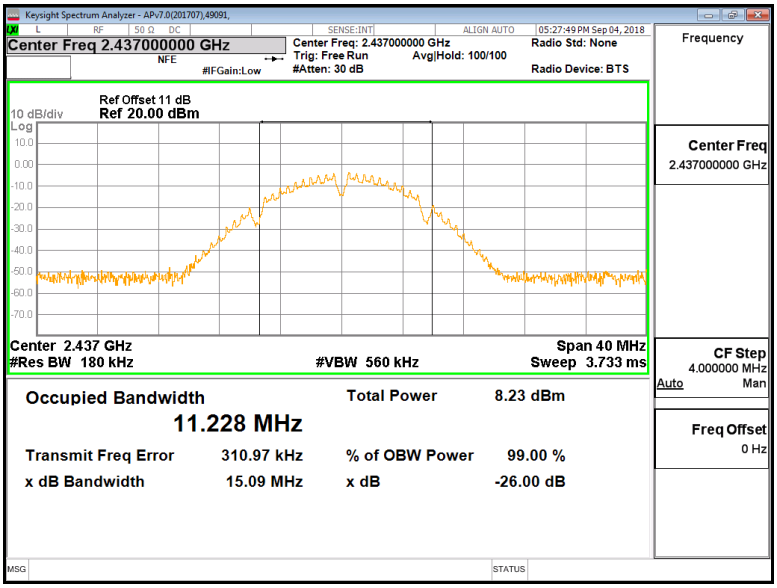
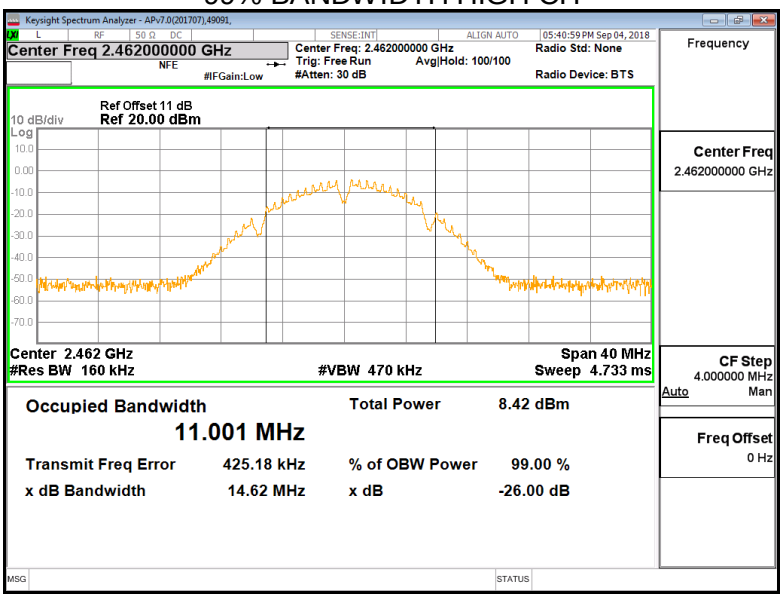
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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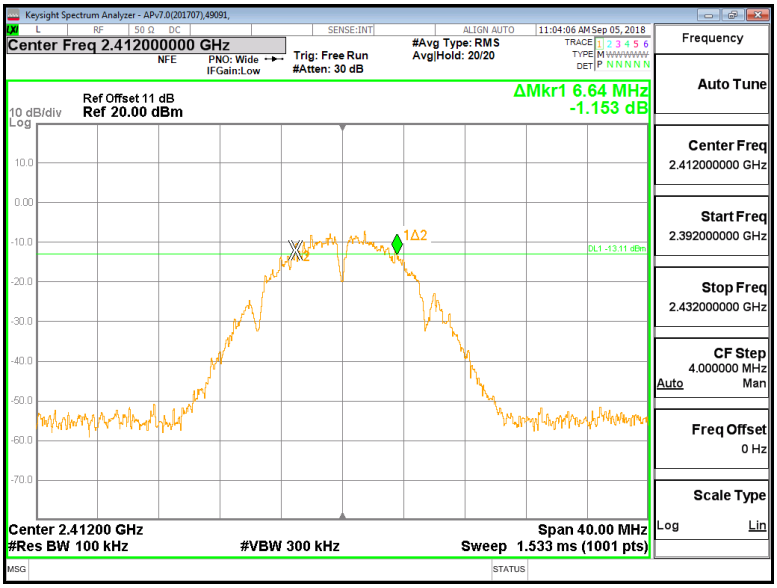
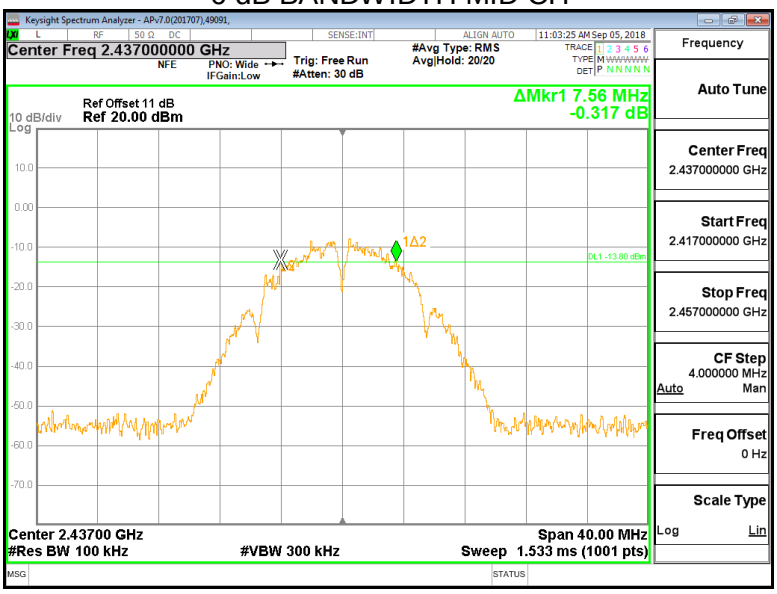
**ANTENNA2**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 6.64 | 11.005 | 500 | Pass |
| 2437 | 7.56 | 10.289 | 500 | Pass |
| 2462 | 6.16 | 11.053 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH





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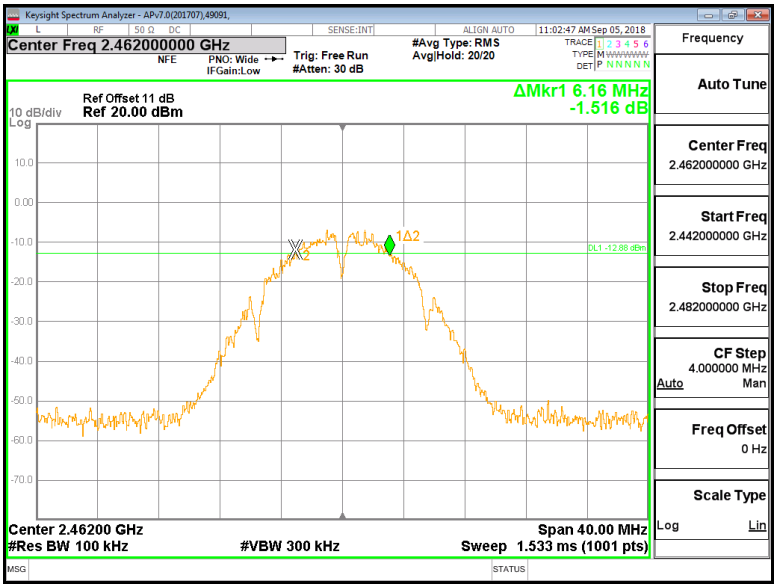
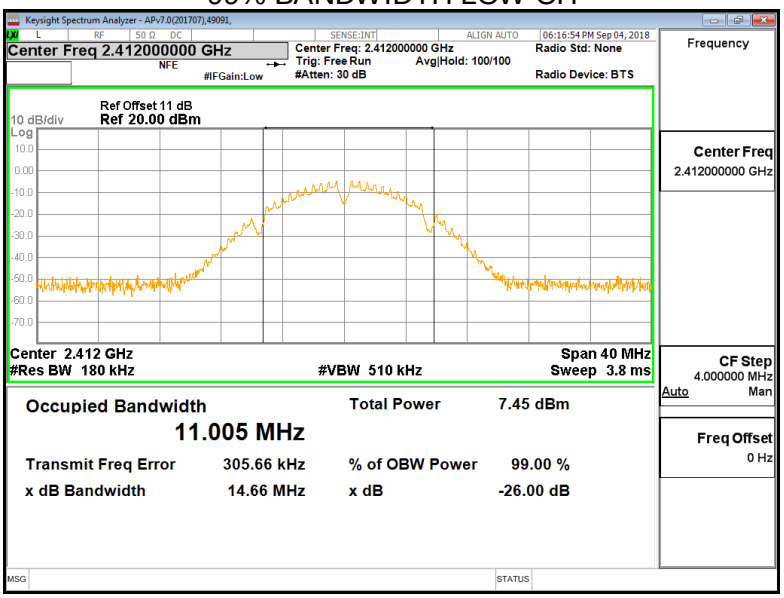
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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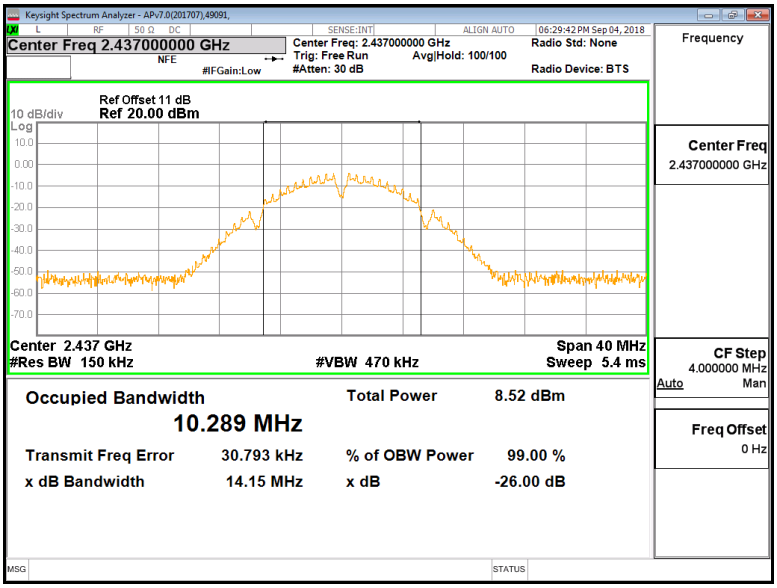
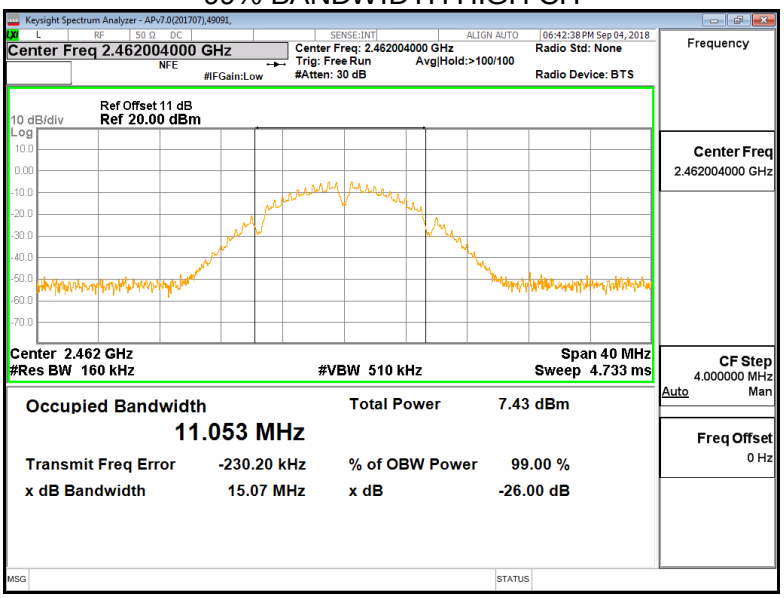
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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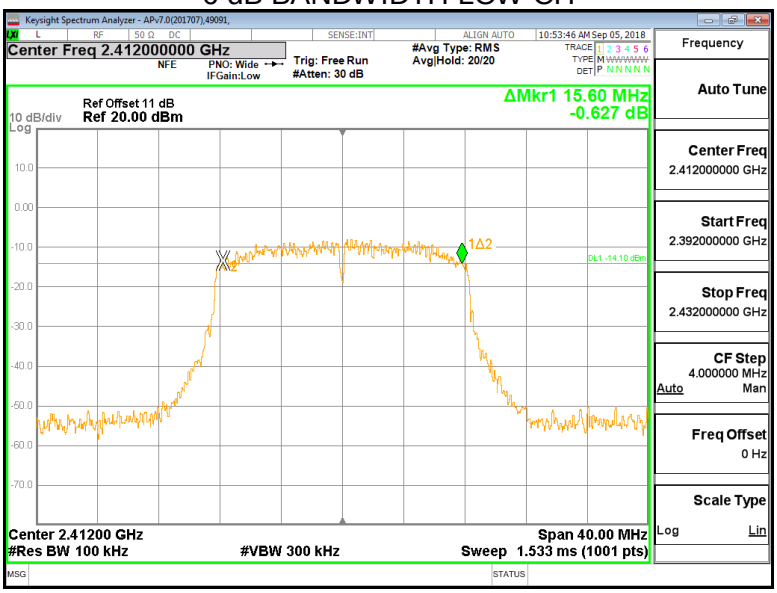
### 7.2.2. 802.11g MIMO MODE

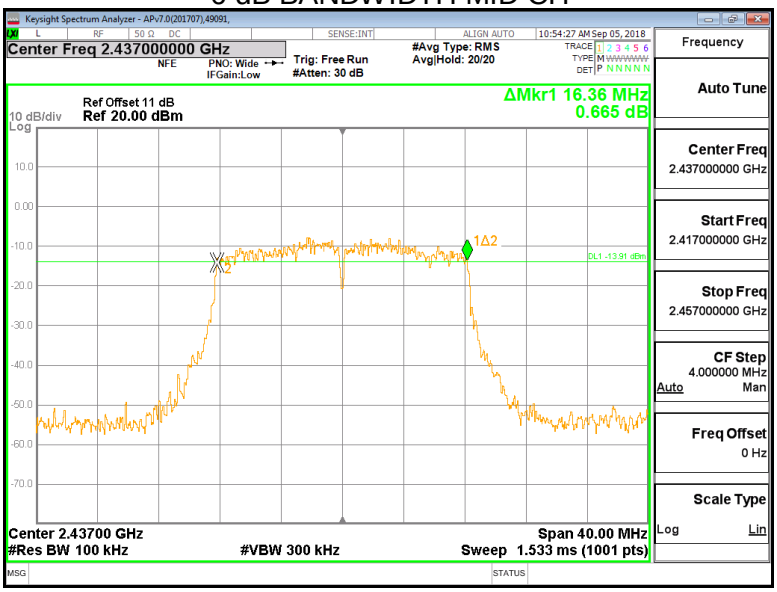
**ANTENNA1**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 15.60 | 16.270 | 500 | Pass |
| 2437 | 16.36 | 16.287 | 500 | Pass |
| 2462 | 15.92 | 16.247 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH





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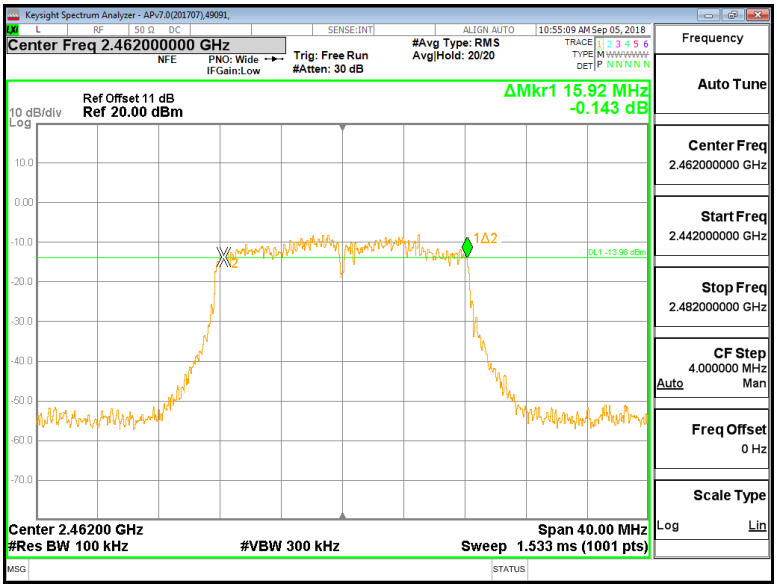
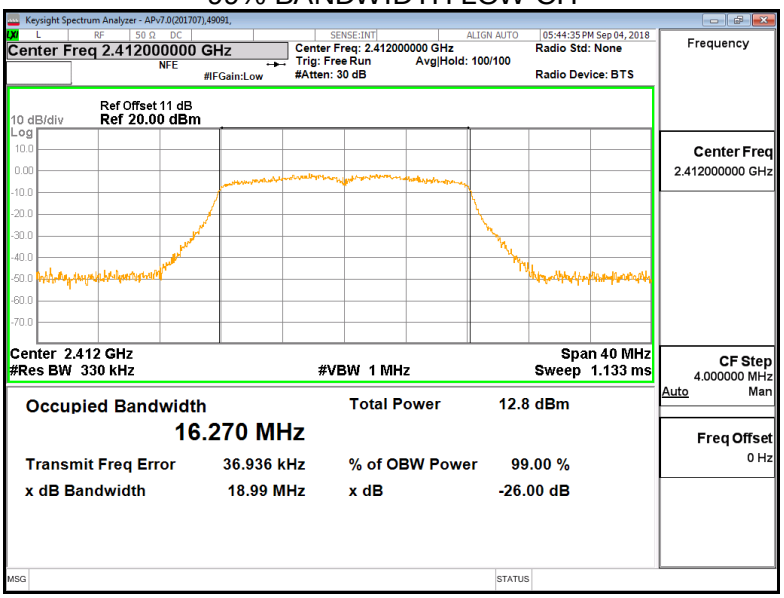
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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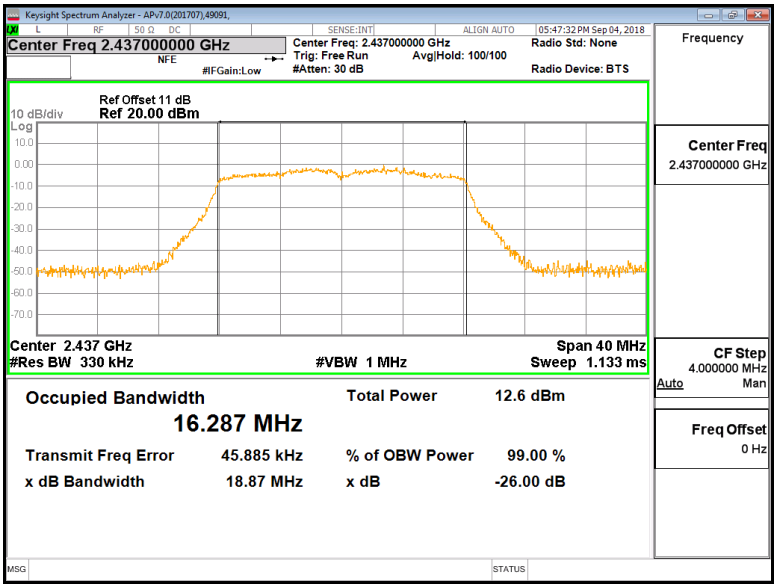
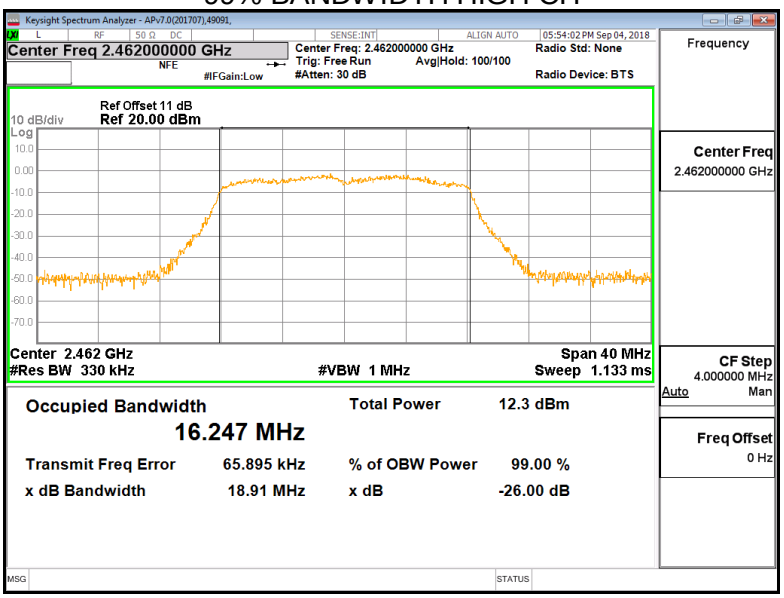
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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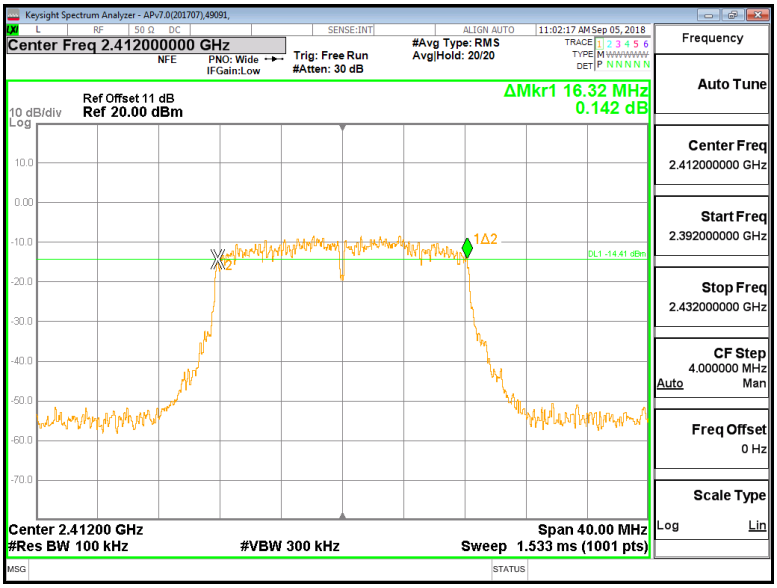
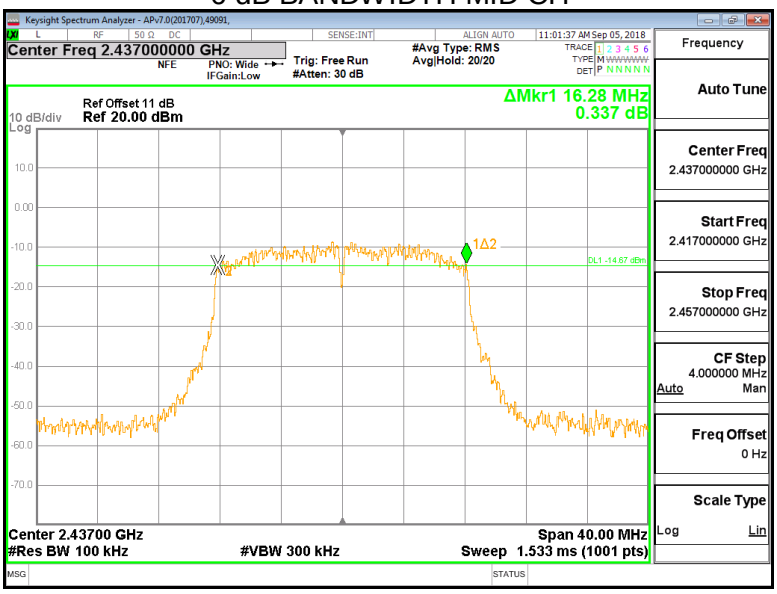
**ANTENNA2**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 16.32 | 16.234 | 500 | Pass |
| 2437 | 16.28 | 16.282 | 500 | Pass |
| 2462 | 16.08 | 16.194 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH





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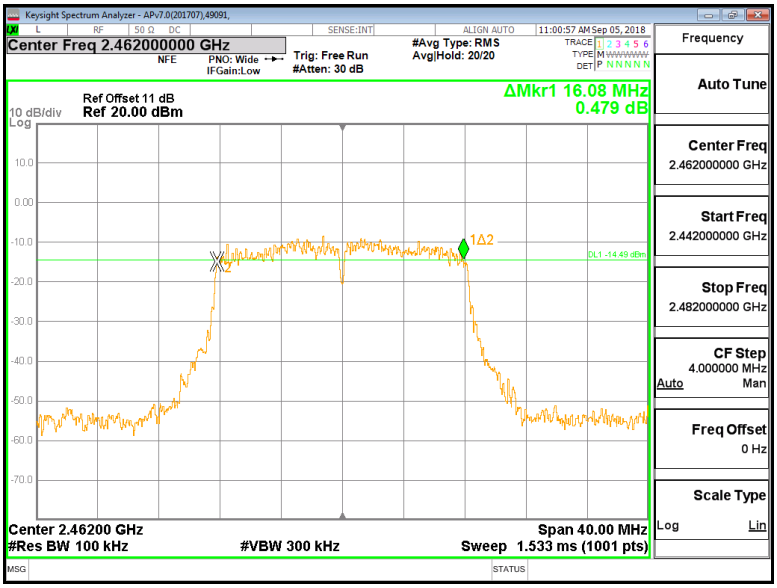
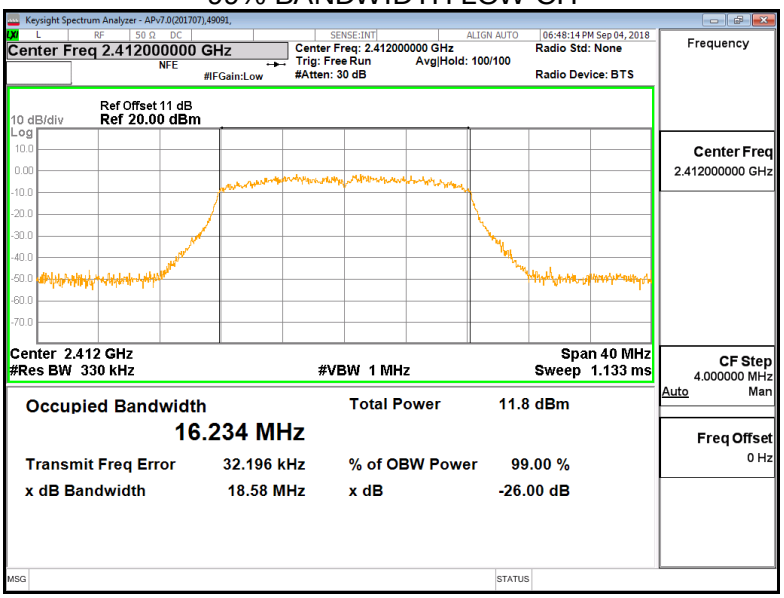
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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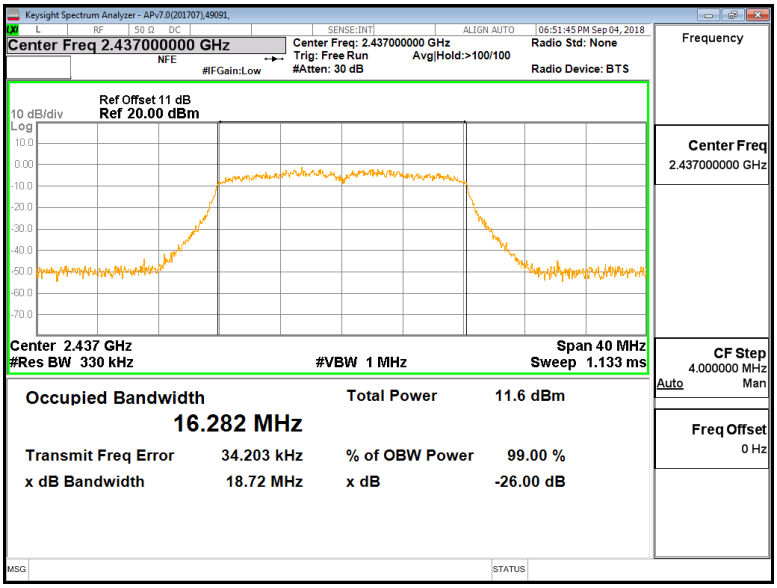
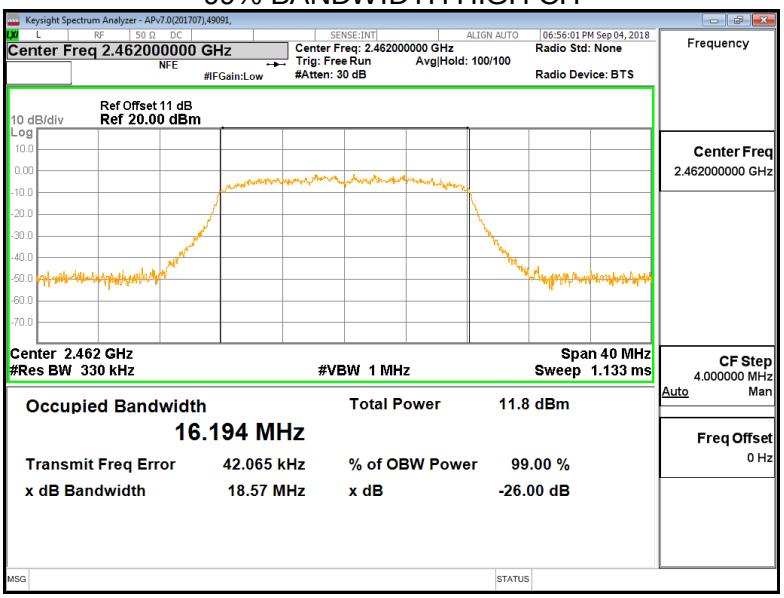
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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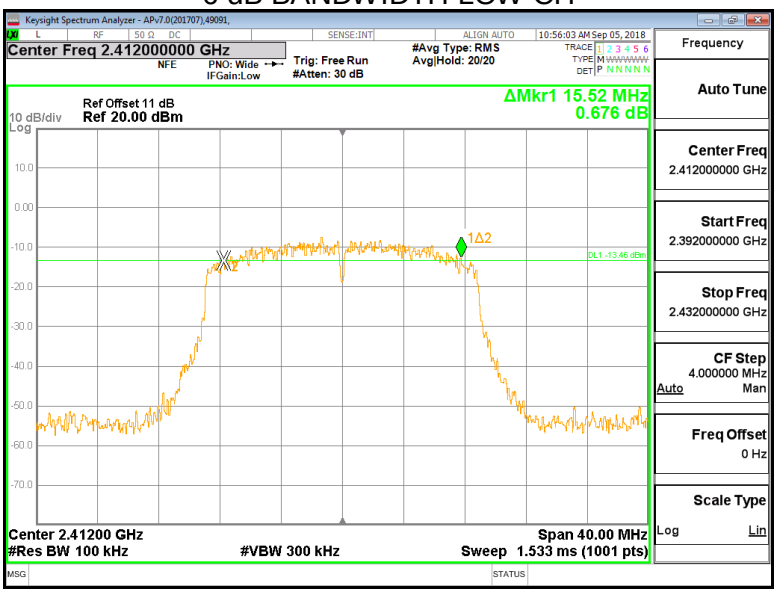
### 7.2.3. 802.11n20 MIMO MODE

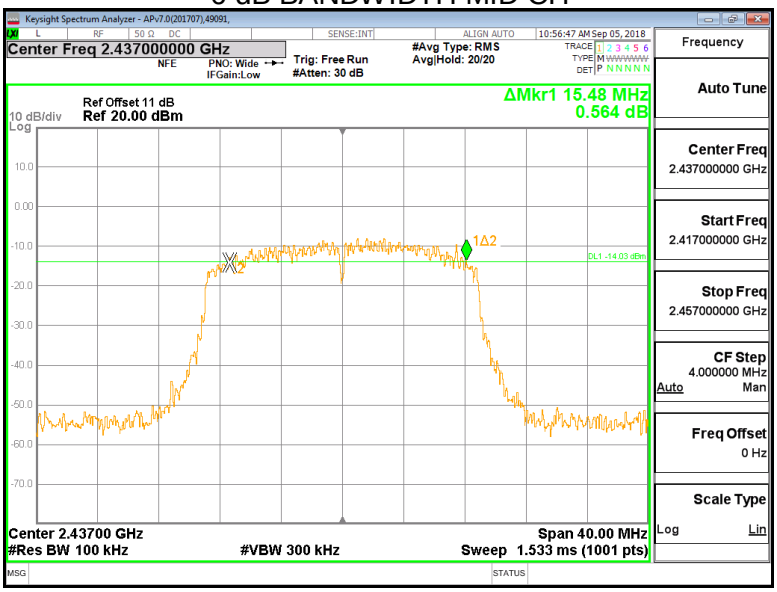
**ANTENNA1**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 15.52 | 17.410 | 500 | Pass |
| 2437 | 15.48 | 17.425 | 500 | Pass |
| 2462 | 17.52 | 17.387 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH





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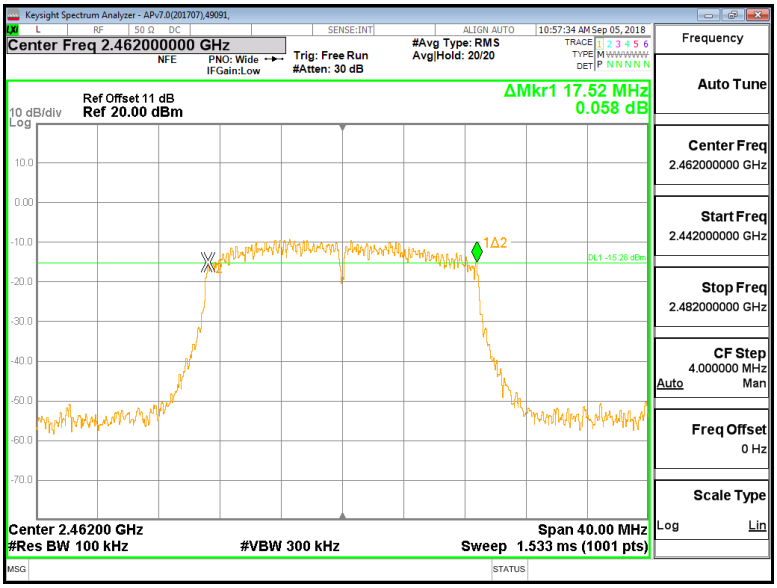
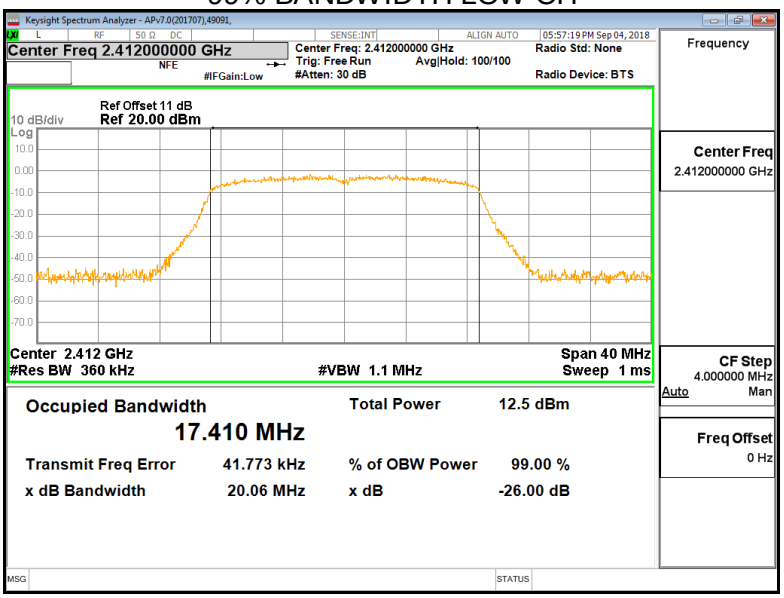
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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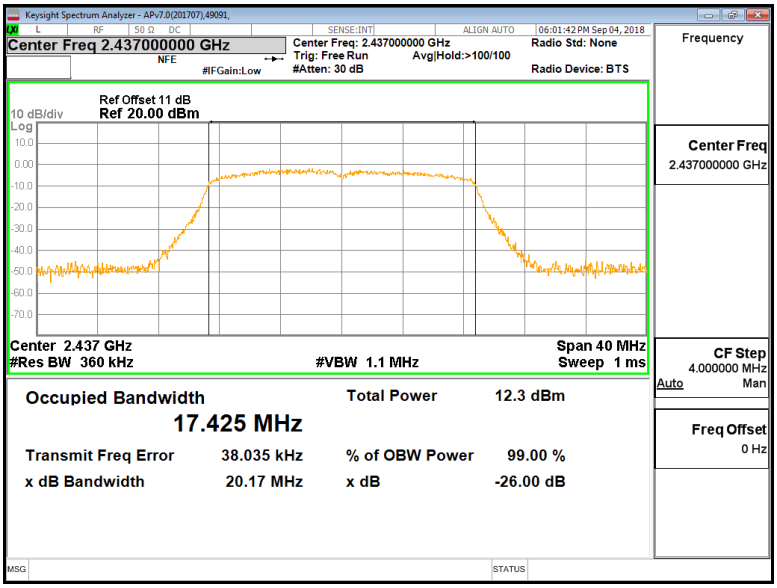
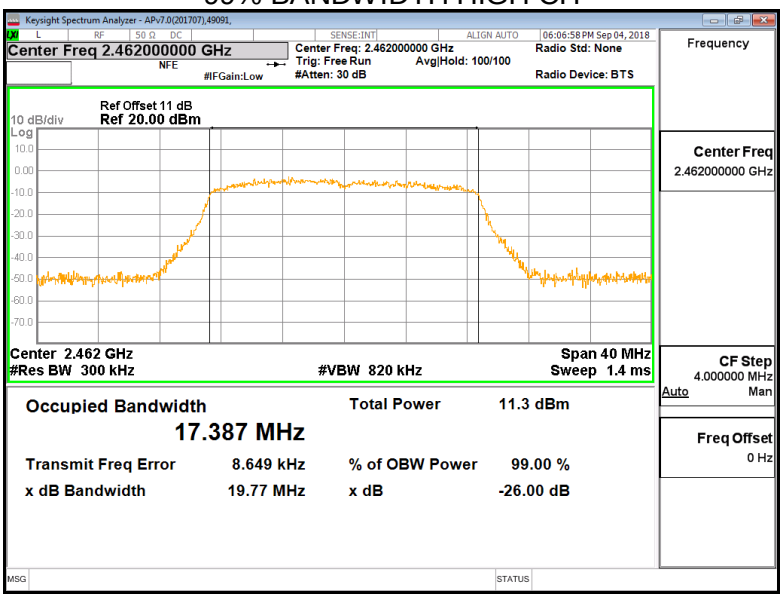
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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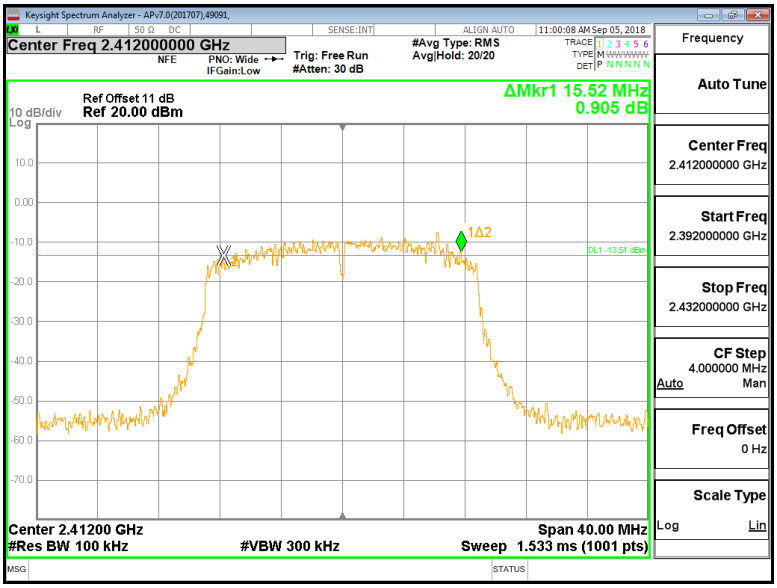
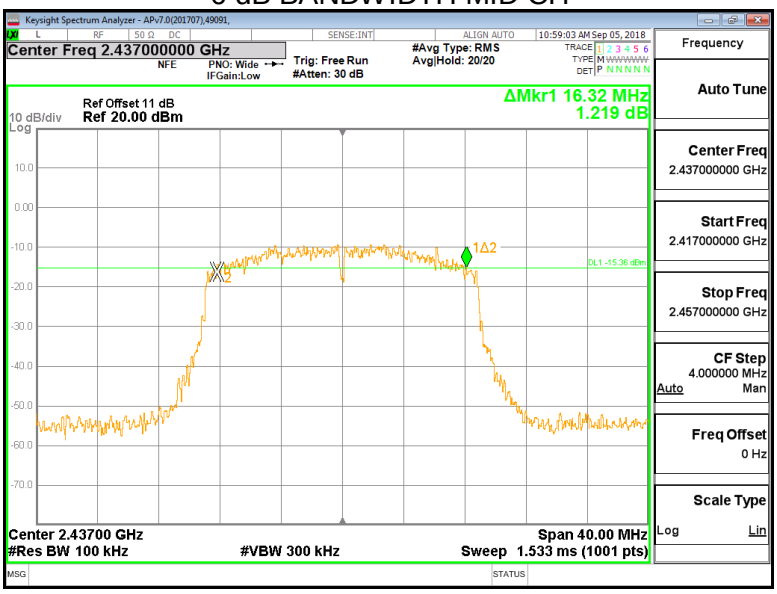
**ANTENNA2**

| Frequency (MHz) | 6dB bandwidth (MHz) | 99% bandwidth (MHz) | Limit For 6dB (kHz) | Result |
|---|---|---|---|---|
| 2412 | 15.52 | 17.306 | 500 | Pass |
| 2437 | 16.32 | 17.235 | 500 | Pass |
| 2462 | 16.52 | 17.291 | 500 | Pass |

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH





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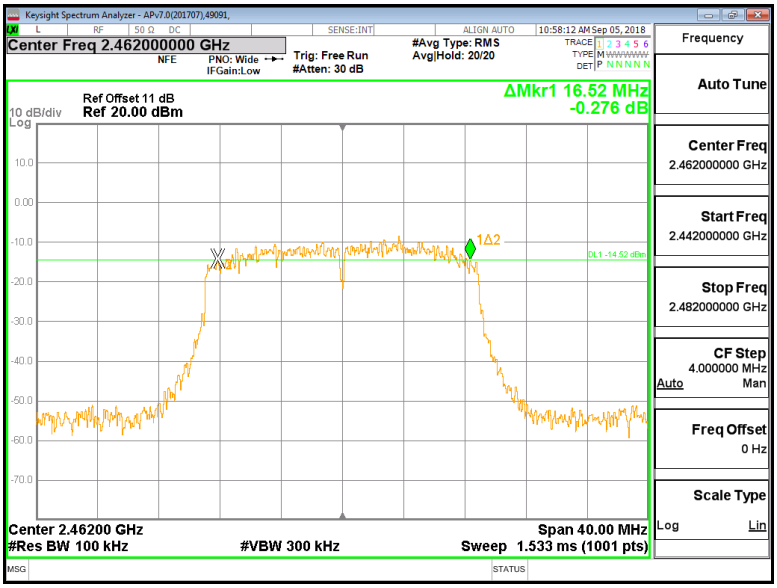
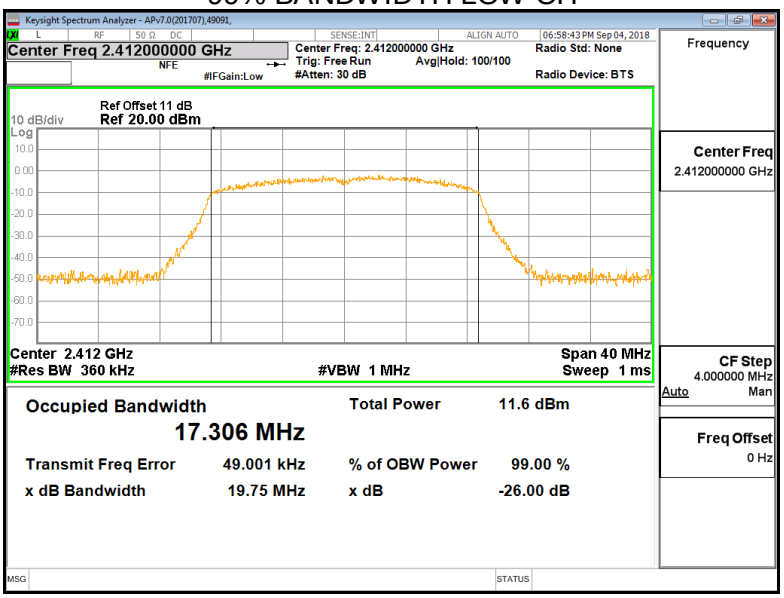
6 dB BANDWIDTH HIGH CH




99% BANDWIDTH LOW CH





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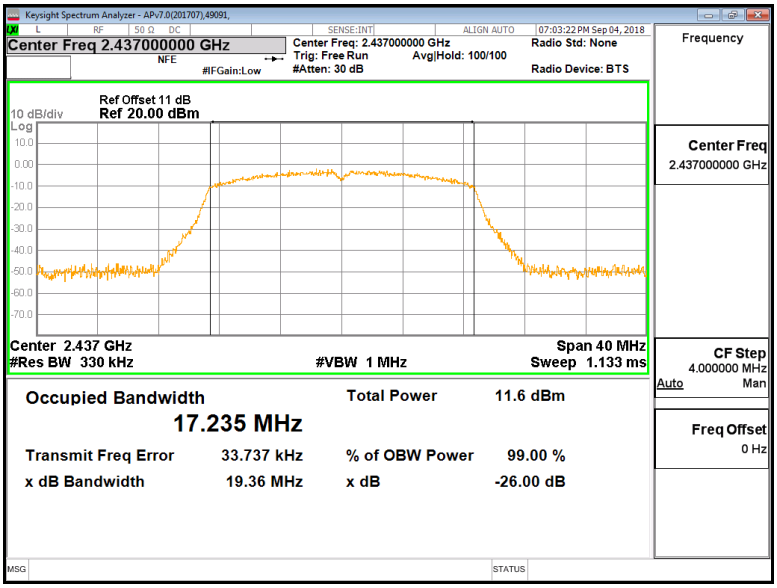
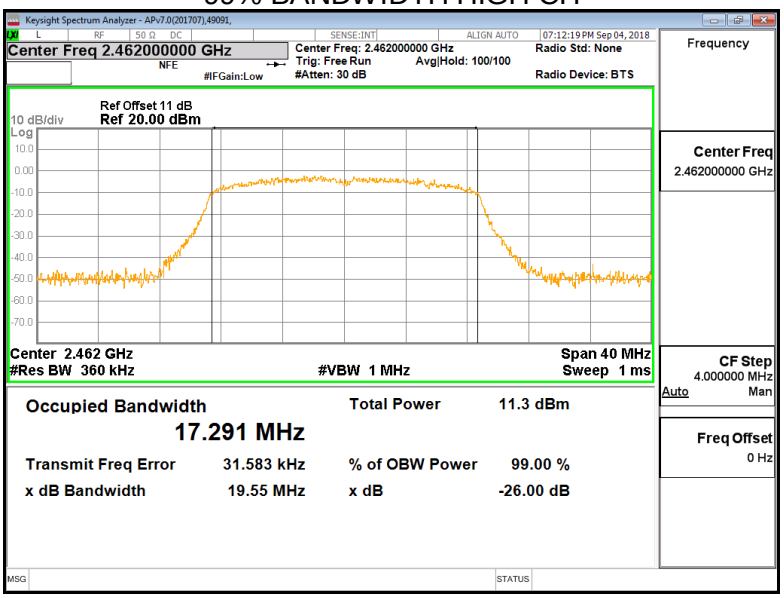
99% BANDWIDTH MID CH




99% BANDWIDTH HIGH CH





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## 7.3. PEAK CONDUCTED OUTPUT POWER

**LIMITS**

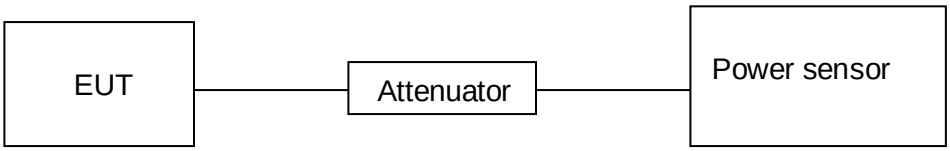
| FCC Part15 (15.247) Subpart C | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| FCC 15.247(b)(3) | Peak Output Power | 1 watt or 30dBm | 2400-2483.5 |

Note:
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.
2. Limit=30dBm – (Directional gain -6)dBi
Directional gain = $10\log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$ =7.11＞6dBi, where $N_{ANT}$ is the number of outputs, $G_{1/2}$ is the Antenna gain. So the power limit shall be reduced to 30-(7.11-6)=28.89dBm

**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.

**TEST SETUP**




**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24.5°C | Relative Humidity | 59% |
| Atmosphere Pressure | 101kPa | Test Voltage | AC 120V |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**RESULTS**

### 7.3.1. 802.11b MODE

**MIMO MODE**

| Mode | Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11b | 2412 | 1 | 7.56 | 10.25 | PASS |
| | | 2 | 6.90 | | |
| | 2437 | 1 | 6.37 | 9.86 | |
| | | 2 | 7.28 | | |
| | 2462 | 1 | 6.12 | 9.33 | |
| | | 2 | 6.52 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11b | 2412 | 1 | 4.42 | 7.16 | PASS |
| | | 2 | 3.87 | | |
| | 2442 | 1 | 3.42 | 6.79 | |
| | | 2 | 4.11 | | |
| | 2462 | 1 | 3.12 | 6.14 | |
| | | 2 | 3.13 | | |


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**SISO MODE**

| Mode | Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11b | 2412 | 1 | 7.52 | / | PASS |
| | | 2 | 6.88 | | |
| | 2437 | 1 | 6.33 | / | |
| | | 2 | 7.21 | | |
| | 2462 | 1 | 6.10 | / | |
| | | 2 | 6.51 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11b | 2412 | 1 | 4.41 | / | PASS |
| | | 2 | 3.85 | | |
| | 2442 | 1 | 3.41 | / | |
| | | 2 | 4.10 | | |
| | 2462 | 1 | 3.11 | / | |
| | | 2 | 3.12 | | |


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### 7.3.2. 802.11g MODE

**MIMO MODE**

| Mode | Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11g | 2412 | 1 | 14.42 | 17.67 | PASS |
| | | 2 | 14.88 | | |
| | 2437 | 1 | 14.35 | 17.60 | |
| | | 2 | 14.81 | | |
| | 2462 | 1 | 13.64 | 17.30 | |
| | | 2 | 14.86 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11g | 2412 | 1 | 6.25 | 9.22 | PASS |
| | | 2 | 6.16 | | |
| | 2442 | 1 | 6.25 | 9.19 | |
| | | 2 | 6.11 | | |
| | 2462 | 1 | 5.46 | 8.63 | |
| | | 2 | 5.77 | | |


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**SISO MODE**

| Mode | Frequency (MHz) | ANT | Maximum PK Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11g | 2412 | 1 | 14.41 | / | PASS |
| | | 2 | 14.76 | | |
| | 2437 | 1 | 14.33 | / | |
| | | 2 | 14.77 | | |
| | 2462 | 1 | 13.61 | / | |
| | | 2 | 14.82 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11g | 2412 | 1 | 6.21 | / | PASS |
| | | 2 | 6.13 | | |
| | 2442 | 1 | 6.23 | / | |
| | | 2 | 6.10 | | |
| | 2462 | 1 | 5.43 | / | |
| | | 2 | 5.73 | | |


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### 7.3.1. 802.11n HT20 MODE

**SISO MODE**

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11n HT20 | 2412 | 1 | 14.71 | / | PASS |
| | | 2 | 14.15 | | |
| | 2437 | 1 | 14.14 | / | |
| | | 2 | 14.23 | | |
| | 2462 | 1 | 13.66 | / | |
| | | 2 | 13.87 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11n HT20 | 2412 | 1 | 6.48 | / | PASS |
| | | 2 | 5.84 | | |
| | 2442 | 1 | 5.54 | / | |
| | | 2 | 5.82 | | |
| | 2462 | 1 | 5.12 | / | |
| | | 2 | 5.47 | | |


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**MIMO MODE**

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11n HT20 | 2412 | 1 | 14.73 | 17.51 | PASS |
| | | 2 | 14.25 | | |
| | 2437 | 1 | 14.25 | 17.27 | |
| | | 2 | 14.27 | | |
| | 2462 | 1 | 13.74 | 16.87 | |
| | | 2 | 13.97 | | |

| Mode | Frequency (MHz) | ANT | Maximum AV Conducted Output Power (dBm) | | Result |
|---|---|---|---|---|---|
| | | | Single | Total | |
| 802.11n HT20 | 2412 | 1 | 6.58 | 9.27 | PASS |
| | | 2 | 5.91 | | |
| | 2442 | 1 | 5.65 | 8.80 | |
| | | 2 | 5.92 | | |
| | 2462 | 1 | 5.22 | 8.39 | |
| | | 2 | 5.54 | | |


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## 7.4. POWER SPECTRAL DENSITY

**LIMITS**

| FCC Part15 (15.247) Subpart C | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) |
| FCC §15.247 (e) | Power Spectral Density | 8 dBm in any 3 kHz band | 2400-2483.5 |
| Note:<br>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 = $10\log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$ =7.11＞6dBi, where $N_{ANT}$ is the number of outputs, $G_{1/2}$ is the Antenna gain.<br>So the power density limit shall be reduced to 8-(7.11-6)=6.89dBm in any 3 kHz band. | | | |

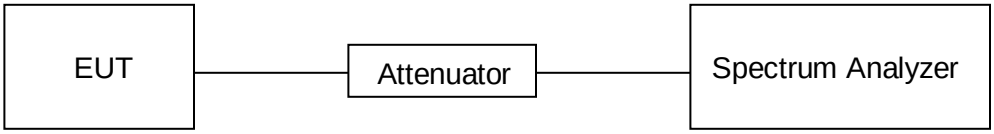
**TEST PROCEDURE**

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

| | |
|---|---|
| Center Frequency | The center 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**





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**TEST ENVIRONMENT**

| | | | |
|---|---|---|---|
| Temperature | 24.5°C | Relative Humidity | 59% |
| Atmosphere Pressure | 101kPa | Test Voltage | AC 120V |

**RESULTS**

### 7.4.1. 802.11b MIMO MODE

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| 2412 | 1 | -20.81 | -17.53 | 6.89 |
| | 2 | -20.28 | | |
| 2437 | 1 | -20.14 | -17.41 | |
| | 2 | -20.71 | | |
| 2462 | 1 | -20.90 | -17.90 | |
| | 2 | -20.92 | | |


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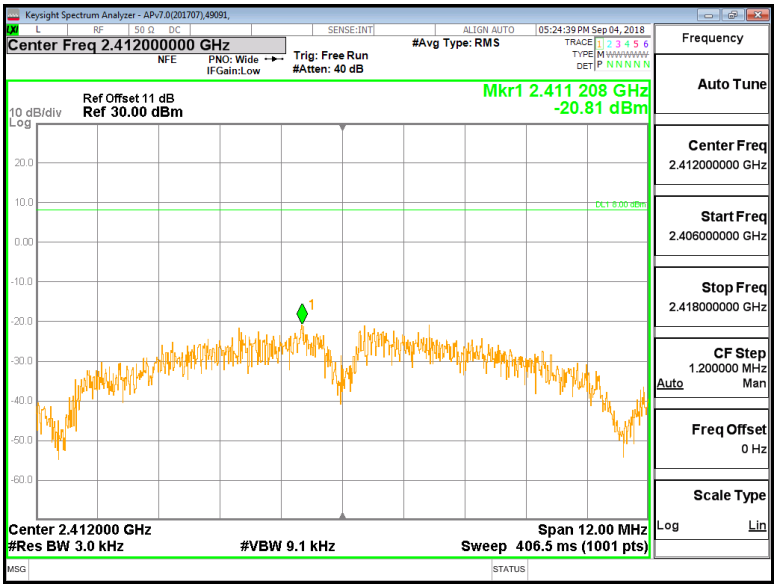
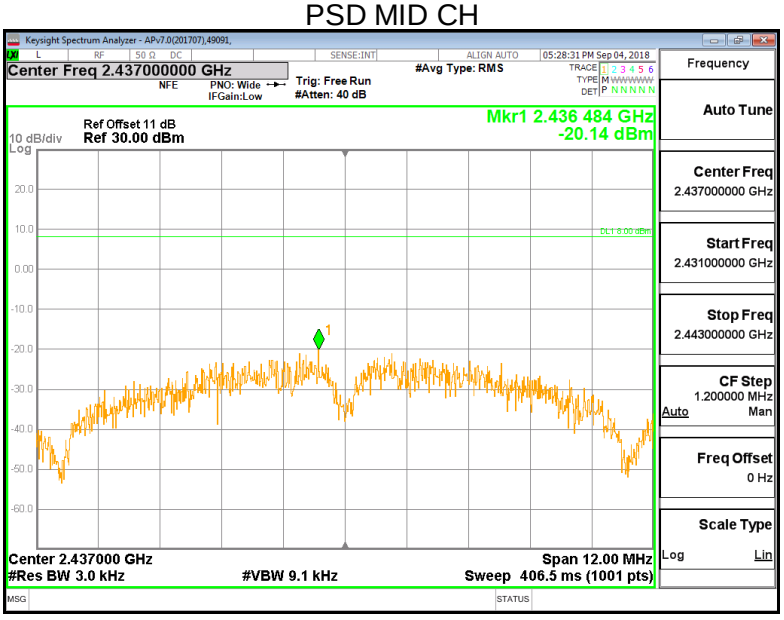
**ANTENNA1**

PSD LOW CH




PSD MID CH





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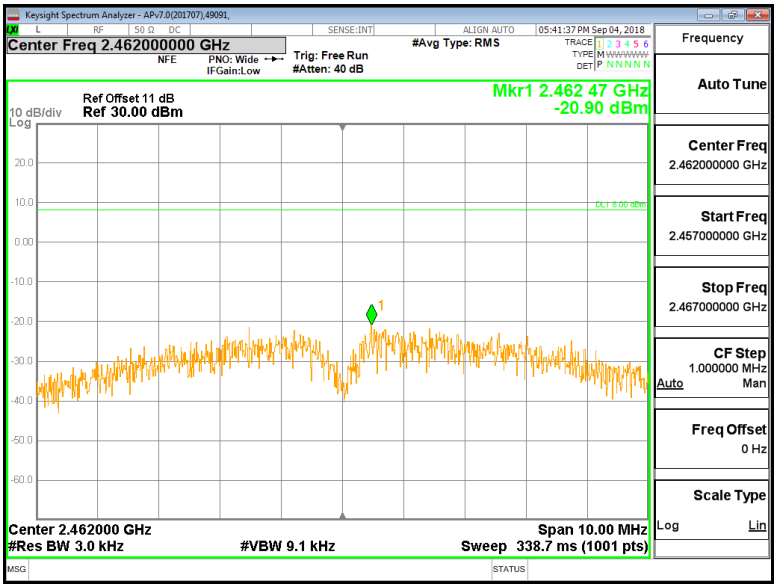
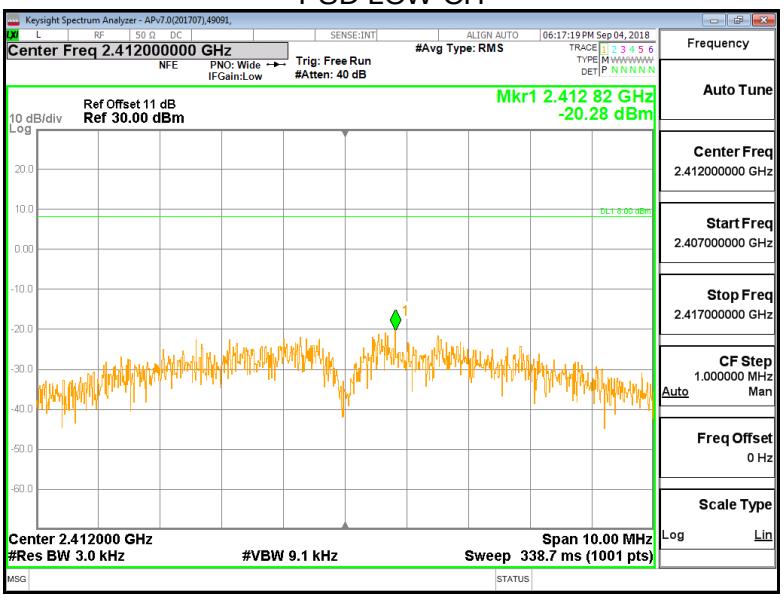
PSD HIGH CH




**ANTENNA2**

PSD LOW CH





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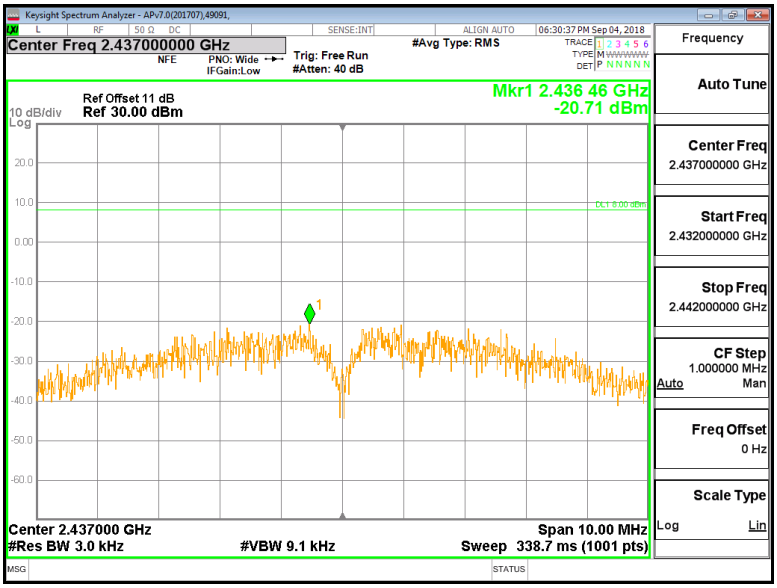
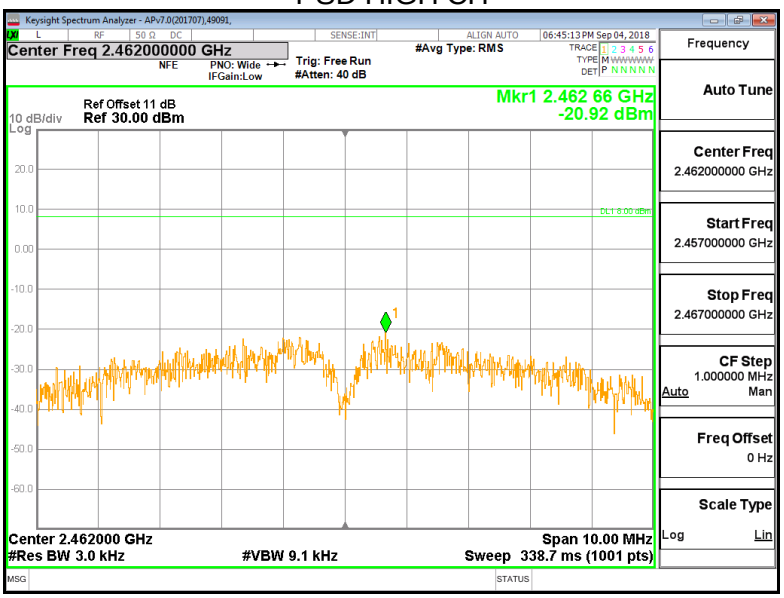
PSD MID CH




PSD HIGH CH





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### 7.4.2. 802.11g MIMO MODE

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| 2412 | 1 | -19.89 | -16.36 | 6.89 |
| | 2 | -18.90 | | |
| 2437 | 1 | -19.21 | -17.12 | |
| | 2 | -21.30 | | |
| 2462 | 1 | -20.62 | -17.69 | |
| | 2 | -20.79 | | |


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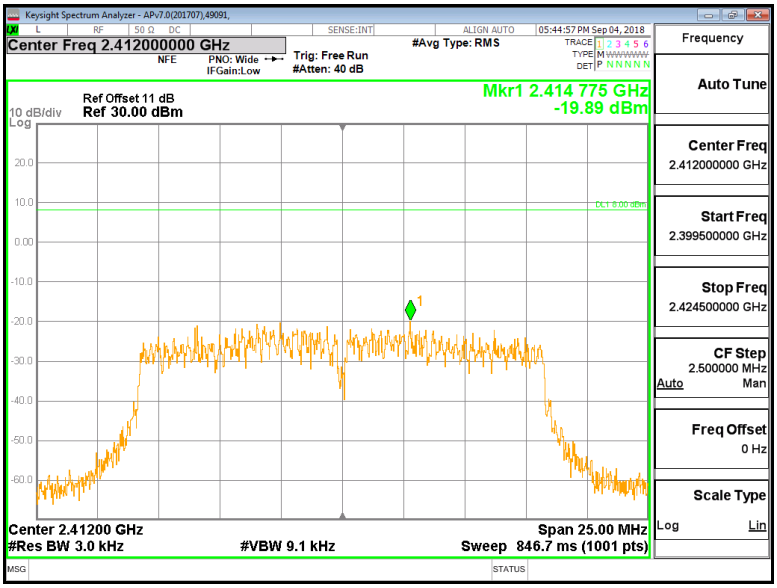
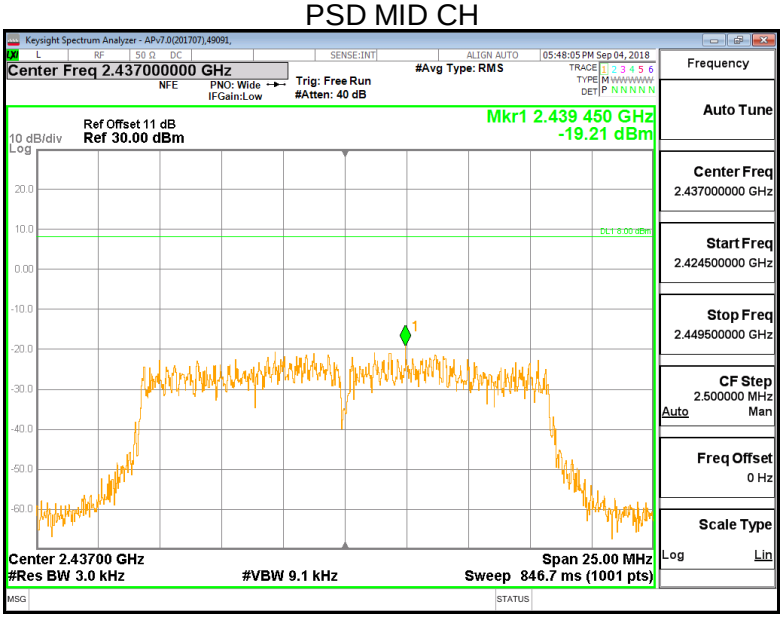
**ANTENNA1**

PSD LOW CH




PSD MID CH





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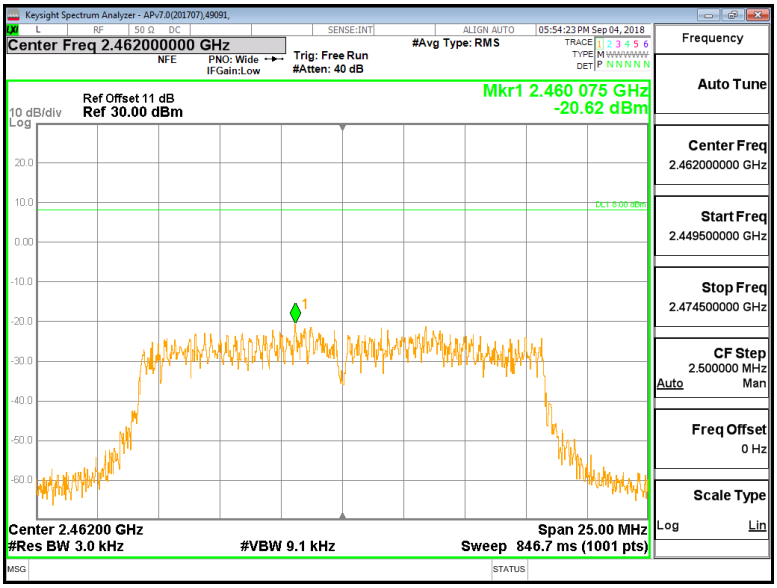
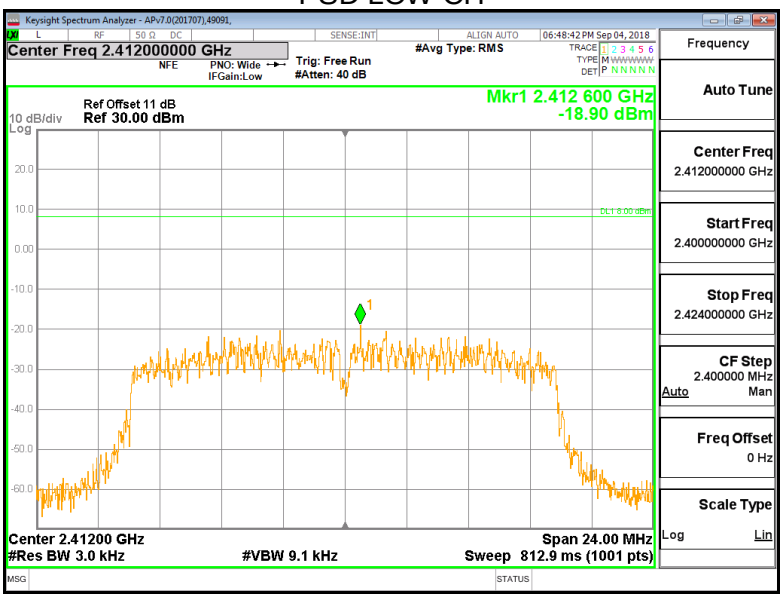
PSD HIGH CH




**ANTENNA2**

PSD LOW CH





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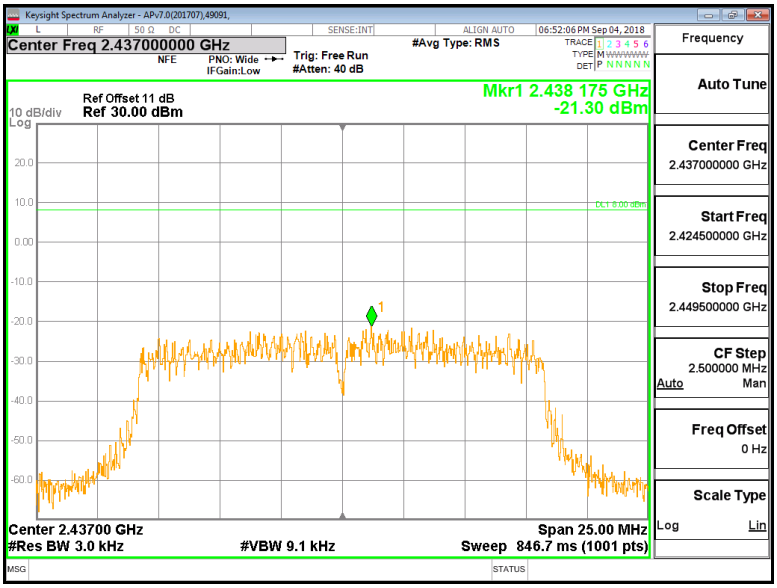
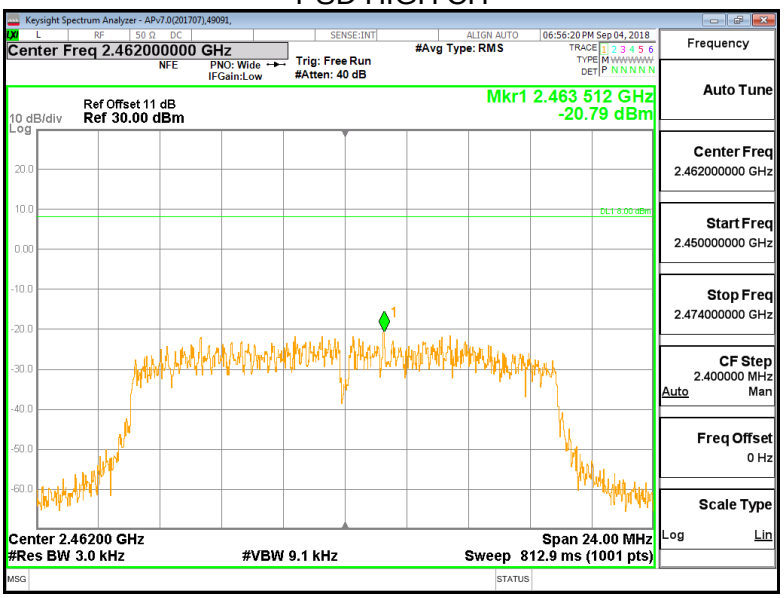
PSD MID CH




PSD HIGH CH





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### 7.4.3. 802.11n20 MIMO MODE

| Frequency (MHz) | ANT | Power Spectral Density (dBm/3kHz) | | Limit (dBm/3kHz) |
|---|---|---|---|---|
| | | Single | Total | |
| 2412 | 1 | -20.42 | -18.08 | 6.89 |
| | 2 | -21.89 | | |
| 2437 | 1 | -20.20 | -17.77 | |
| | 2 | -21.44 | | |
| 2462 | 1 | -21.00 | -18.28 | |
| | 2 | -21.61 | | |


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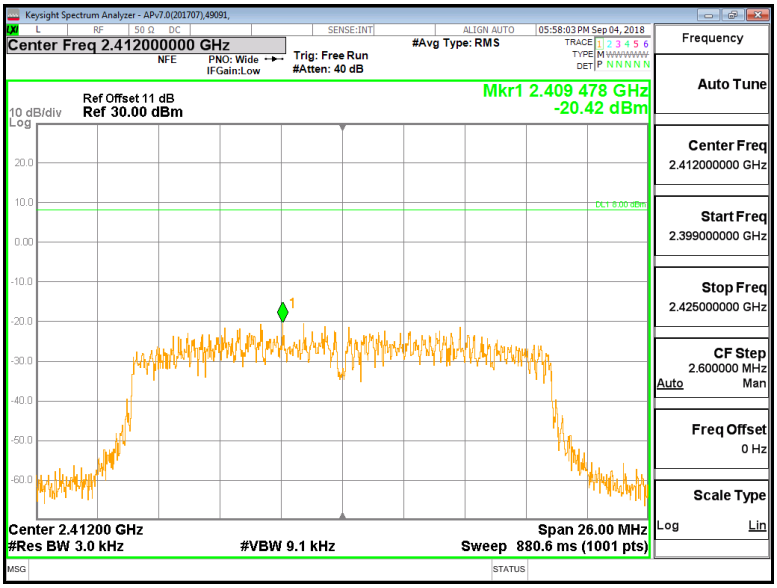
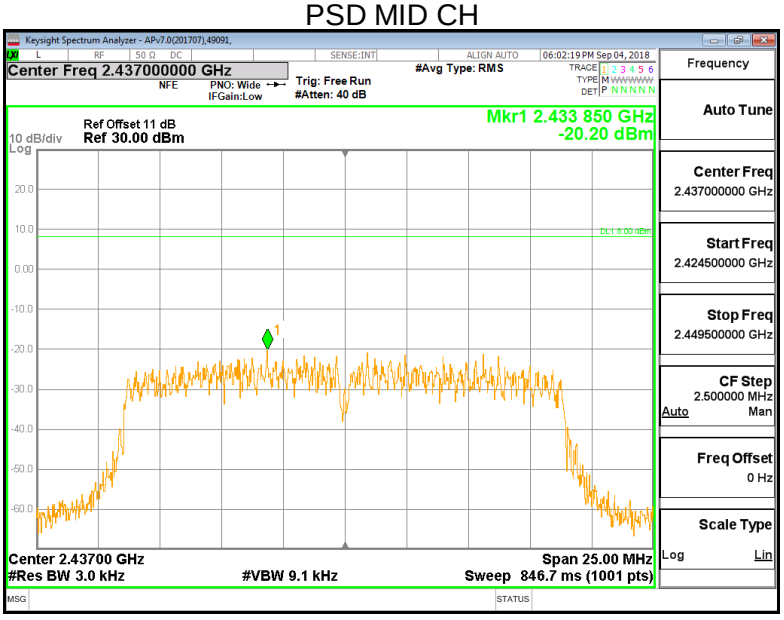
**ANTENNA1**

PSD LOW CH




PSD MID CH





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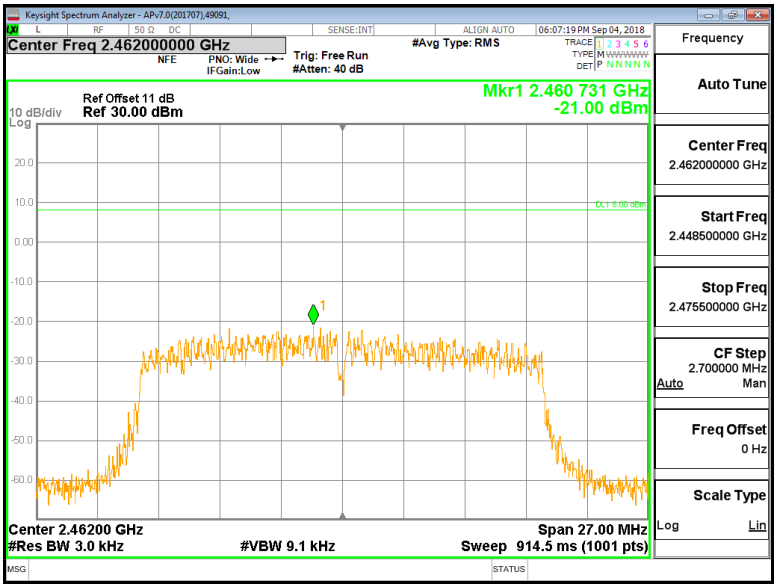
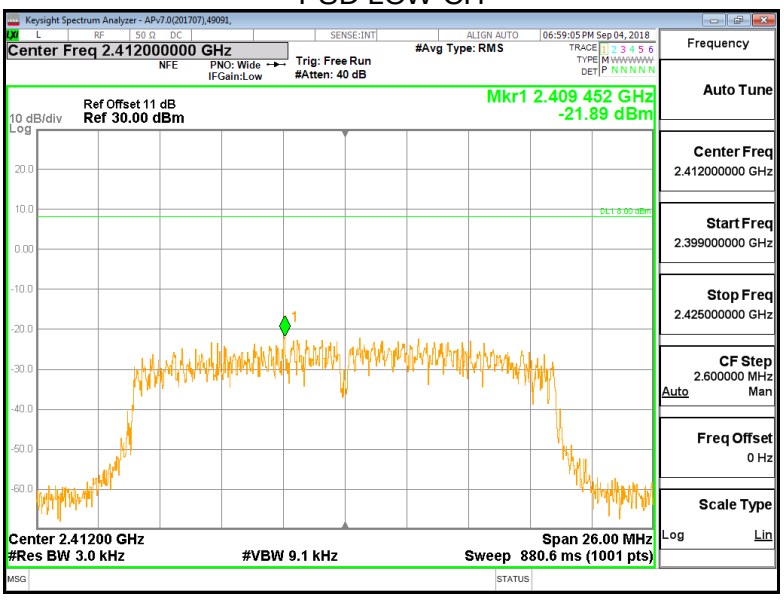
PSD HIGH CH




**ANTENNA2**

PSD LOW CH





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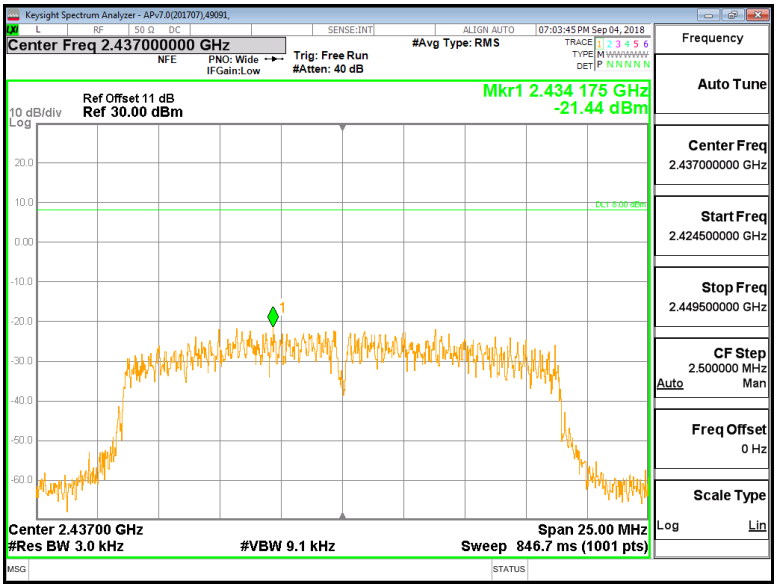
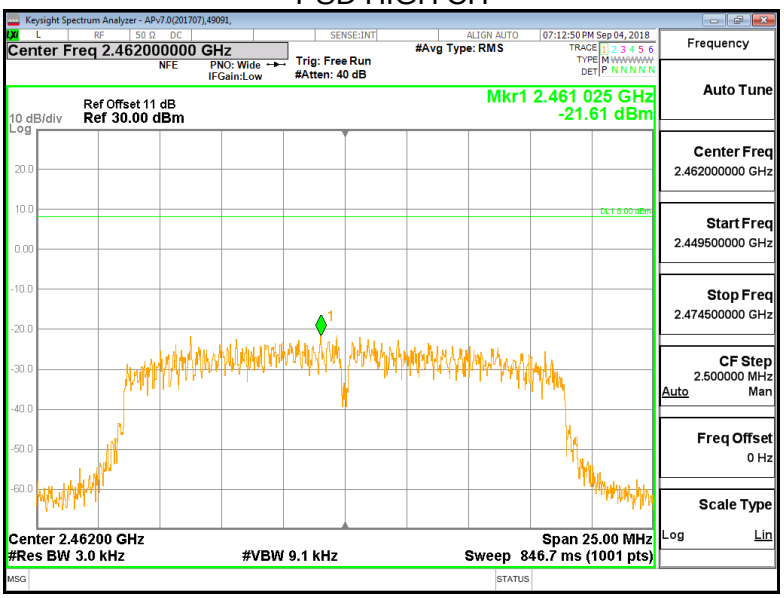
PSD MID CH




PSD HIGH CH





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## 7.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

**LIMITS**

| FCC Part15 (15.247) Subpart C | | |
|---|---|---|
| Section | Test Item | Limit |
| FCC §15.247 (d) | 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 |

**TEST PROCEDURE**

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

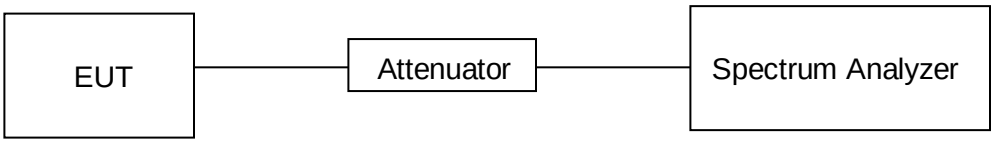
| | |
|---|---|
| Center Frequency | The center frequency of the channel under test |
| Detector | Peak |
| RBW | 100K |
| VBW | ≥3 × RBW |
| Span | 1.5 x DTS bandwidth |
| Trace | Max hold |
| Sweep time | Auto couple. |

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**





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**TEST ENVIRONMENT**

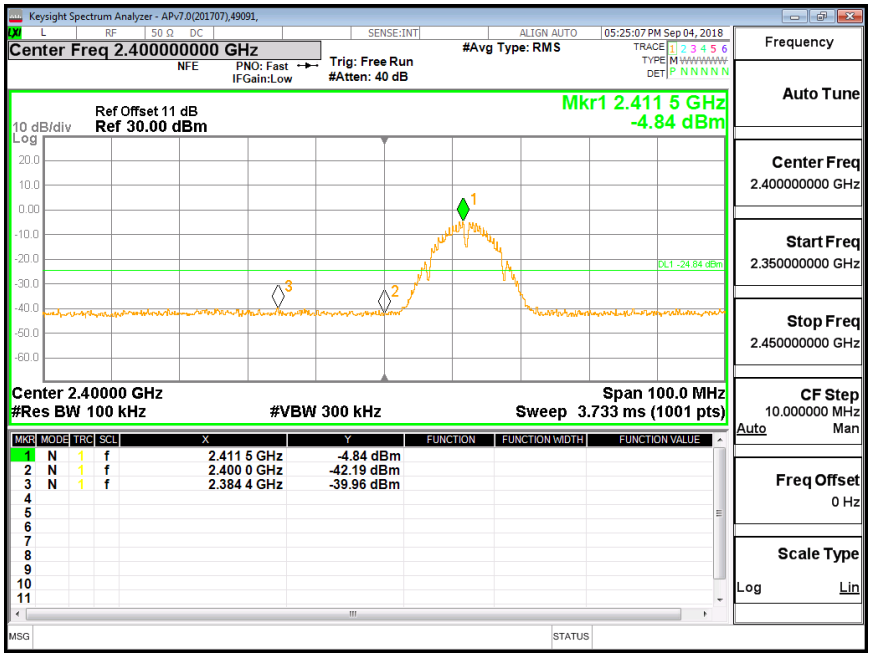
| | | | |
|---|---|---|---|
| Temperature | 24.5°C | Relative Humidity | 59% |
| Atmosphere Pressure | 101kPa | Test Voltage | AC 120V |

**RESULTS**

### 7.5.1. 802.11b MIMO MODE

**ANTENNA1**

LOW CH BANDEDAGE





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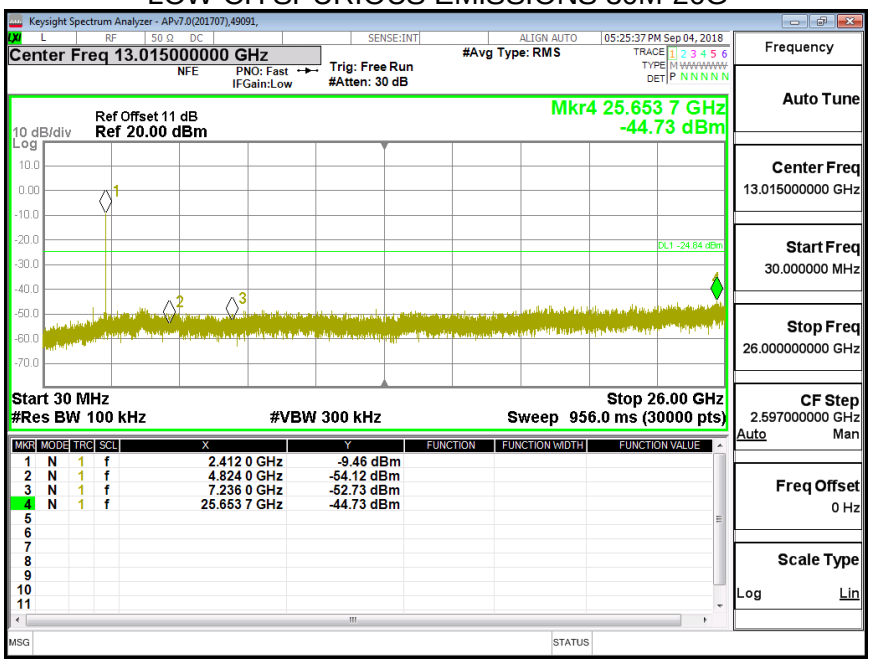
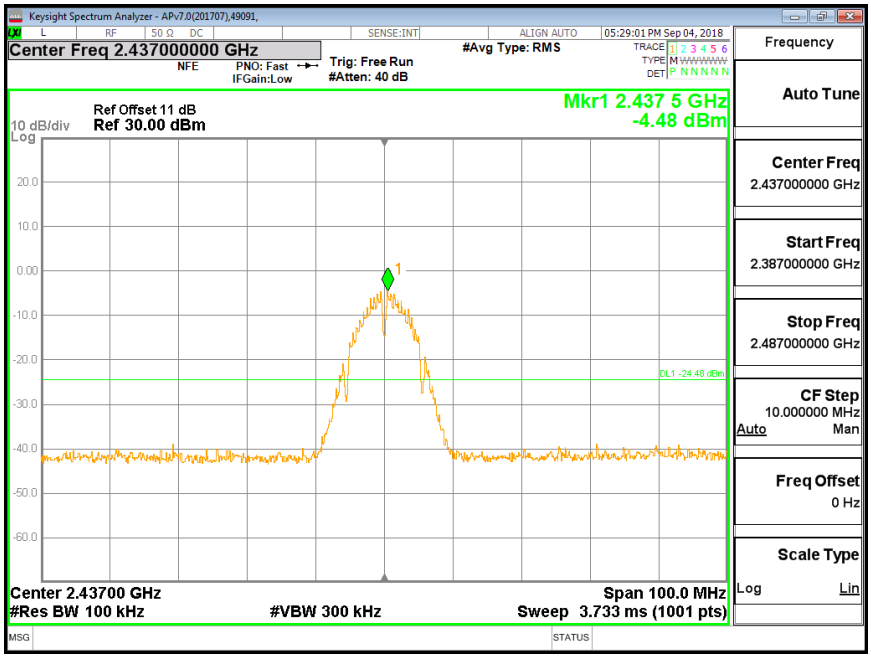
LOW CH SPURIOUS EMISSIONS 30M-26G




MID CH BANDEDAGE





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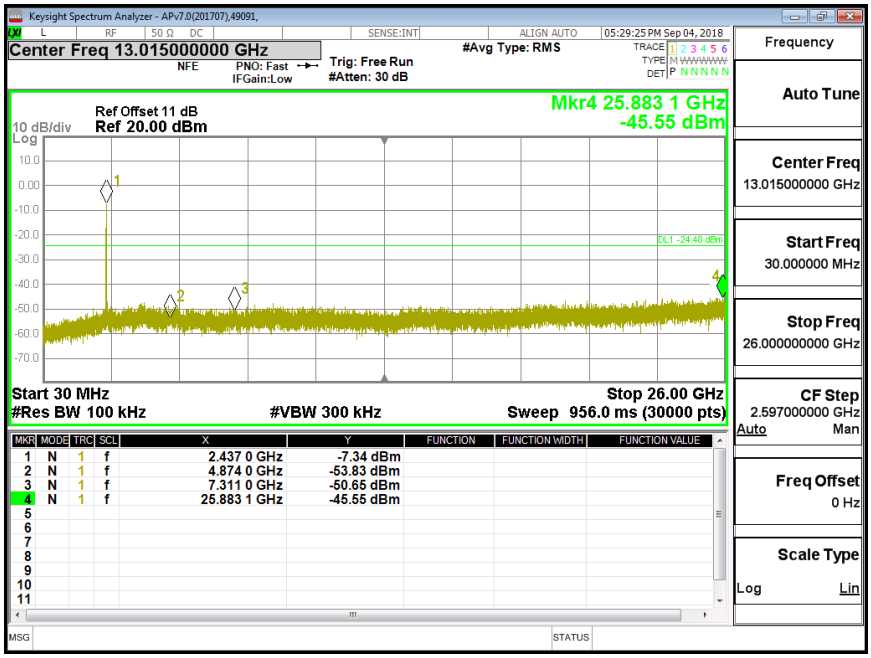
MID CH SPURIOUS EMISSIONS 30M-26G

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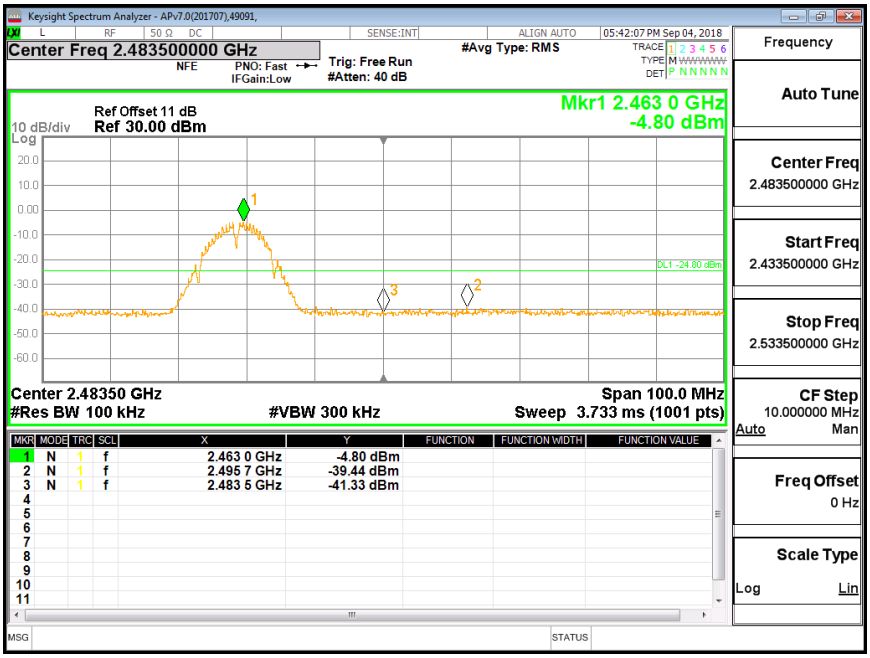



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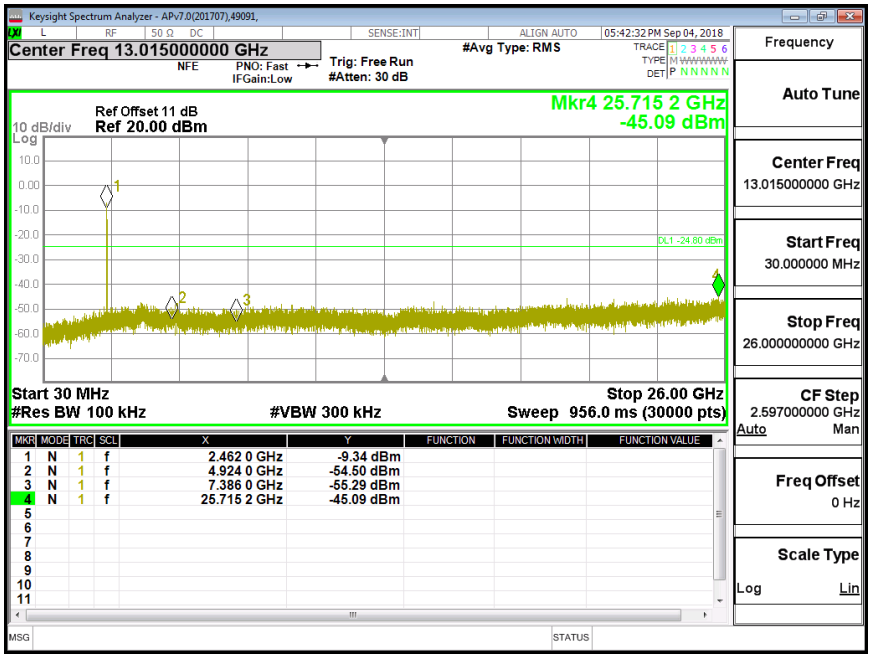
HIGH CH SPURIOUS EMISSIONS 30M-26G





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**ANTENNA2**

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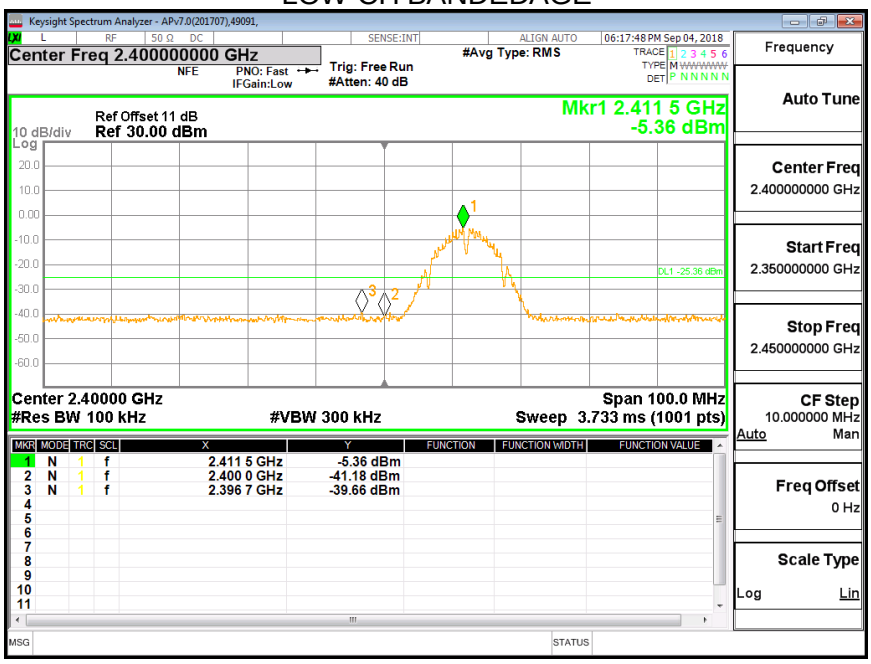
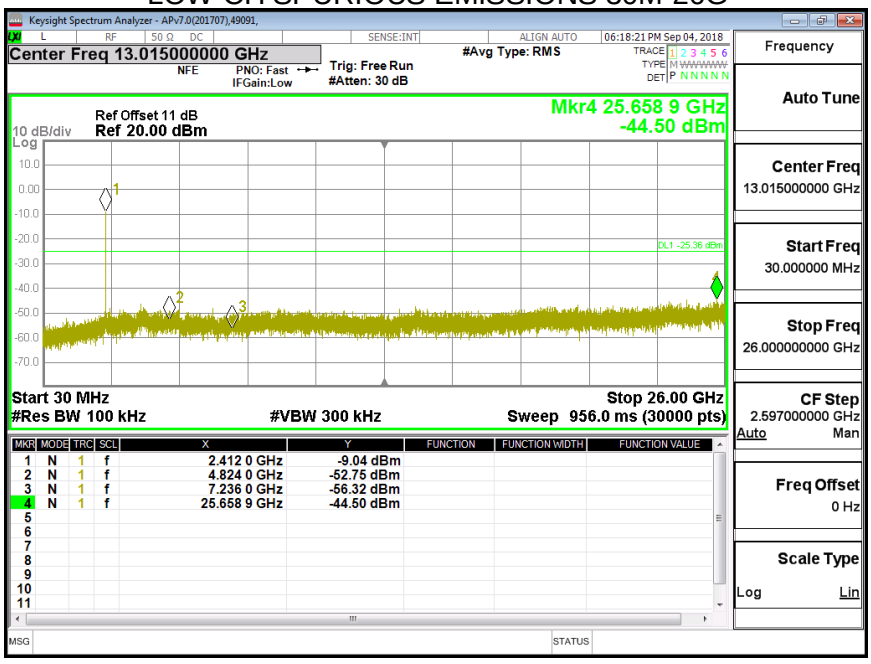



LOW CH SPURIOUS EMISSIONS 30M-26G





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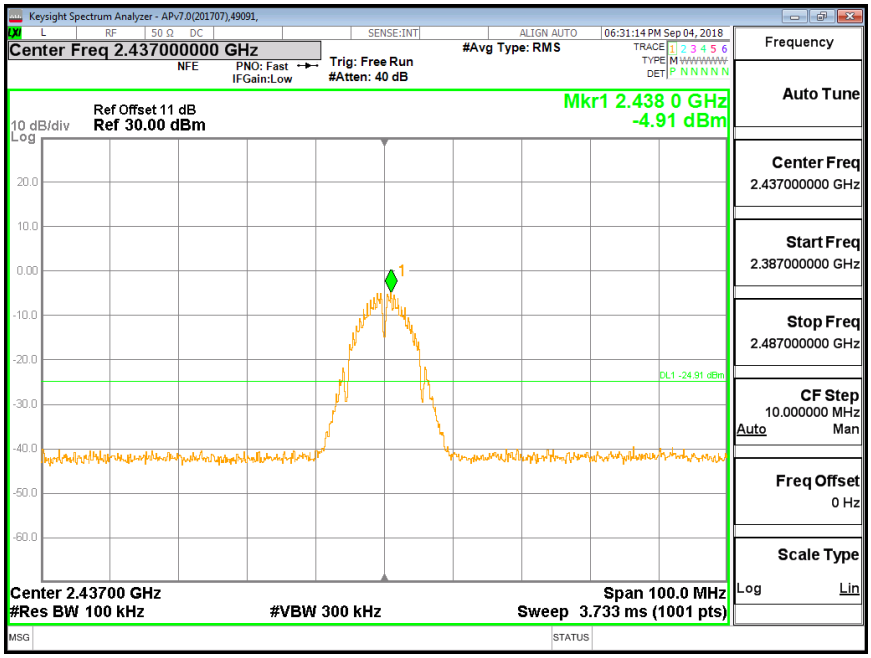
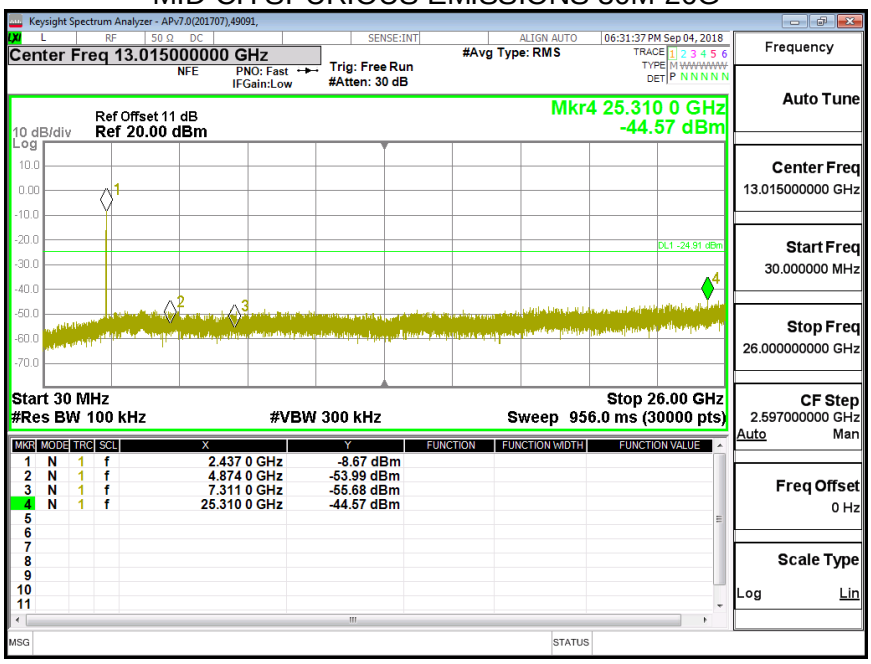



MID CH SPURIOUS EMISSIONS 30M-26G





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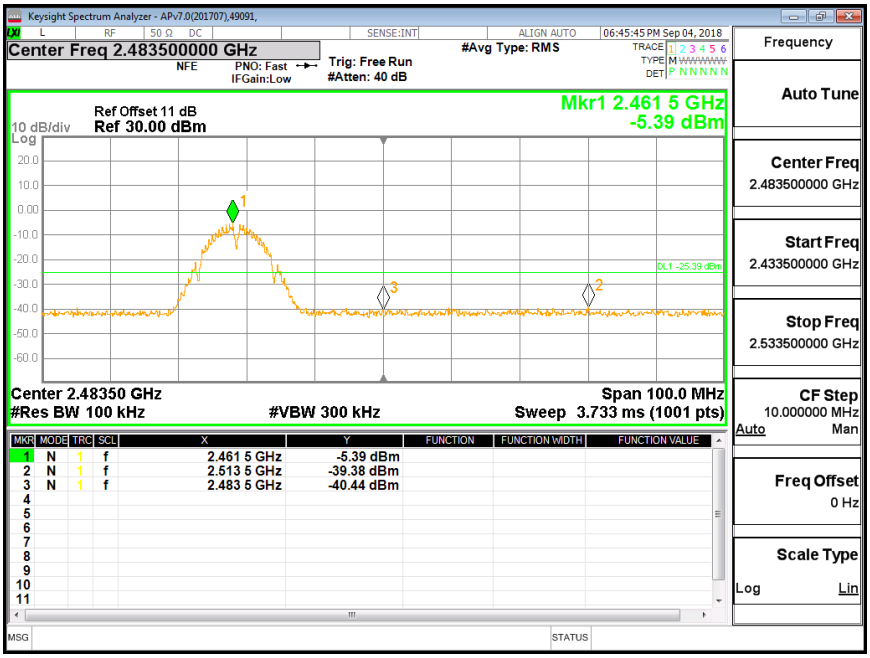
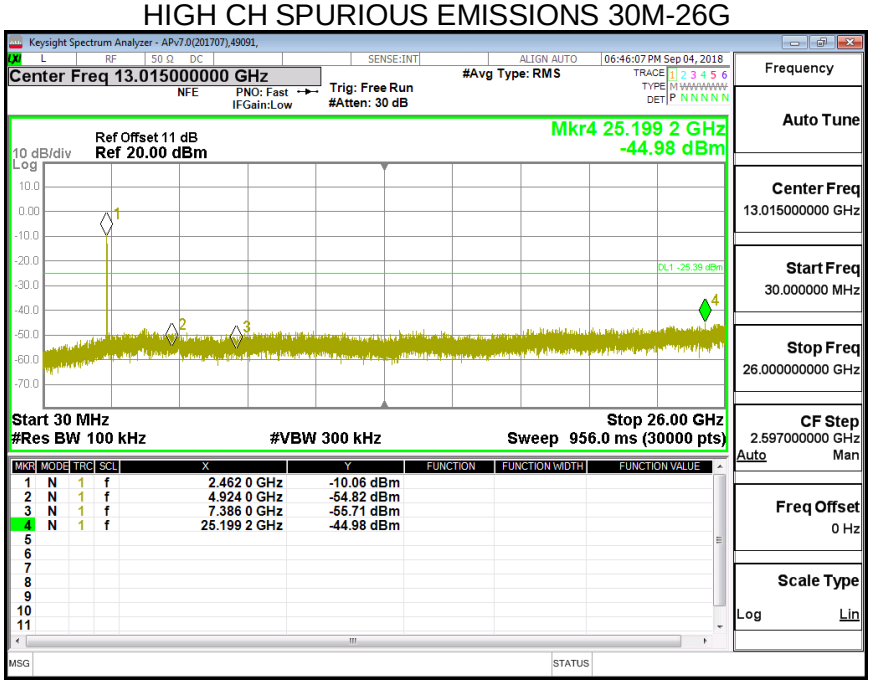



HIGH CH SPURIOUS EMISSIONS 30M-26G





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### 7.5.2. 802.11g MIMO MODE

**ANTENNA1**

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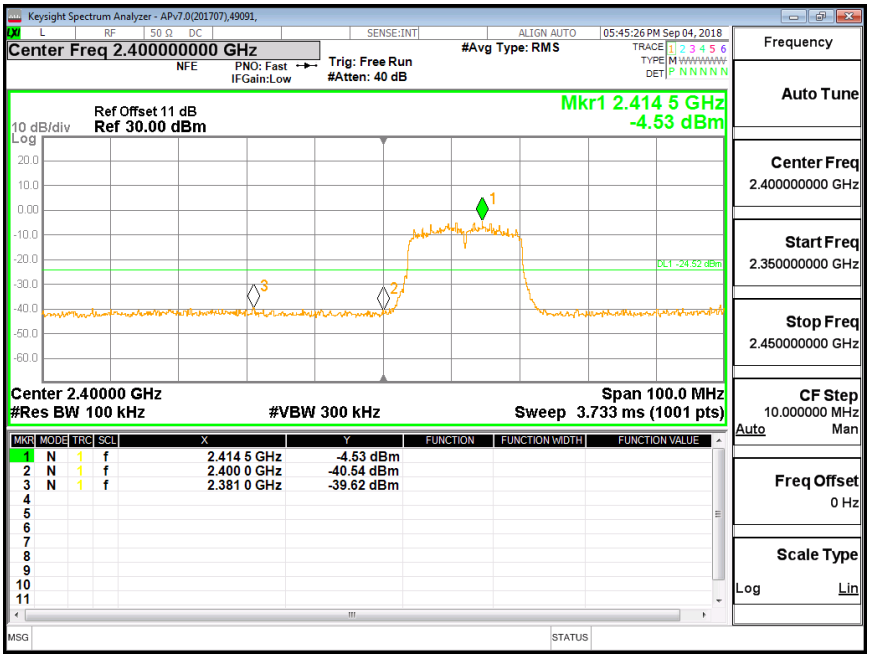
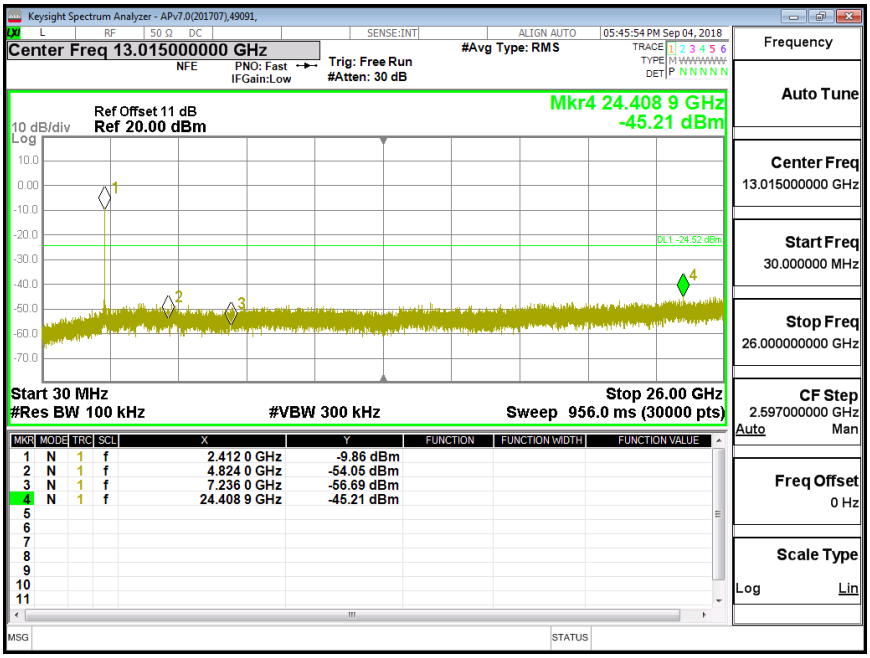



LOW CH SPURIOUS EMISSIONS 30M-26G





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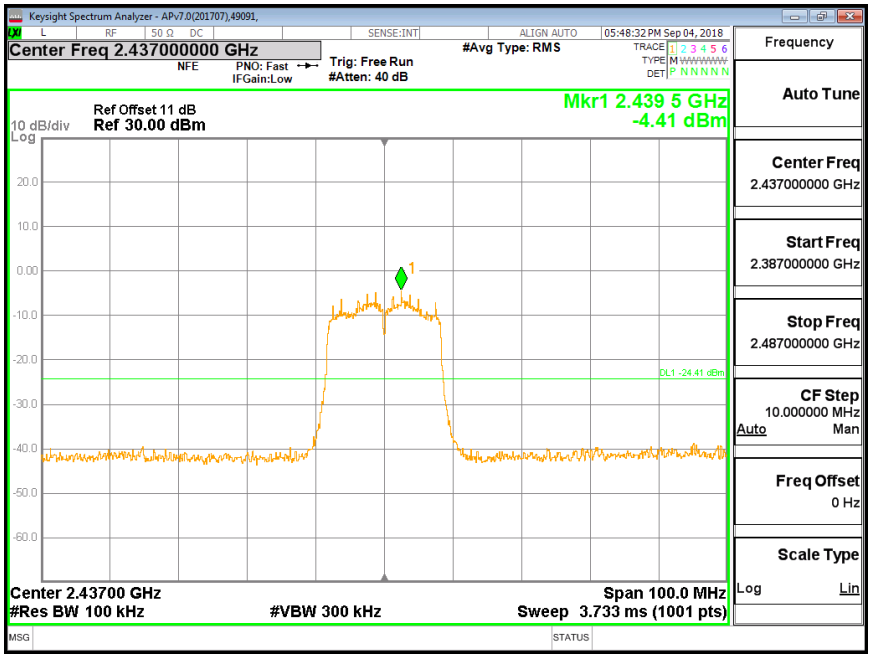
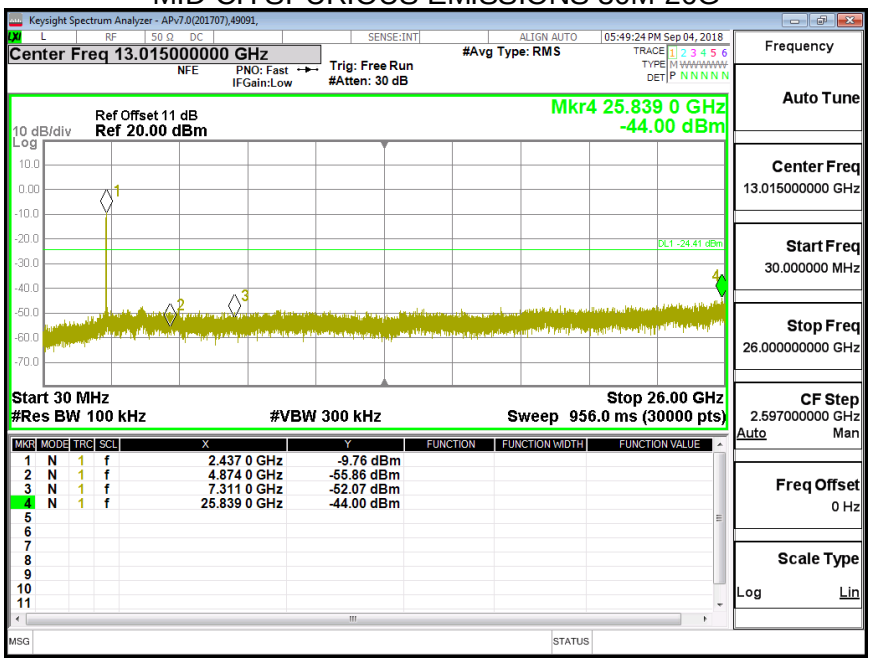



MID CH SPURIOUS EMISSIONS 30M-26G





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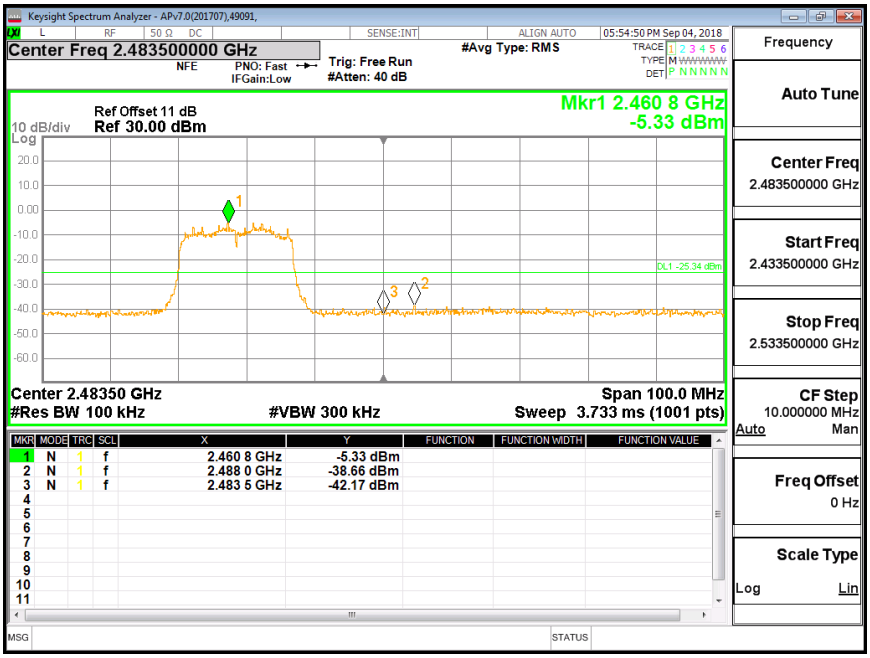
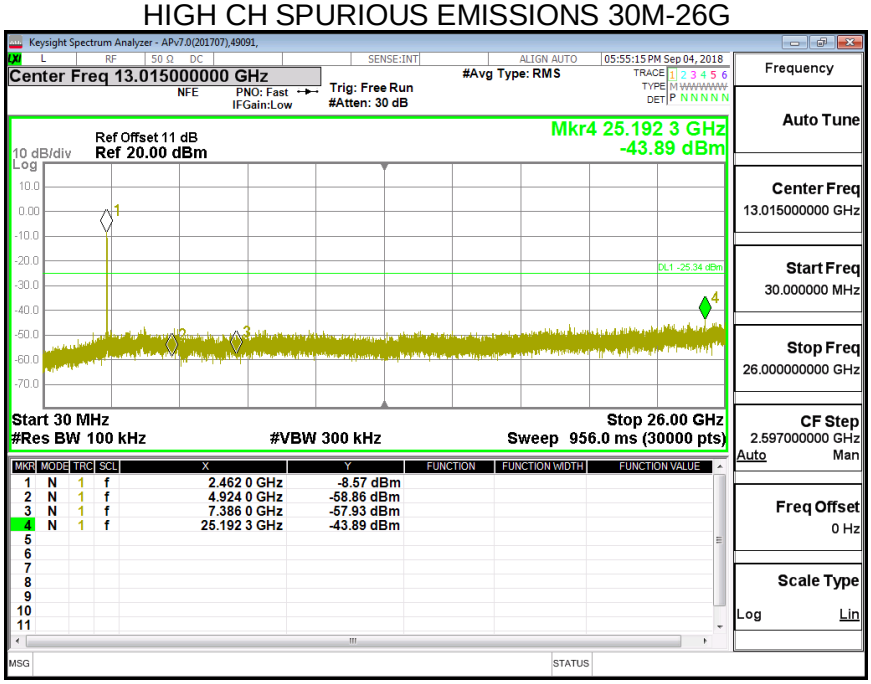



HIGH CH SPURIOUS EMISSIONS 30M-26G





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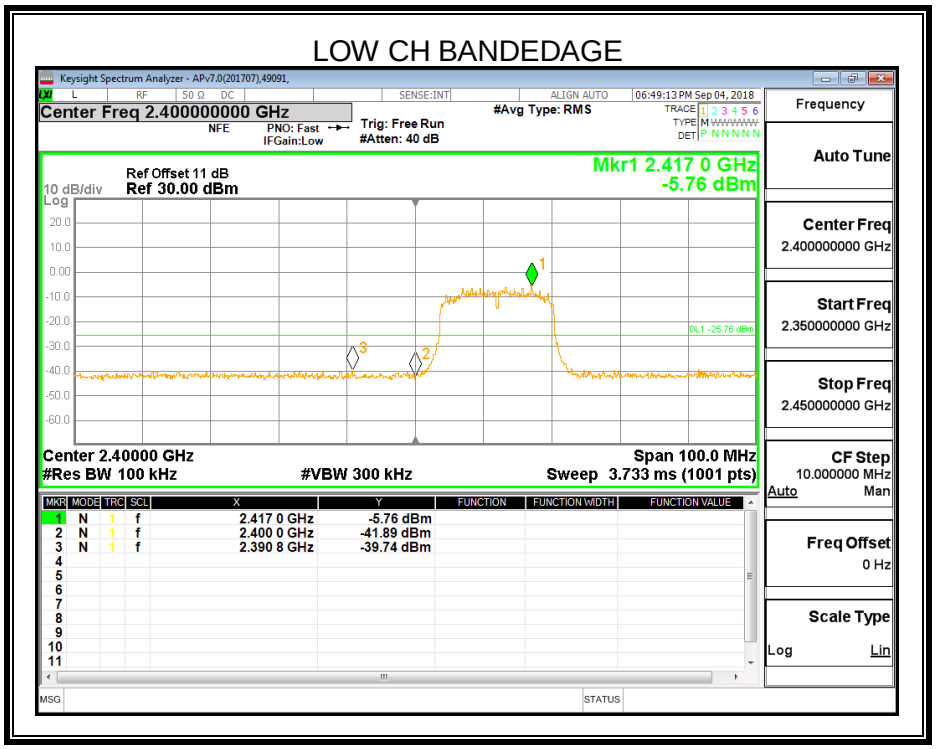


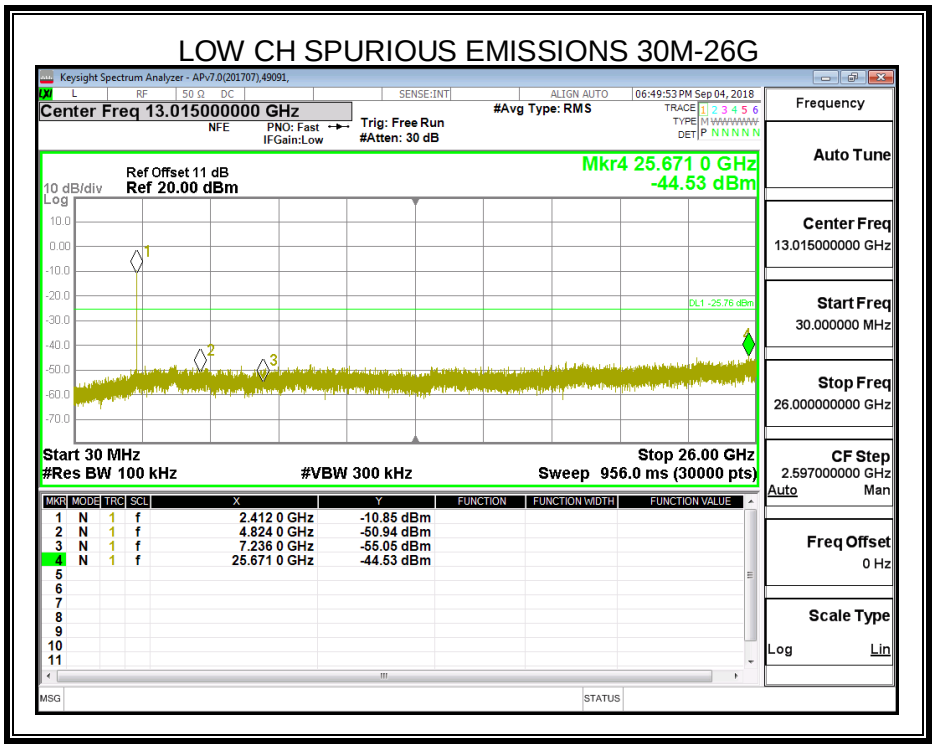



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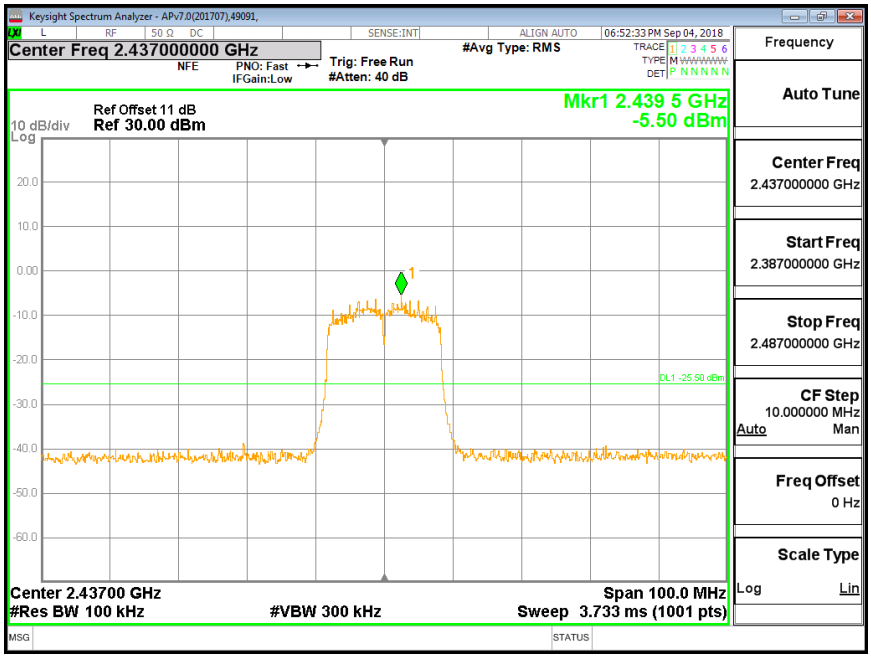
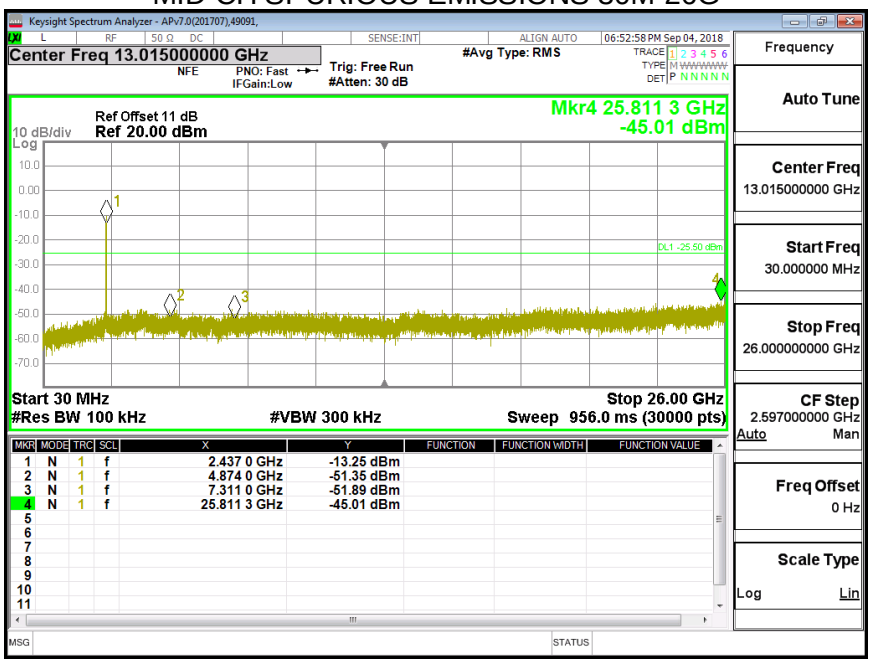



MID CH SPURIOUS EMISSIONS 30M-26G





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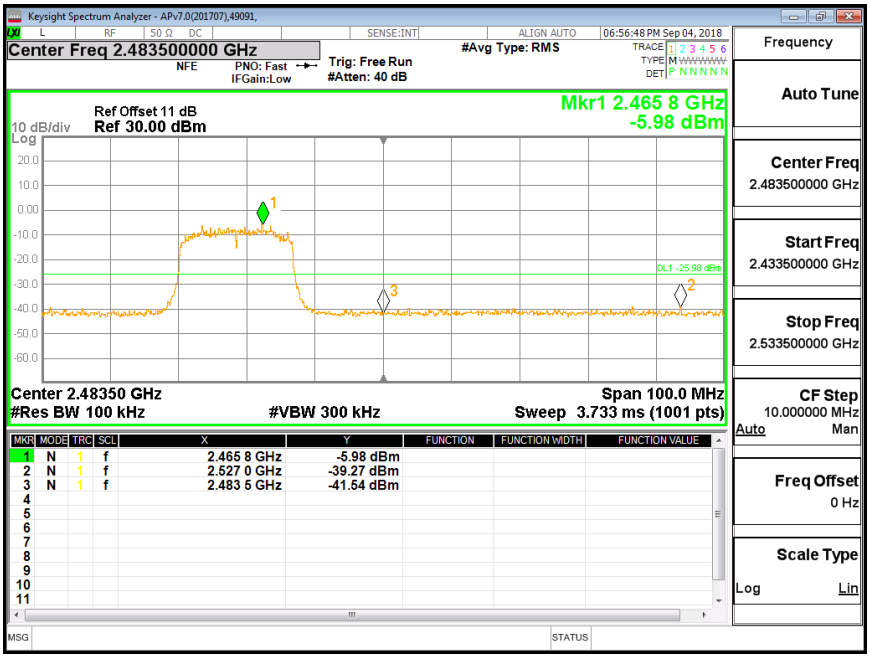
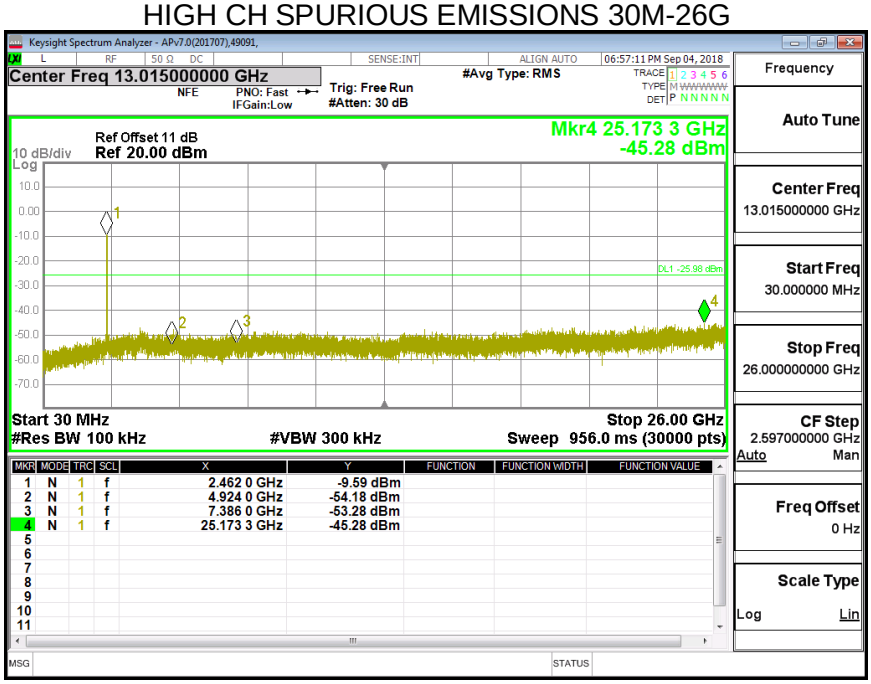



HIGH CH SPURIOUS EMISSIONS 30M-26G





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### 7.5.3. 802.11n20 MIMO MODE

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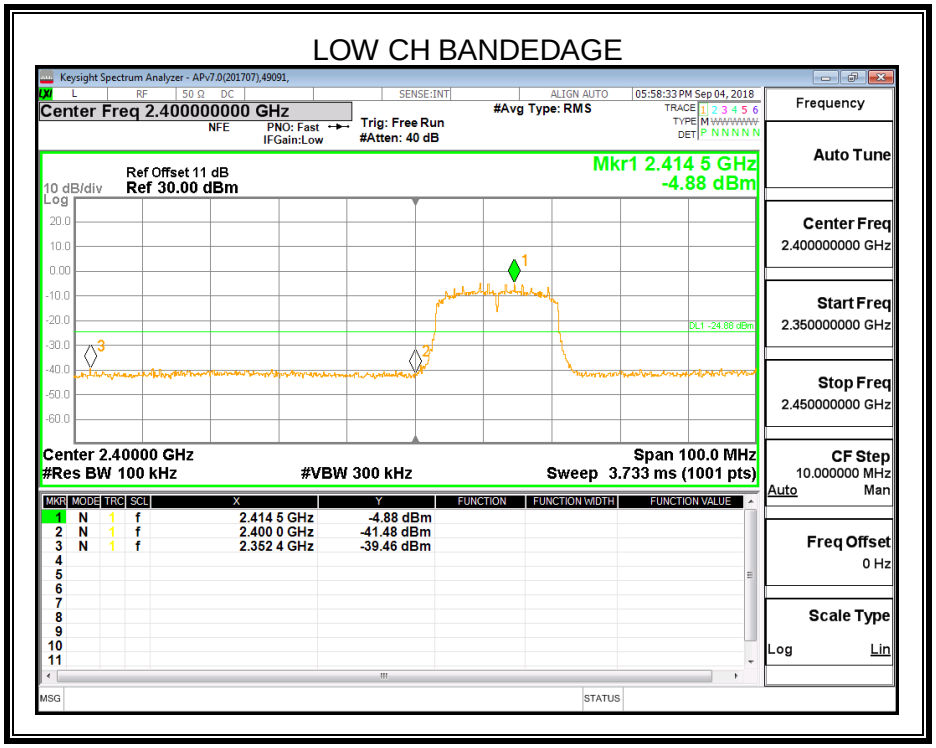


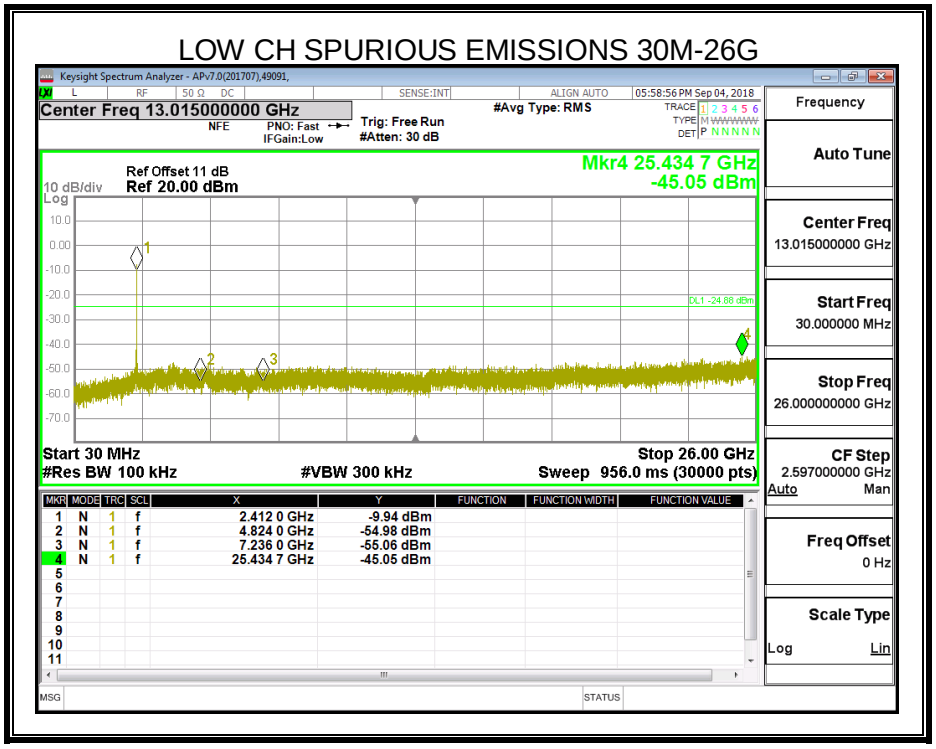



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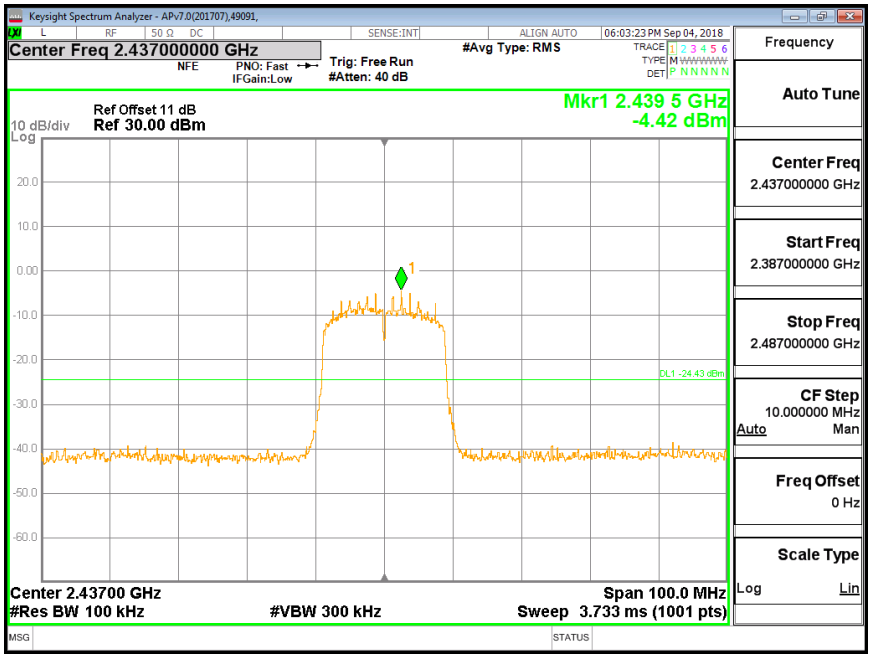
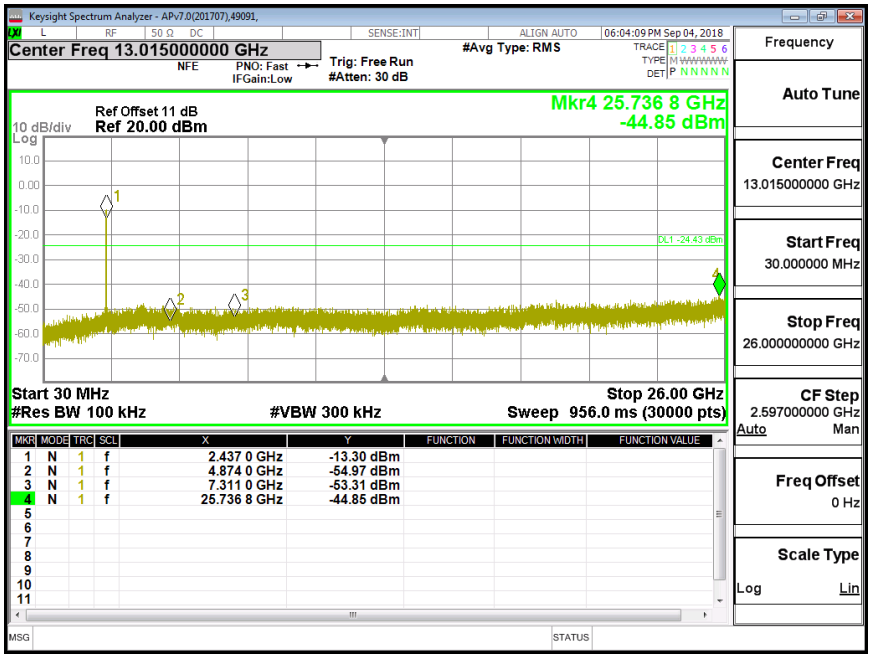



MID CH SPURIOUS EMISSIONS 30M-26G





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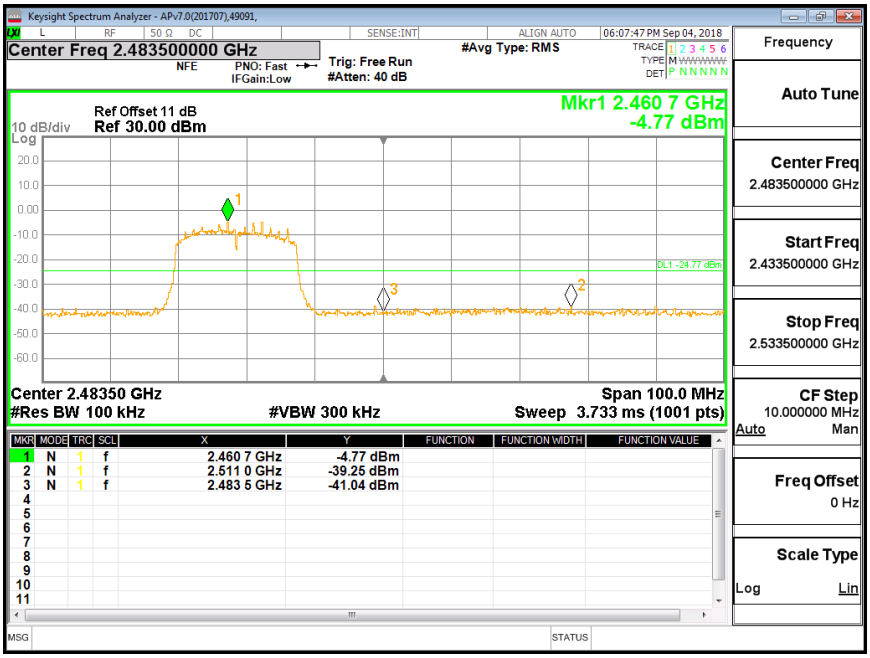
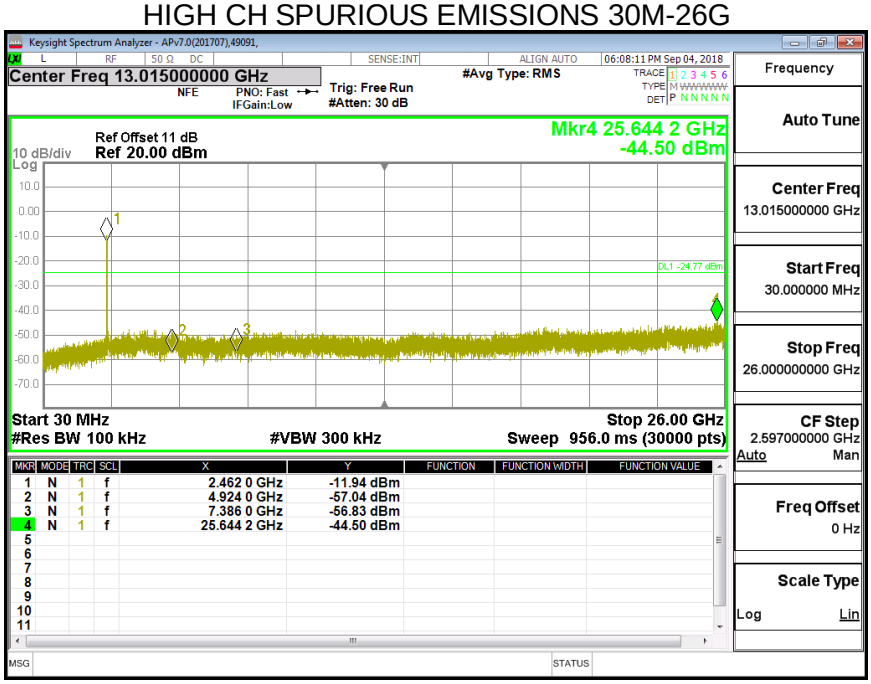



HIGH CH SPURIOUS EMISSIONS 30M-26G





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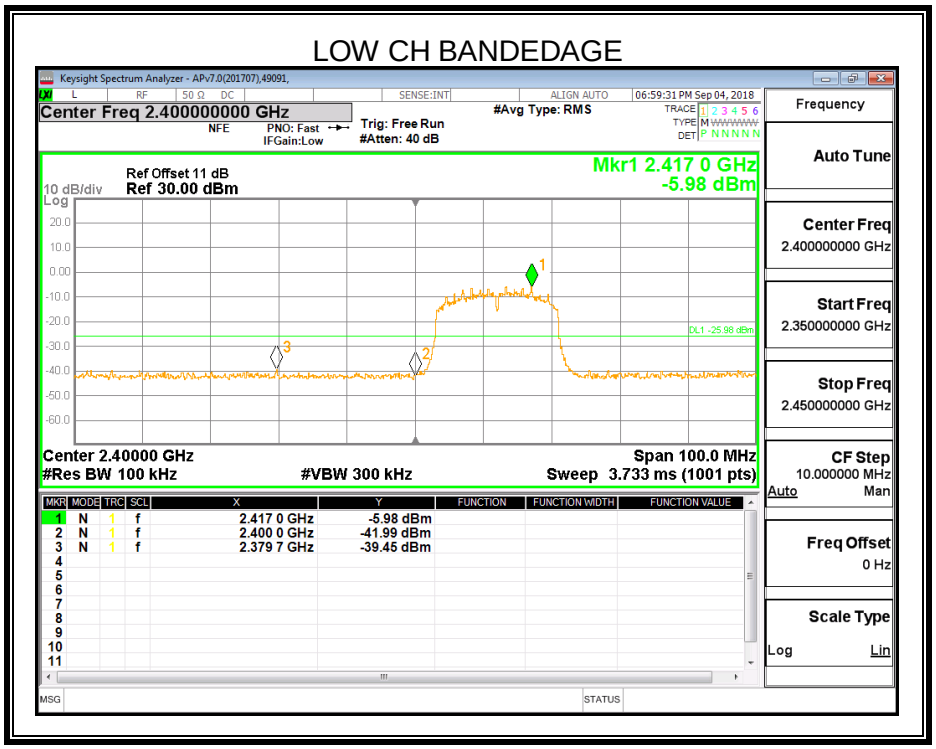


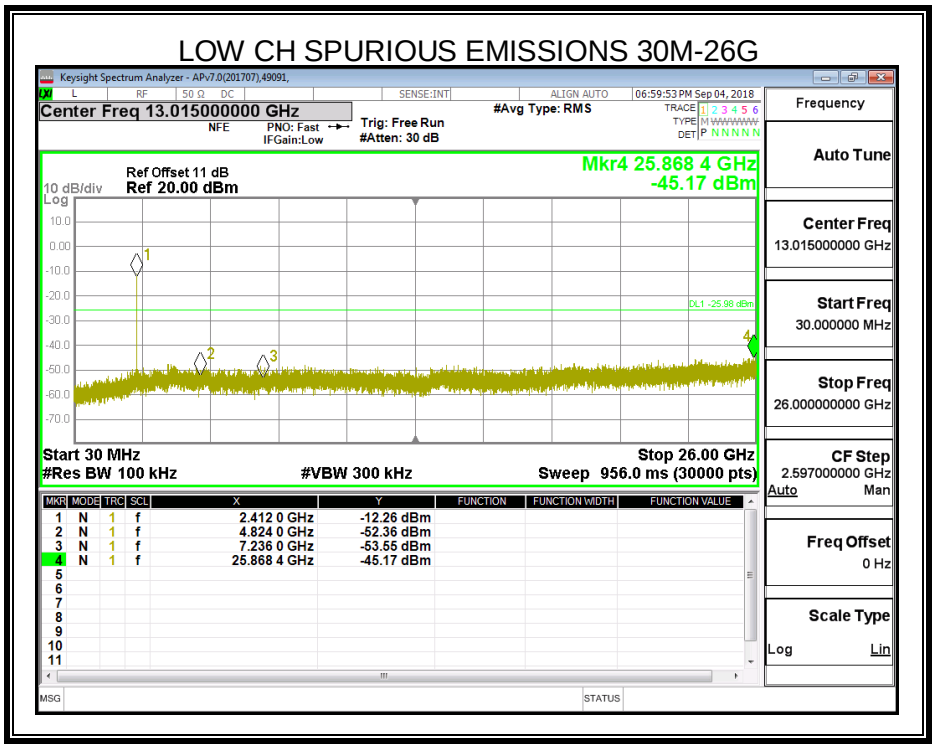



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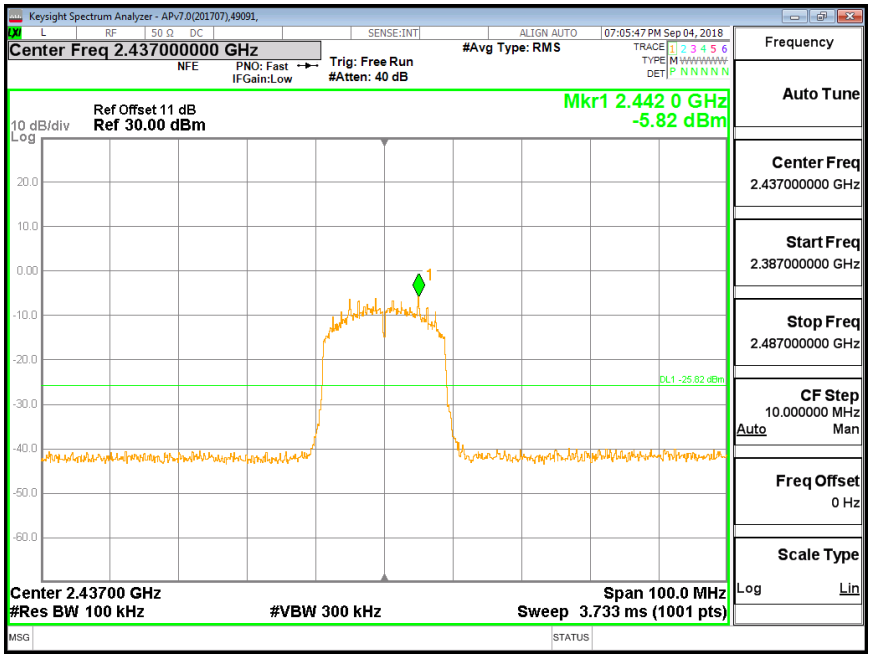
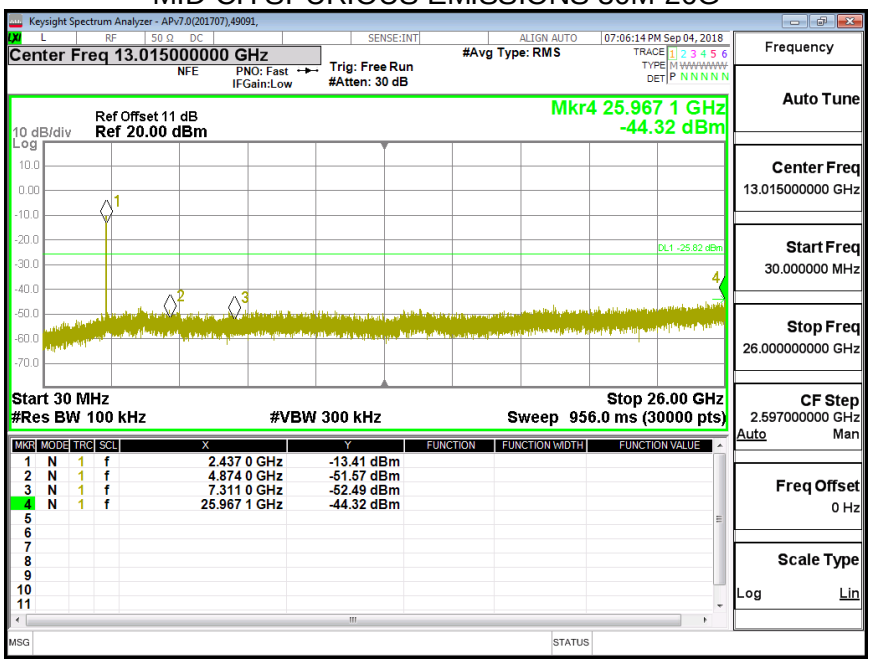



MID CH SPURIOUS EMISSIONS 30M-26G





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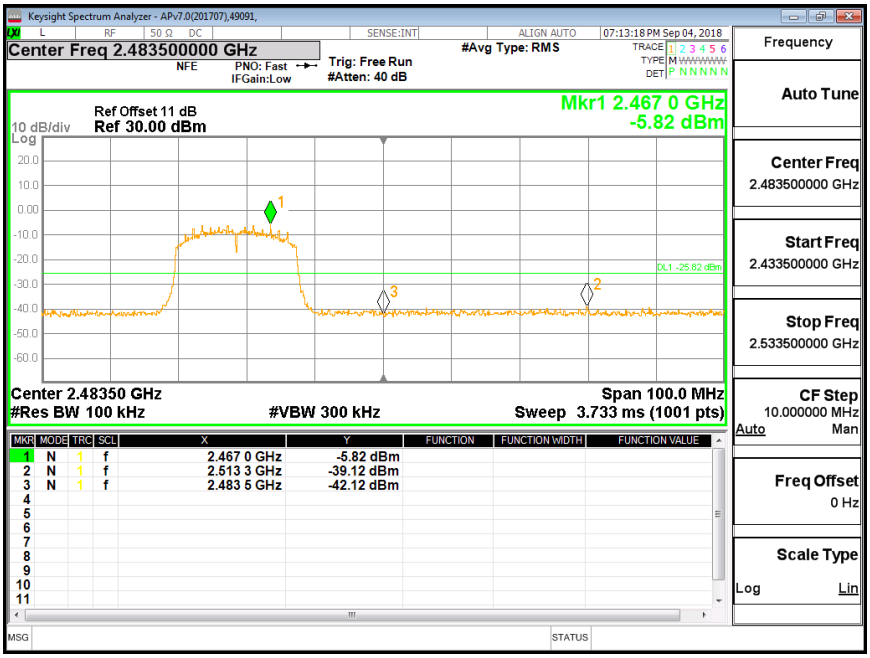
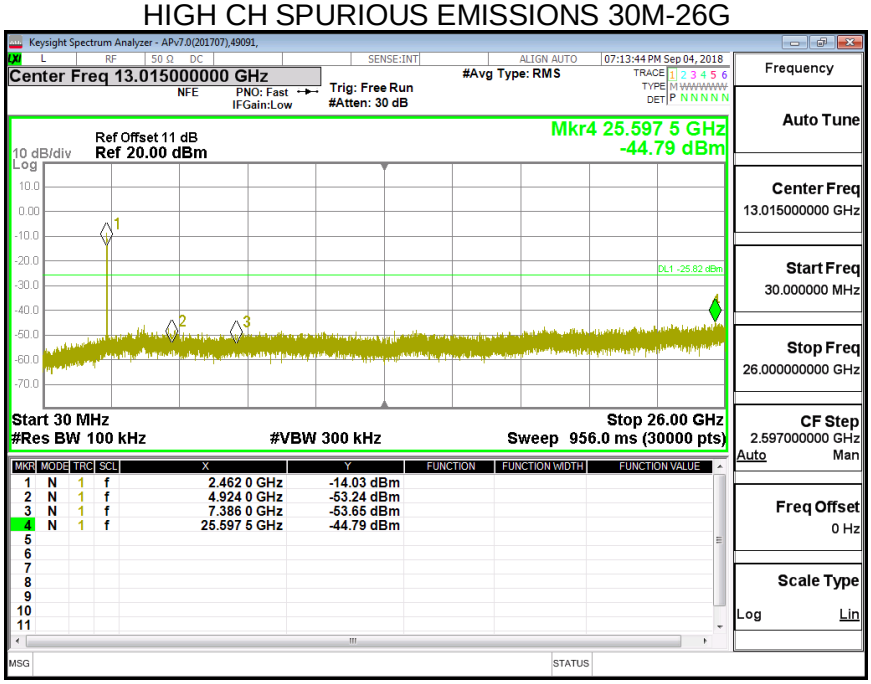



HIGH CH SPURIOUS EMISSIONS 30M-26G





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