FCC Part 15.247

TEST REPORT

For

AAEON Technology Inc.

5F, No. 135, Lane 235, Pao Chiao Rd., Hsin-Tien Dist., New Taipei City 23145, Taiwan, R.O.C

FCC ID: OHBBOXERRK99WB

Report Type Original Report	**Product Type:** Embedded Controller
Report Producer :	**Himiko Chen**
Report Number :	**RLK1808007-00B**
Report Date :	**2018/10/16**
Reviewed By:	**Jerry Chang**
Prepared By:	**Bay Area Compliance Laboratories Corp.(Taiwan)** **70, Lane 169, Sec. 2, Datong Road, Xizhi Dist.,** **New Taipei City 22183, Taiwan, R.O.C.** **Tel: +886 (2)2647 6898** **Fax: +886 (2) 2647 6895** **www.bacl.com.tw**

***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	Report Number	Issue Date	Description	Author/Revised by
1.0	RLK1808007-00B	2018/10/16	Original Report	Himiko Chen

TABLE OF CONTENTS

1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	**AAEON Technology Inc.** 5F, No. 135, Lane 235, Pao Chiao Rd., Hsin-Tien Dist., New Taipei City 23145, Taiwan, R.O.C
Manufacturer	**AAEON Technology Inc**. 5F, No. 135, Lane 235, Pao Chiao Rd., Hsin-Tien Dist., New Taipei City 23145, Taiwan, R.O.C
Brand(Trade) Name	AAEON
Product (Equipment)	Embedded Controller
Model Name	BOXER-RK99
Series Model	xBOXER-RK99x (x - Where x may be any combination of alphanumeric characters or "-"or blank.)
Model Discrepancy	For marketing purpose
EUT Function	IEEE 802.11 bgn + BT4.1
Frequency Range	IEEE 802.11 b/g/n HT20 mode: 2412 ~ 2462 MHz BLE mode : 2402 ~ 2480 MHz
Number of Channels	IEEE 802.11 b/g/n HT20 mode: 11 Channels BLE mode : 40 Channels
Output Power	IEEE 802.11b mode: 16.21 dBm (0.042 W) IEEE 802.11g mode: 22.95 dBm (0.197 W) IEEE 802.11n HT20 mode: 22.78 dBm (0.190 W) BLE mode: 2.72 dBm (0.0019W)
Received Date	Aug. 19, 2018.
Date of Test	Aug. 19, 2018 ~ Oct. 16, 2018
Related Submittal(s)/Grant(s)	FCC Part 15.247 DSS with FCC ID : OHBBOXERRK99WB
Modulation Type	IEEE 802.11b mode: DSSS IEEE 802.11g/n HT 20 mode: OFDM BLE mode : GFSK 1Mbps

**All measurement and test data in this report was gathered from production sample serial number: 1808007*

(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-RK99 is the testing sample, and the final test data are shown on this test report.

1.2 Operation Condition of EUT

Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter *Brand Name: FSP* *Model: FSP060-DIBAN2* *I/P: 100-240Vac,1.5A* *O/P: 12Vdc,5A* ☐ By Power Core
	☐ DC Type ☐ DC Power Supply ☐ Battery ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System

**The worst was Adapter mode*

1.3 Objective and Test Methodology

The Objective and Test Methodology of this Test Report was to document the compliance of the InnoComm Mobile Technology Corporation Appliance (Model: BOXER-RK99; xBOXER-RK99x (x - Where x may be any combination of alphanumeric characters or "-"or blank.)) to the requirements of the following Standards:

-Part 2, Subpart J, Part 15, Subparts A and C, section 15.247 of the Federal Communication Commission's rules.

- ANSI C63.10-2013 of t American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.4 Measurement Uncertainty

Parameter	Expanded Measurement uncertainty
RF output power with Power Meter	± 0.55 dB
Occupied Channel Bandwidth	± 4.45 %
RF Conducted test with Spectrum	± 1.45 dB
AC Power Line Conducted Emission	± 4.64 dB
Radiated Below 1G	± 5.83 dB
Radiated Above 1G-18G	± 5.35 dB
Radiated Above 18G-40G	± 4.49 dB

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.

2 System Test Configuration

2.1 Description of Test Configuration

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

No special accessory, No modification was made to the EUT and No special equipment used during test.

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**	20	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 Peak power and PSD across all data rates and modulations of all bandwidth.

Radiated below 1G were tested worst output power mode.

2.2 Description of Worst Test Configuration

Modulation Used for Conformance Test			
Configuration	**NTX**	**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-1 Mbps	1 Mbps

Worst Case of Power Setting				
EUT Exercise Software		RFTestTool		
Configuration	**NTX**	**Low CH**	**Mid CH**	**High CH**
802.11b mode	1	0	0	0
802.11g mode	1	0	0	0
802.11n HT 20 mode	1	0	0	0
BLE mode	1	Default	Default	Default

2.3 Support Equipment List and Details

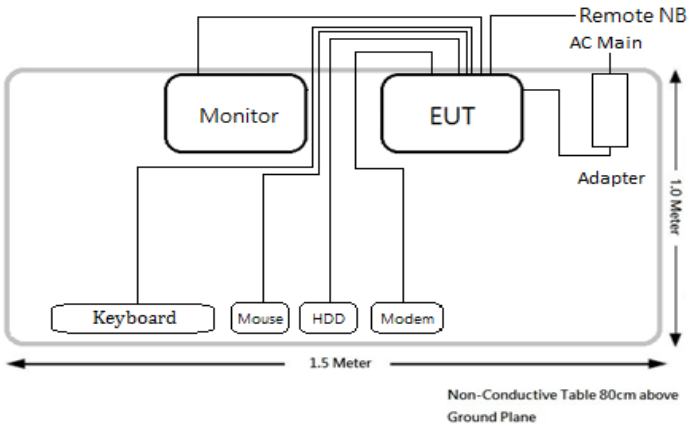
No.	Description	Manufacturer	Model Number	BSMI	FCC ID/ DoC
1	Monitor	DELL	P2415Q	N/A	DoC
2	Adapter	FSP	FSP060-DIBAN2	R43001	DoC
3	Modem	NA	TY5600	NA	DoC
4	HDD	WD	WDBUZG0010BBK-WESN	NA	DoC
5	Mouse	ASUS	MOBTU0A	NA	DoC
6	Keyboard	ASUS	AW211	NA	DoC
7	Notebook	DELL	Latitude E5470	R33002	DoC

2.4 External Cable List and Details

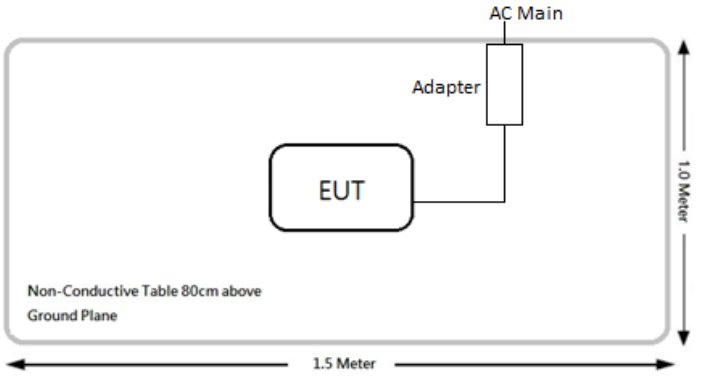
No.	Cable Description	Length (m)	From	To
1	HDIM CABLE	1.8	EUT	Monitor
2	DC CABLE	1.8	EUT	Adapter
3	RS232 CABLE	1.8	EUT	Modem
4	TYPE C TO USB 3.0 CABLE	0.1	EUT	HDD
5	USB 3.0 HDD CABLE	0.5	EUT	HDD
6	MOUSE USB CABLE	1.8	EUT	Mouse
7	KEYBOARD USB CABLE	1.8	EUT	Keyboard
8	LAN CABLE	10.0	EUT	Notebook PC

2.5 Block Diagram of Test Setup

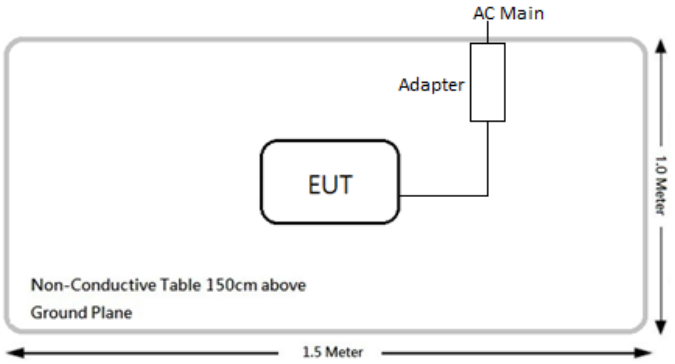
Conduction



Radiation below 1G



Radiation above 1G



2.6 Duty Cycle

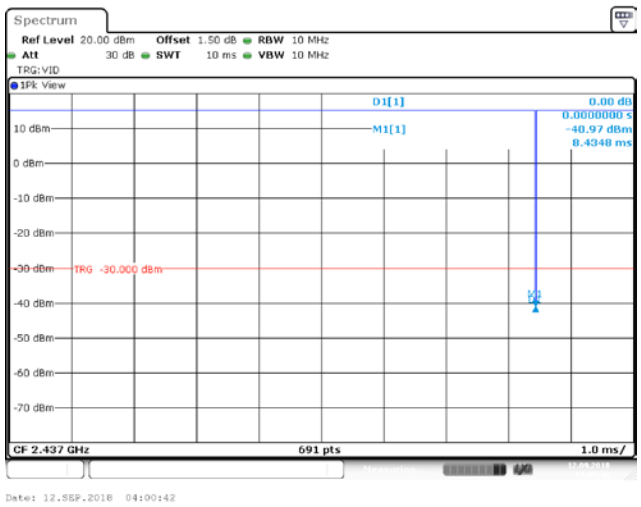
According to KDB 558074 D01 15.247 Meas Guidance v05:

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.

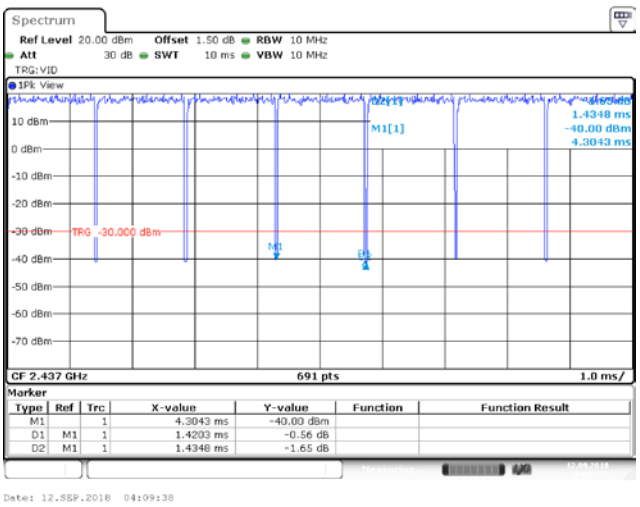
Configuration	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Factor (dB)
802.11b mode	8.43	8.43	100.00%	0.00
802.11g mode	1.42	1.43	99.30%	0.03
802.11n HT 20 mode	1.35	1.36	99.26%	0.03
BLE mode	0.42	0.62	67.74%	1.69

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

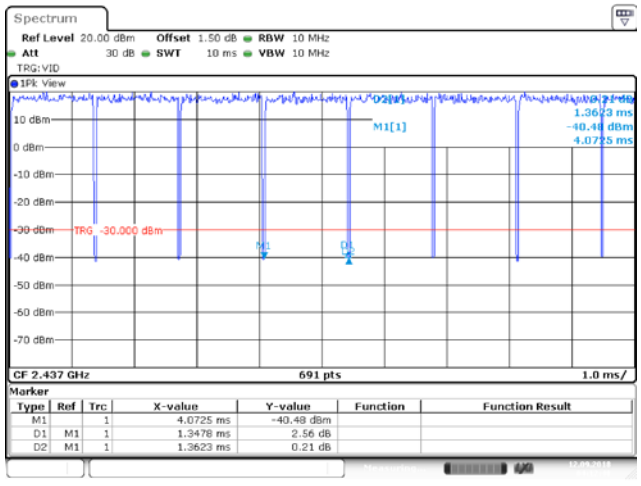
B mode



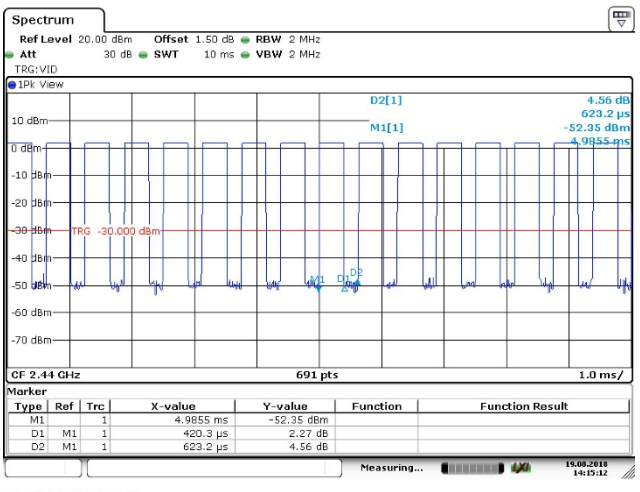
G mode



N 20 mode



BLE mode



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

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

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

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

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

4.2 RF Exposure Evaluation Result

MPE evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi 2.4G	2412-2462	2.50	1.778	23.00	199.526	20	0.0706	1
BLE	2402-2480	2.50	1.778	3.00	1.995	20	0.0007	1
BR+EDR	2402-2480	2.50	1.778	-4.00	0.398	20	0.0001	1

The Wi-Fi and BT can transmit simultaneously:

$=S_{Wi\text{-}Fi}/S_{limit\text{-}Wi\text{-}Fi} + S_{BLE}/S_{limit\text{-}BLE} = 0.0706 + 0.0007 = 0.0713 < 1.0$

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	Model	Antenna Type	Antenna Gain	Result
Aristotle	RFA-02-C2M2-M32-3	Dipole Antenna	2.50 dBi	Compliance

The EUT has an external dedicated antennas arrangement and the connector type is RP-SMA Male, fulfill the requirement of this section.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standard

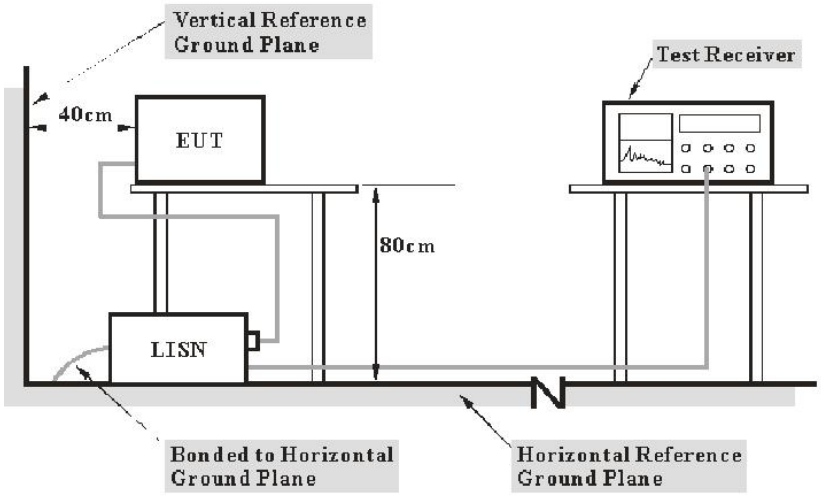
According to FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.
Note 2: A linear average detector is required

6.2 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.

6.3 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

6.4 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.

6.5 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
LISN	Rohde & Schwarz	ENV216	101612	2018/02/22	2019/02/21
LISN	Rohde & Schwarz	ENV216	101248	2018/06/27	2019/06/26
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2018/08/03	2019/08/02
RF Cable	EMEC	EM-CB5D	001	2018/07/02	2019/07/01
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

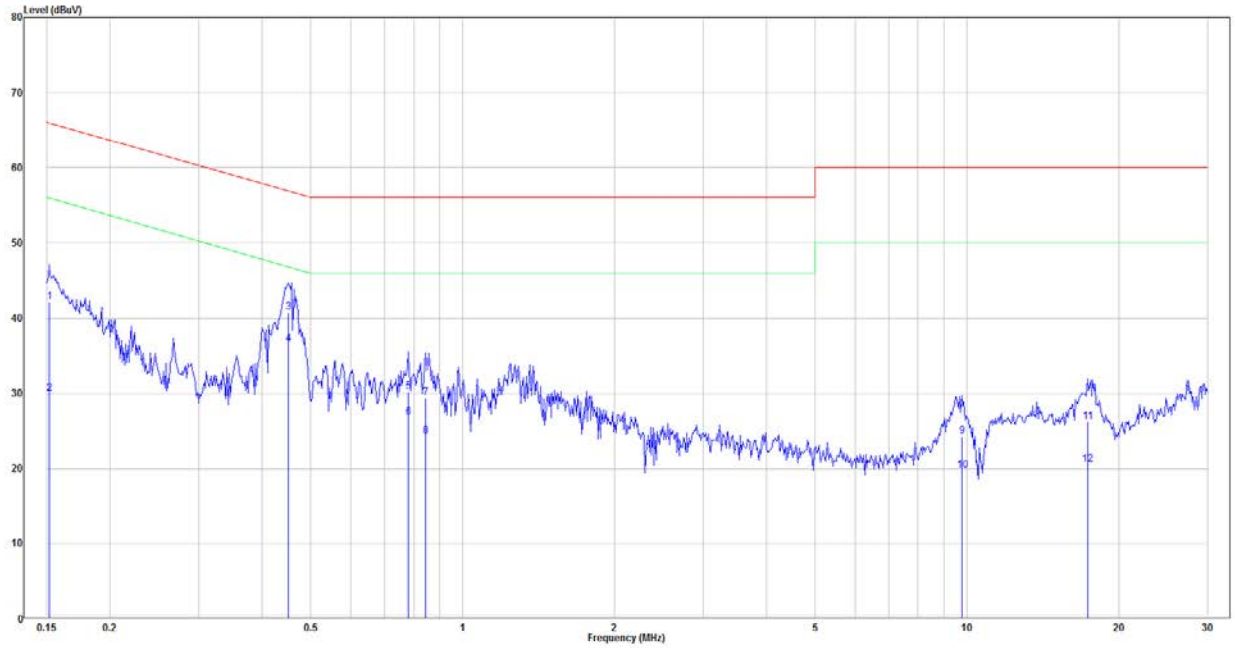
6.6 Test Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	48 %
ATM Pressure:	1010 hPa

The testing was performed by Mars Chen on 2018-10-16.

6.7 AC Line Conducted Emission Test Plot and Data

Mode: AC 120V/60 Hz, Wi-Fi mode, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.152	22.67	19.45	42.12	65.92	-23.80	QP
2	0.152	10.51	19.45	29.96	55.92	-25.96	Average
3	0.451	21.32	19.47	40.79	56.85	-16.06	QP
4	0.451	17.01	19.47	36.48	46.85	-10.37	Average
5	0.781	10.73	19.49	30.21	56.00	-25.79	QP
6	0.781	7.24	19.49	26.73	46.00	-19.27	Average
7	0.846	9.88	19.49	29.37	56.00	-26.63	QP
8	0.846	4.81	19.49	24.30	46.00	-21.70	Average
9	9.774	4.59	19.72	24.31	60.00	-35.69	QP
10	9.774	0.01	19.72	19.73	50.00	-30.27	Average
11	17.338	6.40	19.77	26.18	60.00	-33.82	QP
12	17.338	0.76	19.77	20.53	50.00	-29.47	Average

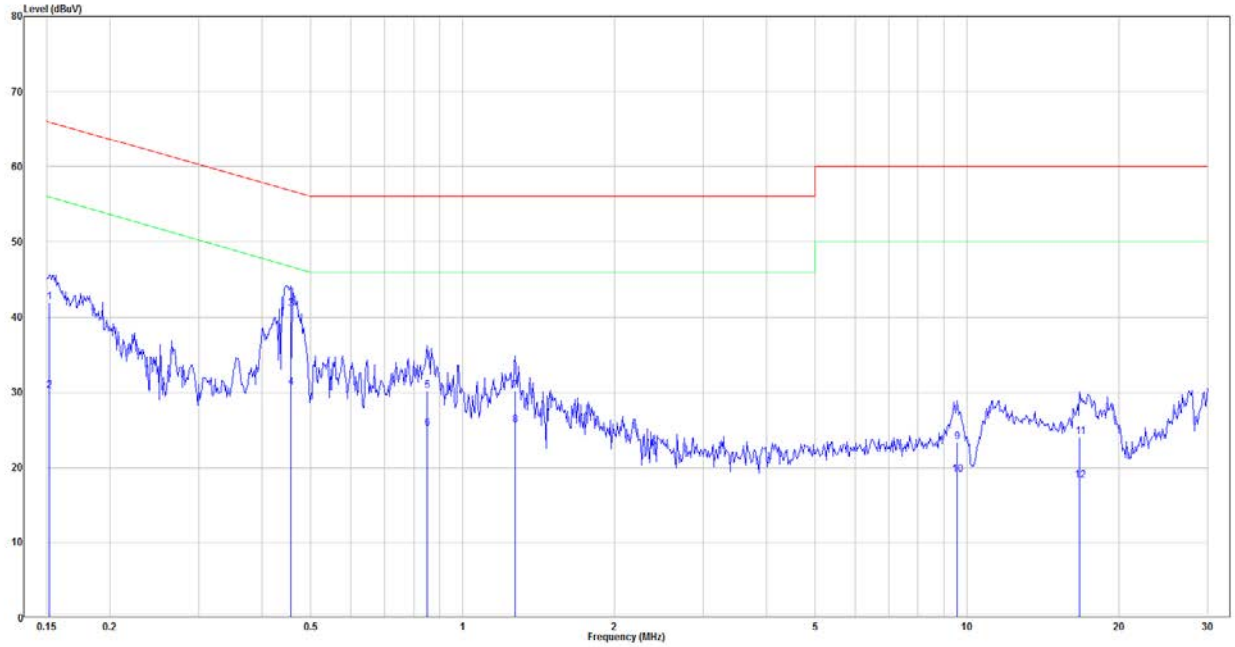
Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Mode: AC 120V/60 Hz, Wi-Fi mode, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.152	22.51	19.44	41.95	65.92	-23.96	QP
2	0.152	10.75	19.44	30.19	55.92	-25.73	Average
3	0.456	21.56	19.46	41.03	56.77	-15.74	QP
4	0.456	11.20	19.46	30.66	46.77	-16.11	Average
5	0.850	10.76	19.48	30.24	56.00	-25.76	QP
6	0.850	5.66	19.48	25.14	46.00	-20.86	Average
7	1.273	10.64	19.50	30.14	56.00	-25.86	QP
8	1.273	6.15	19.50	25.65	46.00	-20.35	Average
9	9.581	3.71	19.70	23.41	60.00	-36.59	QP
10	9.581	-0.68	19.70	19.02	50.00	-30.98	Average
11	16.744	4.27	19.79	24.06	60.00	-35.94	QP
12	16.744	-1.53	19.79	18.26	50.00	-31.74	Average

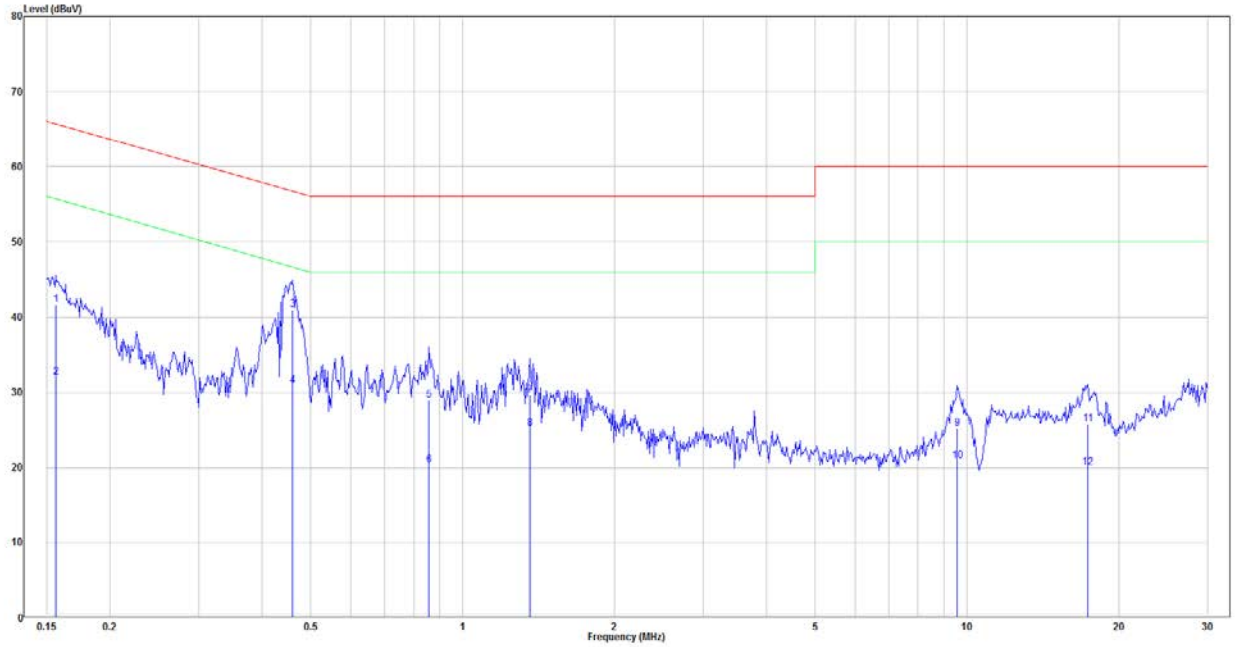
Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Mode: AC 120V/60 Hz, BLE mode, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.156	22.16	19.45	41.61	65.67	-24.05	QP
2	0.156	12.52	19.45	31.97	55.67	-23.69	Average
3	0.460	21.49	19.47	40.96	56.69	-15.72	QP
4	0.460	11.44	19.47	30.92	46.69	-15.77	Average
5	0.858	9.44	19.49	28.93	56.00	-27.07	QP
6	0.858	0.82	19.49	20.31	46.00	-25.69	Average
7	1.358	10.13	19.52	29.65	56.00	-26.35	QP
8	1.358	5.69	19.52	25.20	46.00	-20.80	Average
9	9.581	5.45	19.71	25.16	60.00	-34.84	QP
10	9.581	1.22	19.71	20.94	50.00	-29.06	Average
11	17.338	5.99	19.77	25.76	60.00	-34.24	QP
12	17.338	0.23	19.77	20.00	50.00	-30.00	Average

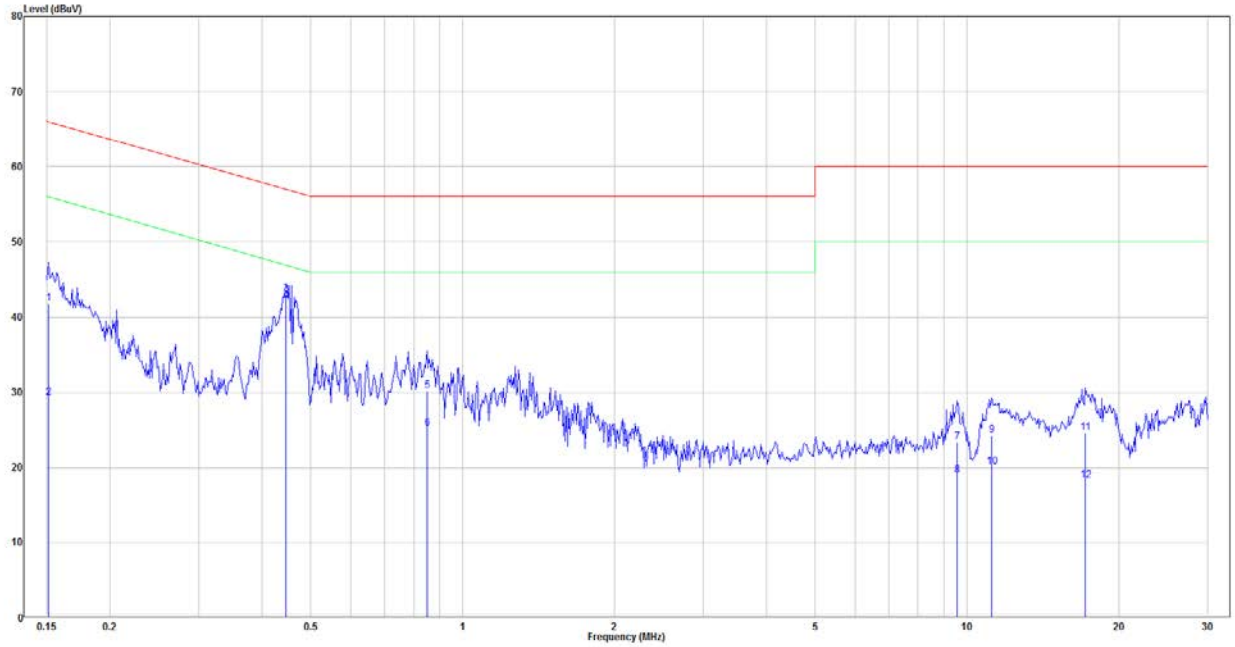
Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Mode: AC 120V/60 Hz, BLE mode, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.151	22.36	19.44	41.80	65.96	-24.16	QP
2	0.151	9.85	19.44	29.29	55.96	-26.67	Average
3	0.447	23.55	19.46	43.01	56.93	-13.92	QP
4	0.447	22.63	19.46	42.09	46.93	-4.84	Average
5	0.850	10.73	19.48	30.21	56.00	-25.79	QP
6	0.850	5.71	19.48	25.19	46.00	-20.81	Average
7	9.581	3.66	19.70	23.37	60.00	-36.63	QP
8	9.581	-0.71	19.70	18.99	50.00	-31.01	Average
9	11.182	4.58	19.73	24.31	60.00	-35.69	QP
10	11.182	0.33	19.73	20.05	50.00	-29.95	Average
11	17.166	4.85	19.80	24.65	60.00	-35.35	QP
12	17.166	-1.51	19.80	18.29	50.00	-31.71	Average

Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

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) 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

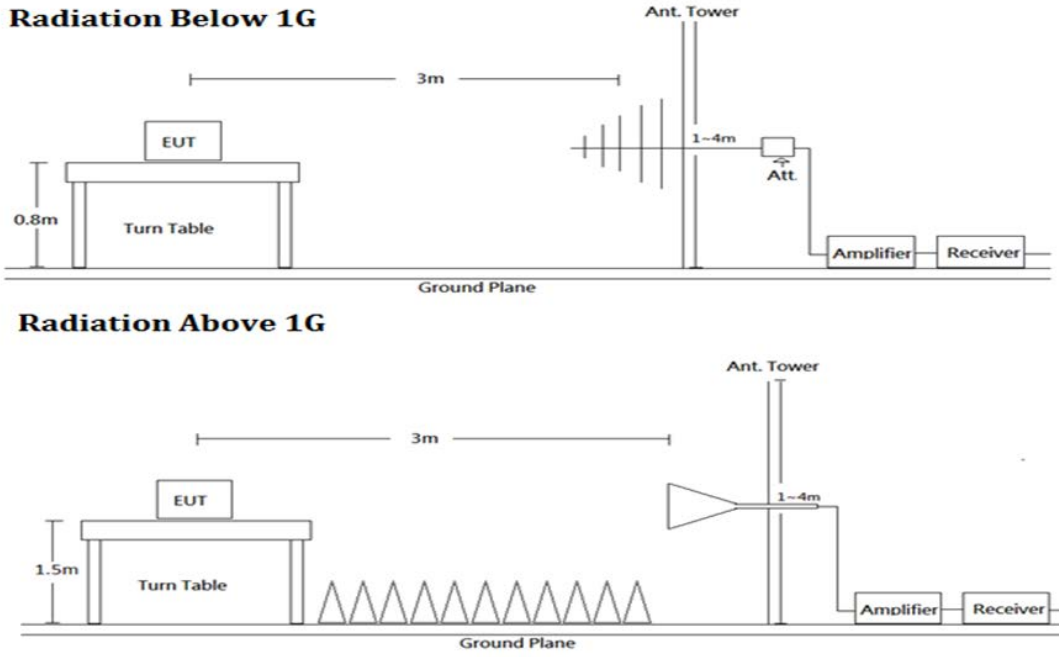
As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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 EUT Setup



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.

7.3 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

7.4 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.

7.5 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
966A Room					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2017/12/20	2018/12/19
Horn Antenna	EMCO	3115	9311-4158	2018/04/20	2019/04/19
Horn Antenna	ETS-Lindgren	3116	62638	2018/08/29	2019/08/28
Preamplifier	Sonoma	310N	130602	2018/07/04	2019/07/03
Preamplifier	EM Electronics Corp.	EM01G18G	060698	2018/04/13	2019/04/12
Microware Preamplifier	EM Electronics Corporation	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	101435	2018/02/12	2019/02/13
Micro flex Cable	UTIFLEX	FSCM 64639 / (2M)	93D0127	2018/07/31	2019/07/30
Micro flex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2017/11/10	2018/11/09
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2018/01/17	2019/01/16
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2018/03/05	2019/03/04
20 dB Attenuator	NCL	BW-S20W5+	NA	Each Use	/
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	060772	N.C.R	N.C.R
Software	Farad	EZ_EMC	BACL-03A1	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2018/05/04	2019/05/03
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

7.6 Test Environmental Conditions

Temperature:	22.1 ℃
Relative Humidity:	61.0 %
ATM Pressure:	1015 hPa

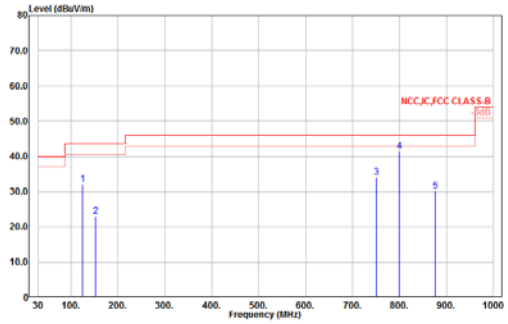
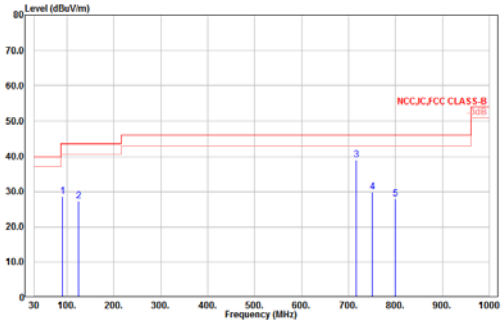
The testing was performed by Leo Cheng from 2018-09-17 to 2018-09-18.

7.7 Radiated Emission Test Plot and Data

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

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

Wi-Fi mode: Worst case is 802.11g mode Low Channel

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	125.060	31.98	43.50	-11.52	48.82	-16.84	Peak	horizontal
2	152.220	23.06	43.50	-20.44	41.62	-18.56	Peak	horizontal
3	750.710	34.05	46.00	-11.95	44.61	-10.56	Peak	horizontal
4	800.180	41.41	46.00	-4.59	51.23	-9.82	Peak	horizontal
5	875.840	30.12	46.00	-15.88	39.07	-8.95	Peak	horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	91.110	28.60	43.50	-14.90	51.37	-22.77	Peak	vertical
2	125.060	27.22	43.50	-16.28	44.06	-16.84	Peak	vertical
3	716.760	38.98	46.00	-7.02	49.94	-10.96	Peak	vertical
4	750.710	29.83	46.00	-16.17	40.39	-10.56	Peak	vertical
5	800.180	27.91	46.00	-18.09	37.73	-9.82	Peak	vertical

Wi-Fi B mode

Low Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.520	36.84	54.00	-17.16	45.53	-8.69	Average
2389.520	55.24	74.00	-18.76	63.93	-8.69	Peak
2411.136	101.12			109.86	-8.74	Average
2411.136	103.59			112.33	-8.74	Peak
4824.000	33.09	54.00	-20.91	34.11	-1.02	Average
4824.000	44.19	74.00	-29.81	45.21	-1.02	Peak
7236.000	41.20	54.00	-12.80	37.89	3.31	Average
7236.000	49.90	74.00	-24.10	46.59	3.31	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2353.904	31.38	54.00	-22.62	40.00	-8.62	Average
2353.904	45.52	74.00	-28.48	54.14	-8.62	Peak
2411.248	86.87			95.61	-8.74	Average
2411.248	89.51			98.25	-8.74	Peak
4824.000	29.14	54.00	-24.86	30.16	-1.02	Average
4824.000	43.18	74.00	-30.82	44.20	-1.02	Peak
7236.000	32.94	54.00	-21.06	29.63	3.31	Average
7236.000	46.22	74.00	-27.78	42.91	3.31	Peak

Mid Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.440	34.58	54.00	-19.42	43.27	-8.69	Average
2389.440	49.70	74.00	-24.30	58.39	-8.69	Peak
2436.240	100.55			109.31	-8.76	Average
2436.240	103.21			111.97	-8.76	Peak
2510.160	33.93	54.00	-20.07	42.72	-8.79	Average
2510.160	47.17	74.00	-26.83	55.96	-8.79	Peak
4874.000	32.72	54.00	-21.28	34.01	-1.29	Average
4874.000	43.96	74.00	-30.04	45.25	-1.29	Peak
7311.000	40.08	54.00	-13.92	36.41	3.67	Average
7311.000	50.41	74.00	-23.59	46.74	3.67	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2362.080	31.29	54.00	-22.71	39.92	-8.63	Average
2362.080	47.12	74.00	-26.88	55.75	-8.63	Peak
2436.000	85.20			93.96	-8.76	Average
2436.000	87.81			96.57	-8.76	Peak
2485.920	30.74	54.00	-23.26	39.53	-8.79	Average
2485.920	45.47	74.00	-28.53	54.26	-8.79	Peak
4874.000	30.41	54.00	-23.59	31.37	-0.96	Average
4874.000	44.73	74.00	-29.27	45.69	-0.96	Peak
7311.000	33.72	54.00	-20.28	30.05	3.67	Average
7311.000	47.94	74.00	-26.06	44.27	3.67	Peak

High Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2461.114	99.23			107.99	-8.76	Average
2461.114	101.83			110.59	-8.76	Peak
2483.654	40.58	54.00	-13.42	49.36	-8.78	Average
2483.654	52.87	74.00	-21.13	61.65	-8.78	Peak
4924.000	34.66	54.00	-19.34	35.41	-0.75	Average
4924.000	45.02	74.00	-28.98	45.77	-0.75	Peak
7386.000	40.80	54.00	-13.20	36.99	3.81	Average
7386.000	50.56	74.00	-23.44	46.75	3.81	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2460.428	84.93			93.69	-8.76	Average
2460.428	87.68			96.44	-8.76	Peak
2489.534	31.42	54.00	-22.58	40.21	-8.79	Average
2489.534	45.55	74.00	-28.45	54.34	-8.79	Peak
4924.000	29.66	54.00	-24.34	30.41	-0.75	Average
4924.000	43.75	74.00	-30.25	44.50	-0.75	Peak
7386.000	34.59	54.00	-19.41	30.78	3.81	Average
7386.000	48.70	74.00	-25.30	44.89	3.81	Peak

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

Low Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.968	47.18	54.00	-6.82	55.87	-8.69	Average
2389.968	64.75	74.00	-9.25	73.44	-8.69	Peak
2411.360	96.97			105.71	-8.74	Average
2411.360	106.43			115.17	-8.74	Peak
4824.000	30.08	54.00	-23.92	31.37	-1.29	Average
4824.000	43.82	74.00	-30.18	45.11	-1.29	Peak
7236.000	34.89	54.00	-19.11	31.63	3.26	Average
7236.000	48.11	74.00	-25.89	44.85	3.26	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.856	37.99	54.00	-16.01	46.68	-8.69	Average
2389.856	56.91	74.00	-17.09	65.60	-8.69	Peak
2411.360	82.34			91.08	-8.74	Average
2411.360	96.43			105.17	-8.74	Peak
4824.000	30.61	54.00	-23.39	31.49	-0.88	Average
4824.000	43.63	74.00	-30.37	44.51	-0.88	Peak
7236.000	33.92	54.00	-20.08	30.61	3.31	Average
7236.000	46.15	74.00	-27.85	42.84	3.31	Peak

Mid Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2388.000	38.98	54.00	-15.02	47.67	-8.69	Average
2388.000	54.52	74.00	-19.48	63.21	-8.69	Peak
2436.480	95.86			104.62	-8.76	Average
2436.480	105.98			114.74	-8.76	Peak
2484.000	38.32	54.00	-15.68	47.10	-8.78	Average
2484.000	52.56	74.00	-21.44	61.34	-8.78	Peak
4874.000	30.16	54.00	-23.84	31.04	-0.88	Average
4874.000	42.96	74.00	-31.04	43.84	-0.88	Peak
7311.000	35.62	54.00	-18.38	32.11	3.51	Average
7311.000	49.89	74.00	-24.11	46.38	3.51	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2383.200	36.30	54.00	-17.70	44.98	-8.68	Average
2383.200	50.21	74.00	-23.79	58.89	-8.68	Peak
2436.480	81.13			89.89	-8.76	Average
2436.480	91.23			99.99	-8.76	Peak
2515.680	36.36	54.00	-17.64	45.14	-8.78	Average
2515.680	50.30	74.00	-23.70	59.08	-8.78	Peak
4874.000	30.36	54.00	-23.64	31.25	-0.89	Average
4874.000	43.14	74.00	-30.86	44.03	-0.89	Peak
7311.000	34.91	54.00	-19.09	31.43	3.48	Average
7311.000	47.62	74.00	-26.38	44.14	3.48	Peak

High Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2462.584	94.80			103.56	-8.76	Average
2462.584	104.84			113.60	-8.76	Peak
2483.654	46.76	54.00	-7.24	55.54	-8.78	Average
2483.654	69.06	74.00	-4.94	77.84	-8.78	Peak
4924.000	30.47	54.00	-23.53	31.22	-0.75	Average
4924.000	43.99	74.00	-30.01	44.74	-0.75	Peak
7386.000	35.54	54.00	-18.46	31.76	3.78	Average
7386.000	48.54	74.00	-25.46	44.76	3.78	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2461.310	80.46			89.22	-8.76	Average
2461.310	90.42			99.18	-8.76	Peak
2483.654	37.34	54.00	-16.66	46.12	-8.78	Average
2483.654	54.09	74.00	-19.91	62.87	-8.78	Peak
4924.000	29.83	54.00	-24.17	30.58	-0.75	Average
4924.000	44.06	74.00	-29.94	44.81	-0.75	Peak
7386.000	34.21	54.00	-19.79	30.40	3.81	Average
7386.000	48.09	74.00	-25.91	44.28	3.81	Peak

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

Low Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.968	48.40	54.00	-5.60	57.09	-8.69	Average
2389.968	69.86	74.00	-4.14	78.55	-8.69	Peak
2410.352	96.07			104.81	-8.74	Average
2410.352	106.66			115.40	-8.74	Peak
4824.000	30.48	54.00	-23.52	31.50	-1.02	Average
4824.000	43.19	74.00	-30.81	44.21	-1.02	Peak
7236.000	34.62	54.00	-19.38	31.31	3.31	Average
7236.000	47.19	74.00	-26.81	43.88	3.31	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2383.472	37.00	54.00	-17.00	45.68	-8.68	Average
2383.472	52.58	74.00	-21.42	61.26	-8.68	Peak
2410.240	81.40			90.14	-8.74	Average
2410.240	92.87			101.61	-8.74	Peak
4824.000	30.47	54.00	-23.53	31.49	-1.02	Average
4824.000	43.58	74.00	-30.42	44.60	-1.02	Peak
7236.000	33.53	54.00	-20.47	30.18	3.35	Average
7236.000	46.78	74.00	-27.22	43.43	3.35	Peak

Mid Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2389.440	38.97	54.00	-15.03	47.66	-8.69	Average
2389.440	55.13	74.00	-18.87	63.82	-8.69	Peak
2436.960	95.34			104.10	-8.76	Average
2436.960	106.00			114.76	-8.76	Peak
2485.200	38.14	54.00	-15.86	46.93	-8.79	Average
2485.200	52.57	74.00	-21.43	61.36	-8.79	Peak
4874.000	30.52	54.00	-23.48	31.41	-0.89	Average
4874.000	43.51	74.00	-30.49	44.40	-0.89	Peak
7311.000	34.96	54.00	-19.04	31.48	3.48	Average
7311.000	47.30	74.00	-26.70	43.82	3.48	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2349.360	36.36	54.00	-17.64	44.96	-8.60	Average
2349.360	50.75	74.00	-23.25	59.35	-8.60	Peak
2436.000	80.31			89.07	-8.76	Average
2436.000	91.23			99.99	-8.76	Peak
2501.040	36.26	54.00	-17.74	45.07	-8.81	Average
2501.040	50.25	74.00	-23.75	59.06	-8.81	Peak
4874.000	30.54	54.00	-23.46	31.42	-0.88	Average
4874.000	42.88	74.00	-31.12	43.76	-0.88	Peak
7311.000	33.73	54.00	-20.27	30.22	3.51	Average
7311.000	46.12	74.00	-27.88	42.61	3.51	Peak

High Channel

Horizontal

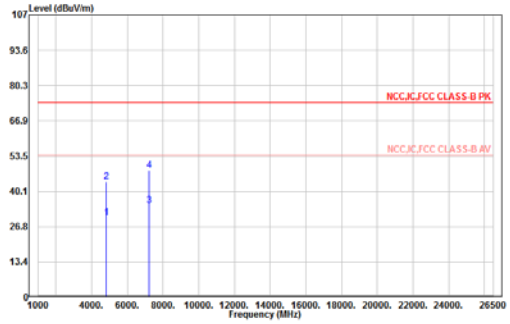
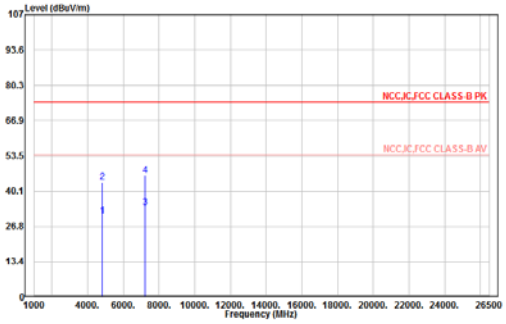
Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2459.840	93.89			102.65	-8.76	Average
2459.840	105.67			114.43	-8.76	Peak
2483.752	48.06	54.00	-5.94	56.84	-8.78	Average
2483.752	71.76	74.00	-2.24	80.54	-8.78	Peak
4924.000	30.57	54.00	-23.43	31.32	-0.75	Average
4924.000	43.70	74.00	-30.30	44.45	-0.75	Peak
7386.000	35.31	54.00	-18.69	31.50	3.81	Average
7386.000	47.46	74.00	-26.54	43.65	3.81	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2459.938	79.74			88.50	-8.76	Average
2459.938	91.81			100.57	-8.76	Peak
2506.194	36.52	54.00	-17.48	45.31	-8.79	Average
2506.194	52.29	74.00	-21.71	61.08	-8.79	Peak
4924.000	29.59	54.00	-24.41	30.34	-0.75	Average
4924.000	42.92	74.00	-31.08	43.67	-0.75	Peak
7386.000	34.21	54.00	-19.79	30.43	3.78	Average
7386.000	47.25	74.00	-26.75	43.47	3.78	Peak

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

Above 1G (1 GHz-26.5 GHz): the output power worst case is 802.11g mode low channel

Horizontal	Vertical
	

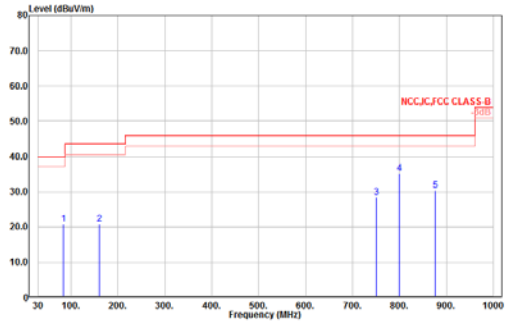
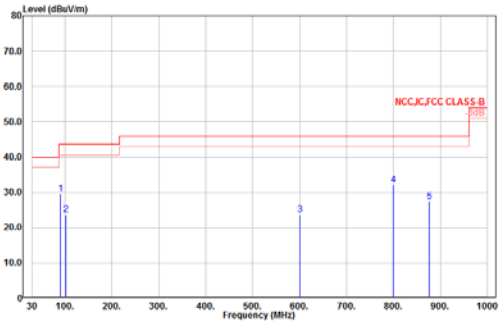
	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	4824.000	30.08	54.00	-23.92	31.37	-1.29	Average	horizontal
2	4824.000	43.82	74.00	-30.18	45.11	-1.29	Peak	horizontal
3 !	7236.000	34.89	54.00	-19.11	31.63	3.26	Average	horizontal
4	7236.000	48.11	74.00	-25.89	44.85	3.26	Peak	horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	4824.000	30.61	54.00	-23.39	31.49	-0.88	Average	vertical
2	4824.000	43.63	74.00	-30.37	44.51	-0.88	Peak	vertical
3	7236.000	33.92	54.00	-20.08	30.61	3.31	Average	vertical
4	7236.000	46.15	74.00	-27.85	42.84	3.31	Peak	vertical

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

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

BLE mode: Worst case is BLE Low Channel

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	83.350	20.76	40.00	-19.24	43.54	-22.78	Peak	horizontal
2	160.950	20.88	43.50	-22.62	39.62	-18.74	Peak	horizontal
3	750.710	28.43	46.00	-17.57	38.99	-10.56	Peak	horizontal
4	800.180	35.17	46.00	-10.83	44.99	-9.82	Peak	horizontal
5	875.840	30.37	46.00	-15.63	39.32	-8.95	Peak	horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	91.110	29.42	43.50	-14.08	52.19	-22.77	Peak	vertical
2	101.780	23.56	43.50	-19.94	43.76	-20.20	Peak	vertical
3	600.360	23.65	46.00	-22.35	36.43	-12.78	Peak	vertical
4	800.180	31.99	46.00	-14.01	41.81	-9.82	Peak	vertical
5	875.840	27.30	46.00	-18.70	36.25	-8.95	Peak	vertical

BLE mode

Low Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2321.700	37.38	54.00	-16.62	45.92	-8.54	Average
2321.700	50.76	74.00	-23.24	59.30	-8.54	Peak
2401.800	100.53			109.25	-8.72	Average
2401.800	101.55			110.27	-8.72	Peak
4804.000	30.43	54.00	-23.57	31.54	-1.11	Average
4804.000	44.22	74.00	-29.78	45.33	-1.11	Peak
7206.000	32.97	54.00	-21.03	29.76	3.21	Average
7206.000	47.34	74.00	-26.66	44.13	3.21	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2345.600	37.36	54.00	-16.64	45.95	-8.59	Average
2345.600	50.01	74.00	-23.99	58.60	-8.59	Peak
2401.800	86.39			95.11	-8.72	Average
2401.800	87.43			96.15	-8.72	Peak
4804.000	29.47	54.00	-24.53	30.58	-1.11	Average
4804.000	43.62	74.00	-30.38	44.73	-1.11	Peak
7206.000	33.02	54.00	-20.98	29.81	3.21	Average
7206.000	46.56	74.00	-27.44	43.35	3.21	Peak

Mid Channel

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2371.920	37.65	54.00	-16.35	46.31	-8.66	Average
2371.920	49.77	74.00	-24.23	58.43	-8.66	Peak
2439.840	98.94			107.69	-8.75	Average
2439.840	100.00			108.75	-8.75	Peak
2492.880	37.43	54.00	-16.57	46.23	-8.80	Average
2492.880	49.82	74.00	-24.18	58.62	-8.80	Peak
4880.000	29.71	54.00	-24.29	30.58	-0.87	Average
4880.000	44.23	74.00	-29.77	45.10	-0.87	Peak
7320.000	33.34	54.00	-20.66	29.79	3.55	Average
7320.000	47.63	74.00	-26.37	44.08	3.55	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2363.760	37.42	54.00	-16.58	46.05	-8.63	Average
2363.760	50.07	74.00	-23.93	58.70	-8.63	Peak
2440.320	85.18			93.93	-8.75	Average
2440.320	86.28			95.03	-8.75	Peak
2498.160	37.35	54.00	-16.65	46.16	-8.81	Average
2498.160	50.31	74.00	-23.69	59.12	-8.81	Peak
4880.000	29.78	54.00	-24.22	30.66	-0.88	Average
4880.000	43.28	74.00	-30.72	44.16	-0.88	Peak
7320.000	32.45	54.00	-21.55	28.92	3.53	Average
7320.000	47.07	74.00	-26.93	43.54	3.53	Peak

High Channel

Horizontal

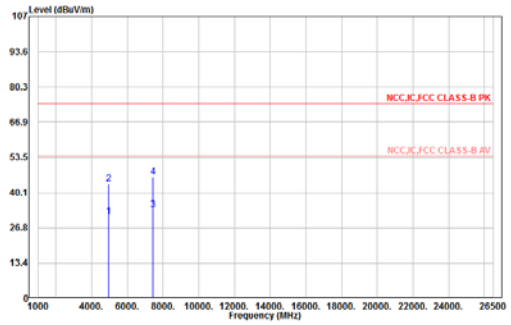
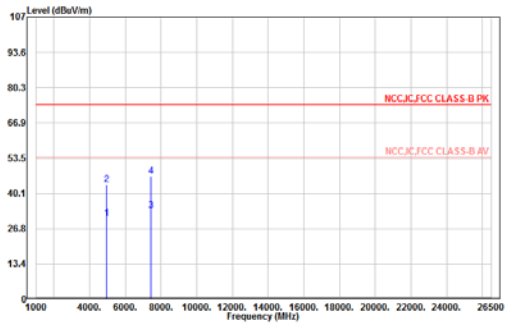
Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2480.240	97.11			105.89	-8.78	Average
2480.240	98.16			106.94	-8.78	Peak
2522.400	37.65	54.00	-16.35	46.42	-8.77	Average
2522.400	49.90	74.00	-24.10	58.67	-8.77	Peak
4960.000	31.06	54.00	-22.94	31.80	-0.74	Average
4960.000	43.58	74.00	-30.42	44.32	-0.74	Peak
7440.000	33.62	54.00	-20.38	29.65	3.97	Average
7440.000	46.13	74.00	-27.87	42.16	3.97	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2480.240	80.56			89.34	-8.78	Average
2480.240	81.66			90.44	-8.78	Peak
2503.040	37.71	54.00	-16.29	46.51	-8.80	Average
2503.040	50.12	74.00	-23.88	58.92	-8.80	Peak
4960.000	30.70	54.00	-23.30	31.44	-0.74	Average
4960.000	43.48	74.00	-30.52	44.22	-0.74	Peak
7440.000	33.61	54.00	-20.39	29.58	4.03	Average
7440.000	46.79	74.00	-27.21	42.76	4.03	Peak

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

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

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	4960.000	31.06	54.00	-22.94	31.80	-0.74	Average	horizontal
2	4960.000	43.58	74.00	-30.42	44.32	-0.74	Peak	horizontal
3	7440.000	33.62	54.00	-20.38	29.65	3.97	Average	horizontal
4	7440.000	46.13	74.00	-27.87	42.16	3.97	Peak	horizontal

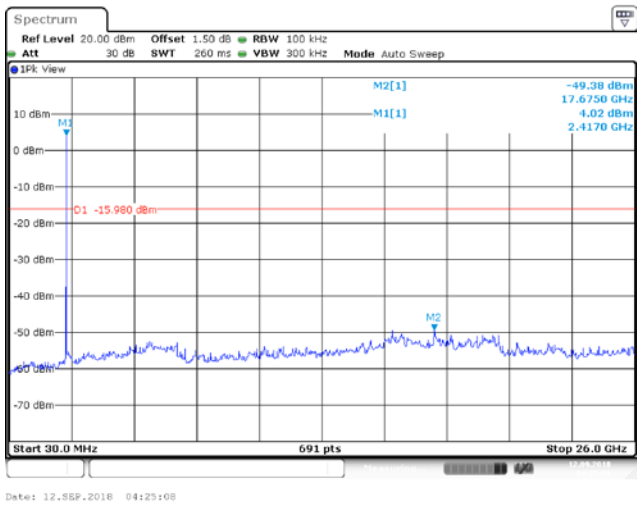
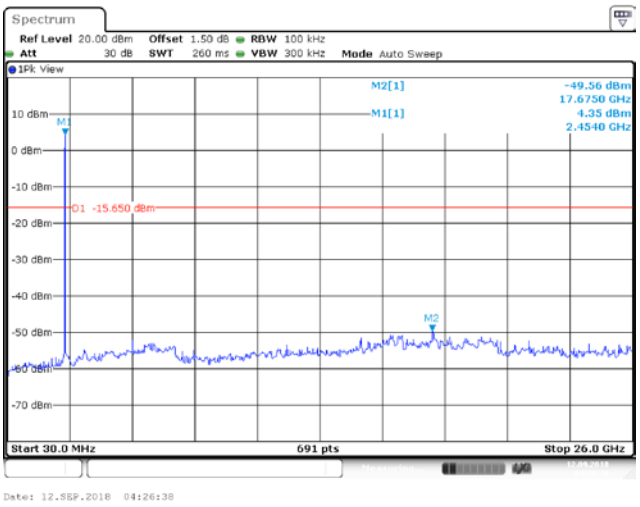
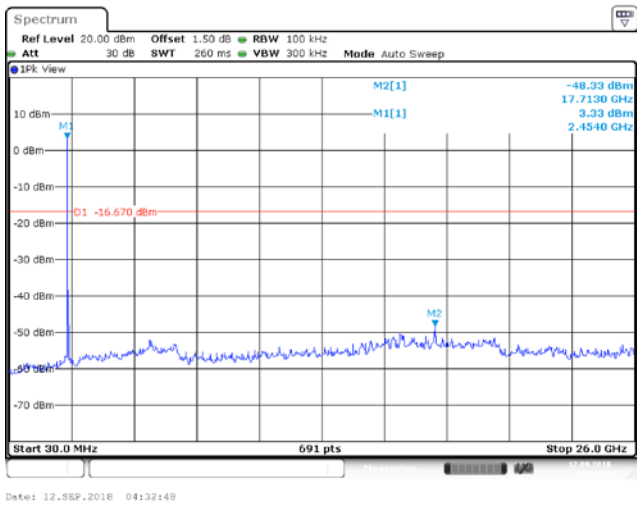
	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	4960.000	30.70	54.00	-23.30	31.44	-0.74	Average	vertical
2	4960.000	43.48	74.00	-30.52	44.22	-0.74	Peak	vertical
3	7440.000	33.61	54.00	-20.39	29.58	4.03	Average	vertical
4	7440.000	46.79	74.00	-27.21	42.76	4.03	Peak	vertical

Conducted Spurious Emissions:

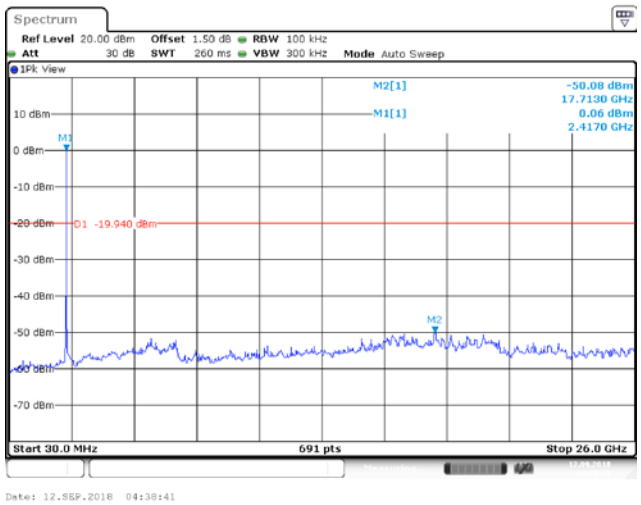
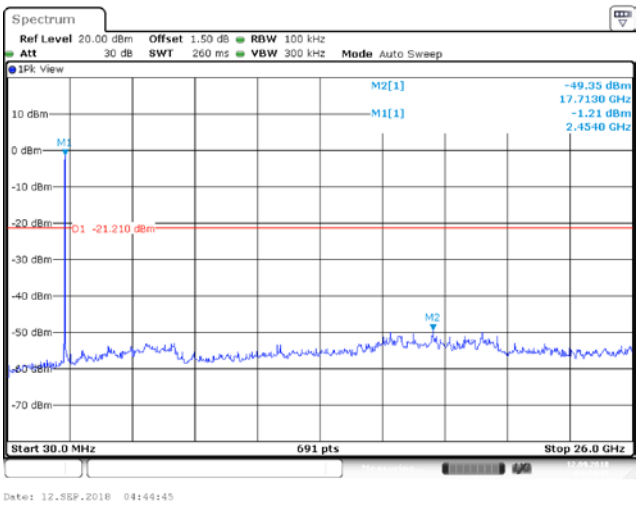
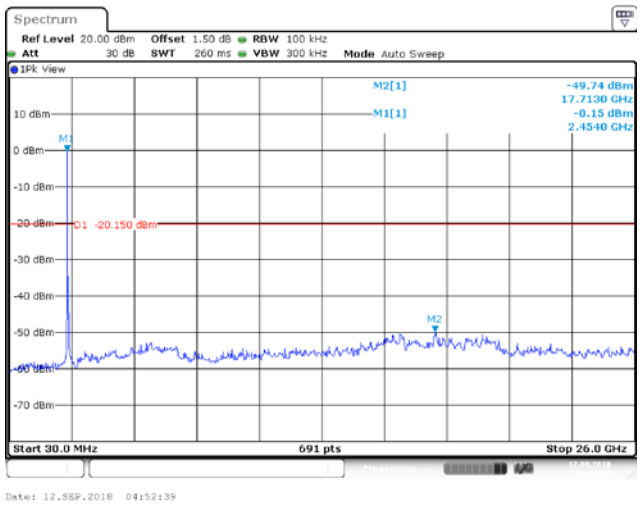
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B mode				
Low	2412	53.40	≥ 20	Compliance
Mid	2437	53.91	≥ 20	Compliance
High	2462	51.66	≥ 20	Compliance
G mode				
Low	2412	50.14	≥ 20	Compliance
Mid	2437	48.14	≥ 20	Compliance
High	2462	49.59	≥ 20	Compliance
N20 mode				
Low	2412	48.56	≥ 20	Compliance
Mid	2437	50.10	≥ 20	Compliance
High	2462	48.43	≥ 20	Compliance
BLE mode				
Low	2402	53.42	≥ 20	Compliance
Mid	2440	51.61	≥ 20	Compliance
High	2480	52.26	≥ 20	Compliance

Please refer to the following plots

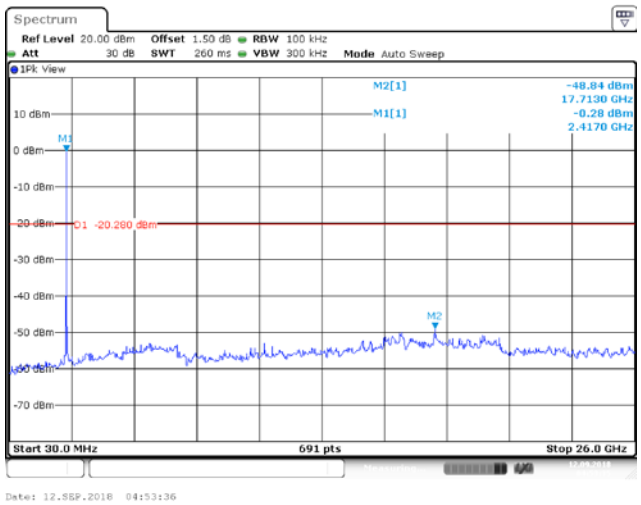
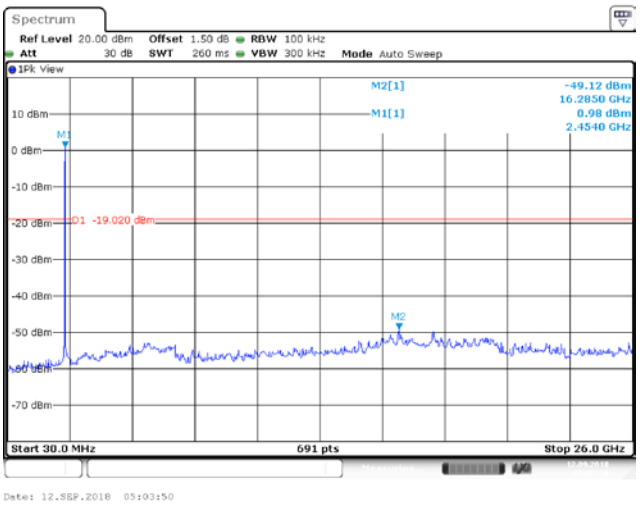
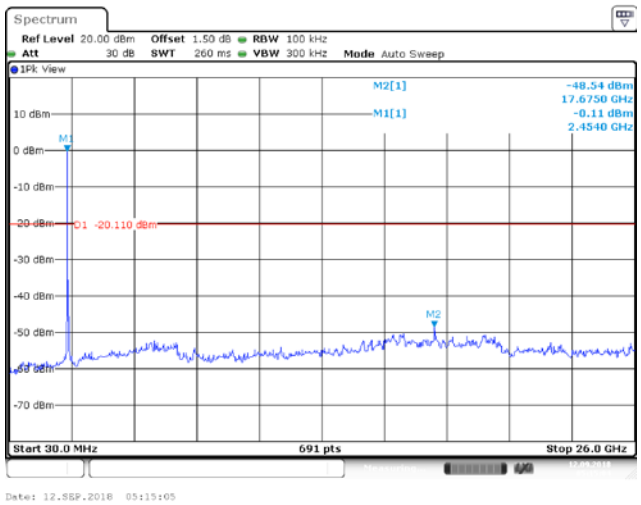
Wi-Fi B mode:

Low Channel	Middle Channel
	
High Channel	
	

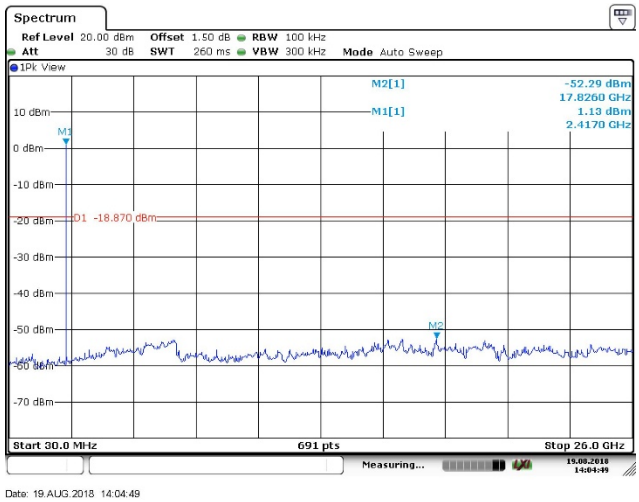
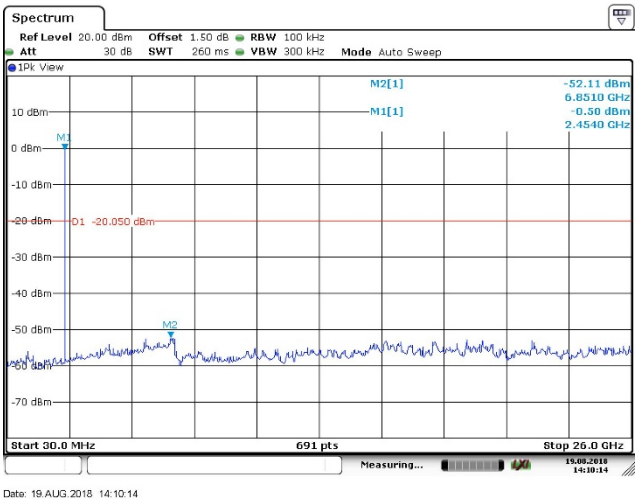
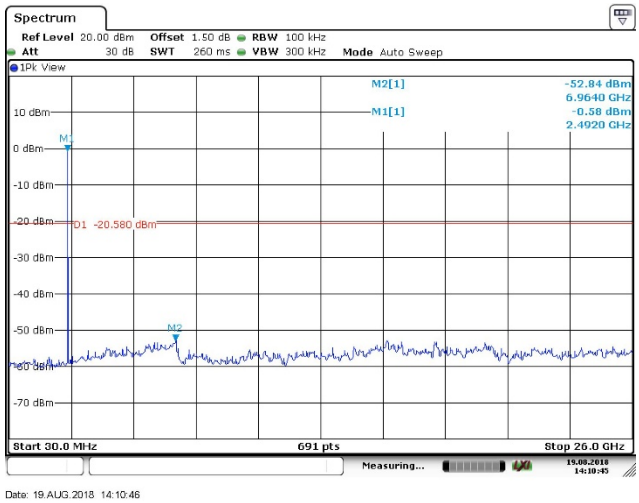
Wi-Fi G mode:

Low Channel	Middle Channel
	
High Channel	
	

Wi-Fi N20 mode:

Low Channel	Middle Channel
	
High Channel	
	

BLE mode:

Low Channel	Middle Channel
	
High Channel	
	

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 ≥ [3 × RBW].
c) Detector = peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

8.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

8.4 Test Environmental Conditions

Temperature:	22.1 ℃
Relative Humidity:	61.0 %
ATM Pressure:	1015 hPa

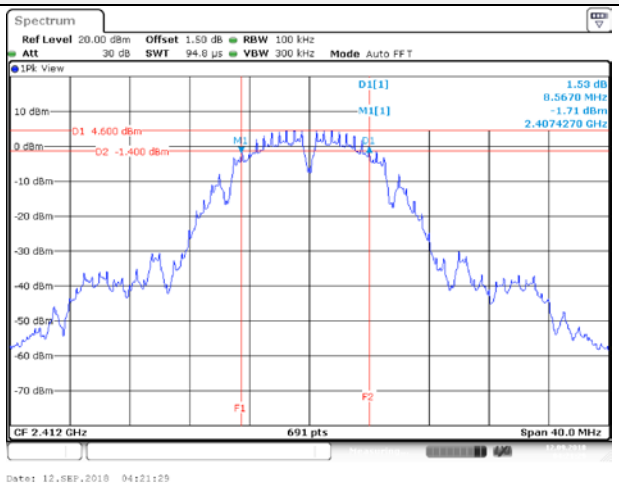
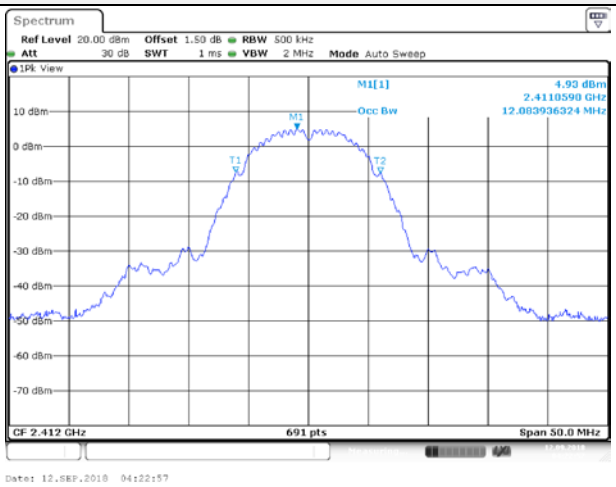
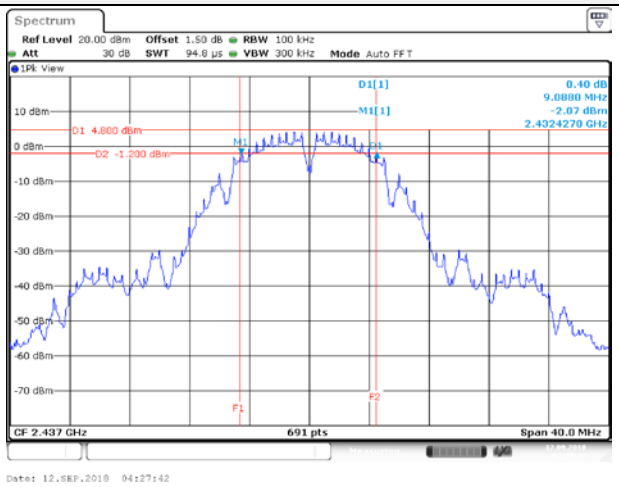
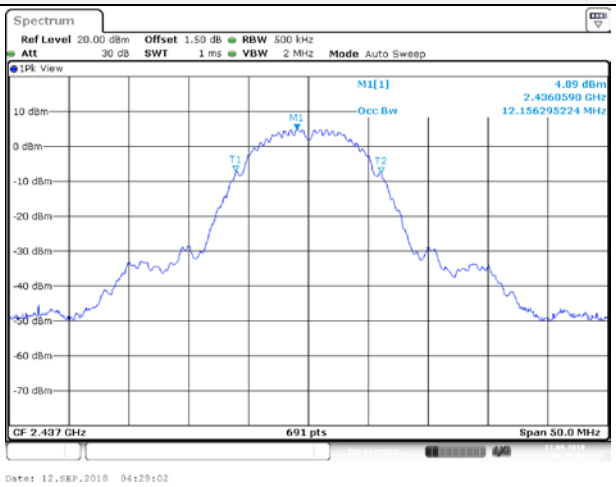
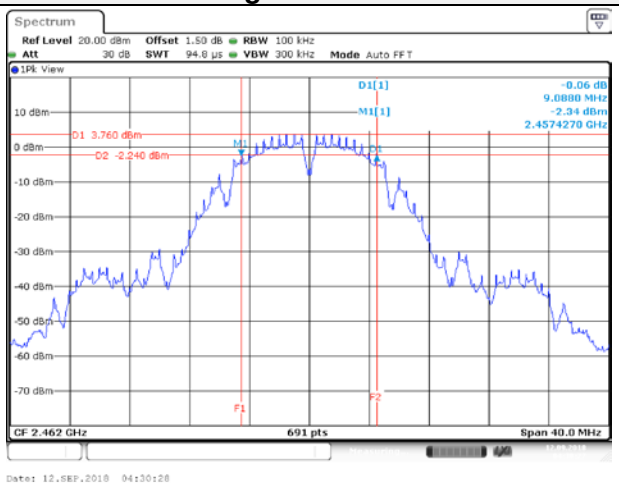
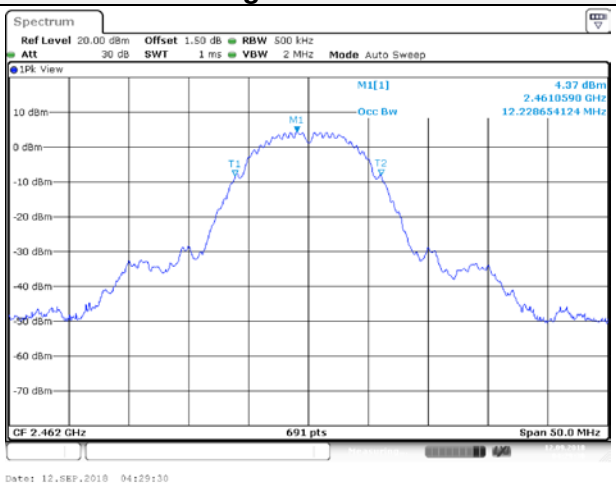
The testing was performed by Eric Lee from 2018-08-19 to 2018-09-12.

8.5 Test Results

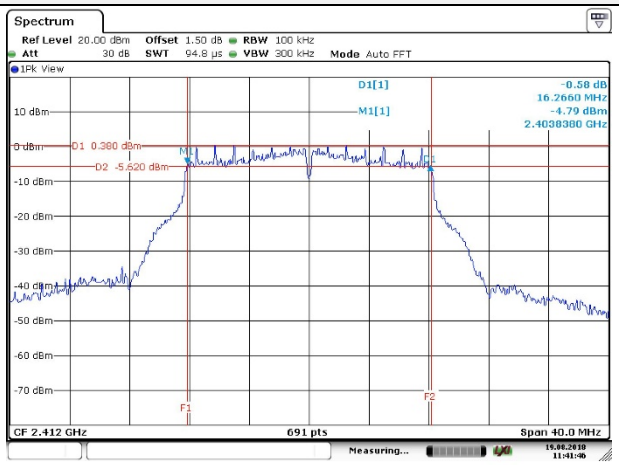
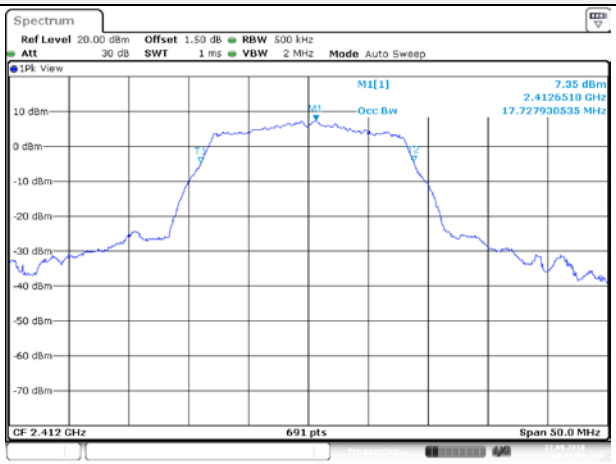
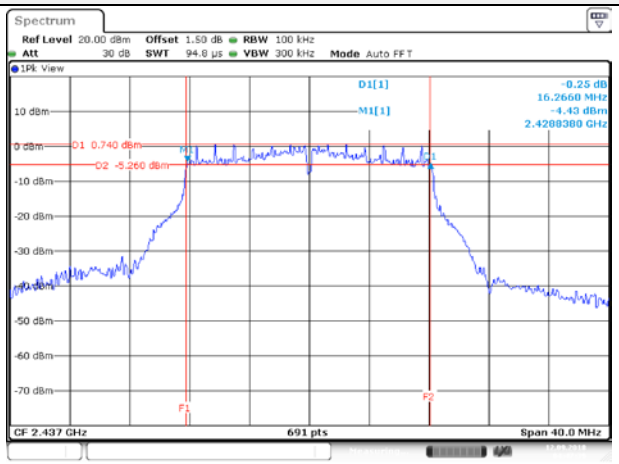
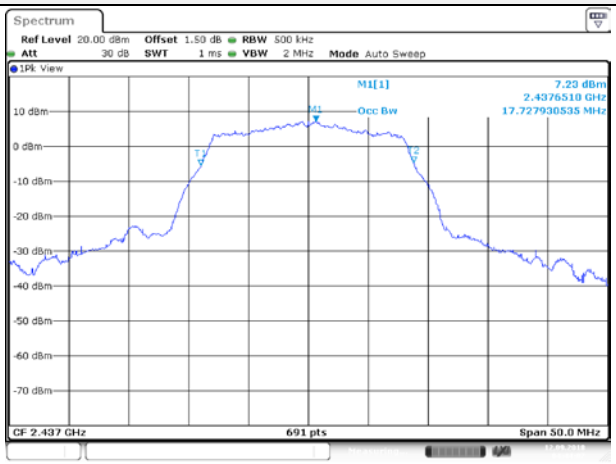
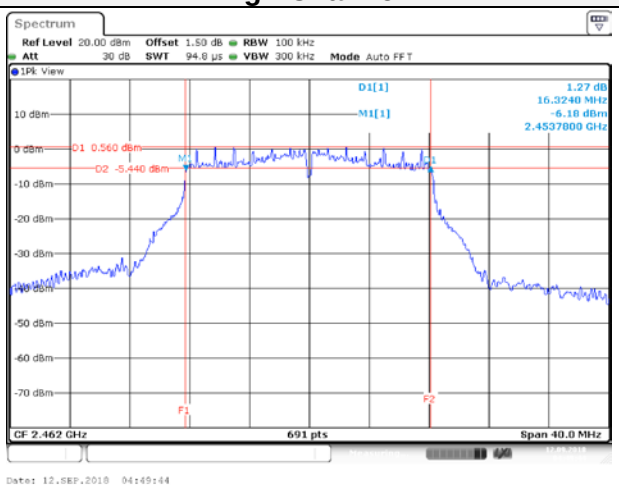
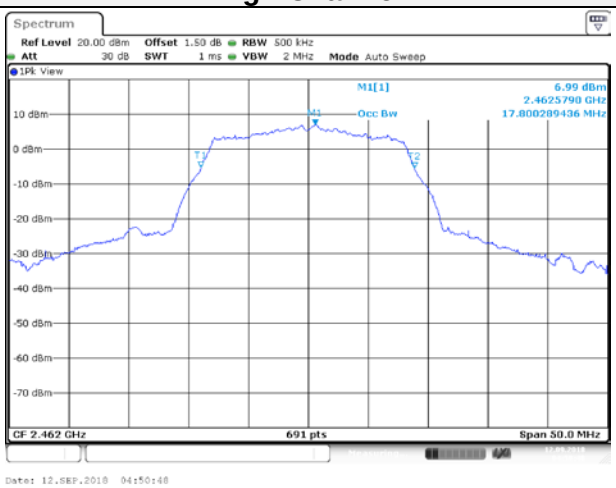
Channel	Frequency (MHz)	99% Bandwidth (MHz)	6 dB OBW (MHz)	6dB Limit (MHz)	Result
B mode					
Low	2412	12.08	8.56	> 0.5	Compliance
Middle	2437	12.15	9.08	> 0.5	Compliance
High	2462	12.22	9.08	> 0.5	Compliance
G mode					
Low	2412	17.72	16.26	> 0.5	Compliance
Middle	2437	17.72	16.26	> 0.5	Compliance
High	2462	17.80	16.32	> 0.5	Compliance
N20 mode					
Low	2412	18.81	17.13	> 0.5	Compliance
Middle	2437	18.88	17.54	> 0.5	Compliance
High	2462	19.03	17.07	> 0.5	Compliance
BLE mode					
Low	2402	1.05	0.73	> 0.5	Compliance
Middle	2440	1.05	0.73	> 0.5	Compliance
High	2480	1.05	0.730	> 0.5	Compliance

Please refer to the following plots

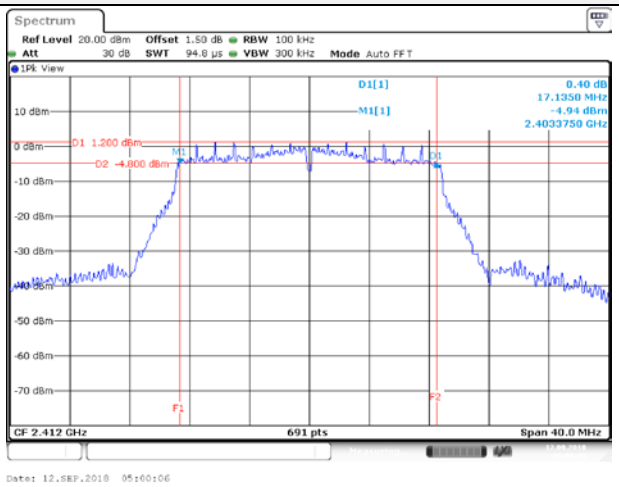
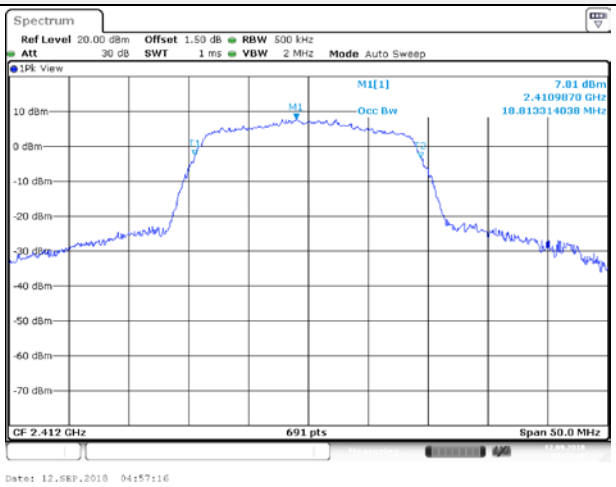
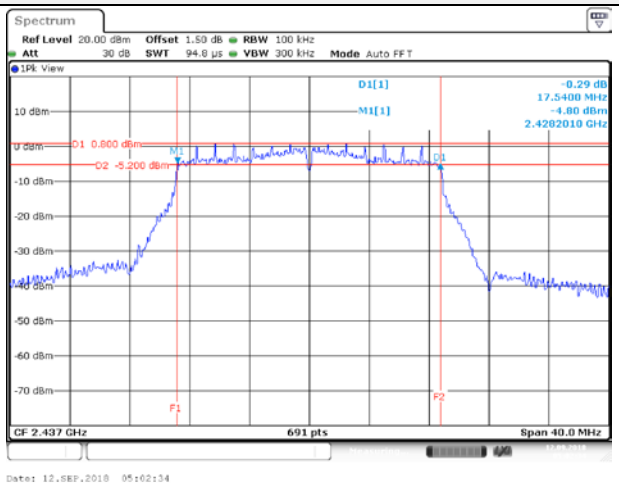
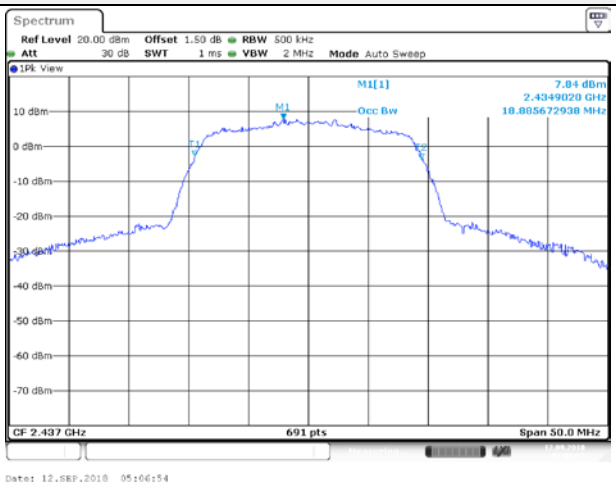
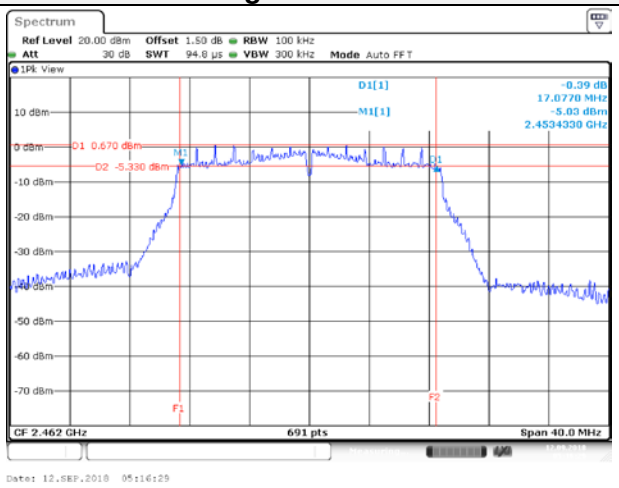
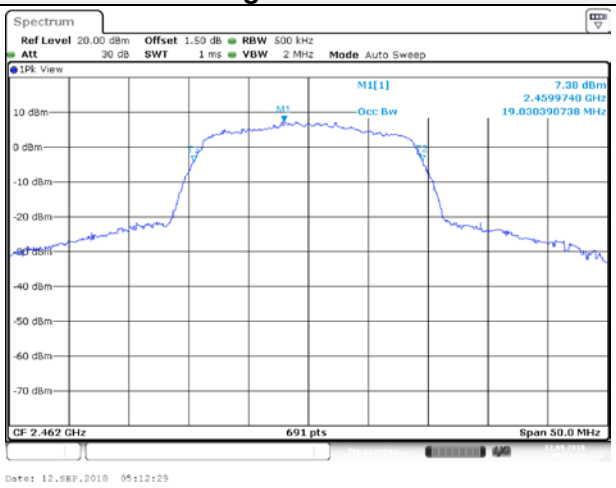
Wi-Fi B mode Low CH:

6 dB Emission Bandwidth	Occupied Bandwidth (99%)
Low Channel	Low Channel
	
Middle Channel	Middle Channel
	
High Channel	High Channel
	

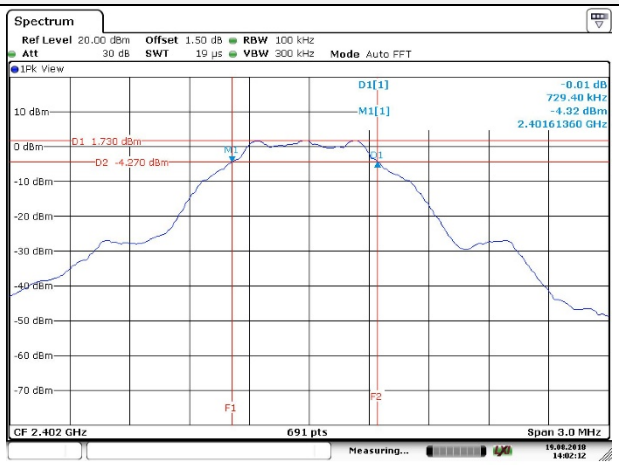
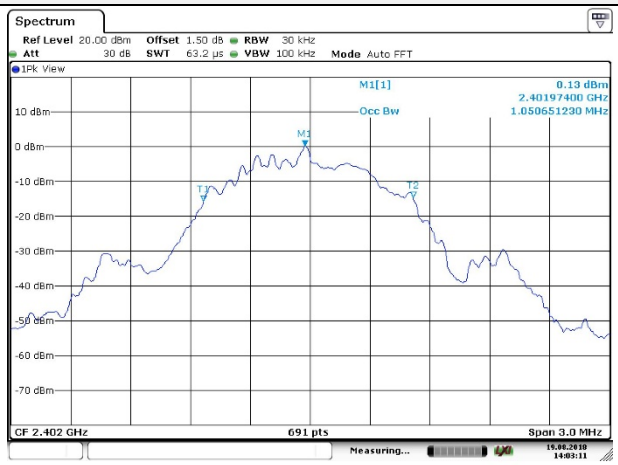
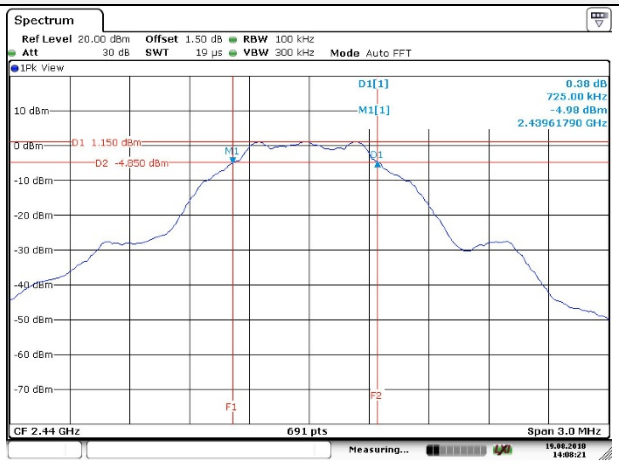
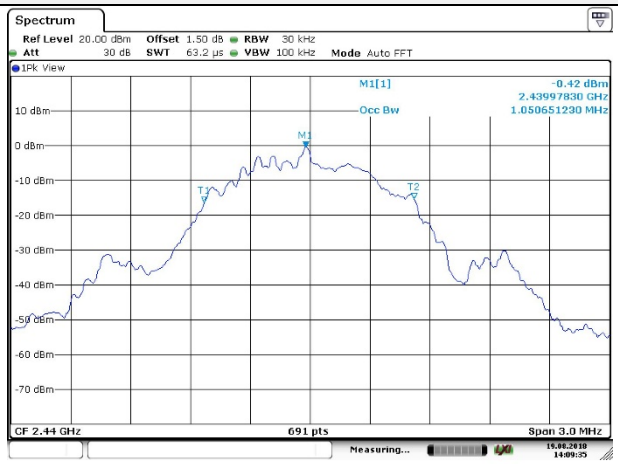
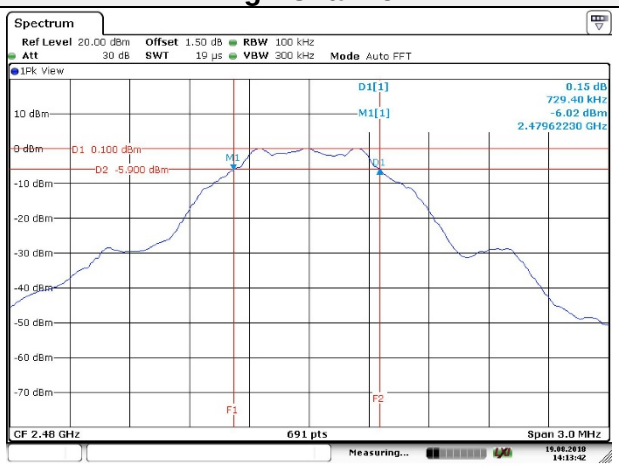
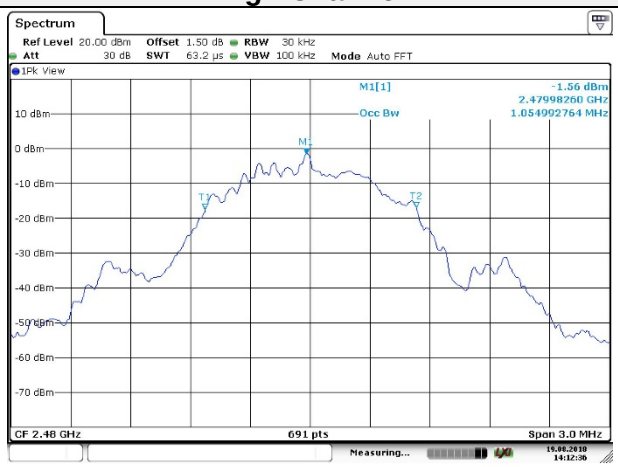
Wi-Fi G mode Low CH:

6 dB Emission Bandwidth	Occupied Bandwidth (99%)
Low Channel	Low Channel
	
Middle Channel	Middle Channel
	
High Channel	High Channel
	

Wi-Fi HT N20 mode Low CH:

6 dB Emission Bandwidth	Occupied Bandwidth (99%)
Low Channel	Low Channel
	
Middle Channel	Middle Channel
	
High Channel	High Channel
	

BLE mode Low CH:

6 dB Emission Bandwidth	Occupied Bandwidth (99%)
Low Channel	**Low Channel**
	
Middle Channel	**Middle Channel**
	
High Channel	**High Channel**
	

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.

3. Add a correction factor to the display.

9.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2018/03/07	2019/03/06
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

9.4 Test Environmental Conditions

Temperature:	22.1 ℃
Relative Humidity:	61.0 %
ATM Pressure:	1015 hPa

The testing was performed by Eric Lee from 2018-08-19 to 2018-09-12.

9.5 Test Results

Channel	Frequency (MHz)	Maximum peak Conducted Output Power (dBm)	Limit (dBm)	Result
B mode				
Low	2412	16.21	30	Compliance
Middle	2437	15.94	30	Compliance
High	2462	15.27	30	Compliance
G mode				
Low	2412	22.95	30	Compliance
Middle	2437	22.76	30	Compliance
High	2462	22.13	30	Compliance
N20 mode				
Low	2412	22.72	30	Compliance
Middle	2437	22.78	30	Compliance
High	2462	22.24	30	Compliance
BLE mode				
Low	2402	2.72	30	Compliance
Middle	2440	2.13	30	Compliance
High	2480	0.96	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	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

10.4 Test Environmental Conditions

Temperature:	22.1 ℃
Relative Humidity:	61.0 %
ATM Pressure:	1015 hPa

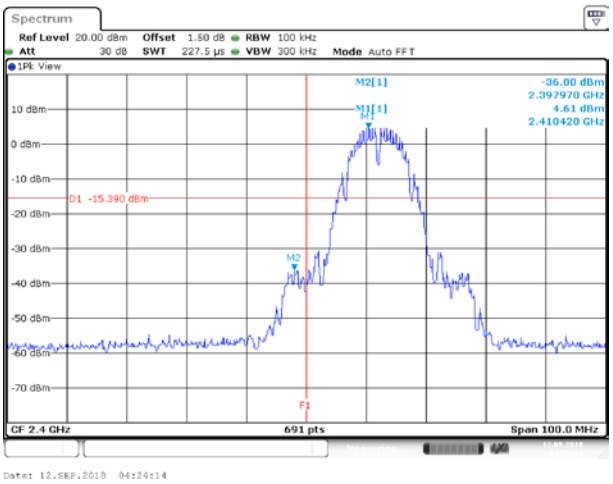
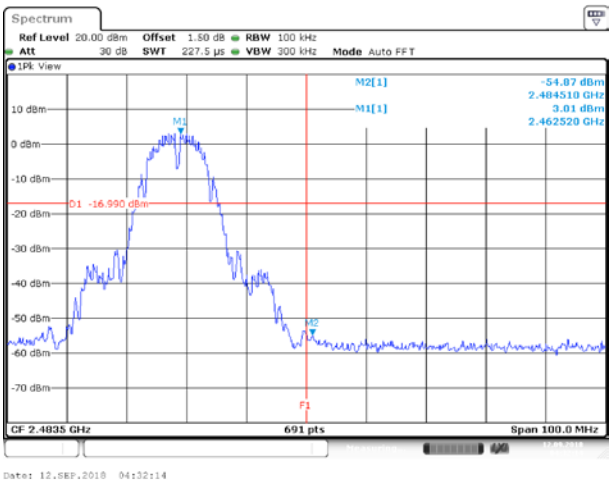
The testing was performed by Eric Lee from 2018-08-19 to 2018-09-12.

10.5 Test Results

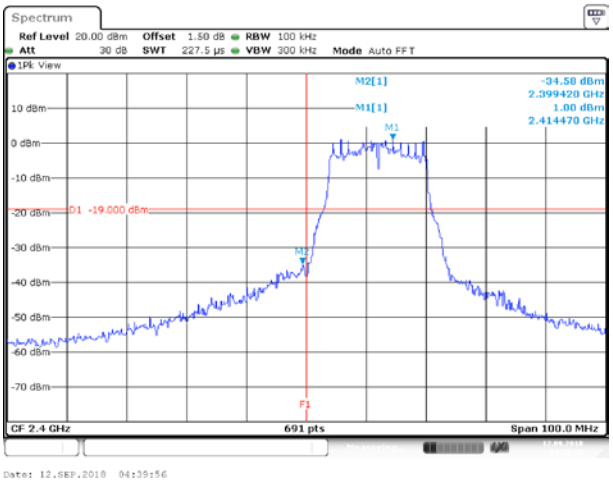
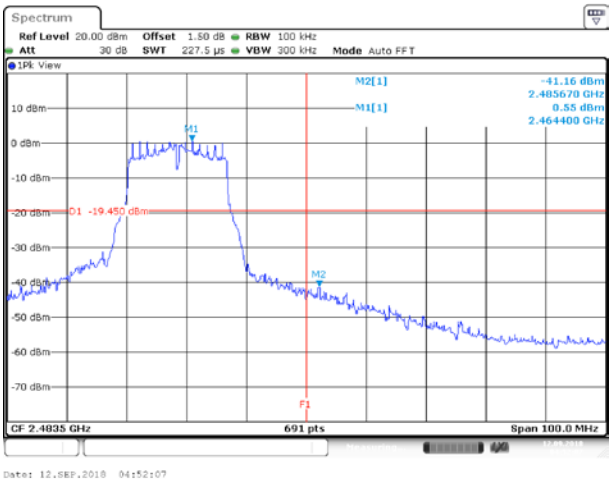
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
B mode				
Low	2412	40.61	≥ 20	PASS
High	2462	57.88	≥ 20	PASS
G mode				
Low	2412	35.58	≥ 20	PASS
High	2462	41.71	≥ 20	PASS
N20 mode				
Low	2412	35.66	≥ 20	PASS
High	2462	41.37	≥ 20	PASS
BLE mode				
Low	2402	57.61	≥ 20	PASS
High	2480	57.45	≥ 20	PASS

Please refer to the following plots

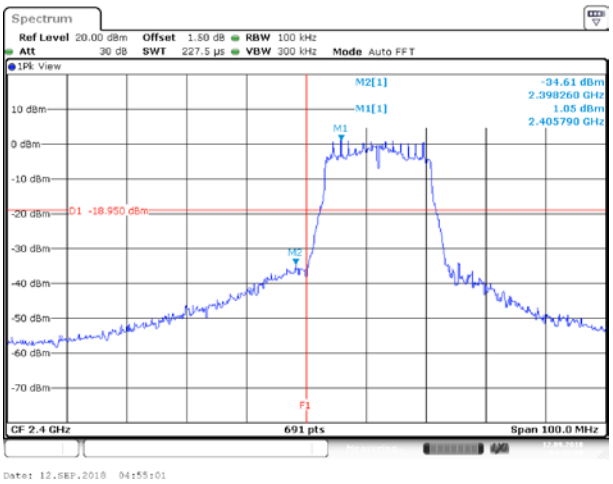
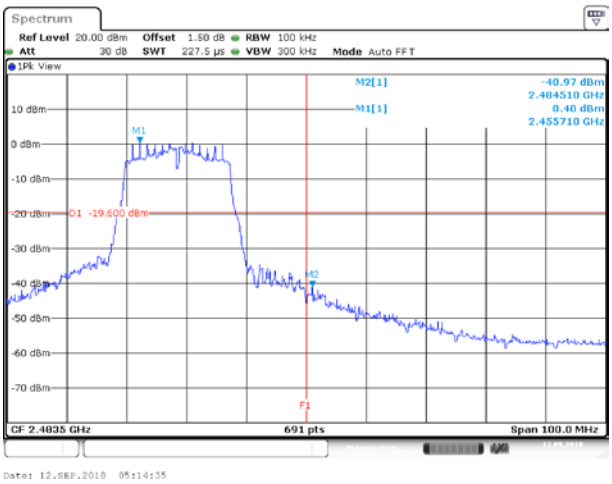
Wi-Fi B mode:

Band Edge, Left Side	Band Edge, Right Side
	

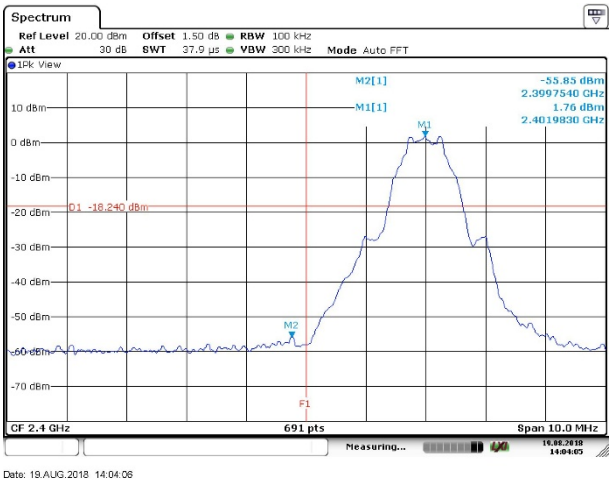
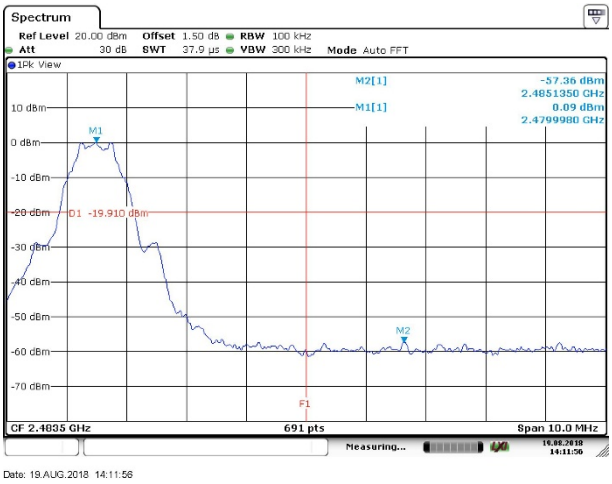
Wi-Fi G mode:

Band Edge, Left Side	Band Edge, Right Side
	

Wi-Fi N20 mode:

Band Edge, Left Side	Band Edge, Right Side
	

BLE mode:

Band Edge, Left Side	Band Edge, Right Side
	

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 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × 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	FSV40	101140	2017/11/15	2018/11/14
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units (SI).*

11.4 Test Environmental Conditions

Temperature:	22.1 ℃
Relative Humidity:	61.0 %
ATM Pressure:	1015 hPa

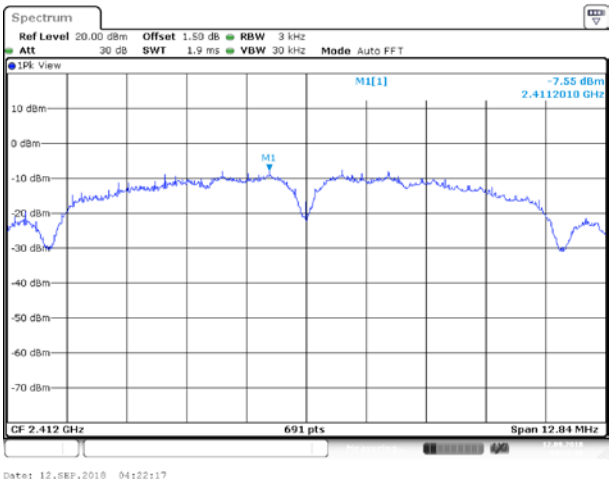
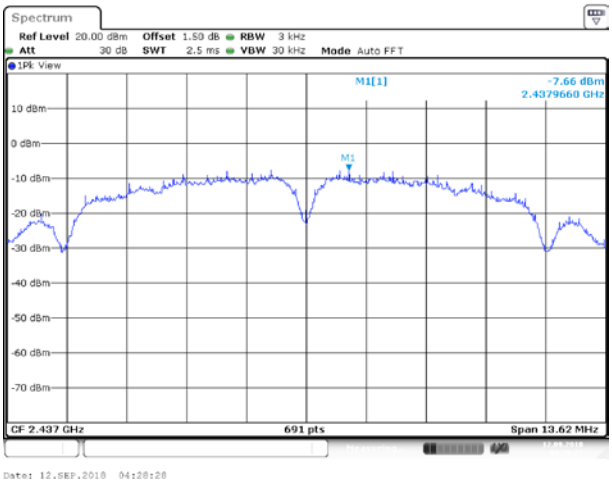
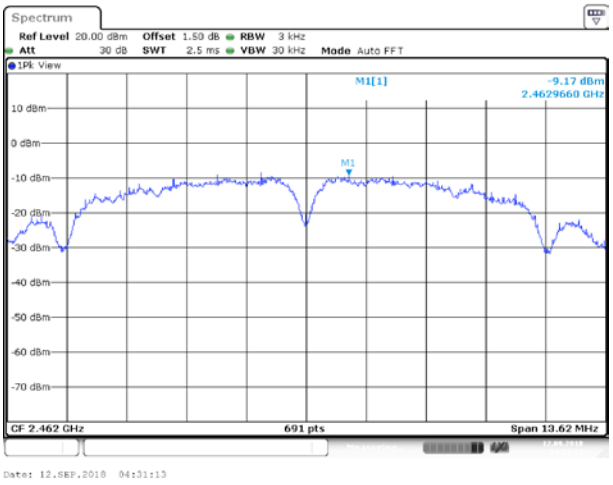
The testing was performed by Eric Lee from 2018-08-19 to 2018-09-12.

11.5 Test Results

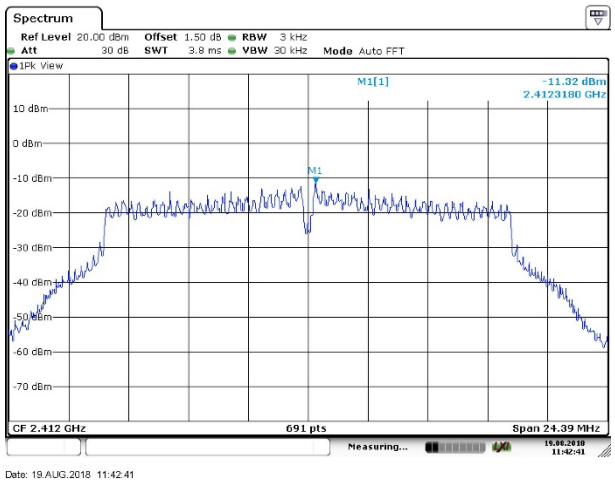
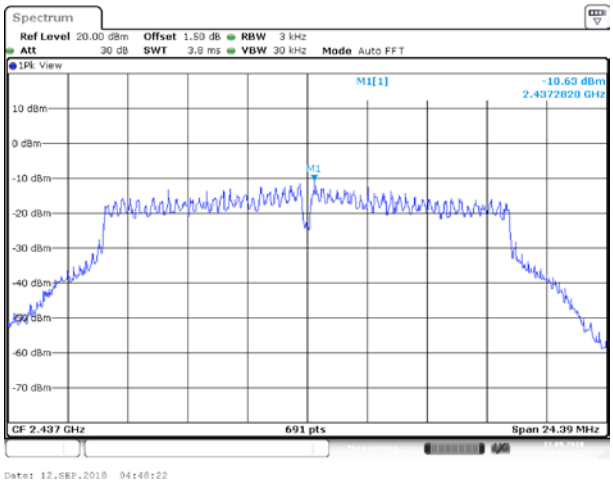
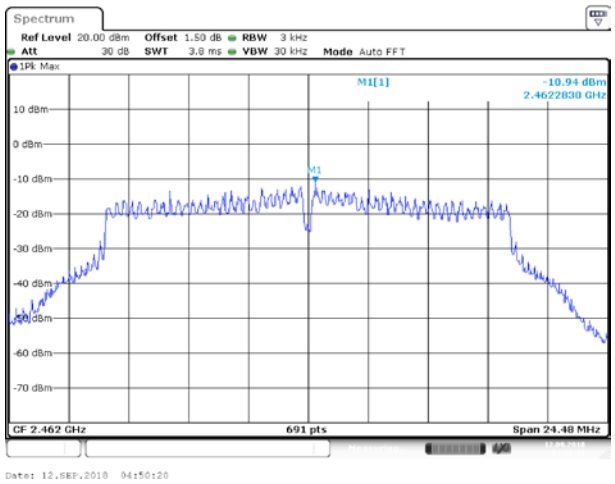
Channel	Frequency (MHz)	Measurement PSD (dBm/3kHz)	Limit (dBm/3 kHz)	Result
B mode				
Low	2412	-7.55	8	Compliance
Middle	2437	-7.66	8	Compliance
High	2462	-9.17	8	Compliance
G mode				
Low	2412	-11.32	8	Compliance
Middle	2437	-10.63	8	Compliance
High	2462	-10.94	8	Compliance
N20 mode				
Low	2412	-10.62	8	Compliance
Middle	2437	-11.54	8	Compliance
High	2462	-11.52	8	Compliance
BLE mode				
Low	2402	-11.67	8	Compliance
Middle	2440	-12.35	8	Compliance
High	2480	-13.35	8	Compliance

Please refer to the following plots

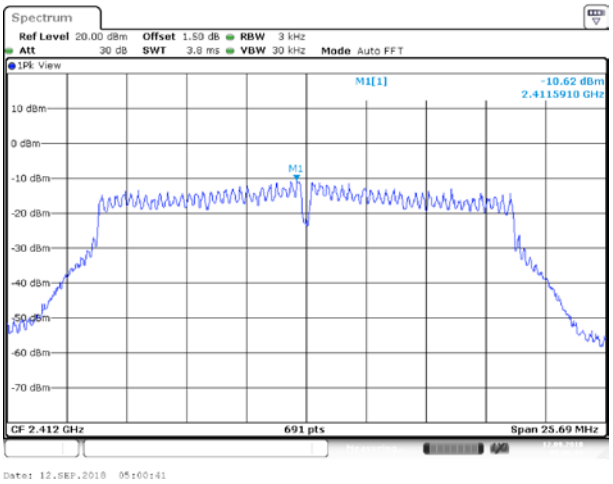
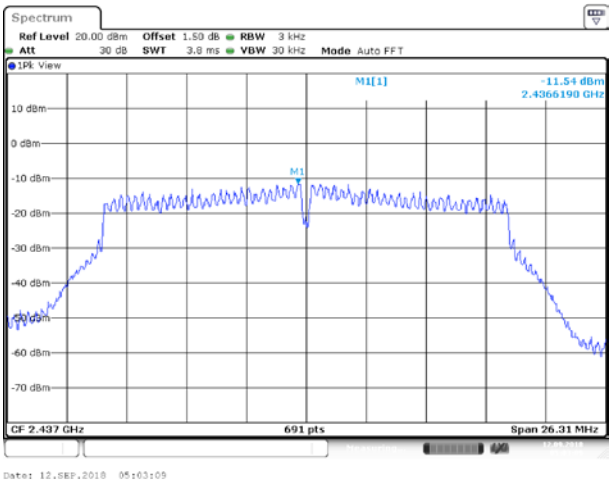
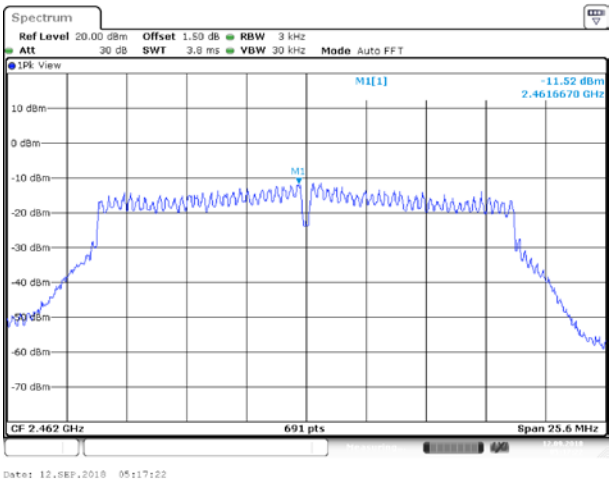
Wi-Fi B mode:

Low Channel	Middle Channel
	
High Channel	
	

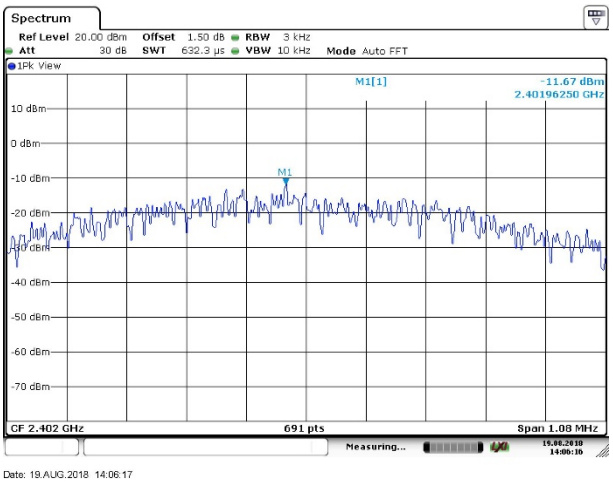
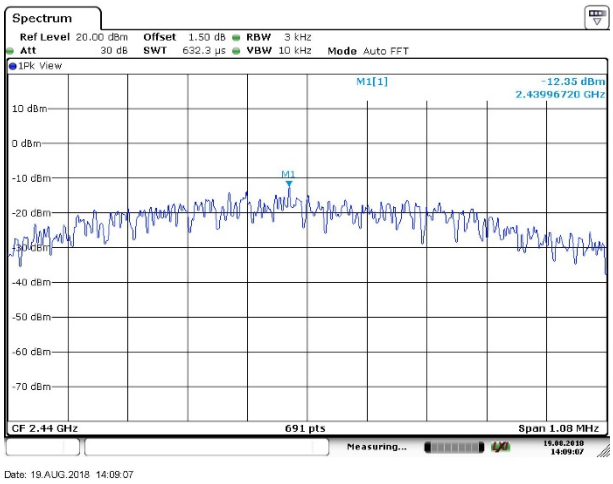
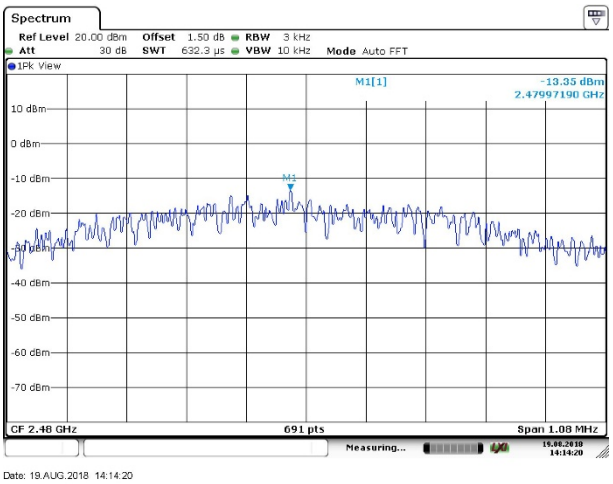
Wi-Fi G mode:

Low Channel	Middle Channel
	
High Channel	
	

Wi-Fi N20 mode:

Low Channel	Middle Channel
	
High Channel	
	

BLE mode:

Low Channel	Middle Channel
	
High Channel	
	

----- END OF REPORT -----