



FCC Part 15.247

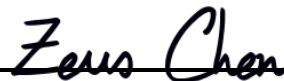
TEST REPORT

For

GIANT MANUFACTURING CO., LTD.

No. 999, Sec. 1, Dongda Rd., Xitun Dist., Taichung City 40763, Taiwan

FCC ID: ZL7-SG10Y

Report Type	Original Report
Product Name:	Smart gateway
Model Name:	10Y
Report Number :	RSHA200526004-00B
Report Date :	2020/08/01
Reviewed By :	Zeus Chen 
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Linkou Laboratory)

Revision History

Revision	Report Number	Issue Date	Description
1.0	RSHA200526004-00B	2020/08/01	Original Report

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	GIANT MANUFACTURING CO., LTD. No. 999, Sec. 1, Dongda Rd., Xitun Dist., Taichung City 40763, Taiwan
Manufacturer	GIANT MANUFACTURING CO., LTD. No. 999, Sec. 1, Dongda Rd., Xitun Dist., Taichung City 40763, Taiwan
Brand Name	GIANT
Product (Equipment)	Smart gateway
Model Name	10Y
Frequency Range	BLE-1Mbps: 2402 - 2480 MHz ANT+ : 2457 MHz
Number of Channels	BLE-1Mbps: 40 Channels ANT+ :1 Channel
Output Power	BLE-1Mbps: 0.68 dBm (0.001 W) ANT+: 4.65 dBm (0.003 W)
Modulation Type	BLE-1Mbps: GFSK ANT+: GFSK
Power Operation	☒ DC Type ☒ DC 36Vdc ☒ From Laptop (For Test)
Related Submittal(s)/Grant(s)	N/A
Received Date	Jun. 15, 2020
Date of Test	Jun. 22, 2020 - Jul. 17, 2020

**All measurement and test data in this report was gathered from production sample serial number: 200526004 Assigned by BACL, Linkou Laboratory).*

1.2 Objective and Test Methodology

The Objective of this Test Report was to document the compliance of the **GIANT MANUFACTURING CO., LTD.**.

Appliance (Model: 10Y) 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 the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.3 Measurement Uncertainty

Parameter	Expanded Measurement uncertainty
RF output power with Power Meter	± 1.488 dB
Occupied Channel Bandwidth	± 453.927 Hz
RF Conducted test with Spectrum	± 2.77 dB
AC Power Line Conducted Emission	± 2.66 dB
Radiated Below 1G	± 3.78 dB
Radiated Above 1G	± 4.29 dB

The test results with statement of conformity, the decision rules are based on the specifications and standards. The test results will not take the measurement uncertainty into account.

1.4 Test Facility

Test Site	Test Date	Temperature (°C)	Relative Humidity (% RH)	Test Engineer
Conduction (Con-01)	Jul. 17, 2020	24.8	52	Blake Wang
Radiated (966B)	Jun. 24, 2020 - Jul. 16, 2020	22.2 - 25.6	52 - 60	Leo Cheng
Conducted (TH-02)	Jun. 22, 2020 - Jul. 14, 2020	22.6 - 23.8	60	Blake Wang

1.5 Test Facility

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

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

Bay Area Compliance Laboratories Corp. (Linkou Laboratory) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3546) by Mutual Recognition Agreement (MRA). 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.: TW1119. The Test Firm Registration No.: 311381. ISSED#: 25102 and CAB identifier is TW3546.

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.

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**, there are totally 40 channels. And Channel 0, 19 and 39 were tested.

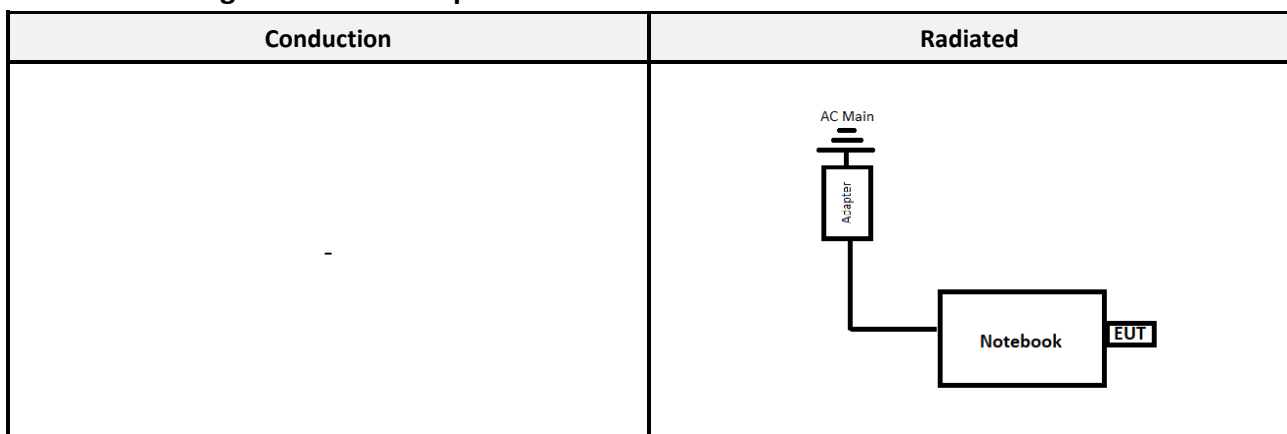
For **Ant+**, there is only 1 channel. And 2457MHz was tested.

Worst Case of Power Setting				
Exercise Software			nRFgo Studio	
Configuration	N _{TX}	Low CH	Middle CH	High CH
BLE-1Mbps	1	Default	Default	Default
Configuration	N _{TX}	-	2457 MHz	-
ANT+	1	-	Default	-

2.2 Support Equipment List and External Cable List

No.	Description	Manufacturer	Model Number	Series Number
A	Notebook	Lenovo	Latitude E6410	Y520-15IKBN

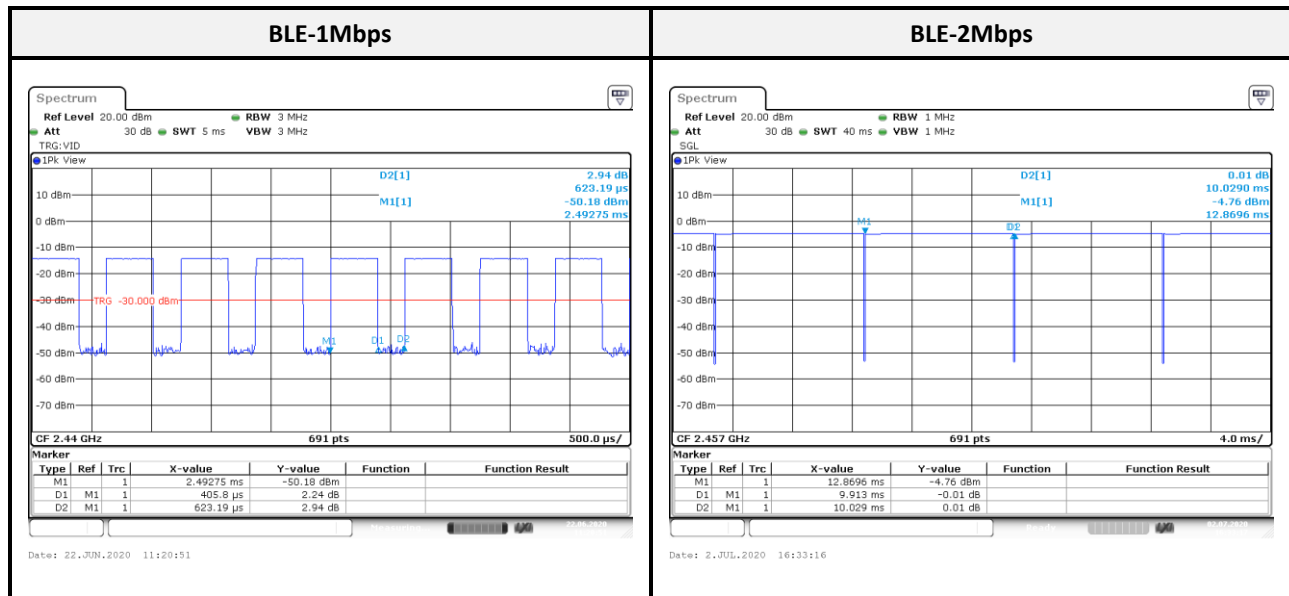
2.3 Block Diagram of Test Setup



2.4 Duty Cycle

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-1Mbps	0.41	0.62	65.13	1.86
ANT+	9.91	10.03	98.84	0.05



*Note: Duty Factor = $10 \cdot \log(1/\text{Duty cycle})$

3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), §1.1310, §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Not Applicable ^{Note1}
§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

Note 1: EUT Power by DC Source.

4 FCC§15.247(i), §1.1307, § 2.1091 – Maximum Permissible Exposure (MPE)

4.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary: Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

4.2 RF Exposure Evaluation Result

MPE Evaluation

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE-1Mbps	2402-2480	1.50	1.4125	0.68	1.1695	20	0.0003	1
ANT+	2457	1.50	1.4125	4.65	2.9174	20	0.0008	1

BLE and ANT+ can transmit simultaneously, MPE evaluation is as below formula:
 $PD1/Limit1 + PD2/Limit2 + \dots < 1$, PD (Power Density)

The worst case is as below:

Max MPE of BLE + Max MPE of ANT+ = $0.0003/1.0 + 0.0008/1 = 0.0011 < 1.0$

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.

5 FCC §15.203 - Antenna Requirements

5.1 Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi

5.2 Antenna List and Details

Type	Brand	Model	Gain	Result
Chip Antenna	Unictron	AA055K	1.5dBi	Compliance

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

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

6.1 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

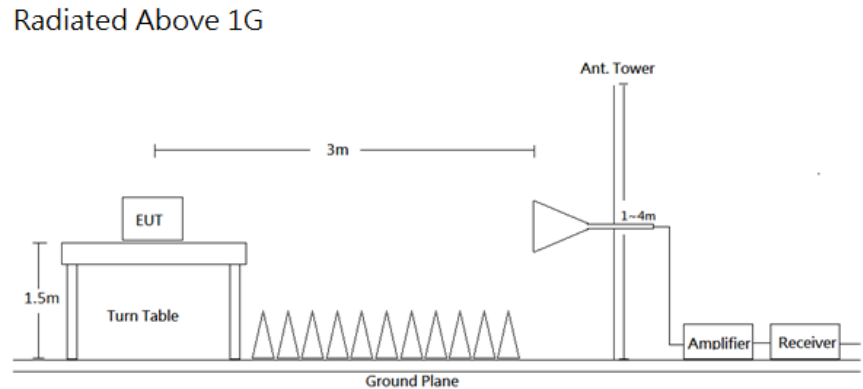
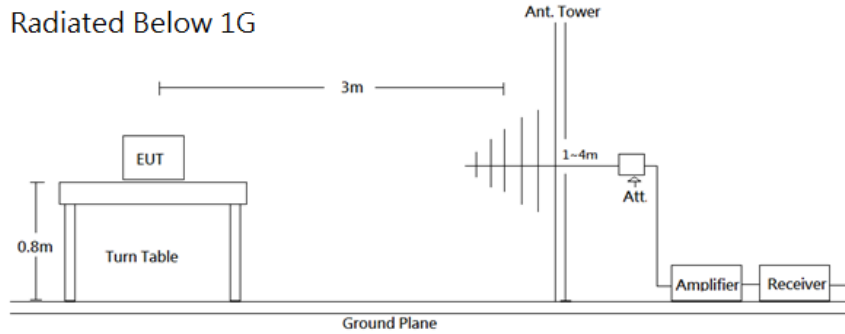
As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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)).

6.2 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	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	-	QP
Above 1 GHz	1 MHz	3 MHz	-	PK
	1 MHz	10 Hz	>98%	Ave
	1 MHz	1/T	<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.

6.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Radiation 3M Room (966A)					
Active Loop	EMCO	6502	0001-3322	2020/03/16	2021/03/15
Bilog Antenna/6 dB Attenuator	SUNOL SCIENCES & EMEC /EMCI	JB3/N-6-06	A111513/AT-N0668	2020/03/19	2021/03/18
Horn Antenna	ETS-Lindgren	3115	00085775	2019/09/11	2020/09/10
Horn Antenna	ETS-Lindgren	3160-09	00123853	2019/09/12	2020/09/11
Preamplifier	A.H. Systems	PAM-0118	470	2020/03/16	2021/03/15
Preamplifier	A.H. Systems	PAM-1840VH	174	2020/03/25	2021/03/24
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
Microflex Cable (1m)	EMCI	EMC106-SM-SM-2000	180515	2019/08/07	2020/08/06
Microflex Cable (2m)	MTJ	H0919	00000-MT28A-100	2019/08/07	2020/08/06
Microflex Cable (8m)	UTIFLEX	UFA210A-1-3149-300300	MFR 64639 232490-001	2019/08/07	2020/08/06
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 (TH-02)					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
RF Cable	MTJ	MT40S	MT40S-001	Each Use	/

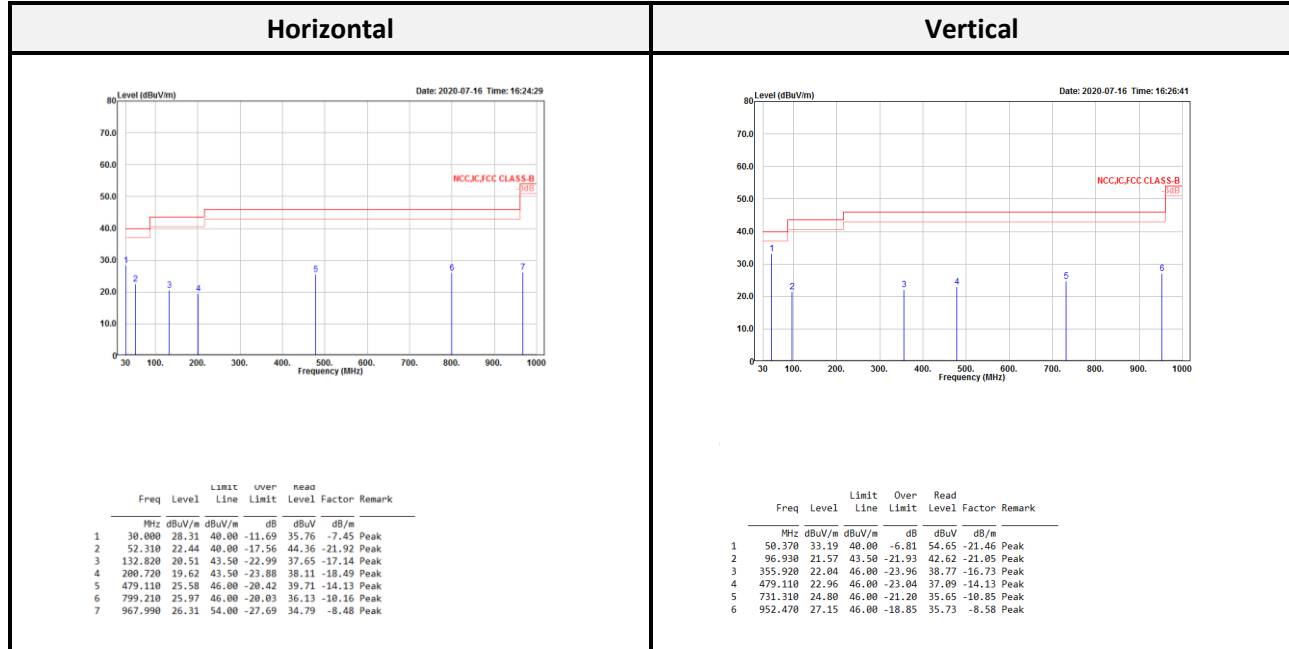
***Statement of Traceability:** The testing equipment's listed above have finished the calibration by Electronics Testing Center, Taiwan (ETC) or other laboratories which were accredited by TAF or equivalent organizations. The calibration result could be traceable to the International System of Units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

6.4 Radiated Test Result

For BLE:

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

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



Note1: Transmit mode

Note2:

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

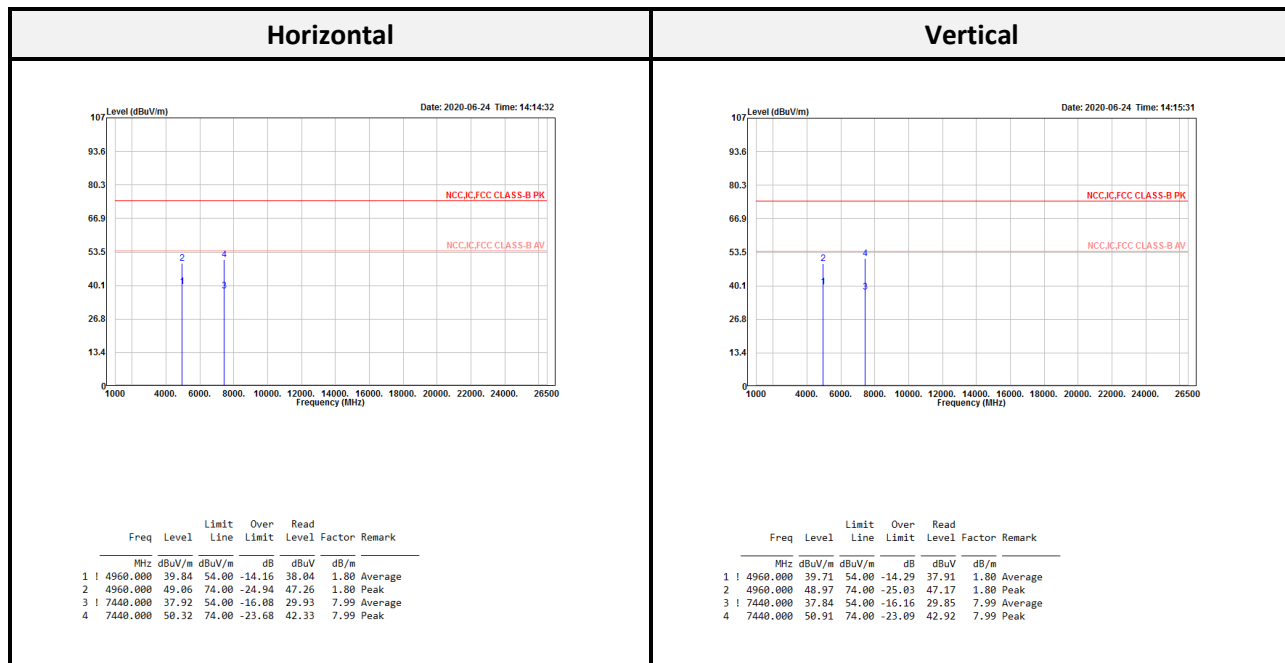
Spurious emissions more than 20 dB below the limit were not reported

Above 1G (1 GHz-26.5 GHz)

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	
2340.000	40.69	54.00	-13.31	46.97	-6.28	Average	2336.500	40.34	54.00	-13.66	46.61	-6.27	Average
2340.000	53.57	74.00	-20.43	59.85	-6.28	Peak	2336.500	53.98	74.00	-20.02	60.25	-6.27	Peak
2402.400	85.86			91.84	-5.98	Average	2401.900	73.82			79.81	-5.99	Average
2402.400	86.93			92.91	-5.98	Peak	2401.900	75.13			81.12	-5.99	Peak
4804.000	37.28	54.00	-16.72	35.64	1.64	Average	4804.000	38.27	54.00	-15.73	36.63	1.64	Average
4804.000	48.20	74.00	-25.80	46.56	1.64	Peak	4804.000	48.96	74.00	-25.04	47.32	1.64	Peak
7206.000	38.50	54.00	-15.50	30.96	7.54	Average	7206.000	39.29	54.00	-14.71	31.75	7.54	Average
7206.000	51.58	74.00	-22.42	44.04	7.54	Peak	7206.000	52.13	74.00	-21.87	44.59	7.54	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	
2388.408	40.88	54.00	-13.12	46.96	-6.08	Average	2367.838	40.72	54.00	-13.28	46.92	-6.20	Average
2388.408	52.88	74.00	-21.12	58.96	-6.08	Peak	2367.838	53.33	74.00	-20.67	59.53	-6.20	Peak
2440.438	87.95			93.60	-5.65	Average	2439.954	76.58			82.23	-5.65	Average
2440.438	89.02			94.67	-5.65	Peak	2439.954	77.88			83.53	-5.65	Peak
2510.134	41.63	54.00	-12.37	47.01	-5.38	Average	2534.334	41.92	54.00	-12.08	47.16	-5.24	Average
2510.134	54.50	74.00	-19.50	59.88	-5.38	Peak	2534.334	54.68	74.00	-19.32	59.92	-5.24	Peak
4880.000	38.43	54.00	-15.57	36.78	1.65	Average	4880.000	38.03	54.00	-15.97	36.38	1.65	Average
4880.000	47.85	74.00	-26.15	46.20	1.65	Peak	4880.000	48.77	74.00	-25.23	47.12	1.65	Peak
7320.000	39.05	54.00	-14.95	31.27	7.78	Average	7320.000	39.33	54.00	-14.67	31.55	7.78	Average
7320.000	51.43	74.00	-22.57	43.65	7.78	Peak	7320.000	51.99	74.00	-22.01	44.21	7.78	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	
2479.758	85.72			91.21	-5.49	Average	2480.250	78.67			84.16	-5.49	Average
2479.758	86.81			92.30	-5.49	Peak	2480.250	79.89			85.38	-5.49	Peak
2514.526	41.61	54.00	-12.39	46.96	-5.35	Average	2514.772	41.49	54.00	-12.51	46.84	-5.35	Average
2514.526	54.85	74.00	-19.15	60.20	-5.35	Peak	2514.772	54.57	74.00	-19.43	59.92	-5.35	Peak
4960.000	39.84	54.00	-14.16	38.04	1.80	Average	4960.000	39.71	54.00	-14.29	37.91	1.80	Average
4960.000	49.06	74.00	-24.94	47.26	1.80	Peak	4960.000	48.97	74.00	-25.03	47.17	1.80	Peak
7440.000	37.92	54.00	-16.08	29.93	7.99	Average	7440.000	37.84	54.00	-16.16	29.85	7.99	Average
7440.000	50.32	74.00	-23.68	42.33	7.99	Peak	7440.000	50.91	74.00	-23.09	42.92	7.99	Peak

Above 1G (1 GHz-26.5 GHz): The worst mode: BLE-1Mbps High CH

Note1: Transmit mode

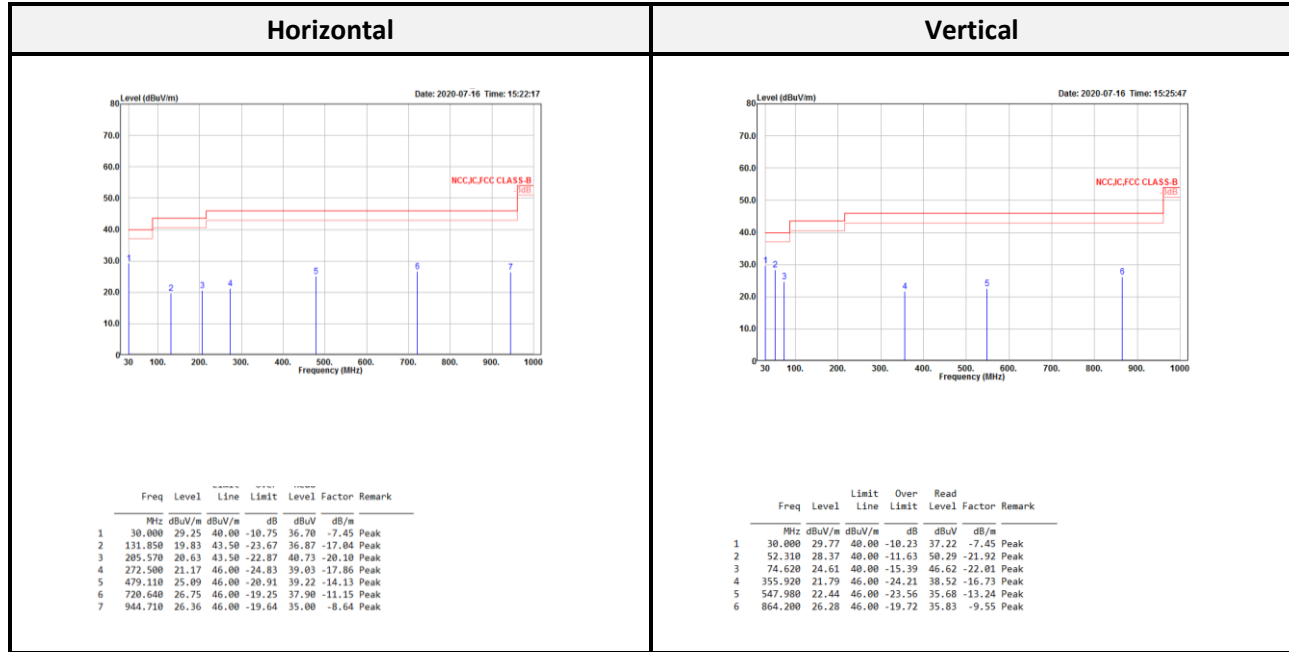
Note2:

Level = Read Level + Factor

Over Limit = Level – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

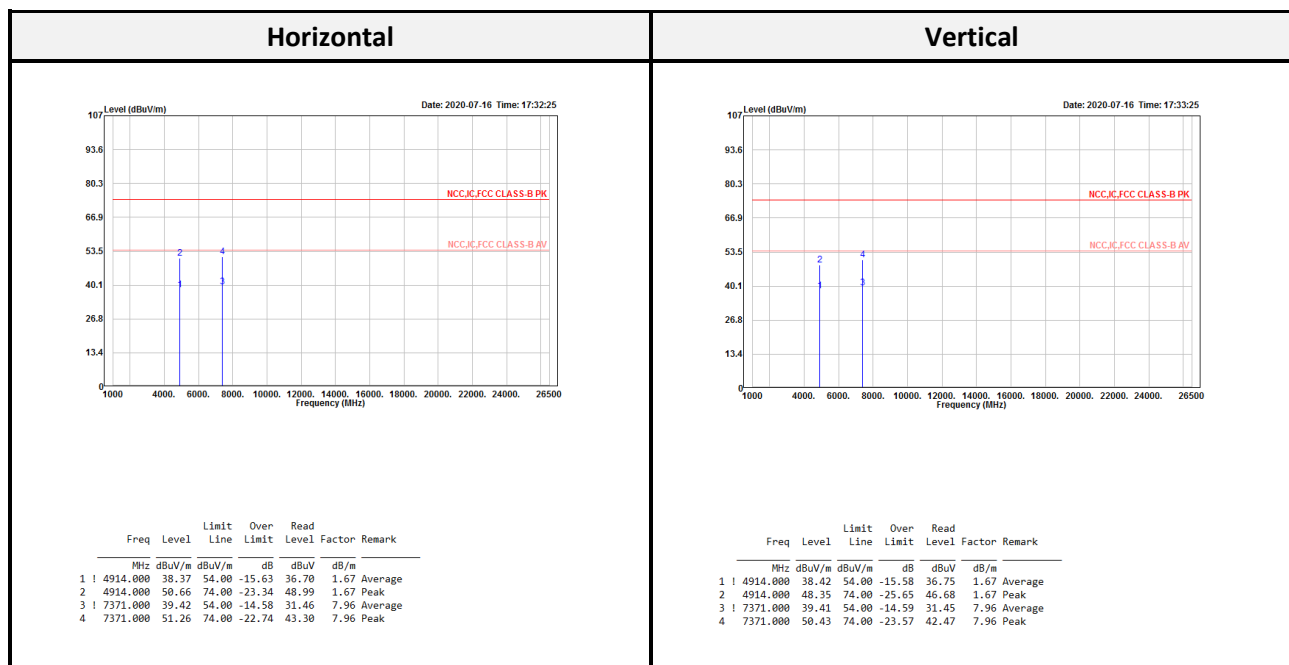
Spurious emissions more than 20 dB below the limit were not reported

For ANT+:**Transmitting mode** (Pre-scan with three orthogonal axis, and worse case as X axis)**Below 1G (30 MHz-1 GHz) test the worst power mode***Note1: Transmit mode**Note2:**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)

Horizontal							Vertical						
Freq	Level	Limit	Over	Read		Remark	Freq	Level	Limit	Over	Read		Remark
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
2385.757	36.18	54.00	-17.82	42.27	-6.09	Average	2382.951	34.81	54.00	-19.19	40.92	-6.11	Average
2385.757	48.50	74.00	-25.50	54.59	-6.09	Peak	2382.951	47.76	74.00	-26.24	53.87	-6.11	Peak
2457.655	93.74			99.28	-5.54	Average	2457.655	82.38			87.92	-5.54	Average
2457.655	95.14			100.68	-5.54	Peak	2457.655	83.66			89.20	-5.54	Peak
2537.270	42.27	54.00	-11.73	47.51	-5.24	Average	2515.174	35.75	54.00	-18.25	41.10	-5.35	Average
2537.270	50.81	74.00	-23.19	56.05	-5.24	Peak	2515.174	48.99	74.00	-25.01	54.34	-5.35	Peak
4914.000	38.37	54.00	-15.63	36.70	1.67	Average	4914.000	38.42	54.00	-15.58	36.75	1.67	Average
4914.000	50.66	74.00	-23.34	48.99	1.67	Peak	4914.000	48.35	74.00	-25.65	46.68	1.67	Peak
7371.000	39.42	54.00	-14.58	31.46	7.96	Average	7371.000	39.41	54.00	-14.59	31.45	7.96	Average
7371.000	51.26	74.00	-22.74	43.30	7.96	Peak	7371.000	50.43	74.00	-23.57	42.47	7.96	Peak

Above 1G (1 GHz-26.5 GHz): The worst mode: ANT+ 2457 MHz.



Note1: Transmit mode

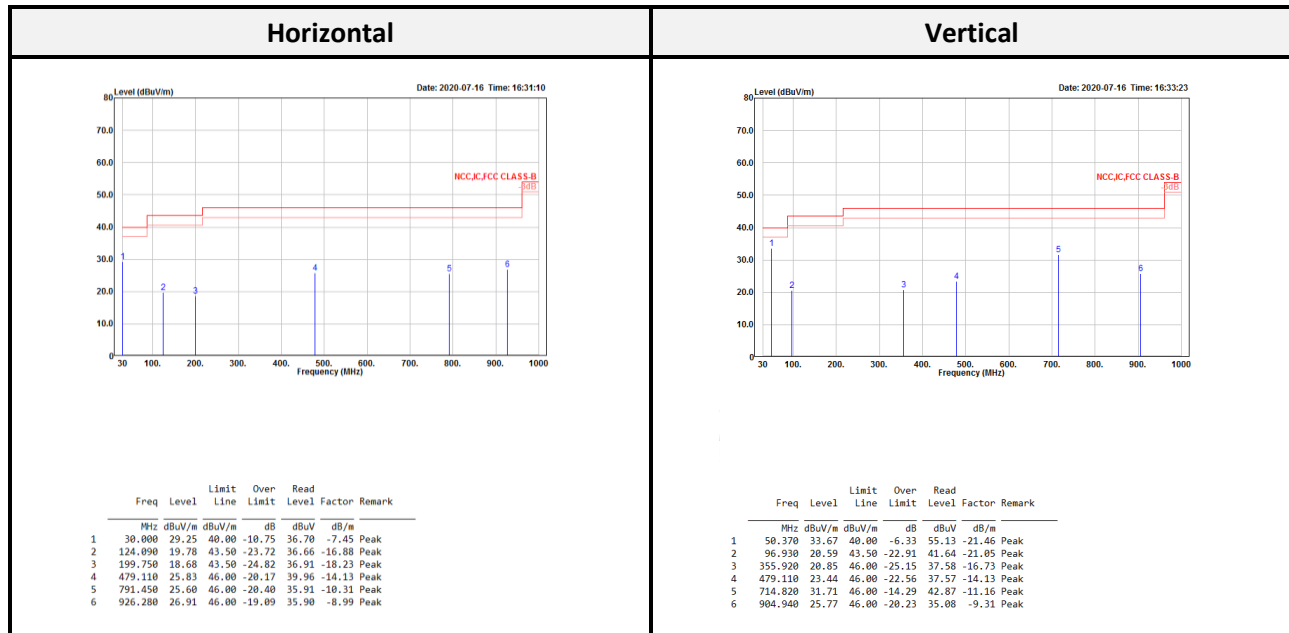
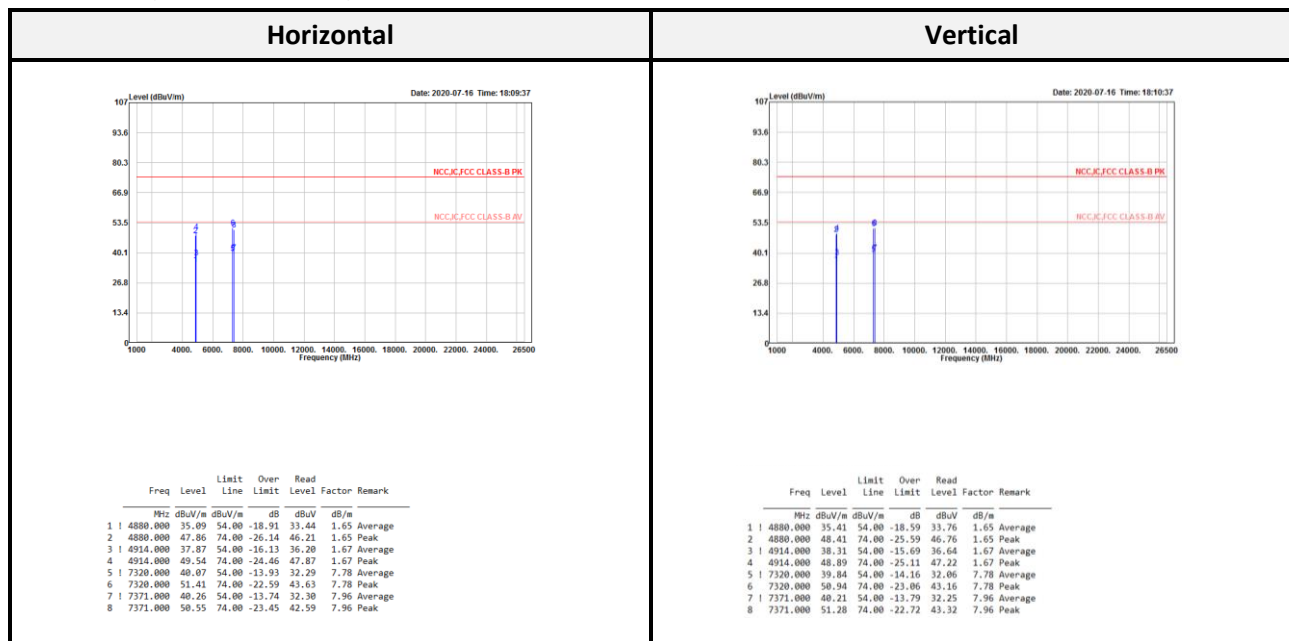
Note2:

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

For Co-location:**Transmitting mode** (Pre-scan with three orthogonal axis, and worse case as X axis)**Below 1G (30 MHz-1 GHz):****Above 1G (1 GHz-26.5 GHz):**

Note1: Transmit mode

Note2:

Level = Read Level + Factor;

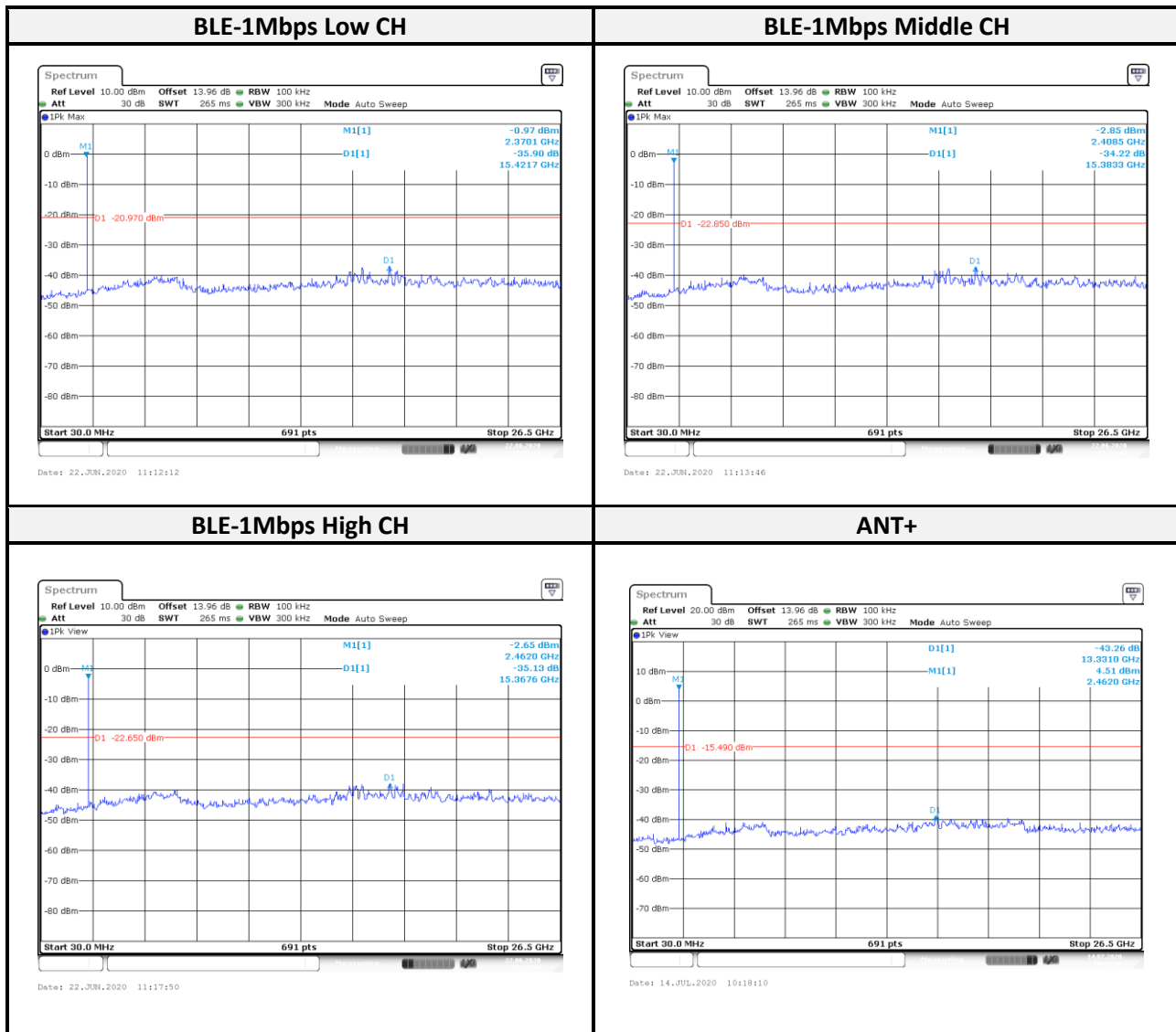
Over Limit = Level – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

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

6.5 Conducted Spurious Emission Test Result

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE-1Mbps	Low	2402	35.90	≥ 20	PASS
	Mid	2440	34.22	≥ 20	PASS
	High	2480	35.13	≥ 20	PASS
ANT+	-	2457	43.26	≥ 20	PASS



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

7.1 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.

7.2 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 $\geq [3 \times \text{RBW}]$. (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.

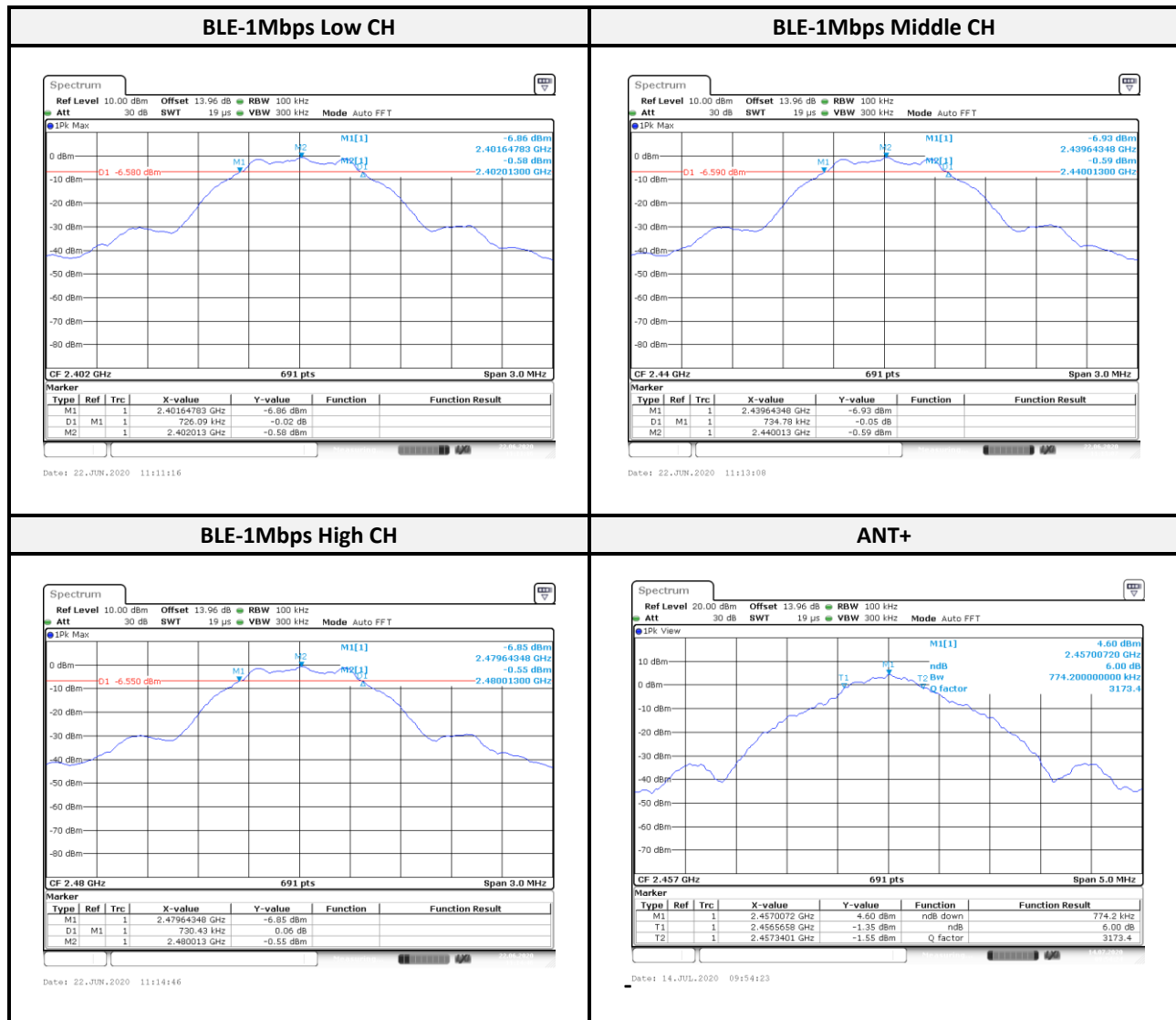
7.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
RF Cable	MTJ	MT40S	MT40S-001	Each Use	/

***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 Results

Configuration	Channel	Frequency (MHz)	6 dB BW (MHz)	6dB Limit (MHz)	Result
BLE-1Mbps	Low	2402	0.73	> 0.5	PASS
	Mid	2440	0.73		PASS
	High	2480	0.73		PASS
ANT+	-	2457	0.77	> 0.5	PASS



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

8.1 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.

8.2 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.

8.3 Test Equipment List and Details

Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
RF Cable	MTJ	MT40S	MT40S-001	Each Use	/
USB Wideband Power Sensor	Agilent	U2021XA	MY56120026	2019/09/06	2020/09/05

***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 Results

Configuration	Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (dBm)
BLE-1Mbps	Low	2402	0.52	0.001	30
	Mid	2440	0.68	0.001	
	High	2480	0.62	0.001	
ANT+	-	2457	4.65	0.003	30

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

9.1 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)).

9.2 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.

9.3 Test Equipment List and Details

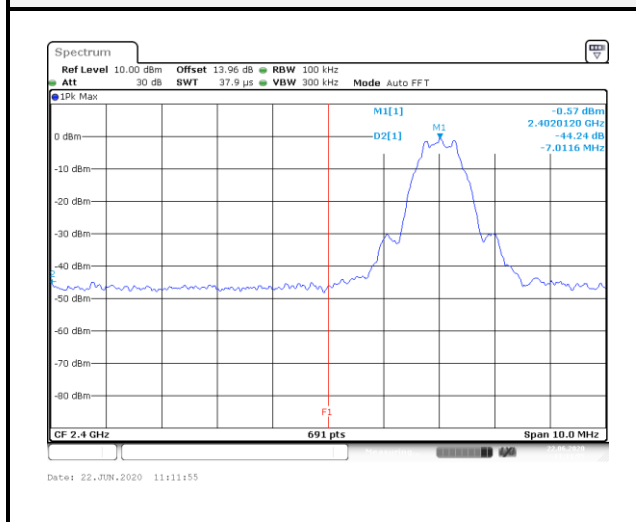
Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
RF Cable	MTJ	MT40S	MT40S-001	Each Use	/

***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).

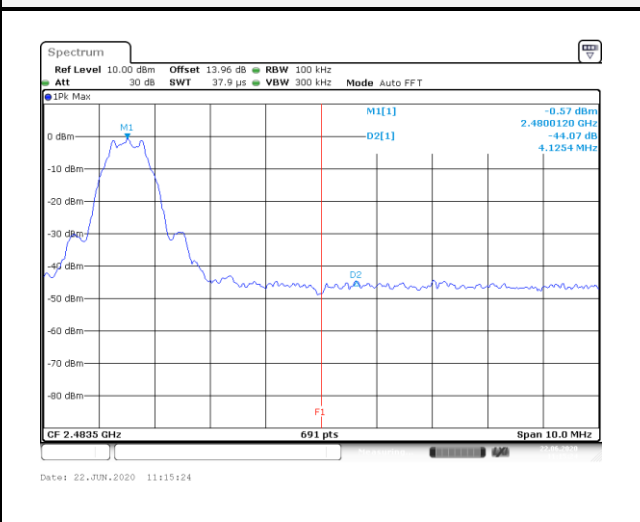
9.4 Test Results

Configuration	Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
BLE-1Mbps	Low	2402	44.24	≥ 20	PASS
	High	2480	44.07	≥ 20	PASS
ANT+	Low	2457	50.08	≥ 20	PASS
	High	2457	49.94	≥ 20	PASS

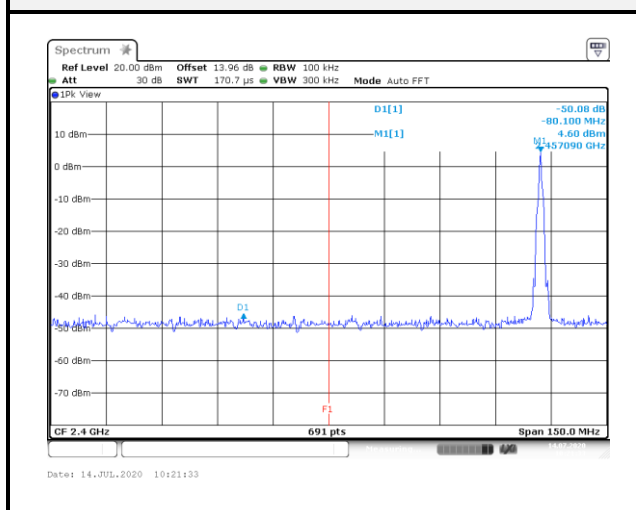
BLE-1Mbps Left Side



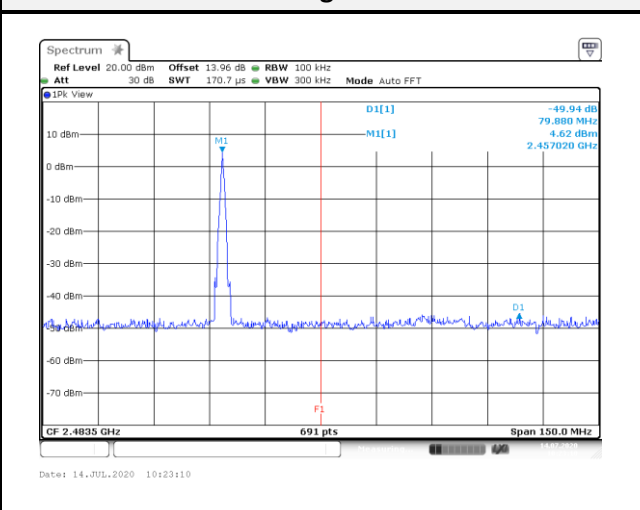
BLE-1Mbps Right Side



ANT+ Left Side



ANT+ Right Side



10 FCC §15.247(e) – Power Spectral Density

10.1 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.

10.2 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.

10.3 Test Equipment List and Details

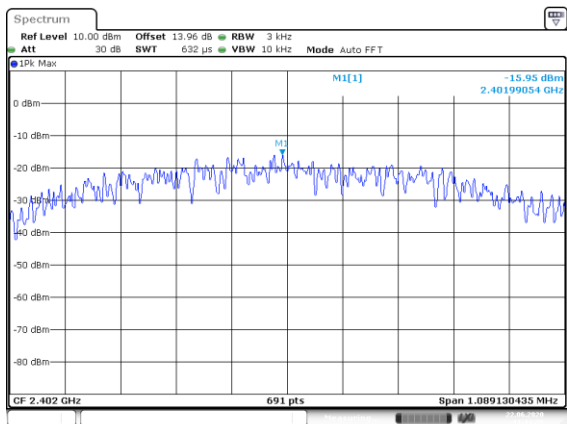
Description	Manufacture	Model	Serial No.	Cal. Date.	Cal. Due.
Conducted Room(TH-02)					
Signal Analyzer 40GHZ	Rohde & Schwarz	FSV40-N	102248	2019/09/11	2020/09/10
RF Cable	MTJ	MT40S	MT40S-001	Each Use	/

***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 Results

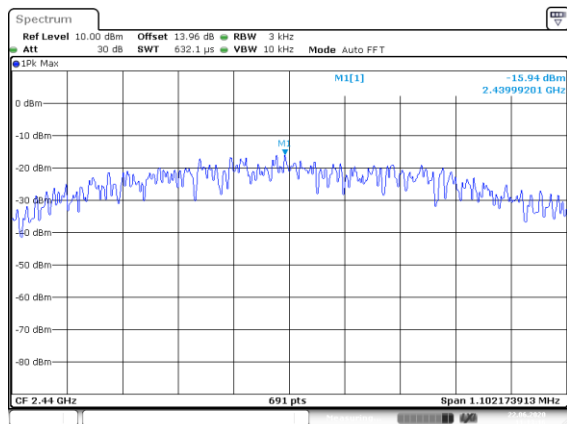
Configuration	Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Result
BLE-1Mbps	Low	2402	-15.95	8.00	PASS
	Mid	2440	-15.94		PASS
	High	2480	-15.96		PASS
ANT+	-	2457	4.54	8.00	PASS

BLE-1Mbps Low CH



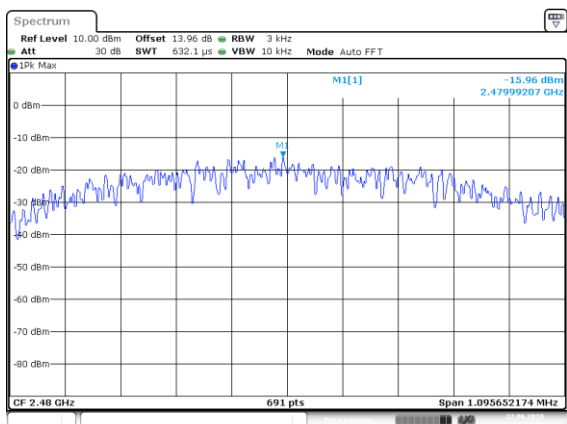
Date: 22.JUN.2020 11:11:25

BLE-1Mbps Middle CH



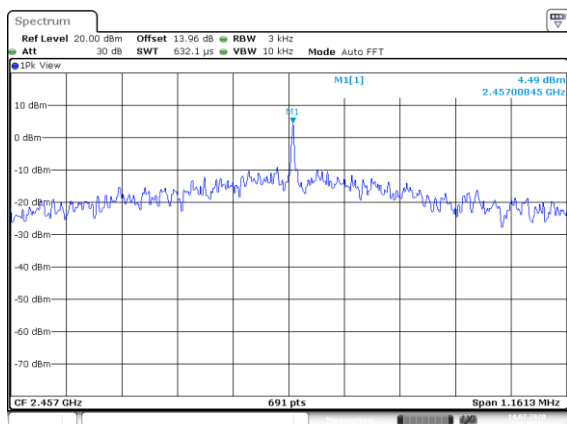
Date: 22.JUN.2020 11:13:16

BLE-1Mbps High CH



Date: 22.JUN.2020 11:14:55

ANT+



Date: 14.JUL.2020 10:16:37

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