



# FCC Part 15.247

## TEST REPORT

For

### AAEON Technology. Inc.

5F, No. 135, Lane 235, Pao Chiao Rd., Taipei City, Taiwan

FCC ID: OHBRICORK88WB

<b>Report Type:</b> Original Report	<b>Product Type:</b> Embedded Controller
<b>Report Producer:</b> <u>Jane Lee</u>	<i>Jane Lee</i>
<b>Report Number:</b> <u>RTWL171229001-00A</u>	
<b>Report Date:</b> <u>2018-02-12</u>	
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Taiwan)

### REVISION HISTORY

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RTWL171229001	RTWL171229001-00A	2018.02.12	Original Report	Jane

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# 1 General Information

## 1.1 Product Description for Equipment under Test (EUT)

<b>Applicant</b>	AAEON Technology, Inc. 5F, No. 135, Lane 235, Pao Chiao Rd., Taipei City, Taiwan
<b>Manufacturer</b>	AAEON Technology, Inc. 5F, No. 135, Lane 235, Pao Chiao Rd., Taipei City, Taiwan
<b>Brand(Trade) Name</b>	AAEON
<b>Product (Equipment)</b>	Embedded Controller
<b>Model Name</b>	BOXER-RK88-0001
<b>Series Model</b>	xxBOXER-RK88xxxxxx
<b>EUT Function</b>	IEEE 802.11 bgn + BT4.1
<b>Frequency Range</b>	IEEE 802.11 b/g/n HT20 mode: 2412 ~ 2462 MHz BLE mode : 2402 ~ 2480 MHz
<b>Number of Channels</b>	IEEE 802.11 b/g/n HT20 mode: 11 Channels BLE mode : 40 Channels
<b>Output Power</b>	IEEE 802.11b mode: 16.34 dBm (0.043 W) IEEE 802.11g mode: 20.59 dBm (0.115W) IEEE 802.11n HT20 mode: 20.69 (0.117 W) BLE mode : 5.64 dBm (0.004 W)
<b>Received Date</b>	Dec 25, 2017.
<b>Date of Test</b>	Dec 27, 2017 ~ Feb 12, 2018
<b>Related Submittal(s)/Grant(s)</b>	DSS FCC Part 15.247, FCC ID : OHBRICORK88WB
<b>Modulation Type</b>	IEEE 802.11b mode: CCK IEEE 802.11g/n HT 20 mode: OFDM BLE mode : GFSK 1Mbps
<b>Software(Firmware) Version</b>	3.10.0

*\*All measurement and test data in this report was gathered from production sample serial number: 171229001*

*(Assigned by BACL, Taiwan).*

*\*Model Discrepancy:*

*The major electrical and mechanical constructions of series models are identical to the basic model, except different Market segmentation. The model, BOXER-RK88-0001 is the testing sample, and the final test data are shown on this test report.*

Series Model :xxBOXER-3288xxxxxx
<i>(x - Where x may be any combination of alphanumeric characters or "-" or blank.)</i>

**1.2 Operation Condition of EUT**

<b>Power Operation (Voltage Range)</b>	<input type="checkbox"/> AC 120V/60Hz <input type="checkbox"/> Adapter <input type="checkbox"/> By Power Cord <input type="checkbox"/> PoE
	<input checked="" type="checkbox"/> DC Type <input checked="" type="checkbox"/> DC :12V <input type="checkbox"/> DC Power Supply <input type="checkbox"/> Battery <input type="checkbox"/> External from USB Cable <input type="checkbox"/> External DC Adapter
	<input type="checkbox"/> Host System

**1.3 Objective**

This report is prepared on behalf of *AAEON Technology, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission’s rules.

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

**1.4 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

KDB 558074 D01 DTS Meas Guidance v04

**1.5 Test Facility**

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on  
 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.  
 68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10-2013.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 974454. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## 2 System Test Configuration

### 2.1 Description of Test Configuration

The system was configured for testing in engineering mode which was selected by manufacturer.

For Wi-Fi 2.4G mode, there are totally 11 channels.

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

For 802.11b/g/n HT20 modes: Channel 1, 6 and 11 were tested.

For BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	21	2442
1	2404	--	--
2	2406	--	--
3	2408	37	2476
--	--	38	2478
19	2440	39	2480

For BLE mode: Channel 0, 19 and 39 were tested.

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

Radiated below 1G were tested worst output power mode.

### 2.2 Equipment Modifications

No modification was made to the EUT

### 2.3 Description of Worst Test Configuration

Modulation Used for Conformance Test			
Configuration	N <sub>TX</sub>	Data Rate	Worst Data Rate
802.11b mode	1	1-11 Mbps	1 Mbps
802.11g mode	1	6-54 Mbps	6 Mbps
802.11n HT 20 mode	1	MCS 0-7	MCS 0
BLE mode	1	125 kbps to 1 Mbps	1 Mbps

Worst Case of Power Setting				
EUT Exercise Software		Ampak RFTestTool VER: 5.5 7		
Configuration	N <sub>TX</sub>	Low CH	Mid CH	High CH
802.11b mode	1	Default	Default	Default
802.11g mode	1	Default	Default	Default
802.11n HT 20 mode	1	Default	Default	Default
BLE mode	1	Default	Default	Default

### 2.4 Support Equipment List and Details

Description	Manufacturer	Model	BSMI	FCC ID / DoC
Notebook	Dell	P62G	N/A	PD98260NGU
Adapter	FSP GROUP INC.	FSP060-DIBAN2	R43001	DoC
USB Keyboard	DELL	SK-8120	R3A002	DoC
Mouse	DELL	MS111-P	R41108	DoC
Monitor	AOC	U2868PQU	R33037	DoC
Modem	DigiFusion	AL-56ERM	N/A	DoC
Mouse	DELL	MS111-P	R41108	DoC
HDD	WD	My Passport Ultra	D33015	DoC
NB	ASUS	P2538U	R31018	DoC

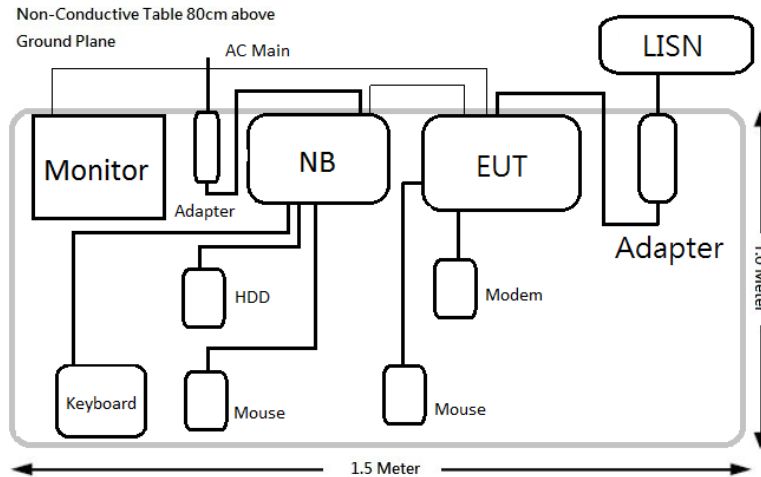


## 2.5 External Cable List and Details

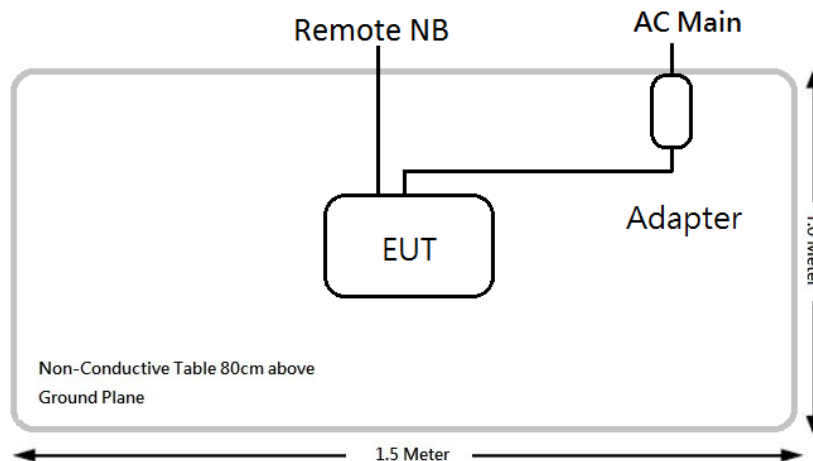
Description	Shielded Type	Ferrite Core	Length
USB Cable	Non-Shielded	N/A	1.8M
USB Cable	Non-Shielded	N/A	1.8M
HDMI Cable	Shielded	N/A	1.8M
RS-232 Cable	Shielded	N/A	1.6M
OTG Cable	Shielded	N/A	1.0M
USB Cable	Non-Shielded	N/A	1.8M
USB Cable	Shielded	N/A	1.0M
LAN Cable	Non-Shielded	N/A	10M
DC Cable	Non-Shielded	N/A	1.6M

## 2.6 Block Diagram of Test Setup

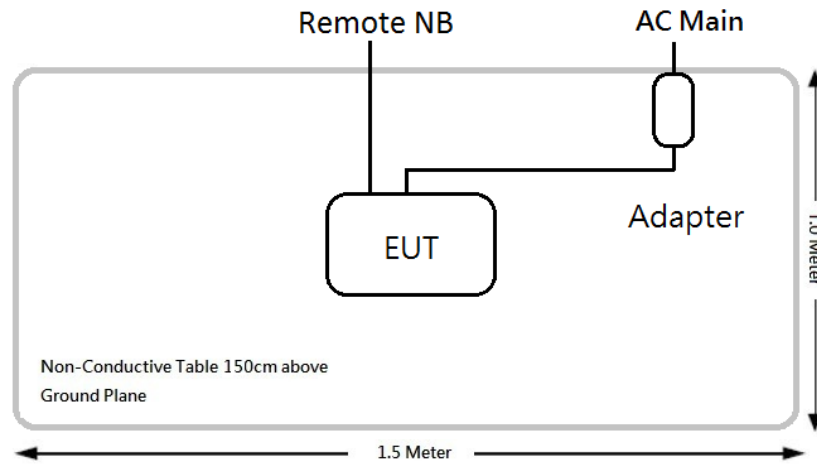
### Conduction



### Radiation below 1G



**Radiation above 1G**



**2.7 Duty Cycle**

According to KDB 558074 D01 DTS Meas Guidance v04 section 6.0:

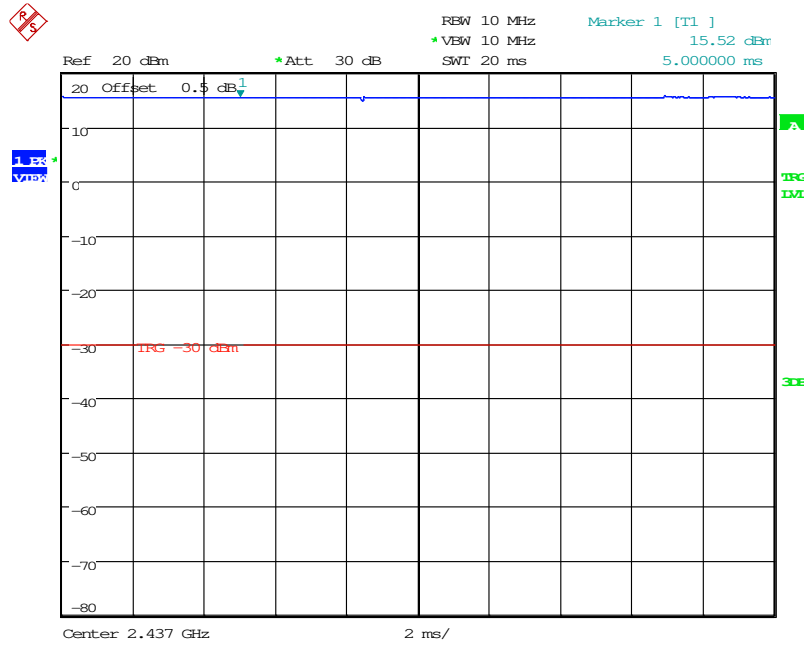
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum power transmission duration, T, are required for each tested mode of operation.

Configuration	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Factor (dB)
<b>802.11b mode</b>	20.00	20.00	100.00	0.00
<b>802.11g mode</b>	1.44	1.44	100.00	0.00
<b>802.11n HT 20 mode</b>	1.34	1.36	98.53	0.06
<b>BLE mode</b>	0.41	0.62	66.13	1.80

Note: Duty Factor = 10\*log (1/Duty cycle)

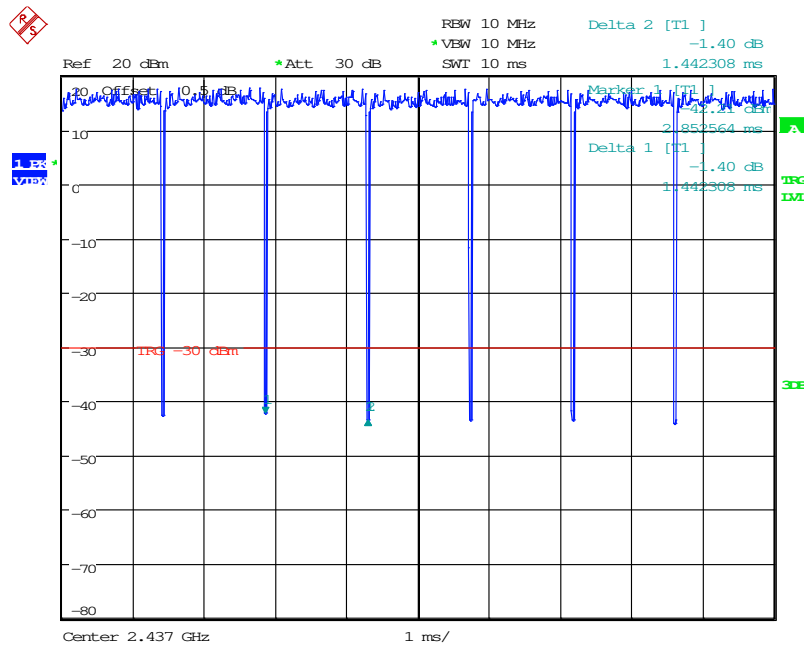
Please refer to the following plots.

### B mode



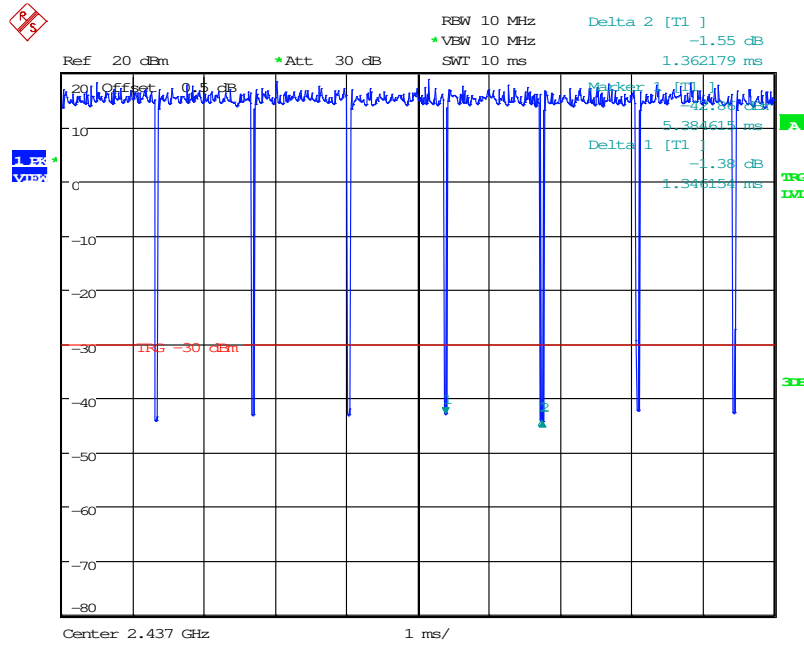
Date: 29.DEC.2017 13:12:00

### G mode



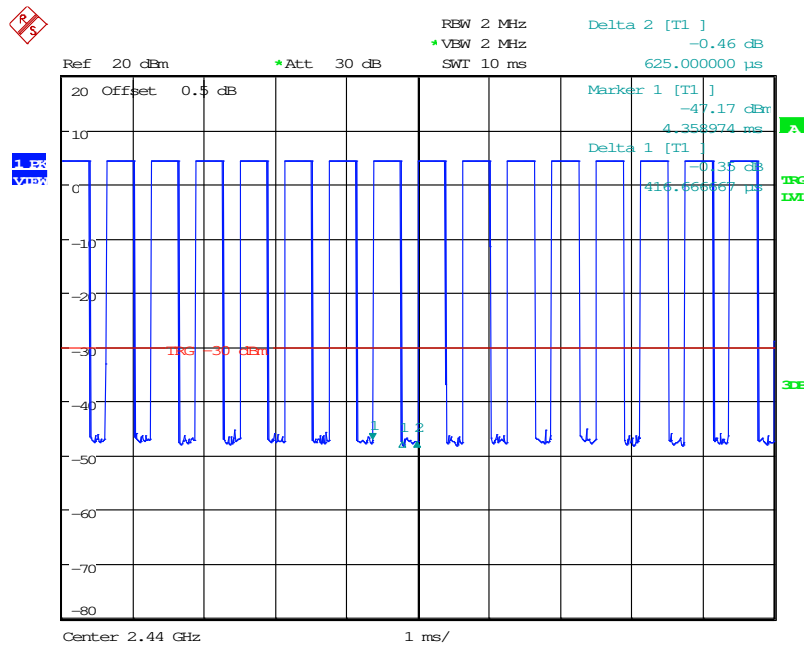
Date: 29.DEC.2017 13:58:09

### N 20 mode



Date: 29.DEC.2017 14:58:31

### BLE mode



Date: 29.DEC.2017 15:47:39

### 3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §1.1310 ,§ 2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

## 4 FCC § 15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE)

### 4.1 Applicable Standard

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

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

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

According to §1.1310 and §2.1091 RF exposure is calculated.

### Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$  = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

### 4.2 RF Exposure Evaluation Result

#### MPE evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412-2462	2.09	1.618	21.0	125.893	20	0.0405	1
BLE	2402-2480	2.09	1.618	6.0	3.981	20	0.0013	1
BT	2402-2480	2.09	1.618	-6.00	0.251	20	0.0001	1

BLE, BT and Wi-Fi will not be launched at the same time, so there will be no co-located.

**Result:** MPE evaluation meet 20 cm the requirement of standard.

## 5 FCC §15.203 – Antenna Requirements

### 5.1 Applicable Standard

According to § 15.203,

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

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6 dBi

### 5.2 Antenna List and Details

Manufacturer	Antenna Type	Antenna Gain	Result
ARISTOTLE ENTERPRISES INC.	Dipole Antenna (Reversed SMA)	2.5 dBi	Compliance

The EUT has an external detachable antenna arrangement, fulfill the requirement of this section.

## 6 FCC §15.207 - AC Line Conducted Emissions

### 6.1 Applicable Standard

FCC §15.207

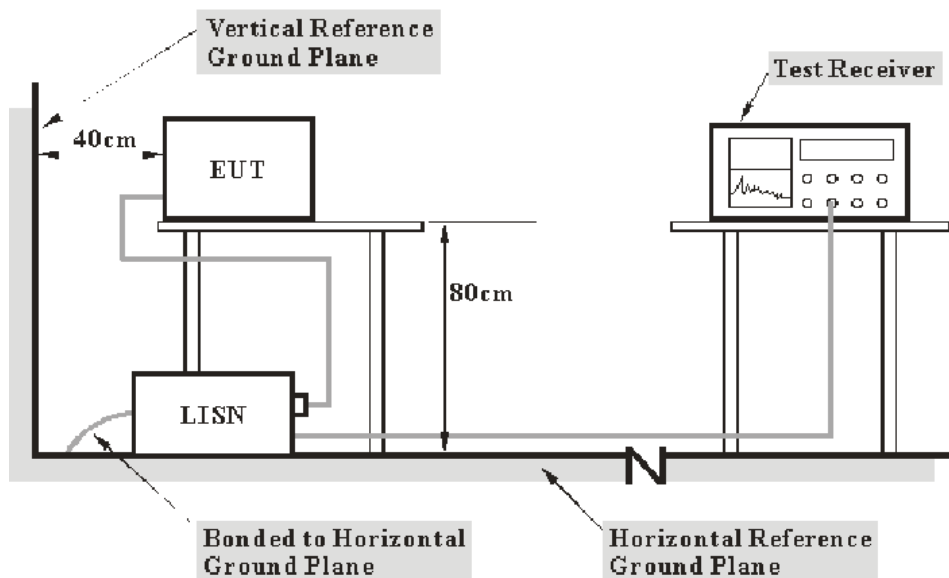
### 6.2 Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN/ISN and receiver, LISN/ISN voltage division factor, LISN/ISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Taiwan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report

Port	Expanded Measurement uncertainty
AC Mains	4.64 dB (k=2, 95% level of confidence)

### 6.3 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.



#### 6.4 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	Receiver RBW
150 kHz - 30 MHz	9 kHz

#### 6.5 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN. Maximizing procedure was performed on the six (6) highest emissions of the EUT. All data was recorded in the Quasi-peak and average detection mode.

#### 6.6 Corrected Factor & Margin Calculation

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

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

$$\text{Over Limit} = \text{Level} - \text{Limit Line}$$

#### 6.7 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
LISN	Rohde & Schwarz	ENV216	101248	2017/07/20	2018/07/19
LISN	EMCO	3816/2	00075848	2017/08/02	2018/08/01
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM025	2017/08/11	2018/08/10
RF Cable	EMEC	EM-CB5D	001	2017/07/24	2018/07/23
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R

\* **Statement of Traceability:** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

## 6.8 Test Environmental Conditions

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	58 %
<b>ATM Pressure:</b>	1010 hPa

*The testing was performed by Ian Tu on 2018-01-22.*

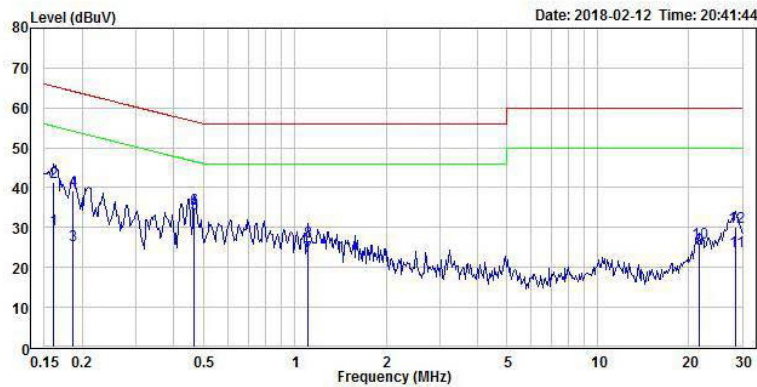
## 6.9 Test Results

Please refer to the following plots and tables.

*Test mode: Transmitting mode*

**Wi-Fi Mode:**

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

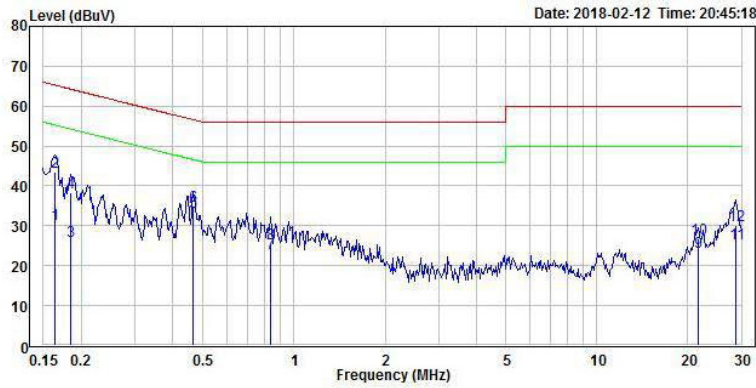


Condition: limit\FCC\FCC Part15B CLASS-B QP.csv Line

EUT :  
 Model : RICO-3288  
 Note : 120V/60Hz  
 : WiFi Test Mode

	Freq	Level	Limit	Over	Read	Remark	Pol/Phase
	MHz	dBuV	Line	Limit	Factor	Level	
	MHz	dBuV	dBuV	dB	dB	dBuV	
1	0.161	29.38	55.40	-26.02	19.50	9.88	Average Line
2	0.161	41.31	65.40	-24.09	19.50	21.81	QP Line
3	0.186	25.55	54.21	-28.66	19.50	6.05	Average Line
4	0.186	39.39	64.21	-24.82	19.50	19.89	QP Line
5	0.465	33.44	46.60	-13.16	19.51	13.93	Average Line
6	0.465	34.61	56.60	-21.99	19.51	15.10	QP Line
7	1.099	22.92	46.00	-23.08	19.53	3.39	Average Line
8	1.099	26.40	56.00	-29.60	19.53	6.87	QP Line
9	21.640	24.49	50.00	-25.51	19.85	4.64	Average Line
10	21.640	26.24	60.00	-33.76	19.85	6.39	QP Line
11	28.600	23.95	50.00	-26.05	19.89	4.06	Average Line
12	28.600	30.13	60.00	-29.87	19.89	10.24	QP Line

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

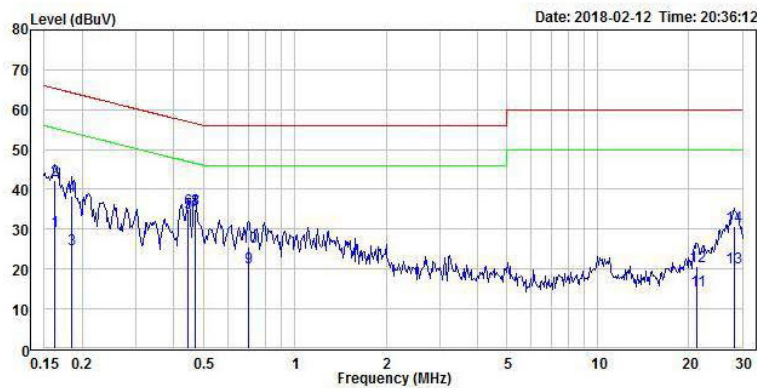


Condition: limit\FCC\FCC Part15B CLASS-B QP.csv Neutral  
 EUT :  
 Model : RICO-3288  
 Note : 120V/60Hz  
 : WiFi Test Mode

	Freq	Level	Limit	Over	Read		
	MHz	dBuV	Line	Limit	Factor	Level	Remark
			dBuV	dB	dB	dBuV	Pol/Phase
1	0.164	30.44	55.27	-24.83	19.63	10.81	Average Neutral
2	0.164	43.48	65.27	-21.79	19.63	23.85	QP Neutral
3	0.185	26.09	54.28	-28.19	19.63	6.46	Average Neutral
4	0.185	38.44	64.28	-25.84	19.63	18.81	QP Neutral
5	0.465	33.61	46.60	-12.99	19.64	13.97	Average Neutral
6	0.465	34.88	56.60	-21.72	19.64	15.24	QP Neutral
7	0.838	23.19	46.00	-22.81	19.66	3.53	Average Neutral
8	0.838	25.69	56.00	-30.31	19.66	6.03	QP Neutral
9	21.640	23.52	50.00	-26.48	20.06	3.46	Average Neutral
10	21.640	26.88	60.00	-33.12	20.06	6.82	QP Neutral
11	28.828	25.55	50.00	-24.45	20.14	5.41	Average Neutral
12	28.828	30.06	60.00	-29.94	20.14	9.92	QP Neutral

**BLE Mode:**

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

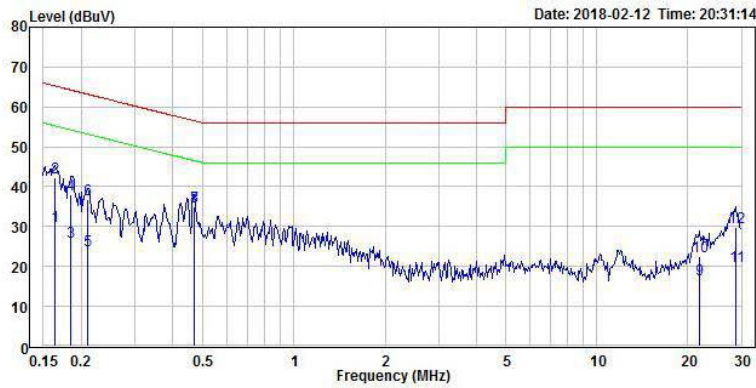


Condition: limit\FCC\FCC Part15B CLASS-B QP.csv Line

EUT :  
 Model : RICO-3288  
 Note : 120V/60Hz  
 : BLE Test Mode

	Freq	Level	Limit	Over	Read	Remark	Pol/Phase
	MHz	dBuV	Line	Limit	Factor	Level	
			dBuV	dB	dB	dBuV	
1	0.162	29.45	55.34	-25.89	19.50	9.95	Average Line
2	0.162	42.20	65.34	-23.14	19.50	22.70	QP Line
3	0.185	24.94	54.28	-29.34	19.50	5.44	Average Line
4	0.185	38.27	64.28	-26.01	19.50	18.77	QP Line
5	0.443	34.16	47.00	-12.84	19.51	14.65	Average Line
6	0.443	34.90	57.00	-22.10	19.51	15.39	QP Line
7	0.469	34.69	46.54	-11.85	19.51	15.18	Average Line
8	0.469	34.85	56.54	-21.69	19.51	15.34	QP Line
9	0.704	20.51	46.00	-25.49	19.52	0.99	Average Line
10	0.704	25.58	56.00	-30.42	19.52	6.06	QP Line
11	21.298	14.74	50.00	-35.26	19.85	-5.11	Average Line
12	21.298	20.84	60.00	-39.16	19.85	0.99	QP Line
13	28.147	20.27	50.00	-29.73	19.89	0.38	Average Line
14	28.147	30.82	60.00	-29.18	19.89	10.93	QP Line

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



Condition: limit\FCC\FCC Part15B CLASS-B QP.csv Neutral  
 EUT :  
 Model : RICO-3288  
 Note : 120V/60Hz  
 : BLE Test Mode

	Freq	Level	Limit	Over	Read	Remark	Pol/Phase
	MHz	dBuV	Line	Limit	Factor	Level	
			dBuV	dB	dB	dBuV	
1	0.164	30.23	55.27	-25.04	19.63	10.60	Average Neutral
2	0.164	42.24	65.27	-23.03	19.63	22.61	QP Neutral
3	0.185	26.14	54.28	-28.14	19.63	6.51	Average Neutral
4	0.185	38.16	64.28	-26.12	19.63	18.53	QP Neutral
5	0.210	24.00	53.22	-29.22	19.63	4.37	Average Neutral
6	0.210	36.66	63.22	-26.56	19.63	17.03	QP Neutral
7	0.469	34.90	46.54	-11.64	19.64	15.26	Average Neutral
8	0.469	35.04	56.54	-21.50	19.64	15.40	QP Neutral
9	21.813	16.62	50.00	-33.38	20.07	-3.45	Average Neutral
10	21.813	22.41	60.00	-37.59	20.07	2.34	QP Neutral
11	28.828	20.08	50.00	-29.92	20.14	-0.06	Average Neutral
12	28.828	29.67	60.00	-30.33	20.14	9.53	QP Neutral

## 7 FCC §15.209, §15.205, §15.247(d) – Spurious Emissions

### 7.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per 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)).

### 7.2 Measurement Uncertainty

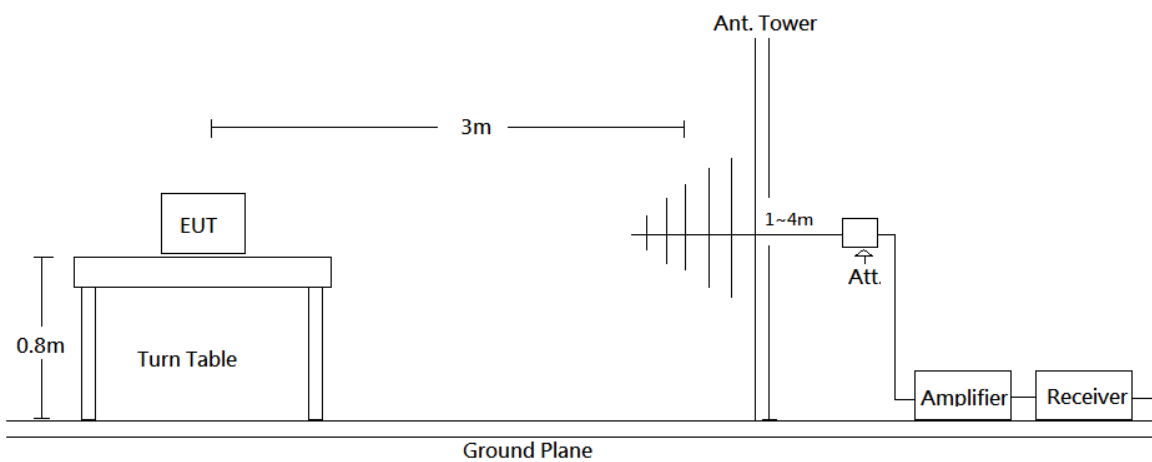
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

Frequency	Measurement uncertainty
30 MHz~200 MHz	3.76 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.12 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.84 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.16 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.84 dB (k=2, 95% level of confidence)
26 GHz~40 GHz	4.30 dB (k=2, 95% level of confidence)

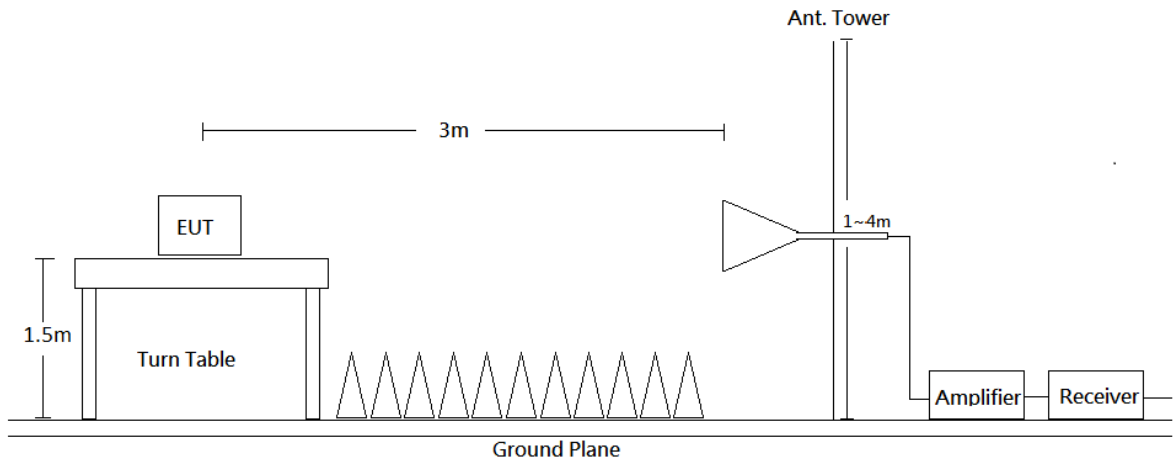
### 7.3 EUT Setup

Blow 1 GHz:





Above 1 GHz:



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

### 7.4 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Detector	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	QP		QP
Above 1 GHz	1 MHz	3 MHz	PK		PK
	1 MHz	3 MHz	RMS	>98%	Ave
	1 MHz	1/T	PK	<98%	Ave

### 7.5 Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

## 7.6 Corrected Factor & Margin Calculation

The Correct Factor 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:

$$\text{Correct Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Result} - \text{Limit}$$

## 7.7 Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.209 Limit. Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

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

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

## 7.8 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
966A Room					
Bilog Antenna	Sunol & Mini-Circuits	JB6/UNAT-6+	A050115/1554 2_01	2017/12/20	2018/12/19
Horn Antenna	EMCO	3115	9311-4158	2017/05/31	2018/05/30
Horn Antenna	ETS-Lindgren	3116	62638	2017/09/04	2018/09/03
Preamplifier	Sonoma	310N	130602	2017/07/03	2018/07/02
Preamplifier	EMEC	EM01G18G	60697	2017/04/14	2018/04/13
Preamplifier	EMEC	EM18G40G	060656	2018/01/15	2019/01/14
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Spectrum Analyzer	Rohde & Schwarz	FSV40	101203	2017/07/13	2018/07/12
Microflex Cable	UTIFLEX	UFB311A-Q-1440- 300300	220490-006	2017/10/31	2018/10/30
Microflex Cable	UTIFLEX	UFA210A-1-3149- 300300	MFR64639 226389-001	2017/11/10	2018/11/09
Microflex Cable	ROSNOL	K1K50-UP0264- K1K50-450CM	160309-1	2017/03/24	2018/03/23
Microflex Cable	ROSNOL	K1K50-UP0264- K1K50-80CM	160309-2	2018/01/29	2019/01/28
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	60772	N.C.R	N.C.R
Software	Farad	EZ_EMG	BACL-03A1	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323- 07	2017/02/22	2018/02/21

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

## 7.9 Test Environmental Conditions

<b>Temperature:</b>	25° C
<b>Relative Humidity:</b>	58 %
<b>ATM Pressure:</b>	1010 hPa

The testing was performed by Ian Tu from 2017-12-29 to 2018-01-05

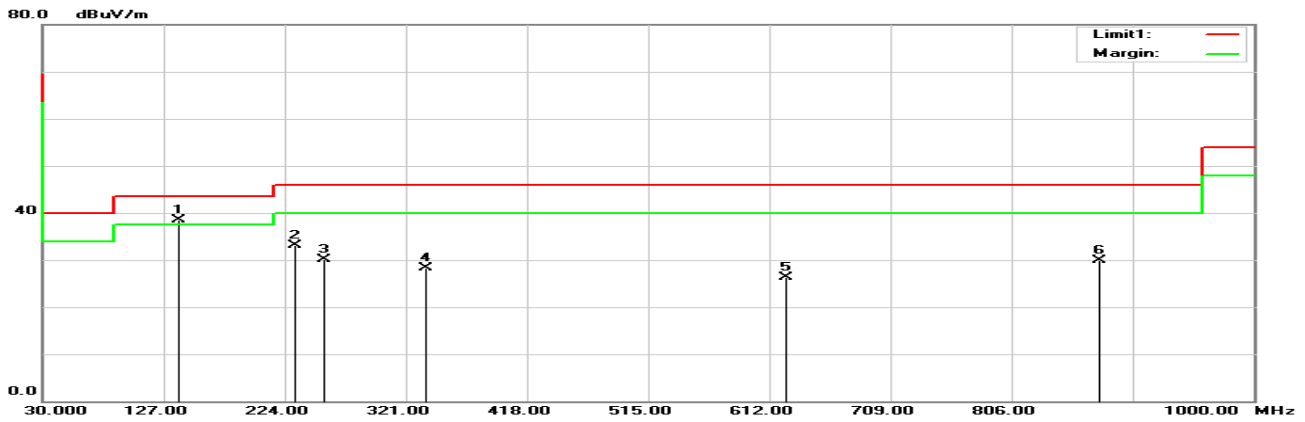
### 7.10 Test Results

**Wi-Fi Mode:** Transmitting Mode (Pre-scan with three orthogonal axis, and worse case as Z axis)

**Below 1G (30 MHz-1 GHz) test the output power worst mode:**

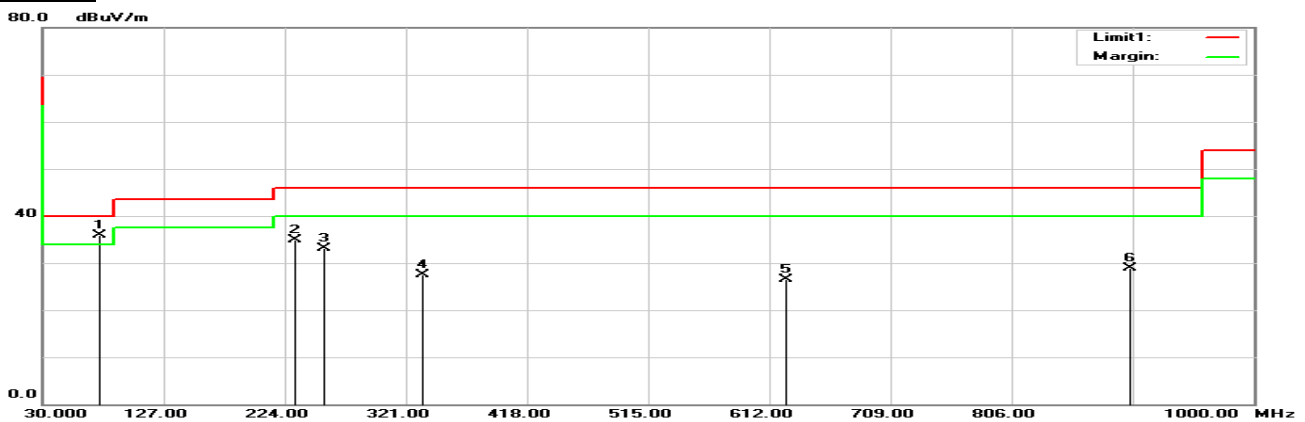
Wi-Fi mode: Worst case is 802.11n HT20 Low Channel

#### Horizontal



Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
139.6100	49.49	-10.99	38.50	43.50	-5.00	100	37	peak
232.7300	45.38	-12.27	33.11	46.00	-12.89	100	88	peak
255.0400	41.93	-11.74	30.19	46.00	-15.81	100	66	peak
336.5200	37.42	-9.11	28.31	46.00	-17.69	100	219	peak
625.5800	29.87	-3.66	26.21	46.00	-19.79	100	44	peak
875.8400	28.95	0.87	29.82	46.00	-16.18	100	241	peak

#### Vertical

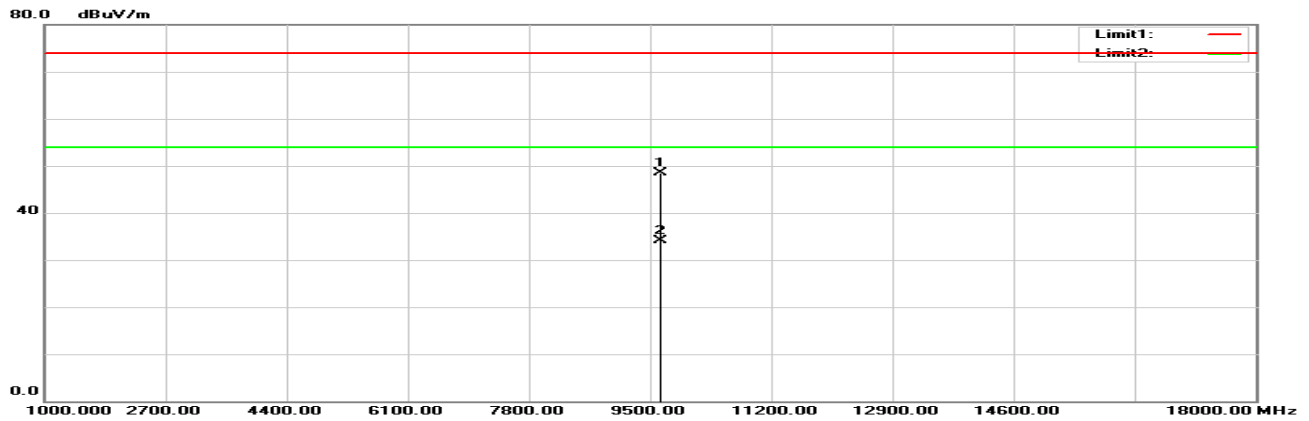


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
75.5900	52.67	-16.86	35.81	40.00	-4.19	100	309	peak
232.7300	47.16	-12.27	34.89	46.00	-11.11	100	357	peak
256.0100	44.74	-11.67	33.07	46.00	-12.93	100	150	peak
334.5800	36.61	-9.15	27.46	46.00	-18.54	100	27	peak
625.5800	30.15	-3.66	26.49	46.00	-19.51	100	101	peak
901.0600	27.47	1.35	28.82	46.00	-17.18	100	68	peak

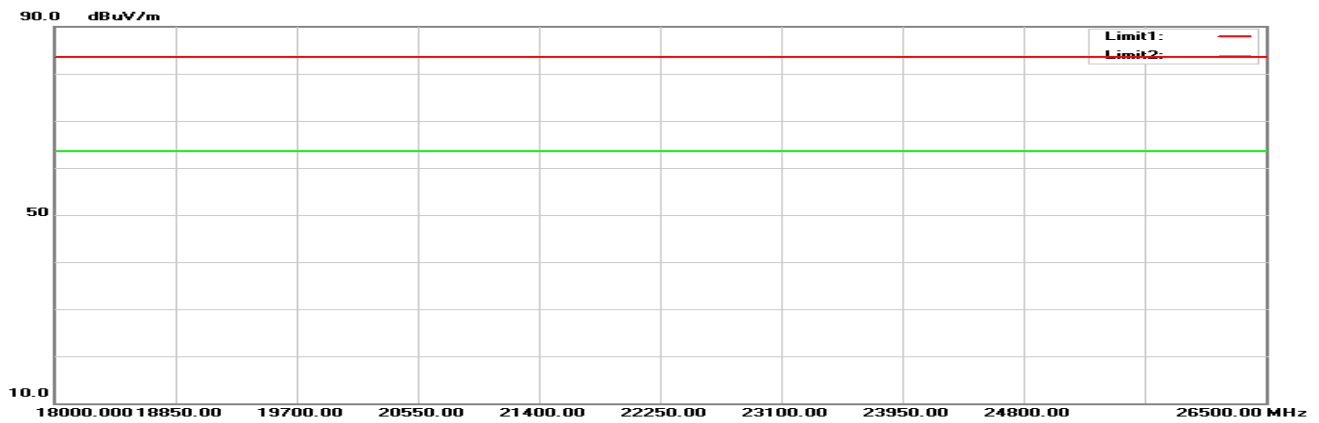
Above 1G (1 GHz-26.5 GHz) test the output power worst mode: Worst case is 802.11n HT20 mode High channel

**Horizontal**

1GHz-18GHz:

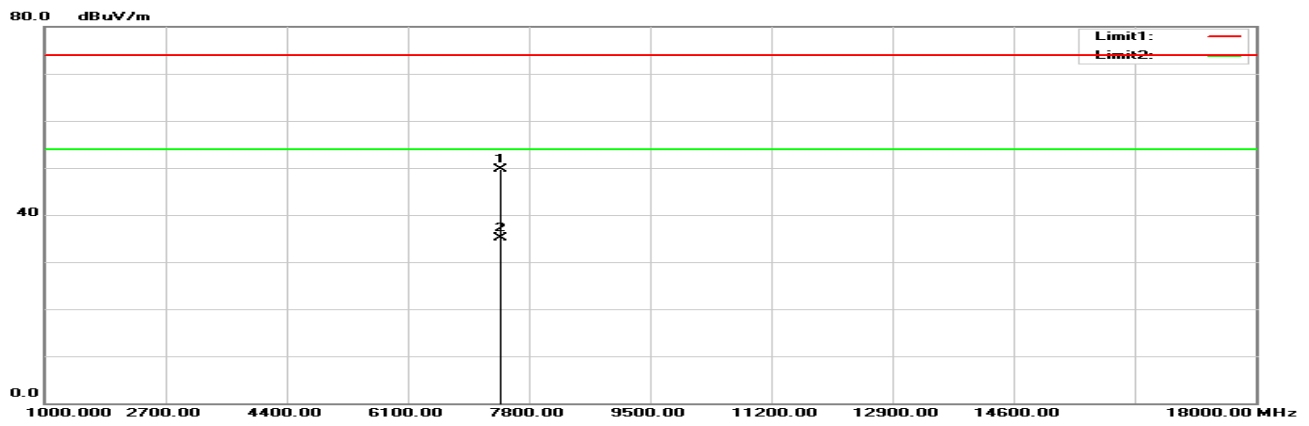


18GHz-26.5GHz:

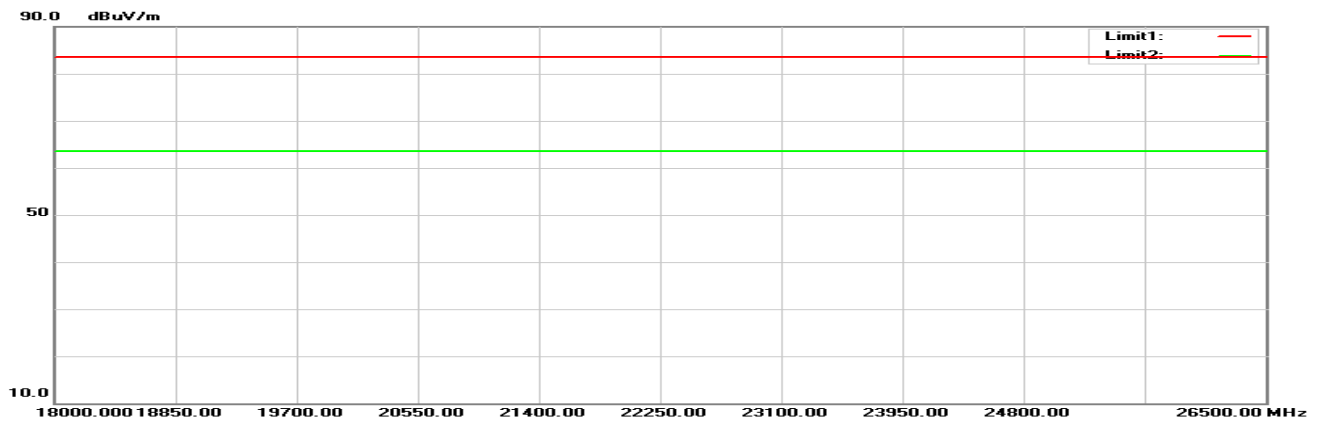


**Vertical**

1GHz-18GHz:



18GHz-26.5GHz:



**Wi-Fi B mode****Horizontal**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2342.660	62.34	-4.99	57.35	74.00	-16.65	150	26	peak
2342.660	48.10	-4.99	43.11	54.00	-10.89	150	26	AVG
2410.970	104.79	-4.84	99.95	N/A	N/A	150	314	peak
2410.970	103.37	-4.84	98.53	N/A	N/A	150	314	AVG
4824.000	39.67	1.05	40.72	74.00	-33.28	150	246	peak
4824.000	27.16	1.05	28.21	54.00	-25.79	150	246	AVG
Mid Channel								
2332.610	62.12	-5.01	57.11	74.00	-16.89	150	221	peak
2332.610	47.89	-5.01	42.88	54.00	-11.12	150	221	AVG
2438.060	104.99	-4.78	100.21	N/A	N/A	150	313	peak
2438.060	103.31	-4.78	98.53	N/A	N/A	150	313	AVG
2484.040	61.59	-4.68	56.91	74.00	-17.09	150	235	peak
2484.040	47.96	-4.68	43.28	54.00	-10.72	150	235	AVG
7311.000	38.70	6.98	45.68	74.00	-28.32	150	225	peak
7311.000	29.31	6.98	36.29	54.00	-17.71	150	225	AVG
High Channel								
2460.850	104.82	-4.73	100.09	N/A	N/A	150	314	peak
2460.850	102.93	-4.73	98.20	N/A	N/A	150	314	AVG
2490.200	63.77	-4.67	59.10	74.00	-14.90	150	287	peak
2490.200	49.32	-4.67	44.65	54.00	-9.35	150	287	AVG
7375.000	40.21	7.23	47.44	74.00	-26.56	150	263	peak
7375.000	34.77	7.23	42.00	54.00	-12.00	150	263	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported

**Vertical**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2370.145	62.87	-4.93	57.94	74.00	-16.06	150	359	peak
2370.145	48.29	-4.93	43.36	54.00	-10.64	150	359	AVG
2410.855	111.53	-4.84	106.69	N/A	N/A	150	240	peak
2410.855	108.31	-4.84	103.47	N/A	N/A	150	240	AVG
4824.000	39.49	1.05	40.54	74.00	-33.46	150	2	peak
4824.000	28.21	1.05	29.26	54.00	-24.74	150	2	AVG
Mid Channel								
2385.620	64.22	-4.90	59.32	74.00	-14.68	150	126	peak
2385.620	49.81	-4.90	44.91	54.00	-9.09	150	126	AVG
2438.060	110.83	-4.78	106.05	N/A	N/A	150	310	peak
2438.060	108.00	-4.78	103.22	N/A	N/A	150	310	AVG
2489.930	63.50	-4.67	58.83	74.00	-15.17	150	256	peak
2489.930	49.23	-4.67	44.56	54.00	-9.44	150	256	AVG
7307.000	42.02	6.97	48.99	74.00	-25.01	150	1	peak
7307.000	38.50	6.97	45.47	54.00	-8.53	150	1	AVG
High Channel								
2460.900	111.76	-4.73	107.03	N/A	N/A	150	242	peak
2460.900	108.74	-4.73	104.01	N/A	N/A	150	242	AVG
2487.150	63.45	-4.67	58.78	74.00	-15.22	150	142	peak
2487.150	49.79	-4.67	45.12	54.00	-8.88	150	142	AVG
7375.000	40.21	7.23	47.44	74.00	-26.56	150	263	peak
7375.000	34.77	7.23	42.00	54.00	-12.00	150	263	AVG

Result = Reading + Correct Factor

Margin = Result - Limit

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported



**Wi-Fi G mode****Horizontal**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2389.120	66.57	-4.89	61.68	74.00	-12.32	150	315	peak
2389.120	52.26	-4.89	47.37	54.00	-6.63	150	315	AVG
2410.165	105.41	-4.83	100.58	N/A	N/A	150	312	peak
2410.165	97.44	-4.83	92.61	N/A	N/A	150	312	AVG
7222.000	38.58	6.63	45.21	74.00	-28.79	150	201	peak
7222.000	26.52	6.63	33.15	54.00	-20.85	150	201	AVG
Mid Channel								
2359.590	63.35	-4.95	58.40	74.00	-15.60	150	235	peak
2359.590	49.45	-4.95	44.50	54.00	-9.50	150	235	AVG
2432.740	105.67	-4.79	100.88	N/A	N/A	150	310	peak
2432.740	98.13	-4.79	93.34	N/A	N/A	150	310	AVG
2490.120	62.81	-4.67	58.14	74.00	-15.86	150	42	peak
2490.120	49.50	-4.67	44.83	54.00	-9.17	150	42	AVG
7324.000	38.18	7.03	45.21	74.00	-28.79	150	328	peak
7324.000	26.07	7.03	33.10	54.00	-20.90	150	328	AVG
High Channel								
2457.550	105.11	-4.74	100.37	N/A	N/A	150	315	peak
2457.550	96.57	-4.74	91.83	N/A	N/A	150	315	AVG
2483.650	69.82	-4.69	65.13	74.00	-8.87	150	305	peak
2483.650	51.28	-4.69	46.59	54.00	-7.41	150	305	AVG
8038.000	38.07	8.42	46.49	74.00	-27.51	150	92	peak
8038.000	24.48	8.42	32.90	54.00	-21.10	150	92	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported

**Vertical**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2389.925	73.00	-4.89	68.11	74.00	-5.89	150	309	peak
2389.925	55.93	-4.89	51.04	54.00	-2.96	150	309	AVG
2407.635	112.32	-4.84	107.48	N/A	N/A	150	309	peak
2407.635	102.28	-4.84	97.44	N/A	N/A	150	309	AVG
7239.000	44.58	6.69	51.27	74.00	-22.73	150	0	peak
7239.000	30.47	6.69	37.16	54.00	-16.84	150	0	AVG
Mid Channel								
2370.990	63.50	-4.93	58.57	74.00	-15.43	150	343	peak
2370.990	49.61	-4.93	44.68	54.00	-9.32	150	343	AVG
2439.770	112.15	-4.78	107.37	N/A	N/A	150	309	peak
2439.770	101.96	-4.78	97.18	N/A	N/A	150	309	AVG
2484.230	63.19	-4.68	58.51	74.00	-15.49	150	236	peak
2484.230	49.32	-4.68	44.64	54.00	-9.36	150	236	AVG
7307.000	43.80	6.97	50.77	74.00	-23.23	150	263	peak
7307.000	30.89	6.97	37.86	54.00	-16.14	150	263	AVG
High Channel								
2457.800	113.09	-4.74	108.35	N/A	N/A	150	241	peak
2457.800	102.83	-4.74	98.09	N/A	N/A	150	241	AVG
2483.700	75.86	-4.68	71.18	74.00	-2.82	150	242	peak
2483.700	54.83	-4.68	50.15	54.00	-3.85	150	242	AVG
7392.000	40.84	7.29	48.13	74.00	-25.87	150	239	peak
7392.000	27.72	7.29	35.01	54.00	-18.99	150	239	AVG

Result = Reading + Correct Factor

Margin = Result - Limit

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported

**Wi-Fi N20 mode****Horizontal**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2389.695	70.89	-4.89	66.00	74.00	-8.00	150	307	peak
2389.695	52.33	-4.89	47.44	54.00	-6.56	150	307	AVG
2417.295	105.05	-4.83	100.22	N/A	N/A	150	314	peak
2417.295	96.85	-4.83	92.02	N/A	N/A	150	314	AVG
11166.000	35.86	13.06	48.92	74.00	-25.08	150	41	peak
11166.000	22.55	13.06	35.61	54.00	-18.39	150	41	AVG
Mid Channel								
2350.850	63.46	-4.98	58.48	74.00	-15.52	150	288	peak
2350.850	49.45	-4.98	44.47	54.00	-9.53	150	288	AVG
2431.410	105.21	-4.79	100.42	N/A	N/A	150	309	peak
2431.410	97.91	-4.79	93.12	N/A	N/A	150	309	AVG
2491.070	63.01	-4.66	58.35	74.00	-15.65	150	4	peak
2491.070	49.36	-4.66	44.70	54.00	-9.30	150	4	AVG
11098.000	35.24	13.04	48.28	74.00	-25.72	150	50	peak
11098.000	22.20	13.04	35.24	54.00	-18.76	150	50	AVG
High Channel								
2460.050	105.35	-4.73	100.62	N/A	N/A	150	331	peak
2460.050	94.78	-4.73	90.05	N/A	N/A	150	331	AVG
2483.900	72.47	-4.68	67.79	74.00	-6.21	150	307	peak
2483.900	51.44	-4.68	46.76	54.00	-7.24	150	307	AVG
9636.000	37.12	11.31	48.43	74.00	-25.57	150	220	peak
9636.000	22.85	11.31	34.16	54.00	-19.84	150	220	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported

**Vertical**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2389.350	76.51	-4.89	71.62	74.00	-2.38	150	221	peak
2389.350	56.16	-4.89	51.27	54.00	-2.73	150	221	AVG
2409.820	113.68	-4.83	108.85	N/A	N/A	150	243	peak
2409.820	102.14	-4.83	97.31	N/A	N/A	150	243	AVG
7239.000	42.63	6.69	49.32	74.00	-24.68	150	67	peak
7239.000	30.01	6.69	36.70	54.00	-17.30	150	67	AVG
Mid Channel								
2378.590	63.35	-4.91	58.44	74.00	-15.56	150	343	peak
2378.590	49.78	-4.91	44.87	54.00	-9.13	150	343	AVG
2442.240	112.49	-4.76	107.73	N/A	N/A	150	242	peak
2442.240	101.77	-4.76	97.01	N/A	N/A	150	242	AVG
2488.410	63.45	-4.67	58.78	74.00	-15.22	150	49	peak
2488.410	49.52	-4.67	44.85	54.00	-9.15	150	49	AVG
7307.000	42.87	6.97	49.84	74.00	-24.16	150	171	peak
7307.000	29.81	6.97	36.78	54.00	-17.22	150	171	AVG
High Channel								
2456.400	113.66	-4.74	108.92	N/A	N/A	150	242	peak
2456.400	102.04	-4.74	97.30	N/A	N/A	150	242	AVG
2483.950	78.45	-4.68	73.77	74.00	-0.23	150	307	peak
2483.950	54.10	-4.68	49.42	54.00	-4.58	150	307	AVG
7392.000	42.40	7.29	49.69	74.00	-24.31	150	2	peak
7392.000	27.81	7.29	35.10	54.00	-18.90	150	2	AVG

Result = Reading + Correct Factor

Margin = Result - Limit

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

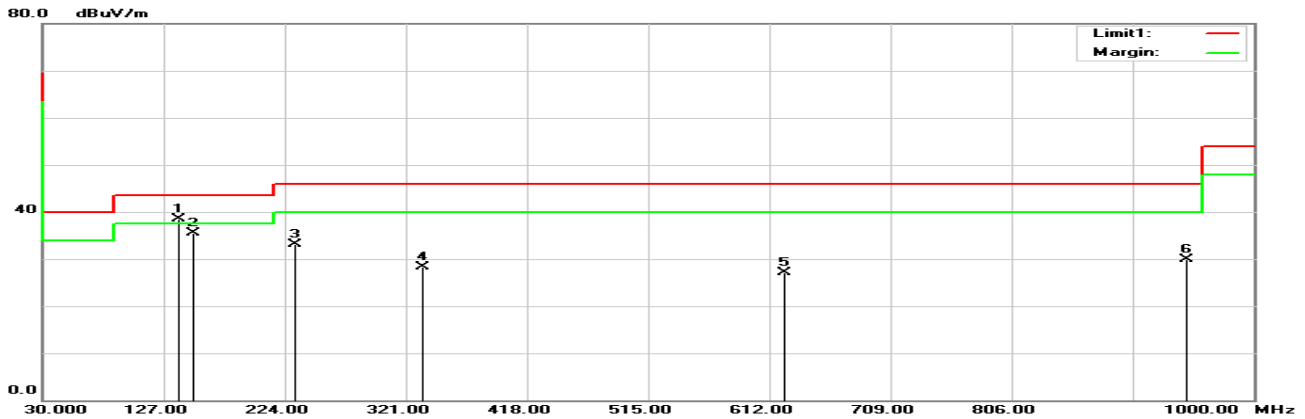
Spurious emissions more than 20 dB below the limit were not reported

**BLE Mode:** Transmitting Mode (Pre-scan with three orthogonal axis, and worse case as Z axis)

**Below 1G (30 MHz-1 GHz) test the output power worst mode:**

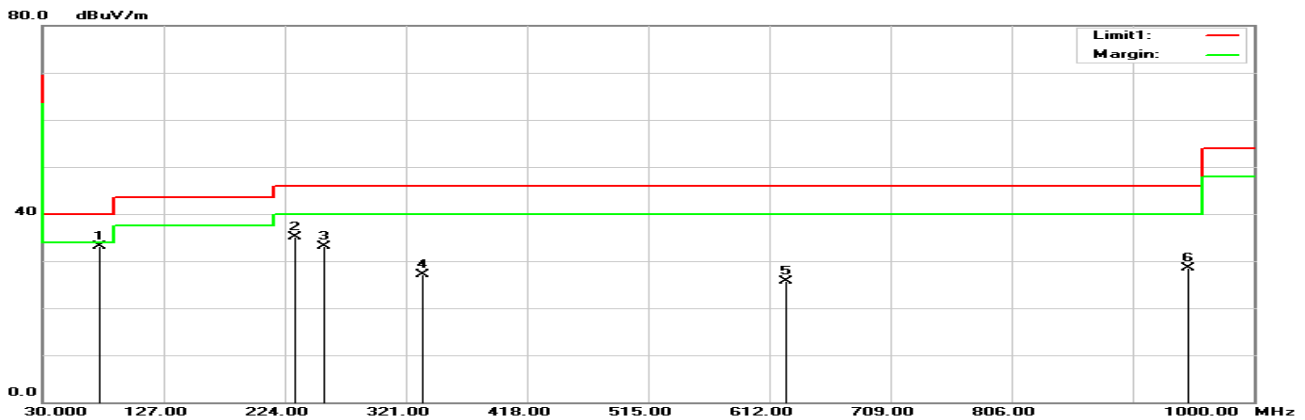
BLE mode: Worst case is BLE Low Channel

**Horizontal**



Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
139.6100	49.45	-10.99	38.46	43.50	-5.04	100	34	peak
151.2500	46.82	-11.28	35.54	43.50	-7.96	100	37	peak
232.7300	45.33	-12.27	33.06	46.00	-12.94	100	80	peak
334.5800	37.40	-9.15	28.25	46.00	-17.75	100	211	peak
624.6100	30.84	-3.67	27.17	46.00	-18.83	100	40	peak
945.6800	27.45	2.48	29.93	46.00	-16.07	100	330	peak

**Vertical**

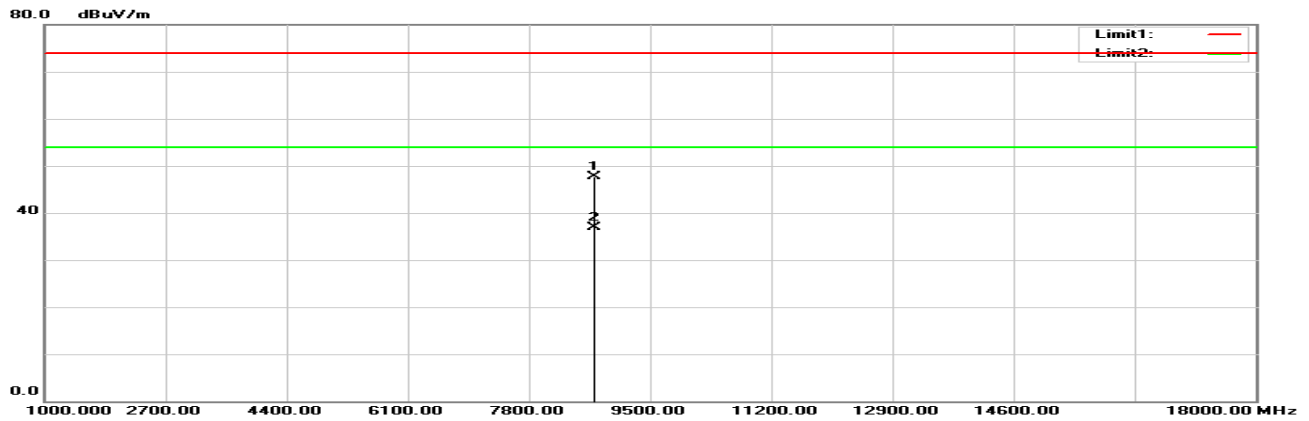


Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
75.5900	49.96	-16.86	33.10	40.00	-6.90	100	335	peak
232.7300	47.36	-12.27	35.09	46.00	-10.91	100	11	peak
256.0100	44.87	-11.67	33.20	46.00	-12.80	100	163	peak
334.5800	36.28	-9.15	27.13	46.00	-18.87	100	7	peak
625.5800	29.40	-3.66	25.74	46.00	-20.26	100	89	peak
947.6200	26.02	2.54	28.56	46.00	-17.44	100	301	peak

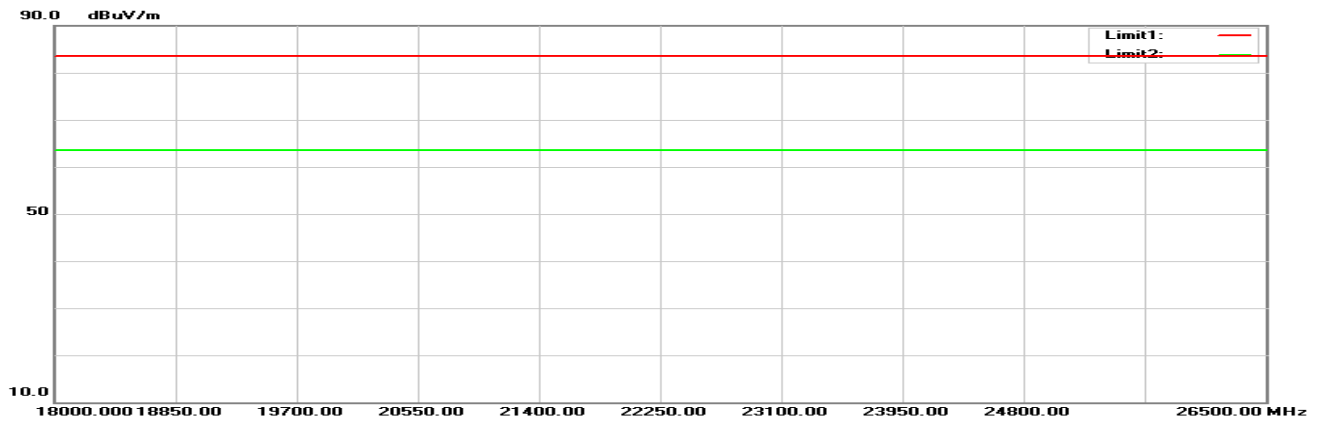
Above 1G (1 GHz-26.5 GHz) test the output power worst mode: Worst case is BLE mode Low channel

**Horizontal**

1GHz-18GHz:



18GHz-26.5GHz:

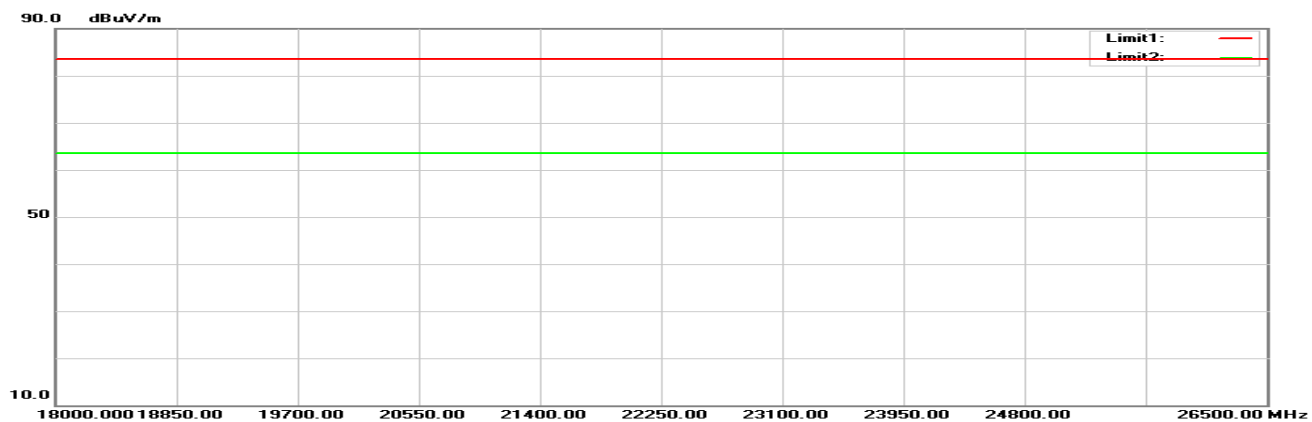


**Vertical**

1GHz-18GHz:



18GHz-26.5GHz:



**BLE mode**

**Horizontal**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2383.245	51.14	-4.91	46.23	74.00	-27.77	150	241	peak
2383.245	36.55	-4.91	31.64	54.00	-22.36	150	241	AVG
2401.770	101.36	-4.86	96.50	N/A	N/A	150	350	peak
2401.770	100.79	-4.86	95.93	N/A	N/A	150	350	AVG
8718.000	37.90	9.86	47.76	74.00	-26.24	150	46	peak
8718.000	26.97	9.86	36.83	54.00	-17.17	150	46	AVG
Mid Channel								
2347.620	49.41	-4.98	44.43	74.00	-29.57	150	359	peak
2347.620	36.69	-4.98	31.71	54.00	-22.29	150	359	AVG
2440.340	102.12	-4.77	97.35	N/A	N/A	150	350	peak
2440.340	101.55	-4.77	96.78	N/A	N/A	150	350	AVG
2492.780	50.50	-4.66	45.84	74.00	-28.16	150	285	peak
2492.780	37.34	-4.66	32.68	54.00	-21.32	150	285	AVG
8565.000	37.66	9.66	47.32	74.00	-26.68	150	125	peak
8565.000	25.32	9.66	34.98	54.00	-19.02	150	125	AVG
High Channel								
2480.200	99.83	-4.68	95.15	N/A	N/A	150	350	peak
2480.200	99.23	-4.68	94.55	N/A	N/A	150	350	AVG
2491.270	51.37	-4.66	46.71	74.00	-27.29	150	280	peak
2491.270	37.09	-4.66	32.43	54.00	-21.57	150	280	AVG
10469.000	36.33	12.49	48.82	74.00	-25.18	150	205	peak
10469.000	24.89	12.49	37.38	54.00	-16.62	150	205	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported



**Vertical**

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low Channel								
2338.785	49.86	-5.00	44.86	74.00	-29.14	150	203	peak
2338.785	35.57	-5.00	30.57	54.00	-23.43	150	203	AVG
2402.245	107.93	-4.86	103.07	N/A	N/A	150	309	peak
2402.245	107.50	-4.86	102.64	N/A	N/A	150	309	AVG
7205.000	41.01	6.56	47.57	74.00	-26.43	150	1	peak
7205.000	33.33	6.56	39.89	54.00	-14.11	150	1	AVG
Mid Channel								
2320.640	50.26	-5.05	45.21	74.00	-28.79	150	235	peak
2320.640	36.99	-5.05	31.94	54.00	-22.06	150	235	AVG
2439.770	108.06	-4.78	103.28	N/A	N/A	150	309	peak
2439.770	107.45	-4.78	102.67	N/A	N/A	150	309	AVG
2490.690	48.98	-4.66	44.32	74.00	-29.68	150	118	peak
2490.690	37.42	-4.66	32.76	54.00	-21.24	150	118	AVG
7324.000	39.46	7.03	46.49	74.00	-27.51	150	356	peak
7324.000	31.75	7.03	38.78	54.00	-15.22	150	356	AVG
High Channel								
2479.690	105.76	-4.68	101.08	N/A	N/A	150	312	peak
2479.690	105.12	-4.68	100.44	N/A	N/A	150	312	AVG
2483.890	51.16	-4.68	46.48	74.00	-27.52	150	86	peak
2483.890	39.01	-4.68	34.33	54.00	-19.67	150	86	AVG
8072.000	39.17	8.51	47.68	74.00	-26.32	150	273	peak
8072.000	25.38	8.51	33.89	54.00	-20.11	150	273	AVG

Result = Reading + Correct Factor

Margin = Result - Limit

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported

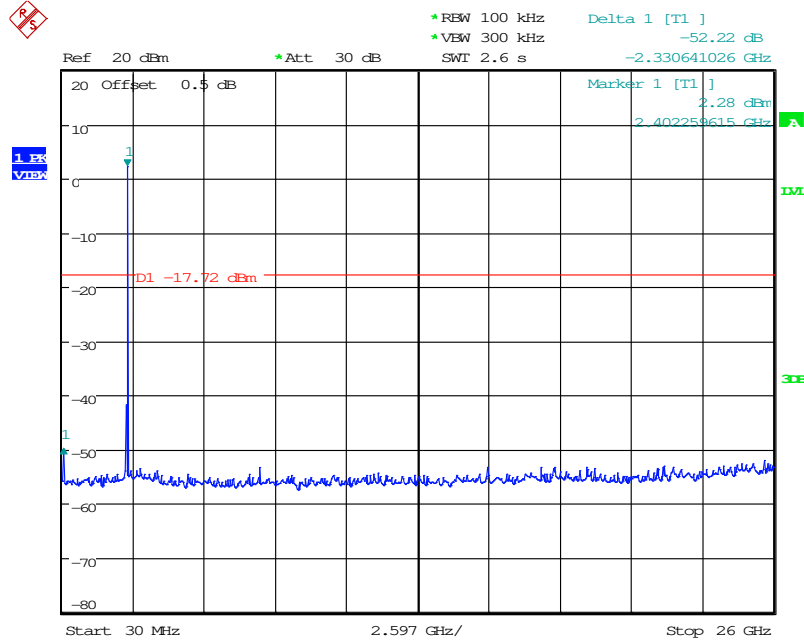
**Conducted Spurious Emissions:**

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
<b>B mode</b>				
Low	2412	52.22	≥ 20	Compliance
Mid	2437	52.60	≥ 20	Compliance
High	2462	55.83	≥ 20	Compliance
<b>G mode</b>				
Low	2412	51.91	≥ 20	Compliance
Mid	2437	49.45	≥ 20	Compliance
High	2462	49.39	≥ 20	Compliance
<b>N20 mode</b>				
Low	2412	50.41	≥ 20	Compliance
Mid	2437	48.28	≥ 20	Compliance
High	2462	52.04	≥ 20	Compliance
<b>BLE mode</b>				
Low	2412	55.64	≥ 20	Compliance
Mid	2437	54.32	≥ 20	Compliance
High	2462	55.21	≥ 20	Compliance

Please refer to the following plots

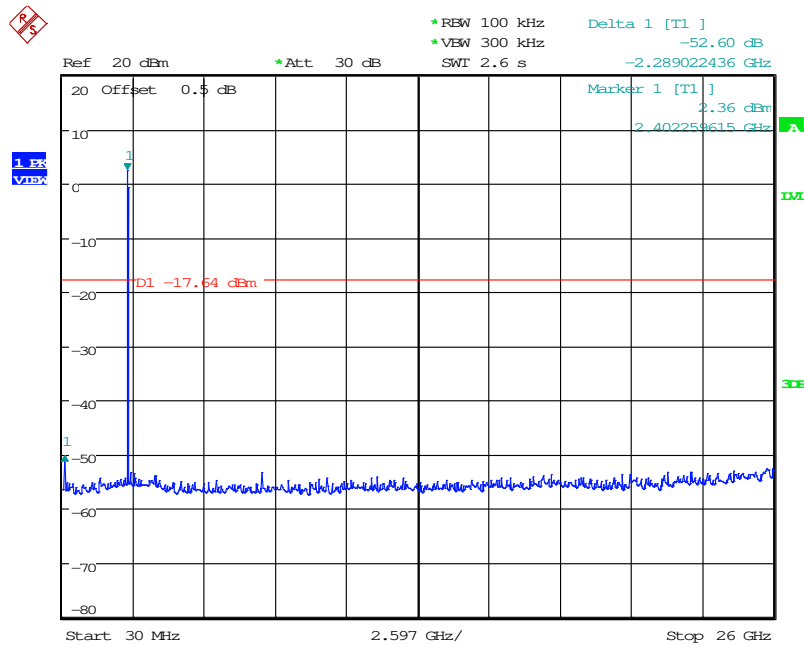
### Wi-Fi B mode:

#### Low Channel



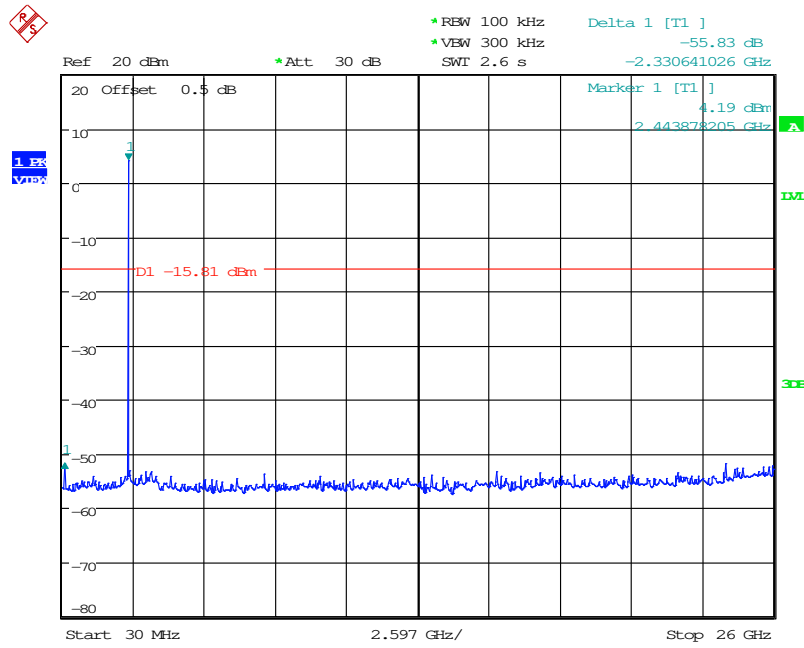
Date: 29.DEC.2017 12:36:23

#### Middle Channel



Date: 29.DEC.2017 12:50:38

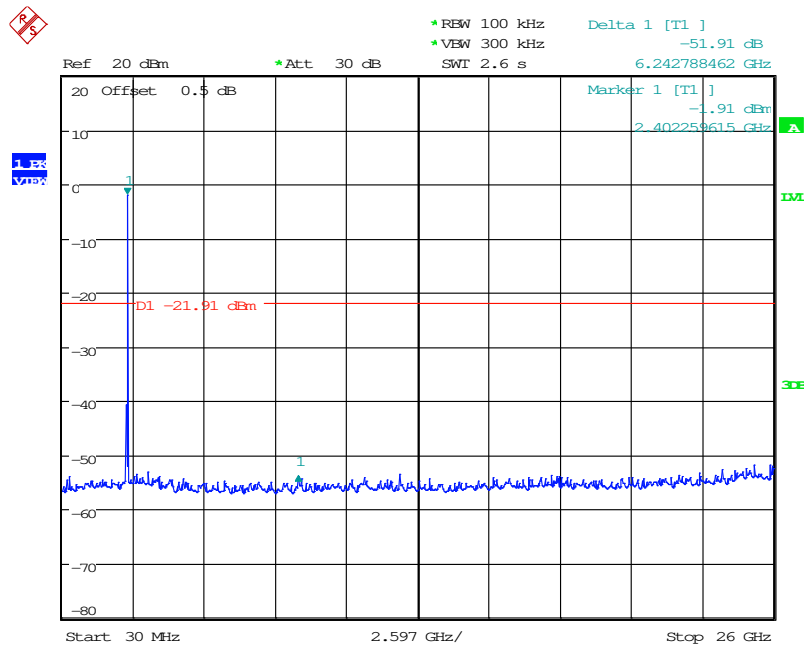
### High Channel



Date: 29.DEC.2017 12:51:40

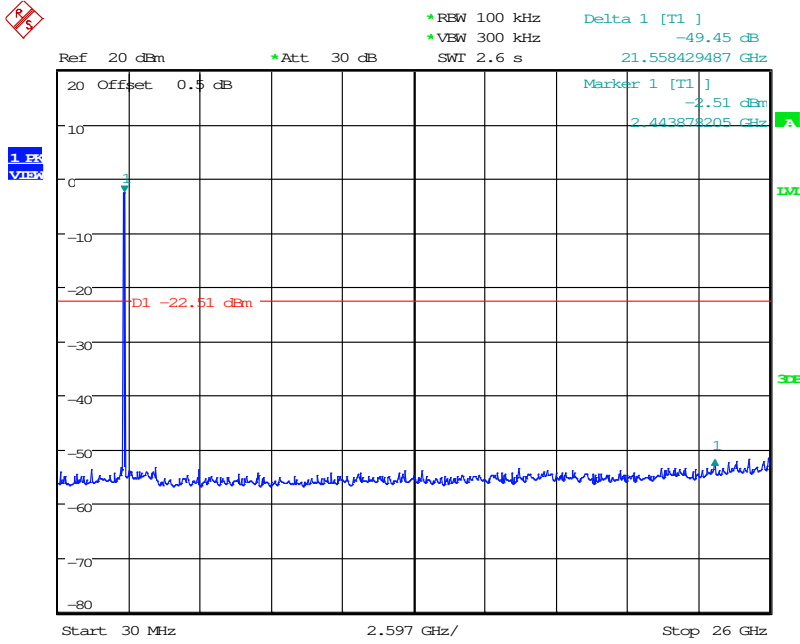
### Wi-Fi G mode:

### Low Channel



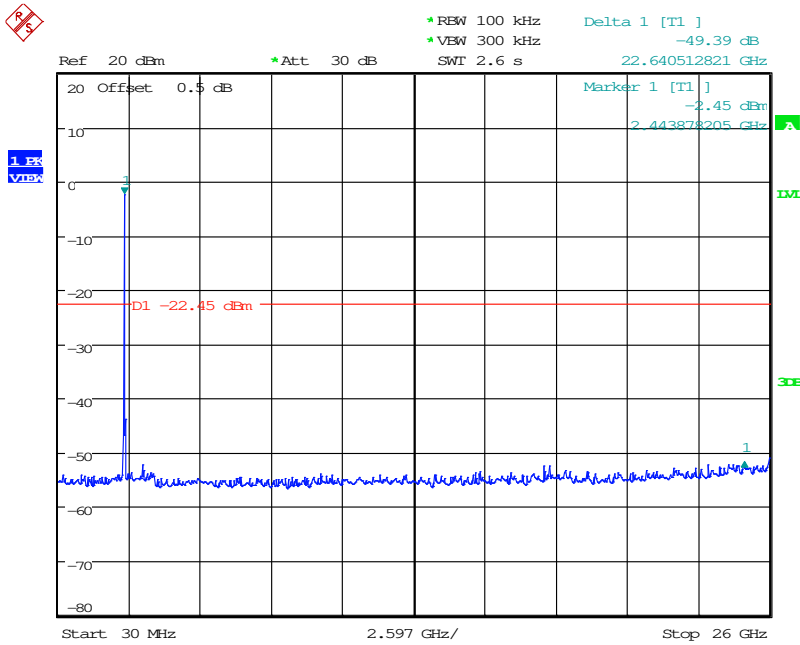
Date: 29.DEC.2017 13:47:30

### Middle Channel



Date: 29.DEC.2017 13:55:55

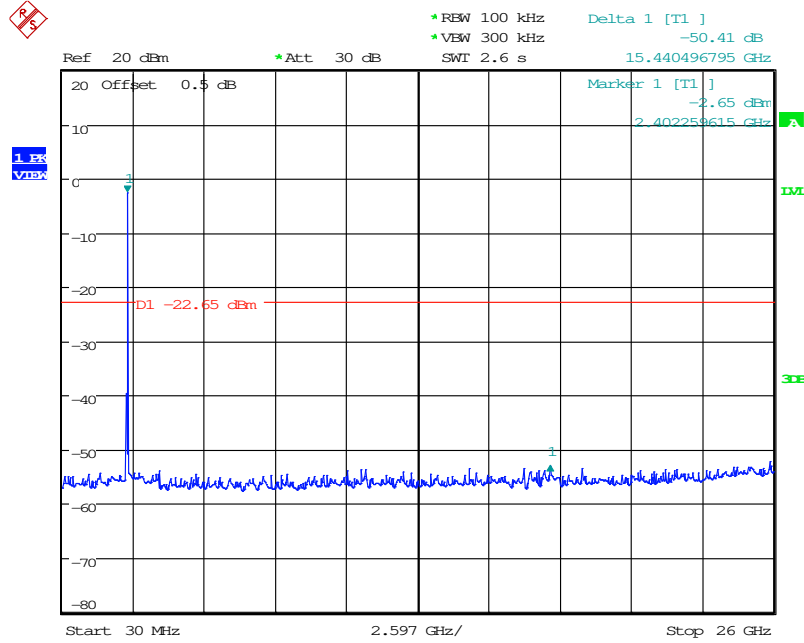
### High Channel



Date: 29.DEC.2017 14:06:58

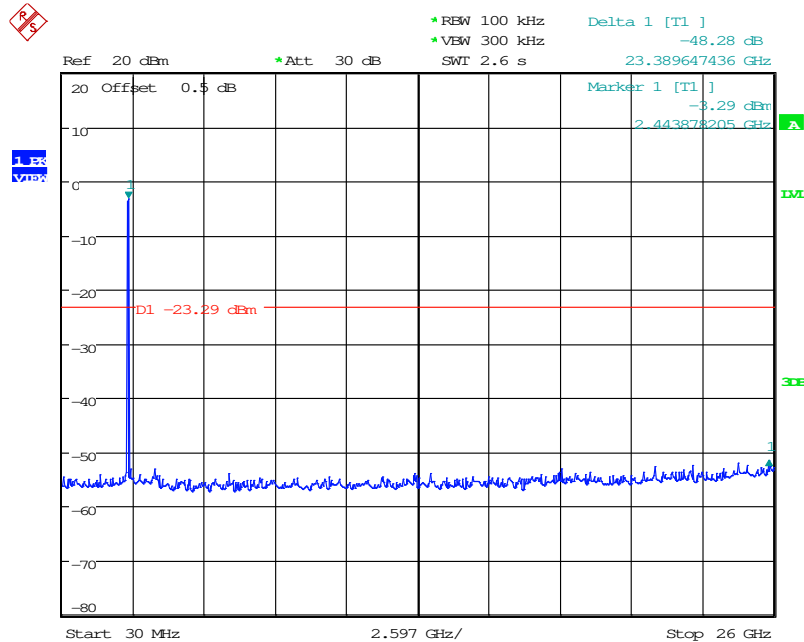
### Wi-Fi N20 mode:

#### Low Channel



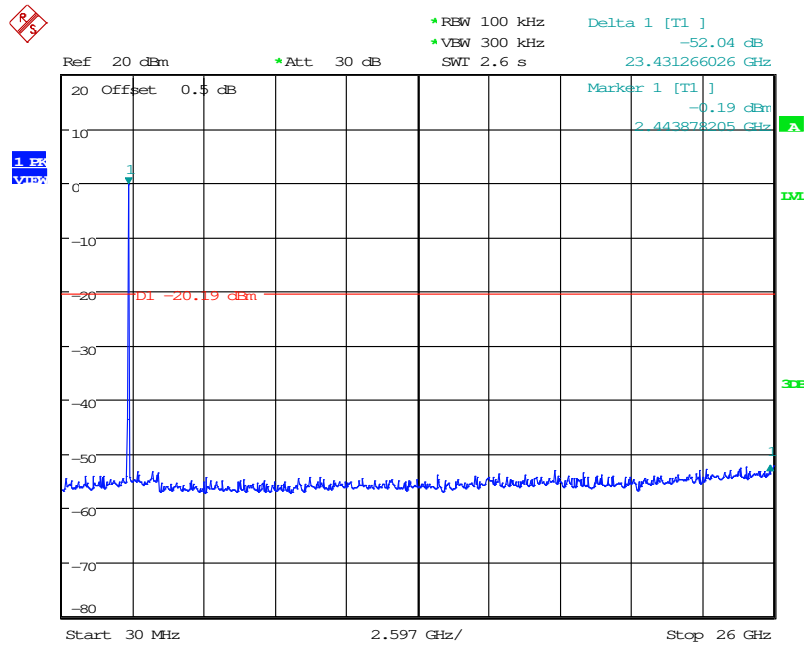
Date: 29.DEC.2017 14:46:48

#### Middle Channel



Date: 29.DEC.2017 14:48:34

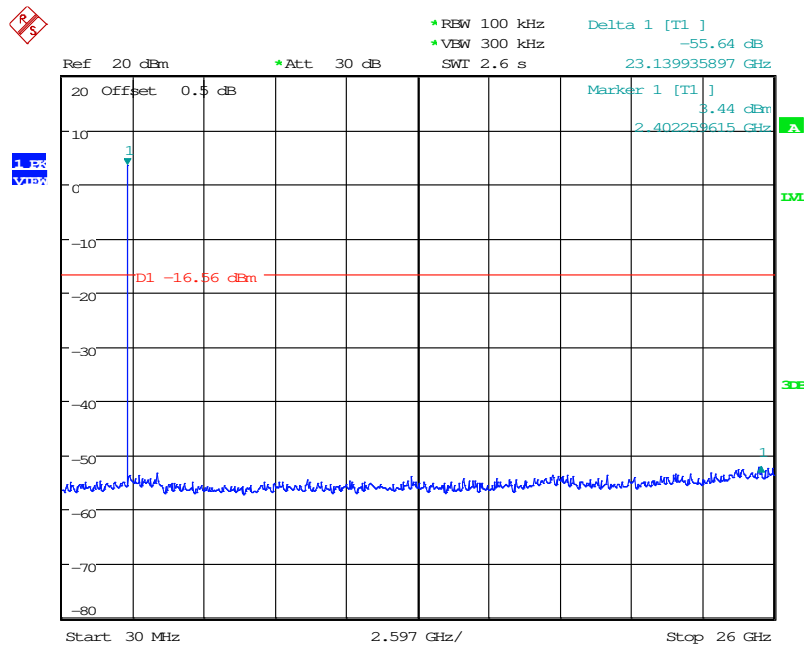
### High Channel



Date: 29.DEC.2017 15:01:15

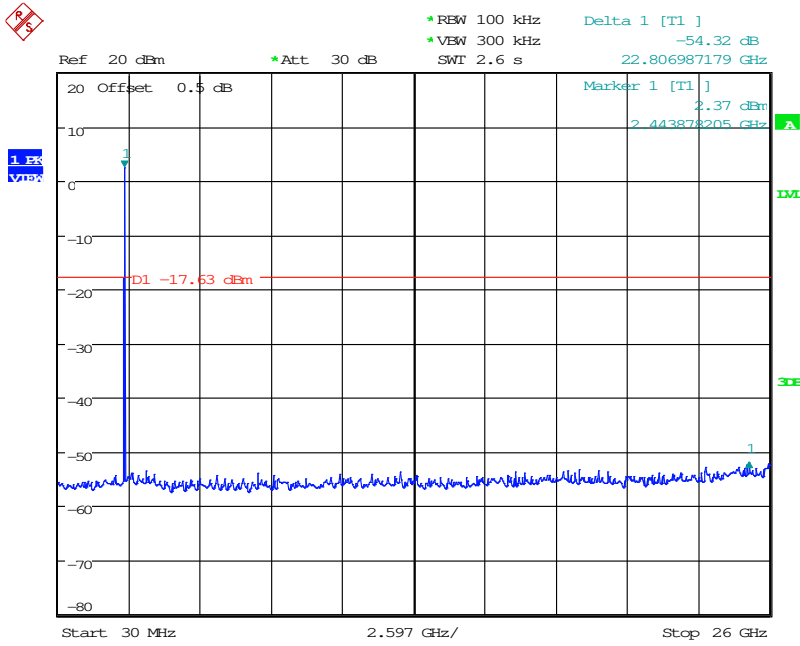
### BLE mode:

### Low Channel



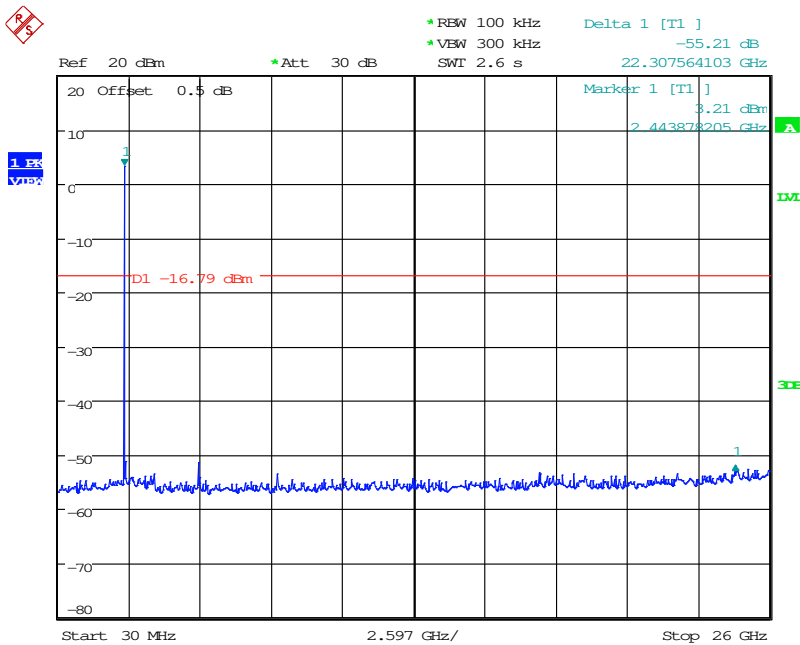
Date: 29.DEC.2017 15:34:34

### Middle Channel



Date: 29.DEC.2017 15:44:11

### High Channel



Date: 29.DEC.2017 15:50:50



## 8 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

### 8.1 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.

### 8.2 Test Procedure

According to ANSI C63.10-2013

#### 6 dB Emission Bandwidth

The steps for the first option are as follows:

- a) Set RBW = 100 kHz.
- b) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- 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.

### 8.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21

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

### 8.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Ian Tu on 2017-12-29.

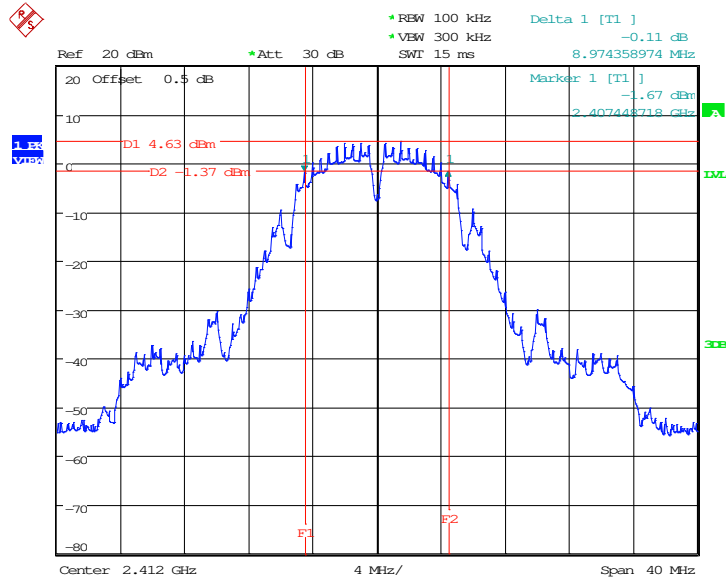
## 8.5 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	Limit (MHz)	Result
<b>B mode</b>				
Low	2412	8.97	> 0.5	Compliance
Middle	2437	9.03	> 0.5	Compliance
High	2462	9.03	> 0.5	Compliance
<b>G mode</b>				
Low	2412	16.34	> 0.5	Compliance
Middle	2437	16.34	> 0.5	Compliance
High	2462	16.34	> 0.5	Compliance
<b>N20 mode</b>				
Low	2412	17.62	> 0.5	Compliance
Middle	2437	17.62	> 0.5	Compliance
High	2462	17.62	> 0.5	Compliance
<b>BLE mode</b>				
Low	2402	0.725	> 0.5	Compliance
Middle	2440	0.721	> 0.5	Compliance
High	2480	0.725	> 0.5	Compliance

Please refer to the following plots

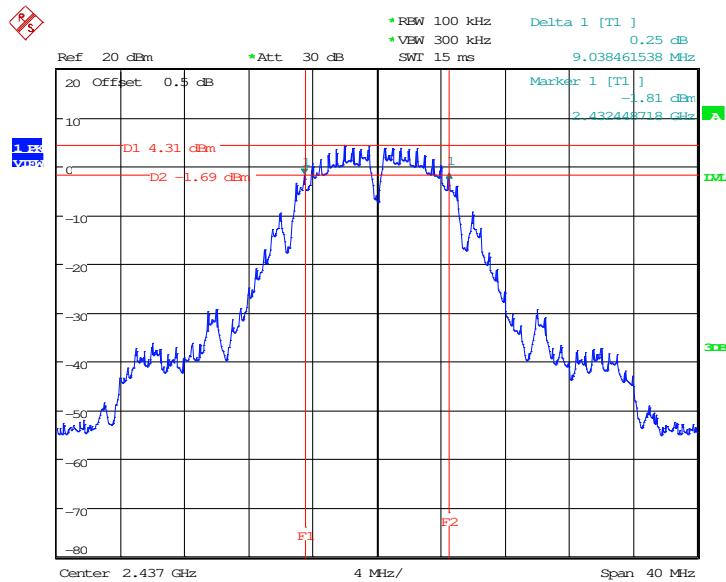
### Wi-Fi B mode:

#### Low Channel



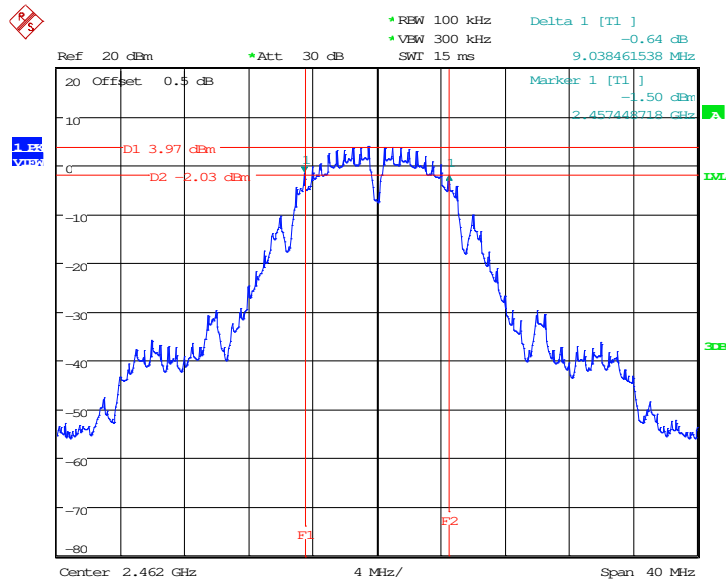
Date: 29.DEC.2017 12:25:14

#### Middle Channel



Date: 29.DEC.2017 12:28:28

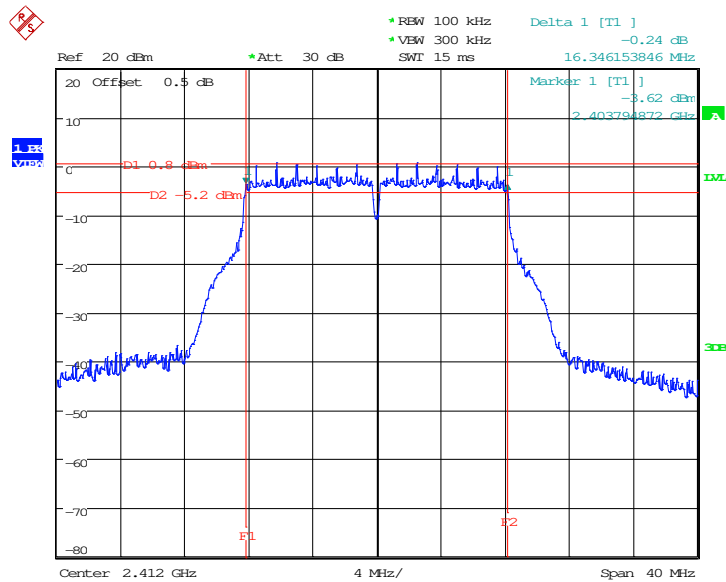
### High Channel



Date: 29.DEC.2017 12:29:41

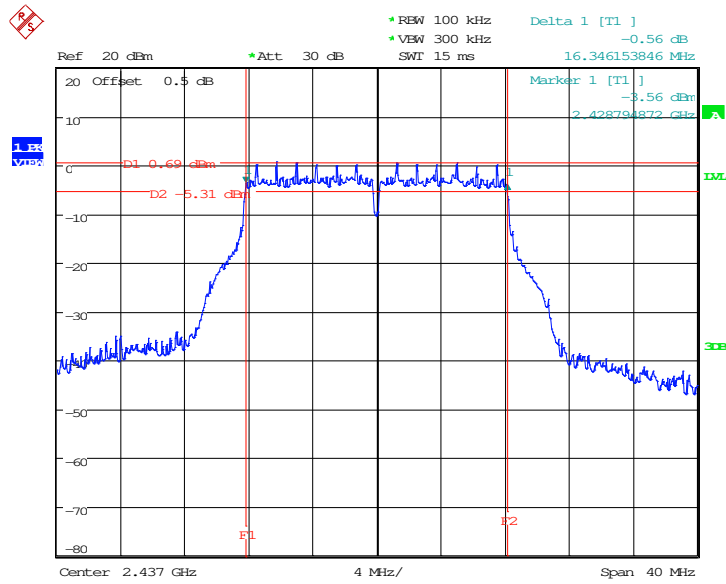
### Wi-Fi G mode:

### Low Channel



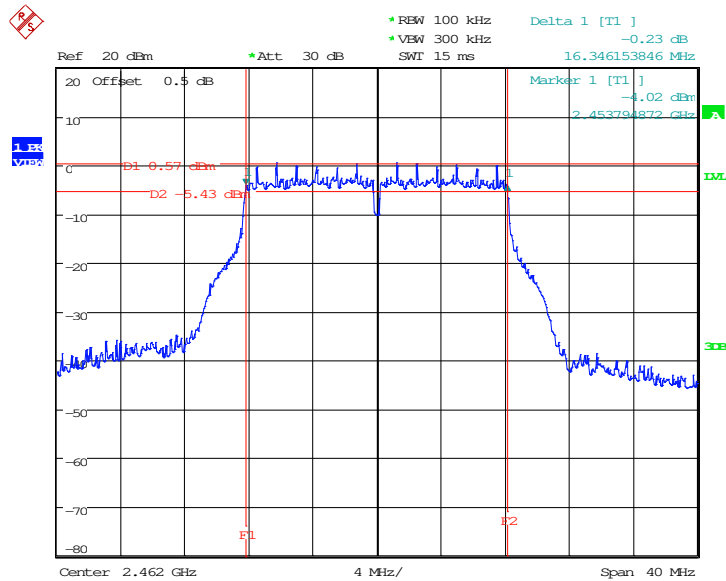
Date: 29.DEC.2017 13:40:46

### Middle Channel



Date: 29.DEC.2017 13:41:58

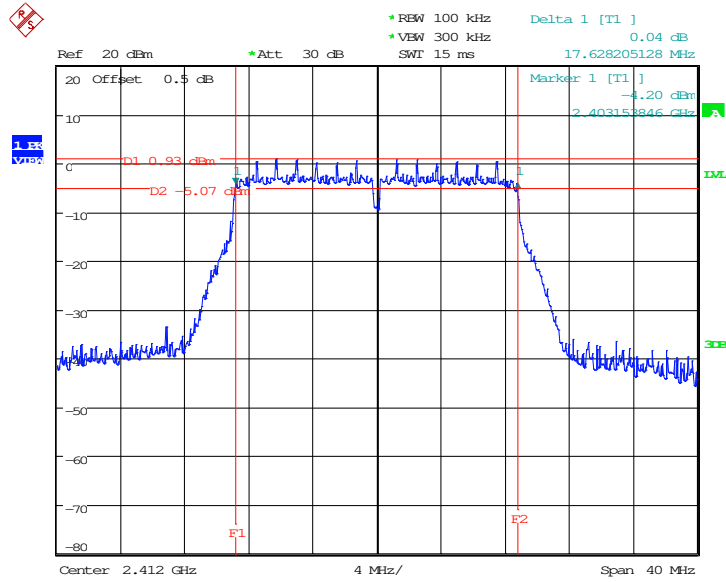
### High Channel



Date: 29.DEC.2017 13:43:14

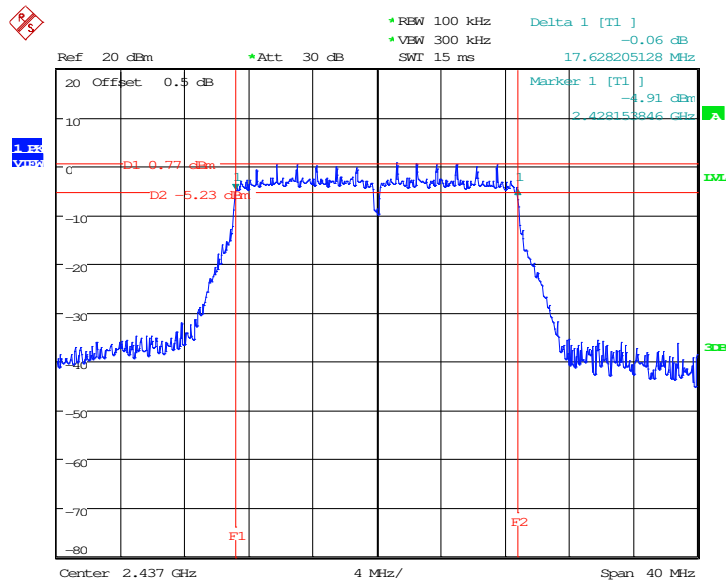
### Wi-Fi N20 mode:

#### Low Channel



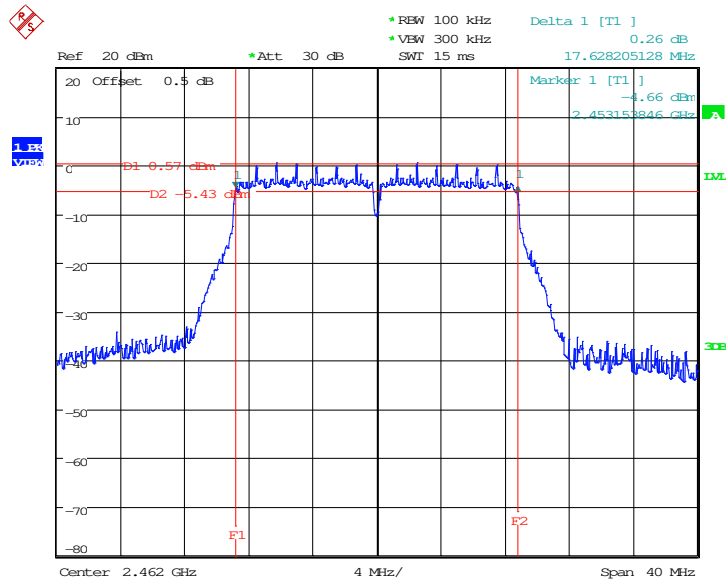
Date: 29.DEC.2017 14:44:14

#### Middle Channel



Date: 29.DEC.2017 14:49:27

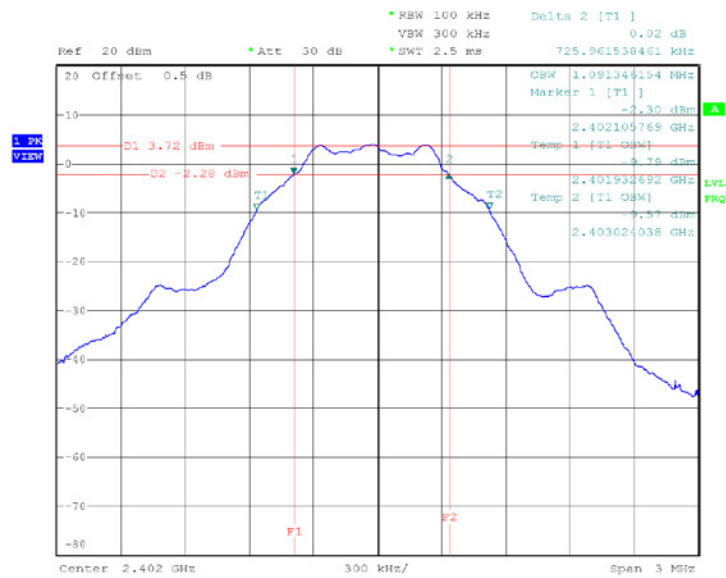
### High Channel



Date: 29.DEC.2017 14:59:59

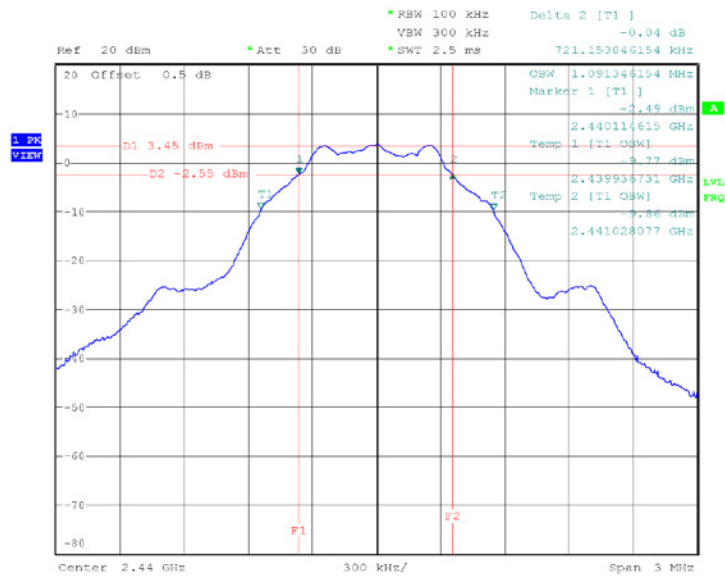
### BLE mode:

### Low Channel



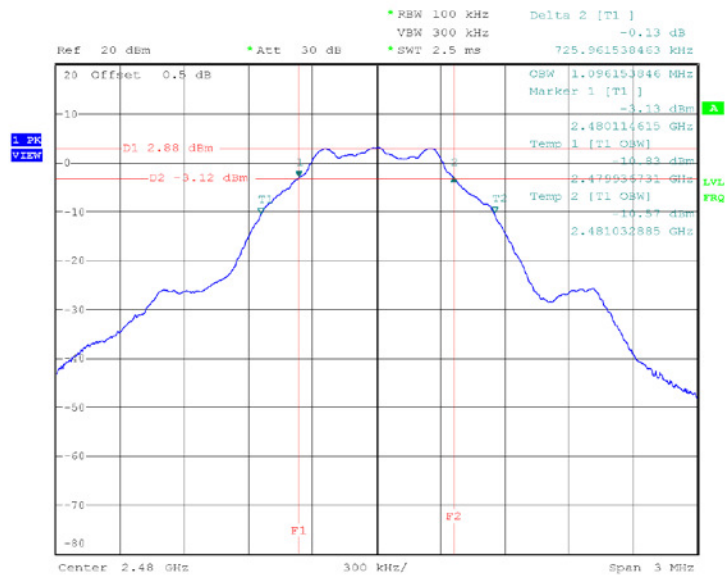
Date: 12.FEB.2018 21:10:28

### Middle Channel



Date: 12.FEB.2018 21:14:29

### High Channel



Date: 12.FEB.2018 21:18:01



## 9 FCC §15.247(b)(3) – Maximum Output Power

### 9.1 Applicable Standard

According to FCC §15.247(b) (3).

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.

### 9.2 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 measuring equipment.



### 9.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2017/03/21	2018/03/20
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21

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

## 9.4 Test Environmental Conditions

<b>Temperature:</b>	26° C
<b>Relative Humidity:</b>	58 %
<b>ATM Pressure:</b>	1010 hPa

The testing was performed by Ian Tu on 2017-12-29.

## 9.5 Test Results

Channel	Frequency (MHz)	Maximum peak Conducted Output Power (dBm)	Limit (dBm)	Result
<b>B mode</b>				
Low	2412	16.27	30	Compliance
Middle	2437	16.34	30	Compliance
High	2462	16.16	30	Compliance
<b>G mode</b>				
Low	2412	20.35	30	Compliance
Middle	2437	20.59	30	Compliance
High	2462	20.00	30	Compliance
<b>N20 mode</b>				
Low	2412	20.69	30	Compliance
Middle	2437	20.55	30	Compliance
High	2462	20.48	30	Compliance
<b>BLE mode</b>				
Low	2402	5.64	30	Compliance
Middle	2440	5.37	30	Compliance
High	2480	4.74	30	Compliance

Channel	Frequency (MHz)	Average Output Power (dBm)	Duty Factor	Total Average Output Power (dBm)	Limit (dBm)	Result
<b>B mode</b>						
Low	2412	13.24	0.00	13.24	30	Compliance
Middle	2437	13.31	0.00	13.31	30	Compliance
High	2462	13.09	0.00	13.09	30	Compliance
<b>G mode</b>						
Low	2412	13.57	0.00	13.57	30	Compliance
Middle	2437	13.84	0.00	13.84	30	Compliance
High	2462	13.49	0.00	13.49	30	Compliance
<b>N20 mode</b>						
Low	2412	14.08	0.06	14.14	30	Compliance
Middle	2437	13.86	0.06	13.92	30	Compliance
High	2462	13.74	0.06	13.80	30	Compliance
<b>BLE mode</b>						
Low	2402	5.42	1.80	7.22	30	Compliance
Middle	2440	5.21	1.80	7.01	30	Compliance
High	2480	4.53	1.80	6.33	30	Compliance

## 10 FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

### 10.1 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)).

### 10.2 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.

### 10.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21

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

### 10.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

*The testing was performed by Ian Tu on 2017-12-29.*

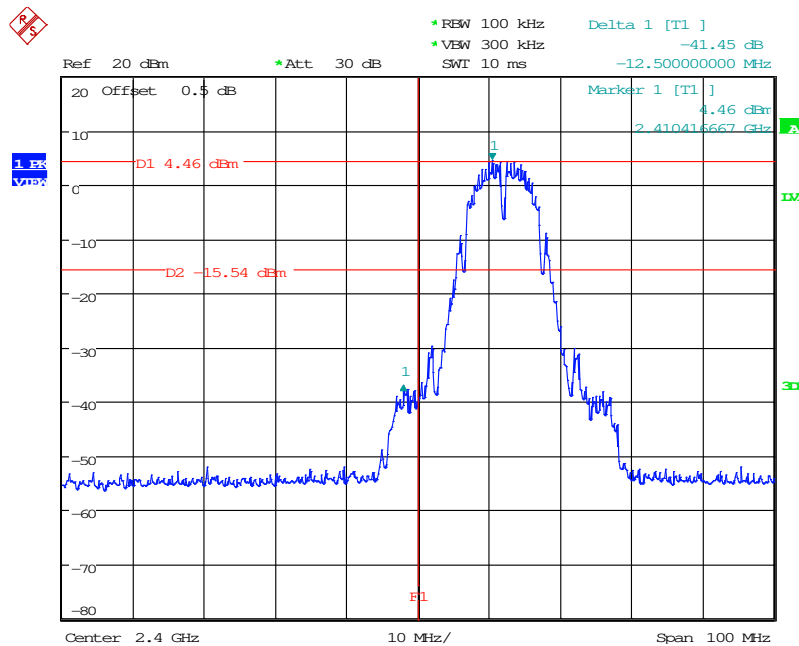
### 10.5 Test Results

Please refer to the following plots

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBe)	Limit (dBe)	RESULT
<b>B mode</b>				
Low	2412	41.45	≥ 20	PASS
High	2462	56.21	≥ 20	PASS
<b>G mode</b>				
Low	2412	38.19	≥ 20	PASS
High	2462	43.85	≥ 20	PASS
<b>N20 mode</b>				
Low	2412	36.08	≥ 20	PASS
High	2462	43.58	≥ 20	PASS
<b>BLE mode</b>				
Low	2402	55.66	≥ 20	PASS
High	2480	55.73	≥ 20	PASS

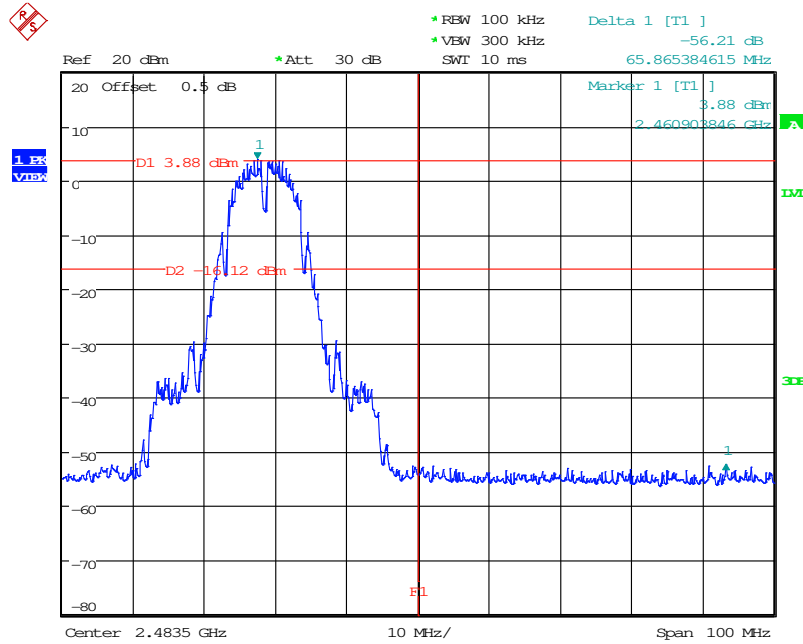
### Wi-Fi B mode:

**Band Edge, Left Side**



Date: 29.DEC.2017 12:26:54

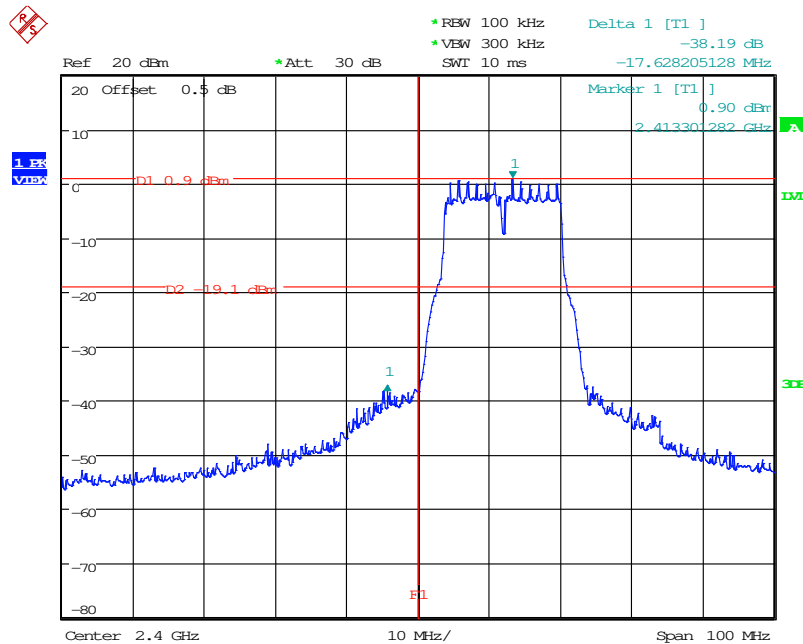
### Band Edge, Right Side



Date: 29.DEC.2017 12:31:00

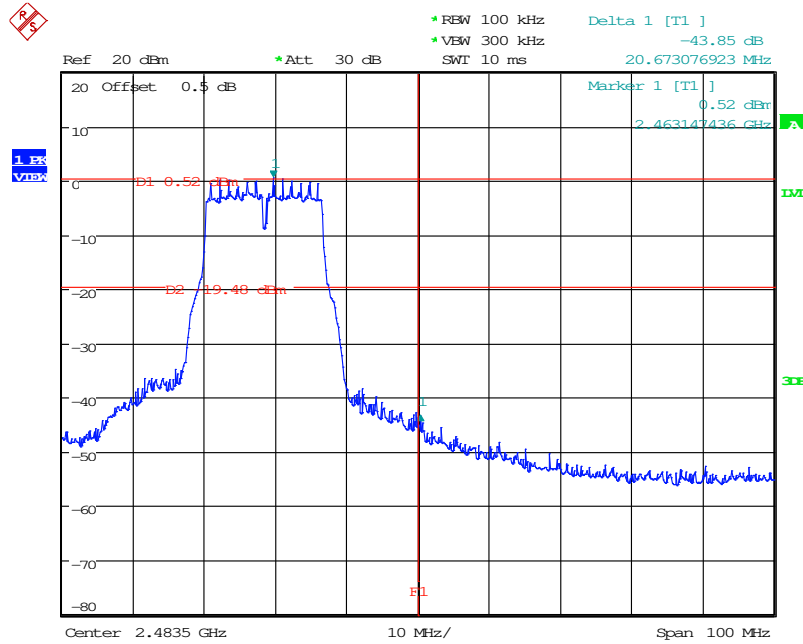
### Wi-Fi G mode:

### Band Edge, Left Side



Date: 29.DEC.2017 13:44:22

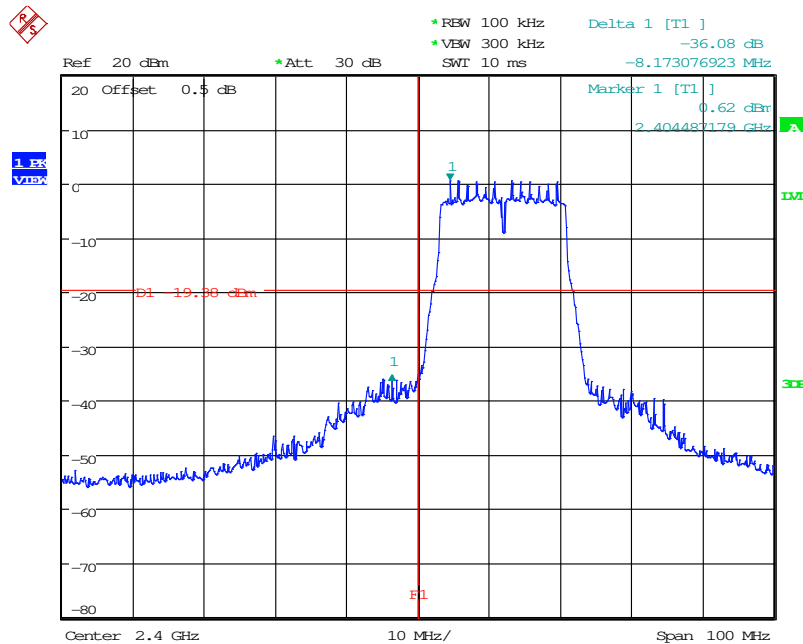
### Band Edge, Right Side



Date: 29.DEC.2017 14:03:43

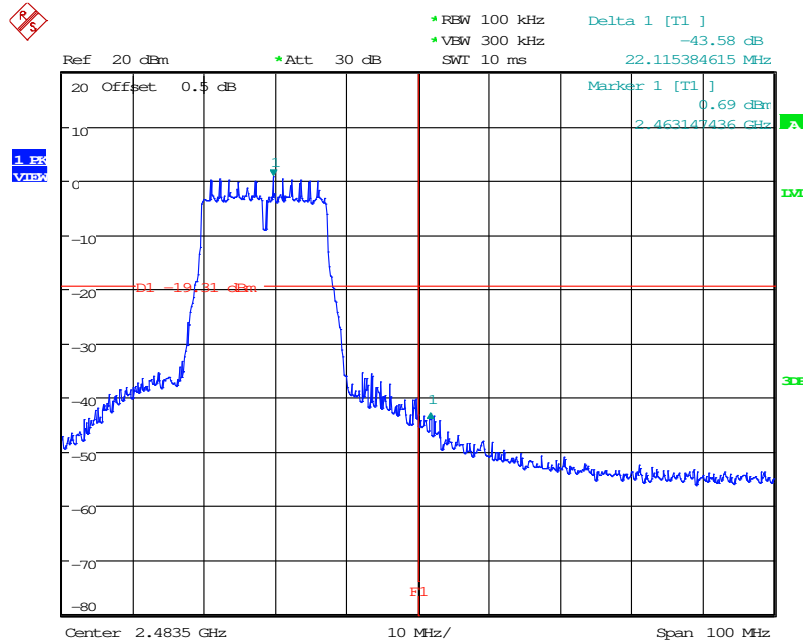
### Wi-Fi N20 mode:

### Band Edge, Left Side



Date: 29.DEC.2017 14:45:11

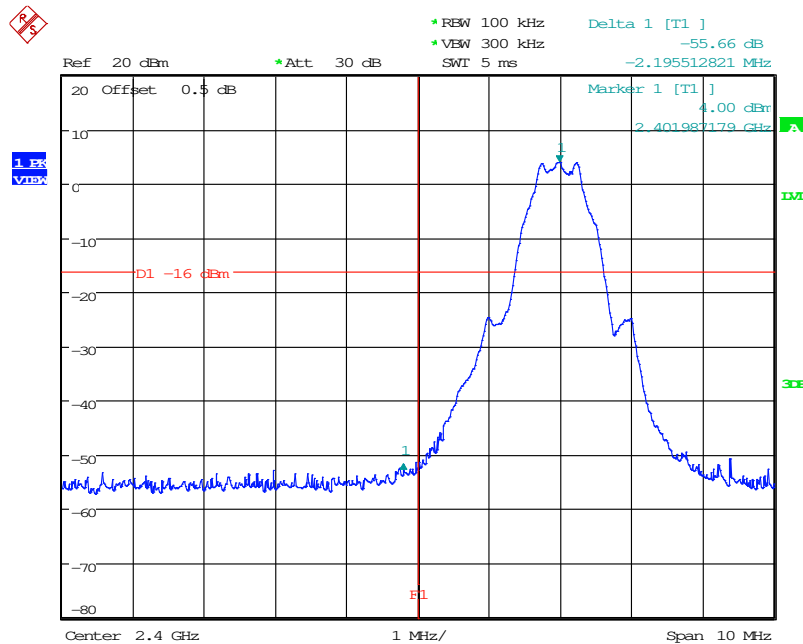
### Band Edge, Right Side



Date: 29.DEC.2017 15:00:41

### BLE mode:

### Band Edge, Left Side



Date: 29.DEC.2017 15:33:40





## 11 FCC §15.247(e) – Power Spectral Density

### 11.1 Applicable Standard

According to FCC §15.247(e).

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

### 11.2 Test Procedure

According to ANSI C63.10-2013

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

### 11.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21

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

**11.4 Test Environmental Conditions**

<b>Temperature:</b>	26° C
<b>Relative Humidity:</b>	58 %
<b>ATM Pressure:</b>	1010 hPa

The testing was performed by Ian Tu on 2017-12-29.

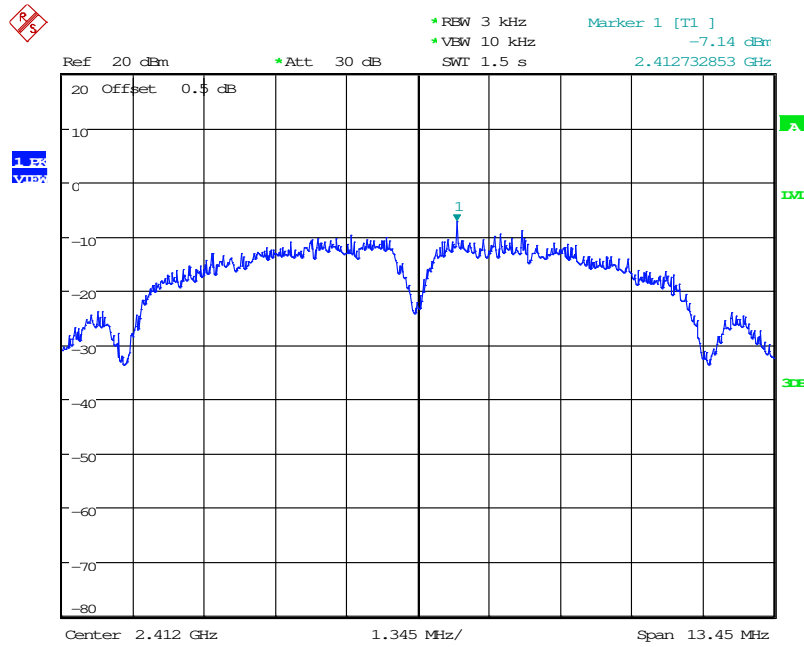
**11.5 Test Results**

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
<b>B mode</b>				
Low	2412	-7.14	8	Compliance
Middle	2437	-9.01	8	Compliance
High	2462	-9.59	8	Compliance
<b>G mode</b>				
Low	2412	-11.91	8	Compliance
Middle	2437	-12.30	8	Compliance
High	2462	-12.15	8	Compliance
<b>N20 mode</b>				
Low	2412	-12.57	8	Compliance
Middle	2437	-12.76	8	Compliance
High	2462	-13.42	8	Compliance
<b>BLE mode</b>				
Low	2402	-9.53	8	Compliance
Middle	2440	-9.75	8	Compliance
High	2480	-10.48	8	Compliance

Please refer to the following plots

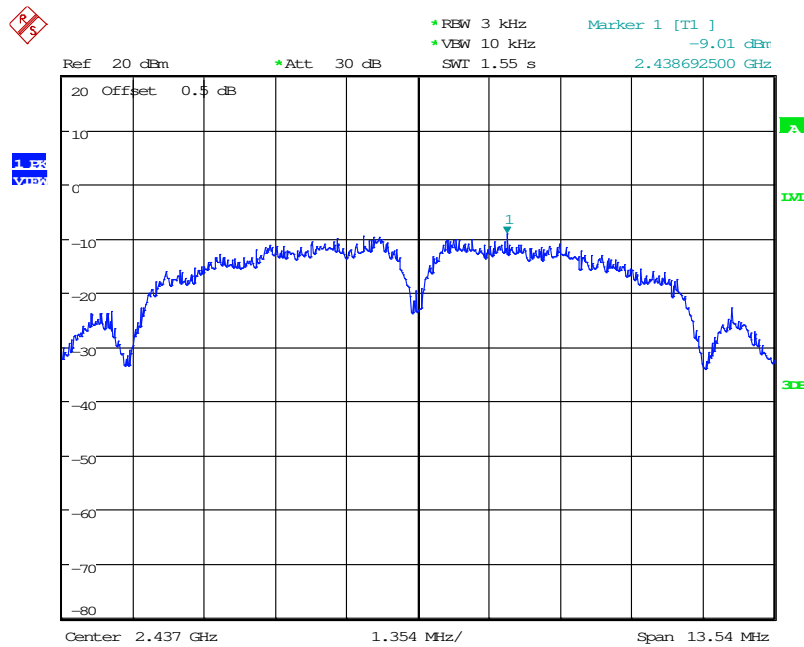
### Wi-Fi B mode:

#### Low Channel



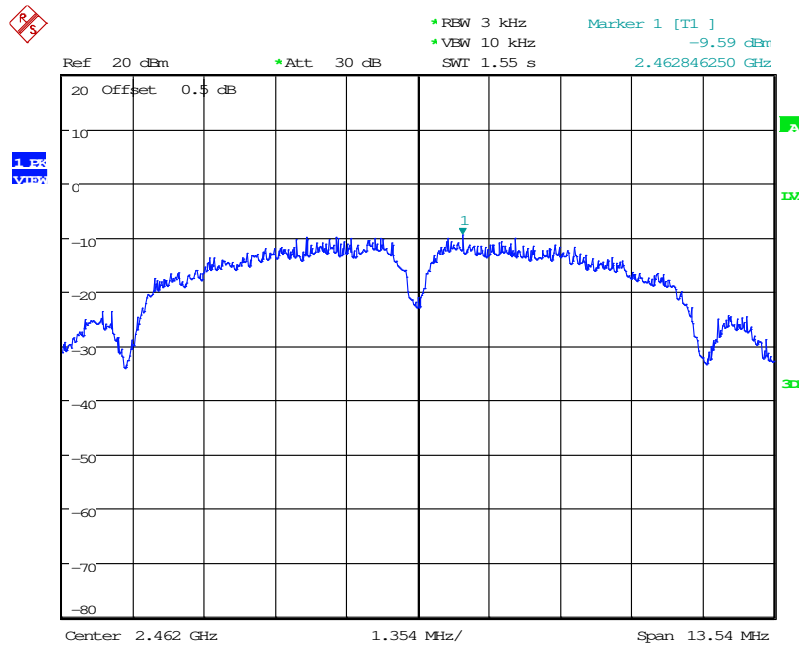
Date: 29.DEC.2017 13:00:51

#### Middle Channel



Date: 29.DEC.2017 13:02:14

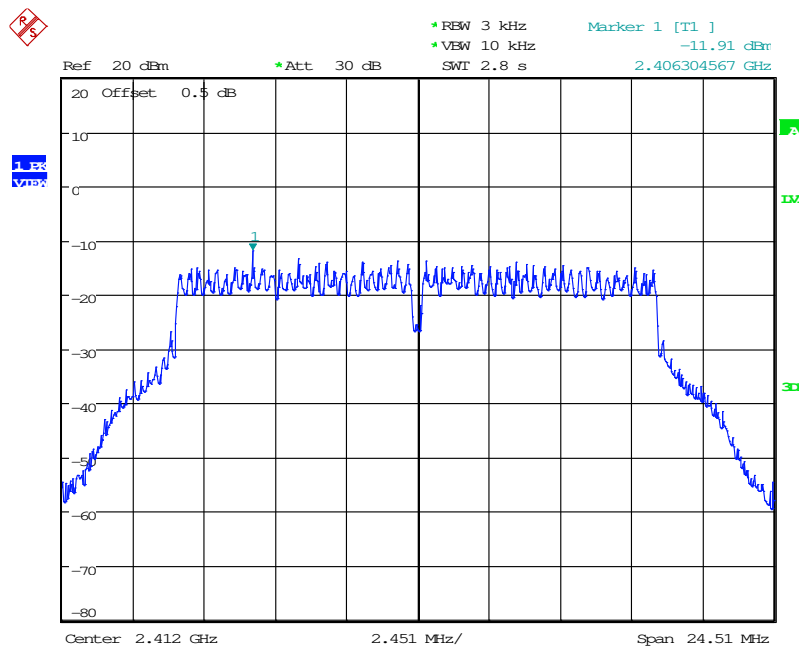
### High Channel



Date: 29.DEC.2017 13:03:05

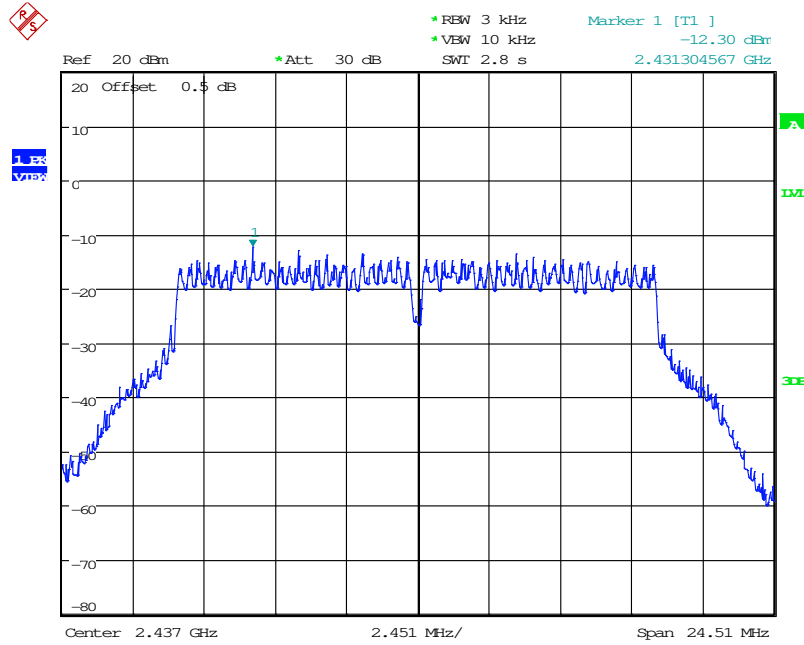
### Wi-Fi G mode:

### Low Channel



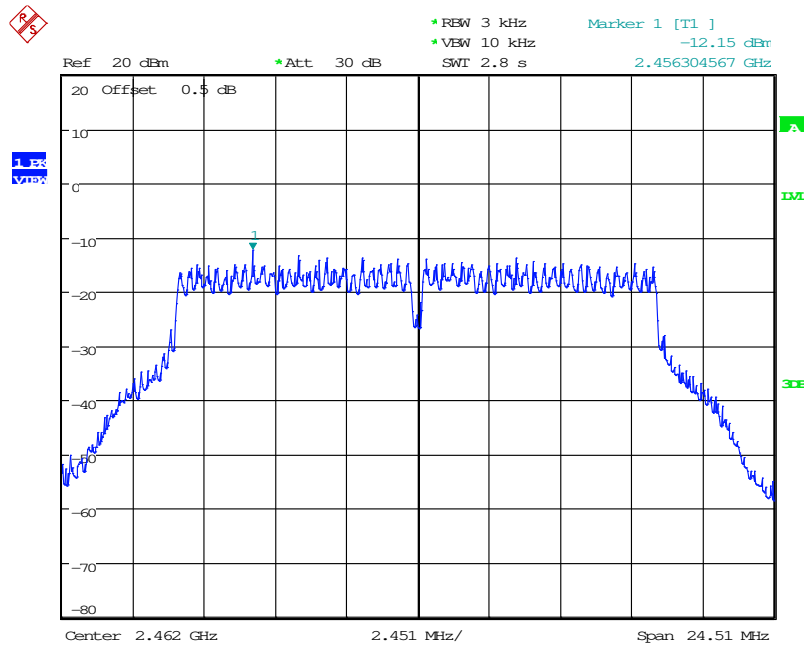
Date: 29.DEC.2017 14:10:55

### Middle Channel



Date: 29.DEC.2017 14:11:58

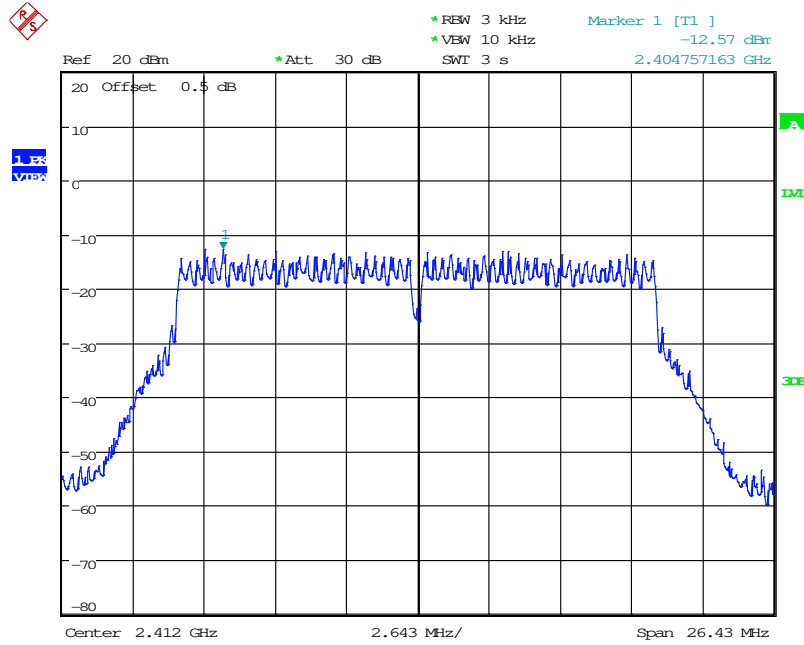
### High Channel



Date: 29.DEC.2017 14:13:53

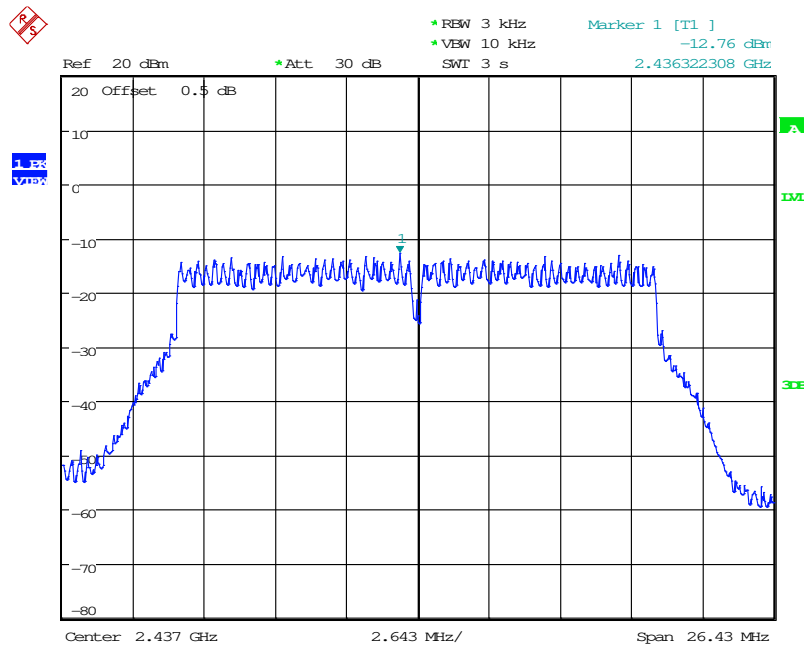
**Wi-Fi N20 mode:**

**Low Channel**



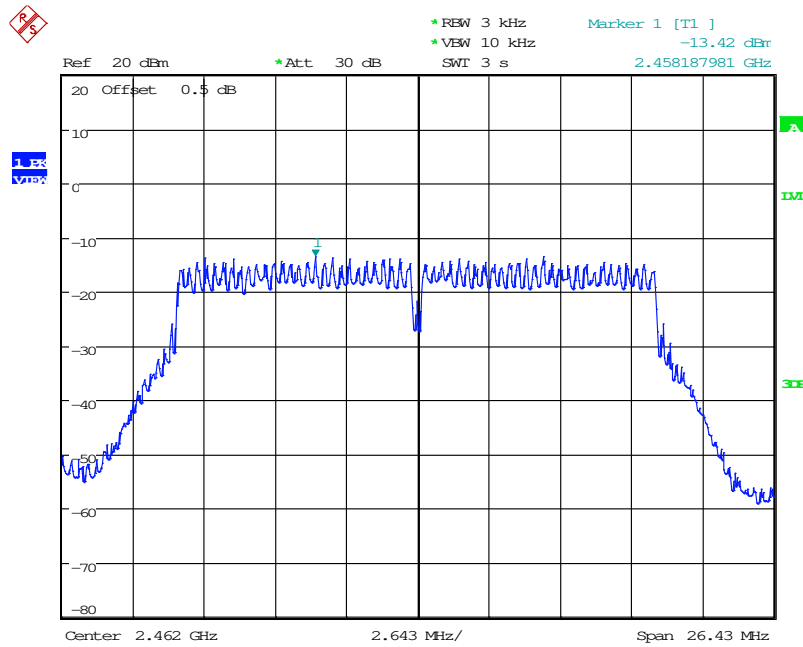
Date: 29.DEC.2017 15:10:44

**Middle Channel**



Date: 29.DEC.2017 15:09:31

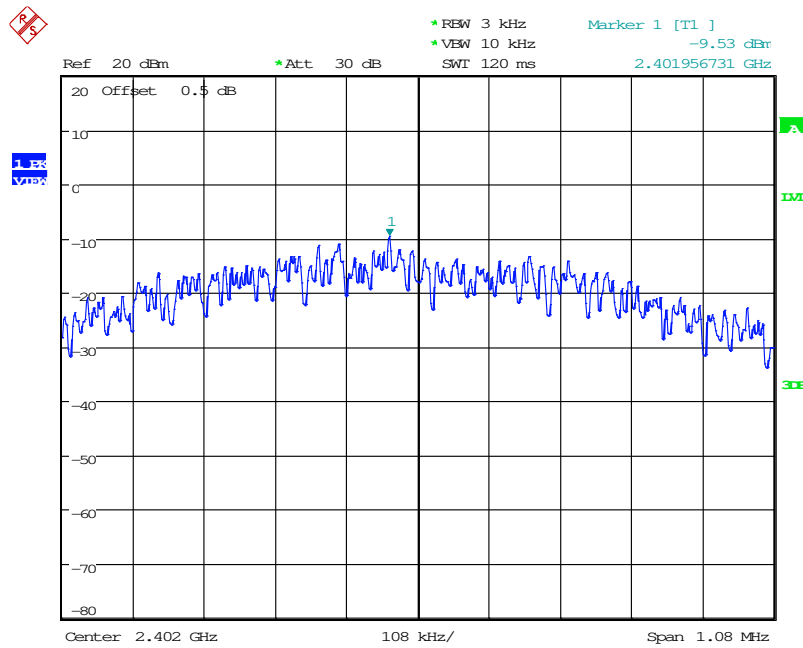
### High Channel



Date: 29.DEC.2017 15:06:54

### BLE mode:

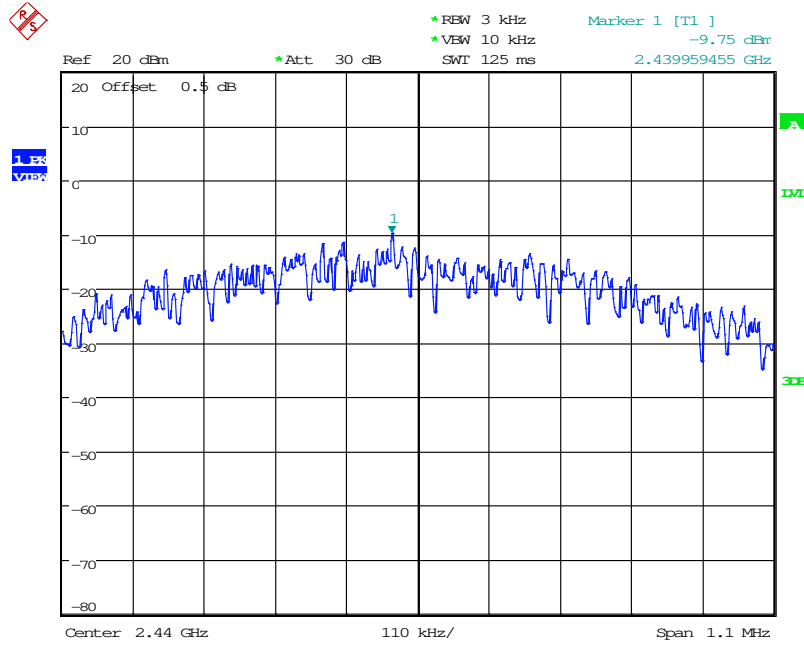
### Low Channel



Date: 29.DEC.2017 16:02:44

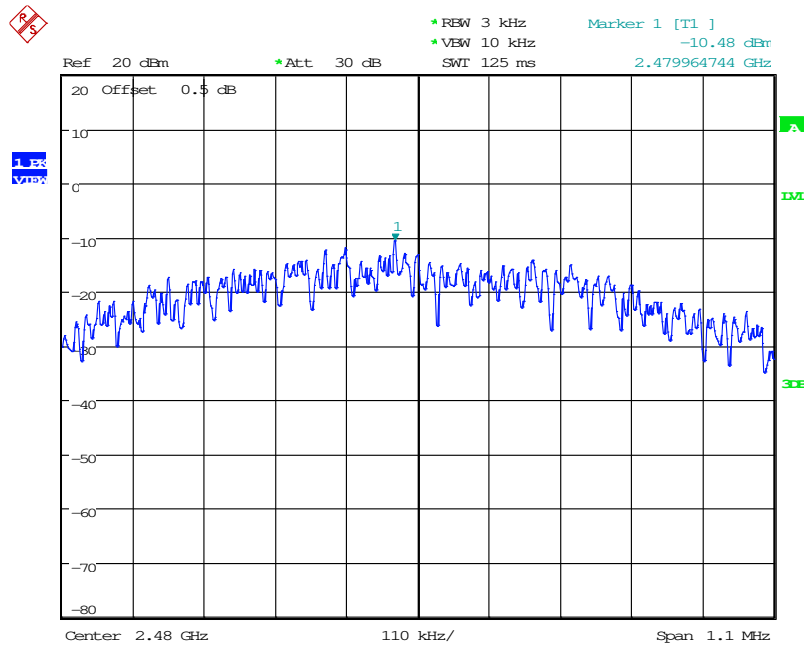


### Middle Channel



Date: 29.DEC.2017 16:04:42

### High Channel



Date: 29.DEC.2017 16:04:19

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