

FCC PART 15.407 TEST REPORT

For

Whoop International Trading Limited

Flat-B 8/F Chong Gming Building 72 Cheung Sha Wan Road, Kowloon Hong Kong

FCC ID: 2AP7LVALOR

Report Type: Original Report	Product Name: Rugged smart phone
Report Number: RDG190108004-00E	
Report Date: 2019-01-26	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		Rugged smart phone
EUT Model:		Rough-52
Multiple Models:		L971
Rated Input Voltage:		3.8VDC from battery and 5VDC from adapter
Adapter Information	Model:	APS-M005050100W-G
	Input:	100-240VAC, 50/60Hz 0.3A Max
	Output:	5VDC, 1.0A
External Dimension:		148mm(L)*77mm(W)*12mm(H)
Serial Number:		190108004
EUT Received Date:		2019-01-10

Note: The series product model L971 is electrically identical with model Rough-52, we selected Rough-52 for fully testing, the differences details was explained in the declaration letter.

Objective

This type approval report is prepared on behalf of **Whoop International Trading Limited** in accordance with Part 2-Subpart J, Part 15-Subparts A, and E of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart E, section 15.203, 15.205, 15.207, 15.209 and 15.407 rules.

Related Submittal(s)/Grant(s)

FCC Part 22H, 24E, 27 PCE submissions with FCC ID: 2AP7LVALOR.

FCC Part 15C DSS submissions with FCC ID: 2AP7LVALOR.

FCC Part 15C DTS submissions with FCC ID: 2AP7LVALOR.

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 789033 D02 General U-NII Test Procedures New Rules v02r01.

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 °C
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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

The system only supports 802.11a/n ht20 in 5.8 GHz band.

In 5.8GHz band (5725~5850MHz), 5 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	161	5805
153	5765	165	5825
157	5785	/	/

Channel 149, 157 and 165 were tested.

EUT Exercise Software

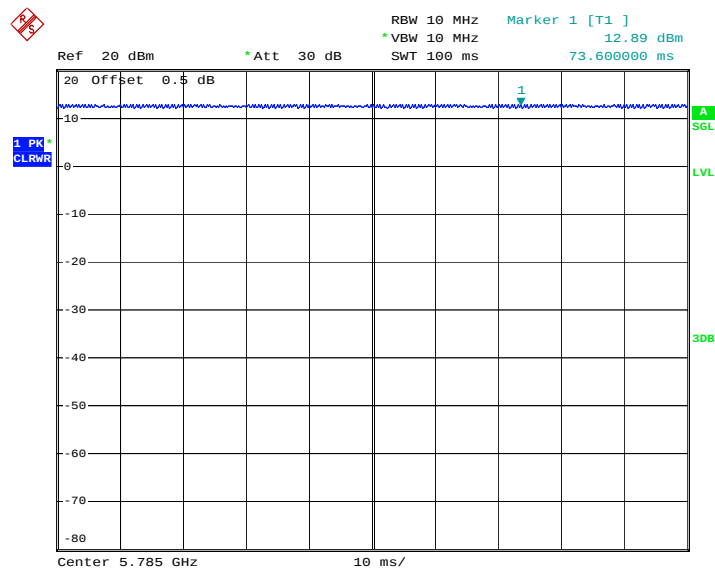
The software “Engineering Mode” was used for testing, which was provided by manufacturer. The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations. The maximum power was configured as below table, that provided by the manufacturer:

Mode	Channel	Frequency (MHz)	Data rate	Power level
802.11a	Low	5745	6 Mbps	17
	Middle	5785	6 Mbps	17
	High	5825	6 Mbps	18
802.11n ht20	Low	5745	MCS0	17
	Middle	5785	MCS0	17
	High	5825	MCS0	18

The duty cycle as below:

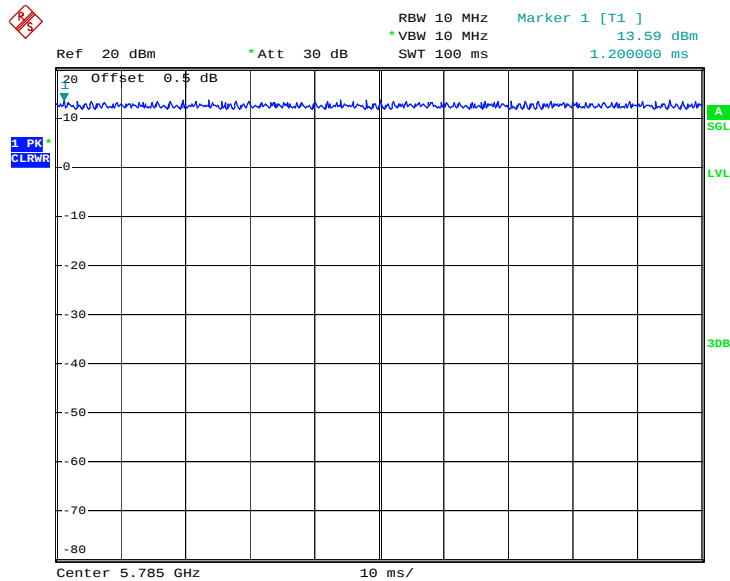
Mode	T _{on} (ms)	T _{on+off} (ms)	Duty Cycle(x) (%)
802.11 a	100	100	100
802.11n ht20	100	100	100

802.11a



Date: 20.JAN.2019 11:10:05

802.11n ht20



Date: 20.JAN.2019 11:11:01

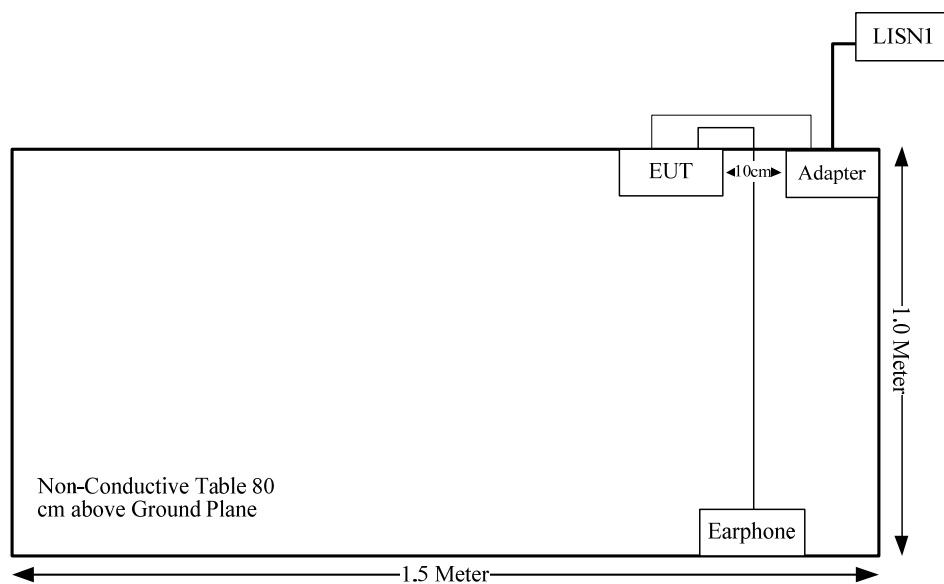
Equipment Modifications

No modification was made to the EUT.

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB cable	No	No	1.2	Adapter	EUT
Earphone cable	No	No	1.2	EUT	Earphone

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.407(b)(6)& §15.207(a)	Conducted Emissions	Compliance
§15.205& §15.209 &§15.407(b)	Undesirable Emission& Restricted Bands	Compliance
§15.407(b)	Out Of Band Emissions	Compliance
§15.407(a) (e)	Emission Bandwidth	Compliance
§15.407(a)	Conducted Transmitter Output Power	Compliance
§15.407 (a)	Power Spectral Density	Compliance

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

Applicable Standard

According to §15.247(i), §1.1310 and §2.1093.

Test Result

Compliant, please refer to the SAR report: RDG190108004-20.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.407 (a)(1), if transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has one internal FPC antenna arrangement for BT/WLAN, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
FPC	50	1.2 dBi/2.4~2.5GHz 1.0 dBi/5.725~5.85GHz

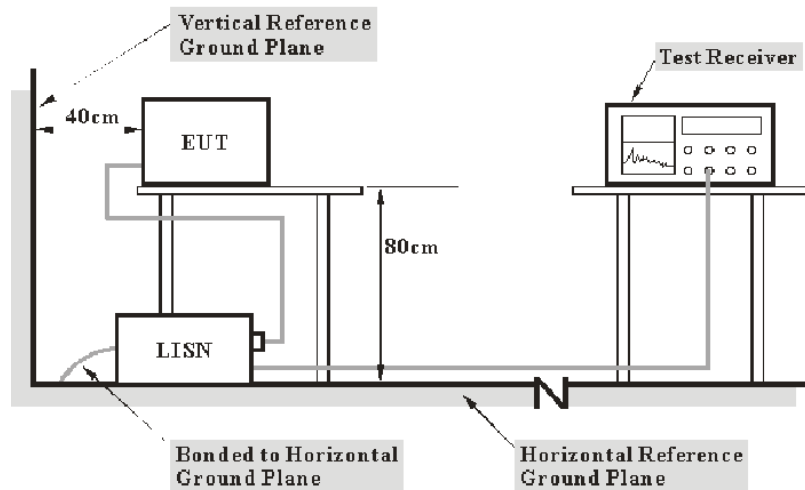
Result: Compliance.

FCC §15.407 (b) (6) §15.207 (a) – CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a), §15.407(b) (6).

EUT Setup



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

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

The spacing between the peripherals was 10 cm.

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

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2018-12-10	2019-12-10
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	2018-12-10	2019-12-10

* **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 Procedure

During the conducted emission test, the EUT 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.

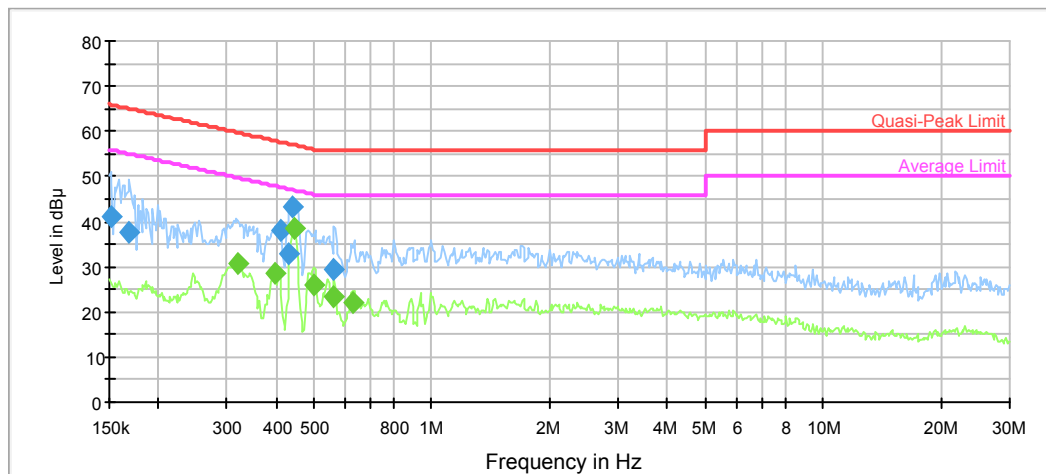
Test Data**Environmental Conditions**

Temperature:	23.5°C
Relative Humidity:	37%
ATM Pressure:	100.8kPa

The testing was performed by Lily Xie on 2019-01-21.

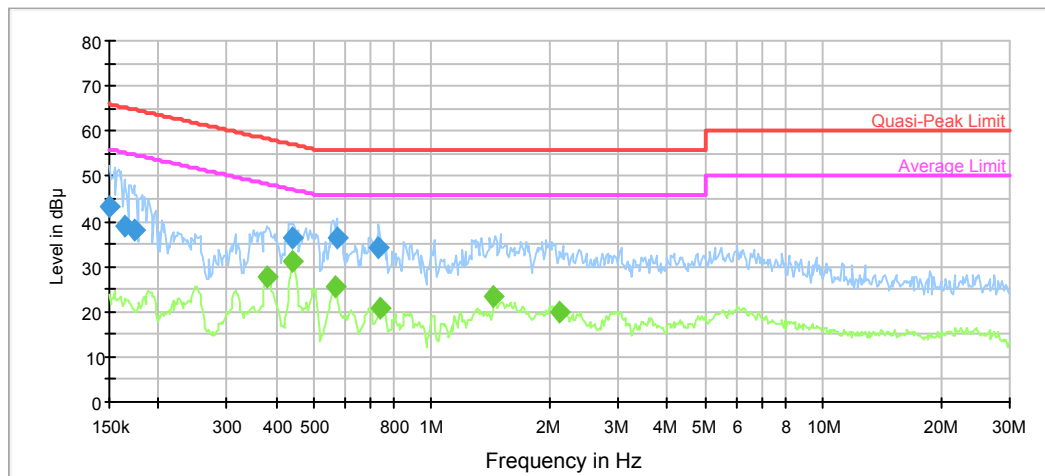
Test Mode: Transmitting

AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.151200	41.2	9.000	L1	11.2	24.7	65.9	Compliance
0.169044	37.8	9.000	L1	10.9	27.2	65.0	Compliance
0.409372	37.9	9.000	L1	10.0	19.8	57.7	Compliance
0.429420	32.9	9.000	L1	9.9	24.4	57.3	Compliance
0.443327	43.1	9.000	L1	9.9	13.9	57.0	Compliance
0.563041	29.3	9.000	L1	9.8	26.7	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.319773	30.5	9.000	L1	10.1	19.2	49.7	Compliance
0.399703	28.5	9.000	L1	10.0	19.2	47.9	Compliance
0.446873	38.6	9.000	L1	9.9	8.3	46.9	Compliance
0.499611	26.0	9.000	L1	9.9	20.0	46.0	Compliance
0.563041	23.3	9.000	L1	9.8	22.7	46.0	Compliance
0.629488	22.1	9.000	L1	9.8	23.9	46.0	Compliance

AC120 V, 60 Hz, Neutral:

frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.150000	43.2	9.000	N	11.2	22.8	66.0	Compliance
0.163741	39.1	9.000	N	11.0	26.1	65.3	Compliance
0.173134	38.1	9.000	N	10.9	26.7	64.8	Compliance
0.443327	36.5	9.000	N	9.9	20.5	57.0	Compliance
0.572086	36.3	9.000	N	9.8	19.7	56.0	Compliance
0.732382	34.1	9.000	N	9.8	21.9	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.381043	27.6	9.000	N	10.0	20.7	48.3	Compliance
0.443327	31.2	9.000	N	9.9	15.8	47.0	Compliance
0.567545	25.7	9.000	N	9.8	20.3	46.0	Compliance
0.738241	20.9	9.000	N	9.8	25.1	46.0	Compliance
1.441726	23.4	9.000	N	9.8	22.6	46.0	Compliance
2.130339	19.9	9.000	N	9.8	26.1	46.0	Compliance

FCC §15.209, §15.205 & §15.407(b) –UNWANTED EMISSION

Applicable Standard

FCC §15.407; §15.209; §15.205;

(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

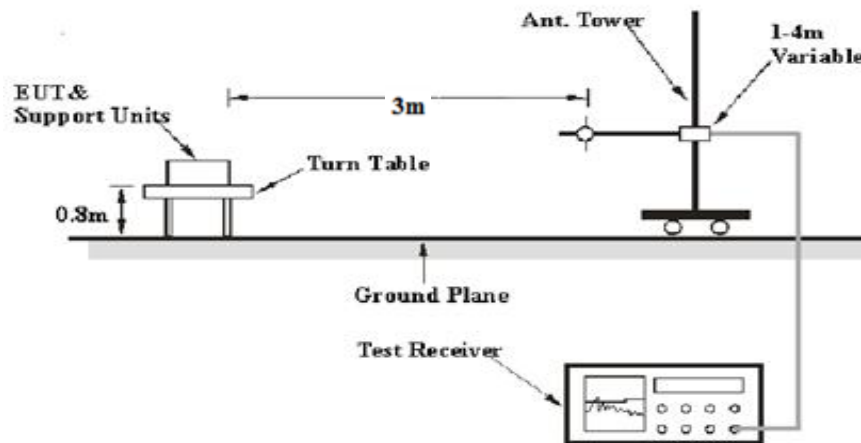
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

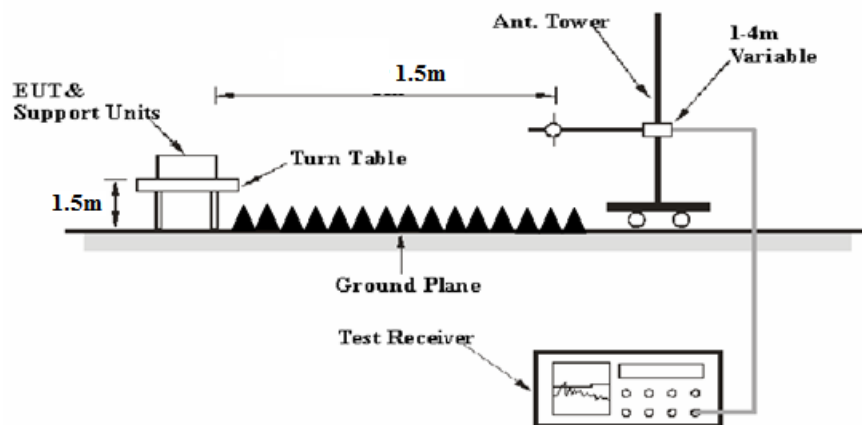
(7) The provisions of §15.205 apply to intentional radiators operating under this section.

EUT Setup

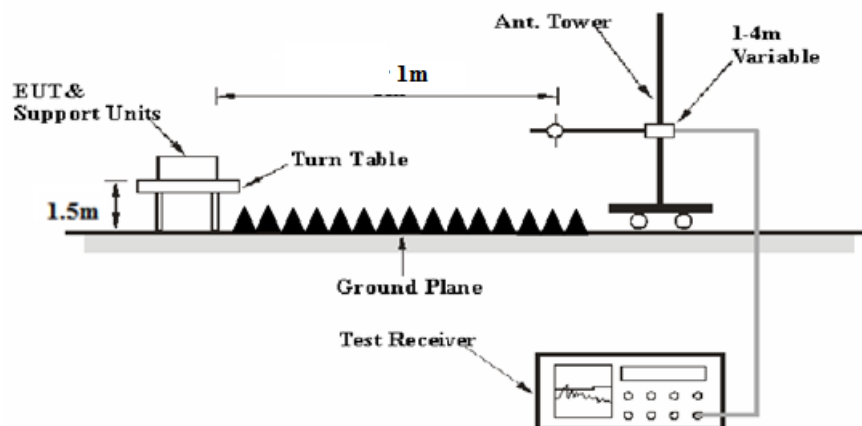
Below 1 GHz:



1-26.5 GHz:



26.5-40 GHz:



The radiated emission Below 1GHz tests were performed in the 3 meters chamber test site A , above 1GHz tests were performed in the 3 meters chamber test site A, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.407 limits

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 40 GHz.

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

30-1000MHz:

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

1GHz- 40GHz:

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

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

During the radiated emission test, the adapter was connected to the first AC floor outlet.

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

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, emission shall be computed as: $E [dB\mu V/m] = EIRP[dBm] + 95.2$, for $d = 3$ meters.

According to C63.10, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m or 1m

Distance extrapolation factor = $20 \log (\text{specific distance } [3m]/\text{test distance } [1.5m])$ dB= 6.02 dB

or

Distance extrapolation factor = $20 \log (\text{specific distance } [3m]/\text{test distance } [1m])$ dB= 9.54 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

Corrected Amplitude & Margin Calculation

For the range 30MHz-1GHz, 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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

For the range 1GHz-40GHz, Test performed at 1.5m or 1m, the Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading and the Distance extrapolation factor. The basic equation is as follows:

$$\begin{aligned} &\text{Corrected Amplitude} \\ &= \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain} - \text{Distance extrapolation factor} \end{aligned}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2018-12-10	2019-12-10
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
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-1400-01	2018-05-06	2019-05-06
HP	Amplifier	8447D	2727A05902	2018-09-05	2019-09-05
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
TDK RF	Horn Antenna	HRN-0118	130 084	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2016-11-18	2019-11-18
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
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2018-06-27	2019-06-27
Sinoscite	Bandstop Filters	BSF5150-5850MN- 0899-003	0899003	2018-05-06	2019-05-06
Mini Circuits	High Pass Filter	VHF-6010+	31118	2018-06-16	2019-06-16

* **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**

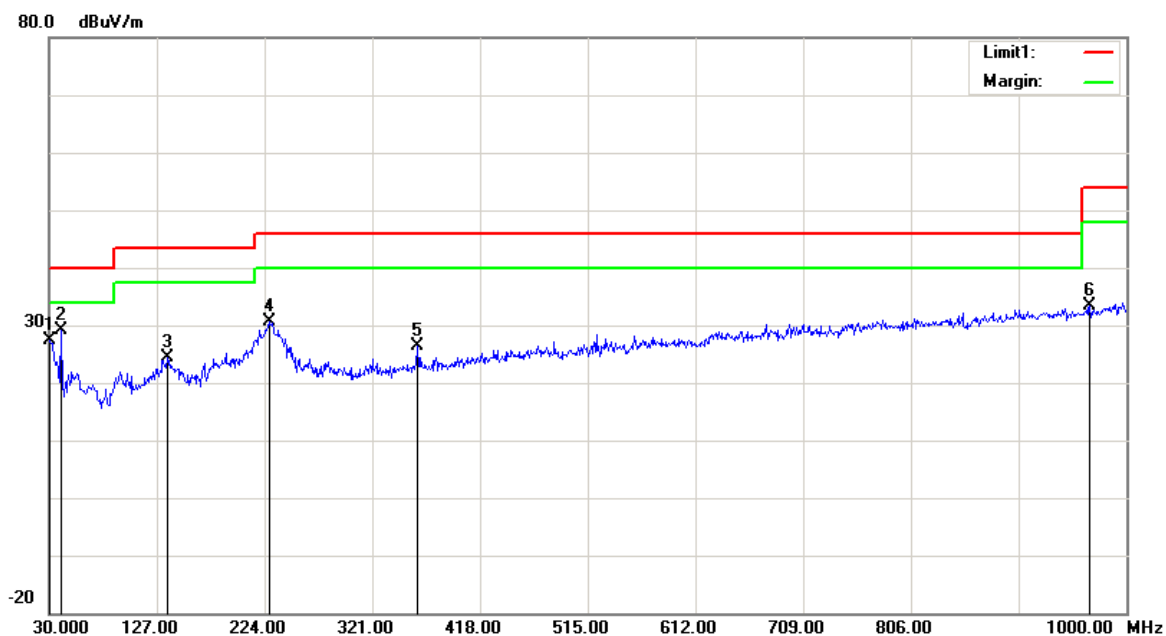
Temperature:	21.2~22.6°C
Relative Humidity:	30~35 %
ATM Pressure:	100.4~100.6kPa

* The testing was performed by Tyler Pan and Vern Shen on 2019-01-18~2019-01-23.

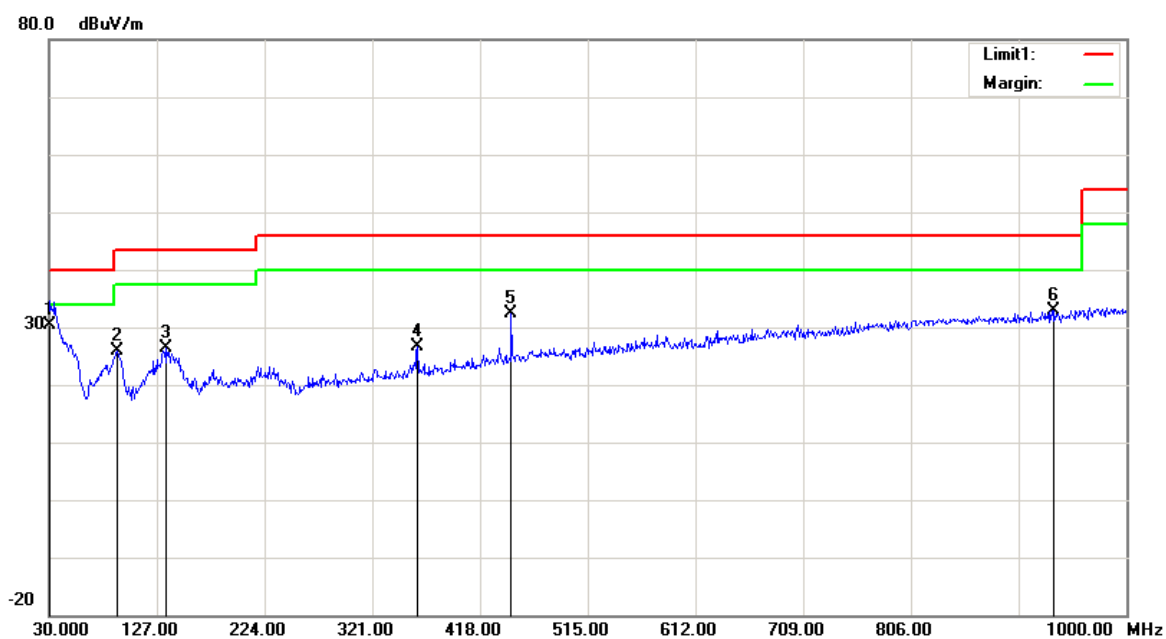
Test Mode: Transmitting

1) Below 1GHz(802.11a 5825 MHz was the worst):

Horizontal



Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.0000	25.71	peak	1.72	27.43	40.00	12.57
40.6700	35.44	peak	-6.32	29.12	40.00	10.88
136.7000	29.69	peak	-5.28	24.41	43.50	19.09
227.8800	37.10	peak	-6.57	30.53	46.00	15.47
361.7400	29.10	peak	-2.80	26.30	46.00	19.70
967.0200	10.32	peak	22.94	33.26	54.00	20.74

Vertical

Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.9700	29.59	QP	0.91	30.50	40.00	9.50
91.1100	36.92	peak	-11.09	25.83	43.50	17.67
135.7300	31.57	peak	-5.15	26.42	43.50	17.08
361.7400	29.47	peak	-2.80	26.67	46.00	19.33
446.1300	33.58	peak	-1.14	32.44	46.00	13.56
935.0100	36.36	peak	-3.41	32.95	46.00	13.05

2) 1GHz-40GHz:
802.11a

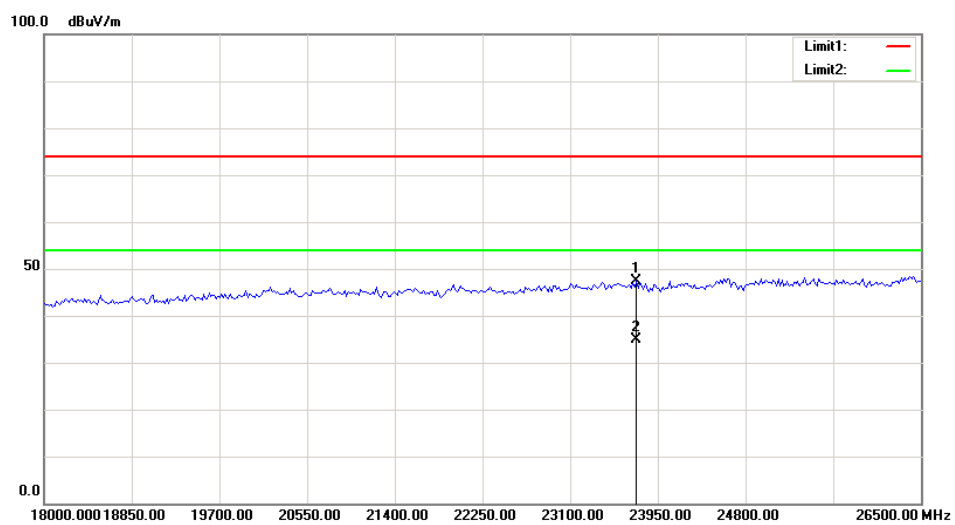
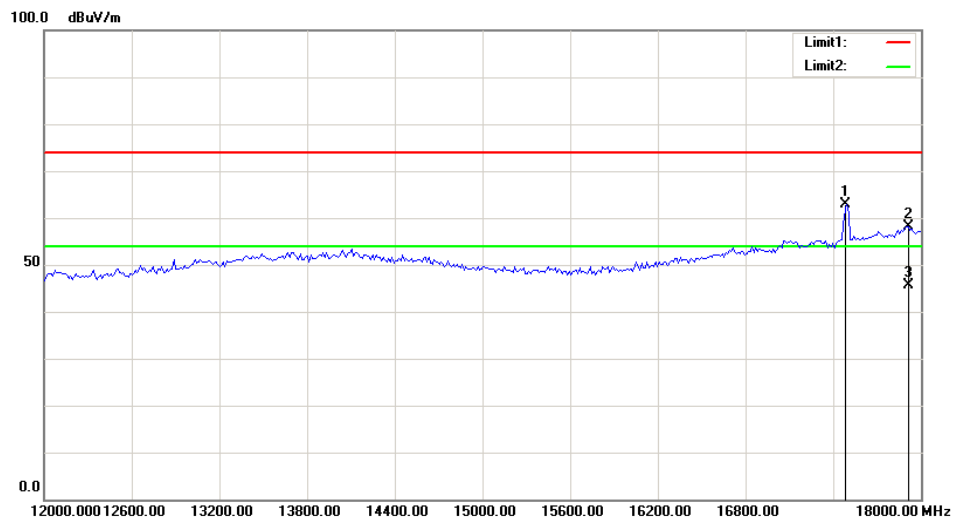
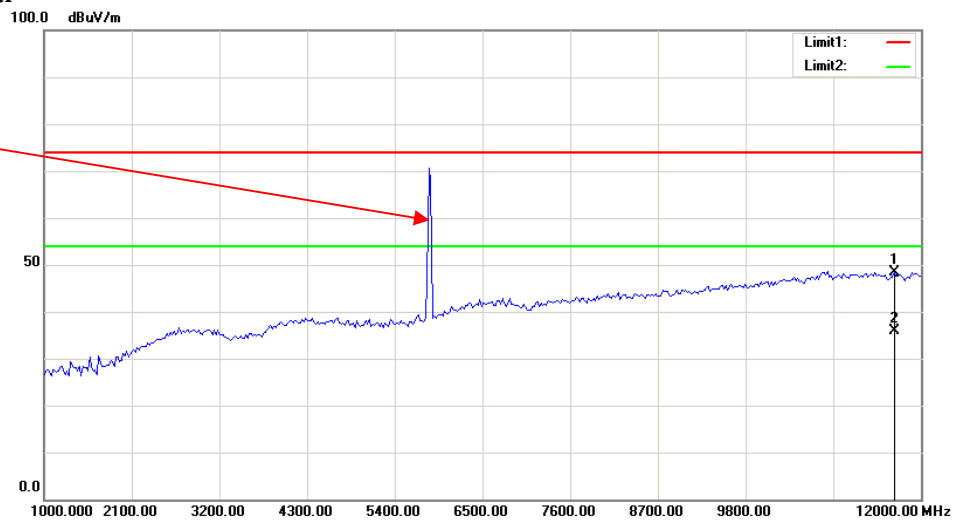
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5745 MHz										
5745.00	66.12	PK	H	31.44	4.96	0.00	102.52	96.5	N/A	N/A
5745.00	56.60	AV	H	31.44	4.96	0.00	93.00	86.98	N/A	N/A
5745.00	68.19	PK	V	31.44	4.96	0.00	104.59	98.57	N/A	N/A
5745.00	58.63	AV	V	31.44	4.96	0.00	95.03	89.01	N/A	N/A
5725.00	44.06	PK	V	31.42	4.96	0.00	80.44	74.42	122.20	47.78
5720.00	35.18	PK	V	31.41	4.96	0.00	71.55	65.53	110.80	45.27
5700.00	27.10	PK	V	31.38	4.97	0.00	63.45	57.43	105.20	47.77
5650.00	26.25	PK	V	31.31	4.95	0.00	62.51	56.49	68.20	11.71
11490.00	36.69	PK	V	38.29	6.98	26.57	55.39	49.37	74.00	24.63
11490.00	24.10	AV	V	38.29	6.98	26.57	42.80	36.78	54.00	17.22
17235.00	42.33	PK	V	41.02	9.01	25.11	67.25	61.23	68.20	6.97
Middle Channel: 5785 MHz										
5785.00	65.43	PK	H	31.50	4.94	0.00	101.87	95.85	N/A	N/A
5785.00	56.04	AV	H	31.50	4.94	0.00	92.48	86.46	N/A	N/A
5785.00	67.69	PK	V	31.50	4.94	0.00	104.13	98.11	N/A	N/A
5785.00	58.14	AV	V	31.50	4.94	0.00	94.58	88.56	N/A	N/A
11570.00	36.24	PK	V	38.36	6.98	26.97	54.61	48.59	74.00	25.41
11570.00	23.76	AV	V	38.36	6.98	26.97	42.13	36.11	54.00	17.89
17355.00	42.76	PK	V	41.28	9.04	25.16	67.92	61.9	68.20	6.30
High Channel: 5825 MHz										
5825.00	65.77	PK	H	31.56	4.94	0.00	102.27	96.25	N/A	N/A
5825.00	56.23	AV	H	31.56	4.94	0.00	92.73	86.71	N/A	N/A
5825.00	68.30	PK	V	31.56	4.94	0.00	104.80	98.78	N/A	N/A
5825.00	58.76	AV	V	31.56	4.94	0.00	95.26	89.24	N/A	N/A
5850.00	29.61	PK	V	31.59	4.95	0.00	66.15	60.13	122.20	62.07
5855.00	28.10	PK	V	31.60	4.95	0.00	64.65	58.63	110.80	52.17
5875.00	27.94	PK	V	31.63	4.95	0.00	64.52	58.5	105.20	46.70
5925.00	27.21	PK	V	31.70	4.95	0.00	63.86	57.84	68.20	10.36
11650.00	36.50	PK	V	38.42	6.99	26.84	55.07	49.05	74.00	24.95
11650.00	24.06	AV	V	38.42	6.99	26.84	42.63	36.61	54.00	17.39
17475.00	42.88	PK	V	41.55	9.06	24.55	68.94	62.92	68.20	5.28

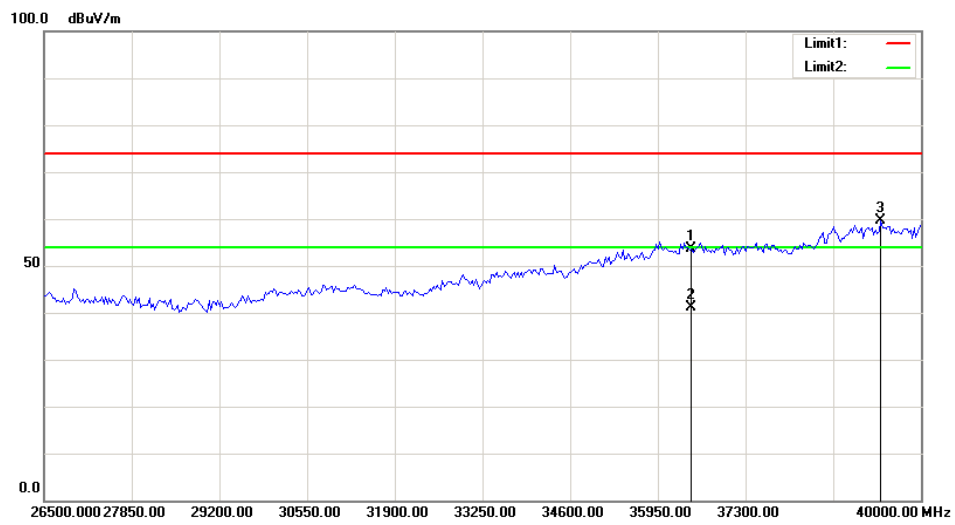
802.11n ht20

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5745 MHz										
5745.00	65.61	PK	H	31.44	4.96	0.00	102.01	95.99	N/A	N/A
5745.00	55.59	AV	H	31.44	4.96	0.00	91.99	85.97	N/A	N/A
5745.00	68.25	PK	V	31.44	4.96	0.00	104.65	98.63	N/A	N/A
5745.00	58.15	AV	V	31.44	4.96	0.00	94.55	88.53	N/A	N/A
5725.00	44.15	PK	V	31.42	4.96	0.00	80.53	74.51	122.20	47.69
5720.00	35.61	PK	V	31.41	4.96	0.00	71.98	65.96	110.80	44.84
5700.00	26.54	PK	V	31.38	4.97	0.00	62.89	56.87	105.20	48.33
5650.00	26.30	PK	V	31.31	4.95	0.00	62.56	56.54	68.20	11.66
11490.00	36.62	PK	V	38.29	6.98	26.57	55.32	49.3	74.00	24.70
11490.00	24.23	AV	V	38.29	6.98	26.57	42.93	36.91	54.00	17.09
17235.00	42.57	PK	V	41.02	9.01	25.11	67.49	61.47	68.20	6.73
Middle Channel: 5785 MHz										
5785.00	65.22	PK	H	31.50	4.94	0.00	101.66	95.64	N/A	N/A
5785.00	55.10	AV	H	31.50	4.94	0.00	91.54	85.52	N/A	N/A
5785.00	67.54	PK	V	31.50	4.94	0.00	103.98	97.96	N/A	N/A
5785.00	57.50	AV	V	31.50	4.94	0.00	93.94	87.92	N/A	N/A
11570.00	36.58	PK	V	38.36	6.98	26.97	54.95	48.93	74.00	25.07
11570.00	24.17	AV	V	38.36	6.98	26.97	42.54	36.52	54.00	17.48
17355.00	42.19	PK	V	41.28	9.04	25.16	67.35	61.33	68.20	6.87
High Channel: 5825 MHz										
5825.00	65.62	PK	H	31.56	4.94	0.00	102.12	96.1	N/A	N/A
5825.00	55.56	AV	H	31.56	4.94	0.00	92.06	86.04	N/A	N/A
5825.00	68.10	PK	V	31.56	4.94	0.00	104.60	98.58	N/A	N/A
5825.00	58.12	AV	V	31.56	4.94	0.00	94.62	88.6	N/A	N/A
5850.00	30.26	PK	V	31.59	4.95	0.00	66.80	60.78	122.20	61.42
5855.00	29.65	PK	V	31.60	4.95	0.00	66.20	60.18	110.80	50.62
5875.00	27.52	PK	V	31.63	4.95	0.00	64.10	58.08	105.20	47.12
5925.00	26.31	PK	V	31.70	4.95	0.00	62.96	56.94	68.20	11.26
11650.00	36.63	PK	V	38.42	6.99	26.84	55.20	49.18	74.00	24.82
11650.00	24.20	AV	V	38.42	6.99	26.84	42.77	36.75	54.00	17.25
17475.00	42.40	PK	V	41.55	9.06	24.55	68.46	62.44	68.20	5.76

Test Plots(For worst mode 802.11a 5825MHz)
Horizontal

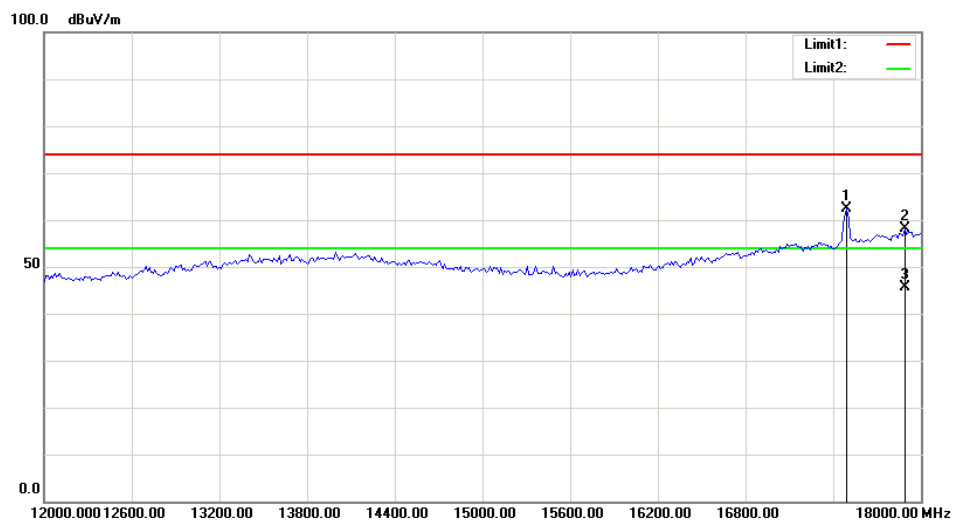
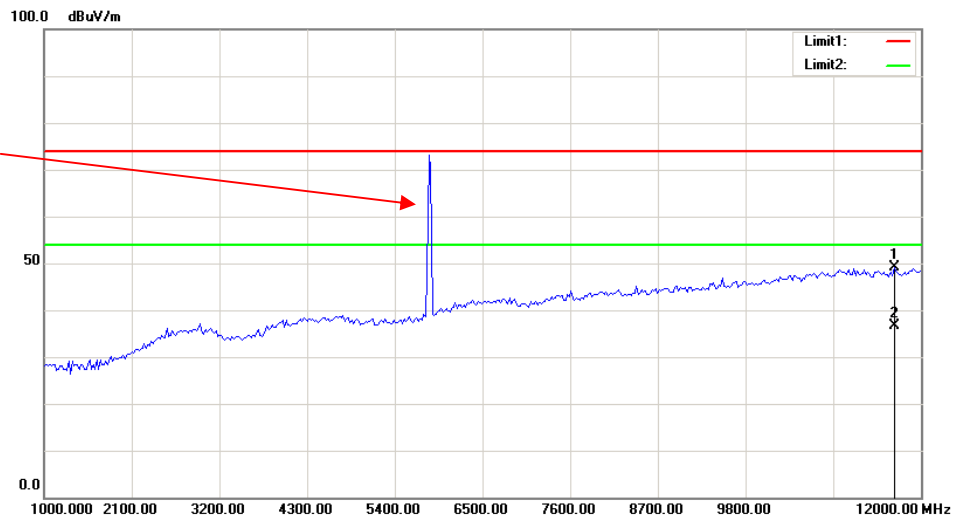
Fundamental
Test with Band
Rejection Filter

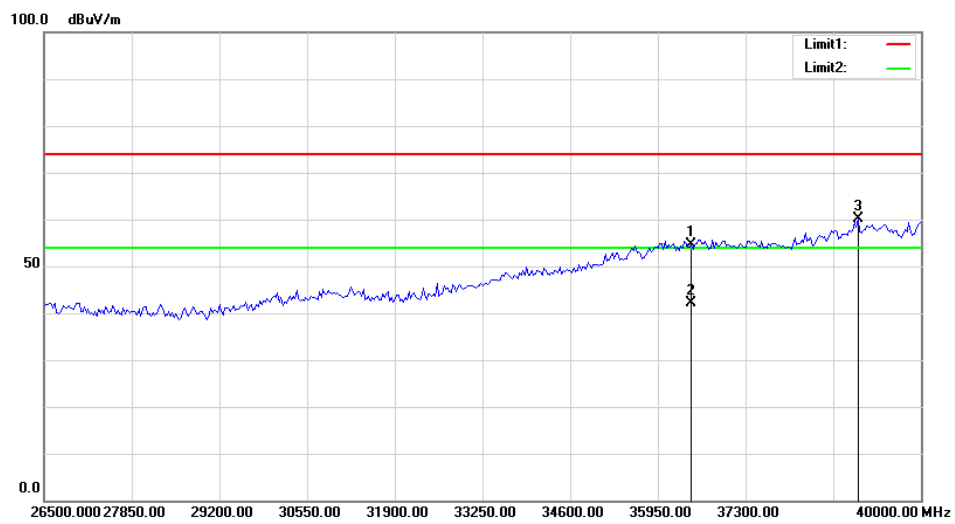
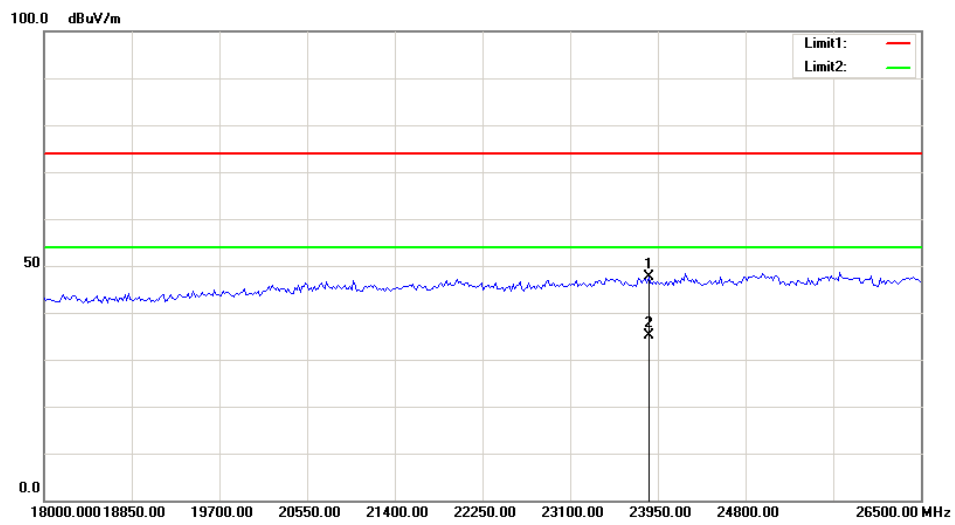




Vertical

Fundamental
Test with Band
Rejection Filter





FCC §15.407(b)–OUT- OF-BAND EMISSIONS

Applicable Standard

FCC §15.407

(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
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:	25.2°C
Relative Humidity:	42 %
ATM Pressure:	102.1 kPa

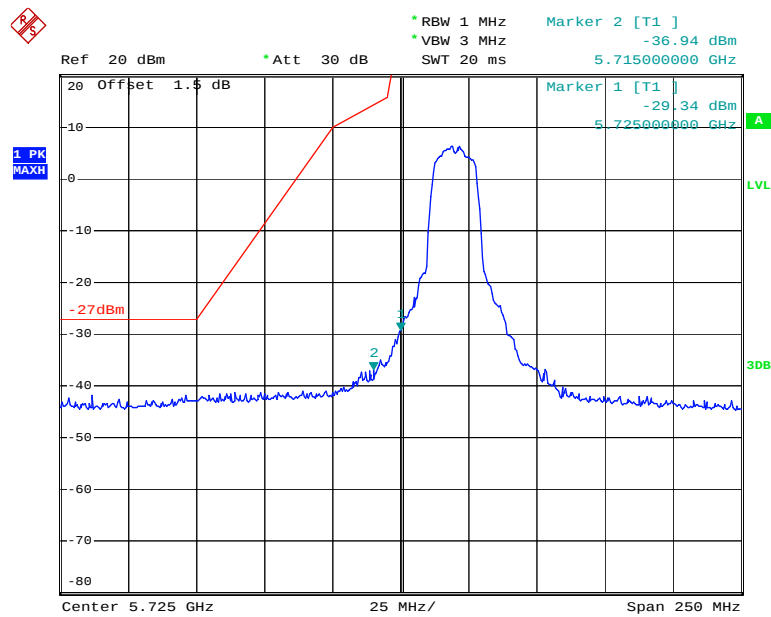
The testing was performed by Blake Yang on 2019-01-20.

Test Result: Pass.

Please refer to the following plots.

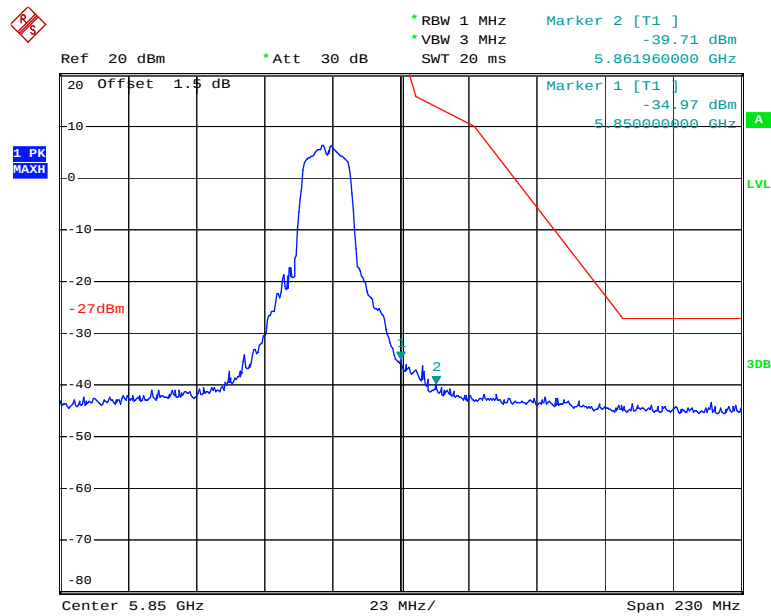
Note: the antenna gain was 1.0dBi, cable loss 0.5dB, offset 1.5dB, all the emissions under limit, compliance the requirements

802.11a Low Channel



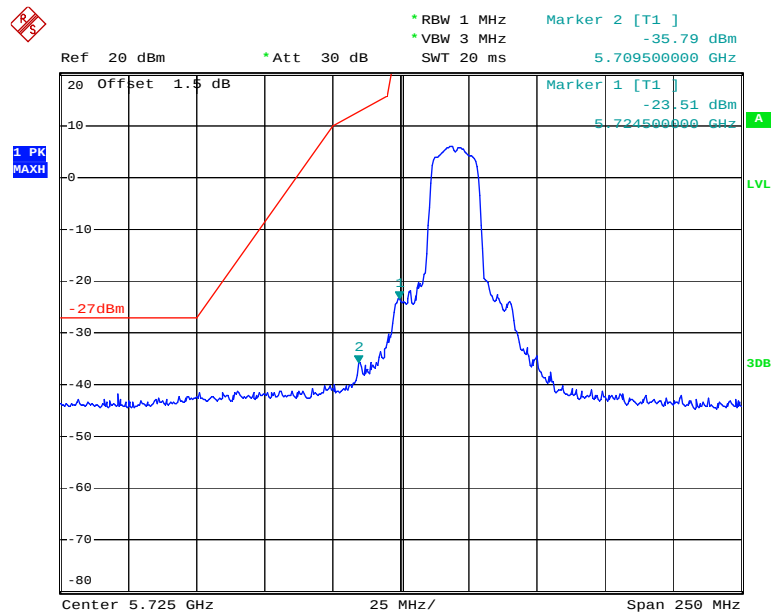
Date: 20.JAN.2019 10:39:15

802.11a High Channel



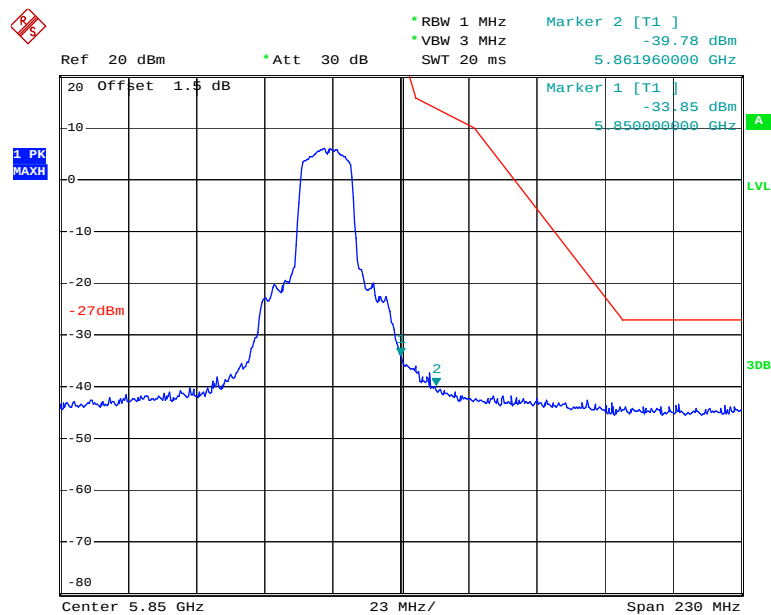
Date: 20.JAN.2019 10:41:42

802.11n ht20 Low Channel



Date: 20.JAN.2019 10:25:35

802.11n ht20 High Channel



Date: 20.JAN.2019 10:28:25

FCC §15.407(a)(e) –EMISSION BANDWIDTH AND OCCUPIED BANDWIDTH**Applicable Standard**

15.407(a) (e)

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
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 Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Data**Environmental Conditions**

Temperature:	25.2°C
Relative Humidity:	42 %
ATM Pressure:	102.1 kPa

The testing was performed by Blake Yang on 2019-01-20.

Test Result: Pass.

Please refer to the following tables and plots.

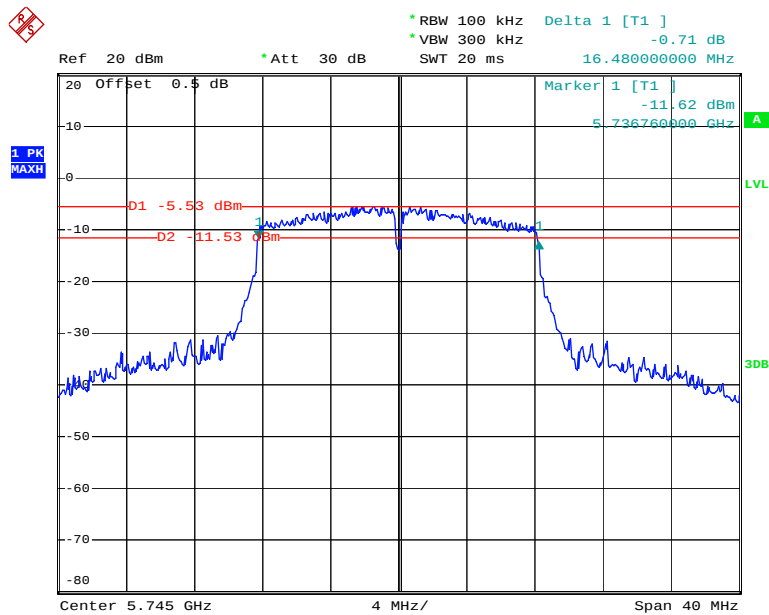
Test mode: Transmitting

Mode	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	6 dB Emission Bandwidth Limits (MHz)	99% Occupied Bandwidth (MHz)
802.11 a	5745	16.480	≥ 0.5	17.040
	5785	16.480	≥ 0.5	17.200
	5825	16.480	≥ 0.5	17.040
802.11n ht20	5745	17.680	≥ 0.5	17.840
	5785	17.680	≥ 0.5	17.840
	5825	17.680	≥ 0.5	17.920

Note: the 99% Occupied Bandwidth have not fall into the band 5150-5250MHz or 5470-5725MHz, please refer to the test plots of 99% Occupied Bandwidth.

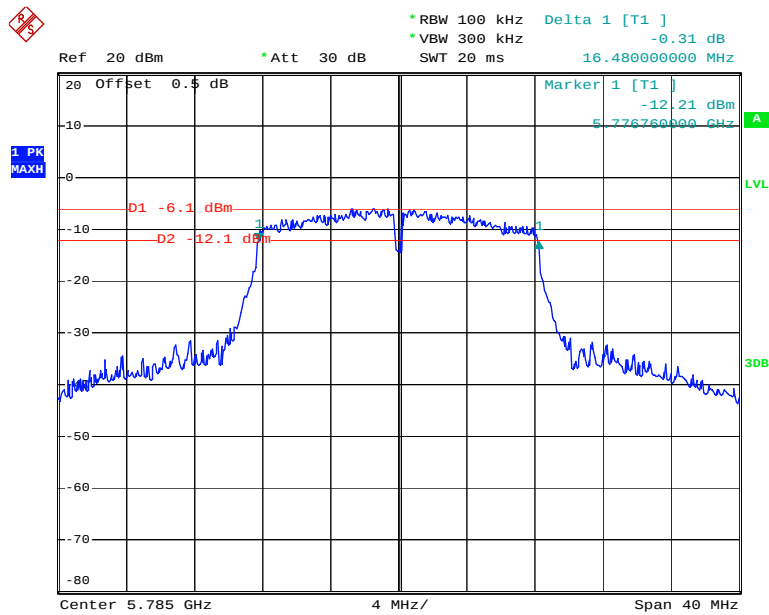
6dB Emission Bandwidth:

802.11a Low Channel



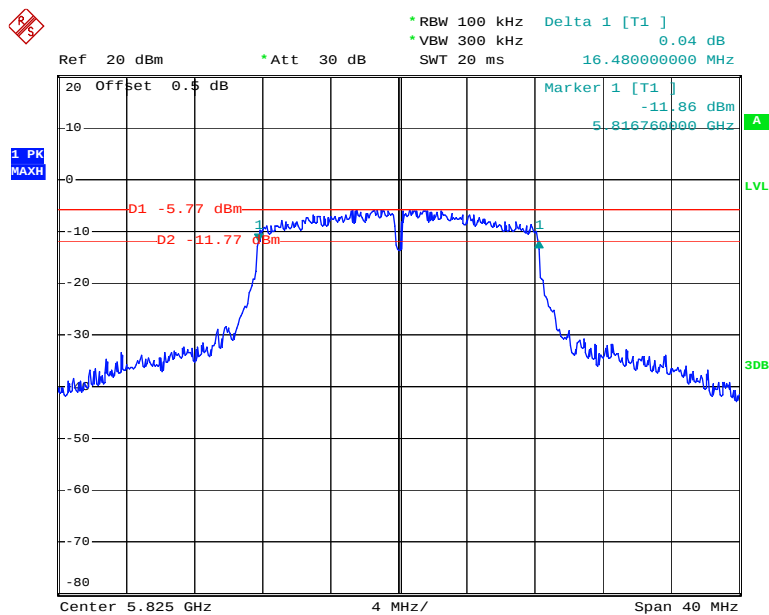
Date: 20.JAN.2019 10:38:17

802.11a Middle Channel



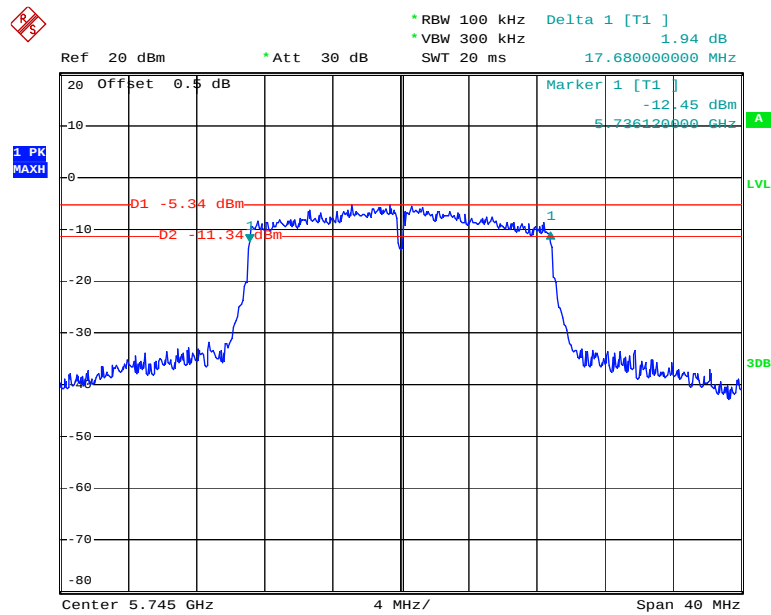
Date: 20.JAN.2019 10:36:31

802.11a High Channel



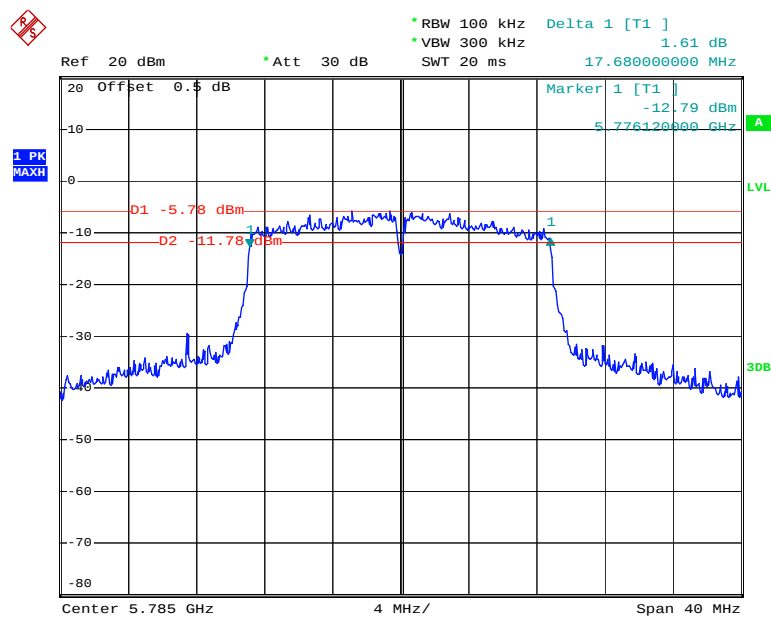
Date: 20.JAN.2019 10:40:44

802.11n ht20 Low Channel



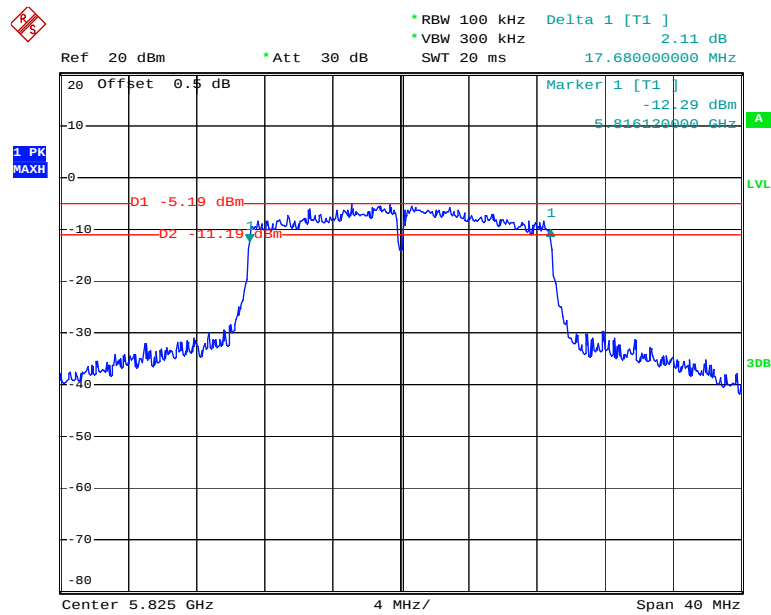
Date: 20.JAN.2019 10:24:36

802.11n ht20 Middle Channel



Date: 20.JAN.2019 10:29:46

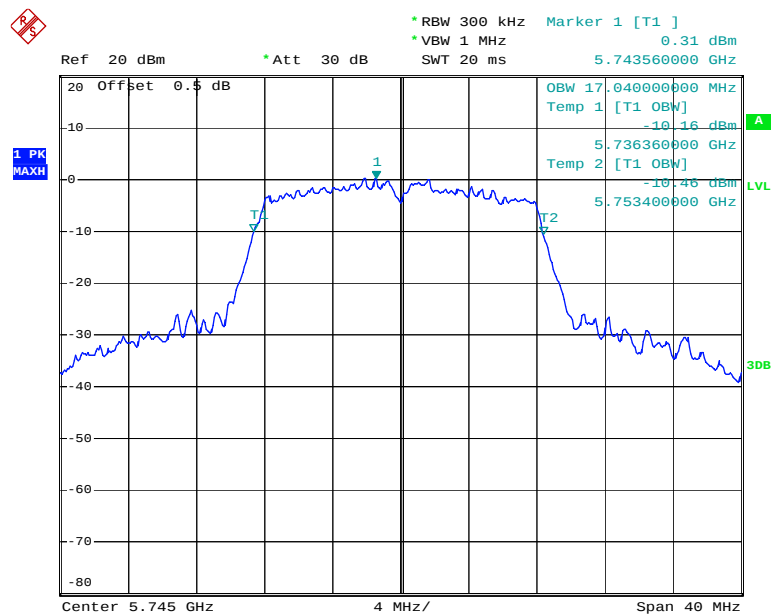
802.11n ht20 High Channel



Date: 20.JAN.2019 10:27:26

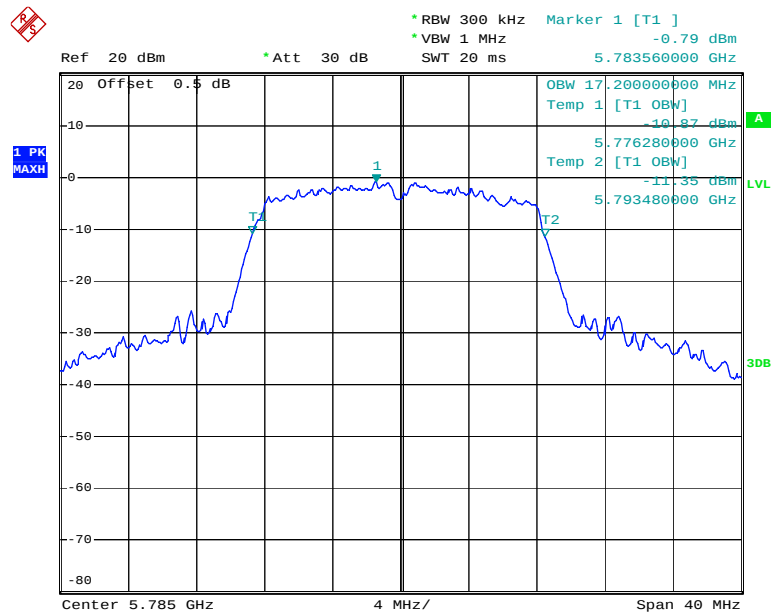
99% Occupied Bandwidth:

802.11a Low Channel



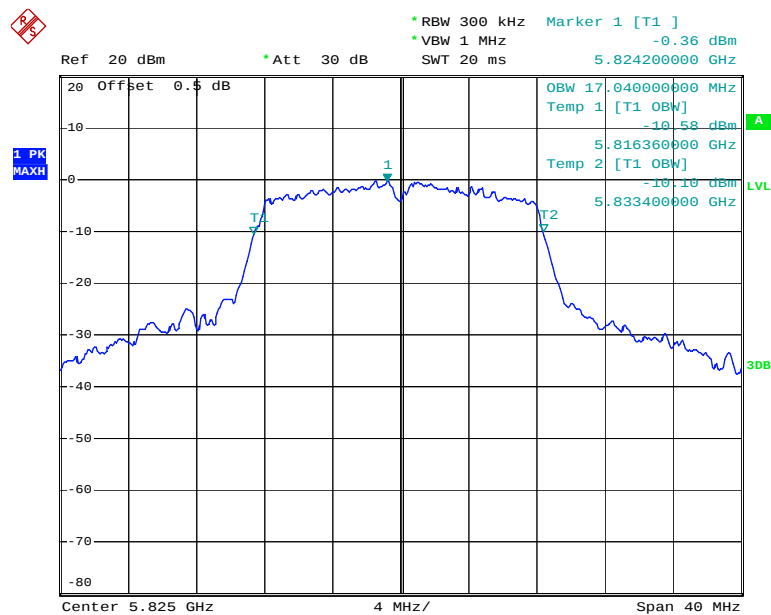
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802.11a Middle Channel



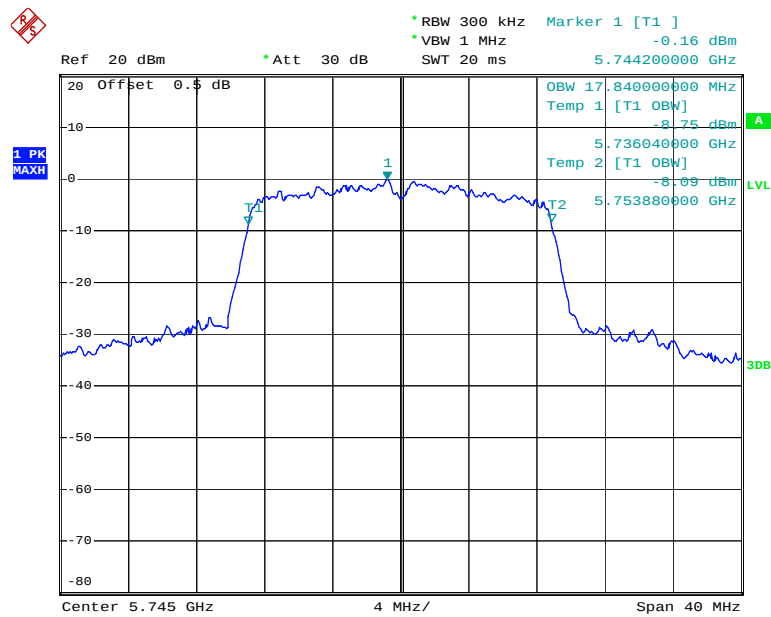
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802.11a High Channel



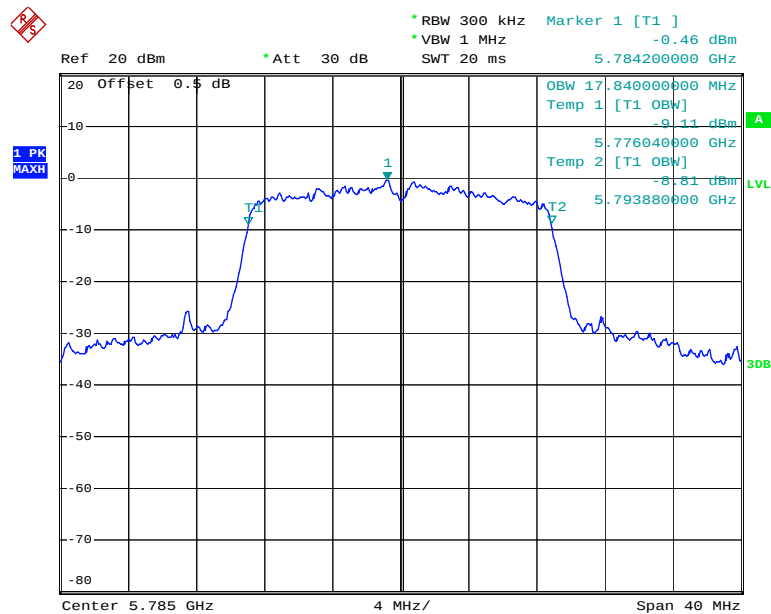
Date: 20.JAN.2019 10:40:56

802.11n ht20 Low Channel



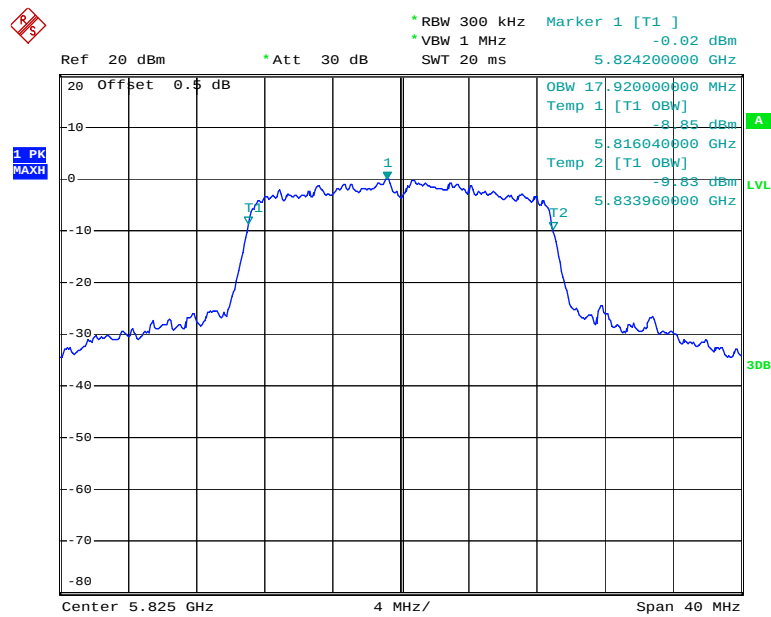
Date: 20.JAN.2019 10:24:52

802.11n ht20 Middle Channel



Date: 20.JAN.2019 10:30:02

802.11n ht20 High Channel



Date: 20.JAN.2019 10:27:42

FCC §15.407(a) –MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm $10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2021XA	MY5425009	2018-03-21	2019-03-21
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 Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Data

Environmental Conditions

Temperature:	25.2°C
Relative Humidity:	42 %
ATM Pressure:	102.1 kPa

The testing was performed by Blake Yang on 2019-01-20.

Test Mode: Transmitting

Mode	Frequency (MHz)	Conducted Average Output Power (dBm)	Limit (dBm)	Result
802.11 a	5745	9.79	30	PASS
	5785	9.45	30	PASS
	5825	9.72	30	PASS
802.11n ht20	5745	9.76	30	PASS
	5785	9.67	30	PASS
	5825	9.73	30	PASS

FCC §15.407(a) - POWER SPECTRAL DENSITY

Applicable Standard

(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm $10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output

power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2018-12-10	2019-12-10
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:	25.2°C
Relative Humidity:	42 %
ATM Pressure:	102.1 kPa

The testing was performed by Blake Yang on 2019-01-20.

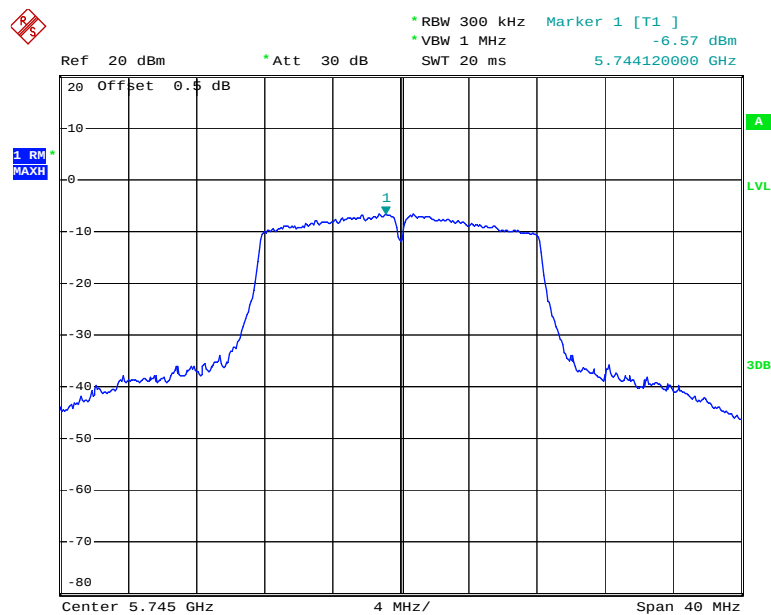
Test Mode: Transmitting

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

Mode	Frequency (MHz)	Reading (dBm/300kHz)	Conducted Power Spectral Density (dBm/500kHz)	Limit (dBm/500kHz)
802.11a	5745	-6.57	-4.35	30
	5785	-7.02	-4.80	30
	5825	-6.83	-4.61	30
802.11n ht20	5745	-6.37	-4.15	30
	5785	-6.96	-4.74	30
	5825	-6.59	-4.37	30

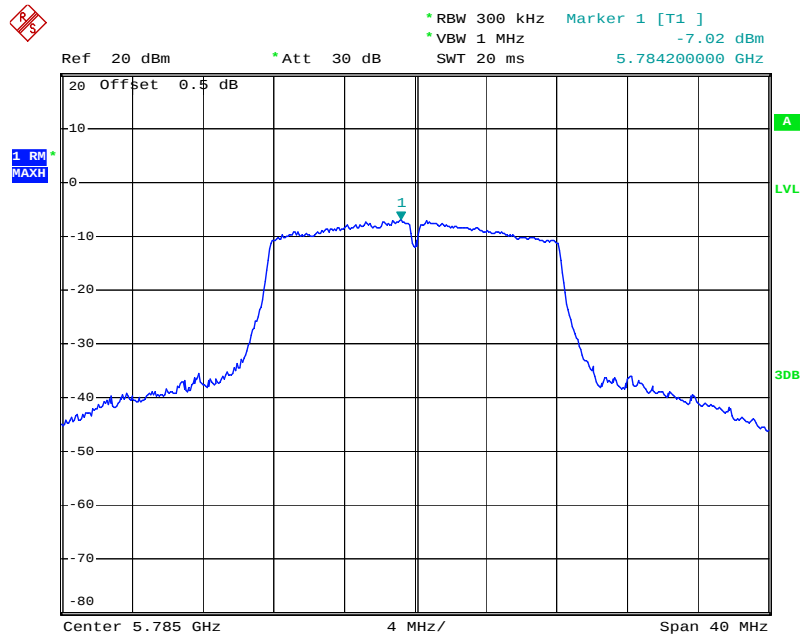
Note: For 5.8GHz band, If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/\text{RBW})$ to the measured result, whereas RBW ($< 500 \text{ kHz}$) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

802.11a Low Channel



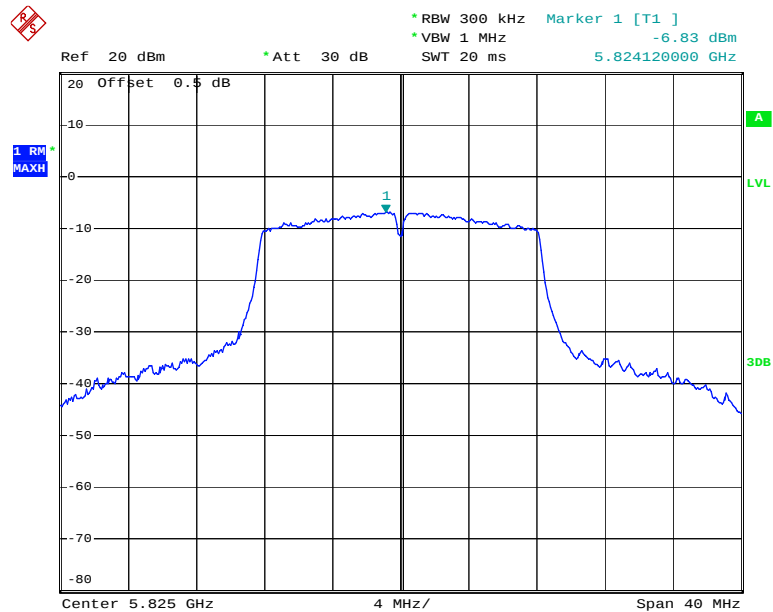
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802.11a Middle Channel



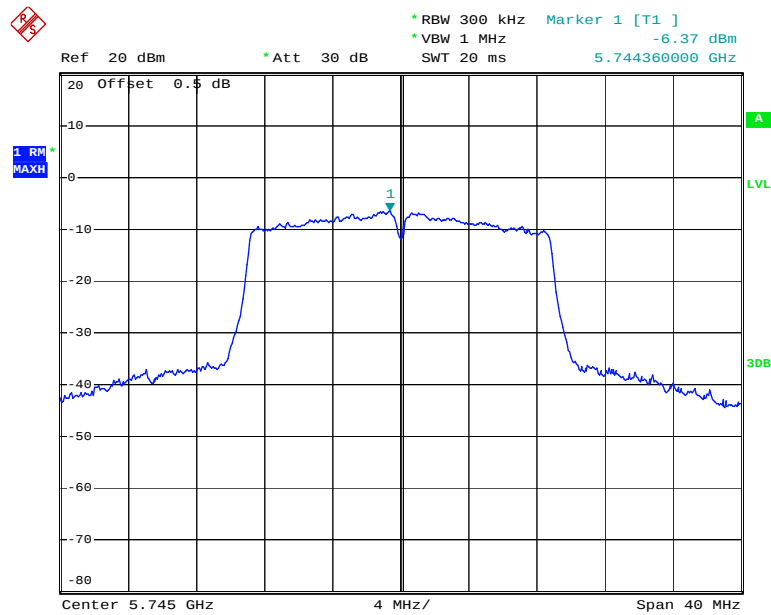
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802.11a High Channel



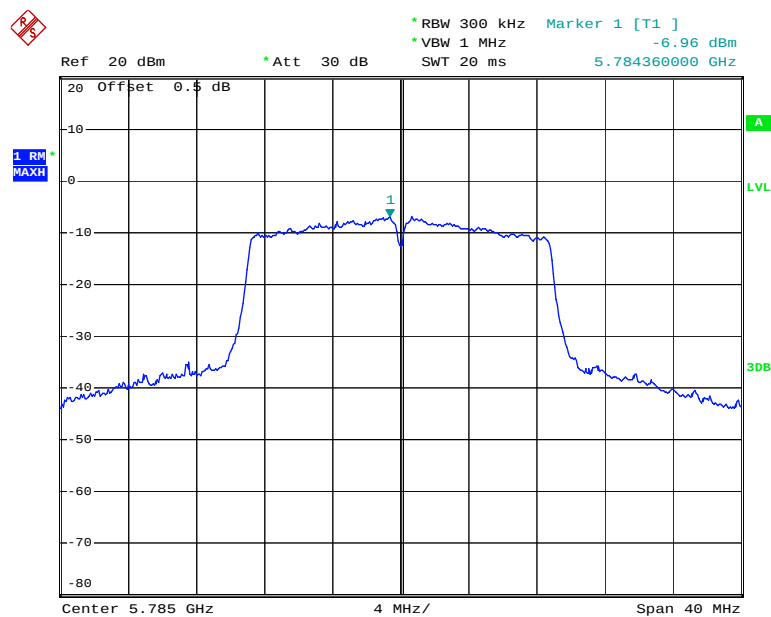
Date: 20.JAN.2019 10:41:09

802.11n ht20 Low Channel



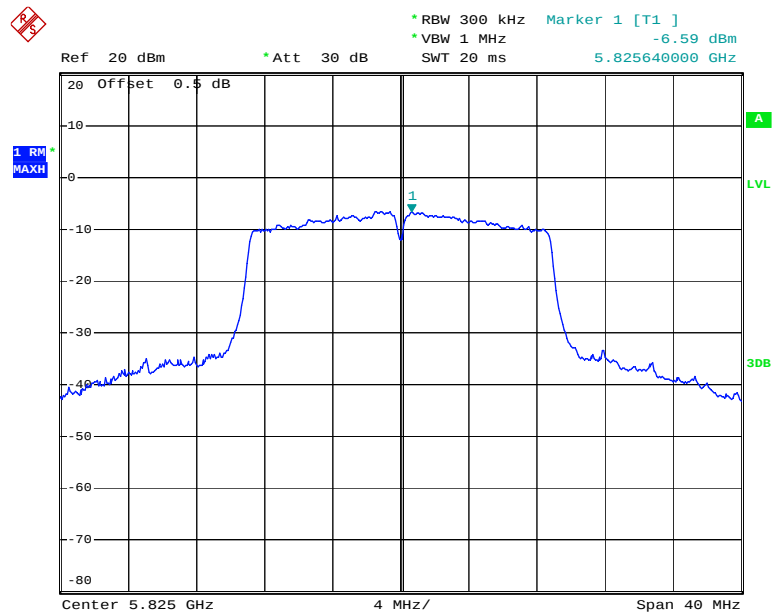
Date: 20.JAN.2019 10:25:05

802.11n ht20 Middle Channel



Date: 20.JAN.2019 10:30:17

802.11n ht20 High Channel



Date: 20.JAN.2019 10:27:55

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