



# **CERTIFICATION TEST REPORT**

**Report Number. :** 12216550-E1V2

**Applicant :** PEOPLENET COMMUNICATIONS CORPORATION  
4400 BAKER ROAD,  
MINNETONKA, MN, 55344, U.S.A.

**Model :** DV423

**FCC ID :** NKS-DV423

**EUT Description :** DIGITAL VIDEO RECORDER

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C

**Date Of Issue:**

May 17, 2018

**Prepared by:**

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Revision History

| Rev. | Issue Date | Revisions                                | Revised By |
|------|------------|------------------------------------------|------------|
| V1   | 5/2/2018   | Initial Issue                            | --         |
| V2   | 5/17/2018  | Updated report to address TCB's question | Tina Chu   |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** PEOPLENET COMMUNICATIONS CORPORATION  
4400 BAKER ROAD,  
MINNETONKA, MN, 55344, U.S.A.

**EUT DESCRIPTION:** DIGITAL VIDEO RECORDER

**MODEL:** DV423

**SERIAL NUMBER:** DVR1801000022

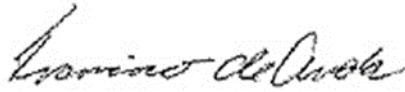
**DATE TESTED:** APRIL 06, 2018 – APRIL 27, 2018

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

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 NVLAP, NIST, or any agency of the U.S. Government.

Approved & Released For  
UL Verification Services Inc. By:



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FRANCISCO DE ANDA  
OPERATIONS LEAD  
UL Verification Services Inc.

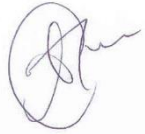
Prepared By:



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JASON QIAN  
TEST ENGINEER  
UL Verification Services Inc.

Reviewed By:



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TINA CHU  
SENIOR PROJECT ENGINEER  
UL Verification Services Inc.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, ANSI C63.10-2013.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 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.

| 47173 Benicia Street                                       | 47266 Benicia Street                            |
|------------------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> Chamber A (IC:2324B-1)            | <input type="checkbox"/> Chamber D (IC:22541-1) |
| <input type="checkbox"/> Chamber B (IC:2324B-2)            | <input type="checkbox"/> Chamber E (IC:22541-2) |
| <input checked="" type="checkbox"/> Chamber C (IC:2324B-3) | <input type="checkbox"/> Chamber F (IC:22541-3) |
|                                                            | <input type="checkbox"/> Chamber G (IC:22541-4) |
|                                                            | <input type="checkbox"/> Chamber H (IC:22541-5) |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

## 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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

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

| Parameter                                           | Uncertainty |
|-----------------------------------------------------|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.84 dB     |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.65 dB     |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz     | 3.15 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 5.36 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.32 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB     |
| Occupied Channel Bandwidth                          | ±0.39 %     |

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The equipment under test is a Digital Video Recorder, 4 camera inputs, powered by vehicle battery. It has Wifi, GPS, and cellular modules installed. Cellular module is FCC certified.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode         | Output Power (dBm) | Output Power (mW) |
|-----------------------|--------------|--------------------|-------------------|
| 2412-2462             | 802.11b      | 19.42              | 87.50             |
|                       | 802.11g      | 23.81              | 240.44            |
|                       | 802.11n HT20 | 22.58              | 181.13            |
|                       | 802.11n HT40 | 22.39              | 173.38            |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band (GHz) | Antenna Peak Gain (dBi) |
|----------------------|-------------------------|
| 2.4                  | 3.46                    |

### 5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Tera Term 4.88.

The firmware installed in the EUT during testing was Version 2663.

## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated bandedge were performed with EUT set to transmit at the channels output power.

Radiated harmonics and spurious emissions from 1 GHz to 18GHz were performed with EUT set to transmit at the Low/Middle/High channel with highest output power.

Radiated emission below 30MHz, below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The EUT and the panel antenna (with the label "This side faces the sky") must be mounted in X-orientation (Flatbed) per installation guide. Therefore, all final radiated testing was performed with the EUT and antenna in X-orientation (Flatbed).

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11n HT20 mode: MCS0

802 11n HT40 mode: MCS0

Wifi and Cellular transmit simultaneously.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |                  |                 |                |        |
|------------------------|------------------|-----------------|----------------|--------|
| Description            | Manufacturer     | Model           | Serial Number  | FCC ID |
| Laptop AC/DC Adapter   | HP               | PPP016C         | F1-1005096420C | NA     |
| Laptop                 | HP               | EliteBook 8530p | 2CE947GWYF     | NA     |
| 12 VDC vehicle battery | Optima Batteries | SPR             | SC3DM          | NA     |
| DC power supply        | DuraComm         | LP-25           | RB1B139142     | NA     |

### I/O CABLES (CONDUCTED TEST)

| I/O Cable List |         |                      |                |            |                  |                             |
|----------------|---------|----------------------|----------------|------------|------------------|-----------------------------|
| Cable No       | Port    | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks                     |
| 1              | DC      | 1                    | DC             | Unshielded | 1.5              | AC/DC Adapter to Laptop     |
| 2              | AC      | 1                    | 3-prongs       | Unshielded | 1                | AC Mains to AC/DC Adapter   |
| 3              | AC      | 1                    | 3-prongs       | Unshielded | 1.5              | DC power supply to AC mains |
| 4              | USB     | 1                    | RS-232         | Unshielded | 1.3              | USB Adapter to Laptop       |
| 5              | Antenna | 1                    | SMA            | Unshielded | 1                | EUT to spectrum analyzer    |
| 6              | DC      | 1                    | HF 4 pin       | Unshielded | 3.6              | DC power supply to EUT      |

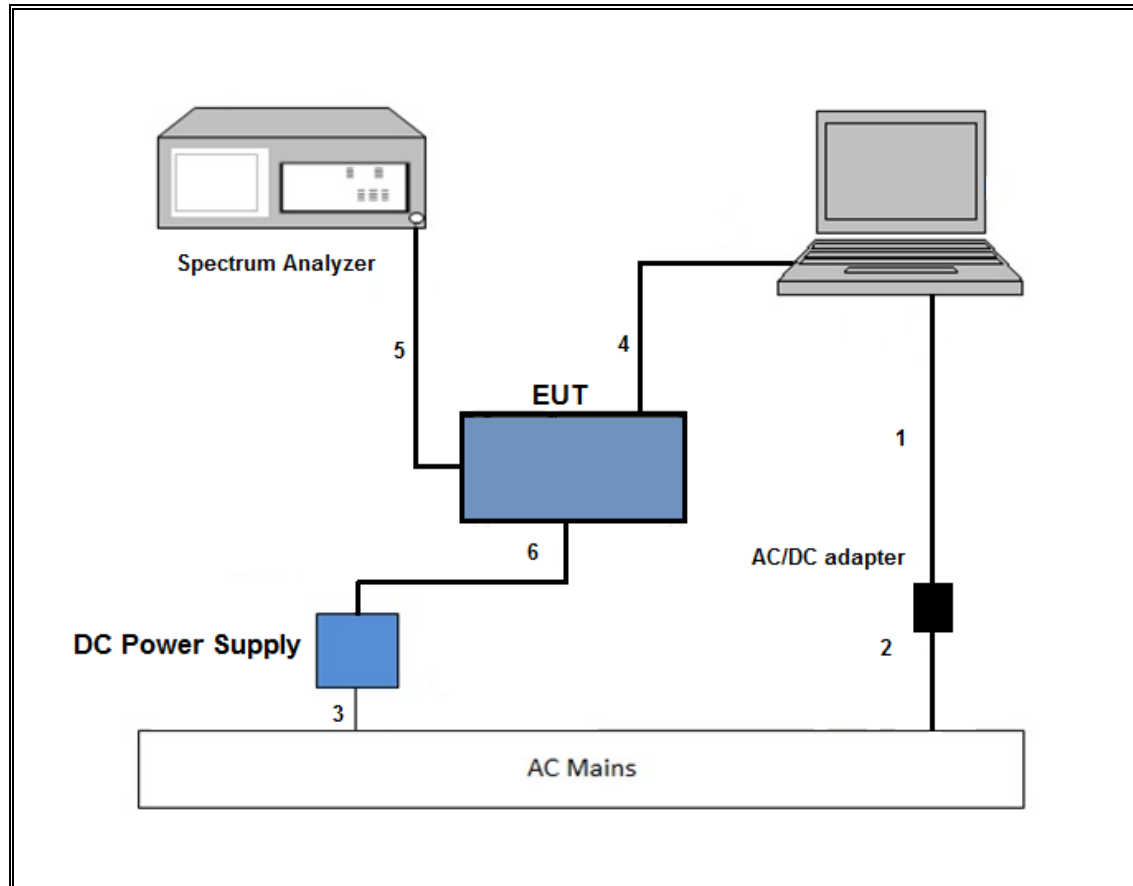
### I/O CABLES (RADIATED TEST)

| I/O Cable List |      |                      |                |            |                  |                        |
|----------------|------|----------------------|----------------|------------|------------------|------------------------|
| Cable No       | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks                |
| 1              | DC   | 1                    | HF 4 pin       | Unshielded | 3.6              | EUT to Vehicle Battery |

### TEST SETUP-CONDUCTED TESTS

EUT powered by DC power supply. Test software exercised the EUT.

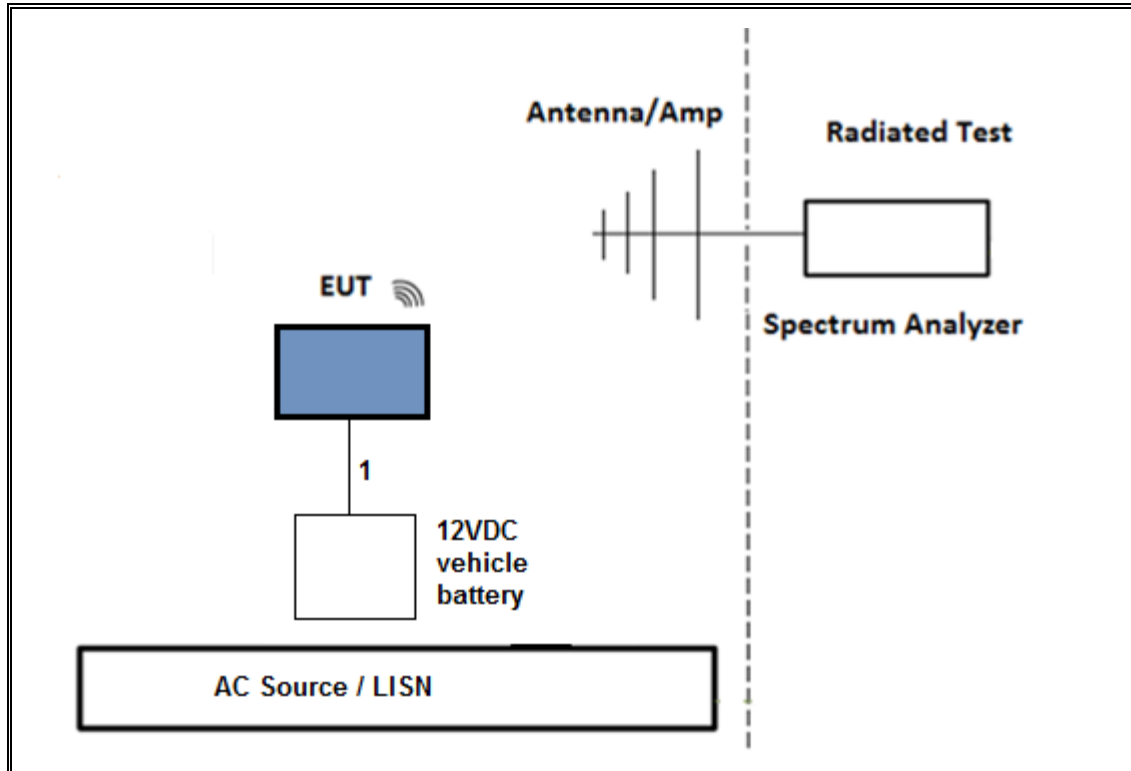
### SETUP DIAGRAM



**TEST SETUP- RADIATED TEST**

EUT powered by external 12 VDC vehicle battery. Test software exercised the EUT.

**SETUP DIAGRAM**



## 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                  | Asset                 | Cal Due    |
| Antenna, Active Loop 9kHz-30MHz             | Com-Power Corp.      | AL-130R                | T1866                 | 10/10/2018 |
| Antenna, Horn 1-18GHz                       | ETS-Lindgren         | 3117                   | T120                  | 06/26/2018 |
| Amplifier, 1 to 18GHz                       | Miteq                | AFS42-00101800-25-S-42 | T931                  | 02/24/2019 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences Corp. | JB1                    | T243                  | 11/02/2018 |
| Amplifier, 10KHz to 1GHz, 32dB              | SONOMA INSTRUMENT    | 310N                   | T300                  | 12/11/2018 |
| Spectrum Analyzer, PXA 3Hz to 44GHz         | Keysight             | N9030A                 | T1210                 | 07/17/2018 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz        | Keysight             | N9030A                 | T905                  | 02/03/2019 |
| Antenna Horn, 18 to 26GHz                   | ARA                  | MWH-1826               | T89                   | 01/18/2019 |
| Antenna Horn, 18 to 26GHz                   | ARA                  | MWH-1826               | T449                  | 06/12/2019 |
| Amplifier, 1 to 26.5GHz 23.5dB gain Minimum | Keysight             | 8449B                  | T404                  | 07/23/2018 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz        | Keysight             | N9030A-544             | T1113                 | 12/21/2018 |
| Power Meter, P-series single channel        | Keysight             | N1912A                 | T1245                 | 05/12/2018 |
| Power Sensor                                | Keysight             | N1921A                 | T413                  | 06/22/2018 |
| UL AUTOMATION SOFTWARE                      |                      |                        |                       |            |
| Radiated Software                           | UL                   | UL EMC                 | Ver 9.5, Dec 01, 2016 |            |
| Conducted Software                          | UL                   | UL EMC                 | Ver 7.7, Dec 14, 2017 |            |

### NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

## 7. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.

6 dB BW: KDB 558074 D01 v04, Section 8.1.

99% BW: ANSI C63.10-2013, Section 6.9.3.

Output Power: KDB 558074 D01 v04, Section 9.2.3.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.2.

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.

Band-edge: KDB 558074 D01 v04, Section 12.1.

## 8. ANTENNA PORT TEST RESULTS

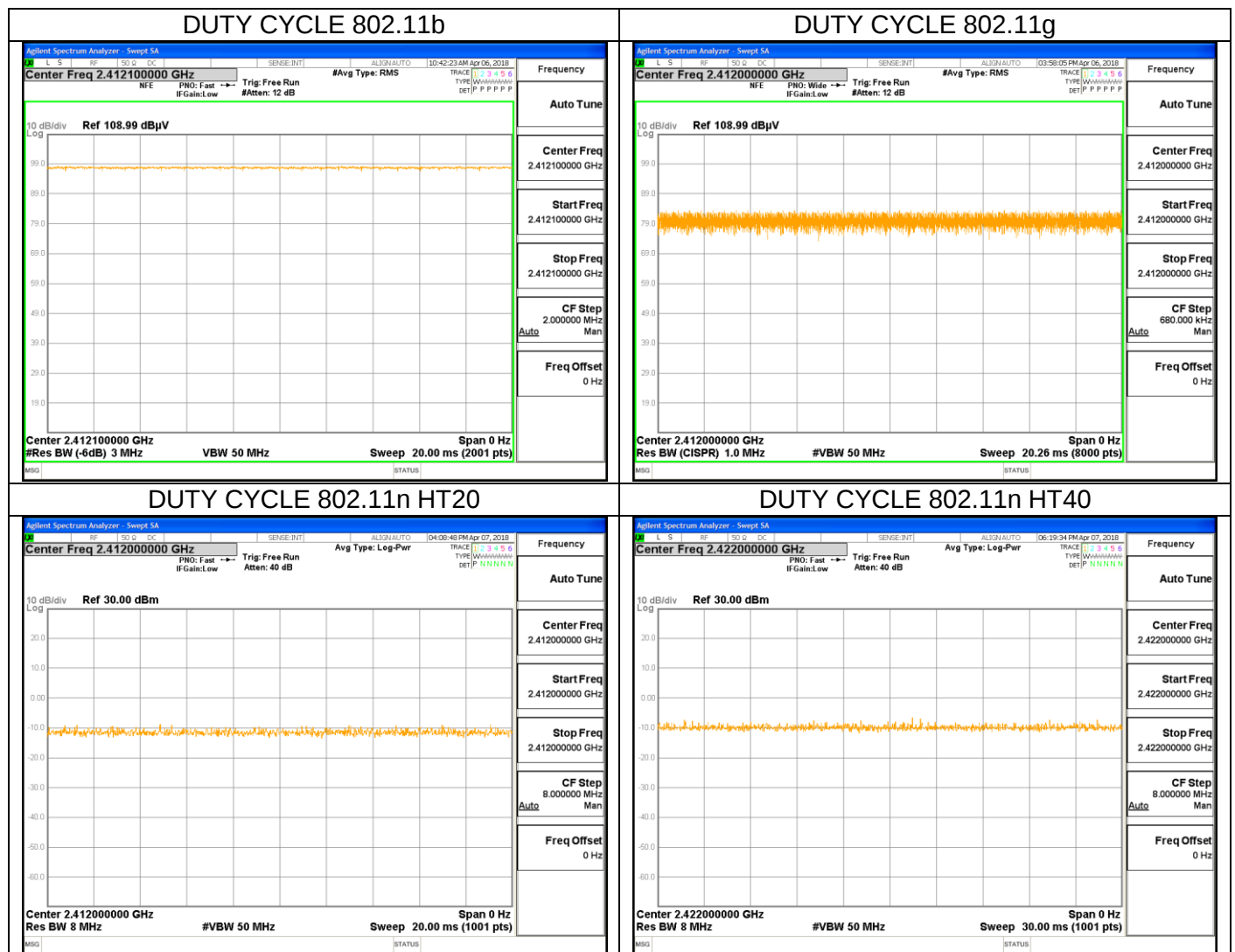
### 8.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

#### ON TIME AND DUTY CYCLE RESULTS

| Mode         | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/B<br>Minimum VBW<br>(kHz) |
|--------------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| 802.11b      | 1.000                  | 1.000            | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| 802.11g      | 1.000                  | 1.000            | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| 802.11n HT20 | 1.000                  | 1.000            | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| 802.11n HT40 | 1.000                  | 1.000            | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |



## 8.2. 99% BANDWIDTH

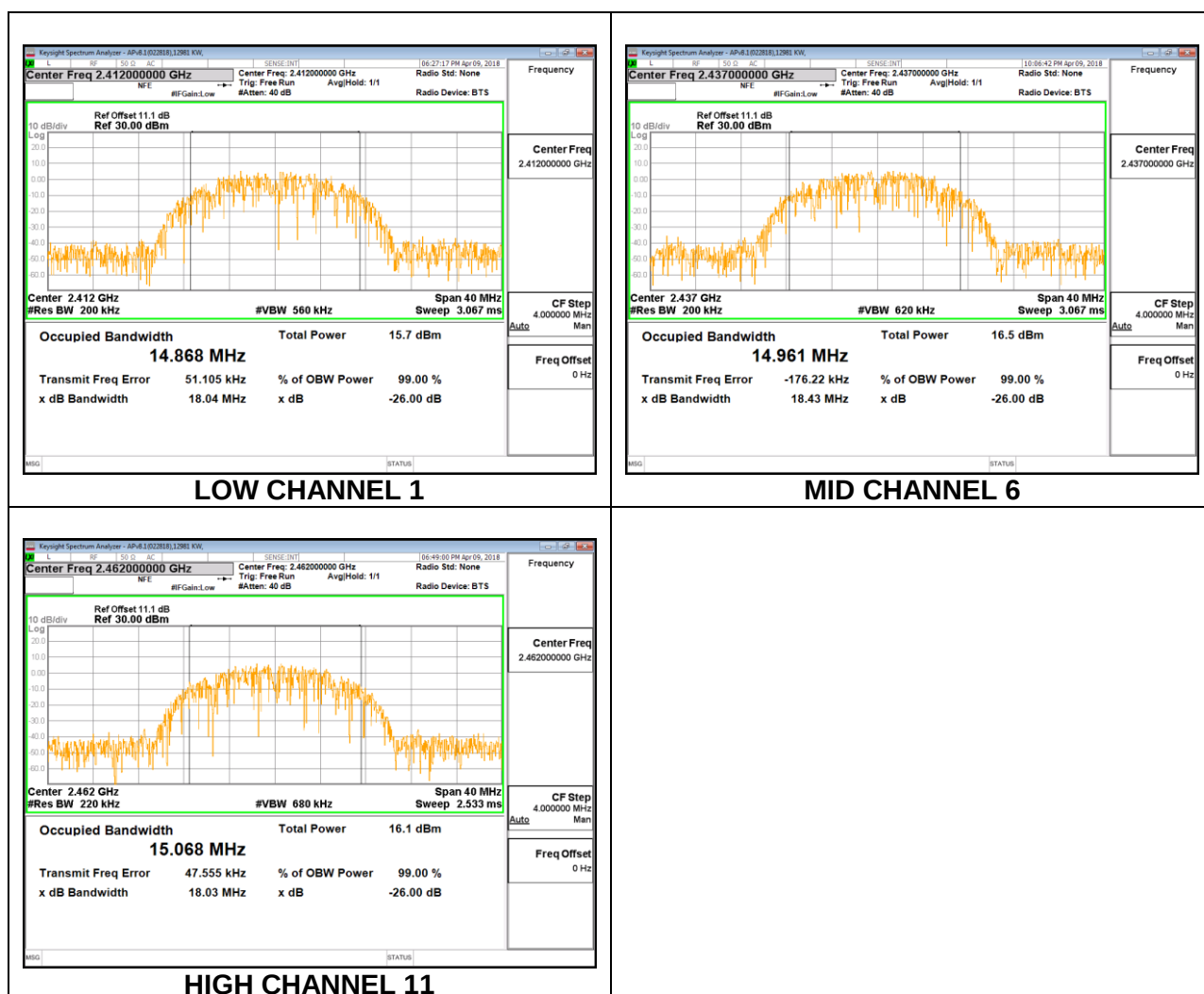
### LIMITS

None; for reporting purposes only.

### RESULTS

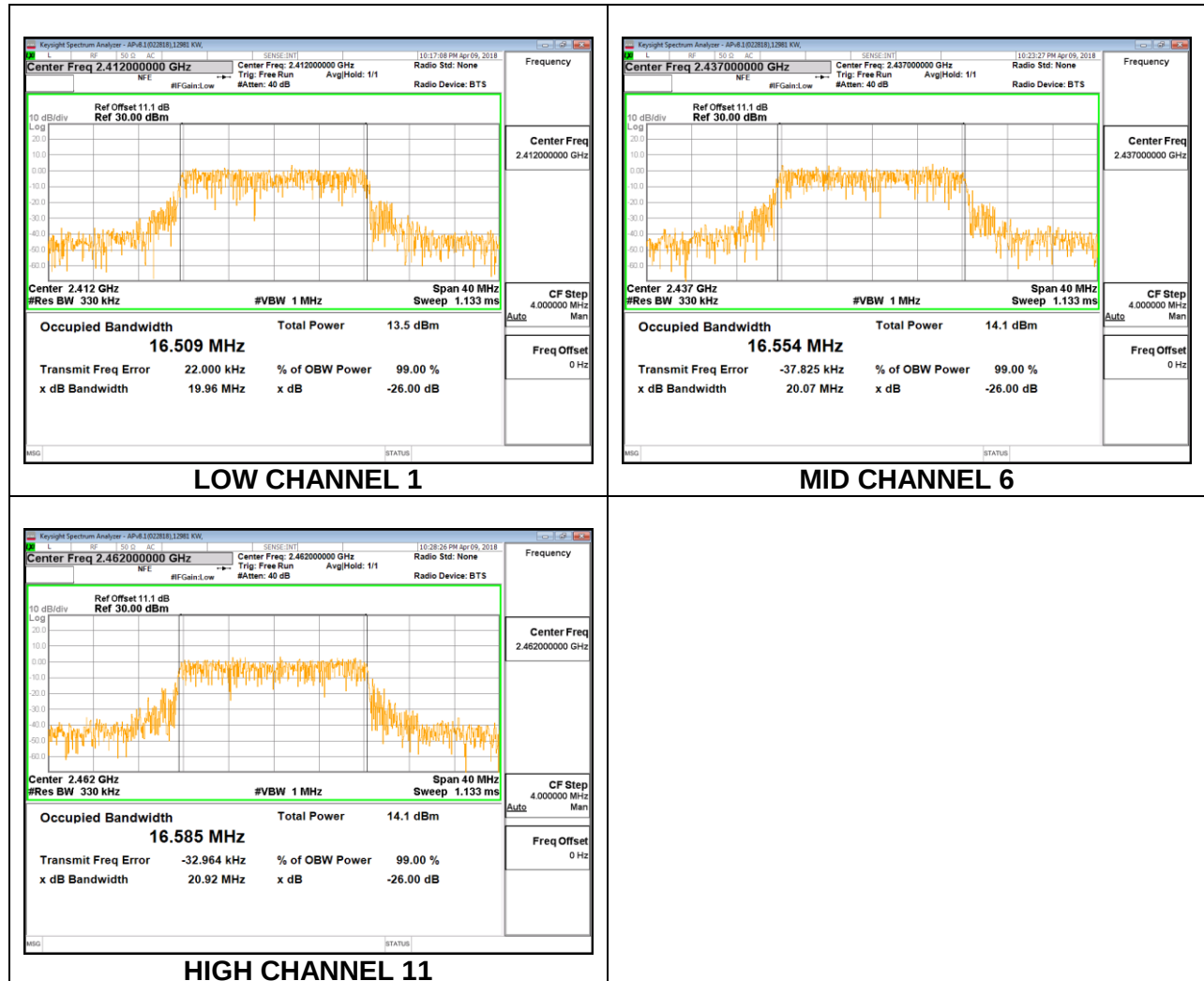
#### 8.2.1. 802.11b MODE

| Channel | Frequency | 99% Bandwidth |
|---------|-----------|---------------|
|         | (MHz)     | (MHz)         |
| Low 1   | 2412      | 14.8680       |
| Mid 6   | 2437      | 14.9610       |
| High 11 | 2462      | 15.0680       |



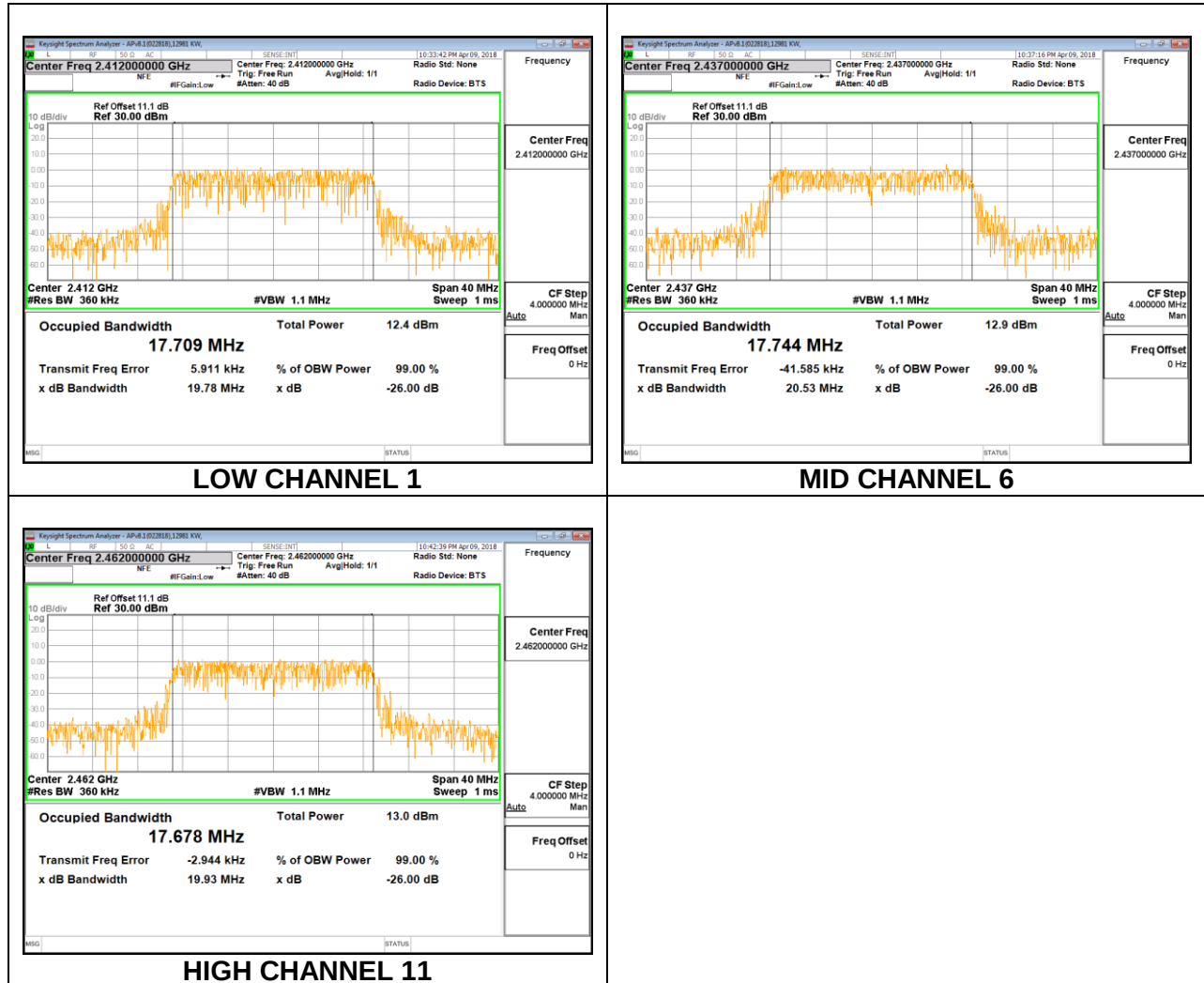
## 8.2.2. 802.11g MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 16.5090                |
| Mid 6   | 2437               | 16.5540                |
| High 11 | 2462               | 16.5850                |



### 8.2.3. 802.11n HT20 MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 17.7090                |
| Mid 6   | 2437               | 17.7440                |
| High 11 | 2462               | 17.6780                |



## 8.2.4. 802.11n HT40 MODE

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 3   | 2422               | 36.3730                |
| Mid 6   | 2437               | 36.2750                |
| High 9  | 2452               | 36.3200                |



### **8.3. 6 dB BANDWIDTH**

#### **LIMITS**

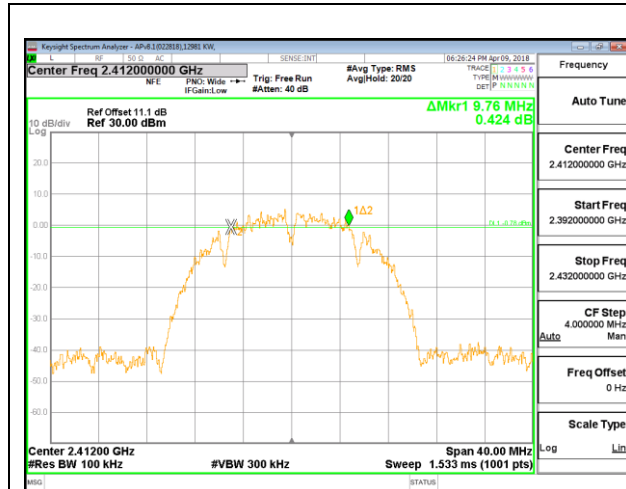
FCC §15.247 (a) (2)

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

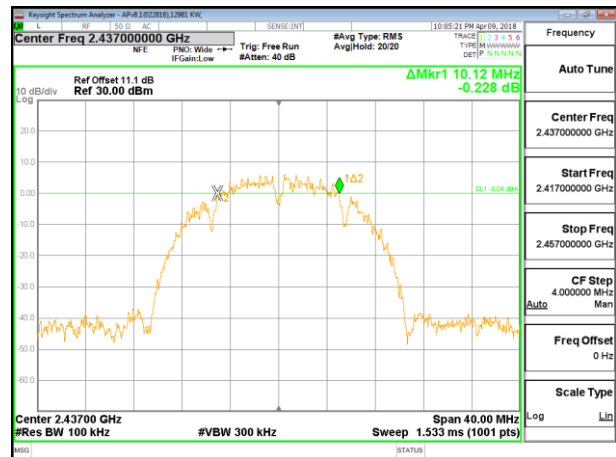
#### **RESULTS**

### 8.3.1. 802.11b MODE

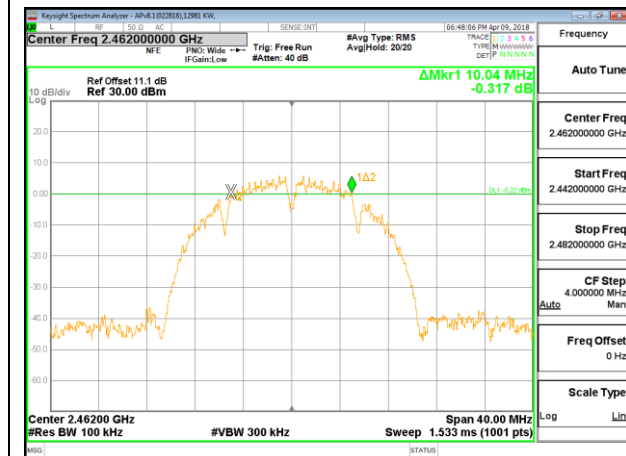
| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---------|-----------|----------------|---------------|
|         | (MHz)     | (MHz)          | (MHz)         |
| Low 1   | 2412      | 9.7600         | 0.5           |
| Mid 6   | 2437      | 10.1200        | 0.5           |
| High 11 | 2462      | 10.0400        | 0.5           |



LOW CHANNEL 1



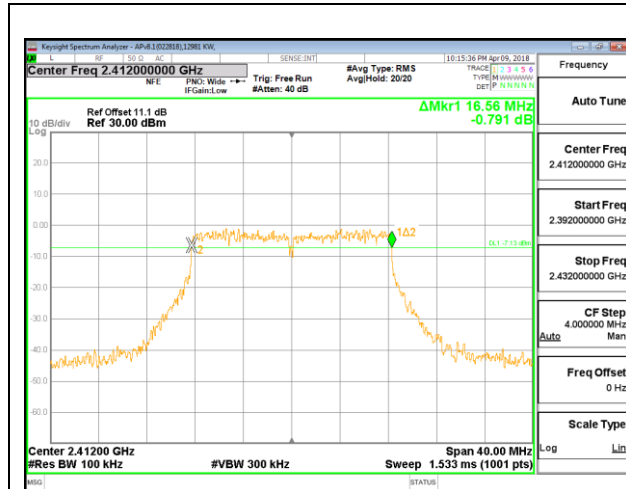
MID CHANNEL 6



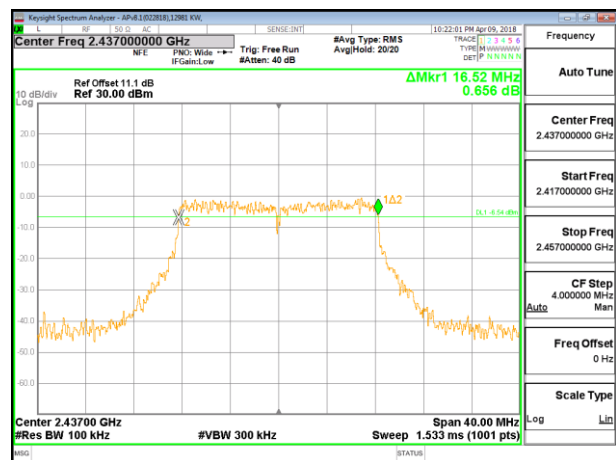
HIGH CHANNEL 11

### 8.3.2. 802.11g MODE

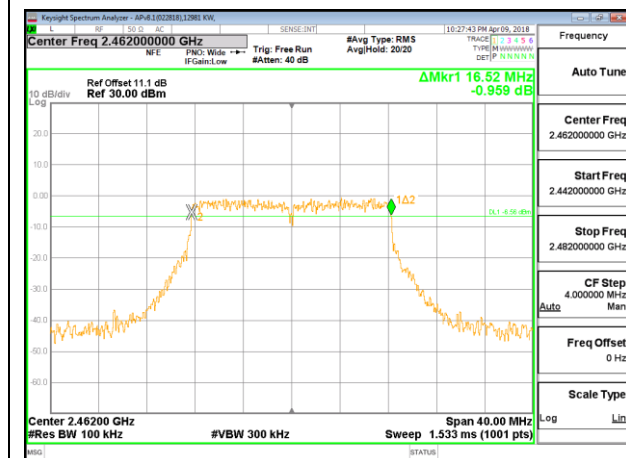
| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---------|-----------|----------------|---------------|
|         | (MHz)     | (MHz)          | (MHz)         |
| Low 1   | 2412      | 16.5600        | 0.5           |
| Mid 6   | 2437      | 16.5200        | 0.5           |
| High 11 | 2462      | 16.5200        | 0.5           |



LOW CHANNEL 1



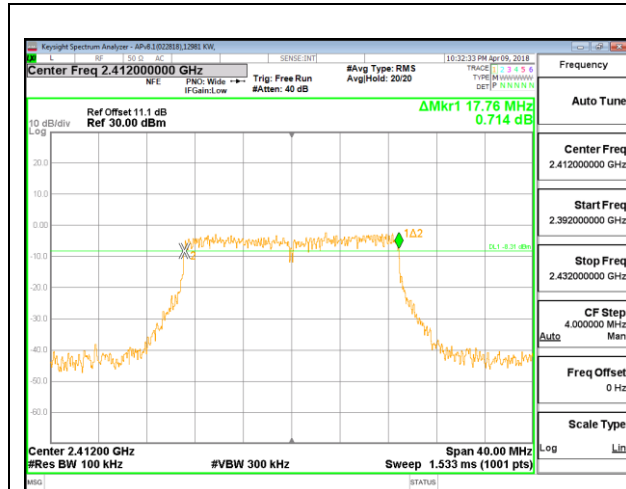
MID CHANNEL 6



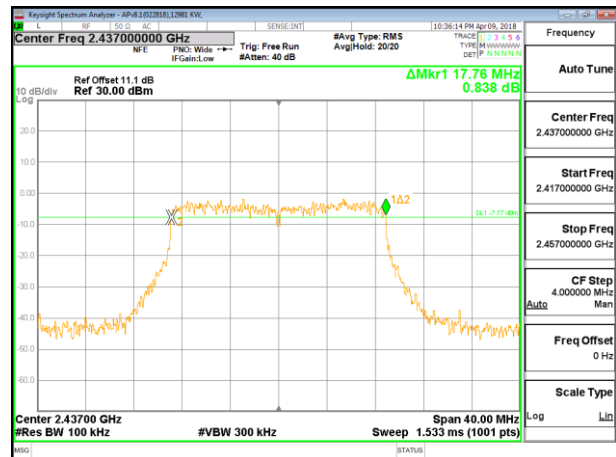
HIGH CHANNEL 11

### 8.3.3. 802.11n HT20 MODE

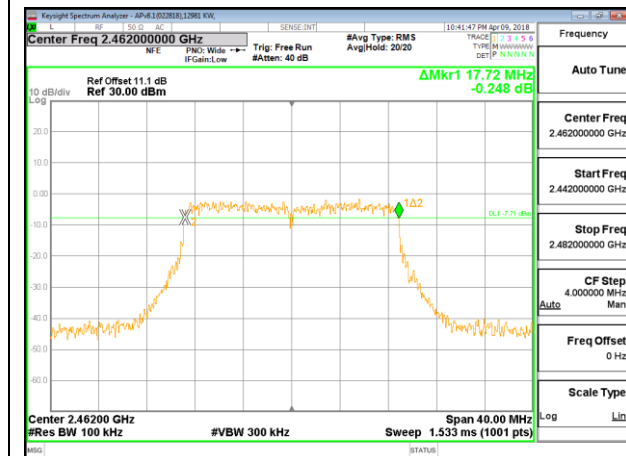
| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---------|-----------|----------------|---------------|
|         | (MHz)     | (MHz)          | (MHz)         |
| Low 1   | 2412      | 17.7600        | 0.5           |
| Mid 6   | 2437      | 17.7600        | 0.5           |
| High 11 | 2462      | 17.7200        | 0.5           |



LOW CHANNEL 1



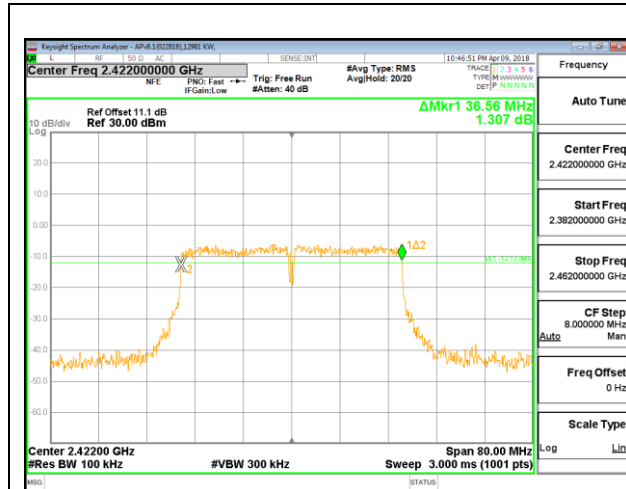
MID CHANNEL 6



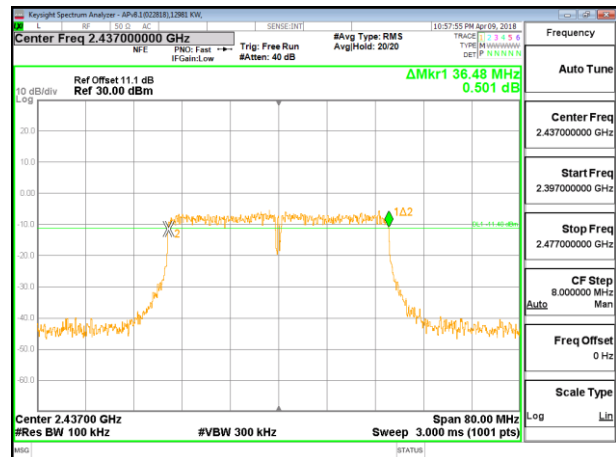
HIGH CHANNEL 11

### 8.3.4. 802.11n HT40 MODE

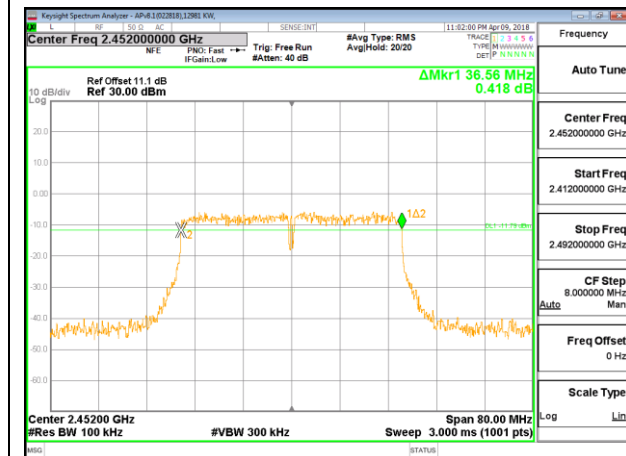
| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|-------------------------|------------------------|
| Low 3   | 2422               | 36.5600                 | 0.5                    |
| Mid 6   | 2437               | 36.4800                 | 0.5                    |
| High 9  | 2452               | 36.5600                 | 0.5                    |



LOW CHANNEL 3



MID CHANNEL 6



HIGH CHANNEL 9

## **8.4. OUTPUT POWER**

### **LIMITS**

FCC §15.247 (b) (3)

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 of 11.1 dB (including 10 dB pad and 1.1 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

### **DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

## **RESULTS**

### **8.4.1. 802.11b MODE**

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

#### **Limits**

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Directional<br/>Gain<br/>(dBi)</b> | <b>FCC<br/>Power<br/>Limit<br/>(dBm)</b> | <b>IC<br/>Power<br/>Limit<br/>(dBm)</b> | <b>IC<br/>EIRP<br/>Limit<br/>(dBm)</b> | <b>Max<br/>Power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------------------|------------------------------------------|-----------------------------------------|----------------------------------------|--------------------------------|
| CH1            | 2412                       | 3.46                                  | 30.00                                    | 30                                      | 36                                     | 30.00                          |
| CH6            | 2437                       | 3.46                                  | 30.00                                    | 30                                      | 36                                     | 30.00                          |
| CH11           | 2462                       | 3.46                                  | 30.00                                    | 30                                      | 36                                     | 30.00                          |

#### **Results**

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Measured<br/>Power<br/>(dBm)</b> | <b>Power<br/>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-------------------------------------|----------------------------------|------------------------|
| CH1            | 2412                       | 19.18                               | 30.00                            | -10.82                 |
| CH6            | 2437                       | 19.33                               | 30.00                            | -10.67                 |
| CH11           | 2462                       | 19.42                               | 30.00                            | -10.58                 |

### 8.4.2. 802.11g MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

#### Limits

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>(dBi) | FCC<br>Power<br>Limit<br>(dBm) | IC<br>Power<br>Limit<br>(dBm) | IC<br>EIRP<br>Limit<br>(dBm) | Max<br>Power<br>(dBm) |
|---------|--------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|-----------------------|
| CH1     | 2412               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH6     | 2437               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH11    | 2462               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |

#### Results

| Channel | Frequency<br>(MHz) | Measured<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|----------------------------|-------------------------|----------------|
| CH1     | 2412               | 23.56                      | 30.00                   | -6.44          |
| CH6     | 2437               | 23.79                      | 30.00                   | -6.21          |
| CH11    | 2462               | 23.81                      | 30.00                   | -6.19          |

### 8.4.3. 802.11n HT20 MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

#### Limits

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>(dBi) | FCC<br>Power<br>Limit<br>(dBm) | IC<br>Power<br>Limit<br>(dBm) | IC<br>EIRP<br>Limit<br>(dBm) | Max<br>Power<br>(dBm) |
|---------|--------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|-----------------------|
| CH1     | 2412               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH6     | 2437               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH11    | 2462               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |

#### Results

| Channel | Frequency<br>(MHz) | Measured<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|----------------------------|-------------------------|----------------|
| CH1     | 2412               | 22.4                       | 30.00                   | -7.60          |
| CH6     | 2437               | 22.5                       | 30.00                   | -7.50          |
| CH11    | 2462               | 22.58                      | 30.00                   | -7.42          |

#### 8.4.4. 802.11n HT40 MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

##### Limits

| Channel | Frequency<br>(MHz) | Directional<br>Gain<br>(dBi) | FCC<br>Power<br>Limit<br>(dBm) | IC<br>Power<br>Limit<br>(dBm) | IC<br>EIRP<br>Limit<br>(dBm) | Max<br>Power<br>(dBm) |
|---------|--------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|-----------------------|
| CH3     | 2422               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH6     | 2437               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |
| CH9     | 2452               | 3.46                         | 30.00                          | 30                            | 36                           | 30.00                 |

##### Results

| Channel | Frequency<br>(MHz) | Measured<br>Power<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Power<br>Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|----------------------------|-----------------------------------|-------------------------|----------------|
| CH3     | 2422               | 22.01                      | 22.01                             | 30.00                   | -7.99          |
| CH6     | 2437               | 22.39                      | 22.39                             | 30.00                   | -7.61          |
| CH9     | 2452               | 22.38                      | 22.38                             | 30.00                   | -7.62          |

## **8.5. AVERAGE POWER**

### **LIMITS**

None; for reporting purposes only

### **TEST PROCEDURE**

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.1 dB (including 10 dB pad and 1.1 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

### **RESULTS**

### 8.5.1. 802.11b MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| CH1     | 2412            | 16.16       |
| CH6     | 2437            | 16.2        |
| CH11    | 2462            | 16.28       |

### 8.5.2. 802.11g MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| CH1     | 2412            | 14.12       |
| CH6     | 2437            | 14.32       |
| CH11    | 2462            | 14.35       |

### 8.5.3. 802.11n HT20 MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| CH1     | 2412            | 12.92       |
| CH6     | 2437            | 13.06       |
| CH11    | 2462            | 13.1        |

### 8.5.4. 802.11n HT40 MODE

|            |       |              |          |
|------------|-------|--------------|----------|
| <b>ID:</b> | 12981 | <b>Date:</b> | 4/9/2018 |
|------------|-------|--------------|----------|

| Channel | Frequency (MHz) | Power (dBm) |
|---------|-----------------|-------------|
| CH3     | 2422            | 11.96       |
| CH6     | 2437            | 12.2        |
| CH9     | 2452            | 12.3        |

## **8.6. POWER SPECTRAL DENSITY**

### **LIMITS**

FCC §15.247 (e)

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.

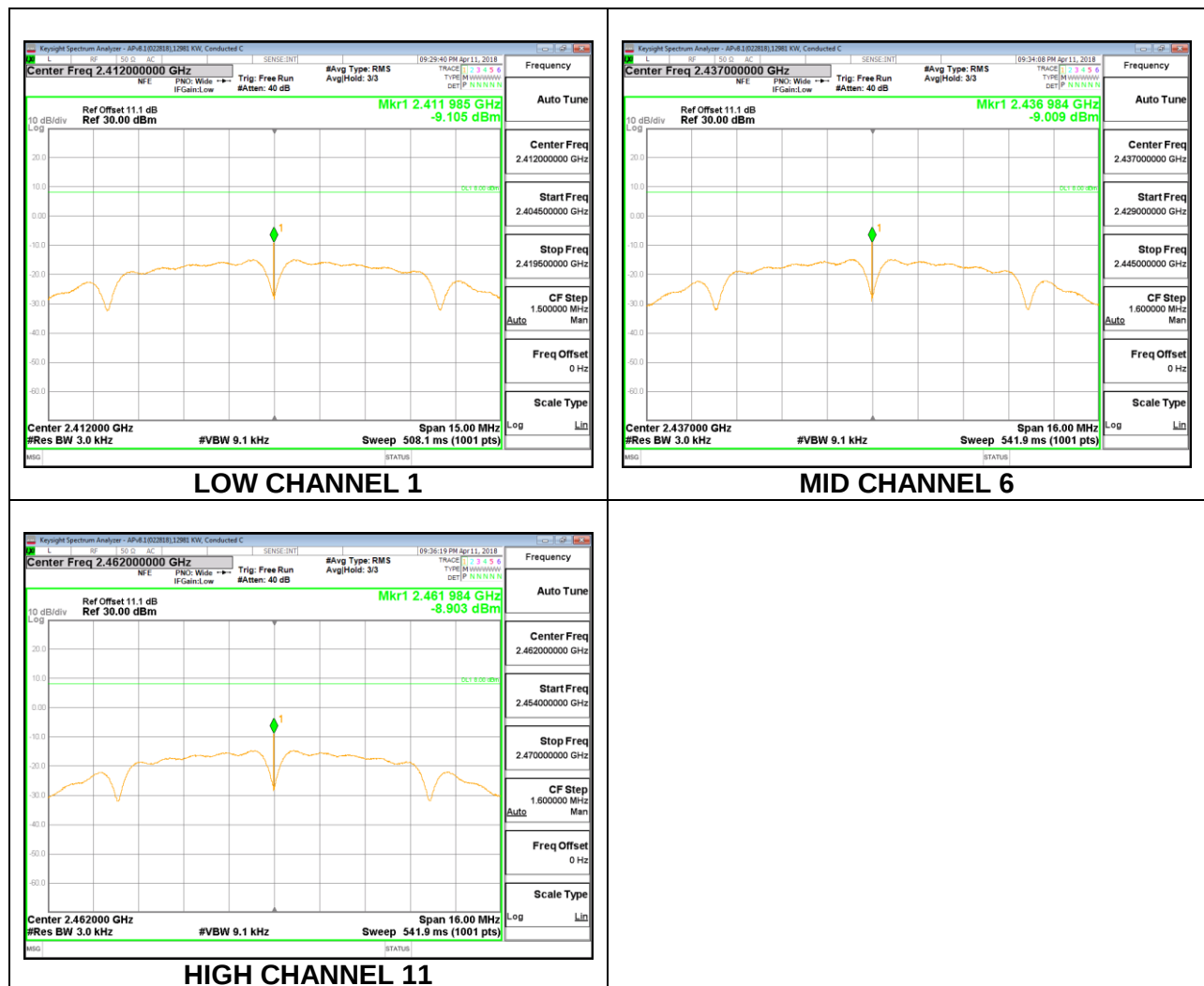
### **RESULTS**

### 8.6.1. 802.11b MODE

|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

#### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>(dBm/<br>3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/<br>3kHz) | Limit<br>(dBm/<br>3kHz) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------|------------------------------------------|-------------------------|----------------|
| Low 1   | 2412               | -9.11                             | -9.11                                    | 8.0                     | -17.1          |
| Mid 6   | 2437               | -9.01                             | -9.01                                    | 8.0                     | -17.0          |
| High 11 | 2462               | -8.90                             | -8.90                                    | 8.0                     | -16.9          |

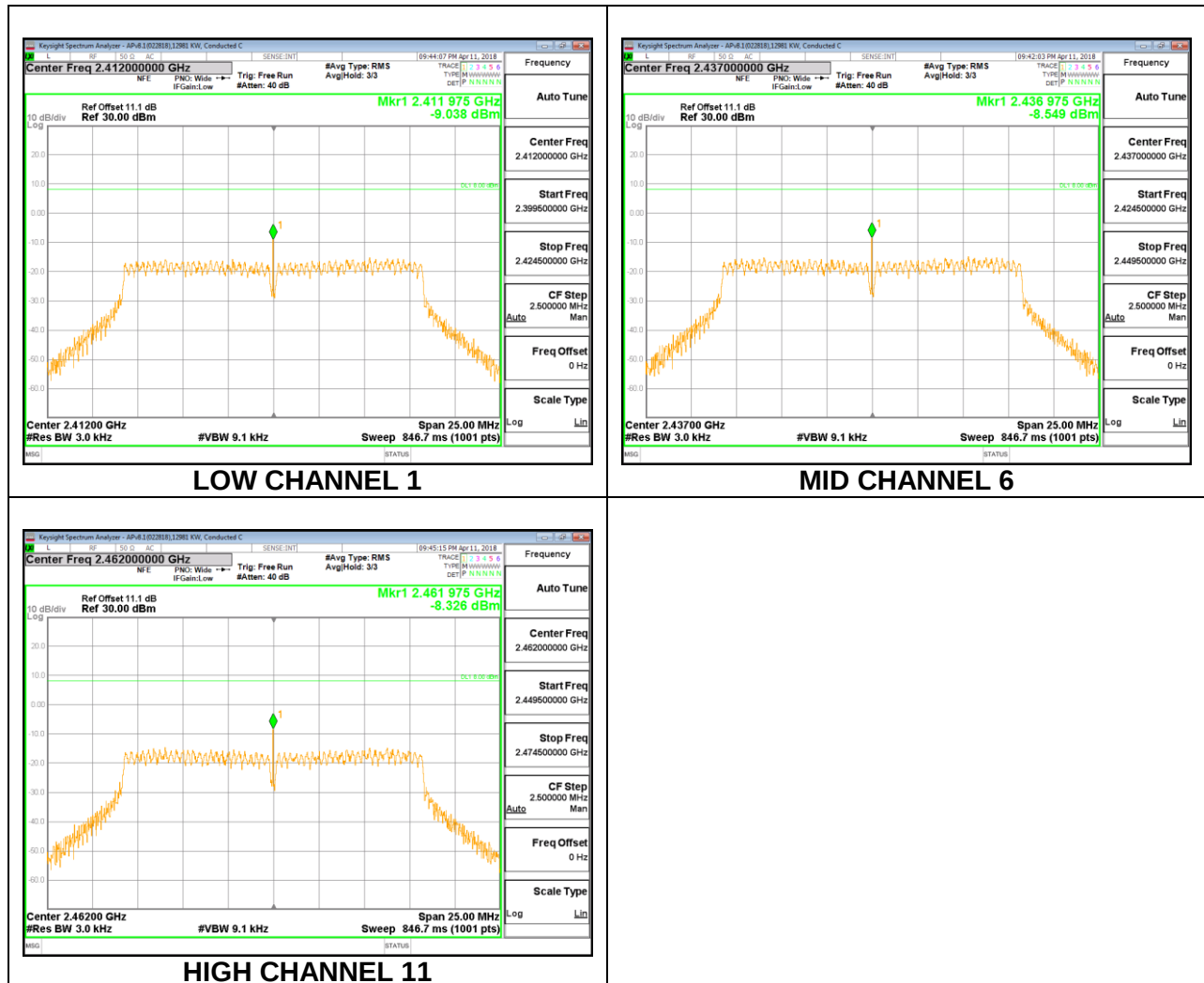


## 8.6.2. 802.11g MODE

|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>(dBm/<br>3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/<br>3kHz) | Limit<br>(dBm/<br>3kHz) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------|------------------------------------------|-------------------------|----------------|
| Low 1   | 2412               | -9.04                             | -9.04                                    | 8.0                     | -17.0          |
| Mid 6   | 2437               | -8.55                             | -8.55                                    | 8.0                     | -16.5          |
| High 11 | 2462               | -8.33                             | -8.33                                    | 8.0                     | -16.3          |

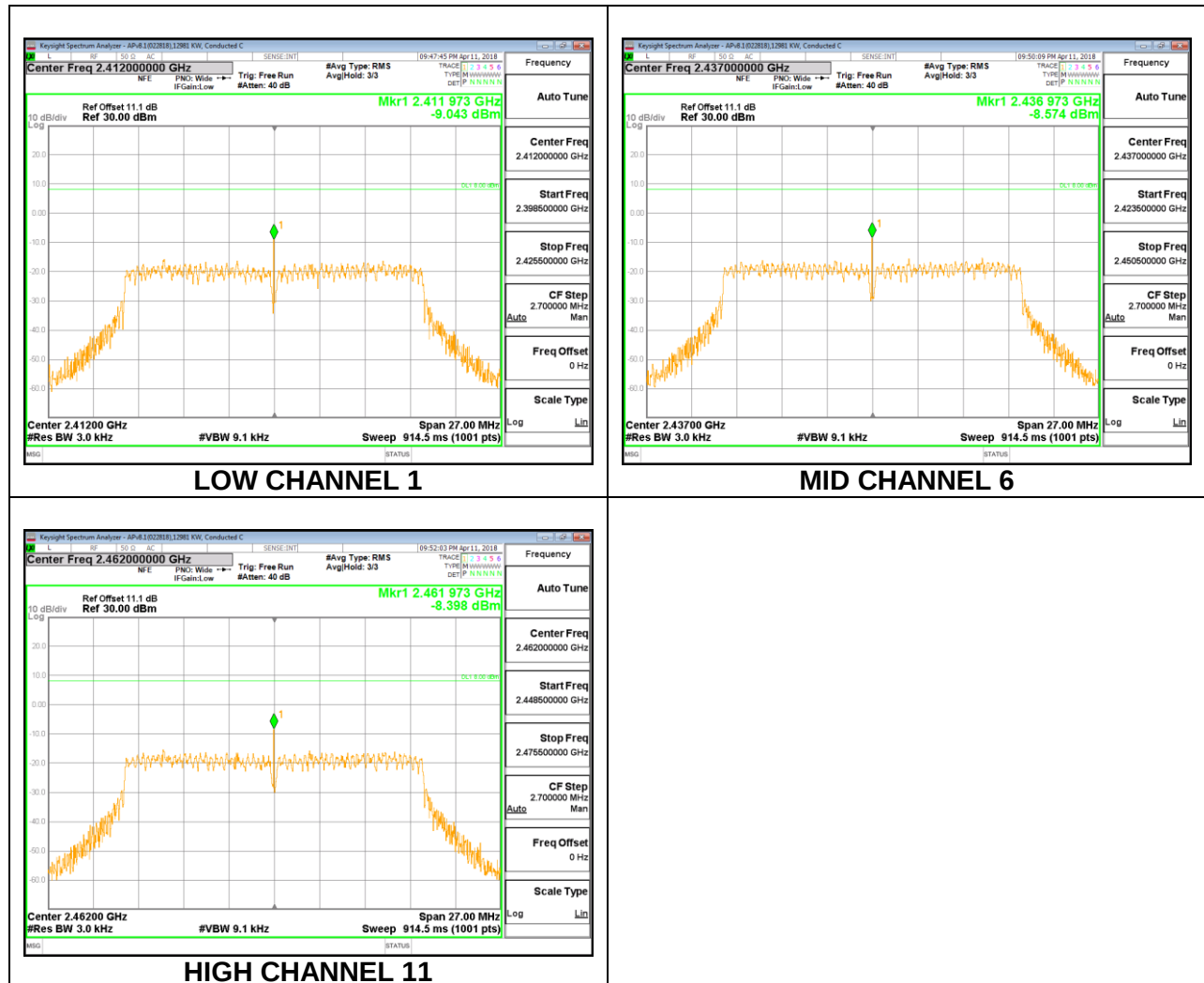


### 8.6.3. 802.11n HT20 MODE

|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

#### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>(dBm/<br>3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/<br>3kHz) | Limit<br>(dBm/<br>3kHz) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------|------------------------------------------|-------------------------|----------------|
| Low 1   | 2412               | -9.04                             | -9.04                                    | 8.0                     | -17.0          |
| Mid 6   | 2437               | -8.57                             | -8.57                                    | 8.0                     | -16.6          |
| High 11 | 2462               | -8.40                             | -8.40                                    | 8.0                     | -16.4          |

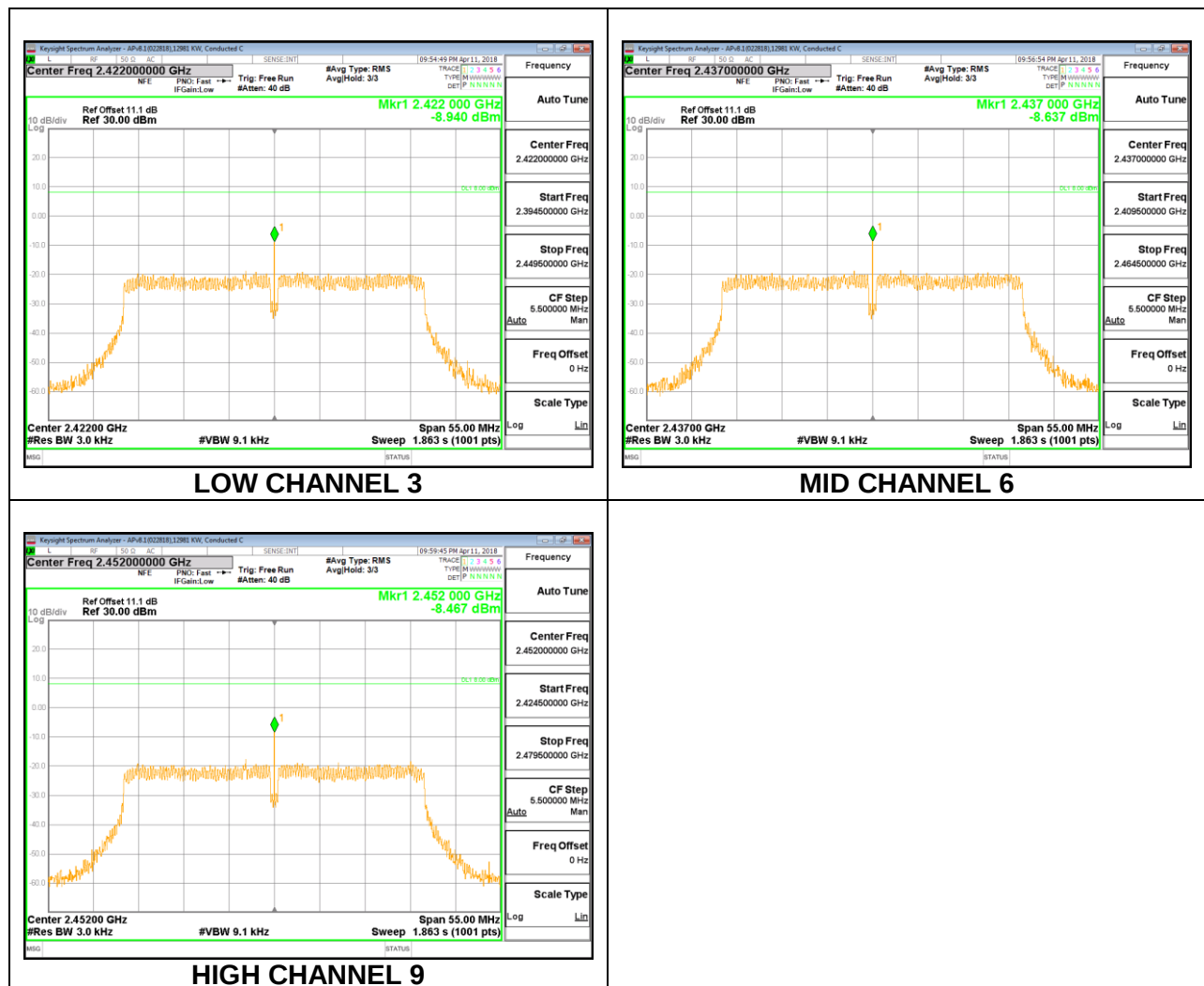


### 8.6.4. 802.11n HT40 MODE

|                    |      |                                        |
|--------------------|------|----------------------------------------|
| Duty Cycle CF (dB) | 0.00 | Included in Calculations of Corr'd PSD |
|--------------------|------|----------------------------------------|

#### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>(dBm/<br>3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/<br>3kHz) | Limit<br>(dBm/<br>3kHz) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------|------------------------------------------|-------------------------|----------------|
| Low 3   | 2422               | -8.94                             | -8.94                                    | 8.0                     | -16.9          |
| Mid 6   | 2437               | -8.64                             | -8.64                                    | 8.0                     | -16.6          |
| High 9  | 2452               | -8.47                             | -8.47                                    | 8.0                     | -16.5          |



## **8.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

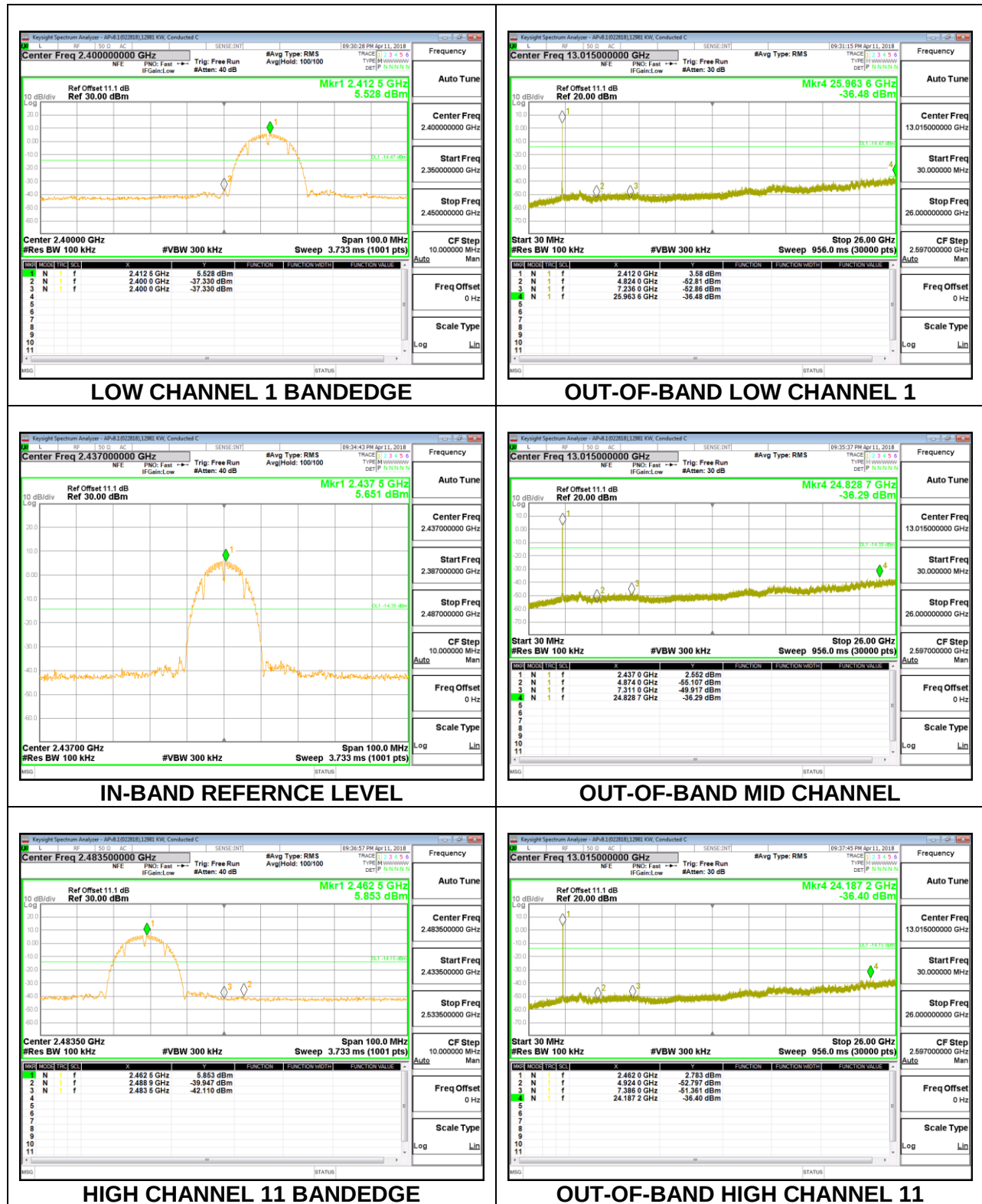
FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

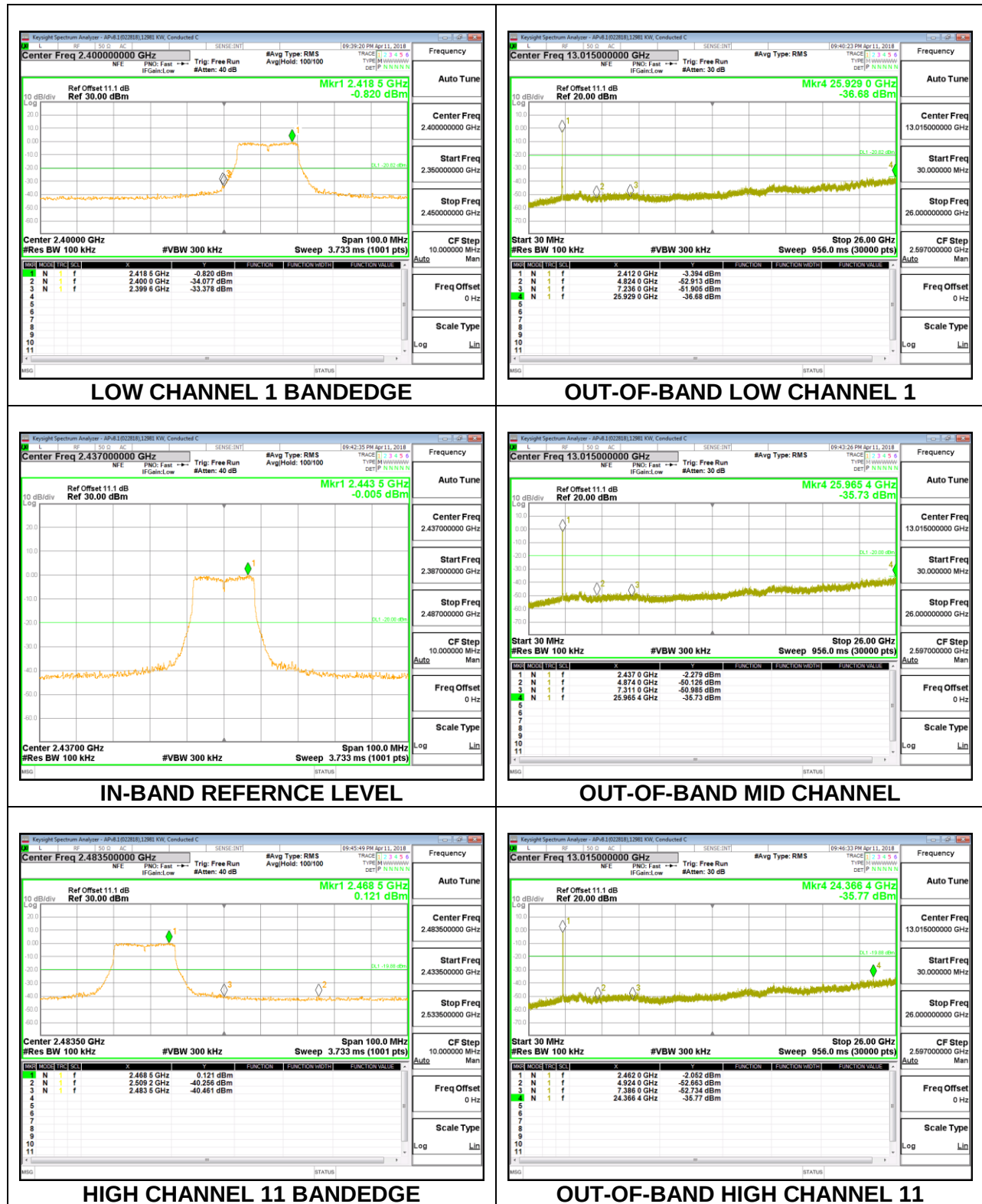
### **RESULTS**

Output power was measured based on the use of peak measurement, therefore the required attenuation is 20 dB.

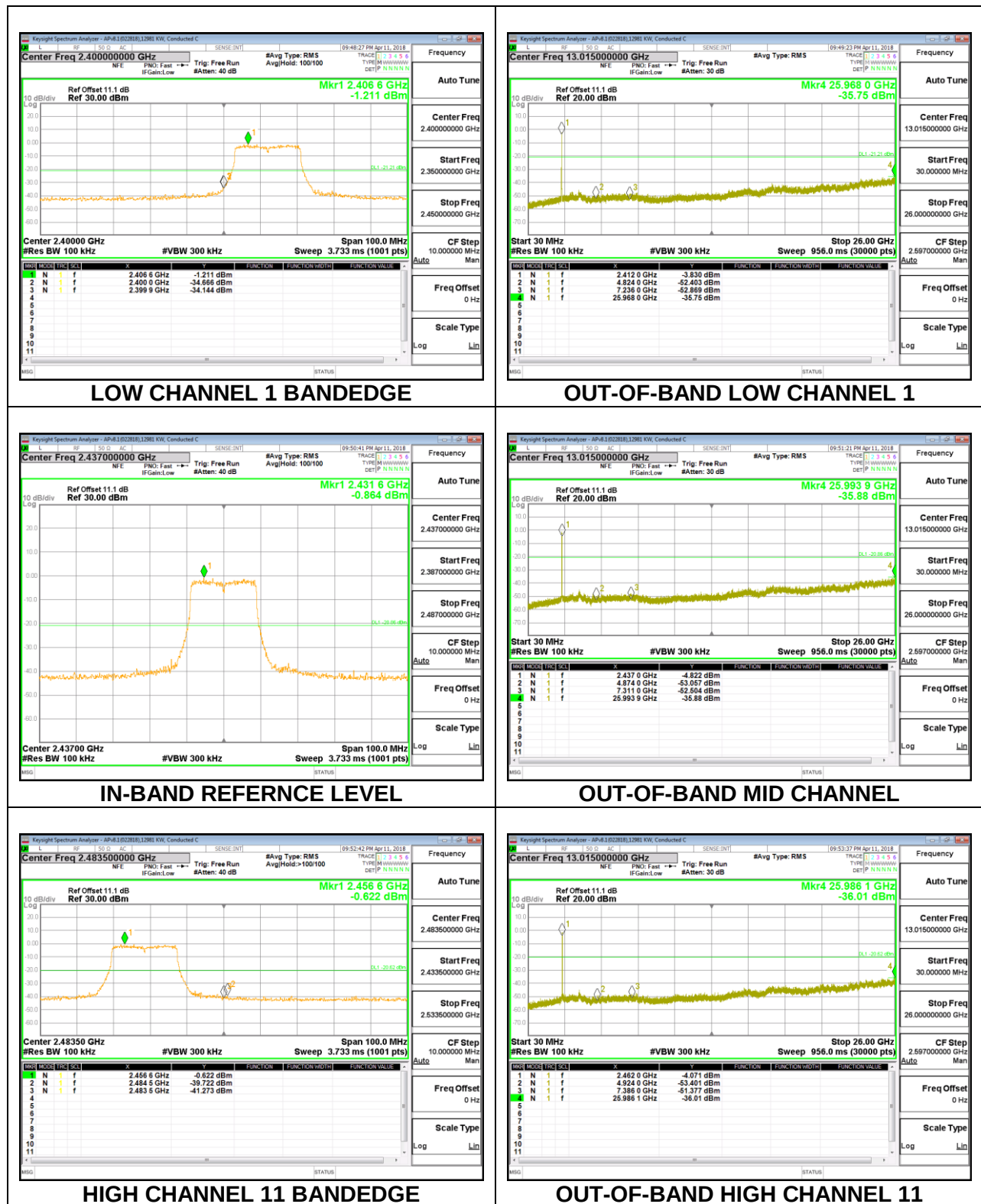
# 8.7.1. 802.11b MODE



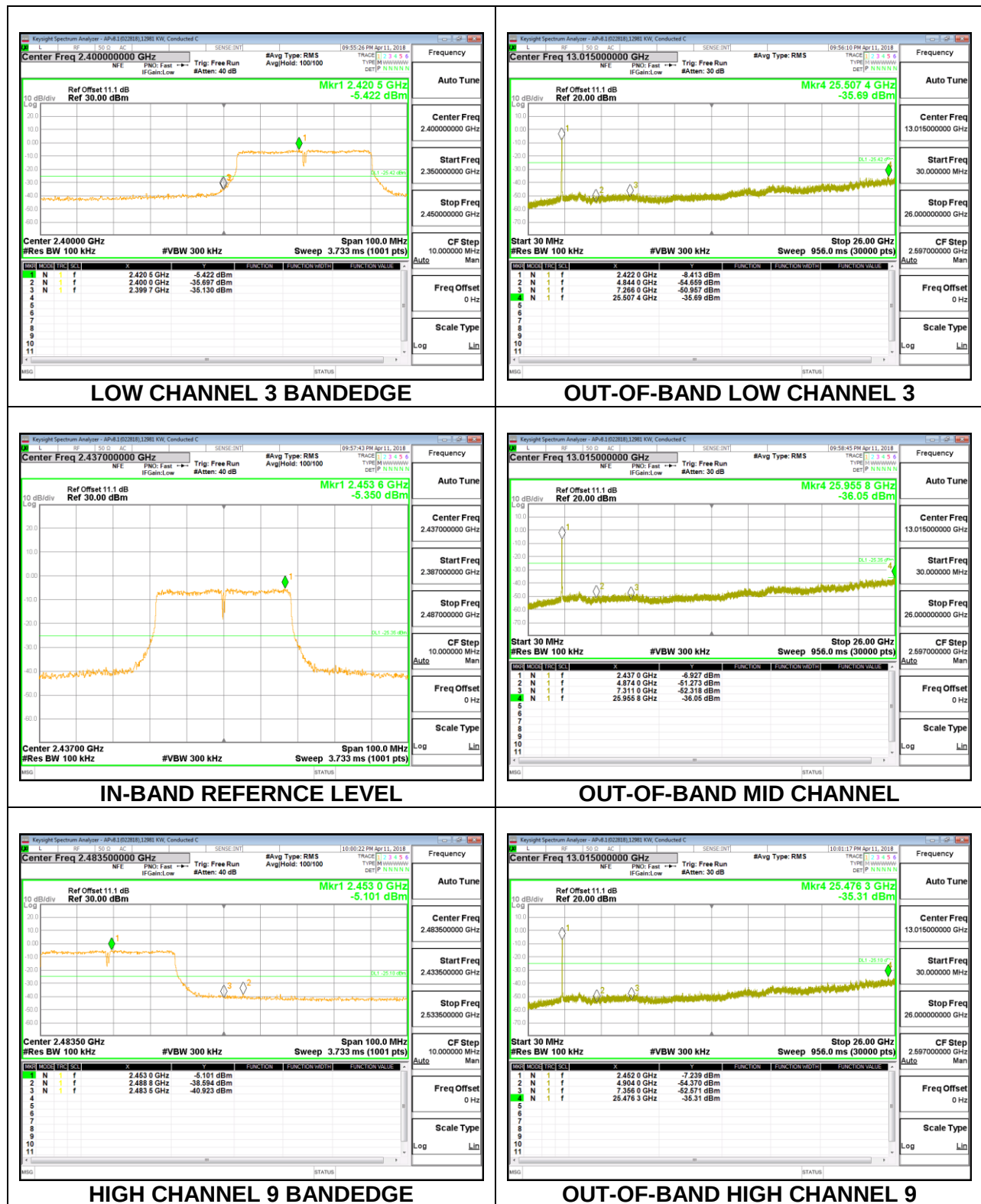
## 8.7.2. 802.11g MODE



### 8.7.3. 802.11n HT20 MODE



## 8.7.4. 802.11n HT40 MODE



## 9. RADIATED TEST RESULTS

### 9.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 0.009-0.490           | 2400/F(kHz) @ 300m                 | 2400/F(kHz) @ 300m                   |
| 0.490-1.705           | 24000/F(kHz) @ 30m                 | 24000/F(kHz) @ 30m                   |
| 1.705-30.0            | 30 @ 30m                           | 30 @ 30m                             |
| 30 - 88               | 100                                | 40                                   |
| 88 - 216              | 150                                | 43.5                                 |
| 216 - 960             | 200                                | 46                                   |
| Above 960             | 500                                | 54                                   |

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

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

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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**KDB 414788 OATS and Chamber Correlation Justification**

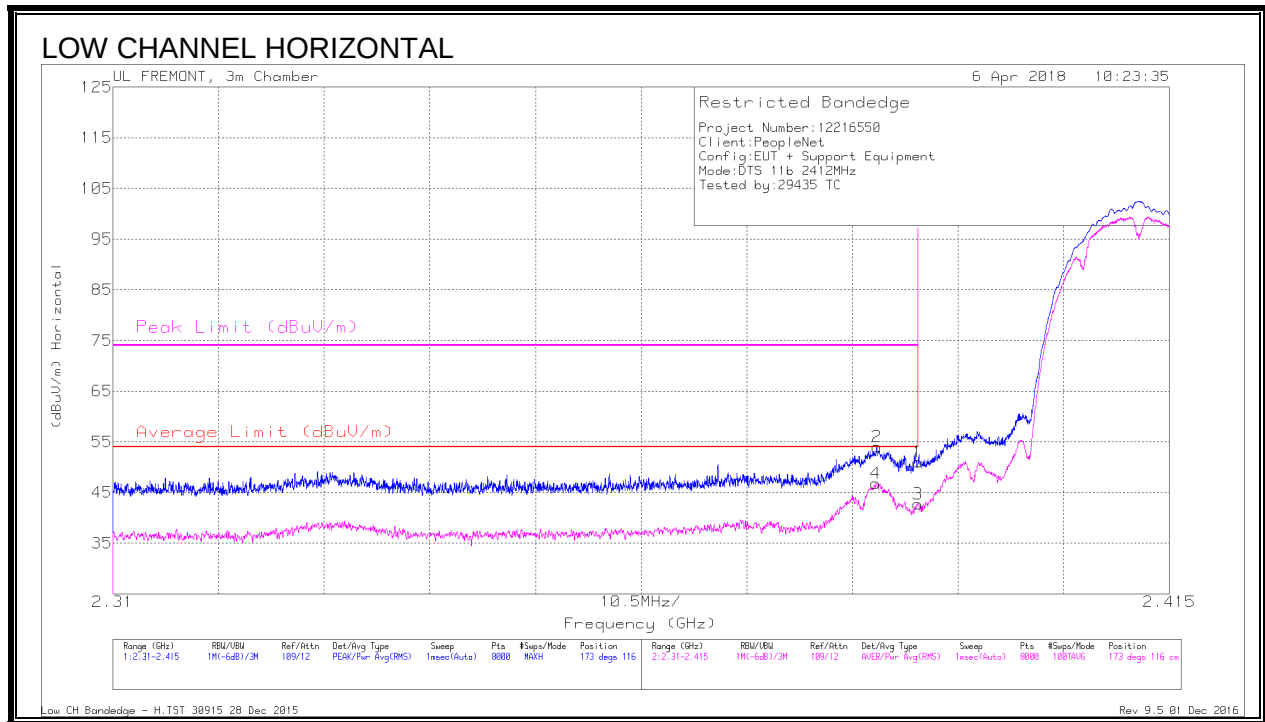
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

## 9.2. TRANSMITTER ABOVE 1 GHz

### 9.2.1. 802.11b MODE IN THE 2.4 GHz BAND

#### AUTHORIZED BANDEGE (LOW CHANNEL, CH 1)

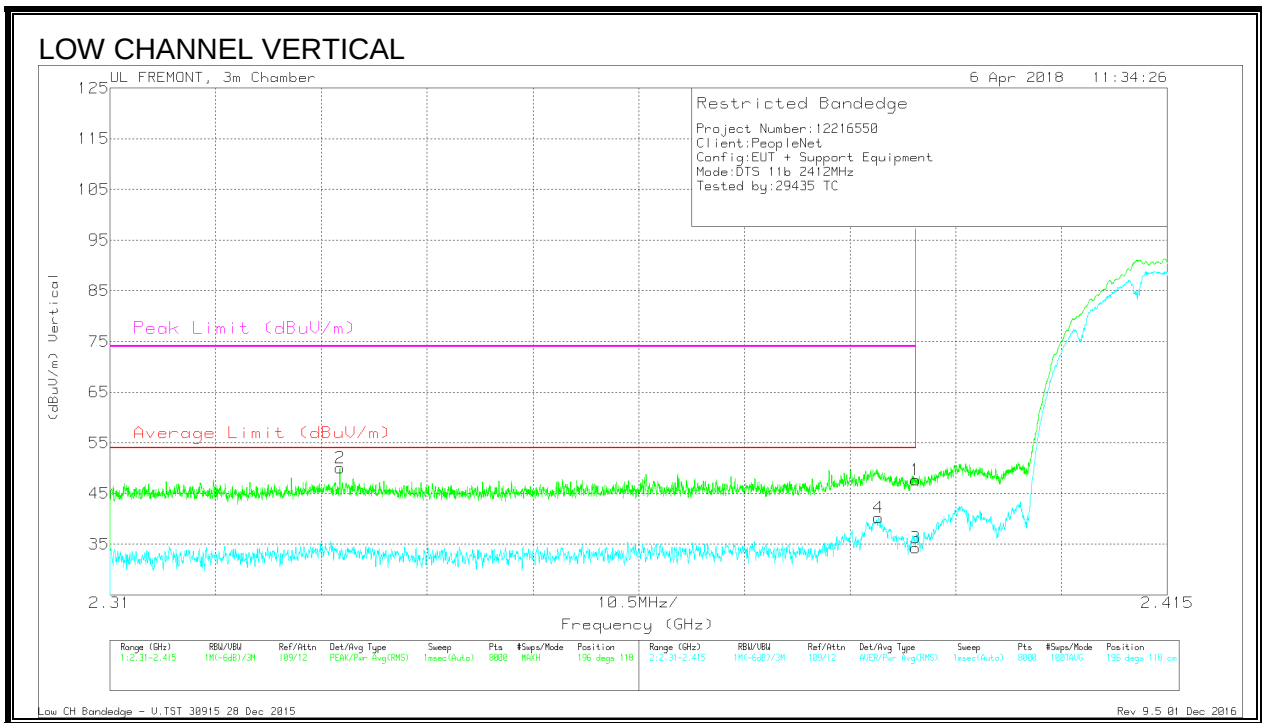


#### DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T120 (dB/m) | Amp/Cbl/Filtr/P ad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|-------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 2      | 2.386           | 43.33                | Pk  | 31.9           | -21.2                   | 54.03                      | -                      | -           | 74                  | -19.97         | 173            | 116         | H        |
| 4      | 2.386           | 36.17                | RMS | 31.9           | -21.2                   | 46.87                      | 54                     | -7.13       | -                   | -              | 173            | 116         | H        |
| 1      | 2.39            | 40.49                | Pk  | 31.9           | -21.4                   | 50.99                      | -                      | -           | 74                  | -23.01         | 173            | 116         | H        |
| 3      | 2.39            | 32.19                | RMS | 31.9           | -21.4                   | 42.69                      | 54                     | -11.31      | -                   | -              | 173            | 116         | H        |

Pk - Peak detector

RMS - RMS detection

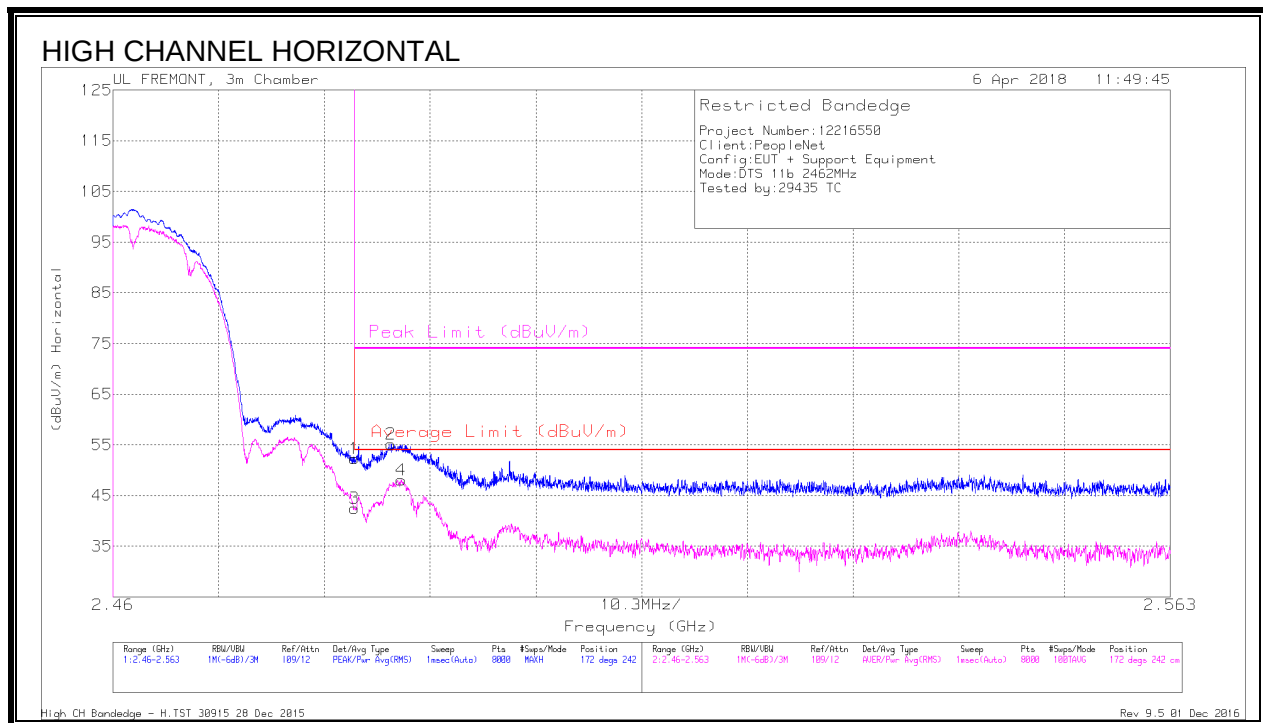


## DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T120 (dB/m) | Amp/CbI/Filtr/P ad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|-------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 2      | 2.333           | 39.59                | Pk  | 31.7           | -21.2                   | 50.09                      | -                      | -           | 74                  | -23.91         | 196            | 118         | V        |
| 4      | 2.386           | 29.49                | RMS | 31.9           | -21.2                   | 40.19                      | 54                     | -13.81      | -                   | -              | 196            | 118         | V        |
| 1      | 2.39            | 37.19                | Pk  | 31.9           | -21.4                   | 47.69                      | -                      | -           | 74                  | -26.31         | 196            | 118         | V        |
| 3      | 2.39            | 23.82                | RMS | 31.9           | -21.4                   | 34.32                      | 54                     | -19.68      | -                   | -              | 196            | 118         | V        |

Pk - Peak detector  
RMS - RMS detection

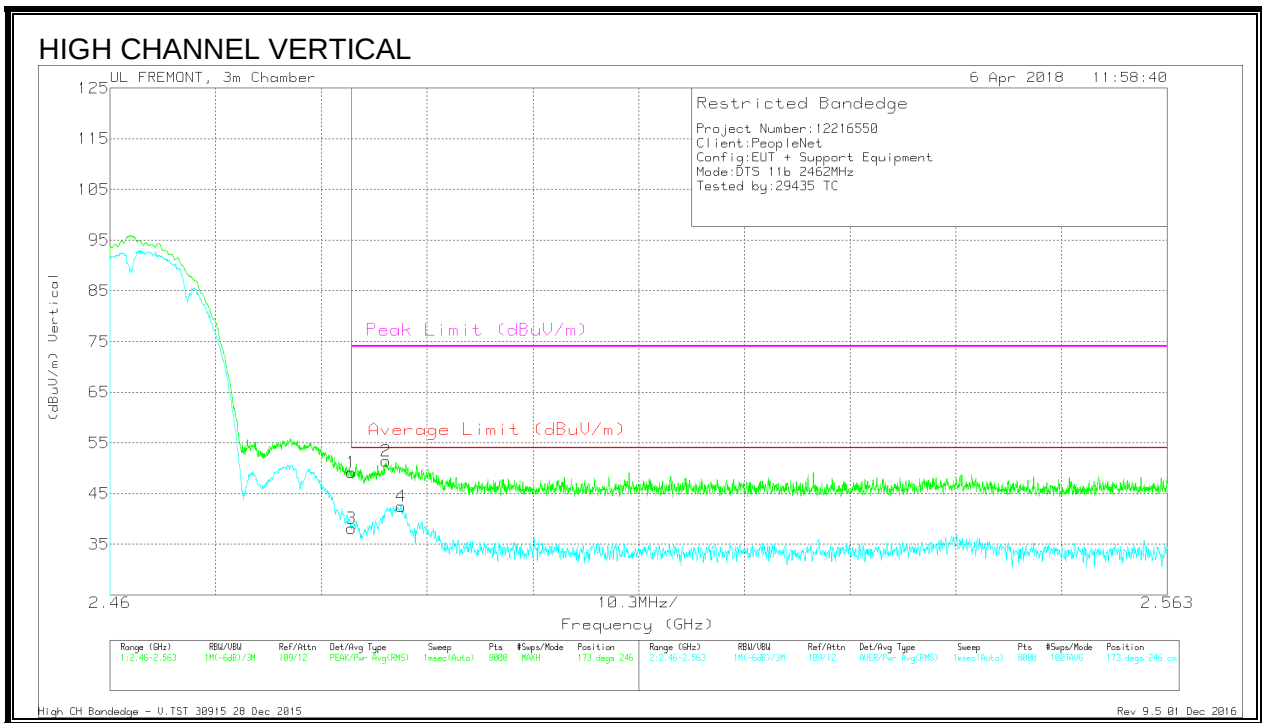
**AUTHORIZED BANDEGE (HIGH CHANNEL, CH 11)**



**DATA**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T120 (dB/m) | Amp/Cbl/Filtr/P ad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|-------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | 2.484           | 41.86                | Pk  | 32.2           | -21.8                   | 52.26                      | -                      | -           | 74                  | -21.74         | 172            | 242         | H        |
| 3      | 2.484           | 32.02                | RMS | 32.2           | -21.8                   | 42.42                      | 54                     | -11.58      | -                   | -              | 172            | 242         | H        |
| 2      | 2.487           | 44.7                 | Pk  | 32.2           | -21.8                   | 55.1                       | -                      | -           | 74                  | -18.9          | 172            | 242         | H        |
| 4      | 2.488           | 37.64                | RMS | 32.2           | -21.8                   | 48.04                      | 54                     | -5.96       | -                   | -              | 172            | 242         | H        |

Pk - Peak detector  
RMS - RMS detection

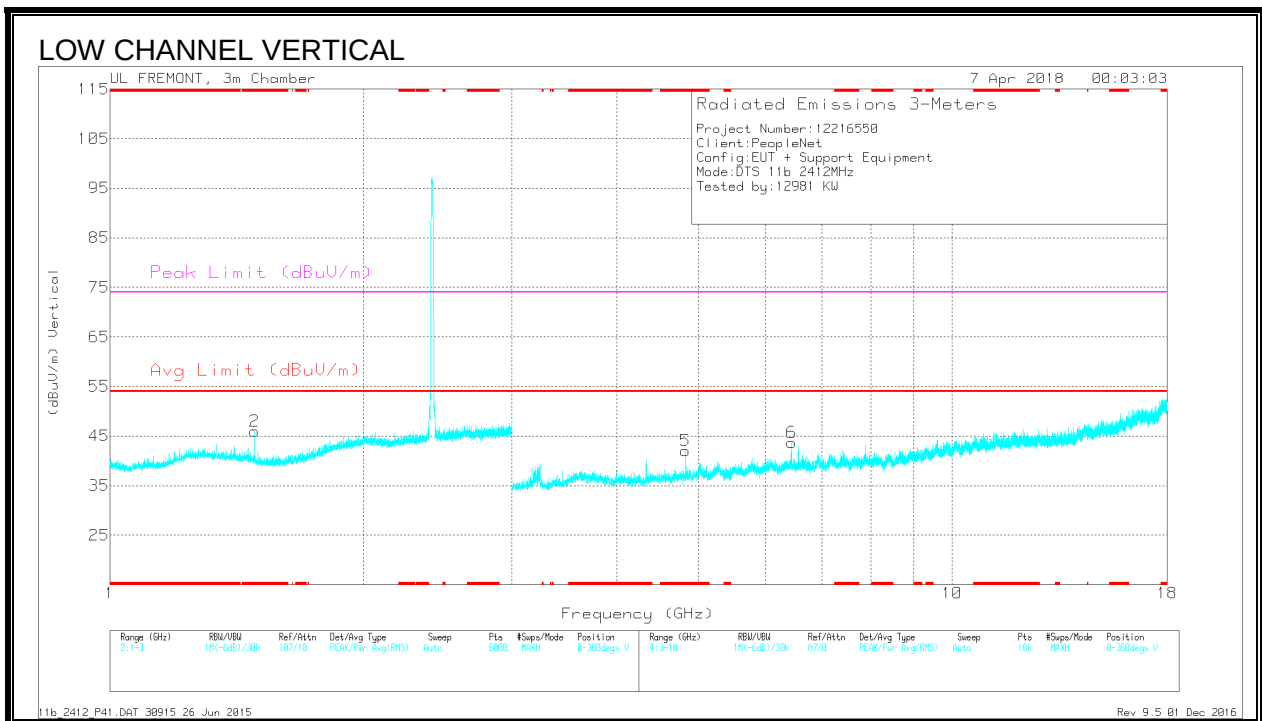
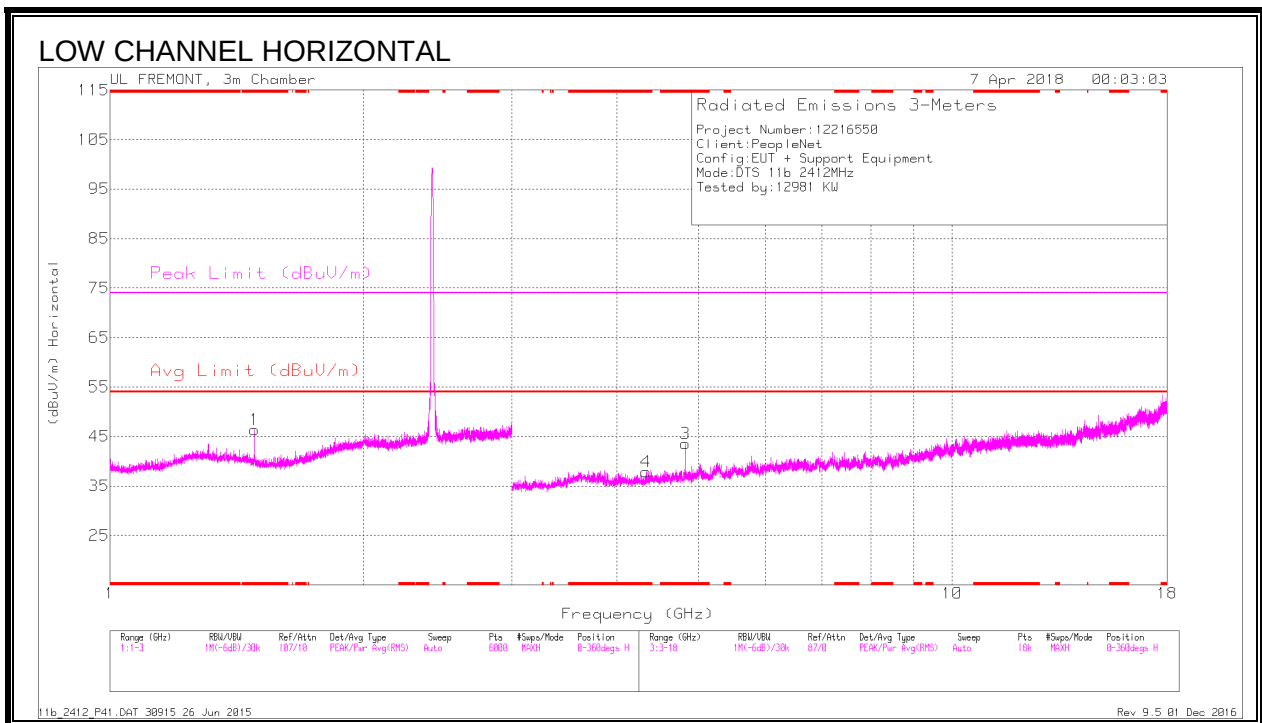


## DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T120 (dB/m) | Amp/Cbl/Fitr/P ad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | 2.484           | 38.78                | Pk  | 32.2           | -21.8                  | 49.18                      | -                      | -           | 74                  | -24.82         | 173            | 246         | V        |
| 3      | 2.484           | 27.72                | RMS | 32.2           | -21.8                  | 38.12                      | 54                     | -15.88      | -                   | -              | 173            | 246         | V        |
| 2      | 2.487           | 41                   | Pk  | 32.2           | -21.8                  | 51.4                       | -                      | -           | 74                  | -22.6          | 173            | 246         | V        |
| 4      | 2.488           | 32.07                | RMS | 32.2           | -21.8                  | 42.47                      | 54                     | -11.53      | -                   | -              | 173            | 246         | V        |

Pk - Peak detector  
RMS - RMS detection

**HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL, CH 1)**



**DATA**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T120 (dB/m) | Amp/Cbl/Fitr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|-----------------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 1.485         | 46.51                | PK2  | 28.4           | -21.6                 | 53.31                      | -                  | -           | 74                  | -20.69         | 175            | 340         | H        |
|        | * 1.485         | 39.74                | MAv1 | 28.4           | -21.6                 | 46.54                      | 54                 | -7.46       | -                   | -              | 175            | 340         | H        |
| 2      | * 1.485         | 45.34                | PK2  | 28.4           | -21.6                 | 52.14                      | -                  | -           | 74                  | -21.86         | 3              | 230         | V        |
|        | * 1.485         | 37.69                | MAv1 | 28.4           | -21.6                 | 44.49                      | 54                 | -9.51       | -                   | -              | 3              | 230         | V        |
| 3      | * 4.329         | 38.42                | PK2  | 33.6           | -28                   | 44.02                      | -                  | -           | 74                  | -29.98         | 66             | 131         | H        |
|        | * 4.33          | 27.32                | MAv1 | 33.6           | -28                   | 32.92                      | 54                 | -21.08      | -                   | -              | 66             | 131         | H        |
| 4      | * 4.824         | 38.12                | PK2  | 34.1           | -26.6                 | 45.62                      | -                  | -           | 74                  | -28.38         | 24             | 202         | H        |
|        | * 4.824         | 26.44                | MAv1 | 34.1           | -26.6                 | 33.94                      | 54                 | -20.06      | -                   | -              | 24             | 202         | H        |
| 5      | * 4.824         | 37.99                | PK2  | 34.1           | -26.6                 | 45.49                      | -                  | -           | 74                  | -28.51         | 131            | 138         | V        |
|        | * 4.824         | 26.89                | MAv1 | 34.1           | -26.6                 | 34.39                      | 54                 | -19.61      | -                   | -              | 131            | 138         | V        |
| 6      | 6.445           | 34.05                | Pk   | 35.7           | -26.1                 | 43.65                      | -                  | -           | -                   | -              | 0-360          | 200         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average