**FCC CFR47 PART 15 SUBPART C**
**INDUSTRY CANADA RSS-247 ISSUE 2**

**DTS Wireless LAN**

# CERTIFICATION TEST REPORT

**FOR**

**BT/BLE, DTS/UNII a/b/g/n/ac and ANT+ Tablet**

**MODEL NUMBER : SM-T830**

**FCC ID: A3LSMT830**
**IC : 649E-SMT830**

**REPORT NUMBER: 4788494706-E1V1**

**ISSUE DATE: JUN 27, 2018**

*Prepared for*
**SAMSUNG ELECTRONICS CO., LTD.**
**129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,**
**GYEONGGI-DO, 16677, KOREA**

*Prepared by*
**UL Korea, Ltd.**
**26th floor, 152, Teheran-ro, Gangnam-gu Seoul, 06236, Korea**

**Suwon Test Site: UL Korea, Ltd. Suwon Laboratory**
**218 Maeyeong-ro, Yeongtong-gu,**
**Suwon-si, Gyeonggi-do, 16675, Korea**
**TEL: (031) 337-9902**
**FAX: (031) 213-5433**

ACCREDITED
Testing Laboratory

**TL-637**

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 06/27/18 | Initial issue | Junwhan Lee |


UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

# TABLE OF CONTENTS

# 1. ATTESTATION OF TEST RESULTS

| | |
|---|---|
| **COMPANY NAME:** | SAMSUNG ELECTRONICS CO., LTD. |
| **EUT DESCRIPTION:** | BT/BLE, DTS/UNII a/b/g/n/ac and ANT+ Tablet |
| **MODEL NUMBER:** | SM-T830 |
| **SERIAL NUMBER:** | R32K10045KW (RADIATED, Original);<br>R32K10044PB (CONDUCTED, Original)<br>R32K300G7VL, R32K300G7ZJ<br>(RADIATED, Spot check and Additional test)<br>R32K300GACA (CONDUCTED, Additional test) |
| **DATE TESTED:** | APR 11, 2018 - JUN 15, 2018 (Original)<br>JUN 16, 2018 – JUN 27, 2018 (Spot check and Additional test) |

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

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

SungGil Park
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

## 1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMT835 DTS WLAN(FCC CFR 47 Part 15C). And the applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

## 1.2. DIFFERENCE

The FCC ID: A3LSMT830(IC : 649E-SMT830, Model number : SM-T830), shares the same enclosure and circuit board as FCC ID: A3LSMT835 (Model number : SM-T835). The WLAN antennas and surrounding circuitry and layout are identical between these two units.

After confirming through preliminary radiated emissions that the performance of the FCC ID: A3LSMT835 (Model number : SM-T835) remains representative of FCC ID: A3LSMT830(IC : 649E-SMT830, Model number : SM-T830). The test data of FCC ID: A3LSMT835 (Model number : SM-T835) being submitted for this application to cover WLAN features.

Model number, SM-T835, is not certified for ISED certification.

Target power for Channel 12/13 were different between A3LSMT835 (Model number : SM-T835) and A3LSMT830 (IC : 649E-SMT830, Model number : SM-T830). So test results for Ch.1/6/11 were re-used by spot check and additional test for Ch. 12/13 were performed newly.

## 1.3. SPOT CHECK VERIFICATION DATA

(Worst case of the radiated spurious and band edge emissions)

| Band | Test Item | Mode | Frequency | Test Limit | Original model | Spot check model | Deviation | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | | | SM-T835 Results | SM-T830 Results | | |
| | | | | | FCC ID : A3LSMT835 | FCC ID : A3LSMT830 IC : 649E-SMT830 | | |
| DTS WLAN (2.4GHz) | Band Edge | 802.11b | 2462 MHz | 54 dBuV/m | 42.66 dBuV/m | 42.54 dBuV/m | -0.12 dB | |
| | RSE | 802.11b | 2412 MHz | 74 dBuV/m | 43.89 dBuV/m | 44.02 dBuV/m | 0.13 dB | |
| | Band Edge | 802.11g | 2462 MHz | 54 dBuV/m | 43.20 dBuV/m | 43.84 dBuV/m | 0.64 dB | |
| | RSE | 802.11g | 2437 MHz | 74 dBuV/m | 42.56 dBuV/m | 41.22 dBuV/m | -1.34 dB | |
| | Band Edge | 802.11n | 2462 MHz | 54 dBuV/m | 42.83 dBuV/m | 44.22 dBuV/m | 1.39 dB | |
| | RSE | 802.11n | 2437 MHz | 74 dBuV/m | 42.30 dBuV/m | 41.12 dBuV/m | -1.18 dB | |

Comparison of two models, upper deviation is within 3dB range and all test results are under FCC Technical Limits.

## 1.4. REFERENCE DETAIL

Reference application that contains the reused reference data.

| Equipment Class | Reference FCC ID | Type Grant/Permissive Change | Reference Application | Folder Test/RF Exposure | Report Tittle / Section |
|---|---|---|---|---|---|
| DTS | A3LSMT835 | Grant | 4788429415-E1V2 | Test | FCC Report DTS WLAN / Test results of Ch.1~Ch.11 |
| | | | 4788429415-E2V1 | Test | FCC Report BLE All sections |
| DXX | A3LSMT835 | Grant | 4788429415-E5V1 | Test | FCC Report ANT+ / All sections |
| NII | A3LSMT835 | Grant | 4788429415-E4V1 | Test | FCC Report UNII WLAN / All sections |

# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. KDB 558074 D01 DTS Meas Guidance v04.
4. ANSI C63.10-2013.
5. KDB 662911 D01 v02r01

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 218 Maeyeong-ro |
|---|
| ☒ Chamber 1 |
| ☐ Chamber 2 |
| ☒ Chamber 3 |

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at http://www.iasonline.org/PDF/TL/TL-637.pdf.

# 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 recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

## 4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|---|---|
| Conducted Disturbance, 0.15 to 30 MHz | 2.32 dB |
| Radiated Disturbance, Below 1GHz | 3.86 dB |
| Radiated Disturbance, Above 1 GHz | 5.97 dB |

Uncertainty figures are valid to a confidence level of 95%.

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Tablet + BT/BLE, DTS/UNII a/b/g/n/ac and ANT+.
This test report addresses the DTS (WLAN) operational mode.

WiFi MIMO Condition

| Frequency | Mode | Antenna 1 | Antenna 2 |
|---|---|---|---|
| 2.4 GHz | 802.11b | TX / RX | TX / RX |
| | 802.11g | TX / RX | TX / RX |
| | 802.11g MIMO | TX / RX | TX / RX |
| | 802.11n | TX / RX | TX / RX |
| | 802.11n MIMO | TX / RX | TX / RX |
| 5 GHz | 802.11a | TX / RX | TX / RX |
| | 802.11a MIMO | TX / RX | TX / RX |
| | 802.11n | TX / RX | TX / RX |
| | 802.11n MIMO | TX / RX | TX / RX |
| | 802.11ac | TX / RX | TX / RX |
| | 802.11ac MIMO | TX / RX | TX / RX |

Simultaneous TX Condition

| Frequency | Supported |
|---|---|
| 2.4 GHz Antenna 1 + 5 GHz Antenna 2 | Yes |
| 2.4 GHz Antenna 2 + 5 GHz Antenna 1 | No |
| 2.4 GHz Antenna 1 + 5 GHz Antenna 1 | No |
| 2.4 GHz Antenna 2 + 5 GHz Antenna 2 | No |

Spurious Emissions for Simultaneous Transmission were reported on UNII Test Report section 11.5. (Test Report number : 4788480746-E4)

## 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

| Frequency Range [MHz] | Mode | Output Power [dBm] | | Output Power [mW] | |
|---|---|---|---|---|---|
| | | Antenna1 | Antenna2 | Antenna1 | Antenna2 |
| 2412 - 2472 | 802.11b | 12.84 | 12.85 | 19.23 | 19.28 |
| | 802.11g MIMO | 15.69 | | 37.07 | |
| | 802.11n20 MIMO | 15.48 | | 35.32 | |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes internal antenna, with a antenna1's maximum gain of -1.84 dBi and antenna2's maximum gain of -4.09 dBi .

## 5.4. LIST OF TEST REDUCTION AND MODES

The output power on covered modes is equal to or less than one referenced.

| Frequency Range (MHz) | Mode | Covered by |
|---|---|---|
| 2412 - 2472 | 802.11b Legacy 1TX | 802.11b Legacy 1TX |
| | 802.11g 1TX | 802.11g CDD 2TX |
| | 802.11g CDD 2TX | 802.11g CDD 2TX |
| | 802.11n HT20 1TX | 802.11n HT20 CDD 2TX |
| | 802.11n HT20 SDM/CDD 2TX | 802.11n HT20 CDD 2TX |

## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

For ANT1 and MIMO, the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Y it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

For ANT2, the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Based on the baseline scan, the worst-case data rates were:

802.11b mode: 1 Mbps (Legacy 1TX)
802.11g mode: 6 Mbps (2TX CDD)
802.11n HT20 mode: MCS0 (2TX CDD)

## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Support Equipment List | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Charger | SAMSUNG | EP-TA20EWE | R37KDCZ1855DK3 | N/A |
| Data Cable | SAMSUNG | EP-DN930CWE | N/A | N/A |
| Earphone | SAMSUNG | EO-EG920BW | N/A | N/A |

**I/O CABLES**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | DC Power | 1 | C Type | Shielded | 1.1m | N/A |
| 2 | Audio | 2 | Mini-Jack | Unshielded | 1.2m | N/A |

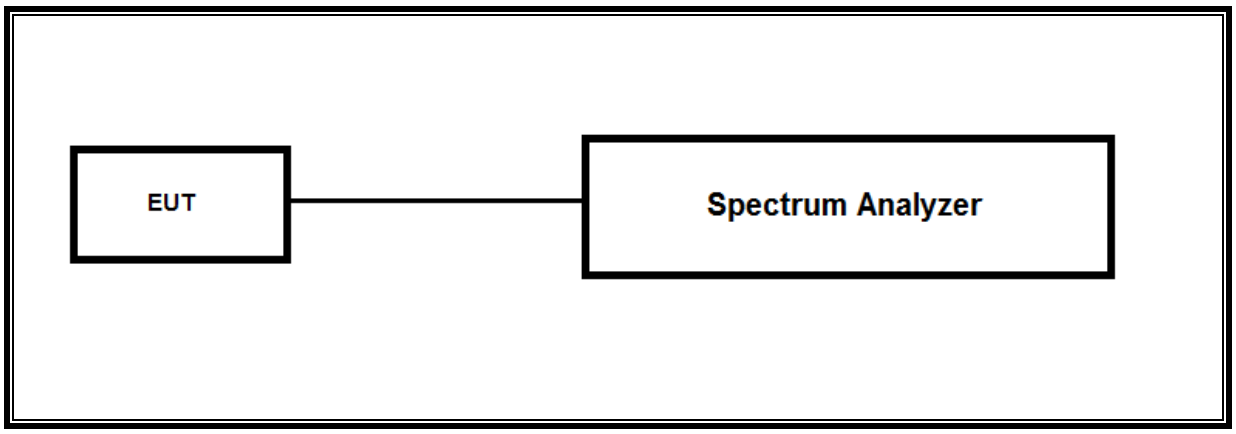
**TEST SETUP**

The EUT is a stand-alone unit during the tests.
Test software exercised the EUT to enable DTS mode.

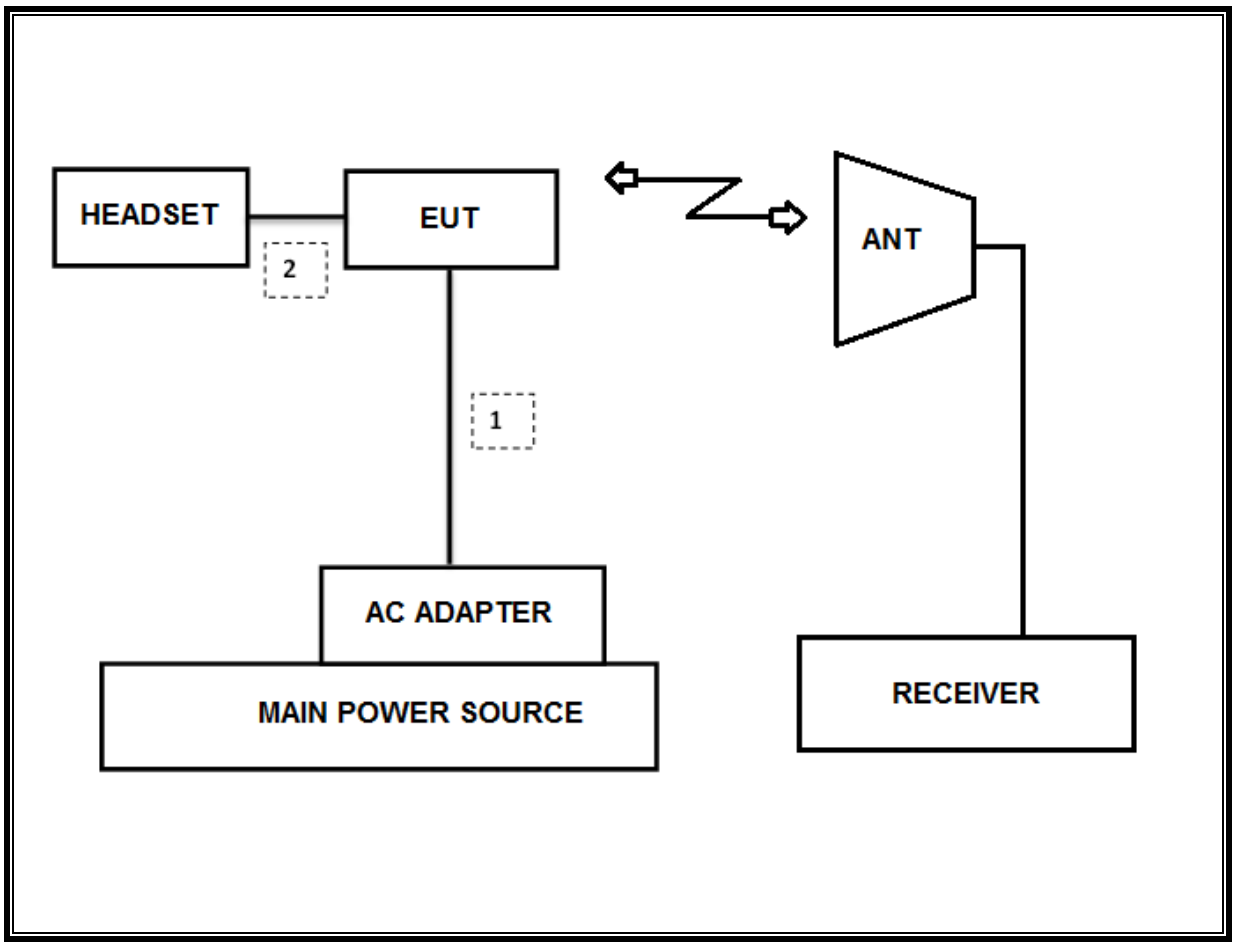
**NOTE**

Additional tests under 1 GHz were performed with the keyboard attached to check on all port terminated conditions. Keyboard is not an in-box item.

**SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)**




**SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)**





UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Test Equipment List | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **S/N** | **Cal Due** |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 750 | 08-31-19 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 749 | 09-14-19 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 845 | 08-31-19 |
| Antenna, Horn, 18 GHz | ETS | 3115 | 00167211 | 10-14-18 |
| Antenna, Horn, 18 GHz | ETS | 3115 | 00161451 | 03-10-19 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00168724 | 05-31-19 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00168717 | 05-31-19 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00205959 | 11-29-18 |
| Antenna, Horn, 40 GHz | ETS | 3116C | 00166155 | 12-04-19 |
| Antenna, Horn, 40 GHz | ETS | 3116C | 00168645 | 12-04-19 |
| Antenna, Horn, 40 GHz | ETS | 3116C-PA | 00168841 | 11-13-19 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 341282 | 08-09-18 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 351741 | 08-07-18 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 370599 | 08-10-18 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 1876511 | 08-08-18 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 1896138 | 08-08-18 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 2029169 | 08-11-18 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | N9030A | MY54170614 | 08-08-18 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | N9030A | MY54490312 | 08-08-18 |
| Spectrum Analyzer, 43.5 GHz | R&S | FSW43 | 104089 | 08-11-18 |
| Average Power Sensor | Agilent / HP | U2000 | MY54270007 | 08-08-18 |
| Attenuator | PASTERNACK | PE7087-10 | A001 | 08-08-18 |
| Attenuator | PASTERNACK | PE7087-10 | A008 | 08-08-18 |
| Attenuator | PASTERNACK | PE7087-10 | 2 | 08-10-18 |
| Attenuator | PASTERNACK | PE7087-10 | A009 | 08-08-18 |
| EMI Test Receive, 40 GHz | R&S | ESU40 | 100439 | 08-08-18 |
| EMI Test Receive, 40 GHz | R&S | ESU40 | 100457 | 08-08-18 |
| EMI Test Receive, 44 GHz | R&S | ESW44 | 101590 | 08-09-18 |
| EMI Test Receive, 3 GHz | R&S | ESR3 | 101832 | 08-07-18 |
| Low Pass Filter 5GHz | Micro-Tronics | LPS17541 | 009 | 08-08-18 |
| Low Pass Filter 5GHz | Micro-Tronics | LPS17541 | 015 | 08-08-18 |
| Low Pass Filter 5GHz | Micro-Tronics | LPS17541 | 020 | 08-11-18 |
| High Pass Filter 3GHz | Micro-Tronics | HPM17543 | 010 | 08-08-18 |
| High Pass Filter 3GHz | Micro-Tronics | HPM17543 | 015 | 08-08-18 |
| High Pass Filter 3GHz | Micro-Tronics | HPM17543 | 020 | 08-11-18 |
| High Pass Filter 6GHz | Micro-Tronics | HPS17542 | 009 | 08-08-18 |
| High Pass Filter 6GHz | Micro-Tronics | HPS17542 | 016 | 08-08-18 |
| High Pass Filter 6GHz | Micro-Tronics | HPS17542 | 021 | 08-11-18 |
| LISN | R&S | ENV-216 | 101837 | 08-09-18 |
| **UL Software** | | | | |
| **Description** | **Manufacturer** | **Model** | **Version** | |
| Radiated software | UL | UL EMC | Ver 9.5 | |
| AC Line Conducted software | UL | UL EMC | Ver 9.5 | |

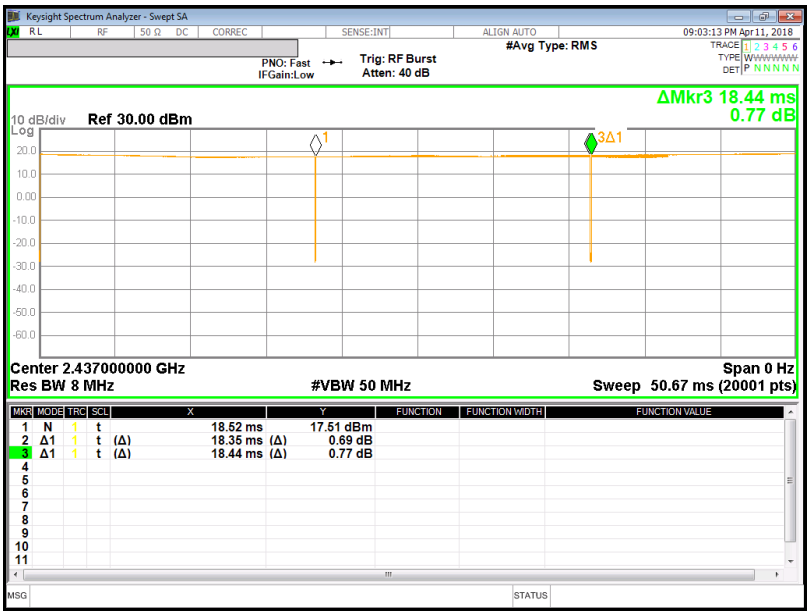
# 7. REFERENCE MEASUREMENT RESULTS

## 7.1. ON TIME AND DUTY CYCLE RESULTS

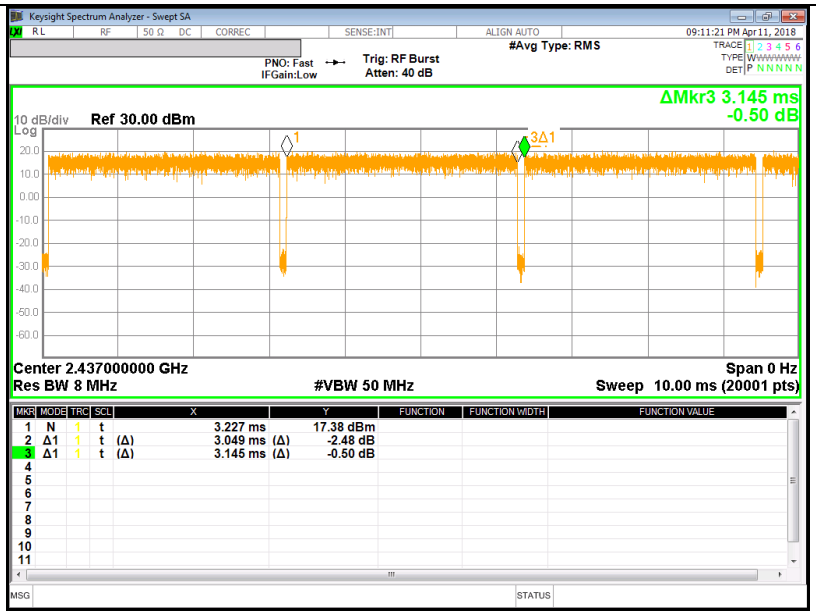
| Mode | ON Time B [msec] | Period [msec] | Duty Cycle x [linear] | Duty Cycle [%] | Duty Cycle Correction Factor [dB] | 1/T Minimum VBW [kHz] |
|---|---|---|---|---|---|---|
| 2400MHz Bands | | | | | | |
| 802.11b | 18.35 | 18.44 | 0.995 | 99.5% | 0.00 | 0.010 |
| 802.11g | 3.049 | 3.145 | 0.969 | 96.9% | 0.13 | 0.328 |
| 802.11n HT20 | 2.834 | 2.929 | 0.968 | 96.8% | 0.14 | 0.353 |

**LIMITS**

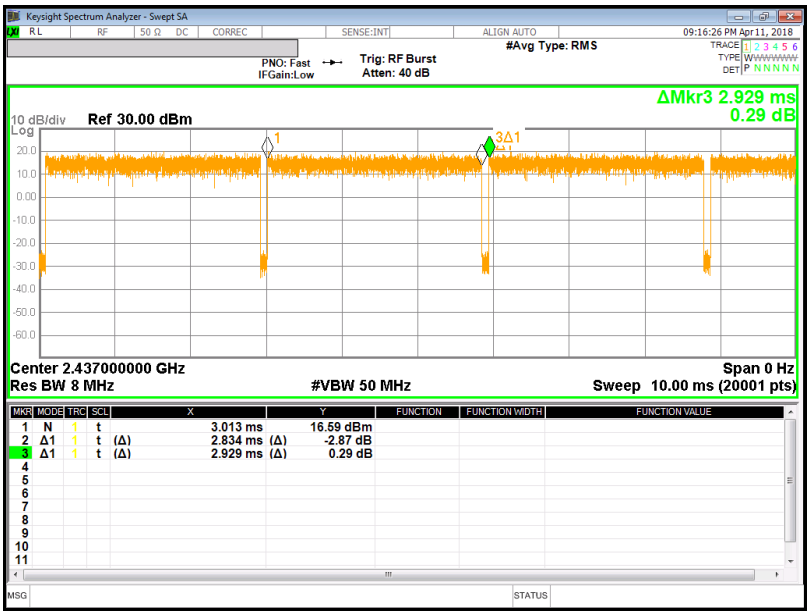
None; for reporting purposes only.




[802.11b Mode]




[802.11g Mode]




[802.11n20 Mode]

## 7.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**RESULTS**

### 7.2.1. 802.11b MODE IN THE 2.4 GHz BAND

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] | |
|---|---|---|---|
| | | Antenna 1 | Antenna 2 |
| 1 | 2412 | 12.422 | 12.758 |
| 6 | 2437 | 12.751 | 12.839 |
| 11 | 2462 | 12.661 | 12.689 |
| 12 | 2467 | 12.610 | 12.678 |
| 13 | 2472 | 12.776 | 12.749 |

### 7.2.2. 802.11g MODE IN THE 2.4 GHz BAND

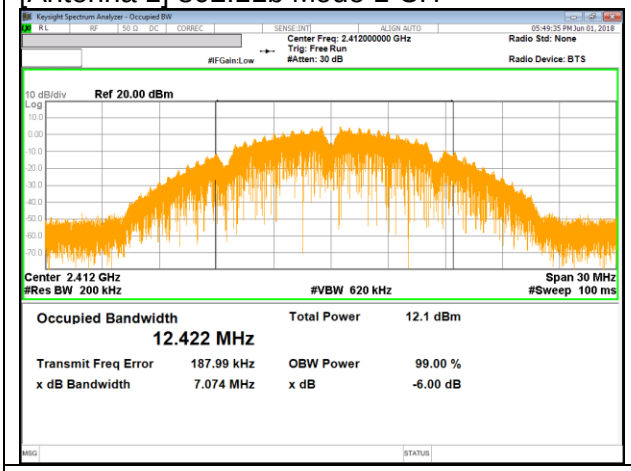
| Channel | Frequency [MHz] | 99% Bandwidth [MHz] | |
|---|---|---|---|
| | | Antenna 1 | Antenna 2 |
| 1 | 2412 | 16.287 | 16.326 |
| 6 | 2437 | 16.360 | 16.352 |
| 11 | 2462 | 16.289 | 16.326 |
| 12 | 2467 | 16.356 | 16.339 |
| 13 | 2472 | 16.259 | 16.319 |

### 7.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

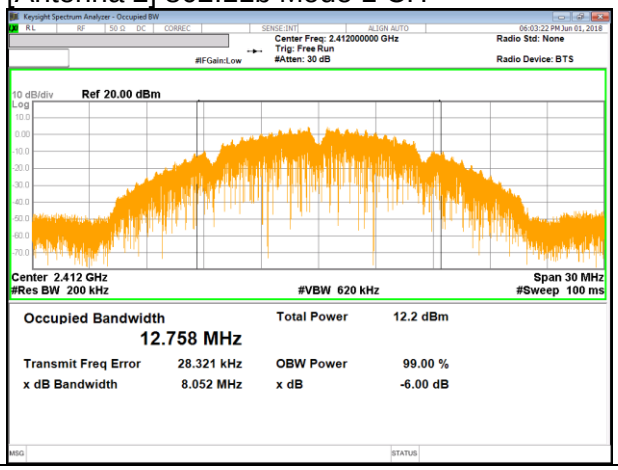
| Channel | Frequency [MHz] | 99% Bandwidth [MHz] | |
|---|---|---|---|
| | | Antenna 1 | Antenna 2 |
| 1 | 2412 | 17.495 | 17.569 |
| 6 | 2437 | 17.623 | 17.599 |
| 11 | 2462 | 17.561 | 17.545 |
| 12 | 2467 | 17.551 | 17.565 |
| 13 | 2472 | 17.450 | 17.513 |

## 7.2.4. 99% BANDWIDTH PLOTS

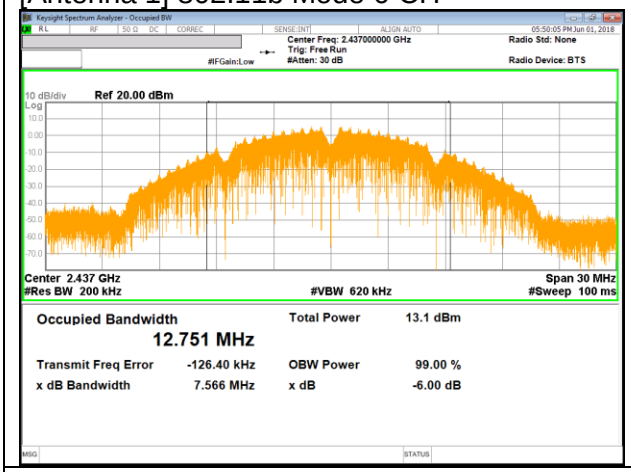
[Antenna 1] 802.11b Mode 1 CH



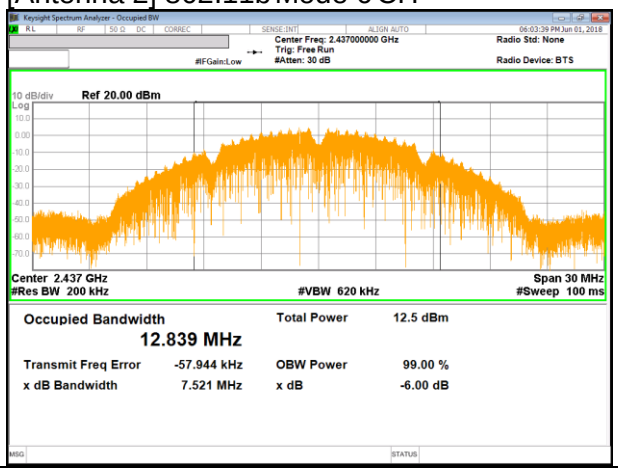

[Antenna 2] 802.11b Mode 1 CH



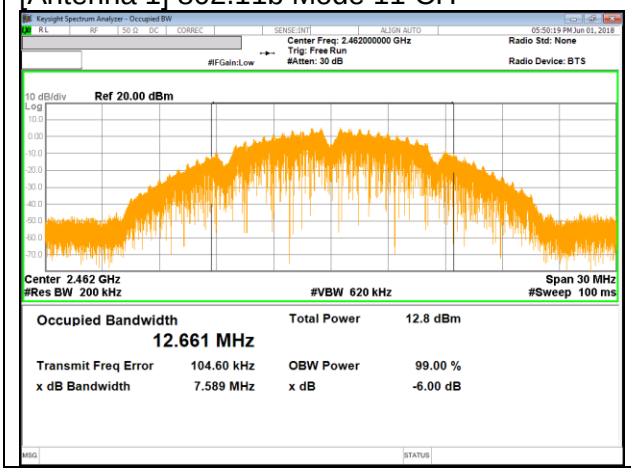

[Antenna 1] 802.11b Mode 6 CH



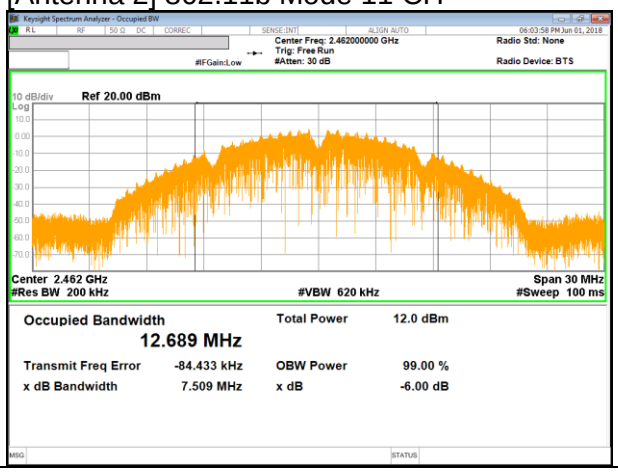

[Antenna 2] 802.11b Mode 6 CH



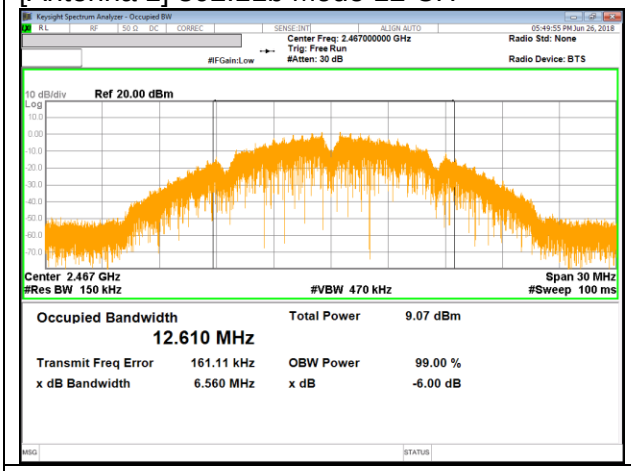

[Antenna 1] 802.11b Mode 11 CH



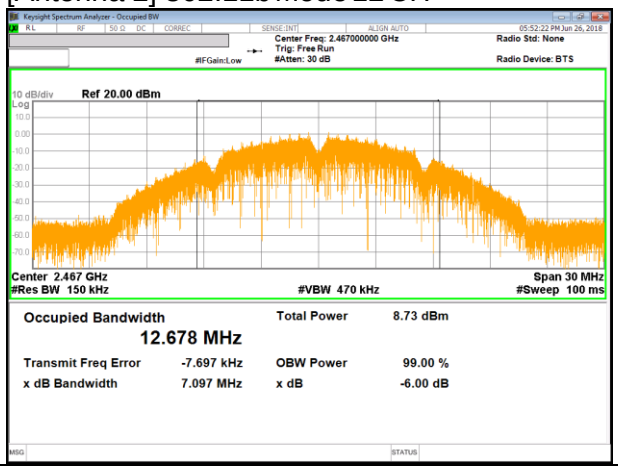

[Antenna 2] 802.11b Mode 11 CH



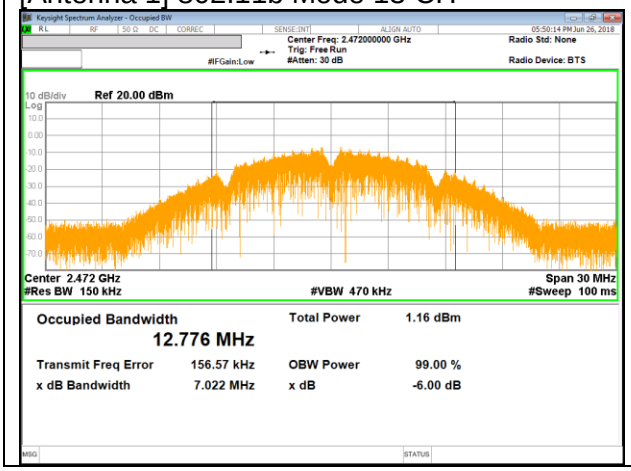
[Antenna 1] 802.11b Mode 12 CH



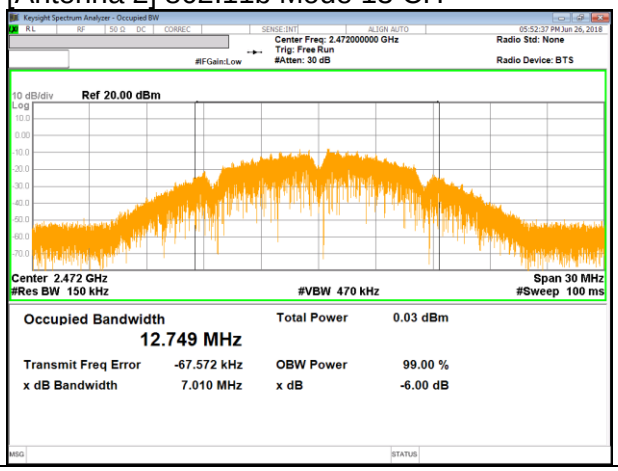

[Antenna 2] 802.11b Mode 12 CH



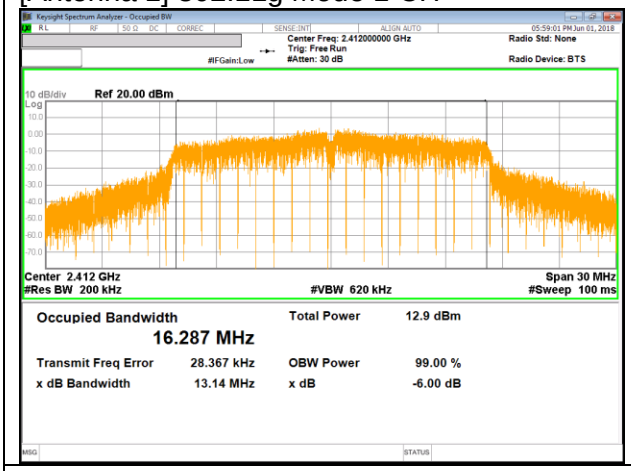

[Antenna 1] 802.11b Mode 13 CH



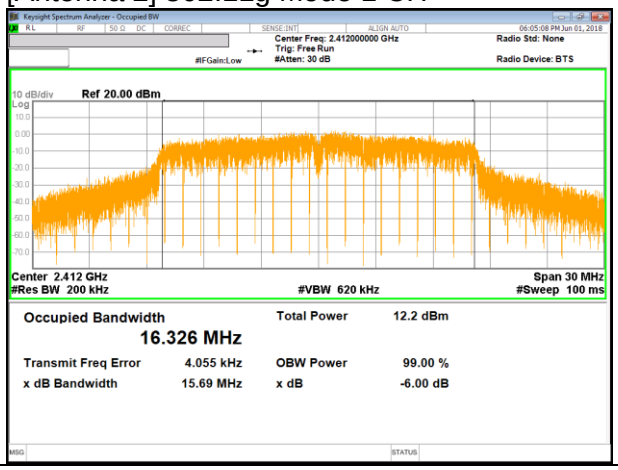

[Antenna 2] 802.11b Mode 13 CH



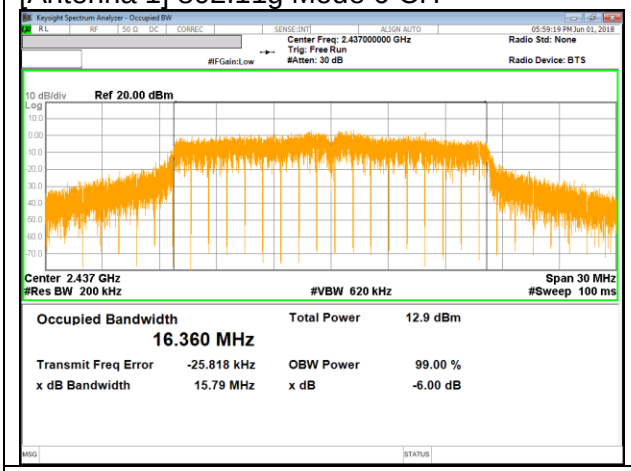
[Antenna 1] 802.11g Mode 1 CH



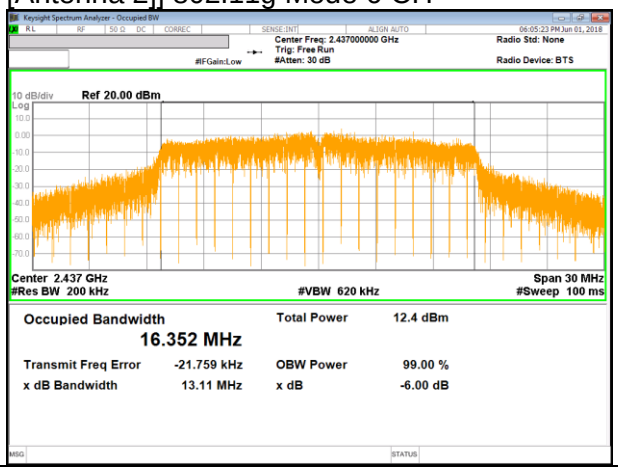

[Antenna 2] 802.11g Mode 1 CH



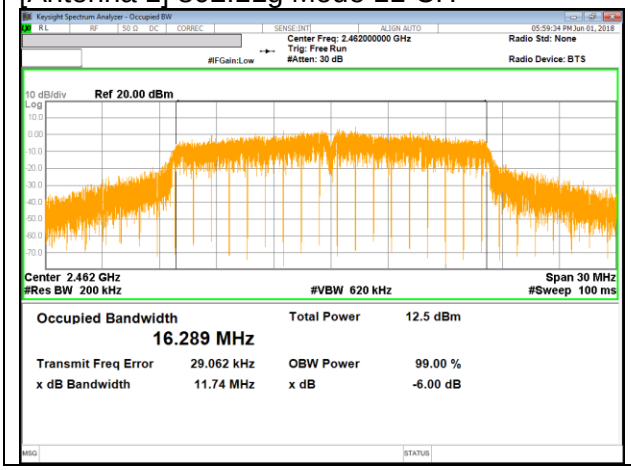

[Antenna 1] 802.11g Mode 6 CH



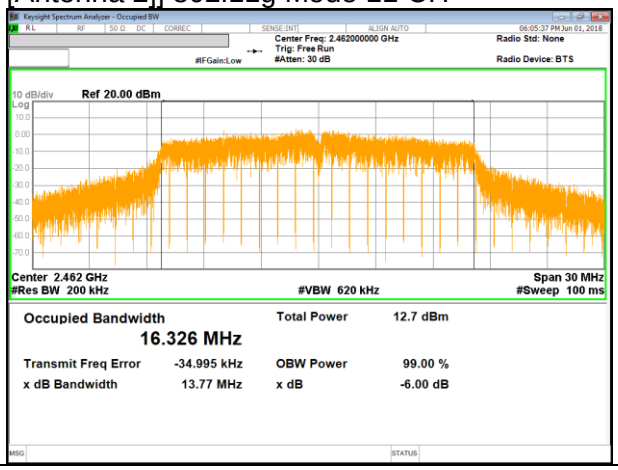

[Antenna 2]] 802.11g Mode 6 CH



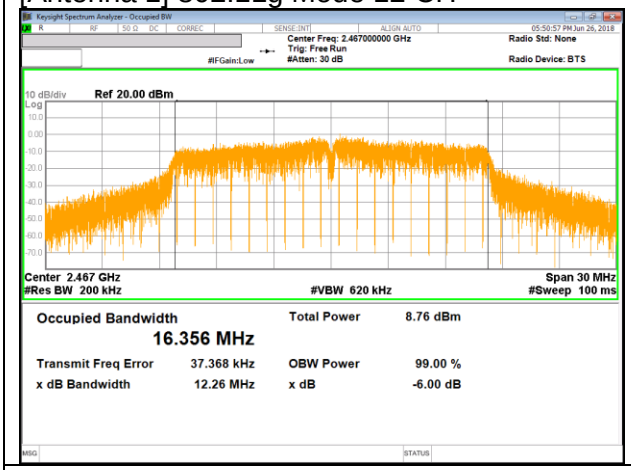

[Antenna 1] 802.11g Mode 11 CH



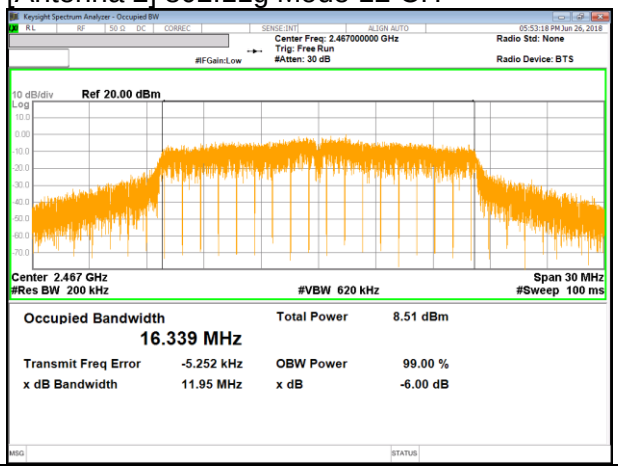

[Antenna 2]] 802.11g Mode 11 CH



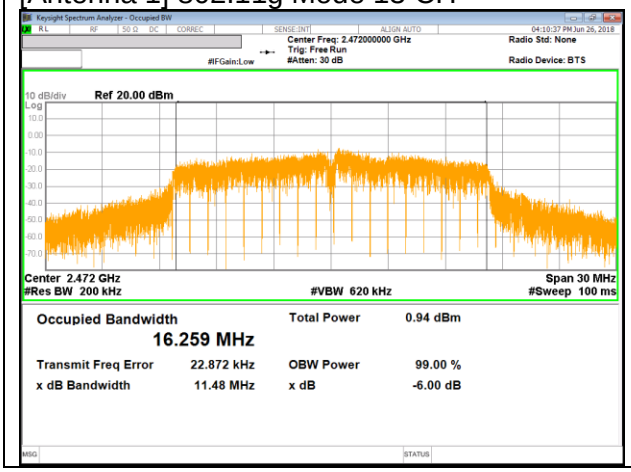
[Antenna 1] 802.11g Mode 12 CH



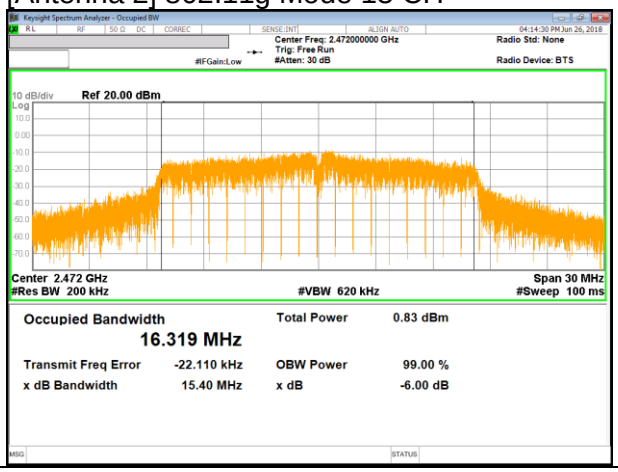

[Antenna 2] 802.11g Mode 12 CH



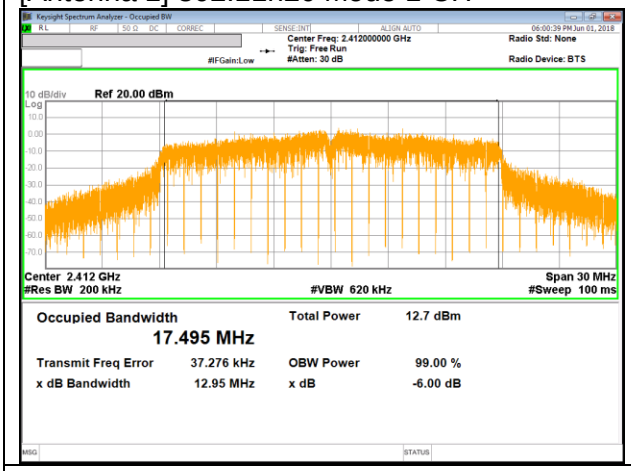

[Antenna 1] 802.11g Mode 13 CH



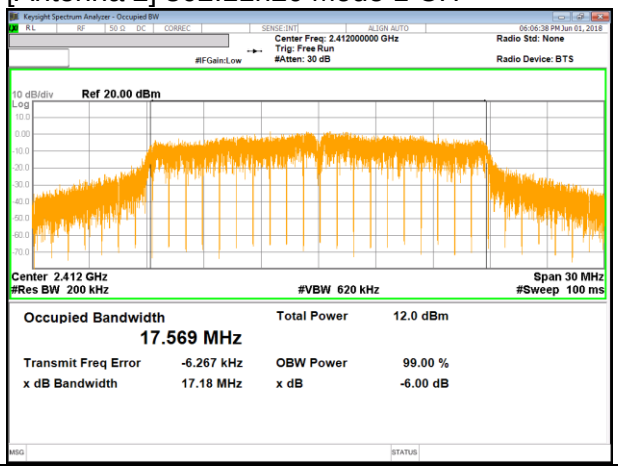

[Antenna 2] 802.11g Mode 13 CH



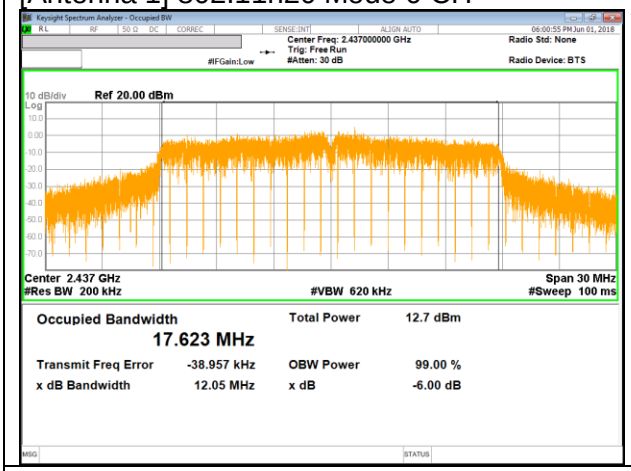
[Antenna 1] 802.11n20 Mode 1 CH



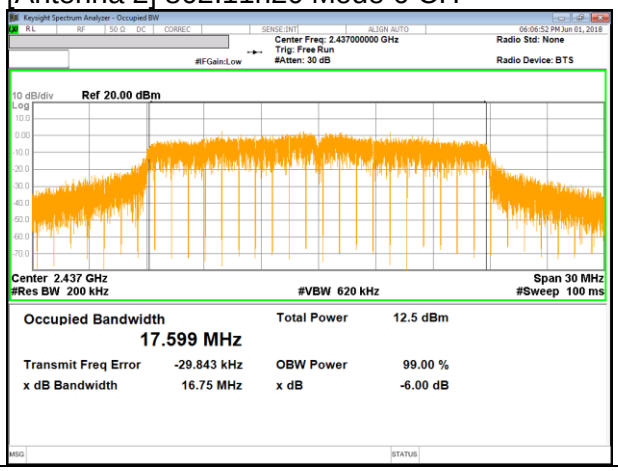

[Antenna 2] 802.11n20 Mode 1 CH



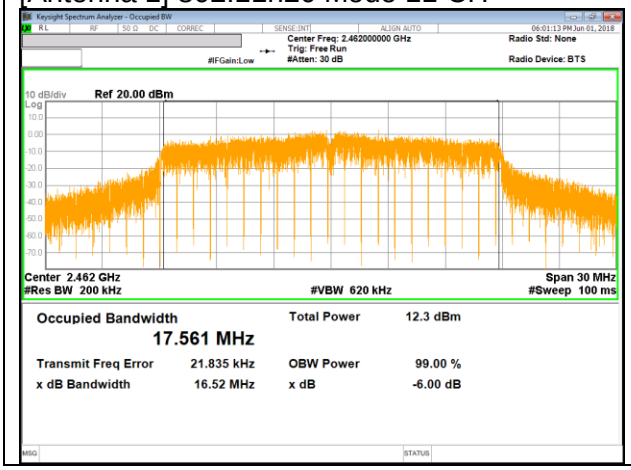

[Antenna 1] 802.11n20 Mode 6 CH



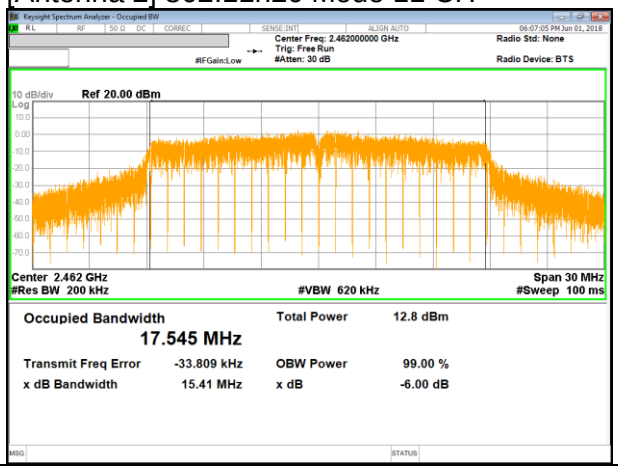

[Antenna 2] 802.11n20 Mode 6 CH



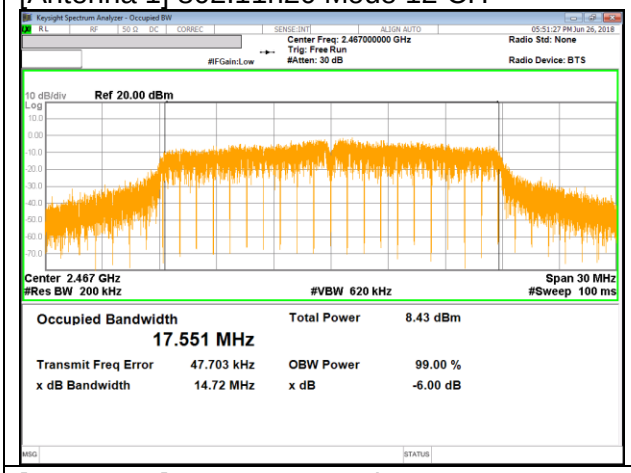

[Antenna 1] 802.11n20 Mode 11 CH



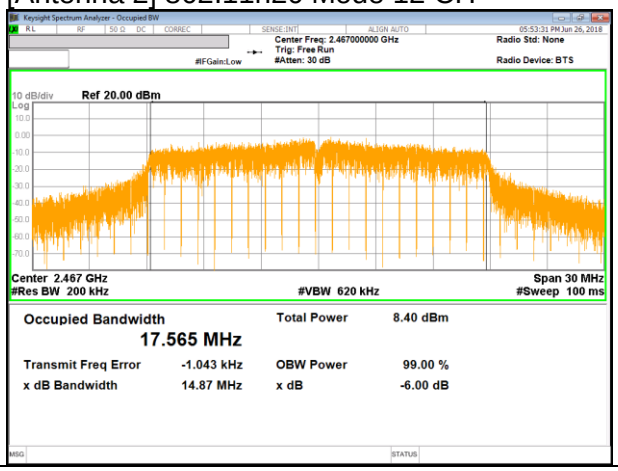

[Antenna 2] 802.11n20 Mode 11 CH



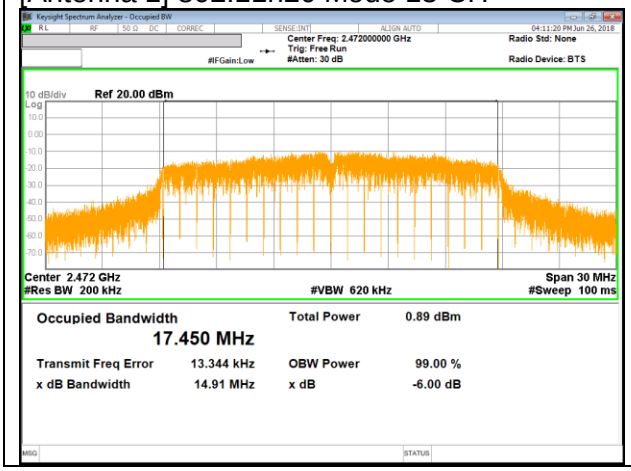
[Antenna 1] 802.11n20 Mode 12 CH



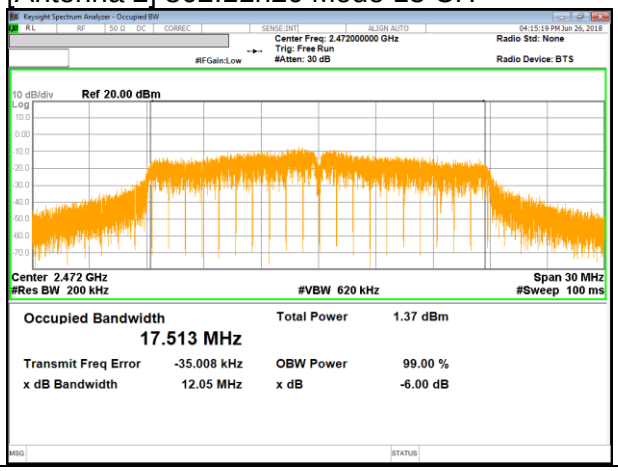

[Antenna 2] 802.11n20 Mode 12 CH




[Antenna 1] 802.11n20 Mode 13 CH




[Antenna 2] 802.11n20 Mode 13 CH



# 8. MEASUREMENT METHODS

6 dB BW : KDB 558074 D01 v04, Section 8.2.

OUTPUT POWER : KDB 558074 D01 v04, Section 9.2.3.1.

POWER SPECTRAL DENSITY : KDB 558074 D01 v04, Section 10.3./10.5.

Out-of-band EMISSIONS (Conducted) : KDB 558074 D01 v04, Section 11.1, 11.2.

Out-of-band EMISSIONS IN NON-RESTRICTED BANDS: KDB 558074 D01 v04, Section 11.0.

Out-of-band EMISSIONS IN RESTRICTED BANDS : KDB 558074 D01 v04, Section 12.1.

AC Power Line Conducted Emission : ANSI C63.10-2013, Section 6.2.


UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

# 9. SUMMARY TABLE

| FCC Part Section | Test Description | Test Limit | Test Condition | Test Result |
|---|---|---|---|---|
| 15.247 (a)(2) | Occupied Band width (6dB) | >500KHz | Conducted | Pass |
| 2.1051, 15.247 (d) | Band Edge / Conducted Spurious Emission | -30dBc | | Pass |
| 15.247 (b)(3) | TX conducted output power | <30dBm | | Pass |
| 15.247 (e) | PSD | <8dBm | | Pass |
| 15.207 (a) | AC Power Line conducted emissions | Section 10 | Power Line conducted | Pass |
| 15.205, 15.209 | Radiated Spurious Emission | < 54dBuV/m | Radiated | Pass |

# 10. ANTENNA PORT TEST RESULTS

## 10.1. 6 dB BANDWIDTH

**LIMITS**

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

**TEST PROCEDURE**

Reference to KDB 558074 D01 DTS Meas Guidance v04: The transmitter output is connected to a spectrum analyzer with the RBW set to100KHz, the VBW >= 3 x RBW, peak detector and max hold.


UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

**RESULTS**

### 10.1.1. 802.11b MODE IN THE 2.4 GHz BAND

| Channel | Frequency [MHz] | 6 dB Bandwidth [MHz] | | Minimum Limit [MHz] |
|---|---|---|---|---|
| | | ANTENNA 1 | ANTENNA 2 | |
| 1 | 2412 | 7.554 | 7.077 | 0.5 |
| 6 | 2437 | 7.045 | 7.546 | 0.5 |
| 11 | 2462 | 7.076 | 7.071 | 0.5 |
| 12 | 2467 | 7.557 | 7.539 | 0.5 |
| 13 | 2472 | 7.069 | 7.546 | 0.5 |
| Worst | | 7.045 | | |

### 10.1.2. 802.11g MODE IN THE 2.4 GHz BAND

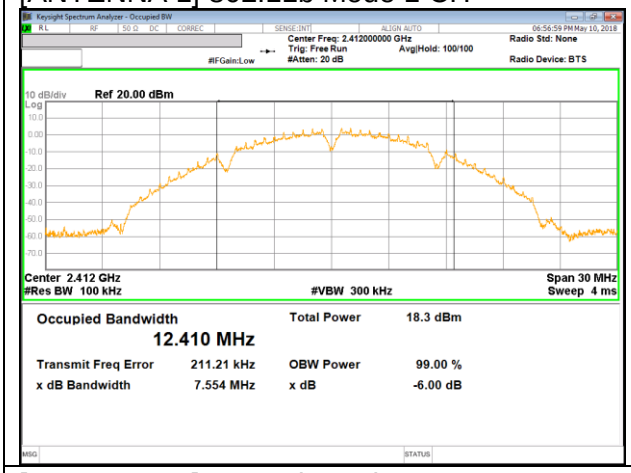
| Channel | Frequency [MHz] | 6 dB Bandwidth [MHz] | | Minimum Limit [MHz] |
|---|---|---|---|---|
| | | ANTENNA 1 | ANTENNA 2 | |
| 1 | 2412 | 11.64 | 13.87 | 0.5 |
| 6 | 2437 | 14.65 | 13.80 | 0.5 |
| 11 | 2462 | 12.52 | 13.76 | 0.5 |
| 12 | 2467 | 11.34 | 15.06 | 0.5 |
| 13 | 2472 | 13.77 | 13.28 | 0.5 |
| Worst | | 11.34 | | |

### 10.1.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

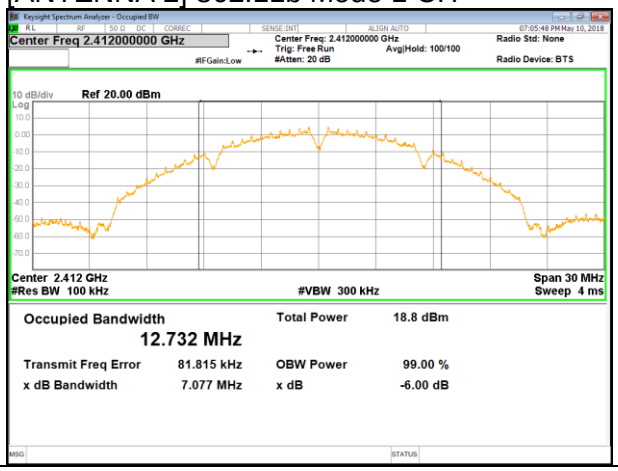
| Channel | Frequency [MHz] | 6 dB Bandwidth [MHz] | | Minimum Limit [MHz] |
|---|---|---|---|---|
| | | ANTENNA 1 | ANTENNA 2 | |
| 1 | 2412 | 13.81 | 13.11 | 0.5 |
| 6 | 2437 | 15.88 | 7.848 | 0.5 |
| 11 | 2462 | 10.67 | 14.99 | 0.5 |
| 12 | 2467 | 13.81 | 15.06 | 0.5 |
| 13 | 2472 | 13.79 | 14.96 | 0.5 |
| Worst | | 7.848 | | |

## 10.1.4. 6 dB BANDWIDTH PLOTS

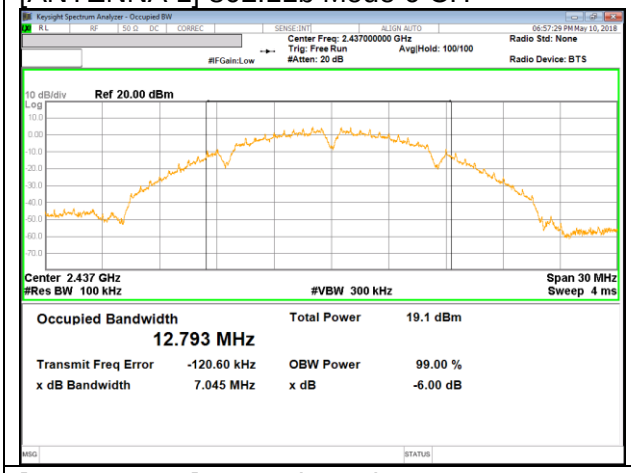
[ANTENNA 1] 802.11b Mode 1 CH



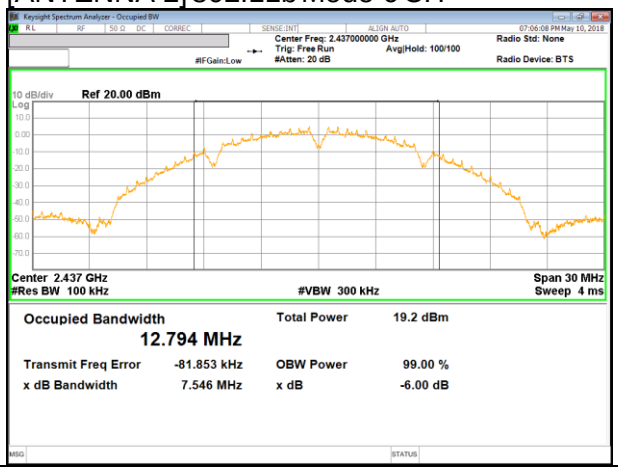

[ANTENNA 2] 802.11b Mode 1 CH



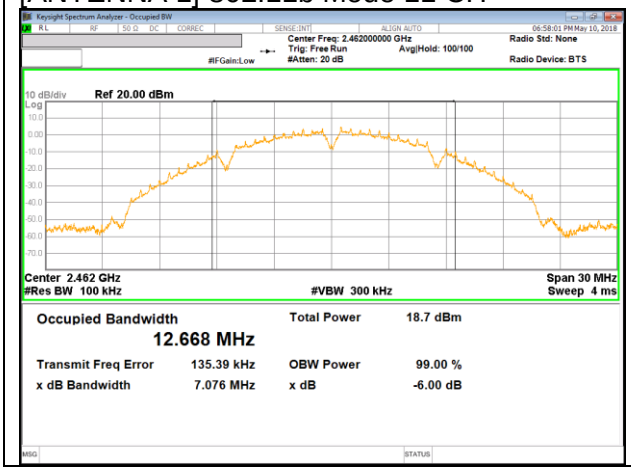

[ANTENNA 1] 802.11b Mode 6 CH



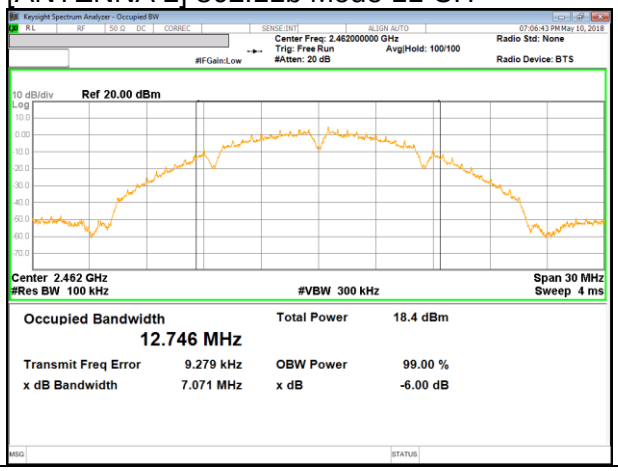

[ANTENNA 2] 802.11b Mode 6 CH



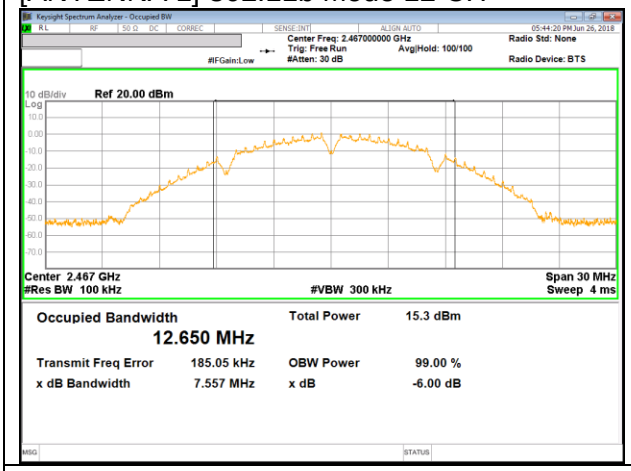

[ANTENNA 1] 802.11b Mode 11 CH



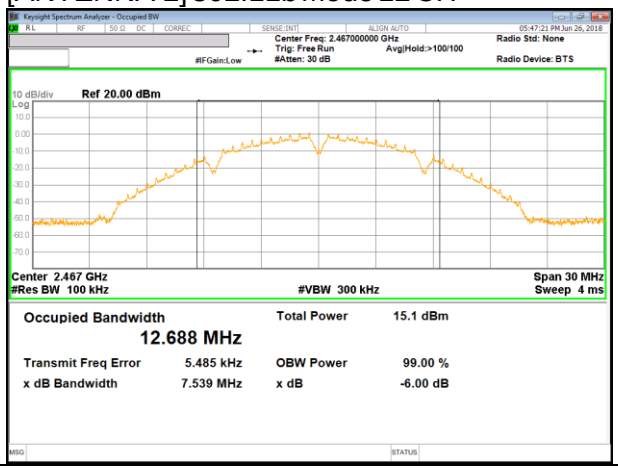

[ANTENNA 2] 802.11b Mode 11 CH



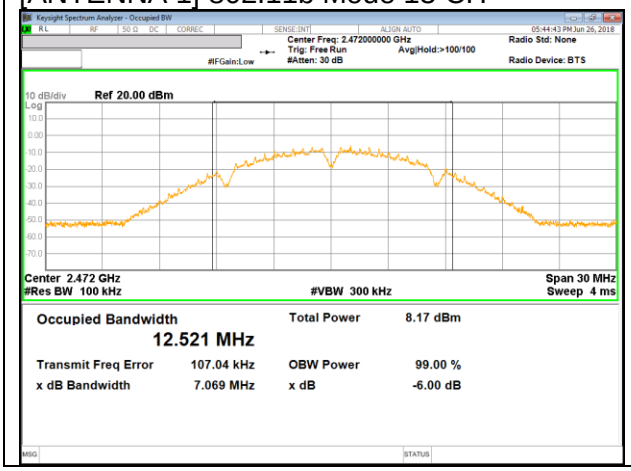
[ANTENNA 1] 802.11b Mode 12 CH



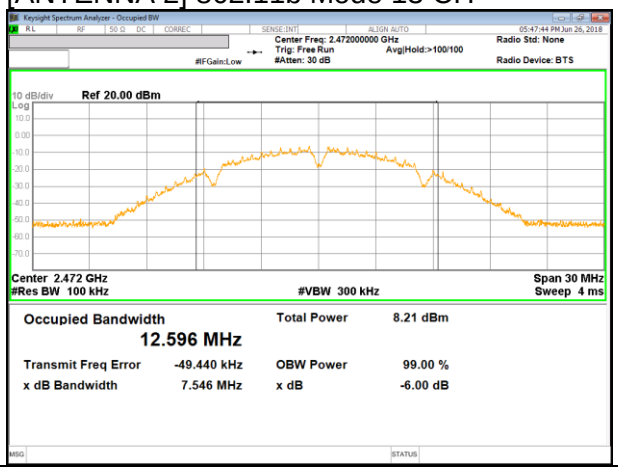

[ANTENNA 2] 802.11b Mode 12 CH



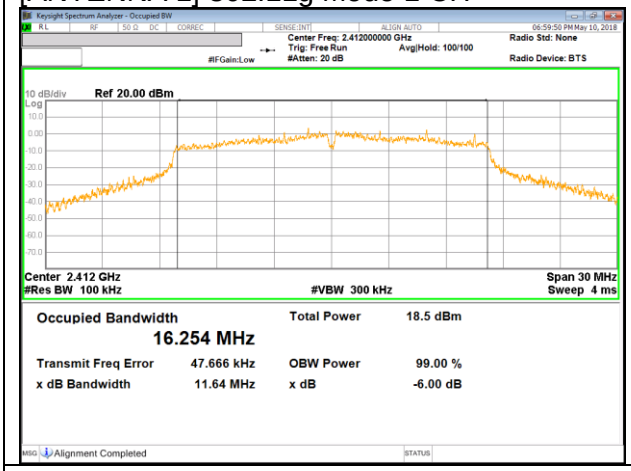

[ANTENNA 1] 802.11b Mode 13 CH



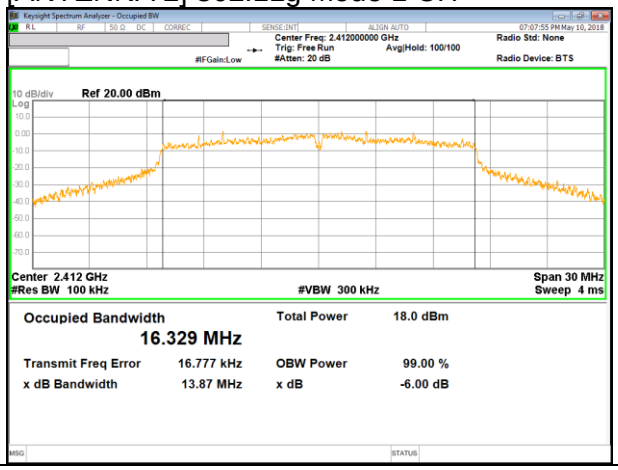

[ANTENNA 2] 802.11b Mode 13 CH



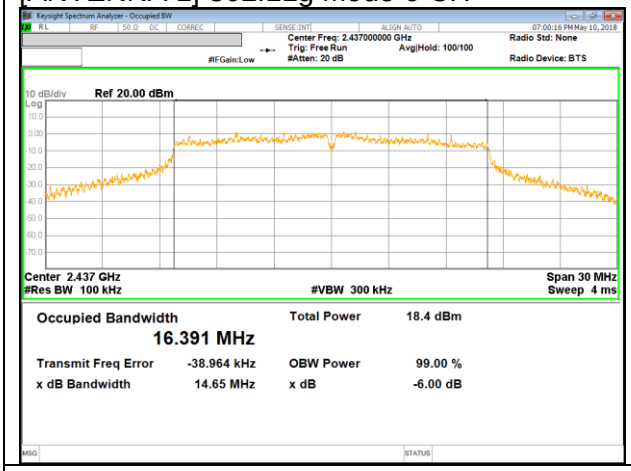
[ANTENNA 1] 802.11g Mode 1 CH



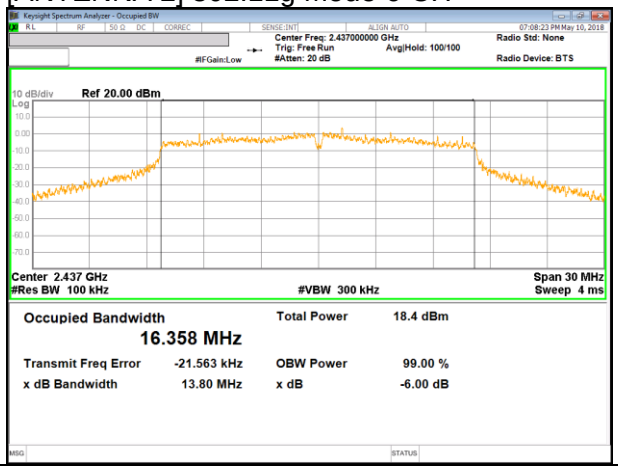

[ANTENNA 2] 802.11g Mode 1 CH



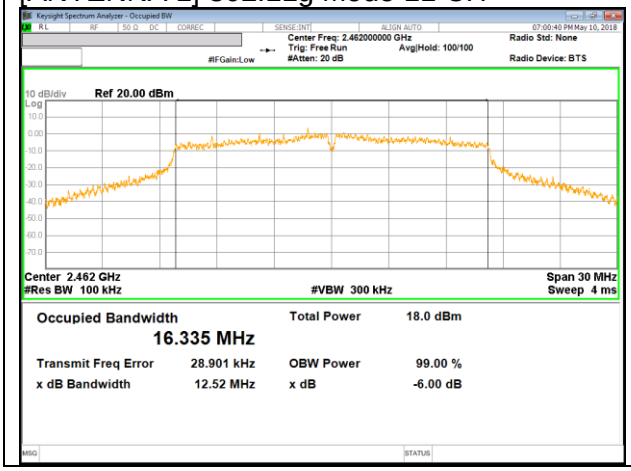

[ANTENNA 1] 802.11g Mode 6 CH



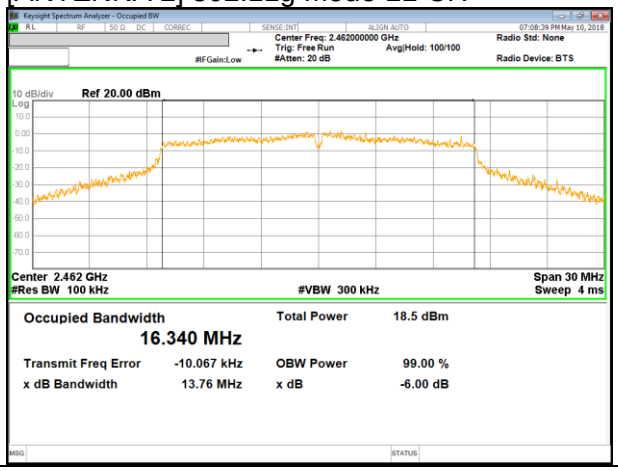

[ANTENNA 2] 802.11g Mode 6 CH



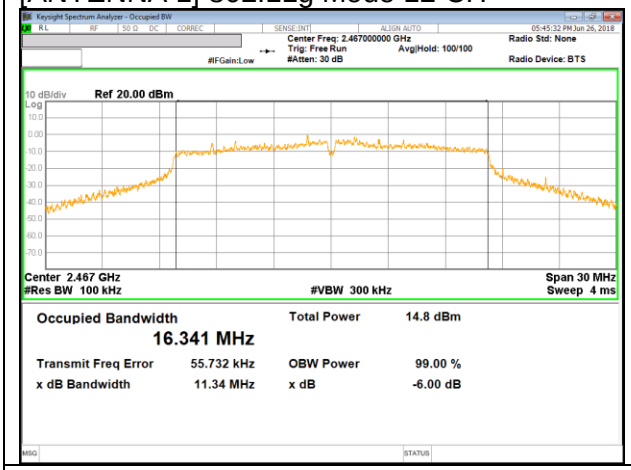

[ANTENNA 1] 802.11g Mode 11 CH



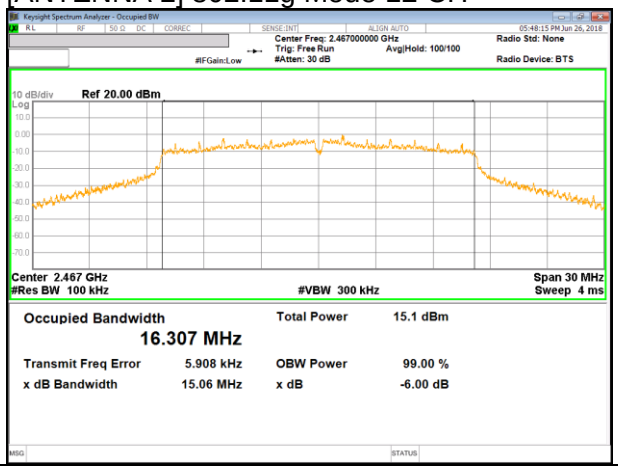

[ANTENNA 2] 802.11g Mode 11 CH



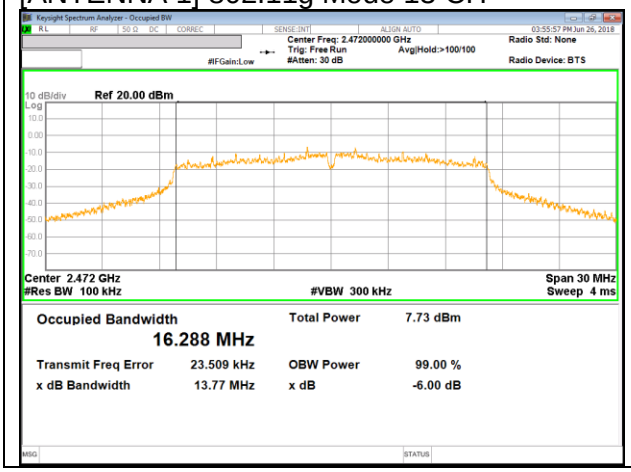
[ANTENNA 1] 802.11g Mode 12 CH



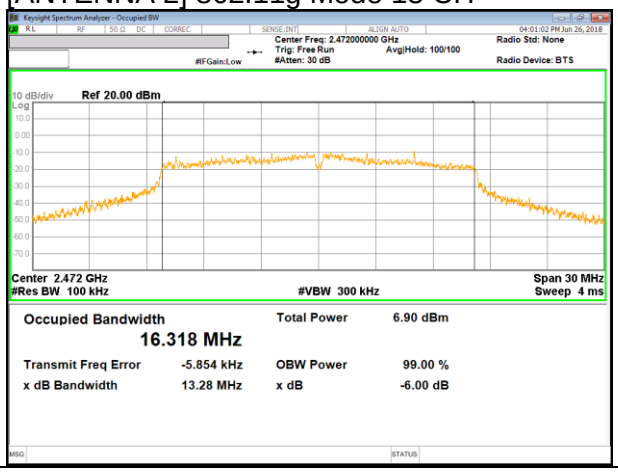

[ANTENNA 2] 802.11g Mode 12 CH



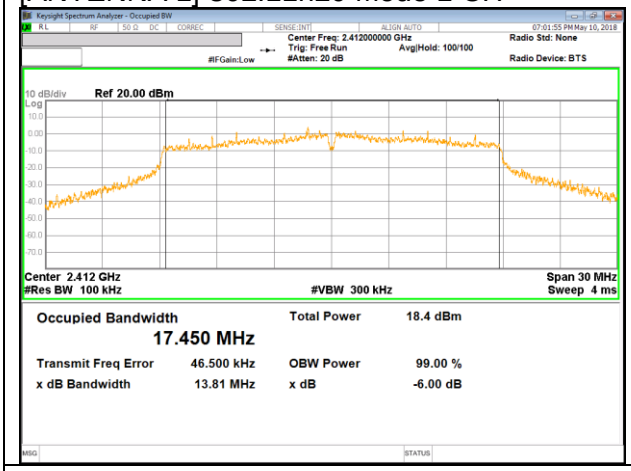

[ANTENNA 1] 802.11g Mode 13 CH



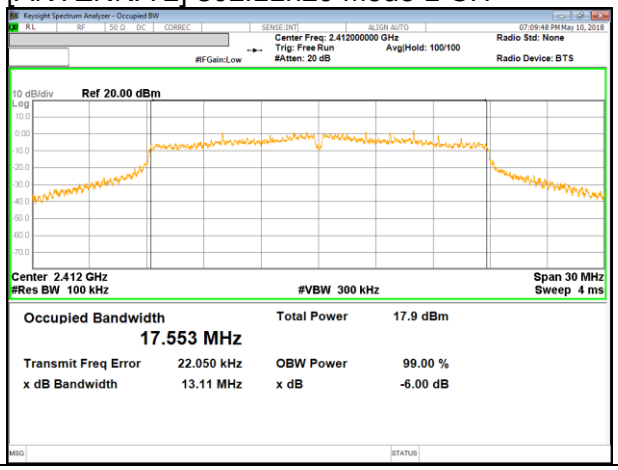

[ANTENNA 2] 802.11g Mode 13 CH



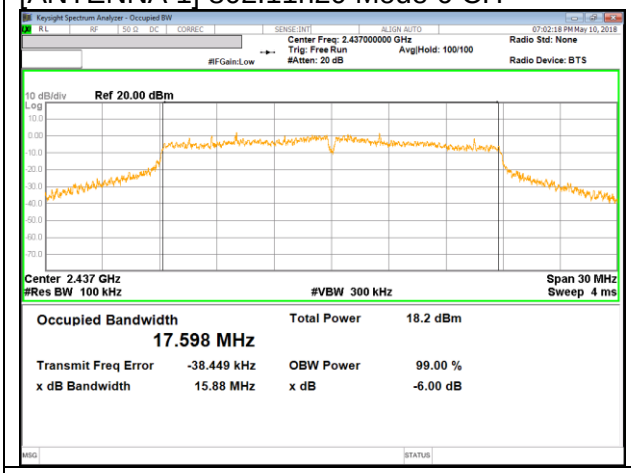
[ANTENNA 1] 802.11n20 Mode 1 CH



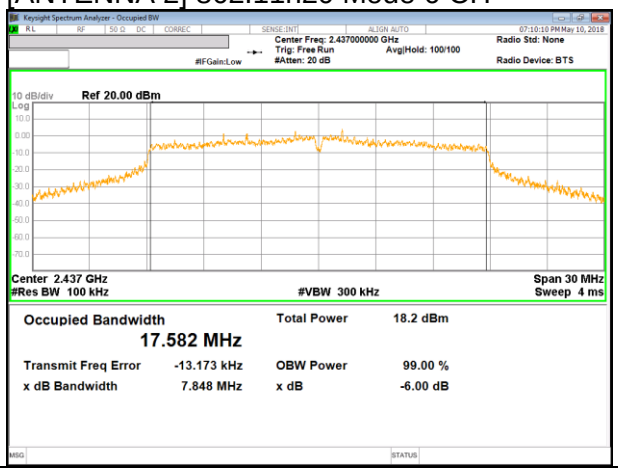

[ANTENNA 2] 802.11n20 Mode 1 CH



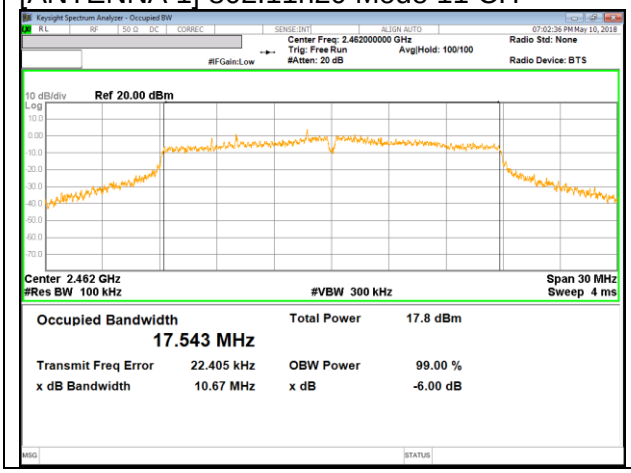

[ANTENNA 1] 802.11n20 Mode 6 CH



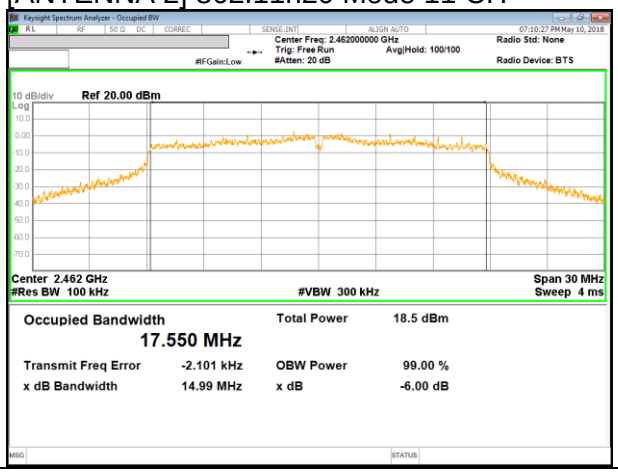

[ANTENNA 2] 802.11n20 Mode 6 CH



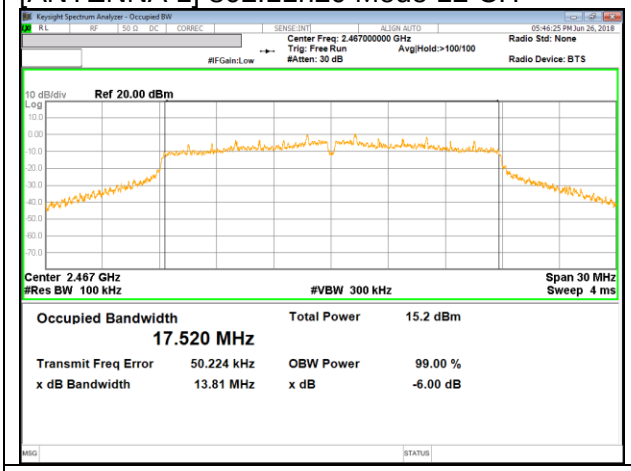

[ANTENNA 1] 802.11n20 Mode 11 CH



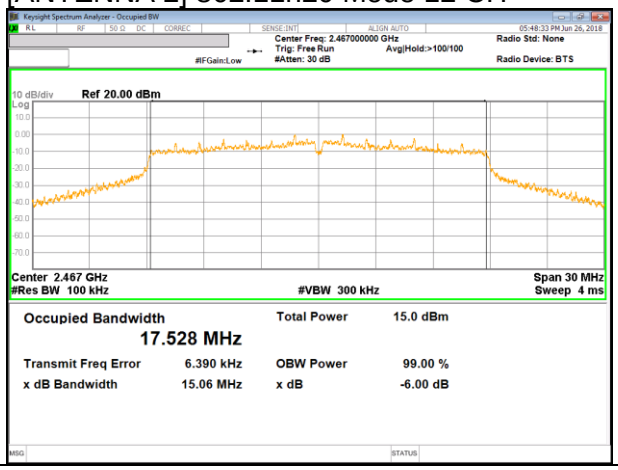

[ANTENNA 2] 802.11n20 Mode 11 CH



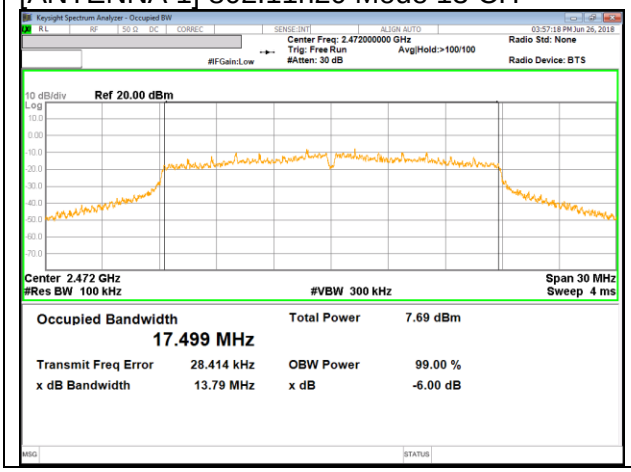
[ANTENNA 1] 802.11n20 Mode 12 CH



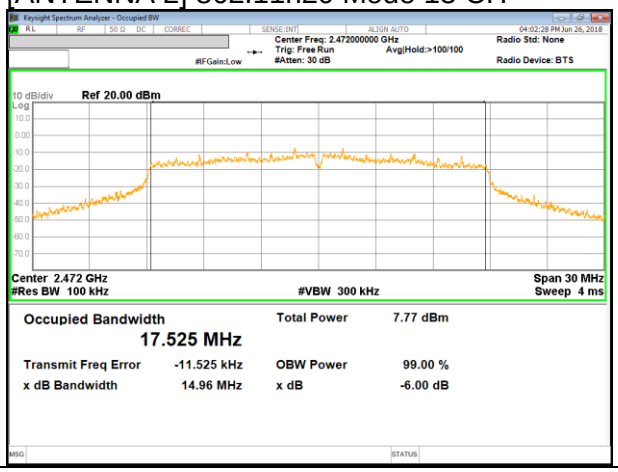

[ANTENNA 2] 802.11n20 Mode 12 CH




[ANTENNA 1] 802.11n20 Mode 13 CH




[ANTENNA 2] 802.11n20 Mode 13 CH



## 10.2. OUTPUT POWER

**LIMITS**

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

The cable assembly insertion loss was entered as an offset in the power meter to allow for direct reading of power.

Output power measurement was performed utilizing the "§9.2.3.1 AVGPM" under KDB558074 D01 DTS Meas Guidance v04.

Duty cycle correction factor is already added to the average output power results for duty cycle factor < 98%. (802.11g, 802.11n mode)

**DIRECTIONAL ANTENNA GAIN**

The TX chains are correlated and the antenna gain is unequal among the chains.
The directional gain is:

2.4GHz

| Antenna 1 Gain [dBi] | Antenna 2 Gain [dBi] | Correlated Chains Directional Gain [dBi] |
|---|---|---|
| -1.84 | -4.09 | 0.12 |

- IEEE 802.11b Mode is not supported MIMO operation. So can't transmit on two antennas as the same time.

**RESULTS**

## 10.2.1. 802.11b MODE IN THE 2.4 GHz BAND

**Limits**

| Channel | Frequency [MHz] | Directional Gain ANTENNA1 [dBi] | Directional Gain ANTENNA2 [dBi] | FCC Power Limit [dBm] | Max Power [dBm] |
|---|---|---|---|---|---|
| 1 | 2412 | -1.84 | -4.09 | 30.00 | 30.00 |
| 6 | 2437 | -1.84 | -4.09 | 30.00 | 30.00 |
| 11 | 2462 | -1.84 | -4.09 | 30.00 | 30.00 |
| 12 | 2467 | -1.84 | -4.09 | 30.00 | 30.00 |
| 13 | 2472 | -1.84 | -4.09 | 30.00 | 30.00 |

| Duty Cycle CF [dB] | 0.00 | Included in Calculations of Corr'd Power |
|---|---|---|

**Results**

| Channel | Frequency [MHz] | ANTENNA1 Meas Power [dBm] | ANTENNA2 Meas Power [dBm] | Maximum Power [dBm] | Power Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | 12.03 | 12.44 | 12.44 | 30.00 | -17.56 |
| 6 | 2437 | 12.84 | 12.85 | 12.85 | 30.00 | -17.15 |
| 11 | 2462 | 12.48 | 12.13 | 12.48 | 30.00 | -17.52 |
| 12 | 2467 | 8.78 | 8.64 | 8.78 | 30.00 | - 21.22 |
| 13 | 2472 | 1.64 | 1.73 | 1.73 | 30.00 | - 28.27 |
| Worst | | | | 12.85 | 30.00 | -17.15 |

## 10.2.2. 802.11g MODE IN THE 2.4 GHz BAND

**Limits**

| Channel | Frequency [MHz] | Directional Gain [dBi] | FCC Power Limit [dBm] | Max Power EIRP Limit [dBm] |
|---|---|---|---|---|
| 1 | 2412 | 0.12 | 30.00 | 30.00 |
| 6 | 2437 | 0.12 | 30.00 | 30.00 |
| 11 | 2462 | 0.12 | 30.00 | 30.00 |
| 12 | 2467 | 0.12 | 30.00 | 30.00 |
| 13 | 2472 | 0.12 | 30.00 | 30.00 |

| Duty Cycle CF [dB] | 0.13 | Included in Calculations of Corr'd Power |
|---|---|---|

**Results**

| Channel | Frequency [MHz] | ANTENNA1 Meas Power [dBm] | ANTENNA2 Meas Power [dBm] | Total Corr'd Power [dBm] | Power Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | 12.86 | 12.25 | 15.58 | 30.00 | -14.42 |
| 6 | 2437 | 12.67 | 12.63 | 15.66 | 30.00 | -14.34 |
| 11 | 2462 | 12.37 | 12.95 | 15.68 | 30.00 | -14.32 |
| 12 | 2467 | 8.68 | 8.55 | 11.63 | 30.00 | -18.37 |
| 13 | 2472 | 0.84 | 1.18 | 4.02 | 30.00 | -25.98 |
| Worst | | | | 15.69 | 30.00 | -14.31 |

## 10.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

**Limits**

| Channel | Frequency [MHz] | Directional Gain [dBi] | FCC Power Limit [dBm] | Max Power EIRP Limit [dBm] |
|---|---|---|---|---|
| 1 | 2412 | 0.12 | 30.00 | 30.00 |
| 6 | 2437 | 0.12 | 30.00 | 30.00 |
| 11 | 2462 | 0.12 | 30.00 | 30.00 |
| 12 | 2467 | 0.12 | 30.00 | 30.00 |
| 13 | 2472 | 0.12 | 30.00 | 30.00 |

| Duty Cycle CF [dB] | 0.14 | Included in Calculations of Corr'd Power |
|---|---|---|

**Results**

| Channel | Frequency [MHz] | ANTENNA1 Meas Power [dBm] | ANTENNA2 Meas Power [dBm] | Total Corr'd Power [dBm] | Power Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | 12.67 | 12.06 | 15.39 | 30.00 | -14.61 |
| 6 | 2437 | 12.5 | 12.44 | 15.48 | 30.00 | -14.52 |
| 11 | 2462 | 12.17 | 12.59 | 15.40 | 30.00 | -14.60 |
| 12 | 2467 | 8.49 | 8.39 | 11.45 | 30.00 | -18.55 |
| 13 | 2472 | 0.64 | 1.00 | 3.83 | 30.00 | -26.17 |
| Worst | | | | 15.48 | 30.00 | -14.52 |

## 10.3. PSD

**LIMITS**

FCC §15.247

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**TEST PROCEDURE**

Power Spectral Density was performed utilizing the “Method §10.3 AVGPSD-1(802.11 b mode) and §10.5 AVGPSD-2(802.11 g/n mode)” under KDB558074 D01 DTS Meas Guidance v04

**RESULTS**

## 10.3.1. 802.11b MODE IN THE 2.4 GHz BAND

| Channel | Frequency [MHz] | Antenna 1 [dBm] | Antenna 2 [dBm] | Max PSD [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | -18.49 | -18.12 | -18.12 | 8.00 | -26.12 |
| 6 | 2437 | -17.85 | -17.85 | -17.85 | 8.00 | -25.85 |
| 11 | 2462 | -18.30 | -18.58 | -18.30 | 8.00 | -26.30 |
| 12 | 2467 | -21.86 | -21.84 | -21.84 | 8.00 | -29.84 |
| 13 | 2472 | -29.75 | -29.28 | -29.28 | 8.00 | -37.28 |

| Duty Cycle CF [dB] | 0.00 | Included in Calculations of PPSD |
|---|---|---|

## 10.3.2. 802.11g MODE IN THE 2.4 GHz BAND

| Channel | Frequency [MHz] | Antenna 1 [dBm] | Antenna 2 [dBm] | Total PSD [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | -18.54 | -19.14 | -15.69 | 8.00 | -23.69 |
| 6 | 2437 | -19.30 | -18.95 | -15.98 | 8.00 | -23.98 |
| 11 | 2462 | -19.39 | -18.77 | -15.93 | 8.00 | -23.93 |
| 12 | 2467 | -23.12 | -22.98 | -19.91 | 8.00 | -27.91 |
| 13 | 2472 | -30.92 | -30.75 | -27.70 | 8.00 | -35.70 |

| Duty Cycle CF [dB] | 0.13 | Included in Calculations of PPSD |
|---|---|---|

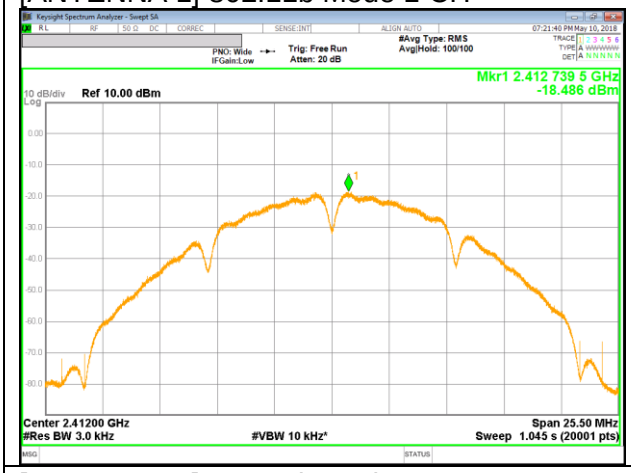
## 10.3.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

| Channel | Frequency [MHz] | Antenna 1 [dBm] | Antenna 2 [dBm] | Total PSD [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2412 | -19.14 | -19.82 | -16.32 | 8.00 | -24.32 |
| 6 | 2437 | -19.57 | -19.50 | -16.38 | 8.00 | -24.38 |
| 11 | 2462 | -19.32 | -19.07 | -16.05 | 8.00 | -24.05 |
| 12 | 2467 | -23.32 | -23.50 | -20.26 | 8.00 | -28.26 |
| 13 | 2472 | -31.06 | -31.02 | -27.89 | 8.00 | -35.89 |

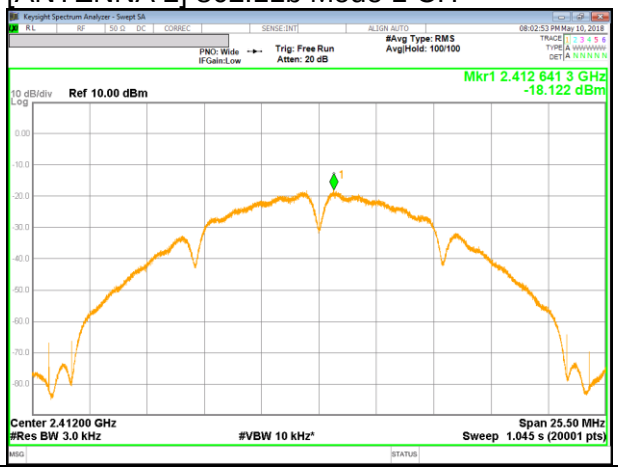
| Duty Cycle CF [dB] | 0.14 | Included in Calculations of PPSD |
|---|---|---|

## 10.3.4. PSD PLOTS

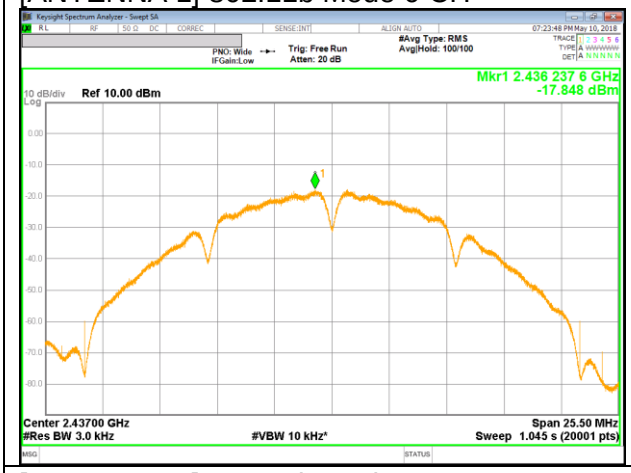
[ANTENNA 1] 802.11b Mode 1 CH



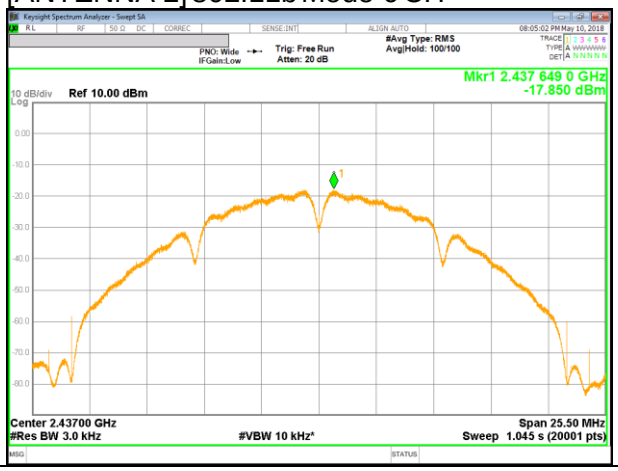

[ANTENNA 2] 802.11b Mode 1 CH



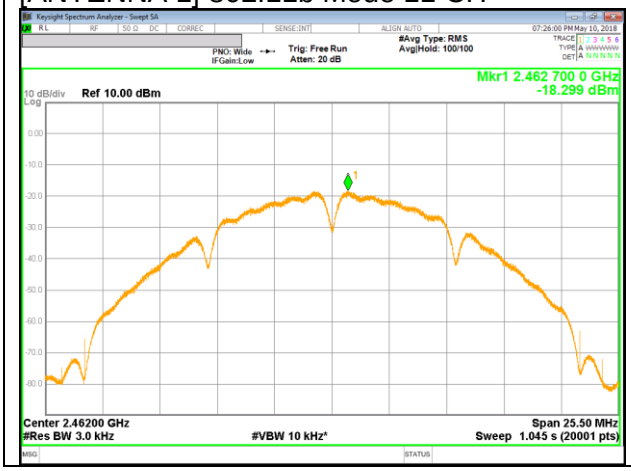

[ANTENNA 1] 802.11b Mode 6 CH



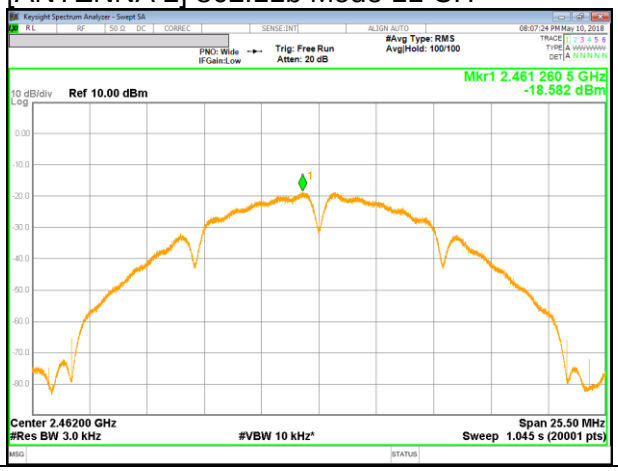

[ANTENNA 2] 802.11b Mode 6 CH



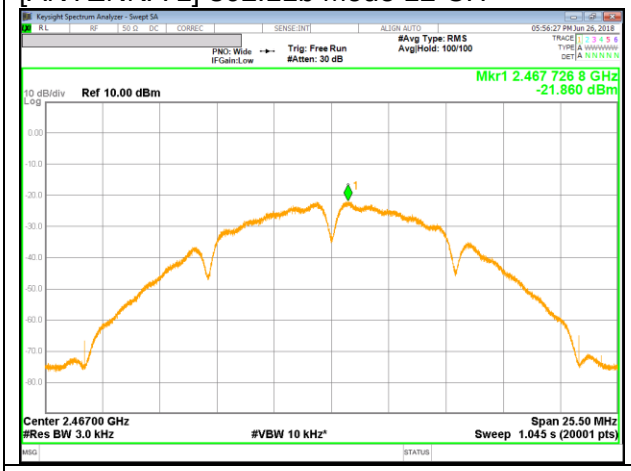

[ANTENNA 1] 802.11b Mode 11 CH



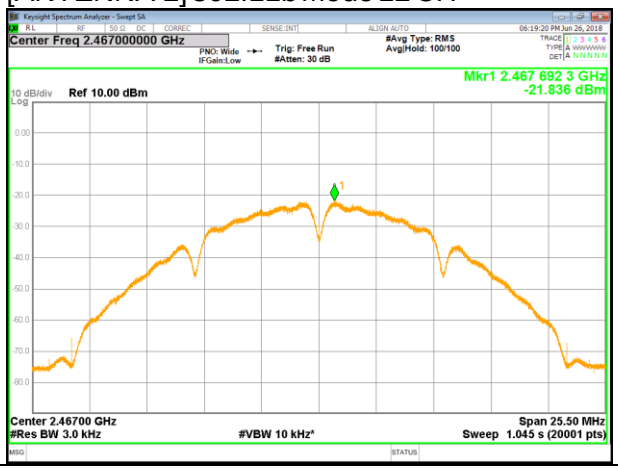

[ANTENNA 2] 802.11b Mode 11 CH



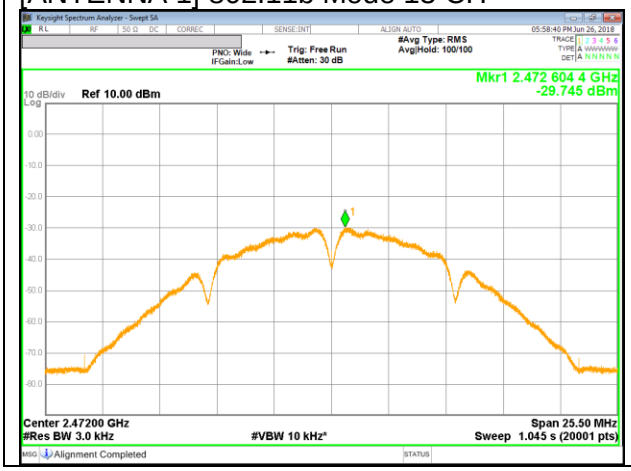
[ANTENNA 1] 802.11b Mode 12 CH



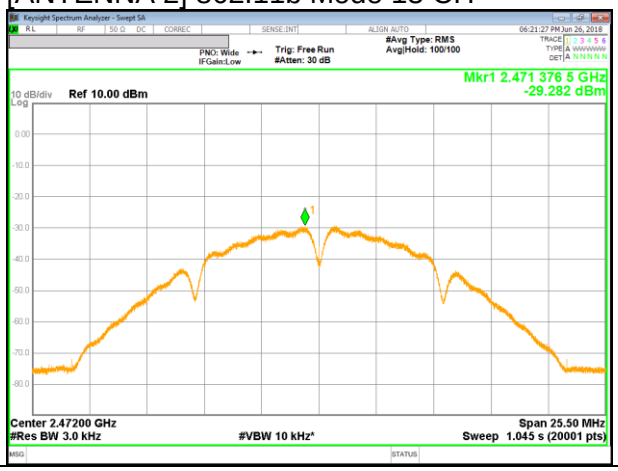

[ANTENNA 2] 802.11b Mode 12 CH



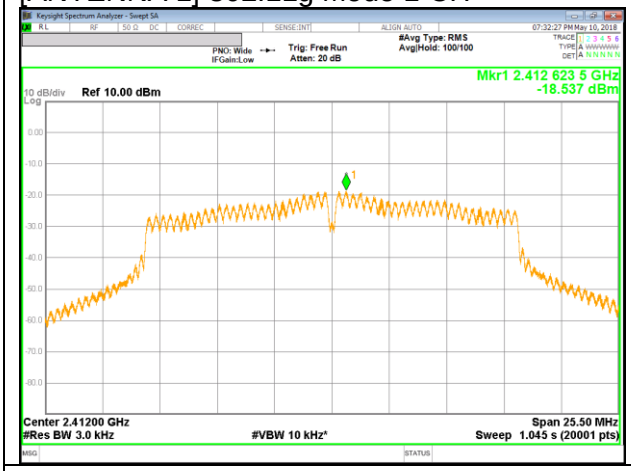

[ANTENNA 1] 802.11b Mode 13 CH



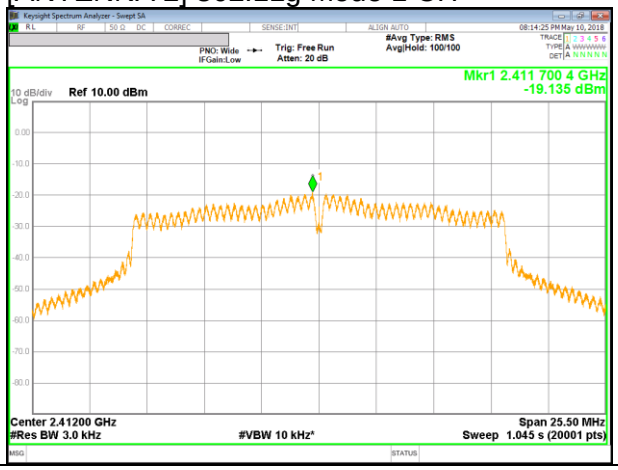

[ANTENNA 2] 802.11b Mode 13 CH



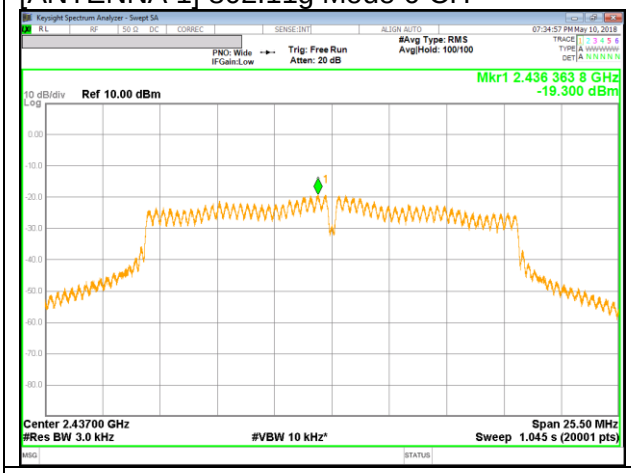
[ANTENNA 1] 802.11g Mode 1 CH



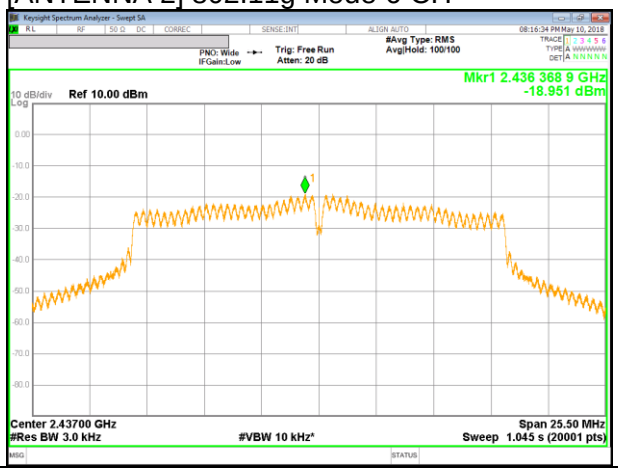

[ANTENNA 2] 802.11g Mode 1 CH



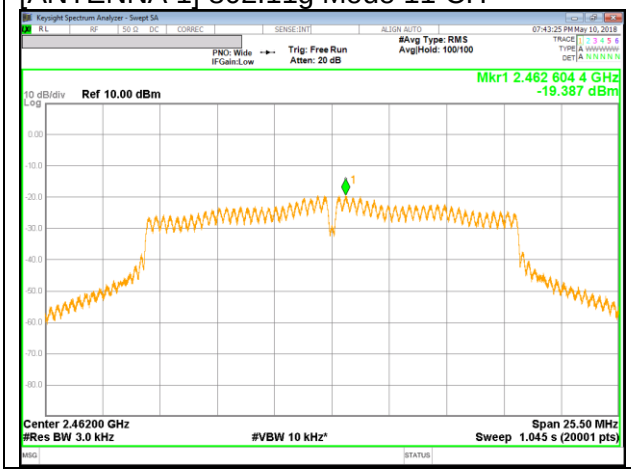

[ANTENNA 1] 802.11g Mode 6 CH



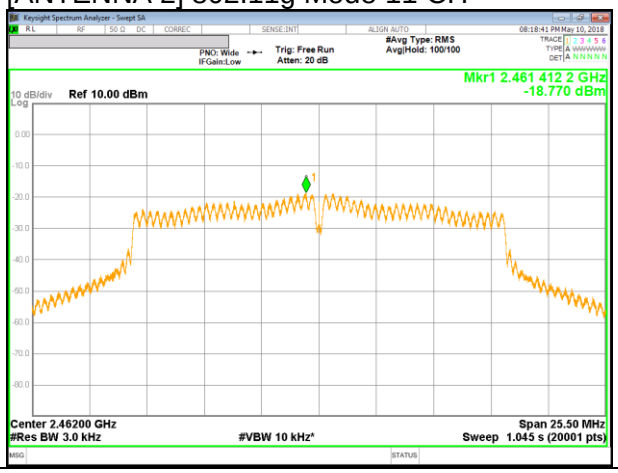

[ANTENNA 2] 802.11g Mode 6 CH



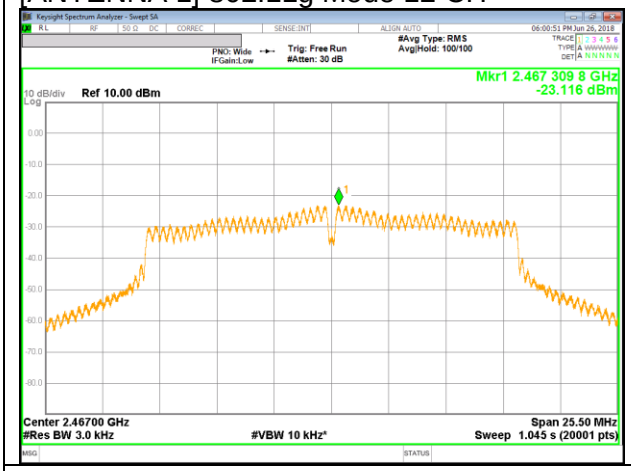

[ANTENNA 1] 802.11g Mode 11 CH



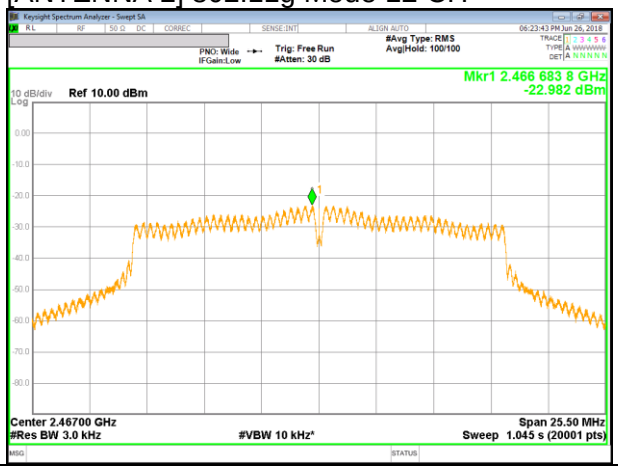

[ANTENNA 2] 802.11g Mode 11 CH



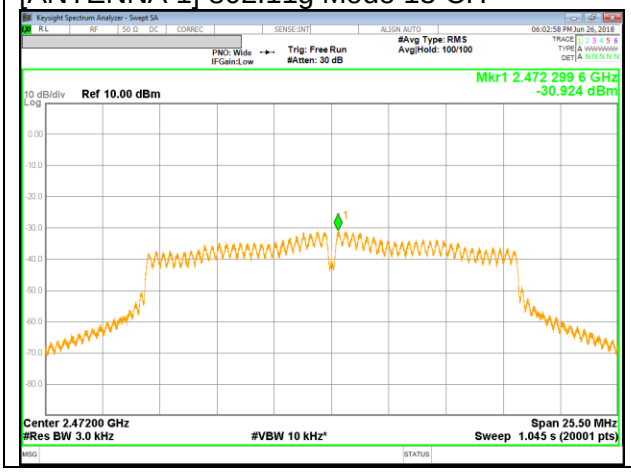
[ANTENNA 1] 802.11g Mode 12 CH




[ANTENNA 2] 802.11g Mode 12 CH




[ANTENNA 1] 802.11g Mode 13 CH




[ANTENNA 2] 802.11g Mode 13 CH