FCC Part 15.247

TEST REPORT

For

IONE ELECTRONIC TECHNOLOGY CO., LTD. TAIWAN BRANCH

8F-2, #75, sec 1, Hsin Tai Wu Rd., Hsi Chih District, New Taipei City, Taiwan, R.O.C.(Far East World Center-Bldg. A)

FCC ID: 2APDTTS-A05BT-ANC

Report Type	**Original Report**
Product Name:	**TUNE IN - Streaming**
Model Name:	**TS-A05BT-ANC**
Report Number :	**RXZ190624003-00A**
Report Date :	**2019/10/21**
Reviewed By :	**Zeus Chen** Zeus Chen
Prepared By: **Bay Area Compliance Laboratories Corp.(Linkou Laboratory)** **No. 6, Wende 2Rd., Guishan Dist., Taoyuan City 33382, Taiwan (R.O.C.)** **Tel: +886 (3)3961072; Fax: +886 (3) 3961027** **www.bacl.com.tw**	

Revision History

Revision	Report Number	Issue Date	Description
1.0	RXZ190624003-00A	2019/10/21	Original Report

TABLE OF CONTENTS

1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	**IONE ELECTRONIC TECHNOLOGY CO., LTD. TAIWAN BRANCH** 8F-2, #75, sec 1, Hsin Tai Wu Rd., Hsi Chih District, New Taipei City, Taiwan, R.O.C.(Far East World Center-Bldg. A)
Manufacturer	**IONE ELECTRONIC TECHNOLOGY CO., LTD. TAIWAN BRANCH** 8F-2, #75, sec 1, Hsin Tai Wu Rd., Hsi Chih District, New Taipei City, Taiwan, R.O.C.(Far East World Center-Bldg. A)
Product (Equipment)	**TUNE IN - Streaming**
Model Name	**TS-A05BT-ANC**
Frequency Range	2402 - 2480 MHz
Number of Channels	40 Channels
Output Power	-2.22 dBm (0.0006 W)
Modulation Type	GFSK
Related Submittal(s)/Grant(s)	**FCC Part 15.247 DSS with FCC ID : 2APDTTS-A05BT-ANC**
Received Date	Jun. 24, 2019
Date of Test	July. 12, 2019 ~ Oct 21, 2019

**All measurement and test data in this report was gathered from production sample serial number: 190624003(Assigned by BACL, LinKou).*

1.2 Operation Condition of EUT

Power Operation (Voltage Range)	☐ AC 120 V/60 Hz ☐ Adapter ☐ By Power Cord.
	☐ DC Type ☐ DC Power Supply: 5Vdc to connector port ☐ Battery ☒ External from USB Cable 5Vdc ☐ External DC Adapter
	☐ Host System

1.3 Objective and Test Methodology

The Objective of this Test Report was to document the compliance of the IONE ELECTRONIC TECHNOLOGY CO., LTD. TAIWAN BRANCH. Appliance (Model: TS-A05BT-ANC) to the requirements of the following Standards:

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

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

-KDB 558074 D01 15.247 Meas Guidance v05r02.

1.4 Measurement Uncertainty

Parameter	Expanded Measurement uncertainty
RF output power with Power Meter	± 0.55 dB
Occupied Channel Bandwidth	± 4.54 Hz
RF Conducted test with Spectrum	± 1.45 dB
AC Power Line Conducted Emission	± 2.66 dB
Radiated Below 1G	± 3.57 dB
Radiated Above 1G-18G	± 4.29 dB
Radiated Above 18G-40G	± 4.67 dB

1.5 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Linkou) to collect test data is located on

☒ No.6, Wende 2Rd., Guishan Dist., Taoyuan City 33382, Taiwan (R.O.C.).

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database. The FCC Registration No.: 0027578244. Designation No.: TW3546. The Test Firm Registration No.: 181430.

2 System Test Configuration

2.1 Test Channels and Description of Worst Test Configuration

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

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

For BLE, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	**2402**	20	2442
1	2404	--	--
2	2406	--	--
3	2408	37	2476
--	--	38	2478
19	**2440**	**39**	**2480**

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

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

Modulation Used for Conformance Test			
Configuration	**NTX**	**Data Rate**	**Worst Data Rate**
BLE mode	1	125 kbps-1 Mbps	1 Mbps

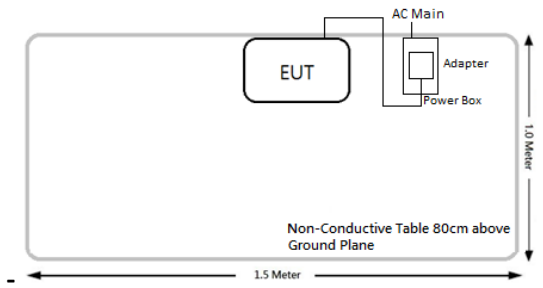
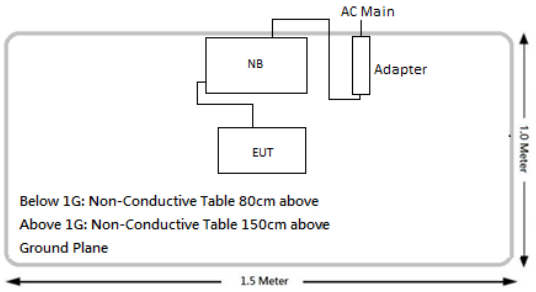
Worst Case of Power Setting				
EUT Exercise Software		QRCT3		
Configuration	**NTX**	**Low CH**	**Mid CH**	**High CH**
BLE mode	1	Default	Default	Default

2.2 Support Equipment List and External Cable List

No.	Description	Manufacturer	Model Number
A	Notebook PC	DELL	Latitude E6410
B	Adapter	MI	A1718 (Apple)

No.	Cable Description	Shielding Type	Length (m)	From	To
1	USB Cable	Non-Shielded	1.0	EUT	Adapter
2	USB Cable	Non-Shielded	1.0	EUT	NB

2.3 Block Diagram of Test Setup

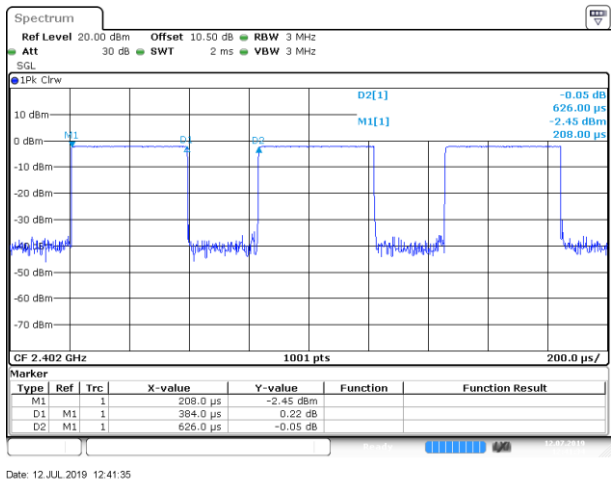
Conduction	Radiation
	

2.4 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05:

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

Configuration	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Factor (dB)
BLE mode	0.384	0.626	61.00	2.15

BLE mode	-
	-

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

3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §1.1307, § 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), §1.1307, § 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 v06

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:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·

[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 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. 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is $\leqslant$ 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

RF Exposure Evaluation:

Frequency (MHz)	Tunp-up Power		Evaluation Distrance (mm)	SAR Excluion Result	Extremity SAR Exclusion Limit (1g SAR)
	(dBm)	(mW)			
2402-2480	-1.00	0.794	5	0.2528	7.5

Result: SAR evaluation is not necessary.

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 6dBi

5.2 Antenna List and Details

Brand	Antenna Type	Antenna Gain	Result
YAGEO	Chip Antenna	1.69 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

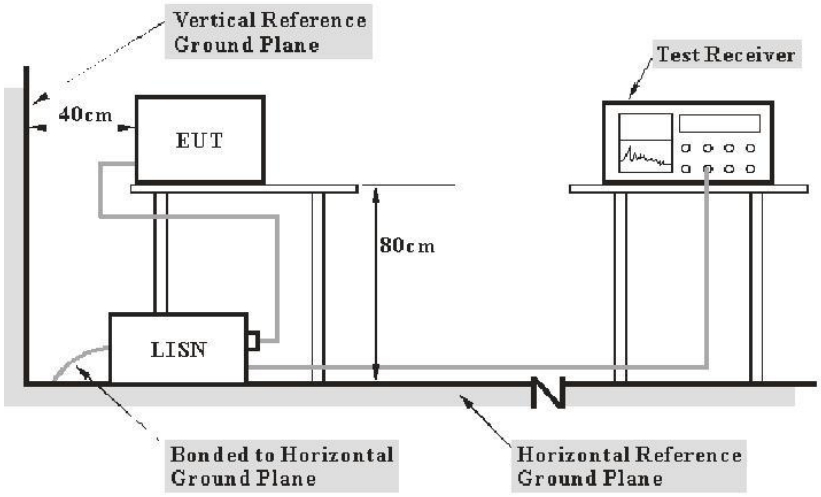
According to FCC §15.207 and §15.407(b)(6),

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

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

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

6.2 EUT Setup and Test Procedure



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

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

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.

6.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conduction Room					
LISN	Rohde & Schwarz	ENV216	100010	2019/09/02	2020/09/01
EMI Test Receiver	Rohde & Schwarz	ESR3	102430	2019/03/27	2020/03/26
Pulse Limiter	SCHWARZBECK	VSTD 9561-F	00432	2019/08/28	2020/08/27
RF Cable	EMCI	EMCCFD300-BM-BM-8000	180526	2019/08/08	2020/08/07
Software	Audix	e3 v9	E3LK-03	N.C.R	N.C.R

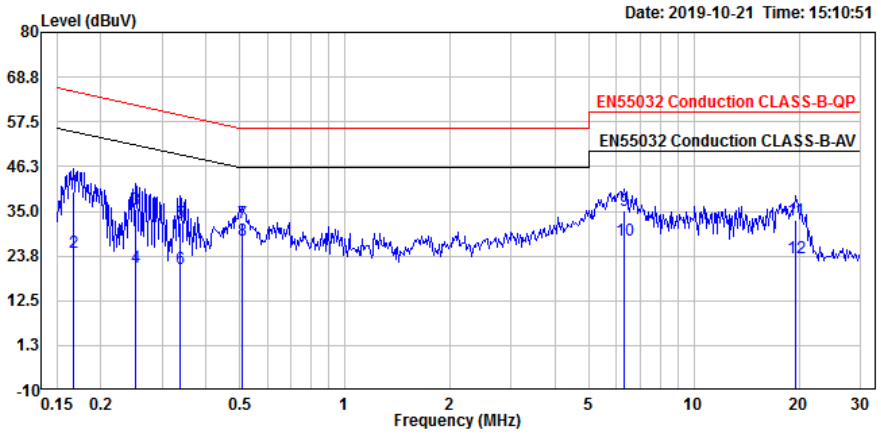
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

6.4 Test Environmental Conditions

Temperature:	25 ℃	**Relative Humidity:**	50 %
ATM Pressure:	1010 hPa	**Test Engineer:**	David Hsu
Test Date:	2019-10-21		

6.5 Test Data and Test Plot

Mode: AC 120 V/60 Hz, Line



	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.168	19.88	39.82	19.94	65.07	-25.25	QP
2	0.168	4.75	24.69	19.94	55.07	-30.38	Average
3	0.252	15.48	35.42	19.94	61.70	-26.28	QP
4	0.252	1.11	21.05	19.94	51.70	-30.65	Average
5	0.338	12.12	32.07	19.95	59.25	-27.18	QP
6	0.338	0.77	20.72	19.95	49.25	-28.53	Average
7	0.508	12.21	32.17	19.96	56.00	-23.83	QP
8	0.508	7.75	27.71	19.96	46.00	-18.29	Average
9	6.294	15.27	35.32	20.05	60.00	-24.68	QP
10	6.294	7.49	27.54	20.05	50.00	-22.46	Average
11	19.511	12.65	32.82	20.17	60.00	-27.18	QP
12	19.511	3.28	23.45	20.17	50.00	-26.55	Average

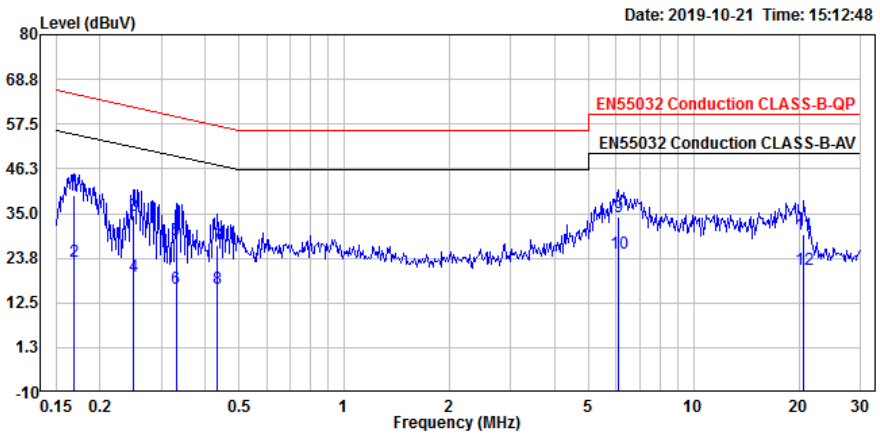
Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

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

Mode: AC 120V/60 Hz, Neutral



	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.169	19.57	39.52	19.95	65.01	-25.49	QP
2	0.169	3.11	23.06	19.95	55.01	-31.95	Average
3	0.250	14.62	34.56	19.94	61.76	-27.20	QP
4	0.250	-0.87	19.07	19.94	51.76	-32.69	Average
5	0.330	8.59	28.54	19.95	59.45	-30.91	QP
6	0.330	-3.83	16.12	19.95	49.45	-33.33	Average
7	0.433	7.15	27.12	19.97	57.20	-30.08	QP
8	0.433	-3.94	16.03	19.97	47.20	-31.17	Average
9	6.097	13.89	33.98	20.09	60.00	-26.02	QP
10	6.097	4.84	24.93	20.09	50.00	-25.07	Average
11	20.630	9.53	29.85	20.32	60.00	-30.15	QP
12	20.630	0.64	20.96	20.32	50.00	-29.04	Average

Note:

Level = Read Level + Factor

Over Limit (Margin) = Level – Limit Line

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

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

7.1 Applicable Standard

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

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

MHz	MHz	MHz	GHz
0.090-0.110	13.36-13.41	399.9-410	4.5-5.15
0.495-0.505	16.42-16.423	608-614	5.35-5.46
2.1735-2.1905	16.69475-16.69525	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6

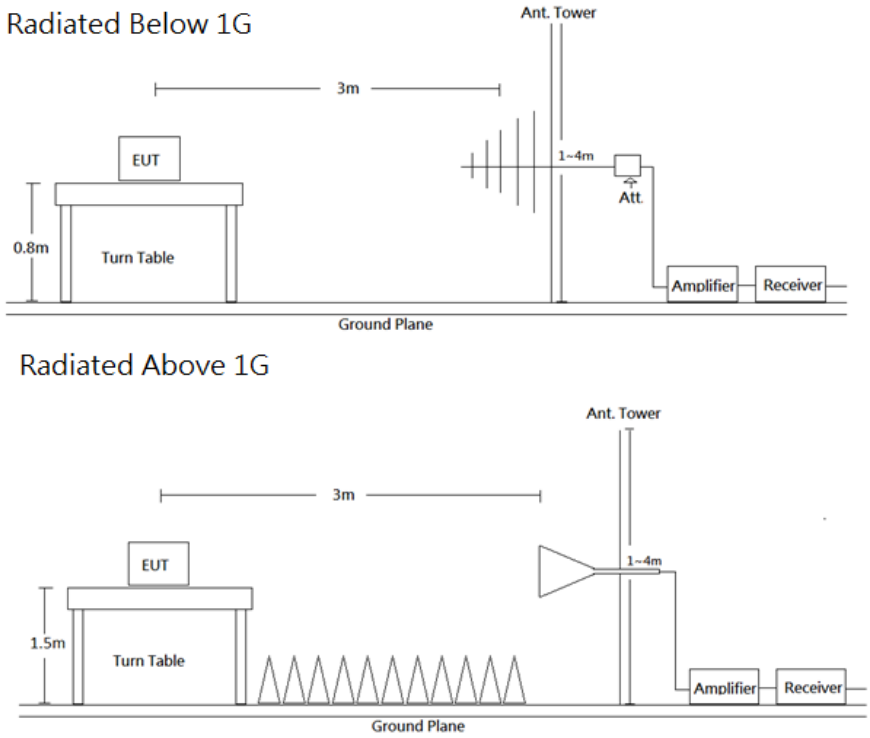
As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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 470-806MHz. 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 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

7.2 EUT Setup and Test Procedure



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.

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

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

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.

7.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
966A Room					
Bilog Antenna/6 dB Attenuator	SUNOL SCIENCES & EMEC /EMCI	JB3/N-6-06	A111513/AT-N0668	2019/03/29	2020/03/28
Horn Antenna	ETS-Lindgren	3115	00109141	2019/07/05	2020/07/04
Horn Antenna	ETS-Lindgren	3160-09	00123852	2019/07/11	2020/07/10
Preamplifier	A.H. Systems	PAM-0118P	478	2019/03/28	2020/03/27
Preamplifier	A.H. Systems	PAM-1840VH	174	2019/02/18	2020/02/17
Signal and Spectrum Analyzer	Rohde & Schwarzr	FSV40	101434	2019/04/17	2020/04/16
Microflex Cable (1m)	EMCI	EMC106-SM-SM-2000	93D0127	2019/05/05	2020/05/04
Microflex Cable (2m)	MTJ	H0919	MFR64639 226389-002	2019/05/05	2020/05/04
Microflex Cable (8m)	UTIFLEX	UFA210A-1-3149-300300	160309-1	2019/05/05	2020/05/04
Turn Table	Chaintek	T-200-S-1	003501	N.C.R	N.C.R
Antenna Tower	Chaintek	MBD-400-1	003504	N.C.R	N.C.R
Controller	Chaintek	3000-1	003507	N.C.R	N.C.R
Software	Audix	e3 v9	E3LK-01	N.C.R	N.C.R
Conducted Room					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

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

7.4 Test Environmental Conditions

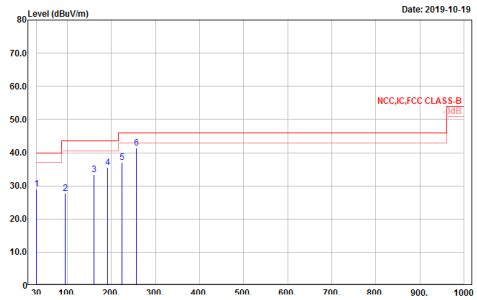
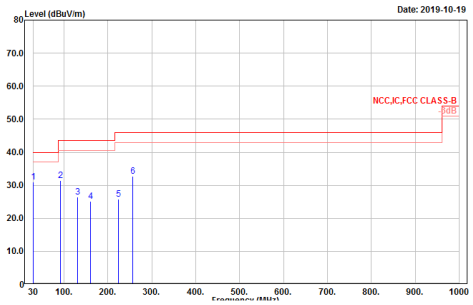
Temperature:	25.6 ℃	**Relative Humidity:**	46 %
ATM Pressure:	1014hPa	**Test Engineer:**	Boris Kao / Boris Kao
Radiated Test Date:	2019-10-18 to 2019-10-19	**Conducted Test Date:**	2019-07-12

7.5 Test Result

BLE Mode:

Transmitting mode (Pre-scan with three orthogonal axis, and worse case as X axis)

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

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	30.970	29.12	40.00	-10.88	35.68	-6.56	Peak	horizontal
2	95.960	27.70	43.50	-15.80	49.16	-21.46	Peak	horizontal
3	159.980	33.36	43.50	-10.14	51.74	-18.38	Peak	horizontal
4	191.990	35.47	43.50	-8.03	55.13	-19.66	Peak	horizontal
5	224.000	37.09	46.00	-8.91	56.98	-19.89	Peak	horizontal
6	256.010	41.37	46.00	-4.63	60.57	-19.20	Peak	horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1	30.970	31.02	40.00	-8.98	37.58	-6.56	Peak	vertical
2	92.080	31.36	43.50	-12.14	53.74	-22.38	Peak	vertical
3	131.850	26.51	43.50	-16.99	43.26	-16.75	Peak	vertical
4	159.980	25.25	43.50	-18.25	43.63	-18.38	Peak	vertical
5	224.000	25.87	46.00	-20.13	45.76	-19.89	Peak	vertical
6	256.010	32.64	46.00	-13.36	51.84	-19.20	Peak	vertical

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

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

Above 1G (1 GHz-26.5 GHz)

BLE mode:

Low CH

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2361.204	25.08	54.00	-28.92	32.78	-7.70	Average
2361.204	36.37	74.00	-37.63	44.07	-7.70	Peak
2401.800	90.67			98.29	-7.62	Average
2401.800	91.40			99.02	-7.62	Peak
4804.000	44.38	54.00	-9.62	43.76	0.62	Average
4804.000	54.46	74.00	-19.54	53.84	0.62	Peak
7206.000	45.25	54.00	-8.75	40.00	5.25	Average
7206.000	53.33	74.00	-20.67	48.08	5.25	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2333.460	23.29	54.00	-30.71	31.07	-7.78	Average
2333.460	37.42	74.00	-36.58	45.20	-7.78	Peak
2401.800	84.33			91.95	-7.62	Average
2401.800	85.07			92.69	-7.62	Peak
4804.000	37.01	54.00	-16.99	36.39	0.62	Average
4804.000	48.07	74.00	-25.93	47.45	0.62	Peak
7206.000	42.39	54.00	-11.61	37.14	5.25	Average
7206.000	52.23	74.00	-21.77	46.98	5.25	Peak

Middle CH

Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2360.160	24.67	54.00	-29.33	32.38	-7.71	Average
2360.160	35.36	74.00	-38.64	43.07	-7.71	Peak
2439.960	93.30			100.82	-7.52	Average
2439.960	93.99			101.51	-7.52	Peak
2488.410	25.75	54.00	-28.25	33.08	-7.33	Average
2488.410	36.80	74.00	-37.20	44.13	-7.33	Peak
4880.000	44.73	54.00	-9.27	43.92	0.81	Average
4880.000	53.01	74.00	-20.99	52.20	0.81	Peak
7320.000	50.08	54.00	-3.92	44.38	5.70	Average
7320.000	56.50	74.00	-17.50	50.80	5.70	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2333.560	25.03	54.00	-28.97	32.81	-7.78	Average
2333.560	37.11	74.00	-36.89	44.89	-7.78	Peak
2439.960	87.51			95.03	-7.52	Average
2439.960	88.23			95.75	-7.52	Peak
2487.650	23.78	54.00	-30.22	31.11	-7.33	Average
2487.650	34.74	74.00	-39.26	42.07	-7.33	Peak
4880.000	40.35	54.00	-13.65	39.54	0.81	Average
4880.000	47.62	74.00	-26.38	46.81	0.81	Peak
7320.000	42.91	54.00	-11.09	37.21	5.70	Average
7320.000	50.51	74.00	-23.49	44.81	5.70	Peak

High CH

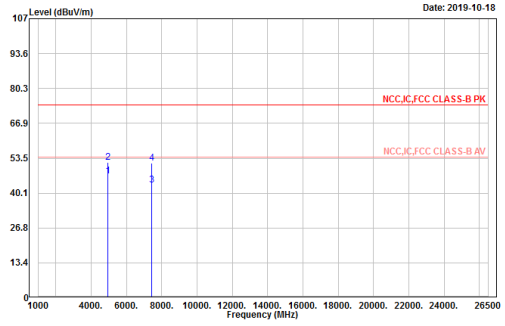
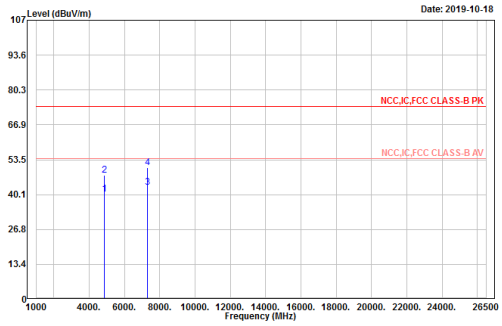
Horizontal

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2479.780	95.12			102.47	-7.35	Average
2479.780	95.40			102.75	-7.35	Peak
2483.620	27.42	54.00	-26.58	34.76	-7.34	Average
2483.620	39.52	74.00	-34.48	46.86	-7.34	Peak
4960.000	46.71	54.00	-7.29	45.90	0.81	Average
4960.000	51.93	74.00	-22.07	51.12	0.81	Peak
7440.000	43.30	54.00	-10.70	37.24	6.06	Average
7440.000	51.65	74.00	-22.35	45.59	6.06	Peak

Vertical

Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2479.750	88.36			95.71	-7.35	Average
2479.750	89.08			96.43	-7.35	Peak
2483.800	24.27	54.00	-29.73	31.61	-7.34	Average
2483.800	36.15	74.00	-37.85	43.49	-7.34	Peak
4960.000	39.24	54.00	-14.76	38.43	0.81	Average
4960.000	47.06	74.00	-26.94	46.25	0.81	Peak
7440.000	40.59	54.00	-13.41	34.53	6.06	Average
7440.000	49.36	74.00	-24.64	43.30	6.06	Peak

Above 1G (1 GHz-26.5 GHz): The worst mode

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1 !	4960.000	46.71	54.00	-7.29	45.90	0.81	Average	horizontal
2	4960.000	51.93	74.00	-22.07	51.12	0.81	Peak	horizontal
3 !	7440.000	43.30	54.00	-10.70	37.24	6.06	Average	horizontal
4	7440.000	51.65	74.00	-22.35	45.59	6.06	Peak	horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		
1 !	4880.000	40.35	54.00	-13.65	39.54	0.81	Average	vertical
2	4880.000	47.62	74.00	-26.38	46.81	0.81	Peak	vertical
3 !	7320.000	42.91	54.00	-11.09	37.21	5.70	Average	vertical
4	7320.000	50.51	74.00	-23.49	44.81	5.70	Peak	vertical

Level = Read Level + Factor

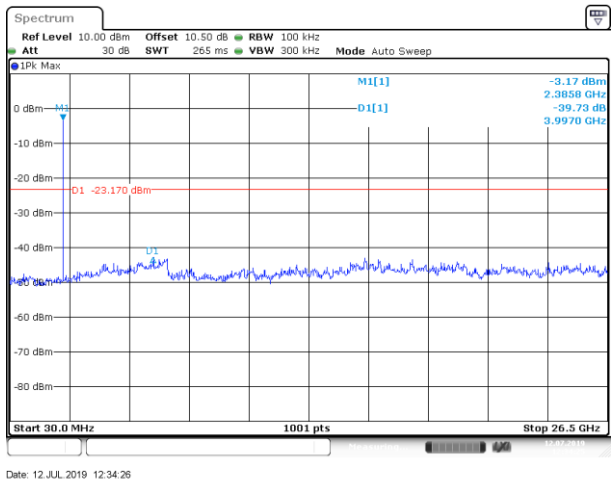
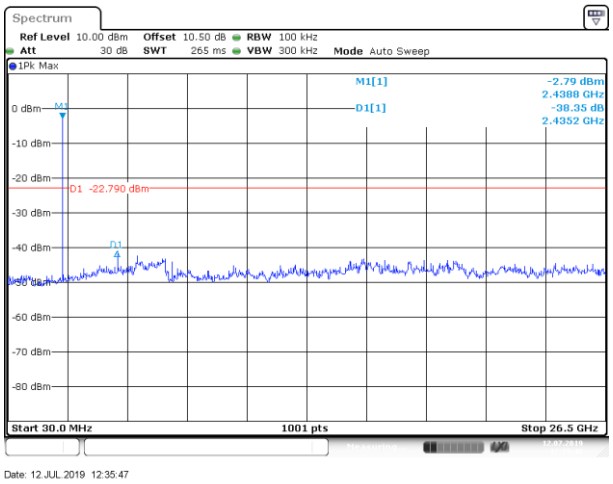
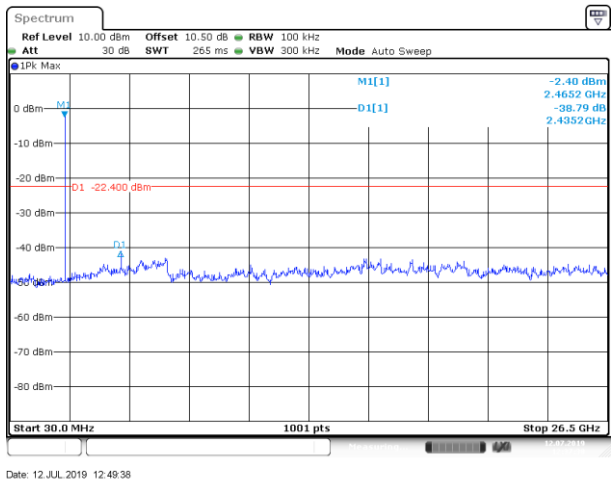
Over Limit = Level – Limit

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
BLE mode				
Low	2402	39.73	≥ 20	Compliance
Mid	2440	38.35	≥ 20	Compliance
High	2480	38.79	≥ 20	Compliance

Low CH	Middle CH
	
High CH	-
	-

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, the steps for the first option are as follows:
(1) Set RBW = 100 kHz. (2) Set the VBW ≥ [3 × RBW]. (3) Detector = peak. (4) Trace mode = max hold.
(5) Sweep = auto couple. (6) Allow the trace to stabilize. (7) 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

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

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

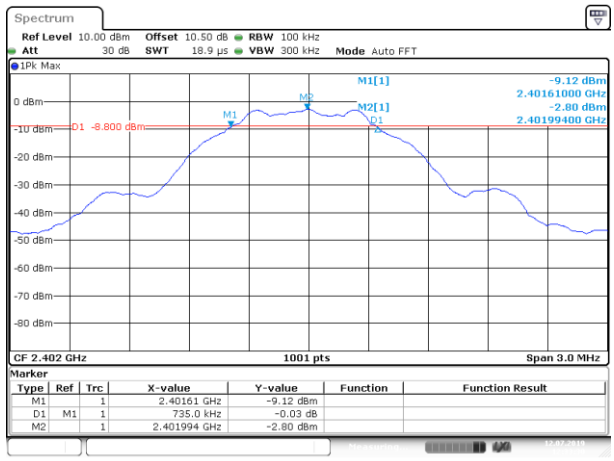
8.4 Test Environmental Conditions

Temperature:	25.6°C	**Relative Humidity:**	46 %
ATM Pressure:	1010hPa	**Test Engineer:**	Boris Kao
Conducted Test Date:	2019-07-12	-	-

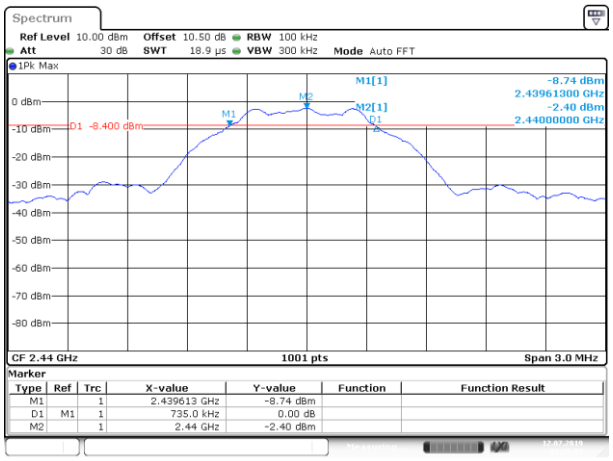
8.5 Test Results

Channel	Frequency (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
BLE mode				
Low	2402	0.735	> 0.5	Compliance
Middle	2440	0.735	> 0.5	Compliance
High	2480	0.741	> 0.5	Compliance

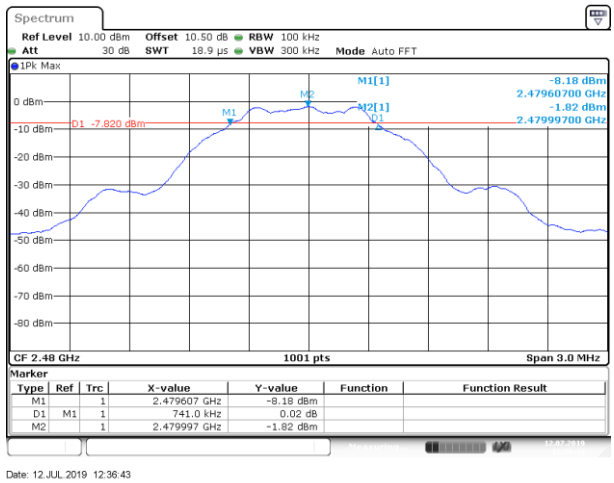
6 dB BW Low CH



6 dB BW Middle CH



6 dB BW High CH



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

9.1 Applicable Standard

According to FCC §15.247(b) (3),

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

9.2 Test Procedure

(1) Place the EUT on a bench and set it in transmitting mode.

(2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment. (3). Add a correction factor to the display.

9.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room					
Power Sensor	Agilent	U2021XA	MY54250014	2018/11/12	2019/11/11
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

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

9.4 Test Environmental Conditions

Temperature:	25.6°C	**Relative Humidity:**	46 %
ATM Pressure:	1010hPa	**Test Engineer:**	Boris Kao
Conducted Test Date:	2019-07-12	-	-

9.5 Test Results

Channel	Frequency (MHz)	Maximum Peak Output Power (dBm)	Maximum Peak Output Power (W)	Limit (dBm)	Result
BLE mode:					
Low	2402	-2.29	0.0006	30	Compliance
Middle	2440	-2.23	0.0006	30	Compliance
High	2480	**-2.22**	0.0006	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.

10.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

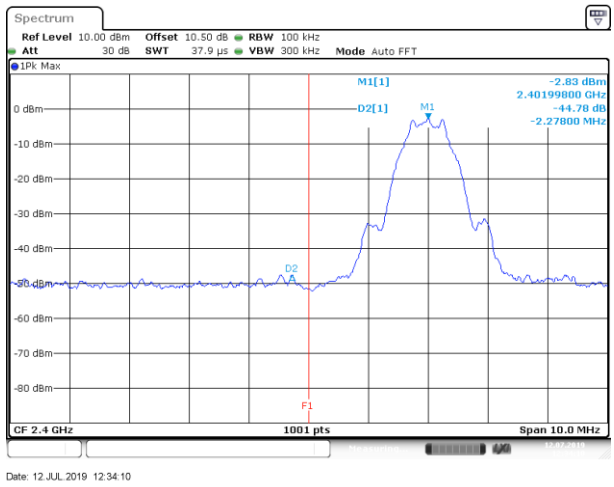
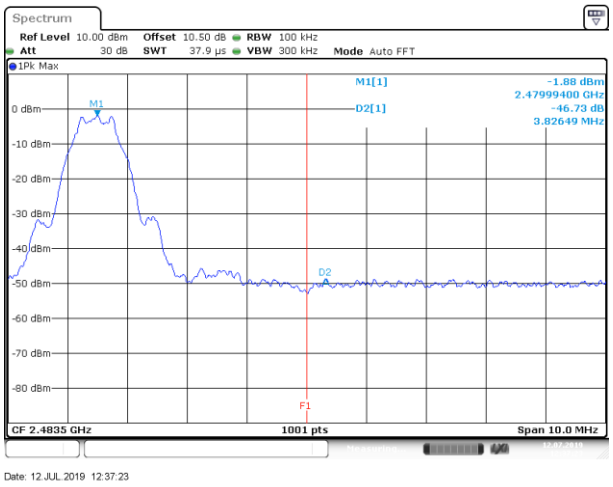
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

10.4 Test Environmental Conditions

Temperature:	25.6°C	**Relative Humidity:**	46 %
ATM Pressure:	1010hPa	**Test Engineer:**	Boris Kao
Conducted Test Date:	2019-07-12	-	-

10.5 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE mode				
Low	2402	44.78	≥ 20	Compliance
High	2480	46.73	≥ 20	Compliance

Left Side	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,

(1) Set analyzer center frequency to DTS channel center frequency.

(2) Set the span to 1.5 times the DTS bandwidth. (3) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

(4) Set the VBW ≥ [3 × RBW]. (5) Detector = peak. (6) Sweep time = auto couple.

(7) Trace mode = max hold. (8) Allow trace to fully stabilize.

(9) Use the peak marker function to determine the maximum amplitude level within the RBW.

(10) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

11.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
Cable	MTJ	MT40S	620620-MT40S-100	2018/12/28	2019/12/27

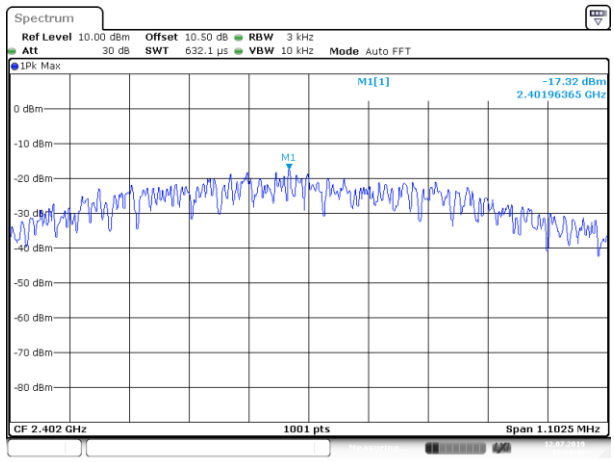
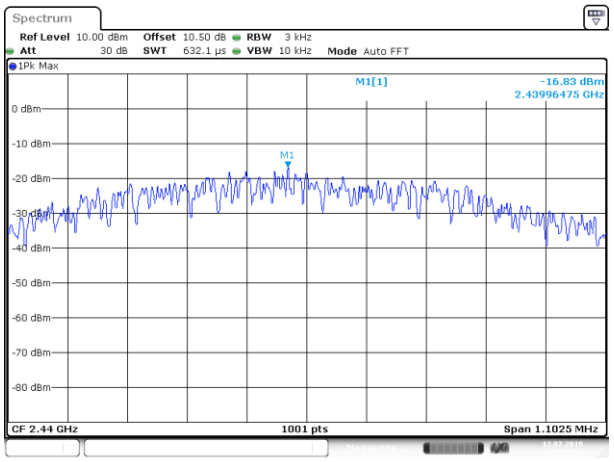
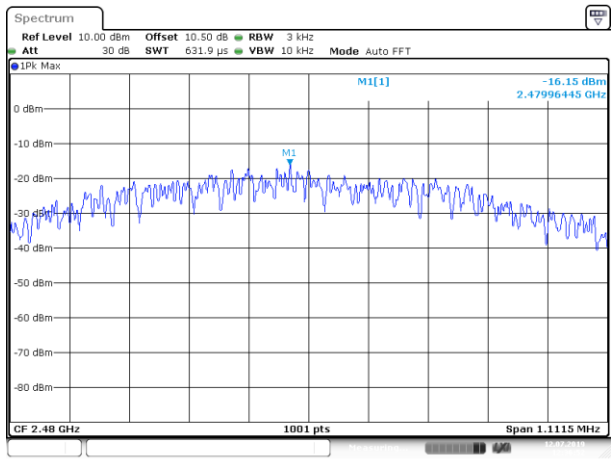
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

11.4 Test Environmental Conditions

Temperature:	25.6°C	**Relative Humidity:**	46 %
ATM Pressure:	1010hPa	**Test Engineer:**	Boris Kao
Conducted Test Date:	2019-07-12	-	-

11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE mode				
Low	2402	-17.32	8	Compliance
Middle	2440	-16.83	8	Compliance
High	2480	-16.15	8	Compliance

Low CH	Middle CH
	
High CH	**-**
	-

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