FCC Part 15.247

TEST REPORT

For

ALATECH Technology Limited

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

FCC ID: YQO35BTM00100

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REVISION HISTORY

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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 TECHOLOGY LTD NO.405 Tongxin Road, Tongxiang Economic Development Zhejiang 314500, China
Product:	35-BTM-00100
Model:	35-BTM-00100
Trade Name:	ALATECH
Frequency Range:	BT BLE Mode: 2402-2480 MHz ANT+ Mode: 2457 MHz
Transmit Power:	BT BLE Mode: -0.31 dBm ANT+ Mode: -0.76 dBm
Modulation Technique:	BT BLE Mode: GFSK ANT+ Mode: GFSK
Number of Channels:	BT BLE Mode: 40 Channels ANT+ Mode: 1 Channel
Antenna Specification:	Chip Antenna / Gain: 5.05 dBi
Voltage Range:	3Vdc for Battery
Date of Test:	Jul. 12, 2017 ~ Aug. 02, 2017

**All measurement and test data in this report was gathered from production sample serial number: 170707002 (Assigned by BACL, Taiwan) The EUT supplied by the applicant was received on 2017-07-04.*

Designation Number: TW3180

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, and 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

1.5 Test Facility

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

Test site at Bay Area Compliance Laboratories Corp. (Taiwan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10-2013.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 431084. 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, 40 channels are provided to testing:

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, 21 and 40.

For ANT+ Mode,

The system was configured for testing in an engineering mode, which was provided by manufacturer. The engineering mode was configured the system transmitting with maximum power. For ANT+ mode, only 1 channel (2457MHz) was used

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

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

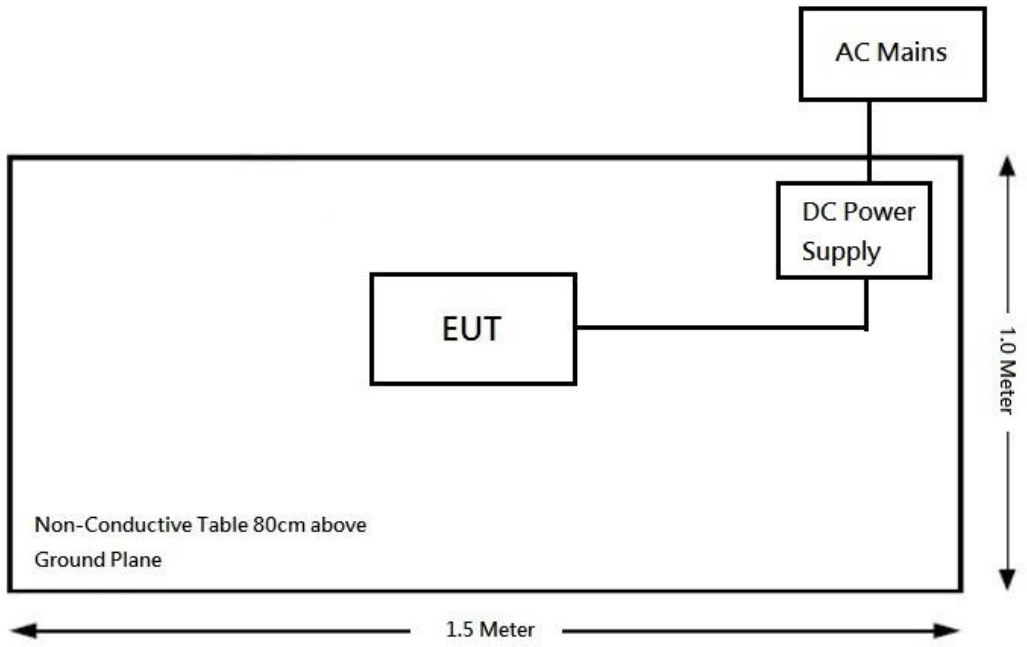
Description	Manufacturer	Model Number	BSMI	FCC ID / DOC	S/N
Laboratory DC Power Supply	INSTEK	GPC-3030DQ	N/A	DOC	D843809

2.5 External Cable List and Details

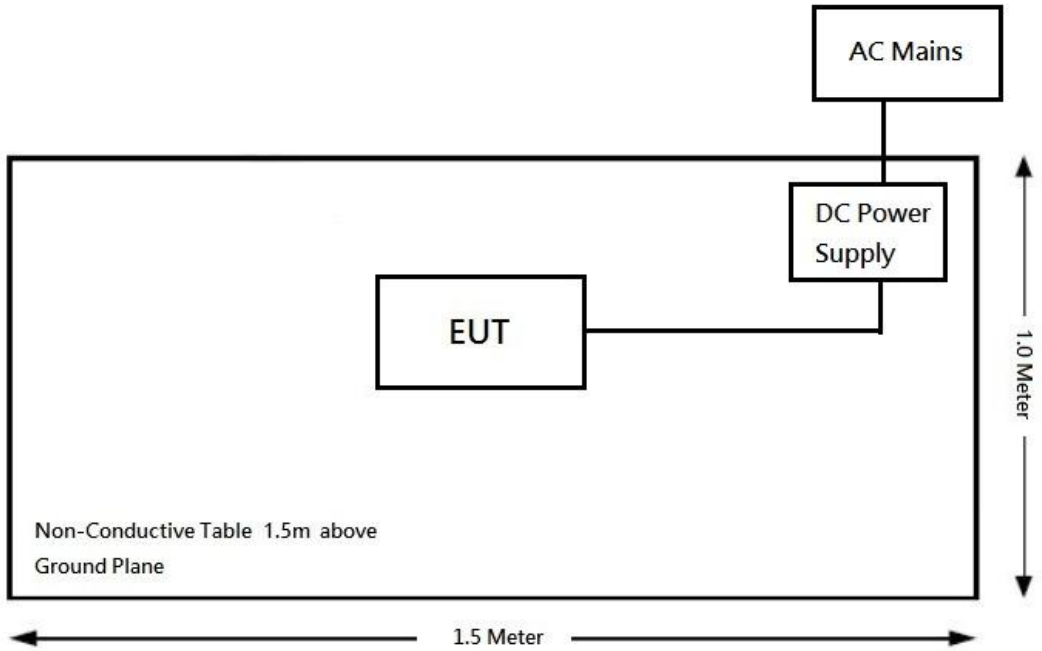
Cable Description	Length (m)	From	To
DC Cable	1.5	Laboratory DC Power Supply	EUT

2.6 Block Diagram of Test Setup

See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.
Below 1GHz:



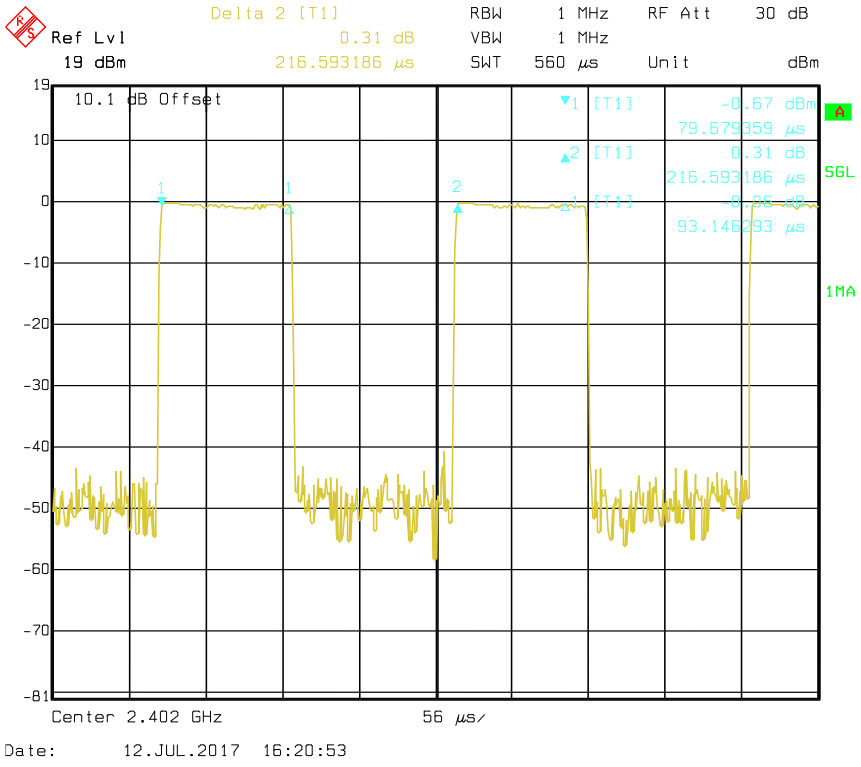
Above 1GHz:



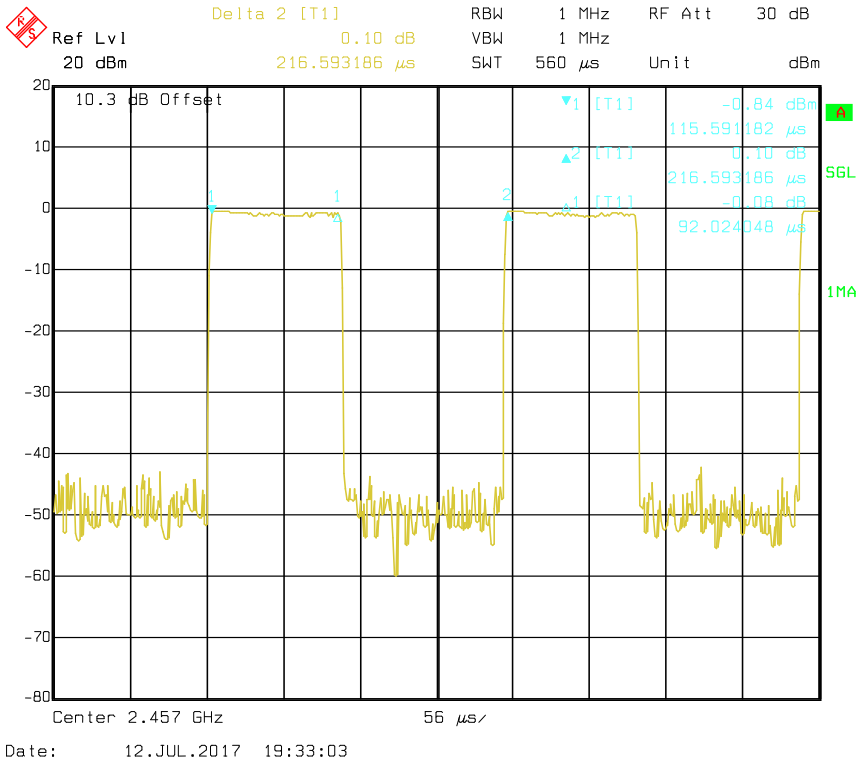
2.7 Duty Cycle

Duty cycle of test signal is < 98%, duty factor shall be considered.
BLE Mode: Duty cycle = 0.43, Duty factor = 10 * log(1/0.43) = 3.66dB
ANT+ Mode: Duty cycle = 0.42, Duty factor = 10 * log(1/0.42) = 3.76dB

BLE Mode



ANT+ Mode


Delta 2 [T1]
RBW 1 MHz
RF Att 30 dB
Ref Lvl
0.10 dB
VBW 1 MHz
20 dBm
216.593186 µs
SWT 560 µs
Unit dBm
10.3 dB Offset
1 [T1] -0.84 dBm
115.591182 µs
2 [T1] 0.10 dB
216.593186 µs
1 [T1] -0.08 dB
92.024048 µs
A
SGL
1MA
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Center 2.457 GHz
56 µs/
Date: 12.JUL.2017 19:33:03

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	Not applicable
§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 §15.247(i)

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
$\leqslant$ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] •
[$\surd$ f(GHz)] $\leqslant$ 3.0 for 1-g SAR and $\leqslant$ 7.5 for 10-g extremity SAR, where

1. f(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.

4.2 RF Exposure Evaluation Result

FCC

Worse case:

SAR evaluation:

Mode	Frequency (MHz)	Tunp-up Power		Evaluation Distrance (mm)	SAR Excluion Result (mW/cm^2)	Extremity SAR Exclusion Limit
		(dBm)	(mW)			(1g SAR)
BLE	2480	0	1	5	0.3	3
ANT+	2457	0	1	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
YAGEO	Chip Antenna	5.05 dBi	Compliance

The EUT has one integral antenna arrangement, which was permanently attached; fulfill the requirement of this section. Please refer to the internal photos.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standard

FCC §15.207

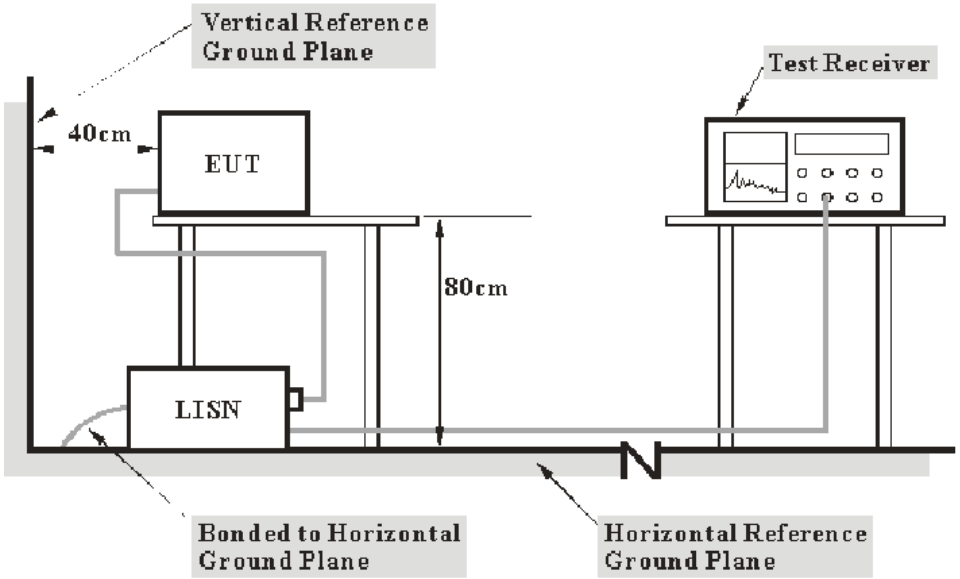
6.2 Measurement Uncertainty

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	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:

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
LISN	EMCO	3816/2	00075848	2016/08/04	2017/08/03
EMI Test Receiver	Rohde & Schwarz	ESCS 30	825022/005	2017/05/24	2018/05/23
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM025	2016/08/19	2017/08/18
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:	N/A
Relative Humidity:	N/A
ATM Pressure:	N/A

6.9 Test Results

Not applicable, because the EUT is powered by DC power supply.

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

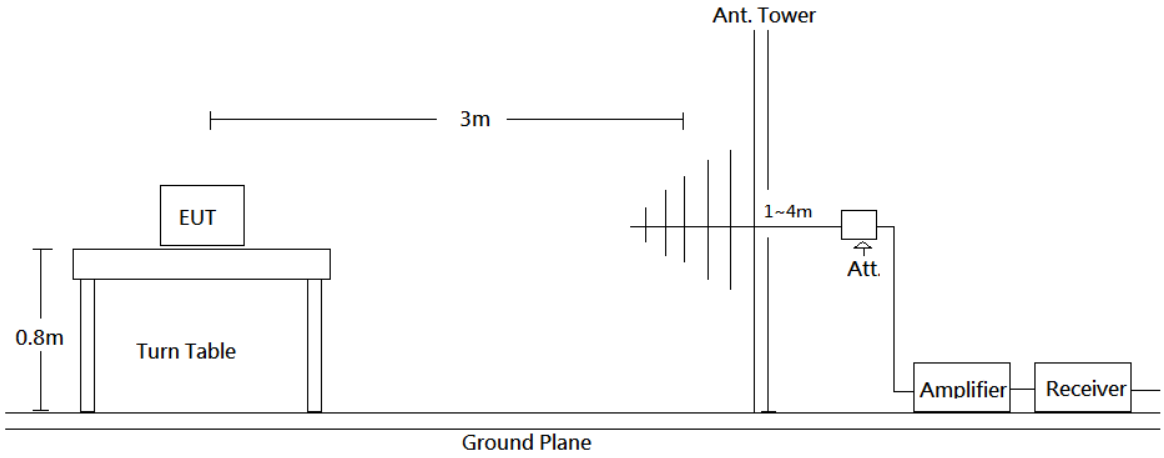
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency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

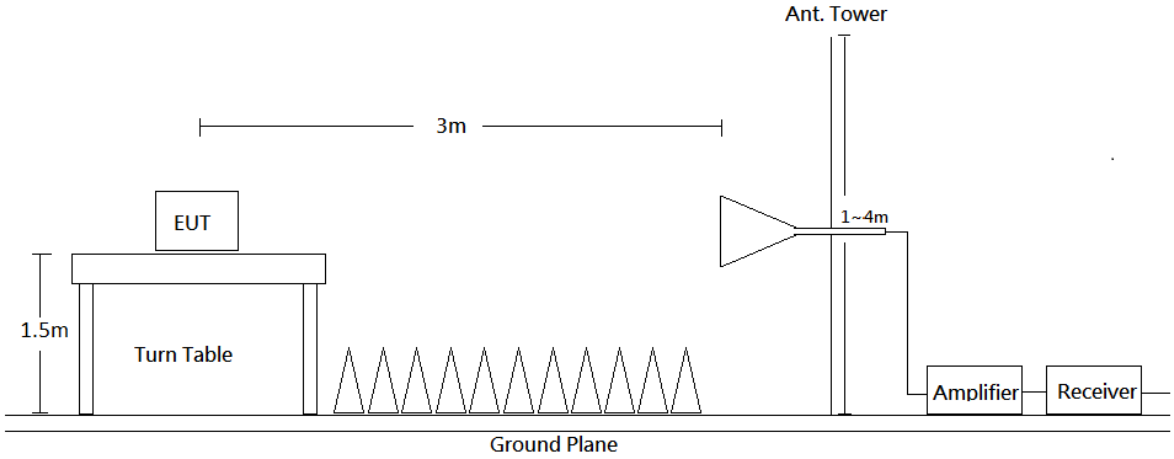
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.76 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.12 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.84 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.16 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.84 dB (k=2, 95% level of confidence)
26 GHz~40 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 C63.10-2013.

Frequency Range	RBW	VBW	IF BW	Detector	Duty cycle
30-1000 MHz	100 kHz	300 kHz	120 kHz	QP	
Above 1 GHz	1 MHz	3 MHz	/	PK	
	1 MHz	10 Hz	/	Ave	>98%
	1 MHz	1/T	/	Ave	<98%

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 / 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	2016/07/13	2017/07/12
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° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2017-07-12.

7.10 Test Results

Mode: *Transmitting Mode*

BLE Mode
Below 1 GHz

2402MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
62.01	39.91	-17.41	22.50	40.00	-17.50	150	118	QP
180.35	33.15	-13.08	20.07	43.50	-23.43	150	2	QP
309.36	31.06	-9.64	21.42	46.00	-24.58	150	304	QP
495.60	28.99	-5.79	23.20	46.00	-22.80	150	140	QP
632.37	28.84	-3.57	25.27	46.00	-20.73	150	117	QP
826.37	28.97	-0.05	28.92	46.00	-17.08	150	79	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
30.00	28.19	-3.59	24.60	40.00	-15.40	150	68	QP
119.24	30.59	-10.89	19.70	43.50	-23.80	150	342	QP
199.75	31.48	-10.76	20.72	43.50	-22.78	150	9	QP
453.89	30.03	-6.48	23.55	46.00	-22.45	150	1	QP
729.37	31.28	-2.23	29.05	46.00	-16.95	150	333	QP
943.74	27.54	2.51	30.05	46.00	-15.95	150	191	QP

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.

2442MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
127.97	28.18	-10.57	17.61	43.50	-25.89	100	186	QP
197.81	28.20	-11.16	17.04	43.50	-26.46	100	277	QP
383.08	28.94	-8.08	20.86	46.00	-25.14	100	238	QP
614.91	28.73	-3.78	24.95	46.00	-21.05	100	139	QP
729.37	30.53	-2.23	28.30	46.00	-17.70	100	282	QP
979.63	27.91	3.42	31.33	54.00	-22.67	100	258	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
101.78	36.90	-14.05	22.85	43.50	-20.65	100	289	QP
314.21	31.06	-9.54	21.52	46.00	-24.48	100	227	QP
496.57	28.61	-5.77	22.84	46.00	-23.16	100	256	QP
613.94	28.47	-3.80	24.67	46.00	-21.33	100	327	QP
704.15	28.52	-2.74	25.78	46.00	-20.22	100	22	QP
915.61	28.22	1.80	30.02	46.00	-15.98	100	40	QP

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.

2480MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
61.04	36.54	-17.47	19.07	40.00	-20.93	100	12	QP
126.03	28.52	-10.63	17.89	43.50	-25.61	100	40	QP
201.69	28.98	-11.09	17.89	43.50	-25.61	100	19	QP
362.71	29.11	-8.51	20.60	46.00	-25.40	100	343	QP
587.75	28.68	-4.23	24.45	46.00	-21.55	100	253	QP
731.31	29.36	-2.18	27.18	46.00	-18.82	100	53	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
62.01	41.61	-17.41	24.20	40.00	-15.80	100	176	QP
314.21	31.52	-9.54	21.98	46.00	-24.02	100	263	QP
453.89	29.29	-6.48	22.81	46.00	-23.19	100	360	QP
582.90	28.61	-4.32	24.29	46.00	-21.71	100	164	QP
729.37	28.48	-2.23	26.25	46.00	-19.75	100	202	QP
890.39	29.43	1.21	30.64	46.00	-15.36	100	54	QP

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 1 GHz

2402 MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBµ/m)	Limit (dBµ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2390.00	63.95	-4.89	59.06	74.00	-14.94	130	210	peak
2390.00	51.89	-4.89	47.00	54.00	-7.00	130	210	AVG
2402.00	94.72	-4.86	89.86	N/A	N/A	185	323	peak
2402.00	93.94	-4.86	89.08	N/A	N/A	185	323	AVG
4804.00	49.94	0.98	50.92	74.00	-23.08	100	17	peak
4804.00	37.59	0.98	38.57	54.00	-15.43	100	17	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBµ/m)	Limit (dBµ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2390.00	63.47	-4.89	58.58	74.00	-15.42	125	91	peak
2390.00	52.28	-4.89	47.39	54.00	-6.61	125	91	AVG
2402.00	85.77	-4.86	80.91	N/A	N/A	110	244	peak
2402.00	84.74	-4.86	79.88	N/A	N/A	110	244	AVG
4804.00	51.37	0.98	52.35	74.00	-21.65	100	283	peak
4804.00	38.79	0.98	39.77	54.00	-14.23	100	283	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.

2442 MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2442.00	94.57	-4.76	89.81	N/A	N/A	135	325	peak
2442.00	93.74	-4.76	88.98	N/A	N/A	135	325	AVG
4884.00	42.00	1.25	43.25	74.00	-30.75	100	168	peak
4884.00	29.14	1.25	30.39	54.00	-23.61	100	168	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2442.00	87.75	-4.76	82.99	N/A	N/A	140	223	peak
2442.00	86.94	-4.76	82.18	N/A	N/A	140	223	AVG
4884.00	46.81	1.25	48.06	74.00	-25.94	100	122	peak
4884.00	34.03	1.25	35.28	54.00	-18.72	100	122	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.

2480 MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBµ/m)	Limit (dBµ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2480.00	96.75	-4.68	92.07	N/A	N/A	165	333	peak
2480.00	96.06	-4.68	91.38	N/A	N/A	165	333	AVG
2483.50	65.66	-4.69	60.97	74.00	-13.03	140	312	peak
2483.50	52.53	-4.69	47.84	54.00	-6.16	140	312	AVG
4960.00	44.47	1.51	45.98	74.00	-28.02	100	230	peak
4960.00	34.38	1.51	35.89	54.00	-18.11	100	230	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBµ/m)	Limit (dBµ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2480.00	89.31	-4.68	84.63	N/A	N/A	100	222	peak
2480.00	88.50	-4.68	83.82	N/A	N/A	100	222	AVG
2483.50	63.36	-4.69	58.67	74.00	-15.33	110	360	peak
2483.50	52.22	-4.69	47.53	54.00	-6.47	110	360	AVG
4960.00	47.60	1.51	49.11	74.00	-24.89	100	1	peak
4960.00	38.43	1.51	39.94	54.00	-14.06	100	1	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.

ANT+ Mode
Below 1 GHz

2457MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
136.70	28.49	-10.80	17.69	43.50	-25.81	100	88	QP
200.72	28.32	-10.88	17.44	43.50	-26.06	100	77	QP
319.06	29.19	-9.44	19.75	46.00	-26.25	100	98	QP
509.18	28.26	-5.59	22.67	46.00	-23.33	100	172	QP
664.38	28.49	-3.20	25.29	46.00	-20.71	100	1	QP
731.31	28.21	-2.18	26.03	46.00	-19.97	100	1	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
47.46	38.57	-15.06	23.51	40.00	-16.49	100	83	QP
310.33	31.24	-9.61	21.63	46.00	-24.37	100	104	QP
441.28	29.04	-6.74	22.30	46.00	-23.70	100	2	QP
581.93	28.28	-4.33	23.95	46.00	-22.05	100	228	QP
744.89	29.81	-1.90	27.91	46.00	-18.09	100	360	QP
862.26	28.63	0.66	29.29	46.00	-16.71	100	145	QP

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 1 GHz

2457 MHz

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2390.00	63.72	-4.89	58.83	74.00	-15.17	150	188	peak
2390.00	52.10	-4.89	47.21	54.00	-6.79	150	188	AVG
2457.00	96.07	-4.74	91.33	N/A	N/A	125	339	peak
2457.00	95.42	-4.74	90.68	N/A	N/A	125	339	AVG
2483.50	63.48	-4.69	58.79	74.00	-15.21	168	261	peak
2483.50	52.26	-4.69	47.57	54.00	-6.43	168	261	AVG
4914.00	45.89	1.35	47.24	74.00	-26.76	100	100	peak
4914.00	35.34	1.35	36.69	54.00	-17.31	100	100	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBμ/m)	Limit (dBμ/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
2390.00	63.04	-4.89	58.15	74.00	-15.85	105	144	peak
2390.00	52.21	-4.89	47.32	54.00	-6.68	105	144	AVG
2457.00	87.82	-4.74	83.08	N/A	N/A	100	360	peak
2457.00	86.91	-4.74	82.17	N/A	N/A	100	360	AVG
2483.50	64.19	-4.69	59.50	74.00	-14.50	130	125	peak
2483.50	52.09	-4.69	47.40	54.00	-6.60	130	125	AVG
4914.00	49.99	1.35	51.34	74.00	-22.66	100	1	peak
4914.00	40.58	1.35	41.93	54.00	-12.07	100	1	AVG

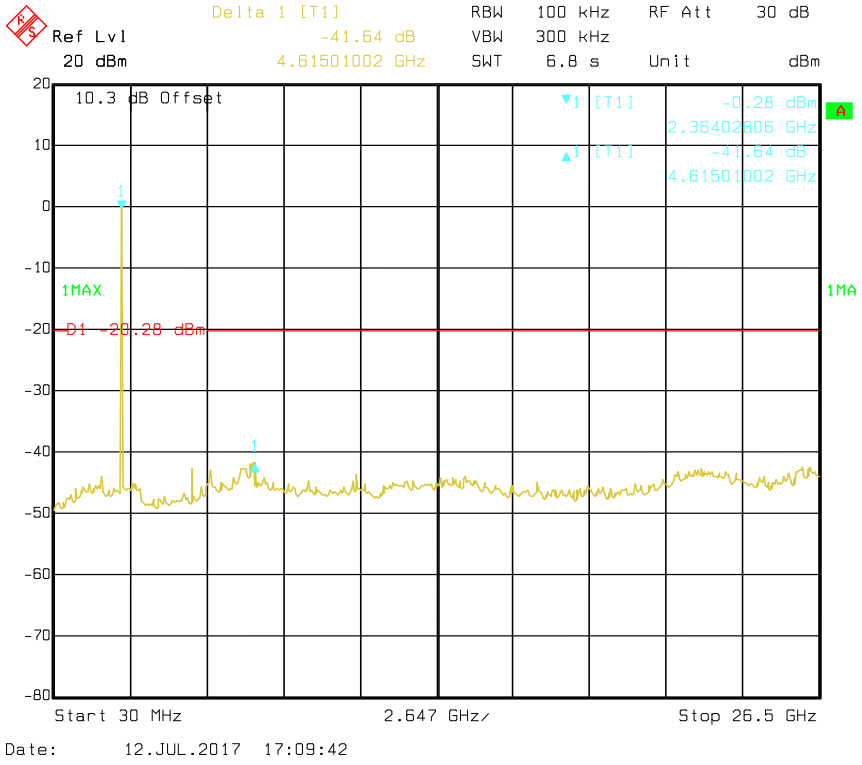
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

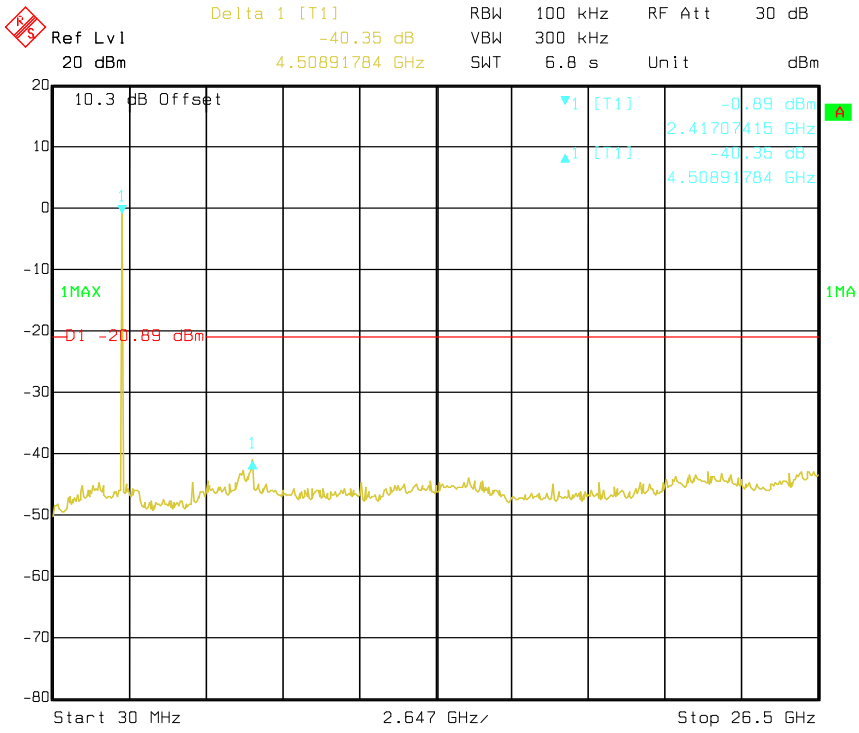
Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE Mode			
2402	41.64	≥ 20	PASS
2442	40.35	≥ 20	PASS
2480	39.30	≥ 20	PASS
ANT+ Mode			
2457	40.68	≥ 20	PASS

BLE Mode

Low Channel

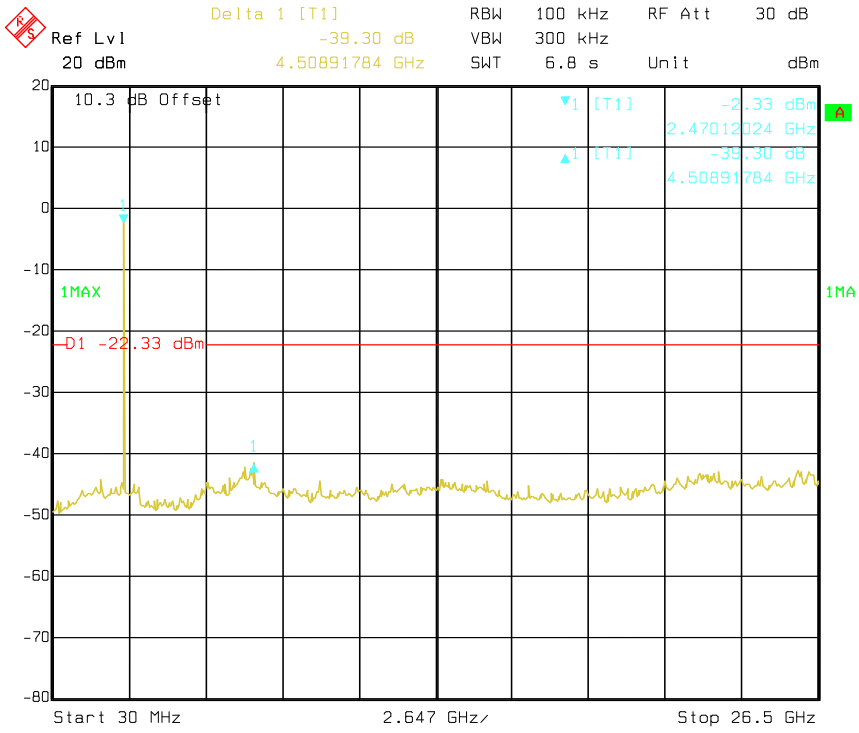


Middle Channel



Date: 12.JUL.2017 18:35:22

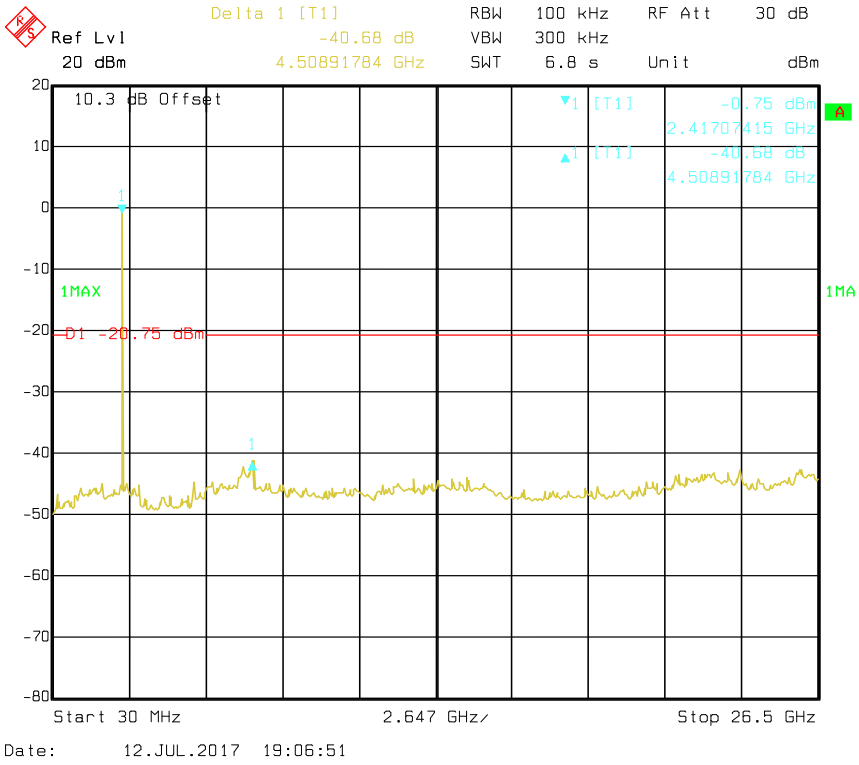
High Channel



Date: 12.JUL.2017 18:04:47

ANT+ Mode

Middle 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.

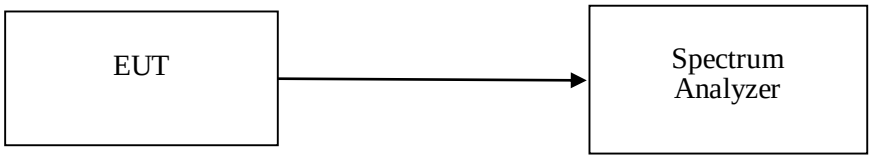
8.2 Test Procedure

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 it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.

4. Repeat above procedures until all frequencies measured were complete.



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 2017-07-12.

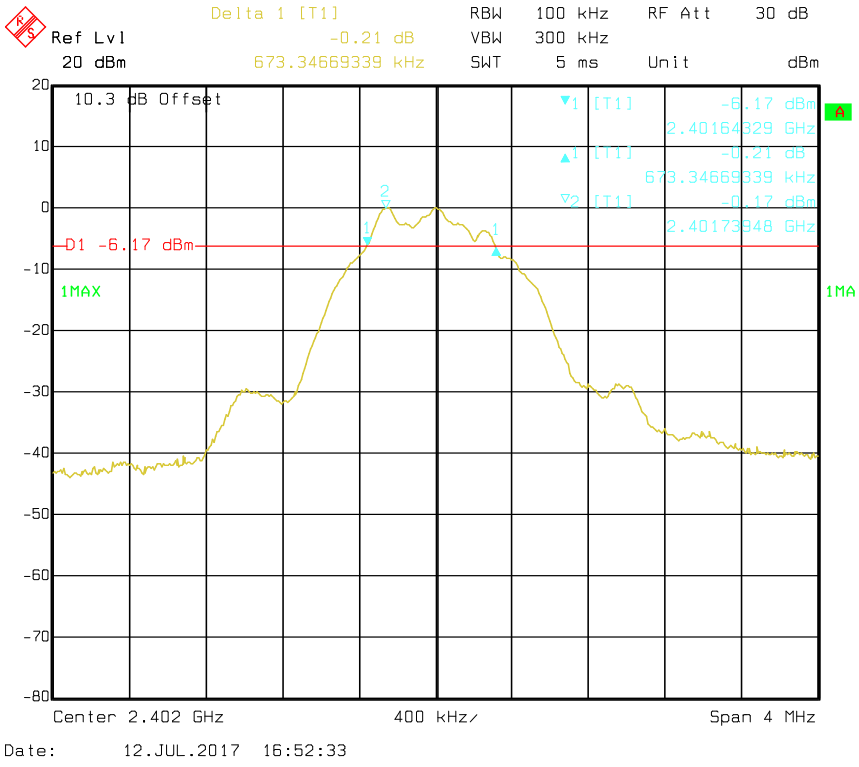
8.5 Test Results

Frequency (MHz)	6 dB OBW (MHz)	Limit (MHz)	Result
BLE Mode			
2402	0.67	> 0.5	Compliance
2442	0.67	> 0.5	Compliance
2480	0.67	> 0.5	Compliance
ANT+ Mode			
2457	0.67	> 0.5	Compliance

Please refer to the following plots

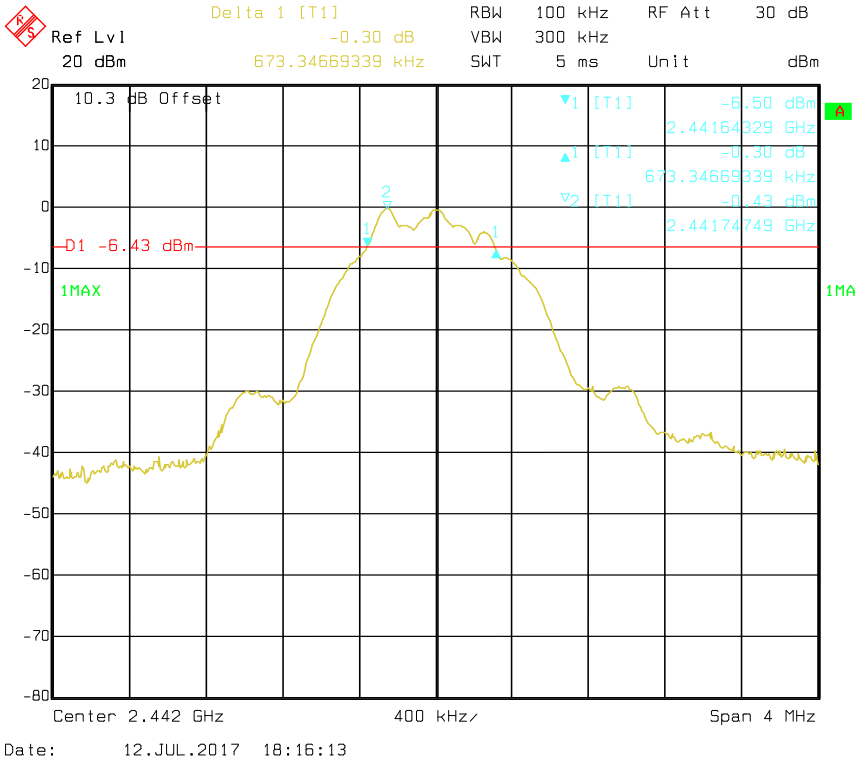
BLE Mode

Low Channel



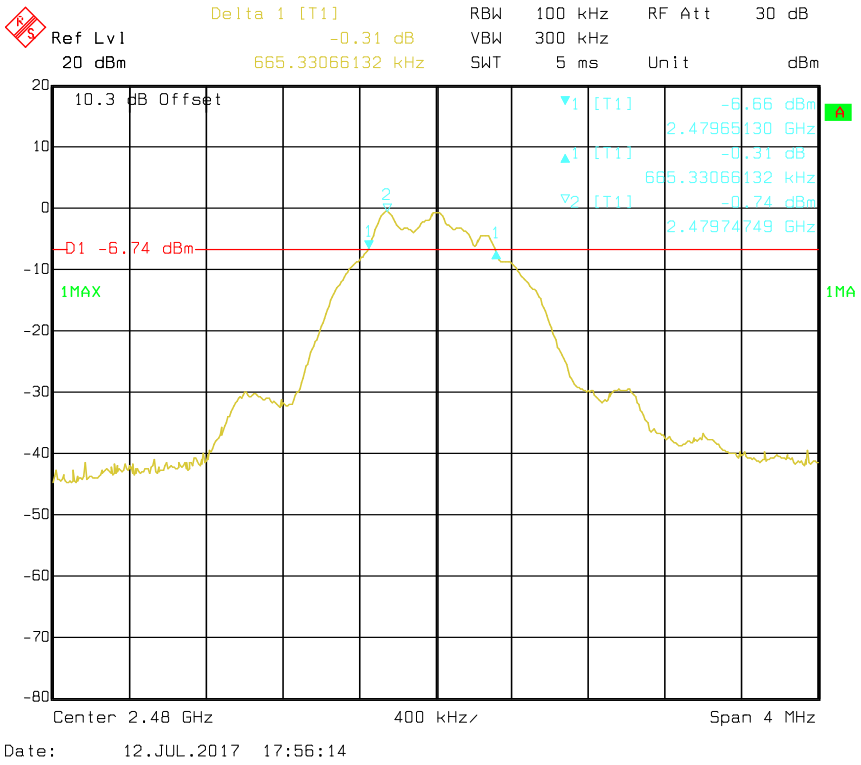
Date: 12.JUL.2017 16:52:33

Middle Channel



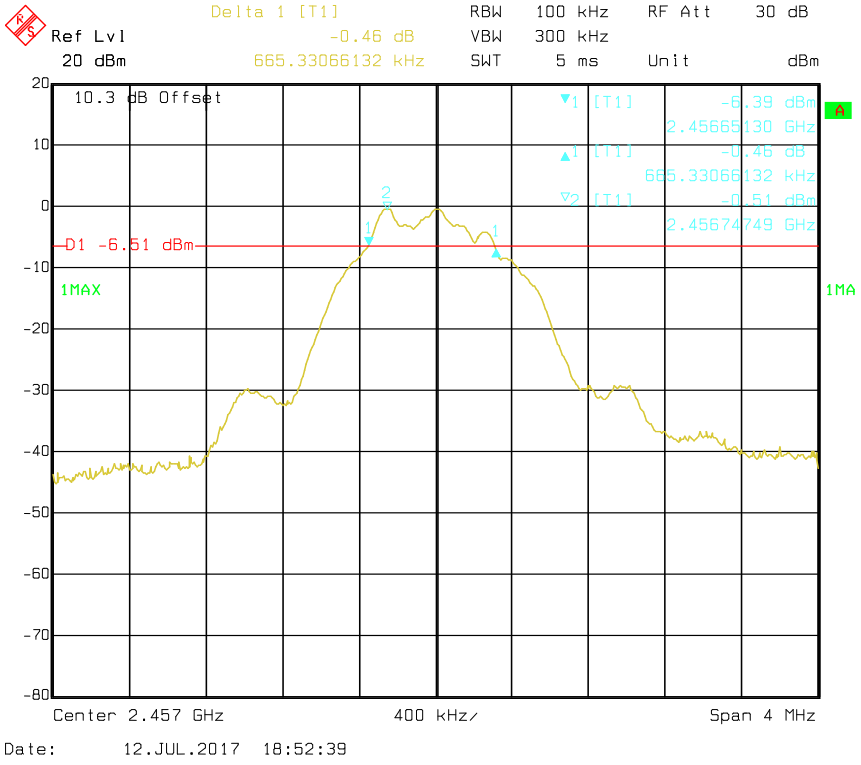
Date: 12.JUL.2017 18:16:13

High Channel



ANT+ Mode

Middle Channel



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

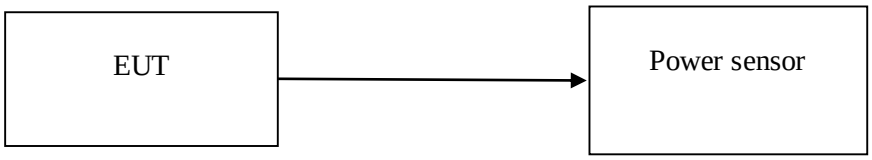
9.1 Applicable Standard

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 an EMI Test Receiver.
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	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	2017/3/9	2018/3/8

*** *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 2017-07-12.

9.5 Test Results

Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Result
BLE Mode			
2402	-0.31	30	Compliance
2442	-0.61	30	Compliance
2480	-1.06	30	Compliance
ANT+ Mode			
2457	-0.76	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 2017-07-12 ~ 2017-07-13.

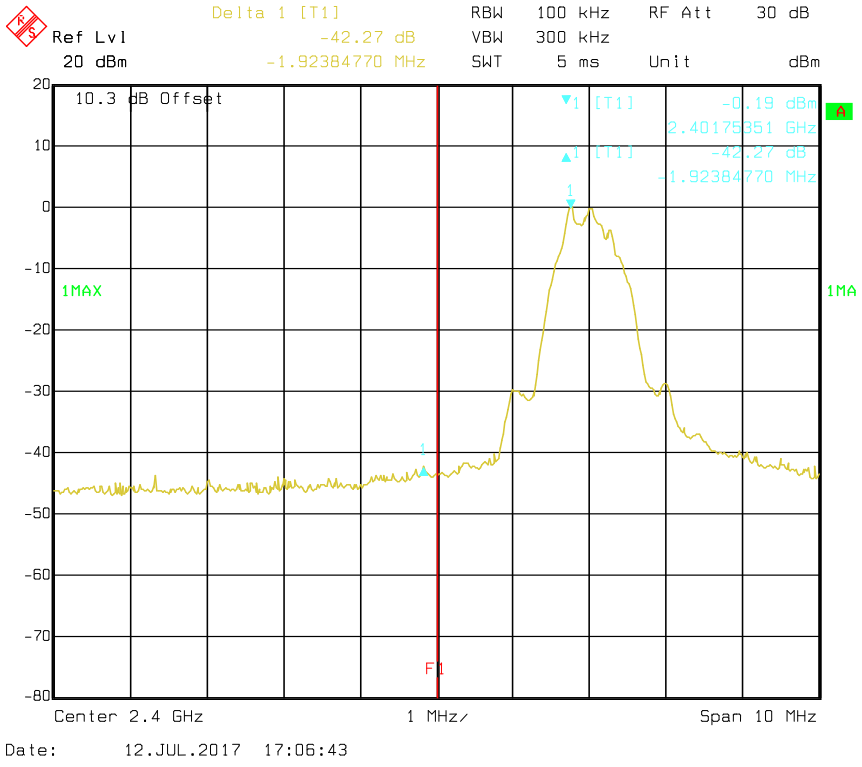
10.5 Test Results

Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE Mode			
2402	42.27	≥ 20	PASS
2480	44.37	≥ 20	PASS
ANT+ Mode			
2457	43.58	≥ 20	PASS

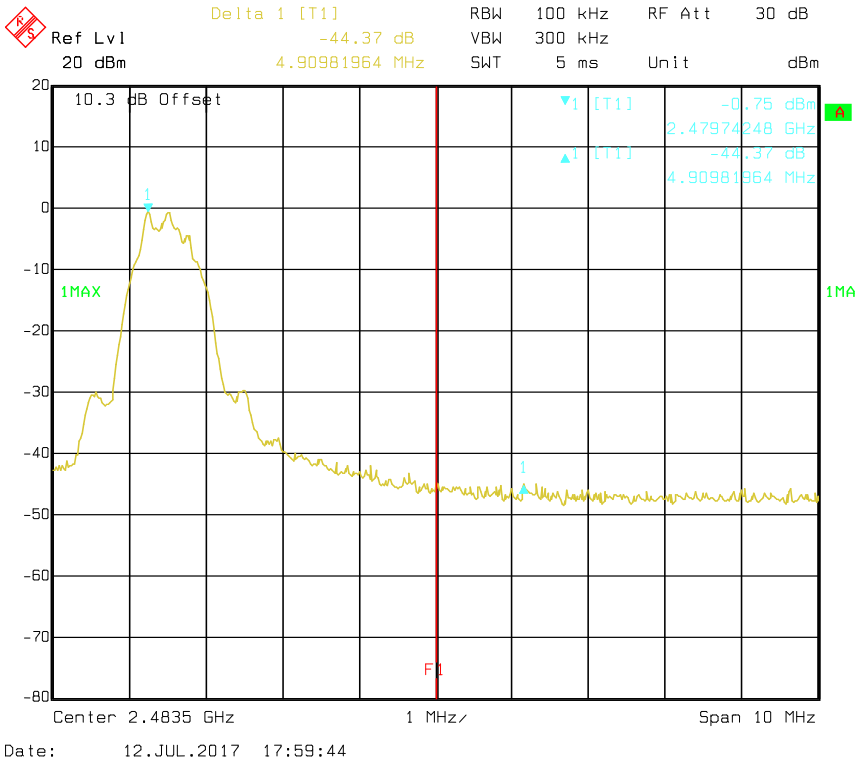
Please refer to the following plots

BLE Mode

Band Edge, Left Side

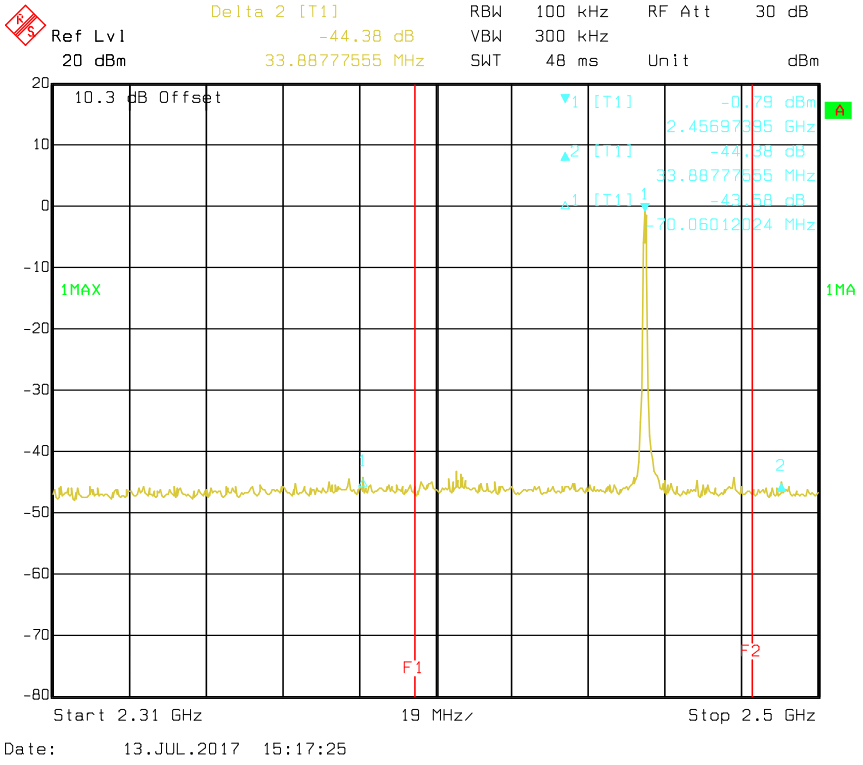


Band Edge, Right Side



ANT+ Mode

Band Edge



11 FCC §15.247(e) – Power Spectral Density

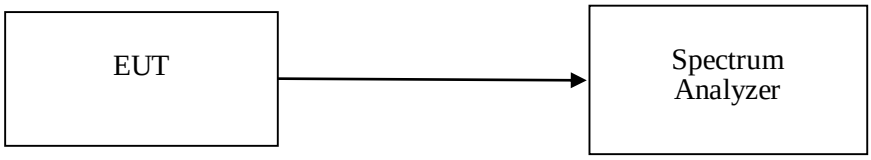
11.1 Applicable Standard

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

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 was set 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. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Repeat above procedures until all frequencies measured were complete.



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.

11.3 Test Environmental Conditions

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

The testing was performed by Andy Shih on 2017-07-12.

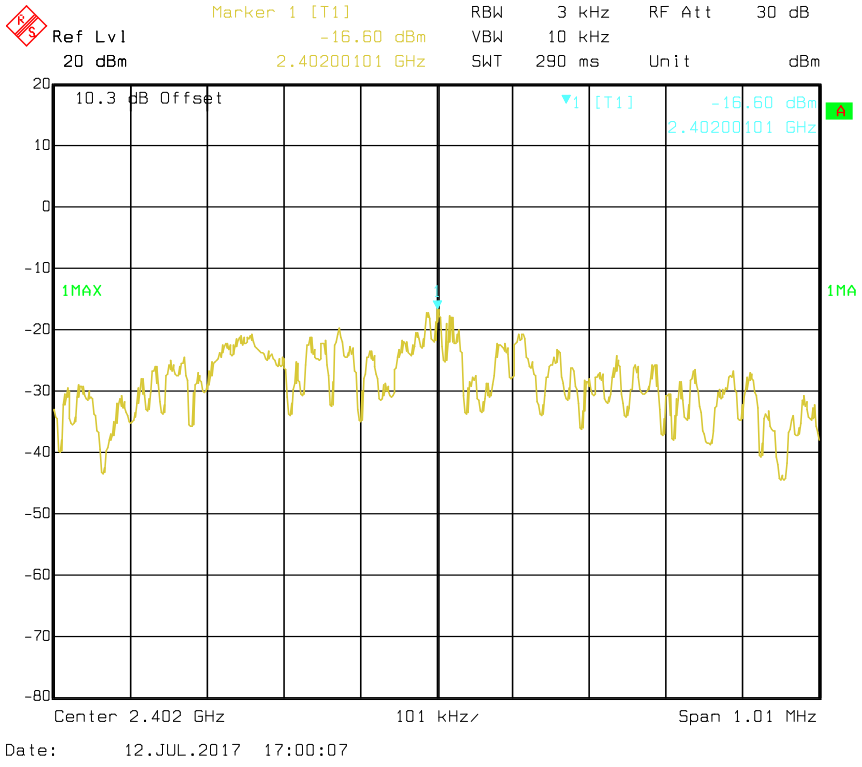
11.4 Test Results

Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE Mode			
2402	-16.60	8	Compliance
2442	-16.95	8	Compliance
2480	-17.20	8	Compliance
ANT+ Mode			
2457	-17.05	8	Compliance

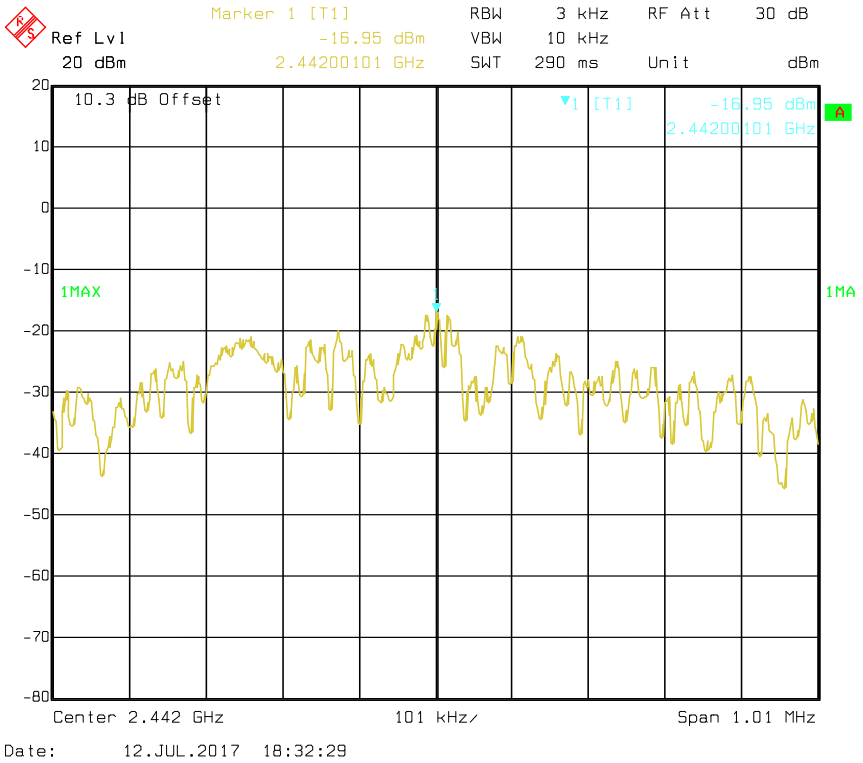
Please refer to the following plots

BLE Mode

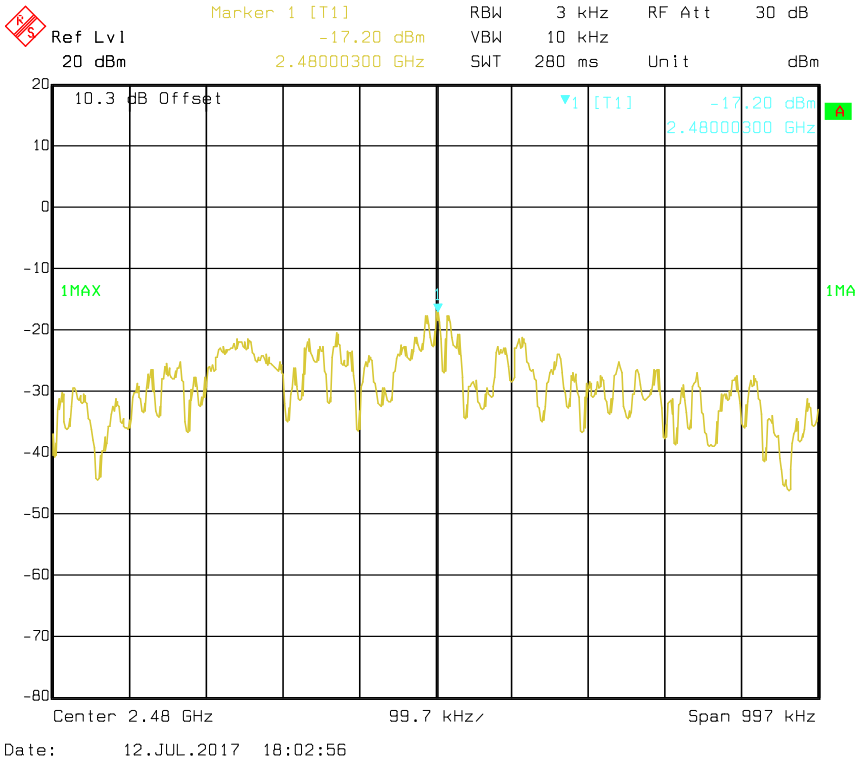
Low Channel



Middle Channel

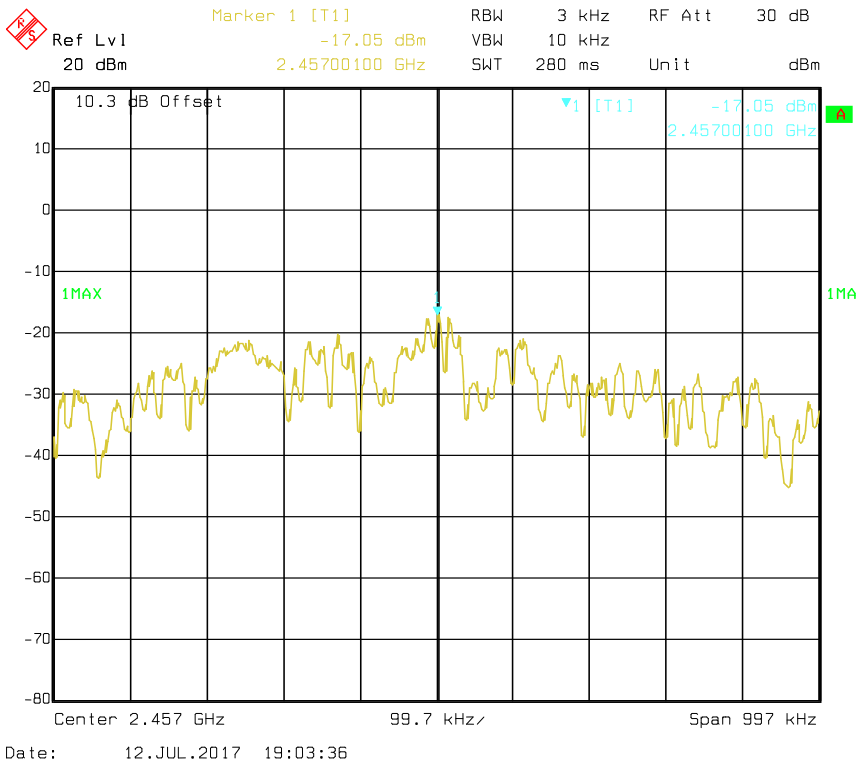


High Channel



ANT+ Mode

Middle Channel



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