



FCC Part 15.247

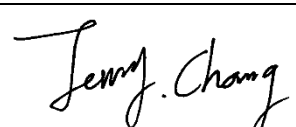
TEST REPORT

For

ALATECH Technology Limited

39F., No. 758, Jungming S.RD. Taichung, Taiwan

FCC ID: YQOWB001

Report Type: Original Report	Product Type: Star ONE
Report Producer: <u>Kaylee Chiang</u> 	
Report Number: <u>RTWA170707003-00A</u>	
Report Date: <u>2017-08-21</u>	
Reviewed By: <u>Jerry Chang</u> 	
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	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RTWA170707003	RTWA170707003-00A	2017.08.21	Original Report	Kaylee

TABLE OF CONTENTS

1	GENERAL INFORMATION.....	5
1.1	PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	5
1.2	OBJECTIVE.....	5
1.3	RELATED SUBMITTAL(S)/GRANT(S)	5
1.4	TEST METHODOLOGY	6
1.5	TEST FACILITY	6
2	SYSTEM TEST CONFIGURATION.....	7
2.1	DESCRIPTION OF TEST CONFIGURATION	7
2.2	EQUIPMENT MODIFICATIONS	7
2.3	EUT EXERCISE SOFTWARE.....	7
2.4	SUPPORT EQUIPMENT LIST AND DETAILS	7
2.5	EXTERNAL CABLE LIST AND DETAILS	7
2.6	BLOCK DIAGRAM OF TEST SETUP.....	8
3	SUMMARY OF TEST RESULTS.....	11
4	FCC §15.247(I) & 2.1093 - RF EXPOSURE	12
4.1	APPLICABLE STANDARD	12
4.2	RF EXPOSURE EVALUATION RESULT	12
5	FCC §15.203 – ANTENNA REQUIREMENTS.....	13
5.1	APPLICABLE STANDARD	13
5.2	ANTENNA LIST AND DETAILS	13
6	FCC §15.207 - AC LINE CONDUCTED EMISSIONS.....	14
6.1	APPLICABLE STANDARD	14
6.2	MEASUREMENT UNCERTAINTY	14
6.3	EUT SETUP.....	15
6.4	EMI TEST RECEIVER SETUP	15
6.5	TEST PROCEDURE	15
6.6	CORRECTED FACTOR & MARGIN CALCULATION	16
6.7	TEST EQUIPMENT LIST AND DETAILS	16
6.8	TEST ENVIRONMENTAL CONDITIONS.....	16
6.9	TEST RESULTS	16
7	FCC §15.209, §15.205, §15.247(D) – SPURIOUS EMISSIONS.....	19
7.1	APPLICABLE STANDARD	19
7.2	MEASUREMENT UNCERTAINTY	19
7.3	EUT SETUP.....	19
7.4	EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP.....	20
7.5	TEST PROCEDURE	20
7.6	CORRECTED FACTOR & MARGIN CALCULATION	21
7.7	TEST RESULTS SUMMARY	21
7.8	TEST EQUIPMENT LIST AND DETAILS	22
7.9	TEST ENVIRONMENTAL CONDITIONS.....	22
7.10	TEST RESULTS	23
8	FCC §15.247(A)(2) – 6 DB EMISSION BANDWIDTH	27
8.1	APPLICABLE STANDARD	27
8.2	TEST PROCEDURE	27
8.3	TEST EQUIPMENT LIST AND DETAILS	27
8.4	TEST ENVIRONMENTAL CONDITIONS.....	28
8.5	TEST RESULTS	28
9	FCC §15.247(B)(3) – MAXIMUM OUTPUT POWER	30
9.1	APPLICABLE STANDARD	30

9.2	TEST PROCEDURE	30
9.3	TEST EQUIPMENT LIST AND DETAILS	30
9.4	TEST ENVIRONMENTAL CONDITIONS.....	31
9.5	TEST RESULTS	31
10	FCC §15.247(D) – 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE	32
10.1	APPLICABLE STANDARD	32
10.2	TEST PROCEDURE	32
10.3	TEST EQUIPMENT LIST AND DETAILS	33
10.4	TEST ENVIRONMENTAL CONDITIONS.....	33
10.5	TEST RESULTS	33
11	FCC §15.247(E) – POWER SPECTRAL DENSITY	35
11.1	APPLICABLE STANDARD	35
11.2	TEST PROCEDURE	35
11.3	TEST EQUIPMENT LIST AND DETAILS	36
11.4	TEST ENVIRONMENTAL CONDITIONS.....	36
11.5	TEST RESULTS	36

1 General Information

1.1 Product Description for Equipment Under Test (EUT)

Applicant: ALATECH Technology Limited
39F., No. 758, Jungming S. RD. Taichung, Taiwan

Manufacturer: ZHEJIANG ALA FITNESS TECHNOLOGY LTD
NO.405 Tongxin Road, Tongxiang Economic Development Zhejiang
314500, China

Product: Star ONE

Model: WB001

Trade Name: ALATECH

Frequency Range: 2402-2480 MHz

Transmit Power: BLE Mode: -1.77 dBm

Modulation Technique: BLE Mode: GFSK

Transmit Data Rate: BLE Mode: 1 Mbps

Number of Channels: BLE Mode: 40 Channels

Antenna Specification: Monopole Antenna/Gain: 2.08 dBi

Voltage Range: 3.7Vdc from Battery

Date of Test: Jul. 18, 2017 ~ Aug. 21, 2017

**All measurement and test data in this report was gathered from production sample serial number: 170707003
(Assigned by BACL, Taiwan) The EUT supplied by the applicant was received on 2017-07-04.*

1.2 Objective

This report is prepared on behalf of *ALATECH Technology Limited* 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)

FCC Part 15.249 DXX submission with FCC ID: YQOWB001

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

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 BT 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

For BLE Modes were tested with channel 1, 21 and 40

2.2 Equipment Modifications

No modification was made to the EUT

2.3 EUT Exercise Software

N/A

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

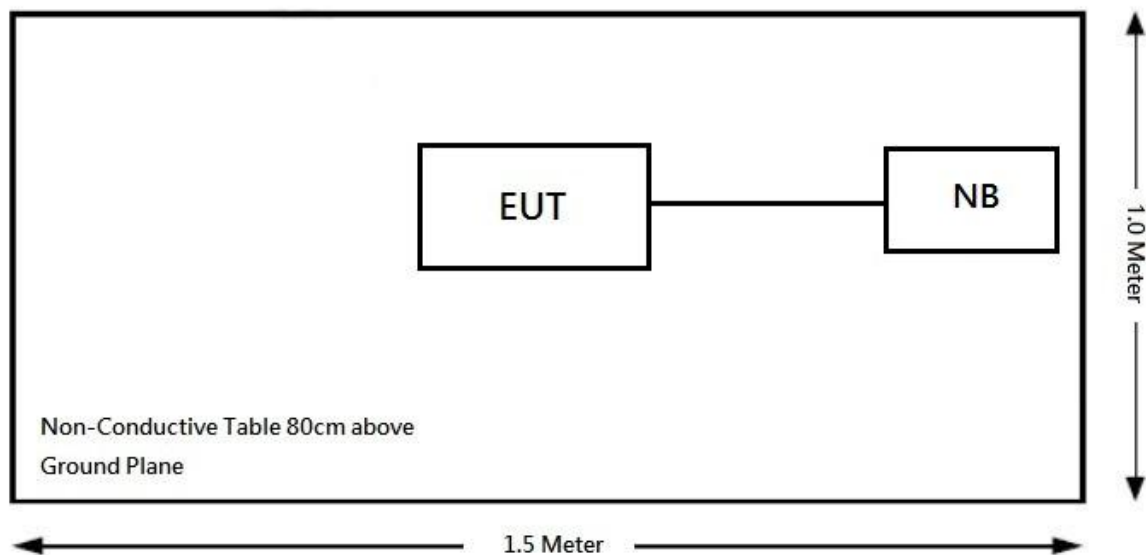
Cable Description	Length (m)	From	To
Mini USB Cable	1.5	NB	EUT

2.6 Block Diagram of Test Setup

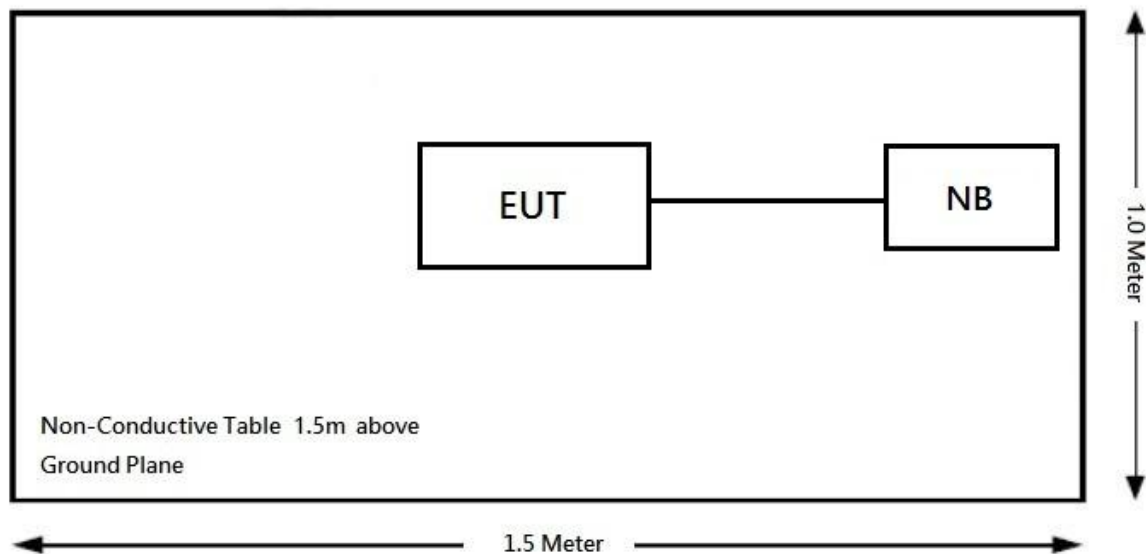
See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.

Radiation:

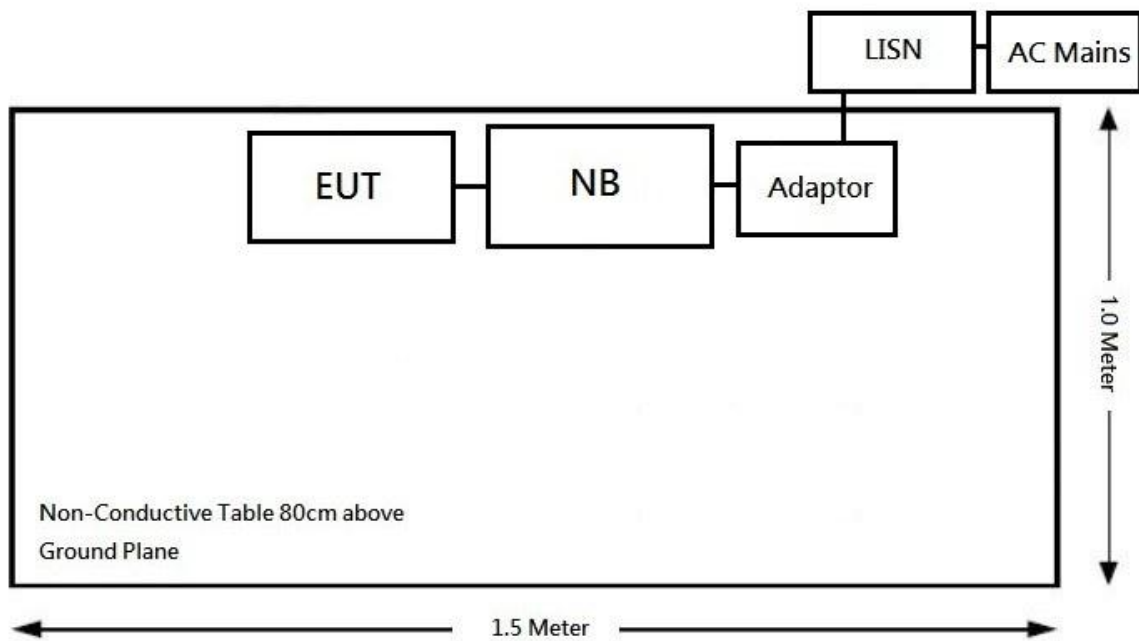
Below 1GHz:



Above 1GHz:

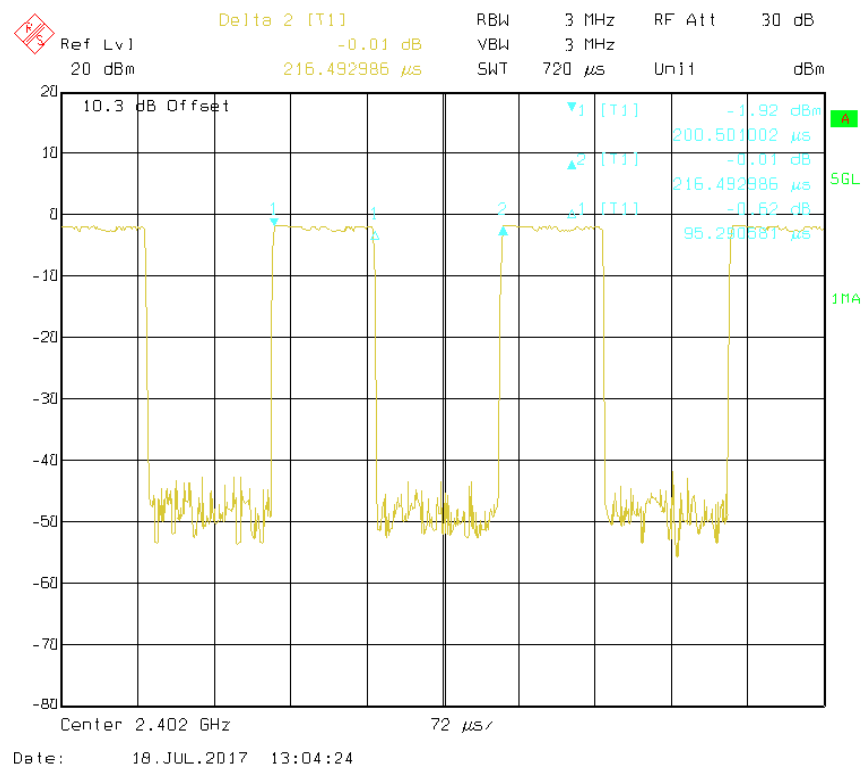


Conduction:



2.7 Duty Cycle

BLE Mode: Duty cycle = 0.44, Duty factor = $10 \cdot \log(1/0.44) = 3.57\text{dB}$



3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §2.1093	RF Exposure	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) & 2.1093 - RF Exposure

4.1 Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances

≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot$

$[\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

4.2 RF Exposure Evaluation Result

FCC

Worse case:

Frequency (MHz)	Tune-up Power		Evaluation Distance (mm)	SAR Exclusion Result	SAR Exclusion Limit (1g SAR)
	(dBm)	(mW)			
2480	-1	0.79	5	0.3	3

Result: SAR test is exempted.

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 exceed 6 dBi.

5.2 Antenna List and Details

Manufacturer	Type	Antenna Gain	Result
Alatech Technology Limited	monopole Antenna	2.08 dBi	Compliance

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standard

According to FCC §15.207 Conducted limits:

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 μ H/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

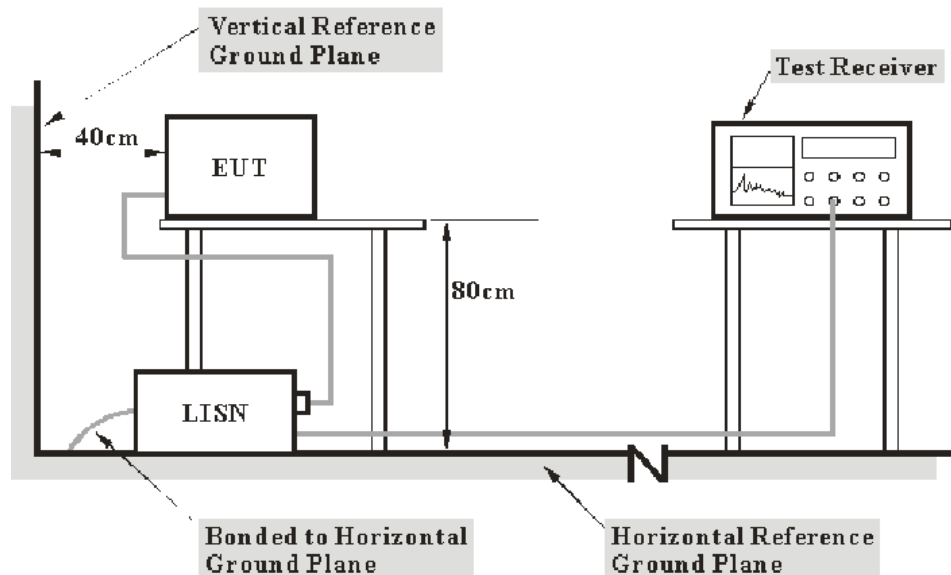
6.2 Measurement Uncertainty

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	IF B/W
150 kHz - 30 MHz	9 kHz

6.5 Test Procedure

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

6.6 Corrected Factor & Margin Calculation

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

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

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

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

6.7 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Date	Calibration Due Date
LISN	Rohde & Schwarz	ENV216	101248	2017/07/20	2018/07/19
LISN	EMCO	3816/2	75848	2016/08/02	2017/08/01
EMI Test Receiver	Rohde & Schwarz	ESCI	100540	2017/05/24	2018/05/23
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM025	2016/08/11	2017/08/10
RF Cable	EMEC	EM-CB5D	001	2017/07/24	2018/07/23
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R

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

6.8 Test Environmental Conditions

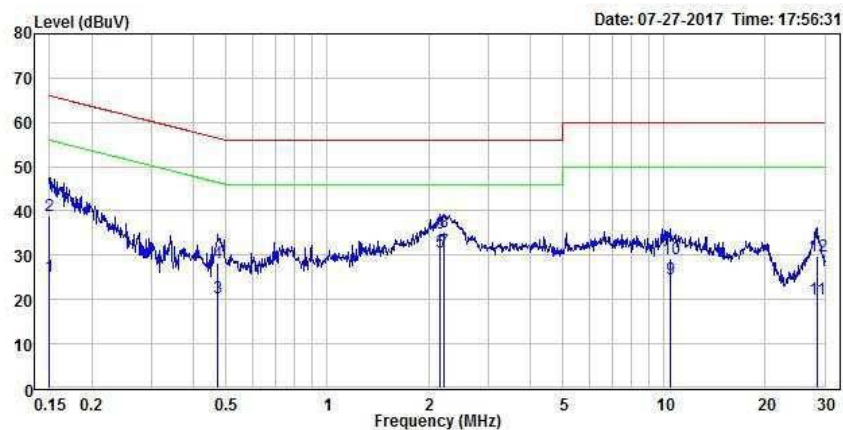
Temperature:	25 °C
Relative Humidity:	58 %
ATM Pressure:	1020 hPa

The testing was performed by Andy Shih on 2017-07-27.

6.9 Test Results

Test Mode: Charge+ Transmitting

Please refer to the following plots and tables.

Main: AC 120V/60 Hz, Line

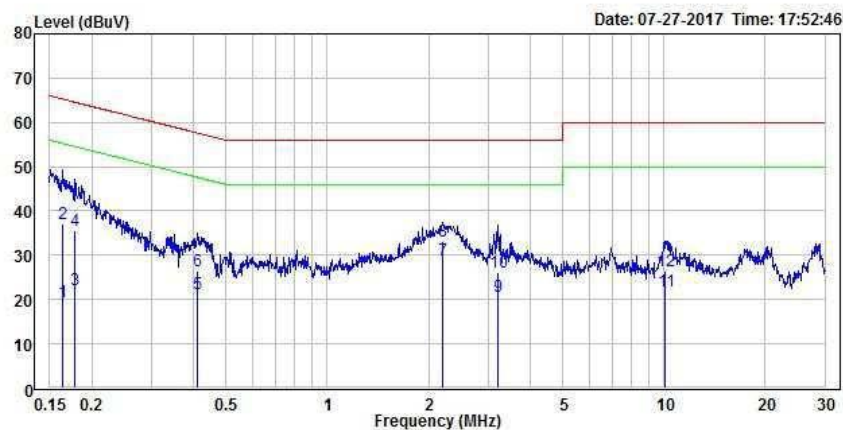
Condition: Line

EUT :

Mode :

Note :

	Freq	Level	Limit	Over		Read		
	MHz	dBuV	Line	Limit	Factor	Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.150	25.30	56.00	-30.70	19.56	5.74	Average	Line
2	0.150	38.92	66.00	-27.08	19.56	19.36	QP	Line
3	0.474	20.35	46.45	-26.10	19.55	0.80	Average	Line
4	0.474	28.30	56.45	-28.15	19.55	8.75	QP	Line
5	2.160	30.59	46.00	-15.41	19.66	10.93	Average	Line
6	2.160	34.91	56.00	-21.09	19.66	15.25	QP	Line
7	2.212	31.17	46.00	-14.83	19.67	11.50	Average	Line
8	2.212	35.40	56.00	-20.60	19.67	15.73	QP	Line
9	10.414	24.71	50.00	-25.29	19.82	4.89	Average	Line
10	10.414	29.35	60.00	-30.65	19.82	9.53	QP	Line
11	28.483	20.09	50.00	-29.91	19.92	0.17	Average	Line
12	28.483	29.74	60.00	-30.26	19.92	9.82	QP	Line

Main: AC 120V/60 Hz, Neutral

Condition: Neutral

EUT :

Mode :

Note :

	Freq	Level	Limit	Over		Read		
	MHz	dBuV	Line	Limit	Factor	Level	Remark	Pol/Phase
	MHz	dBuV	dBuV	dB	dB	dBuV		
1	0.163	19.38	55.30	-35.92	19.55	-0.17	Average	Neutral
2	0.163	37.14	65.30	-28.16	19.55	17.59	QP	Neutral
3	0.178	22.24	54.57	-32.33	19.54	2.70	Average	Neutral
4	0.178	35.51	64.57	-29.06	19.54	15.97	QP	Neutral
5	0.412	21.24	47.61	-26.37	19.54	1.70	Average	Neutral
6	0.412	26.50	57.61	-31.11	19.54	6.96	QP	Neutral
7	2.195	28.77	46.00	-17.23	19.66	9.11	Average	Neutral
8	2.195	33.05	56.00	-22.95	19.66	13.39	QP	Neutral
9	3.220	20.76	46.00	-25.24	19.68	1.08	Average	Neutral
10	3.220	26.12	56.00	-29.88	19.68	6.44	QP	Neutral
11	10.086	22.00	50.00	-28.00	19.86	2.14	Average	Neutral
12	10.086	26.48	60.00	-33.52	19.86	6.62	QP	Neutral

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

7.1 Applicable Standard

FCC§15.247 (d); §15.209; §15.205

7.2 Measurement Uncertainty

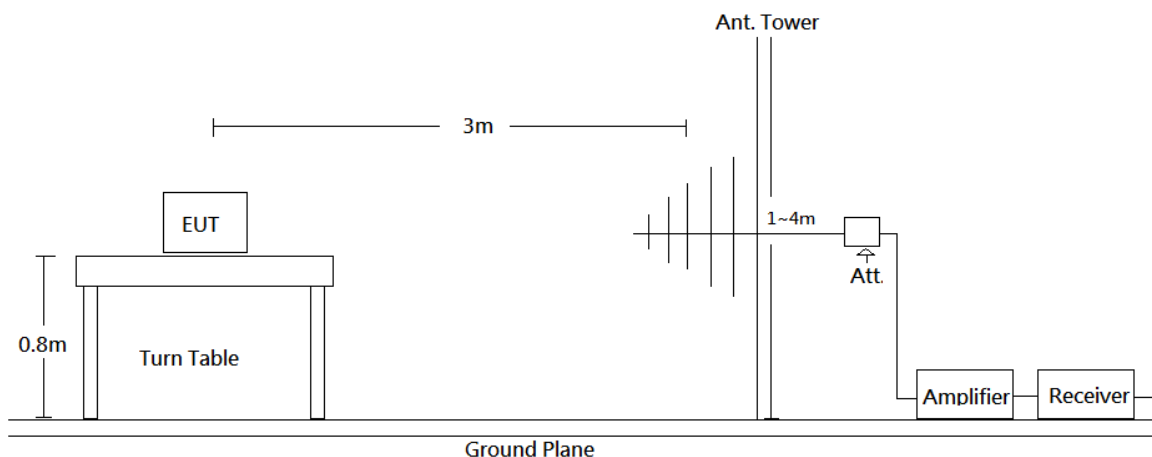
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency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

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

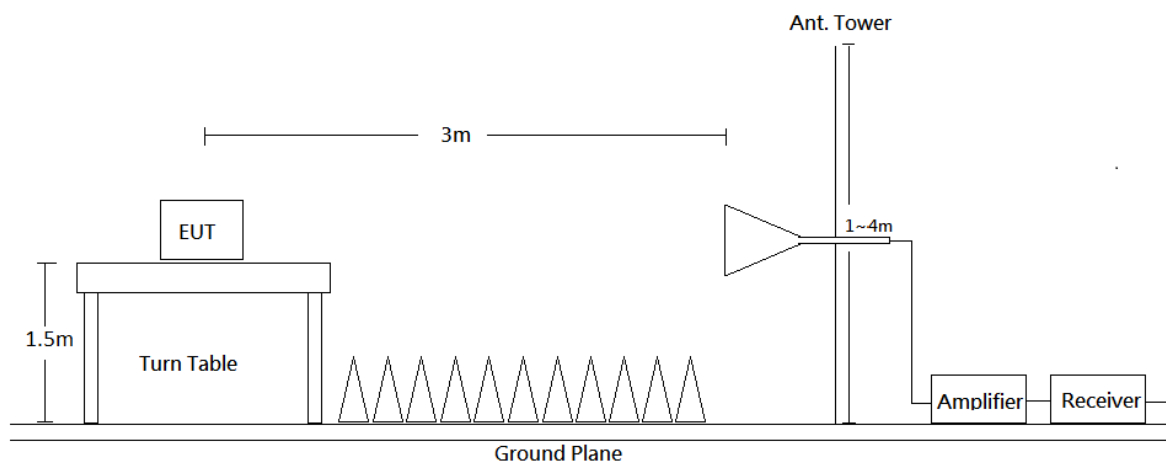
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.76 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.12 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.84 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.16 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.84 dB (k=2, 95% level of confidence)
26 GHz~40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

7.3 EUT Setup

Blow 1 GHz:



Above 1 GHz:



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

7.4 EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	RBW	VBW	IF BW	Detector
30-1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Ave

7.5 Test Procedure

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

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

7.6 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

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

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

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

7.7 Test Results Summary

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

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

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

7.8 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
966A Room					
Bilog Antenna	Sunol & Mini-Circuits	JB6/ UNAT-6+	A050115 / 15542_01	2016/11/16	2017/11/15
Horn Antenna	EMCO	3115	9311-4158	2017/05/31	2018/05/30
Horn Antenna	ETS-Lindgren	3116	00062638	2016/09/05	2017/09/04
Preamplifier	Sonoma	310N	130602	2017/07/03	2018/07/02
Preamplifier	EMEC	EM01G18G	060697	2017/04/14	2018/04/16
Preamplifier	EMEC	EM18G40G	060656	2016/12/13	2017/12/12
EMI Test Receiver	R & S	ESR7	101419	2016/11/03	2017/11/03
Spectrum Analyzer	Rohde & Schwarz	FSV40	101203	2017/07/13	2018/07/12
Microflex Cable	UTIFLEX	UFB311A-Q-1440- 300300	220490-006	2016/11/02	2017/11/01
Microflex Cable	UTIFLEX	UFA210A-1-3149- 300300	MFR64639 226389-001	2016/11/29	2017/11/28
Microflex Cable	ROSNOL	K1K50-UP0264- K1K50-450CM	160309-1	2017/03/24	2018/03/23
Microflex Cable	ROSNOL	K1K50-UP0264- K1K50-80CM	160309-2	2017/01/20	2018/01/19
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	FSEK30	825084/006	2016/12/15	2017/12/14
Cable	WOKEN	SFL402	S02-160323- 07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2017/03/09	2018/03/08

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

7.9 Test Environmental Conditions

Temperature:	25.2° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2017-07-18.

7.10 Test Results

(Pre-scan with three orthogonal axis, and worse case as Y axis.)

Mode: Transmitting

Horizontal

Frequency (MHz)	Reading (dB μ V)	Correct Factor(dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Degree ($^{\circ}$)	Remark
BLE, Low channel								
201.69	28.11	-11.09	17.02	43.50	-26.48	100	142	QP
390.84	28.40	-7.92	20.48	46.00	-25.52	100	189	QP
487.84	28.51	-5.92	22.59	46.00	-23.41	100	189	QP
685.72	27.87	-2.97	24.90	46.00	-21.10	100	179	QP
817.64	27.49	-0.22	27.27	46.00	-18.73	100	341	QP
927.25	27.68	2.08	29.76	46.00	-16.24	100	356	QP
2390.00	63.16	-4.89	58.27	74.00	-15.73	160	161	peak
2390.00	52.14	-4.89	47.25	54.00	-6.75	160	161	AVG
2402.00	97.44	-4.86	92.58	N/A	N/A	143	18	peak
2402.00	96.50	-4.86	91.64	N/A	N/A	143	18	AVG
4804.00	41.61	0.98	42.59	74.00	-31.41	100	243	peak
4804.00	27.61	0.98	28.59	54.00	-25.41	100	243	AVG
7206.00	45.46	6.56	52.02	74.00	-21.98	100	326	peak
7206.00	30.40	6.56	36.96	54.00	-17.04	100	326	AVG
BLE, Middle channel								
134.76	29.08	-10.72	18.36	43.50	-25.14	100	81	QP
313.24	28.32	-9.56	18.76	46.00	-27.24	100	196	QP
382.11	28.34	-8.10	20.24	46.00	-25.76	100	290	QP
585.81	28.40	-4.25	24.15	46.00	-21.85	100	198	QP
655.65	28.43	-3.29	25.14	46.00	-20.86	100	12	QP
795.33	27.88	-0.68	27.20	46.00	-18.80	100	359	QP
2442.00	95.08	-4.76	90.32	N/A	N/A	110	32	peak
2442.00	94.09	-4.76	89.33	N/A	N/A	110	32	AVG
4884.00	45.26	1.25	46.51	74.00	-27.49	100	57	peak
4884.00	38.39	1.25	39.64	54.00	-14.36	100	57	AVG
7326.00	45.47	7.04	52.51	74.00	-21.49	100	321	peak
7326.00	30.53	7.04	37.57	54.00	-16.43	100	321	AVG
BLE, High channel								
133.79	28.12	-10.68	17.44	43.50	-26.06	100	1	QP
199.75	28.30	-10.76	17.54	43.50	-25.96	100	167	QP
416.06	27.28	-7.34	19.94	46.00	-26.06	100	245	QP
528.58	29.56	-5.31	24.25	46.00	-21.75	100	225	QP
706.09	27.86	-2.70	25.16	46.00	-20.84	100	11	QP
793.39	29.06	-0.73	28.33	46.00	-17.67	100	165	QP
2480.00	94.23	-4.68	89.55	N/A	N/A	140	331	peak
2480.00	93.09	-4.68	88.41	N/A	N/A	140	331	AVG
2483.50	63.24	-4.69	58.55	74.00	-15.45	190	193	peak
2483.50	52.35	-4.69	47.66	54.00	-6.34	190	193	AVG
4960.00	43.99	1.51	45.50	74.00	-28.50	100	187	peak
4960.00	36.05	1.51	37.56	54.00	-16.44	100	187	AVG
7440.00	45.28	7.49	52.77	74.00	-21.23	100	53	peak
7440.00	29.79	7.49	37.28	54.00	-16.72	100	53	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 μ V)	Correct Factor(dB/m)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
BLE, Low channel								
81.41	44.30	-16.77	27.53	40.00	-12.47	100	268	QP
310.33	31.82	-9.61	22.21	46.00	-23.79	100	280	QP
485.90	28.53	-5.95	22.58	46.00	-23.42	100	276	QP
652.74	28.35	-3.32	25.03	46.00	-20.97	100	335	QP
715.79	27.70	-2.51	25.19	46.00	-20.81	100	352	QP
817.64	28.87	-0.22	28.65	46.00	-17.35	100	279	QP
2390.00	63.44	-4.89	58.55	74.00	-15.45	175	290	peak
2390.00	52.51	-4.89	47.62	54.00	-6.38	175	290	AVG
2402.00	94.08	-4.86	89.22	N/A	N/A	136	290	peak
2402.00	93.27	-4.86	88.41	N/A	N/A	136	290	AVG
4804.000	45.97	0.98	46.95	74.00	-27.05	100	329	peak
4804.00	35.81	0.98	36.79	54.00	-17.21	100	329	AVG
7206.00	45.10	6.56	51.66	74.00	-22.34	100	358	peak
7206.00	29.84	6.56	36.40	54.00	-17.60	100	358	AVG
BLE, Middle channel								
47.46	39.92	-15.06	24.86	40.00	-15.14	100	125	QP
101.78	34.38	-14.05	20.33	43.50	-23.17	100	48	QP
166.77	31.12	-11.98	19.14	43.50	-24.36	100	360	QP
310.33	30.71	-9.61	21.10	46.00	-24.90	100	101	QP
639.16	28.05	-3.49	24.56	46.00	-21.44	100	46	QP
942.77	27.42	2.48	29.90	46.00	-16.10	100	275	QP
2442.00	93.97	-4.76	89.21	N/A	N/A	120	245	peak
2442.00	92.86	-4.76	88.10	N/A	N/A	120	245	AVG
4884.00	45.09	1.25	46.34	74.00	-27.66	100	96	peak
4884.00	37.25	1.25	38.50	54.00	-15.50	100	96	AVG
7326.00	45.60	7.04	52.64	74.00	-21.36	100	355	peak
7326.00	30.25	7.04	37.29	54.00	-16.71	100	355	AVG
BLE, High channel								
62.01	38.19	-17.41	20.78	40.00	-19.22	100	345	QP
166.77	31.22	-11.98	19.24	43.50	-24.26	100	32	QP
314.21	30.66	-9.54	21.12	46.00	-24.88	100	169	QP
567.38	28.92	-4.63	24.29	46.00	-21.71	100	360	QP
638.19	28.74	-3.50	25.24	46.00	-20.76	100	52	QP
813.76	27.83	-0.30	27.53	46.00	-18.47	100	48	QP
2480.00	95.20	-4.68	90.52	N/A	N/A	100	249	peak
2480.00	93.85	-4.68	89.17	N/A	N/A	100	249	AVG
2483.50	63.89	-4.69	59.20	74.00	-14.80	145	354	peak
2483.50	52.29	-4.69	47.60	54.00	-6.40	145	354	AVG
4960.00	43.78	1.51	45.29	74.00	-28.71	100	98	peak
4960.00	35.61	1.51	37.12	54.00	-16.88	100	98	AVG
7440.00	44.58	7.49	52.07	74.00	-21.93	100	320	peak
7440.00	29.56	7.49	37.05	54.00	-16.95	100	320	AVG

Result = Reading + Correct Factor

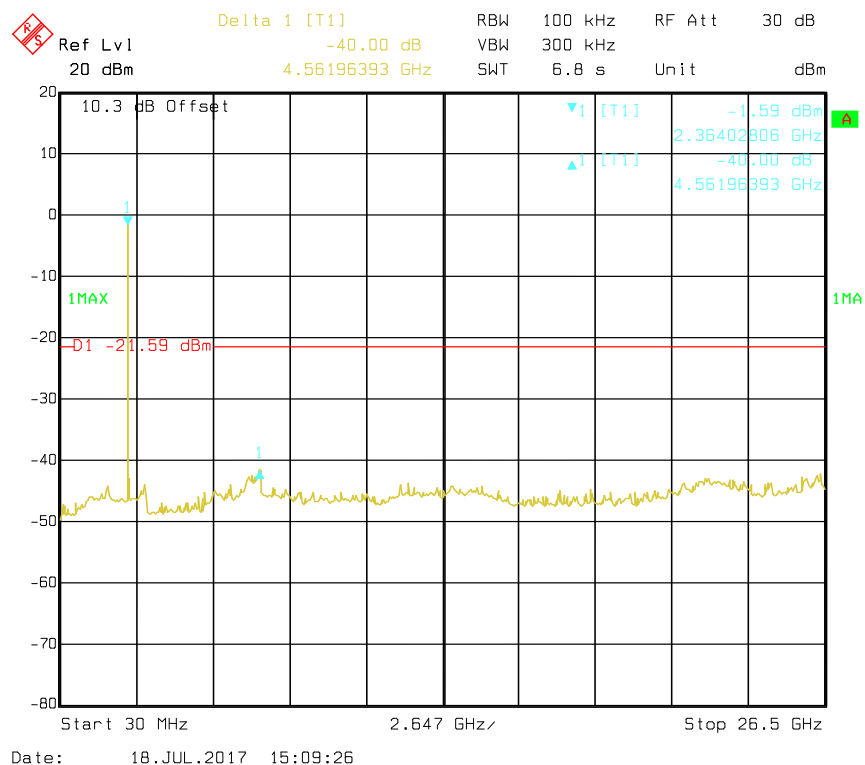
Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

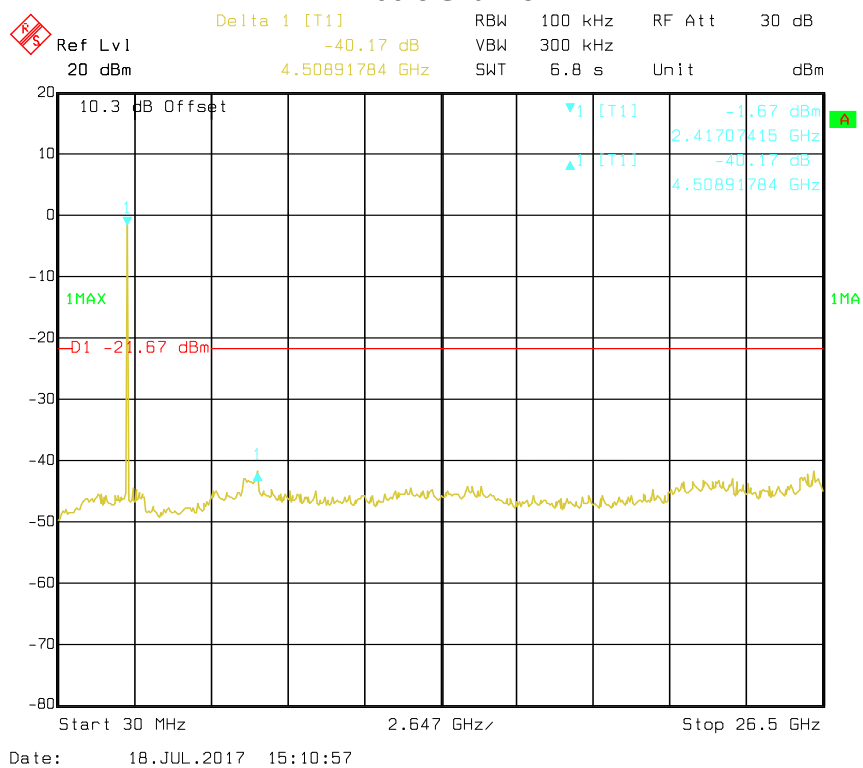
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

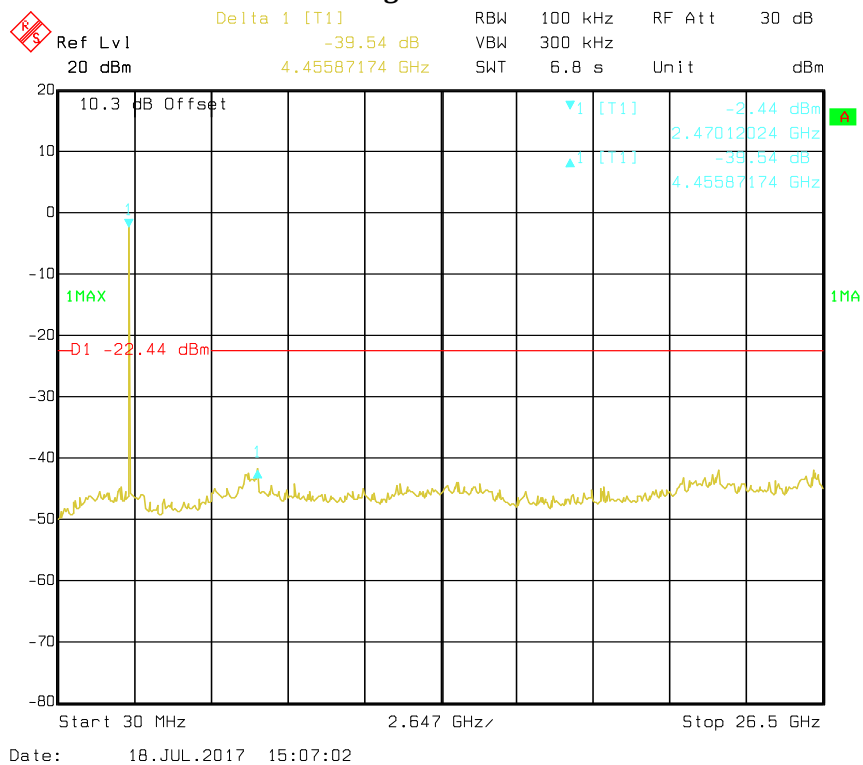
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	40.00	≥ 20	PASS
Mid	2442	40.17	≥ 20	PASS
High	2480	39.54	≥ 20	PASS

Low Channel

Middle Channel



High Channel



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

8.1 Applicable Standard

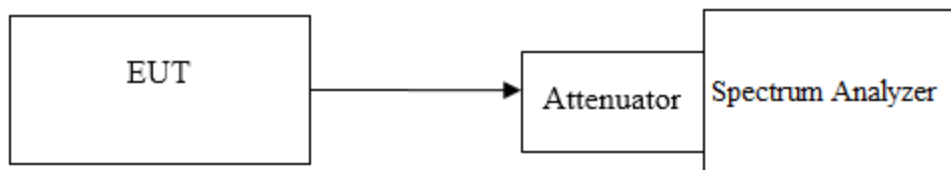
According to FCC §15.247(a) (2).

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

The steps for the first option are as follows:

- a) Set RBW = 100 kHz.
- b) Set the VBW $\geq [3 \times \text{RBW}]$.
- c) Detector = peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



8.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	825084/006	2016/12/15	2017/12/14
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2017/03/09	2018/03/08

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

8.4 Test Environmental Conditions

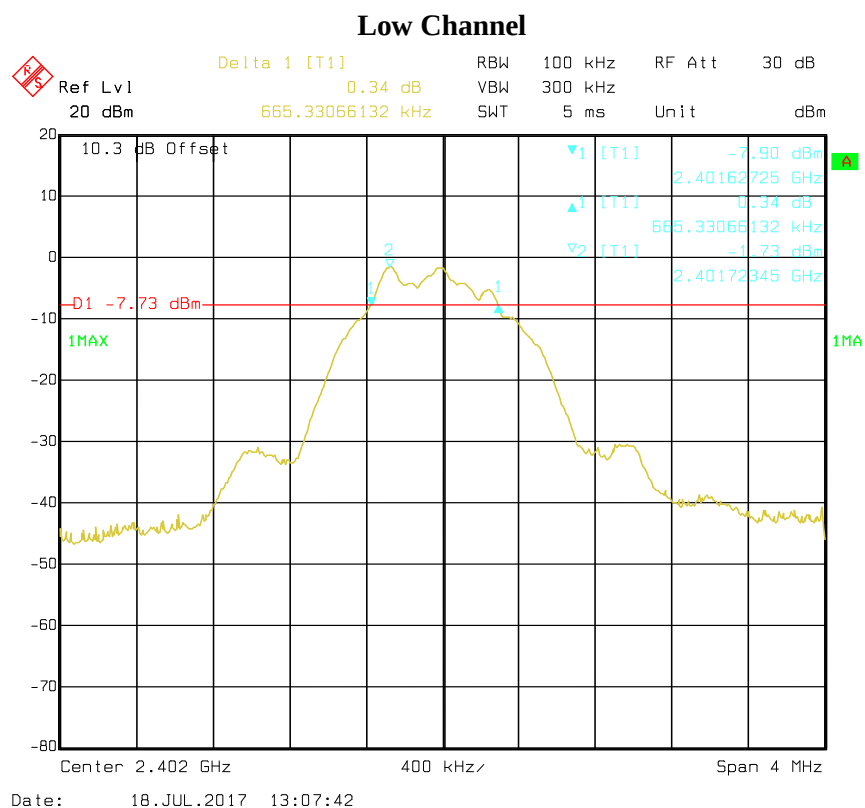
Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2017-07-18.

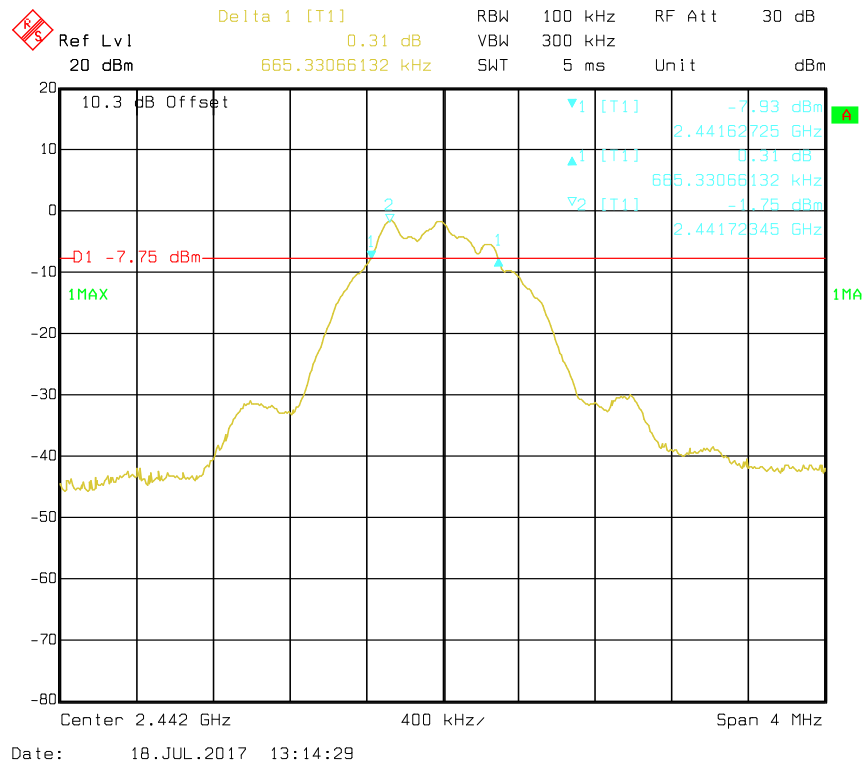
8.5 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	Limit (MHz)	Result
Low	2402	0.67	> 0.5	Compliance
Middle	2442	0.67	> 0.5	Compliance
High	2480	0.66	> 0.5	Compliance

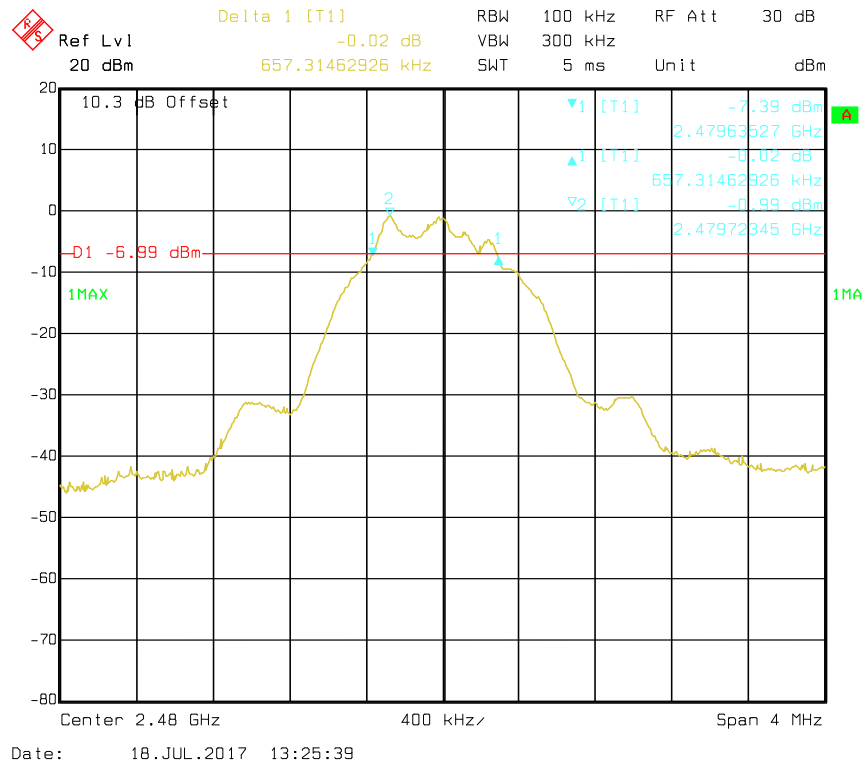
Please refer to the following plots



Middle Channel



High Channel



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

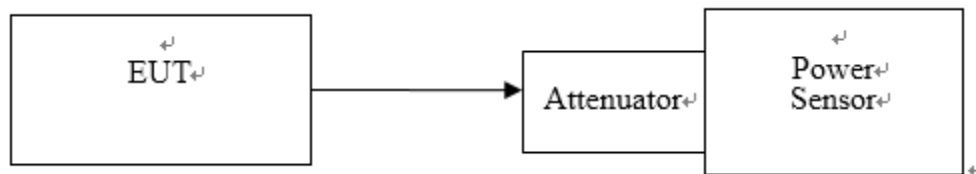
9.1 Applicable Standard

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.



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
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2017/03/09	2018/03/08

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

9.4 Test Environmental Conditions

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

The testing was performed by Andy Shih on 2017-07-18.

9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Result
Low	2402	-1.97	30	Compliance
Middle	2442	-1.89	30	Compliance
High	2480	-1.77	30	Compliance

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

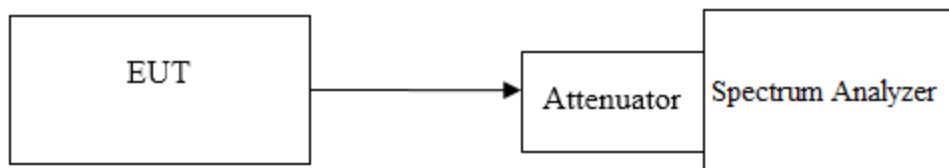
10.1 Applicable Standard

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	FSEK30	825084/006	2016/12/15	2017/12/14
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2017/03/09	2018/03/08

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

10.4 Test Environmental Conditions

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

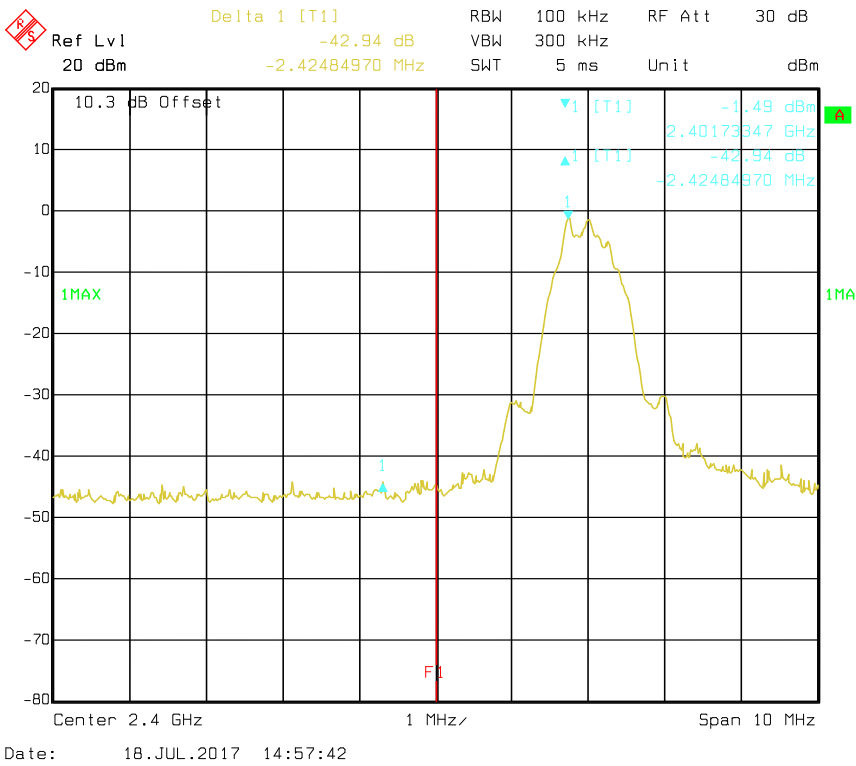
The testing was performed by Andy Shih on 2017-07-18.

10.5 Test Results

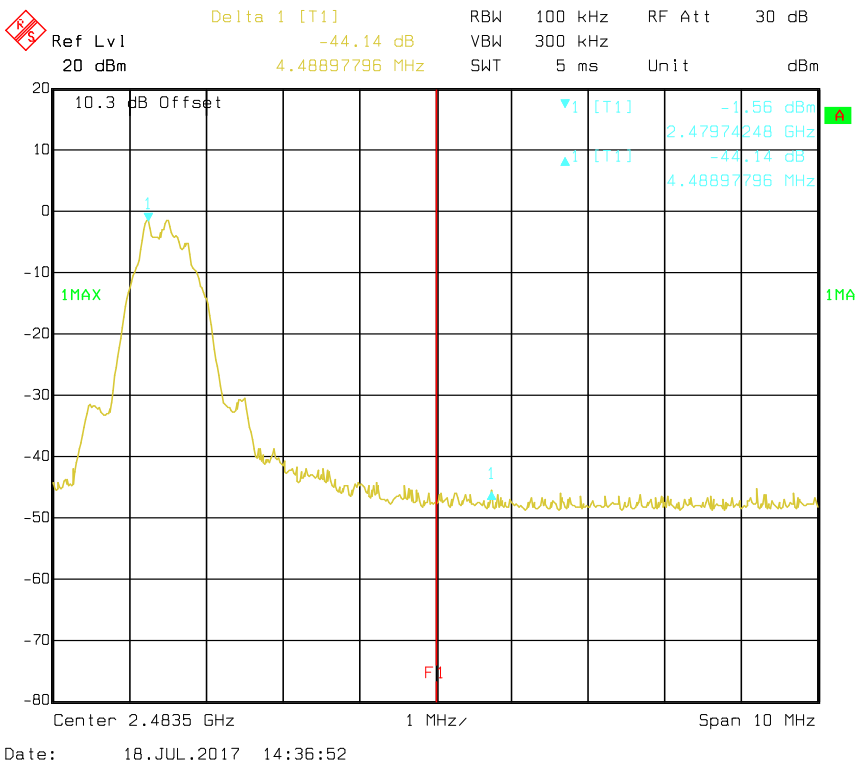
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	42.94	≥ 20	PASS
High	2480	44.14	≥ 20	PASS

Please refer to the following plots

Band Edge, Left Side



Band Edge, Right Side



11 FCC §15.247(e) – Power Spectral Density

11.1 Applicable Standard

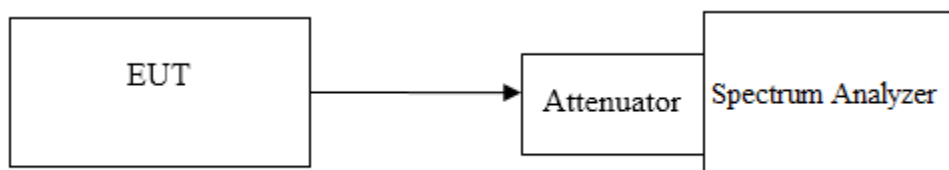
According to FCC §15.247(e).

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



11.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	825084/006	2016/12/15	2017/12/14
Cable	WOKEN	SFL402	S02-160323-07	2017/02/22	2018/02/21
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2017/03/09	2018/03/08

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

11.4 Test Environmental Conditions

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

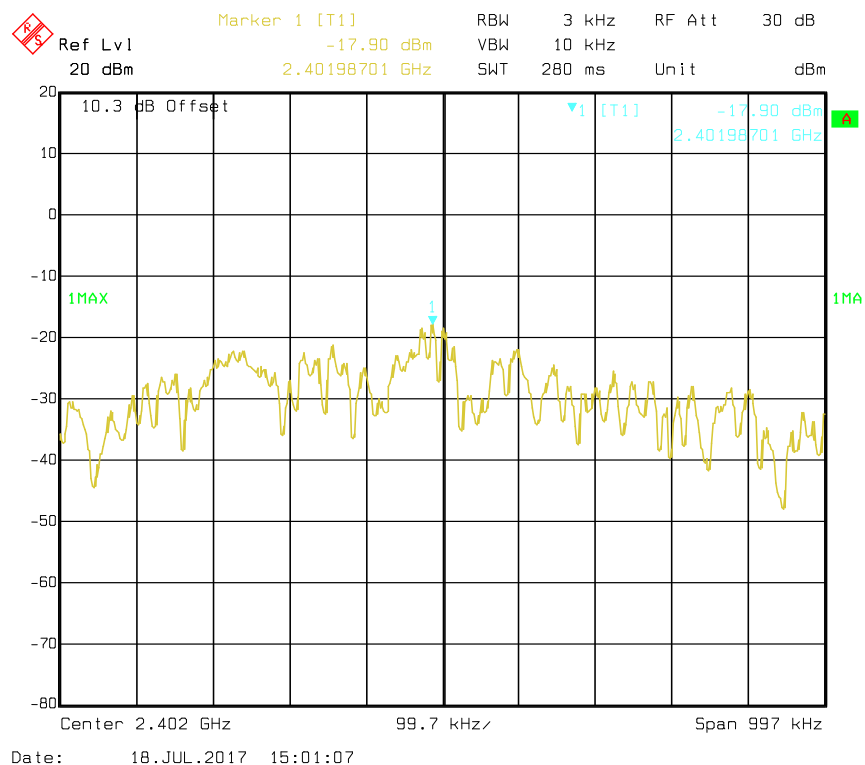
The testing was performed by Andy Shih on 2017-07-18.

11.5 Test Results

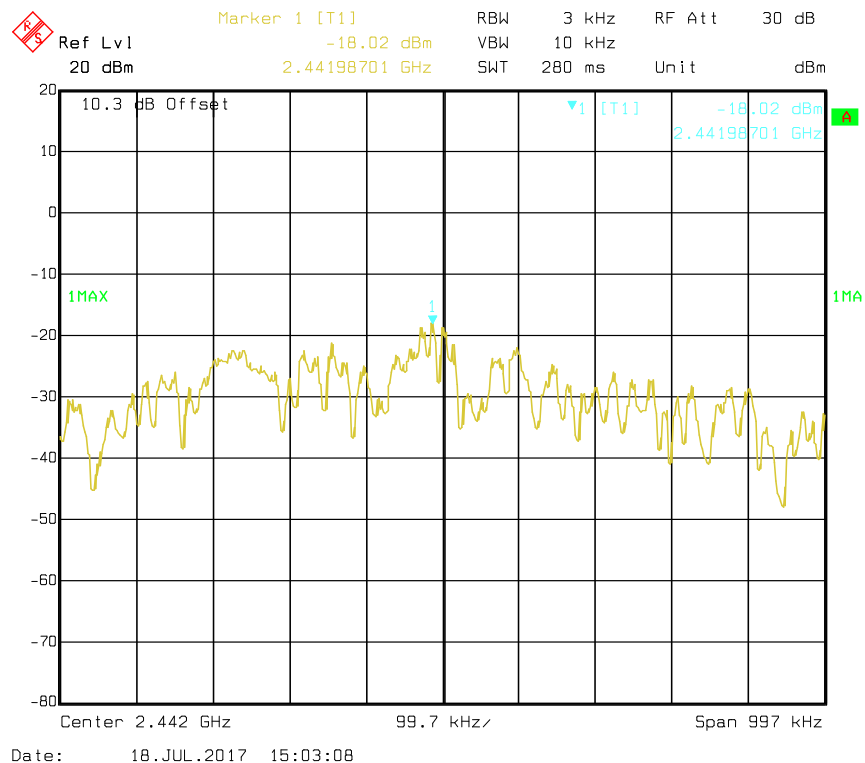
Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
Low	2402	-17.90	8	Compliance
Middle	2442	-18.02	8	Compliance
High	2480	-17.96	8	Compliance

Please refer to the following plots

Low Channel



Middle Channel



10.3 dB Offset

Marker 1 [T1]

Ref Lvl 20 dBm

RBW 3 kHz

VBW 10 kHz

SWT 280 ms

RF Att 30 dB

Unit dBm

1MAX

▼1 [T1]

-17.96 dBm

2.47998520 GHz

Center 2.48 GHz

98.5 kHz

Span 985 kHz

Date: 18.JUL.2017 15:04:46

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