

FCC PART 15.249

TEST REPORT

For

Shenzhen Rapoo Technology Co., Ltd.

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

FCC ID: PP2KX

Report Type: Original Report		Product Type: Mechanical Keyboard	
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Report Number:	R2DG140227005-00		
Report Date:	2014-04-26		
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Shenzhen Rapoo Technology Co., Ltd.* 's product, model number: *KX (FCC ID: PP2KX)* (the "EUT") in this report was a *Mechanical Keyboard*, which was measured approximately: 32.4 cm (L) x 12.6 cm (W) x 2.5 cm (H), rated input voltage: DC3.7V rechargeable Li-ion battery.

* All measurement and test data in this report was gathered from production sample serial number: 140227005 (Assigned by BACL, Dongguan). The EUT was received on 2014-03-03.

Objective

This type approval report was 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 C63.4-2003, 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 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

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 and switched the channels by keys.

16 channels were provided by the manufacturer:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	5727	5	5750	9	5771	13	5786
2	5730	6	5753	10	5776	14	5790
3	5734	7	5756	11	5779	15	5792
4	5738	8	5759	12	5782	16	5794

EUT was tested with Channel 5727 MHz, 5771 MHz and 5794 MHz.

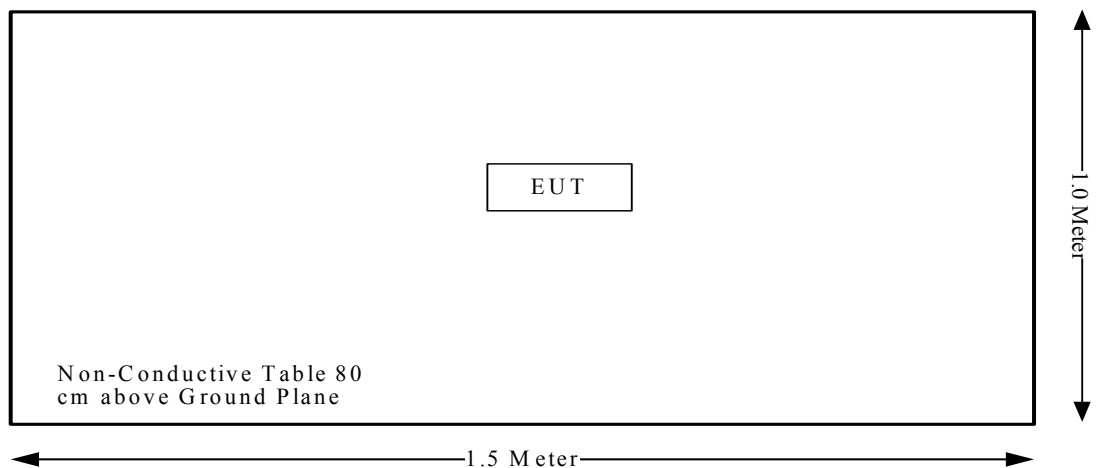
EUT Exercise Software

No software was used in the test.

Equipment Modifications

No modifications were made to the unit tested.

Configuration 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
FCC§15.249(d)	Out of band emission (50dB attenuation)	Compliance

Not Applicable*: the EUT was powered by battery only under wireless mode.

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 has one integral antenna arrangement and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the internal 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_{cispr} 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_{cispr} of Table 1, then:

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

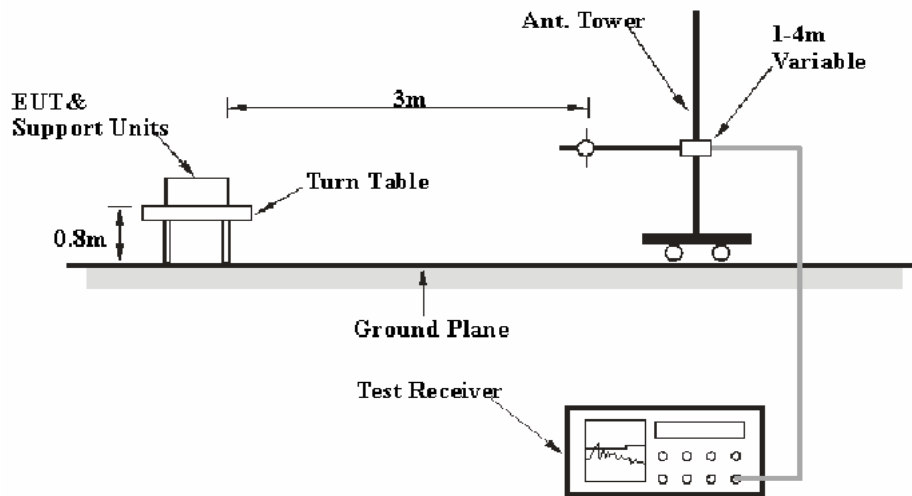
6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

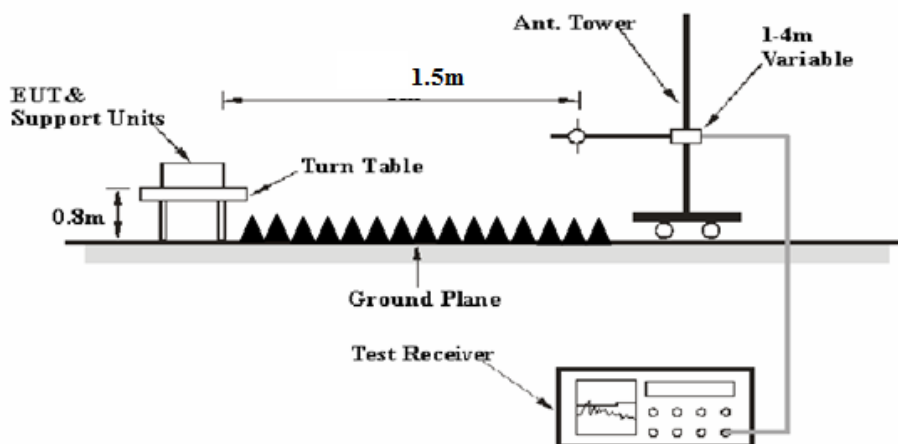
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission and out of band emission tests use the setup accordance with the ANSI C63.4-2003. 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	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Ave.

Test Procedure

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

The Radiated measurements was performed, the EIRP converted to field strength as follows:

$$\text{EIRP[dBm]} = \text{E[dB}\mu\text{V/m]} + 20 \log(\text{d[meters]}) - 104.77$$

Or, if d is 3 meters:

$$\text{EIRP[dBm]} = \text{E[dB}\mu\text{V/m]} - 95.2$$

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)

or Limit line = Specific limits(dB μ V) + 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:

$$\text{Margin} = \text{Limit} - \text{Extrapolation result}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2013-05-06	2014-05-05
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
HP	Amplifier	8447E	2434A02181	2013-09-06	2014-09-05
ETS LINDGREN	Horn Antenna	3115	000 527 35	2012-09-06	2015-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2014-02-19	2015-02-18
R&S	Spectrum Analyzer	FSP 38	100478	2013-06-16	2014-06-15
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2013-06-16	2014-06-15
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2013-06-16	2014-06-15
Quinstar	Amplifier	QLW- 18405536-JO	15964001001	2013-09-06	2014-09-05

* **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:

11.01 dB at 17181 MHz in the Vertical polarization

Test Data

Environmental Conditions

Temperature:	22.7 °C
Relative Humidity:	71 %
ATM Pressure:	101 kPa

* The testing was performed by Allen Qiao on 2014-04-25.

Test Mode: Transmitting

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m @1.5m)	Extrapolation result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB(1/m))						
Low channel: 5727 MHz										
5727	63.36	PK	H	32.15	6.04	26.62	74.93	68.93	114.00	45.07
5727	40.67	AV	H	32.15	6.04	26.62	52.24	46.24	94.00	47.76
5727	70.61	PK	V	32.15	6.04	26.62	82.18	76.18	114.00	37.82
5727	48.72	AV	V	32.15	6.04	26.62	60.29	54.29	94.00	39.71
5725	52.74	PK	V	32.15	6.04	26.63	64.30	58.30	74.00	15.70
5725	26.98	AV	V	32.15	6.04	26.63	38.54	32.54	54.00	21.46
11454	40.09	PK	V	37.85	9.79	26.17	61.56	55.56	74.00	18.44
11454	20.69	AV	V	37.85	9.79	26.17	42.16	36.16	54.00	17.84
17181	31.78	PK	V	40.59	14.31	25.58	61.10	55.10	74.00	18.90
17181	19.67	AV	V	40.59	14.31	25.58	48.99	42.99	54.00	11.01
5711	30.18	PK	V	32.14	5.99	26.64	41.67	35.67	74.00	38.33
5711	18.74	AV	V	32.14	5.99	26.64	30.23	24.23	54.00	29.77
5724.9	44.86	PK	V	32.14	6.03	26.63	56.40	50.40	74.00	23.60
5724.9	23.35	AV	V	32.14	6.03	26.63	34.89	28.89	54.00	25.11
287.4	30.54	QP	V	13.87	2.04	21.51	/	24.94	46.00	21.06
Middle channel: 5771 MHz										
5771	63.48	PK	H	32.15	6.12	26.57	75.18	69.18	114.00	44.82
5771	40.98	AV	H	32.15	6.12	26.57	52.68	46.68	94.00	47.32
5771	69.65	PK	V	32.15	6.12	26.57	81.35	75.35	114.00	38.65
5771	47.79	AV	V	32.15	6.12	26.57	59.49	53.49	94.00	40.51
2581	34.21	PK	V	26.11	4.63	27.41	37.54	31.54	74.00	42.46
2581	21.42	AV	V	26.11	4.63	27.41	24.75	18.75	54.00	35.25
7387	33.29	PK	V	34.53	7.55	25.86	49.51	43.51	74.00	30.49
7387	20.81	AV	V	34.53	7.55	25.86	37.03	31.03	54.00	22.97
1735	35.15	PK	V	24.07	3.60	27.62	35.20	29.20	74.00	44.80
1735	22.14	AV	V	24.07	3.60	27.62	22.19	16.19	54.00	37.81
11542	40.14	PK	V	37.90	9.81	26.10	61.75	55.75	74.00	18.25
11542	22.43	AV	V	37.90	9.81	26.10	44.04	38.04	54.00	15.96
17313	31.64	PK	V	41.38	13.60	25.63	60.99	54.99	74.00	19.01
17313	19.11	AV	V	41.38	13.60	25.63	48.46	42.46	54.00	11.54
287.4	30.25	QP	V	13.87	2.04	21.51	/	23.55	46.00	22.45

High channel: 5794 MHz										
5794	63.02	PK	H	32.16	6.13	26.55	74.76	68.76	114.00	45.24
5794	40.28	AV	H	32.16	6.13	26.55	52.02	46.02	94.00	47.98
5794	69.62	PK	V	32.16	6.13	26.55	81.36	75.36	114.00	38.64
5794	47.37	AV	V	32.16	6.13	26.55	59.11	53.11	94.00	40.89
5875	31.61	PK	V	32.18	6.31	26.75	43.35	37.35	74.00	36.65
5875	20.23	AV	V	32.18	6.31	26.75	31.97	25.97	54.00	28.03
11588	40.69	PK	V	37.90	9.73	26.06	62.26	56.26	74.00	17.74
11588	21.49	AV	V	37.90	9.73	26.06	43.06	37.06	54.00	16.94
17382	31.21	PK	V	41.79	13.23	25.63	60.60	54.60	74.00	19.40
17382	19.55	AV	V	41.79	13.23	25.63	48.94	42.94	54.00	11.06
2008	35.38	PK	V	24.62	3.84	27.47	36.37	30.37	74.00	43.63
2008	23.85	AV	V	24.62	3.84	27.47	24.84	18.84	54.00	35.16
7145	32.16	PK	V	33.95	7.42	26.00	47.53	41.53	74.00	32.47
7145	21.86	AV	V	33.95	7.42	26.00	37.23	31.23	54.00	22.77
2140	34.85	PK	V	24.96	4.11	27.35	36.57	30.57	74.00	43.43
2140	23.37	AV	V	24.96	4.11	27.35	25.09	19.09	54.00	34.91
287.4	30.31	QP	V	13.87	2.04	21.51	/	24.71	46.00	21.29

FCC§15.249(d) - OUT OF BAND EMISSION (50dB 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	2013-06-16	2014-06-15

* **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:	22.7 °C
Relative Humidity:	71 %
ATM Pressure:	101 kPa

* The testing was performed by Allen Qiao on 2014-04-25.

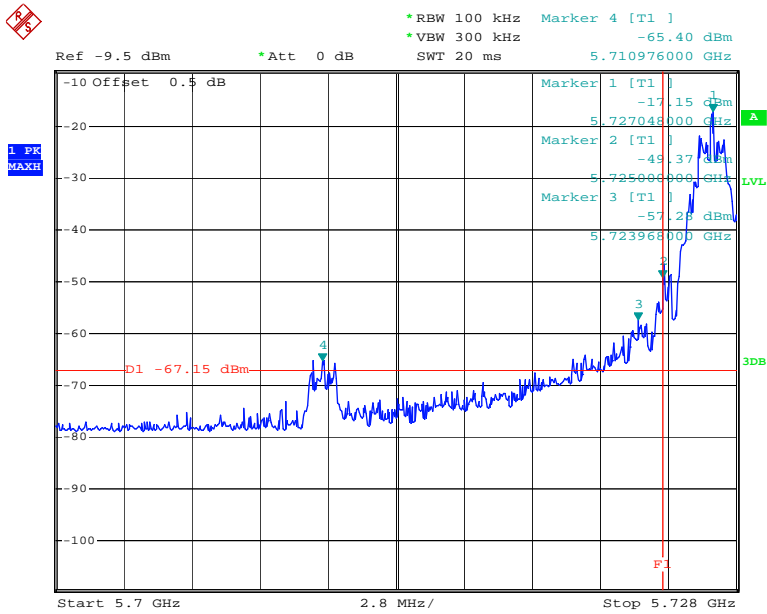
Test Result: Compliance.

Please refer to the following table and plots:

Frequency (MHz)	Delta Peak to Band Emission (dBc)	Delta Limit (dBc)
5725	32.22 (note)	50
5875	58.51	50

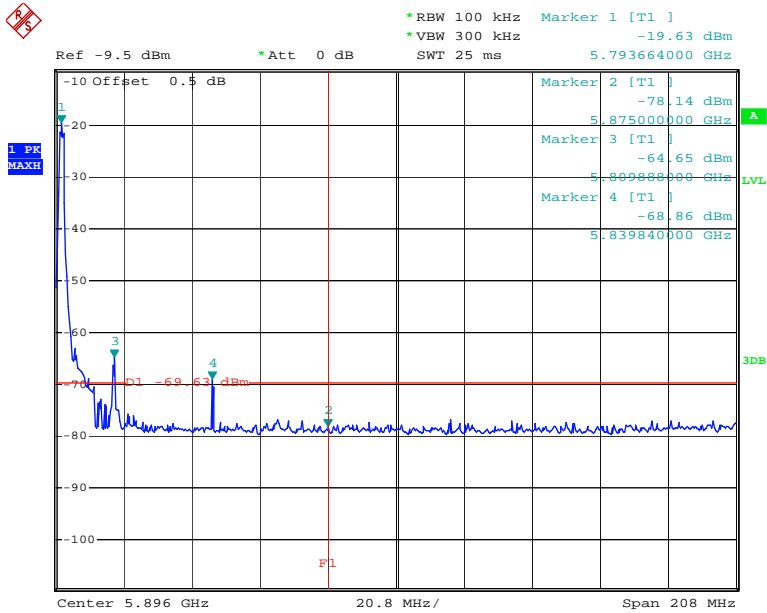
note: The delta peak to band emission compliance with 15.209 requirement

Band Edge, Left Side



Date: 25.APR.2014 14:43:51

Band Edge, Right Side



Date: 25.APR.2014 14:54:39

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