EMC TEST REPORT for Intentional Radiator

No. SH12030205-001

Applicant	: Greenwave Reality Pte Ltd 41 Science Park Road, #03-01, The Gemini, Science Park II, Singapore 117610 Singapore
Manufacturer	: Leeleds Lighting (Xiamen) Co.,Ltd. Huli Branch No.5-7, Second Fanghu West Road, Huli District, Xiamen, China
Product Name	: Touch Remote Control
Type/Model	: CT1UV-Y-XX ("U" stands for "0-9/A-Z"; "V" stands for "0-9; "Y" stands for "0-9/A-Z"; "XX" stands for "00-99/AA-ZZ")

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2010): Radio Frequency Devices

ANSIC63.4 (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

RSS-210 Issue 8 (December 2010): Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

RSS-Gen Issue 3 (December 2010): General Requirements and Information for the Certification of Radiocommunication Equipment

Date of issue: March 27, 2012

Prepared by:

Wakeyou Wang (*Project Engineer*)

Reviewed by:

Daniel Zhao (*Reviewer*)

Description of Test Facility

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Content

1. General Information

1.1 Applicant Information

Applicant:	Greenwave Reality Pte Ltd 41 Science Park Road, #03-01, The Gemini, Science Park II, Singapore 117610 Singapore
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Manufacturer:	Leeleds Lighting (Xiamen) Co.,Ltd. Huli Branch No.5-7, Second Fanghu West Road, Huli District, Xiamen, China
Sample received date:	March 5, 2012
Date of test:	March 5, 2012 ~ March 27, 2012

1.2 Identification of the EUT

Equipment:	Touch Remote Control
Type/model:	CT1UV-Y-XX ("U" stands for "0-9/A-Z"; "V" stands for "0-9; "Y" stands for "0-9/A-Z"; "XX" stands for "00-99/AA-ZZ")
FCC ID:	Z3M-GCT10
IC:	10257A-GCT10

1.3 Technical specification

Operation Frequency Band:	2405 - 2480MHz
Modulation:	O-QPSK
Antenna Designation:	PCB antenna
Gain of Antenna:	0.5dBi
Rating:	Battery DC 2*1.5V
Description of EUT:	There are a series of models. They are electrically identical except for different outside view / color. Therefore, one of them was chosen in random to perform test as representative. The EUT is a wireless remote controller. (IEEE 802.15.4 compliant transceiver)

Channel Description:

Channel Identifier	Frequency (MHz)	Channel Identifier	Frequency (MHz)
1	2405	9	2445
2	2410	10	2450
3	2415	11	2455
4	2420	12	2460
5	2425	13	2465
6	2430	14	2470
7	2435	15	2475
8	2440	16	2480

1.4 Mode of operation during the test / Test peripherals used

While testing transmitter mode of the EUT, the internal modulation was applied.
For the EUT can be used in any axes as the user wants, it was set up in three axis (X, Y, Z) while the antenna always was kept vertically and performed test. The three axes were tested one by one while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded.

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESIB 26	R&S	EC 3045	2011-10-21	2012-10-20
Semi-anechoic chamber	-	Albatross project	EC 3048	2011-5-21	2012-5-20
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2011-5-16	2013-5-15
Horn antenna	HF 906	R&S	EC 3049	2011-5-13	2013-5-12
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2011-4-12	2012-4-11
Test Receiver	ESCS 30	R&S	EC 2107	2011-10-21	2012-10-20
A.M.N.	ESH2-Z5	R&S	EC 3119	2012-1-9	2013-1-8
A.M.N.	ESH3-Z5	R&S	EC 2109	2012-1-10	2013-1-9
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2012-2-8	2013-2-7
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2012-2-8	2013-2-7
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2012-2-8	2013-2-7
Band Reject Filter	WRCGV 2400/2483-2390/2493-35/10SS	Wainwright	EC4297-4	2012-2-8	2013-2-7
Test Receiver	FSV40	R&S	/	2011-10-21	2012-10-20
Preamplifier	AP-025C	Quietek	QT-AP003	2011-11-25	2012-11-24
Preamplifier	AP-180C	Quietek	CHM-0602013	2011-11-25	2012-11-24
Broad-Band Horn Antenna	BBHA9120D	Schwarzbeck	496	2011-11-25	2012-11-24
Broad-Band Horn Antenna	BBHA9170	Schwarzbeck	294	2011-11-25	2012-11-24

2.2 Test Standard

47CFR Part 15 (2010)
ANSI C63.4 (2003)
RSS-210 Issue 8 (December 2010)
RSS-Gen Issue 3 (December 2010)

2.3 Test Summary

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TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Radiated emission	15.249 & 15.205	RSS-210 Issue 8 Annex A2.9 & Clause 2.2	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	-	Pass
Occupied bandwidth	-	RSS-Gen Issue 3 Clause 4.6.1	Pass
Power line conducted emission	15.207	RSS-Gen Issue 3 Clause 7.2.4	NA

2.4 Data rate VS power

The data rate of EUT is fixed and cannot by adjusted.

3. Radiated emission

Test result: **PASS**

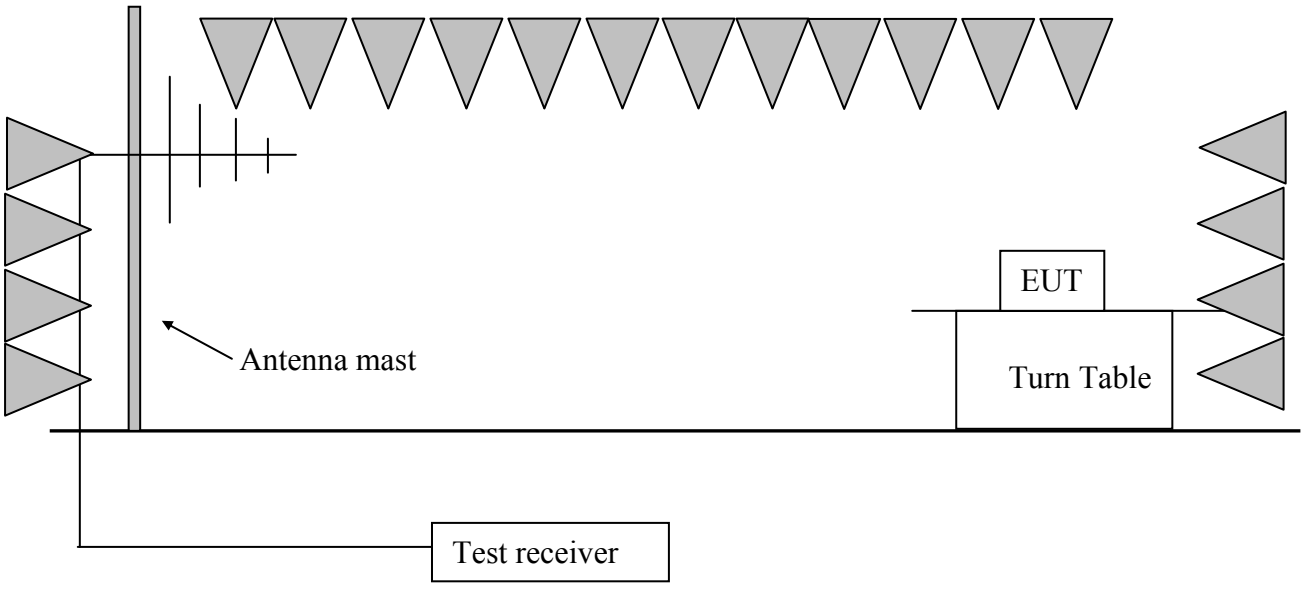
3.1 Test limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
☐902 - 928	94	54
☒2400 - 2483.5	94	54
☐5725 - 5875	94	54
☐24000 - 24250	108	68

The 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) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

3.2 Test Configuration



3.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.
The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 100kHz, VBW = 300kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

3.4 Test protocol

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2405.38	33.40	98.50	114.00	15.50	PK
	V	30.00	20.80	23.00	54.00	31.00	PK
	V	784.22	22.90	29.20	54.00	24.80	PK
	V	2390.00	-8.00	41.10	74.00	32.90	PK
	H	4810.61	-1.50	44.10	74.00	29.90	PK
	V	7214.44	5.40	57.50	74.00	16.50	PK
	V	9619.28	10.90	46.10	74.00	27.90	PK
	V	10945.89	11.50	45.60	74.00	28.40	PK
M	H	2441.35	33.40	97.10	114.00	16.90	PK
	V	30.00	20.80	23.00	54.00	31.00	PK
	V	784.22	22.90	29.20	54.00	24.80	PK
	H	4883.52	-1.50	44.80	74.00	29.20	PK
	V	7325.08	5.40	56.90	74.00	17.10	PK
	V	9621.65	10.90	46.40	74.00	27.60	PK
	V	10968.89	11.50	45.50	74.00	28.50	PK
H	H	2480.90	33.40	96.30	114.00	17.70	PK
	V	30.00	20.80	23.00	54.00	31.00	PK
	V	784.22	22.90	29.20	54.00	24.80	PK
	V	2483.50	-7.80	51.50	74.00	22.50	PK
	H	4961.71	-1.50	43.60	74.00	30.40	PK
	V	7438.28	5.40	57.10	74.00	16.90	PK
	V	9620.85	10.90	46.00	74.00	28.00	PK
	V	10965.33	11.50	45.80	74.00	28.20	PK

Remark: 1.Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for >1GHz)
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit - Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV, limit = 40.00dBuV/m.

Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m; Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

Calculating the AV value according to the duty cycle:

CH	Antenna	Frequency (MHz)	PK Reading (dBuV/m)	Correct Factor (dB)	AV Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)
L	H	2405.38	98.50	-5.80	92.70	94.00	1.30
	V	2390.00	41.10		35.30	54.00	18.70
	H	4810.61	44.10		38.30	54.00	15.70
	V	7214.44	57.50		51.70	54.00	2.30
	V	9619.28	46.10		40.30	54.00	13.70
	V	10945.89	45.60		39.80	54.00	14.20
M	H	2441.35	97.10		91.30	94.00	2.70
	H	4883.52	44.80		39.00	54.00	15.00
	V	7325.08	56.90		51.10	54.00	2.90
	V	9621.65	46.40		40.60	54.00	13.40
	V	10968.89	45.50		39.70	54.00	14.30
H	H	2480.90	96.30		90.50	94.00	3.50
	V	2483.50	51.50		45.70	54.00	8.30
	H	4961.71	43.60		37.80	54.00	16.20
	V	7438.28	57.10		51.30	54.00	2.70
	V	9620.85	46.00		40.20	54.00	13.80
	V	10965.33	45.80		40.00	54.00	14.00

Remark: 1.Correct Factor = 20lg (duty cycle) = 20lg (0.512) = -5.80
2. AV Reading = PK Reading + Correct Factor
3. Margin = limit - AV Reading

4. Assigned bandwidth (20dB bandwidth)

Test result: **PASS**

4.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band as clause 3.1 shows.

4.2 Test Configuration

See clause 3.2.

4.3 Test procedure and test setup

The 20dB Bandwidth per FCC §15.215(c) is measured using the Spectrum Analyzer.

4.4 Test protocol

20dB bandwidth (MHz)	Permitted band (MHz)	Result
2403.82 ~ 2481.16	2400~ 2483.50	Pass

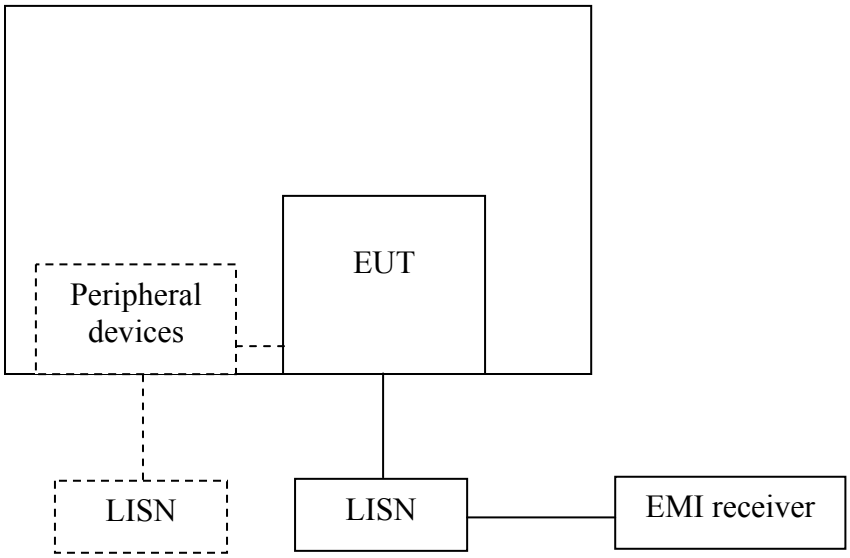
5. Power line conducted emission

Test result: **NA**

5.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

5.2 Test configuration



☐ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

5.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement.
The bandwidth of the test receiver is set at 9 kHz.

5.4 Test protocol

Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).
2. Margin (dB) = Limit - Corrected Reading.

6. Occupied Bandwidth

Test Status: Tested

6.1 Test limit

None

6.2 Test Configuration

See clause 3.2.

6.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 3 Clause 4.6.1 was measured using the Spectrum Analyzer.

6.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

Channel	Occupied Bandwidth (MHz)	Max. reading (MHz)
L	2.10	2.15
M	2.12	
H	2.15	

7. Spurious emission for receiver

Test result: **NA**

7.1 Test limit

The spurious emission shall test through 3 times tuneable or local oscillator frequency whichever is the higher, without exceeding 40 GHz.
1) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2nW per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5nW above 1 GHz.
2) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

7.2 Test Configuration

Please refer to clause 3.2

7.3 Test procedure and test setup

Please refer to clause 3.2

7.4 Test protocol

Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit – Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 = 32.20dB/m; Corrected Reading = 10dBuV + 32.20dB/m = 42.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 42.20dBuV/m, then Margin = 54 -42.20 = 11.80dBuV/m