TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.247

TEST REPORT

For

Third Reality, Inc.

No. 647 East Longhua Road, Huangpu District, Shanghai, China

FCC ID: 2AOCT-3RSV023BWZP

Report Type:	**Product Type:**
Original Report	Third Reality Smart Speaker

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Report Number:	RSHD191119001-00D
Report Date:	2019-12-25
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Third Reality, Inc.
Tested Model	3RSV023BWZP
Product Type	Third Reality Smart Speaker
Power Supply	DC 5V charging by Adapter
RF Function	Zigbee
Operating Band/Frequency	Zigbee: 2405-2480MHz
Channel Number	Zigbee: 16
Channel Separation	Zigbee: 5MHz
Modulation Type	Zigbee: O-QPSK
Antenna Type	Zigbee: PIFA Antenna
Maximum Antenna Gain	Zigbee: 2dBi

Adapter Information:
Model: LX050200
Input: AC 100-240 V 50/60Hz 0.35A
Output: DC 5V, 2A

**All measurement and test data in this report was gathered from production sample serial number: 20191119001. (Assigned by the BACL. The EUT supplied by the applicant was received on 2019-11-19)*

Objective

This report is prepared on behalf of *Third Reality, Inc.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine Compliance 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 DSS Submittal with FCC ID: 2AOCT-3RSV023BWZP
FCC Part 15.247 DTS Submittal with FCC ID: 2AOCT-3RSV023BWZP

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 15.247 Meas Guidance v05 r02.

All emissions measurement was performed at Bay Area Compliance 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%

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

Test Facility

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

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and 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

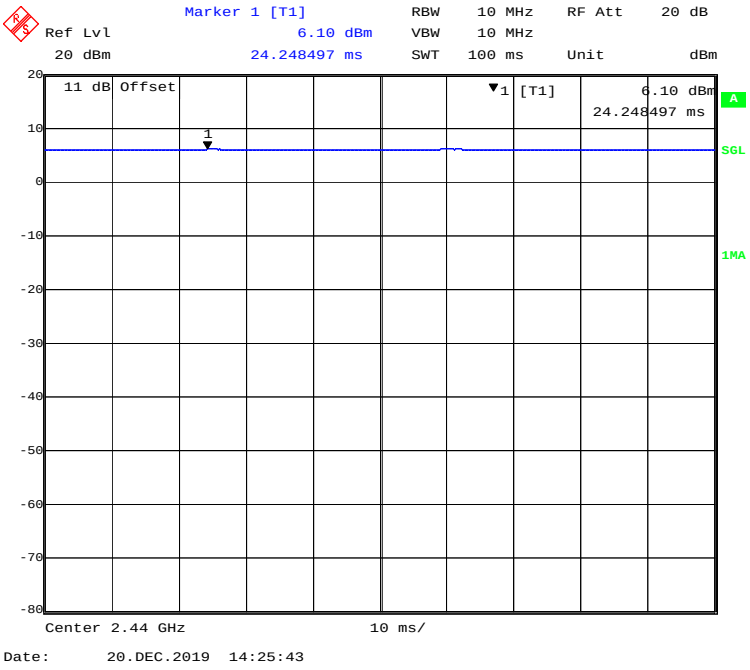
RF test tool: Secure CRT

The worst case was performed as below:

Channel	Power Level
Low	-8
Middle	-8
High	-8

Duty Cycle:

Middle Channel : 2440MHz



Mode	Duty Cycle	T(us)	1/T(kHz)	10log(1/x)
Zigbee	100%	/	/	0

Note: “x” means the Duty Cycle.

Support Equipment List and Details

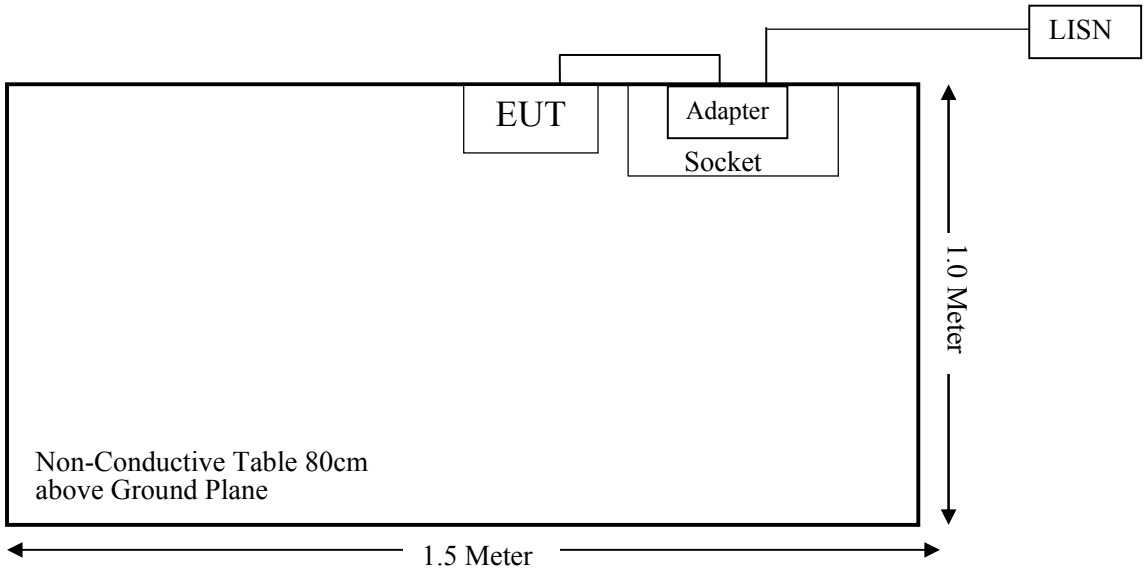
Manufacturer	Description	Model	Serial Number
/	Socket	/	/

External I/O Cable

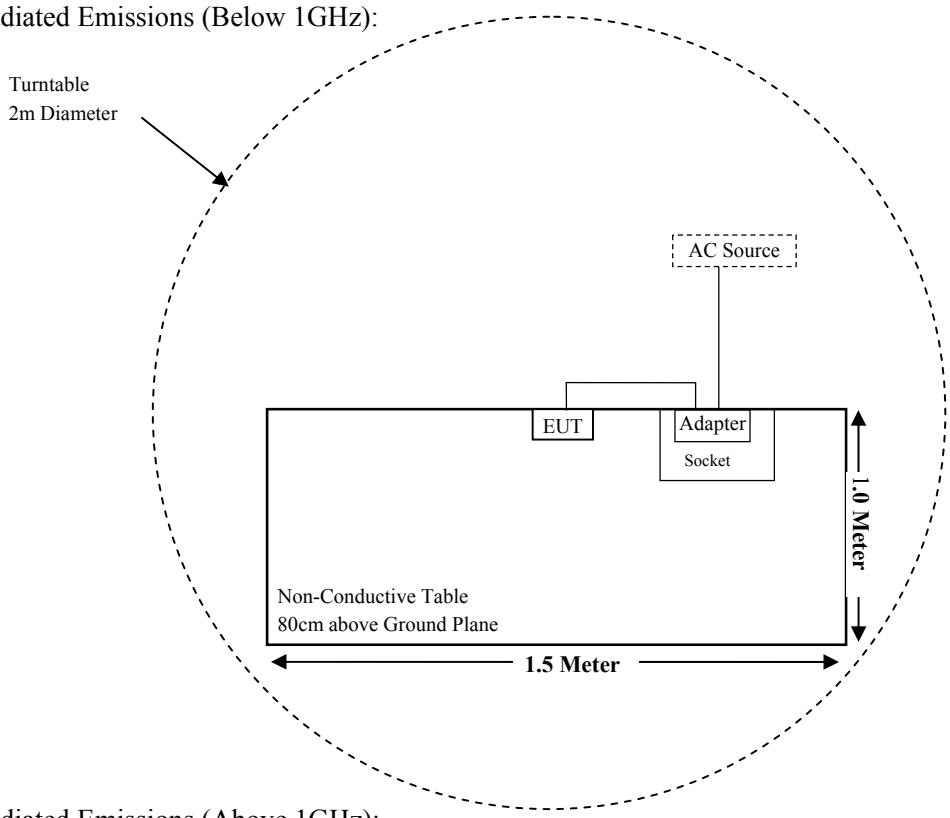
Cable Description	Length (m)	From Port	To
Cable	1.0	EUT	Adapter
Cable	1.0	Socket	AC source

Block Diagram of Test Setup

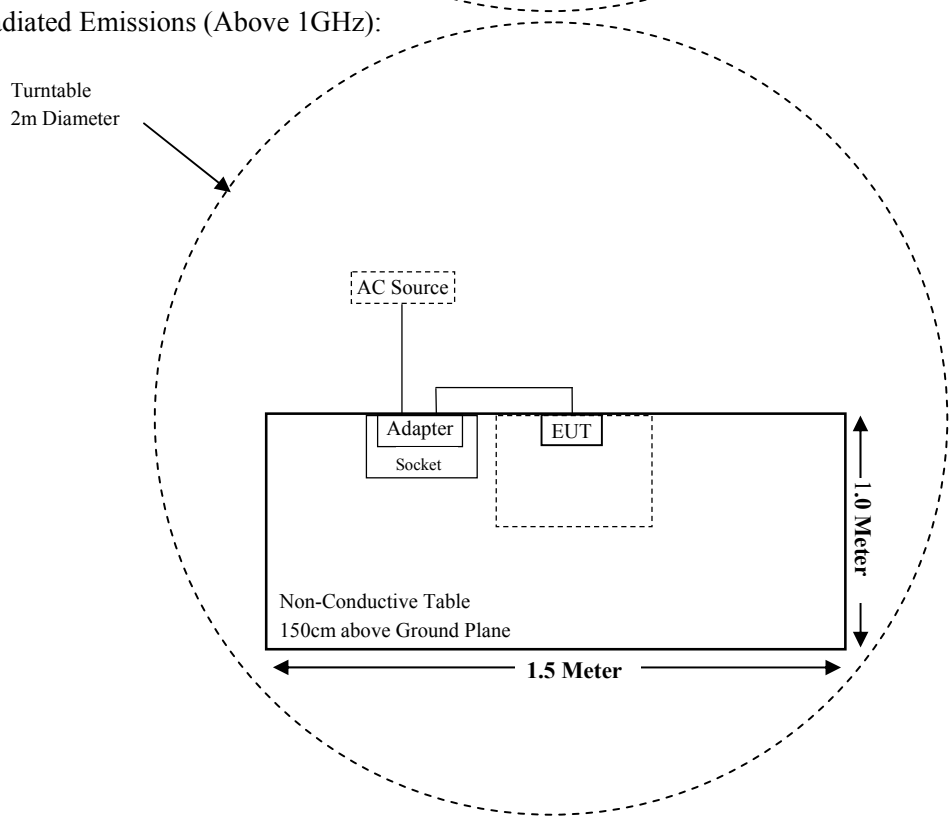
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 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	2019-11-30	2020-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrument	Pre-amplifier	310N	171205	2019-08-14	2020-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2019-08-27	2020-08-26
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
ETS-LINDGREN	Horn Antenna	3116	00084159	2019-12-12	2022-12-11
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2019-03-22	2020-03-21
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2019-08-05	2020-08-04
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048/027	2019-11-30	2020-11-29
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
Third Reality, Inc.	RF Cable	Third Reality, Inc.01	C01	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
Rohde & Schwarz	LISN	ENV216	3560655016	2019-11-30	2020-11-29
Audix	Test Software	e3	V9	/	/
Rohde & Schwarz	Pulse limiter	ESH3-Z2	0357.8810.54	/	/
MICRO-COAX	Coaxial Cable	Cable-15	015	2019-08-15	2020-08-14

*** Statement of Traceability:** Bay Area Compliance 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;

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/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):

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)			
Wi-Fi	2412-2462	2.00	1.58	21.50	141.25	20	0.0444	1.00
BLE	2402-2480	2.00	1.58	4.00	2.51	20	0.0008	1.00
Bluetooth	2402-2480	2.00	1.58	6.00	3.98	20	0.0013	1.00
Zigbee	2405~2480	2.00	1.58	4.50	2.82	20	0.0009	1.00

Note:
Wi-Fi and BT/BLE cannot transmit simultaneously.
Wi-Fi & Zigbee or BT/BLE & Zigbee can transmit simultaneously; the worst condition is Wi-Fi & Zigbee as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0444/1.00+0.0009/1.00=0.0453 < 1.0$$

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 Compliance 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 a PIFA antenna for Zigbee, and the antenna gain is 2.0 dBi, which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

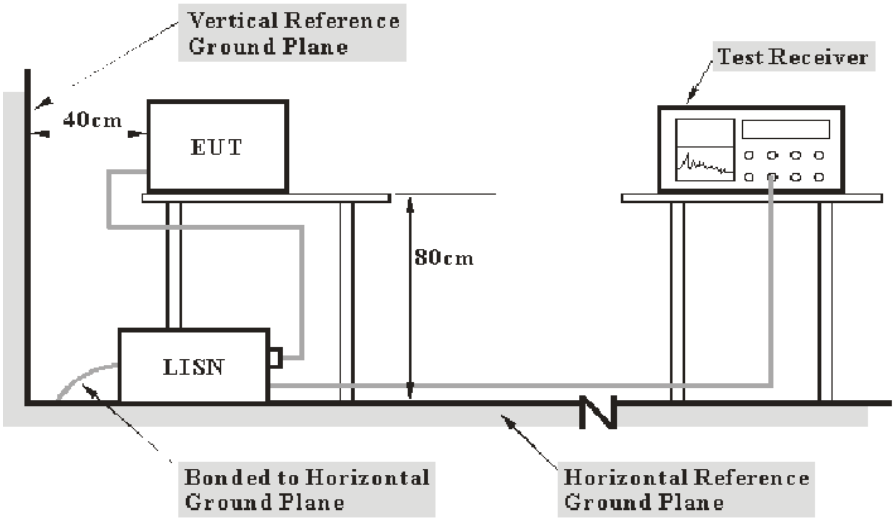
Result: Compliant

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

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

ANSI C63.10-2013 clause 6.2

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 final data was recorded in the Quasi-peak and average detection mode.

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

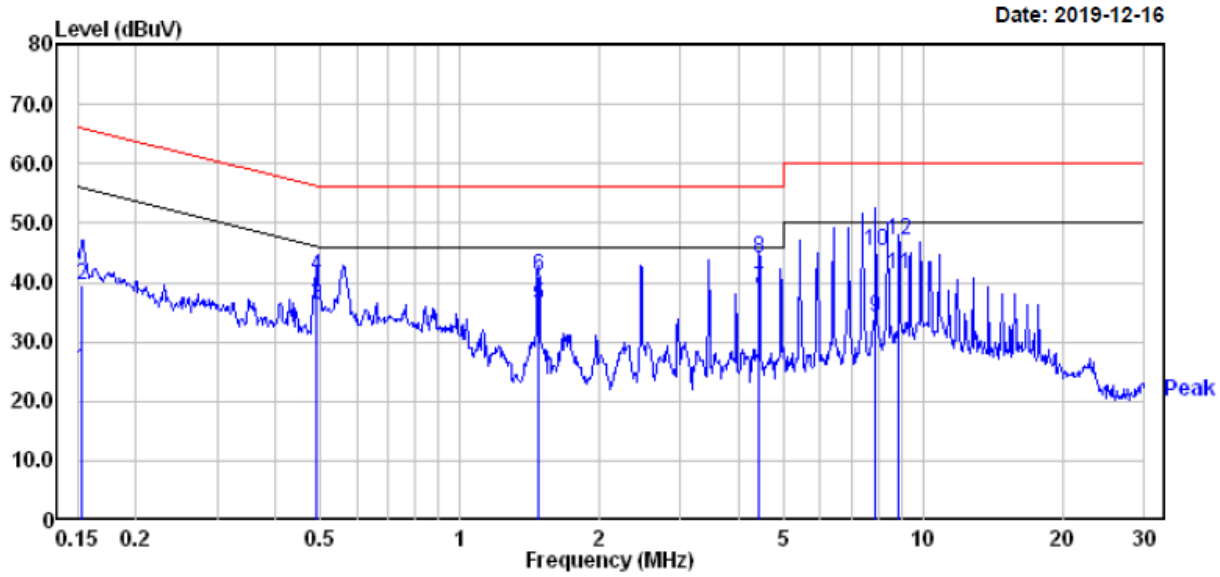
Temperature:	20.2-20.6 ℃
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.5 kPa

The testing was performed by Chao Gao from 2019-12-16 to 2019-12-26.

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

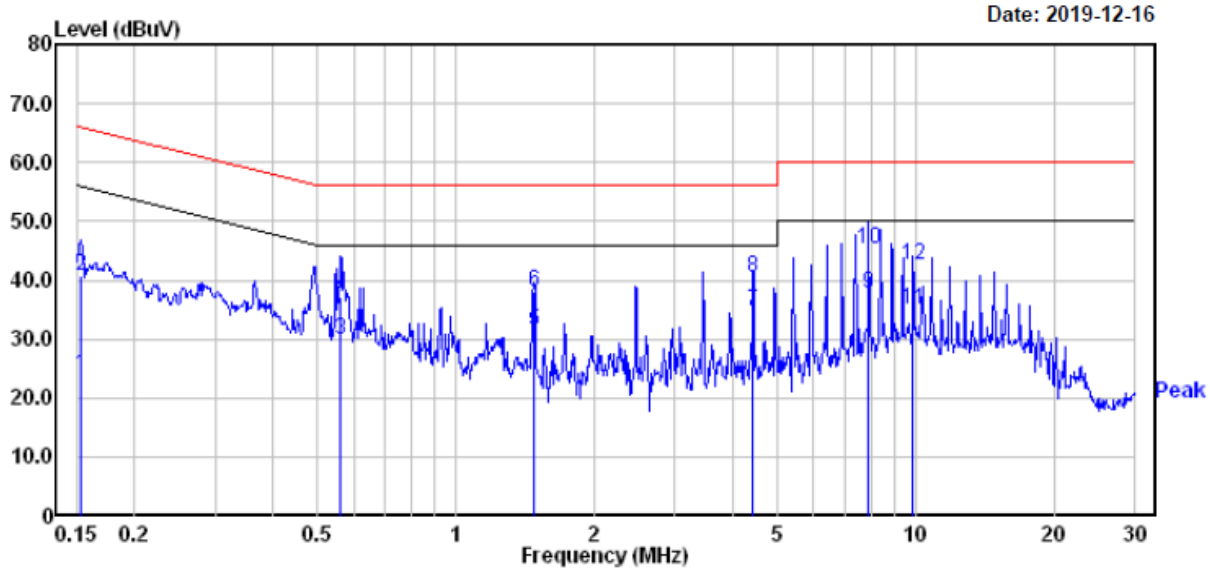
Test Result: Compliant

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.152	5.40	19.82	25.22	55.87	-30.65	Average
2	0.152	19.70	19.82	39.52	65.87	-26.35	QP
3	0.492	16.50	19.76	36.26	46.14	-9.88	Average
4	0.492	21.40	19.76	41.16	56.14	-14.98	QP
5	1.480	16.40	19.84	36.24	46.00	-9.76	Average
6	1.480	21.20	19.84	41.04	56.00	-14.96	QP
7	4.430	19.61	19.47	39.08	46.00	-6.92	Average
8	4.430	24.61	19.47	44.08	56.00	-11.92	QP
9	7.893	14.60	19.53	34.13	50.00	-15.87	Average
10	7.893	25.90	19.53	45.43	60.00	-14.57	QP
11	8.869	21.70	19.54	41.24	50.00	-8.76	Average
12	8.869	27.60	19.54	47.14	60.00	-12.86	QP

AC 120V/60 Hz, Neutral



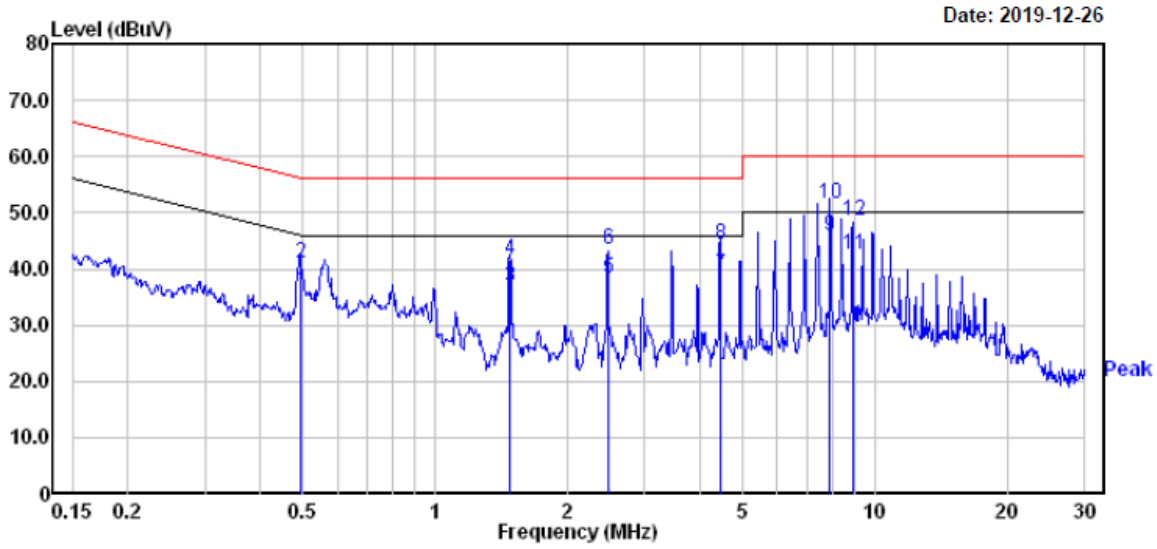
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.152	4.00	19.82	23.82	55.87	-32.05	Average
2	0.152	20.90	19.82	40.72	65.87	-25.15	QP
3	0.561	10.10	19.75	29.85	46.00	-16.15	Average
4	0.561	17.40	19.75	37.15	56.00	-18.85	QP
5	1.480	11.70	19.84	31.54	46.00	-14.46	Average
6	1.480	18.10	19.84	37.94	56.00	-18.06	QP
7	4.430	15.11	19.47	34.58	46.00	-11.42	Average
8	4.430	21.11	19.47	40.58	56.00	-15.42	QP
9	7.893	18.20	19.53	37.73	50.00	-12.27	Average
10	7.893	25.80	19.53	45.33	60.00	-14.67	QP
11	9.861	15.60	19.55	35.15	50.00	-14.85	Average
12	9.861	23.10	19.55	42.65	60.00	-17.35	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)

Transmitting simultaneously test:

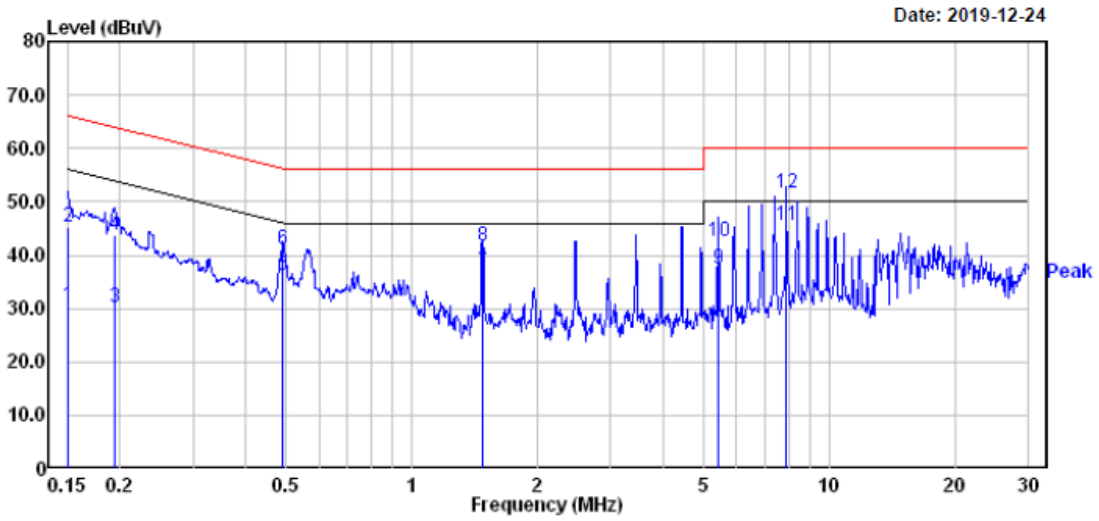
*(The worst case **802.11g mode middle channel of Wi-Fi and low channel of Zigbee** transmitting simultaneously was recorded)*

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.494	16.30	19.76	36.06	46.10	-10.04	Average
2	0.494	21.30	19.76	41.06	56.10	-15.04	QP
3	1.480	16.90	19.84	36.74	46.00	-9.26	Average
4	1.480	21.80	19.84	41.64	56.00	-14.36	QP
5	2.474	19.00	19.49	38.49	46.00	-7.51	Average
6	2.474	24.00	19.49	43.49	56.00	-12.51	QP
7	4.454	19.61	19.47	39.08	46.00	-6.92	Average
8	4.454	24.81	19.47	44.28	56.00	-11.72	QP
9	7.893	26.30	19.53	45.83	50.00	-4.17	Average
10	7.893	32.00	19.53	51.53	60.00	-8.47	QP
11	8.916	22.99	19.55	42.54	50.00	-7.46	Average
12	8.916	28.99	19.55	48.54	60.00	-11.46	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	10.60	19.82	30.42	56.00	-25.58	Average
2	0.150	25.60	19.82	45.42	66.00	-20.58	QP
3	0.194	10.30	19.82	30.12	53.84	-23.72	Average
4	0.194	24.00	19.82	43.82	63.84	-20.02	QP
5	0.492	16.50	19.76	36.26	46.14	-9.88	Average
6	0.492	21.40	19.76	41.16	56.14	-14.98	QP
7	1.480	17.10	19.84	36.94	46.00	-9.06	Average
8	1.480	21.90	19.84	41.74	56.00	-14.26	QP
9	5.419	17.91	19.49	37.40	50.00	-12.60	Average
10	5.419	23.21	19.49	42.70	60.00	-17.30	QP
11	7.893	26.10	19.53	45.63	50.00	-4.37	Average
12	7.893	32.00	19.53	51.53	60.00	-8.47	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)

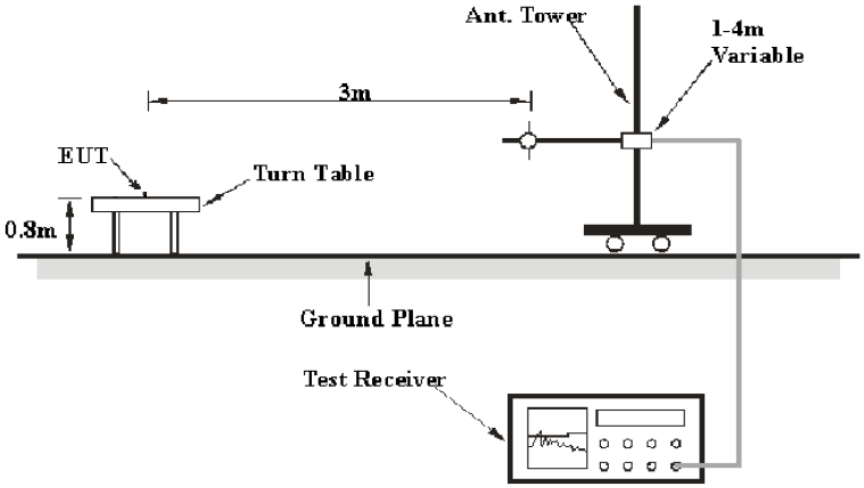
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

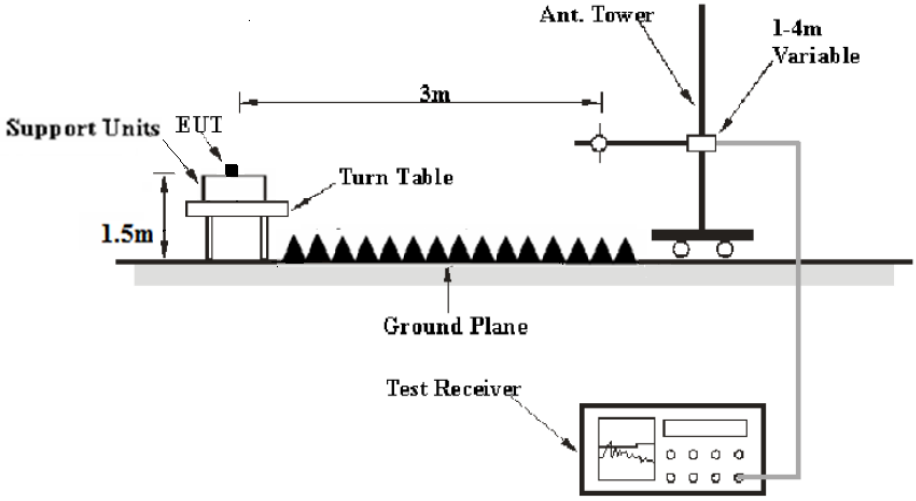
FCC §15.247 (d); §15.209; §15.205;

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	/	Ave.

Test Procedure

According to ANSI C63.10-2013 clause 6.5, 6.6 and 6.7.

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection mode for frequencies above 1 GHz.

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 Compliance 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 complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

Temperature:	22.5-24.1 ℃
Relative Humidity:	50-52 %
ATM Pressure:	101.2-101.5kPa

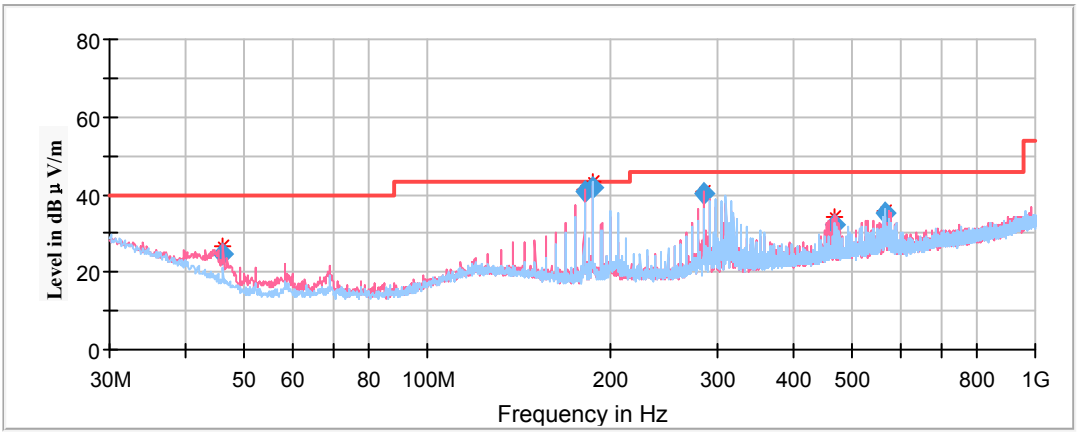
The testing was performed by Chao Gao from 2019-12-20 to 2019-12-25.

EUT operation mode: Transmitting

Test Result: Compliant

30MHz-1GHz:

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



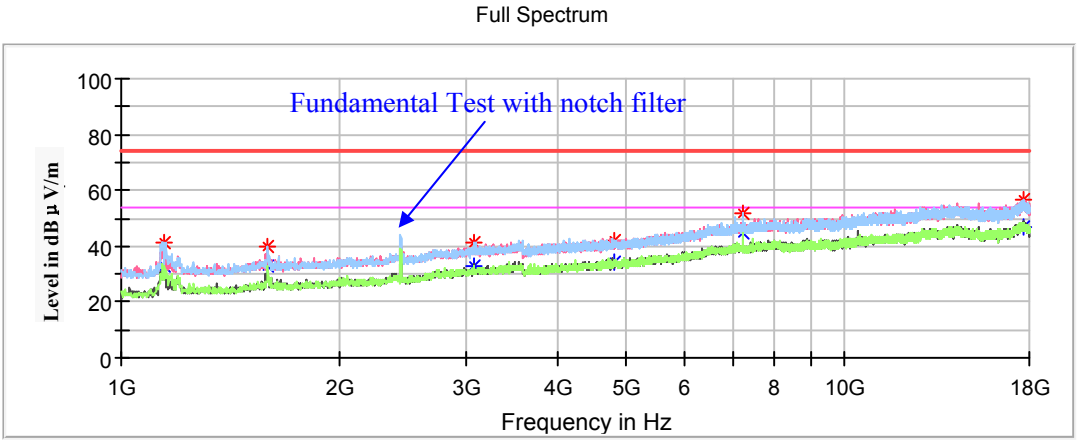
Frequency (MHz)	Corrected Amplitude QuasiPeak (dBµV/m)	Rx Antenna Height (cm)	Rx Antenna Polar (H/V)	Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
46.094450	24.57	100.0	V	91.0	-14.9	40.00	15.43
181.246750	40.93	100.0	V	71.0	-13.5	43.50	2.57
187.391800	41.95	200.0	H	215.0	-13.1	43.50	1.55
285.697050	40.26	200.0	V	207.0	-10.9	46.00	5.74
466.966700	32.02	200.0	V	102.0	-7.0	46.00	13.98
565.250950	35.28	100.0	H	57.0	-5.5	46.00	10.72

1GHz-18GHz:

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

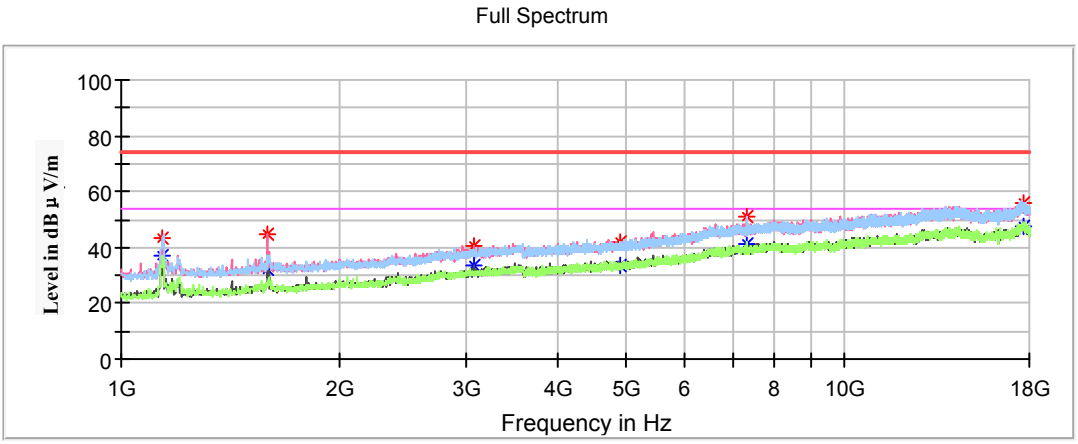
Note:
1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
   Corrected Amplitude (dBµV/m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV/m)

Low Channel: 2405MHz



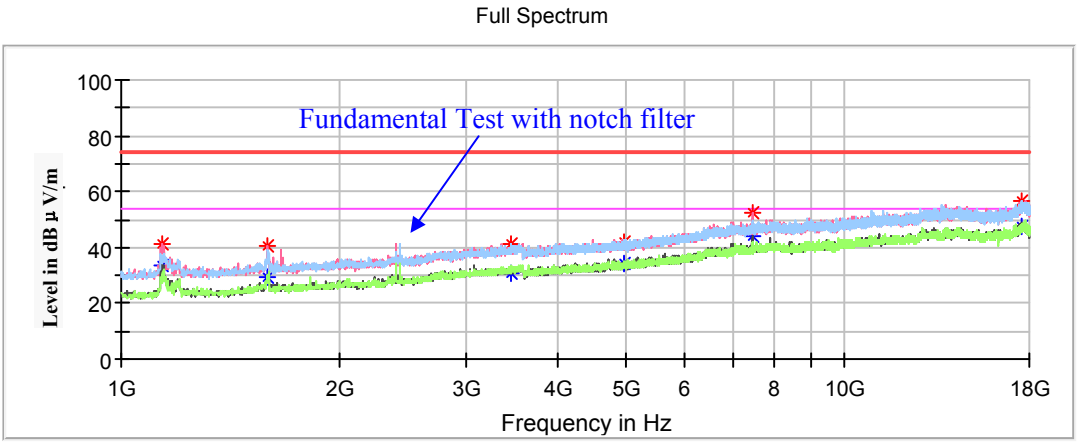
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Max Peak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1142.800000	---	33.09	150.0	H	23.0	-11.9	54.00	20.91
1142.800000	41.38	---	150.0	H	23.0	-11.9	74.00	32.62
1595.000000	---	32.76	200.0	H	20.0	-9.6	54.00	21.24
1595.000000	39.77	---	200.0	H	20.0	-9.6	74.00	34.23
3070.600000	---	32.97	200.0	H	348.0	-4.3	54.00	21.03
3070.600000	41.39	---	200.0	H	348.0	-4.3	74.00	32.61
4810.000000	---	34.54	150.0	V	307.0	-0.5	54.00	19.46
4810.000000	42.21	---	150.0	V	307.0	-0.5	74.00	31.79
7215.000000	---	44.54	150.0	V	263.0	5.7	54.00	9.46
7215.000000	51.99	---	150.0	V	263.0	5.7	74.00	22.01
17622.600000	---	46.86	200.0	H	81.0	14.1	54.00	7.14
17622.600000	56.62	---	200.0	H	81.0	14.1	74.00	17.38

Middle Channel: 2440MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Max Peak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1141.100000	---	37.24	200.0	H	80.0	-11.9	54.00	16.76
1141.100000	43.43	---	200.0	H	80.0	-11.9	74.00	30.57
1595.000000	---	31.89	200.0	V	358.0	-9.6	54.00	22.11
1595.000000	45.06	---	200.0	V	358.0	-9.6	74.00	28.94
3070.600000	---	33.78	200.0	V	204.0	-4.3	54.00	20.22
3070.600000	40.85	---	200.0	V	204.0	-4.3	74.00	33.15
4880.000000	---	33.48	200.0	H	186.0	-0.4	54.00	20.52
4880.000000	42.29	---	200.0	H	186.0	-0.4	74.00	31.71
7320.000000	---	41.43	150.0	H	264.0	5.8	54.00	12.57
7320.000000	50.95	---	150.0	H	264.0	5.8	74.00	23.05
17626.000000	---	47.62	150.0	H	114.0	14.1	54.00	6.38
17626.000000	56.24	---	150.0	H	114.0	14.1	74.00	17.76

High Channel: 2480MHz

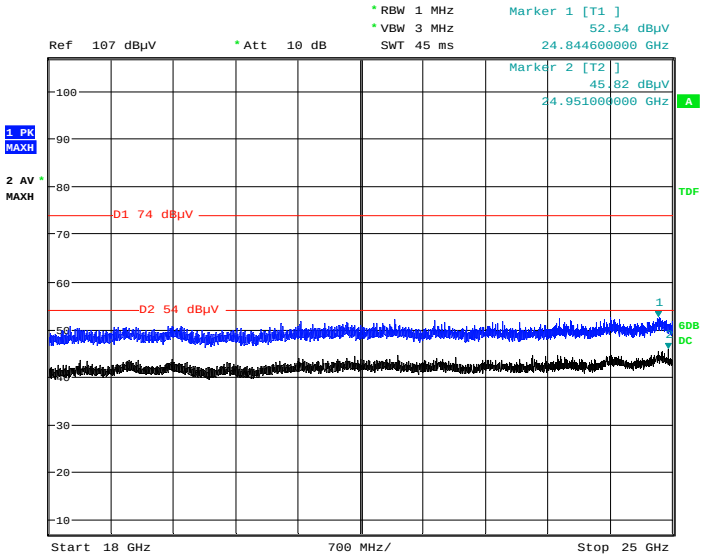


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Max Peak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1139.400000	40.93	---	200.0	V	85.0	-11.9	74.00	33.07
1139.400000	---	33.77	200.0	V	85.0	-11.9	54.00	20.23
1593.300000	40.35	---	150.0	V	291.0	-9.6	74.00	33.65
1593.300000	---	29.26	150.0	V	291.0	-9.6	54.00	24.74
3451.400000	---	31.10	200.0	H	349.0	-3.6	54.00	22.90
3451.400000	41.25	---	200.0	H	349.0	-3.6	74.00	32.75
4960.000000	---	34.48	200.0	H	280.0	-0.3	54.00	19.52
4960.000000	41.86	---	200.0	H	280.0	-0.3	74.00	32.14
7440.000000	52.21	---	200.0	H	218.0	6.0	74.00	21.79
7440.000000	---	43.82	200.0	H	218.0	6.0	54.00	10.18
17592.000000	56.60	---	150.0	V	0.0	14.1	74.00	17.40
17592.000000	---	47.27	150.0	V	0.0	14.1	54.00	6.73

18GHz - 25GHz

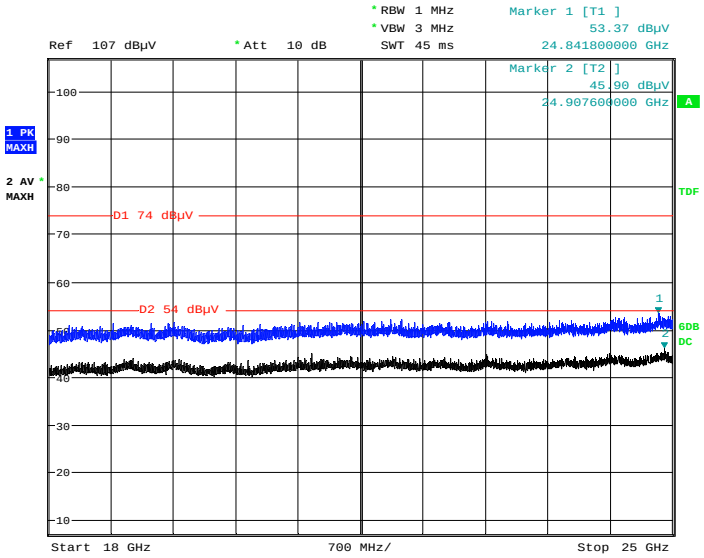
*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **low channel of operation in X-axis of orientation** was recorded)*

Horizontal



Date: 20.DEC.2019 09:48:41

Vertical



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Restricted Bands Emissions Test:

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

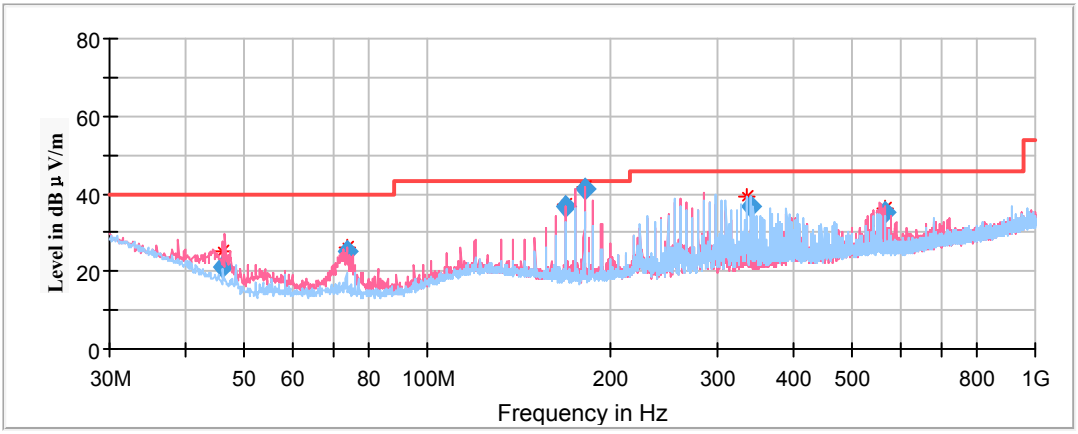
Note:
1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) - Amplifier Factor (dB)
   Corrected Amplitude (dBμV/m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/m)

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)				
Low Channel: 2405MHz								
2390.000000	---	38.89	200.0	V	22.0	2.8	54.00	15.11
2390.000000	49.75	---	200.0	V	22.0	2.8	74.00	24.25
2390.000000	---	38.12	150.0	H	118.0	2.8	54.00	15.88
2390.000000	49.06	---	150.0	H	118.0	2.8	74.00	24.94
High Channel: 2480MHz								
2483.500000	---	44.11	150.0	V	115.0	3.0	54.00	9.89
2483.500000	63.01	---	150.0	V	115.0	3.0	74.00	10.99
2483.500000	---	43.86	200.0	H	325.0	3.0	54.00	10.14
2483.500000	62.65	---	200.0	H	325.0	3.0	74.00	11.35

Transmitting simultaneously test:

*(The worst case **802.11g mode middle channel of Wi-Fi and low channel of Zigbee** transmitting simultaneously in X-axis of orientation was recorded)*

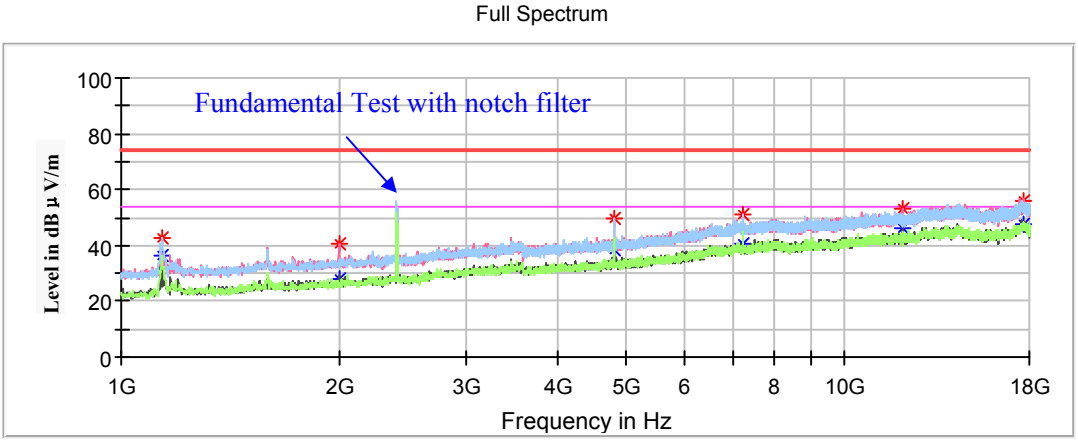
30MHz-1GHz



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)				
46.041800	22.09	100.0	V	0.0	-15.1	40.00	17.91
73.771250	25.64	100.0	V	199.0	-17.5	40.00	14.36
168.976200	37.45	100.0	V	0.0	-13.1	43.50	6.05
181.198750	41.66	100.0	V	204.0	-13.5	43.50	1.84
334.822500	38.01	100.0	H	161.0	-9.7	46.00	7.99
565.244950	35.67	200.0	V	30.0	-5.5	46.00	10.33

1GHz-18GHz

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)

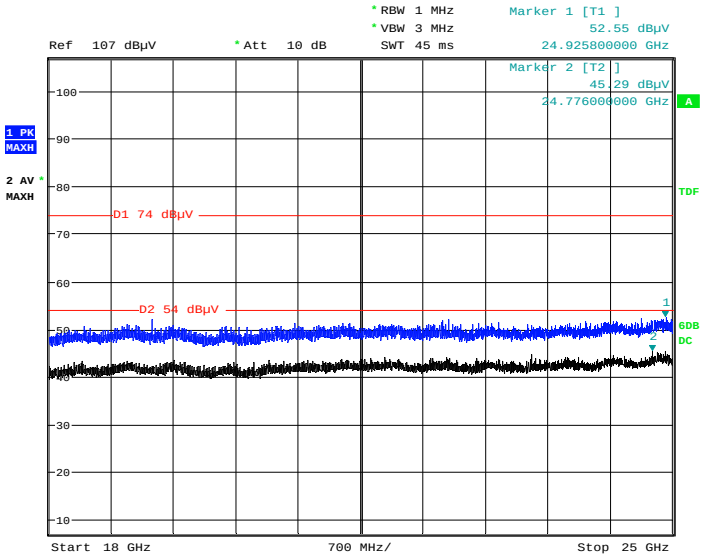


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1139.400000	---	36.15	200.0	H	51.0	-11.9	54.00	17.85
1139.400000	42.54	---	200.0	H	51.0	-11.9	74.00	31.46
1999.600000	---	27.82	200.0	V	324.0	-8.2	54.00	26.18
1999.600000	40.47	---	200.0	V	324.0	-8.2	74.00	33.53
4808.000000	---	38.57	200.0	H	183.0	-0.5	54.00	15.43
4808.000000	49.68	---	200.0	H	183.0	-0.5	74.00	24.32
7215.200000	---	40.83	200.0	H	198.0	5.7	54.00	13.17
7215.200000	51.32	---	200.0	H	198.0	5.7	74.00	22.68
12027.900000	---	46.13	200.0	V	207.0	10.1	54.00	7.87
12027.900000	53.40	---	200.0	V	207.0	10.1	74.00	20.60
17646.400000	---	47.43	200.0	V	207.0	14.0	54.00	6.57
17646.400000	56.25	---	200.0	V	207.0	14.0	74.00	17.75

18GHz-25GHz

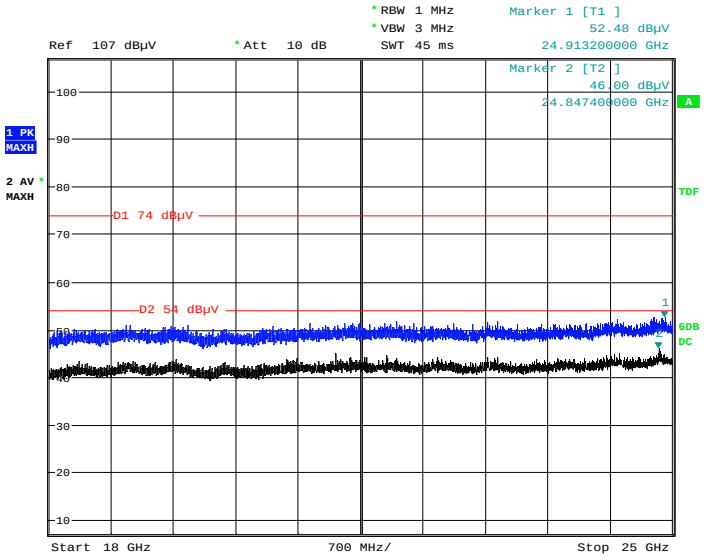
*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **low channel of operation in the X axis of orientation** was recorded)*

Horizontal



Date: 25.DEC.2019 14:00:33

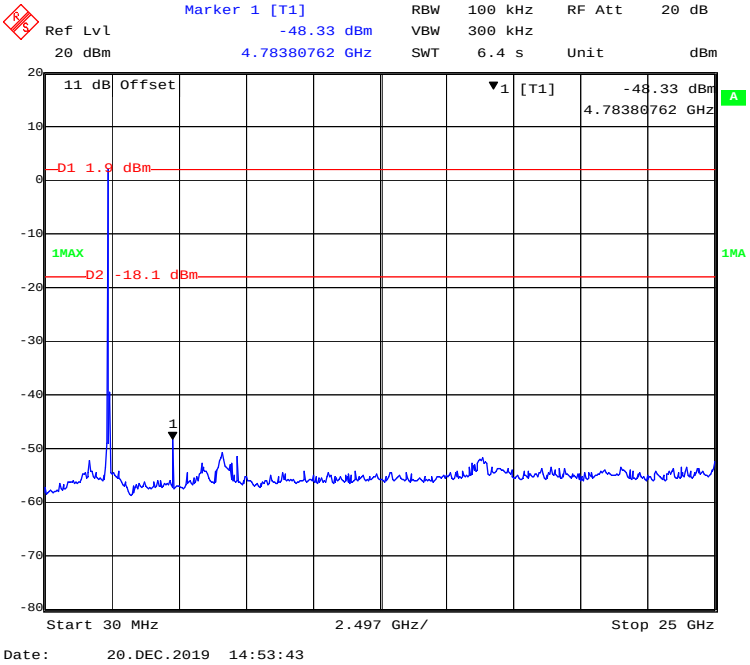
Vertical



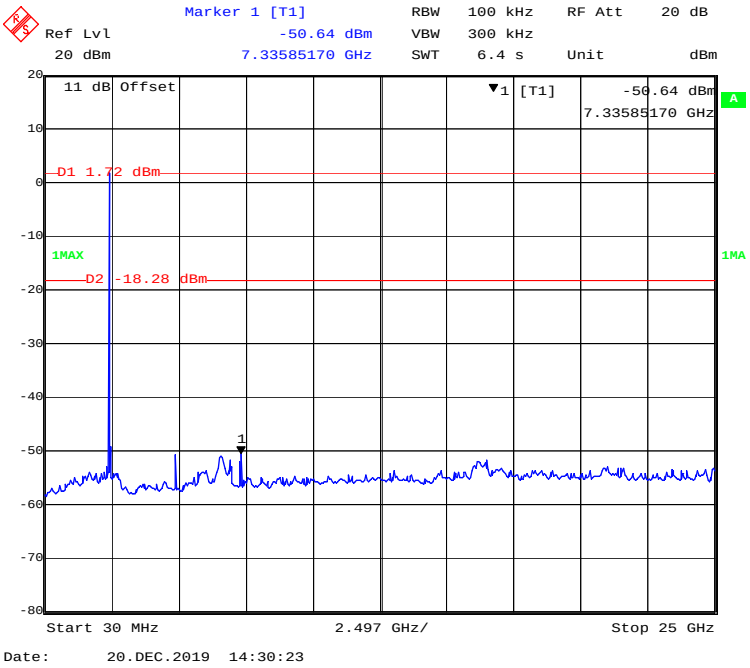
Date: 25.DEC.2019 14:36:19

Conducted Spurious Emissions at Antenna Port

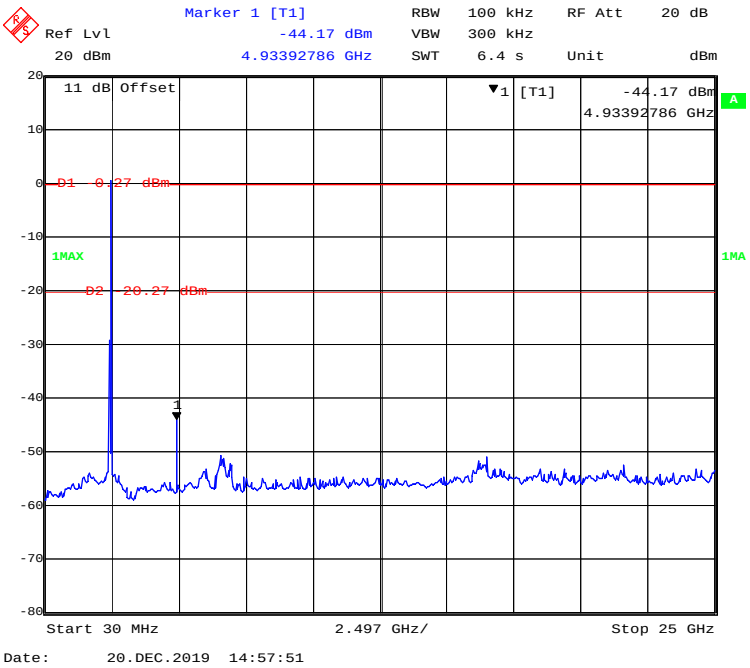
Low Channel : 2405MHz



Middle Channel : 2440MHz



High Channel : 2480MHz



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

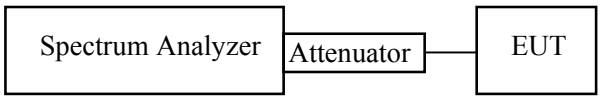
Applicable Standard

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:	21.1 ℃
Relative Humidity:	48 %
ATM Pressure:	101.1 kPa

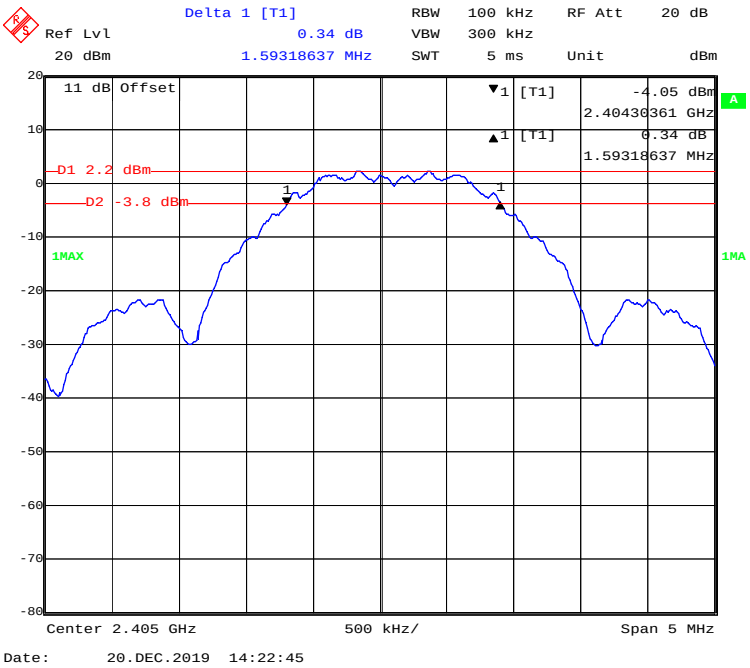
The testing was performed by Chao Gao on 2019-12-20.

EUT operation mode: Transmitting

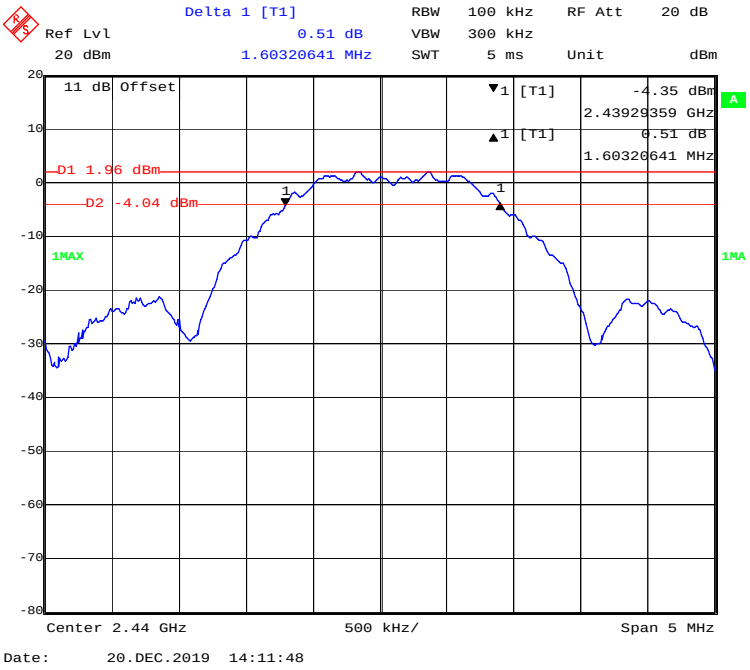
Test Result: Compliant

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
Low	2405	1.593	≥0.5
Middle	2440	1.603	≥0.5
High	2480	1.613	≥0.5

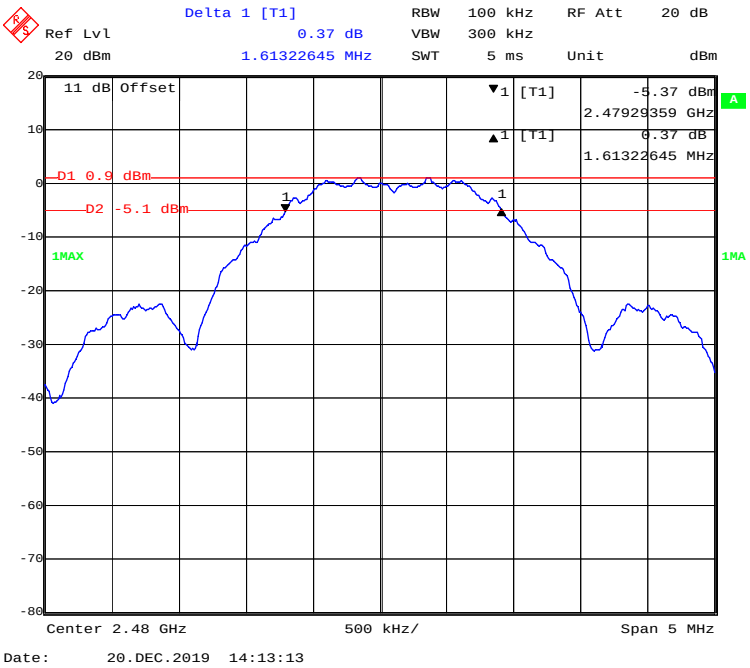
Low Channel: 2405MHz



Middle Channel: 2440MHz



High Channel: 2480MHz



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

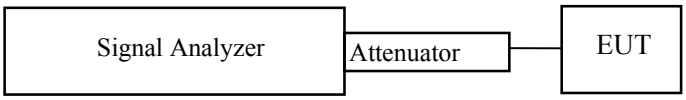
Applicable Standard

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, 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.

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:	21.8℃
Relative Humidity:	54 %
ATM Pressure:	101.2 kPa

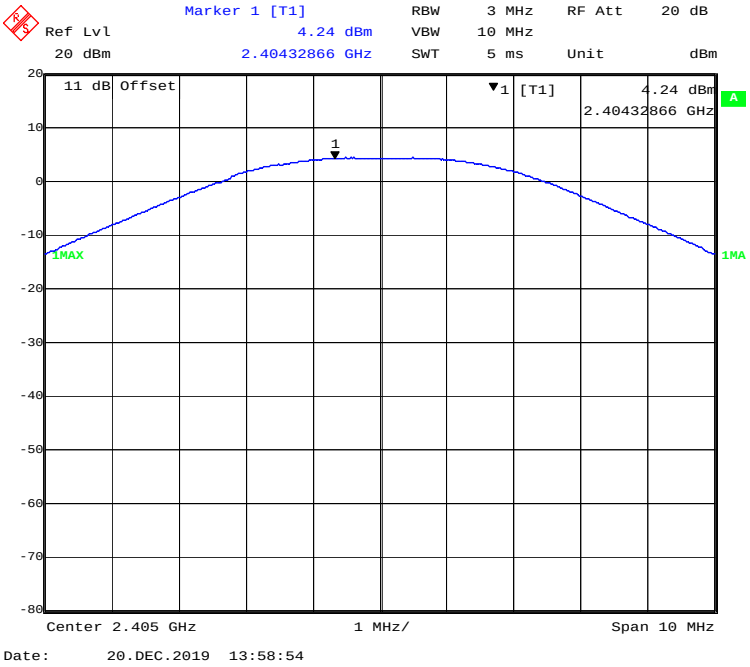
The testing was performed by Chao Gao on 2019-12-20

EUT operation mode: Transmitting

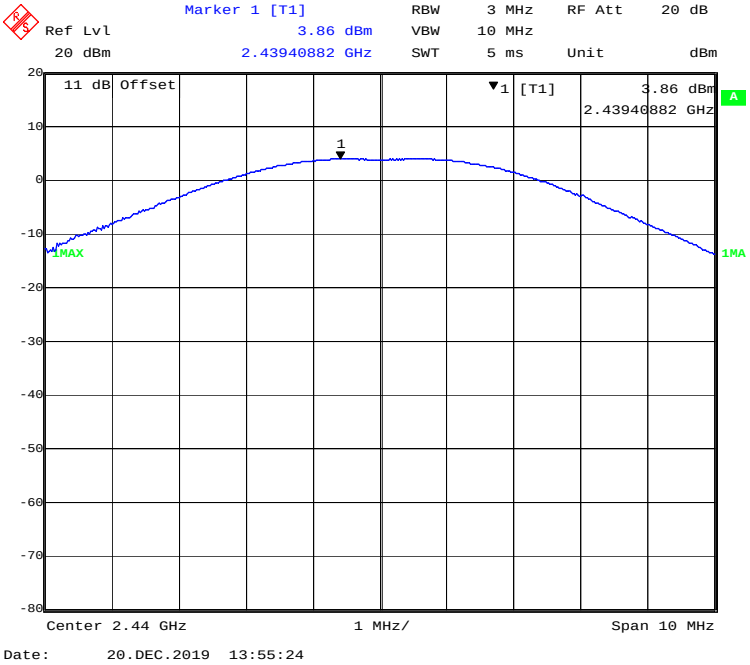
Test Result: Compliant

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	2405	4.24	30	Pass
Middle	2440	3.86	30	Pass
High	2480	3.35	30	Pass

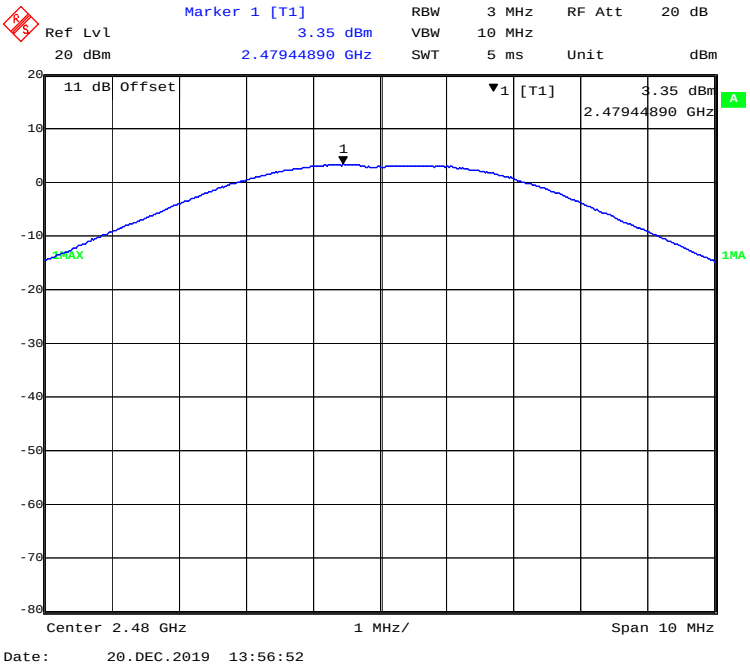
Low Channel: 2405MHz



Middle Channel: 2440MHz



High Channel: 2480MHz



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 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)).

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

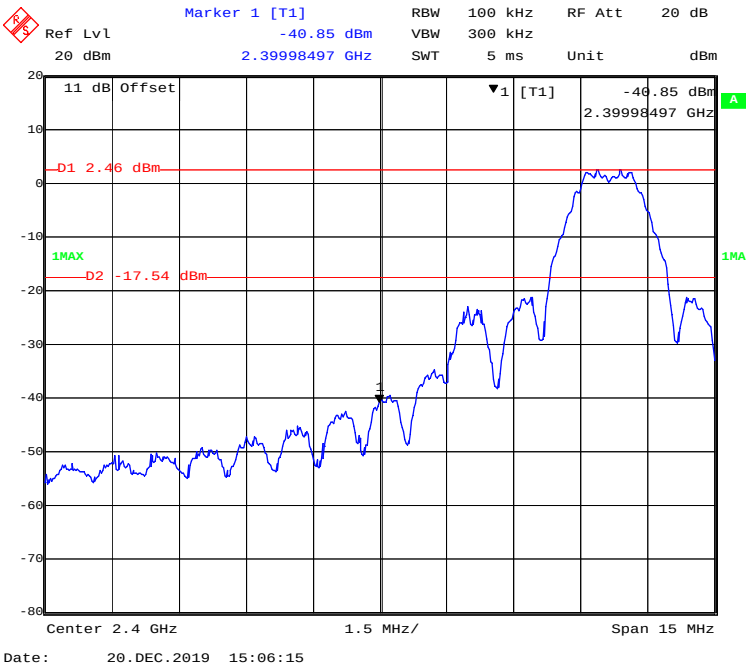
Temperature:	21.2 ℃
Relative Humidity:	48 %
ATM Pressure:	101.1 kPa

The testing was performed by Chao Gao on 2019-12-20

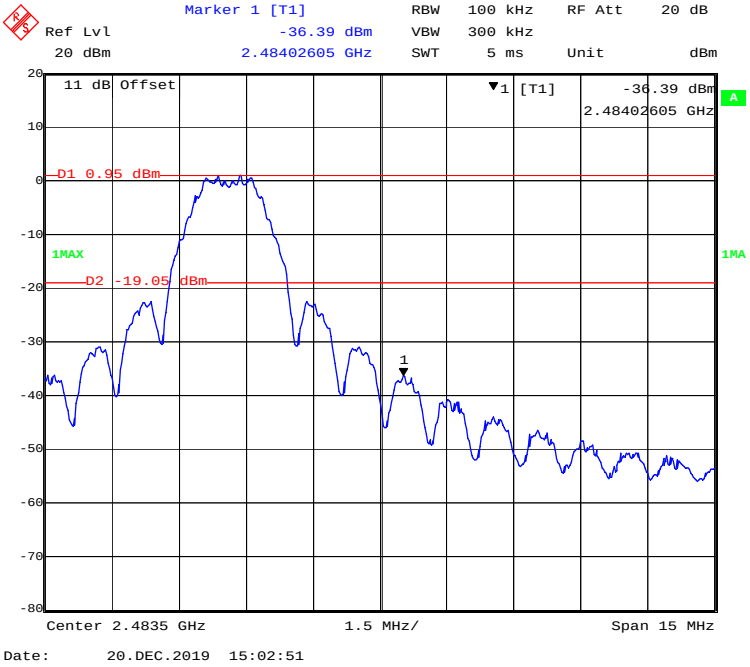
EUT operation mode: Transmitting

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

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

1. Set the RBW to: 3kHz≤ RBW≤100 kHz.
2. Set the VBW ≥ 3xRBW.
3. Set the span to 1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level within the RBW.
9. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

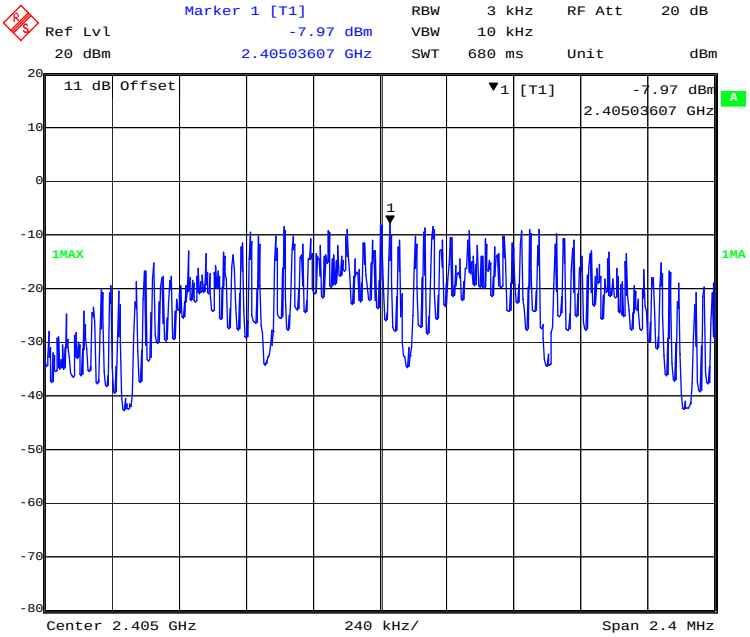
Temperature:	21.3 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Chao Gao on 2019-12-20.
.
EUT operation mode: Transmitting

Test Result: Compliant.

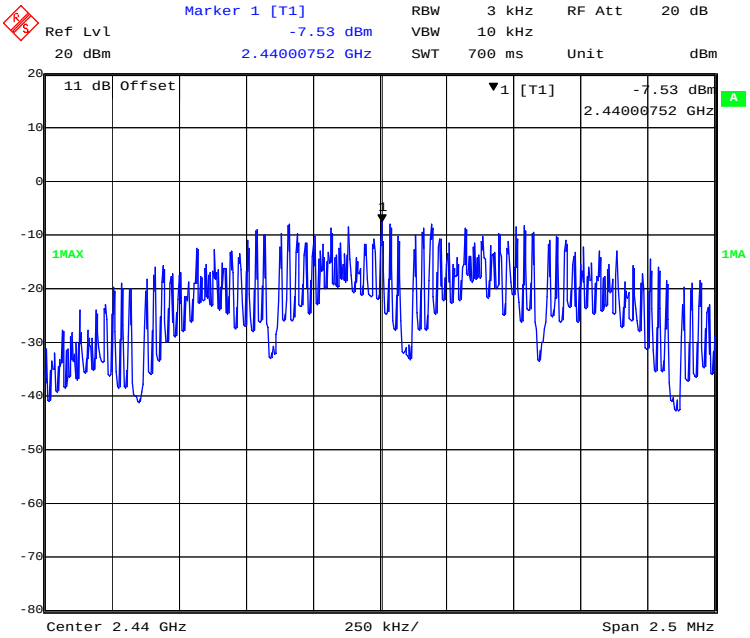
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low	2405	-7.97	≤8
Middle	2440	-7.53	≤8
High	2480	-8.14	≤8

Low Channel: 2405MHz



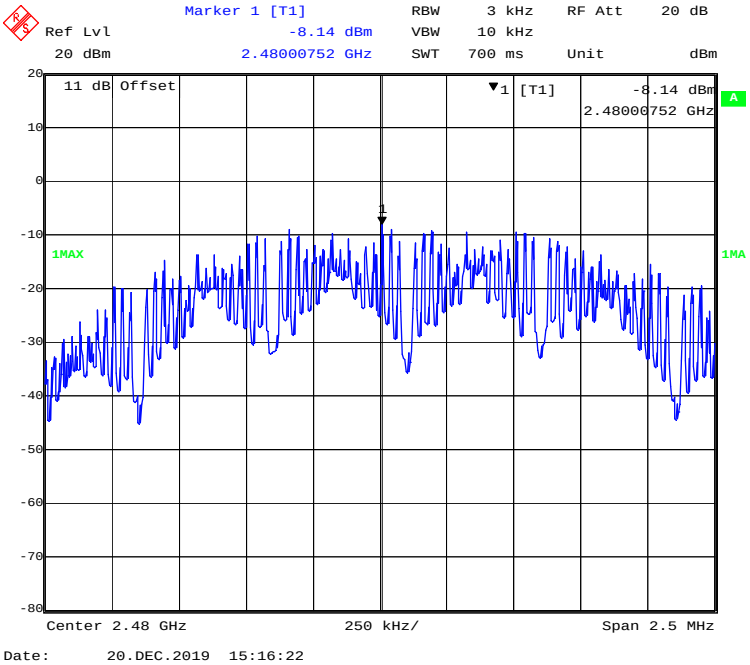
Date: 20.DEC.2019 15:12:12

Middle Channel: 2440MHz



Date: 20.DEC.2019 15:15:09

High Channel: 2480MHz



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