FCC Part 15.247

TEST REPORT

For

Siao Shan Po Life Co., Ltd.

4F., No.5, Ln. 123, Sec. 2, Jianguo S. Rd., Da'an Dist., Taipei City 106, Taiwan

FCC ID: 2AOXB-STMS03

Report Type:	**Product Type:**
Original Report	Stereo Puzzle - Wireless Speaker

Report Producer:	Kaylee Chiang
Report Number:	RXZ1801020-00A
Report Date:	2018-02-13
Reviewed By:	Jerry Chang

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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	RXZ1801020	RXZ1801020-00A	2018.02.13	Original Report	Kaylee

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1 General Information

1.1 Product Description for Equipment Under Test (EUT)

Applicant:	Siao Shan Po Life Co., Ltd. 4F., No.5, Ln. 123, Sec. 2, Jianguo S. Rd., Da'an Dist., Taipei City 106, Taiwan
Manufacturer:	Siao Shan Po Life Co., Ltd. 4F., No.5, Ln. 123, Sec. 2, Jianguo S. Rd., Da'an Dist., Taipei City 106, Taiwan
Product:	Stereo Puzzle - Wireless Speaker
Model:	ST-MS-03
Trade Name:	Shanpo
Frequency Range:	2402-2480 MHz
Transmit Power:	BLE Mode: 3.30 dBm
Modulation Technique:	BLE Mode: GFSK
Transmit Data Rate:	BLE Mode: 1 Mbps
Number of Channels:	BLE Mode: 40 Channels
Antenna Specification:	PCB Antenna/Gain: 1.9 dBi
Voltage Range:	5Vdc from USB 4.5Vdc from Battery
Date of Test:	Feb 07, 2018 ~ Feb 13, 2018

**All measurement and test data in this report was gathered from production sample serial number: 1801020 (Assigned by BACL, Taiwan). The EUT supplied by the applicant was received on 2018-01-16.*

1.2 Objective

This report is prepared on behalf of *Siao Shan Po Life Co., Ltd.* 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.

1.3 Related Submittal(s)/Grant(s)

N/A

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.

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

For BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	21	2442
2	2404	--	--
3	2406	--	--
4	2408	38	2476
--	--	39	2478
20	2440	40	2480

EUT was tested with Channel 1, 20 and 40.

2.2 Equipment Modifications

No modification was made to the EUT

2.3 EUT Exercise Software

Used "CSR BlueTest3" software.

Test Software Version		Engineering Mode		
Test Frequency		Low	Mid	High
Power Level Setting	BLE Mode	0	0	0

2.4 Support Equipment List and Details

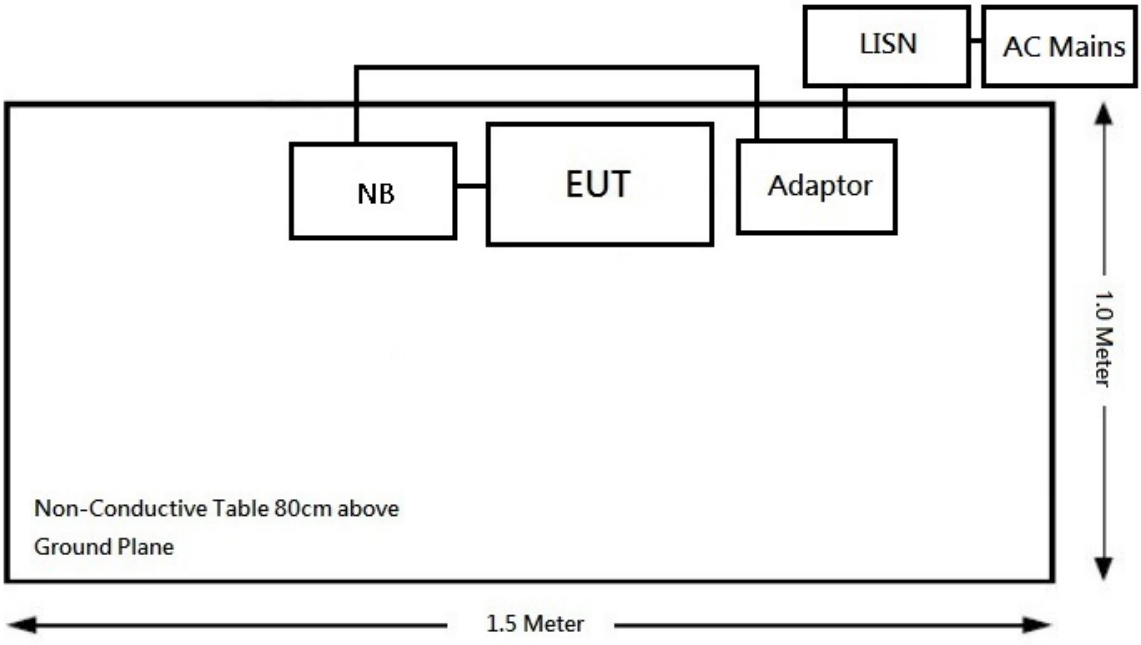
Description	Manufacturer	Model Number	BSMI	FCC ID / DOC	S/N
NB	DELL	E6410	N/A	PD98260NGU	10912240367

2.5 External Cable List and Details

Cable Description	Length (m)	From	To
Mini USB Cable	1.5	NB	EUT

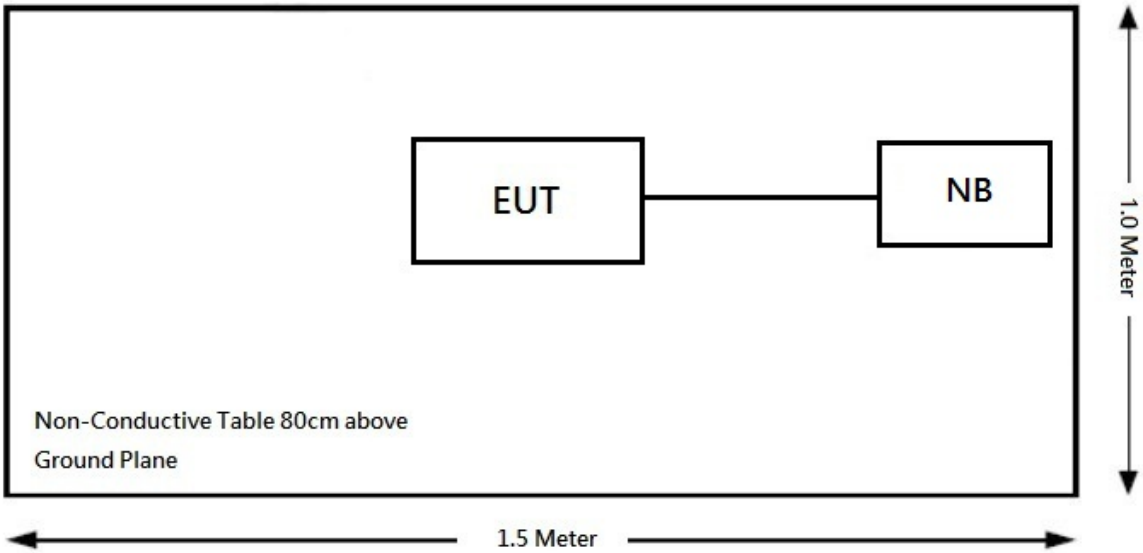
2.6 Block Diagram of Test Setup

See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.
Conduction:

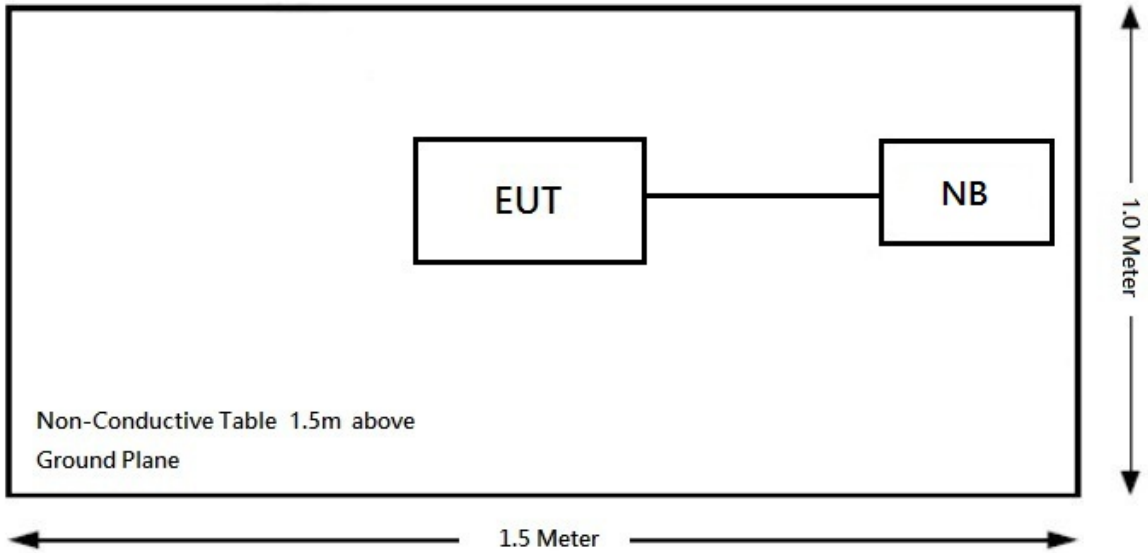


Radiation

Below 1GHz:



Above 1GHz:


EUT
NB
1.0 Meter
Non-Conductive Table 1.5m above
Ground Plane
1.5 Meter

2.7 Duty Cycle

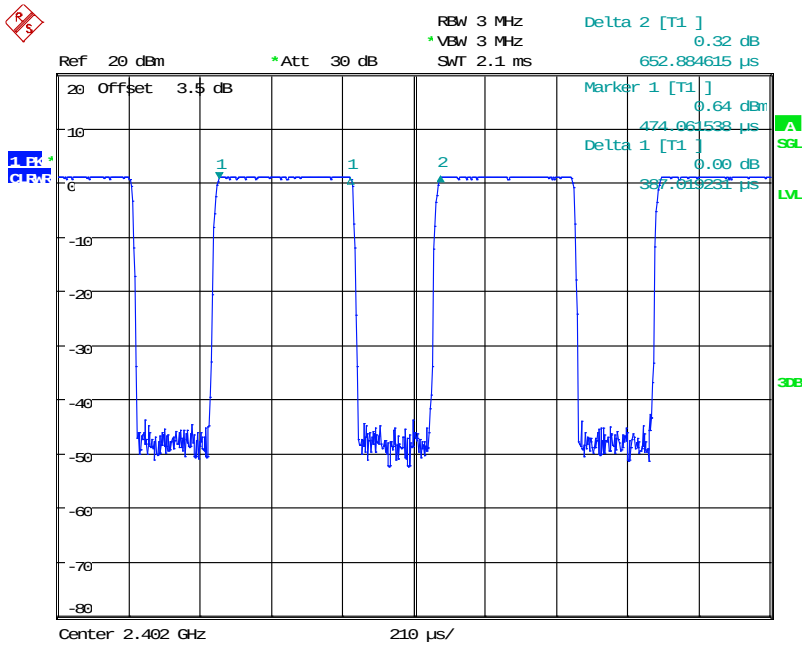
According to KDB 558074 D01 DTS Meas Guidance v04 section 6.0:

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 maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	0.381	0.652	59	2.29

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

Please refer to the following plots.



Date: 9.FEB.2018 13:41:40

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);

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)			
BLE	2480	1.9	1.549	3.5	2.239	20	0.0007	1

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
Siao Shan Po Life Co., Ltd.	PCB Antenna	1.9 dBi	Compliance

The EUT has an internal antenna arrangement, which was permanently attached, fulfill the requirement of this section.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standard

FCC §15.207

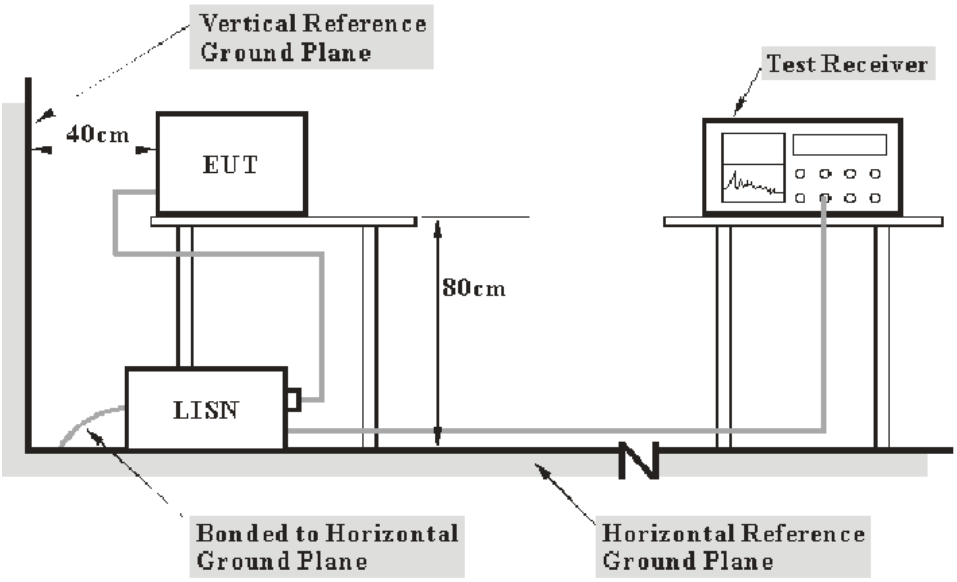
6.2 Measurement Uncertainty

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:

Factor = LISN VDF + Cable Loss + 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:

Over Limit = Level – 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
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM025	2017/08/10	2018/08/09
RF Cable	EMEC	EM-CB5D	001	2017/07/10	2018/07/09
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

Temperature:	25 ℃
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2018-02-13.

6.9 Test Results

Please refer to the following plots and tables.

Test mode: Transmitting

Main: AC 120V/60 Hz, Line

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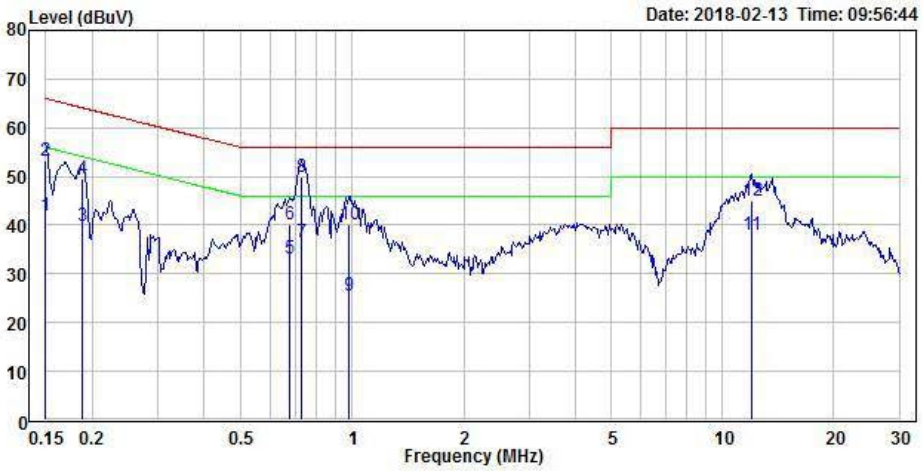

Condition: Neutral
EUT :
Model :
Note :
Power : 110V/60Hz

	Freq	Level	Limit Line	Over Limit	Factor	Read Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.150	41.95	56.00	-14.05	19.63	22.32	Average	Neutral
2	0.150	53.10	66.00	-12.90	19.63	33.47	QP	Neutral
3	0.187	39.71	54.15	-14.44	19.63	20.08	Average	Neutral
4	0.187	49.47	64.15	-14.68	19.63	29.84	QP	Neutral
5	0.676	33.07	46.00	-12.93	19.66	13.41	Average	Neutral
6	0.676	40.03	56.00	-15.97	19.66	20.37	QP	Neutral
7	0.726	36.54	46.00	-9.46	19.66	16.88	Average	Neutral
8	0.726	50.04	56.00	-5.96	19.66	30.38	QP	Neutral
9	0.976	25.69	46.00	-20.31	19.67	6.02	Average	Neutral
10	0.976	40.06	56.00	-15.94	19.67	20.39	QP	Neutral
11	12.000	37.89	50.00	-12.11	19.93	17.96	Average	Neutral
12	12.000	45.06	60.00	-14.94	19.93	25.13	QP	Neutral

Main: AC 120V/60 Hz, Neutral

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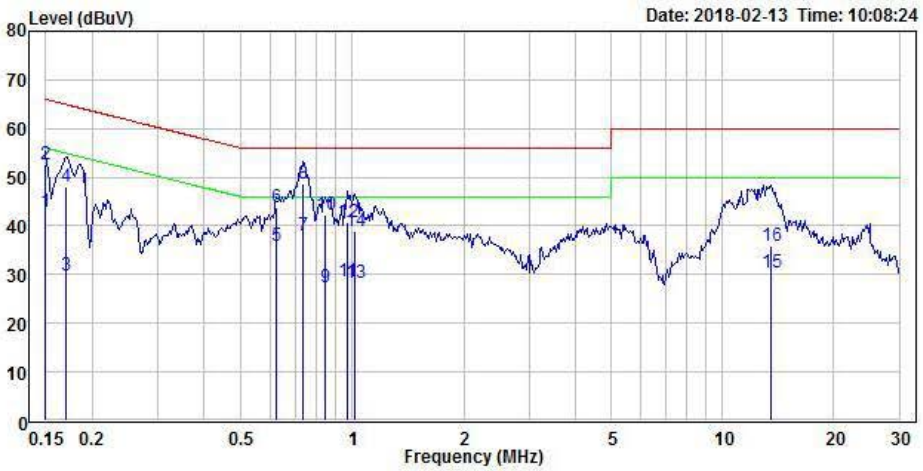


Condition: Li
EUT :
Model :
Note :
Power : 110V/60Hz

	Freq	Level	Limit Line	Over Limit	Factor	Read Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.150	42.83	56.00	-13.17	19.50	23.33	Average	Line
2	0.150	52.60	66.00	-13.40	19.50	33.10	QP	Line
3	0.170	29.95	54.94	-24.99	19.50	10.45	Average	Line
4	0.170	48.11	64.94	-16.83	19.50	28.61	QP	Line
5	0.624	35.78	46.00	-10.22	19.52	16.26	Average	Line
6	0.624	43.81	56.00	-12.19	19.52	24.29	QP	Line
7	0.738	38.00	46.00	-8.00	19.52	18.48	Average	Line
8	0.738	48.61	56.00	-7.39	19.52	29.09	QP	Line
9	0.845	27.36	46.00	-18.64	19.53	7.83	Average	Line
10	0.845	42.24	56.00	-13.76	19.53	22.71	QP	Line
11	0.968	28.70	46.00	-17.30	19.53	9.17	Average	Line
12	0.968	40.83	56.00	-15.17	19.53	21.30	QP	Line
13	1.015	28.30	46.00	-17.70	19.53	8.77	Average	Line
14	1.015	38.85	56.00	-17.15	19.53	19.32	QP	Line
15	13.524	30.35	50.00	-19.65	19.79	10.56	Average	Line
16	13.524	35.99	60.00	-24.01	19.79	16.20	QP	Line

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 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 Measurement Uncertainty

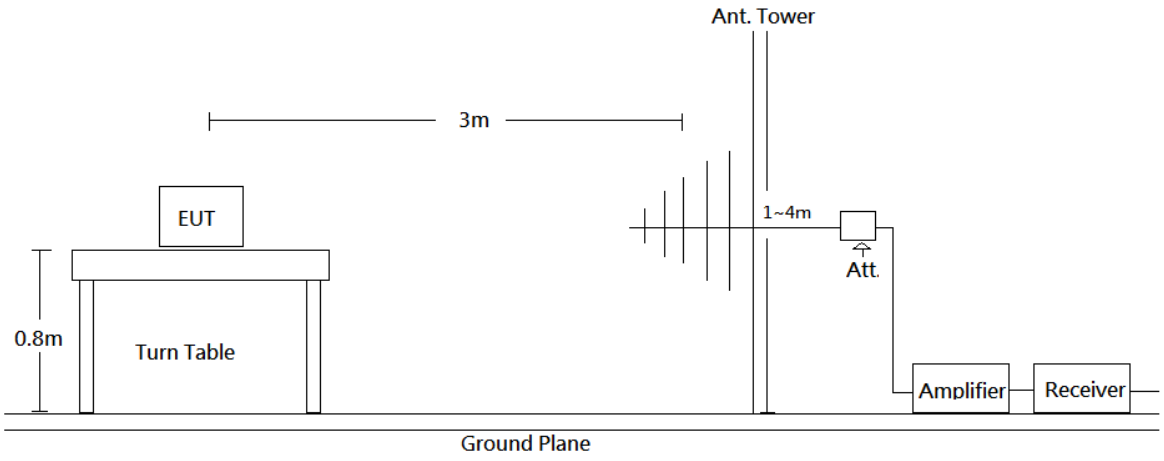
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency 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.

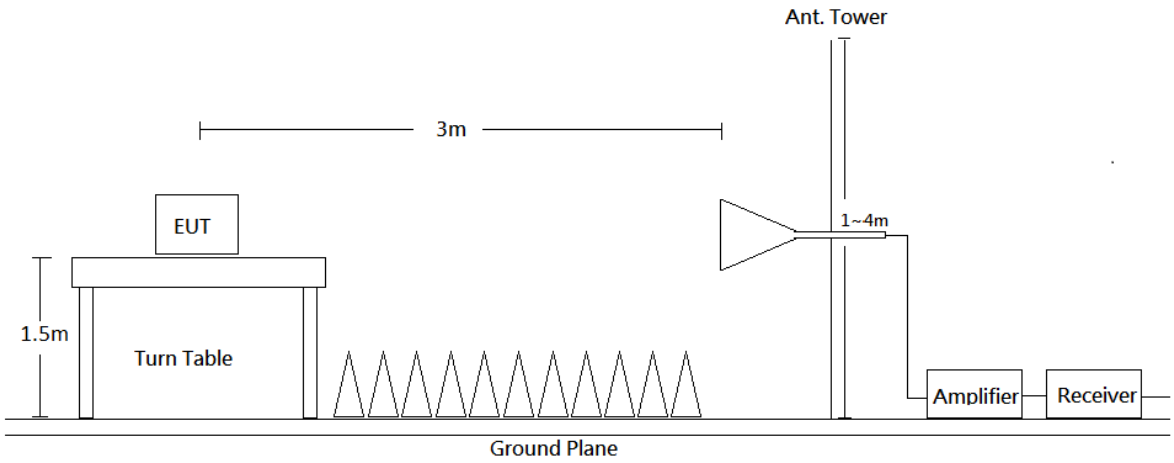
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.76 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.12 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.84 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.16 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.84 dB (k=2, 95% level of confidence)
26 GHz~40 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 for below 1GHz and spectrum analyzer for above 1GHz 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:

Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Result –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

$Lm + U(Lm) \leq Llim + Ucispr$

In BACL, U(Lm) is less than Ucispr, if Lm is less than Llim, 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	2017/05/24	2018/05/23
Horn Antenna	ETS-Lindgren	3116	62638	2017/09/13	2018/09/12
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	2017/03/14	2018/03/13
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2018/01/17	2019/01/16
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_EMC	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
Attenuator	MINI-CIRCUITS	BW-S3W5+	N/A	2017/12/14	2018/12/13

***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

Temperature:	25° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2018-02-07 ~ 2018-02-09.

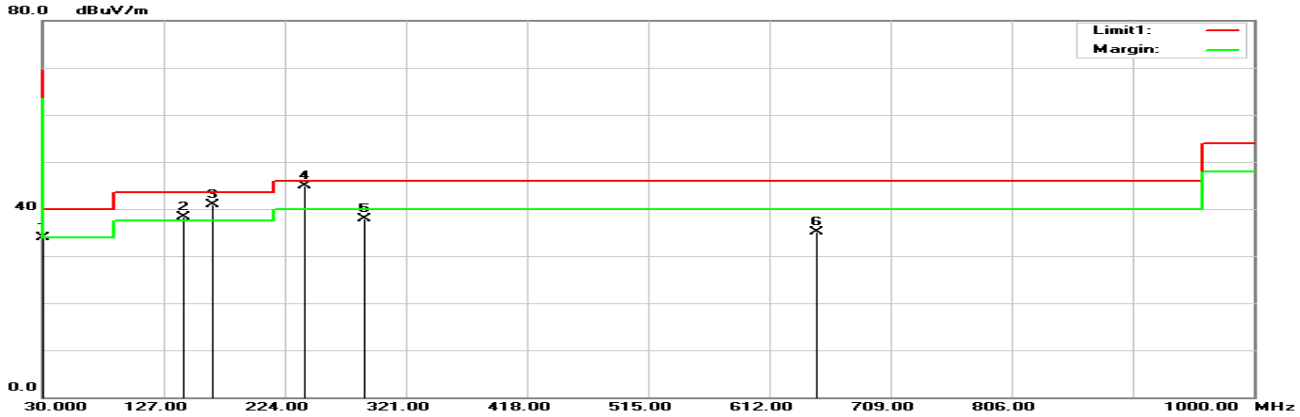
7.10 Test Results

Test Mode: Transmitting

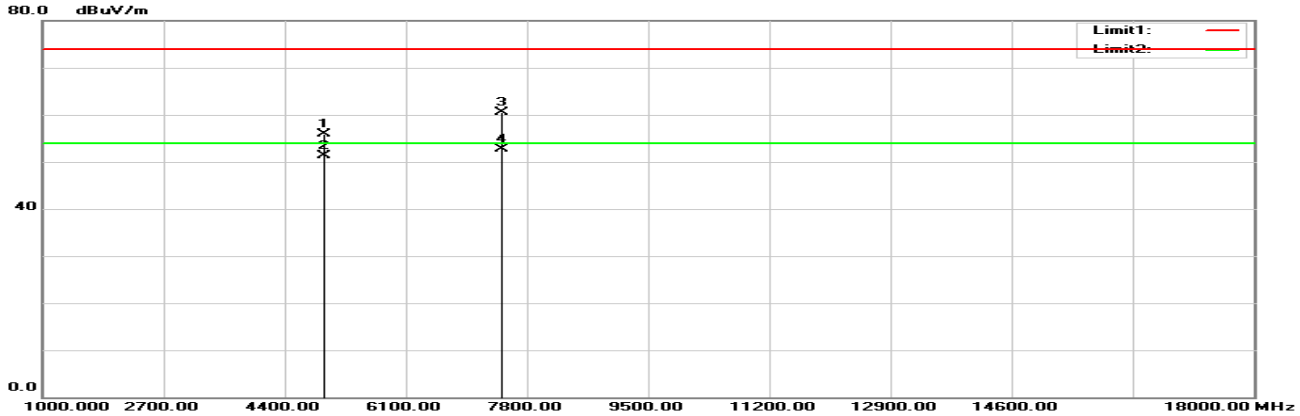
BLE Mode

Horizontal (*worst case is BLE mode high channel*)

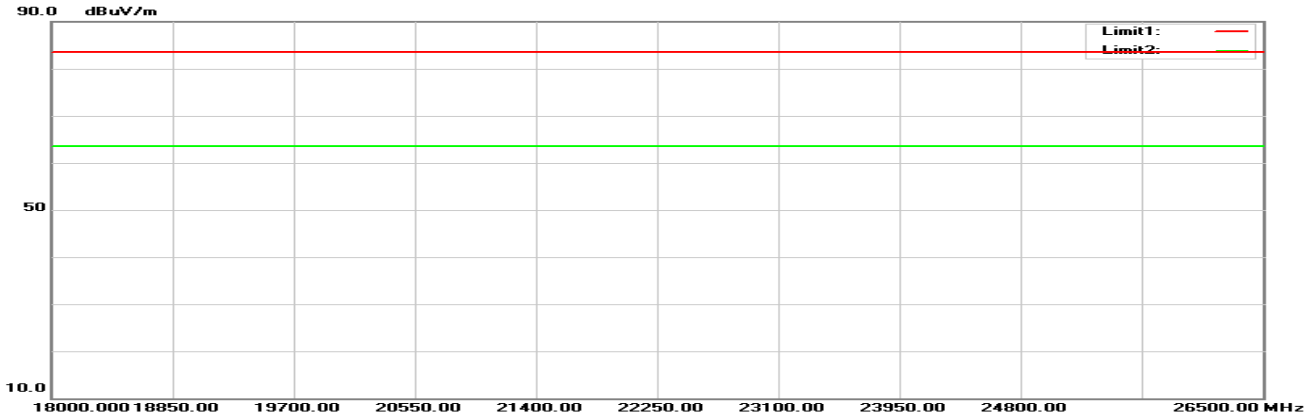
30MHz-1GHz:



1GHz-18GHz:

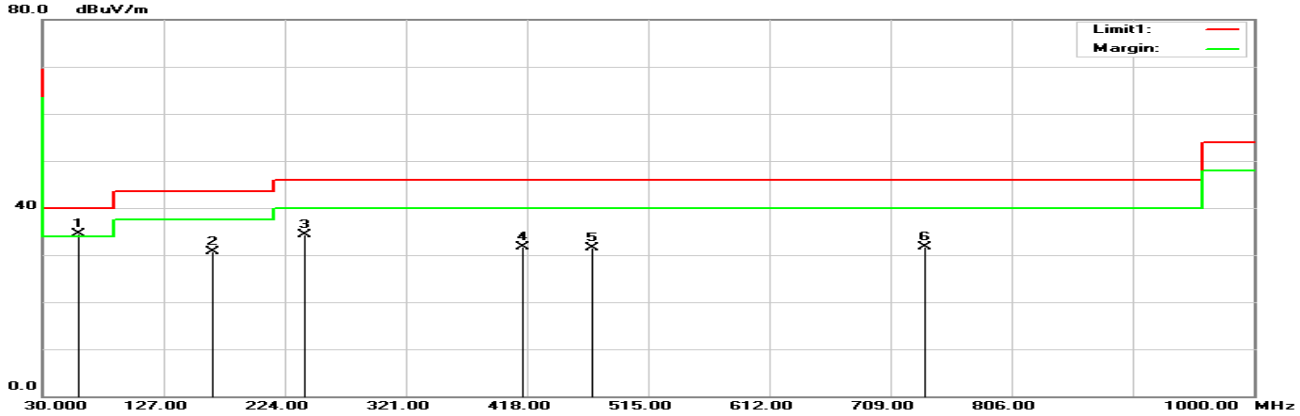


18GHz-26.5GHz:

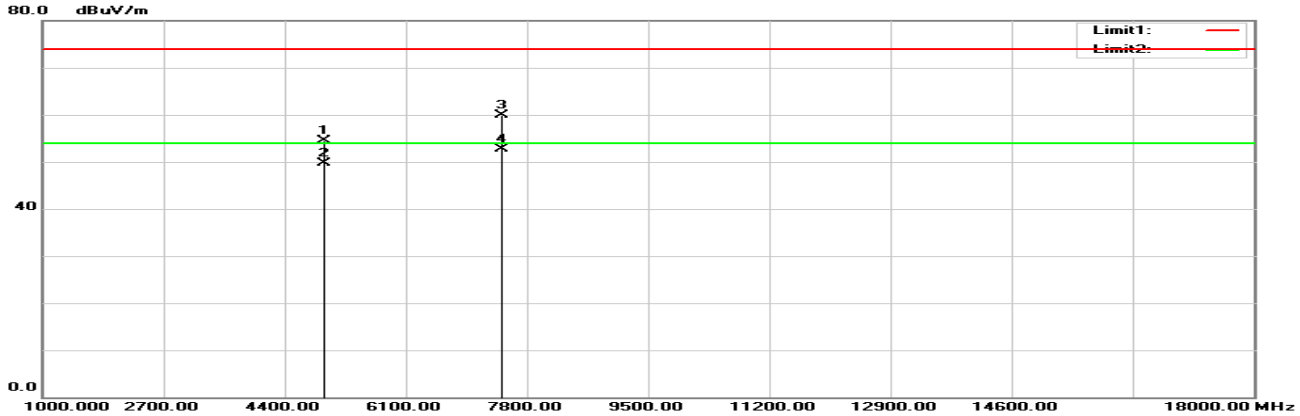


Vertical (*worst case is BLE mode high channel*)

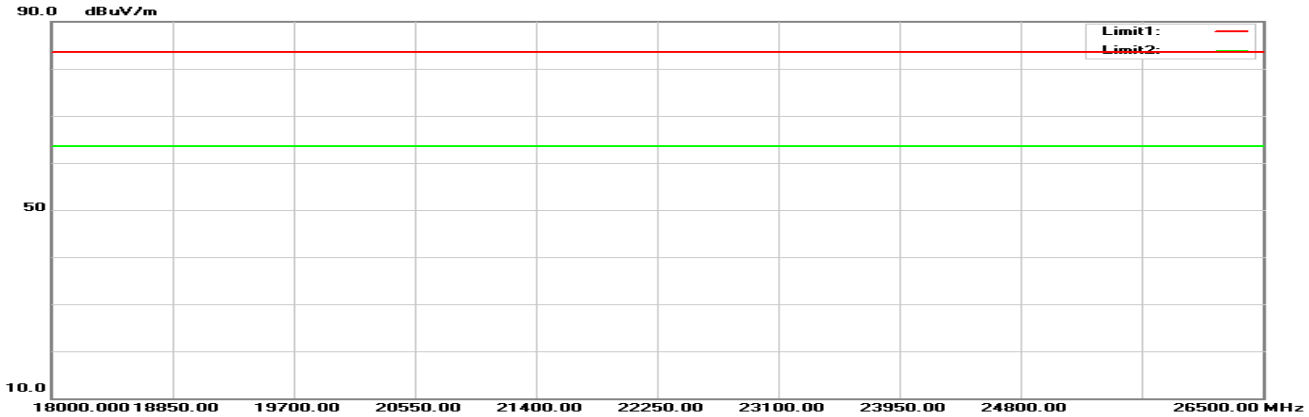
30MHz-1GHz:



1GHz-18GHz:



18GHz-26.5GHz:



Horizontal

Frequency (MHz)	Reading (dB μV)	Correct Factor(dB/m)	Result (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Height (cm)	Degree (˚)	Remark
BLE Low Channel								
59.1000	53.00	-17.31	35.69	40.00	-4.31	100	160	QP
173.5600	53.03	-12.48	40.55	43.50	-2.95	100	41	QP
239.5200	56.58	-12.05	44.53	46.00	-1.47	100	24	QP
257.9500	52.78	-11.40	41.38	46.00	-4.62	100	181	QP
415.0900	44.76	-7.28	37.48	46.00	-8.52	100	247	QP
649.8300	38.40	-3.46	34.94	46.00	-11.06	100	34	QP
2390.000	64.62	-4.89	59.73	74.00	-14.27	100	1	peak
2390.000	51.20	-4.89	46.31	54.00	-7.69	100	1	AVG
2402.000	100.15	-4.86	95.29	N/A	N/A	100	85	peak
2402.000	99.20	-4.86	94.34	N/A	N/A	100	85	AVG
4804.000	52.67	0.98	53.65	74.00	-20.35	100	305	peak
4804.000	47.29	0.98	48.27	54.00	-5.73	100	305	AVG
7206.000	50.76	6.56	57.32	74.00	-16.68	100	360	peak
7206.000	43.50	6.56	50.06	54.00	-3.94	100	360	AVG
BLE Mid Channel								
59.1000	52.45	-17.31	35.14	40.00	-4.86	100	119	QP
168.7100	53.03	-12.05	40.98	43.50	-2.52	100	39	QP
239.5200	56.23	-12.05	44.18	46.00	-1.82	100	36	QP
288.0200	47.68	-9.96	37.72	46.00	-8.28	100	104	QP
415.0900	44.83	-7.28	37.55	46.00	-8.45	100	252	QP
874.8700	31.12	0.60	31.72	46.00	-14.28	100	225	QP
2440.000	100.17	-4.78	95.39	N/A	N/A	139	84	peak
2440.000	99.36	-4.78	94.58	N/A	N/A	139	84	AVG
4880.000	54.23	1.24	55.47	74.00	-18.53	109	297	peak
4880.000	48.98	1.24	50.22	54.00	-3.78	109	297	AVG
7320.000	53.84	7.01	60.85	74.00	-13.15	100	19	peak
7320.000	45.71	7.01	52.72	54.00	-1.28	100	19	AVG
BLE High Channel								
30.0000	37.18	-3.26	33.92	40.00	-6.08	100	215	QP
143.4900	49.29	-10.97	38.32	43.50	-5.18	100	118	QP
165.8000	52.58	-11.77	40.81	43.50	-2.69	100	37	QP
239.5200	56.92	-12.05	44.87	46.00	-1.13	100	52	QP
288.0200	47.92	-9.96	37.96	46.00	-8.04	100	122	QP
649.8300	38.61	-3.46	35.15	46.00	-10.85	100	32	QP
2480.000	100.24	-4.68	95.56	N/A	N/A	133	84	peak
2480.000	99.10	-4.68	94.42	N/A	N/A	133	84	AVG
2483.500	65.55	-4.69	60.86	74.00	-13.14	100	284	peak
2483.500	51.47	-4.69	46.78	54.00	-7.22	100	284	AVG
4960.000	54.34	1.51	55.85	74.00	-18.15	121	291	peak
4960.000	49.80	1.51	51.31	54.00	-2.69	121	291	AVG
7440.000	53.06	7.49	60.55	74.00	-13.45	100	23	peak
7440.000	45.24	7.49	52.73	54.00	-1.27	100	23	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

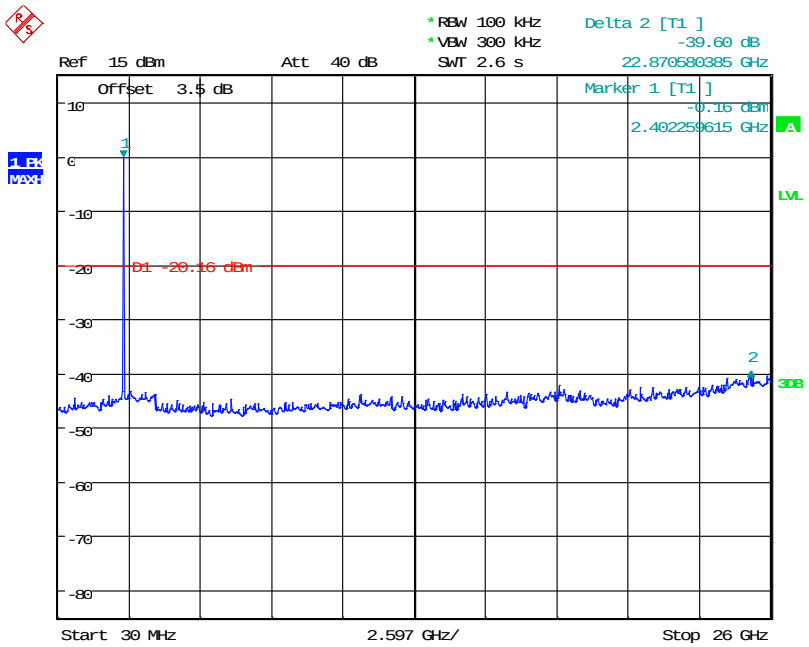
Frequency (MHz)	Reading (dB μV)	Correct Factor(dB/m)	Result (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Height (cm)	Degree (˚)	Remark
BLE Low Channel								
59.1000	53.85	-17.31	36.54	40.00	-3.46	100	26	QP
136.7000	41.73	-10.80	30.93	43.50	-12.57	100	31	QP
239.5200	45.63	-12.05	33.58	46.00	-12.42	100	230	QP
415.0900	39.70	-7.28	32.42	46.00	-13.58	100	75	QP
470.3800	38.91	-6.19	32.72	46.00	-13.28	100	7	QP
807.9400	31.57	-0.46	31.11	46.00	-14.89	100	9	QP
2390.000	64.15	-4.89	59.26	74.00	-14.74	100	150	peak
2390.000	51.32	-4.89	46.43	54.00	-7.57	100	150	AVG
2402.000	95.78	-4.86	90.92	N/A	N/A	136	26	peak
2402.000	94.72	-4.86	89.86	N/A	N/A	136	26	AVG
4804.000	51.49	0.98	52.47	74.00	-21.53	100	288	peak
4804.000	45.55	0.98	46.53	54.00	-7.47	100	288	AVG
7206.000	51.74	6.56	58.30	74.00	-15.70	100	180	peak
7206.000	44.95	6.56	51.51	54.00	-2.49	100	180	AVG
BLE Mid Channel								
59.1000	51.76	-17.31	34.45	40.00	-5.55	100	16	QP
101.7800	45.05	-14.07	30.98	43.50	-12.52	100	16	QP
239.5200	45.85	-12.05	33.80	46.00	-12.20	100	265	QP
394.7200	38.56	-7.70	30.86	46.00	-15.14	100	57	QP
470.3800	37.96	-6.19	31.77	46.00	-14.23	100	360	QP
962.1700	31.48	2.70	34.18	54.00	-19.82	100	287	QP
2440.000	94.39	-4.78	89.61	N/A	N/A	100	87	peak
2440.000	93.44	-4.78	88.66	N/A	N/A	100	87	AVG
4880.000	54.17	1.24	55.41	74.00	-18.59	100	278	peak
4880.000	49.76	1.24	51.00	54.00	-3.00	100	278	AVG
7320.000	52.07	7.01	59.08	74.00	-14.92	202	7	peak
7320.000	45.19	7.01	52.20	54.00	-1.80	202	7	AVG
BLE High Channel								
59.1000	51.90	-17.31	34.59	40.00	-5.41	100	264	QP
165.8000	42.48	-11.77	30.71	43.50	-12.79	100	344	QP
239.5200	46.38	-12.05	34.33	46.00	-11.67	100	252	QP
415.0900	39.05	-7.28	31.77	46.00	-14.23	100	79	QP
470.3800	37.77	-6.19	31.58	46.00	-14.42	100	359	QP
737.1300	34.01	-2.28	31.73	46.00	-14.27	100	80	QP
2480.000	93.77	-4.68	89.09	N/A	N/A	100	86	peak
2480.000	92.85	-4.68	88.17	N/A	N/A	100	86	AVG
2483.500	65.67	-4.69	60.98	74.00	-13.02	100	99	peak
2483.500	51.45	-4.69	46.76	54.00	-7.24	100	99	AVG
4960.000	52.98	1.51	54.49	74.00	-19.51	128	130	peak
4960.000	48.17	1.51	49.68	54.00	-4.32	128	130	AVG
7440.000	52.34	7.49	59.83	74.00	-14.17	100	128	peak
7440.000	45.18	7.49	52.67	54.00	-1.33	100	128	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:

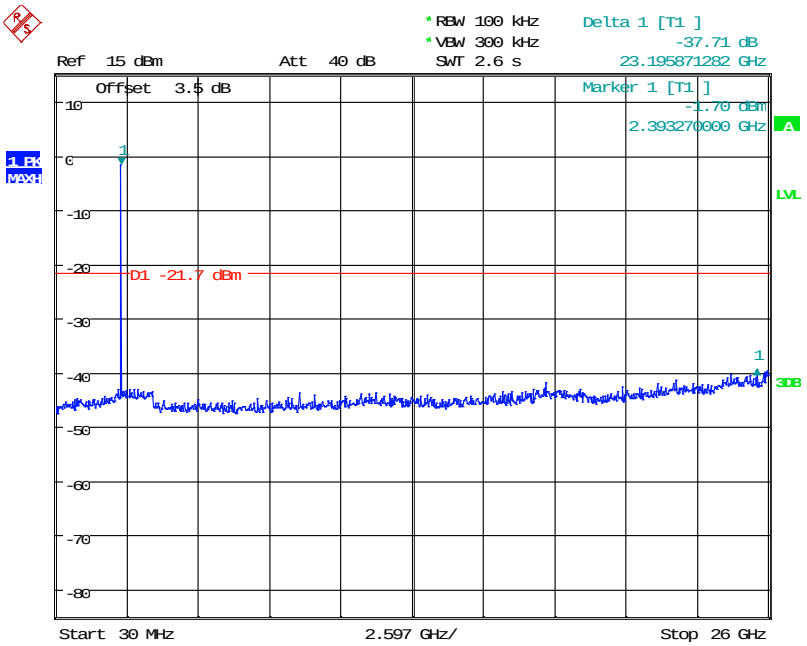
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	39.60	≥ 20	PASS
Mid	2440	37.71	≥ 20	PASS
High	2480	36.66	≥ 20	PASS

Low Channel



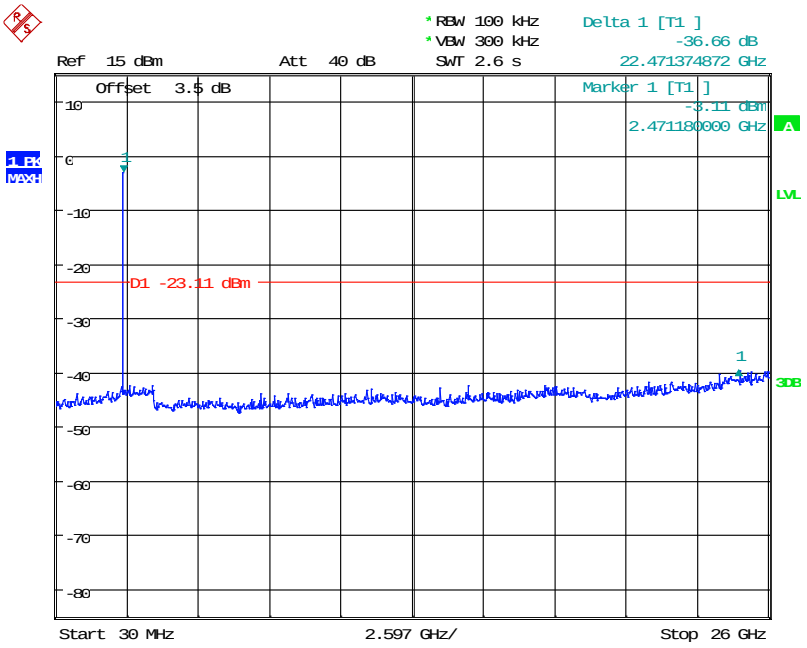
Date: 9.FEB.2018 13:18:00

Middle Channel



Date: 9.FEB.2018 13:38:15

High Channel



Date: 9.FEB.2018 13:30:52

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	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S3W5+	N/A	2017/12/14	2018/12/13

***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

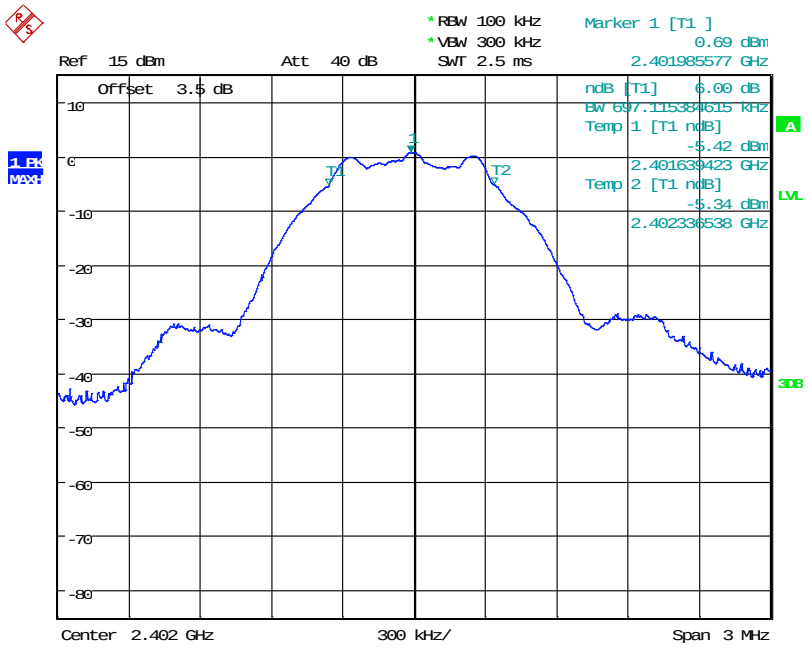
The testing was performed by Andy Shih on 2018-02-09.

8.5 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	Limit (MHz)	Result
Low	2402	0.697	> 0.5	Compliance
Middle	2440	0.697	> 0.5	Compliance
High	2480	0.692	> 0.5	Compliance

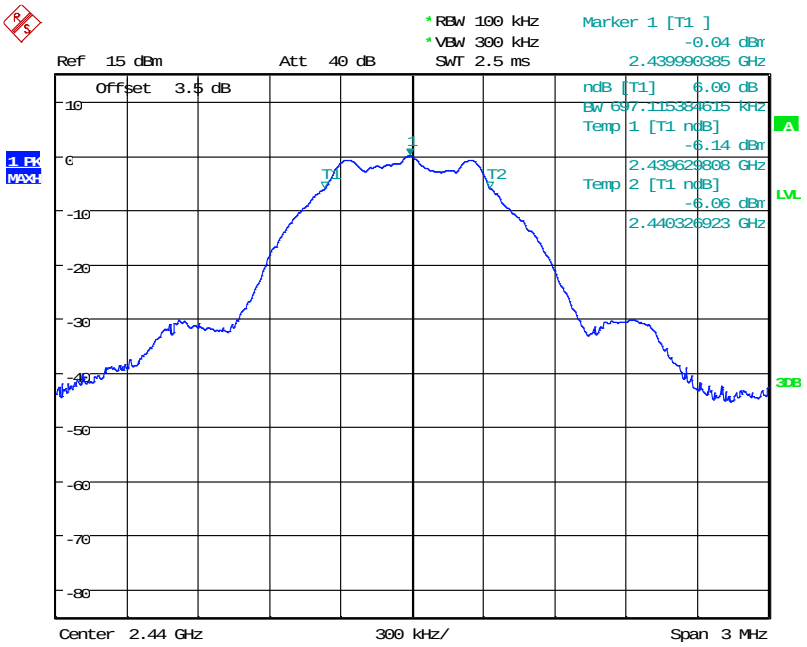
Please refer to the following plots

Low Channel



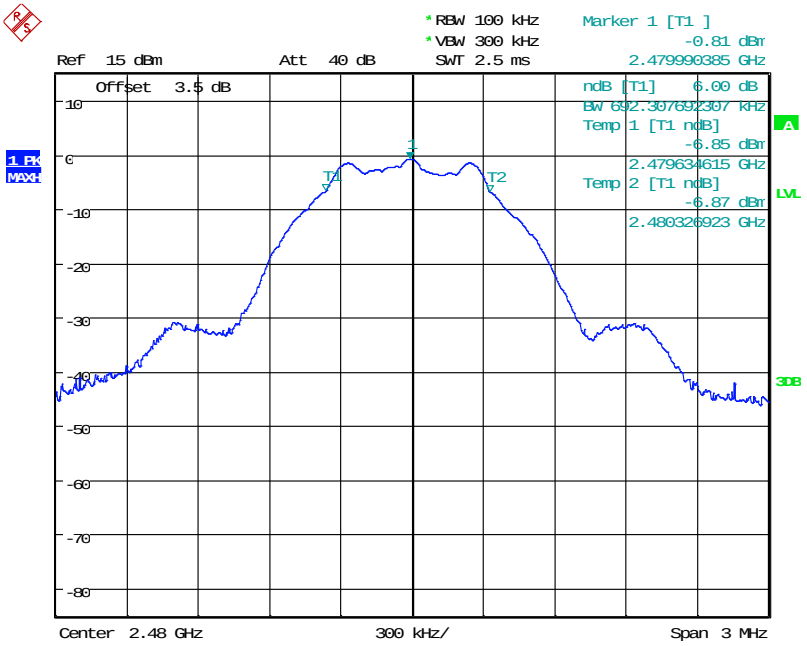
Date: 9.FEB.2018 13:16:46

Middle Channel



Date: 9.FEB.2018 13:18:56

High Channel



Date: 9.FEB.2018 13:20:40

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

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

The testing was performed by Andy Shih on 2018-02-09.

9.5 Test Results

Channel	Frequency (MHz)	Maximum peak Conducted Output Power (dBm)	Maximum peak Conducted Output Power (W)	Limit (W)	Result
Low	2402	3.30	0.002	1	Compliance
Middle	2440	2.86	0.002	1	Compliance
High	2480	1.03	0.001	1	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
Attenuator	MINI-CIRCUITS	BW-S3W5+	N/A	2017/12/14	2018/12/13

***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

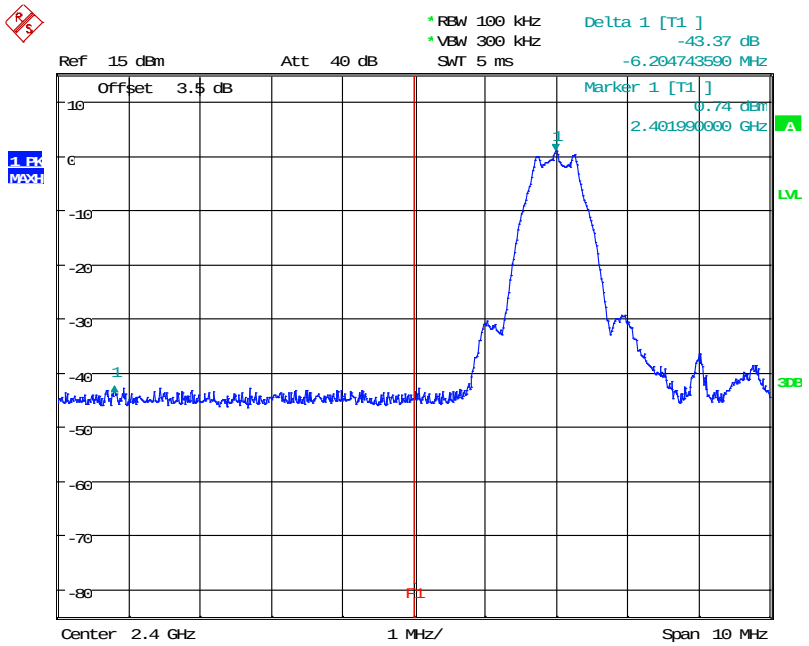
The testing was performed by Andy Shih on 2018-02-09.

10.5 Test Results

Please refer to the following plots

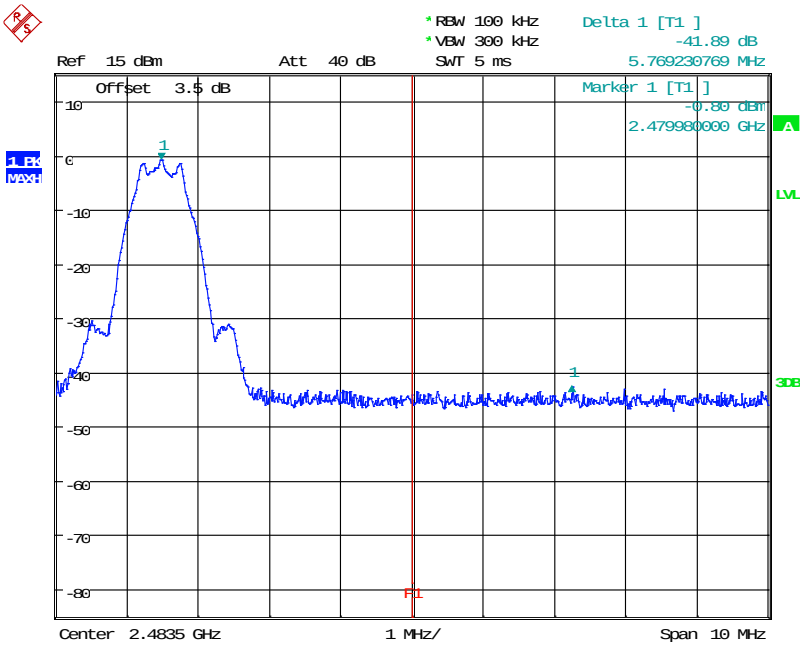
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	43.37	≥ 20	PASS
High	2480	41.89	≥ 20	PASS

Band Edge, Left Side



Date: 9.FEB.2018 13:40:04

Band Edge, Right Side



Date: 9.FEB.2018 13:24:59

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	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S3W5+	N/A	2017/12/14	2018/12/13

***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

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

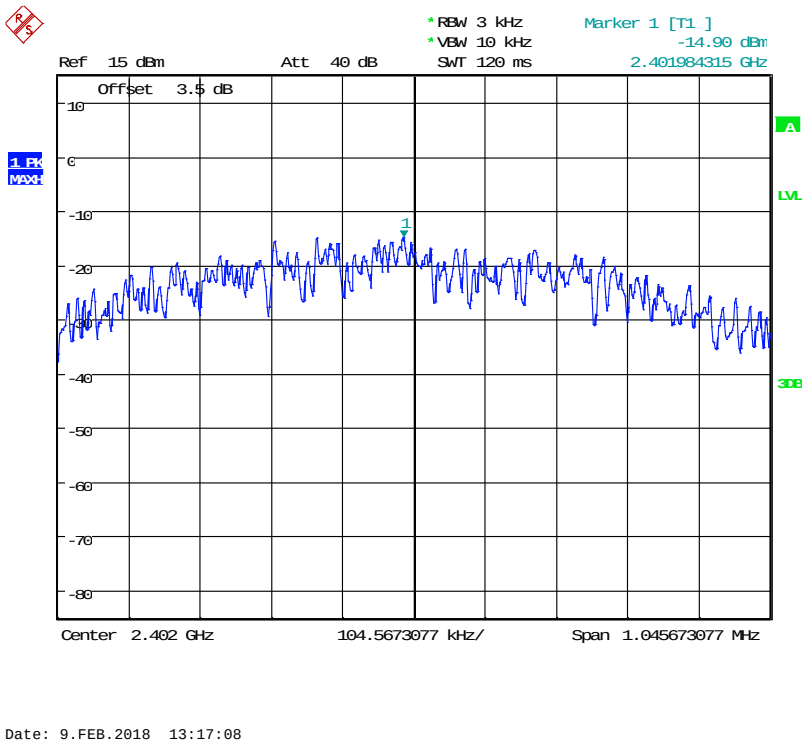
The testing was performed by Andy Shih on 2018-02-09.

11.5 Test Results

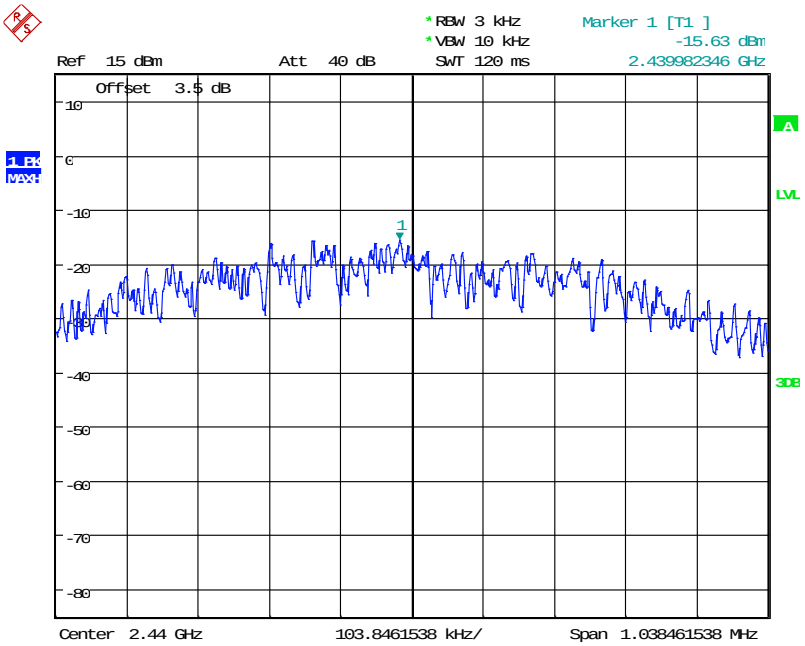
Channel	Frequency (MHz)	PPSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
Low	2402	-14.90	8	Compliance
Middle	2440	-15.63	8	Compliance
High	2480	-16.41	8	Compliance

Please refer to the following plots

Low Channel



Middle Channel



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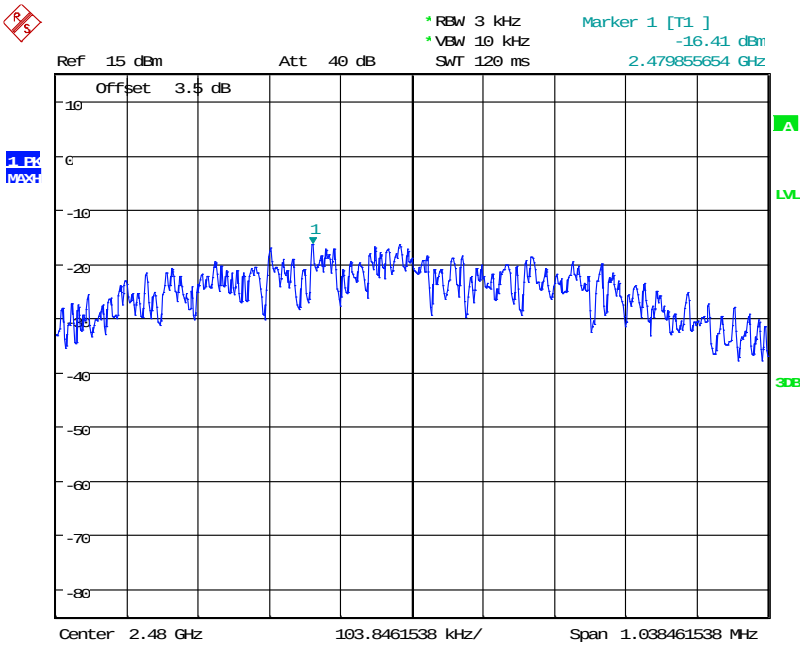
High Channel



Date: 9.FEB.2018 13:21:02

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