TESTING LABORATOTAY
CERTIFICATE # 4821.01

# FCC PART 15.247

# TEST REPORT

For

## SY Electronic Technical Co., Ltd.

4th Floor, 2 BLDG. East, Minqi Technology Park Pingshan 1st RD., Nanshan Shenzhen China

**FCC ID: 2AO3B-HS100W01**
**Model: HS100W**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | DefendX Wireless Indoor/Outdoor Camera |

**Report Number:** RSZ180123001-00B

**Report Date:** 2018-03-30

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

The *SY Electronic Technical Co., Ltd.'s* product, model number: HS100W *(FCC ID: 2AO3B-HS100W01)* or the "EUT" in this report was a *DefendX Wireless Indoor/Outdoor Camera,* which was measured approximately: 10.6cm (L) × 8.8 cm (W) × 5.5cm (H), rated with input voltage: DC 3.7V*2 battery or DC 12V from Adapter .The highest operating frequency is 2480MHz.

Adapter Infornation:
Model: KT241120200H
Input: 100-240V~50/60Hz, 0.8A
Output: 12V, 2A.

**All measurement and test data in this report was gathered from production sample serial number: 1800083. (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2018-01-23.*

## Objective

This report is prepared on behalf of *SY Electronic Technical Co., Ltd.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

## Related Submittal(s)/Grant(s)

FCC Part 15B JBP submissions with FCC ID: 2AO3B-HS100W01.

## Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And 558074 D01 DTS Meas Guidance v04.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

| Parameter | | Uncertainty |
|---|---|---|
| Occupied Channel Bandwidth | | ±5% |
| RF Output Power with Power meter | | ±0.5dB |
| RF conducted test with spectrum | | ±1.5dB |
| AC Power Lines Conducted Emissions | | ±1.95dB |
| Emissions, Radiated | Below 1GHz | ±4.75dB |
| | Above 1GHz | ±4.88dB |
| Temperature | | ±3℃ |
| Humidity | | ±6% |
| Supply voltages | | ±0.4% |

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 382179, the FCC Designation No. : CN5001.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

# SYSTEM TEST CONFIGURATION

## Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 11 channels are provided to testing:

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

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11

For 802.11n-HT40 mode, 7 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 1 | 2422 | 5 | 2442 |
| 2 | 2427 | 6 | 2447 |
| 3 | 2432 | 7 | 2452 |
| 4 | 2437 | / | / |

EUT was tested with Channel 1, 4 and 7.

For BLE mode, 40 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 0 | 2402 | 20 | 2442 |
| 1 | 2404 | 21 | 2444 |
| 2 | 2406 | 22 | 2446 |
| 3 | 2408 | 23 | 2448 |
| 4 | 2410 | 24 | 2450 |
| 5 | 2412 | 25 | 2452 |
| 6 | 2414 | 26 | 2454 |
| 7 | 2416 | 27 | 2456 |
| 8 | 2418 | 28 | 2458 |
| 9 | 2420 | 29 | 2460 |
| 10 | 2422 | 30 | 2462 |
| 11 | 2424 | 31 | 2464 |
| 12 | 2426 | 32 | 2466 |
| 13 | 2428 | 33 | 2468 |
| 14 | 2430 | 34 | 2470 |
| 15 | 2432 | 35 | 2472 |
| 16 | 2434 | 36 | 2474 |
| 17 | 2436 | 37 | 2476 |
| 18 | 2438 | 38 | 2478 |
| 19 | 2440 | 39 | 2480 |

EUT was tested with Channel 0, 19 and 39.

## Equipment Modifications

No modification was made to the EUT tested.

## EUT Exercise Software

Software of "BeeMPTool RF Lab" was used to test BLE mode. And Software of "QCOM V1.6" was used to test Wi-Fi mode.

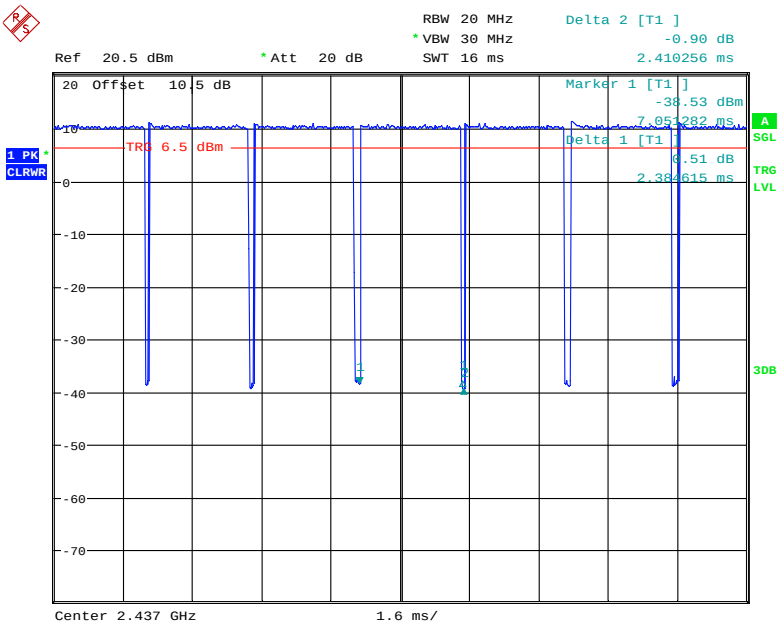
The device was tested with the worst case was performed as below:

| Mode | Data rate | Power level | | |
|---|---|---|---|---|
| | | Low channel | Middle channel | High channel |
| 802.11b | 1 Mbps | Default | Default | Default |
| 802.11g | 6 Mbps | Default | Default | Default |
| 802.11n-HT20 | MCS0 | Default | Default | Default |
| 802.11n-HT40 | MCS0 | Default | Default | Default |
| BLE | / | Default | Default | Default |

Pre-scan with all the data rates, the above data rate is the worst case for Wi-Fi test.

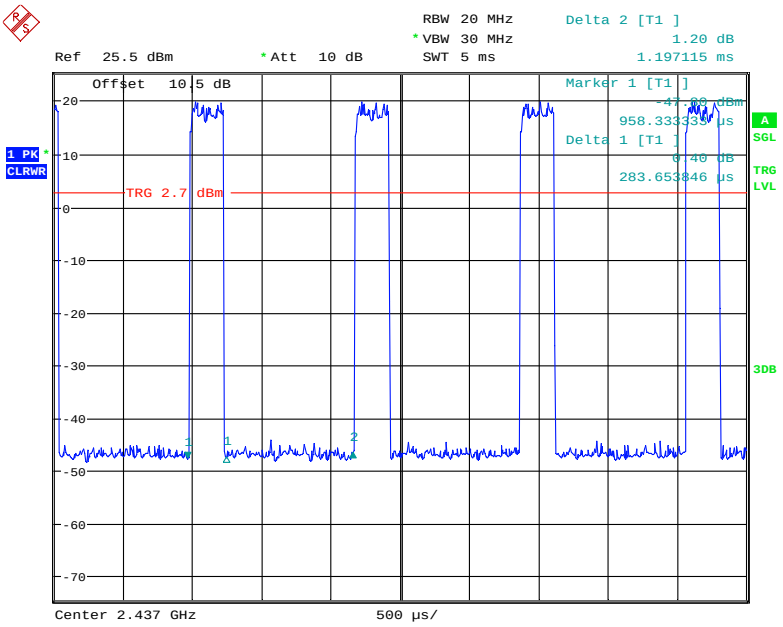
## Duty cycle

### 802.11b mode



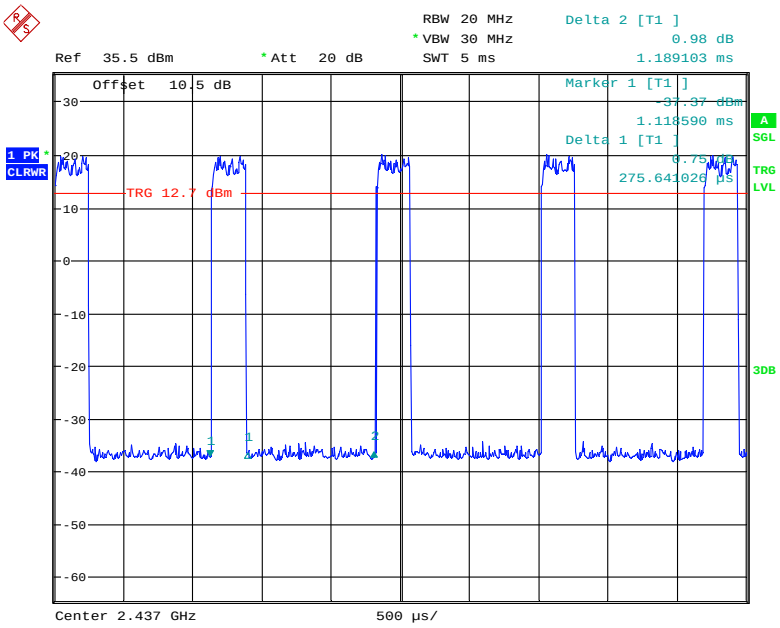

Date: 16.MAR.2018 19:36:29

### 802.11g mode



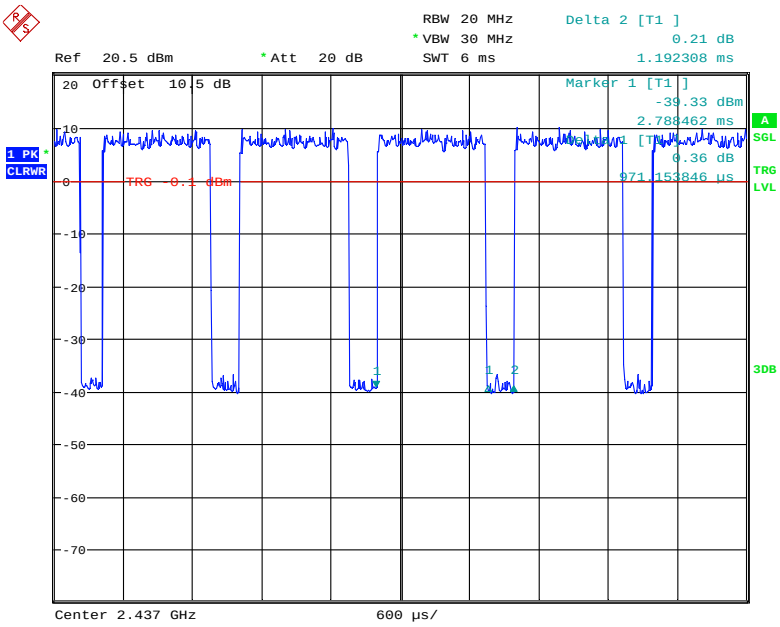

Date: 6.FEB.2018 11:09:00

## 802.11n-HT20 Mode



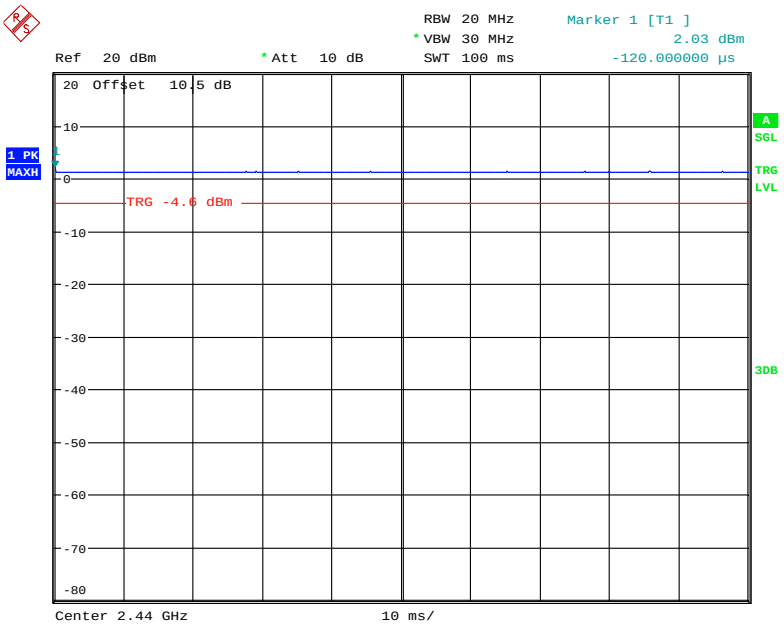

Date: 6.FEB.2018 11:23:30

## 802.11n-HT40 Mode




Date: 16.MAR.2018 19:34:38

## BLE Mode




Date: 1.FEB.2018 19:38:38

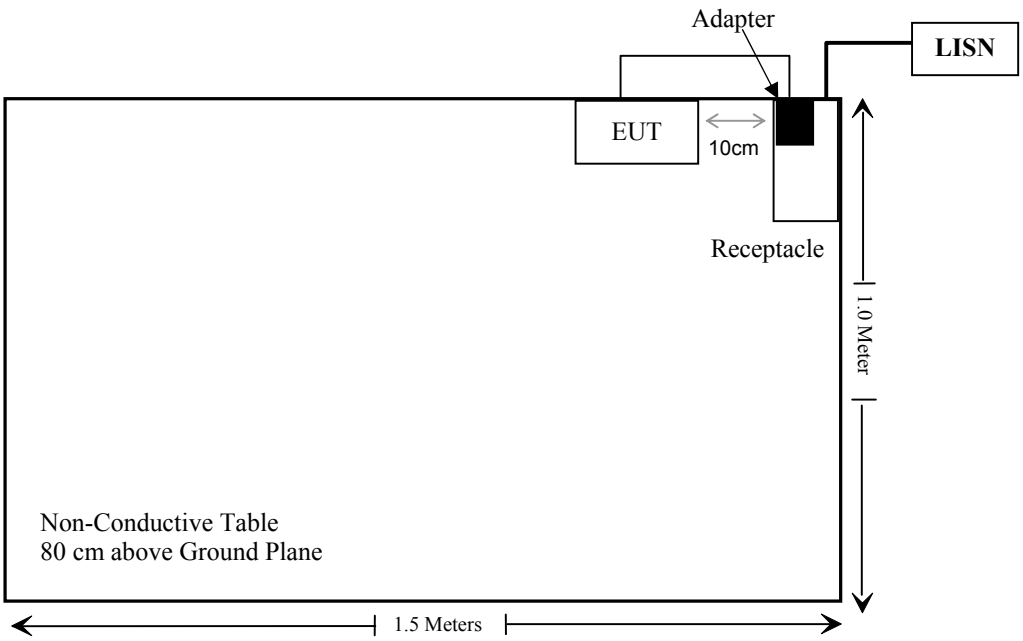
| Band | Duty Cycle (%) | T(ms) | 1/T(kHz) | VBW Setting | 10log(1/ Duty Cycle) |
|---|---|---|---|---|---|
| **802.11b** | 98.96 | 2.385 | - | 10Hz | 0.05 |
| **802.11g** | 23.73 | 0.284 | 3.52 | 10kHz | 6.25 |
| **802.11n-HT20** | 23.21 | 0.276 | 3.62 | 10kHz | 6.34 |
| **802.11n-HT40** | 81.46 | 0.971 | 1.03 | 3kHz | 0.89 |
| **BLE** | 100 | - | - | 10Hz | 0 |

## External I/O Cable

| Cable Description | Length (m) | From Port | To |
|---|---|---|---|
| Un-Shielding Un-Detachable DC Power Cable with Magnet Ring | 1.7 | EUT | Adapter |

## Block Diagram of Test Setup

For conducted emission



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.247 (i), §2.1091 | Maximum Permissible Exposure(MPE) | Compliance |
| §15.203 | Antenna Requirement | Compliance |
| §15.207 (a) | AC Line Conducted Emissions | Compliance |
| §15.205, §15.209, §15.247(d) | Spurious Emissions | Compliance |
| §15.247 (a)(2) | 6 dB Emission Bandwidth | Compliance |
| §15.247(b)(3) | Maximum Conducted Output Power | Compliance |
| §15.247(d) | 100 kHz Bandwidth of Frequency Band Edge | Compliance |
| §15.247(e) | Power Spectral Density | Compliance |

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **Conducted Emissions Test** | | | | | |
| Rohde & Schwarz | EMI Test Receiver | ESCS30 | 100176 | 2017-08-04 | 2018-08-04 |
| Rohde & Schwarz | LISN | ENV216 | 3560.6650.12-101613-Yb | 2017-12-21 | 2018-12-21 |
| Rohde & Schwarz | Transient Limiter | ESH3Z2 | DE25985 | 2017-11-29 | 2018-05-21 |
| Rohde & Schwarz | CE Test software | EMC 32 | V8.53.0 | NCR | NCR |
| N/A | Conducted Emission Cable | N/A | UF A210B-1-0720-504504 | 2017-11-12 | 2018-05-12 |
| **Radiated Emission Test** | | | | | |
| A.H.System | Horn Antenna | SAS-200/571 | 135 | 2015-08-18 | 2018-08-17 |
| Rohde & Schwarz | Signal Analyzer | FSEM | 845987/005 | 2017-04-24 | 2018-04-24 |
| Mini | Pre-amplifier | ZVA-183-S+ | 5969001149 | 2017-05-21 | 2018-05-21 |
| HP | Amplifier | HP8447E | 1937A01046 | 2017-11-19 | 2018-05-21 |
| Sunol Sciences | Broadband Antenna | JB1 | A040904-2 | 2017-12-17 | 2020-12-16 |
| Rohde & Schwarz | EMI Test Receiver | ESCI | 101120 | 2018-01-11 | 2019-01-11 |
| Ducommun technologies | RF Cable | UFA210A-1-4724-30050U | MFR64369 223410-001 | 2017-11-19 | 2018-05-21 |
| Ducommun technologies | RF Cable | 104PEA | 218124002 | 2017-11-19 | 2018-05-21 |
| Ducommun technologies | RF Cable | RG-214 | 1 | 2017-11-19 | 2018-05-21 |
| Ducommun technologies | RF Cable | RG-214 | 2 | 2017-11-22 | 2018-05-22 |
| Ducommun Technologies | Horn Antenna | ARH-4223-02 | 1007726-04 | 2017-12-29 | 2020-12-28 |
| Ducommun Technologies | Pre-amplifier | ALN-22093530-01 | 991373-01 | 2017-08-03 | 2018-08-03 |
| Sinoscite | Band Reject Filter | BSF2402-2480MN-0898-001 | N/A | 2017-05-21 | 2018-05-21 |

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **RF Conducted Test** | | | | | |
| Agilent | P-Series Power Meter | N1912A | MY5000448 | 2018-01-02 | 2019-01-02 |
| Agilent | Wideband Power Sensor | N1921A | MY54210016 | 2018-01-02 | 2019-01-02 |
| WEINSCHEL | 10dB Attenuator | 5324 | AU 3842 | 2017-11-22 | 2018-05-22 |
| Rohde & Schwarz | SPECTRUM ANALYZER | FSU26 | 200120 | 2017-12-24 | 2018-12-24 |
| Ducommun technologies | RF Cable | RG-214 | 3 | 2017-11-22 | 2018-05-22 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

# FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

## Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure | | | | |
|---|---|---|---|---|
| **Frequency Range (MHz)** | **Electric Field Strength (V/m)** | **Magnetic Field Strength (A/m)** | **Power Density ($mW/cm^2$)** | **Averaging Time (Minutes)** |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *($180/f^2$) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100,000 | / | / | 1.0 | 30 |

f = frequency in MHz
* = Plane-wave equivalent power density

## Result

**Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. $mW/cm^2$)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Worst case as below:

| Item | Frequency (MHz) | Antenna Gain | | Turn up conducted Peak power | | Evaluation Distance (cm) | Power Density ($mW/cm^2$) | MPE Limit ($mW/cm^2$) |
|---|---|---|---|---|---|---|---|---|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| BLE | 2402-2480 | 0 | 1.00 | 1 | 1.26 | 20 | 0.0003 | 1 |
| Wi-Fi | 2412-2462 | 3 | 2.00 | 20 | 100 | 20 | 0.0400 | 1 |

Simultaneous transmitting consideration: BLE module and Wi-Fi module

The ratio=$MPE_{BLE}$/limit+$MPE_{Wi\text{-}Fi}$/limit=0.0003/1+0.0400/1=0.0403＜1.0, simultaneous exposure is not required.

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**

# FCC §15.203 - ANTENNA REQUIREMENT

## Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

## Antenna Connector Construction

The EUT has an internal FPC antenna arrangement for Wi-Fi, which was permanently attached and the antenna gain is 3 dBi, fulfill the requirement of this section.

And the EUT has an internal PCB antenna arrangement for Bluetooth LE, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section.

Please refer to the EUT photos.

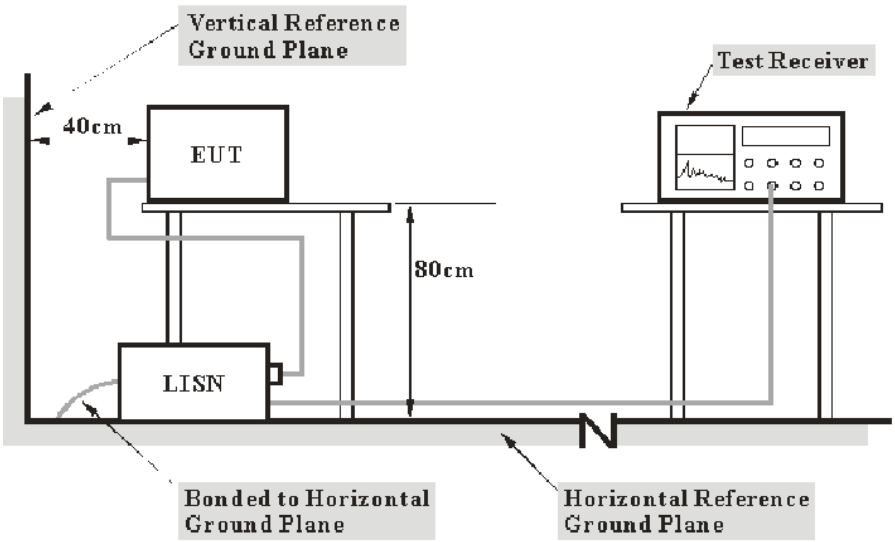
**Result:** Compliance.

# FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

## Applicable Standard

FCC§15.207

## EUT Setup




Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

## EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

| Frequency Range | IF B/W |
|---|---|
| 150 kHz – 30 MHz | 9 kHz |

## Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

## Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207,

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than $U_{cispr}$, if $L_m$ is less than $L_{lim}$, it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

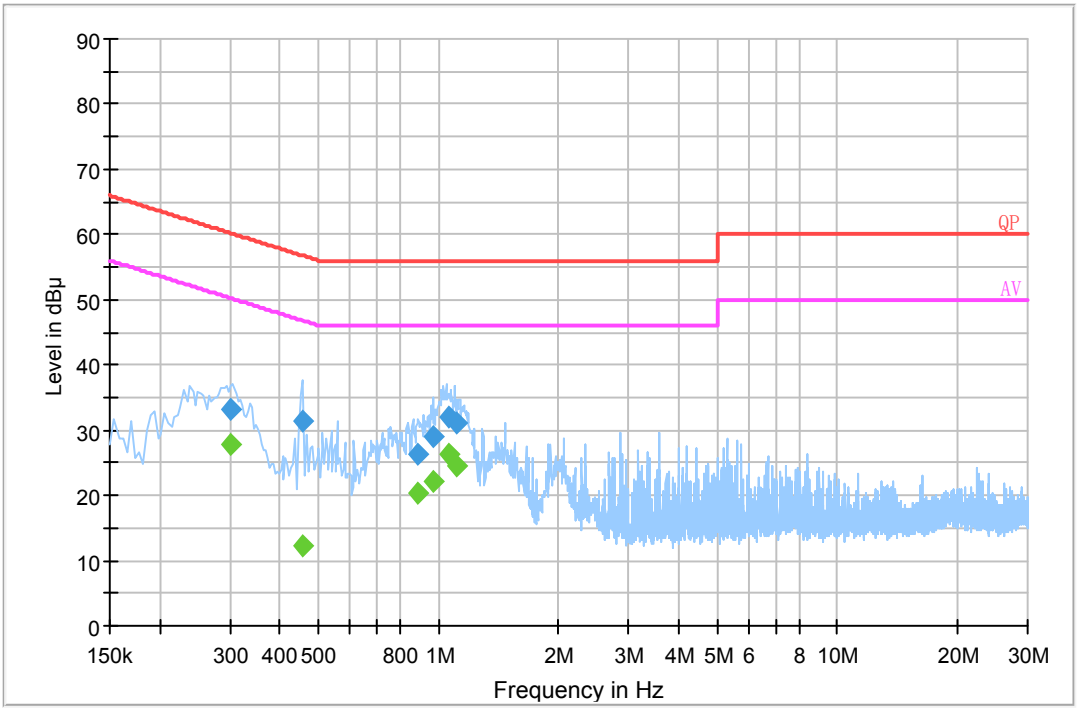
| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Simon Wang on 2018-02-07.*

*EUT operation mode: Transmitting & charging*

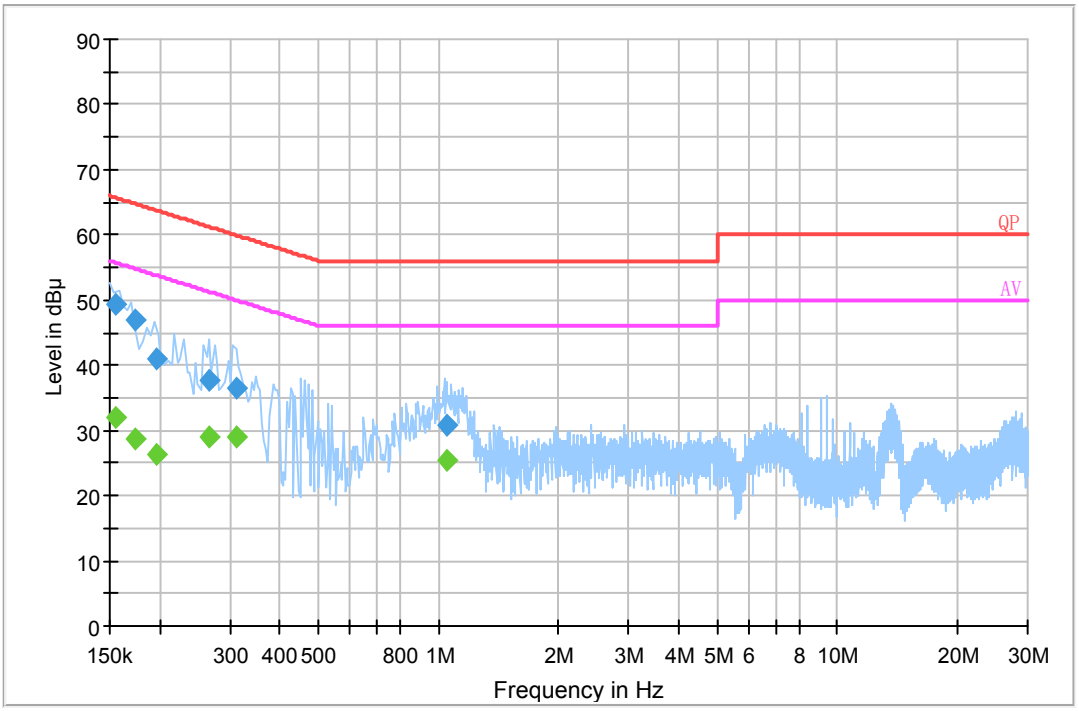
*Note: Worst case for Simultaneous transmitting as below*

**AC 120V/60 Hz, Line**




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.301410 | 33.3 | 20.2 | 60.2 | 26.9 | QP |
| 0.459130 | 31.5 | 20.2 | 56.7 | 25.2 | QP |
| 0.888650 | 26.4 | 20.1 | 56.0 | 29.6 | QP |
| 0.967450 | 29.0 | 20.1 | 56.0 | 27.0 | QP |
| 1.061690 | 32.0 | 20.1 | 56.0 | 24.0 | QP |
| 1.113110 | 31.2 | 20.1 | 56.0 | 24.8 | QP |
| 0.301410 | 28.0 | 20.2 | 50.2 | 22.2 | Ave. |
| 0.459130 | 12.4 | 20.2 | 46.7 | 34.3 | Ave. |
| 0.888650 | 20.2 | 20.1 | 46.0 | 25.8 | Ave. |
| 0.967450 | 22.1 | 20.1 | 46.0 | 23.9 | Ave. |
| 1.061690 | 26.3 | 20.1 | 46.0 | 19.7 | Ave. |
| 1.113110 | 24.6 | 20.1 | 46.0 | 21.4 | Ave. |

**AC 120V/60 Hz, Neutral**




| Frequency (MHz) | Corrected Amplitude (dBµV) | Correction Factor (dB) | Limit (dBµV) | Margin (dB) | Detector (PK/Ave./QP) |
|---|---|---|---|---|---|
| 0.154500 | 49.3 | 20.2 | 65.8 | 16.5 | QP |
| 0.174500 | 46.9 | 20.2 | 64.7 | 17.8 | QP |
| 0.197500 | 41.1 | 20.2 | 63.7 | 22.6 | QP |
| 0.265500 | 37.5 | 20.2 | 61.3 | 23.8 | QP |
| 0.310590 | 36.5 | 20.2 | 60.0 | 23.5 | QP |
| 1.049510 | 30.7 | 20.1 | 56.0 | 25.3 | QP |
| 0.154500 | 32.1 | 20.2 | 55.8 | 23.7 | Ave. |
| 0.174500 | 28.7 | 20.2 | 54.7 | 26.0 | Ave. |
| 0.197500 | 26.3 | 20.2 | 53.7 | 27.4 | Ave. |
| 0.265500 | 28.9 | 20.2 | 51.3 | 22.4 | Ave. |
| 0.310590 | 29.0 | 20.2 | 50.0 | 21.0 | Ave. |
| 1.049510 | 25.5 | 20.1 | 46.0 | 20.5 | Ave. |

**Note:**
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

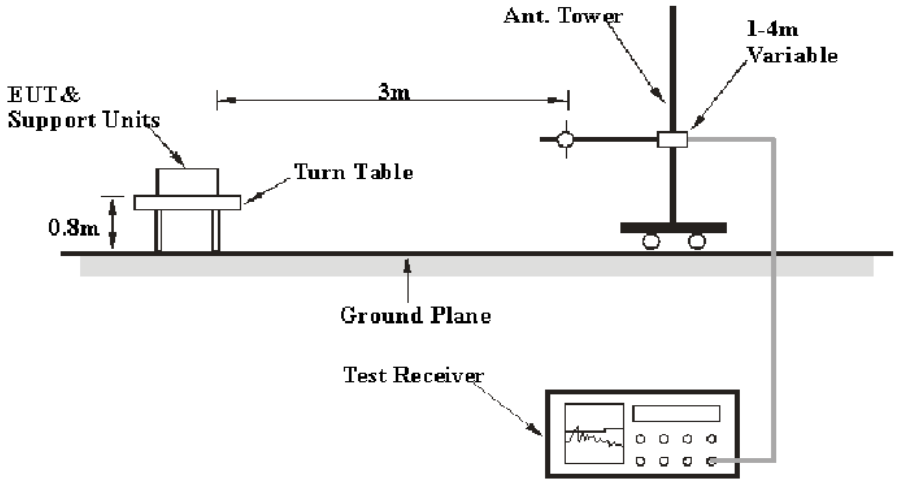
# FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

## Applicable Standard

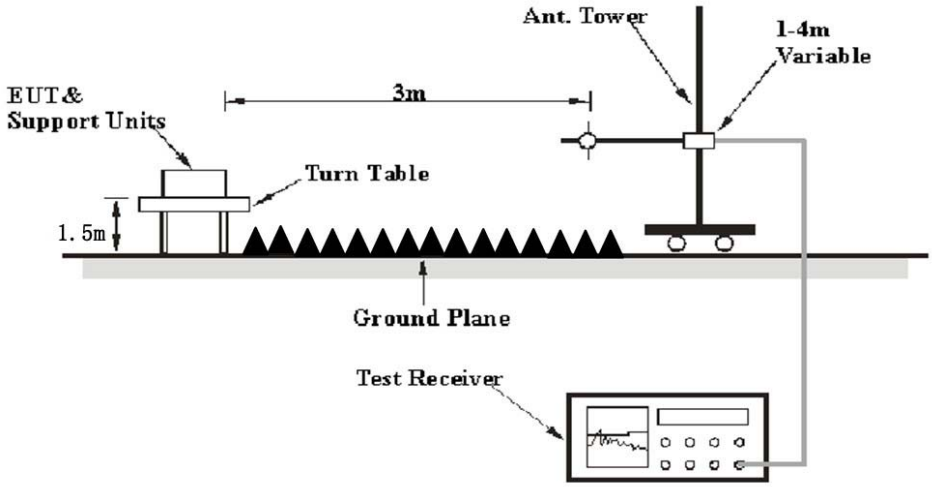
FCC §15.247 (d); §15.209; §15.205;

## EUT Setup

**Below 1 GHz:**




**Above 1GHz:**




The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range | RBW | Video B/W | IF B/W | Measurement |
|---|---|---|---|---|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1MHz | 3 MHz | / | PK |
| | 1MHz | 10 Hz Note 1 | / | Average |
| | 1MHz | ＞1/T Note 2 | / | Average |

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than $U_{cispr}$, if $L_m$ is less than $L_{lim}$, it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

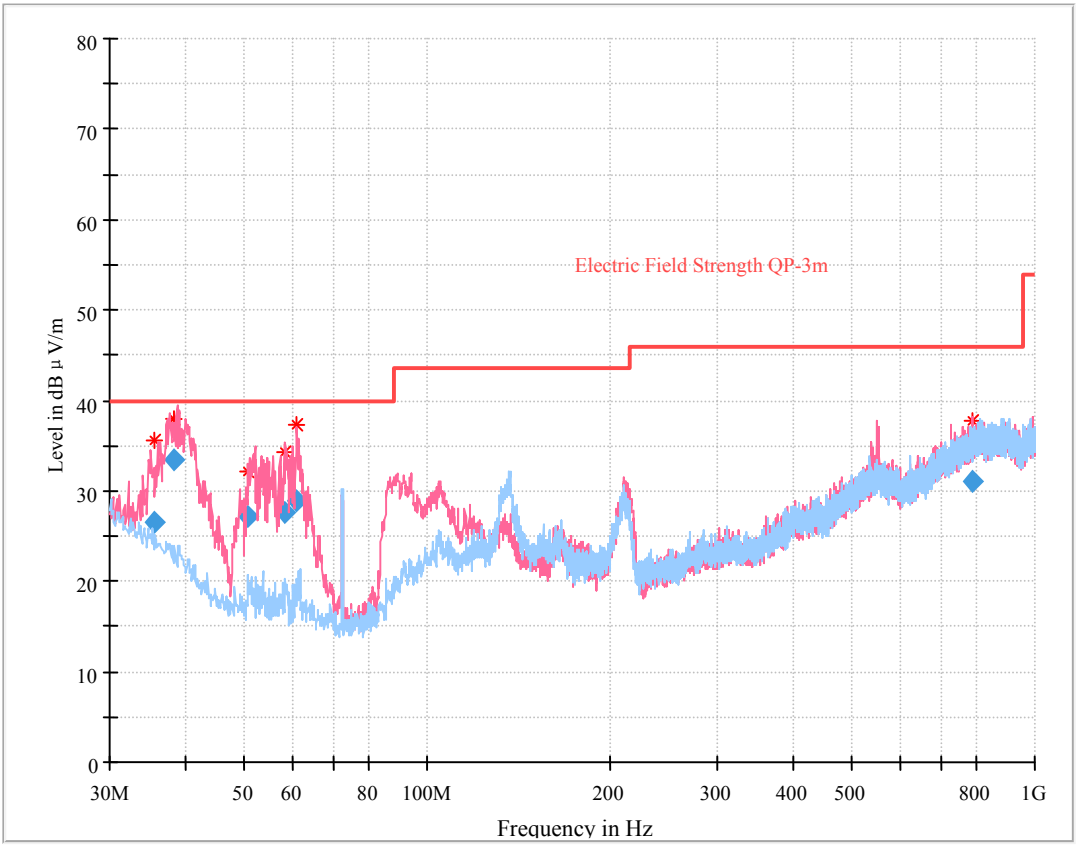
| | |
|---|---|
| **Temperature:** | 24~25 ℃ |
| **Relative Humidity:** | 50~52 % |
| **ATM Pressure:** | 100.0~101.0 kPa |

*The testing was performed by Simon Wang on 2018-02-05 and 2018-03-29.*

*EUT operation mode: Transmitting*

**For BLE mode:**

**30 MHz-1 GHz: worst case for High channel**



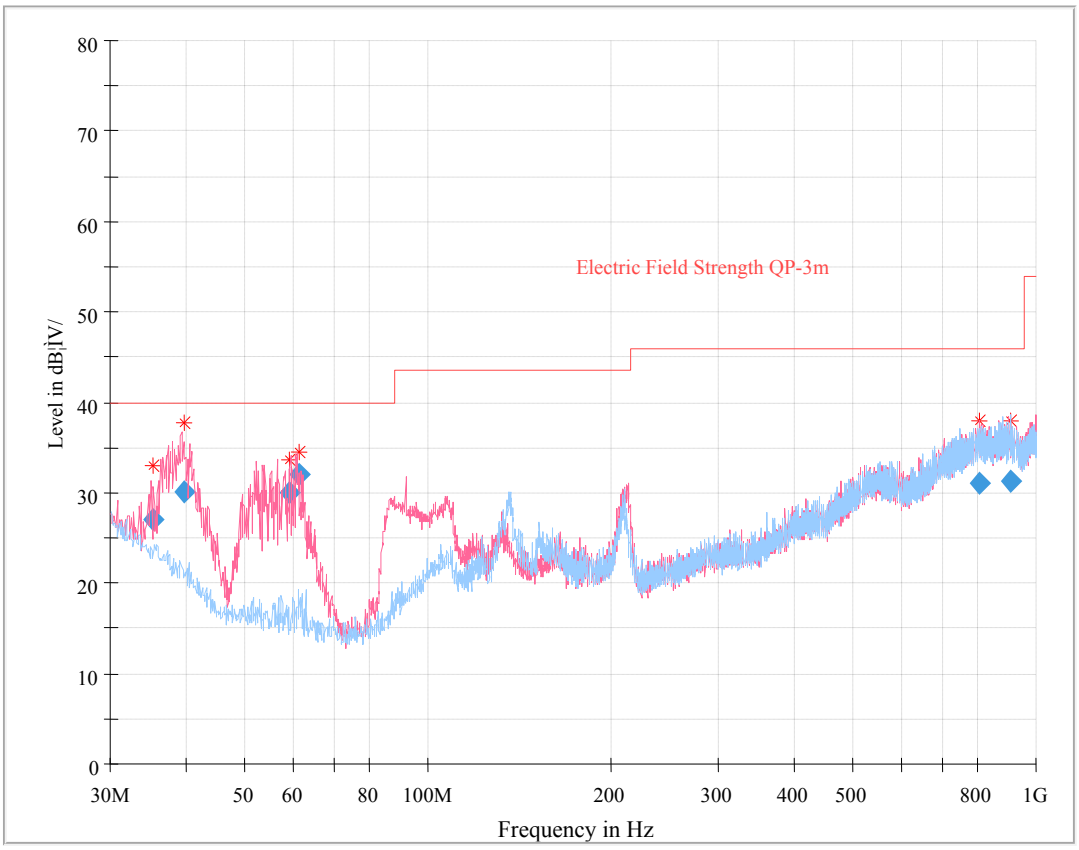

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 35.428500 | 26.45 | 101.0 | V | 58.0 | -3.2 | 40.00 | 13.55 |
| 38.336000 | 33.49 | 105.0 | V | 35.0 | -5.0 | 40.00 | 6.51 |
| 50.722000 | 27.12 | 109.0 | V | 302.0 | -11.0 | 40.00 | 12.88 |
| 58.160125 | 27.55 | 105.0 | V | 221.0 | -11.7 | 40.00 | 12.45 |
| 60.784375 | 28.94 | 121.0 | V | 217.0 | -11.9 | 40.00 | 11.06 |
| 792.213000 | 31.00 | 308.0 | V | 55.0 | 8.8 | 46.00 | 15.00 |

**1 GHz-25 GHz:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2402 MHz)** | | | | | | | | | |
| 2402.00 | 62.69 | PK | 317 | 2.2 | H | 33.92 | 96.61 | / | / |
| 2402.00 | 61.99 | Ave. | 317 | 2.2 | H | 33.92 | 95.91 | / | / |
| 2402.00 | 56.08 | PK | 321 | 1.7 | V | 33.92 | 90.00 | / | / |
| 2402.00 | 55.29 | Ave. | 321 | 1.7 | V | 33.92 | 89.21 | / | / |
| 2376.41 | 27.70 | PK | 107 | 1.7 | H | 33.92 | 61.62 | 74 | 12.38 |
| 2376.41 | 14.18 | Ave. | 107 | 1.7 | H | 33.92 | 48.10 | 54 | 5.90 |
| 2486.39 | 27.02 | PK | 88 | 1.4 | H | 34.08 | 61.10 | 74 | 12.90 |
| 2486.39 | 13.46 | Ave. | 88 | 1.4 | H | 34.08 | 47.54 | 54 | 6.46 |
| 4804.00 | 43.60 | PK | 316 | 1.6 | H | 5.84 | 49.44 | 74 | 24.56 |
| 4804.00 | 30.49 | Ave. | 316 | 1.6 | H | 5.84 | 36.33 | 54 | 17.67 |
| **Middle Channel (2440 MHz)** | | | | | | | | | |
| 2440.00 | 61.84 | PK | 115 | 1.9 | H | 33.92 | 95.76 | / | / |
| 2440.00 | 61.05 | Ave. | 115 | 1.9 | H | 33.92 | 94.97 | / | / |
| 2440.00 | 55.21 | PK | 334 | 1.1 | V | 33.92 | 89.13 | / | / |
| 2440.00 | 54.67 | Ave. | 334 | 1.1 | V | 33.92 | 88.59 | / | / |
| 4880.00 | 43.84 | PK | 186 | 1.4 | H | 6.21 | 50.05 | 74 | 23.95 |
| 4880.00 | 30.25 | Ave. | 186 | 1.4 | H | 6.21 | 36.46 | 54 | 17.54 |
| **High Channel (2480 MHz)** | | | | | | | | | |
| 2480.00 | 61.29 | PK | 101 | 1.4 | H | 34.08 | 95.37 | / | / |
| 2480.00 | 60.48 | Ave. | 101 | 1.4 | H | 34.08 | 94.56 | / | / |
| 2480.00 | 54.63 | PK | 299 | 2.5 | V | 34.08 | 88.71 | / | / |
| 2480.00 | 53.85 | Ave. | 299 | 2.5 | V | 34.08 | 87.93 | / | / |
| 2389.47 | 28.11 | PK | 191 | 2.4 | H | 33.92 | 62.03 | 74 | 11.97 |
| 2389.47 | 14.24 | Ave. | 191 | 2.4 | H | 33.92 | 48.16 | 54 | 5.84 |
| 2483.56 | 27.77 | PK | 18 | 2.4 | H | 34.08 | 61.85 | 74 | 12.15 |
| 2483.56 | 16.51 | Ave. | 18 | 2.4 | H | 34.08 | 50.59 | 54 | 3.41 |
| 4960.00 | 44.65 | PK | 104 | 1.6 | H | 7.82 | 52.47 | 74 | 21.53 |
| 4960.00 | 30.83 | Ave. | 104 | 1.6 | H | 7.82 | 38.65 | 54 | 15.35 |

**For WIFI Mode:**

**30 MHz~1 GHz: (worst case at 802.11n HT20Mode, Low channel)**




| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 35.416375 | 25.15 | 128.0 | V | 331.0 | -3.2 | 40.00 | 14.85 |
| 39.657250 | 30.04 | 107.0 | V | 47.0 | -5.8 | 40.00 | 9.96 |
| 59.100250 | 30.06 | 125.0 | V | 186.0 | -11.8 | 40.00 | 9.94 |
| 61.408625 | 32.08 | 128.0 | V | 209.0 | -11.9 | 40.00 | 7.92 |
| 806.064750 | 31.15 | 294.0 | V | 323.0 | 9.0 | 46.00 | 14.85 |
| 906.281250 | 31.34 | 268.0 | H | 245.0 | 9.5 | 46.00 | 14.66 |

**802.11b Mode:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2412 MHz)** | | | | | | | | | |
| 2412.00 | 69.25 | PK | 163 | 1.2 | H | 33.92 | 103.17 | / | / |
| 2412.00 | 64.59 | Ave. | 163 | 1.2 | H | 33.92 | 98.51 | / | / |
| 2412.00 | 64.61 | PK | 218 | 1.9 | V | 33.92 | 98.53 | / | / |
| 2412.00 | 59.81 | Ave. | 218 | 1.9 | V | 33.92 | 93.73 | / | / |
| 2372.28 | 28.37 | PK | 195 | 2.3 | H | 33.92 | 62.29 | 74 | 11.71 |
| 2372.28 | 14.23 | Ave. | 195 | 2.3 | H | 33.92 | 48.15 | 54 | 5.85 |
| 2493.12 | 26.71 | PK | 348 | 2.4 | V | 34.08 | 60.79 | 74 | 13.21 |
| 2493.12 | 13.5 | Ave. | 348 | 2.4 | V | 34.08 | 47.58 | 54 | 6.42 |
| 4824.00 | 44.27 | PK | 198 | 1.5 | H | 5.84 | 50.11 | 74 | 23.89 |
| 4824.00 | 29.09 | Ave. | 198 | 1.5 | H | 5.84 | 34.93 | 54 | 19.07 |
| **Middle Channel (2437MHz)** | | | | | | | | | |
| 2437.00 | 69.84 | PK | 210 | 2.3 | H | 33.92 | 103.76 | / | / |
| 2437.00 | 65.28 | Ave. | 210 | 2.3 | H | 33.92 | 99.20 | / | / |
| 2437.00 | 65.23 | PK | 260 | 1.2 | V | 33.92 | 99.15 | / | / |
| 2437.00 | 61.06 | Ave. | 260 | 1.2 | V | 33.92 | 94.98 | / | / |
| 4874.0 | 43.82 | PK | 82 | 1.1 | H | 6.21 | 50.03 | 74 | 23.97 |
| 4874.00 | 29.05 | Ave. | 82 | 1.1 | H | 6.21 | 35.26 | 54 | 18.74 |
| **High Channel (2462 MHz)** | | | | | | | | | |
| 2462.00 | 70.09 | PK | 326 | 1.7 | H | 34.08 | 104.17 | / | / |
| 2462.00 | 65.09 | Ave. | 326 | 1.7 | H | 34.08 | 99.17 | / | / |
| 2462.00 | 64.17 | PK | 332 | 1.2 | V | 34.08 | 98.25 | / | / |
| 2462.00 | 59.54 | Ave. | 332 | 1.2 | V | 34.08 | 93.62 | / | / |
| 2356.12 | 28.03 | PK | 209 | 2.4 | H | 33.92 | 61.95 | 74 | 12.05 |
| 2356.12 | 14.23 | Ave. | 209 | 2.4 | H | 33.92 | 48.15 | 54 | 5.85 |
| 2495.66 | 27.45 | PK | 78 | 1.3 | V | 34.08 | 61.53 | 74 | 12.47 |
| 2495.66 | 13.74 | Ave. | 78 | 1.3 | V | 34.08 | 47.82 | 54 | 6.18 |
| 4924.00 | 43.1 | PK | 184 | 1.4 | H | 6.21 | 49.31 | 74 | 24.69 |
| 4924.00 | 29.53 | Ave. | 184 | 1.4 | H | 6.21 | 35.74 | 54 | 18.26 |

**802.11g Mode:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2412 MHz)** | | | | | | | | | |
| 2412.00 | 72.2 | PK | 275 | 1.6 | H | 33.92 | 106.12 | / | / |
| 2412.00 | 59.43 | Ave. | 275 | 1.6 | H | 33.92 | 93.35 | / | / |
| 2412.00 | 68.34 | PK | 250 | 1.4 | V | 33.92 | 102.26 | / | / |
| 2412.00 | 55.59 | Ave. | 250 | 1.4 | V | 33.92 | 89.51 | / | / |
| 2374.25 | 27.34 | PK | 114 | 1.9 | H | 33.92 | 61.26 | 74 | 12.74 |
| 2374.25 | 14.2 | Ave. | 114 | 1.9 | H | 33.92 | 48.12 | 54 | 5.88 |
| 2495.66 | 27.05 | PK | 331 | 2.2 | V | 34.08 | 61.13 | 74 | 12.87 |
| 2495.66 | 13.45 | Ave. | 331 | 2.2 | V | 34.08 | 47.53 | 54 | 6.47 |
| 4824.00 | 43.20 | PK | 203 | 1.4 | H | 5.84 | 49.04 | 74 | 24.96 |
| 4824.00 | 29.03 | Ave. | 203 | 1.4 | H | 5.84 | 34.87 | 54 | 19.13 |
| **Middle Channel (2437 MHz)** | | | | | | | | | |
| 2437.00 | 71.20 | PK | 104 | 1.5 | H | 33.92 | 105.12 | / | / |
| 2437.00 | 58.36 | Ave. | 104 | 1.5 | H | 33.92 | 92.28 | / | / |
| 2437.00 | 68.24 | PK | 195 | 1.2 | V | 33.92 | 102.16 | / | / |
| 2437.00 | 55.61 | Ave. | 195 | 1.2 | V | 33.92 | 89.53 | / | / |
| 4874.00 | 43.27 | PK | 274 | 1.3 | H | 6.21 | 49.48 | 74 | 24.52 |
| 4874.00 | 29.04 | Ave. | 274 | 1.3 | H | 6.21 | 35.25 | 54 | 18.75 |
| **High Channel (2462 MHz)** | | | | | | | | | |
| 2462.00 | 74.02 | PK | 78 | 2.0 | H | 34.08 | 108.10 | / | / |
| 2462.00 | 61.92 | Ave. | 78 | 2.0 | H | 34.08 | 96.00 | / | / |
| 2462.00 | 66.01 | PK | 170 | 1.8 | V | 34.08 | 100.09 | / | / |
| 2462.00 | 54.24 | Ave. | 170 | 1.8 | V | 34.08 | 88.32 | / | / |
| 2382.74 | 27.70 | PK | 346 | 2.1 | H | 33.92 | 61.62 | 74 | 12.38 |
| 2382.74 | 14.21 | Ave. | 346 | 2.1 | H | 33.92 | 48.13 | 54 | 5.87 |
| 2487.60 | 28.13 | PK | 7 | 2.3 | H | 34.08 | 62.21 | 74 | 11.79 |
| 2487.60 | 13.81 | Ave. | 7 | 2.3 | H | 34.08 | 47.89 | 54 | 6.11 |
| 4924.00 | 43.20 | PK | 113 | 2.2 | H | 6.21 | 49.41 | 74 | 24.59 |
| 4924.00 | 28.86 | Ave. | 113 | 2.2 | H | 6.21 | 35.07 | 54 | 18.93 |

**802.11n-HT20 Mode:**

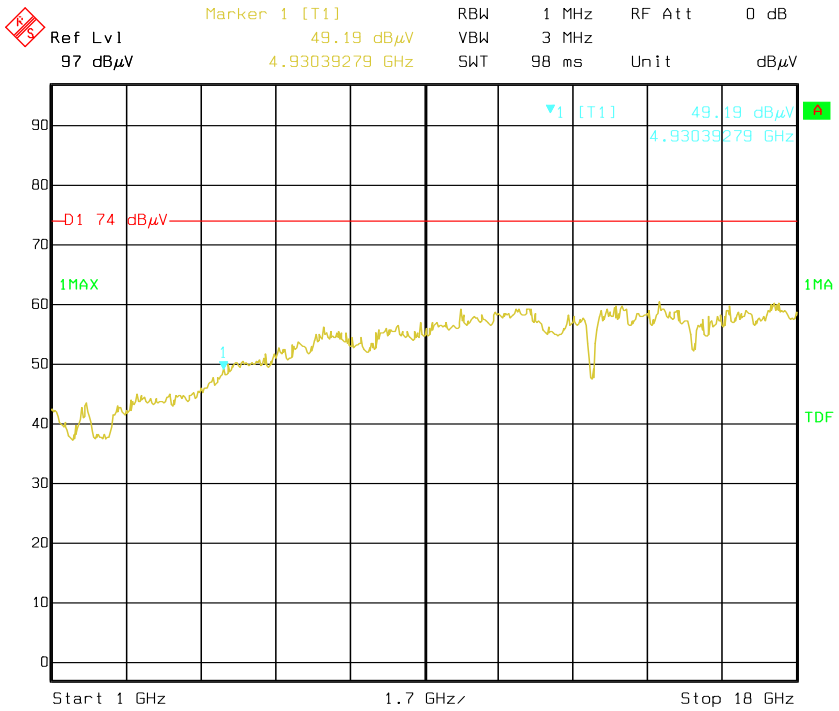
| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2412 MHz)** | | | | | | | | | |
| 2412.00 | 73.46 | PK | 326 | 2.0 | H | 33.92 | 107.38 | / | / |
| 2412.00 | 60.20 | Ave. | 326 | 2.0 | H | 33.92 | 94.12 | / | / |
| 2412.00 | 66.88 | PK | 40 | 1.2 | V | 33.92 | 100.80 | / | / |
| 2412.00 | 53.52 | Ave. | 40 | 1.2 | V | 33.92 | 87.44 | / | / |
| 2380.10 | 28.20 | PK | 295 | 1.8 | H | 33.92 | 62.12 | 74 | 11.88 |
| 2380.10 | 14.20 | Ave. | 295 | 1.8 | H | 33.92 | 48.12 | 54 | 5.88 |
| 2487.65 | 27.12 | PK | 167 | 1.4 | H | 34.08 | 61.20 | 74 | 12.80 |
| 2487.65 | 13.45 | Ave. | 167 | 1.4 | H | 34.08 | 47.53 | 54 | 6.47 |
| 4824.00 | 43.92 | PK | 165 | 2.2 | H | 5.84 | 49.76 | 74 | 24.24 |
| 4824.00 | 29.18 | Ave. | 165 | 2.2 | H | 5.84 | 35.02 | 54 | 18.98 |
| **Middle Channel (2437MHz)** | | | | | | | | | |
| 2437.00 | 72.69 | PK | 119 | 1.0 | H | 33.92 | 106.61 | / | / |
| 2437.00 | 59.24 | Ave. | 119 | 1.0 | H | 33.92 | 93.16 | / | / |
| 2437.00 | 66.57 | PK | 206 | 1.6 | V | 33.92 | 100.49 | / | / |
| 2437.00 | 53.10 | Ave. | 206 | 1.6 | V | 33.92 | 87.02 | / | / |
| 4874.00 | 43.2 | PK | 178 | 1.9 | H | 6.21 | 49.41 | 74 | 24.59 |
| 4874.00 | 28.83 | Ave. | 178 | 1.9 | H | 6.21 | 35.04 | 54 | 18.96 |
| **High Channel (2462MHz)** | | | | | | | | | |
| 2462.00 | 73.48 | PK | 262 | 2.0 | H | 34.08 | 107.56 | / | / |
| 2462.00 | 60.56 | Ave. | 262 | 2.0 | H | 34.08 | 94.64 | / | / |
| 2462.00 | 65.78 | PK | 215 | 1.4 | V | 34.08 | 99.86 | / | / |
| 2462.00 | 52.12 | Ave. | 215 | 1.4 | V | 34.08 | 86.20 | / | / |
| 2341.36 | 27.26 | PK | 44 | 1.8 | H | 33.83 | 61.09 | 74 | 12.91 |
| 2341.36 | 14.18 | Ave. | 44 | 1.8 | H | 33.83 | 48.01 | 54 | 5.99 |
| 2485.45 | 27.82 | PK | 215 | 1.5 | H | 34.08 | 61.90 | 74 | 12.10 |
| 2485.45 | 13.72 | Ave. | 215 | 1.5 | H | 34.08 | 47.80 | 54 | 6.20 |
| 4924.00 | 43.03 | PK | 290 | 1.5 | H | 6.21 | 49.24 | 74 | 24.76 |
| 4924.00 | 29.15 | Ave. | 290 | 1.5 | H | 6.21 | 35.36 | 54 | 18.64 |

**802.11n-HT40 Mode:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2422 MHz)** | | | | | | | | | |
| 2422.00 | 59.14 | PK | 203 | 1.9 | H | 33.92 | 93.06 | / | / |
| 2422.00 | 46.59 | Ave. | 203 | 1.9 | H | 33.92 | 80.51 | / | / |
| 2422.00 | 53.80 | PK | 87 | 2.2 | V | 33.92 | 87.72 | / | / |
| 2422.00 | 40.57 | Ave. | 87 | 2.2 | V | 33.92 | 74.49 | / | / |
| 2347.64 | 27.63 | PK | 282 | 1.5 | H | 33.83 | 61.46 | 74 | 12.54 |
| 2347.64 | 14.22 | Ave. | 282 | 1.5 | H | 33.83 | 48.05 | 54 | 5.95 |
| 2489.63 | 27.03 | PK | 21 | 1.1 | H | 34.08 | 61.11 | 74 | 12.89 |
| 2489.63 | 13.52 | Ave. | 21 | 1.1 | H | 34.08 | 47.60 | 54 | 6.40 |
| 4844.00 | 43.01 | PK | 337 | 2.1 | H | 5.84 | 48.85 | 74 | 25.15 |
| 4844.00 | 28.89 | Ave. | 337 | 2.1 | H | 5.84 | 34.73 | 54 | 19.27 |
| **Middle Channel (2437MHz)** | | | | | | | | | |
| 2437.00 | 59.31 | PK | 277 | 2.4 | H | 33.92 | 93.23 | / | / |
| 2437.00 | 46.10 | Ave. | 277 | 2.4 | H | 33.92 | 80.02 | / | / |
| 2437.00 | 53.42 | PK | 105 | 1.6 | V | 33.92 | 87.34 | / | / |
| 2437.00 | 40.23 | Ave. | 105 | 1.6 | V | 33.92 | 74.15 | / | / |
| 4874.00 | 42.86 | PK | 132 | 1.0 | H | 6.21 | 49.07 | 74 | 24.93 |
| 4874.00 | 28.86 | Ave. | 132 | 1.0 | H | 6.21 | 35.07 | 54 | 18.93 |
| **High Channel (2452 MHz)** | | | | | | | | | |
| 2452.00 | 61.61 | PK | 87 | 1.2 | H | 34.08 | 95.69 | / | / |
| 2452.00 | 48.21 | Ave. | 87 | 1.2 | H | 34.08 | 82.29 | / | / |
| 2452.00 | 55.43 | PK | 219 | 1.8 | V | 34.08 | 89.51 | / | / |
| 2452.00 | 42.24 | Ave. | 219 | 1.8 | V | 34.08 | 76.32 | / | / |
| 2384.94 | 27.63 | PK | 230 | 2.3 | H | 33.92 | 61.55 | 74 | 12.45 |
| 2384.94 | 14.23 | Ave. | 230 | 2.3 | H | 33.92 | 48.15 | 54 | 5.85 |
| 2487.62 | 27.84 | PK | 30 | 2.0 | H | 34.08 | 61.92 | 74 | 12.08 |
| 2487.62 | 13.53 | Ave. | 30 | 2.0 | H | 34.08 | 47.61 | 54 | 6.39 |
| 4904.00 | 42.84 | PK | 271 | 1.1 | H | 6.21 | 49.05 | 74 | 24.95 |
| 4904.00 | 28.63 | Ave. | 271 | 1.1 | H | 6.21 | 34.84 | 54 | 19.16 |

**Note:**
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

**Pre-scan with Peak 802.11b Mode, High channel**
**Horizontal**

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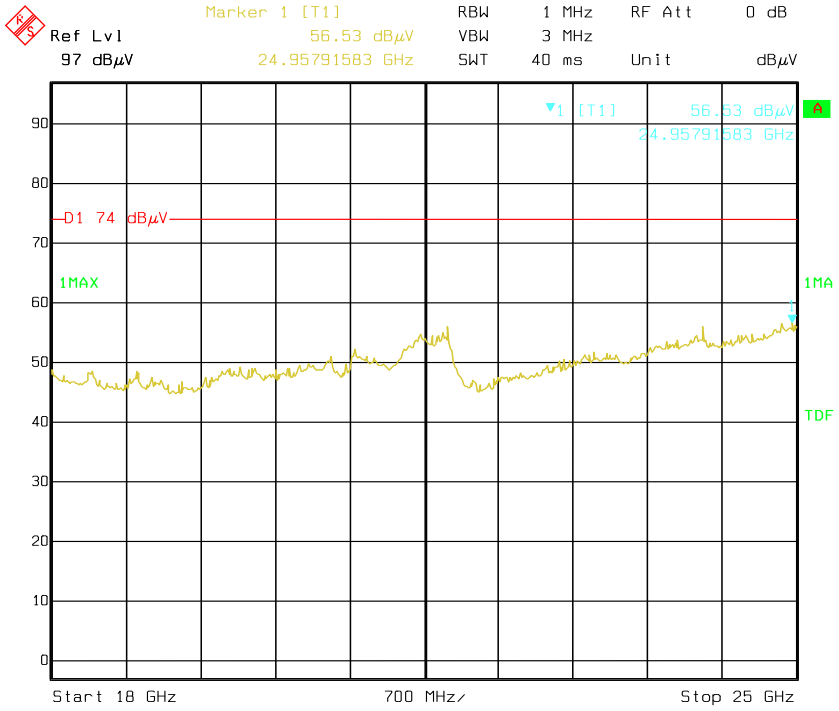


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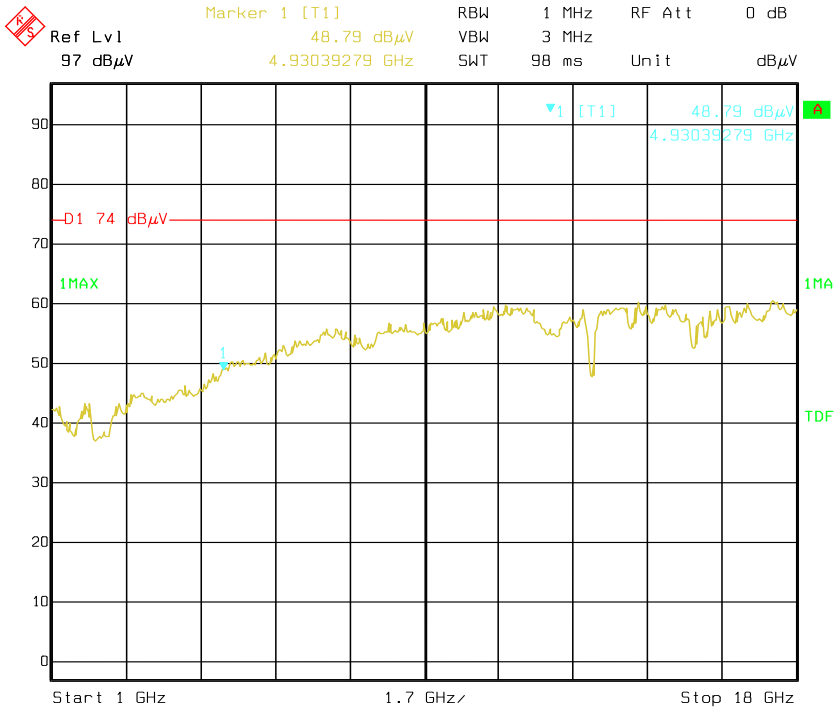
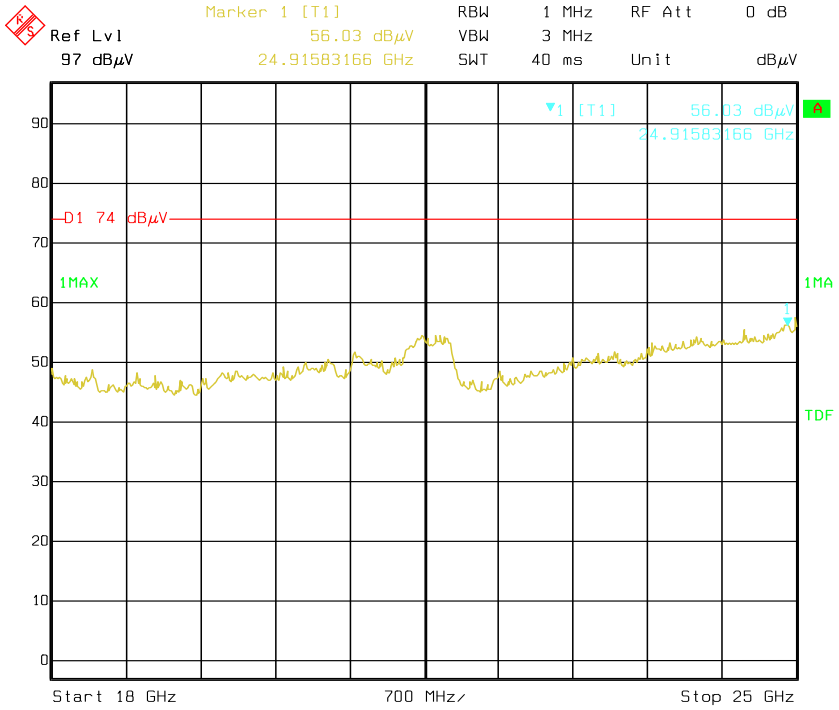
## Vertical

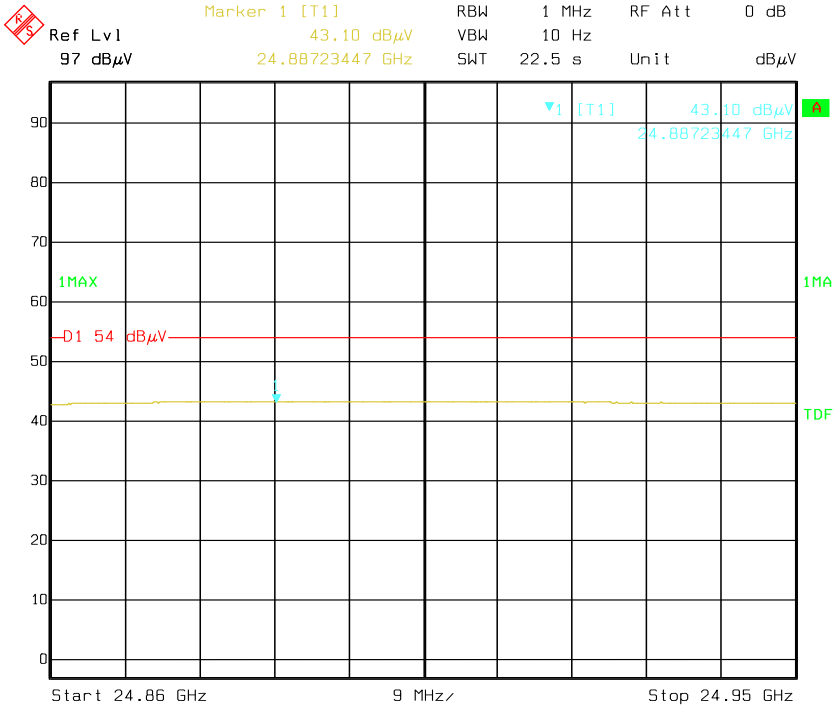



Date: 5.FEB.2018 21:03:05

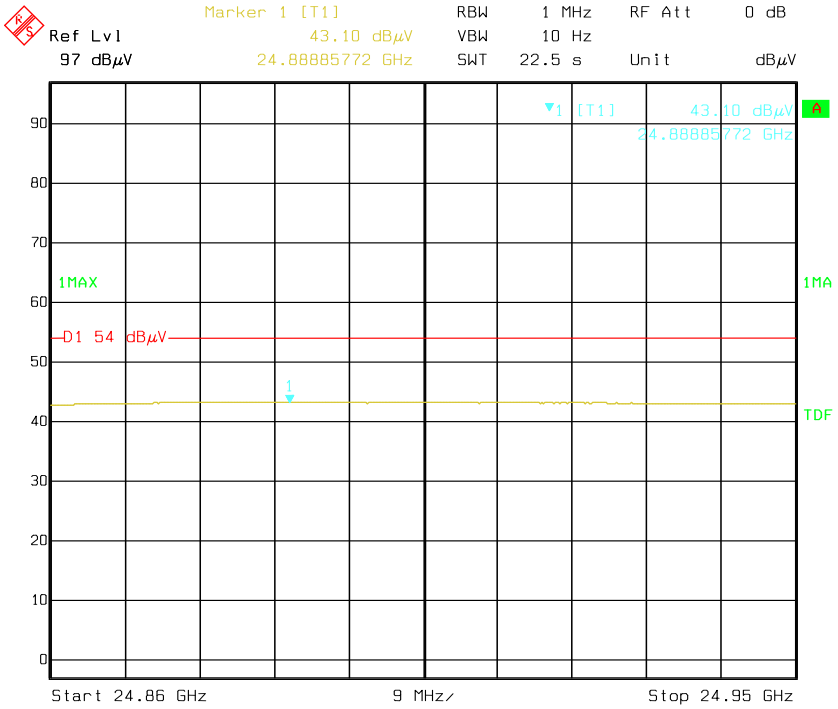



Date: 5.FEB.2018 21:39:08

**Pre-scan Average with channel**
**Horizontal**




**Vertical**



For Co-location mode: BLE and Wi-Fi Simultaneous transmitting

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.247/205/209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| 32.55 | 23.37 | QP | 24 | 1.4 | H | -1.41 | 21.96 | 40 | 18.04 |
| 101.54 | 31.35 | QP | 156 | 1.6 | H | -9.05 | 22.3 | 43.5 | 21.20 |
| 1521.96 | 43.20 | PK | 234 | 2.4 | H | -5.52 | 37.68 | 74 | 36.32 |
| 1521.96 | 26.81 | Ave. | 234 | 2.4 | H | -5.52 | 21.29 | 54 | 32.71 |
| 1128.70 | 41.38 | PK | 358 | 1.8 | V | -8.61 | 32.77 | 74 | 41.23 |
| 1128.70 | 24.96 | Ave. | 358 | 1.8 | V | -8.61 | 16.35 | 54 | 37.65 |

**Note:**
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude

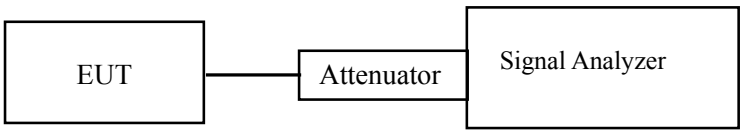
# FCC §15.247(a) (2) –6 dB EMISSION BANDWIDTH&99% OCCUPIED BANDWIDTH

## Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24~25 ℃ |
| **Relative Humidity:** | 50~52 % |
| **ATM Pressure:** | 100.0~101.0 kPa |

*The testing was performed by Simon Wang from 2018-02-01 to 2018-02-06.*

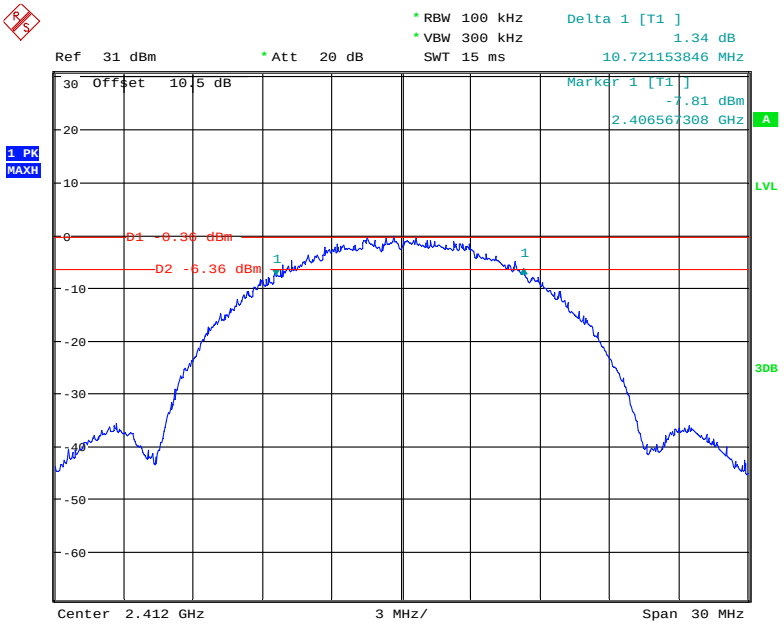
**Test Result:** Pass.

Please refer to the following table and plots.

*EUT operation mode: Transmitting*

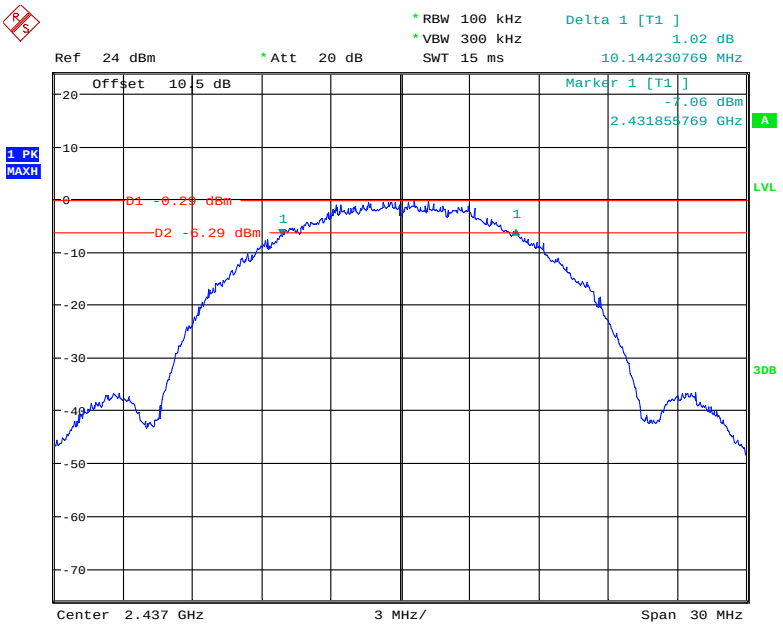
| Channel | Frequency (MHz) | 6dB bandwidth (MHz) | Limit (kHz) |
|---|---|---|---|
| 802.11b mode | | | |
| Low | 2412 | 10.72 | ≥500 |
| Middle | 2437 | 10.14 | ≥500 |
| High | 2462 | 10.48 | ≥500 |
| 802.11g mode | | | |
| Low | 2412 | 16.49 | ≥500 |
| Middle | 2437 | 16.54 | ≥500 |
| High | 2462 | 16.59 | ≥500 |
| 802.11n HT 20 mode | | | |
| Low | 2412 | 16.49 | ≥500 |
| Middle | 2437 | 16.49 | ≥500 |
| High | 2462 | 16.44 | ≥500 |
| 802.11n HT 40 mode | | | |
| Low | 2422 | 36.15 | ≥500 |
| Middle | 2437 | 36.35 | ≥500 |
| High | 2452 | 35.67 | ≥500 |
| BLE mode | | | |
| Low | 2402 | 0.718 | ≥500 |
| Middle | 2440 | 0.715 | ≥500 |
| High | 2480 | 0.718 | ≥500 |

## 6dB Bandwidth, 802.11b Low Channel



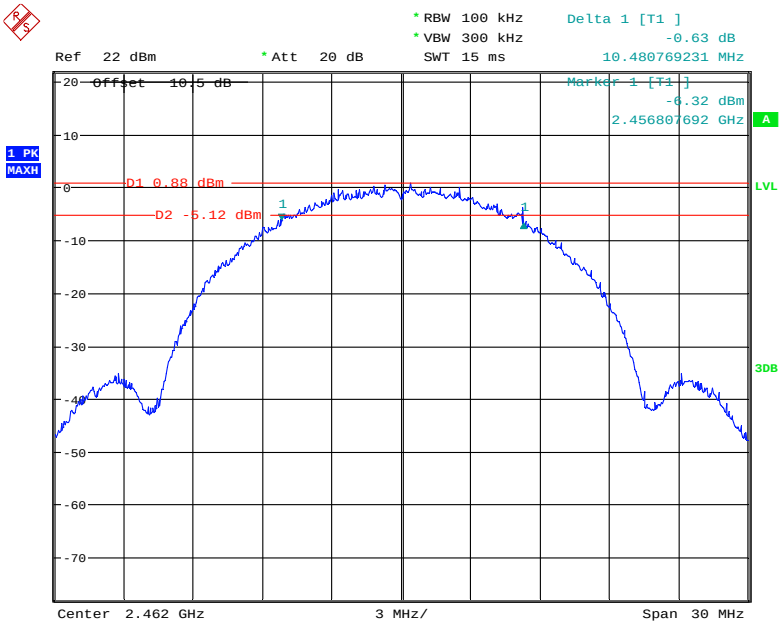

Date: 1.FEB.2018 16:00:12

## 6dB Bandwidth, 802.11b Middle Channel



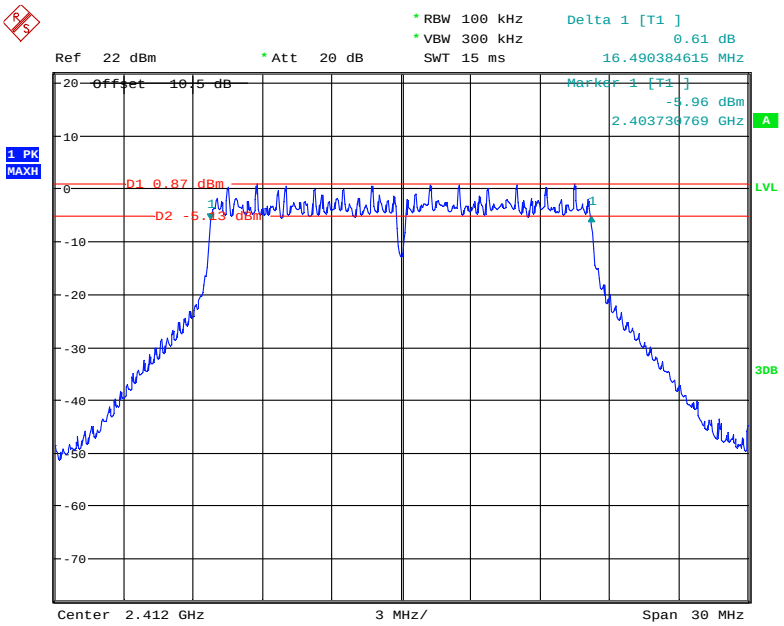

Date: 1.FEB.2018 16:07:45

## 6dB Bandwidth, 802.11b High Channel



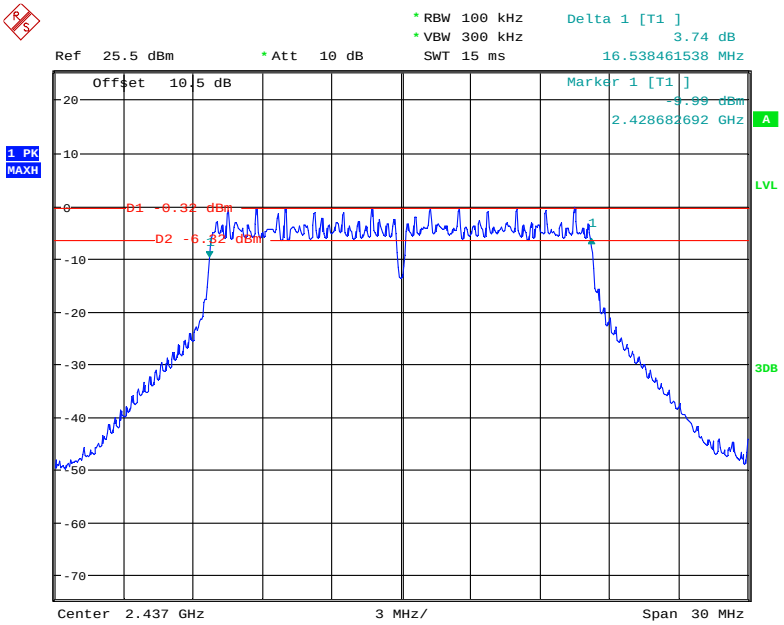

Date: 1.FEB.2018 16:17:14

## 6dB Bandwidth, 802.11g Low Channel



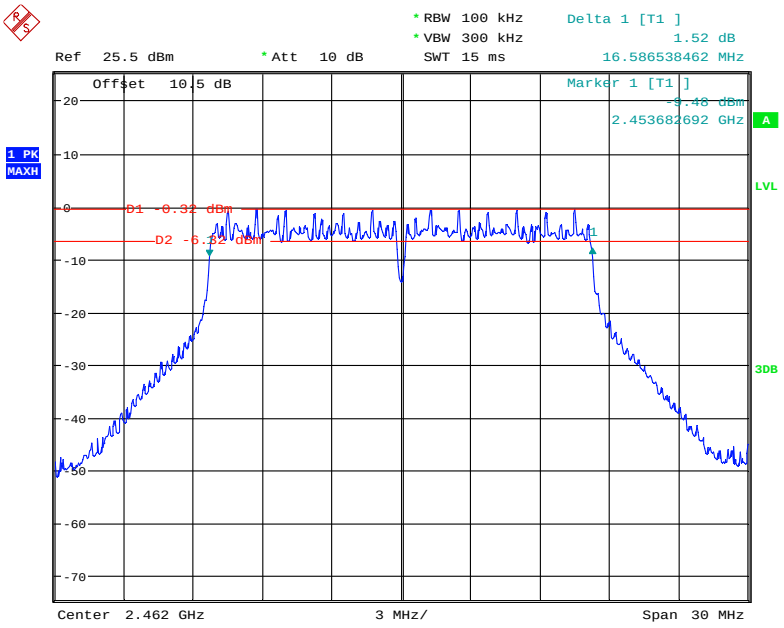

Date: 1.FEB.2018 16:27:25

## 6dB Bandwidth, 802.11g Middle Channel



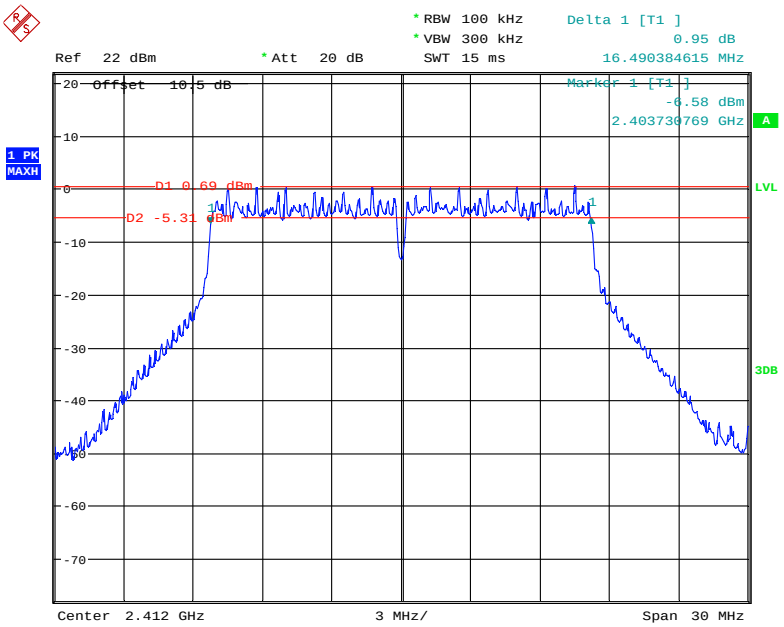

Date: 6.FEB.2018 11:01:38

## 6dB Bandwidth, 802.11g High Channel



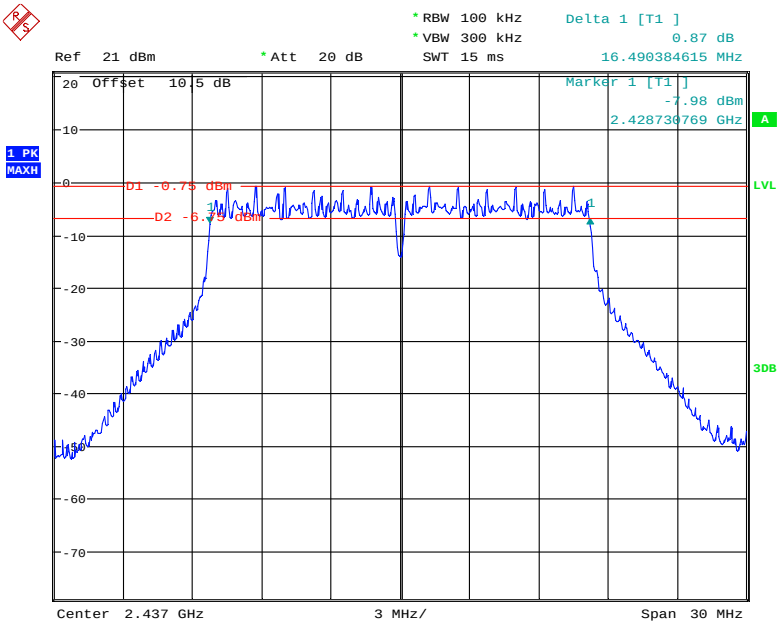

Date: 6.FEB.2018 11:13:53

## 6dB Bandwidth, 802.11n-HT20 Low Channel



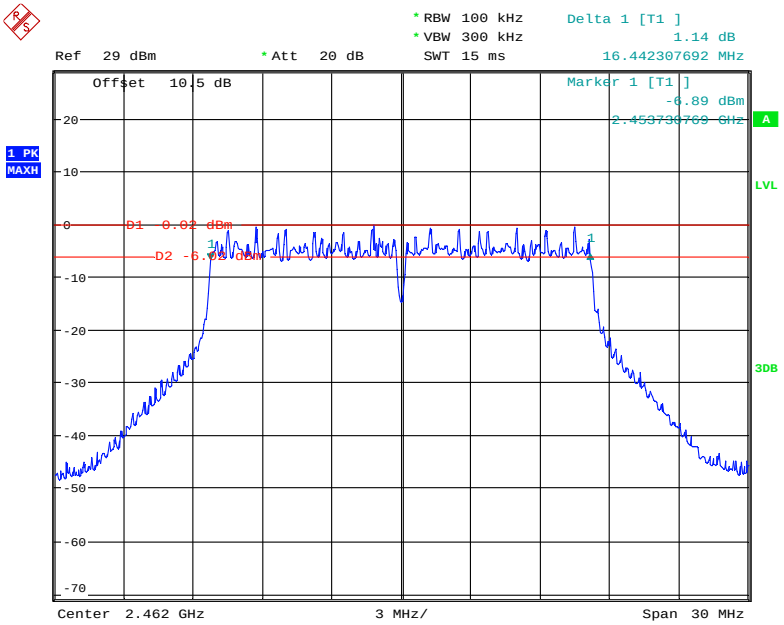

Date: 6.FEB.2018 13:09:13

## 6dB Bandwidth, 802.11n-HT20 Middle Channel



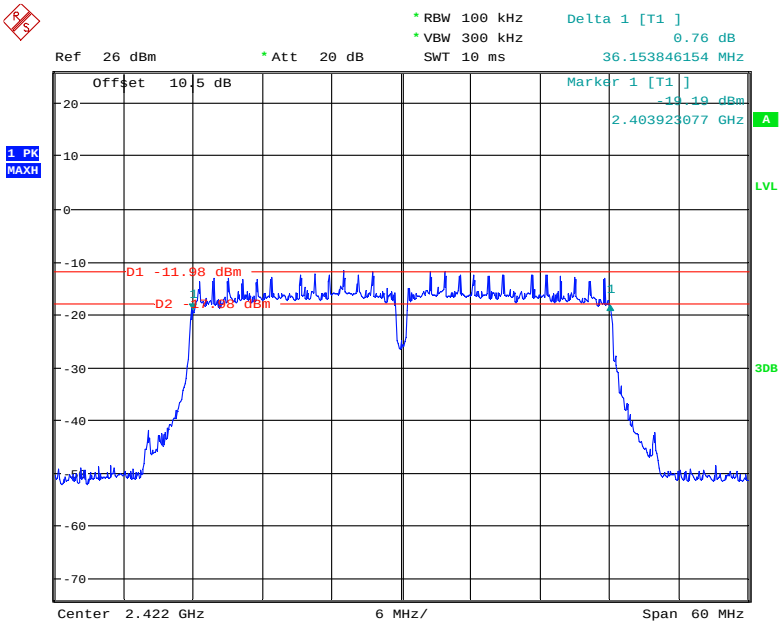

Date: 6.FEB.2018 11:20:56

## 6dB Bandwidth, 802.11n-HT20 High Channel



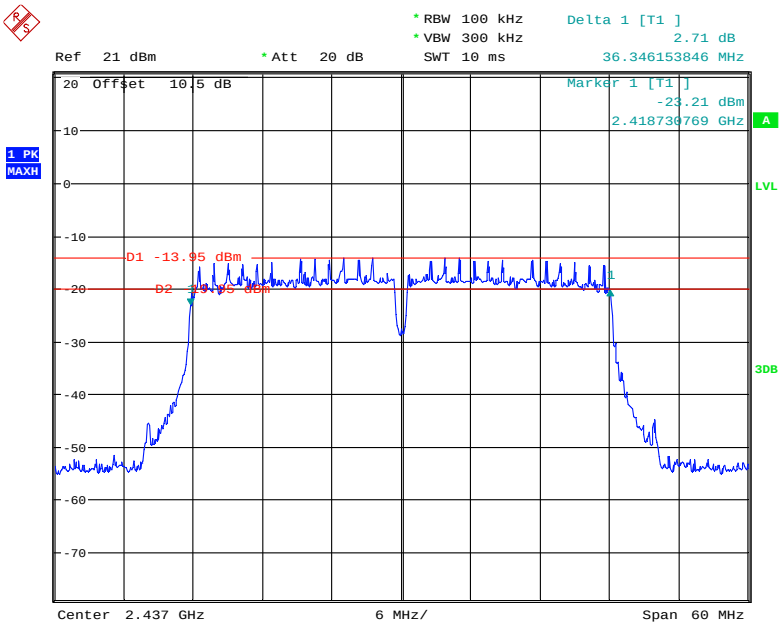

Date: 6.FEB.2018 11:26:58

## 6dB Bandwidth, 802.11n-HT40 Low Channel



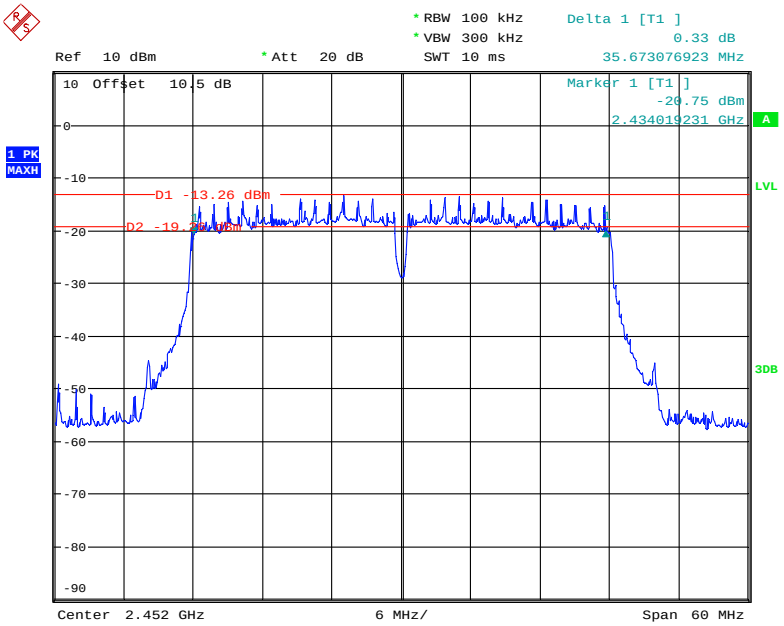

Date: 1.FEB.2018 17:26:24

## 6dB Bandwidth, 802.11n-HT40 Middle Channel



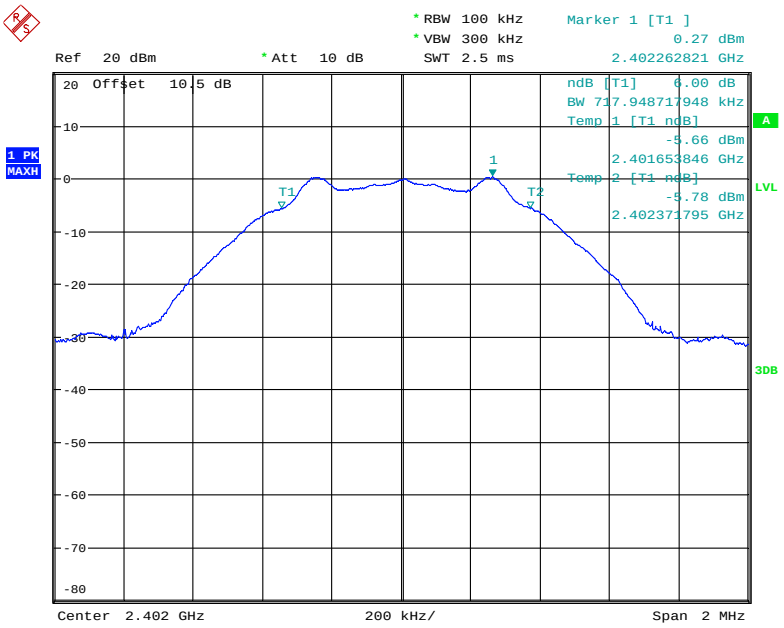

Date: 6.FEB.2018 11:33:52

## 6dB Bandwidth, 802.11n-HT40 High Channel



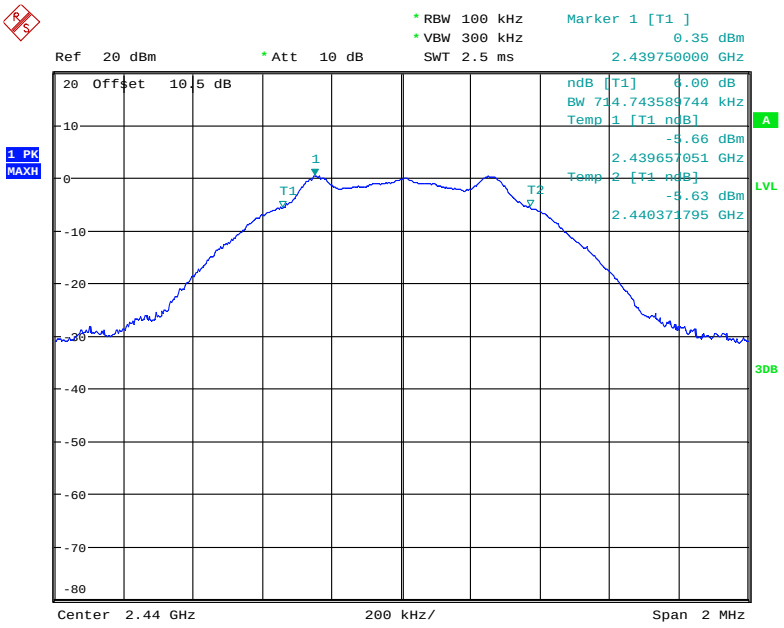

Date: 6.FEB.2018 11:59:23

## BLE Low Channel



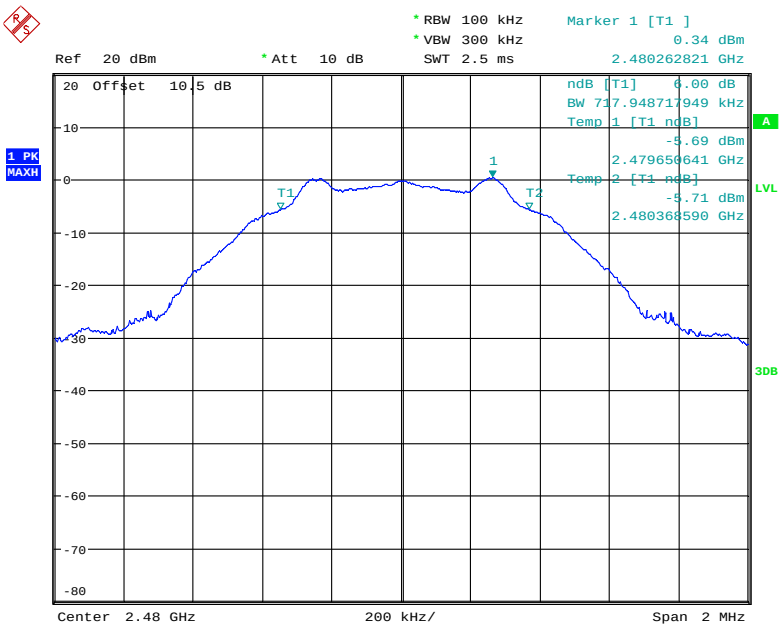

Date: 1.FEB.2018 19:06:42

## BLE Middle Channel




Date: 1.FEB.2018 19:05:05

## BLE High Channel




Date: 1.FEB.2018 19:03:59

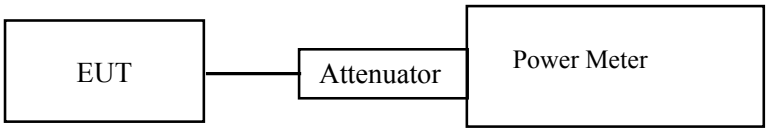
# FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

## Applicable Standard

According to 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. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

## Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Simon Wang on 2018-02-06.*

*EUT operation mode: Transmitting*

**Wi-Fi mode**

| Channel | Frequency (MHz) | Max Conducted Peak Output Power (dBm) | Max Conducted Average Output Power (dBm) | Limit (dBm) |
|---|---|---|---|---|
| 802.11b | | | | |
| Low | 2412 | 14.06 | 11.01 | 30 |
| Middle | 2437 | 13.68 | 11.40 | 30 |
| High | 2462 | 14.85 | 12.00 | 30 |
| 802.11g | | | | |
| Low | 2412 | 19.35 | 14.02 | 30 |
| Middle | 2437 | 18.25 | 13.38 | 30 |
| High | 2462 | 18.25 | 13.17 | 30 |
| 802.11n HT20 | | | | |
| Low | 2412 | 19.37 | 14.68 | 30 |
| Middle | 2437 | 18.11 | 12.82 | 30 |
| High | 2462 | 18.15 | 13.03 | 30 |
| 802.11n HT40 | | | | |
| Low | 2422 | 9.71 | 4.40 | 30 |
| Middle | 2437 | 7.86 | 2.39 | 30 |
| High | 2452 | 7.49 | 2.08 | 30 |

Note: Duty cycle was considered for test result of Average output power.

**BLE mode**

| Channel | Frequency (MHz) | Max Peak Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| Low | 2402 | 0.21 | 30 | Pass |
| Middle | 2440 | 0.40 | 30 | Pass |
| High | 2480 | 0.48 | 30 | Pass |

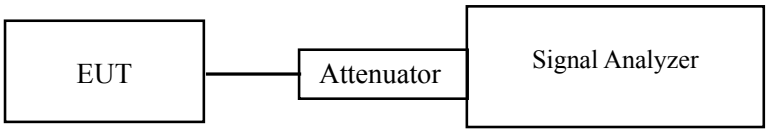
# FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

## Applicable Standard

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

## Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24~25 ℃ |
| **Relative Humidity:** | 50~52 % |
| **ATM Pressure:** | 100.0~101.0 kPa |

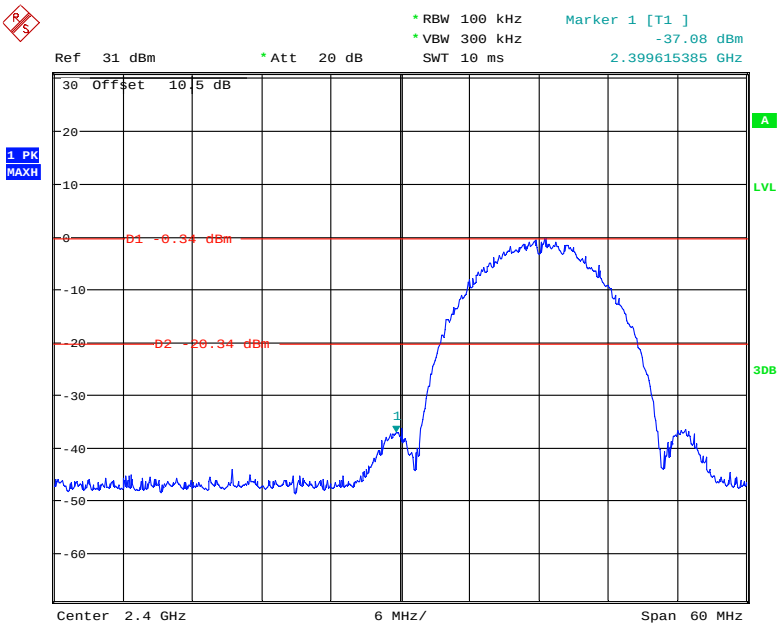
*The testing was performed by Simon Wang from 2018-02-01 to 2018-02-06.*

*EUT operation mode: Transmitting*

**Test Result:** Compliance

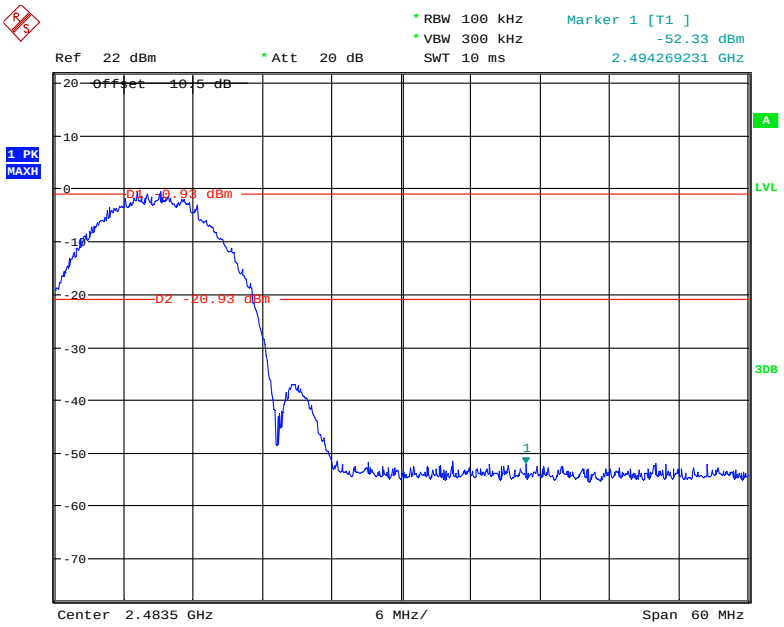
Please refer to the following plots.

## 802.11b: Band Edge, Left Side



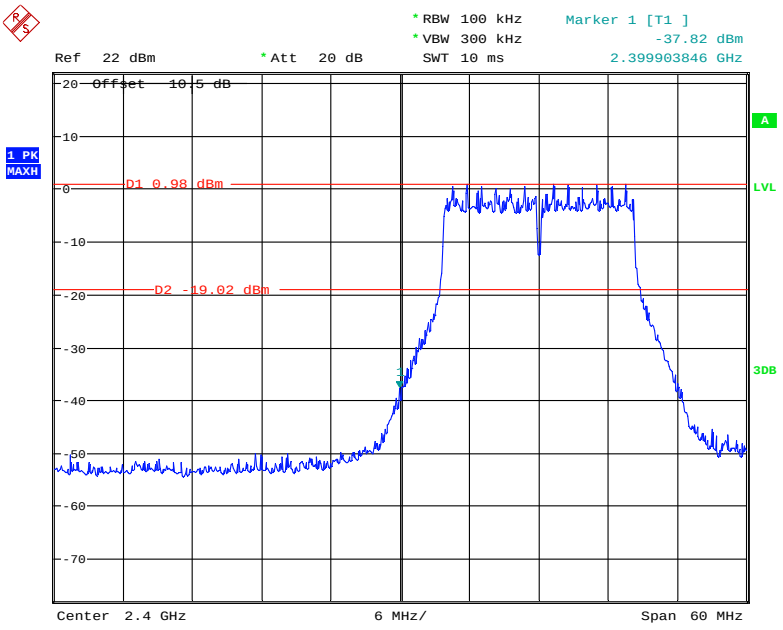

Date: 1.FEB.2018 16:03:57

## 802.11b: Band Edge, Right Side



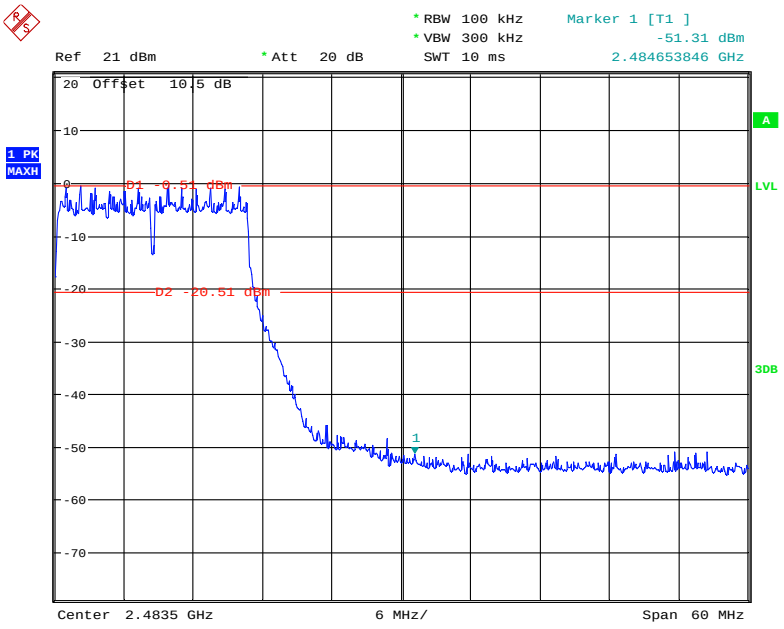

Date: 1.FEB.2018 16:22:23

## 802.11g: Band Edge, Left Side



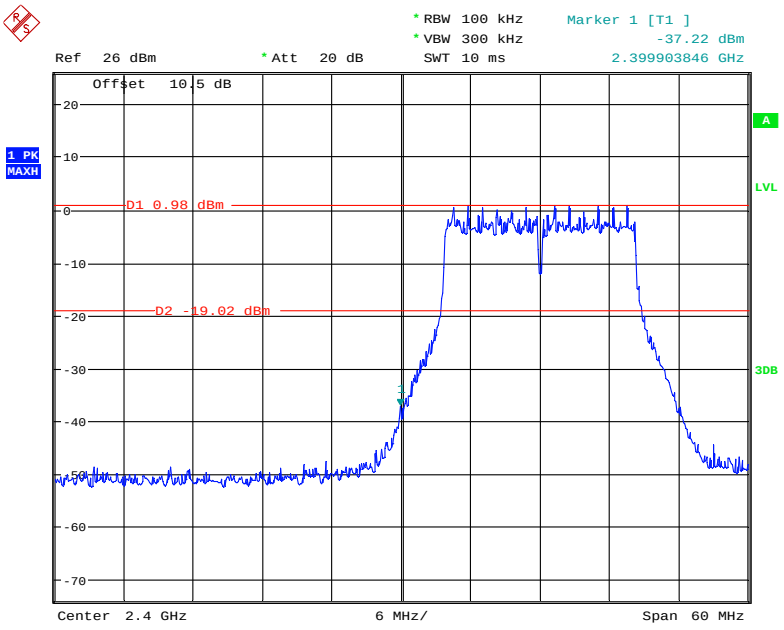

Date: 1.FEB.2018 16:30:42

## 802.11g: Band Edge, Right Side



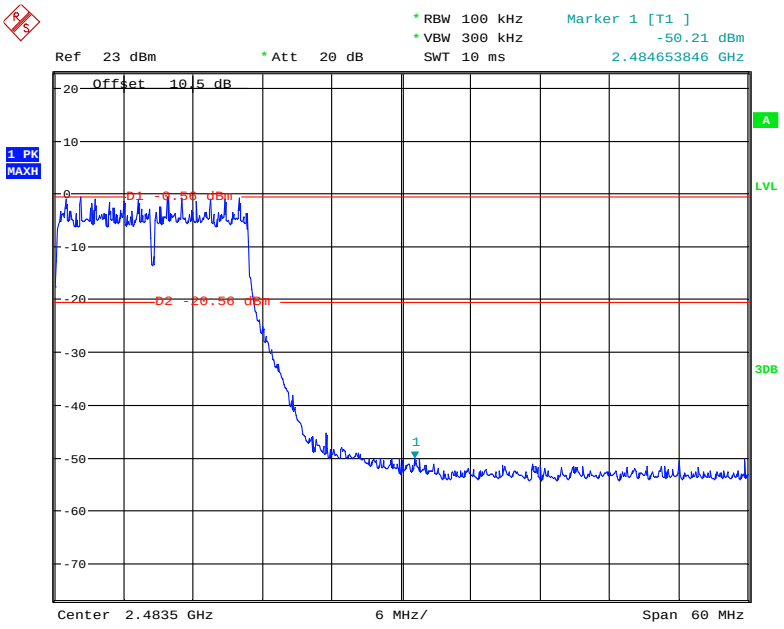

Date: 6.FEB.2018 11:17:01

## 802.11n-HT20: Band Edge, Left Side



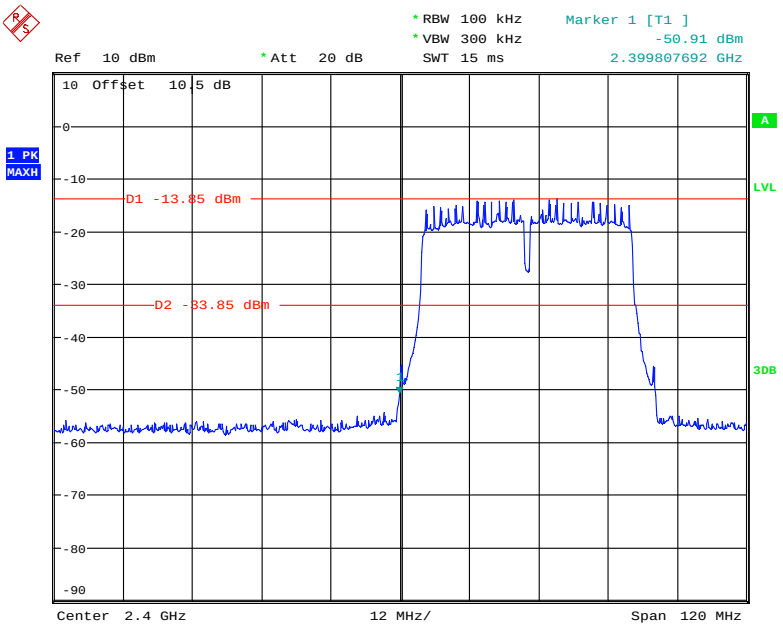

Date: 1.FEB.2018 17:16:07

## 802.11n-HT20: Band Edge, Right Side



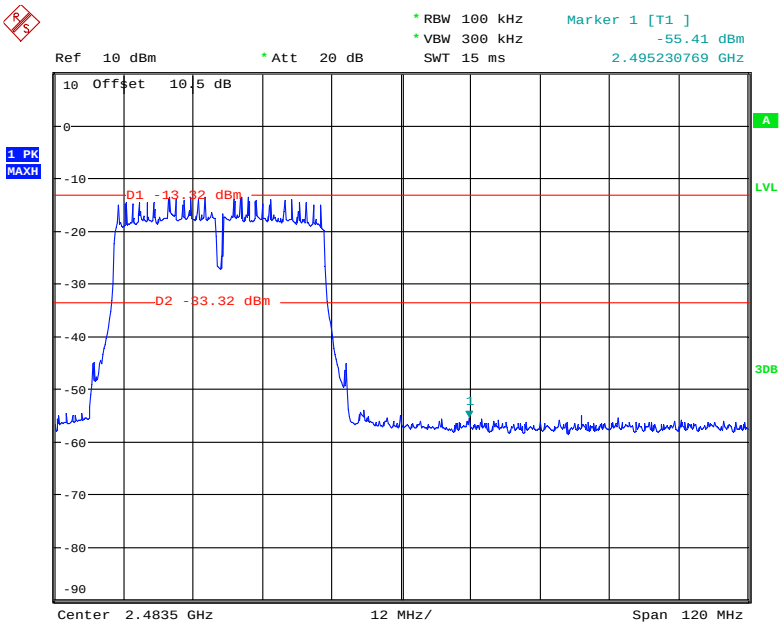

Date: 6.FEB.2018 11:30:01

## 802.11n-HT40: Band Edge, Left Side



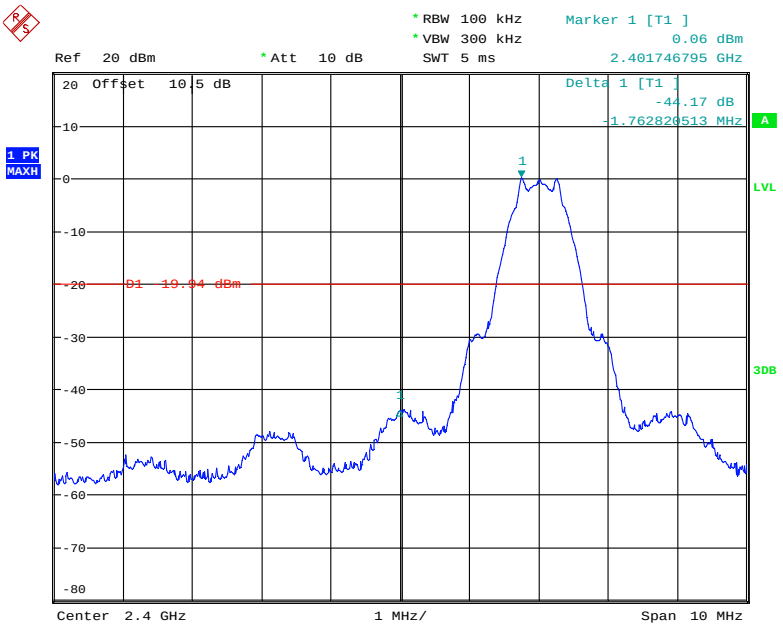

Date: 6.FEB.2018 11:56:03

## 802.11n-HT40: Band Edge, Right Side



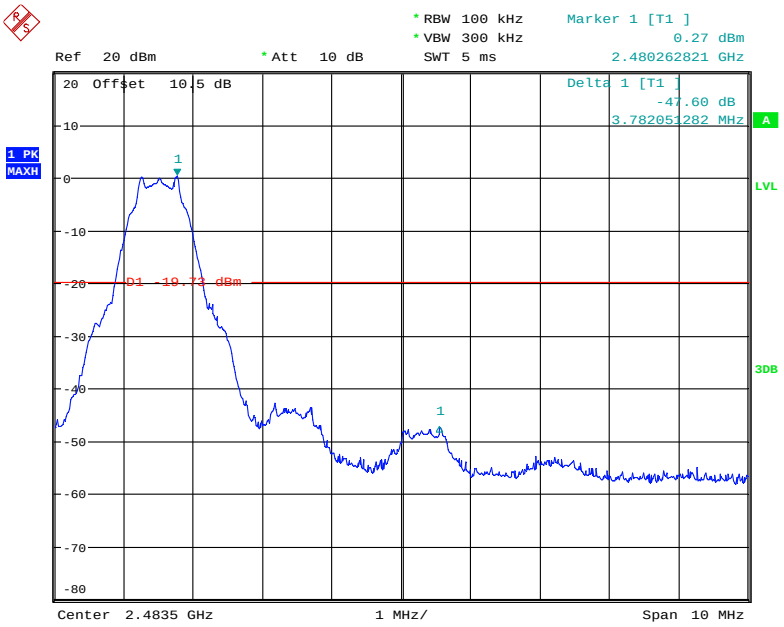

Date: 6.FEB.2018 11:51:26

## BLE: Band Edge, Left Side




Date: 1.FEB.2018 19:28:39

## BLE: Band Edge, Right Side




Date: 1.FEB.2018 19:29:55

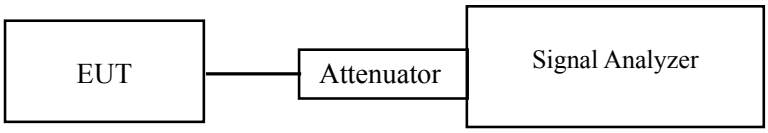
# FCC §15.247(e) - POWER SPECTRAL DENSITY

## Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

## Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.




## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 24~25 ℃ |
| **Relative Humidity:** | 50~52 % |
| **ATM Pressure:** | 100.0~101.0 kPa |

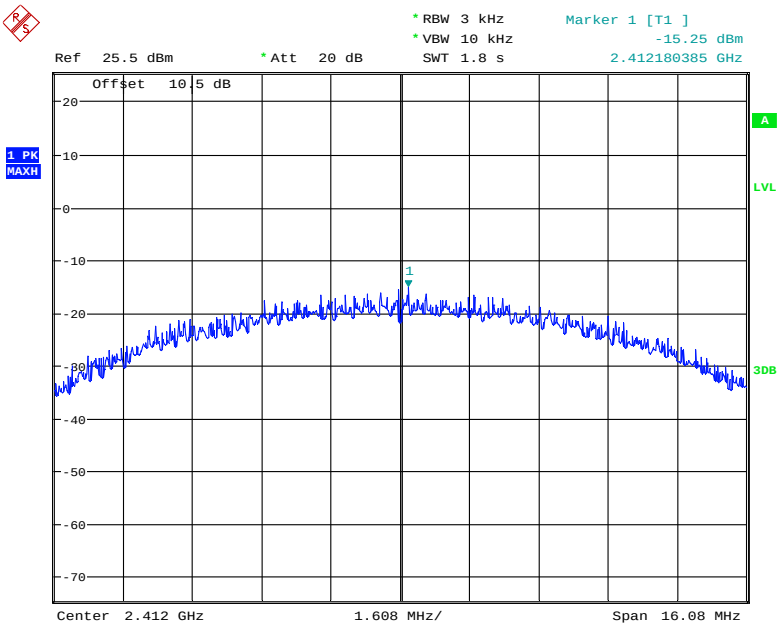
*The testing was performed by Simon Wang from 2018-02-01 to2018-03-08.*

*EUT operation mode: Transmitting*

**Test Result:** Pass

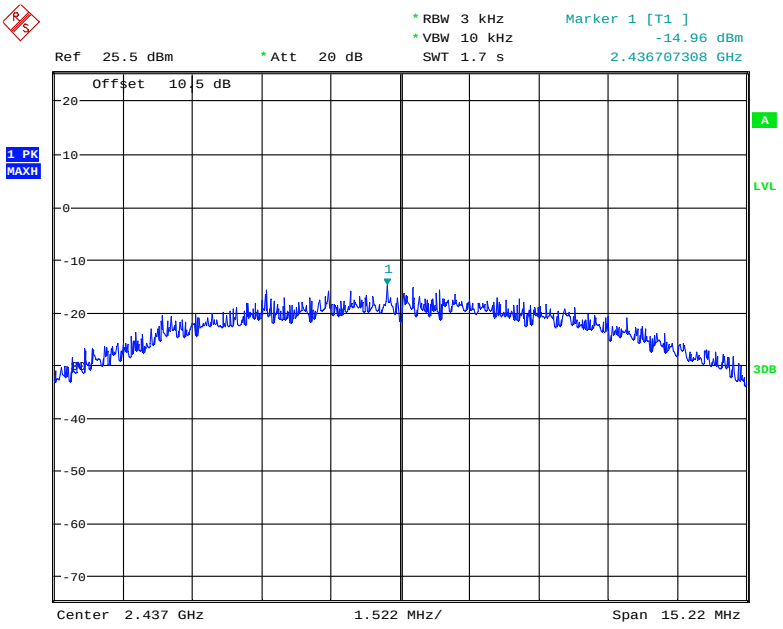
| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|---|
| 802.11b mode | | | |
| Low | 2412 | -15.25 | ≤8 |
| Middle | 2437 | -14.96 | ≤8 |
| High | 2462 | -14.87 | ≤8 |
| 802.11g mode | | | |
| Low | 2412 | -14.42 | ≤8 |
| Middle | 2437 | -14.20 | ≤8 |
| High | 2462 | -13.39 | ≤8 |
| 802.11n-HT20 mode | | | |
| Low | 2412 | -14.11 | ≤8 |
| Middle | 2437 | -13.36 | ≤8 |
| High | 2462 | -13.14 | ≤8 |
| 802.11n HT40 | | | |
| Low | 2422 | -27.07 | ≤8 |
| Middle | 2437 | -27.08 | ≤8 |
| High | 2452 | -25.53 | ≤8 |
| BLE mode | | | |
| Low | 2402 | -10.93 | ≤8 |
| Middle | 2440 | -10.72 | ≤8 |
| High | 2480 | -10.83 | ≤8 |

## Power Spectral Density, 802.11b Low Channel



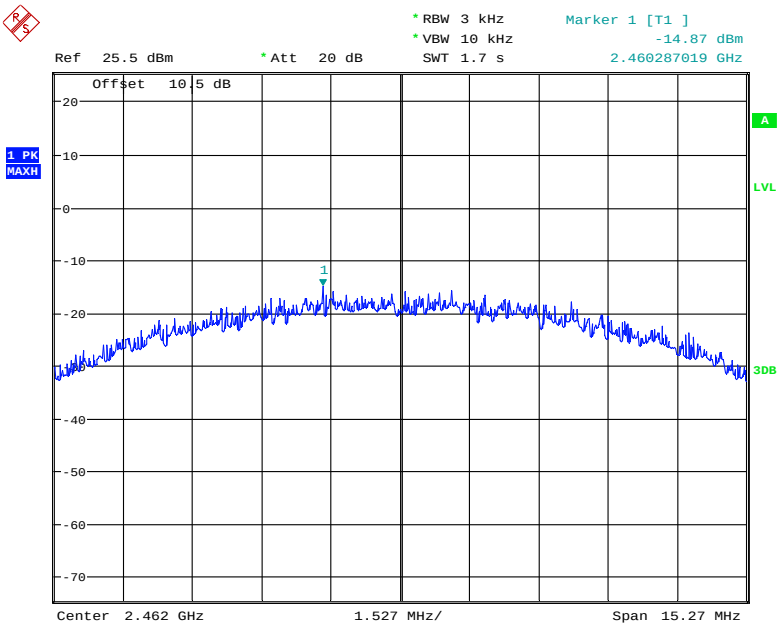

Date: 8.MAR.2018 15:45:44

## Power Spectral Density, 802.11b Middle Channel



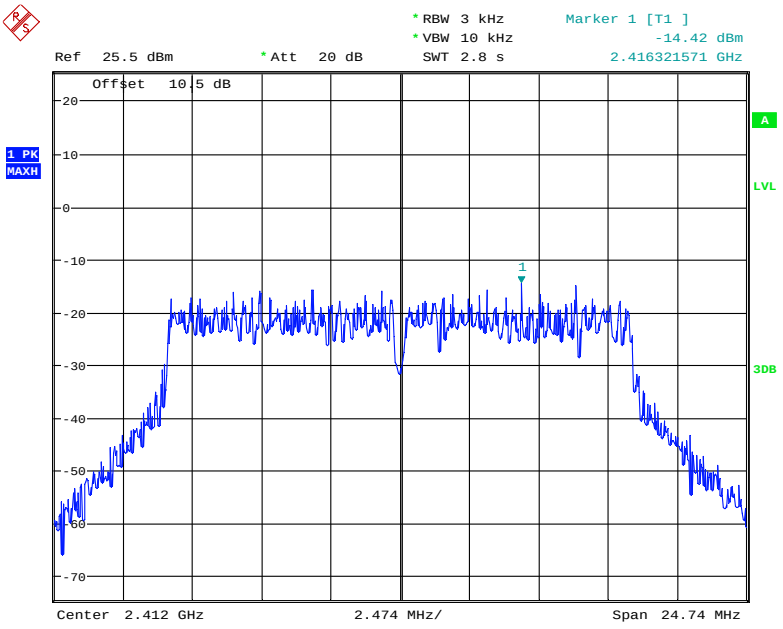

Date: 8.MAR.2018 16:00:24

## Power Spectral Density, 802.11b High Channel



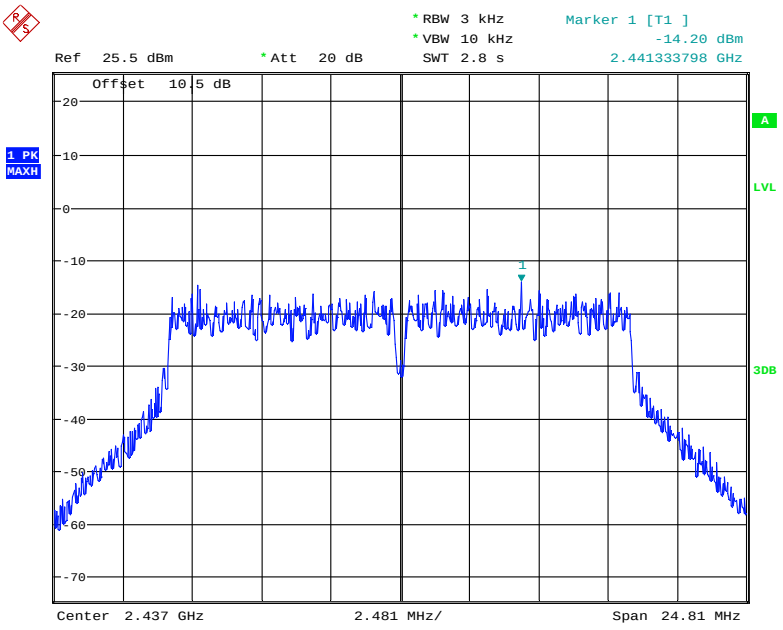

Date: 8.MAR.2018 15:47:59

## Power Spectral Density, 802.11g Low Channel



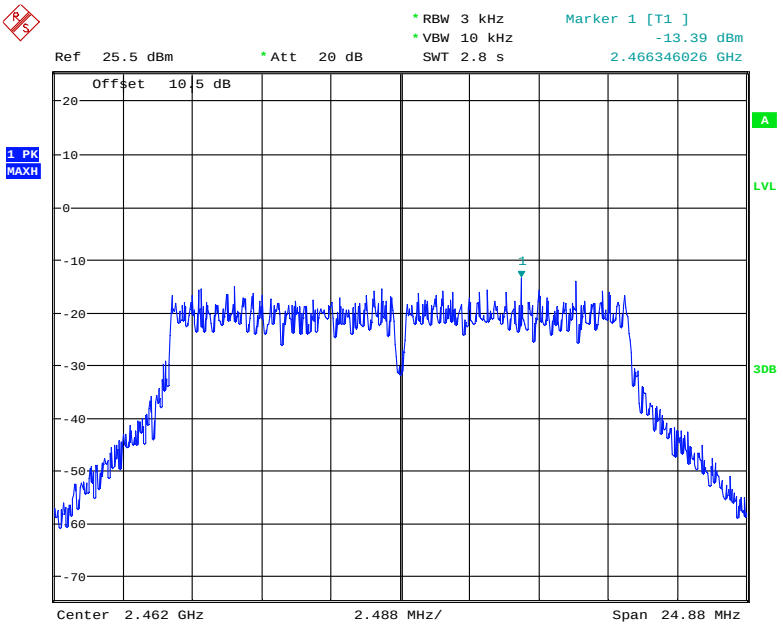

Date: 8.MAR.2018 15:51:20

## Power Spectral Density, 802.11g Middle Channel



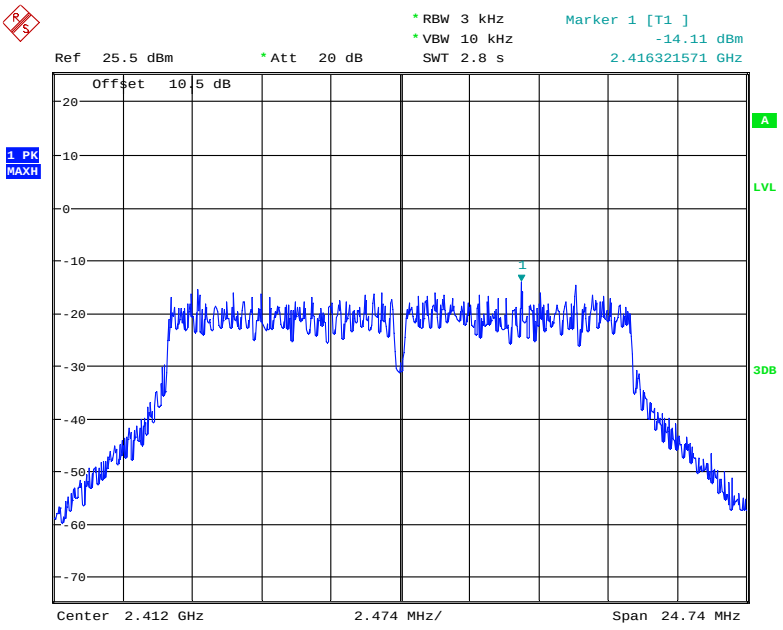

Date: 8.MAR.2018 15:56:59

## Power Spectral Density, 802.11g High Channel



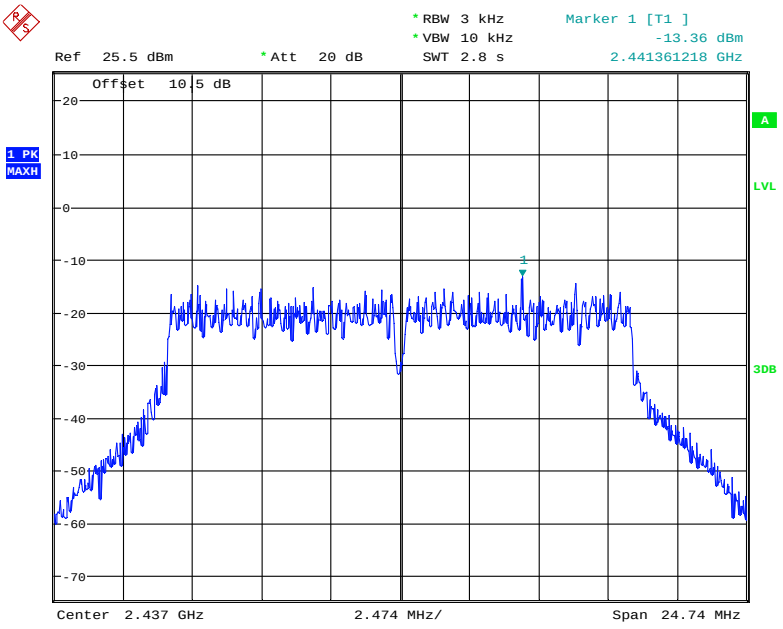

Date: 8.MAR.2018 15:58:37

## Power Spectral Density, 802.11n-HT20 Low Channel



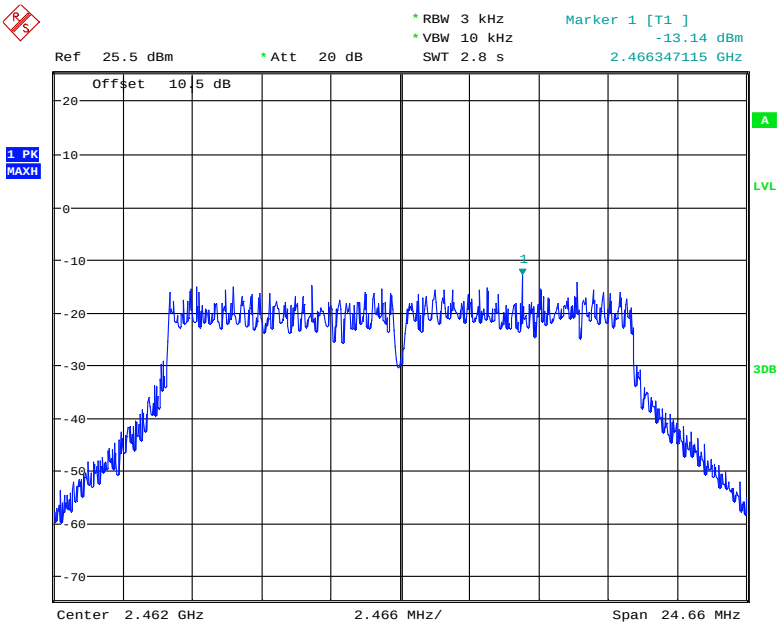

Date: 8.MAR.2018 16:02:52

## Power Spectral Density, 802.11n-HT20 Middle Channel



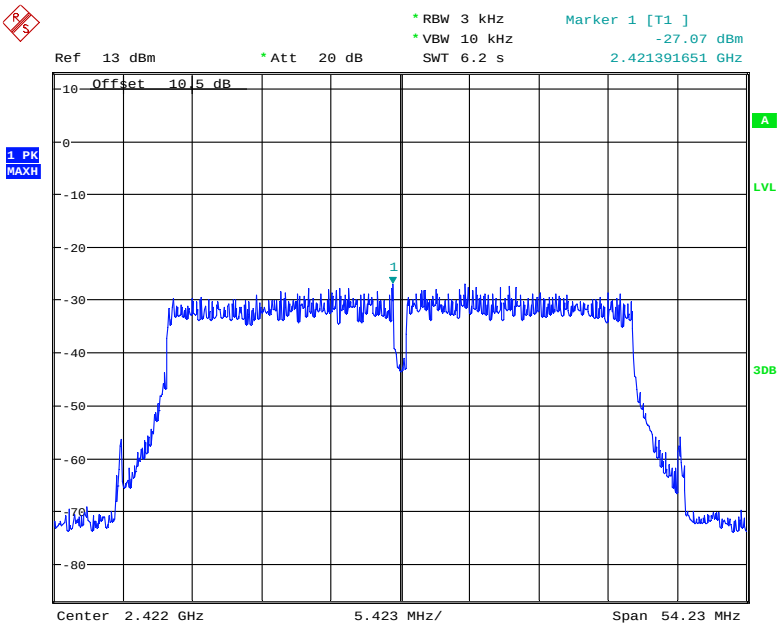

Date: 8.MAR.2018 16:04:29

## Power Spectral Density, 802.11n-HT20 High Channel



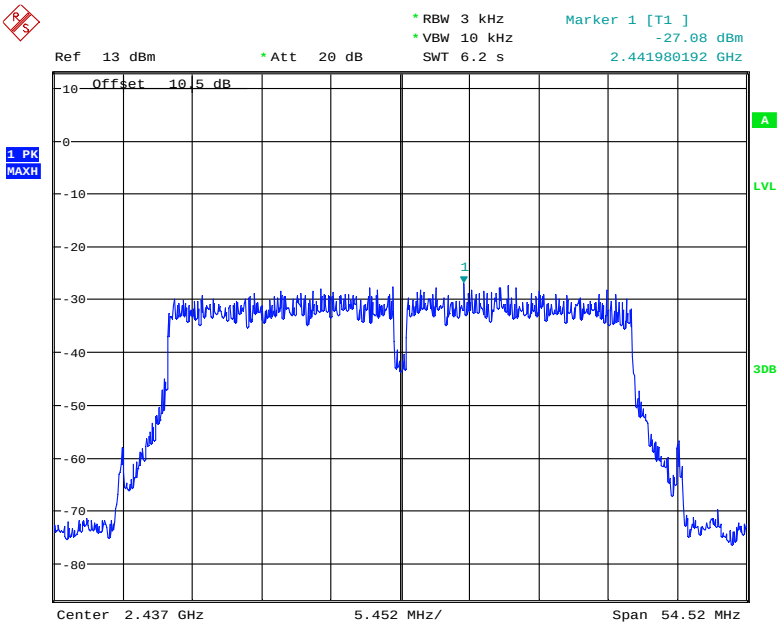

Date: 8.MAR.2018 16:05:50

## Power Spectral Density, 802.11n-HT40 Low Channel



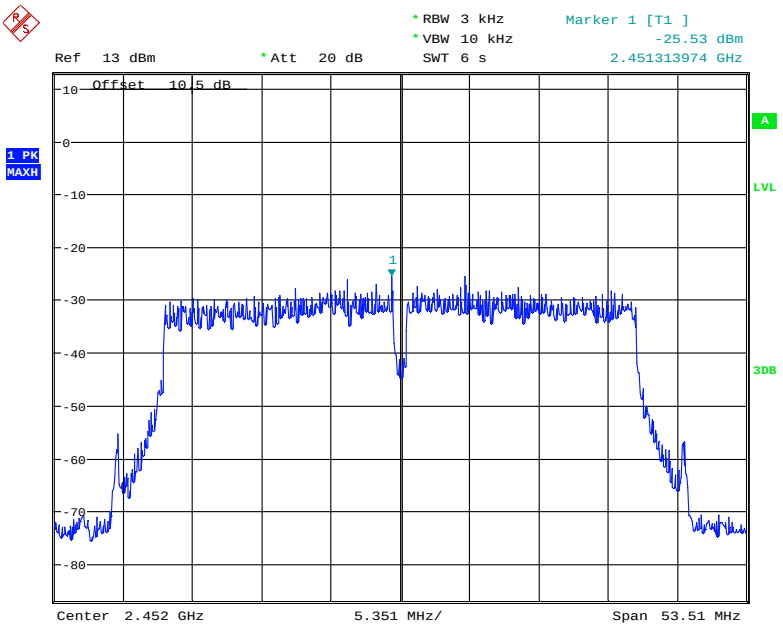

Date: 8.MAR.2018 16:11:53

## Power Spectral Density, 802.11n-HT40 Middle Channel



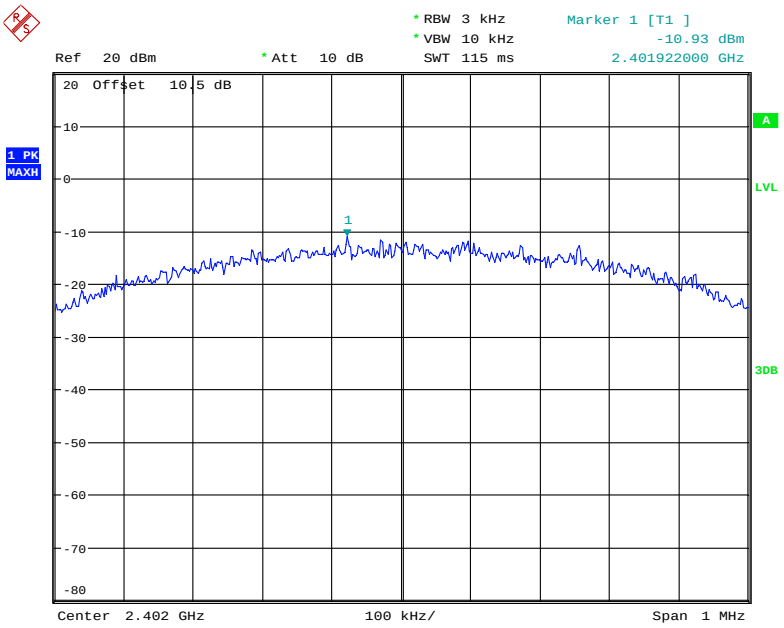

Date: 8.MAR.2018 16:13:52

## Power Spectral Density, 802.11n-HT40 High Channel



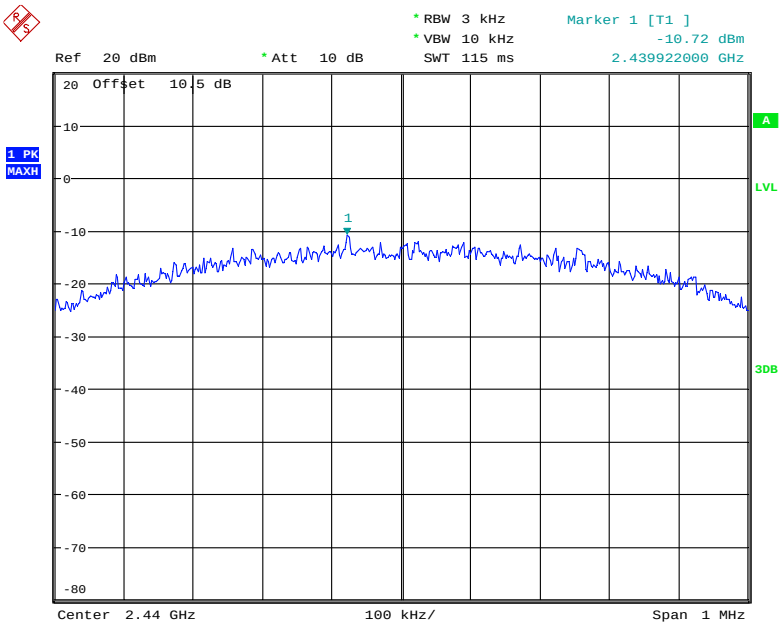

Date: 8.MAR.2018 16:17:00

## Power Spectral Density, BLE Low Channel



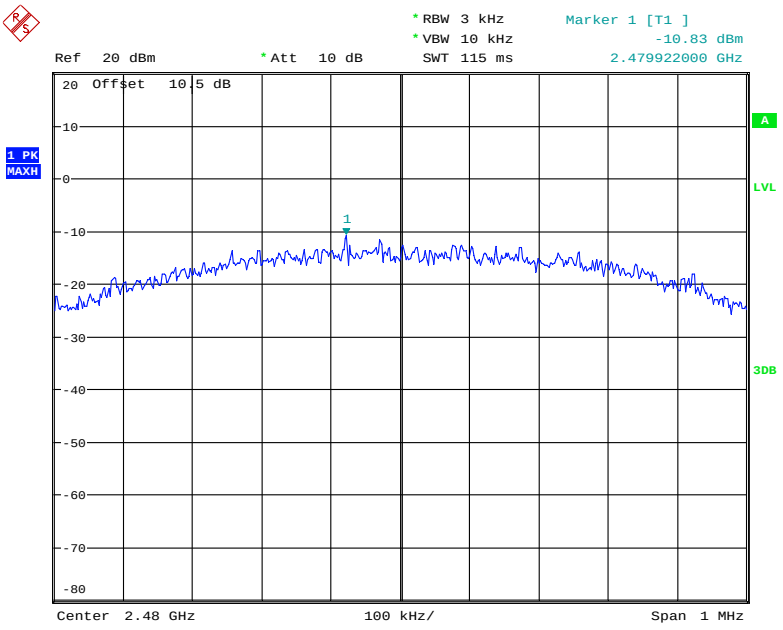

Date: 1.FEB.2018 21:16:10

## Power Spectral Density, BLE Middle Channel




Date: 1.FEB.2018 21:20:34

## Power Spectral Density, BLE High Channel




Date: 1.FEB.2018 21:21:16

******* END OF REPORT *******