

FCC PART 15.225



TEST REPORT

For

Shanghai Smarfid Security Equipment Co., Ltd.

No. 88, Lane 600, XinLi Road, Minhang District, Shanghai, 201615 China

FCC ID: X3A-BT3227K

Report Type: Original Report	Product Type: Bluetooth & Multi-technologies Reader
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Report Number:	RSHD191213002-00B
Report Date:	2019-12-25
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TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY	4
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
JUSTIFICATION	5
EUT EXERCISE SOFTWARE	5
EQUIPMENT MODIFICATIONS	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
EXTERNAL I/O CABLE.....	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	8
TEST EQUIPMENT LIST	9
FCC§15.203 - ANTENNA REQUIREMENT.....	10
APPLICABLE STANDARD	10
ANTENNA CONNECTED CONSTRUCTION	10
FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS	11
APPLICABLE STANDARD	11
EUT SETUP	11
EMI TEST RECEIVER SETUP.....	11
TEST PROCEDURE	11
FACTOR & OVER LIMIT CALCULATION.....	12
TEST RESULTS SUMMARY	12
TEST DATA	12
FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST	15
APPLICABLE STANDARD	15
EUT SETUP	15
EMI TEST RECEIVER SETUP.....	16
CORRECTED AMPLITUDE & MARGIN CALCULATION -	16
TEST RESULTS SUMMARY	16
TEST DATA	16
FCC§15.225(E) - FREQUENCY STABILITY.....	24
APPLICABLE STANDARD	24
TEST PROCEDURE	24
TEST DATA	25
§15.215(C) - 20DB EMISSION BANDWIDTH TESTING	26
REQUIREMENT	26
TEST PROCEDURE	26
TEST DATA	26

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	Shanghai Smarfid Security Equipment Co., Ltd.
Product Type:	Bluetooth & Multi-technologies Reader
Tested Model:	BT322-7K
Series Model:	BT322-7N、 BT322-8K、 BT322-8N
Power Supply:	DC 12V
RF Function:	NFC
Operating Band /Frequency:	13.56 MHz
Antenna Type:	PCB Antenna
Maximum Antenna Gain:	6dBi

Note: The model difference was explained in the attached declaration letter.

Pre-scan all models , the test result of this model(BT322-7K)was the worst and only the worse case's test data was recorded in the report.

**All measurement and test data in this report was gathered from production sample serial number: 20191213002. (Assigned by the BACL. The EUT supplied by the applicant was received on 2019-12-13)*

Objective

This Type approval report is prepared on behalf of *Shanghai Smarfid Security Equipment Co., Ltd.* in accordance with Part 2- Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission's rules.

The objective is to determine the Compliance of the EUT with FCC rules, sec 15.203, 15.205, 15.207, 15.209 and 15.225.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submissions with FCC ID: X3A-BT3227K.

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.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab 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		3.19 dB
RF conducted test with spectrum		0.9dB
Radiated emission	9kHz~30MHz	6.07dB
	30MHz~1GHz	6.11dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
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), 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

Justification

The system was configured for testing in a typical fashion (as normally used by a typical user).

EUT Exercise Software

The EUT is tested in the engineering mode.

Equipment Modifications

No modification on the EUT.

Support Equipment List and Details

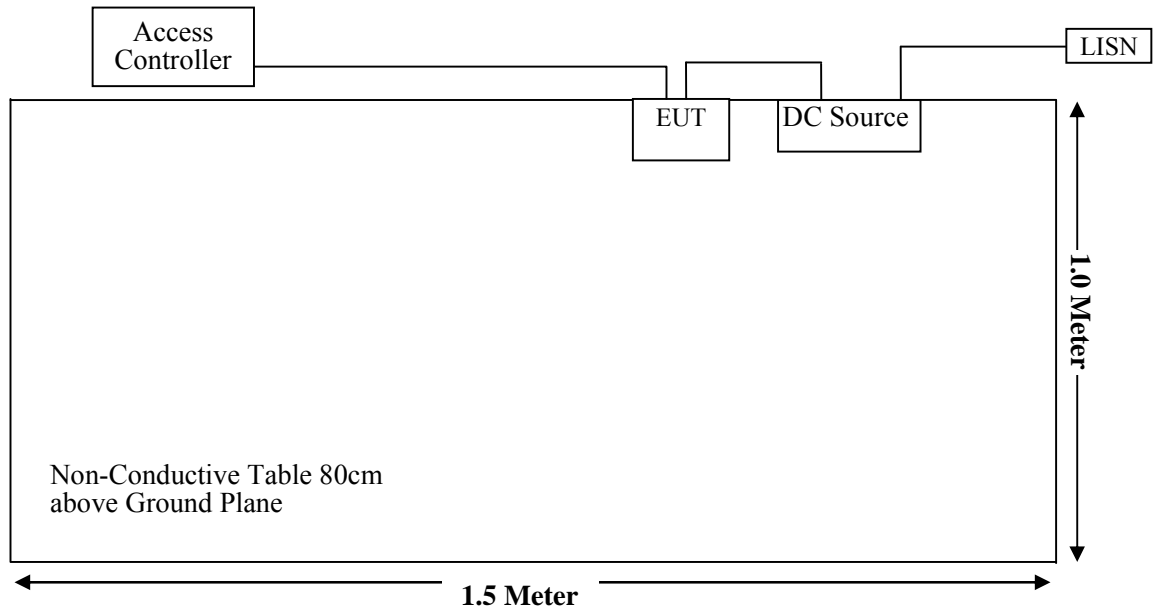
Manufacturer	Description	Model	Serial Number
/	Access Controller	/	/
ZHAOXIN	DC Power Supply	RXN-605D	DC002

External I/O Cable

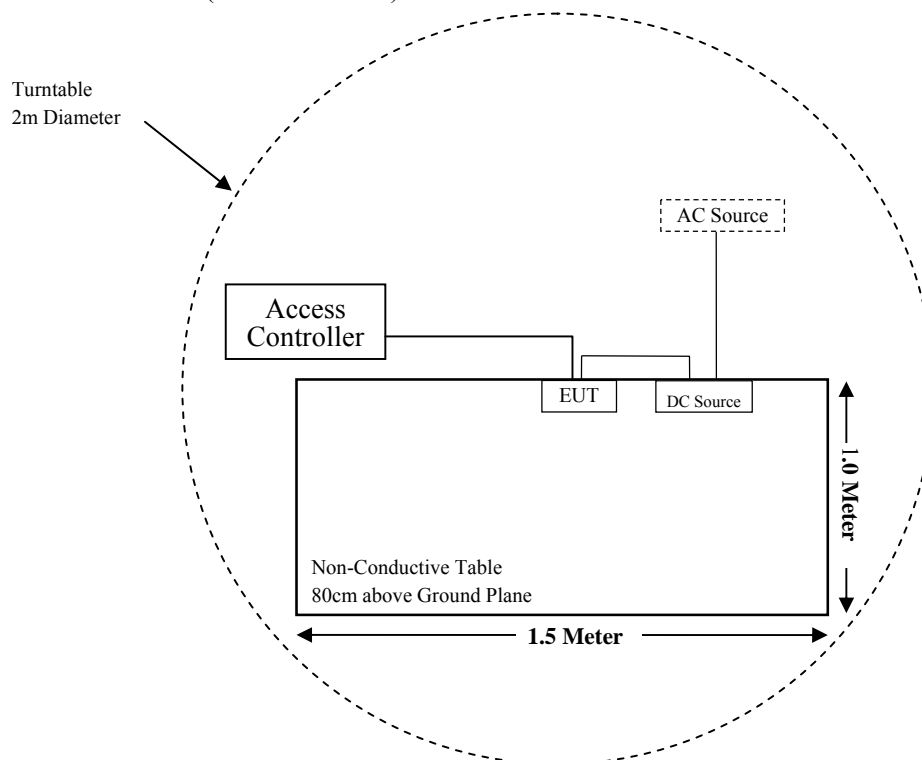
Cable Description	Length (m)	From Port	To
Cable1	1.0	EUT	DC Source
Cable2	1.0	DC Source	AC Source
Cable3	5.0	EUT	Access Controller

Block Diagram of Test Setup

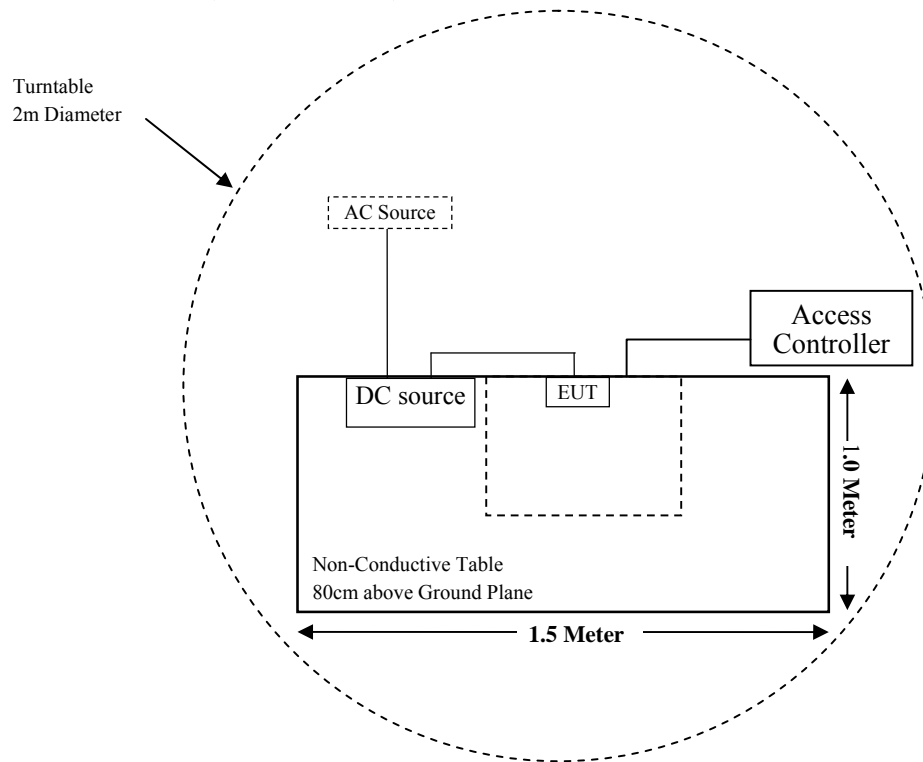
For Conducted Emissions:



For Radiated Emissions (Below 30 MHz):



For Radiated Emissions (Above 30 MHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.225 §15.209 §15.205	Radiated Emission Test	Compliant
§15.225(e)	Frequency Stability	Compliant
§15.215(c)	20dB Emission Bandwidth Testing	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2018-01-09	2021-01-08
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2019-07-23	2020-07-22
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2022-01-08
Sonoma Instrument	Pre-amplifier	310N	171205	2019-08-15	2020-08-14
ETS-LINDGREN	Loop Antenna	6512	00108100	2019-04-25	2022-04-24
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
Rohde & Schwarz	Auto test Software	e3	V9	/	/
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
BEST	DC Power Supply	PS-1502D+	DC001	2019-10-10	2020-10-09
BACL	Temperature & Humidity Chamber	BTH-150	30023	2019-10-10	2020-10-09
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
Rohde & Schwarz	LISN	ENV216	3560655016	2019-08-30	2020-08-29
Audix	Test Software	e3	V9	/	/
Narda	Attenuator/10dB	10690812-2	26850-6	2019-01-10	2020-01-09
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§15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Antenna Connected Construction

The EUT has a PCB antenna and antenna gain is 6 dBi, which was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

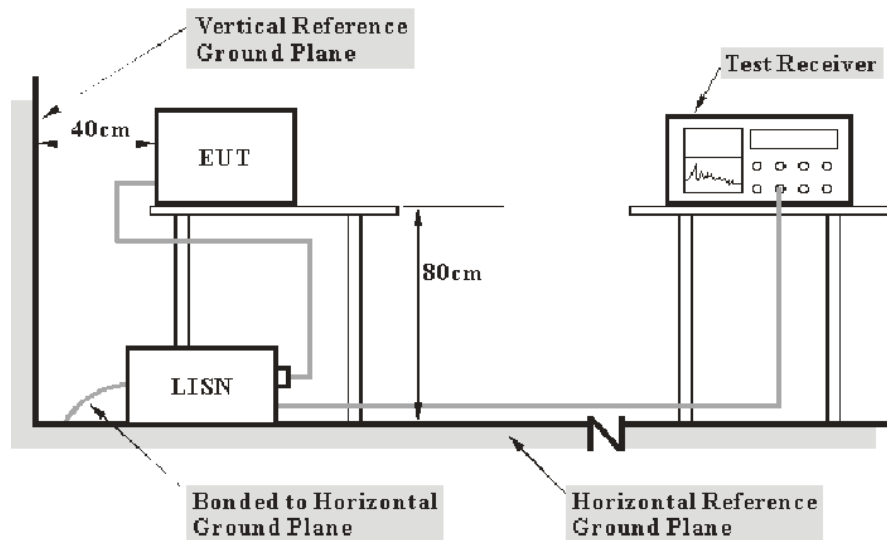
Result: Compliant.

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 DC source was connected to the outlet of the LISN.

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

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

Factor & Over Limit Calculation

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

$$\text{Factor (dB)} = \text{LISN VDF (dB)} + \text{Cable Loss (dB)} + \text{Attenuator (dB)}$$

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:

$$\text{Over Limit (dB)} = \text{Read level (dB}\mu\text{V)} + \text{Factor (dB)} - \text{Limit (dB}\mu\text{V)}$$

Test Results Summary

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

Test Data

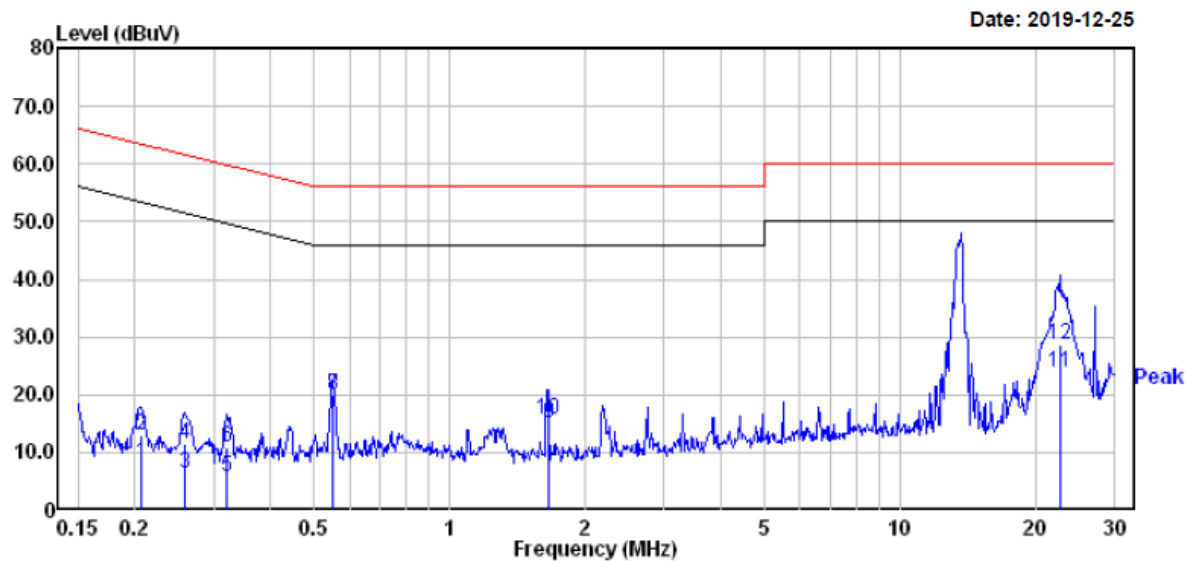
Environmental Conditions

Temperature:	20.4°C
Relative Humidity:	53 %
ATM Pressure:	101.5 kPa

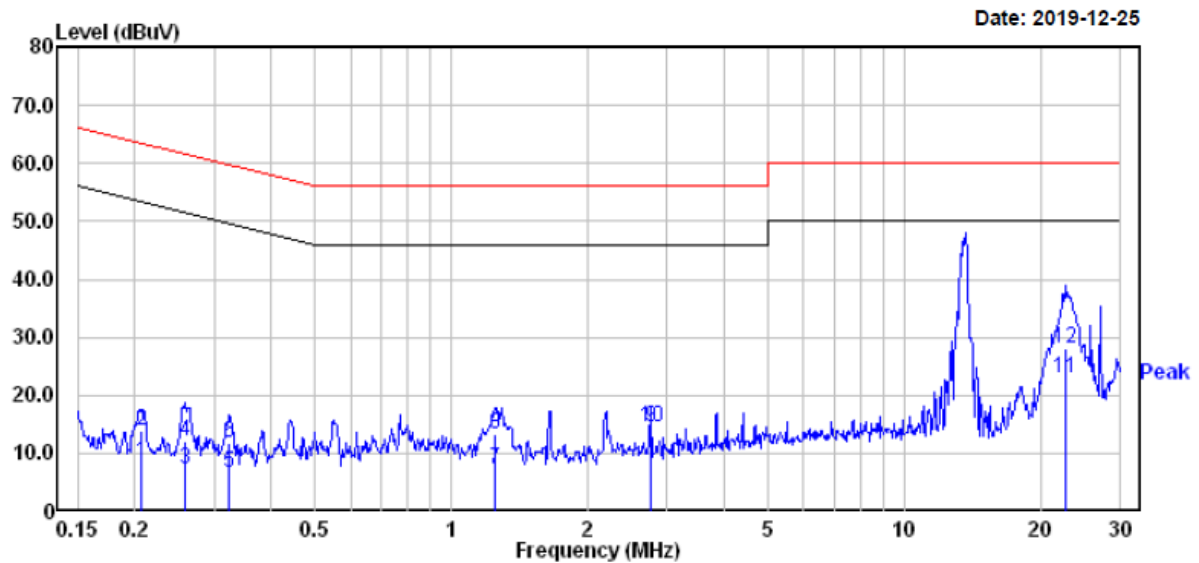
The testing was performed by Stone Zhang on 2019-12-25.

EUT operation mode: Transmitting

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.207	-8.20	16.23	8.03	53.32	-45.29	Average
2	0.207	-3.20	16.23	13.03	63.32	-50.29	QP
3	0.259	-9.69	16.14	6.45	51.47	-45.02	Average
4	0.259	-4.79	16.14	11.35	61.47	-50.12	QP
5	0.320	-10.40	16.09	5.69	49.71	-44.02	Average
6	0.320	-5.20	16.09	10.89	59.71	-48.82	QP
7	0.549	3.90	16.03	19.93	46.00	-26.07	Average
8	0.549	4.00	16.03	20.03	56.00	-35.97	QP
9	1.654	-1.01	16.06	15.05	46.00	-30.95	Average
10	1.654	-0.41	16.06	15.65	56.00	-40.35	QP
11	22.655	7.30	16.42	23.72	50.00	-26.28	Average
12	22.655	12.40	16.42	28.82	60.00	-31.18	QP

AC 120V/60 Hz, Neutral

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.206	-7.69	16.23	8.54	53.36	-44.82	Average
2	0.206	-2.39	16.23	13.84	63.36	-49.52	QP
3	0.258	-8.89	16.14	7.25	51.51	-44.26	Average
4	0.258	-4.09	16.14	12.05	61.51	-49.46	QP
5	0.323	-9.50	16.09	6.59	49.62	-43.03	Average
6	0.323	-4.20	16.09	11.89	59.62	-47.73	QP
7	1.249	-8.79	16.04	7.25	46.00	-38.75	Average
8	1.249	-2.69	16.04	13.35	56.00	-42.65	QP
9	2.750	-1.70	16.09	14.39	46.00	-31.61	Average
10	2.750	-1.50	16.09	14.59	56.00	-41.41	QP
11	22.655	6.50	16.42	22.92	50.00	-27.08	Average
12	22.655	11.70	16.42	28.12	60.00	-31.88	QP

Note:

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

FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST

Applicable Standard

As per FCC Part 15.225

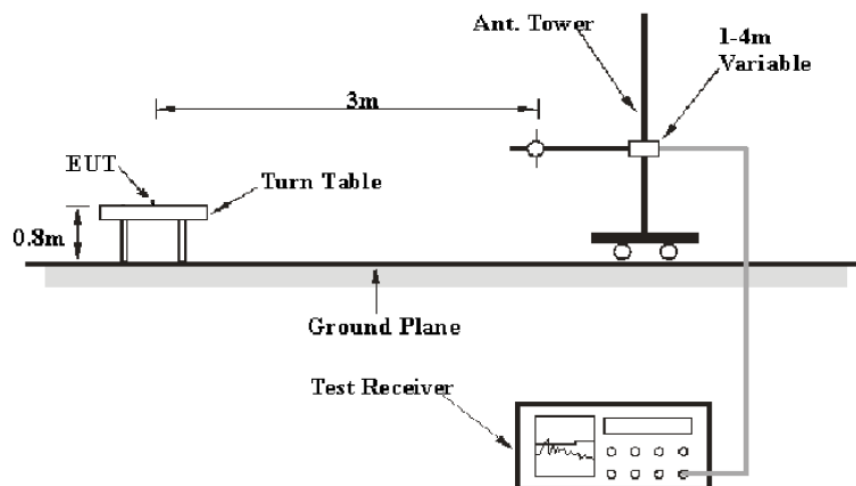
(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

EUT Setup



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.10. The specification used was the FCC Part Subpart C limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

According to FCC Rules, 47 CFR 15.33, the EUT emissions were investigated up to 1000 MHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
9 kHz – 150 kHz	200 Hz	1 kHz	/	QP
150 kHz – 30 MHz	9 kHz	30 kHz	/	QP
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP

Factor & Over Limit Calculation

The Factor is calculated by adding Antenna Factor, Cable Loss and Amplifier Gain. The basic equation is as follows:

$$\text{Factor (dB)} = \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} + \text{Amplifier Gain (dB)}$$

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 margin calculation is as follows:

$$\text{Over Limit (dB)} = \text{Read level (dB}\mu\text{V)} + \text{Factor (dB)} - \text{Limit (dB}\mu\text{V)}$$

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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209, 15.205, 15.225.

Test Data

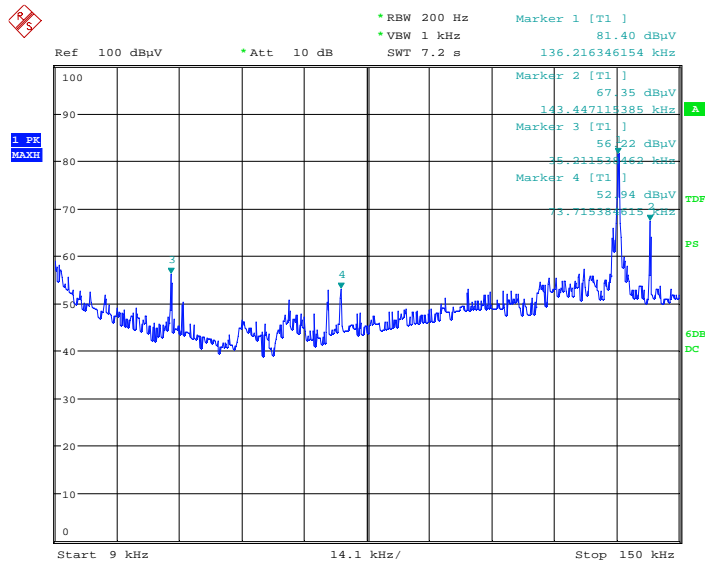
Environmental Conditions

Temperature:	20.4~21.4℃
Relative Humidity:	50~53 %
ATM Pressure:	101.3~101.5 kPa

The testing was performed by Stone Zhang from 2019-12-17 to 2019-12-25.

Test mode: Transmitting

1) Spurious Emissions (9 kHz~150 kHz):



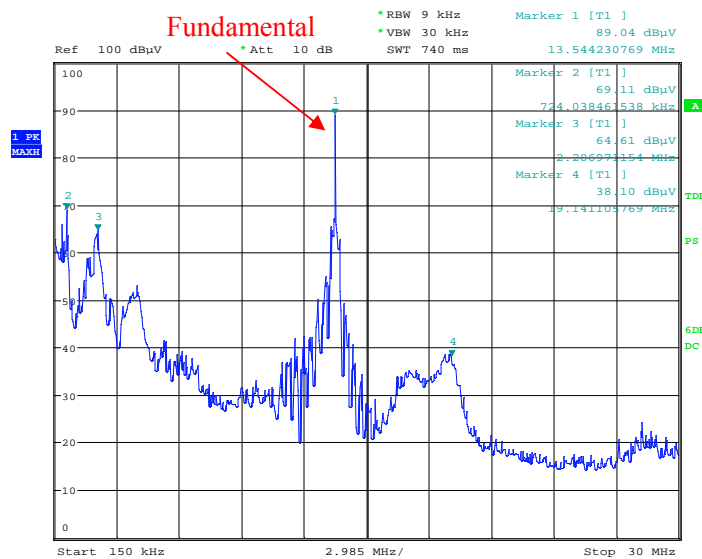
Date: 19.DEC.2019 11:19:08

Frequency (MHz)	Corrected Amplitude (dBμV/m)@3m	Detector PK/QP/Ave.	Corrected Factor (dB/m)	FCC Part 15.225/15.209	
				Limit (dBμV/m)@3m	Margin (dB)
0.03521	56.22	PK	45.85	116.67	60.45
0.06545	52.86	PK	44.53	111.29	58.43
0.07372	61.35	PK	45.89	110.25	48.90
0.08515	48.26	PK	47.77	109.00	60.74
0.13622	81.40	PK	50.71	104.92	23.52
0.14344	70.20	PK	50.81	104.47	34.27

Note: The EMI Test Receiver only can mark 4 points.

Note: The average emissions which fall into frequencies 9-90 kHz, 110-490 kHz was not recorded, because the peak emissions are below the average limit.

2) Spurious Emissions (150 kHz~30 MHz):



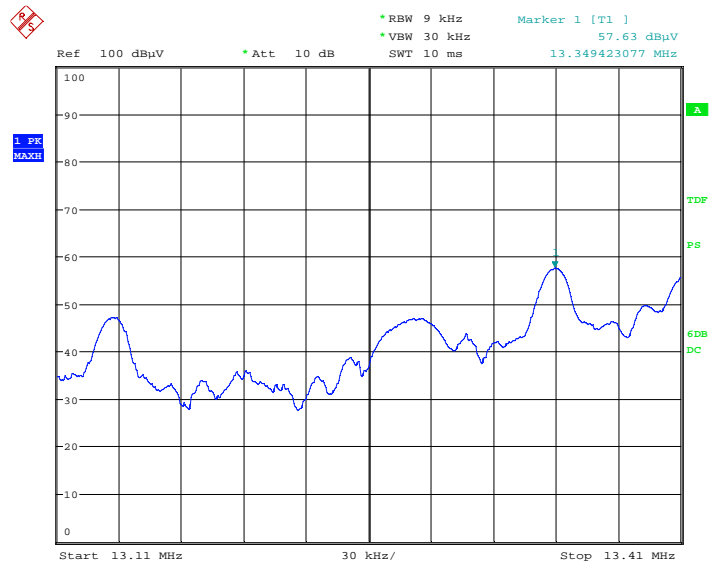
Date: 25.DEC.2019 23:46:38

Frequency (MHz)	Corrected Amplitude (dBμV/m)@3m	Detector PK/QP/Ave.	Corrected Factor (dB/m)	FCC Part 15.225/15.209	
				Limit (dBμV/m)@3m	Margin (dB)
0.72	69.11	PK	20.35	70.41	1.30
2.21	64.61	PK	13.52	69.54	4.93
5.26	56.48	PK	8.01	69.54	13.06
13.56	89.04	PK	6.12	124.00	34.96
19.14	38.10	PK	5.57	69.54	31.44
27.56	24.67	PK	5.24	69.54	44.87

Note: The EMI Test Receiver only can mark 4 points.

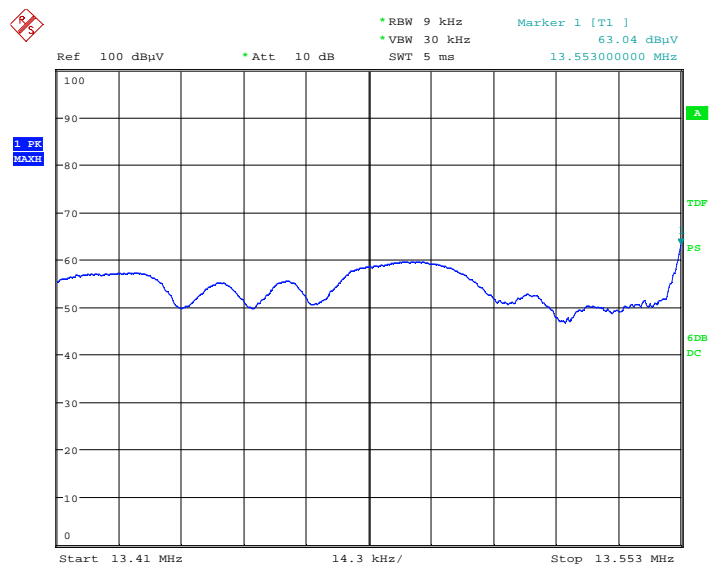
Note: The average emissions which fall into frequencies 9-90 kHz, 110-490 kHz was not recorded, because the peak emissions are below the average limit.

3) Spurious Emissions (13.11MHz~13.41 MHz):



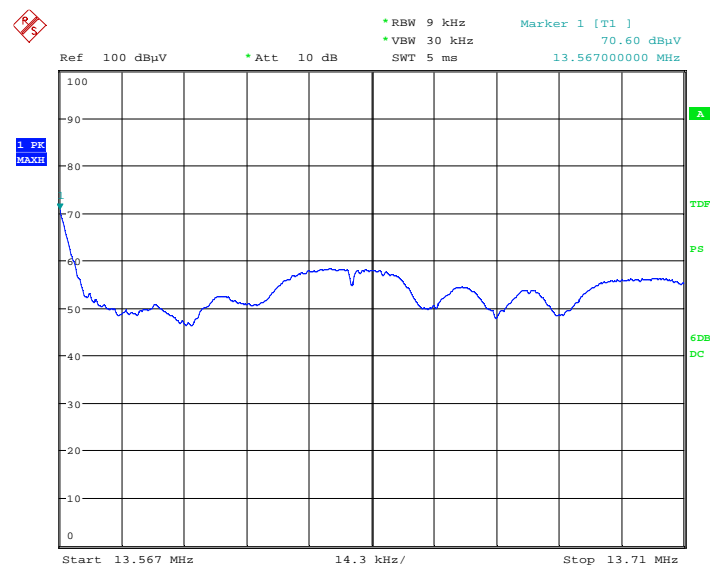
Date: 19.DEC.2019 11:25:48

Spurious Emissions (13.41MHz~13.553 MHz):



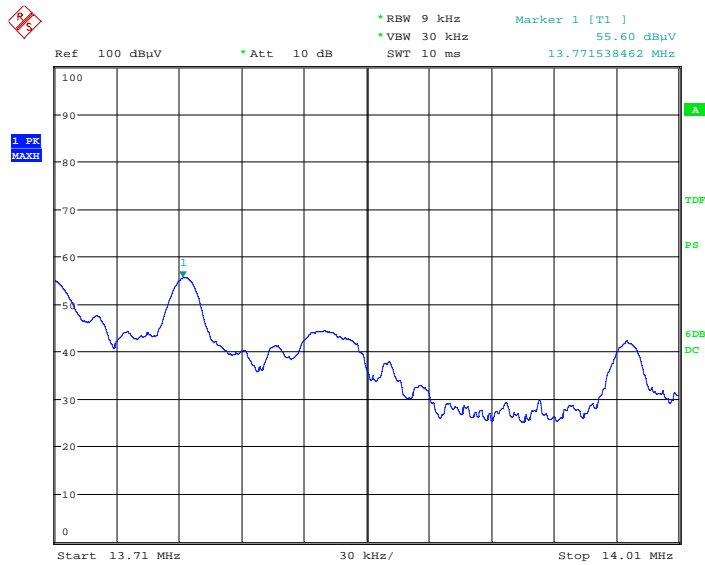
Date: 19.DEC.2019 11:27:05

Spurious Emissions (13.567MHz~13.710 MHz):



Date: 19.DEC.2019 11:27:47

Spurious Emissions (13.710MHz~14.010 MHz):



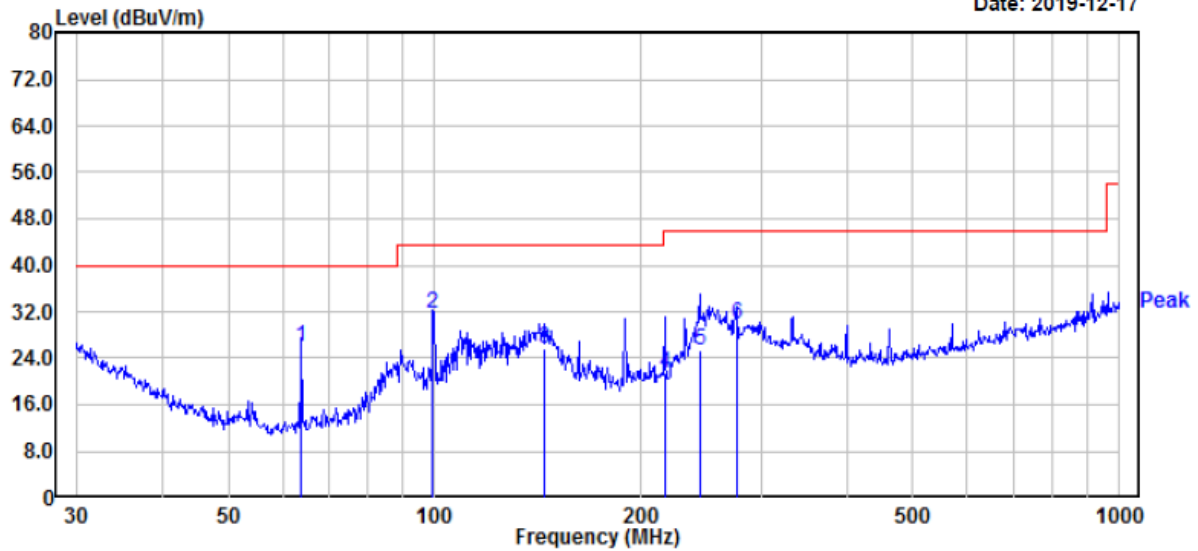
Date: 19.DEC.2019 11:28:51

Frequency (MHz)	Corrected Amplitude (dBμV/m)@3m	Detector PK/QP/Ave.	Corrected Factor (dB/m)	FCC Part 15.225	
				Limit (dBμV/m) @ 3m	Margin (dB)
13.350	57.63	PK	6.14	80.5	22.87
13.553	63.04	PK	6.12	90.5	27.46
13.567	70.60	PK	6.12	90.5	19.90
13.772	55.60	PK	6.09	80.5	24.90

3) Spurious Emissions (30 MHz ~1 GHz):

Horizontal

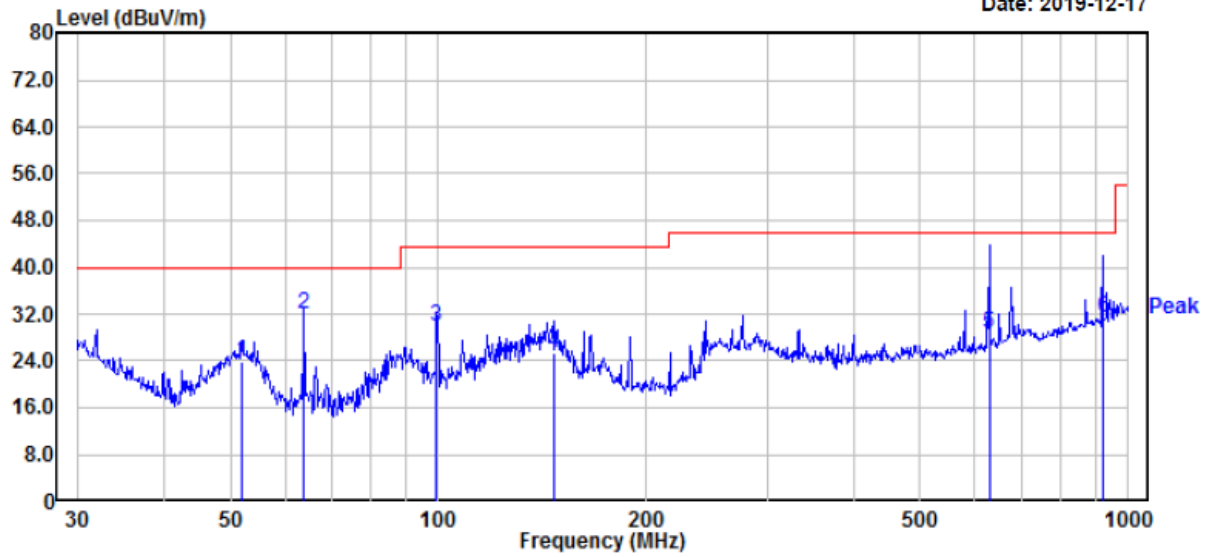
Date: 2019-12-17



		Read			Limit	Over	APos	TPos	Remark
	Freq	Level	Factor	Level	Line	Limit			
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	63.98	43.30	-17.29	26.01	40.00	-13.99	200	58	QP
2	99.53	46.40	-14.74	31.66	43.50	-11.84	200	77	QP
3	144.33	37.40	-11.82	25.58	43.50	-17.92	200	58	QP
4	216.78	34.50	-13.17	21.33	46.00	-24.67	100	166	QP
5	244.23	37.79	-12.48	25.31	46.00	-20.69	100	155	QP
6	276.12	40.59	-10.78	29.81	46.00	-16.19	100	76	QP

Vertical

Date: 2019-12-17



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	APos	TPos	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	51.84	41.00	-17.05	23.95	40.00	-16.05	100	117	QP
2	63.98	49.30	-17.29	32.01	40.00	-7.99	100	117	QP
3	99.53	44.70	-14.74	29.96	43.50	-13.54	100	178	QP
4	147.40	37.10	-11.86	25.24	43.50	-18.26	100	126	QP
5	629.48	32.20	-3.45	28.75	46.00	-17.25	100	10	QP
6	919.29	29.90	1.44	31.34	46.00	-14.66	100	10	QP

Note:

1) Factor (dB) = Antenna Factor (dB/m) + Cable Loss (dB) + Amplifier Gain (dB)

2) Over Limit (dB) = Read level (dBuV) + Factor (dB) - Limit (dBuV)

FCC§15.225(e) - FREQUENCY STABILITY

Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Procedure

a) Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.

b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory agency is the recommended measuring instrument.

c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.

f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

g) Measure the frequency at each of frequencies specified in 5.6.

h) Switch OFF the EUT but do not switch OFF the oscillator heater.

i) Lower the chamber temperature by not more than 10°C , and allow the temperature inside the chamber to stabilize.

j) Repeat step f) through step i) down to the lowest specified temperature.

Test Data**Environmental Conditions**

Temperature:	21.2 °C
Relative Humidity:	50 %
ATM Pressure:	101.3kPa

The testing was performed by Stone Zhang on 2019-12-19.

Test Mode: Transmitting.

Test Result: Pass

F₀=13.56MHz				
Power Supply(V_{DC})	Temperature (°C)	Measured Frequency (MHz)	Frequency Error (%)	Part 15.225 Limit
12.0	-20	13.5607183	0.00530	±0.01%
	-10	13.5607138	0.00526	±0.01%
	+0	13.5607118	0.00525	±0.01%
	+10	13.5607106	0.00524	±0.01%
	+20	13.5606892	0.00508	±0.01%
	+30	13.5606865	0.00506	±0.01%
	+40	13.5606842	0.00505	±0.01%
	+50	13.5605489	0.00405	±0.01%
10.2	+20	13.5608265	0.00610	±0.01%
13.8	+20	13.5606742	0.00497	±0.01%

§15.215(c) - 20dB EMISSION BANDWIDTH TESTING

Requirement

Per 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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 it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

Test Data

Environmental Conditions

Temperature:	21.2 °C
Relative Humidity:	50 %
ATM Pressure:	101.3kPa

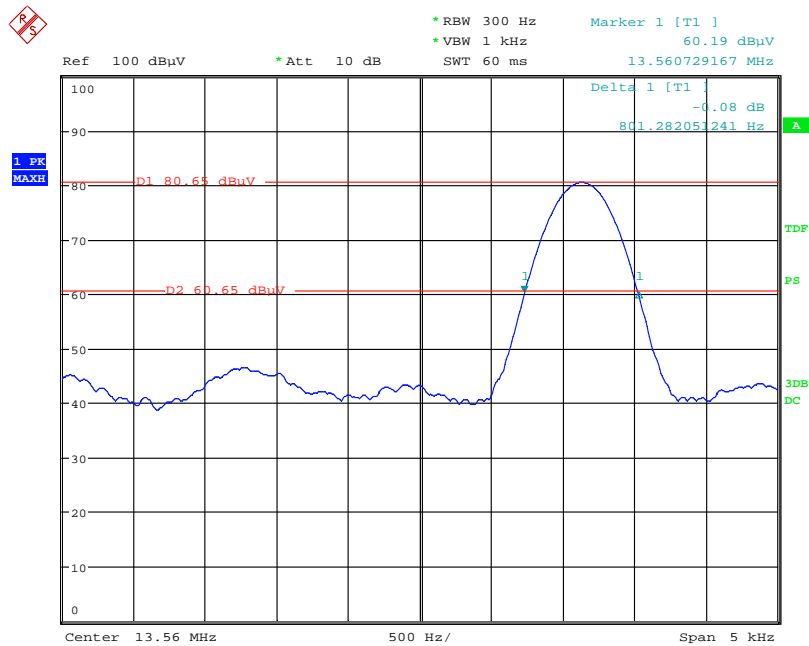
The testing was performed by Stone Zhang on 2019-12-19.

Test Mode: Transmitting

Test Result: Pass.

Frequency (MHz)	20 dB Bandwidth (kHz)
13.56	0.801

20 dB Emission Bandwidth



Date: 19.DEC.2019 11:31:18

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