TESTING LABORATORY
CERTIFICATE #4820.01

# FCC PART 15.247

# RSS-GEN, ISSUE 5, APRIL 2018

# RSS-247, ISSUE 2, FEBRUARY 2017

# TEST REPORT

For

## Beijing Penslink Co.,Ltd

502 Room,2 Building,6th Yard, Fuandonglu Street, Chaoyang District Beijing, China

**FCC ID: 2AQXJ-P0102A**
**IC: 24286-P0102A**

| **Report Type:** | **Product Name:** |
|---|---|
| Original Report | Petfon |

| | |
|---|---|
| **Report Number:** | RDG180628007-00B |
| **Report Date:** | 2018-10-24 |
| **Reviewed By:** | Jerry Zhang<br>EMC Manager<br>Jerry Zhang |
| **Test Laboratory:** | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industry Area,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br>www.baclcorp.com.cn |

**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan). This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*".

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| **EUT Name:** | Petfon |
| **EUT Model:** | P0102A, P0102B |
| **FCC ID:** | 2AQXJ-P0102A |
| **IC:** | 24286-P0102A |
| **Rated Input Voltage:** | DC 3.7V from battery or DC 5V charged by Charger box(Controller)<br>DC 3.7V from battery or DC 5V charged by Charger box(Tracker) |
| **External Dimension:** | 42mm(L)* 42mm(W)* 18mm(H) (Controller)<br>42mm(L)* 42mm(W)* 18mm(H) (Tracker) |
| **Serial Number:** | 180628007-1 (Controller)<br>180628007-2(Tracker) |
| **EUT Received Date:** | 2018.06.28 |

Note: the Controller and Tracker have identical schematics and PCB layout, only antenna, keys and appearance different, test performed at both unit for AC Line Conducted Emissions and Radiation Spurious emissions, other test items only performed at Controller.

## Objective

This report is prepared on behalf of ***Beijing Penslink Co.,Ltd*** in accordance with Part 2, Subpart J, Part 15, Subparts A, and C of the Federal Communications Commission's rules and RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, April 2018 of the Innovation, Science and Economic Development Canada.

The tests were performed in order to determine the compliance of the EUT with FCC Rules Part 15-Subpart C, section 15.203, 15.205,15.207, 15.209, 15.247 rules and RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, April 2018 of the Innovation, Science and Economic Development Canada.

## 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 KDB 558074 D01 15.247 Meas Guidance v05, and RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, April 2018 of the Innovation, Science and Economic Development Canada.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

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## Measurement Uncertainty

| Parameter | Measurement Uncertainty |
|---|---|
| Occupied Channel Bandwidth | ±5 % |
| RF output power, conducted | ±0.61dB |
| Power Spectral Density, conducted | ±0.61 dB |
| Unwanted Emissions, radiated | 30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB,<br>1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,<br>18G~26.5G:5.47 dB,26.5G~40G:5.63 dB |
| Unwanted Emissions, conducted | ±1.5 dB |
| Temperature | ±1℃ |
| Humidity | ±5% |
| DC and low frequency voltages | ±0.4% |
| Duty Cycle | 1% |
| AC Power Lines Conducted Emission | 3.12 dB (150 kHz to 30 MHz) |

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, 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. : 897218,the FCC Designation No. : CN1220.

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

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# SYSTEM TEST CONFIGURATION

## Description of Test Configuration

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

For 2.4GHz band, total 11 channels are provided:

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

For 802.11b, 802.11g, and 802.11n ht20 modes were test with channel 1,6,11. For 802.11n ht40 mode was tested with channel 3, 6, 9.

The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations.

For Bluetooth LE mode, 40 channels are provided for testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|
| 0 | 2402 | 20 | 2442 |
| 1 | 2404 | … | … |
| … | … | … | … |
| … | … | … | … |
| .. | … | 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.

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## EUT Exercise Software

The software "wifi_Tool" was used for testing, which was provided by manufacturer. The maximum power was configured as below table, that provided by the manufacturer:

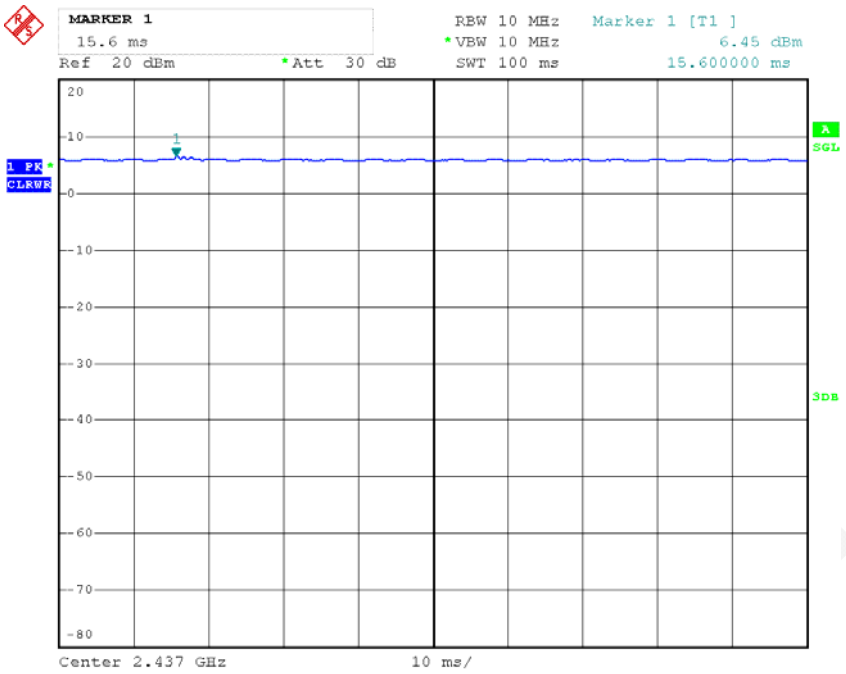
| Mode | Channel | Frequency (MHz) | Data Rate | Power level |
|---|---|---|---|---|
| 802.11b | Low | 2412 | 1Mbps | 46 |
| | Middle | 2437 | 1Mbps | 42 |
| | High | 2462 | 1Mbps | 37 |
| 802.11g | Low | 2412 | 6Mbps | 46 |
| | Middle | 2437 | 6Mbps | 42 |
| | High | 2462 | 6Mbps | 46 |
| 802.11n ht20 | Low | 2412 | MCS0 | 46 |
| | Middle | 2437 | MCS0 | 46 |
| | High | 2462 | MCS0 | 46 |
| 802.11n ht40 | Low | 2422 | MCS0 | 46 |
| | Middle | 2437 | MCS0 | 48 |
| | High | 2452 | MCS0 | 49 |

Bluetooth LE mode was configured by the system default setting

The maximum duty cycle as following table:

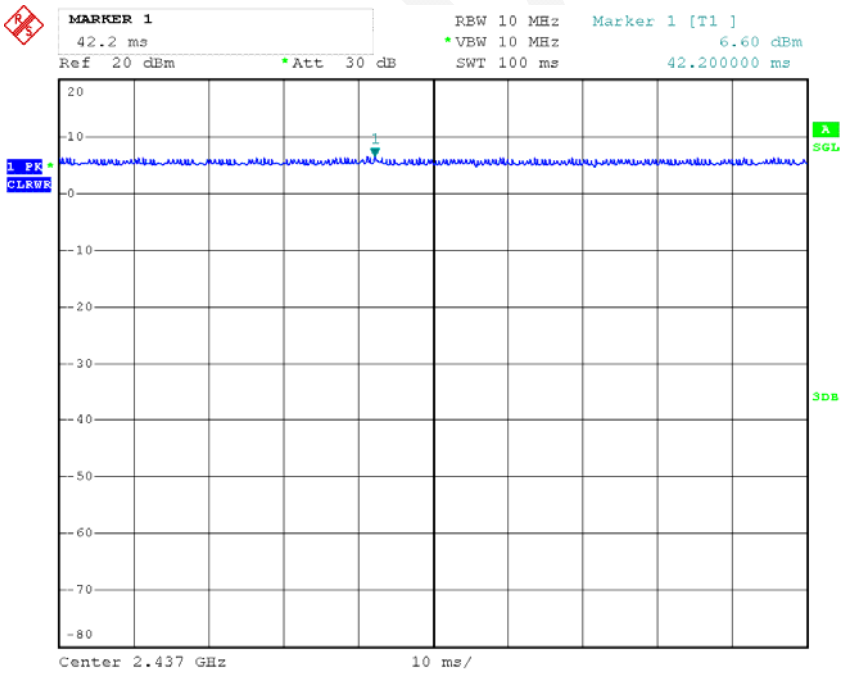
| Test mode | $T_{on}$ (ms) | $T_{on+off}$ (ms) | Duty Cycle (%) |
|---|---|---|---|
| 802.11b | 100 | 100 | 100 |
| 802.11g | 100 | 100 | 100 |
| 802.11n ht20 | 100 | 100 | 100 |
| 802.11n ht40 | 100 | 100 | 100 |
| BLE | 0.415 | 0.630 | 65.87 |

**802.11b**



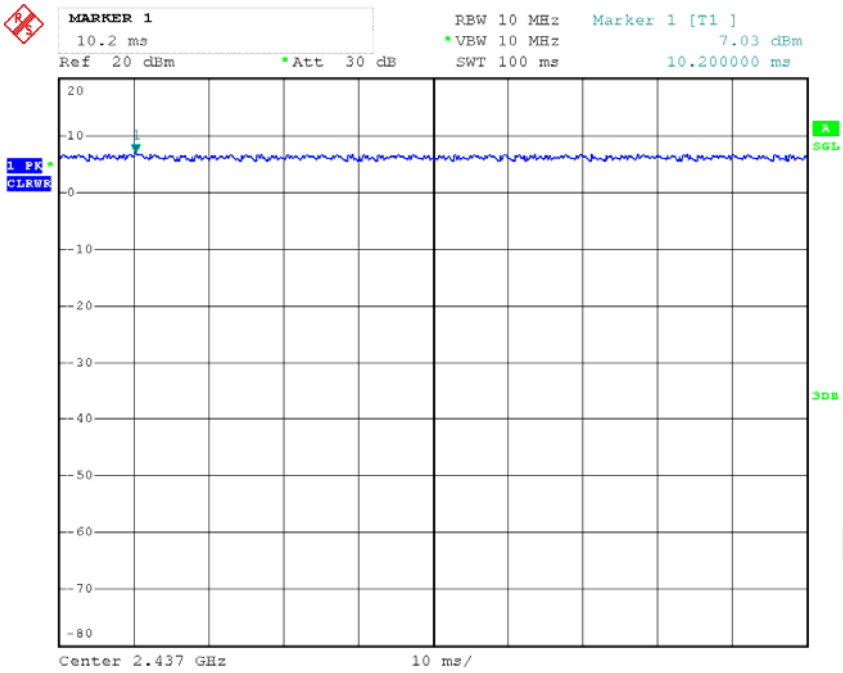

Date: 13.JUL.2018 08:58:45

**802.11g**



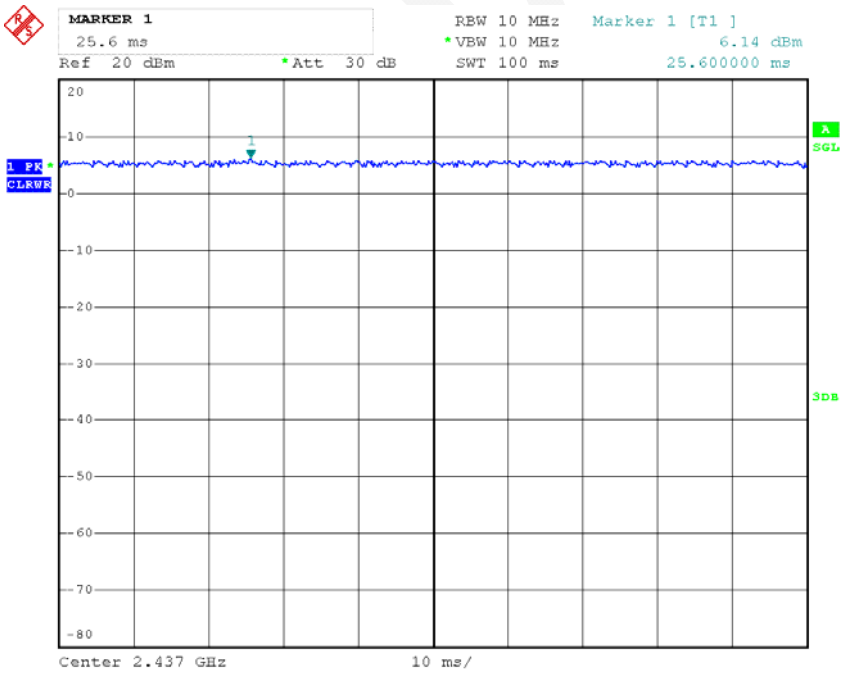

Date: 13.JUL.2018 08:58:24

**802.11n ht20**



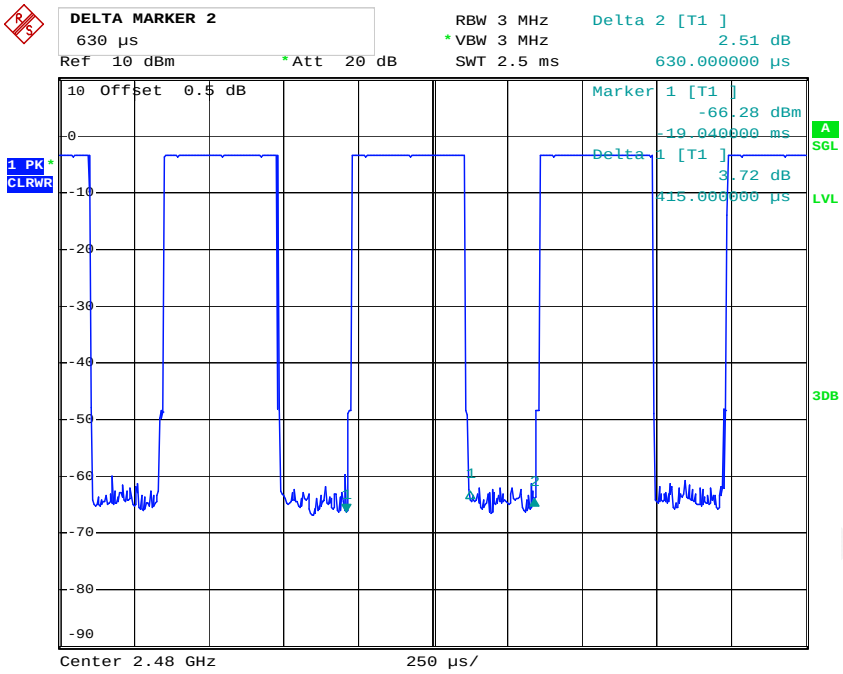

Date: 13.JUL.2018 08:59:19

**802.11n ht40**




Date: 13.JUL.2018 08:59:56

**BLE**




Date: 12.JUL.2018 22:22:42

## Equipment Modifications

No modification was made to the EUT.

## Support Equipment List and Details

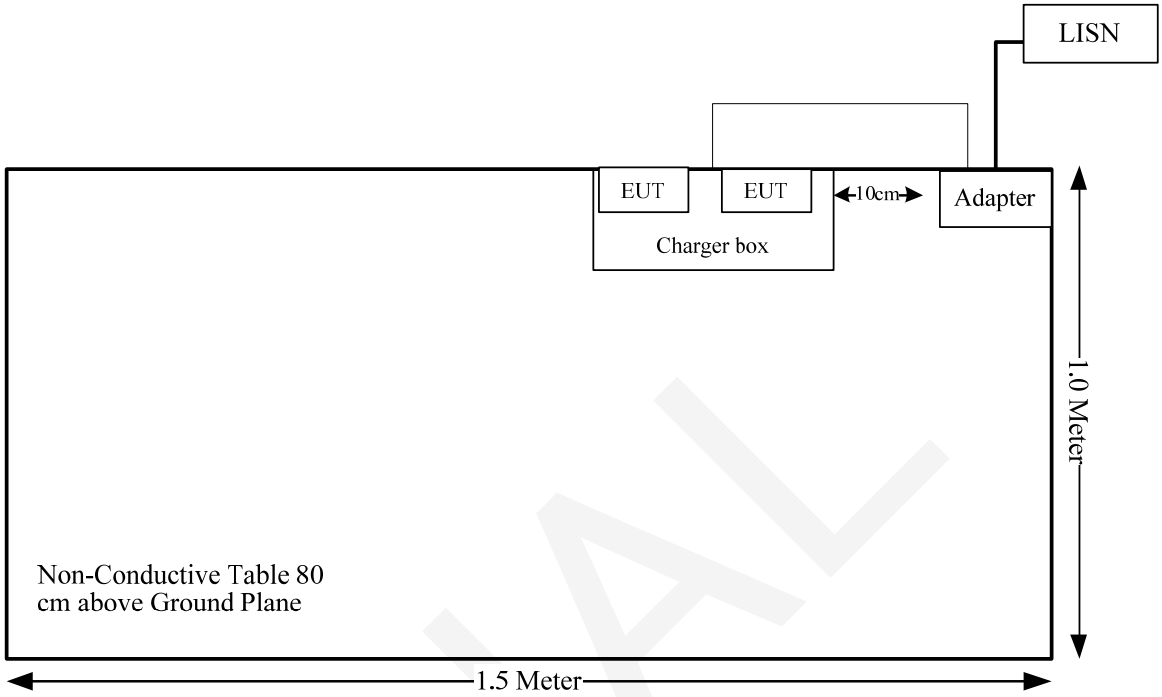
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Huawei | adapter | HW-050200C3W | H333L5FM06947 |

## Support Cable List and Details

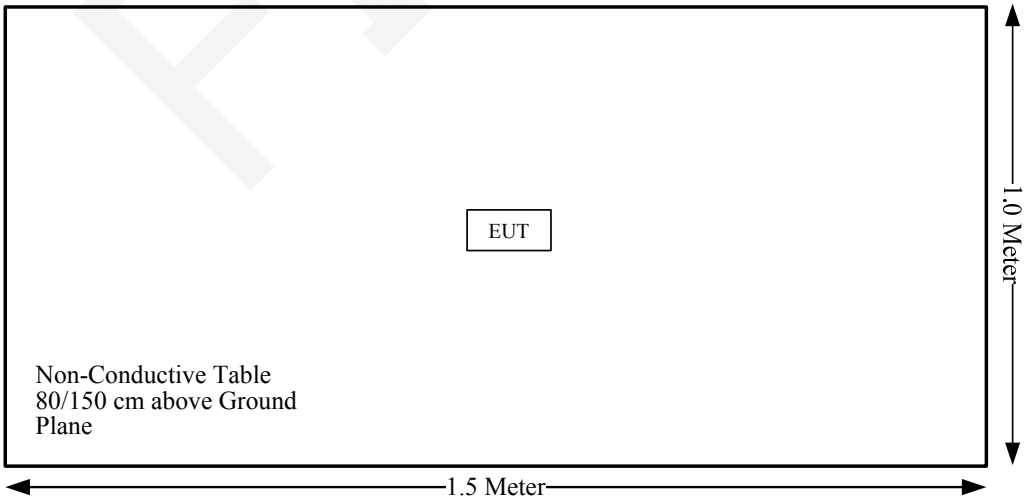
| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port | To |
|---|---|---|---|---|---|
| USB cable | no | no | 0.8 | adapter | charger box |

## Block Diagram of Test Setup

AC Line Conducted Emissions:




Radiated Emissions:

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# SUMMARY OF TEST RESULTS

| Rules | Description of Test | Result |
|---|---|---|
| FCC §15.247 (i) & §1.1310 & §2.1093 | RF Exposure | Compliance |
| RSS-102 §2.5.1 | Exemption Limits for Routine Evaluation -SAR Evaluation | Compliance |
| FCC§15.203,<br>RSS-Gen Clause 6.8 | Antenna Requirement | Compliance |
| FCC§15.207 (a),<br>RSS-Gen Clause 8.8 | AC Line Conducted Emissions | Compliance |
| FCC§15.205, §15.209,<br>FCC §15.247(d),<br>RSS-247 Clause 5.5<br>RSS-Gen Clause 8.10 | Spurious Emissions | Compliance |
| FCC§15.247 (a)(2),<br>RSS-247 Clause 5.2 a)<br>RSS-Gen Clause 6.7 | 6 dB Bandwidth | Compliance |
| FCC§15.247(b)(3),<br>RSS-247 Clause 5.4 d) | Maximum Conducted Output Power | Compliance |
| FCC§15.247(d),<br>RSS-247 Clause5.5 | 100 kHz Bandwidth of Frequency Band Edge | Compliance |
| FCC§15.247(e),<br>RSS-247 Clause5.2 b) | Power Spectral Density | Compliance |

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# FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE

## Applicable Standard

According to§15.247(i) and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

**Measurement Result**

**For Bluetooth LE mode:**

The max conducted power including tune-up tolerance is -3.0 dBm (0.5 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=0.5/5*(√2.480) = 0.2< 3.0

**So the stand-alone SAR evaluation is not necessary.**

**For WIFI:**

**Please refer to the SAR report: RDG180628007-20**

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# RSS-102 § 2.5.1 EXEMPTION LIMITS FOR ROUTINE EVALUATION – SAR EVALUATION

## Applicable Standard

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

**Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance[4,5]**

| Frequency (MHz) | Exemption Limits (mW) | | | | |
|---|---|---|---|---|---|
| | At separation distance of ≤5 mm | At separation distance of 10 mm | At separation distance of 15 mm | At separation distance of 20 mm | At separation distance of 25 mm |
| ≤300 | 71 mW | 101 mW | 132 mW | 162 mW | 193 mW |
| 450 | 52 mW | 70 mW | 88 mW | 106 mW | 123 mW |
| 835 | 17 mW | 30 mW | 42 mW | 55 mW | 67 mW |
| 1900 | 7 mW | 10 mW | 18 mW | 34 mW | 60 mW |
| 2450 | 4 mW | 7 mW | 15 mW | 30 mW | 52 mW |
| 3500 | 2 mW | 6 mW | 16 mW | 32 mW | 55 mW |
| 5800 | 1 mW | 6 mW | 15 mW | 27 mW | 41 mW |

| Frequency (MHz) | Exemption Limits (mW) | | | | |
|---|---|---|---|---|---|
| | At separation distance of 30 mm | At separation distance of 35 mm | At separation distance of 40 mm | At separation distance of 45 mm | At separation distance of ≥50 mm |
| ≤300 | 223 mW | 254 mW | 284 mW | 315 mW | 345 mW |
| 450 | 141 mW | 159 mW | 177 mW | 195 mW | 213 mW |
| 835 | 80 mW | 92 mW | 105 mW | 117 mW | 130 mW |
| 1900 | 99 mW | 153 mW | 225 mW | 316 mW | 431 mW |
| 2450 | 83 mW | 123 mW | 173 mW | 235 mW | 309 mW |
| 3500 | 86 mW | 124 mW | 170 mW | 225 mW | 290 mW |
| 5800 | 56 mW | 71 mW | 85 mW | 97 mW | 106 mW |

## Measurement Result:

**For Bluetooth LE mode:**
The maximum output power including tune up tolerance is -3.0 dBm, which was declared by manufacturer. The antenna gain is 1.0 dBi, so the EIRP=-3.0+1.0= -2.0dBm(0.63 mW)

The exemption power(P) limits for routine evaluation in 2402-2480MHz is:
(2480-2450)/(3500-2450)=(4-P)/(4-2)
=>P=3.96 mW@2480MHz
> 0.63 mW

So the SAR evaluation can be exempted.

**For WIFI:**

Please refer to the SAR report: RDG180628007-20

# FCC §15.203& RSS-GEN CLAUSE 6.8 - ANTENNA REQUIREMENT

## Applicable Standard

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

According to RSS-Gen §6.8, The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

*This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.*

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

## Antenna Information And Connector Construction

Both Controller and Tracker have 3 internal antenna, fulfill the requirement of this section. Please refer to the EUT photos and below information.

| Unit | Antenna | Antenna Type | Connector Type | input impedance (Ohm) | Antenna Gain /Frequency |
|---|---|---|---|---|---|
| Controller | Lora | FPC | ejector pin | 50 | 3.0 dBi/ 902-928MHz |
| | WIFI | Ceramic | Welded | 50 | 1.0 dBi/ 2.4-2.5GHz |
| | BT | Ceramic | Welded | 50 | 1.0 dBi/ 2.4-2.5GHz |
| Tracker | Lora | FPC | ejector pin | 50 | 3.0 dBi/ 902-928MHz |
| | WIFI | Ceramic | Welded | 50 | 1.0 dBi/ 2.4-2.5GHz |
| | BT | Ceramic | Welded | 50 | 1.0 dBi/ 2.4-2.5GHz |

**Result:** Compliance.

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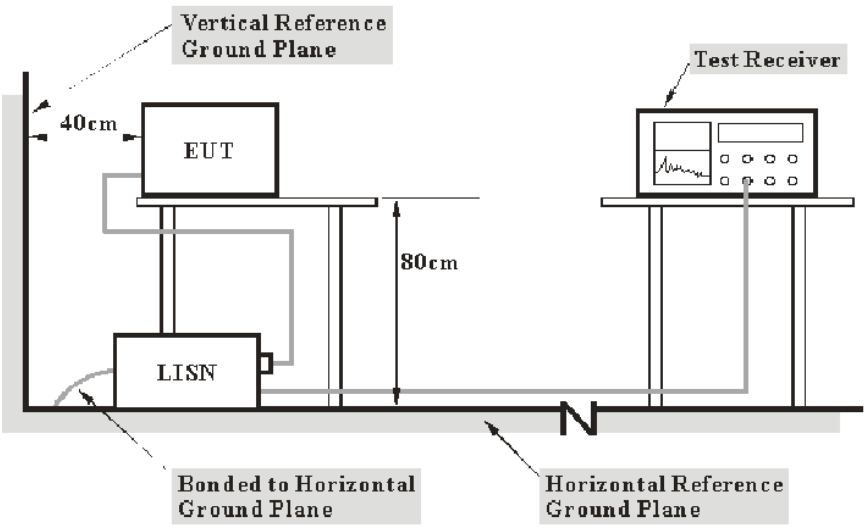
# FCC §15.207 (a) & RSS-GEN CLAUSE 8.8– AC LINE CONDUCTED EMISSIONS

## Applicable Standard

FCC§15.207(a), RSS-Gen§8.8.

## 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 and the RSS-Gen limits.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main lisn with a 120 V/60 Hz AC power source.

## 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 first LISN.

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

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

## Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$
$C_f = A_C + VDF$

Herein,
$V_C$ (cord. Reading): corrected voltage amplitude
$V_R$: reading voltage amplitude
$A_c$: attenuation caused by cable loss
VDF: voltage division factor of AMN
$C_f$: Correction Factor

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESCS 30 | 830245/006 | 2017-12-11 | 2018-12-11 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0200-01 | 2018-09-05 | 2019-09-05 |
| R&S | Test Software | EMC32 | Version8.53.0 | N/A | N/A |
| R&S | Two-line V-network | ENV 216 | 101614 | 2017-12-08 | 2018-12-08 |

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

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## Test Data

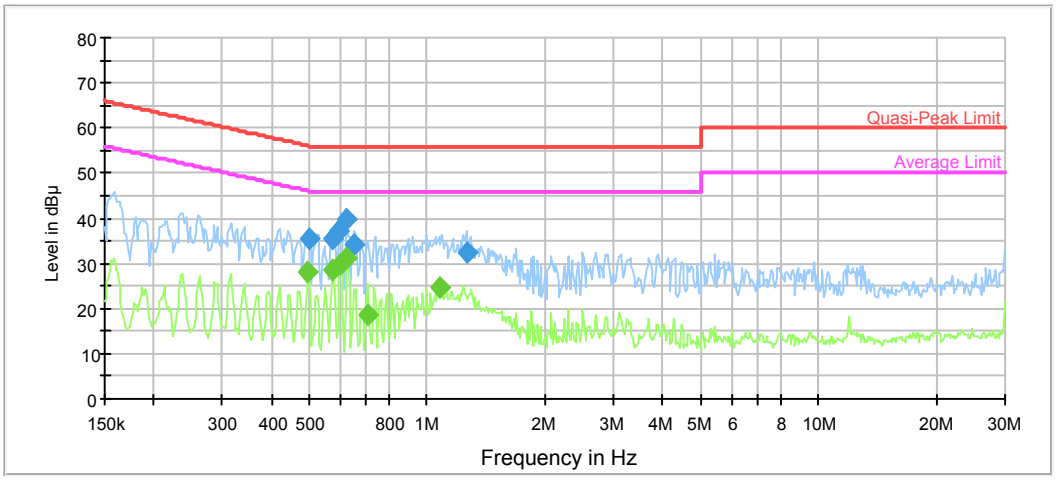
### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27.6°C |
| **Relative Humidity:** | 50 % |
| **ATM Pressure:** | 100.6 kPa |

*The testing was performed by Alex You on 2018-09-08.*

*Test Mode: Transmitting (Wi-Fi mode 802.11b middle channel was the worst)*

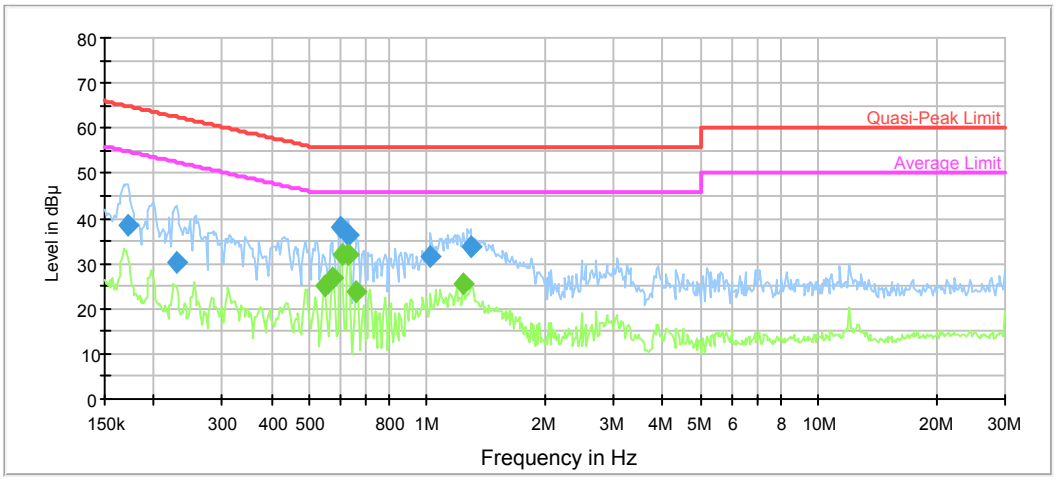
### AC120 V, 60 Hz, Line:




| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|
| 0.499611 | 35.3 | 9.000 | L1 | 9.9 | 20.7 | 56.0 | Compliance |
| 0.572086 | 35.3 | 9.000 | L1 | 9.8 | 20.7 | 56.0 | Compliance |
| 0.595338 | 37.0 | 9.000 | L1 | 9.8 | 19.0 | 56.0 | Compliance |
| 0.624492 | 39.7 | 9.000 | L1 | 9.8 | 16.3 | 56.0 | Compliance |
| 0.649874 | 34.1 | 9.000 | L1 | 9.8 | 21.9 | 56.0 | Compliance |
| 1.259081 | 32.3 | 9.000 | L1 | 9.8 | 23.7 | 56.0 | Compliance |

| Frequency (MHz) | Average (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|
| 0.495646 | 28.1 | 9.000 | L1 | 9.9 | 18.0 | 46.1 | Compliance |
| 0.576662 | 28.4 | 9.000 | L1 | 9.8 | 17.6 | 46.0 | Compliance |
| 0.600101 | 29.6 | 9.000 | L1 | 9.8 | 16.4 | 46.0 | Compliance |
| 0.624492 | 31.2 | 9.000 | L1 | 9.8 | 14.8 | 46.0 | Compliance |
| 0.703777 | 18.8 | 9.000 | L1 | 9.8 | 27.2 | 46.0 | Compliance |
| 1.082190 | 24.7 | 9.000 | L1 | 9.8 | 21.3 | 46.0 | Compliance |

**AC120 V, 60 Hz, Neutral:**




| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|
| 0.171759 | 38.5 | 9.000 | N | 10.9 | 26.4 | 64.9 | Compliance |
| 0.228823 | 30.5 | 9.000 | N | 10.4 | 32.0 | 62.5 | Compliance |
| 0.600101 | 38.3 | 9.000 | N | 9.8 | 17.7 | 56.0 | Compliance |
| 0.629488 | 36.4 | 9.000 | N | 9.8 | 19.6 | 56.0 | Compliance |
| 1.023481 | 31.6 | 9.000 | N | 9.8 | 24.4 | 56.0 | Compliance |
| 1.289541 | 33.7 | 9.000 | N | 9.8 | 22.3 | 56.0 | Compliance |

| Frequency (MHz) | Average (dBµV) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|
| 0.545378 | 25.2 | 9.000 | N | 9.8 | 20.8 | 46.0 | Compliance |
| 0.576662 | 27.0 | 9.000 | N | 9.8 | 19.0 | 46.0 | Compliance |
| 0.604902 | 32.0 | 9.000 | N | 9.8 | 14.0 | 46.0 | Compliance |
| 0.629488 | 32.1 | 9.000 | N | 9.8 | 13.9 | 46.0 | Compliance |
| 0.660314 | 23.8 | 9.000 | N | 9.8 | 22.2 | 46.0 | Compliance |
| 1.239175 | 25.5 | 9.000 | N | 9.8 | 20.5 | 46.0 | Compliance |

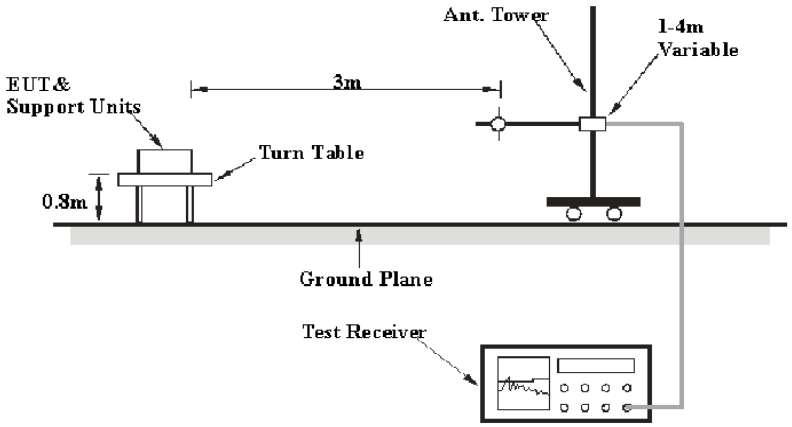
# FCC §15.209, §15.205, §15.247(d) & RSS-247 CLAUSE 5.5, RSS-GEN CLAUSE 8.10- SPURIOUS EMISSIONS

## Applicable Standard

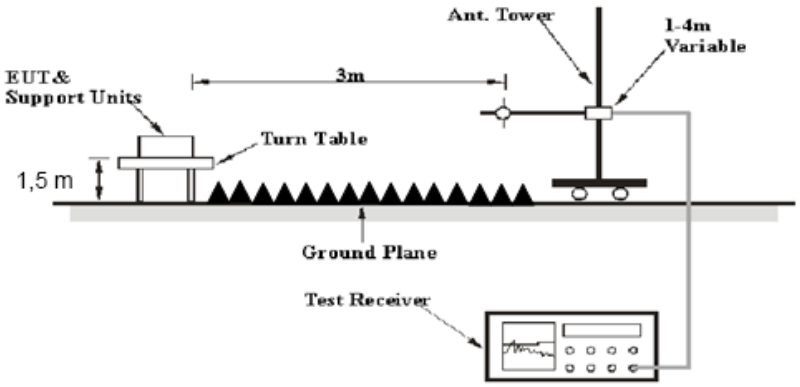
FCC §15.247 (d); §15.209; §15.205, RSS-247 §5.5, RSS-GEN §8.10.

## EUT Setup

**Below 1GHz:**




**Above 1GHz:**




The radiated emission tests were performed in the 3 meters chamber test site A for the range 30MHz to 1GHz and the 3 meters chamber A test site for above 1GHz, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247, the RSS-247 §5.5,RSS-Gen §8.10 limits..

The spacing between the peripherals was 10 cm.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz.

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

30MHz-1000MHz:

| Measurement | RBW | Video B/W | IF B/W |
|---|---|---|---|
| QP | 120 kHz | 300 kHz | 120kHz |

1GHz- 26.5GHz:

| Measurement | Duty cycle | RBW | Video B/W |
|---|---|---|---|
| PK | Any | 1MHz | 3 MHz |
| Ave. | >98% | 1MHz | 10 Hz |
| | <98% | 1MHz | 1/T |

Note: T is minimum transmission duration

## 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 Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESCI | 100224 | 2017-12-11 | 2018-12-11 |
| Sunol Sciences | Antenna | JB3 | A060611-1 | 2017-11-10 | 2020-11-10 |
| Farad | Test Software | EZ-EMC | V1.1.4.2 | N/A | N/A |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0400-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0075-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-1000-01 | 2018-09-05 | 2019-09-05 |
| HP | Amplifier | 8447D | 2727A05902 | 2018-09-05 | 2019-09-05 |
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 831929/005 | 2018-08-31 | 2019-08-31 |
| TDK RF | Horn Antenna | HRN-0118 | 130 084 | 2016-01-05 | 2019-01-04 |
| MICRO-COAX | Coaxial Cable | UFA147-1-2362-100100 | 64639 231029-001 | 2018-02-24 | 2019-02-28 |
| Mini | Pre-amplifier | ZVA-183-S+ | 5969001149 | 2018-09-05 | 2019-09-05 |
| E-Microwave | Band-stop Filters | OBSF-2400-2483.5-S | OE01601525 | 2018-06-16 | 2019-06-16 |
| Micro-tronics | High Pass Filter | HPM50111 | S/N-G217 | 2018-06-16 | 2019-06-16 |
| MITEQ | Amplifier | AFS42-00101800-25-S-42 | 2001271 | 2018-09-05 | 2019-09-05 |
| Quinstar | Amplifier | QLW-18405536-JO | 15964001001 | 2018-06-27 | 2019-06-27 |

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

## Test Data

### Environmental Conditions

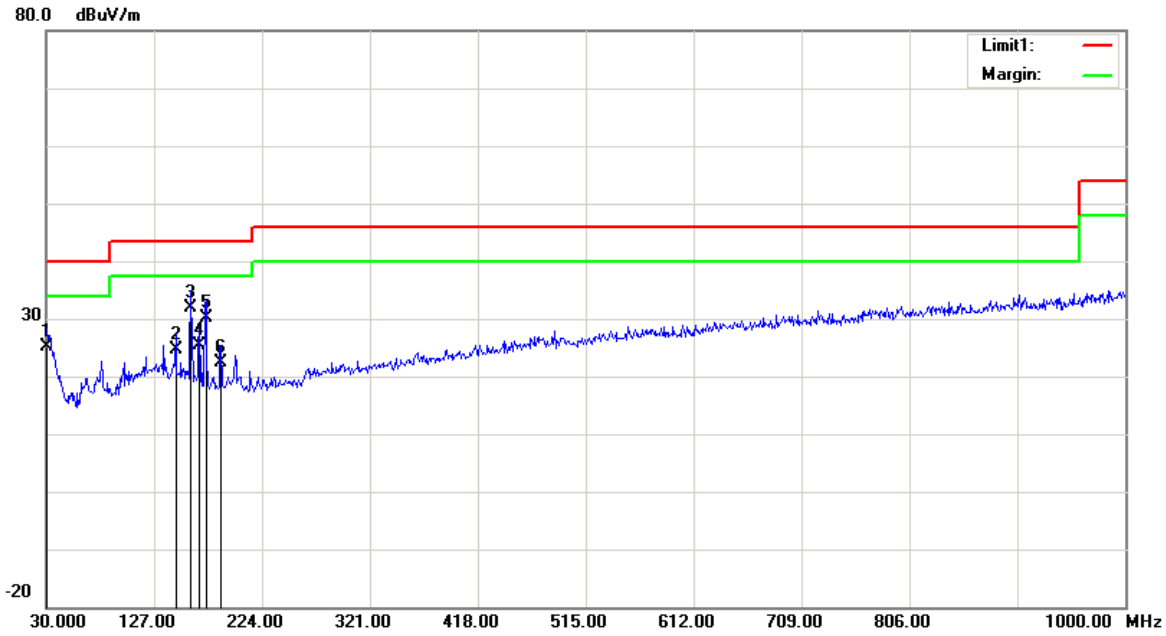
| | |
|---|---|
| **Temperature:** | 26.4~27.7 °C |
| **Relative Humidity:** | 40~44 % |
| **ATM Pressure:** | 100~100.7kPa |

** The testing was performed by Sunny Cen & Vern Shen on 2018-07-13~2018-09-18.*

*Test Mode: Transmitting*

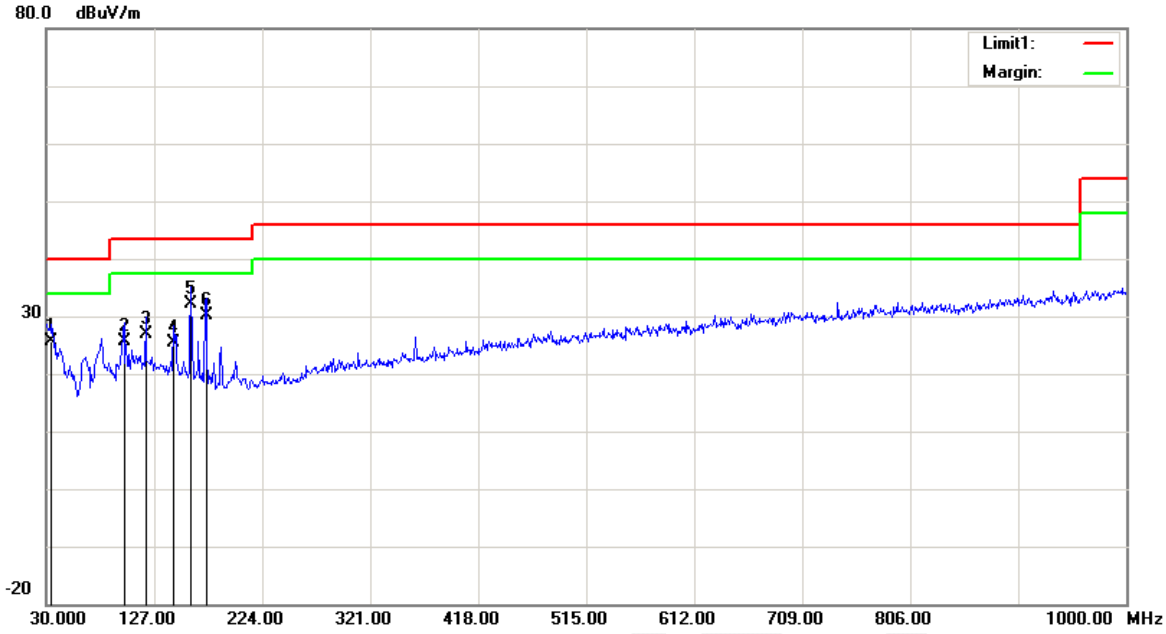
**1) 30MHz-1GHz** (802.11g Low channel was the worst):

**Horizontal:**




| Frequency (MHz) | Receiver Reading (dBuV) | Detector | Correction Factor (dB/m) | Cord. Amp. (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30.9700 | 24.35 | QP | 0.85 | 25.20 | 40.00 | 14.80 |
| 146.4000 | 30.70 | QP | -6.00 | 24.70 | 43.50 | 18.80 |
| 159.9800 | 37.73 | QP | -5.83 | 31.90 | 43.50 | 11.60 |
| 167.7400 | 31.67 | QP | -6.37 | 25.30 | 43.50 | 18.20 |
| 173.5600 | 36.95 | QP | -6.85 | 30.10 | 43.50 | 13.40 |
| 187.1400 | 29.50 | QP | -7.20 | 22.30 | 43.50 | 21.20 |

**Vertical:**




| Frequency (MHz) | Receiver Reading (dBuV) | Detector | Correction Factor (dB/m) | Cord. Amp. (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 34.8500 | 27.64 | QP | -2.04 | 25.60 | 40.00 | 14.40 |
| 99.8400 | 34.59 | QP | -8.89 | 25.70 | 43.50 | 17.80 |
| 119.2400 | 31.69 | QP | -4.89 | 26.80 | 43.50 | 16.70 |
| 144.4600 | 31.33 | QP | -5.93 | 25.40 | 43.50 | 18.10 |
| 159.9800 | 37.93 | QP | -5.83 | 32.10 | 43.50 | 11.40 |
| 173.5600 | 36.95 | QP | -6.85 | 30.10 | 43.50 | 13.40 |

**2) 1-26.5GHz:**

**802.11b Mode:**

| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | Detector | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2412 MHz | | | | | | | | | |
| 2412.00 | 70.31 | PK | H | 24.84 | 3.35 | 0.00 | 98.50 | N/A | N/A |
| 2412.00 | 65.12 | AV | H | 24.84 | 3.35 | 0.00 | 93.31 | N/A | N/A |
| 2412.00 | 62.48 | PK | V | 24.84 | 3.35 | 0.00 | 90.67 | N/A | N/A |
| 2412.00 | 57.34 | AV | V | 24.84 | 3.35 | 0.00 | 85.53 | N/A | N/A |
| 2390.00 | 29.65 | PK | H | 24.80 | 3.33 | 0.00 | 57.78 | 74.00 | 16.22 |
| 2390.00 | 15.68 | AV | H | 24.80 | 3.33 | 0.00 | 43.81 | 54.00 | 10.19 |
| 4824.00 | 46.72 | PK | H | 29.75 | 4.58 | 27.41 | 53.64 | 74.00 | 20.36 |
| 4824.00 | 39.85 | AV | H | 29.75 | 4.58 | 27.41 | 46.77 | 54.00 | 7.23 |
| 7236.00 | 42.72 | PK | H | 33.98 | 5.62 | 27.22 | 55.10 | 74.00 | 18.90 |
| 7236.00 | 35.27 | AV | H | 33.98 | 5.62 | 27.22 | 47.65 | 54.00 | 6.35 |
| Middle Channel: 2437 MHz | | | | | | | | | |
| 2437.00 | 68.64 | PK | H | 24.89 | 3.36 | 0.00 | 96.89 | N/A | N/A |
| 2437.00 | 64.57 | AV | H | 24.89 | 3.36 | 0.00 | 92.82 | N/A | N/A |
| 2437.00 | 60.38 | PK | V | 24.89 | 3.36 | 0.00 | 88.63 | N/A | N/A |
| 2437.00 | 54.85 | AV | V | 24.89 | 3.36 | 0.00 | 83.10 | N/A | N/A |
| 4874.00 | 45.00 | PK | H | 29.85 | 4.57 | 27.54 | 51.88 | 74.00 | 22.12 |
| 4874.00 | 38.63 | AV | H | 29.85 | 4.57 | 27.54 | 45.51 | 54.00 | 8.49 |
| 7311.00 | 42.91 | PK | H | 34.10 | 5.68 | 27.28 | 55.41 | 74.00 | 18.59 |
| 7311.00 | 34.83 | AV | H | 34.10 | 5.68 | 27.28 | 47.33 | 54.00 | 6.67 |
| High Channel: 2462 MHz | | | | | | | | | |
| 2462.00 | 66.77 | PK | H | 24.93 | 3.37 | 0.00 | 95.07 | N/A | N/A |
| 2462.00 | 61.89 | AV | H | 24.93 | 3.37 | 0.00 | 90.19 | N/A | N/A |
| 2462.00 | 54.84 | PK | V | 24.93 | 3.37 | 0.00 | 83.14 | N/A | N/A |
| 2462.00 | 49.37 | AV | V | 24.93 | 3.37 | 0.00 | 77.67 | N/A | N/A |
| 2483.50 | 29.34 | PK | H | 24.97 | 3.38 | 0.00 | 57.69 | 74.00 | 16.31 |
| 2483.50 | 16.52 | AV | H | 24.97 | 3.38 | 0.00 | 44.87 | 54.00 | 9.13 |
| 4924.00 | 45.72 | PK | H | 29.95 | 4.57 | 27.51 | 52.73 | 74.00 | 21.27 |
| 4924.00 | 38.55 | AV | H | 29.95 | 4.57 | 27.51 | 45.56 | 54.00 | 8.44 |
| 7386.00 | 41.74 | PK | H | 34.22 | 5.74 | 27.18 | 54.52 | 74.00 | 19.48 |
| 7386.00 | 33.97 | AV | H | 34.22 | 5.74 | 27.18 | 46.75 | 54.00 | 7.25 |

**802.11g Mode:**

| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBµV) | Detector | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2412 MHz | | | | | | | | | |
| 2412.00 | 70.62 | PK | H | 24.84 | 3.35 | 0.00 | 98.81 | N/A | N/A |
| 2412.00 | 60.24 | AV | H | 24.84 | 3.35 | 0.00 | 88.43 | N/A | N/A |
| 2412.00 | 66.34 | PK | V | 24.84 | 3.35 | 0.00 | 94.53 | N/A | N/A |
| 2412.00 | 56.45 | AV | V | 24.84 | 3.35 | 0.00 | 84.64 | N/A | N/A |
| 2390.00 | 30.57 | PK | H | 24.80 | 3.33 | 0.00 | 58.70 | 74.00 | 15.30 |
| 2390.00 | 17.85 | AV | H | 24.80 | 3.33 | 0.00 | 45.98 | 54.00 | 8.02 |
| 4824.00 | 46.82 | PK | H | 29.75 | 4.58 | 27.41 | 53.74 | 74.00 | 20.26 |
| 4824.00 | 36.91 | AV | H | 29.75 | 4.58 | 27.41 | 43.83 | 54.00 | 10.17 |
| 7236.00 | 43.75 | PK | H | 33.98 | 5.62 | 27.22 | 56.13 | 74.00 | 17.87 |
| 7236.00 | 33.68 | AV | H | 33.98 | 5.62 | 27.22 | 46.06 | 54.00 | 7.94 |
| Middle Channel: 2437 MHz | | | | | | | | | |
| 2437.00 | 69.04 | PK | H | 24.89 | 3.36 | 0.00 | 97.29 | N/A | N/A |
| 2437.00 | 59.85 | AV | H | 24.89 | 3.36 | 0.00 | 88.10 | N/A | N/A |
| 2437.00 | 65.32 | PK | V | 24.89 | 3.36 | 0.00 | 93.57 | N/A | N/A |
| 2437.00 | 55.76 | AV | V | 24.89 | 3.36 | 0.00 | 84.01 | N/A | N/A |
| 4874.00 | 48.26 | PK | H | 29.85 | 4.57 | 27.54 | 55.14 | 74.00 | 18.86 |
| 4874.00 | 37.96 | AV | H | 29.85 | 4.57 | 27.54 | 44.84 | 54.00 | 9.16 |
| 7311.00 | 43.58 | PK | H | 34.10 | 5.68 | 27.28 | 56.08 | 74.00 | 17.92 |
| 7311.00 | 35.44 | AV | H | 34.10 | 5.68 | 27.28 | 47.94 | 54.00 | 6.06 |
| High Channel: 2462 MHz | | | | | | | | | |
| 2462.00 | 69.52 | PK | H | 24.93 | 3.37 | 0.00 | 97.82 | N/A | N/A |
| 2462.00 | 59.97 | AV | H | 24.93 | 3.37 | 0.00 | 88.27 | N/A | N/A |
| 2462.00 | 65.56 | PK | V | 24.93 | 3.37 | 0.00 | 93.86 | N/A | N/A |
| 2462.00 | 56.13 | AV | V | 24.93 | 3.37 | 0.00 | 84.43 | N/A | N/A |
| 2483.50 | 33.85 | PK | H | 24.97 | 3.38 | 0.00 | 62.20 | 74.00 | 11.80 |
| 2483.50 | 19.78 | AV | H | 24.97 | 3.38 | 0.00 | 48.13 | 54.00 | 5.87 |
| 4924.00 | 47.68 | PK | H | 29.95 | 4.57 | 27.51 | 54.69 | 74.00 | 19.31 |
| 4924.00 | 38.21 | AV | H | 29.95 | 4.57 | 27.51 | 45.22 | 54.00 | 8.78 |
| 7386.00 | 44.61 | PK | H | 34.22 | 5.74 | 27.18 | 57.39 | 74.00 | 16.61 |
| 7386.00 | 33.63 | AV | H | 34.22 | 5.74 | 27.18 | 46.41 | 54.00 | 7.59 |

**802.11n ht20 Mode:**

| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBµV) | Detector | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2412 MHz | | | | | | | | | |
| 2412.00 | 70.24 | PK | H | 24.84 | 3.35 | 0.00 | 98.43 | N/A | N/A |
| 2412.00 | 60.21 | AV | H | 24.84 | 3.35 | 0.00 | 88.40 | N/A | N/A |
| 2412.00 | 65.34 | PK | V | 24.84 | 3.35 | 0.00 | 93.53 | N/A | N/A |
| 2412.00 | 55.67 | AV | V | 24.84 | 3.35 | 0.00 | 83.86 | N/A | N/A |
| 2390.00 | 31.24 | PK | H | 24.80 | 3.33 | 0.00 | 59.37 | 74.00 | 14.63 |
| 2390.00 | 15.41 | AV | H | 24.80 | 3.33 | 0.00 | 43.54 | 54.00 | 10.46 |
| 4824.00 | 47.40 | PK | H | 29.75 | 4.58 | 27.41 | 54.32 | 74.00 | 19.68 |
| 4824.00 | 37.01 | AV | H | 29.75 | 4.58 | 27.41 | 43.93 | 54.00 | 10.07 |
| 7236.00 | 43.94 | PK | H | 33.98 | 5.62 | 27.22 | 56.32 | 74.00 | 17.68 |
| 7236.00 | 35.04 | AV | H | 33.98 | 5.62 | 27.22 | 47.42 | 54.00 | 6.58 |
| Middle Channel: 2437 MHz | | | | | | | | | |
| 2437.00 | 68.68 | PK | H | 24.89 | 3.36 | 0.00 | 96.93 | N/A | N/A |
| 2437.00 | 58.79 | AV | H | 24.89 | 3.36 | 0.00 | 87.04 | N/A | N/A |
| 2437.00 | 65.22 | PK | V | 24.89 | 3.36 | 0.00 | 93.47 | N/A | N/A |
| 2437.00 | 55.48 | AV | V | 24.89 | 3.36 | 0.00 | 83.73 | N/A | N/A |
| 4874.00 | 47.24 | PK | H | 29.85 | 4.57 | 27.54 | 54.12 | 74.00 | 19.88 |
| 4874.00 | 37.01 | AV | H | 29.85 | 4.57 | 27.54 | 43.89 | 54.00 | 10.11 |
| 7311.00 | 45.42 | PK | H | 34.10 | 5.68 | 27.28 | 57.92 | 74.00 | 16.08 |
| 7311.00 | 34.34 | AV | H | 34.10 | 5.68 | 27.28 | 46.84 | 54.00 | 7.16 |
| High Channel: 2462 MHz | | | | | | | | | |
| 2462.00 | 68.64 | PK | H | 24.93 | 3.37 | 0.00 | 96.94 | N/A | N/A |
| 2462.00 | 58.90 | AV | H | 24.93 | 3.37 | 0.00 | 87.20 | N/A | N/A |
| 2462.00 | 63.47 | PK | V | 24.93 | 3.37 | 0.00 | 91.77 | N/A | N/A |
| 2462.00 | 53.54 | AV | V | 24.93 | 3.37 | 0.00 | 81.84 | N/A | N/A |
| 2483.50 | 40.25 | PK | H | 24.97 | 3.38 | 0.00 | 68.60 | 74.00 | 5.40 |
| 2483.50 | 21.43 | AV | H | 24.97 | 3.38 | 0.00 | 49.78 | 54.00 | 4.22 |
| 4924.00 | 48.25 | PK | H | 29.95 | 4.57 | 27.51 | 55.26 | 74.00 | 18.74 |
| 4924.00 | 38.27 | AV | H | 29.95 | 4.57 | 27.51 | 45.28 | 54.00 | 8.72 |
| 7386.00 | 45.09 | PK | H | 34.22 | 5.74 | 27.18 | 57.87 | 74.00 | 16.13 |
| 7386.00 | 33.94 | AV | H | 34.22 | 5.74 | 27.18 | 46.72 | 54.00 | 7.28 |

**802.11n ht40 Mode:**

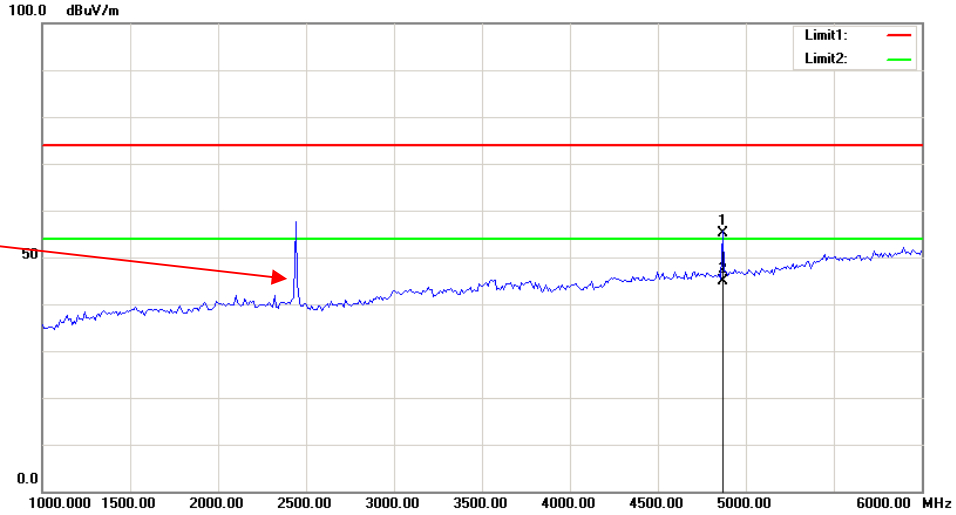
| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBµV) | Detector | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2422 MHz | | | | | | | | | |
| 2422.00 | 68.01 | PK | H | 24.86 | 3.35 | 0.00 | 96.22 | N/A | N/A |
| 2422.00 | 58.70 | AV | H | 24.86 | 3.35 | 0.00 | 86.91 | N/A | N/A |
| 2422.00 | 63.47 | PK | V | 24.86 | 3.35 | 0.00 | 91.68 | N/A | N/A |
| 2422.00 | 53.58 | AV | V | 24.86 | 3.35 | 0.00 | 81.79 | N/A | N/A |
| 2390.00 | 33.37 | PK | H | 24.80 | 3.33 | 0.00 | 61.50 | 74.00 | 12.50 |
| 2390.00 | 18.34 | AV | H | 24.80 | 3.33 | 0.00 | 46.47 | 54.00 | 7.53 |
| 4844.00 | 47.99 | PK | H | 29.79 | 4.57 | 27.46 | 54.89 | 74.00 | 19.11 |
| 4844.00 | 38.18 | AV | H | 29.79 | 4.57 | 27.46 | 45.08 | 54.00 | 8.92 |
| 7266.00 | 44.87 | PK | H | 34.03 | 5.64 | 27.25 | 57.29 | 74.00 | 16.71 |
| 7266.00 | 33.65 | AV | H | 34.03 | 5.64 | 27.25 | 46.07 | 54.00 | 7.93 |
| Middle Channel: 2437 MHz | | | | | | | | | |
| 2437.00 | 67.68 | PK | H | 24.89 | 3.36 | 0.00 | 95.93 | N/A | N/A |
| 2437.00 | 57.85 | AV | H | 24.89 | 3.36 | 0.00 | 86.10 | N/A | N/A |
| 2437.00 | 63.82 | PK | V | 24.89 | 3.36 | 0.00 | 92.07 | N/A | N/A |
| 2437.00 | 53.95 | AV | V | 24.89 | 3.36 | 0.00 | 82.20 | N/A | N/A |
| 4874.00 | 47.72 | PK | H | 29.85 | 4.57 | 27.54 | 54.60 | 74.00 | 19.40 |
| 4874.00 | 37.68 | AV | H | 29.85 | 4.57 | 27.54 | 44.56 | 54.00 | 9.44 |
| 7311.00 | 44.82 | PK | H | 34.10 | 5.68 | 27.28 | 57.32 | 74.00 | 16.68 |
| 7311.00 | 35.35 | AV | H | 34.10 | 5.68 | 27.28 | 47.85 | 54.00 | 6.15 |
| High Channel: 2452 MHz | | | | | | | | | |
| 2452.00 | 67.97 | PK | H | 24.91 | 3.37 | 0.00 | 96.25 | N/A | N/A |
| 2452.00 | 58.11 | AV | H | 24.91 | 3.37 | 0.00 | 86.39 | N/A | N/A |
| 2452.00 | 63.15 | PK | V | 24.91 | 3.37 | 0.00 | 91.43 | N/A | N/A |
| 2452.00 | 53.38 | AV | V | 24.91 | 3.37 | 0.00 | 81.66 | N/A | N/A |
| 2483.50 | 38.60 | PK | H | 24.97 | 3.38 | 0.00 | 66.95 | 74.00 | 7.05 |
| 2483.50 | 24.50 | AV | H | 24.97 | 3.38 | 0.00 | 52.85 | 54.00 | 1.15 |
| 4904.00 | 48.49 | PK | H | 29.91 | 4.56 | 27.58 | 55.38 | 74.00 | 18.62 |
| 4904.00 | 37.21 | AV | H | 29.91 | 4.56 | 27.58 | 44.10 | 54.00 | 9.90 |
| 7356.00 | 43.74 | PK | H | 34.17 | 5.72 | 27.22 | 56.41 | 74.00 | 17.59 |
| 7356.00 | 34.25 | AV | H | 34.17 | 5.72 | 27.22 | 46.92 | 54.00 | 7.08 |

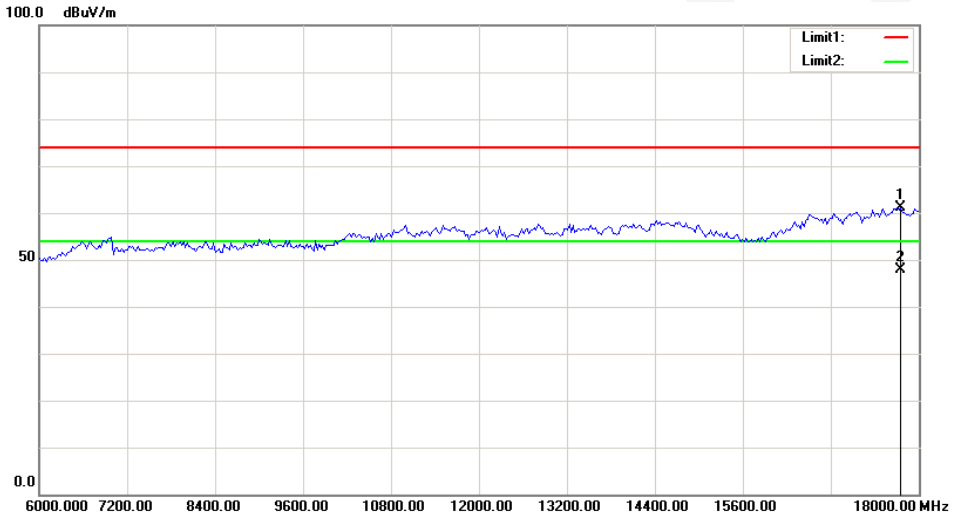
**BLE Mode:**

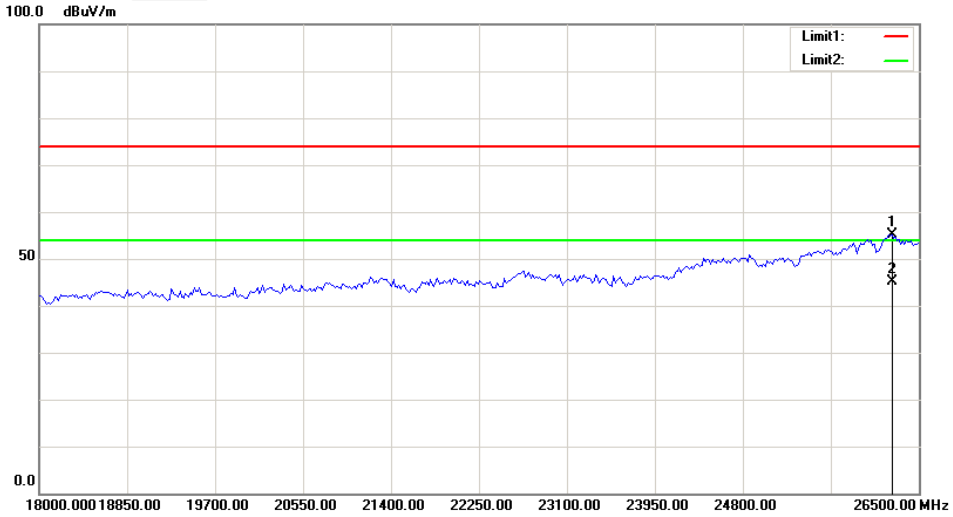
| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | Detector | Polar (H/V) | Factor (dB/m) | | | | | |
| Low Channel: 2402 MHz | | | | | | | | | |
| 2402.00 | 61.42 | PK | H | 24.82 | 3.34 | 0.00 | 89.58 | N/A | N/A |
| 2402.00 | 55.68 | AV | H | 24.82 | 3.34 | 0.00 | 83.84 | N/A | N/A |
| 2402.00 | 60.45 | PK | V | 24.82 | 3.34 | 0.00 | 88.61 | N/A | N/A |
| 2402.00 | 54.26 | AV | V | 24.82 | 3.34 | 0.00 | 82.42 | N/A | N/A |
| 2390.00 | 28.34 | PK | H | 24.80 | 3.33 | 0.00 | 56.47 | 74.00 | 17.53 |
| 2390.00 | 15.68 | AV | H | 24.80 | 3.33 | 0.00 | 43.81 | 54.00 | 10.19 |
| 4804.00 | 43.62 | PK | H | 29.71 | 4.58 | 27.36 | 50.55 | 74.00 | 23.45 |
| 4804.00 | 37.85 | AV | H | 29.71 | 4.58 | 27.36 | 44.78 | 54.00 | 9.22 |
| 7206.00 | 40.21 | PK | H | 33.93 | 5.59 | 27.19 | 52.54 | 74.00 | 21.46 |
| 7206.00 | 34.24 | AV | H | 33.93 | 5.59 | 27.19 | 46.57 | 54.00 | 7.43 |
| Middle Channel: 2440 MHz | | | | | | | | | |
| 2440.00 | 58.62 | PK | H | 24.89 | 3.36 | 0.00 | 86.87 | N/A | N/A |
| 2440.00 | 52.32 | AV | H | 24.89 | 3.36 | 0.00 | 80.57 | N/A | N/A |
| 2440.00 | 53.69 | PK | V | 24.89 | 3.36 | 0.00 | 81.94 | N/A | N/A |
| 2440.00 | 48.35 | AV | V | 24.89 | 3.36 | 0.00 | 76.60 | N/A | N/A |
| 4880.00 | 43.57 | PK | H | 29.86 | 4.56 | 27.55 | 50.44 | 74.00 | 23.56 |
| 4880.00 | 37.51 | AV | H | 29.86 | 4.56 | 27.55 | 44.38 | 54.00 | 9.62 |
| 7320.00 | 40.22 | PK | H | 34.11 | 5.69 | 27.26 | 52.76 | 74.00 | 21.24 |
| 7320.00 | 34.24 | AV | H | 34.11 | 5.69 | 27.26 | 46.78 | 54.00 | 7.22 |
| High Channel: 2480 MHz | | | | | | | | | |
| 2480.00 | 58.75 | PK | H | 24.96 | 3.38 | 0.00 | 87.09 | N/A | N/A |
| 2480.00 | 52.45 | AV | H | 24.96 | 3.38 | 0.00 | 80.79 | N/A | N/A |
| 2480.00 | 54.32 | PK | V | 24.96 | 3.38 | 0.00 | 82.66 | N/A | N/A |
| 2480.00 | 48.63 | AV | V | 24.96 | 3.38 | 0.00 | 76.97 | N/A | N/A |
| 2483.50 | 28.64 | PK | H | 24.97 | 3.38 | 0.00 | 56.99 | 74.00 | 17.01 |
| 2483.50 | 15.85 | AV | H | 24.97 | 3.38 | 0.00 | 44.20 | 54.00 | 9.80 |
| 4960.00 | 46.31 | PK | H | 30.02 | 4.58 | 27.37 | 53.54 | 74.00 | 20.46 |
| 4960.00 | 40.27 | AV | H | 30.02 | 4.58 | 27.37 | 47.50 | 54.00 | 6.50 |
| 7440.00 | 40.57 | PK | H | 34.30 | 5.79 | 27.22 | 53.44 | 74.00 | 20.56 |
| 7440.00 | 34.42 | AV | H | 34.30 | 5.79 | 27.22 | 47.29 | 54.00 | 6.71 |

**Test plots**(802.11 g mode middle channel was the worst)
**Horizontal:**

Fundamental Test with Band Rejection Filter

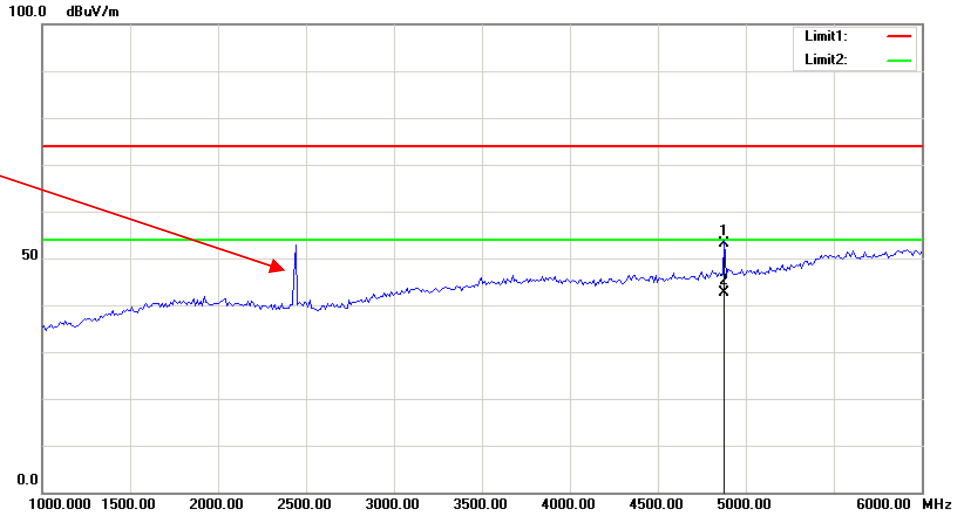


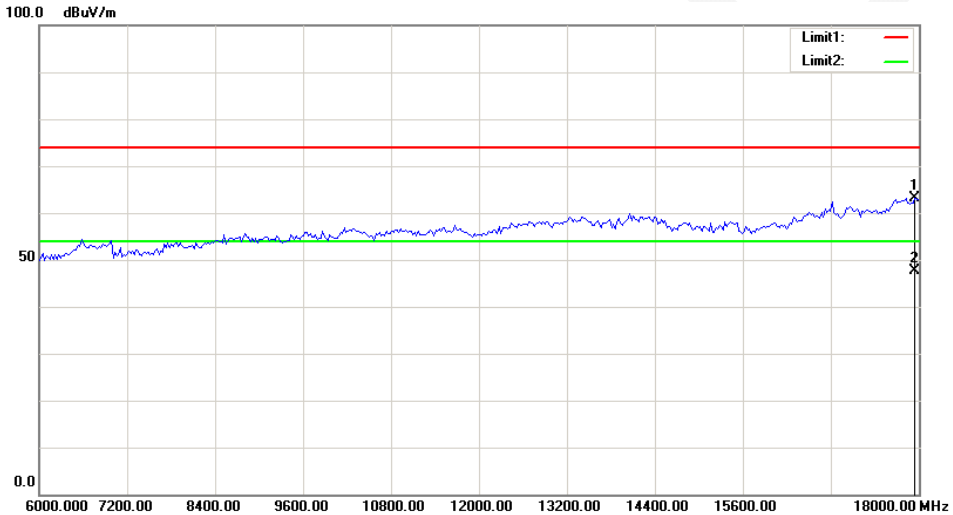



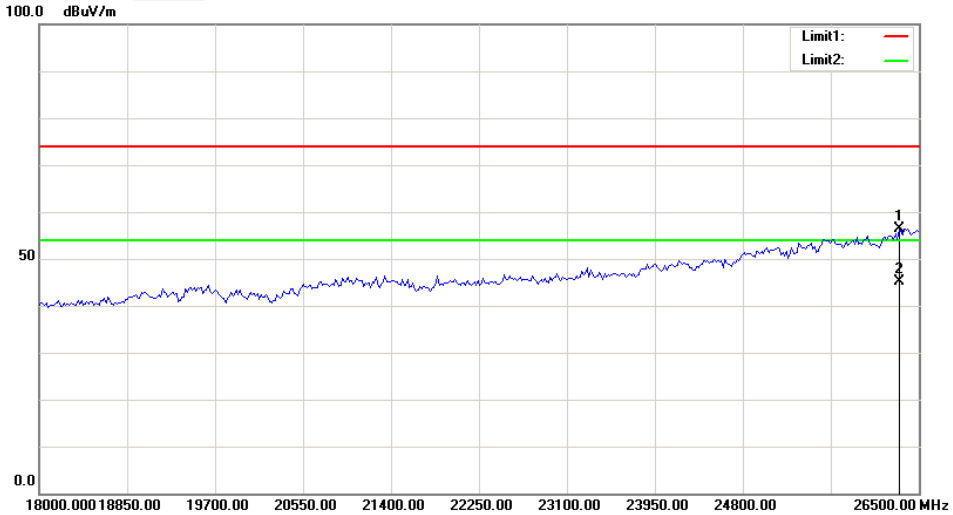



**Vertical:**

Fundamental Test with Band Rejection Filter



# FCC §15.247(a) (2) & RSS-247 CLAUSE 5.2 a) &RSS-GEN CLAUSE 6.7–6 dB EMISSION BANDWIDTH AND 99% OCCUPIED BANDWIDTH

## Applicable Standard

According to FCC §15.247(a) (2)

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.

According to RSS-247 §5.2 a)

The minimum 6 dB bandwidth shall be 500 kHz.

According to RSS-Gen §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

## Test Procedure

**6dB bandwidth test:**
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3×RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

**99% Occupied bandwidth test:**
Use Occupied bandwidth test function, measure the 99% Occupied bandwidth.
Repeat above procedures until all frequencies measured were complete.

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESPI | 100120 | 2017-12-11 | 2018-12-11 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/02 | Each time | N/A |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 28.9 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 99.8 kPa |

** The testing was performed by Tiago Huang & Swim Lv on 2018-07-12.*

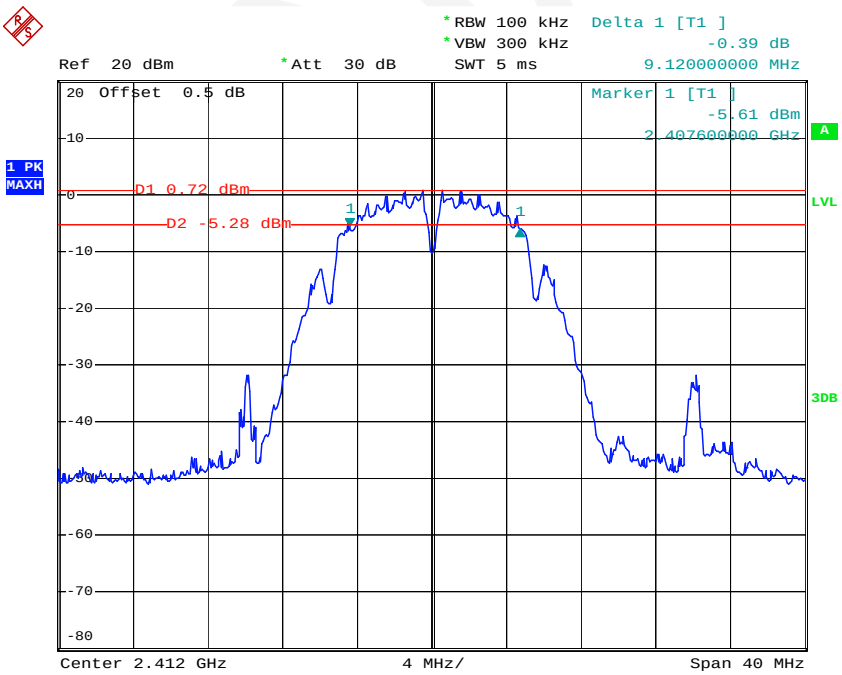
*Test Mode: Transmitting*

*Test Result: Compliant. Please refer to the following table and plots.*

| Test mode | Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) | Limit (MHz) |
|---|---|---|---|---|---|
| 802.11b | Low | 2412 | 9.12 | 11.92 | ≥0.5 |
| | Middle | 2437 | 9.36 | 12.40 | ≥0.5 |
| | High | 2462 | 9.28 | 12.56 | ≥0.5 |
| 802.11g | Low | 2412 | 16.64 | 17.44 | ≥0.5 |
| | Middle | 2437 | 16.64 | 17.28 | ≥0.5 |
| | High | 2462 | 16.64 | 17.52 | ≥0.5 |
| 802.11n ht20 | Low | 2412 | 17.76 | 17.84 | ≥0.5 |
| | Middle | 2437 | 17.76 | 17.84 | ≥0.5 |
| | High | 2462 | 17.76 | 17.92 | ≥0.5 |
| 802.11n ht40 | Low | 2422 | 36.64 | 36.96 | ≥0.5 |
| | Middle | 2437 | 33.28 | 36.00 | ≥0.5 |
| | High | 2452 | 32.00 | 36.00 | ≥0.5 |
| BLE | Low | 2402 | 0.720 | 1.044 | ≥0.5 |
| | Middle | 2440 | 0.732 | 1.044 | ≥0.5 |
| | High | 2480 | 0.724 | 1.040 | ≥0.5 |

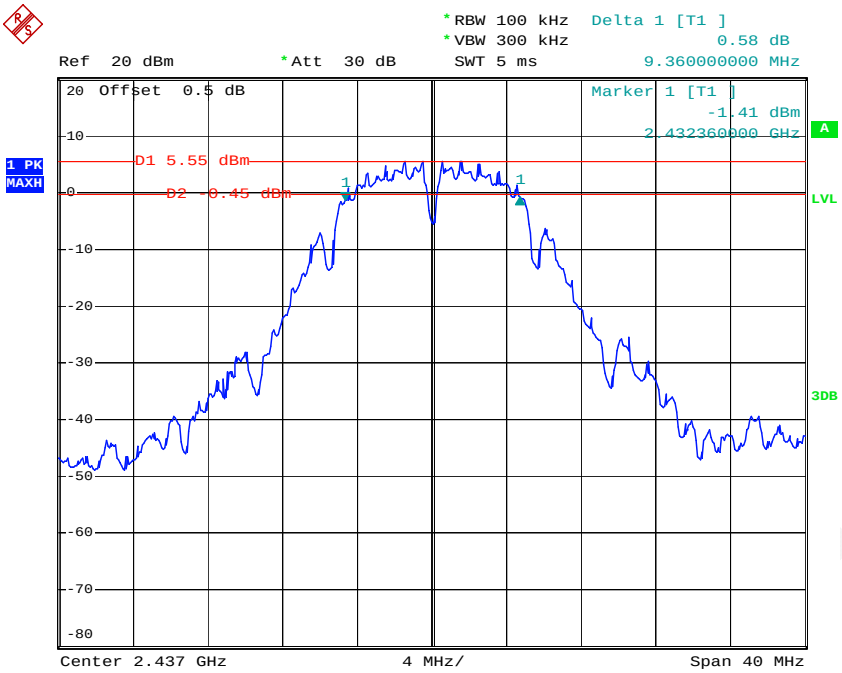
**6dB bandwidth:**

**802.11b Low Channel**



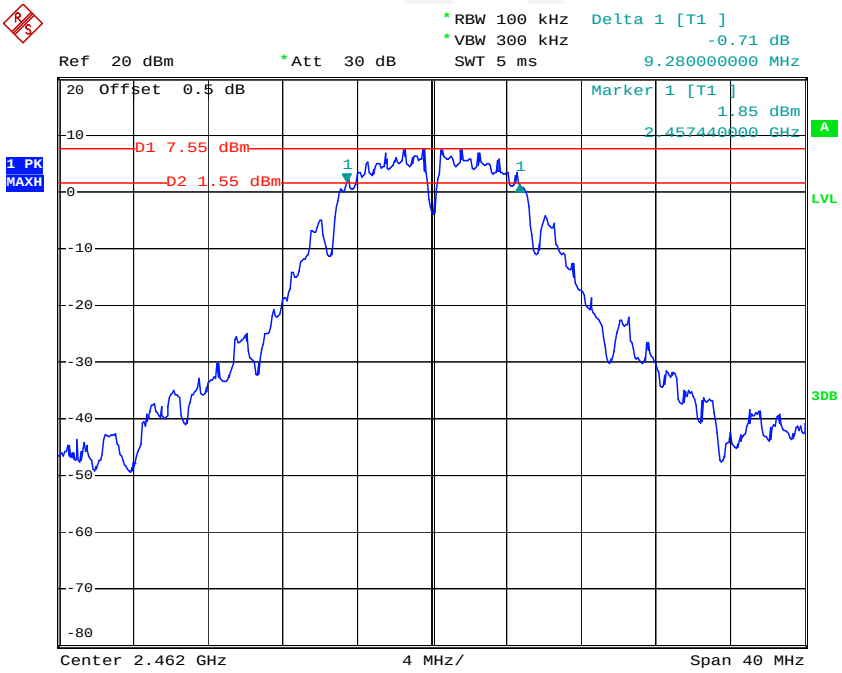

Date: 12.JUL.2018 15:17:39

## 802.11b Middle Channel



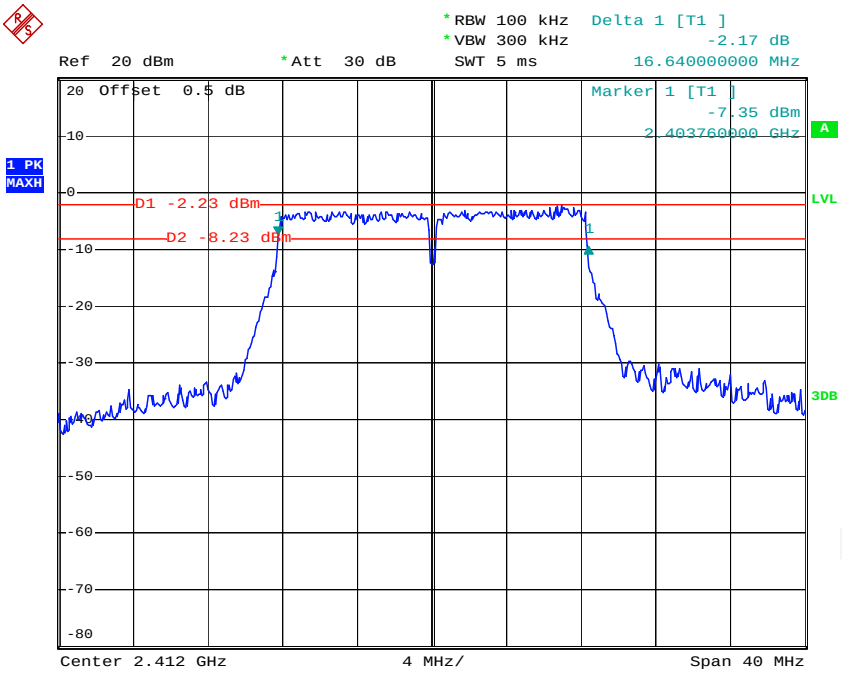

Date: 12.JUL.2018 15:25:07

## 802.11b High Channel



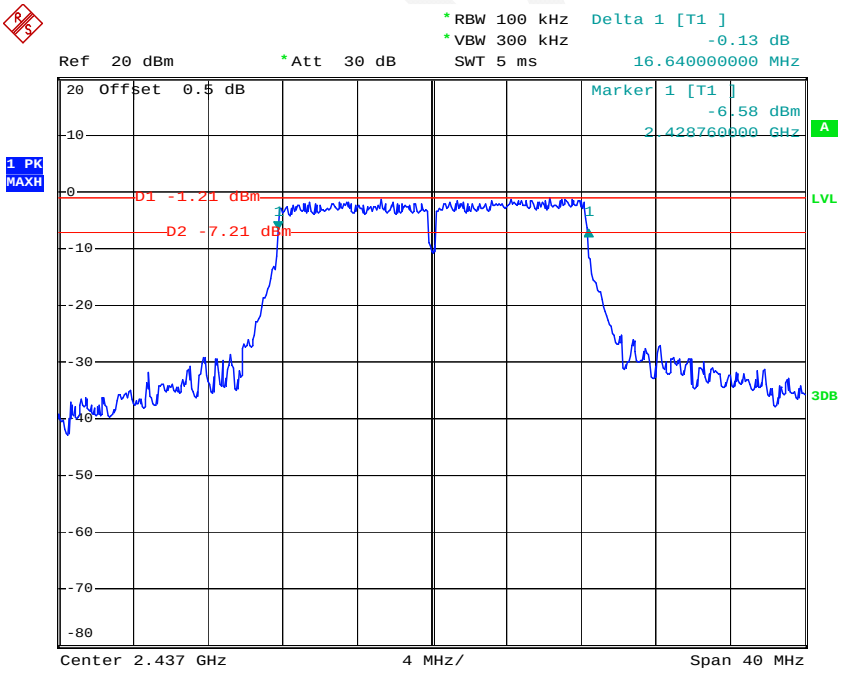

Date: 12.JUL.2018 15:27:10

## 802.11g Low Channel



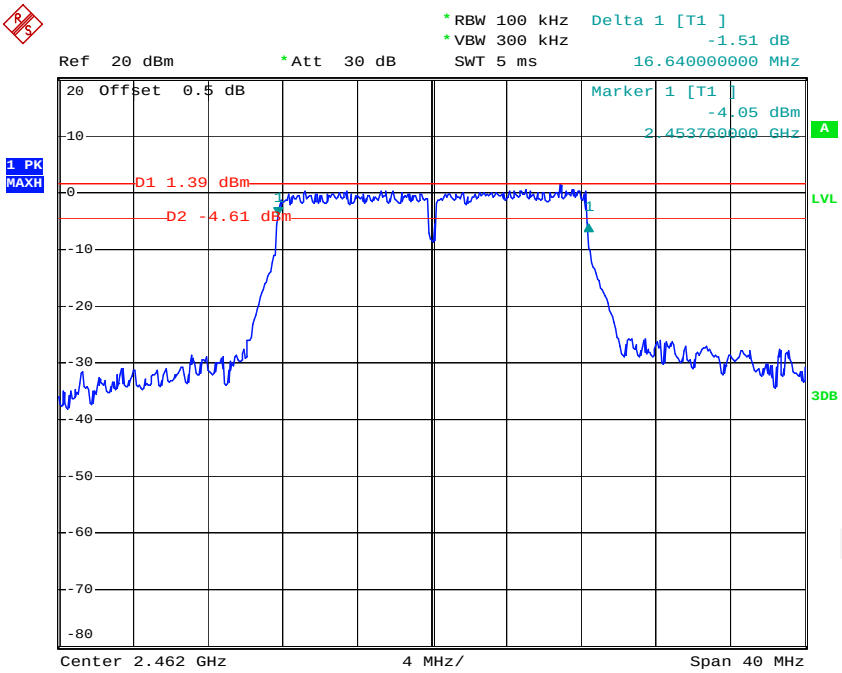

Date: 12.JUL.2018 15:33:08

## 802.11g Middle Channel



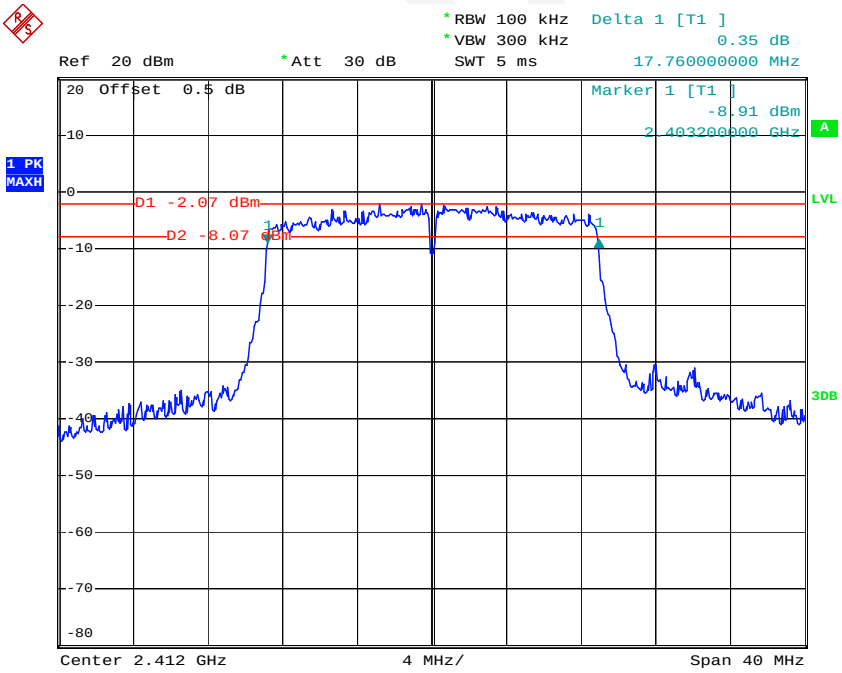

Date: 12.JUL.2018 15:35:19

## 802.11g High Channel



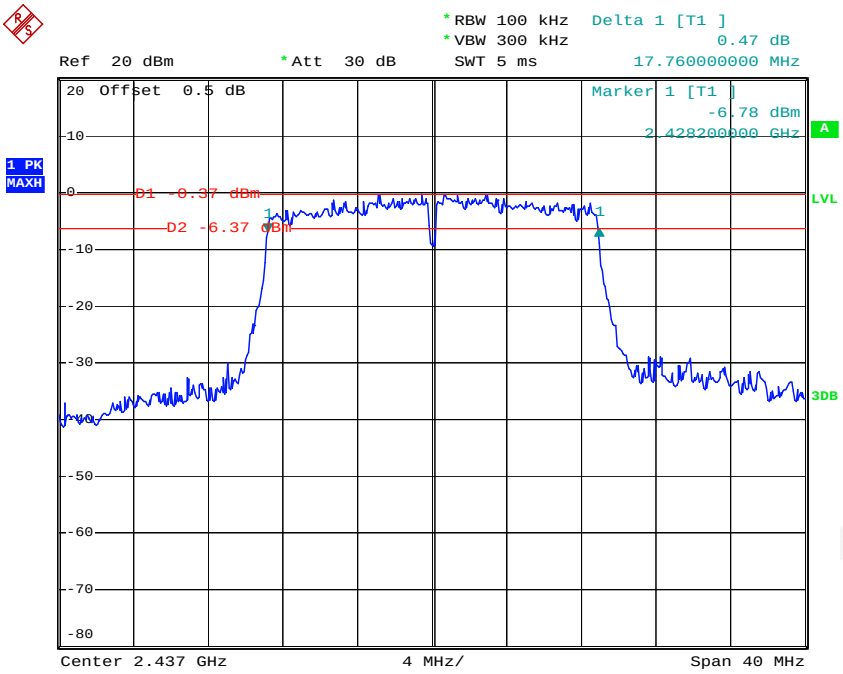

Date: 12.JUL.2018 15:37:26

## 802.11n ht20 Low Channel



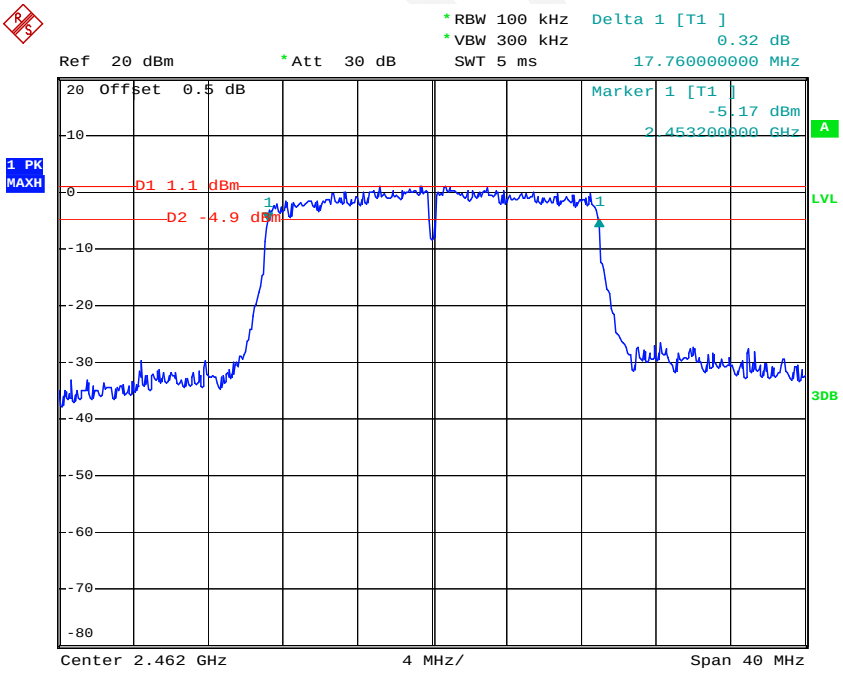

Date: 12.JUL.2018 15:39:56

## 802.11n ht20 Middle Channel



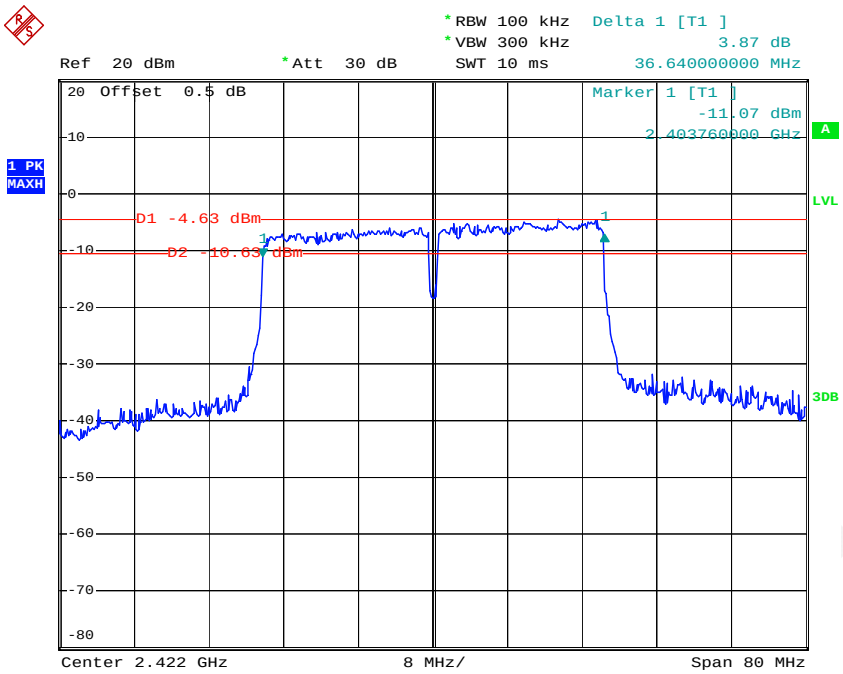

Date: 12.JUL.2018 15:43:50

## 802.11n ht20 High Channel



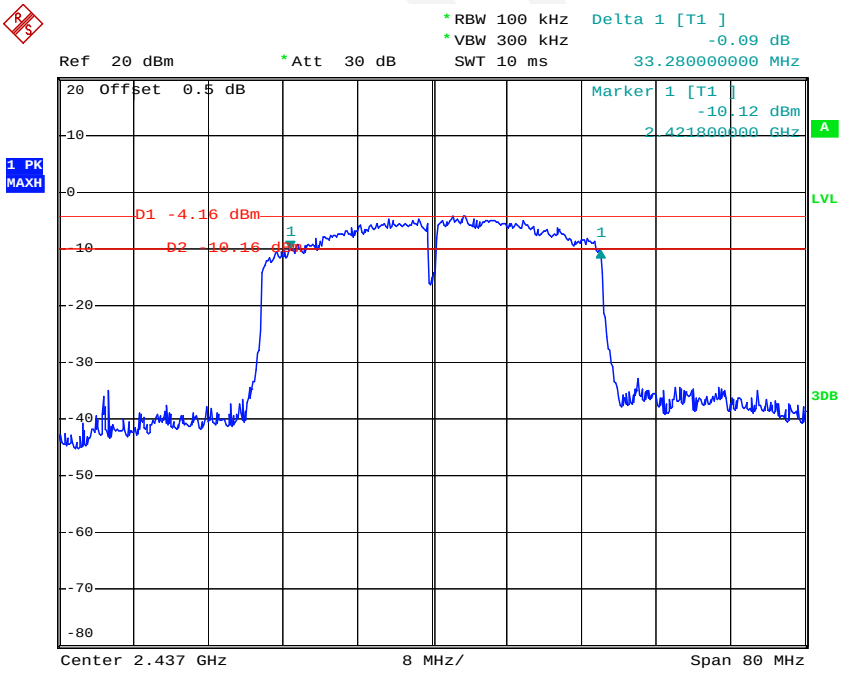

Date: 12.JUL.2018 15:47:00

## 802.11n ht40 Low Channel



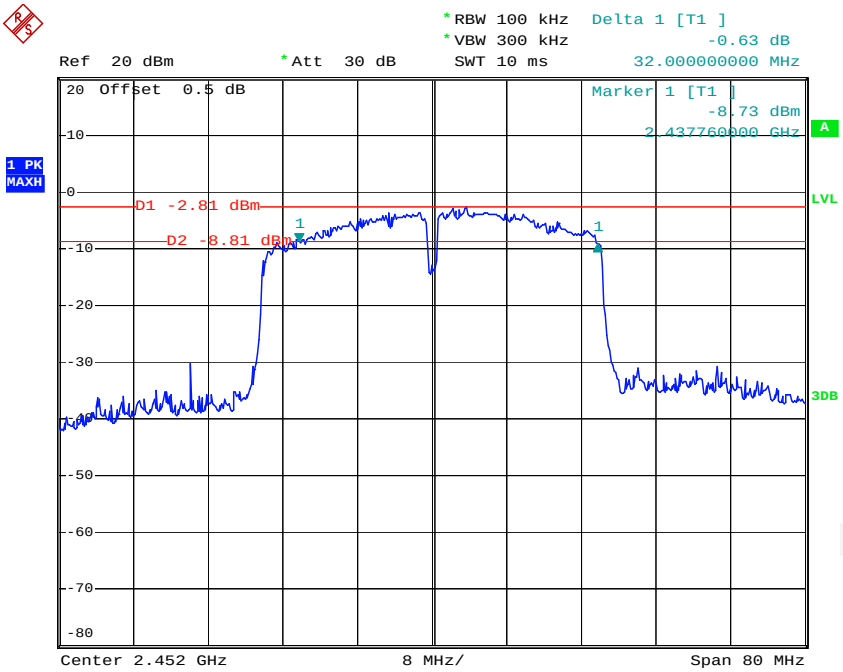

Date: 12.JUL.2018 15:49:51

## 802.11n ht40 Middle Channel



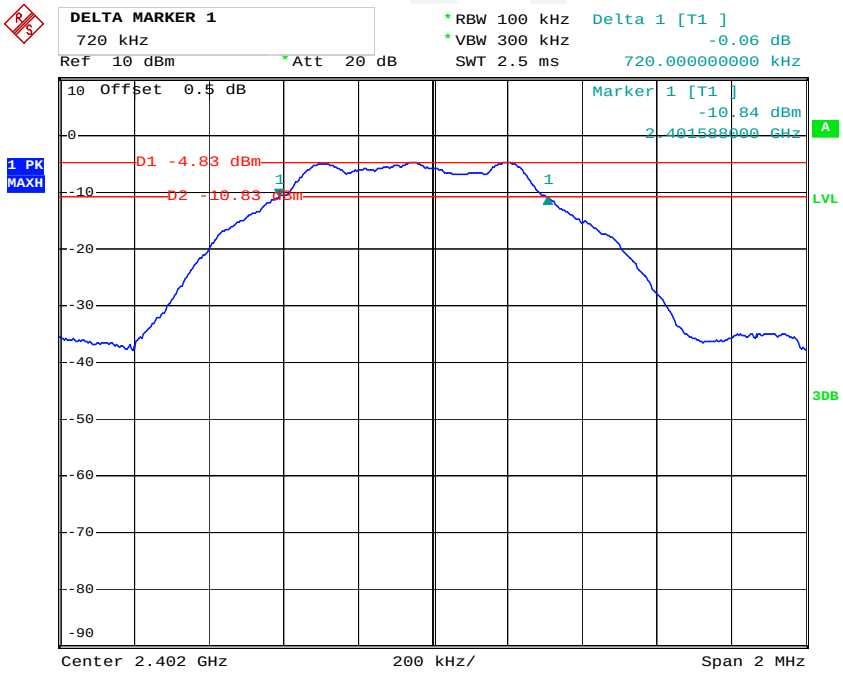

Date: 12.JUL.2018 15:55:31

## 802.11n ht40 High Channel



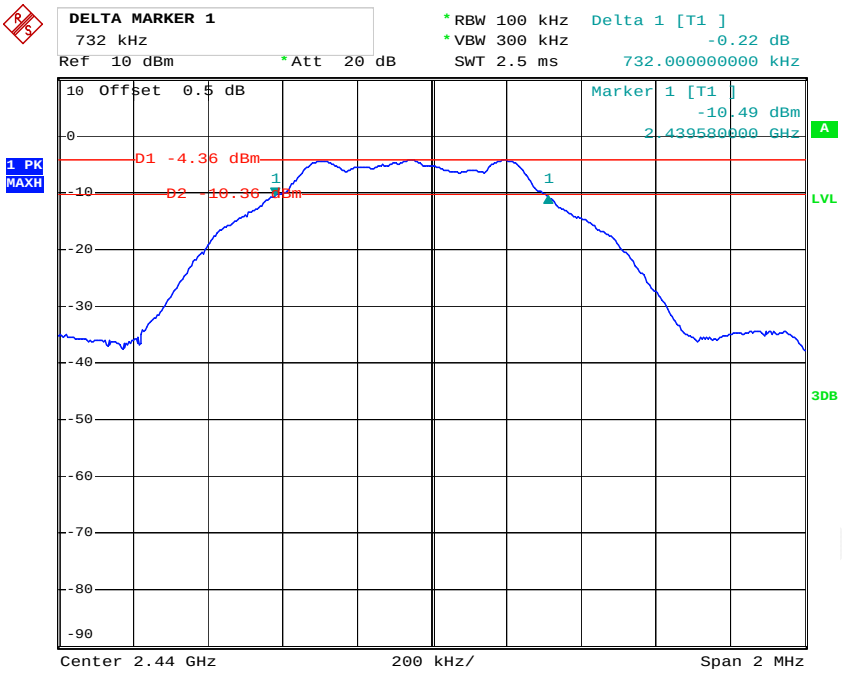

Date: 12.JUL.2018 15:59:49

## BLE Low Channel



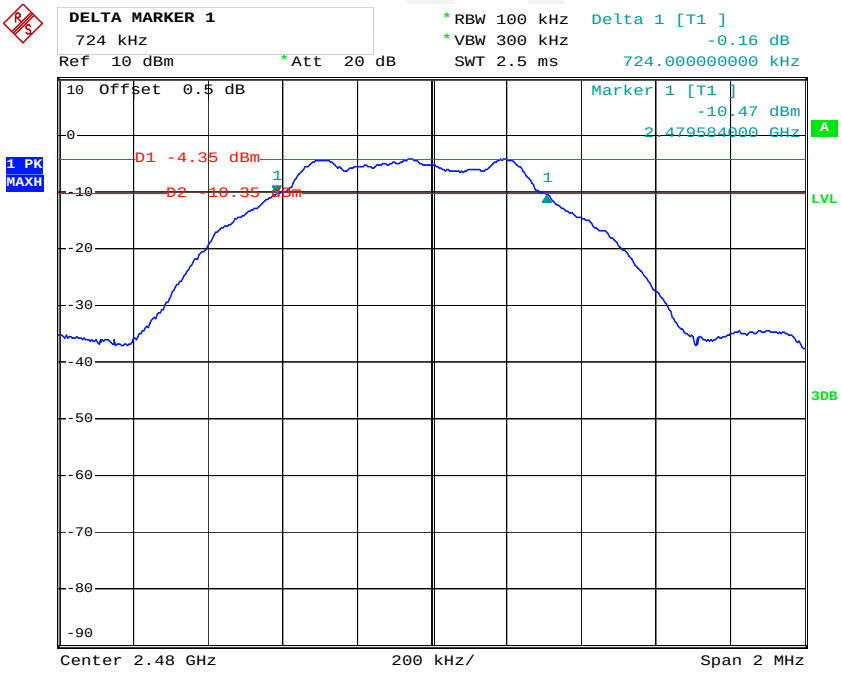

Date: 12.JUL.2018 22:18:59

## BLE Middle Channel




Date: 12.JUL.2018 22:17:48

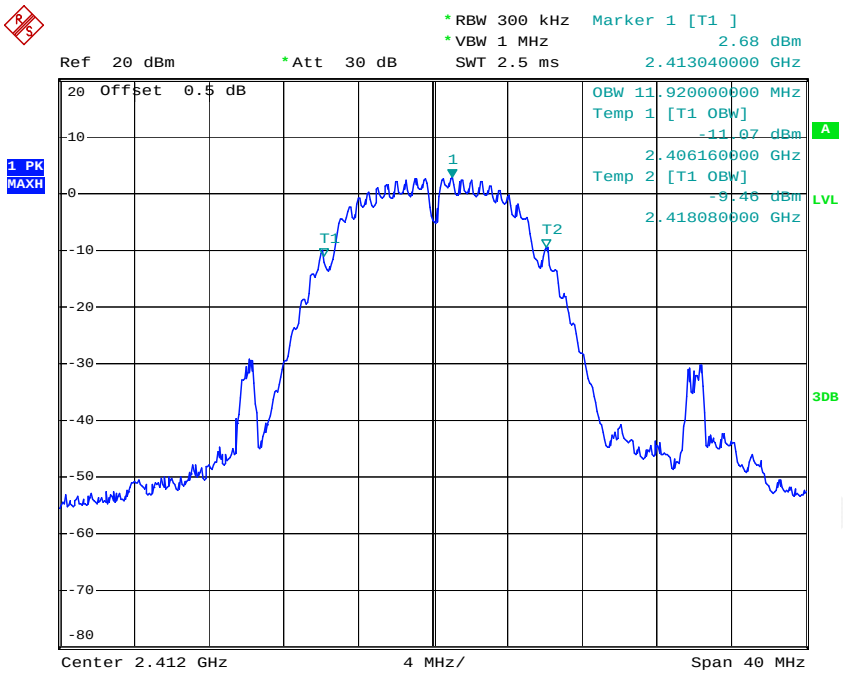
## BLE High Channel




Date: 12.JUL.2018 22:16:35

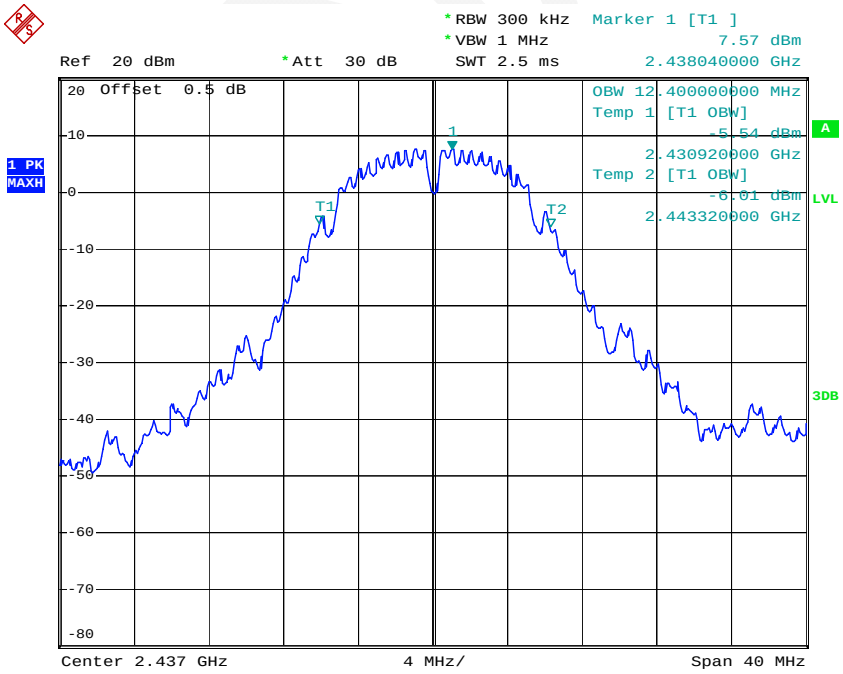
**99% Occupied bandwidth:**

**802.11b Low Channel**



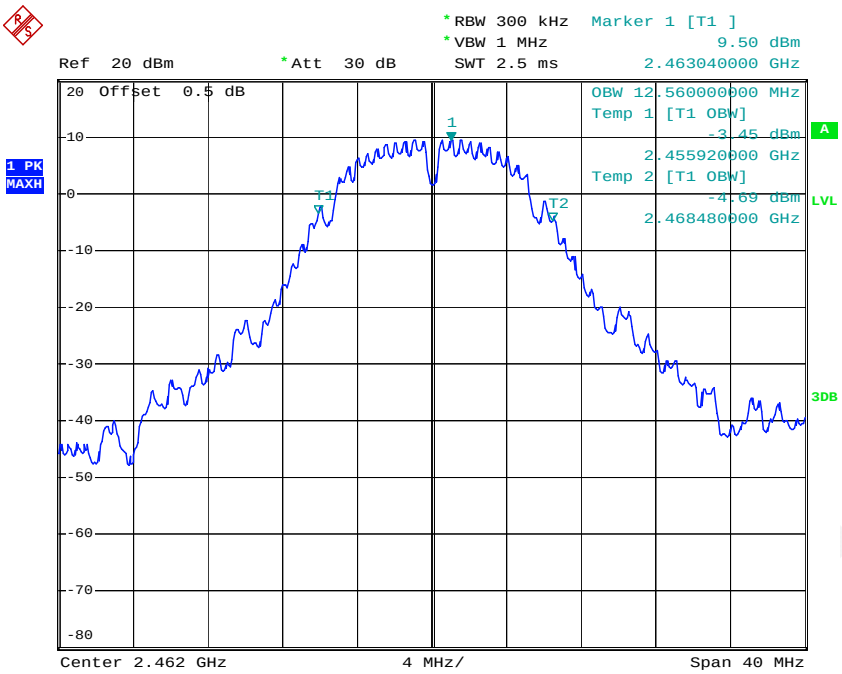

Date: 12.JUL.2018 15:17:58

**802.11b Middle Channel**



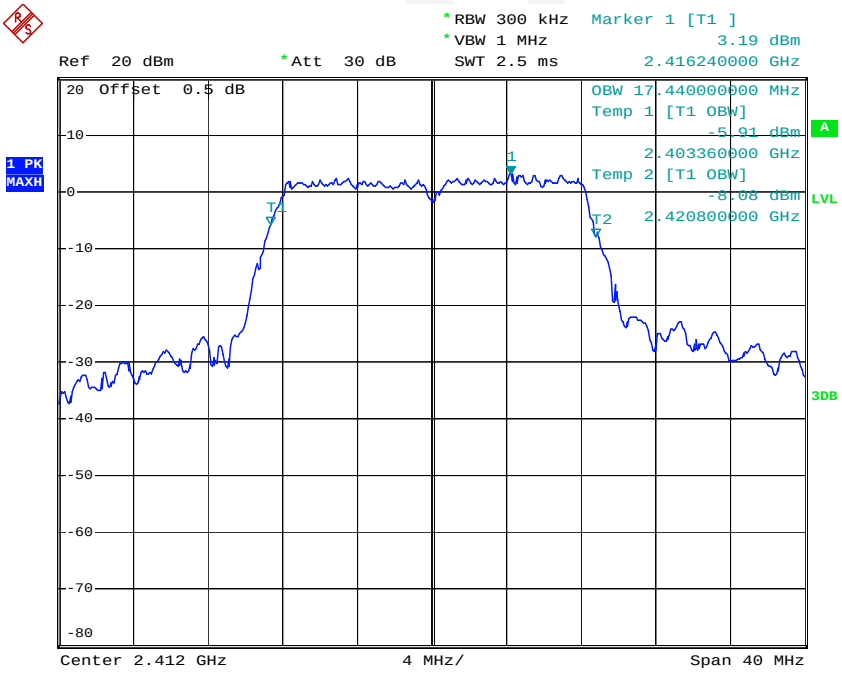

Date: 12.JUL.2018 15:25:26

## 802.11b High Channel



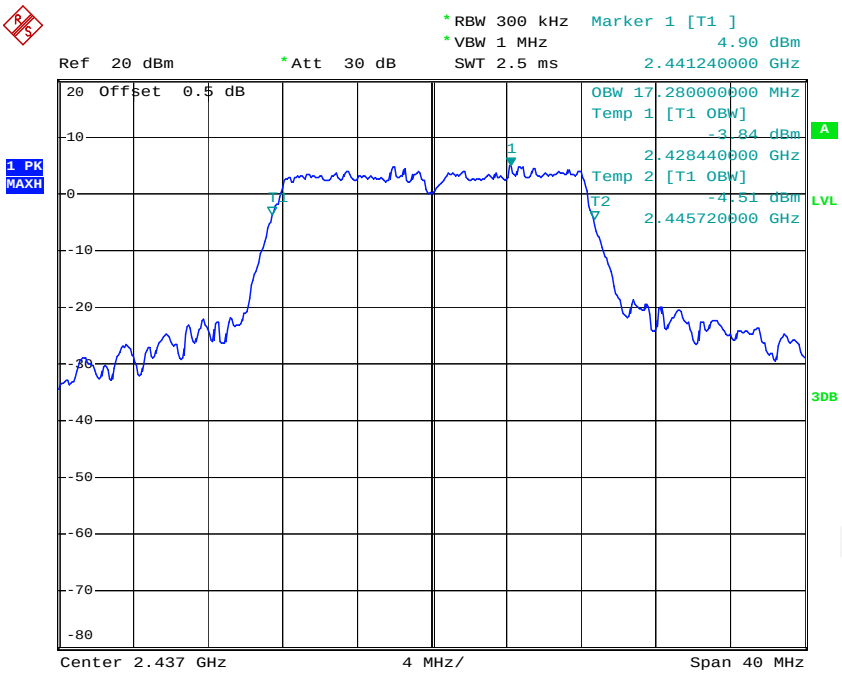

Date: 12.JUL.2018 15:27:24

## 802.11g Low Channel




Date: 12.JUL.2018 15:33:25

## 802.11g Middle Channel

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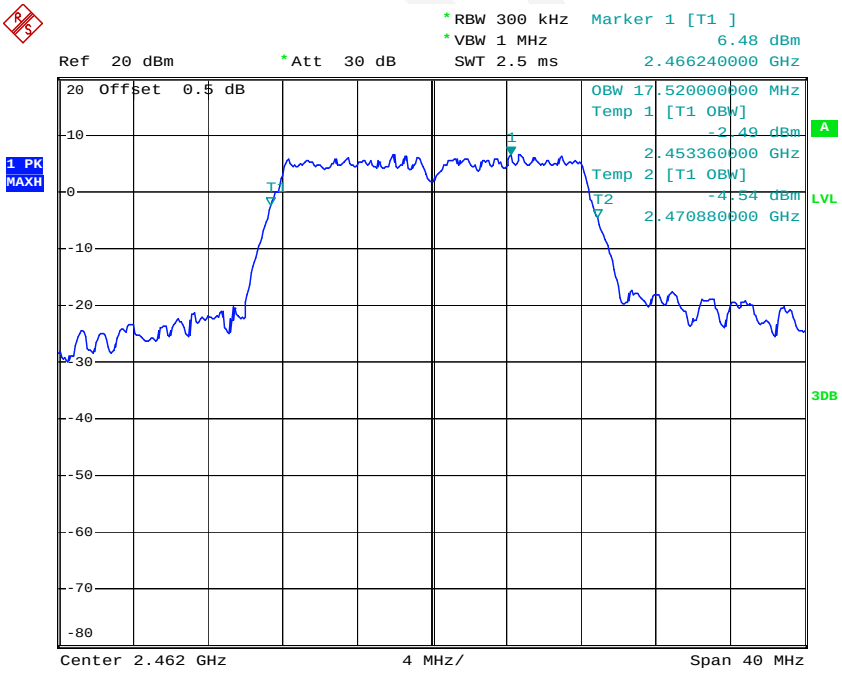
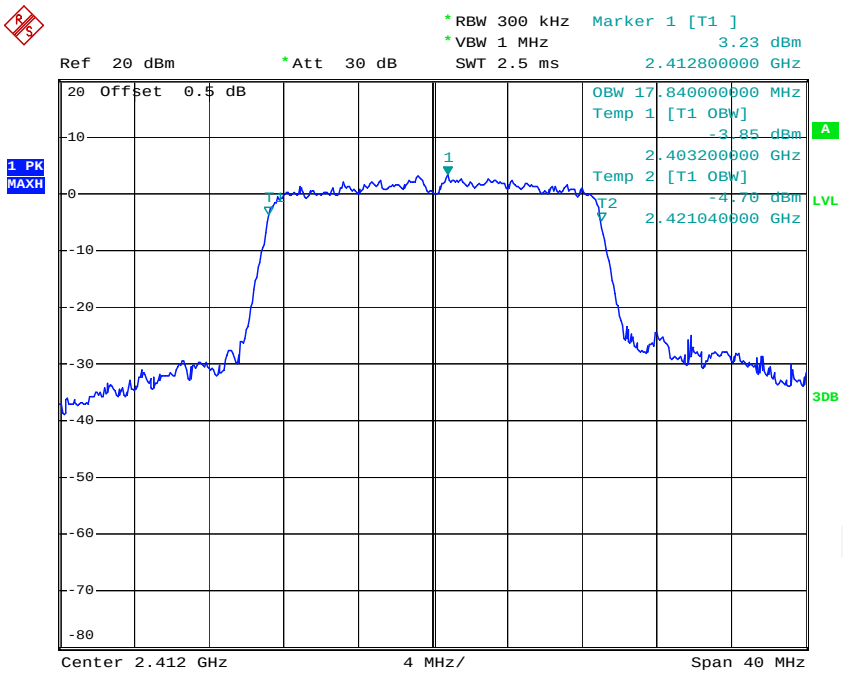
## 802.11g High Channel



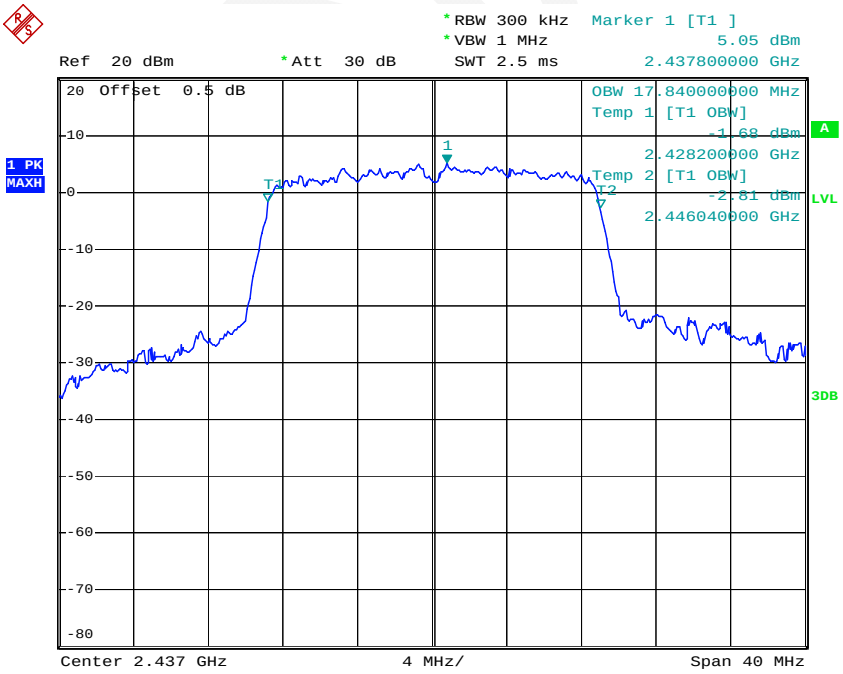

Date: 12.JUL.2018 15:37:43

## 802.11n ht20 Low Channel



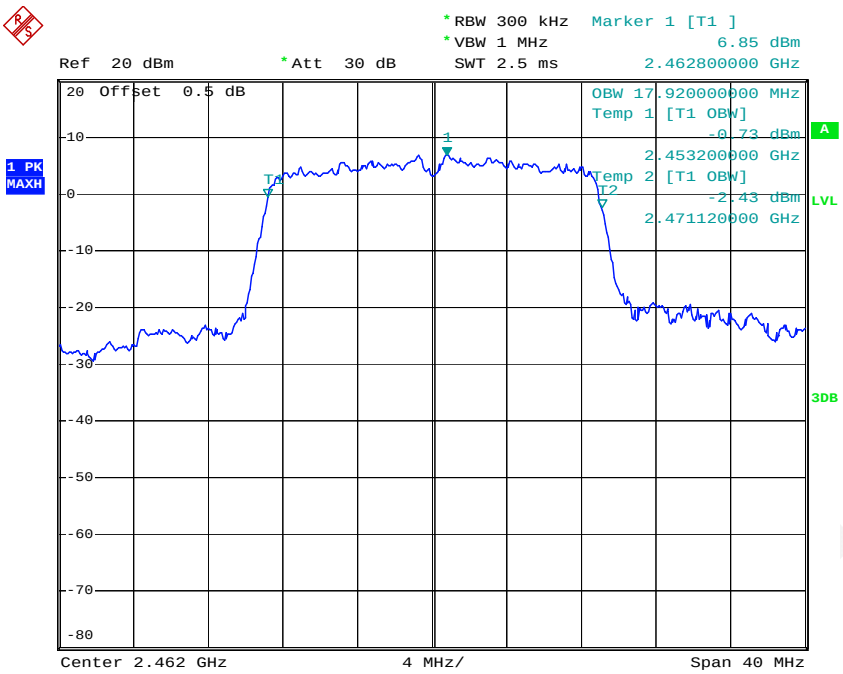

Date: 12.JUL.2018 15:40:13

## 802.11n ht20 Middle Channel



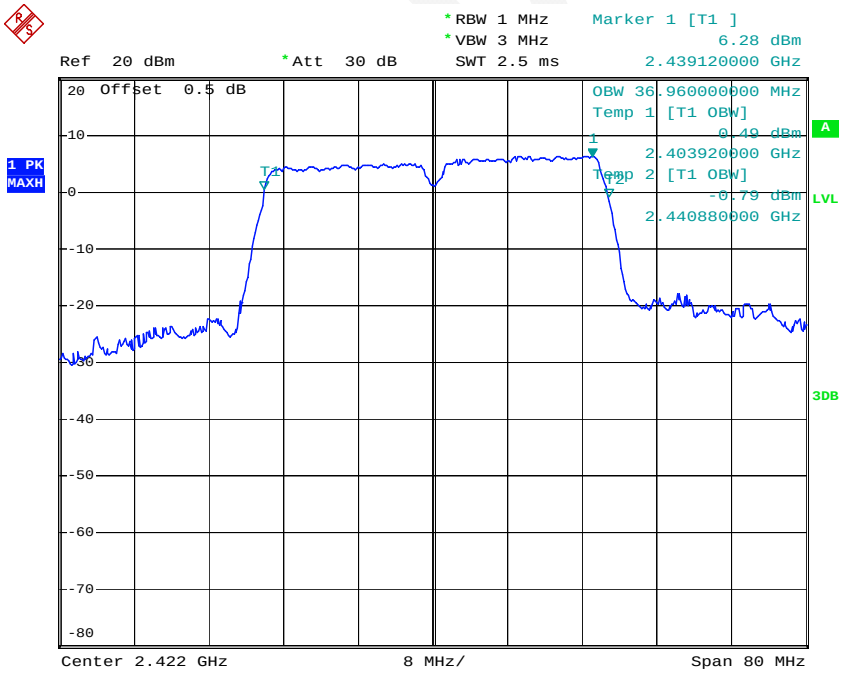

Date: 12.JUL.2018 15:44:13

## 802.11n ht20 High Channel



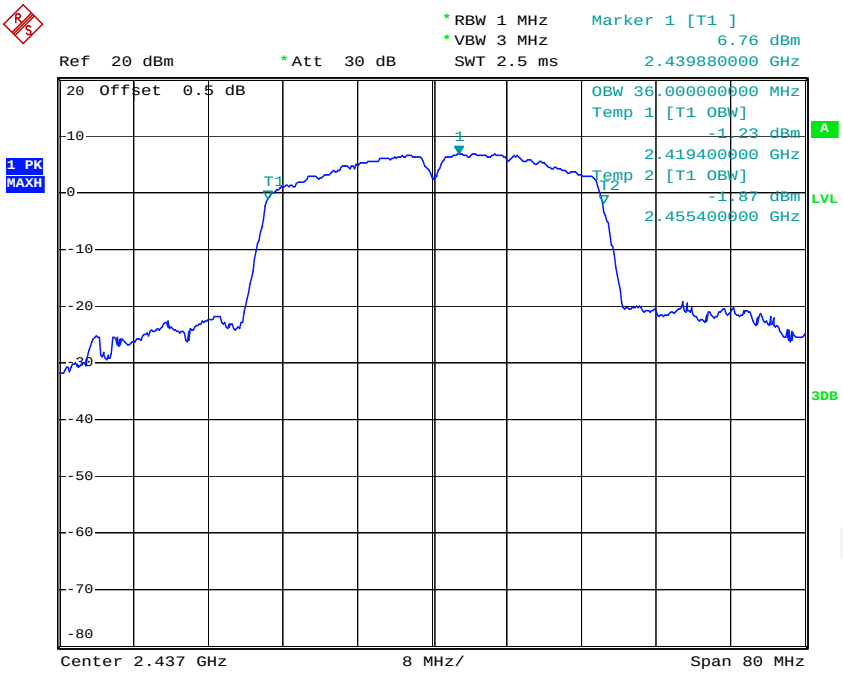

Date: 12.JUL.2018 15:47:23

## 802.11n ht40 Low Channel



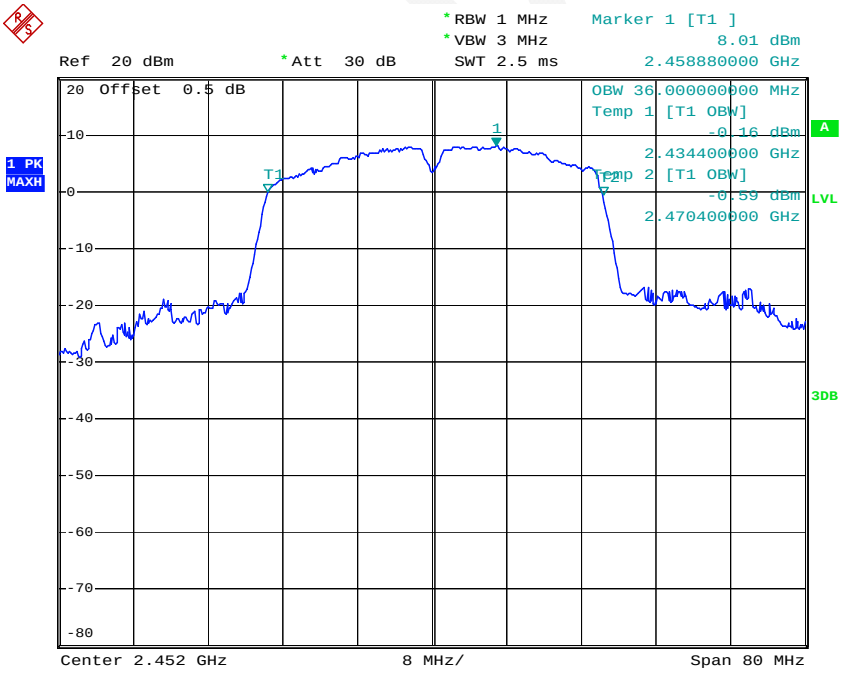

Date: 12.JUL.2018 15:50:14

## 802.11n ht40 Middle Channel



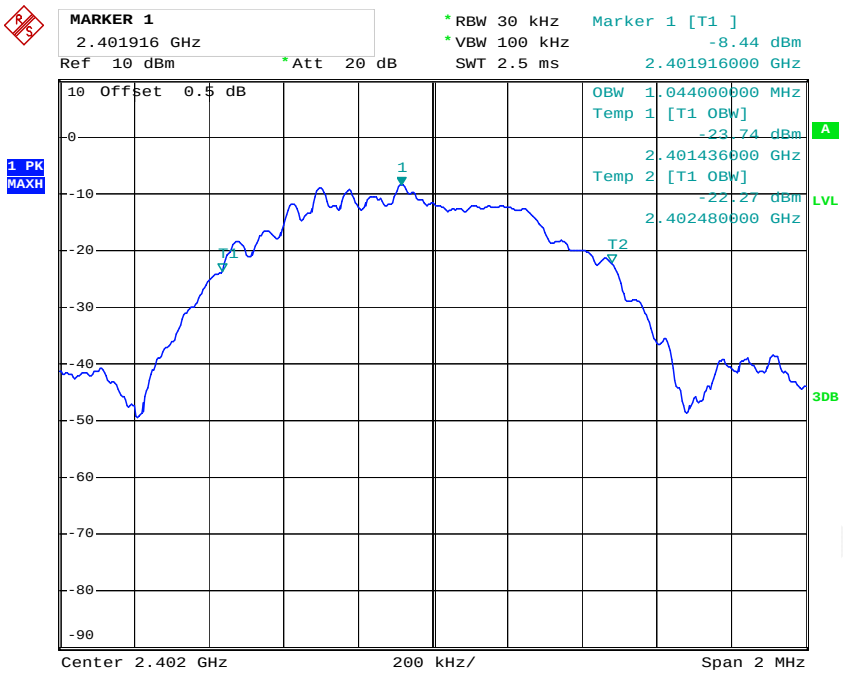

Date: 12.JUL.2018 15:56:00

## 802.11n ht40 High Channel



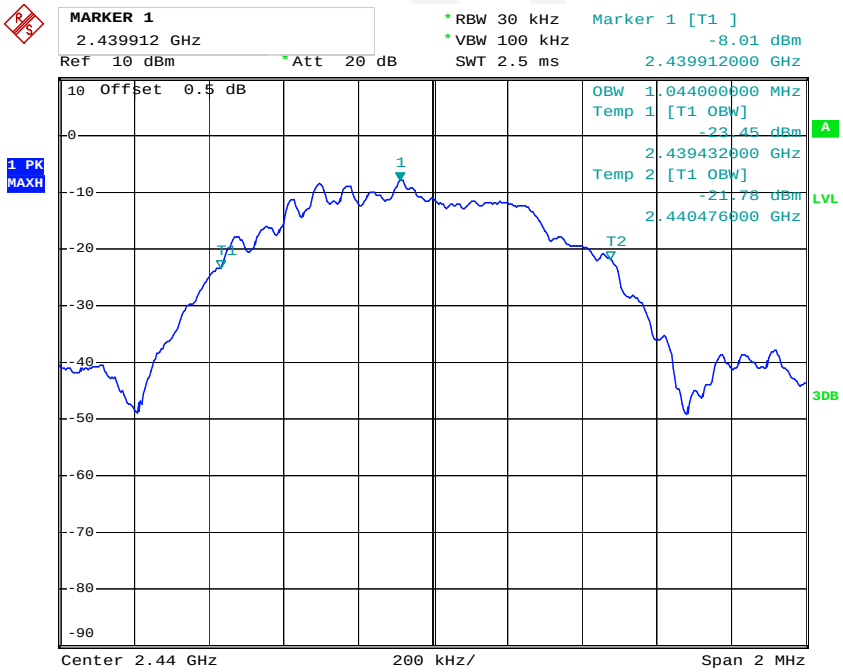

Date: 12.JUL.2018 16:00:12

## BLE Low Channel



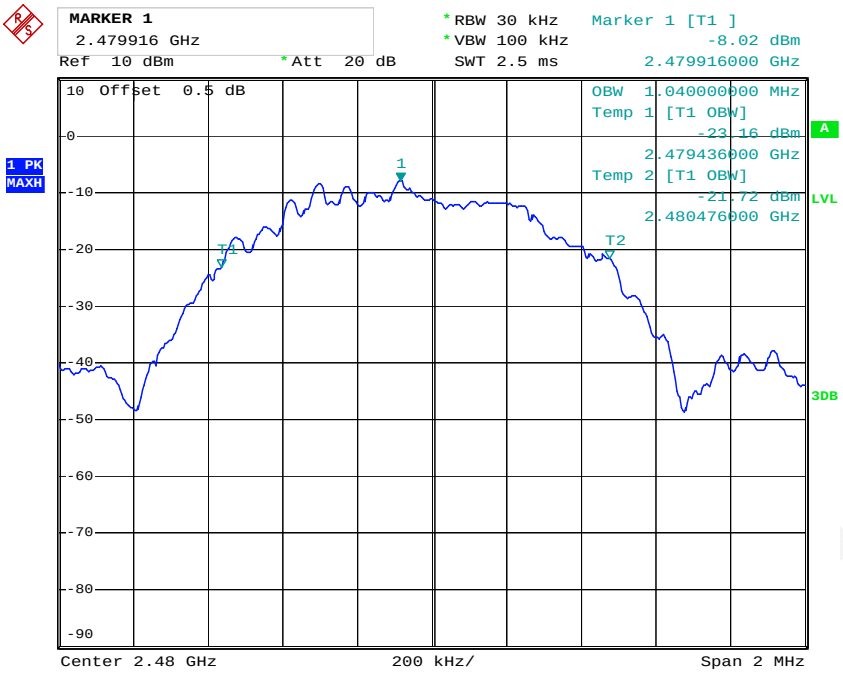

Date: 12.JUL.2018 22:14:10

## BLE Middle Channel




Date: 12.JUL.2018 22:14:40

## BLE High Channel




Date: 12.JUL.2018 22:15:18

# FCC §15.247(b) (3)& RSS-247 CLAUSE 5.4 d) - MAXIMUM PEAK CONDUCTED OUTPUT POWER

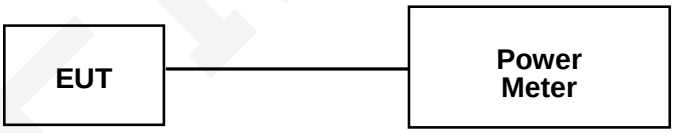
## Applicable Standard

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.

According to RSS-247§5.4 d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(e), the e.i.r.p. shall not exceed 4 W.
As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, 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 test equipment.
3. Add a correction factor to the display.
4. Set the power Meter to test Peak output power, record the result as peak power.
5. Set the power meter to test average output power, record the result as average power.




## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| Agilent | USB Wideband Power Sensor | U2022XA | MY5417006 | 2017-12-11 | 2018-12-11 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/02 | Each time | N/A |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 28.9 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 99.8 kPa |

** The testing was performed by Tiago Huang & Swim Lv on 2018-07-12.*

*Test Mode: Transmitting*

*Test Result: Compliance. Please refer to the following table.*

| Test mode | Frequency (MHz) | Max Conducted Output Power(dBm) | | | Peak EIRP (dBm) | EIRP Limit for ISED (dBm) |
|---|---|---|---|---|---|---|
| | | Peak | Average | Limit | | |
| 802.11b | 2412 | 17.67 | 13.72 | 30 | 18.67 | 36 |
| | 2437 | 17.91 | 14.45 | 30 | 18.91 | 36 |
| | 2462 | 18.09 | 14.57 | 30 | 19.09 | 36 |
| 802.11g | 2412 | 18.91 | 11.23 | 30 | 19.91 | 36 |
| | 2437 | 20.56 | 12.84 | 30 | 21.56 | 36 |
| | 2462 | 22.60 | 14.73 | 30 | 23.6 | 36 |
| 802.11n ht20 | 2412 | 19.20 | 11.09 | 30 | 20.2 | 36 |
| | 2437 | 20.98 | 12.89 | 30 | 21.98 | 36 |
| | 2462 | 22.83 | 14.60 | 30 | 23.83 | 36 |
| 802.11n ht40 | 2422 | 19.91 | 11.77 | 30 | 20.91 | 36 |
| | 2437 | 20.56 | 12.22 | 30 | 21.56 | 36 |
| | 2452 | 21.45 | 12.61 | 30 | 22.45 | 36 |
| BLE | 2402 | -3.86 | / | 30 | -2.86 | 36 |
| | 2440 | -3.34 | / | 30 | -2.34 | 36 |
| | 2480 | -3.34 | / | 30 | -2.34 | 36 |

# FCC §15.247(d)& RSS-247 CLAUSE 5.5 – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

## Applicable Standard

According to 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. 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)).

According to RSS-247 Clause 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 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 Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESPI | 100120 | 2017-12-11 | 2018-12-11 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/02 | Each time | N/A |

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

## Test Data

### Environmental Conditions

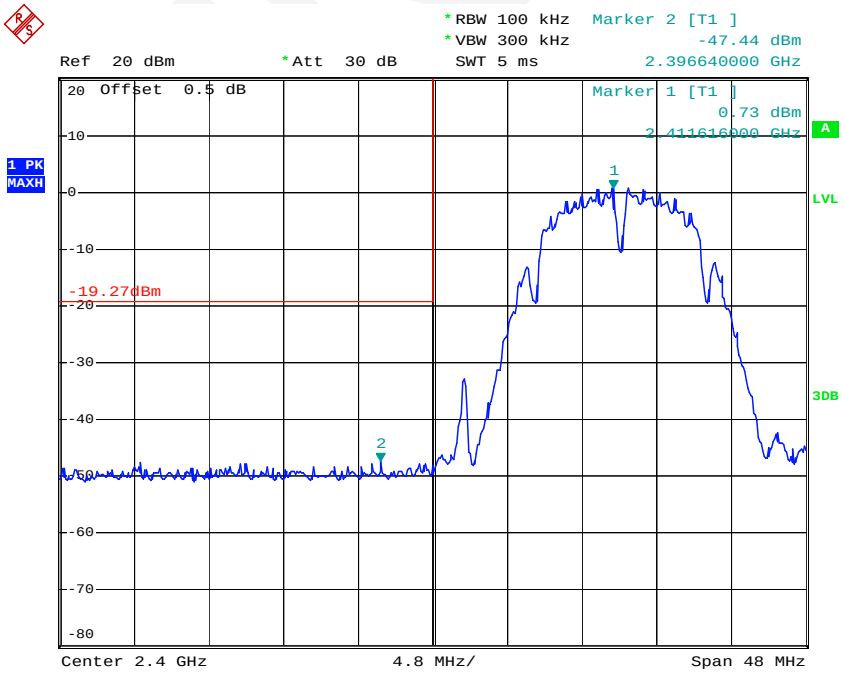
| | |
|---|---|
| **Temperature:** | 28.9 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 99.8 kPa |

** The testing was performed by Tiago Huang & Swim Lv on 2018-07-12.*

*Test mode: Transmitting*

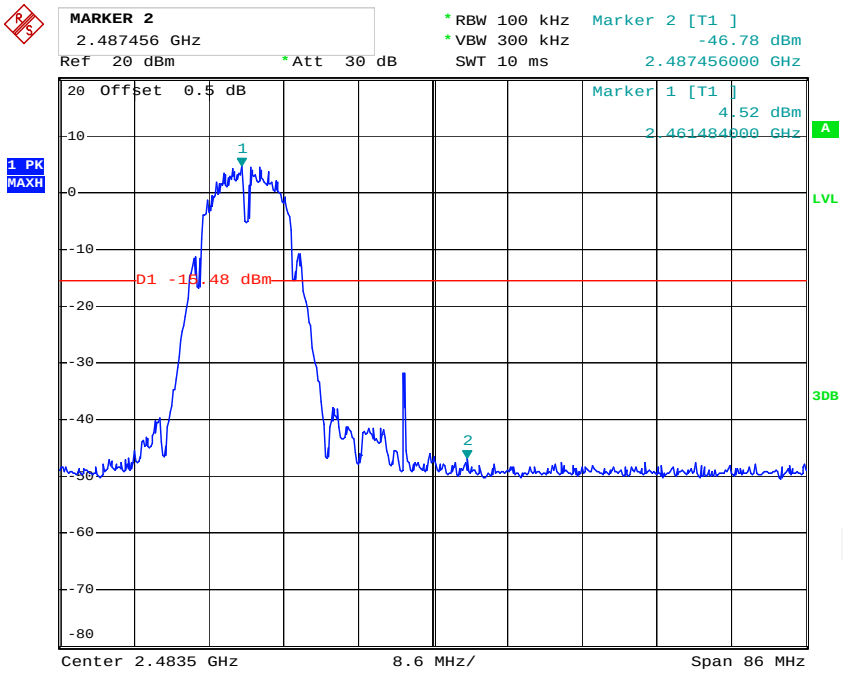
*Test Result: Compliant. Please refer to following plots.*

**802.11b: Band Edge, Left Side**



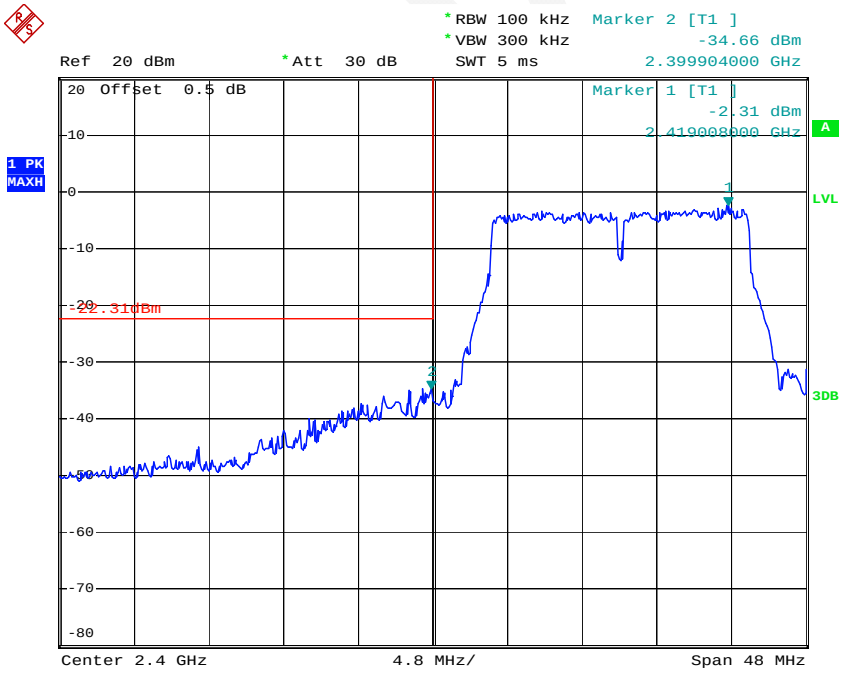

Date: 12.JUL.2018 15:18:58

## 802.11b: Band Edge, Right Side



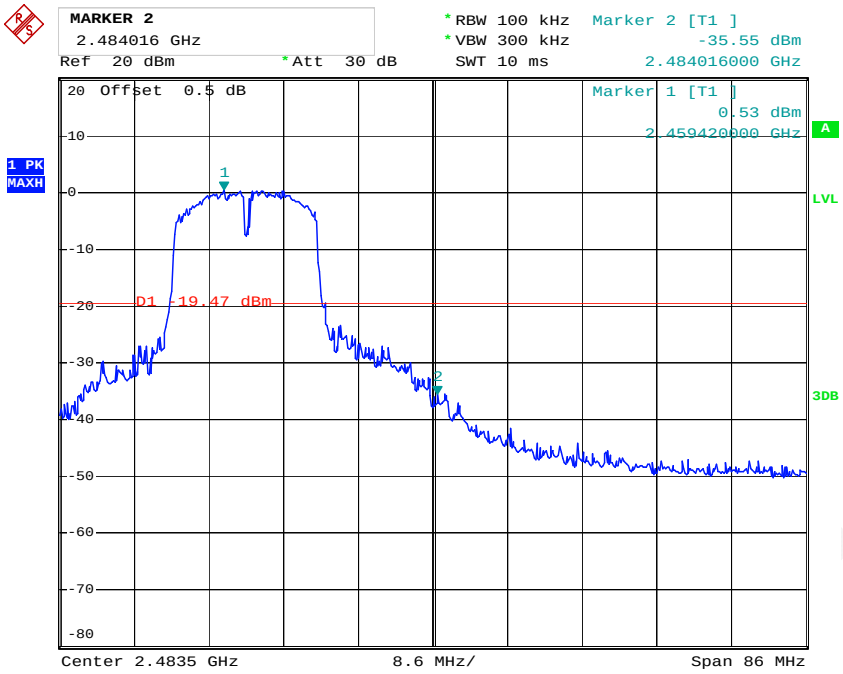

Date: 12.JUL.2018 17:07:29

## 802.11g: Band Edge, Left Side



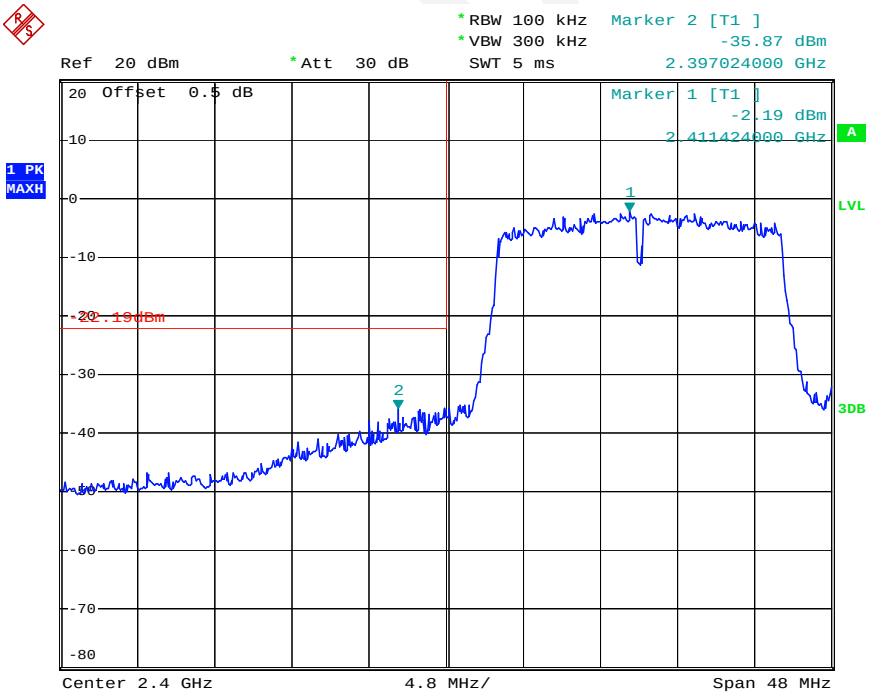

Date: 12.JUL.2018 15:34:38

## 802.11g: Band Edge, Right Side



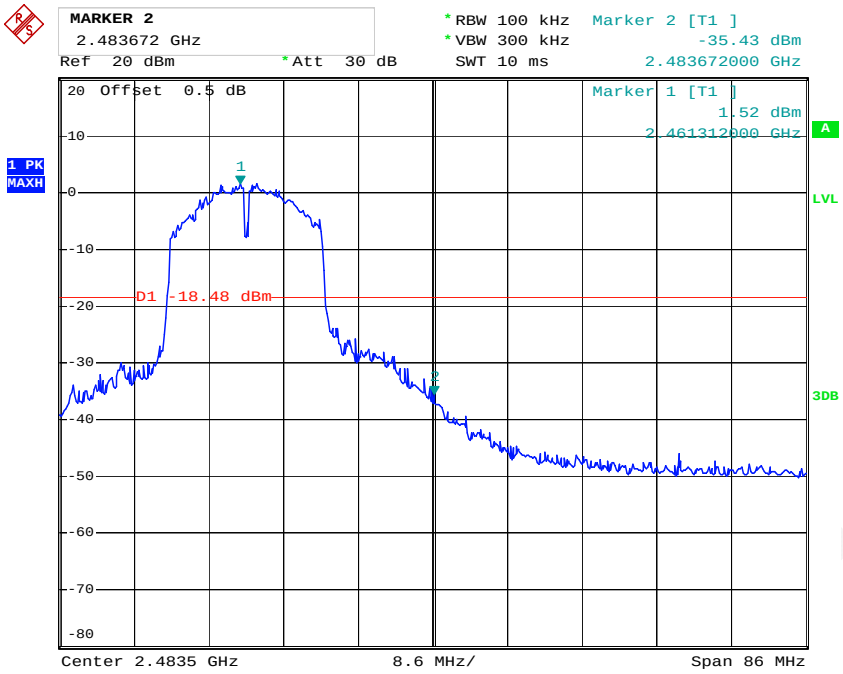

Date: 12.JUL.2018 17:06:07

## 802.11n ht20 Band Edge, Left Side



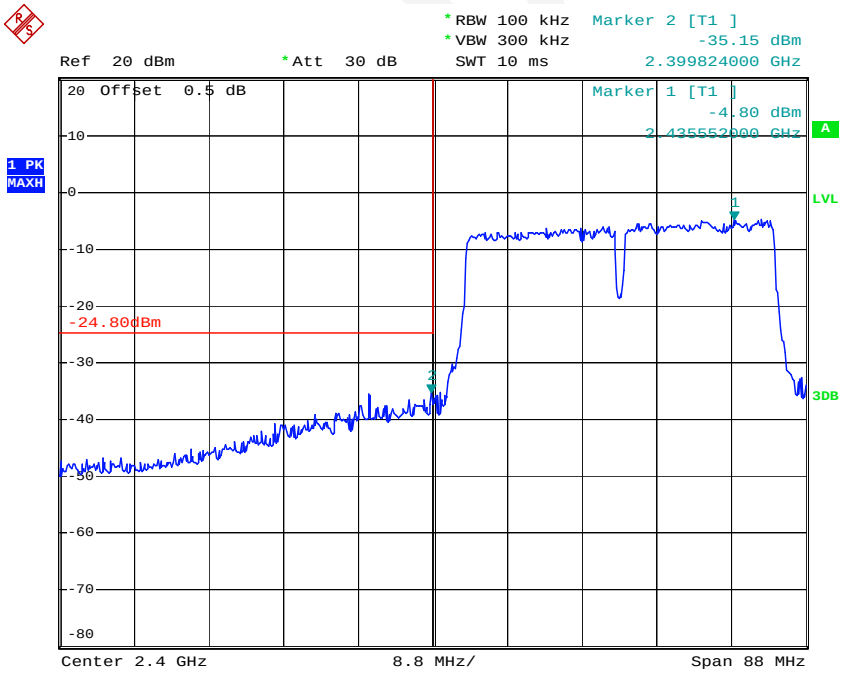

Date: 12.JUL.2018 15:41:56

## 802.11n ht20 Band Edge, Right Side



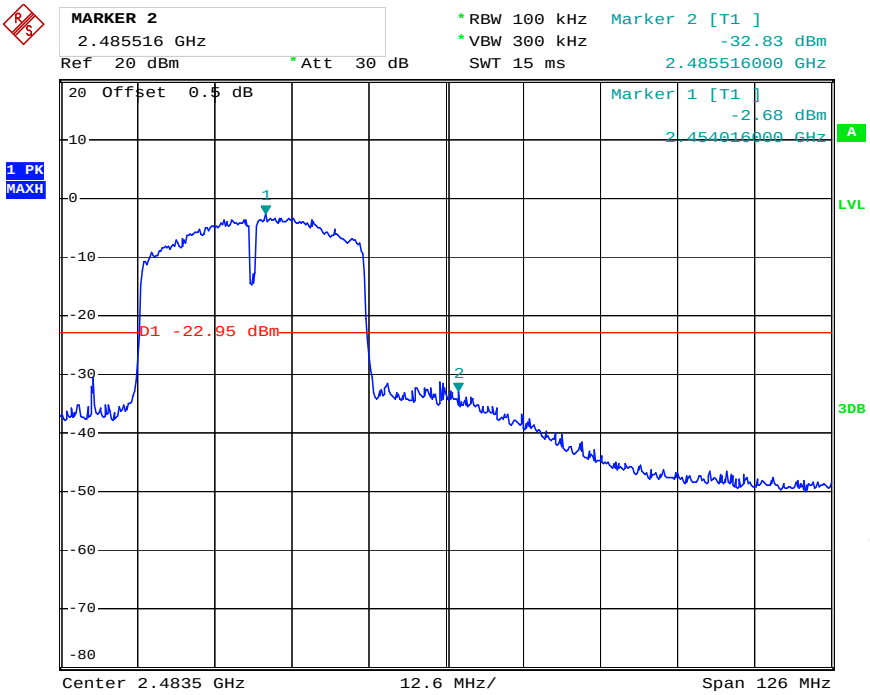

Date: 12.JUL.2018 17:04:49

## 802.11n ht40: Band Edge, Left Side



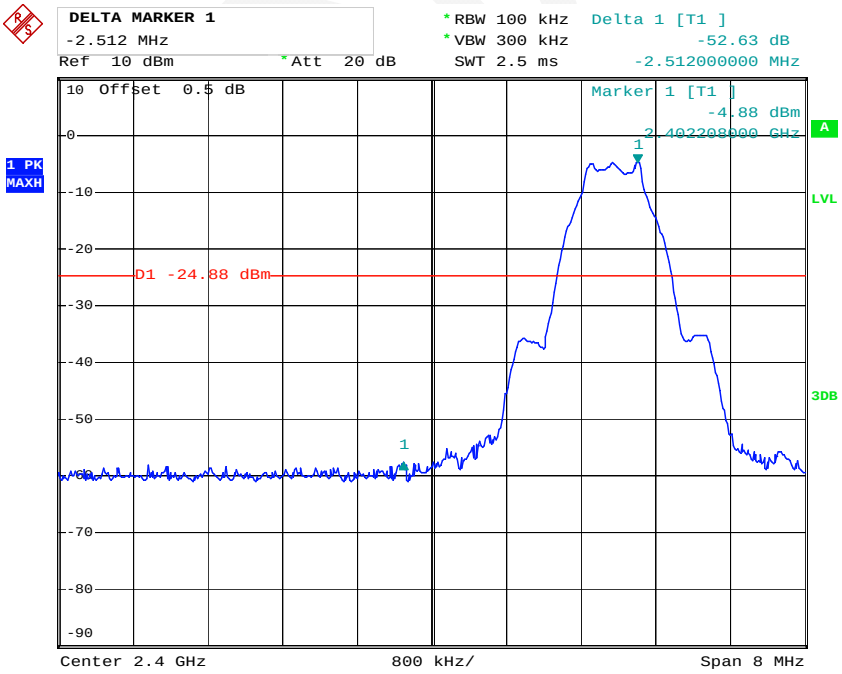

Date: 12.JUL.2018 15:52:09

## 802.11n ht40 Band Edge, Right Side



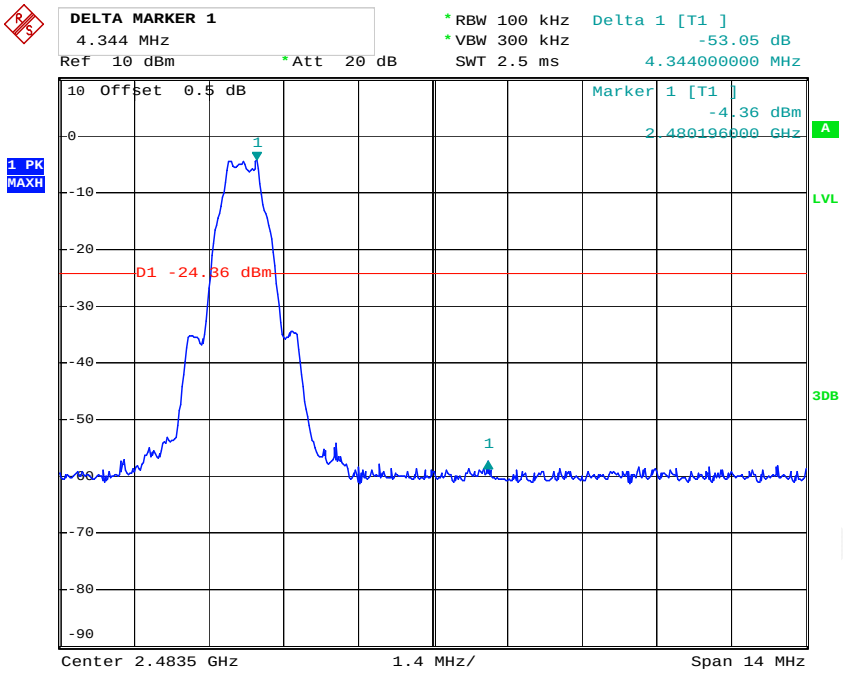

Date: 12.JUL.2018 17:03:32

## BLE Band Edge, Left Side




Date: 12.JUL.2018 22:20:15

## BLE Band Edge, Right Side




Date: 12.JUL.2018 22:21:07

# FCC §15.247(e) & RSS-247 CLAUSE 5.2 b - POWER SPECTRAL DENSITY

## Applicable Standard

According to FCC§15.247(e):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.

According to RSS-247 §5.2 b):

b) The transmitter 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. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

## 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 was set 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 the RBW = 3 kHz, VBW = 10 kHz, Set the span to 1.5 times the DTS bandwidth.
4. Use the peak marker function to determine the maximum amplitude level.

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESPI | 100120 | 2017-12-11 | 2018-12-11 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/02 | Each time | N/A |

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

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 28.9 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 99.8 kPa |

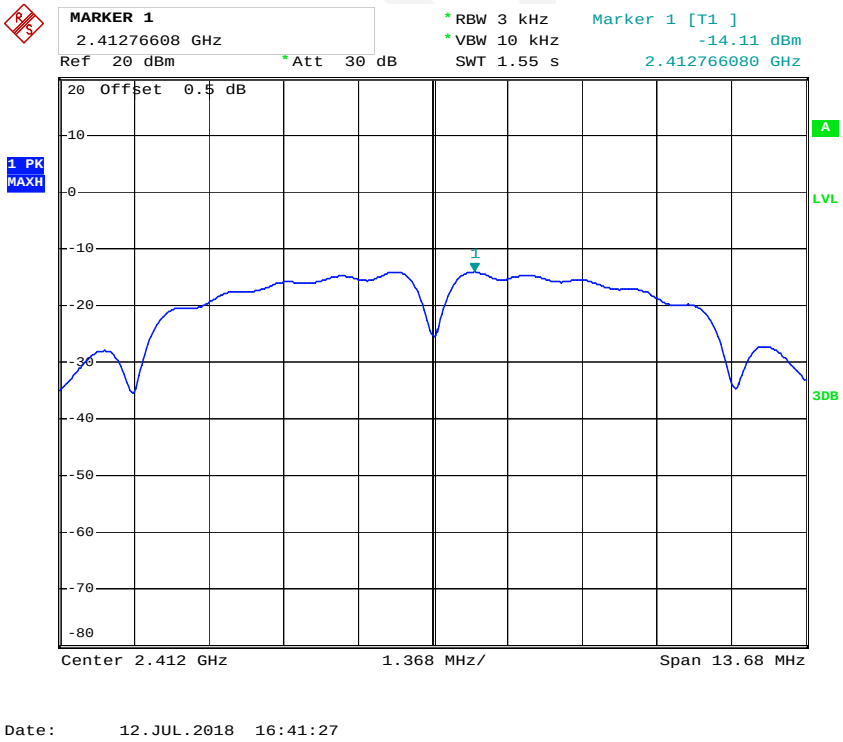
** The testing was performed by Tiago Huang & Swim Lv on 2018-07-12.*

*Test Mode: Transmitting*

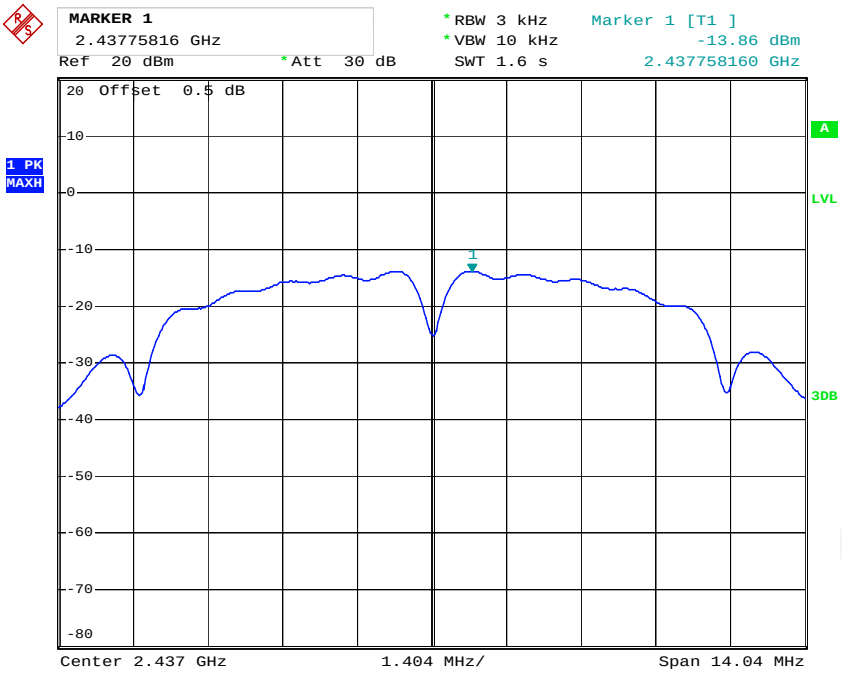
*Test Result: Compliance. Please refer to the following table and plots*

| Test mode | Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) |
|---|---|---|---|---|
| 802.11b | Low | 2412 | -14.11 | ≤8 |
| | Middle | 2437 | -13.86 | ≤8 |
| | High | 2462 | -13.26 | ≤8 |
| 802.11g | Low | 2412 | -17.11 | ≤8 |
| | Middle | 2437 | -15.42 | ≤8 |
| | High | 2462 | -13.41 | ≤8 |
| 802.11n ht20 | Low | 2412 | -16.65 | ≤8 |
| | Middle | 2437 | -14.75 | ≤8 |
| | High | 2462 | -13.10 | ≤8 |
| 802.11n ht40 | Low | 2422 | -16.83 | ≤8 |
| | Middle | 2437 | -17.26 | ≤8 |
| | High | 2452 | -15.89 | ≤8 |
| BLE | Low | 2402 | -19.46 | ≤8 |
| | Middle | 2440 | -19.06 | ≤8 |
| | High | 2480 | -19.02 | ≤8 |

**Power Spectral Density, 802.11b Low Channel**

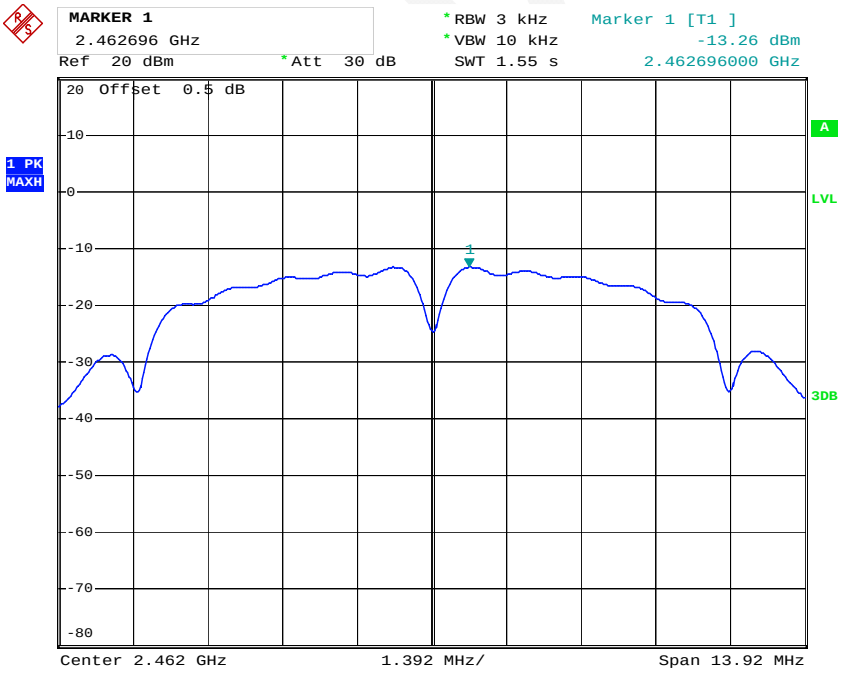


## Power Spectral Density, 802.11b Middle Channel



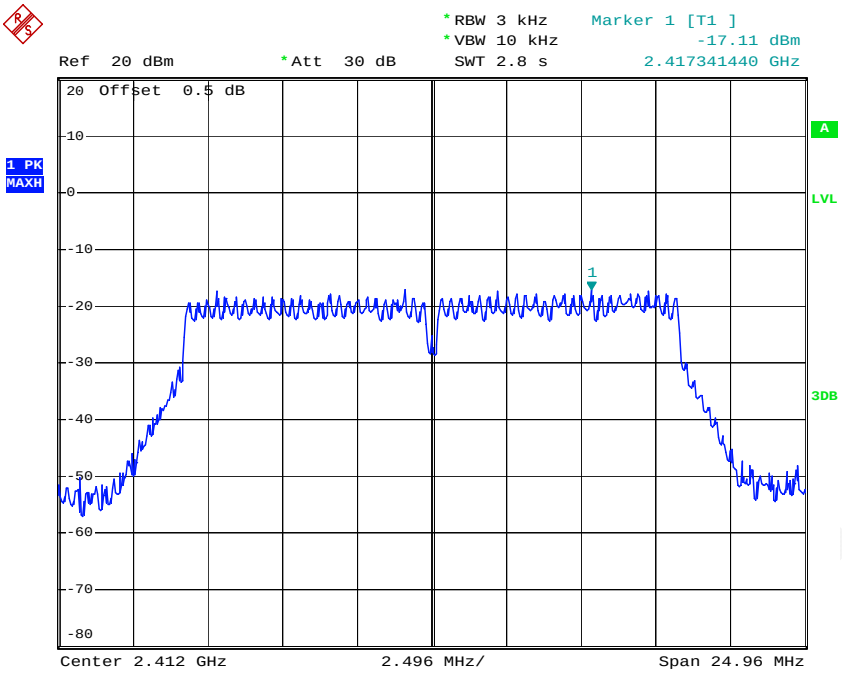

Date: 12.JUL.2018 16:43:03

## Power Spectral Density, 802.11b High Channel



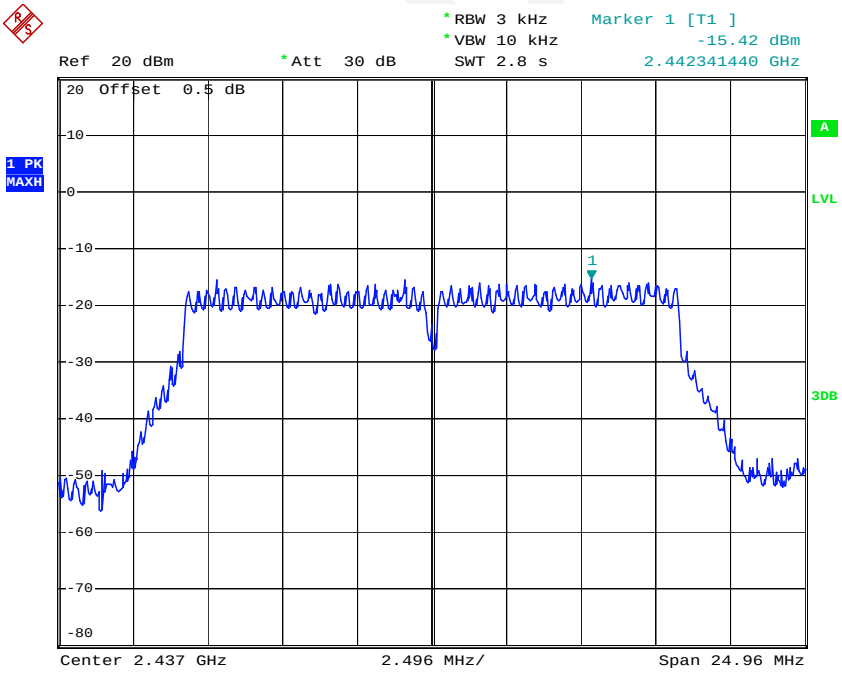

Date: 12.JUL.2018 16:45:17

## Power Spectral Density, 802.11g Low Channel



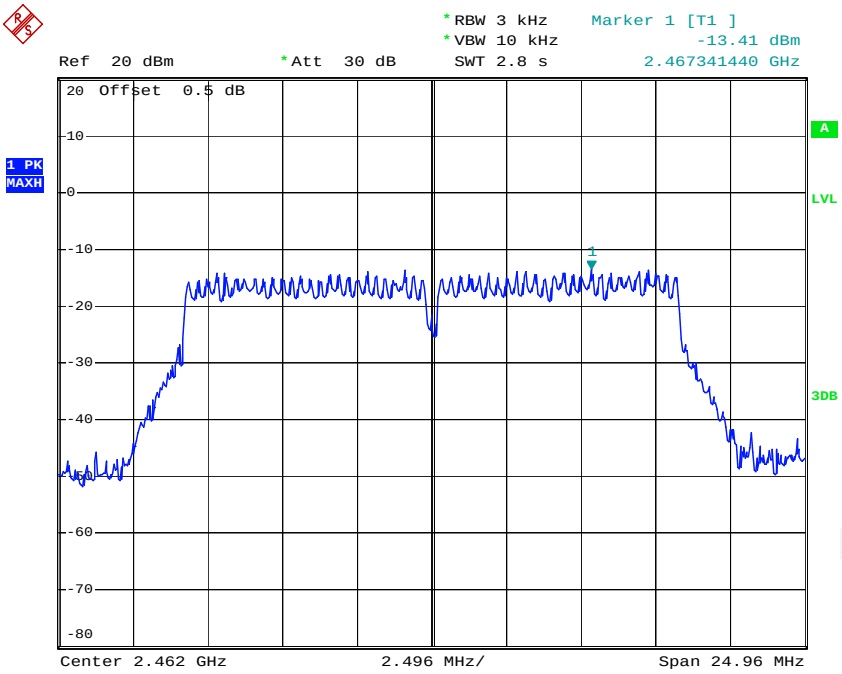

Date: 12.JUL.2018 15:34:21

## Power Spectral Density, 802.11g Middle Channel



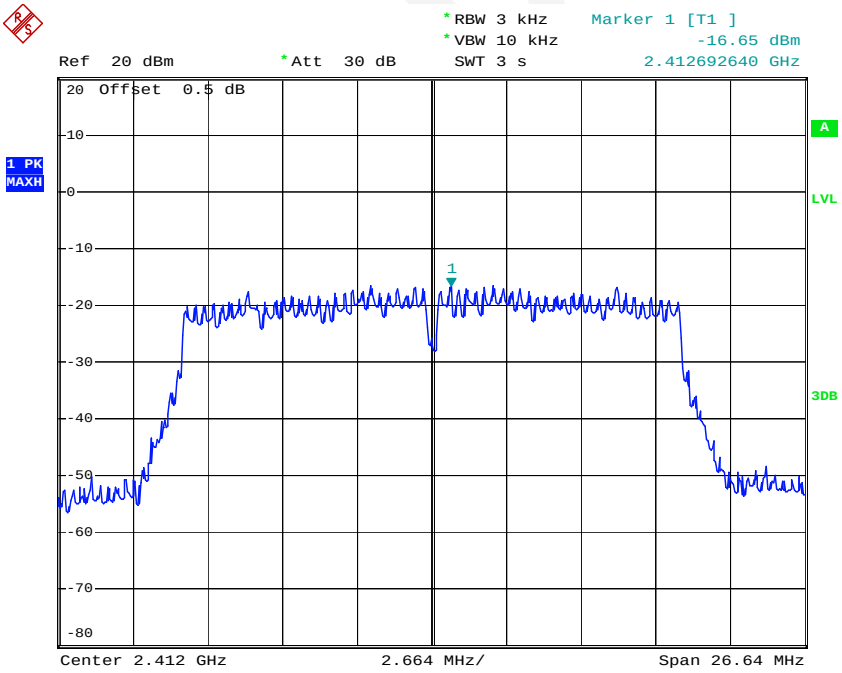

Date: 12.JUL.2018 15:36:24

## Power Spectral Density, 802.11g High Channel



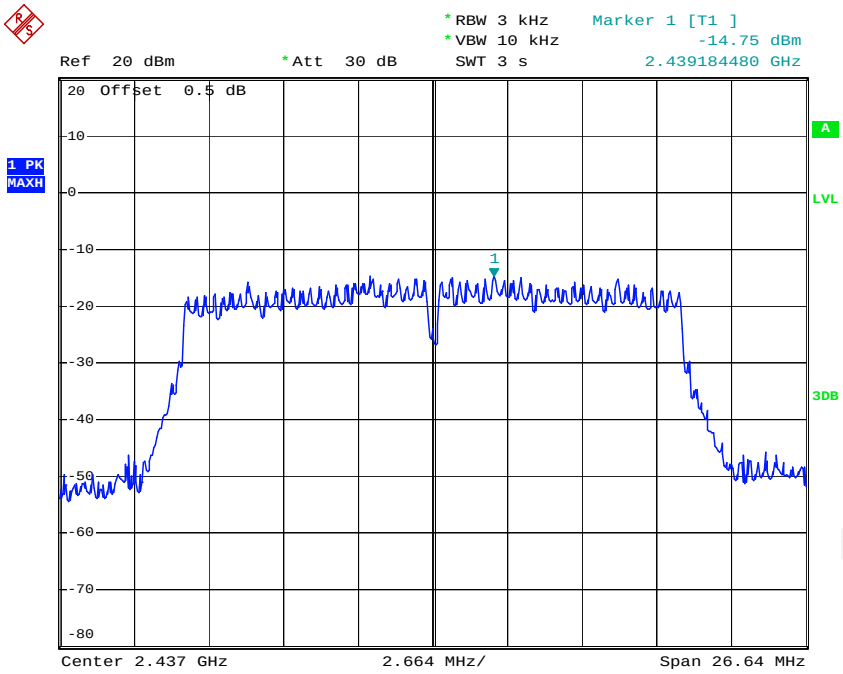

Date: 12.JUL.2018 15:38:48

## Power Spectral Density, 802.11n ht20 Low Channel



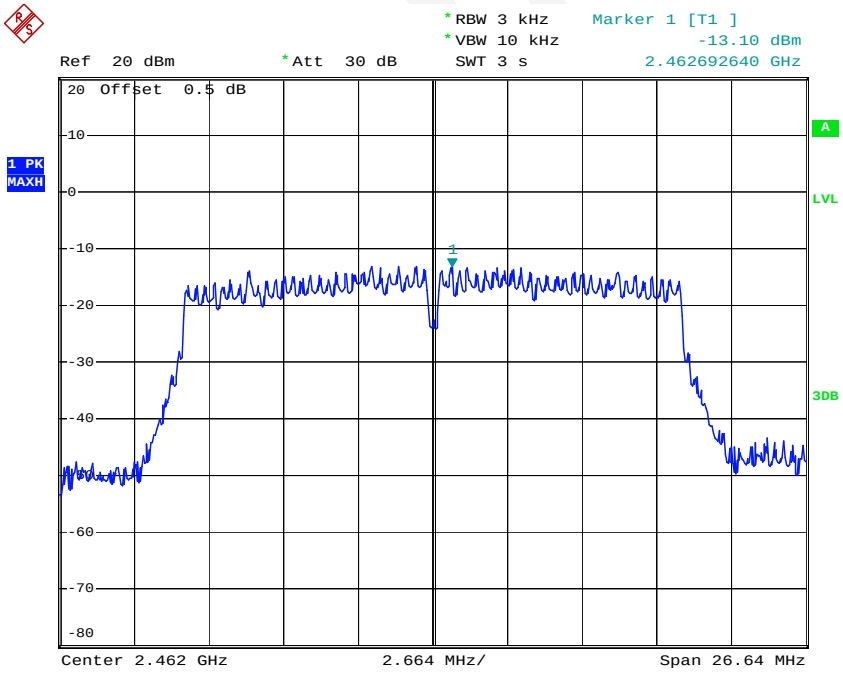

Date: 12.JUL.2018 15:41:30

## Power Spectral Density, 802.11n ht20 Middle Channel



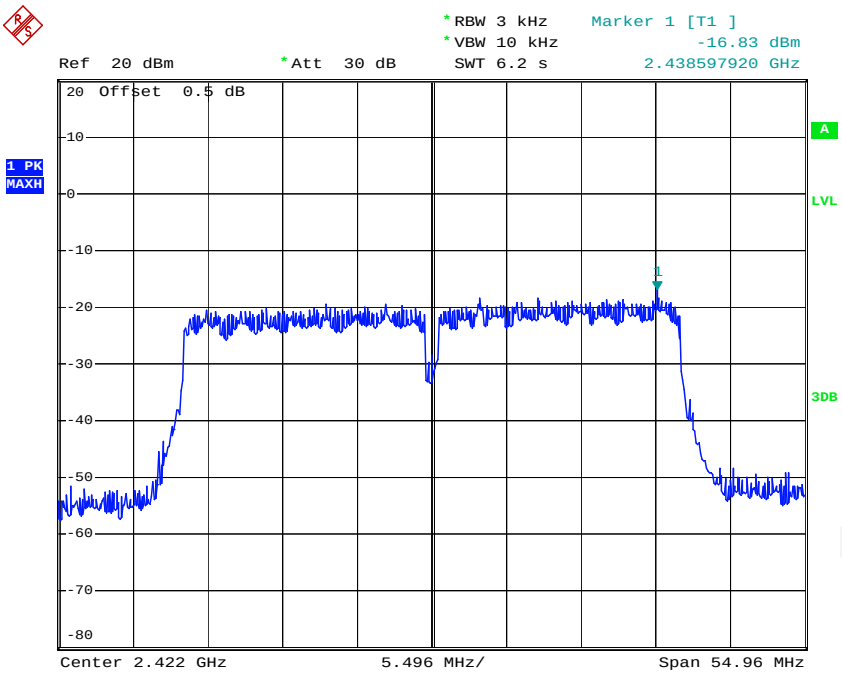

Date: 12.JUL.2018 15:45:30

## Power Spectral Density, 802.11n ht20 High Channel



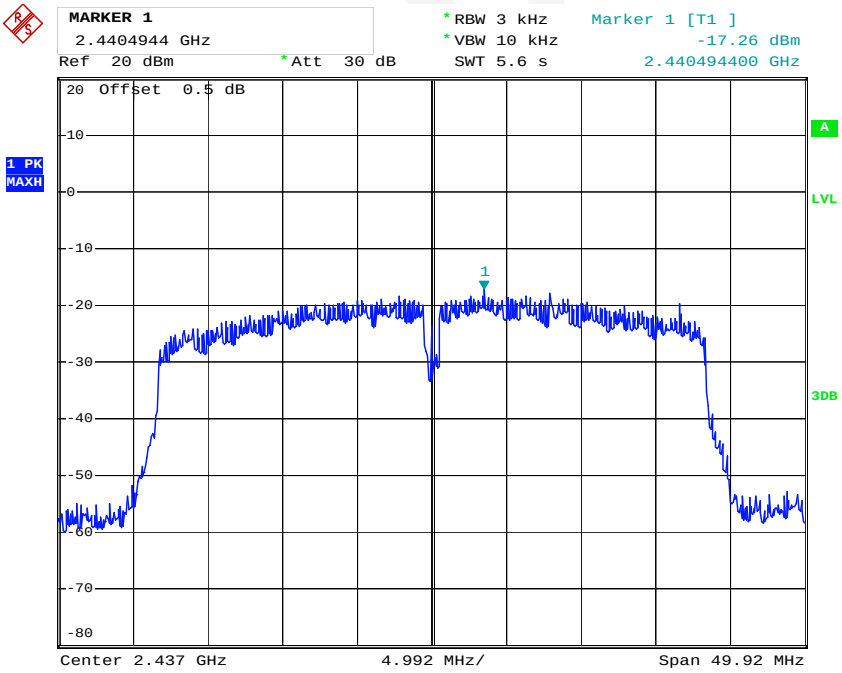

Date: 12.JUL.2018 15:48:41

## Power Spectral Density, 802.11n ht40 Low Channel




Date: 12.JUL.2018 15:51:43

## Power Spectral Density, 802.11n ht40 Middle Channel

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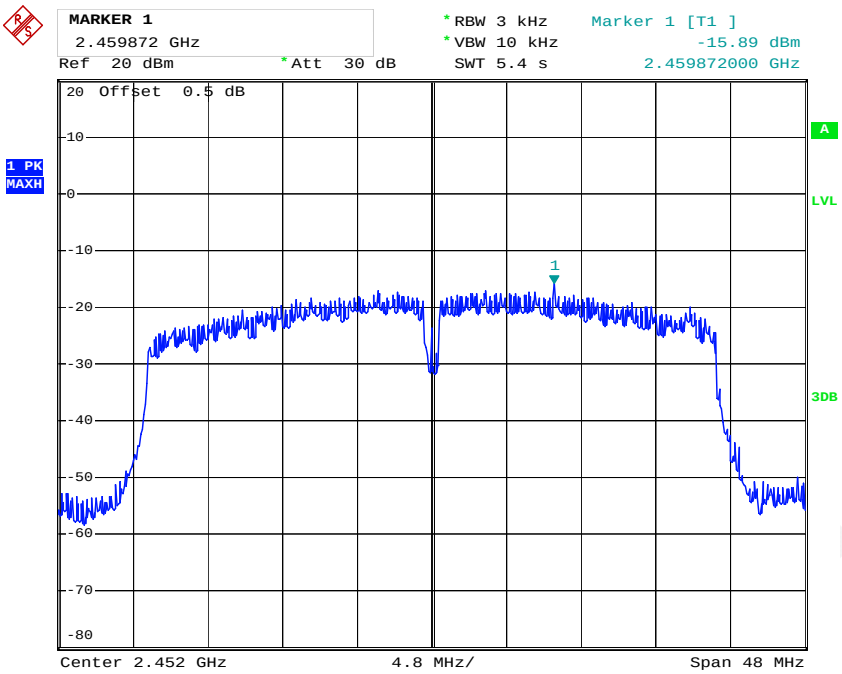
## Power Spectral Density, 802.11n ht40 High Channel

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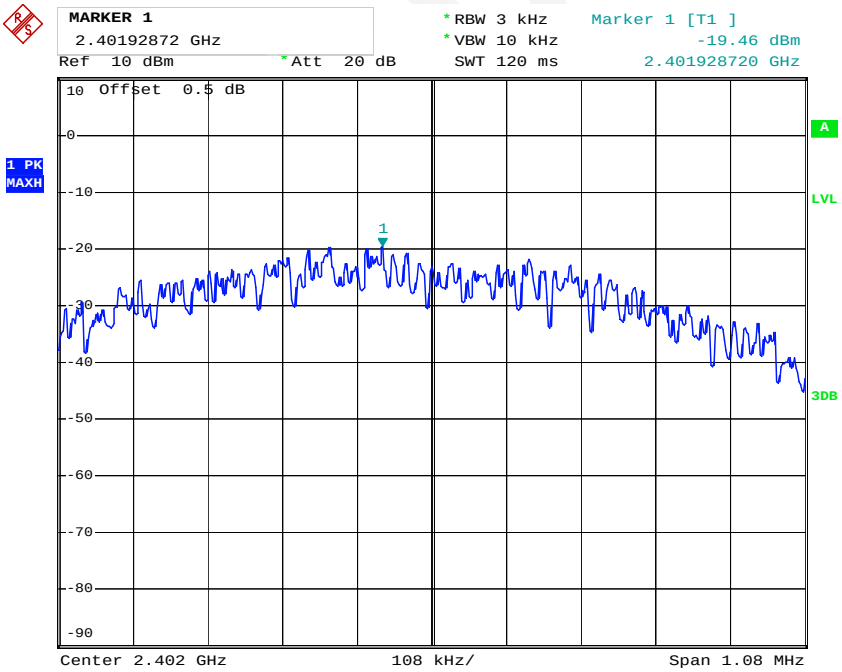
## Power Spectral Density, BLE Low Channel

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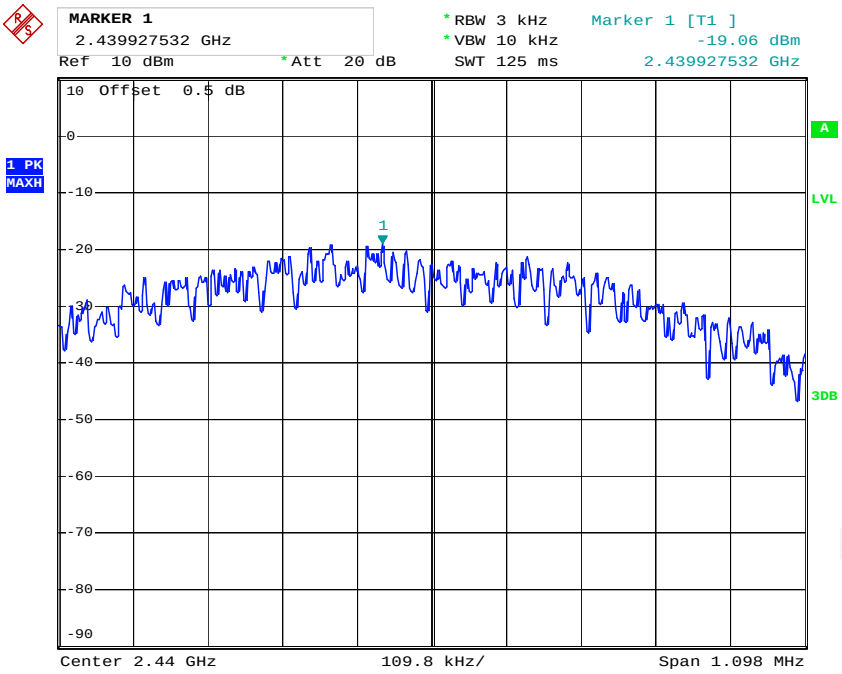
## Power Spectral Density, BLE Middle Channel

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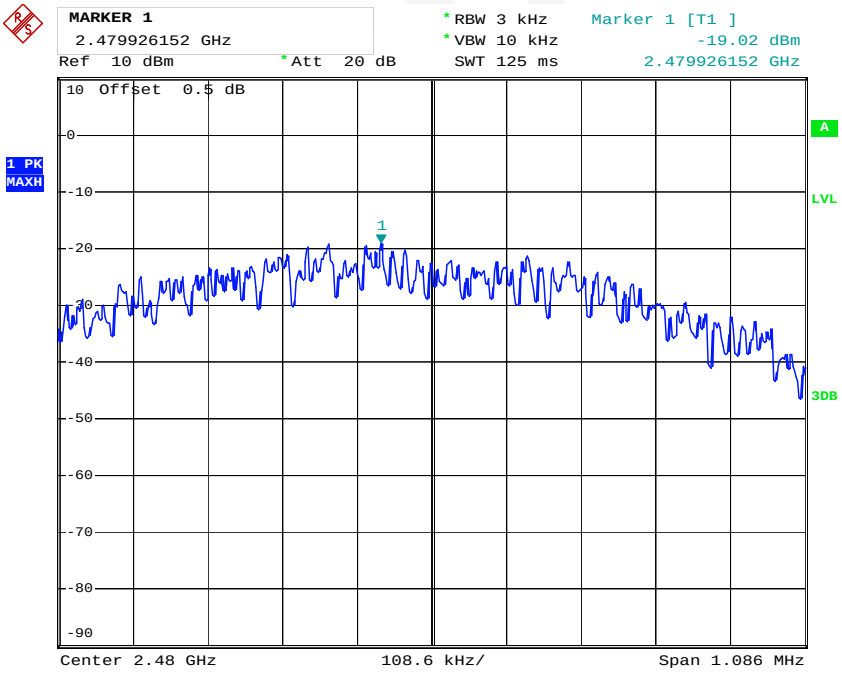
## Power Spectral Density, BLE High Channel

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