



FCC Part 15.247

TEST REPORT

For

ALATECH Technology Limited

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

FCC ID: YQOWB002

Report Type	Original Report
Product Type:	Star2 GPS Watch
Report Number :	RLK190624002-00B
Report Date :	2019/08/08
Reviewed By:	Flight Hsieh <i>Flight.Hsieh</i>
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	

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Taiwan)

Revision History

Revision	Report Number	Issue Date	Description
1.0	RLK190624002-00B	2019/08/08	Original Report

TABLE OF CONTENTS

1 GENERAL INFORMATION5

1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....5

1.2 OPERATION CONDITION OF EUT5

1.3 OBJECTIVE AND TEST METHODOLOGY6

1.4 MEASUREMENT UNCERTAINTY.....6

1.5 TEST FACILITY6

2 SYSTEM TEST CONFIGURATION.....7

2.1 TEST CHANNELS AND DESCRIPTION OF WORST TEST CONFIGURATION.....7

2.2 SUPPORT EQUIPMENT LIST AND EXTERNAL CABLE LIST8

2.3 BLOCK DIAGRAM OF TEST SETUP8

2.4 DUTY CYCLE.....9

3 SUMMARY OF TEST RESULTS..... 10

4 FCC§15.247(I), §1.1307(B)(1), § 2.1093 - RF EXPOSURE 11

4.1 APPLICABLE STANDARD 11

4.2 RF EXPOSURE EVALUATION RESULT 11

5 FCC §15.203 - ANTENNA REQUIREMENTS 12

5.1 APPLICABLE STANDARD 12

5.2 ANTENNA LIST AND DETAILS 12

6 FCC §15.207 - AC LINE CONDUCTED EMISSIONS 13

6.1 APPLICABLE STANDARD 13

6.2 EUT SETUP AND TEST PROCEDURE..... 13

6.3 TEST EQUIPMENT LIST AND DETAILS 14

6.4 TEST ENVIRONMENTAL CONDITIONS 14

6.5 AC LINE CONDUCTED EMISSION TEST PLOT AND DATA..... 15

7 FCC §15.209, §15.205, §15.247(D) – SPURIOUS EMISSIONS 17

7.1 APPLICABLE STANDARD 17

7.2 EUT SETUP AND TEST PROCEDURE..... 19

7.3 TEST EQUIPMENT LIST AND DETAILS 20

7.4 TEST ENVIRONMENTAL CONDITIONS 20

7.5 RADIATED EMISSION TEST PLOT AND DATA..... 21

8 FCC §15.247(A)(2) – 6 DB EMISSION BANDWIDTH 25

8.1 APPLICABLE STANDARD 25

8.2 TEST PROCEDURE 25

8.3 TEST EQUIPMENT LIST AND DETAILS 25

8.4 TEST ENVIRONMENTAL CONDITIONS 25

8.5 TEST RESULTS 25

9 FCC §15.247(B) (3) – MAXIMUM OUTPUT POWER..... 27

9.1 APPLICABLE STANDARD 27

9.2 TEST PROCEDURE 27

9.3 TEST EQUIPMENT LIST AND DETAILS 27

9.4 TEST ENVIRONMENTAL CONDITIONS 27

9.5 TEST RESULTS 28

10 FCC §15.247(D) – 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE 29

10.1 APPLICABLE STANDARD 29

10.2 TEST PROCEDURE 29

10.3 TEST EQUIPMENT LIST AND DETAILS 30

10.4 TEST ENVIRONMENTAL CONDITIONS 30


10.5 TEST RESULTS 30

11 FCC §15.247(E) – POWER SPECTRAL DENSITY 31

11.1	APPLICABLE STANDARD	31
11.2	TEST PROCEDURE	31
11.3	TEST EQUIPMENT LIST AND DETAILS	31
11.4	TEST ENVIRONMENTAL CONDITIONS	31
11.5	TEST RESULTS	32

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 Zone, Zhejiang, China
Brand(Trade) Name	
Product (Equipment)	Star2 GPS Watch
Model Name	WB002
EUT Function	BT4.0 (BLE only)
Frequency Range	2402 ~ 2480 MHz
Number of Channels	40 Channels
Output Power	-0.91 dBm (0.0008 W)
Received Date	Jun. 24, 2019
Date of Test	Jul. 08, 2019 ~ Jul. 16, 2019
Modulation Type	GFSK

*All measurement and test data in this report was gathered from production sample serial number: 190624002 (Assigned by BA CL, Taiwan).

1.2 Operation Condition of EUT

Power Operation (Voltage Range)	<input checked="" type="checkbox"/> AC 120 V/60 Hz <input checked="" type="checkbox"/> Adapter (Not for Sale) via USB with Dock. <input type="checkbox"/> By Power Cord.
	<input type="checkbox"/> DC Type <input type="checkbox"/> DC Power Supply <input checked="" type="checkbox"/> Battery: lithium battery PL502023 3.7Vdc 230 mAH <input checked="" type="checkbox"/> External from USB Cable 5Vdc <input type="checkbox"/> External DC Adapter
	<input type="checkbox"/> Host System

1.3 Objective and Test Methodology

The Objective of this Test Report was to document the compliance of the ALATECH Technology Limited Appliance (Model: WB002) 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 of "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUMSYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES"

1.4 Measurement Uncertainty

Parameter	Expanded Measurement uncertainty
RF output power with Power Meter	± 0.55 dB
Occupied Channel Bandwidth	± 4.45 %
RF Conducted test with Spectrum	± 1.45 dB
AC Power Line Conducted Emission	± 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 mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
2	2404	---	---
3	2406	---	---
4	2408	37	2476
---	---	38	2478
19	2440	39	2480

Channel 0, 20 and 39 were tested.

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

Radiated below 1G were tested worst output power mode. The mode charging via USB was worst that evaluation charging via USB and Battery.

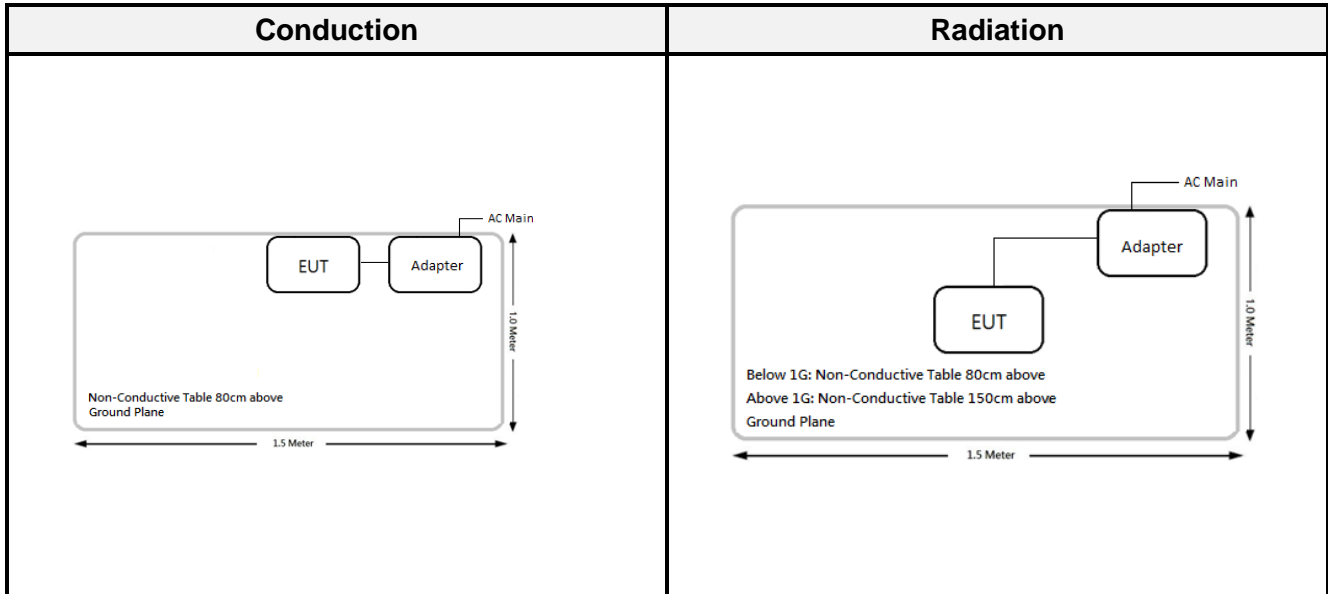
Modulation Used for Conformance Test			
Configuration	NTX	Data Rate	Worst Data Rate
BLE mode	1	125 kbps-1 Mbps	1 Mbps

Worst Case of Power Setting				
EUT Exercise Software		Blue Tooth txMode		
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	BSMI	FCC ID / DoC
A	Adapter	DVE	DSA-5PFU1-05	NA	DoC
B	Adapter	Apple	A1385	N/A	DoC

2.3 Block Diagram of Test Setup

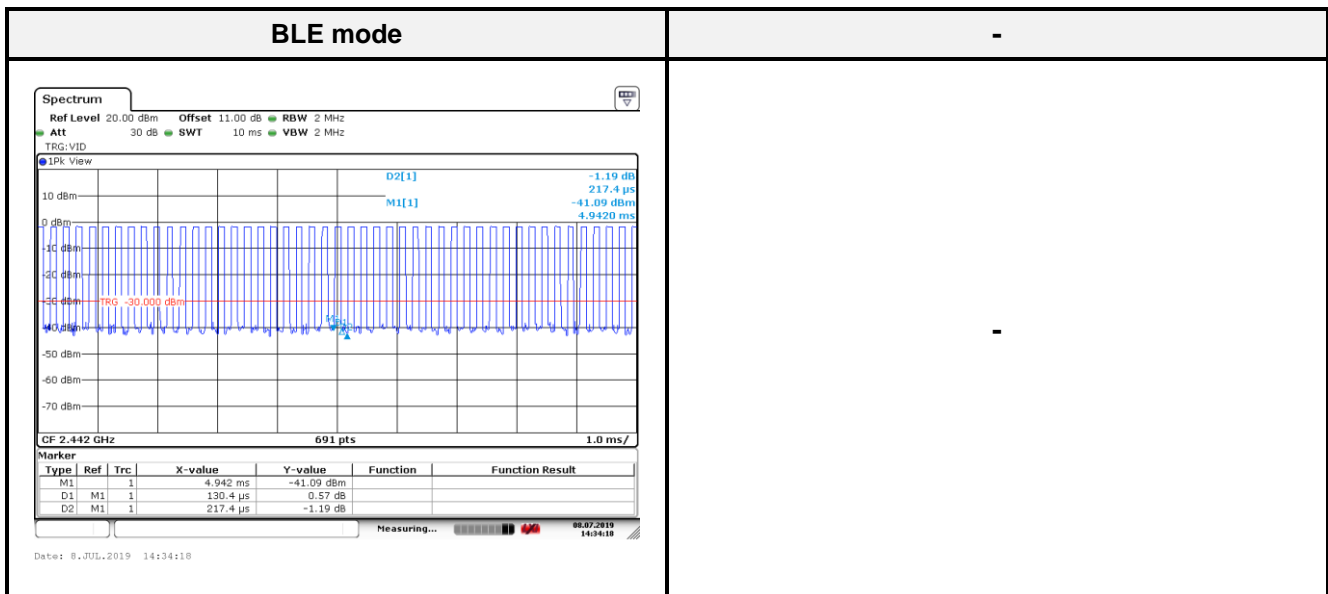


2.4 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05r02:

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	0.13	0.21	61.90	2.08



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

3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §1.1317, §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(b)(1), § 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:

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

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

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 ≤ 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

MPE evaluation:

Frequency (MHz)	Tune-up Power		Evaluation Distance (mm)	SAR Exclusion Result	SAR Exclusion Limit
	(dBm)	(mW)			(1g SAR)
2402-2480	0	1.000	5	0.3183	3

**Note: BLE and ANT + will not be launched at the same time, so there will be no co-located.*

Therefore, the stand-alone SAR evaluation for BLE 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

Manufacturer	Model	Antenna Type	Antenna Gain	Result
ALATECH	BT-ANT	FPC Antenna	-2.19	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

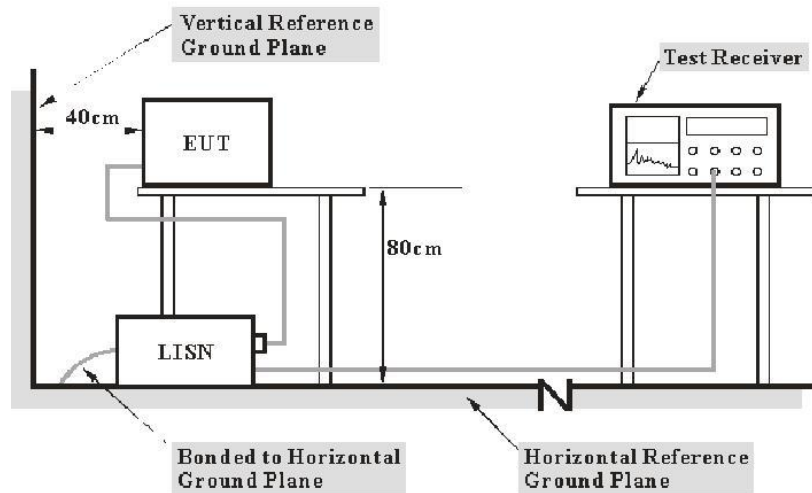
According to FCC §15.207

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.

Channel	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 30MHz. 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	101612	2019/02/21	2020/02/20
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2018/08/03	2019/08/02
RF Cable	EMEC	EM-CB5D	001	2019/07/01	2020/06/30
Software	AUDIX	e3	V9.150826k	N.C.R	N.C.R

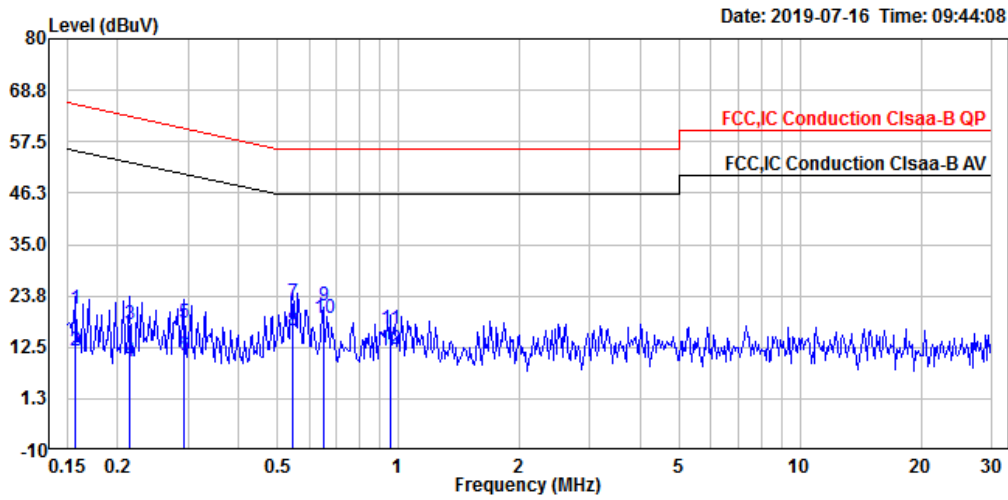
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

6.4 Test Environmental Conditions

Temperature:	20 °C	Relative Humidity:	50 %
ATM Pressure:	1010hPa	Test Engineer:	Ray Huang
Test Date:	2019-07-16		

6.5 AC Line Conducted Emission Test Plot and Data

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



	Read Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.157	1.02	20.89	19.87	65.60	-44.71	QP
2	0.157	-8.01	11.86	19.87	55.60	-43.74	Average
3	0.215	-2.47	17.39	19.86	63.02	-45.63	QP
4	0.215	-10.35	9.51	19.86	53.02	-43.51	Average
5	0.293	-1.88	17.99	19.87	60.44	-42.45	QP
6	0.293	-9.09	10.78	19.87	50.44	-39.66	Average
7	0.545	2.32	22.20	19.88	56.00	-33.80	QP
8	0.545	-3.65	16.23	19.88	46.00	-29.77	Average
9	0.650	1.82	21.71	19.89	56.00	-34.29	QP
10	0.650	-0.99	18.90	19.89	46.00	-27.10	Average
11	0.952	-3.24	16.66	19.90	56.00	-39.34	QP
12	0.952	-7.99	11.91	19.90	46.00	-34.09	Average

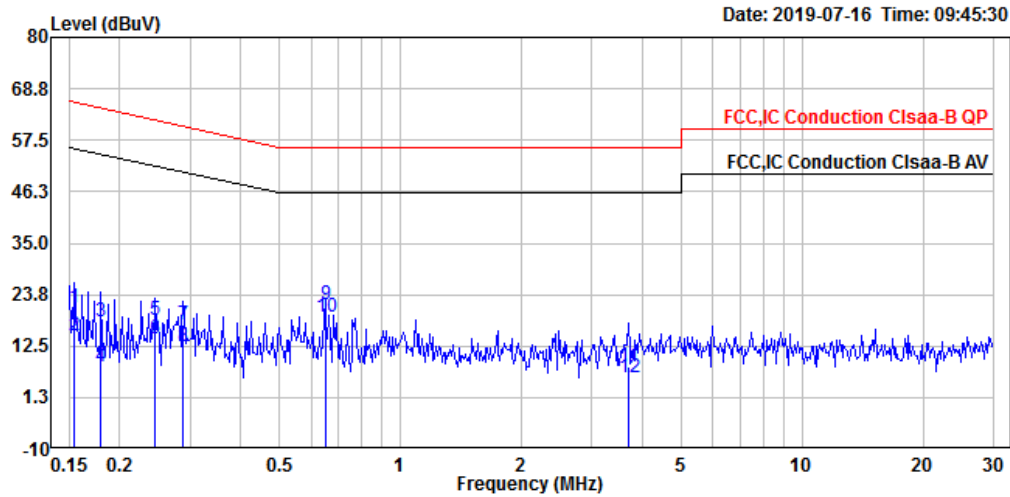
Note:

$Level = Read\ Level + Factor$

$Over\ Limit\ (Margin) = Level - Limit\ Line$

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

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



	Read Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.155	1.01	20.88	19.87	65.74	-44.86	QP
2	0.155	-5.24	14.63	19.87	55.74	-41.11	Average
3	0.180	-2.06	17.80	19.86	64.48	-46.68	QP
4	0.180	-11.70	8.16	19.86	54.48	-46.32	Average
5	0.246	-1.70	18.17	19.87	61.90	-43.73	QP
6	0.246	-5.86	14.01	19.87	51.90	-37.89	Average
7	0.288	-2.57	17.29	19.86	60.57	-43.28	QP
8	0.288	-7.31	12.55	19.86	50.57	-38.02	Average
9	0.650	1.58	21.47	19.89	56.00	-34.53	QP
10	0.650	-1.09	18.80	19.89	46.00	-27.20	Average
11	3.691	-12.13	7.87	20.00	56.00	-48.13	QP
12	3.691	-14.26	5.74	20.00	46.00	-40.26	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

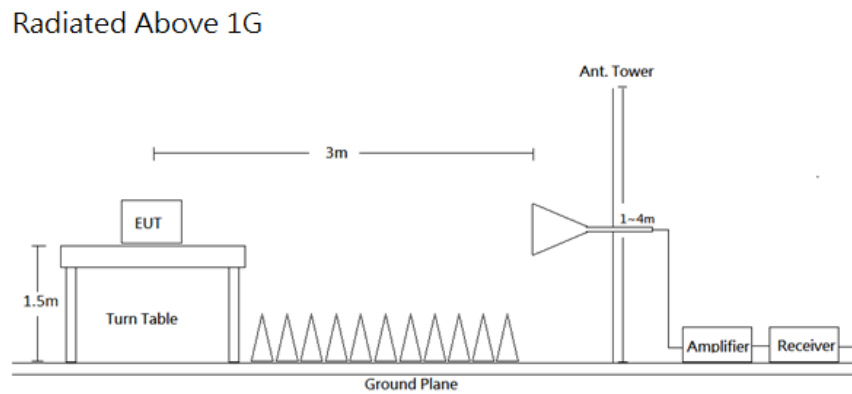
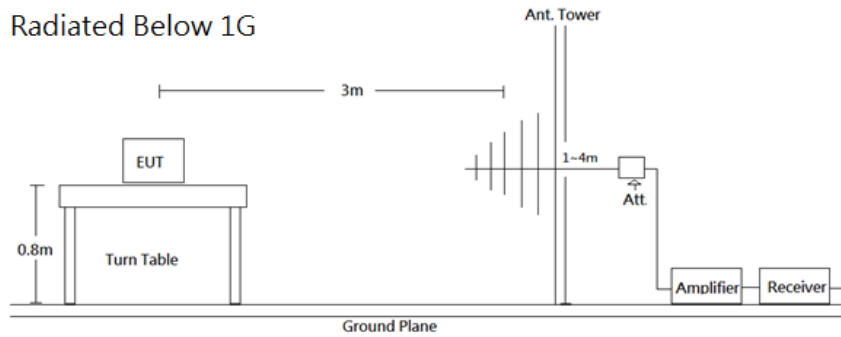
As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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 with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2018/12/11	2019/12/10
Horn Antenna	ETS-Lindgren	3115	00040736	2019/03/22	2020/03/21
Horn Antenna	ETS-Lindgren	3116	62638	2018/08/29	2019/08/28
Preamplifier	Sonoma	310N	130601	2018/09/20	2019/09/19
Preamplifier	EM Electronics Corp.	EM01G18G	060657	2018/12/07	2019/12/06
Microware Preamplifier	EM Electronics Corporation	EM18G40G	060656	2019/01/11	2020/01/10
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Signal Analyzer	Rohde & Schwarz	FSV40	101435	2019/02/14	2020/02/13
Micro flex Cable	UTIFLEX	FSCM 64639 / (2M)	93D0127	2018/07/31	2019/07/30
Micro flex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2018/11/16	2019/11/15
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2019/03/04	2020/03/03
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2019/01/16	2020/01/15
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	60772	N.C.R	N.C.R
Software	AUDIX	e3	E3LK-01	N.C.R	N.C.R
Conducted Room					
Signal Analyzer	Rohde & Schwarz	FSV40	101435	2019/02/14	2020/02/13
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10

***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).

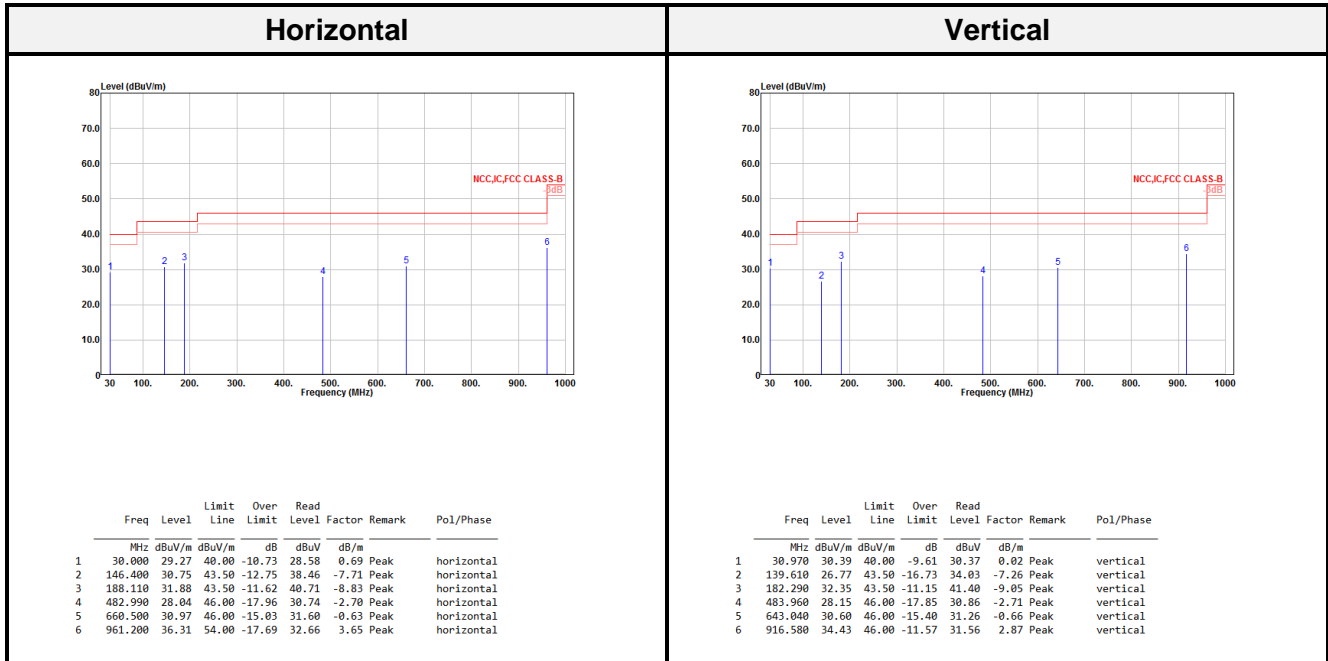
7.4 Test Environmental Conditions

Temperature:	20 °C	Relative Humidity:	50 %
ATM Pressure:	1014 hPa	Test Engineer:	Leo Chang
Conducted Test Date:	2019-07-08	Radiated Test Date:	2019-07-12

7.5 Radiated Emission Test Plot and Data

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

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



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)

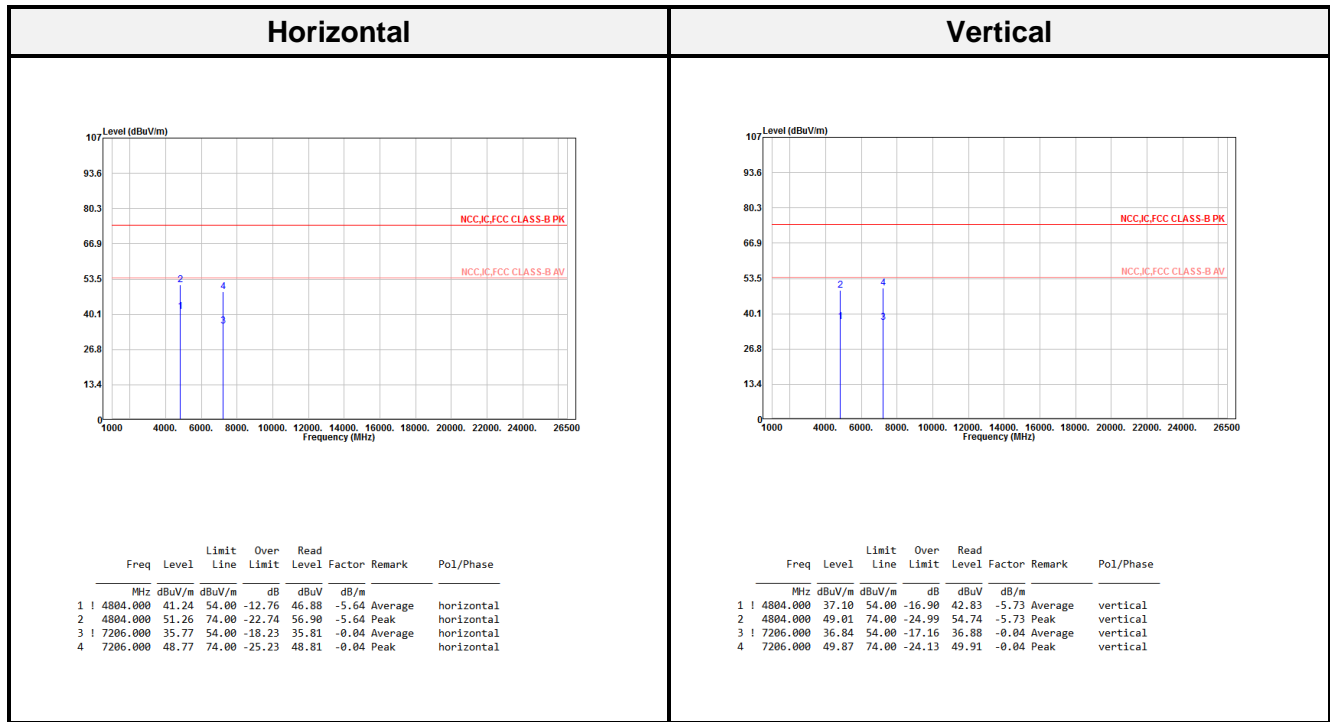
BLE mode:

Low CH													
Horizontal							Vertical						
Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2365.284	33.12	54.00	-20.88	45.72	-12.60	Average	2329.513	33.37	54.00	-20.63	46.11	-12.74	Average
2365.284	45.85	74.00	-28.15	58.45	-12.60	Peak	2329.513	45.91	74.00	-28.09	58.65	-12.74	Peak
2402.208	77.64			89.90	-12.26	Average	2401.700	80.09			92.35	-12.26	Average
4804.000	83.31			95.57	-12.26	Peak	2401.700	84.74			97.00	-12.26	Peak
4804.000	41.24	54.00	-12.76	46.88	-5.64	Average	4804.000	37.10	54.00	-16.90	42.83	-5.73	Average
4804.000	51.26	74.00	-22.74	56.90	-5.64	Peak	4804.000	49.01	74.00	-24.99	54.74	-5.73	Peak
7206.000	35.77	54.00	-18.23	35.81	-0.04	Average	7206.000	36.84	54.00	-17.16	36.88	-0.04	Average
7206.000	48.77	74.00	-25.23	48.81	-0.04	Peak	7206.000	49.87	74.00	-24.13	49.91	-0.04	Peak

Middle CH													
Horizontal							Vertical						
Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2383.440	32.10	54.00	-21.90	44.53	-12.43	Average	2338.320	31.91	54.00	-22.09	44.64	-12.73	Average
2383.440	45.51	74.00	-28.49	57.94	-12.43	Peak	2338.320	46.09	74.00	-27.91	58.82	-12.73	Peak
2441.760	75.55			87.78	-12.23	Average	2442.240	79.48			91.71	-12.23	Average
2441.760	79.43			91.66	-12.23	Peak	2442.240	83.81			96.04	-12.23	Peak
2521.680	32.32	54.00	-21.68	44.55	-12.23	Average	2536.320	32.75	54.00	-21.25	44.92	-12.17	Average
2521.680	46.68	74.00	-27.32	58.91	-12.23	Peak	2536.320	46.21	74.00	-27.79	58.38	-12.17	Peak
4884.000	40.76	54.00	-13.24	46.37	-5.61	Average	4884.000	36.73	54.00	-17.27	42.34	-5.61	Average
4884.000	52.75	74.00	-21.25	58.36	-5.61	Peak	4884.000	49.90	74.00	-24.10	55.51	-5.61	Peak
7326.000	34.80	54.00	-19.20	34.42	0.38	Average	7326.000	34.28	54.00	-19.72	33.90	0.38	Average
7326.000	48.85	74.00	-25.15	48.47	0.38	Peak	7326.000	47.66	74.00	-26.34	47.28	0.38	Peak

High CH													
Horizontal							Vertical						
Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2479.644	76.38			88.65	-12.27	Average	2480.190	78.08			90.35	-12.27	Average
2479.644	84.47			96.74	-12.27	Peak	2480.190	86.36			98.63	-12.27	Peak
2483.778	33.33	54.00	-20.67	45.60	-12.27	Average	2483.544	33.14	54.00	-20.86	45.40	-12.26	Average
2483.778	53.01	74.00	-20.99	65.28	-12.27	Peak	2483.544	54.61	74.00	-19.39	66.87	-12.26	Peak
4960.000	41.05	54.00	-12.95	46.87	-5.82	Average	4960.000	36.73	54.00	-17.27	42.55	-5.82	Average
4960.000	51.50	74.00	-22.50	57.32	-5.82	Peak	4960.000	50.59	74.00	-23.41	56.41	-5.82	Peak
7440.000	36.11	54.00	-17.89	35.21	0.90	Average	7440.000	35.42	54.00	-18.58	34.52	0.90	Average
7440.000	48.63	74.00	-25.37	47.73	0.90	Peak	7440.000	50.43	74.00	-23.57	49.53	0.90	Peak

Above 1G (1 GHz-26.5 GHz): Test the worst mode: Low Channel



Result = Reading + Correct Factor

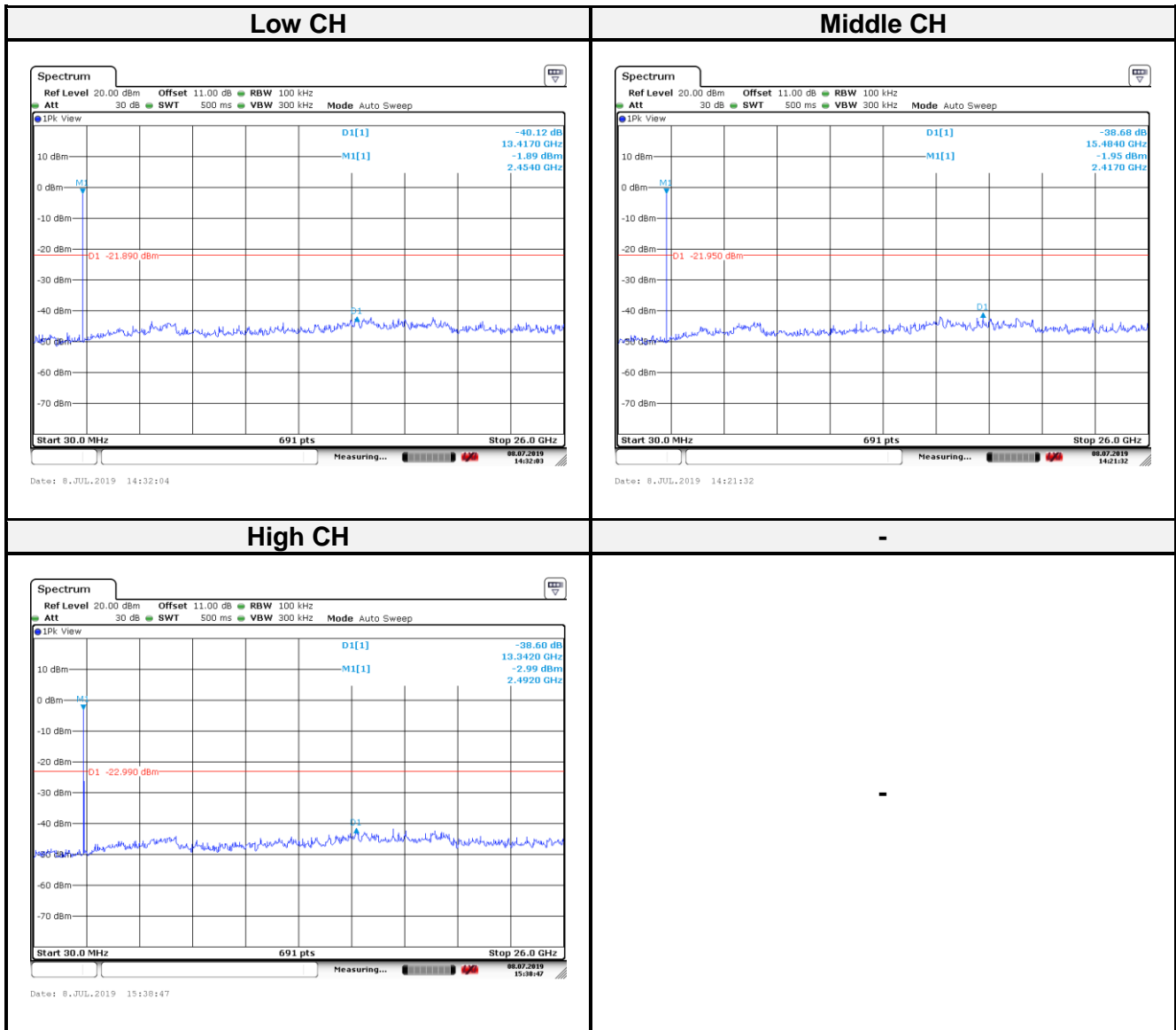
Margin = Result – Limit

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
BLE mode				
Low	2402	40.12	≥ 20	Compliance
Mid	2442	38.68	≥ 20	Compliance
High	2480	38.60	≥ 20	Compliance



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 \geq [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	Rohde & Schwarz	FSV40	101435	2019/02/14	2020/02/13
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10

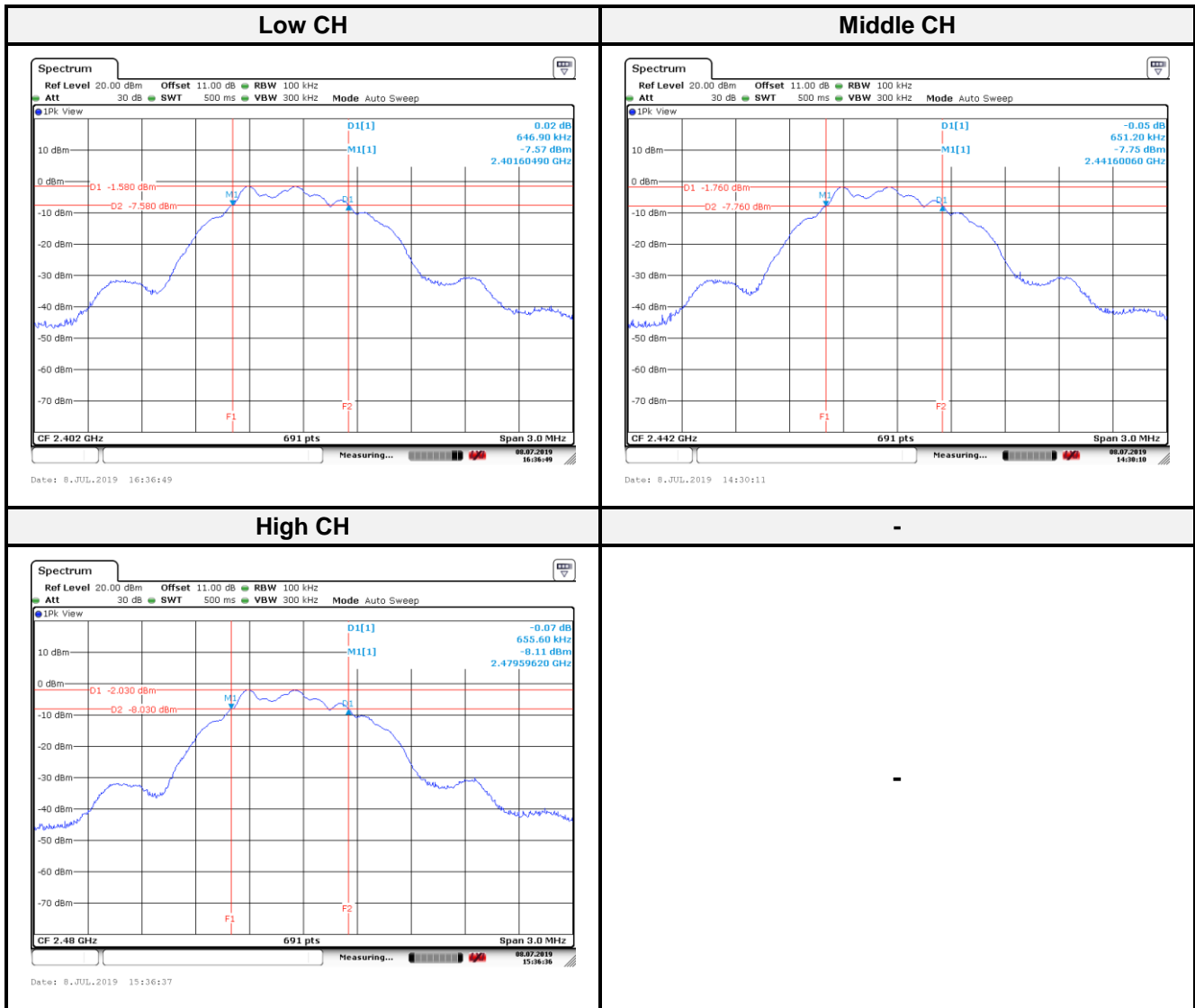
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

8.4 Test Environmental Conditions

Temperature:	29~30 °C	Relative Humidity:	54~55 %
ATM Pressure:	1015 hPa	Test Engineer:	Ian Tu
Conducted Test Date:	2019-07-08	-	-

8.5 Test Results

Channel	Frequency (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
BLE mode				
Low	2402	0.6469	> 0.5	Compliance
Middle	2442	0.6512	> 0.5	Compliance
High	2480	0.6556	> 0.5	Compliance



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	KEYSIGHT	U2021XA	MY54080018	2019/03/06	2020/03/05
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10

**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:	29~30 °C	Relative Humidity:	54~55 %
ATM Pressure:	1015 hPa	Test Engineer:	Ian Tu
Conducted Test Date:	2019-07-08	-	-

9.5 Test Results

Channel	Frequency (MHz)	Peak Output Power (dBm)	Total Peak Output Power (W)	Limit (dBm)	Result
BLE mode					
Low	2402	-0.91	0.0008	30	Compliance
Middle	2442	-0.95	0.0008	30	Compliance
High	2480	-1.01	0.0007	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	Rohde & Schwarz	FSV40	101435	2019/02/14	2020/02/13
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10

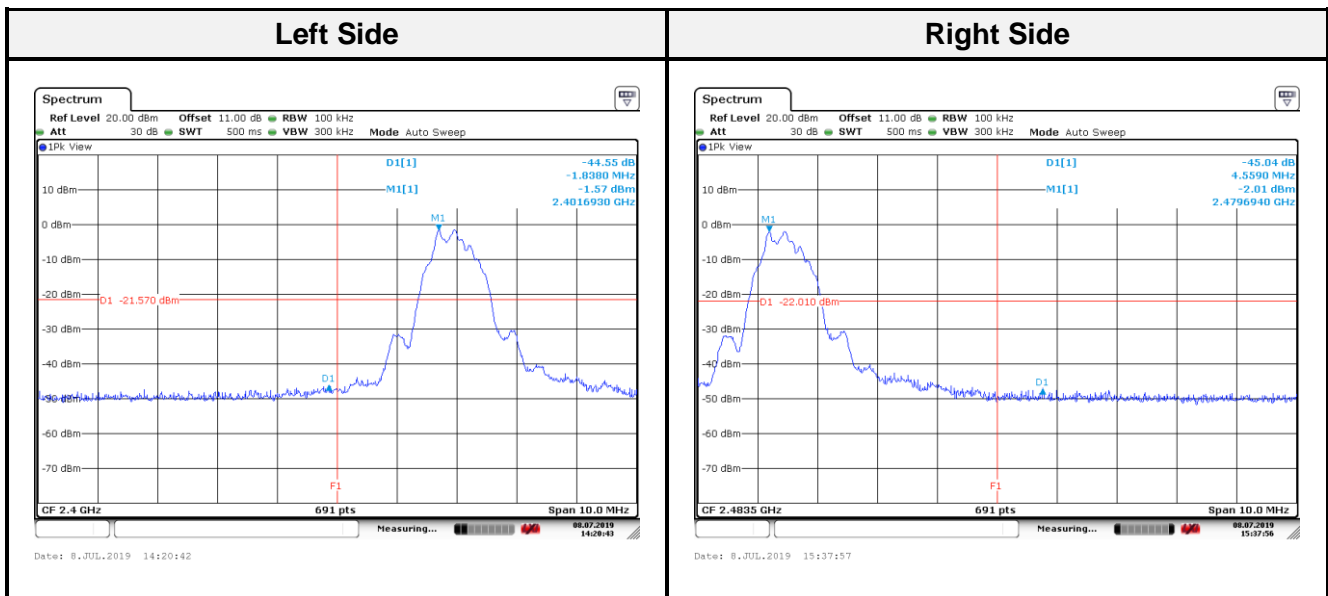
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

10.4 Test Environmental Conditions

Temperature:	29~30 °C	Relative Humidity:	54~55 %
ATM Pressure:	1015 hPa	Test Engineer:	Ian Tu
Conducted Test Date:	2019-07-08		-

10.5 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE mode				
Low	2402	44.55	≥ 20	Compliance
High	2480	45.04	≥ 20	Compliance



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 $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- (4) Set the VBW $\geq [3 \times \text{RBW}]$. (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	Rohde & Schwarz	FSV40	101435	2019/02/14	2020/02/13
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10

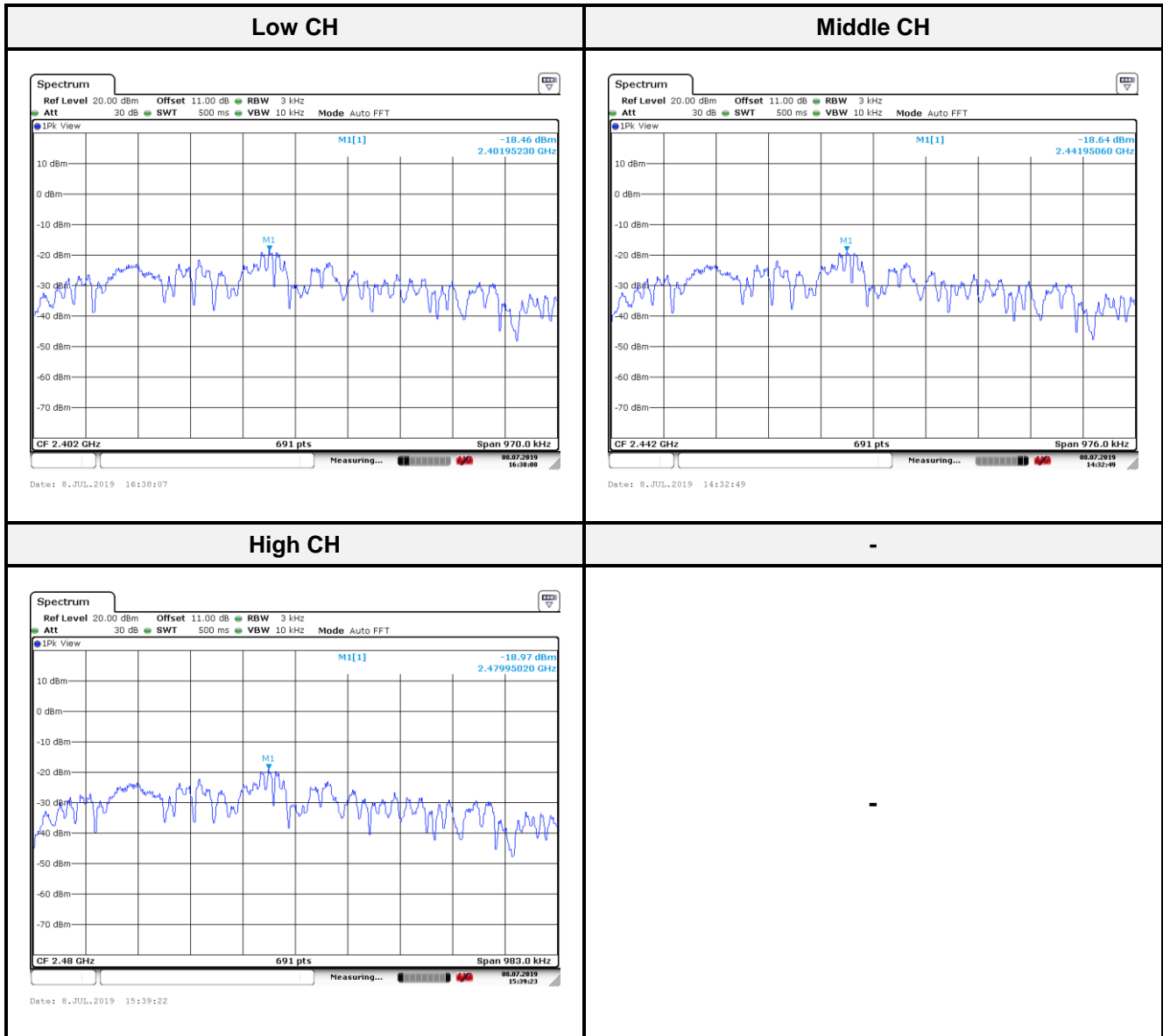
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

11.4 Test Environmental Conditions

Temperature:	29~30 °C	Relative Humidity:	54~55 %
ATM Pressure:	1015 hPa	Test Engineer:	Ian Tu
Conducted Test Date:	2019-07-08	-	-

11.5 Test Results

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE mode				
Low	2402	-18.46	8	Compliance
Middle	2442	-18.64	8	Compliance
High	2480	-18.97	8	Compliance



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