TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.247

TEST REPORT

For

Hangzhou Roombanker Technology Co., Ltd.

A#801 Wantong center, Hangzhou, China

FCC ID: 2AUXBDSGW-020

Report Type:	Product Type:
Original Report	Dual band Wi-Fi Smart Gateway

Project Engineer:	CK Huang
Report Number:	RSHD201119001-00B
Report Date:	2021-01-25
Reviewed By:	Oscar Ye EMC Manager
Prepared By:	Bay Area Compliant Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Hangzhou Roombanker Technology Co., Ltd.
Tested Model	DSGW-020
Series Model	DSGW-020-1, DSGW-020-2, DSGW-020-3, DSGW-020-4, DSGW-020-5
Model Difference	See declaration letter
Product Type	Dual band Wi-Fi Smart Gateway
Power Supply:	DC 5V from Adapter and DC 48V from PoE
RF Function:	Zigbee
Operating Band/Frequency:	2405~2480 MHz
Channel Number:	16
Channel Separation:	5 MHz
Modulation Type	OQPSK
Antenna Type:	FPC Antenna
Maximum Antenna Gain:	0 dBi

Adapter information:
Model: A8A-050200U-US1
Input: AC 100-240V, 50/60Hz, 0.35A
Output: DC 5V, 2A

Note: The Maximum Antenna Gain was declared by the manufacturer.

**All measurement and test data in this report was gathered from production sample serial number: RSHD201119001-1. (Assigned by the BACL. The EUT supplied by the applicant was received on 2020-11-19)*

Objective

This report is prepared on behalf of *Hangzhou Roombanker Technology Co., Ltd.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine Compliant with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS for Wi-Fi & BLE Submittal with FCC ID: 2AUXBDSGW-020
FCC Part 15.407 NII Submittal with FCC ID: 2AUXBDSGW-020

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliant Testing of Unlicensed Wireless Devices and FCC 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliant Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The Test site used by Bay Area Compliant Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliant Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01), the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel list for Zigbee mode:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	…	…
…	…	…	…
…	…	…	…
…	…	25	2475
18	2440	26	2480

EUT was tested with Channel 11, 18 and 26.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

RF test tool: secureCRT

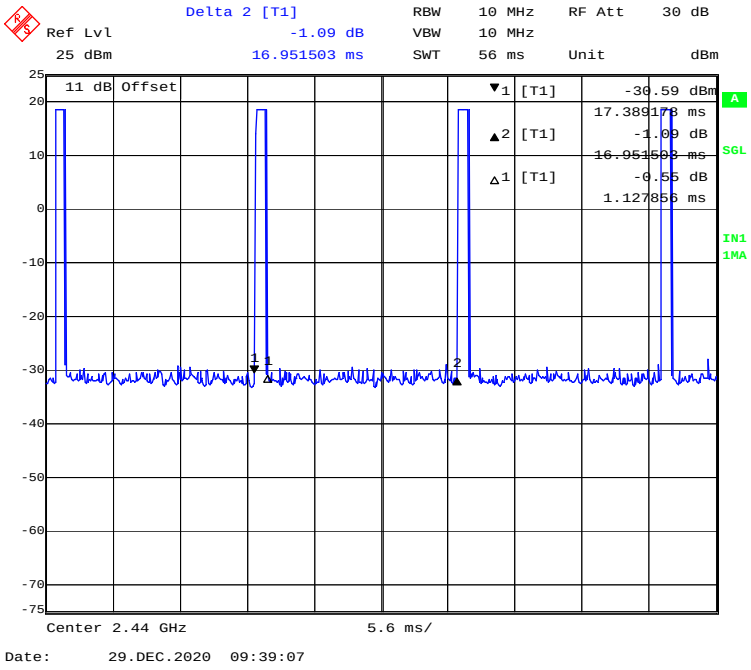
Power Level Setting:

Channel	Power Level Setting
Low	20
Middle	20
High	18

Note: The power level setting was declared by the applicant.

Duty Cycle:

Middle Channel



Mode	Duty Cycle (%)	T(ms)	1/T(kHz)	10log(1/x)
Zigbee	6.65	1.128	0.89	11.77

Note: "x" means the Duty Cycle.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
TP-LINK	Router	TL-WDR5620	1188431022424
DELL	Notebook	GX620	D65874152
DELL	Adapter 1	LA65NS0-00	DF263
NETGEAR	PoE	GS308P	4F217B5000891
NETGEAR	Adapter 2	2ABF060R	332-10771-01

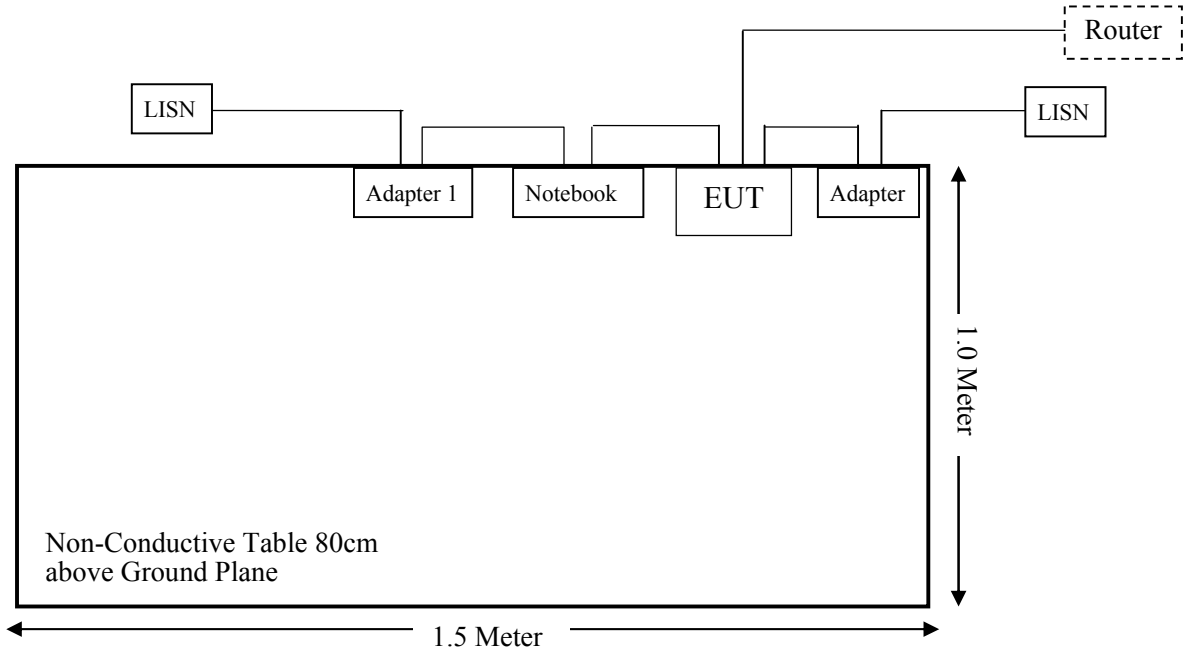
External I/O Cable

Cable Description	Length (m)	From Port	To
Power Cable 1	1.0	EUT	Adapter
Power Cable 2	1.0	Adapter	LISN/AC source
RJ45 Cable 1	3.0	EUT	Router
RJ45 Cable 2	3.0	EUT	Notebook
Power Cable 3	1.0	Notebook	Adapter 1
Power Cable 4	1.0	Adapter 1	LISN/AC source
RJ45 Cable 3	3.0	EUT	PoE
Power Cable 5	1.0	PoE	Adapter 2
Power Cable 6	1.0	Adapter 2	LISN/AC source

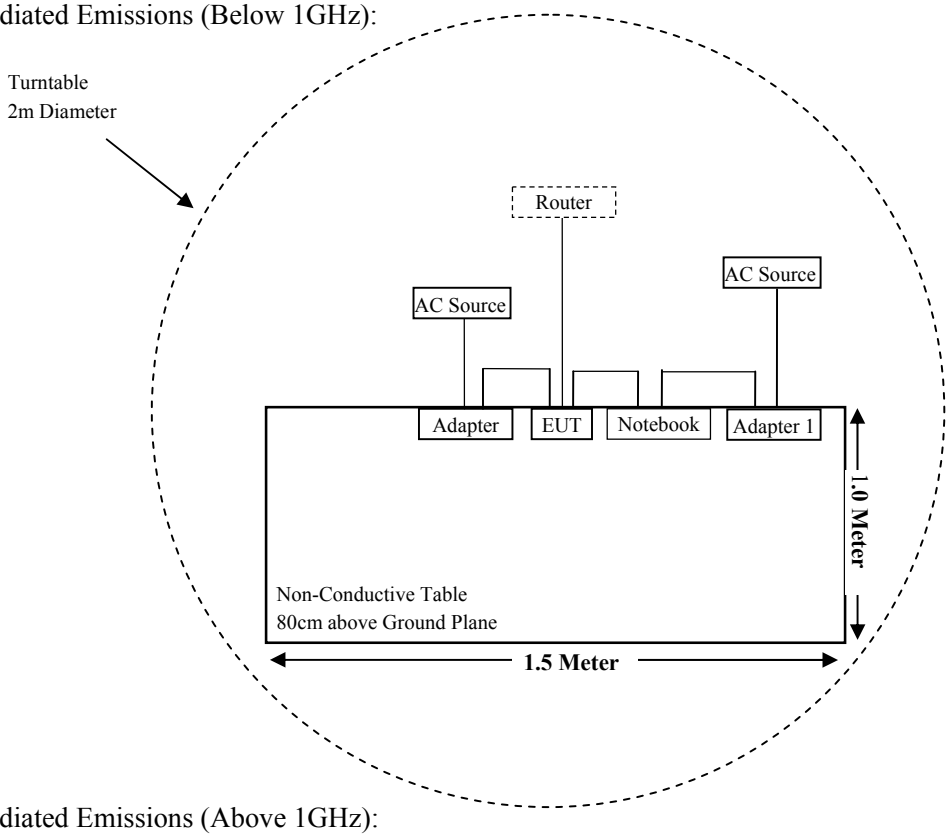
Block Diagram of Test Setup

For adapter power supply:

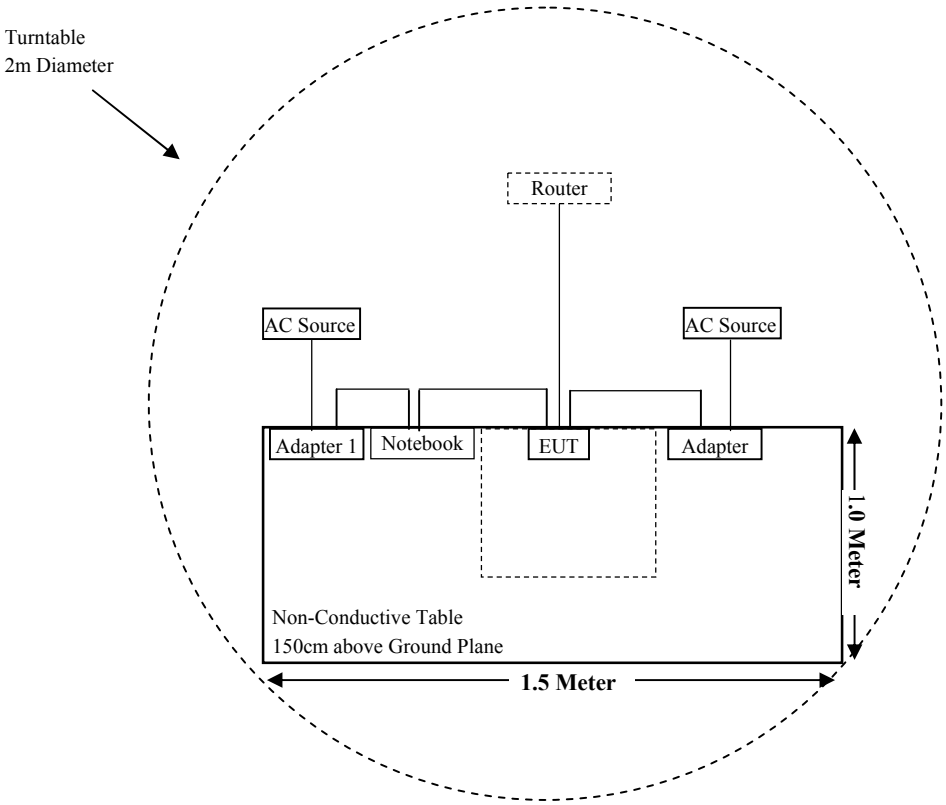
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):

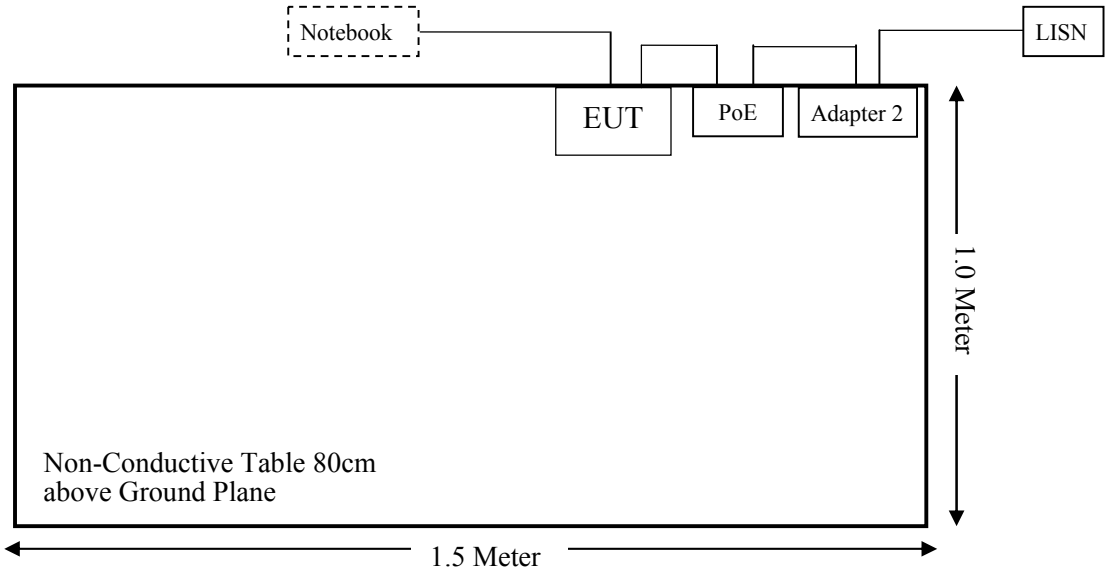


For Radiated Emissions (Above 1GHz):

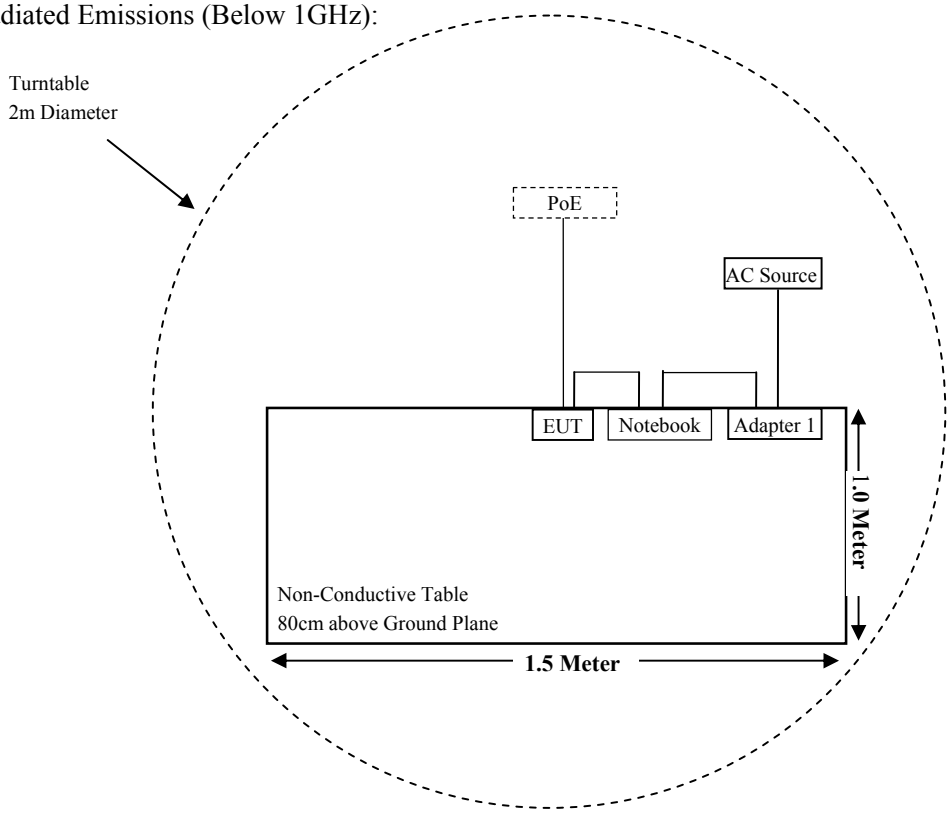


For PoE power supply:

For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2020-11-27	2021-11-26
Sunol Sciences	Hybrid Antenna	JB3	A090314-2	2020-01-07	2023-01-06
Sonoma Instrument	Pre-amplifier	310N	171205	2020-08-14	2021-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2020-08-15	2021-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207/040	2020-04-01	2021-03-31
ETS-LINDGREN	Horn Antenna	3115	9311-4159	2020-07-15	2023-07-14
ETS-LINDGREN	Horn Antenna	3116	2516	2020-01-17	2023-01-16
A.H.Systems,inc	Amplifier	PAM-0118P	512	2020-08-14	2021-08-13
EM Electronics Corporation	Amplifier	EM18G40G	060726	2020-03-22	2021-03-21
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2020-08-05	2021-08-04
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-4	004	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-5	005	2020-08-15	2021-08-14
RF Conducted Test					
Rohde & Schwarz	EMI Test Receiver	ESIB26	100146	2020-11-27	2021-11-26
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048/027	2020-11-27	2021-11-26
Narda	Attenuator	10dB	010	2020-08-15	2021-08-14
Roombanker	RF Cable	Roombanker 01	C01	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2020-07-28	2021-07-27
Rohde & Schwarz	LISN	ENV216	101115	2020-11-27	2021-11-26
COM-POWER	LISN	LI-3P-132	20200002	2020-11-27	2021-11-26
Audix	Test Software	e3	V9	/	/
Rohde & Schwarz	Pulse limiter	ESH3-Z2	100552	2020-08-10	2021-08-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2020-08-15	2021-08-14

*** Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §2.1091 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;

Calculated Formulary:

Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
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:

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

Calculated Data (worst case):

2.4G Wi-Fi&BLE&Zigbee&5G Wi-Fi:

Mode	Frequency (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
2.4G Wi-Fi 802.11b	2412~2462	2.0	1.58	21.50	141.25	20	0.0444	1.0
2.4G Wi-Fi 802.11g		2.0	1.58	21.00	125.89	20	0.0396	1.0
2.4G Wi-Fi 802.11n-HT20		2.0	1.58	24.50	281.84	20	0.0886	1.0
2.4G Wi-Fi 802.11n-HT40	2422~2452	2.0	1.58	25.00	316.23	20	**0.0994**	**1.0**
BLE(1Mbps)	2402~2480	0	1.00	8.50	7.08	20	**0.0014**	**1.0**
BLE(2Mbps)	2402~2480	0	1.00	8.50	7.08	20	0.0014	1.0
Zigbee	2405~2480	0	1.00	19.50	89.13	20	**0.0177**	**1.0**
5G Wi-Fi 802.11a	5150~5250	2.0	1.58	16.00	39.81	20	0.0125	1.0
	5725~5850	2.0	1.58	14.00	25.12	20	0.0079	1.0
5G Wi-Fi 802.11ac20	5150~5250	2.0	1.58	15.50	35.48	20	0.0112	1.0
	5725~5850	2.0	1.58	16.50	44.67	20	**0.0140**	**1.0**
5G Wi-Fi 802.11n20	5150~5250	2.0	1.58	15.50	35.48	20	0.0112	1.0
	5725~5850	2.0	1.58	16.50	44.67	20	0.0140	1.0
5G Wi-Fi 802.11ac40	5150~5250	2.0	1.58	16.00	39.81	20	0.0125	1.0
	5725~5850	2.0	1.58	15.00	31.62	20	0.0099	1.0
5G Wi-Fi 802.11n40	5150~5250	2.0	1.58	15.50	35.48	20	0.0112	1.0
	5725~5850	2.0	1.58	14.50	28.18	20	0.0089	1.0
5G Wi-Fi 802.11ac80	5150~5250	2.0	1.58	15.50	35.48	20	0.0112	1.0
	5725~5850	2.0	1.58	14.50	28.18	20	0.0089	1.0

GSM:

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
GSM 850	824.2-848.8	4	2.51	27.50	562.34	20	**0.2810**	**0.55**
GSM 1900	1850.2-1909.8	4	2.51	26.50	446.68	20	0.2232	1.00

Note:
GPRS 850: Tune-up maximum output power with 1 slot is 32.50 dBm, 2 slots is 32.50 dBm, 3 slots is 31.50 dBm, 4 slots is 30.50 dBm, so the tune-up time based Ave. power compared to sloted Ave. power is 27.50dBm.
EGPRS 850: Tune-up maximum output power with 1 slot is 27.00 dBm, 2 slots is 27.00 dBm, 3 slots is 26.50 dBm, 4 slots is 26.50 dBm so the tune-up time based Ave. power compared to sloted Ave. power is 23.50 dBm.
GPRS 1900: Tune-up maximum output power with 1 slot is 30.00 dBm, 2 slots is 30.00 dBm, 3 slots is 30.00 dBm, 4 slots is 29.50 dBm so the tune-up time based Ave. power compared to sloted Ave. power is 26.50 dBm.
EGPRS 1900: Tune-up maximum output power with 1 slot is 26.50 dBm, 2 slots is 26.00 dBm, 3 slots is 26.00 dBm, 4 slots is 26.00 dBm so the tune-up time based Ave. power compared to sloted Ave. power is 23.00 dBm.

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.26 dB	-3 dB

LTE CAT-M1:

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
LTE Band 2	1850.7~1909.3	4	2.51	24	251.19	20	0.1255	1.00
LTE Band 4	1710.7~1754.3	4	2.51	23	199.53	20	0.0997	1.00
LTE Band 5	824.7~848.3	4	2.51	24	251.19	20	0.1255	0.55
LTE Band 12	699.7~715.3	4	2.51	24	251.19	20	0.1255	0.47
LTE Band 13	779.5~784.5	4	2.51	24	251.19	20	0.1255	0.52
LTE Band 26	814.7~848.3	4	2.51	24	251.19	20	0.1255	0.54

LTE NB-IOT:

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
LTE Band 2	1850.7~1909.3	4	2.51	25	316.23	20	0.1579	1.00
LTE Band 4	1710.7~1754.3	4	2.51	25	316.23	20	0.1579	1.00
LTE Band 5	824.7~848.3	4	2.51	25	316.23	20	0.1579	0.55
LTE Band 12	699.7~715.3	4	2.51	25	316.23	20	0.1579	0.47
LTE Band 13	779.5~784.5	4	2.51	25	316.23	20	0.1579	0.52

Note:
1. For the above tune up power were declared by the manufacturer.
2. For 802.11b, 802.11g, 802.11a, the tune-up power is base on SISO mode
   For 802.11ac20/n20/n40/ac40/ac80, the tune-up power is base on MIMO mode
3. The LTE module FCC ID: XMR201707BG96 (Grant:09/08/2020).
4. 2.4G Wi-Fi & BLE & Zigbee & 5G Wi-Fi & GSM850 can transmit simultaneously; the worst condition as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0994/1.00+0.0014/1.00+0.0177/1.00+0.0140/1.00+0.2810/0.55=0.6434 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.

FCC §15.203 - ANTENNA REQUIREMENT

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. The structure and application of the EUT were analyzed to determine Compliant with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
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 exceeds 6 dBi.

Antenna Connector Construction

The EUT has an FPC antenna for Zigbee and the antenna gain is 0 dBi, which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

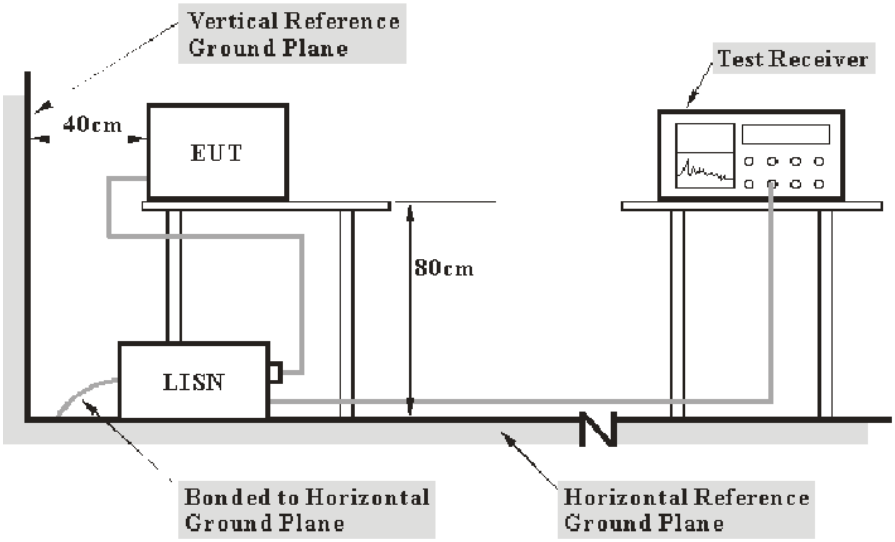
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

Factor & Over Limit Calculation

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

Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

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

Over Limit (dB) = Read level (dBμV) + Factor (dB) - Limit (dBμV)

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

Environmental Conditions

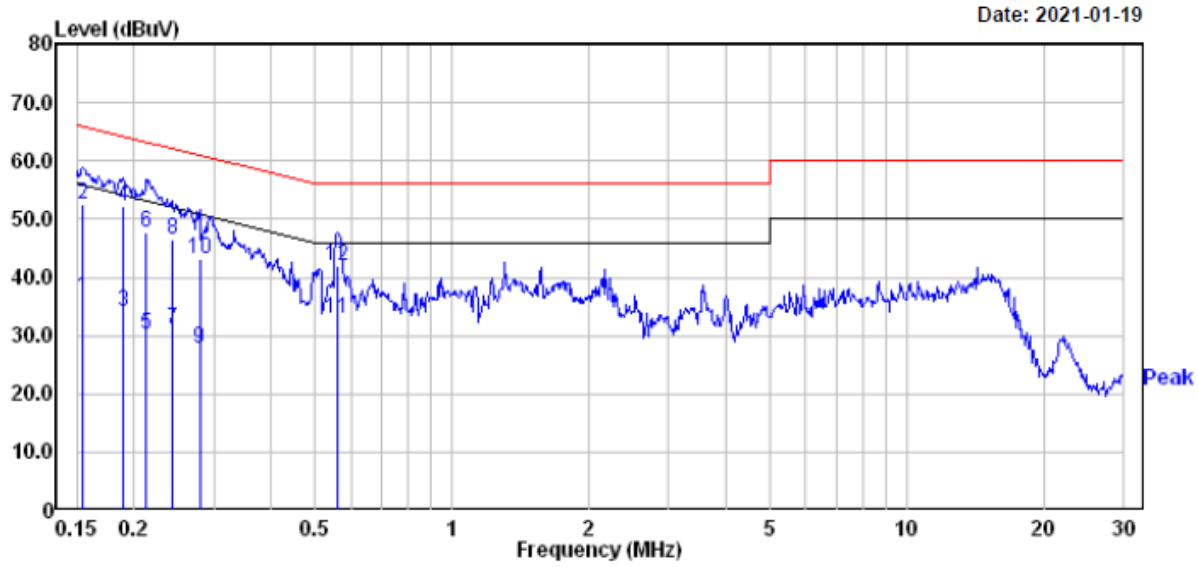
Temperature:	24.3 ℃
Relative Humidity:	50 %
ATM Pressure:	102.3 kPa

The testing was performed by CK Huang on 2021-01-19.

EUT operation mode: Transmitting in low channel (worst case)

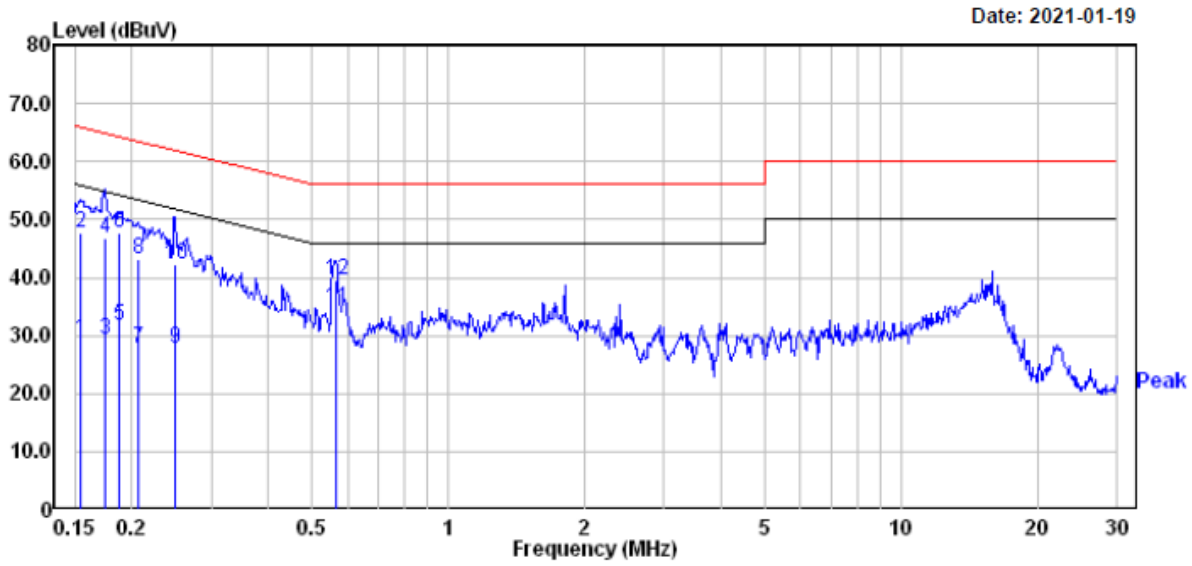
For adapter power supply

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.154	16.70	19.82	36.52	55.78	-19.26	Average
2	0.154	32.70	19.82	52.52	65.78	-13.26	QP
3	0.189	14.20	19.82	34.02	54.06	-20.04	Average
4	0.189	32.40	19.82	52.22	64.06	-11.84	QP
5	0.213	10.50	19.82	30.32	53.10	-22.78	Average
6	0.213	27.90	19.82	47.72	63.10	-15.38	QP
7	0.243	11.20	19.82	31.02	52.00	-20.98	Average
8	0.243	26.60	19.82	46.42	62.00	-15.58	QP
9	0.279	8.00	19.82	27.82	50.85	-23.03	Average
10	0.279	23.20	19.82	43.02	60.85	-17.83	QP
11	0.558	13.10	19.75	32.85	46.00	-13.15	Average
12	0.558	22.20	19.75	41.95	56.00	-14.05	QP

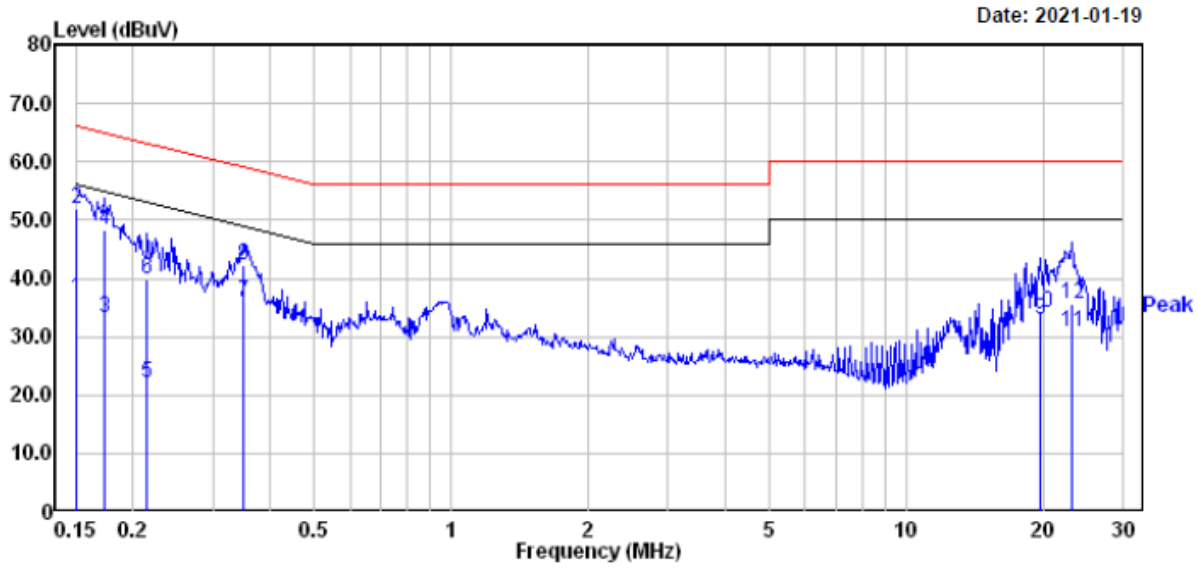
AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.154	9.50	19.82	29.32	55.78	-26.46	Average
2	0.154	27.90	19.82	47.72	65.78	-18.06	QP
3	0.174	9.50	19.83	29.33	54.77	-25.44	Average
4	0.174	26.90	19.83	46.73	64.77	-18.04	QP
5	0.187	12.01	19.82	31.83	54.15	-22.32	Average
6	0.187	28.01	19.82	47.83	64.15	-16.32	QP
7	0.206	8.10	19.82	27.92	53.36	-25.44	Average
8	0.206	23.50	19.82	43.32	63.36	-20.04	QP
9	0.249	8.00	19.82	27.82	51.78	-23.96	Average
10	0.249	22.30	19.82	42.12	61.78	-19.66	QP
11	0.567	15.10	19.75	34.85	46.00	-11.15	Average
12	0.567	19.70	19.75	39.45	56.00	-16.55	QP

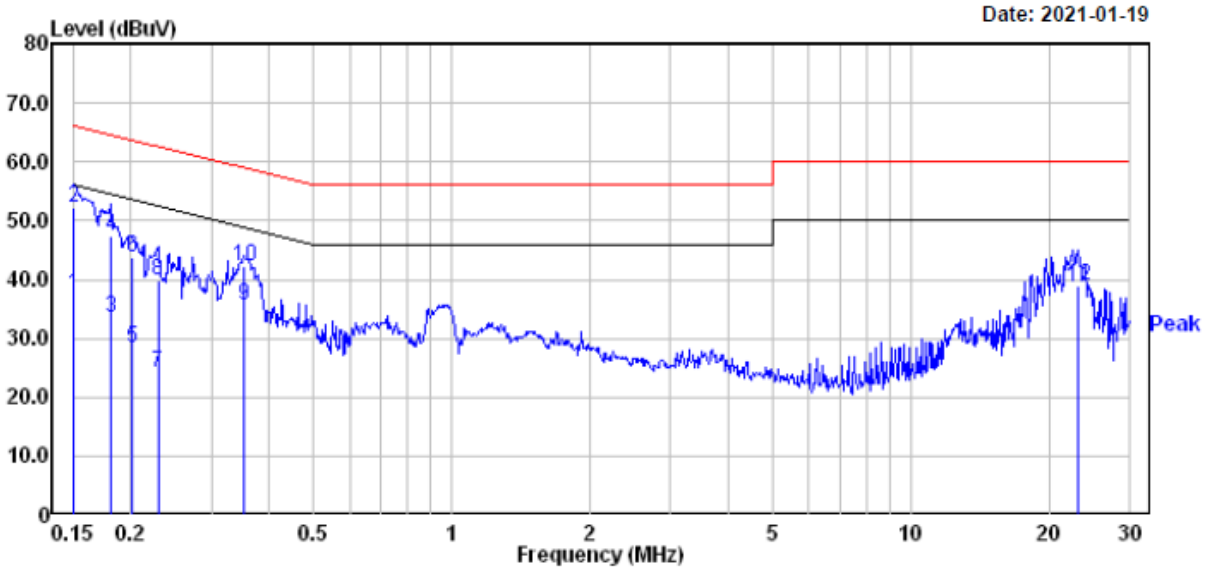
For PoE power supply

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.150	16.70	19.82	36.52	56.00	-19.48	Average
2	0.150	32.20	19.82	52.02	66.00	-13.98	QP
3	0.173	13.40	19.83	33.23	54.81	-21.58	Average
4	0.173	28.60	19.83	48.43	64.81	-16.38	QP
5	0.215	2.10	19.82	21.92	53.01	-31.09	Average
6	0.215	20.10	19.82	39.92	63.01	-23.09	QP
7	0.350	16.10	19.81	35.91	48.96	-13.05	Average
8	0.350	22.50	19.81	42.31	58.96	-16.65	QP
9	19.740	12.90	19.94	32.84	50.00	-17.16	Average
10	19.740	14.10	19.94	34.04	60.00	-25.96	QP
11	23.140	10.89	19.79	30.68	50.00	-19.32	Average
12	23.140	15.89	19.79	35.68	60.00	-24.32	QP

AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.150	17.60	19.82	37.42	56.00	-18.58	Average
2	0.150	32.30	19.82	52.12	66.00	-13.88	QP
3	0.181	13.60	19.83	33.43	54.46	-21.03	Average
4	0.181	27.50	19.83	47.33	64.46	-17.13	QP
5	0.202	8.50	19.82	28.32	53.54	-25.22	Average
6	0.202	23.90	19.82	43.72	63.54	-19.82	QP
7	0.229	4.30	19.82	24.12	52.48	-28.36	Average
8	0.229	20.00	19.82	39.82	62.48	-22.66	QP
9	0.354	15.80	19.80	35.60	48.87	-13.27	Average
10	0.354	22.40	19.80	42.20	58.87	-16.67	QP
11	23.140	18.99	19.79	38.78	50.00	-11.22	Average
12	23.140	19.29	19.79	39.08	60.00	-20.92	QP

Note:

1) Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
2) Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

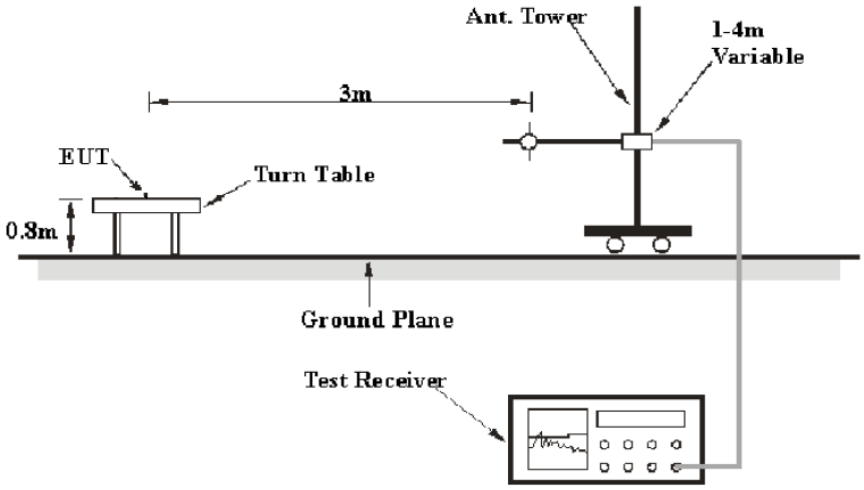
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

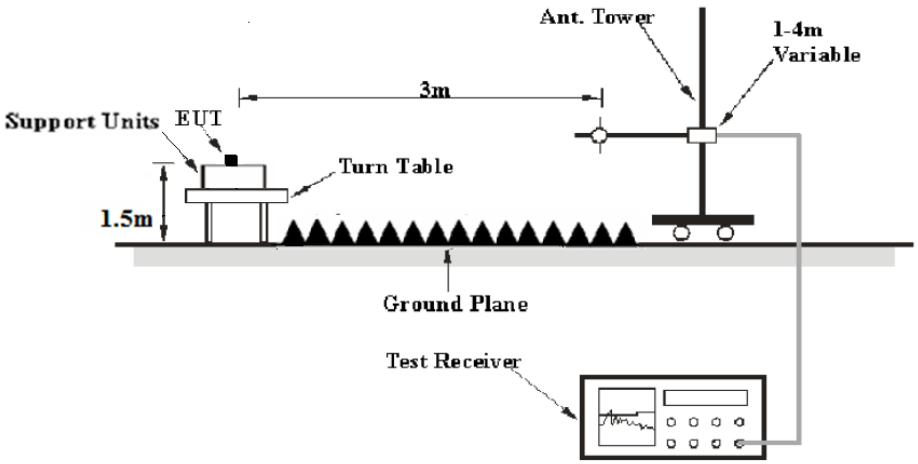
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



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

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver setup was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	AVG

Test Procedure

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

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude (dBμV/m) = Meter Reading (dBμV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB)

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

Margin (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/m)

Test Results Summary

According to the recorded data in following table, the EUT is compliant with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

Temperature:	21.1~22.3 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101.1~101.3 kPa

The testing was performed by CK Huang from 2020-12-05 to 2020-12-29.

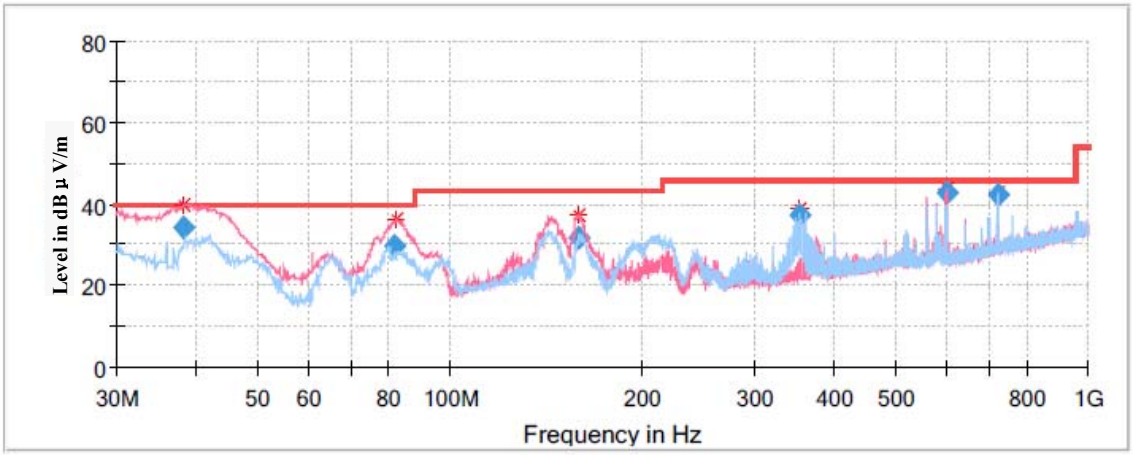
EUT operation mode: Transmitting

Spurious Emission Test:

30MHz-1GHz

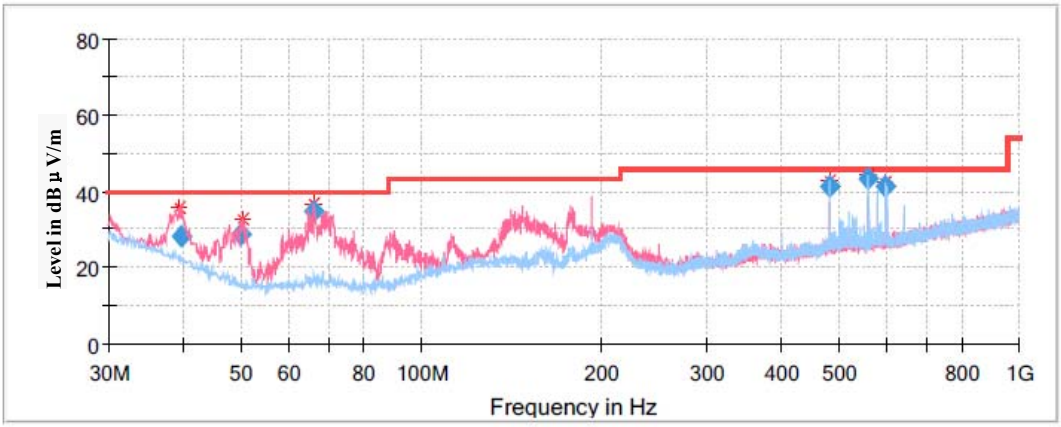
*(Pre-scan with Low channel, Middle channel, High channel of operation in the X,Y and Z axes of orientation, the worst case **low channel of operation in Z-axis of orientation** was recorded)*

For adapter power supply



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
38.147350	34.04	100.0	V	11.0	-9.3	40.00	5.96
81.863250	29.90	100.0	V	101.0	-17.0	40.00	10.10
158.715450	31.50	100.0	V	108.0	-11.9	43.50	12.00
353.993200	37.36	100.0	H	180.0	-9.1	46.00	8.64
599.973700	42.53	100.0	V	289.0	-5.0	46.00	3.47
720.008250	42.40	100.0	H	192.0	-2.0	46.00	3.60

For PoE power supply

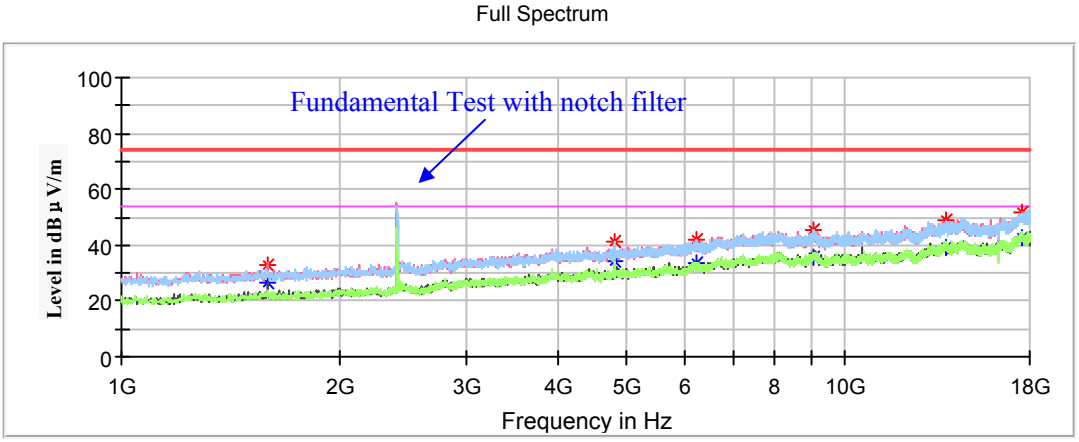


Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
39.568450	28.37	100.0	V	124.0	-10.3	40.00	11.63
49.812900	28.83	100.0	V	0.0	-17.1	40.00	11.17
66.282850	34.57	100.0	V	0.0	-16.5	40.00	5.43
479.989050	41.08	200.0	H	49.0	-6.0	46.00	4.92
559.990050	43.23	200.0	H	134.0	-5.1	46.00	2.77
597.477900	41.39	200.0	H	8.0	-5.0	46.00	4.61

1GHz-18GHz – adapter power supply (worst case)
*(Pre-scan in the X,Y and Z axes of orientation, the worst case **Z-axis of orientation** was recorded.)*

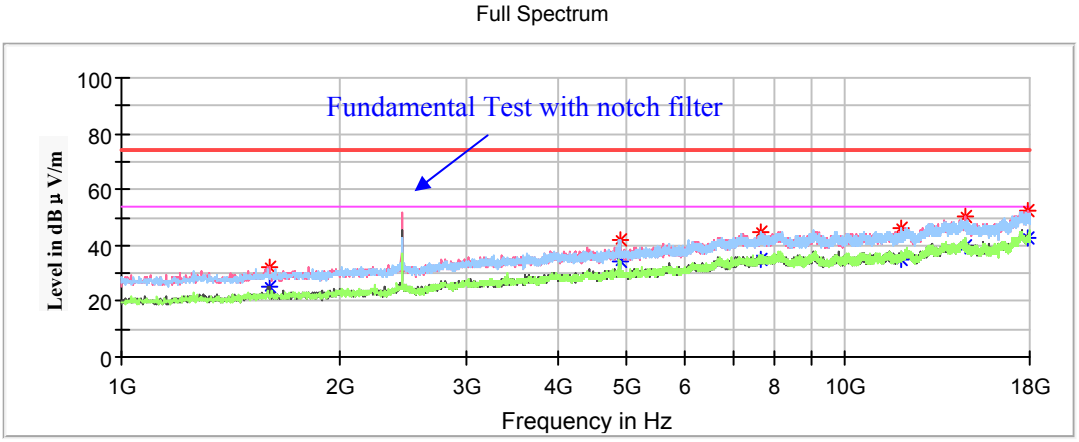
Note:
1. This test was performed with the 2.4 - 2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) - Amplifier Factor (dB)
   Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/m)

2405MHz



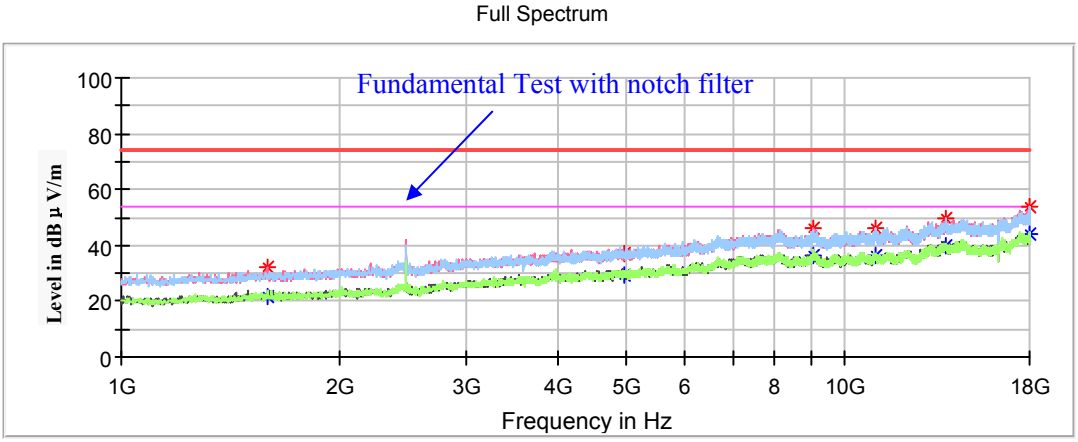
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
1591.600000	---	26.56	150.0	V	229.0	-16.0	54.00	27.44
1591.600000	32.92	---	150.0	V	229.0	-16.0	74.00	41.08
4810.000000	---	34.31	150.0	H	251.0	-5.6	54.00	19.69
4810.000000	41.32	---	150.0	H	251.0	-5.6	74.00	32.68
6227.500000	---	33.54	150.0	H	91.0	-2.2	54.00	20.46
6227.500000	42.29	---	150.0	H	91.0	-2.2	74.00	31.71
9032.500000	---	35.91	200.0	H	0.0	1.9	54.00	18.09
9032.500000	45.38	---	200.0	H	0.0	1.9	74.00	28.62
13744.900000	---	39.22	200.0	V	135.0	5.9	54.00	14.78
13744.900000	48.76	---	200.0	V	135.0	5.9	74.00	25.24
17529.100000	---	42.52	200.0	H	36.0	8.9	54.00	11.48
17529.100000	52.02	---	200.0	H	36.0	8.9	74.00	21.98

2440MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1601.800000	32.11	---	150.0	V	323.0	-16.0	74.00	41.89
1601.800000	---	25.11	150.0	V	323.0	-16.0	54.00	28.89
4880.000000	42.02	---	150.0	H	197.0	-5.4	74.00	31.98
4880.000000	---	34.00	150.0	H	197.0	-5.4	54.00	20.00
7655.500000	---	34.95	150.0	V	5.0	1.3	54.00	19.05
7655.500000	44.56	---	150.0	V	5.0	1.3	74.00	29.44
11975.200000	---	35.21	150.0	H	171.0	3.8	54.00	18.79
11975.200000	46.09	---	150.0	H	171.0	3.8	74.00	27.91
14656.100000	---	40.09	200.0	H	70.0	6.1	54.00	13.91
14656.100000	50.26	---	200.0	H	70.0	6.1	74.00	23.74
17935.400000	---	42.97	150.0	V	152.0	8.8	54.00	11.03
17935.400000	52.32	---	150.0	V	152.0	8.8	74.00	21.68

High Channel: 2480MHz

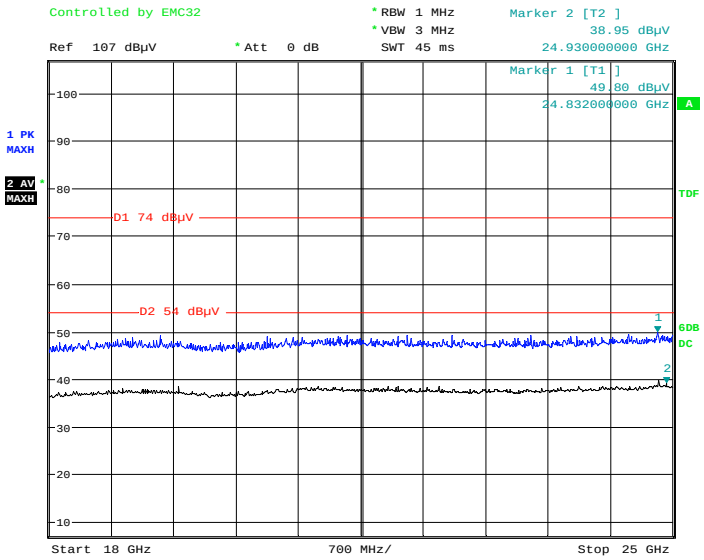


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1588.200000	31.88	---	150.0	V	242.0	-16.0	74.00	42.12
1588.200000	---	21.40	150.0	V	242.0	-16.0	54.00	32.60
4960.000000	37.38	---	150.0	H	131.0	-5.3	74.00	36.62
4960.000000	---	29.10	150.0	H	131.0	-5.3	54.00	24.90
9051.200000	46.40	---	200.0	V	351.0	1.9	74.00	27.60
9051.200000	---	36.08	200.0	V	351.0	1.9	54.00	17.92
11024.900000	---	36.23	200.0	H	160.0	2.9	54.00	17.77
11024.900000	45.81	---	200.0	H	160.0	2.9	74.00	28.19
13797.600000	---	39.77	150.0	V	62.0	6.0	54.00	14.23
13797.600000	49.32	---	150.0	V	62.0	6.0	74.00	24.68
17988.100000	---	44.19	200.0	H	358.0	8.8	54.00	9.81
17988.100000	54.08	---	200.0	H	358.0	8.8	74.00	19.92

18GHz-25GHz – adapter power supply (worst case)

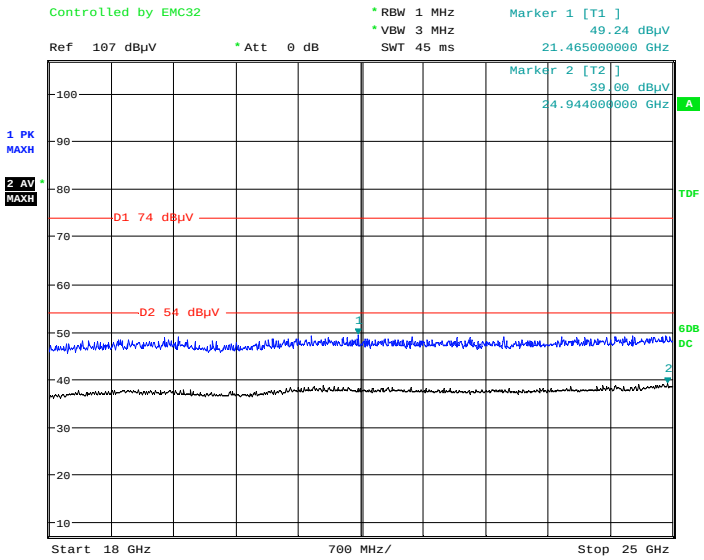
*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **low channel of operation in Z-axis of orientation** was recorded)*

Horizontal



Date: 5.DEC.2020 13:41:48

Vertical



Date: 5.DEC.2020 13:43:48

Restricted Bands Emissions Test:

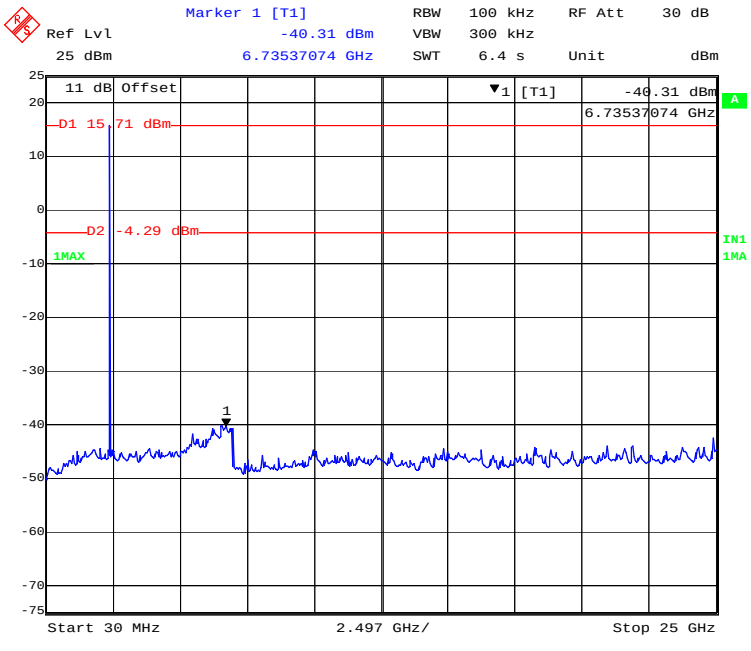
*(Pre-scan in the X, Y and Z axes of orientation, the worst case **Z-axis of orientation** was recorded.)*

Note:
1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) - Amplifier Factor (dB)
   Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/m)

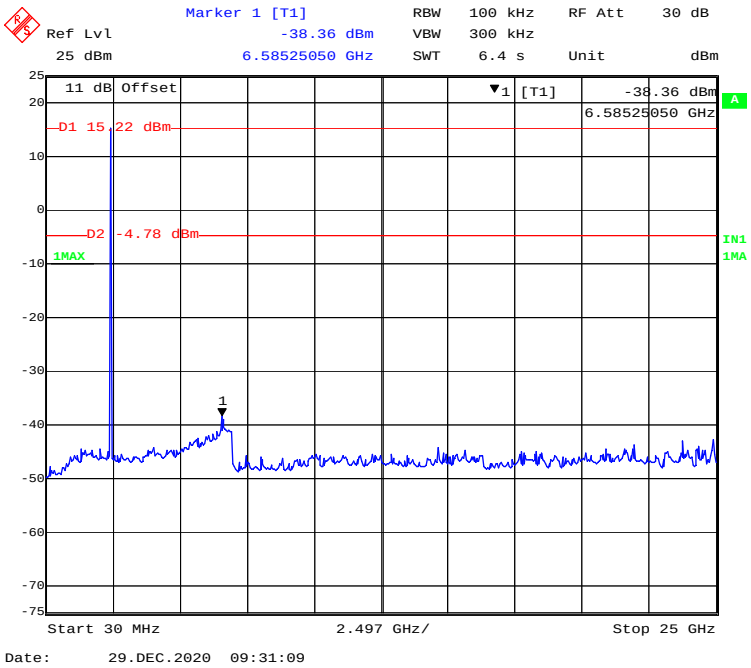
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV/m)	Average (dBμV/m)	Height (cm)	Polar (H/V)				
2405MHz								
2390.00	46.32	---	150.0	H	358.0	-2.9	74.00	27.68
2390.00	---	41.56	150.0	H	358.0	-2.9	54.00	12.44
2480MHz								
2483.50	55.46	---	200.0	H	242.0	-2.5	74.00	18.54
2483.50	---	50.60	200.0	H	242.0	-2.5	54.00	3.40

Conducted Spurious Emissions at Antenna Port

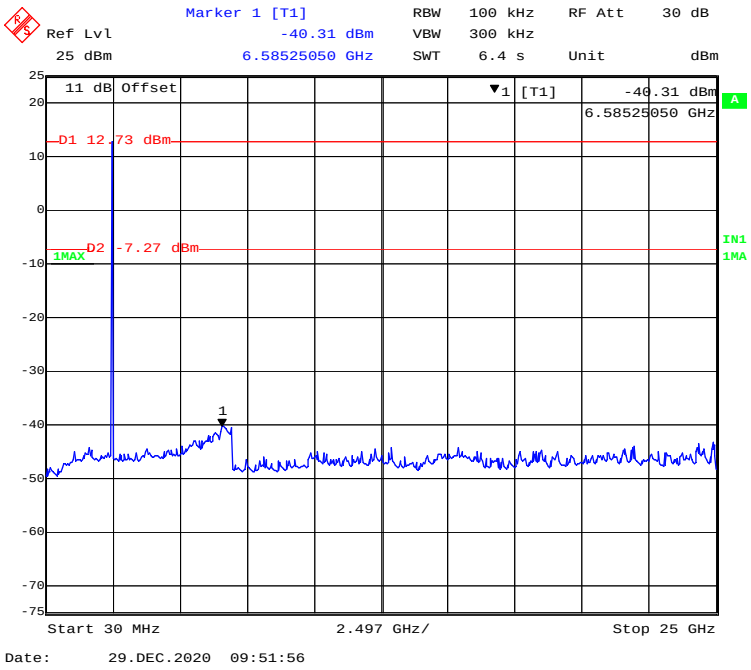
2405MHz



2440MHz



2480MHz


Marker 1 [T1]
Ref Lvl
25 dBm
-40.31 dBm
6.58525050 GHz
RBW 100 kHz
VBW 300 kHz
SWT 6.4 s
RF Att 30 dB
Unit dBm
11 dB Offset
1 [T1]
-40.31 dBm
6.58525050 GHz
D1 12.73 dBm
D2 -7.27 dBm
1MAX
A
IN1
1MA
Start 30 MHz
2.497 GHz/
Stop 25 GHz
Date: 29.DEC.2020 09:51:56

FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

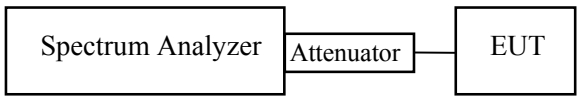
Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013 sub-clause 11.8.1

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x 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.



Test Data

Environmental Conditions

Temperature:	22.3-23.5 ℃
Relative Humidity:	48-51 %
ATM Pressure:	101.3-101.5 kPa

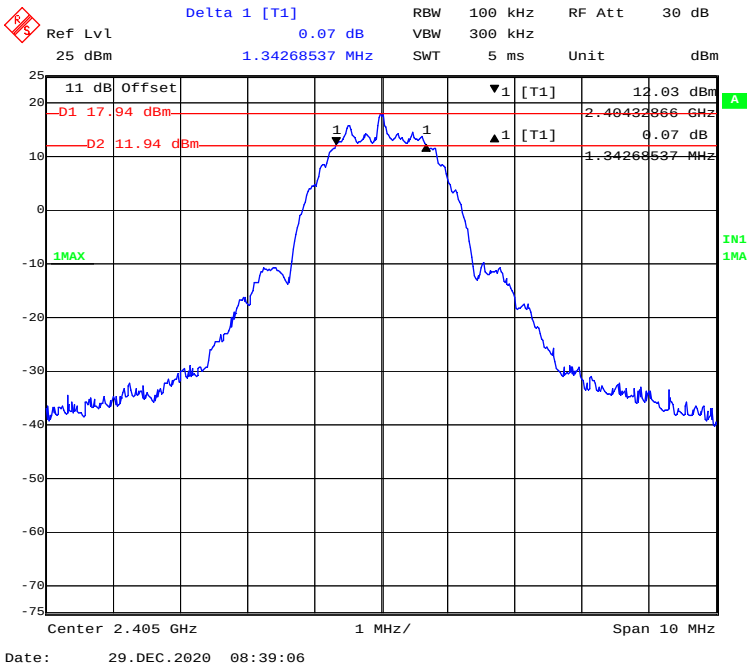
The testing was performed by CK Huang from 2020-12-29 to 2021-01-25.

Test Result: Compliant.

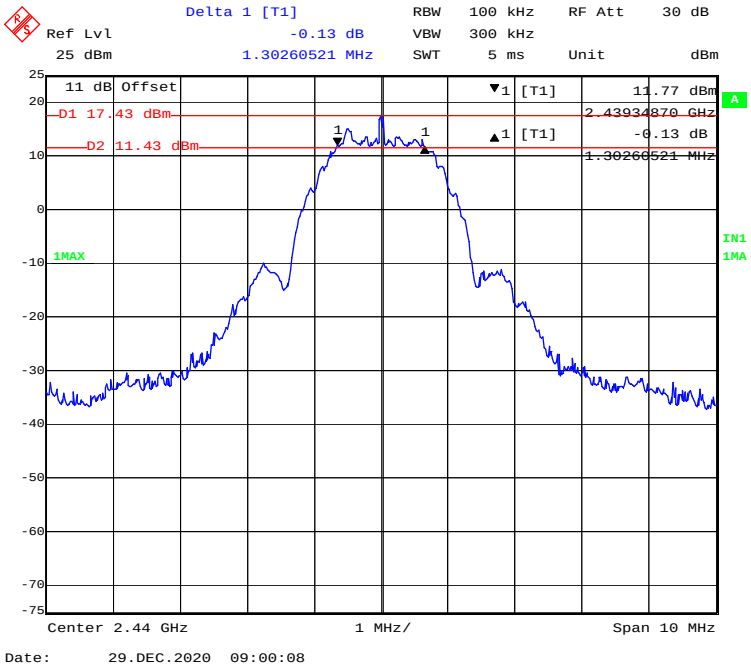
EUT operation mode: Transmitting

Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
2405	1.343	≥0.5
2440	1.303	≥0.5
2480	1.303	≥0.5

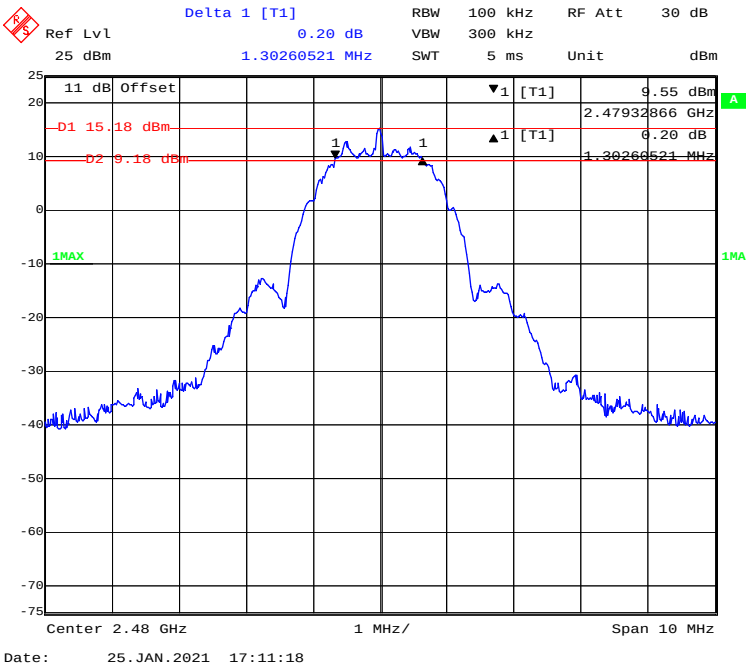
2405MHz



2440MHz



2480MHz


Delta 1 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
0.20 dB
VBW 300 kHz
25 dBm
1.30260521 MHz
SWT 5 ms
Unit dBm
11 dB Offset
▼1 [T1]
9.55 dBm
2.47932866 GHz
D1 15.18 dBm
▲1 [T1]
0.20 dB
D2 9.18 dBm
1.30260521 MHz
1MAX
1MA
Center 2.48 GHz
1 MHz/
Span 10 MHz
Date: 25.JAN.2021 17:11:18

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

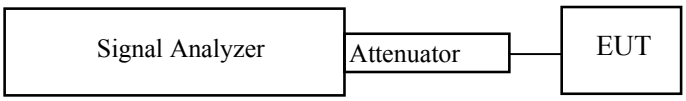
Applicable Standard

According to FCC §15.247(b) (3), for 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, Compliant 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.

Test Procedure

According to ANSI C63.10-2013 sub-clause 11.9.1.3

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ 3 x RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.



Test Data

Environmental Conditions

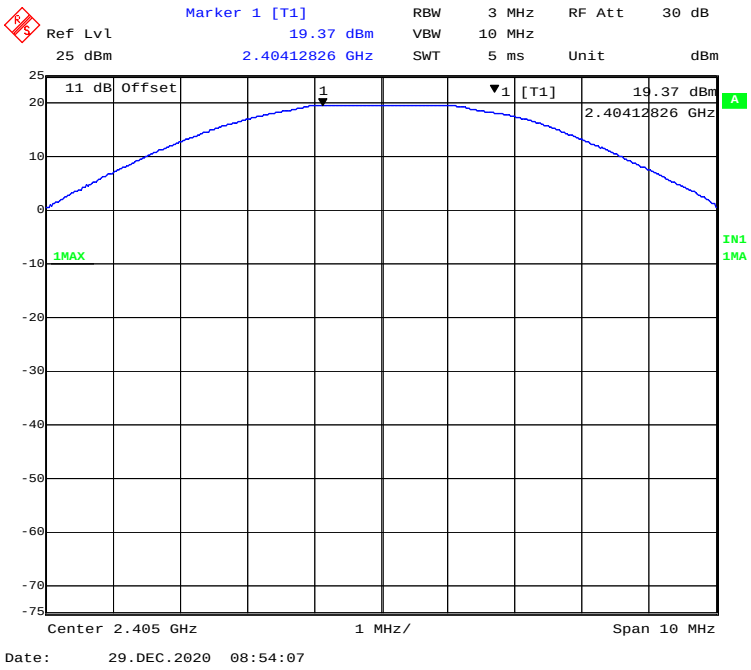
Temperature:	22.8 ℃
Relative Humidity:	54 %
ATM Pressure:	101.2 kPa

The testing was performed by CK Huang on 2020-12-29.

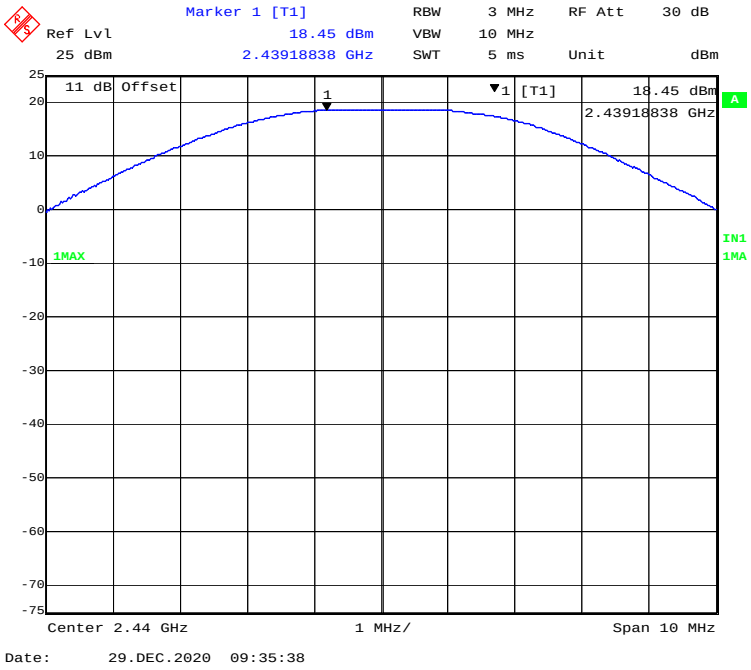
EUT operation mode: Transmitting

Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
2405	19.37	30	Pass
2440	18.45	30	Pass
2480	16.18	30	Pass

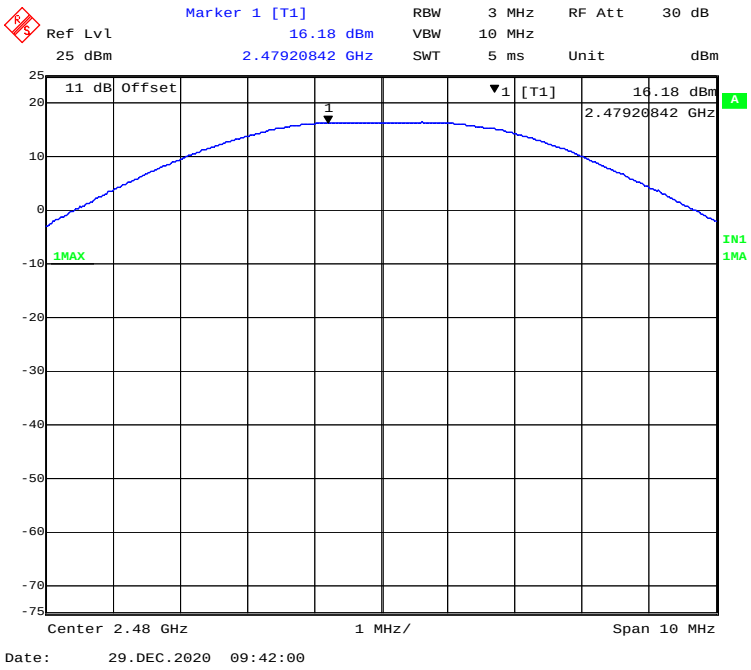
2405MHz



2440MHz



2480MHz


Marker 1 [T1]
Ref Lvl
16.18 dBm
25 dBm
2.47920842 GHz
RBW 3 MHz
VBW 10 MHz
SWT 5 ms
RF Att 30 dB
Unit dBm
11 dB Offset
1 [T1]
16.18 dBm
2.47920842 GHz
A
IN1
1MA
1MAX
25
20
10
0
-10
-20
-30
-40
-50
-60
-70
-75
Center 2.48 GHz
1 MHz/
Span 10 MHz
Date: 29.DEC.2020 09:42:00

FCC §15.247(d) – BAND EDGE

Applicable Standard

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 Compliant 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)).

Test Procedure

According to ANSI C63.10-2013 sub-clause 6.10.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

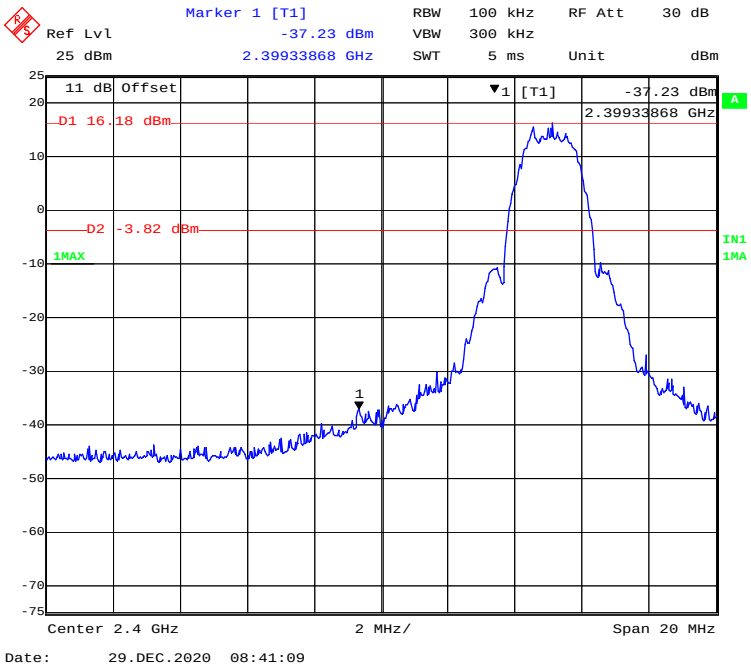
Temperature:	22.3 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by CK Huang on 2020-12-29.

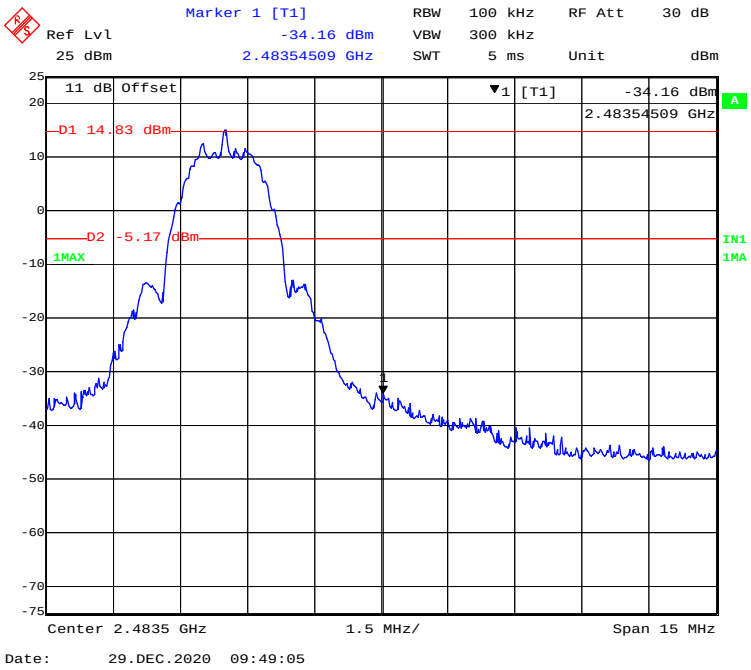
EUT operation mode: Transmitting

Test Result: Compliant.

Left Side



Right Side



FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013 sub-clause 11.10.2

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate Compliant.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
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 limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	22.3-23.5 ℃
Relative Humidity:	48-51 %
ATM Pressure:	101.3-101.5 kPa

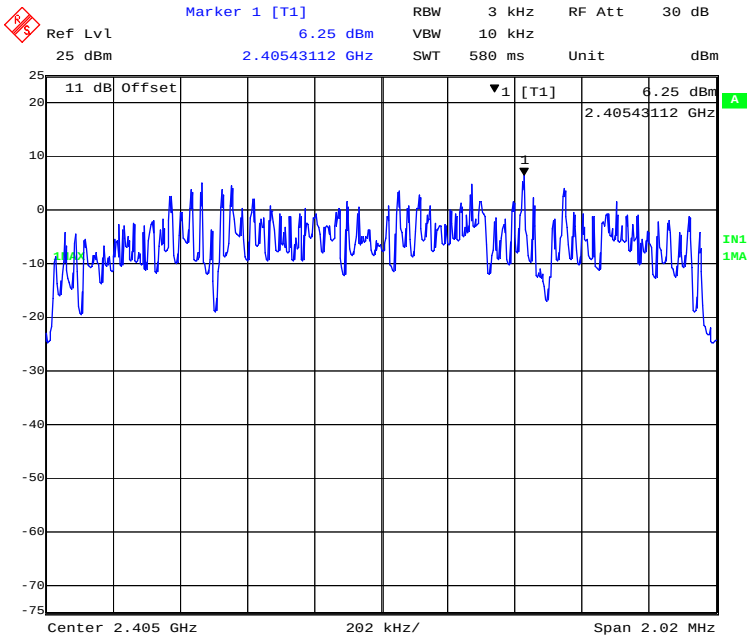
The testing was performed by CK Huang from 2020-12-29 to 2021-01-25.

EUT operation mode: Transmitting

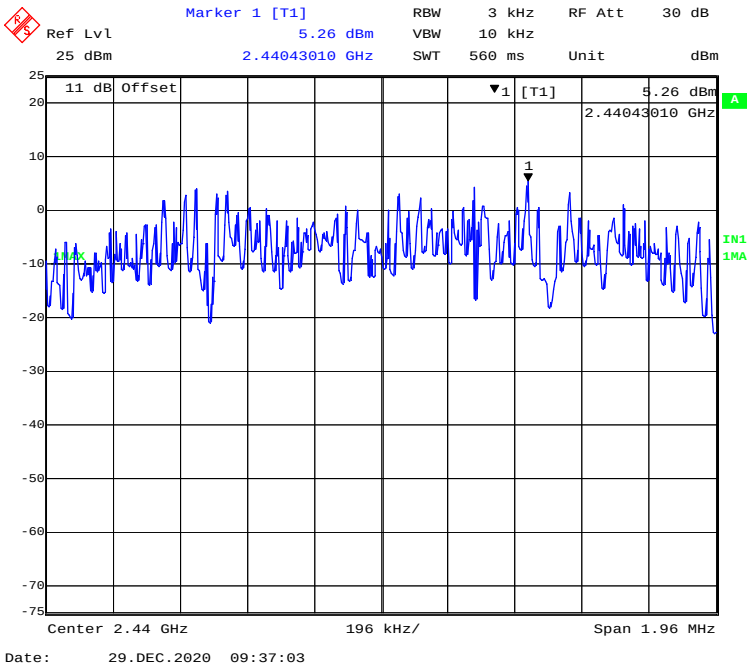
Test Result: Compliant.

Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
2405	6.25	≤8
2440	5.26	≤8
2480	3.23	≤8

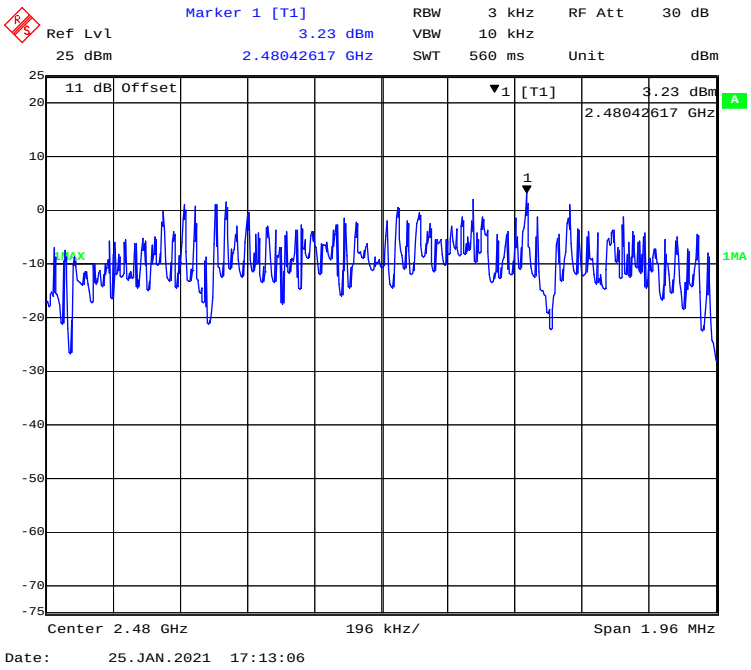
2405MHz



2440MHz



2480MHz


Marker 1 [T1]
RBW 3 kHz
RF Att 30 dB
Ref Lvl
3.23 dBm
VBW 10 kHz
25 dBm
2.48042617 GHz
SWT 560 ms
Unit dBm
11 dB Offset
▼1 [T1]
3.23 dBm
2.48042617 GHz
A
1MA
MAX
Center 2.48 GHz
196 kHz/
Span 1.96 MHz
Date: 25.JAN.2021 17:13:06

Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

5: This report cannot be reproduced except in full, without prior written approval of the Company.

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******* END OF REPORT *******