

FCC PART 15.249

TEST REPORT

For

Shenzhen Rapoo Technology Co., Ltd.

22, Jinxiu Road East, Pingshan District, Shenzhen, China

FCC ID: PP2UA3500

Report Type: Original Report		Product Type: Aircraft	
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Report Number:	RDG150331003-00		
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Shenzhen Rapoo Technology Co., Ltd.*'s product, model number: *UA3500 (FCC ID: PP2UA3500)* (the "EUT") in this report was a *Aircraft*, which was measured approximately: 30 cm (L) x 30 cm (W) x 16 cm (H), rated input voltage: 11.1V from battery.

All measurement and test data in this report was gathered from production sample serial number: 150331003 (Assigned by BACL, Dongguan). The EUT was received on 2015-04-02.

Objective

This type approval report is prepared on behalf of *Shenzhen Rapoo Technology Co., Ltd.* in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communications Commission's 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 15.249 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan).

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in Engineering Mode, which was provided by the manufacturer. The engineering mode was configured as maximum power by default setting and switched the channel by key.

64 channels were provided by the manufacturer:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	5731	17	5747	33	5763	49	5779
2	5732	18	5748	34	5764	50	5780
...	...	...	...	...	...	...	...
...	...	26	5756	...	...	...	...
...	...	...	...	...	...	...	...
15	5745	31	5761	47	5777	63	5793
16	5746	32	5762	48	5778	64	5794

The manufacturer provided the channel 5731 MHz, 5756 MHz and 5794 MHz for test.

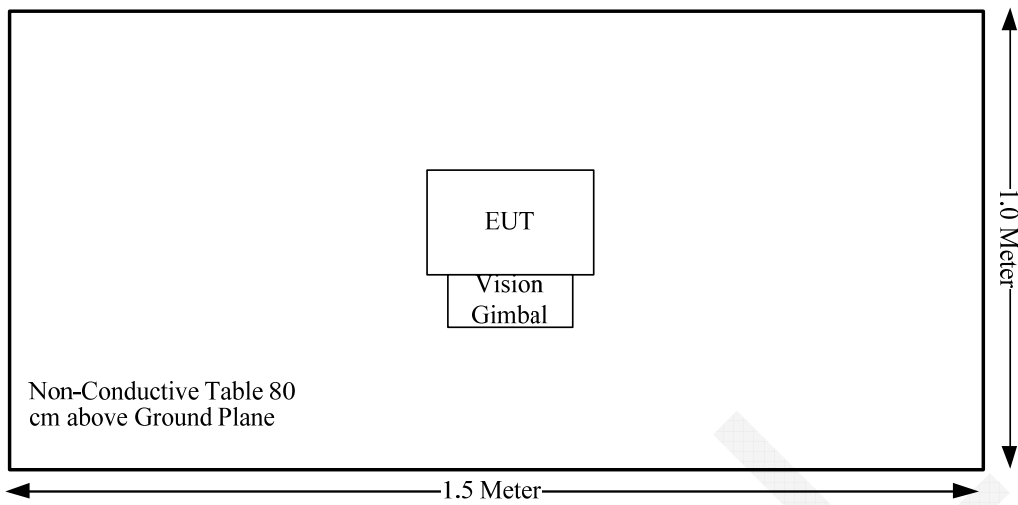
EUT Exercise Software

No software was used during the test.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Rapoo	Vision Gimbal	VG0300	150331006

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Not Applicable
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance
§15.249(d)	Outside of Band Emission (50dB attenuation)	Compliance

Not Applicable: The EUT is battery operated equipment.

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, 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.

Antenna Connector Construction

The EUT have two internal antennas arrangement one for transmitting and one for receiving, and the antenna gain is 2.7 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cisprr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cisprr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisprr})$, exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisprr})$, exceeds the disturbance limit.

Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:

30M~200MHz: 5.0 dB

200M~1GHz: 6.2 dB

1G~6GHz: 4.45 dB

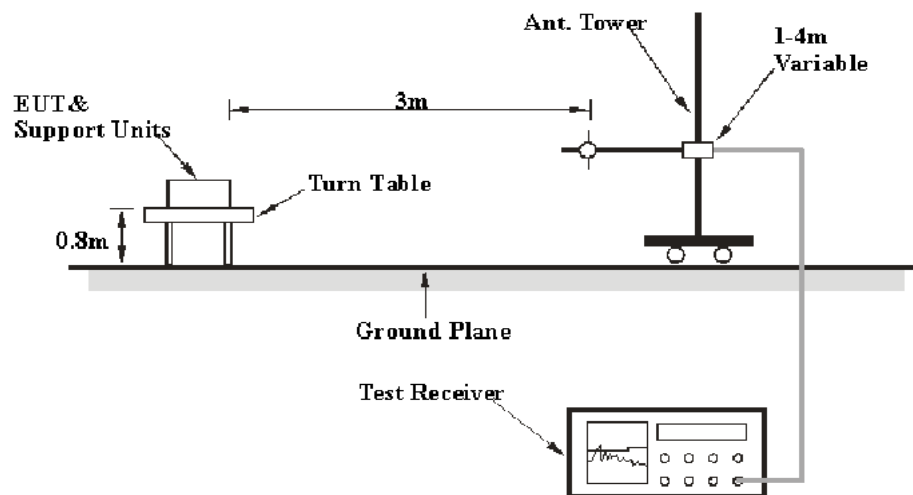
6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

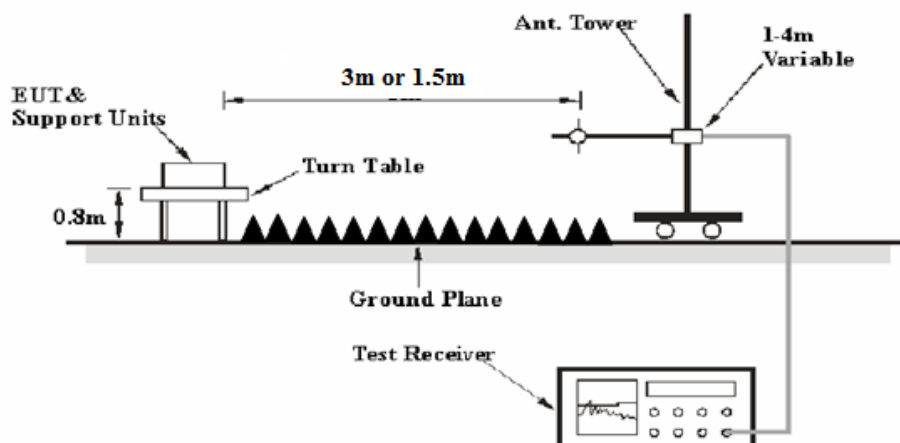
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

Test Equipment Setup

The system was investigated from 30 MHz to 40 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were 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 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

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

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

According to C63.4, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m

Distance extrapolation factor = $20 \log (\text{specific distance [3m]}/\text{test distance [1.5m]})$ dB

Extrapolation result = Corrected Amplitude (dB μ V/m) - distance extrapolation factor (6dB)

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 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:

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2014-05-09	2015-05-09
Sunol Sciences	Antenna	JB3	A060611-3	2014-07-28	2017-07-27
HP	Amplifier	8447E	2434A02181	2014-09-01	2015-09-01
R&S	Spectrum Analyzer	E4440A	SG43360054	2014-12-04	2015-12-04
ETS-Lindgren	Horn Antenna	3115	000 527 35	2012-09-06	2015-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2015-02-19	2016-02-19
R&S	Spectrum Analyzer	FSP 38	100478	2014-05-09	2015-05-09
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2014-06-16	2017-06-15
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2014-06-16	2017-06-15
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2014-09-06	2015-09-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 & 15.205 & 15.249, with the worst margin reading of:

3.66 dB at 5731 MHz in the Vertical polarization

Test Data**Environmental Conditions**

Temperature:	26.9°C
Relative Humidity:	67 %
ATM Pressure:	100.1kPa

The testing was performed by Allen Qiao on 2015-04-04.

Test Mode: Transmitting (the test distance is 1.5m for above 1GHz, 3m for below 1GHz)

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB(1/m))						
Frequency: 5731MHz										
5731	70.24	PK	H	32.15	5.57	0.00	107.96	101.96	114.00	12.04
5731	53.67	AV	H	32.15	5.57	0.00	91.39	85.39	94.00	8.61
5731	75.88	PK	V	32.15	5.57	0.00	113.60	107.60	114.00	6.40
5731	58.62	AV	V	32.15	5.57	0.00	96.34	90.34	94.00	3.66 *
5715	30.56	PK	V	32.15	5.60	0.00	68.31	62.31	74.00	11.69
5715	16.02	AV	V	32.15	5.60	0.00	53.77	47.77	54.00	6.23
10360	34.26	PK	V	36.97	8.36	25.52	54.07	48.07	74.00	25.93
10360	21.36	AV	V	36.97	8.36	25.52	41.17	35.17	54.00	18.83
17193	31.18	PK	V	40.66	13.93	25.61	60.16	54.16	74.00	19.84
17193	19.58	AV	V	40.66	13.93	25.61	48.56	42.56	54.00	11.44
1363	33.64	PK	V	23.24	3.16	26.96	33.08	27.08	74.00	46.92
1363	30.12	AV	V	23.24	3.16	26.96	29.56	23.56	54.00	30.44
2674	35.16	PK	V	26.35	4.63	27.47	38.67	32.67	74.00	41.33
2674	22.28	AV	V	26.35	4.63	27.47	25.79	19.79	54.00	34.21
341.37	45.40	QP	H	14.86	2.20	21.62	40.84	40.84	46.00	5.16
Frequency: 5756MHz										
5756	68.88	PK	H	32.15	5.50	0.00	106.53	100.53	114.00	13.47
5756	53.02	AV	H	32.15	5.50	0.00	90.67	84.67	94.00	9.33
5756	74.88	PK	V	32.15	5.50	0.00	112.53	106.53	114.00	7.47
5756	58.38	AV	V	32.15	5.50	0.00	96.03	90.03	94.00	3.97 *
10400	33.58	PK	V	36.98	8.32	25.50	53.38	47.38	74.00	26.62
10400	20.74	AV	V	36.98	8.32	25.50	40.54	34.54	54.00	19.46
15600	30.62	PK	V	37.32	14.69	24.69	57.94	51.94	74.00	22.06
15600	19.03	AV	V	37.32	14.69	24.69	46.35	40.35	54.00	13.65
1363	33.22	PK	V	23.24	3.16	26.96	32.66	26.66	74.00	47.34
1363	29.48	AV	V	23.24	3.16	26.96	28.92	22.92	54.00	31.08
2674	34.54	PK	V	26.35	4.63	27.47	38.05	32.05	74.00	41.95
2674	21.74	AV	V	26.35	4.63	27.47	25.25	19.25	54.00	34.75
216.24	27.10	QP	V	11.42	1.78	21.47	18.83	18.83	40.00	21.17
341.37	45.10	QP	H	14.86	2.20	21.62	40.54	40.54	46.00	5.46
Frequency: 5794MHz										
5794	68.78	PK	H	32.16	5.46	0.00	106.40	100.40	114.00	13.60
5794	51.36	AV	H	32.16	5.46	0.00	88.98	82.98	94.00	11.02
5794	74.61	PK	V	32.16	5.46	0.00	112.23	106.23	114.00	7.77
5794	58.11	AV	V	32.16	5.46	0.00	95.73	89.73	94.00	4.27
5875	28.13	PK	V	32.18	5.97	0.00	66.28	60.28	74.00	13.72
5875	15.44	AV	V	32.18	5.97	0.00	53.59	47.59	54.00	6.41
10480	33.05	PK	V	37.00	8.23	26.01	52.27	46.27	74.00	27.73
10480	20.08	AV	V	37.00	8.23	26.01	39.30	33.30	54.00	20.70
15720	30.13	PK	V	37.10	14.20	24.92	56.51	50.51	74.00	23.49
15720	18.40	AV	V	37.10	14.20	24.92	44.78	38.78	54.00	15.22
1363	32.79	PK	V	23.24	3.16	26.96	32.23	26.23	74.00	47.77
1363	29.01	AV	V	23.24	3.16	26.96	28.45	22.45	54.00	31.55
2674	33.85	PK	V	26.35	4.63	27.47	37.36	31.36	74.00	42.64
2674	21.25	AV	V	26.35	4.63	27.47	24.76	18.76	54.00	35.24
341.37	44.90	QP	H	14.86	2.20	21.62	40.34	40.34	46.00	5.66

*Within measurement uncertainty!

FCC §15.215(c) – 20 dB BANDWIDTH TESTING**Applicable Standard**

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.

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 on the test table without connection to measurement instrument. Turn on the EUT. 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.
4. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2014-05-09	2015-05-09

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	25.6°C
Relative Humidity:	53 %
ATM Pressure:	101.4kPa

* The testing was performed by Allen Qiao on 2015-04-08.

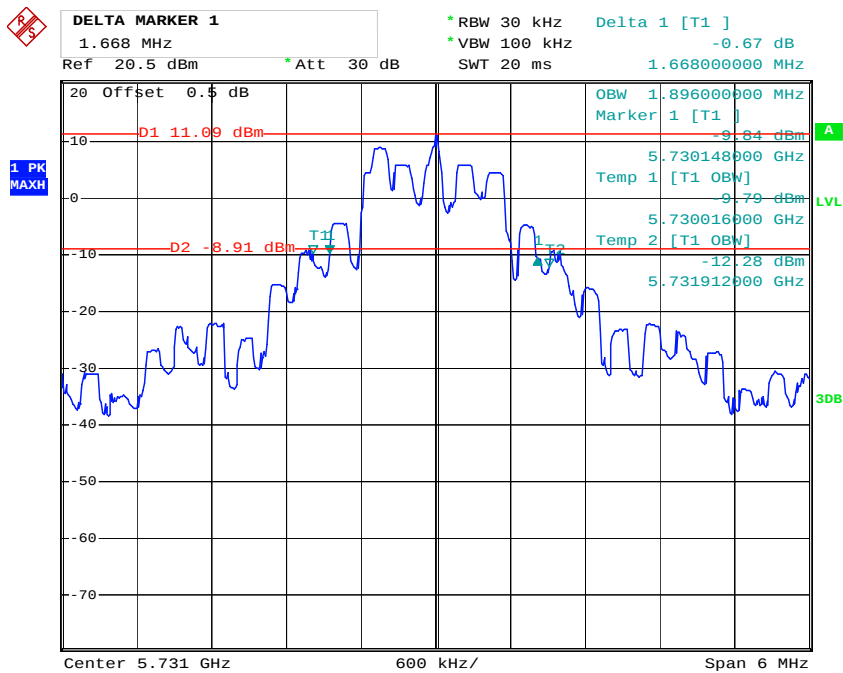
Test Result: Compliant.

Please refer to following tables and plots

Test Mode: Transmitting

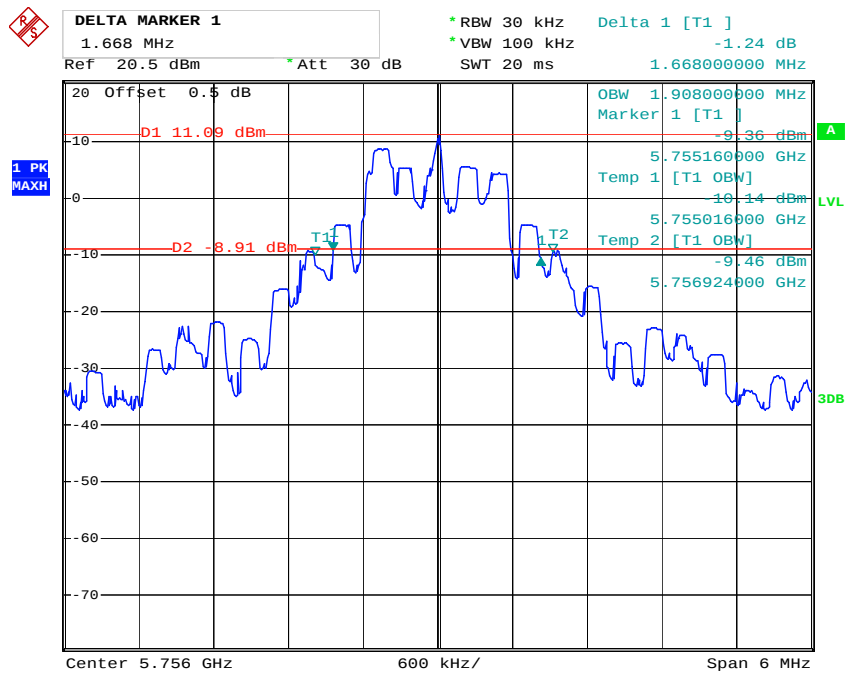
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	5731	1.668
Middle	5756	1.668
High	5794	1.680

Low Channel



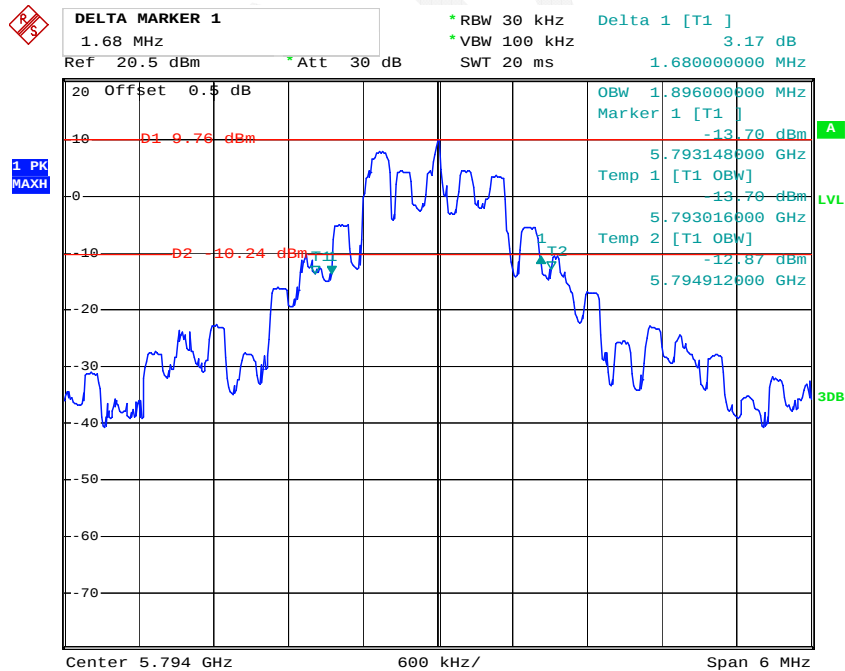
Date: 8.APR.2015 15:17:25

Middle Channel



Date: 8.APR.2015 15:19:26

High Channel



Date: 8.APR.2015 15:15:14

FCC§15.249(d) - OUT OF BAND EMISSION (50 dB ATTENUATION)

Applicable Standard

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation

Test Procedure

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2014-05-09	2015-05-09

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	25.6 °C
Relative Humidity:	53 %
ATM Pressure:	101.4kPa

* The testing was performed by Allen Qiao on 2015-04-08.

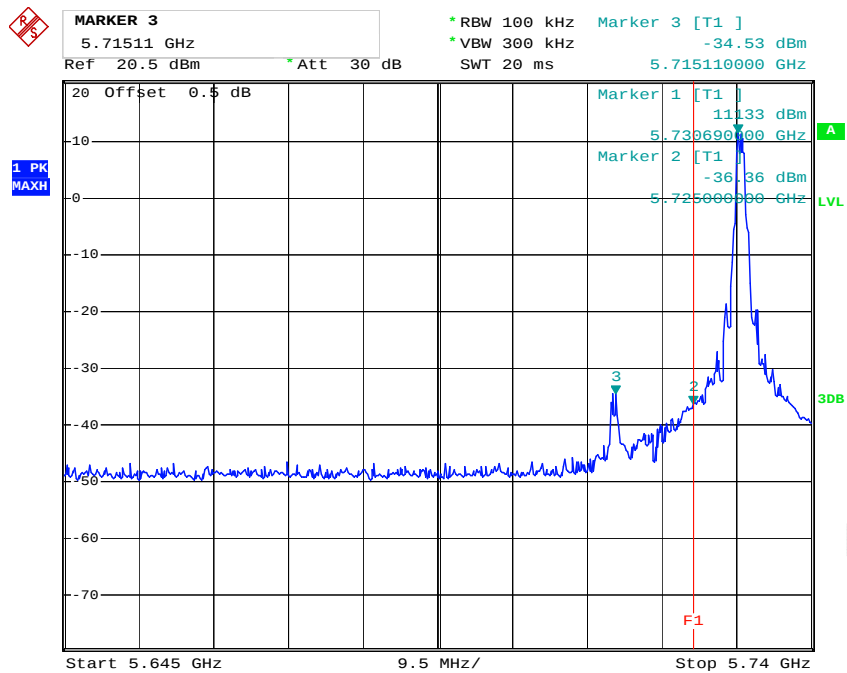
Test Result: Compliant.

Please refer to the following table and plots:

Band Edge	Delta Peak to Band Emission (dBc)	Delta Limit (dBc)
Left	45.86 ^{note}	50
Right	57.16	50

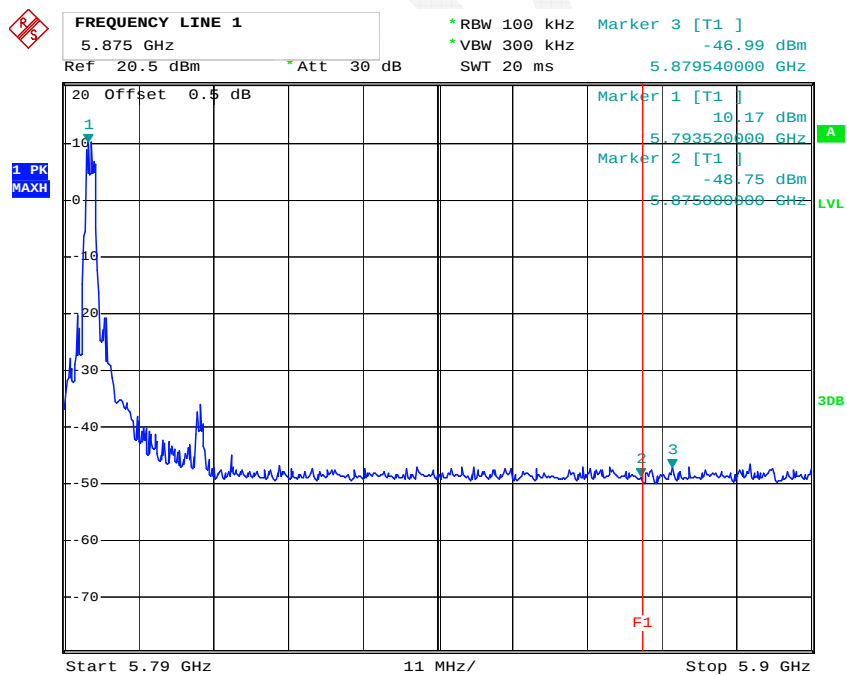
Note: The left band emission compliant with the general radiated emission limits in §15.209, please refer to radiated emissions test section.

Band Edge, Left Side



Date: 8.APR.2015 15:25:42

Band Edge, Right Side



Date: 8.APR.2015 15:23:10

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