TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.247

RSS-GEN, ISSUE 5, AMENDMENT 1, MARCH 2019

RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Hammerhead Navigation Inc.

19 Morris Avenue Building 128, Brooklyn Navy Yard Brooklyn, NY 11205 United States

FCC ID: 2ADMX-HK2
IC: 12534A-HK2

Report Type:	**Product Name:**
Original Report	KAROO 2

Report Number:	RDG200827001-00D
Report Date:	2020-10-14
Reviewed By:	Ivan Cao Assistant Manager
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
RELATED SUBMITTAL(S)/GRANT(S) 4
TEST METHODOLOGY 4
MEASUREMENT UNCERTAINTY 5
TEST FACILITY 5
DECLARATIONS 5
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EUT EXERCISE SOFTWARE 7
EQUIPMENT MODIFICATIONS 11
SUPPORT EQUIPMENT LIST AND DETAILS 11
SUPPORT CABLE LIST AND DETAILS 11
BLOCK DIAGRAM OF TEST SETUP 11
SUMMARY OF TEST RESULTS **12**
FCC §15.247 (i) & §1.1310 & §2.1093- RF Exposure **13**
APPLICABLE STANDARD 13
RSS-102 § 2.5.1 EXEMPTION LIMITS FOR ROUTINE EVALUATION – SAR EVALUATION **14**
APPLICABLE STANDARD 14
FCC §15.203& RSS-GEN CLAUSE 6.8 - ANTENNA REQUIREMENT **16**
APPLICABLE STANDARD 16
ANTENNA CONNECTOR CONSTRUCTION 16
FCC §15.207 (a) & RSS-GEN CLAUSE 8.8– AC LINE CONDUCTED EMISSIONS **17**
APPLICABLE STANDARD 17
EUT SETUP 17
EMI TEST RECEIVER SETUP 17
TEST PROCEDURE 17
CORRECTED AMPLITUDE & MARGIN CALCULATION 18
TEST EQUIPMENT LIST AND DETAILS 18
TEST DATA 19
FCC §15.209, §15.205 & §15.247(d), RSS-247 CLAUSE 5.5, RSS-GEN CLAUSE 8.10 - SPURIOUS EMISSIONS **21**
APPLICABLE STANDARD 21
EUT SETUP 21
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 22
TEST PROCEDURE 22
CORRECTED AMPLITUDE & MARGIN CALCULATION 22
TEST EQUIPMENT LIST AND DETAILS 23
TEST DATA 23
FCC §15.247(a) (2), RSS-247 CLAUSE 5.2 a) &RSS-GEN CLAUSE 6.7–6 dB EMISSION BANDWIDTH AND 99% OCCUPIED BANDWIDTH **31**
APPLICABLE STANDARD 31
TEST PROCEDURE 32
TEST EQUIPMENT LIST AND DETAILS 32

TEST DATA 32
FCC §15.247(b) (3) , RSS-247 CLAUSE 5.4 D - MAXIMUM PEAK CONDUCTED OUTPUT POWER 50
APPLICABLE STANDARD 50
TEST PROCEDURE 50
TEST EQUIPMENT LIST AND DETAILS.....50
TEST DATA 51
FCC §15.247(d), RSS-247 CLAUSE 5.5 – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE 52
APPLICABLE STANDARD 52
TEST PROCEDURE 52
TEST EQUIPMENT LIST AND DETAILS.....53
TEST DATA 53
FCC §15.247(e), RSS-247 CLAUSE 5.2 B - POWER SPECTRAL DENSITY 60
APPLICABLE STANDARD 60
TEST PROCEDURE 60
TEST EQUIPMENT LIST AND DETAILS.....60
TEST DATA 61

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	KAROO 2
EUT Model:	KAROO 2
Operation Frequency:	2412-2462MHz(802.11b/g/n ht20) 2422-2452 MHz(802.11n ht40) 2402-2480MHz(BLE) 2457(ANT^+)
Maximum Peak Output Power (Conducted):	802.11:21.51 dBm BLE:1.30 dBm ANT^+: 2.79 dBm
FVIN:	SMT_K2_00_012_EQ3001_HW01
Modulation Type:	BLE/ANT^+:GFSK 802.11 b mode: DSSS 802.11g/n mode: OFDM
Rated Input Voltage:	DC 3.8V from battery or DC 5V from USB port
Serial Number:	RDG200827001-RF-S1
EUT Received Date:	2020.08.27
EUT Received Status:	Good

Objective

This report is prepared on behalf of ***Hammerhead Navigation Inc.*** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules, RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, Amendment 1, March 2019 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, 15.209 and 15.247 rules, RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, Amendment 1, March 2019 of the Innovation, Science and Economic Development Canada.

Related Submittal(s)/Grant(s)

FCC Part 15C DSS, 15E NII, Part 22H/24E/27 PCB submissions with FCC ID: 2ADMX-HK2
RSS-247 FHSs,LE-LAN, RSS-132, 133,199 submissions with IC: 12534A-HK2

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 15.247 Meas Guidance v05r02, RSS-247, Issue 2, February 2017, RSS-Gen Issue 5, Amendment 1, March 2019 of the Innovation, Science and Economic Development Canada.

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

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,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,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)

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

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 lab has been recognized as the FCC accredited lab 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 lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "△ ". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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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.

The device supports 2.4G Band 802.11b/g/n ht20/n ht40, BLE 1Mbps and ANT+.

For 802.11b/g/n ht20/n ht40, 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/g/n ht20 modes, test was performed with channel 1,6,11.
For 802.11n ht40 mode, test was performed 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.

ANT+ mode operates in 2457MHz.

EUT Exercise Software

▵ For 802.11 mode, software " QRCT " was used during test, the maximum power was configured as below, which was provided by manufacturer:

Mode	Channel	Frequency (MHz)	Data rate	Power level Setting
802.11 b	Low	2412	1Mbps	15
	Middle	2437	1Mbps	14
	High	2462	1Mbps	13
802.11 g	Low	2412	6Mbps	16
	Middle	2437	6Mbps	14
	High	2462	6Mbps	14
802.11n ht20	Low	2412	MCS0	15
	Middle	2437	MCS0	13
	High	2462	MCS0	13
802.11n ht40	Low	2422	MCS0	14
	Middle	2437	MCS0	13
	High	2452	MCS0	13

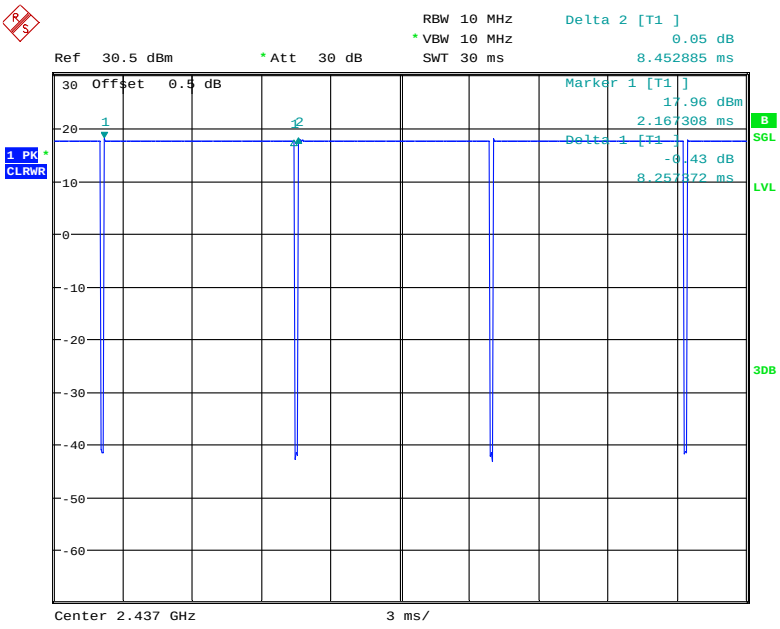
▵ For BLE mode, the ' QRCT ' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table:

Test Frequency (MHz)	Power level Setting
2402	default
2440	default
2480	default

The maximum duty cycle as following table:

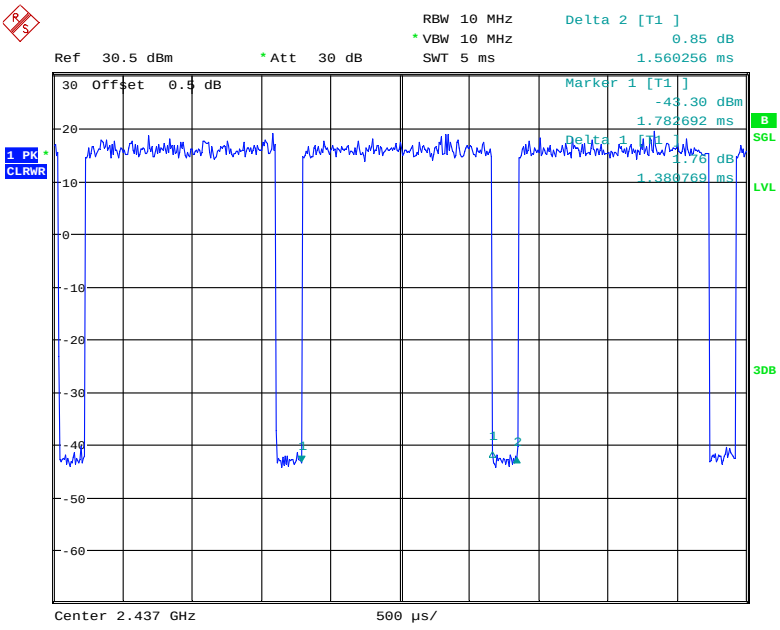
Test mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
802.11b	8.258	8.453	97.69
802.11g	1.381	1.560	88.53
802.11n ht20	1.305	1.477	88.35
802.11n ht40	0.654	0.846	77.30
BLE	0.427	0.630	67.78
ANT^{+}	2.116	2.223	95.19

802.11b



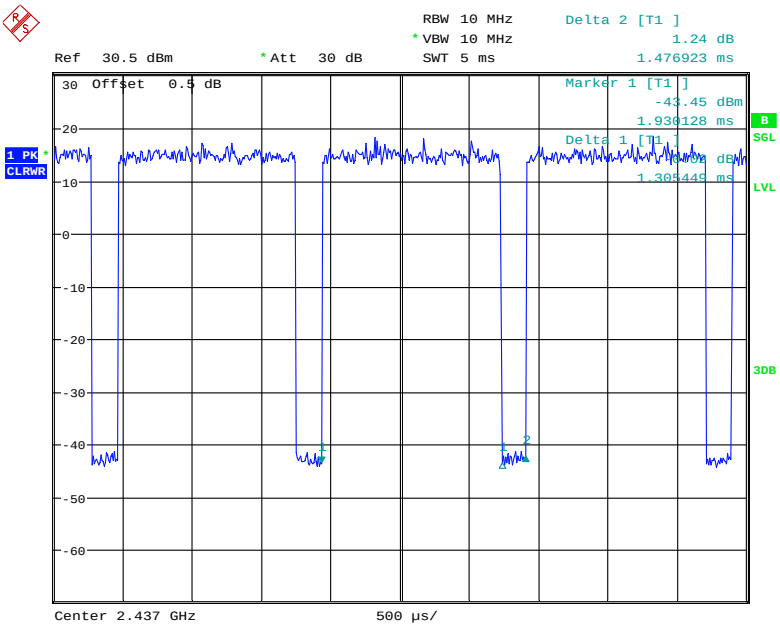
Date: 30.SEP.2020 11:38:30

802.11g



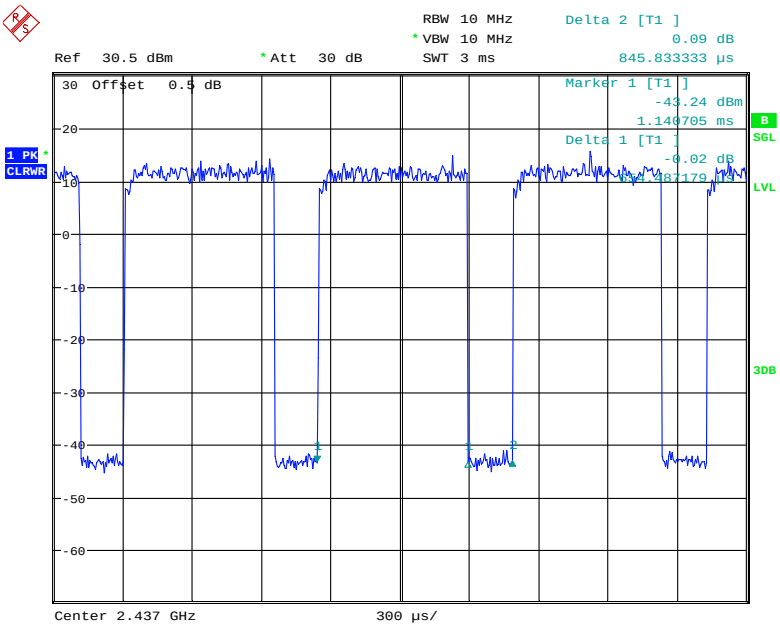
Date: 30.SEP.2020 11:39:35

802.11n ht20



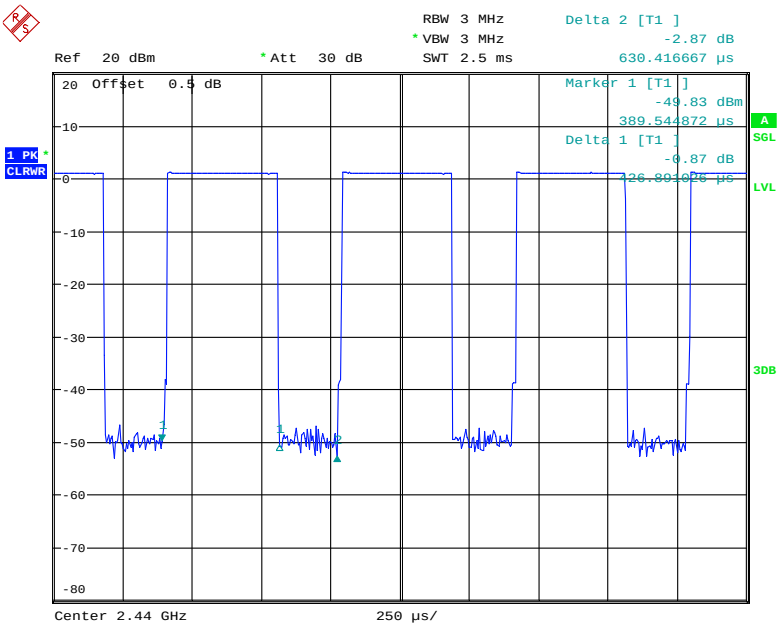
Date: 30.SEP.2020 11:40:50

802.11n ht40



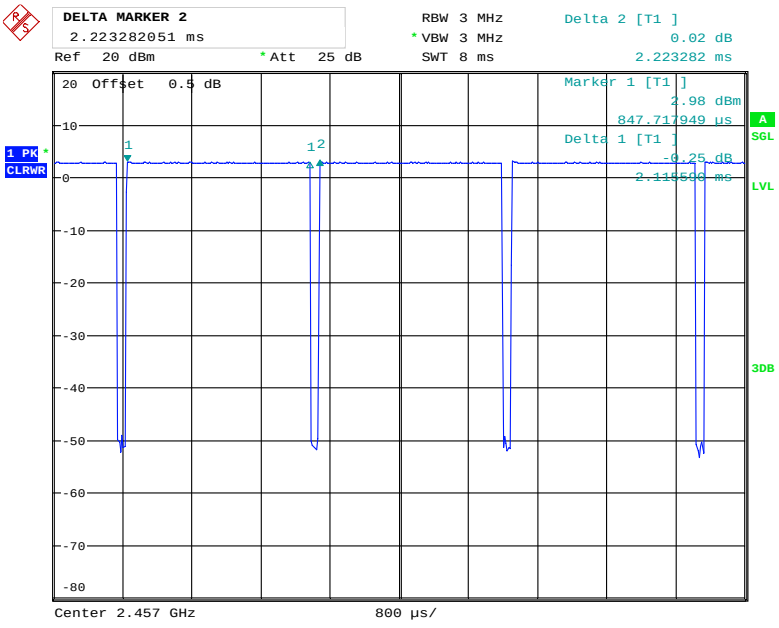
Date: 30.SEP.2020 11:41:58

BLE



Date: 29.SEP.2020 17:32:05

ANT+



Date: 30.SEP.2020 13:27:19

Equipment Modifications

No modification was made to the EUT.

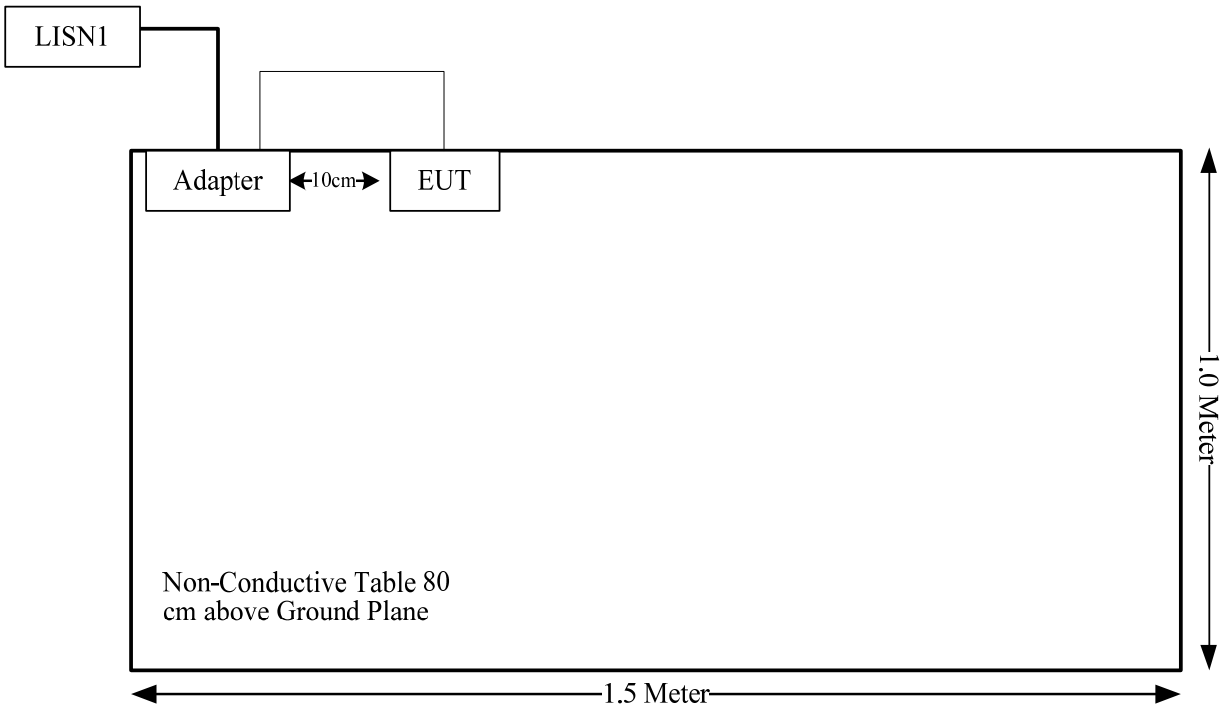
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Shenzhen Honor Electronic CO., LTD	Adapter	ADS-12CG-06	EG193LB190493013K

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	Yes	No	0.8	Adaper	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
RSS-102 Clause 2.5.1	Exemption Limit For Routine Evaluation-SAR Evaluation	Compliance
FCC §15.203, RSS-GEN Clause 6.8	Antenna Requirement	Compliance
FCC §15.207 (a); RSS-Gen Clause 8.8	AC Line Conducted Emissions	Compliance
FCC §15.205, §15.209, §15.247(d); RSS-247 Clause 5.5 RSS-Gen Clause 8.10	Spurious Emissions	Compliance
FCC §15.247 (a)(2); RSS-247 Clause 5.2 a) RSS-Gen Clause 6.7	6 dB Bandwidth and 99% Occupied Bandwidth	Compliance
FCC §15.247(b)(3); RSS-247 Clause 5.4 d)	Maximum Conducted Output Power	Compliance
FCC §15.247(d); RSS-247 Clause5.5	100 kHz Bandwidth of Frequency Band Edge	Compliance
FCC §15.247(e) RSS-247 Clause5.2 b)	Power Spectral Density	Compliance

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 BLE mode:

The max conducted power including tune-up tolerance is 2.0 dBm (1.58 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=1.58/5*(√2.480) = 0.5< 3.0

Result: Compliance. The stand-alone SAR evaluation is not necessary.

For ANT^{+} mode:

The max conducted power including tune-up tolerance is 3.0 dBm (2.0 mW).
[(max. power of channel, mW)/(min. test separation distance, mm)][√f(GHz)]
=2.0/5*(√2.457) = 0.6< 3.0

Result: Compliance. The stand-alone SAR evaluation is not necessary.

For 802.11b/g/n mode:

Result: Compliance. Please refer to the SAR report: RDG200827001-20.

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 BLE:
The max tune-up conducted power is 2.0 dBm, Antenna Gain:0.5 dBi,
EIRP: 2.5 dBm(1.78mW)

The exemption power(P) limits for routine evaluation in 2402-2480MHz is:
(2480-2450)/(3500-2450)=(P -4)/(2-4)
=>P=3.94 mW@2480 MHz
> 1.78mW

So the stand-alone SAR evaluation can be exempted.

For ANT+:
The max tune-up conducted power is 3.0 dBm, Antenna Gain:0.7 dBi,
EIRP: 3.7 dBm(2.34mW)

The exemption power(P) limits for routine evaluation in 2402-2480MHz is:
(2457-2450)/(3500-2450)=(P -4)/(2-4)
=>P=3.99 mW@2457 MHz
> 2.34mW

So the stand-alone SAR evaluation can be exempted.

For 802.11b/g/n mode:

Result: Compliance. Please refer to the SAR report: RDG200827001-20.

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 Connector Construction

The EUT has one internal antenna for Bluetooth&Wi-Fi, and one internal antenna for ANT+, fulfill the requirement of this section. Please refer to below information and the EUT photos:

Usage	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Bluetooth/Wi-Fi	FPC	50	0.5 dBi/2.4~2.5GHz
ANT+	FPC	50	0.7 dBi/2.4~2.5GHz

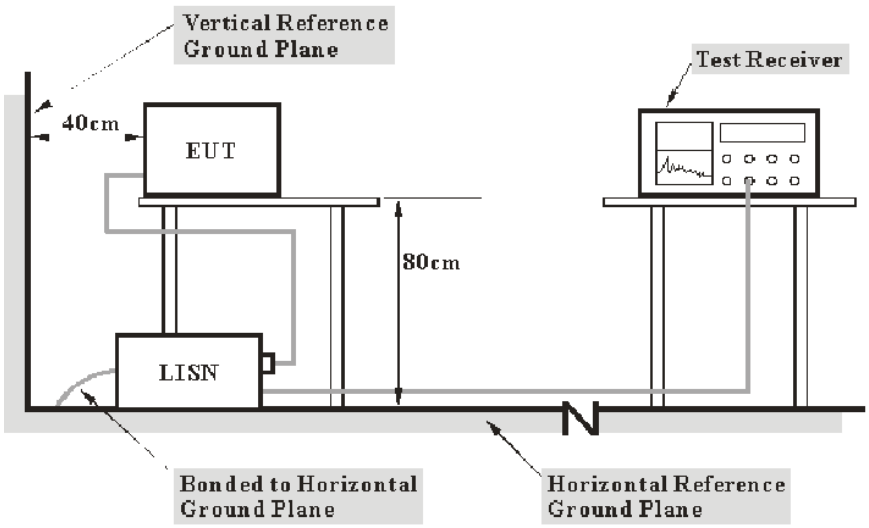
Result: Compliance.

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 outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

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	LISN	ENV 216	101614	2020-09-12	2021-09-12
R&S	EMI Test Receiver	ESCI	101121	2020-07-07	2021-07-07
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2020-09-05	2021-09-05
R&S	Test Software	EMC32	Version 9.10.00	N/A	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).

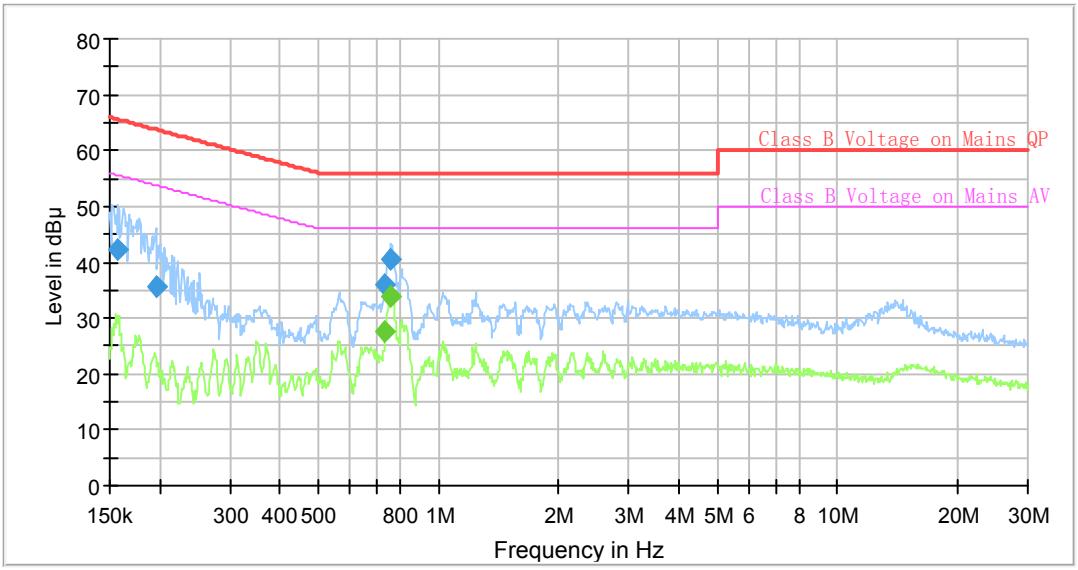
Test Data

Environmental Conditions

Temperature:	24.5℃
Relative Humidity:	57%
ATM Pressure:	100.4kPa
Test by:	Barry Yang
Test Date:	2020-10-12

Test Mode: Transmitting(802.11b middle channel was the worst)

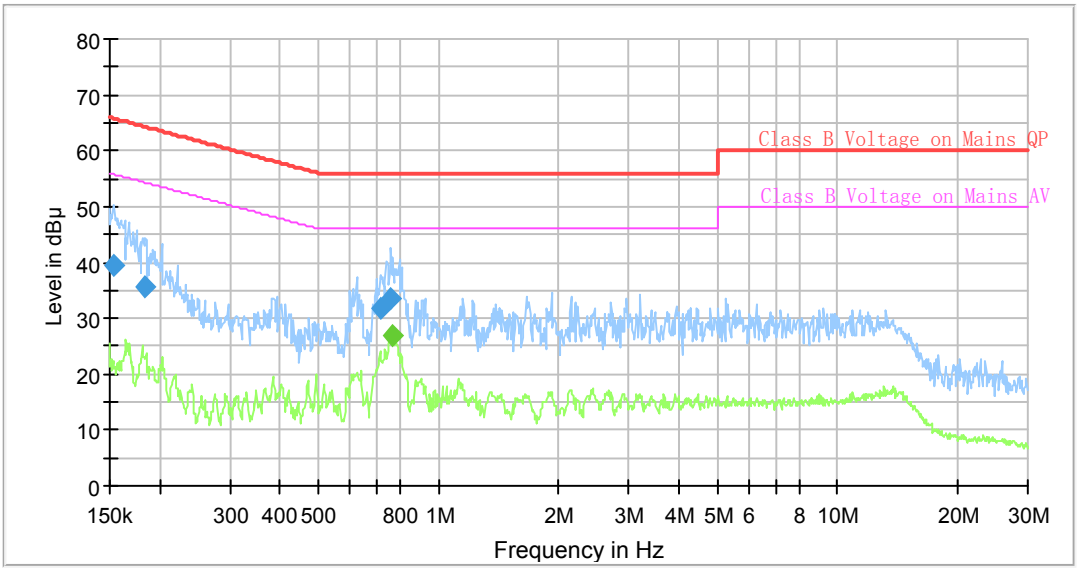
AC120 V, 60 Hz, Line:



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.157671	42.25	---	65.59	23.34	9.000	L1	9.6
0.196363	35.55	---	63.76	28.21	9.000	L1	9.6
0.732654	---	27.51	46.00	18.49	9.000	L1	9.7
0.732654	35.92	---	56.00	20.08	9.000	L1	9.7
0.758685	---	33.80	46.00	12.20	9.000	L1	9.7
0.758685	40.46	---	56.00	15.54	9.000	L1	9.7

AC120 V, 60 Hz, Neutral:



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.153788	39.33	---	65.79	26.46	9.000	N	9.6
0.184035	35.63	---	64.30	28.67	9.000	N	9.6
0.714609	31.79	---	56.00	24.21	9.000	N	9.6
0.758685	33.60	---	56.00	22.40	9.000	N	9.6
0.770122	---	26.80	46.00	19.20	9.000	N	9.6

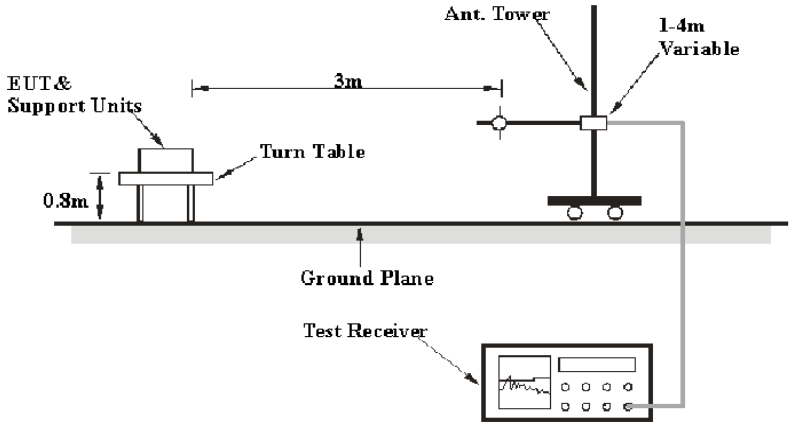
FCC §15.209, §15.205 & §15.247(d), RSS-247 CLAUSE 5.5, RSS-GEN CLAUSE 8.10 - SPURIOUS EMISSIONS

Applicable Standard

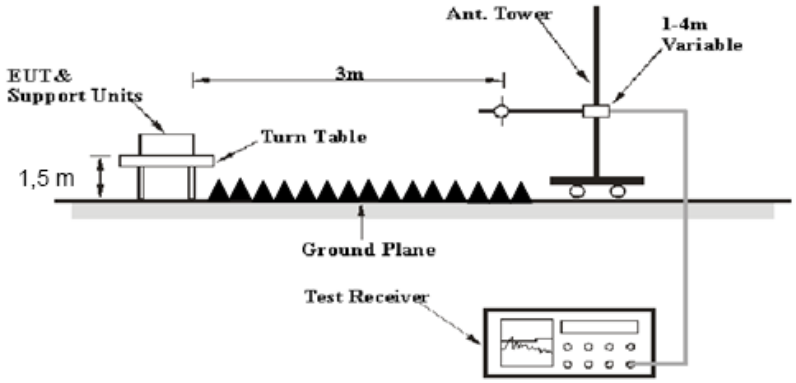
FCC §15.247 (d); §15.209; §15.205; RSS-247 §5.5, RSS-GEN §8.10.

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission Below 1GHz tests were performed in the 10 meters chamber, above 1GHz tests were performed in the 3 meters chamber B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, FCC 15.247 and RSS-247,RSS-Gen limits.

The spacing between the peripherals was 10 cm.

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:

30MHz-1000MHz:

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

1GHz- 25GHz:

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

Note: T is minimum transmission duration

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

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
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-2	2020-08-25	2023-08-25
R&S	EMI Test Receiver	ESCI	100224	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2020-09-24	2021-09-24
Sonoma	Amplifier	310N	185914	2019-10-13	2020-10-13
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2017-12-06	2020-12-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2020-07-07	2021-07-07
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2020-06-27	2021-06-27
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2020-06-27	2021-06-27
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2020-06-16	2021-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2020-06-16	2021-06-16

*** 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

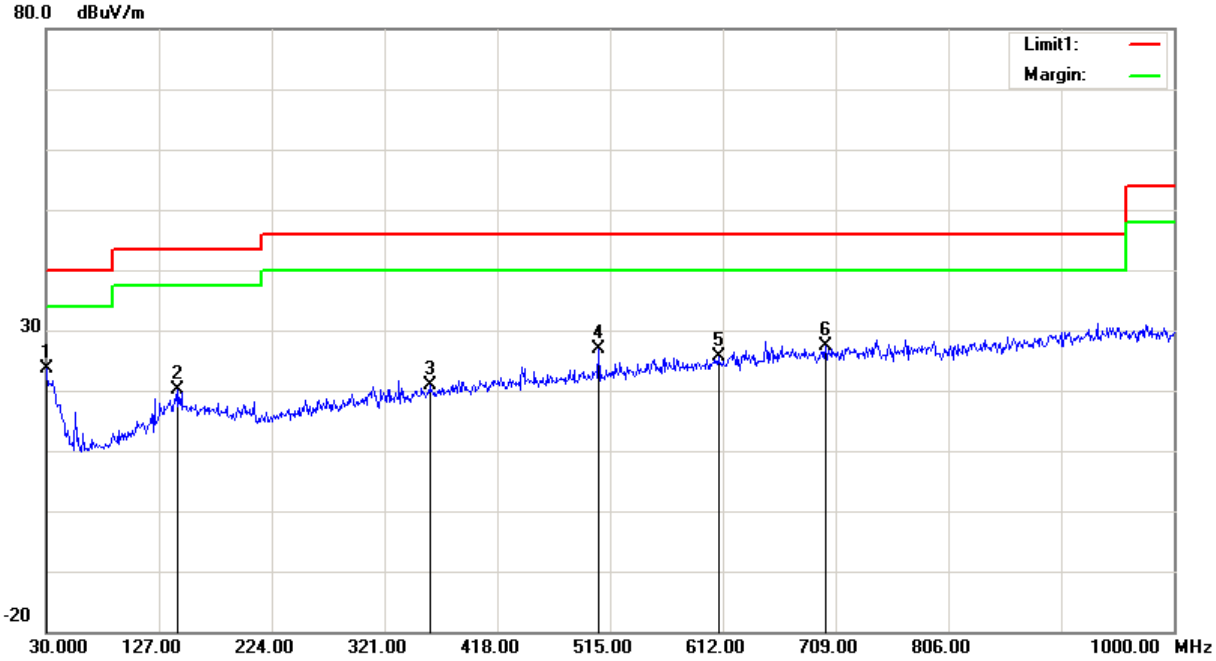
Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	24.5 °C	29~30 °C
Relative Humidity:	36%	39~43%
ATM Pressure:	100.6 kPa	100.1~100.9 kPa
Tester:	Jackson Zhang	Jalon Liu ,Carlos Jia
Test Date:	2020-09-25	2020-09-16~2020-09-21

Test Result: Compliance, please Refer to the following data

Test Mode: Transmitting

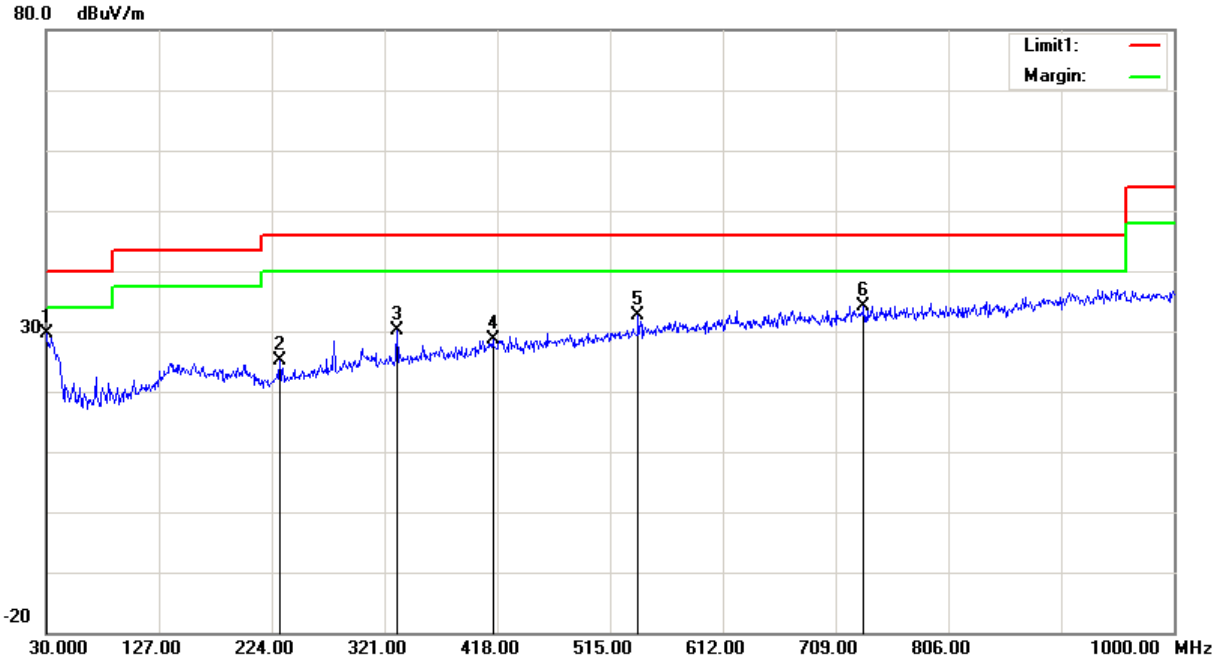
1) 30MHz-1GHz(802.11b mode low channel was the worst)

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	27.76	peak	-4.10	23.66	40.00	16.34
143.4900	29.26	peak	-9.02	20.24	43.50	23.26
359.8000	26.83	peak	-5.95	20.88	46.00	25.12
505.3000	30.08	peak	-3.22	26.86	46.00	19.14
608.1200	26.68	peak	-1.08	25.60	46.00	20.40
700.2700	27.42	peak	0.06	27.48	46.00	18.52

Vertical:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	33.71	peak	-4.10	29.61	40.00	10.39
230.7900	35.59	peak	-10.40	25.19	46.00	20.81
331.6700	37.23	peak	-7.00	30.23	46.00	15.77
414.1200	33.40	peak	-4.83	28.57	46.00	17.43
539.2500	34.79	peak	-2.10	32.69	46.00	13.31
733.2500	33.46	peak	0.72	34.18	46.00	11.82

2) 1-25GHz:

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									
2390.00	26.06	PK	H	28.08	1.80	0.00	55.94	74.00	18.06
2390.00	13.46	AV	H	28.08	1.80	0.00	43.34	54.00	10.66
4824.00	38.37	PK	H	32.95	3.19	25.62	48.89	74.00	25.11
4824.00	30.07	AV	H	32.95	3.19	25.62	40.59	54.00	13.41
7236.00	36.32	PK	H	35.81	4.77	25.64	51.26	74.00	22.74
7236.00	24.08	AV	H	35.81	4.77	25.64	39.02	54.00	14.98
Middle Channel: 2437 MHz									
4874.00	38.45	PK	H	33.05	3.26	25.65	49.11	74.00	24.89
4874.00	30.88	AV	H	33.05	3.26	25.65	41.54	54.00	12.46
7311.00	36.21	PK	H	36.01	4.64	25.71	51.15	74.00	22.85
7311.00	23.41	AV	H	36.01	4.64	25.71	38.35	54.00	15.65
High Channel: 2462 MHz									
2483.50	30.09	PK	H	28.27	1.84	0.00	60.20	74.00	13.80
2483.50	21.29	AV	H	28.27	1.84	0.00	51.40	54.00	2.60
4924.00	38.27	PK	H	33.15	3.27	25.65	49.04	74.00	24.96
4924.00	30.25	AV	H	33.15	3.27	25.65	41.02	54.00	12.98
7386.00	35.89	PK	H	36.20	4.51	25.79	50.81	74.00	23.19
7386.00	23.41	AV	H	36.20	4.51	25.79	38.33	54.00	15.67

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									
2390.00	26.17	PK	H	28.08	1.80	0.00	56.05	74.00	17.95
2390.00	13.47	AV	H	28.08	1.80	0.00	43.35	54.00	10.65
4824.00	36.45	PK	H	32.95	3.19	25.62	46.97	74.00	27.03
4824.00	24.68	AV	H	32.95	3.19	25.62	35.20	54.00	18.80
7236.00	36.05	PK	H	35.81	4.77	25.64	50.99	74.00	23.01
7236.00	23.54	AV	H	35.81	4.77	25.64	38.48	54.00	15.52
Middle Channel: 2437 MHz									
4874.00	35.85	PK	H	33.05	3.26	25.65	46.51	74.00	27.49
4874.00	23.41	AV	H	33.05	3.26	25.65	34.07	54.00	19.93
7311.00	35.76	PK	H	36.01	4.64	25.71	50.70	74.00	23.30
7311.00	23.25	AV	H	36.01	4.64	25.71	38.19	54.00	15.81
High Channel: 2462 MHz									
2483.50	41.01	PK	H	28.27	1.84	0.00	71.12	74.00	2.88
2483.50	21.29	AV	H	28.27	1.84	0.00	51.40	54.00	2.60
4924.00	35.52	PK	H	33.15	3.27	25.65	46.29	74.00	27.71
4924.00	23.41	AV	H	33.15	3.27	25.65	34.18	54.00	19.82
7386.00	35.69	PK	H	36.20	4.51	25.79	50.61	74.00	23.39
7386.00	23.41	AV	H	36.20	4.51	25.79	38.33	54.00	15.67

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									
2390.00	28.95	PK	H	28.08	1.80	0.00	58.83	74.00	15.17
2390.00	14.50	AV	H	28.08	1.80	0.00	44.38	54.00	9.62
4824.00	36.05	PK	H	32.95	3.19	25.62	46.57	74.00	27.43
4824.00	23.47	AV	H	32.95	3.19	25.62	33.99	54.00	20.01
7236.00	36.33	PK	H	35.81	4.77	25.64	51.27	74.00	22.73
7236.00	24.02	AV	H	35.81	4.77	25.64	38.96	54.00	15.04
Middle Channel: 2437 MHz									
4874.00	36.12	PK	H	33.05	3.26	25.65	46.78	74.00	27.22
4874.00	23.00	AV	H	33.05	3.26	25.65	33.66	54.00	20.34
7311.00	35.78	PK	H	36.01	4.64	25.71	50.72	74.00	23.28
7311.00	23.41	AV	H	36.01	4.64	25.71	38.35	54.00	15.65
High Channel: 2462 MHz									
2483.50	42.38	PK	H	28.27	1.84	0.00	72.49	74.00	1.51
2483.50	21.70	AV	H	28.27	1.84	0.00	51.81	54.00	2.19
4924.00	36.44	PK	H	33.15	3.27	25.65	47.21	74.00	26.79
4924.00	24.12	AV	H	33.15	3.27	25.65	34.89	54.00	19.11
7386.00	36.02	PK	H	36.20	4.51	25.79	50.94	74.00	23.06
7386.00	23.78	AV	H	36.20	4.51	25.79	38.70	54.00	15.30

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									
2390.00	30.12	PK	H	28.08	1.80	0.00	60.00	74.00	14.00
2390.00	16.51	AV	H	28.08	1.80	0.00	46.39	54.00	7.61
4844.00	36.08	PK	H	32.99	3.22	25.63	46.66	74.00	27.34
4844.00	23.45	AV	H	32.99	3.22	25.63	34.03	54.00	19.97
7266.00	36.07	PK	H	35.89	4.72	25.67	51.01	74.00	22.99
7266.00	23.52	AV	H	35.89	4.72	25.67	38.46	54.00	15.54
Middle Channel: 2437 MHz									
4874.00	36.21	PK	H	33.05	3.26	25.65	46.87	74.00	27.13
4874.00	23.98	AV	H	33.05	3.26	25.65	34.64	54.00	19.36
7311.00	36.02	PK	H	36.01	4.64	25.71	50.96	74.00	23.04
7311.00	23.41	AV	H	36.01	4.64	25.71	38.35	54.00	15.65
High Channel: 2452 MHz									
2483.50	36.83	PK	H	28.27	1.84	0.00	66.94	74.00	7.06
2483.50	20.00	AV	H	28.27	1.84	0.00	50.11	54.00	3.89
4904.00	36.12	PK	H	33.11	3.30	25.67	46.86	74.00	27.14
4904.00	23.63	AV	H	33.11	3.30	25.67	34.37	54.00	19.63
7356.00	35.89	PK	H	36.13	4.56	25.76	50.82	74.00	23.18
7356.00	23.25	AV	H	36.13	4.56	25.76	38.18	54.00	15.82

BLE mode:

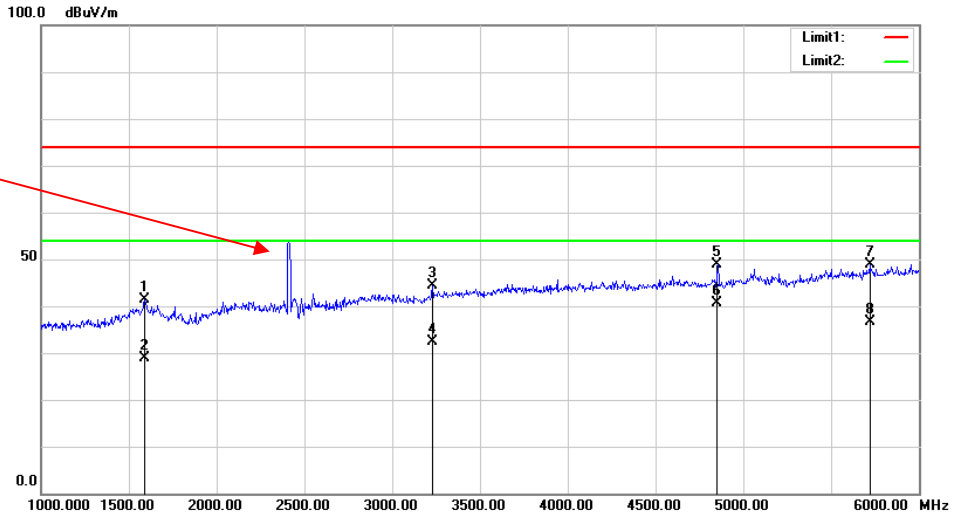
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2390.00	26.14	PK	H	28.08	1.80	0.00	56.02	74.00	17.98
2390.00	13.41	AV	H	28.08	1.80	0.00	43.29	54.00	10.71
4804.00	35.45	PK	H	32.91	3.17	25.60	45.93	74.00	28.07
4804.00	23.25	AV	H	32.91	3.17	25.60	33.73	54.00	20.27
7206.00	35.74	PK	H	35.74	4.82	25.60	50.70	74.00	23.30
7206.00	23.36	AV	H	35.74	4.82	25.60	38.32	54.00	15.68
Middle Channel: 2440 MHz									
4880.00	35.54	PK	H	33.06	3.27	25.66	46.21	74.00	27.79
4880.00	23.22	AV	H	33.06	3.27	25.66	33.89	54.00	20.11
7320.00	35.48	PK	H	36.03	4.62	25.72	50.41	74.00	23.59
7320.00	23.02	AV	H	36.03	4.62	25.72	37.95	54.00	16.05
High Channel: 2480 MHz									
2483.50	26.83	PK	H	28.27	1.84	0.00	56.94	74.00	17.06
2483.50	13.90	AV	H	28.27	1.84	0.00	44.01	54.00	9.99
4960.00	35.92	PK	H	33.22	3.23	25.63	46.74	74.00	27.26
4960.00	23.58	AV	H	33.22	3.23	25.63	34.40	54.00	19.60
7440.00	35.97	PK	H	36.34	4.41	25.85	50.87	74.00	23.13
7440.00	23.63	AV	H	36.34	4.41	25.85	38.53	54.00	15.47

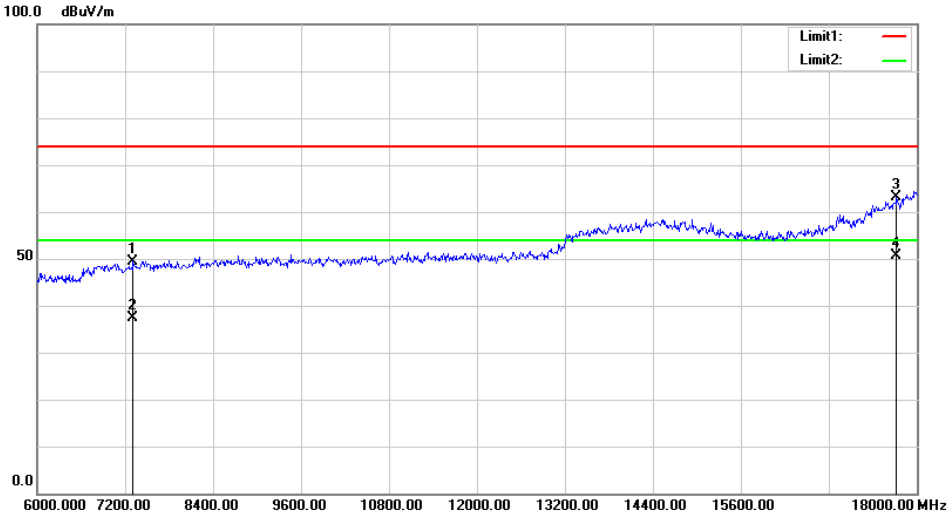
ANT+ mode:

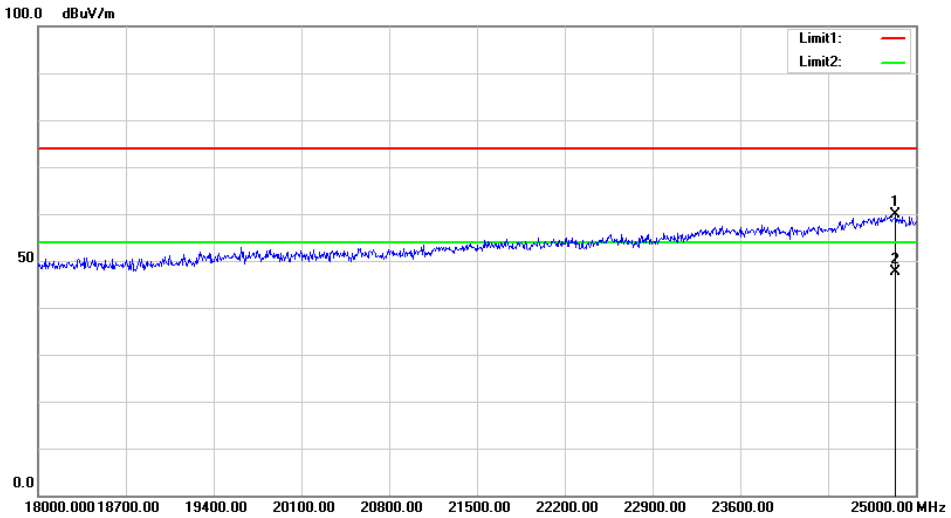
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
2457 MHz									
2390.00	29.30	PK	H	24.80	3.33	0.00	57.43	74.00	16.57
2390.00	16.82	AV	H	24.80	3.33	0.00	44.95	54.00	9.05
2483.50	26.83	PK	H	28.27	1.84	0.00	56.94	74.00	17.06
2483.50	14.27	AV	H	28.27	1.84	0.00	44.38	54.00	9.62
4914.00	48.23	PK	H	29.93	4.56	27.55	55.17	74.00	18.83
4914.00	44.35	AV	H	29.93	4.56	27.55	51.29	54.00	2.71
7371.00	42.30	PK	H	34.19	5.73	27.20	55.02	74.00	18.98
7371.00	35.43	AV	H	34.19	5.73	27.20	48.15	54.00	5.85

Test plots(ANT+ was the worst)
Horizontal:

Fundamental Test with Band Rejection Filter

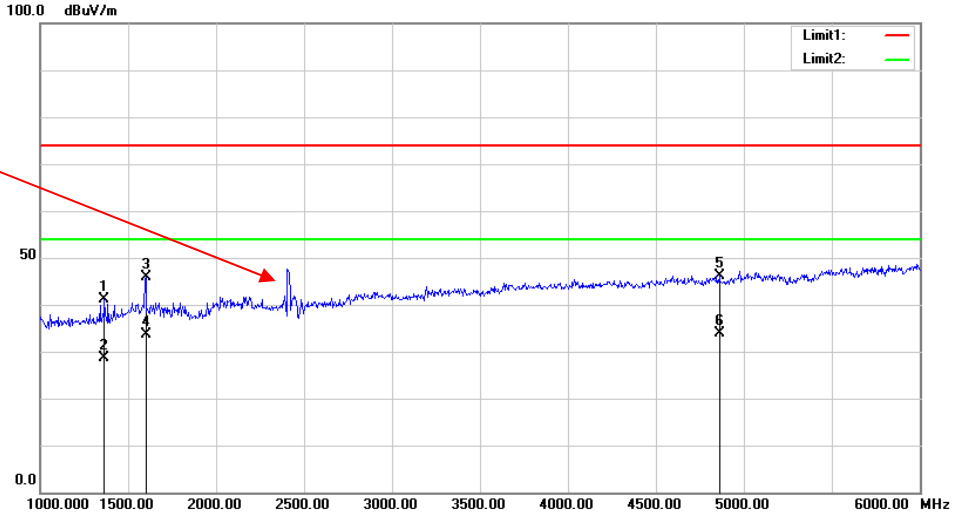


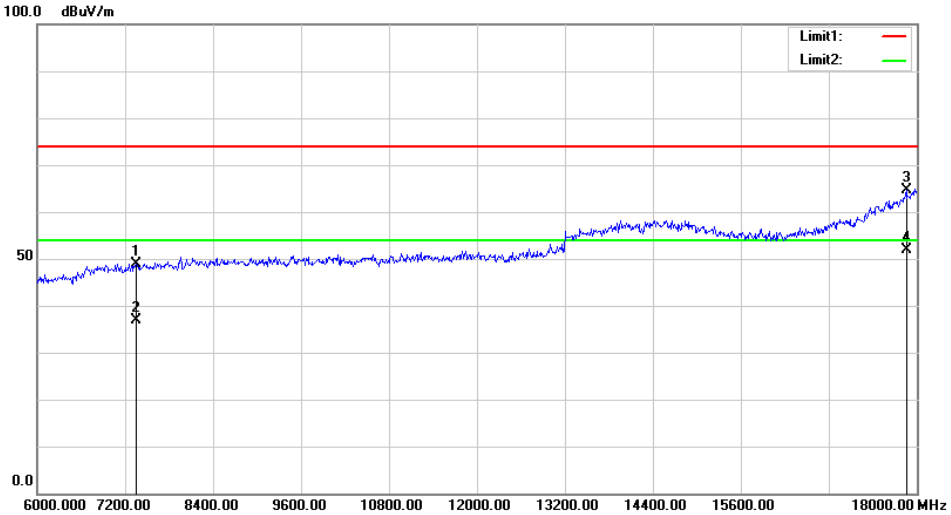


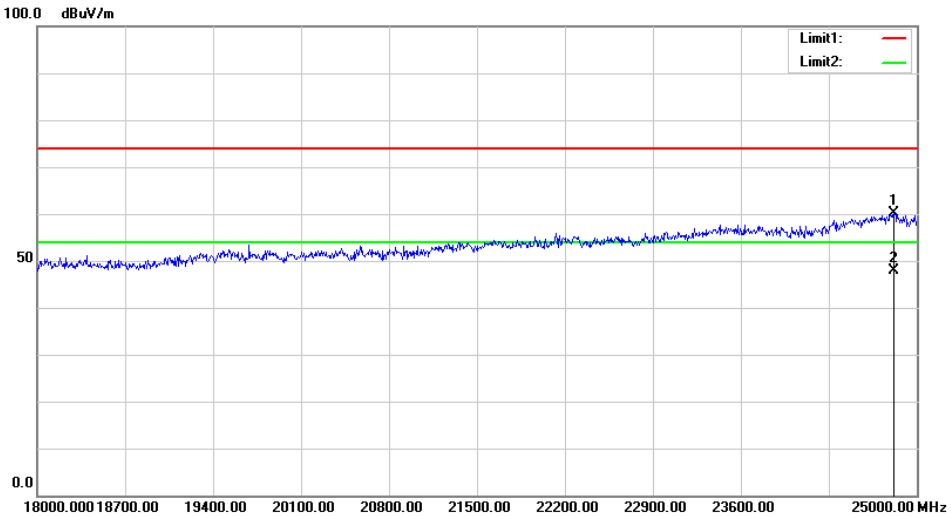


Vertical:

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:

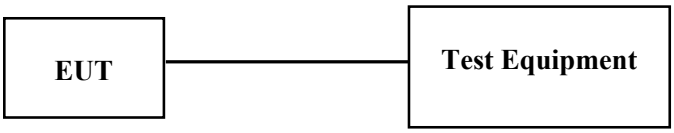
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid 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

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.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100035	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	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:	26.2 ~*27.8* °C
Relative Humidity:	50 ~*54* %
ATM Pressure:	100.8 ~*101.1* kPa
Tester:	*Rita Huang*
Test Date:	*2020-09-29~2020-09-30*

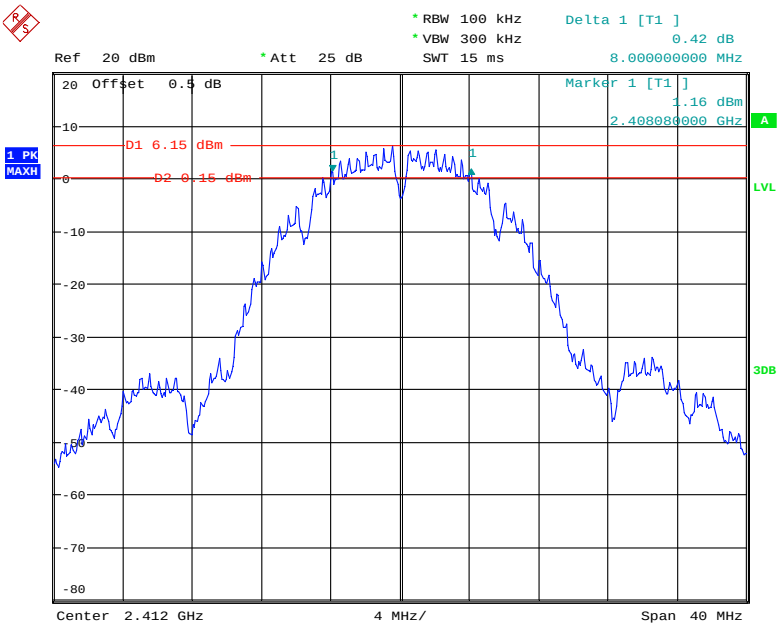
Test Mode: Transmitting

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

Test mode	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)
802.11 b	2412	8.000	13.440	≥0.5
	2437	8.560	13.520	≥0.5
	2462	8.560	13.680	≥0.5
802.11 g	2412	16.400	17.440	≥0.5
	2437	16.480	17.520	≥0.5
	2462	16.480	17.760	≥0.5
802.11n ht20	2412	17.680	18.400	≥0.5
	2437	17.680	18.400	≥0.5
	2462	17.600	18.480	≥0.5
802.11n ht40	2422	35.840	36.640	≥0.5
	2437	35.520	36.640	≥0.5
	2452	35.680	36.640	≥0.5
BLE	2402	0.672	1.056	≥0.5
	2440	0.672	1.056	≥0.5
	2480	0.664	1.060	≥0.5
ANT^{+}	2457	0.503	0.920	≥0.5

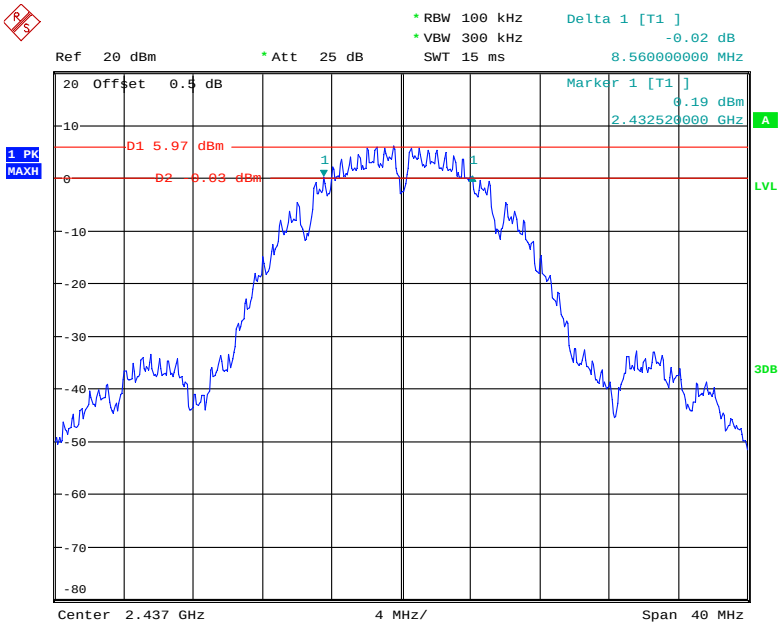
6dB Bandwidth:

802.11b Low Channel



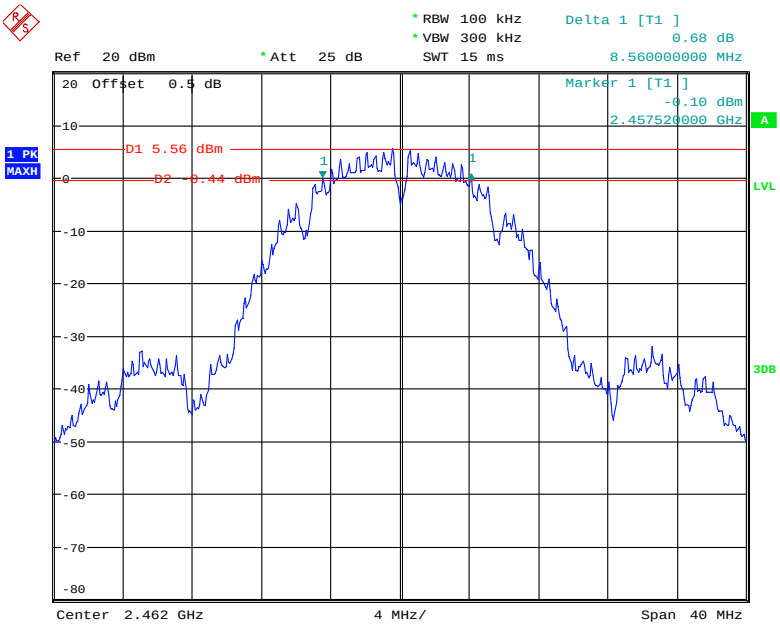
Date: 30.SEP.2020 10:35:56

802.11b Middle Channel



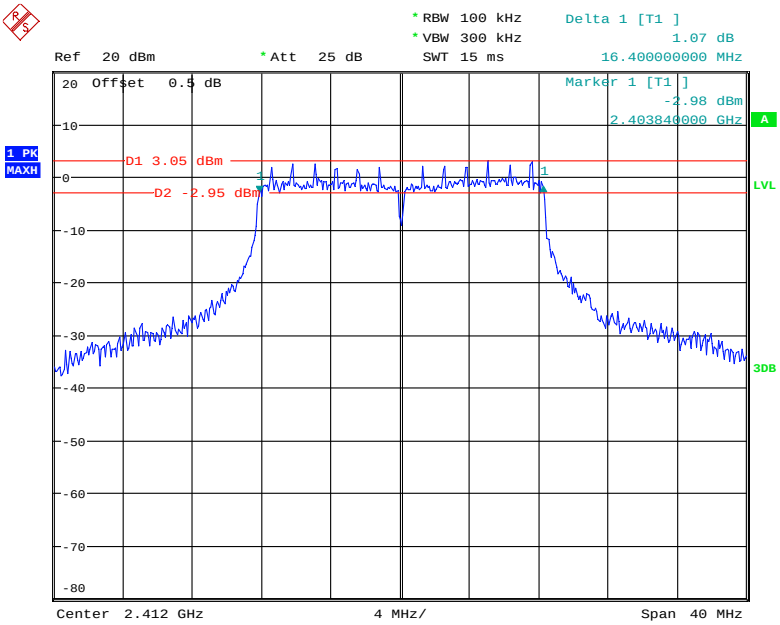
Date: 30.SEP.2020 10:38:29

802.11b High Channel



Date: 30.SEP.2020 10:40:57

802.11g Low Channel



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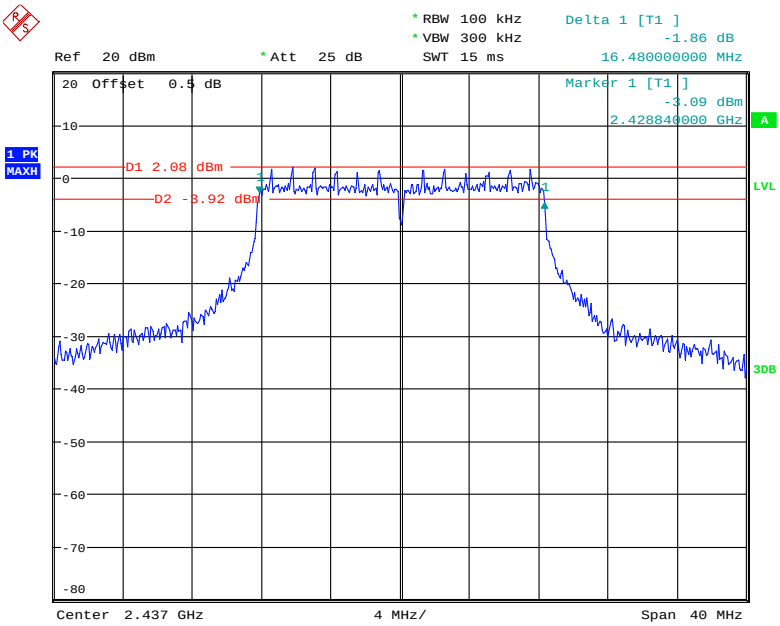
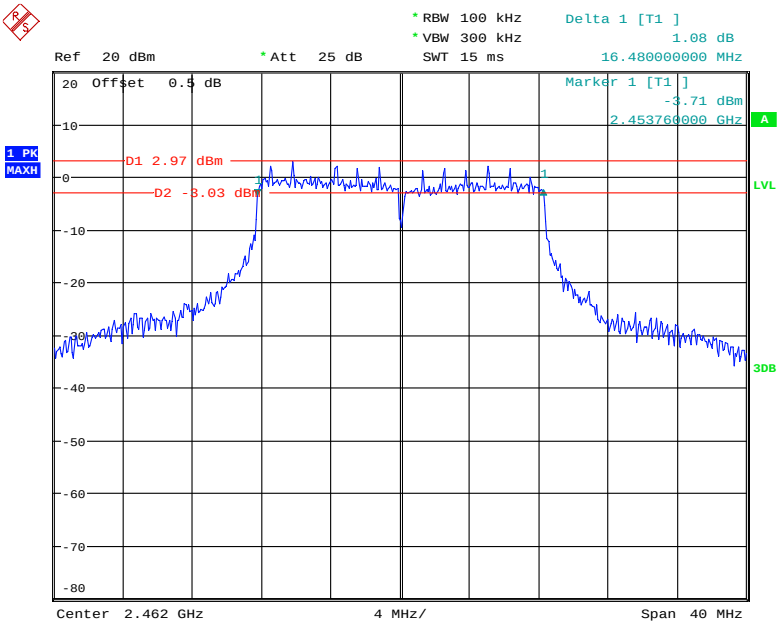
802.11g Middle Channel



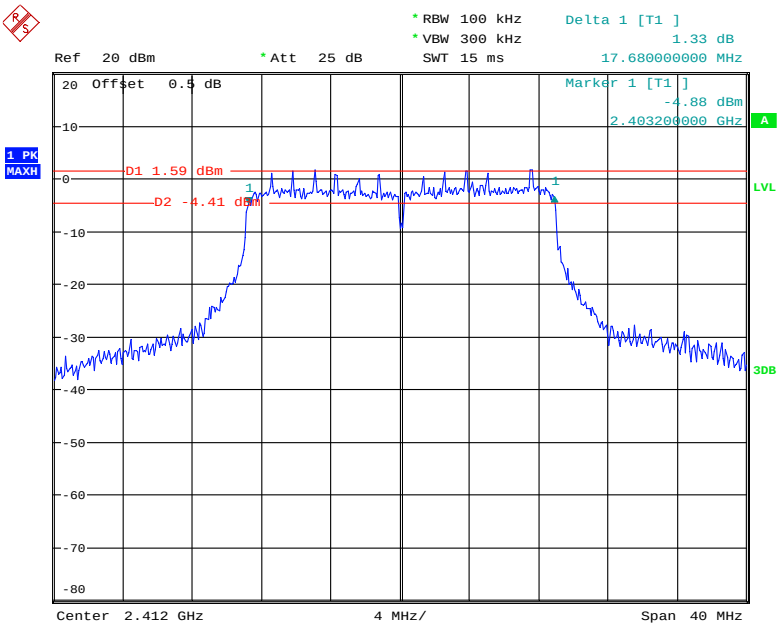
Date: 30.SEP.2020 10:43:57

802.11g High Channel



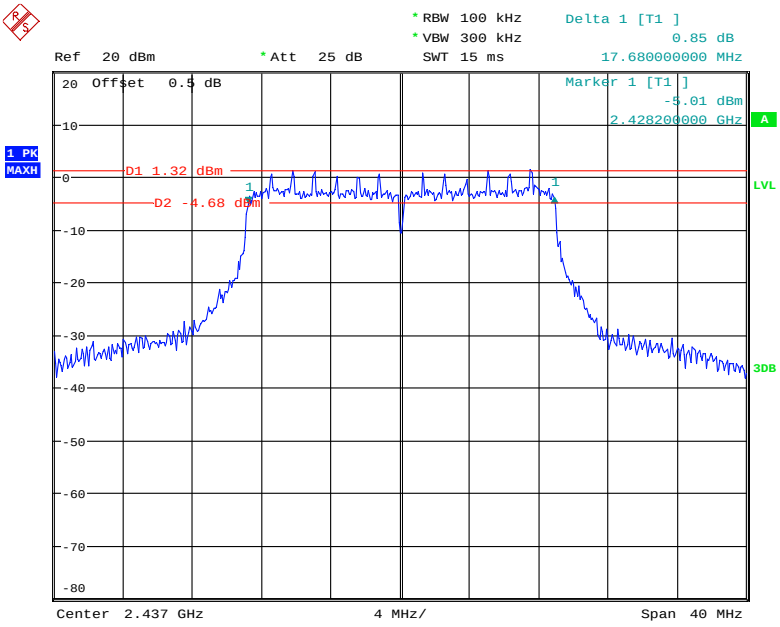
Date: 30.SEP.2020 10:42:02

802.11n ht20 Low Channel



Date: 30.SEP.2020 10:47:23

802.11n ht20 Middle Channel



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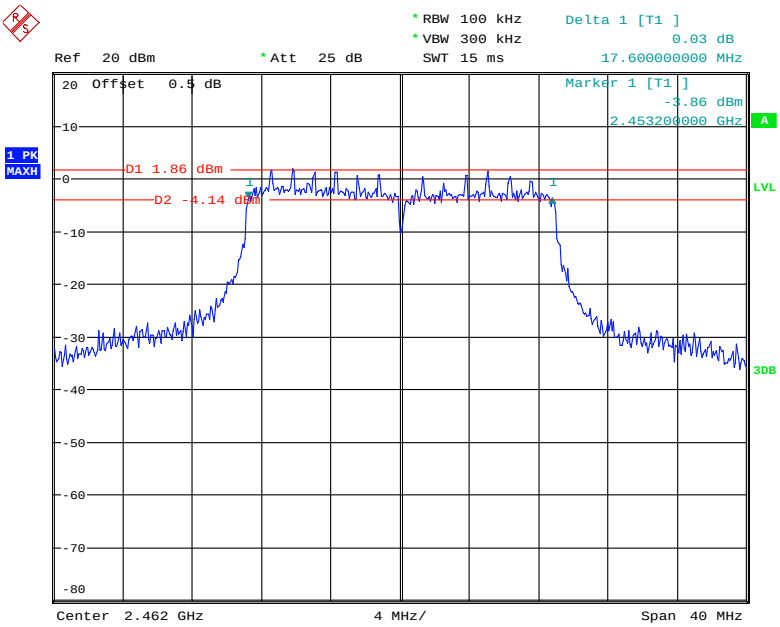
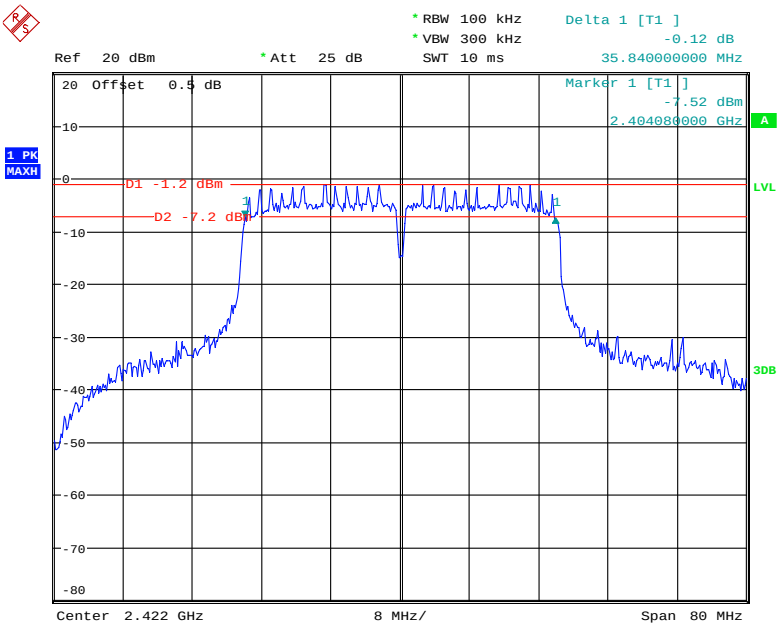


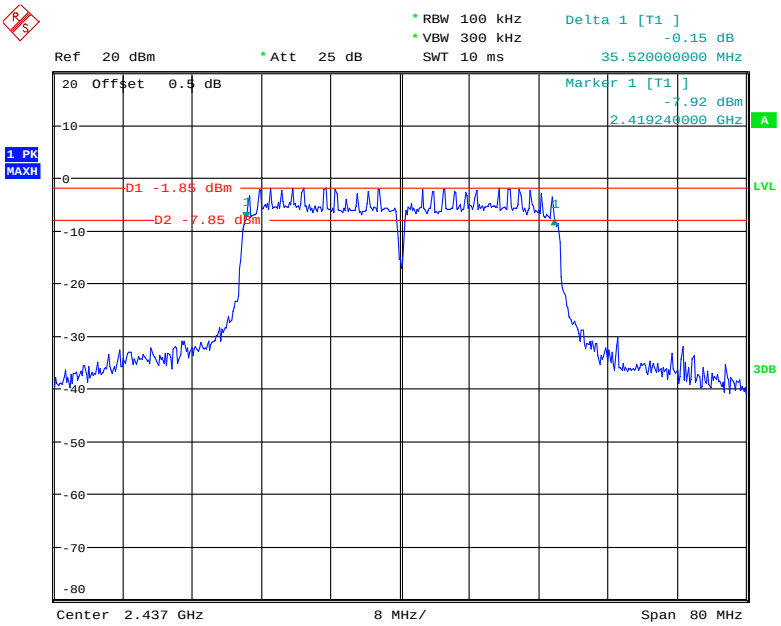
Date: 30.SEP.2020 10:50:51

802.11n ht40 Low Channel



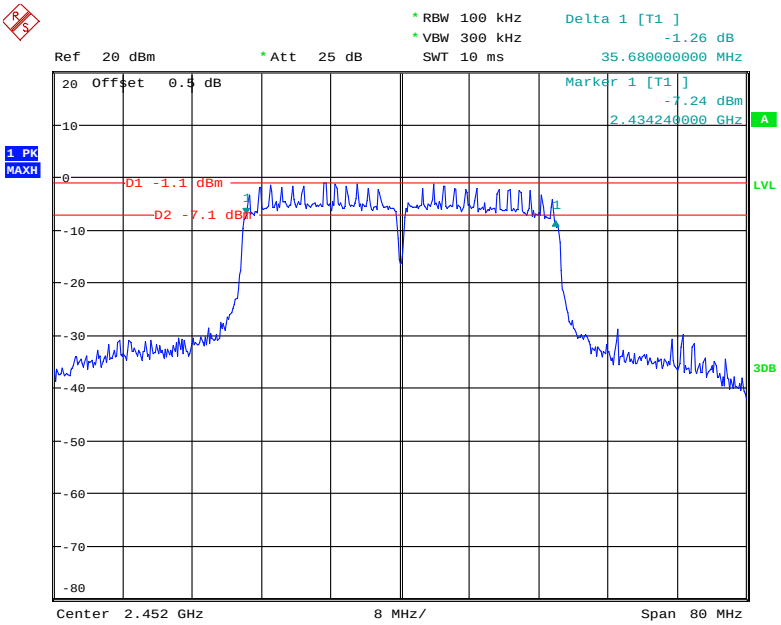
Date: 30.SEP.2020 10:57:36

802.11n ht40 Middle Channel



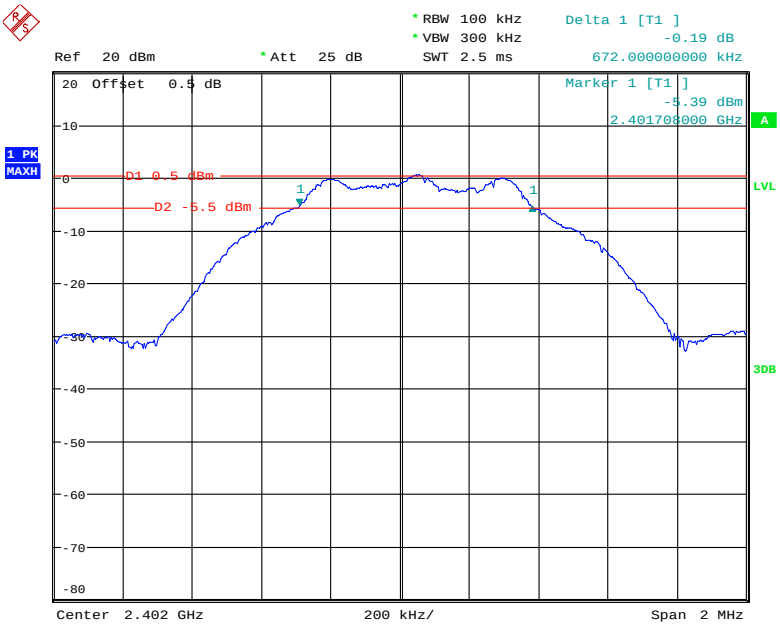
Date: 30.SEP.2020 10:55:27

802.11n ht40 High Channel



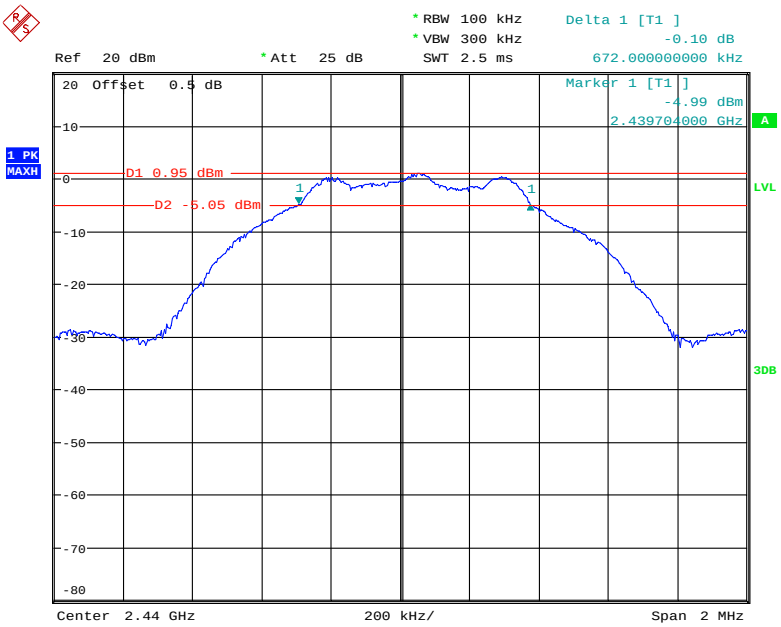
Date: 30.SEP.2020 10:53:07

BLE Low Channel



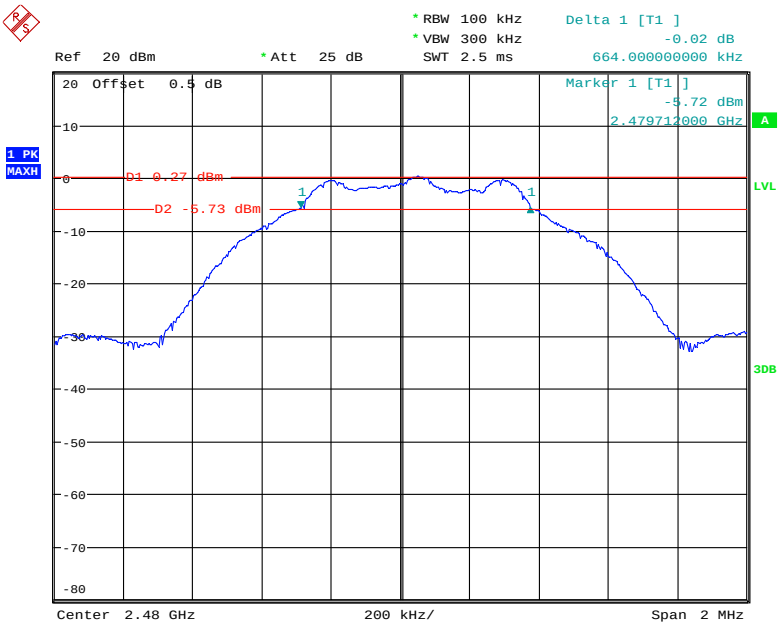
Date: 29.SEP.2020 17:24:15

BLE Middle Channel



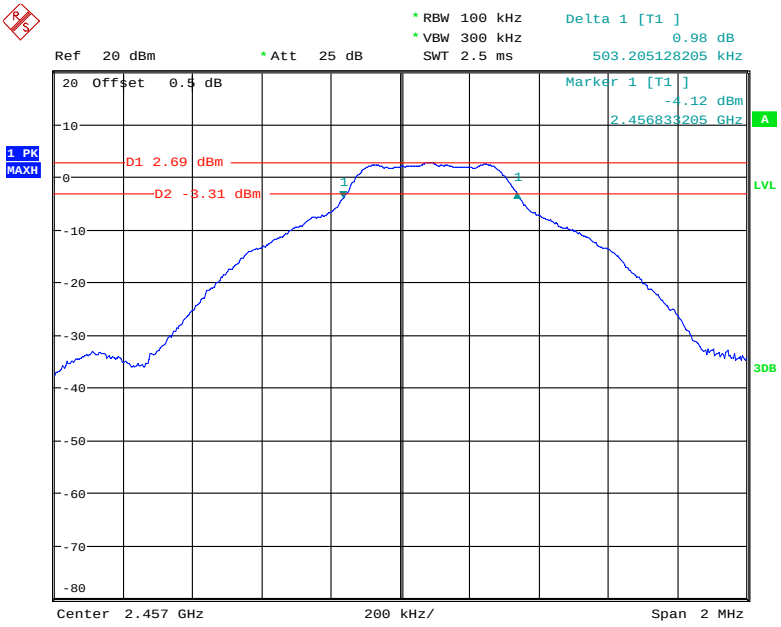
Date: 29.SEP.2020 17:27:04

BLE High Channel



Date: 29.SEP.2020 17:25:36

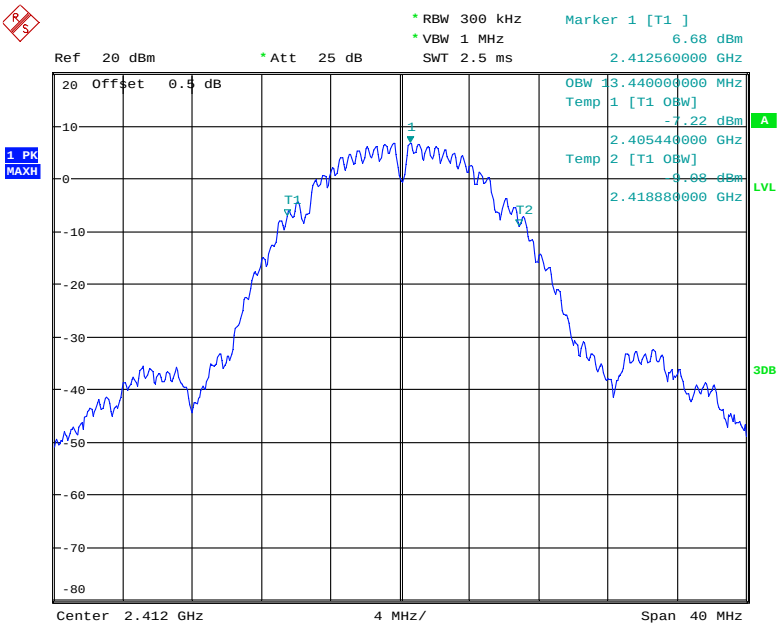
ANT+



Date: 30.SEP.2020 13:53:24

99% Occupied Bandwidth:

802.11b Low Channel



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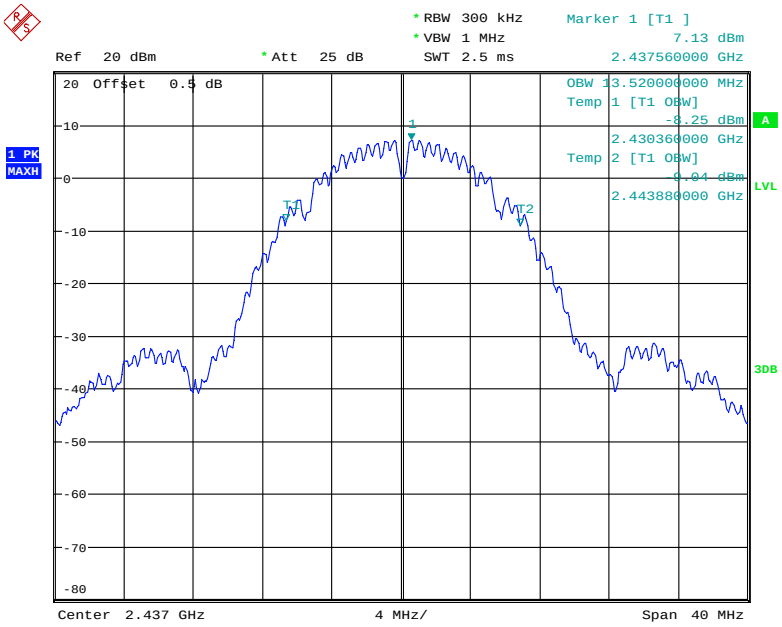
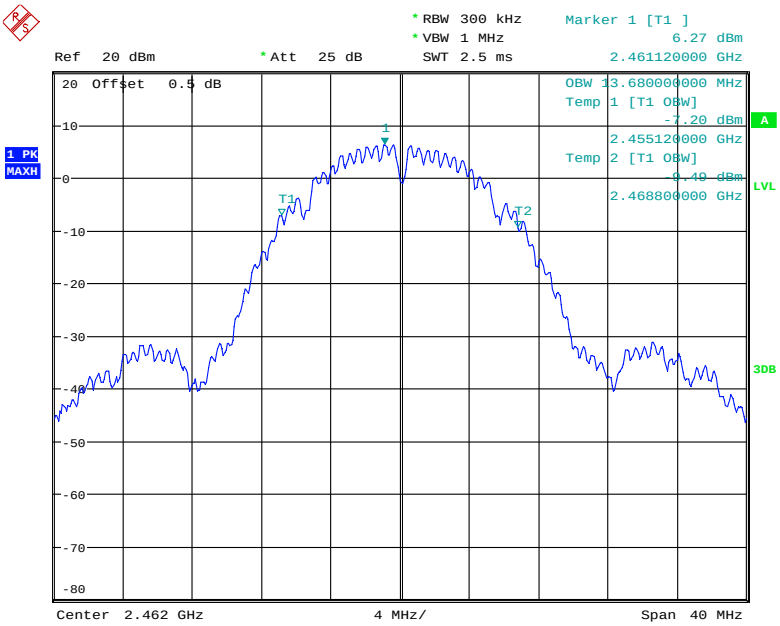
802.11b Middle Channel



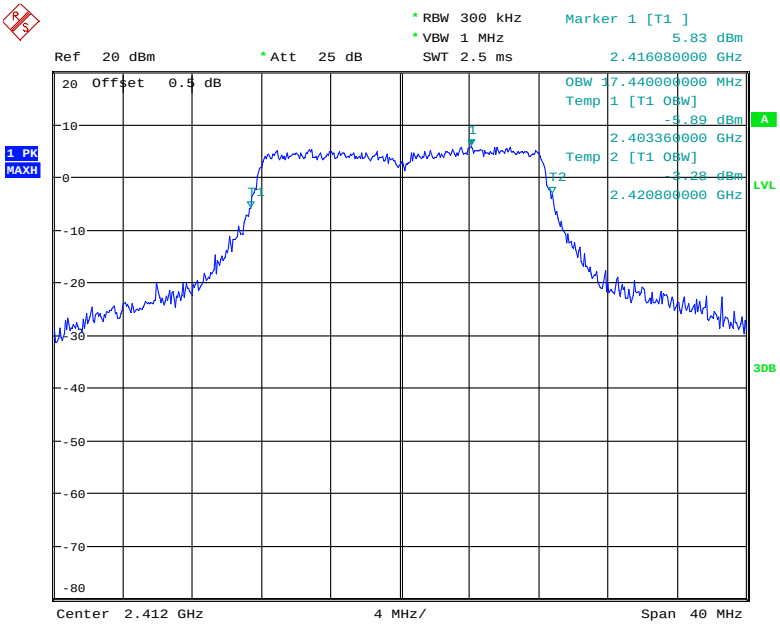
Date: 30.SEP.2020 10:38:40

802.11b High Channel



Date: 30.SEP.2020 10:39:54

802.11g Low Channel



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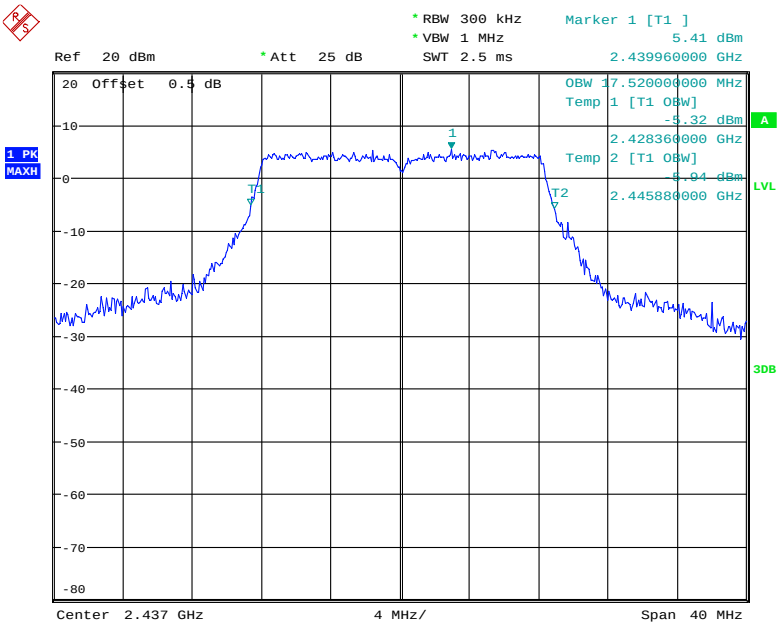
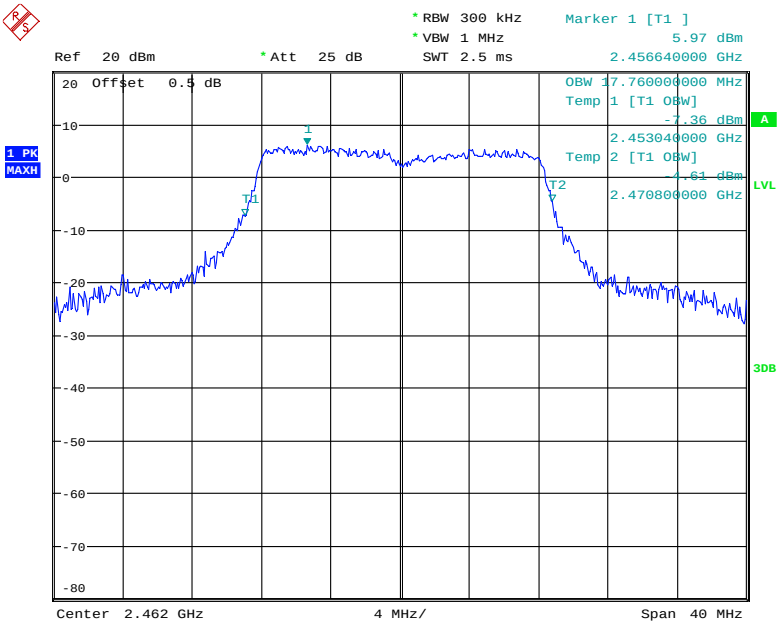
802.11g Middle Channel



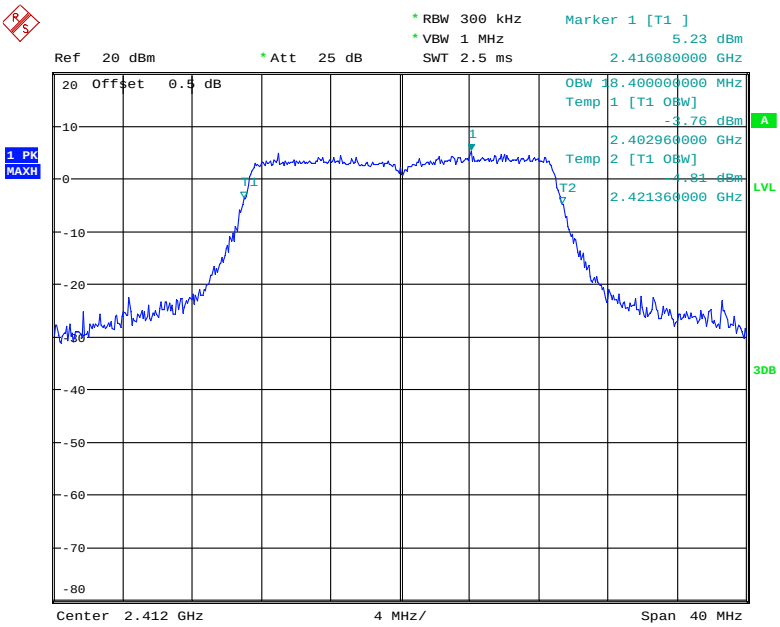
Date: 30.SEP.2020 10:44:14

802.11g High Channel



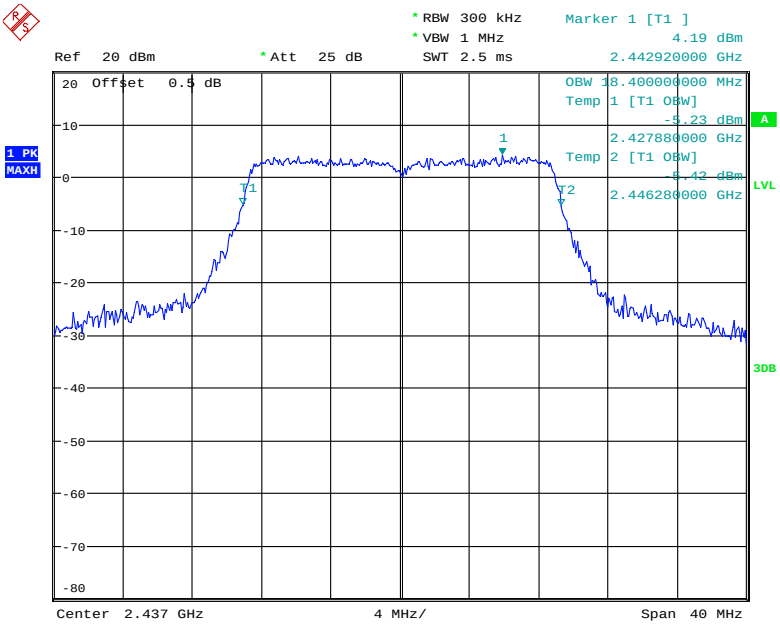
Date: 30.SEP.2020 10:42:19

802.11n ht20 Low Channel



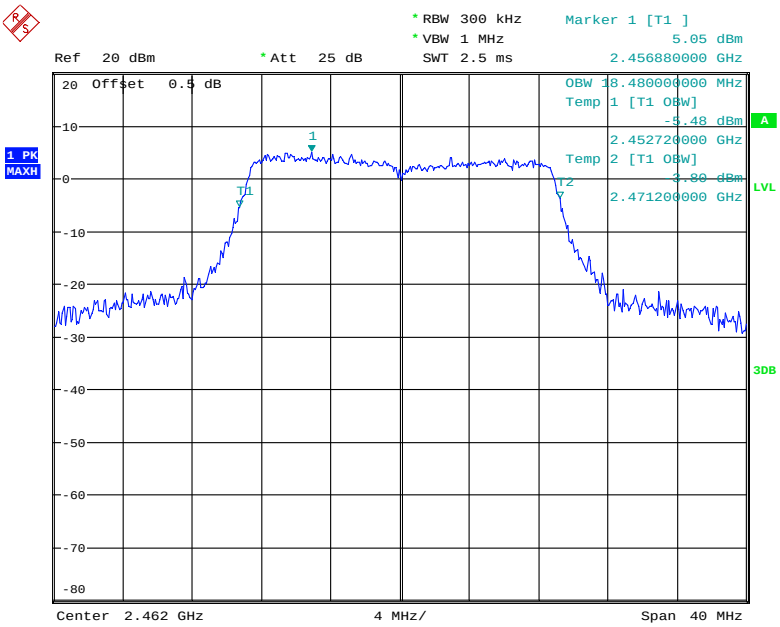
Date: 30.SEP.2020 10:47:40

802.11n ht20 Middle Channel



Date: 30.SEP.2020 10:49:40

802.11n ht20 High Channel



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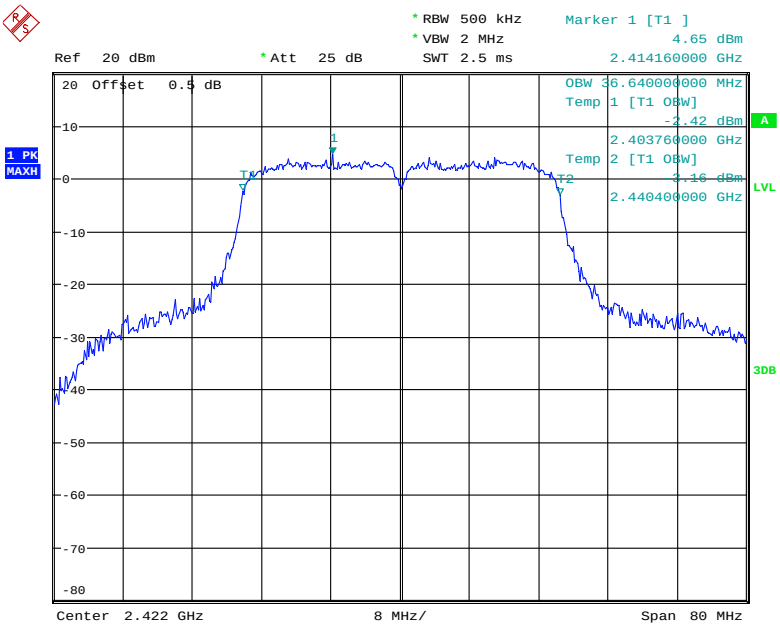
802.11n ht40 Low Channel



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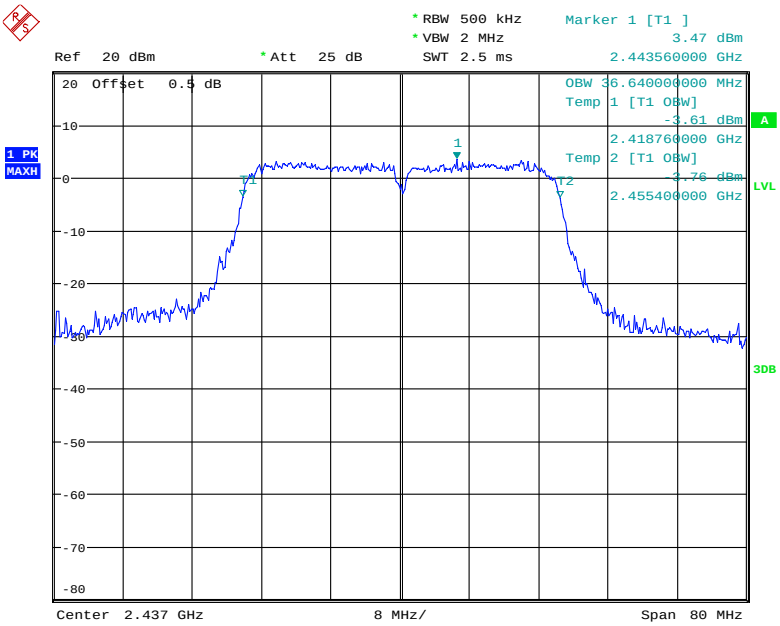
802.11n ht40 Middle Channel



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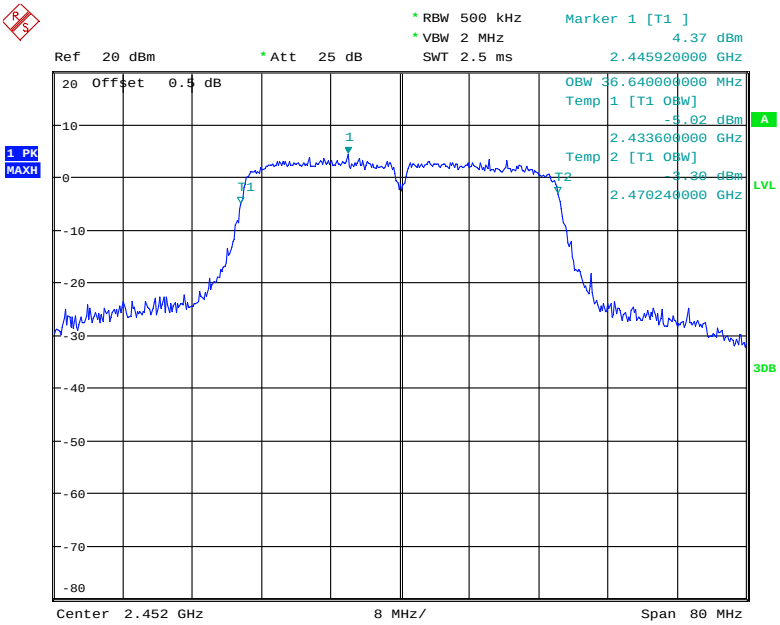
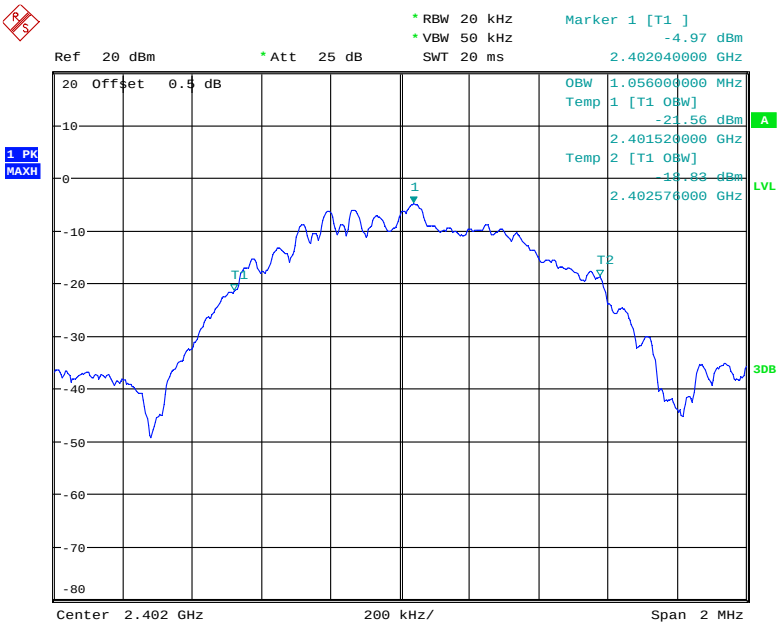
802.11n ht40 High Channel



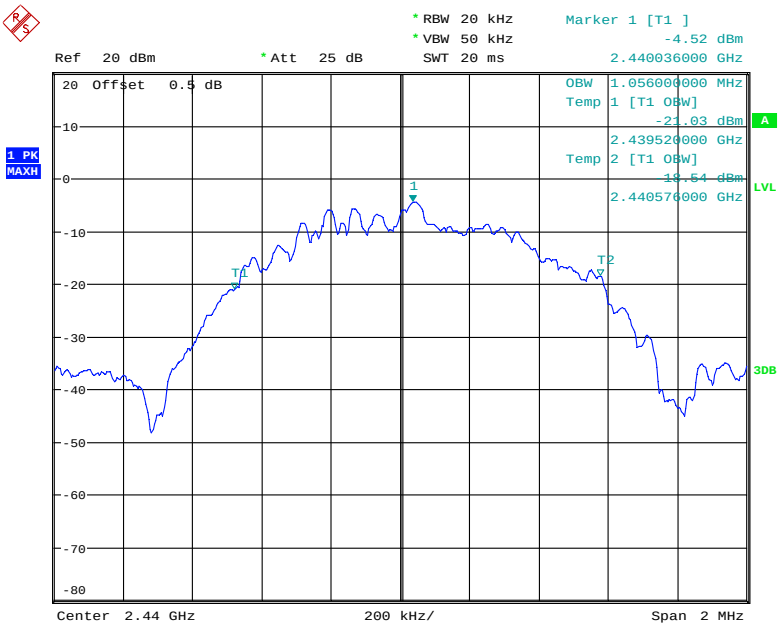
Date: 30.SEP.2020 10:53:22

BLE Low Channel



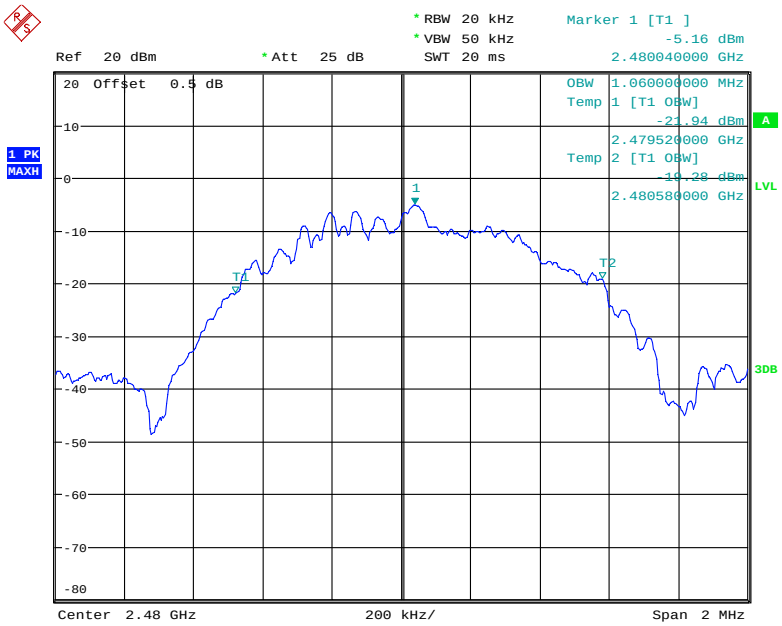
Date: 29.SEP.2020 17:24:30

BLE Middle Channel



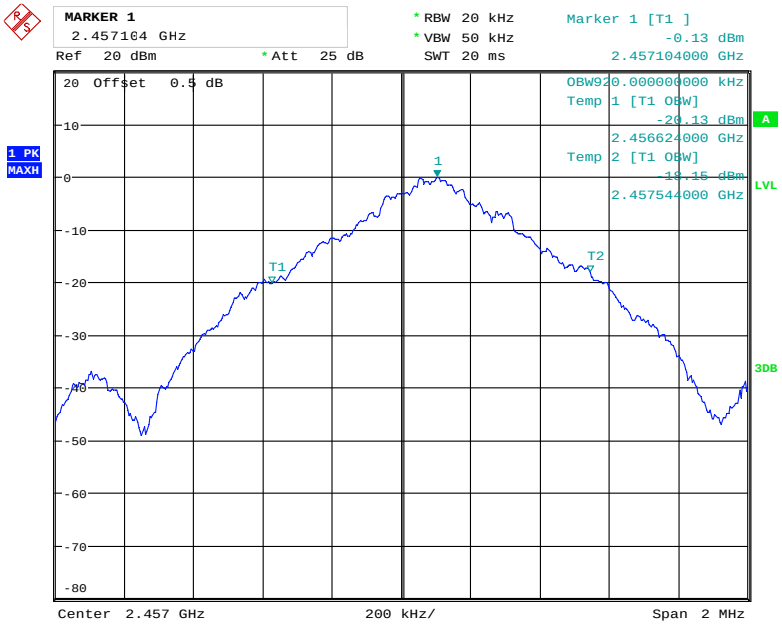
Date: 29.SEP.2020 17:27:15

BLE High Channel



Date: 29.SEP.2020 17:25:48

ANT+



Date: 30.SEP.2020 13:25:23

FCC §15.247(b) (3) , RSS-247 CLAUSE 5.4 D - MAXIMUM PEAK CONDUCTED OUTPUT POWER

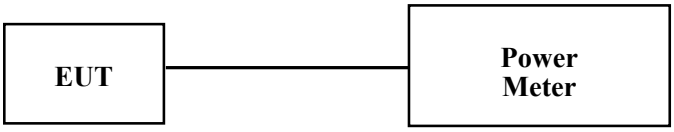
Applicable Standard

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 average output power, record the result as average power.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	Each time	N/A
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2020-09-12	2021-09-12

**** 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:	26.2 ~*27.8* °C
Relative Humidity:	50 ~*54* %
ATM Pressure:	100.8 ~*101.1* kPa
Tester:	*Rita Huang*
Test Date:	*2020-09-29~2020-09-30*

Test Mode: Transmitting
Test Result: Compliance. Please refer to the following table.

Mode	Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)	Maximum Conducted Average Output Power (dBm)	Limit (dBm)
802.11b	2412	17.08	14.49	30
	2437	17.46	14.69	30
	2462	16.82	14.18	30
802.11g	2412	21.51	13.71	30
	2437	21.28	13.16	30
	2462	20.97	13.67	30
802.11n ht20	2412	21.32	12.87	30
	2437	20.66	12.27	30
	2462	20.83	12.77	30
802.11n ht40	2422	20.89	12.91	30
	2437	20.79	12.59	30
	2452	20.96	12.98	30
BLE	2402	0.89	/	30
	2440	1.30	/	30
	2480	0.60	/	30
ANT+	2457	2.79		30

Note: The duty cycle factor have been calculated into average power result for 802.11 power test.
The test performed at antenna port, the antenna gain is 0.5dBi for 802.11b/g/n&BLE, 0.7dBi for ANT+, meet the EIRP limit of ISED.

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	ESCI	100035	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	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

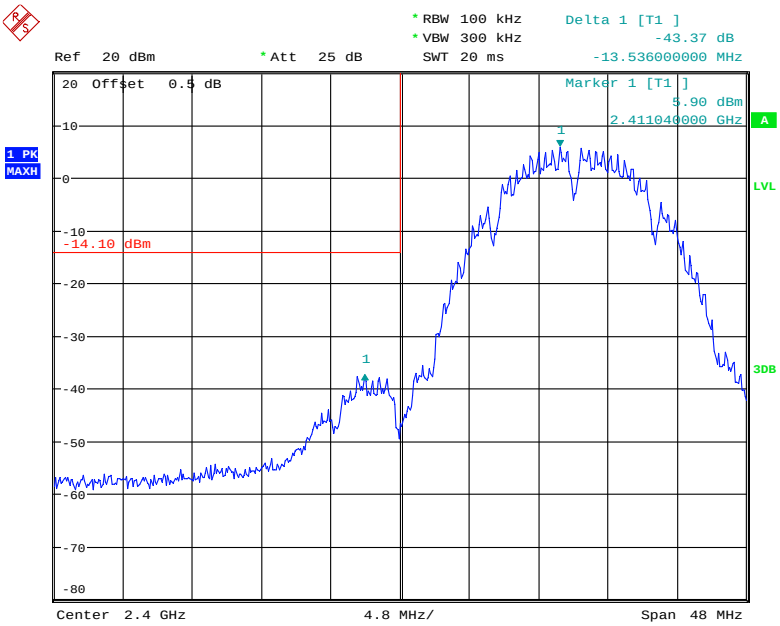
Environmental Conditions

Temperature:	26.2 ~*27.8* °C
Relative Humidity:	50 ~*54* %
ATM Pressure:	100.8 ~*101.1* kPa
Tester:	*Rita Huang*
Test Date:	*2020-09-29~2020-09-30*

Test mode: Transmitting

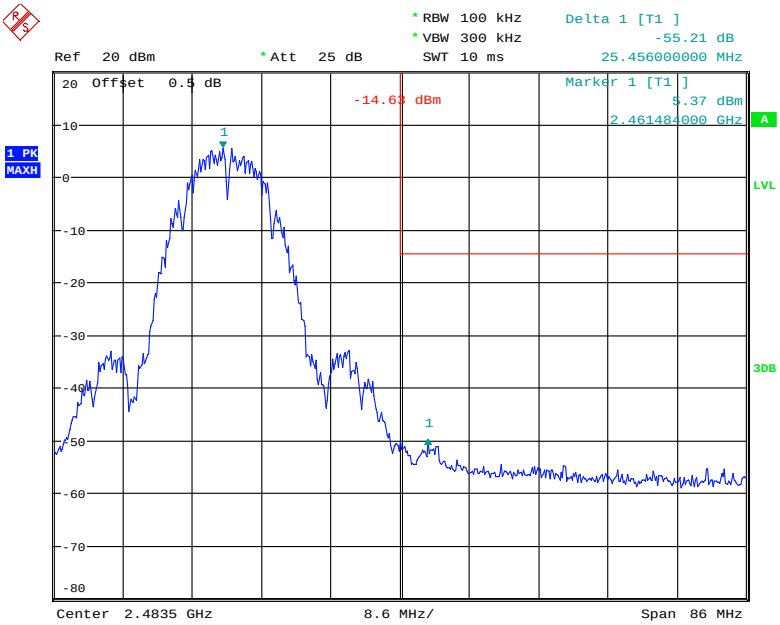
Test Result: Compliance. Please refer to following plots.

802.11b: Band Edge, Left Side



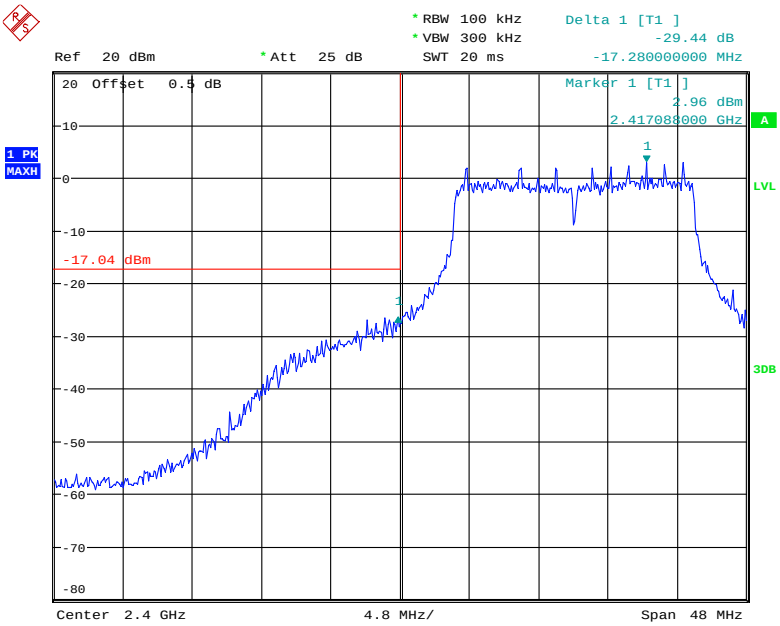
Date: 30.SEP.2020 10:36:49

802.11b: Band Edge, Right Side



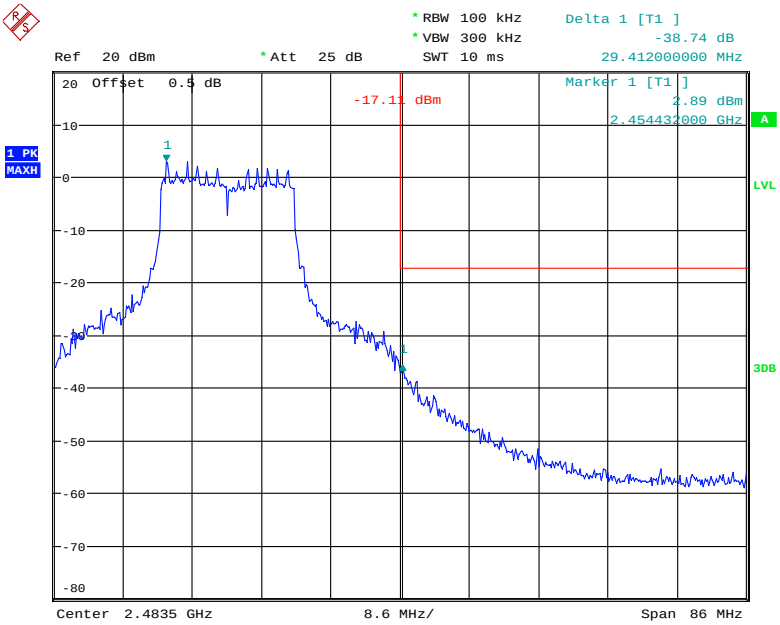
Date: 30.SEP.2020 10:40:33

802.11g: Band Edge, Left Side



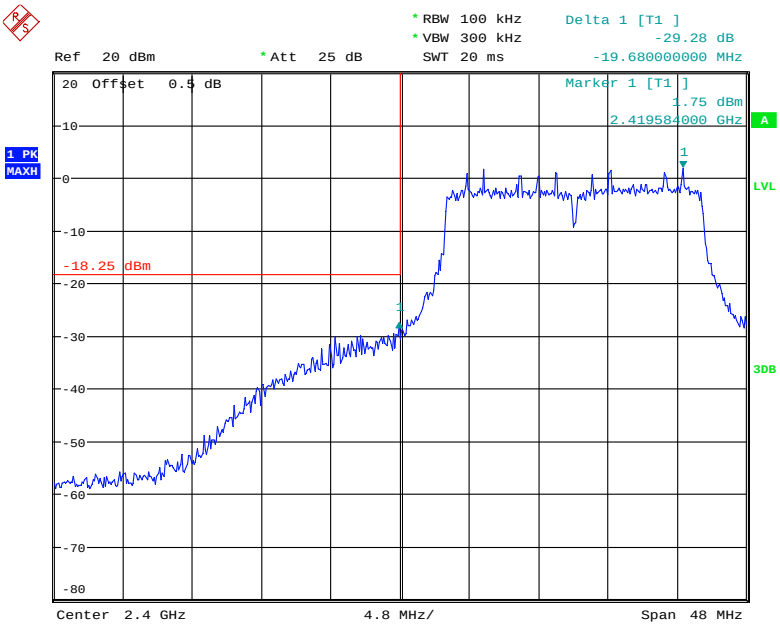
Date: 30.SEP.2020 10:46:41

802.11g: Band Edge, Right Side



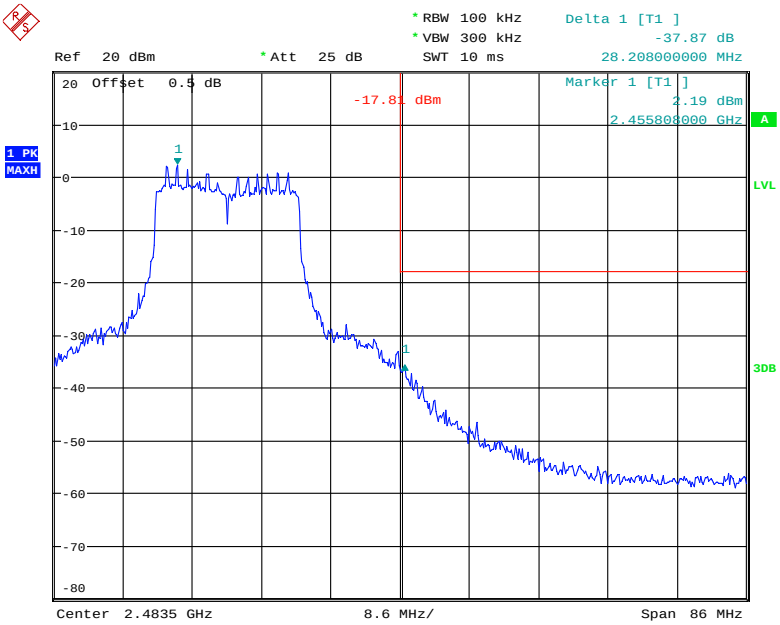
Date: 30.SEP.2020 10:43:21

802.11n ht20: Band Edge, Left Side



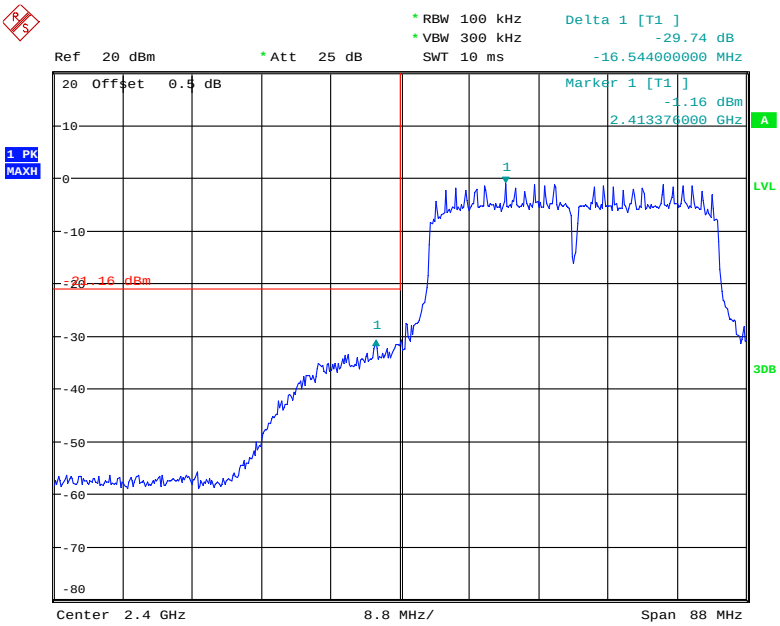
Date: 30.SEP.2020 10:48:43

802.11n ht20: Band Edge, Right Side



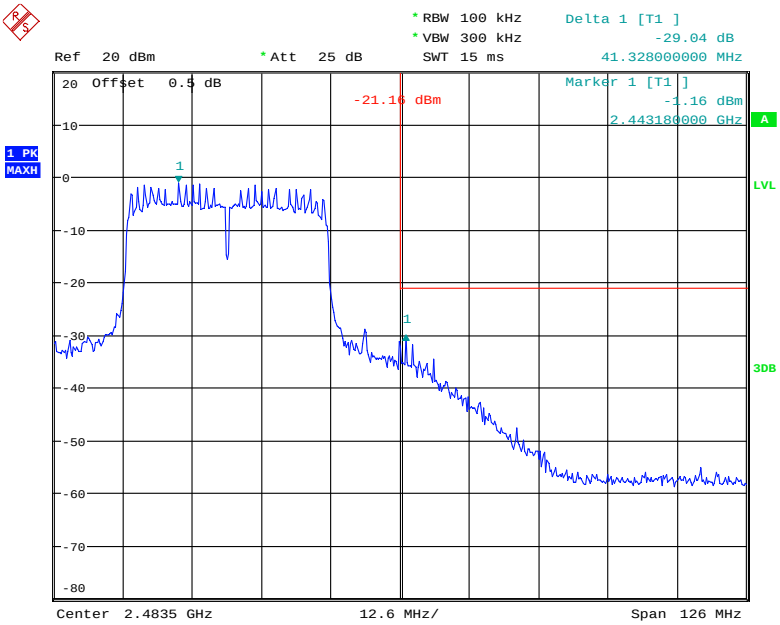
Date: 30.SEP.2020 10:52:07

802.11n ht40: Band Edge, Left Side



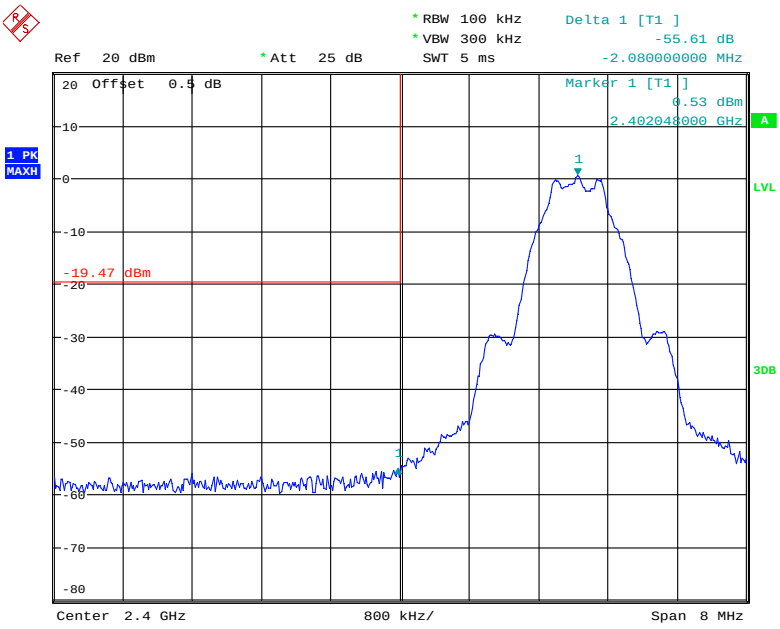
Date: 30.SEP.2020 10:59:17

802.11n ht40: Band Edge, Right Side



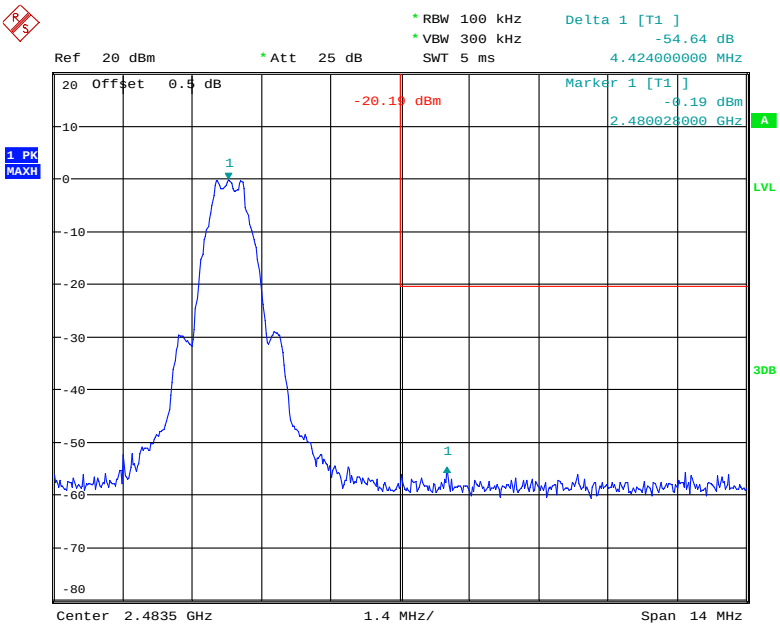
Date: 30.SEP.2020 10:54:44

BLE: Band Edge, Left Side



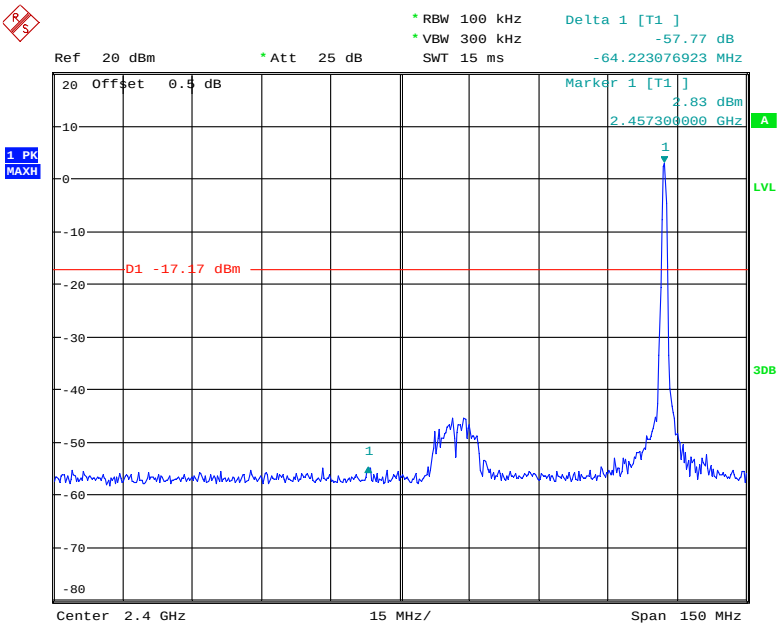
Date: 29.SEP.2020 17:25:12

BLE: Band Edge, Right Side



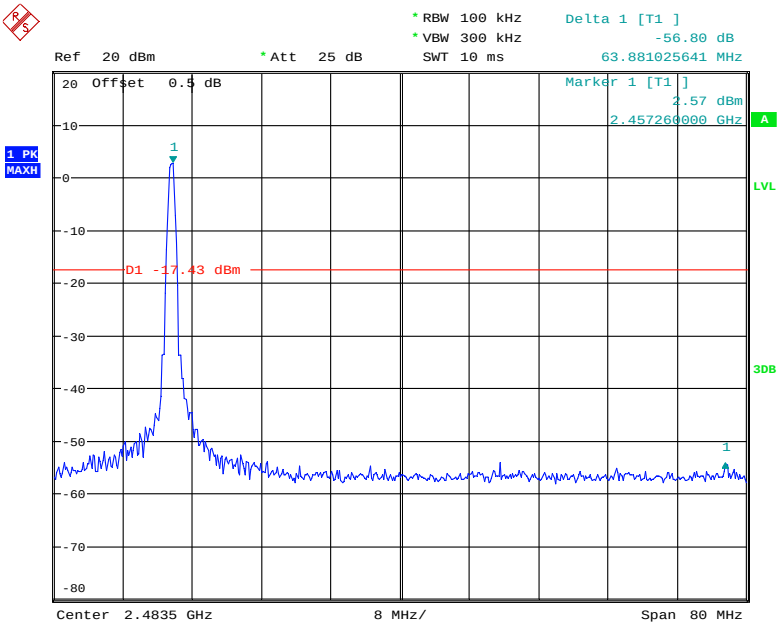
Date: 29.SEP.2020 17:26:30

ANT+: Band Edge, Left Side



Date: 30.SEP.2020 13:20:36

ANT+: Band Edge, Right Side



Date: 30.SEP.2020 13:17:37

FCC §15.247(e), RSS-247 CLAUSE 5.2 B - 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.

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	ESCI	100035	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	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

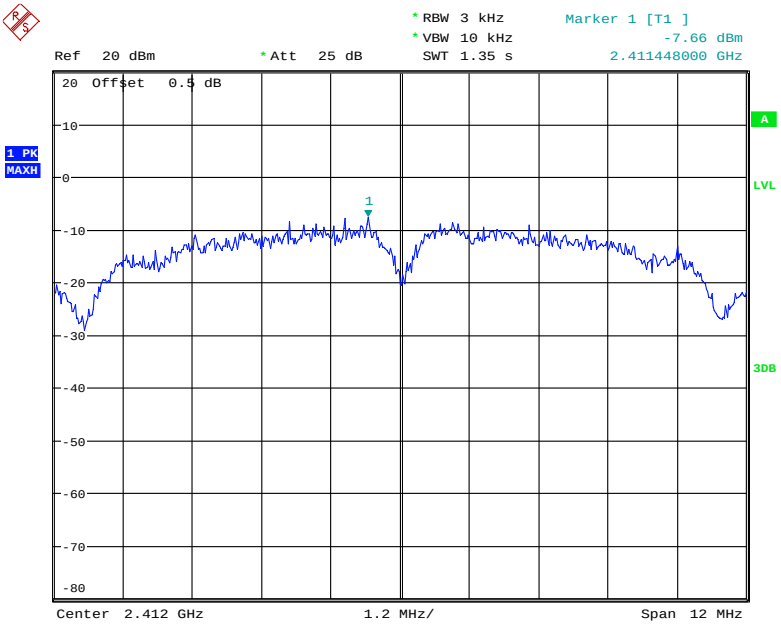
Temperature:	26.2 ~*27.8* °C
Relative Humidity:	50 ~*54* %
ATM Pressure:	100.8 ~*101.1* kPa
Tester:	*Rita Huang*
Test Date:	*2020-09-29~2020-09-30*

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

Test Mode: Transmitting

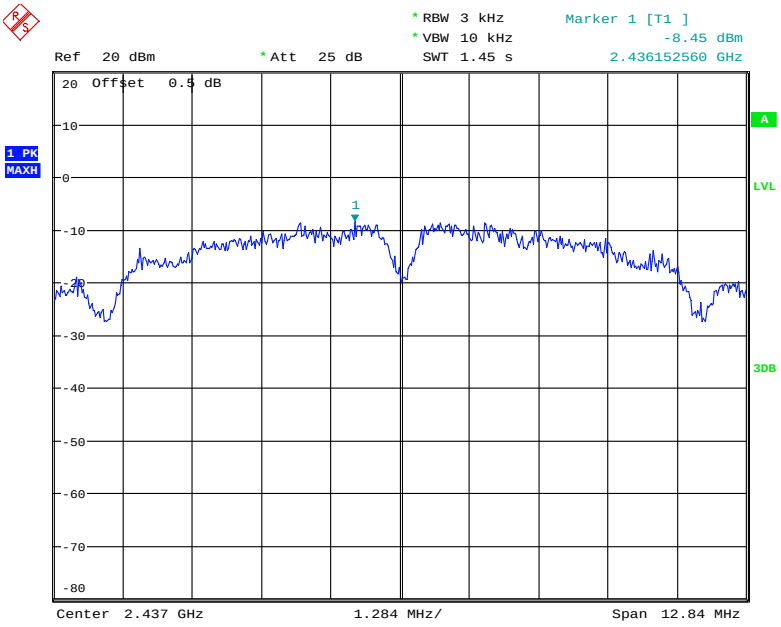
Test mode	Frequency (MHz)	Power Spectral Density	Limit (dBm/3kHz)
802.11 b	2412	-7.66	≤8
	2437	-8.45	≤8
	2462	-8.94	≤8
802.11 g	2412	-11.57	≤8
	2437	-11.69	≤8
	2462	-10.06	≤8
802.11n ht20	2412	-11.92	≤8
	2437	-13.01	≤8
	2462	-11.80	≤8
802.11n ht40	2422	-14.56	≤8
	2437	-15.07	≤8
	2452	-15.03	≤8
BLE	2402	-14.75	≤8
	2440	-14.28	≤8
	2480	-14.87	≤8
ANT+	2457	-6.29	≤8

Power Spectral Density, 802.11b Low Channel



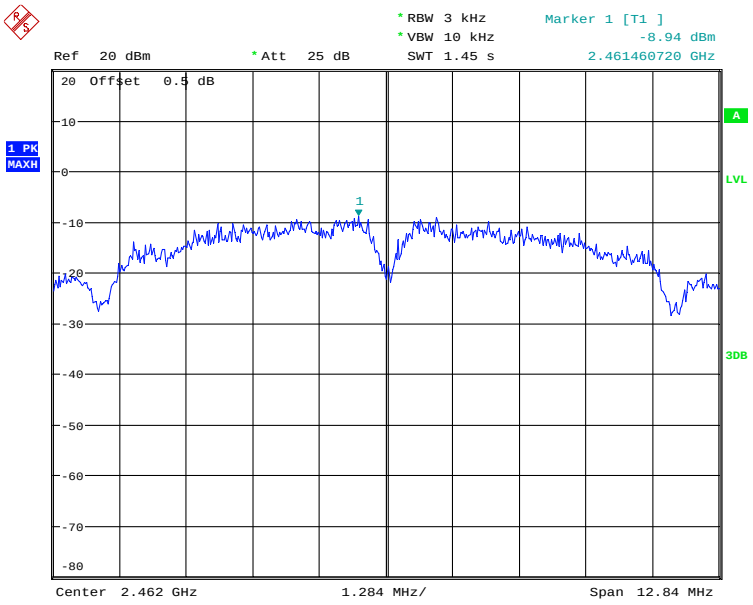
Date: 30.SEP.2020 10:36:34

Power Spectral Density, 802.11b Middle Channel



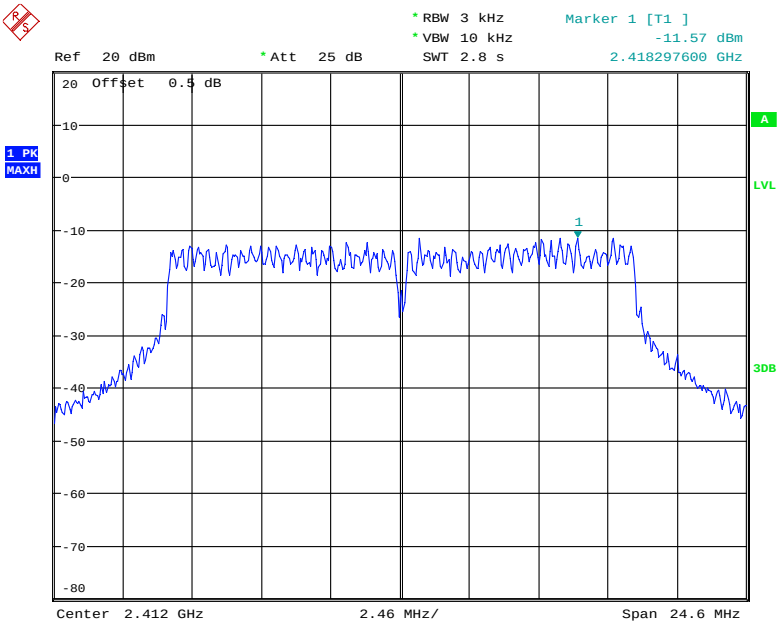
Date: 30.SEP.2020 10:39:04

Power Spectral Density, 802.11b High Channel



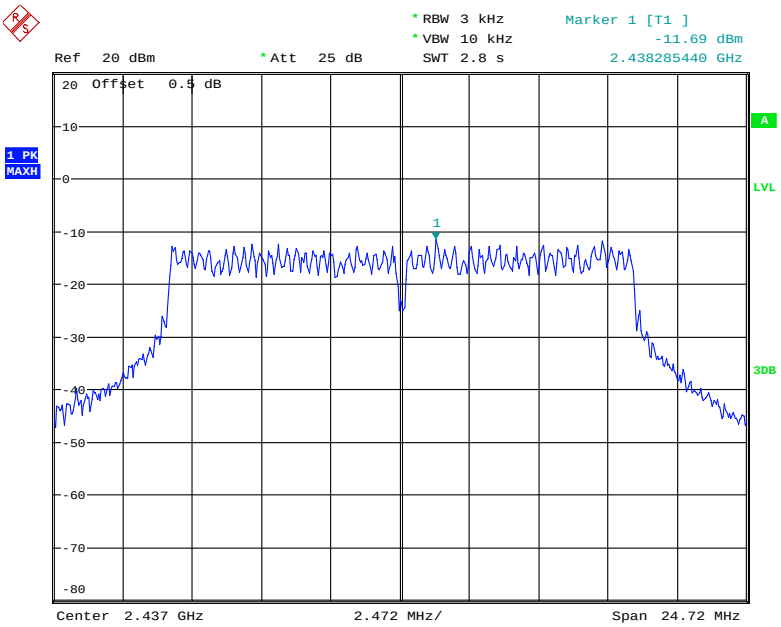
Date: 30.SEP.2020 10:41:20

Power Spectral Density, 802.11g Low Channel



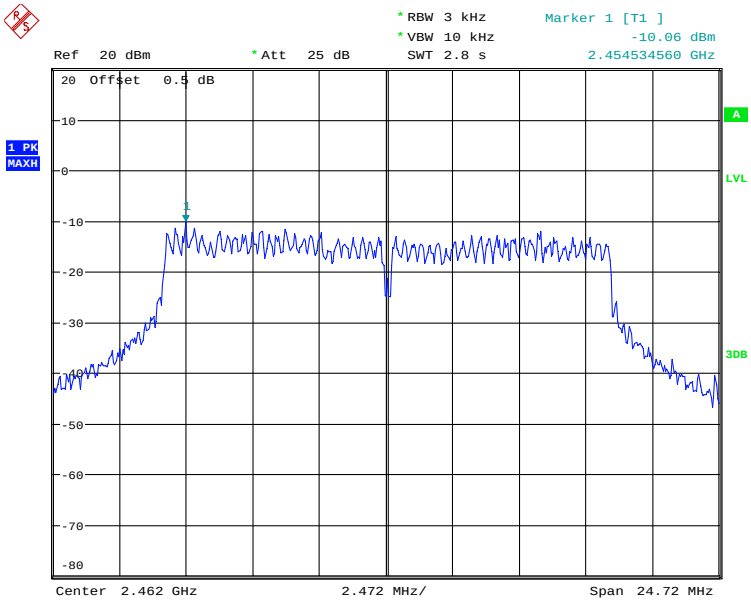
Date: 30.SEP.2020 10:46:27

Power Spectral Density, 802.11g Middle Channel



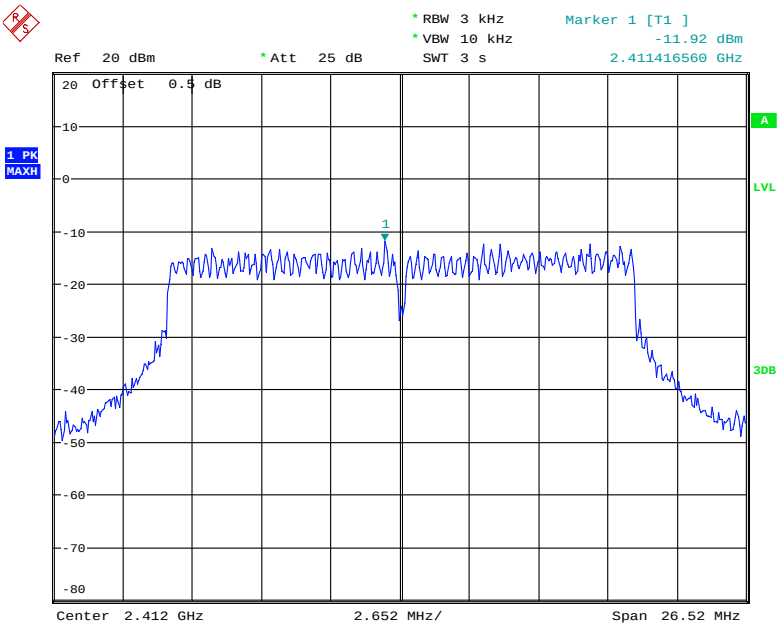
Date: 30.SEP.2020 10:45:00

Power Spectral Density, 802.11g High Channel



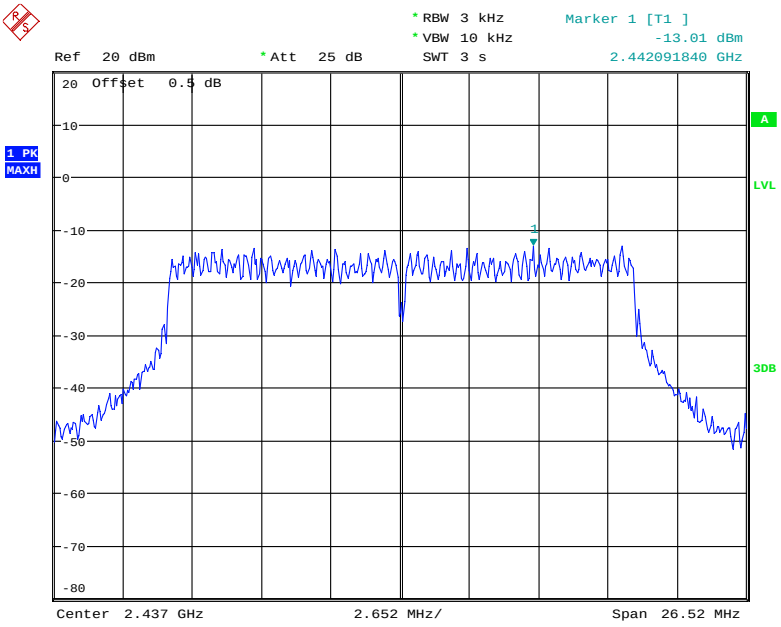
Date: 30.SEP.2020 10:43:07

Power Spectral Density, 802.11n ht20 Low Channel



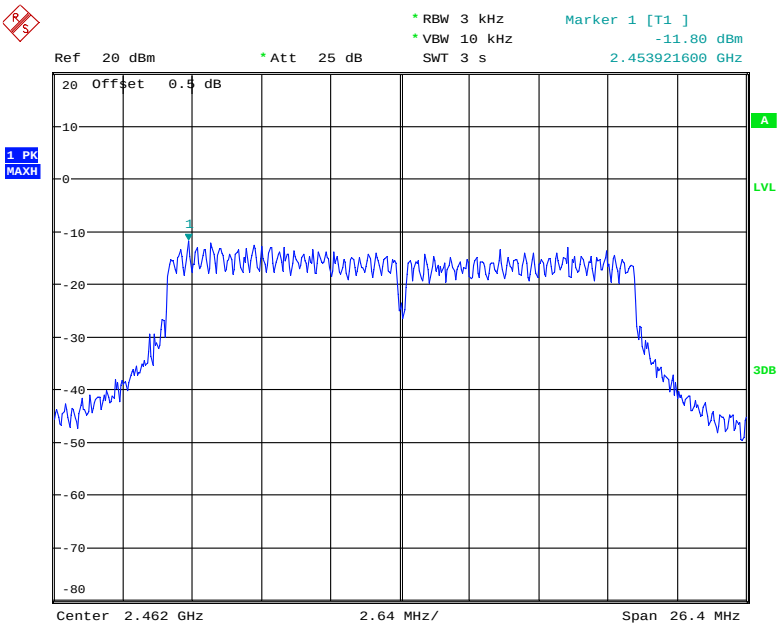
Date: 30.SEP.2020 10:48:28

Power Spectral Density, 802.11n ht20 Middle Channel



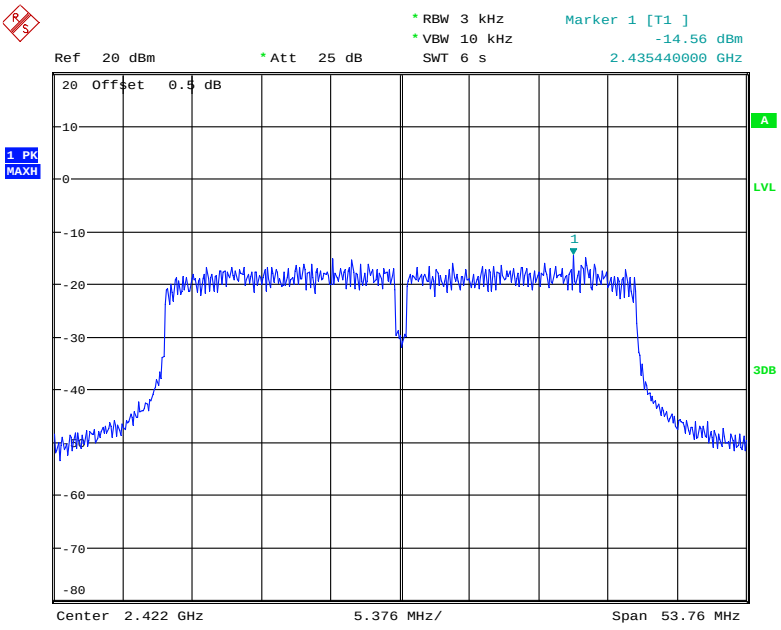
Date: 30.SEP.2020 10:50:18

Power Spectral Density, 802.11n ht20 High Channel



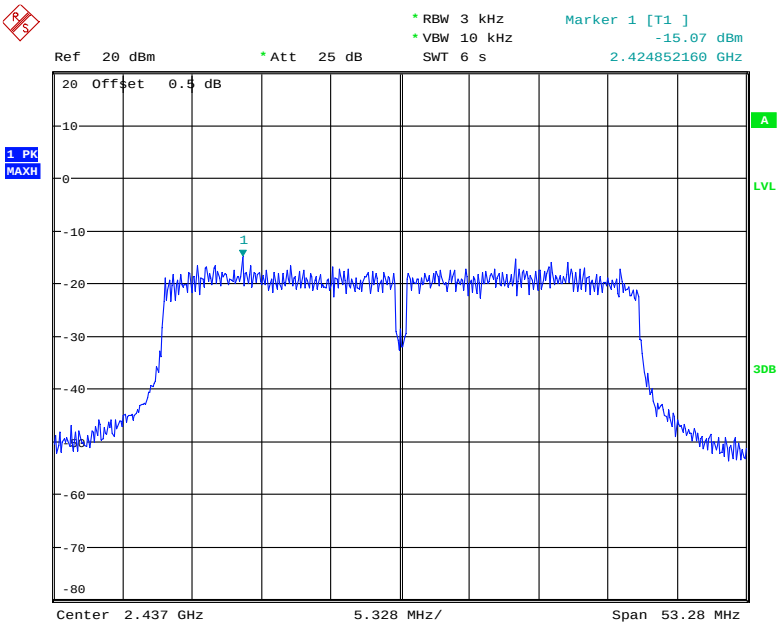
Date: 30.SEP.2020 10:51:53

Power Spectral Density, 802.11n ht40 Low Channel



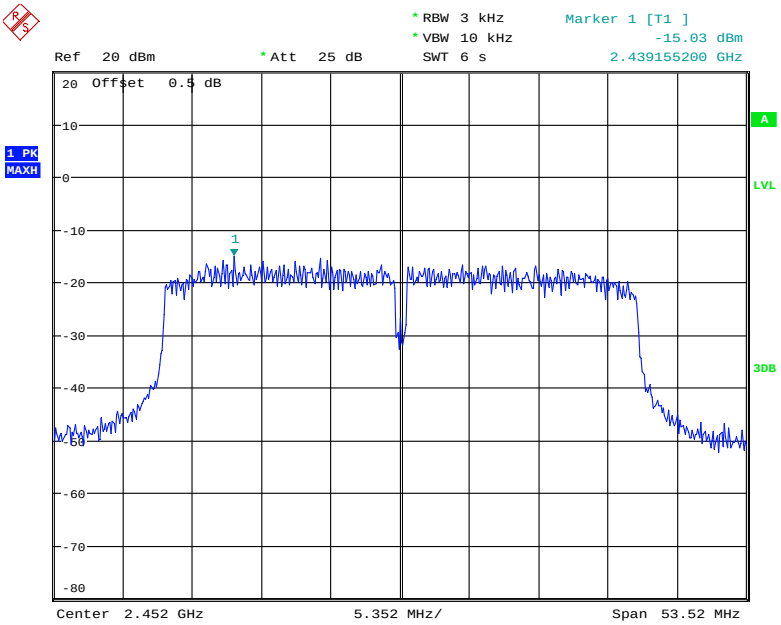
Date: 30.SEP.2020 10:59:00

Power Spectral Density, 802.11n ht40 Middle Channel



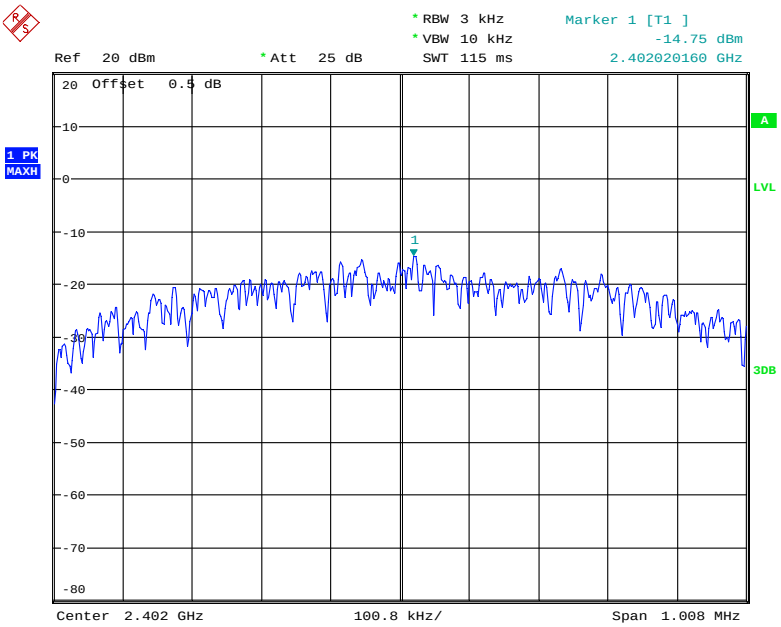
Date: 30.SEP.2020 10:56:53

Power Spectral Density, 802.11n ht40 High Channel



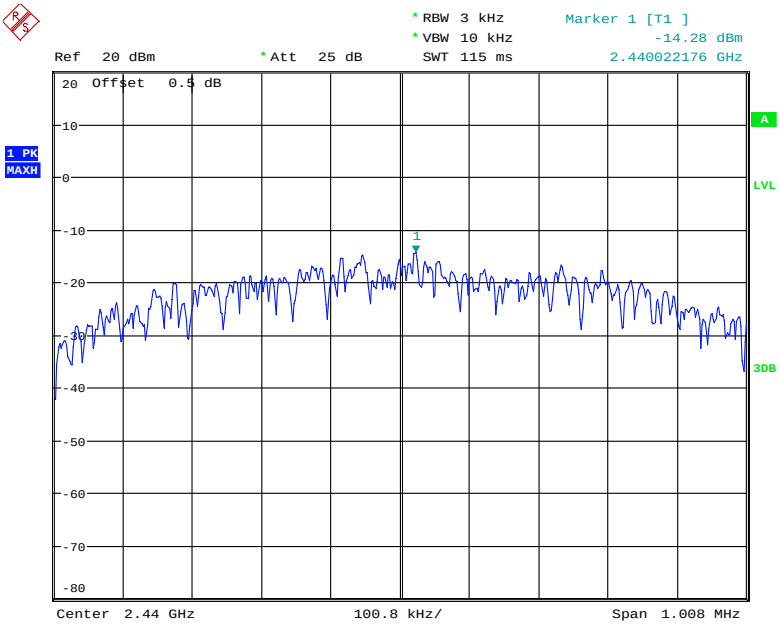
Date: 30.SEP.2020 10:54:29

Power Spectral Density, BLE Low Channel



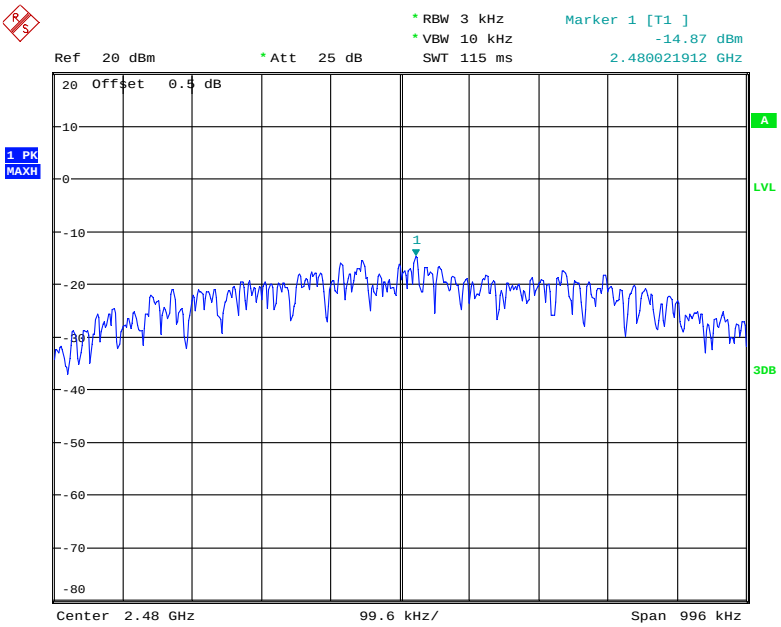
Date: 29.SEP.2020 17:24:58

Power Spectral Density, BLE Middle Channel



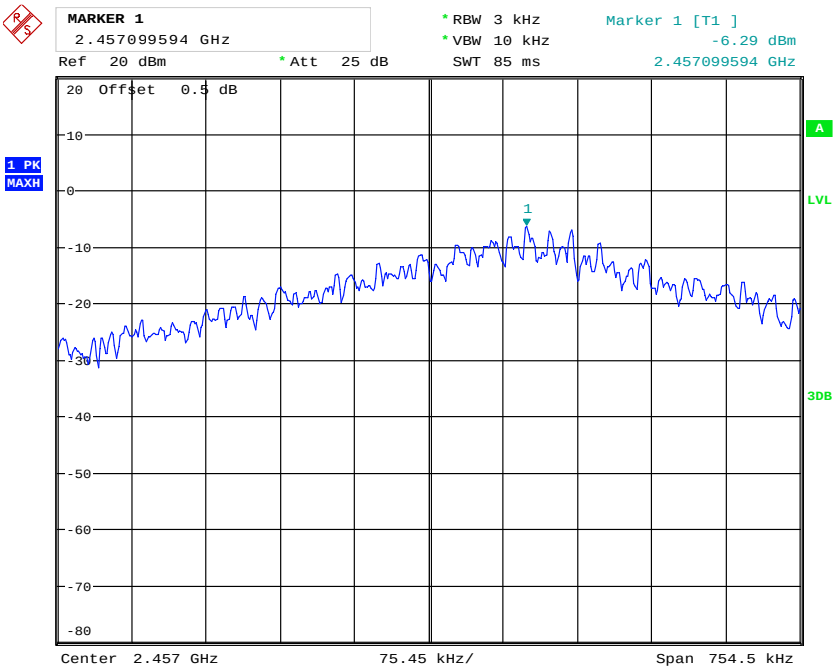
Date: 29.SEP.2020 17:27:42

Power Spectral Density, BLE High Channel



Date: 29.SEP.2020 17:26:15

Power Spectral Density,ANT+



Date: 30.SEP.2020 13:54:51

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