EMC TEST REPORT
No. SH08030942-002

Applicant	:	Klipsch L.L.C. 3502 Woodview Trace Suite 200, Indianapolis, Indiana, 46268, USA
Manufacturer	:	Hansong (Nanjing) Technology Ltd. 8 Kangping Road, jiangning Econ. And Tech. Development Zone, Nanjing, 211100, China
Equipment	:	Wireless Powered Subwoofer
Type/Model	:	CS-700SUB

SUMMARY

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

47CFR Part 15 (2007): 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 7 (June 2007): Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

RSS-Gen Issue 2 (June 2007): General Requirements and Information for the Certification of Radiocommunication Equipment

Date of issue: April 13, 2008

Tested by:

Wakeyou Wang (*Project Engineer*)

Reviewed by:

Daniel Zhao (*Reviewer*)

Description of Test Facility

Name: Intertek Testing Services Limited Shanghai
Address: Building No.86, 1198 Qinzhou Road(North), Shanghai 200233, P.R. China

FCC Registration Number: 236597
IC Assigned Code: 6201A

Name of contact: Steve Li
Tel: +86 21 64956565 ext. 214
Fax: +86 21 54262335 ext. 214

Content

1. General Information

1.1 Applicant Information

Applicant:	Klipsch L.L.C. 3502 Woodview Trace Suite 200, Indianapolis, Indiana, 46268, USA
Name of contact:	Clinton Bradley
Tel:	317-860-8618
Fax:	317-860-9618
Manufacturer:	Hansong (Nanjing) Technology Ltd. 8 Kangping Road, jiangning Econ. And Tech. Development Zone, Nanjing, 211100, China
Sample received date :	March 27, 2008
Date of test :	March 27, 2008 ~ April 13, 2008

1.2 Identification of the EUT

Equipment:	Wireless Powered Subwoofer
Type/model:	CS-700SUB
FCC ID:	STI-CS700SUB
IC:	5788A-CS700SUB

1.3 Technical specification

Operation Frequency Band:	2400-2483.5MHz
Modulation:	BPSK
Antenna Designation:	Internal omnidirectional antenna
Gain of Antenna:	1.80dBi max.
Rating:	AC 100~120V, 60Hz, 1A
Description of EUT:	Here is one model only. The EUT is a subwoofer. It works together with a "DVD receiver". The "DVD receiver" transmits RF signal and the subwoofer receives. Just after the subwoofer is powered, it transmits a signal to "DVD receiver" to set up linking with each other. After the communication is set up, the subwoofer receives the RF signal from "DVD receiver" and demodulates to be low-frequency audio signal (lower than 100Hz) and sounds out.

Channel Description:

Channel	Central frequency (MHz)
1	2412
2	2438
3	2464

1.4 Mode of operation during the test / Test peripherals used

Within this test report, EUT was tested under 120V/60Hz. The subwoofer has transmitting as well as receiving condition, so both were observed.
The channel 1, 2 and 3 as the lowest, middle and highest channel were tested.

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2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESIB 26	R&S	EC 3045	2007-6-1	2008-5-31
Semi-anechoic chamber	-	Albatross project	EC 3048	2007-6-1	2008-5-31
A.M.N.	ESH2-Z5	R&S	EC 3119	2008-1-23	2009-1-22
Test Receiver	ESCS 30	R&S	EC 2107	2008-1-23	2009-1-22
Ultra-broadband antenna	HL 562	R&S	EC 3046-1	2007-6-30	2008-6-29
Horn antenna	HF 906	R&S	EC 3049	2007-6-30	2008-6-29
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2007-6-30	2008-6-29
Pre-amplifier	Pre-amp 40	Beijing Radio 2	-	2008-3-4	2009-3-3
Horn antenna	K638A	Beijing Radio 2	-	2008-3-4	2009-3-3
Power meter	PM2002	AR	EC3043-7	2008-1-23	2009-1-22
Power sensor	PH2000	AR	EC3043-8	2008-1-23	2009-1-22
Signal generator	SMR 20	R&S	EC 3044-1	2007-8-21	2008-8-20
Spectrum Analyzer	E7402A	Agilent	EC2254	2007-9-17	2008-9-16

2.2 Test Standard

47CFR Part 15 (2007)
ANSI C63.4: 2003
RSS-210 Issue 7 (June 2007)
RSS-Gen Issue 2 (June 2007)

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-210 Issue 7 Annex 8	Pass
Maximum peak output power	15.247(b)(1)	RSS-210 Issue 7 Annex 8	Pass
Power spectrum density	15.247(e)	RSS-210 Issue 7 Annex 8	Pass
Spurious emission	15.209	RSS-210 Issue 7 Clause 2	Pass
Restrict band radiated emission	15.205	RSS-210 Issue 7 Clause 2	Pass
Emission outside the frequency band	15.247(d)	RSS-210 Issue 7 Annex 8	Pass
Power line conducted emission	15.207	RSS-Gen Issue 2 Clause 7.2.2	Pass
Channel number of hopping system	15.247(a)(1)(iii)	RSS-210 Issue 7 Annex 8	NA
Average time of occupancy in any channel	15.247(a)(1)(iii)	RSS-210 Issue 7 Annex 8	NA
Occupied bandwidth	-	RSS-Gen Issue 2 Clause 4.6.1	Tested
Spurious emission for receiver	-	RSS-210 Issue 7 Clause 2.3	Pass

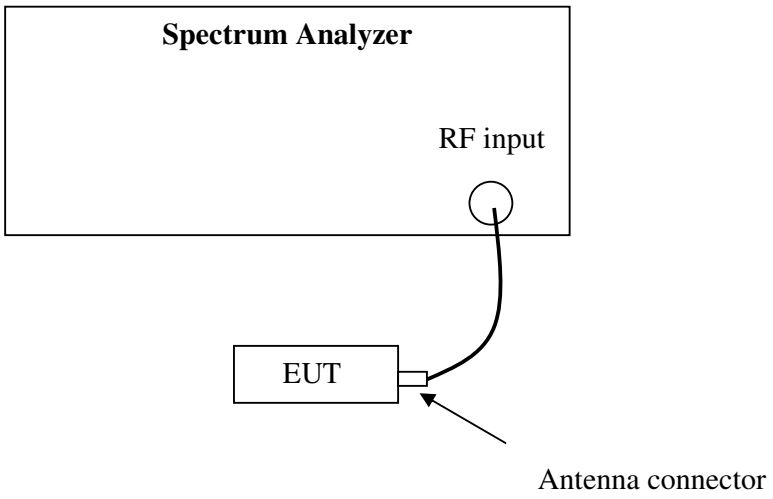
3. Minimum 6dB Bandwidth

Test result: PASS

3.1 Limit

For systems using digital modulation techniques that 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.

3.2 Test Configuration



3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW. The test was performed at 3 channels (lowest, middle and highest channel).

3.4 Test Protocol

Temperature : 22℃
Relative Humidity : 43%

Channel	Bandwidth (MHz)	Limit (MHz)
1	8.08	⩾0.5
2	8.08	⩾0.5
3	8.08	⩾0.5

3.5 Measurement uncertainty

The measurement uncertainty is ±100Hz.

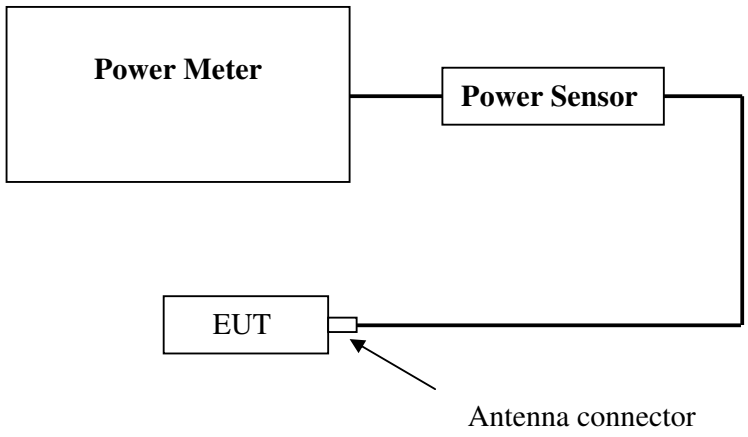
4. Maximum peak output power

Test result: Pass

4.1 Test limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

4.2 Test Configuration



4.3 Test procedure and test setup

The power output per FCC § 15.247(b)(1) was measured on the EUT using a power meter via power sensor. The test was performed at 3 channels (lowest, middle and highest channel).

4.4 Test protocol

Temperature : 22 °C
Relative Humidity : 43 %

Channel	Cable loss **L**(dB)	Reading of power meter **R**(dBm)	Corrected reading **C**(dBm)	Limit (dBm)
1	0.56	11.92	12.48	≤30
2	0.56	11.34	11.90	≤30
3	0.56	11.28	11.84	≤30

Remark: C = L + R

4.5 Measurement uncertainty

The measurement uncertainty is ±1dB.

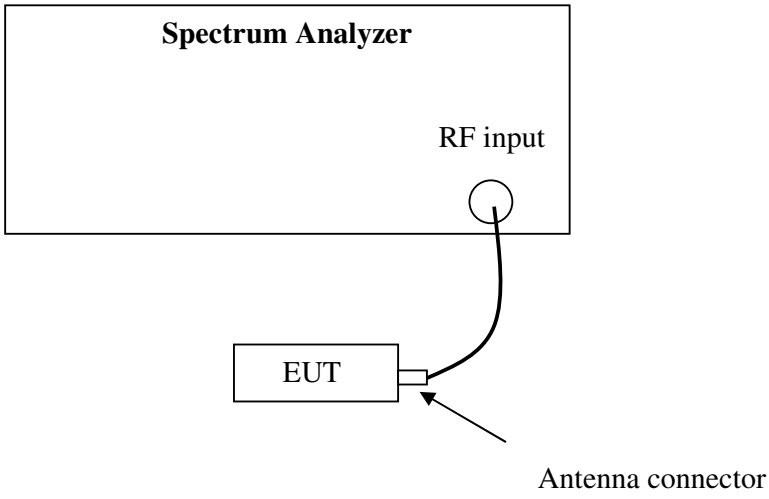
5. Power spectrum density

Test result: **Pass**

5.1 Test limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC §15.247(e) was measured using the Spectrum Analyzer with the resolutions bandwidth set at 3kHz, the video bandwidth set at 10kHz. The test was performed at 3 channels (lowest, middle and highest channel).

5.4 Test Protocol

Temperature : 22 ℃
Relative Humidity : 43 %

Channel	Reading of Receiver (dBm/3kHz) **R**	Cable loss (dB) **L**	Corrected Reading (dBm/3kHz) **C**	Limit (dBm/3kHz)
1	-10.84 *(96.16dBuV/3kHz)*	0.56	-10.28	≤ 8
6	-11.53 *(95.47dBuV/3kHz)*	0.56	-10.97	≤ 8
11	-12.2 *(94.80dBuV/3kHz)*	0.56	-11.64	≤ 8

Remark: **C = R+ L**

5.5 Measurement uncertainty

The measurement uncertainty is ±1dB/3kHz.

6. Spurious emission

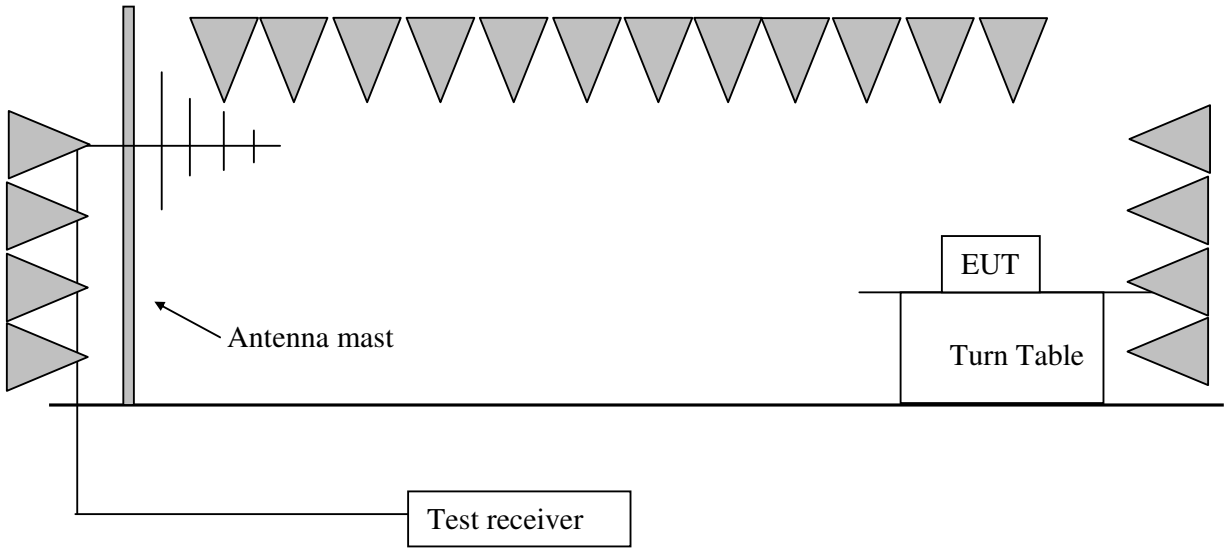
Test result: PASS

6.1 Test limit

The spurious emission shall test through the 10th harmonic or to 40GHz, whichever is lower. It must 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

6.2 Test Configuration



6.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, the pre-amplifier is 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.

6.4 Test protocol

Spurious emission test below 1GHz, highest reading related to the limit

Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	236.05	9.90	28.90	46.00	17.10	QP
H	247.72	10.30	29.70	46.00	16.30	QP
H	282.71	11.50	29.90	46.00	16.10	QP
H	327.41	13.10	29.40	46.00	16.60	QP
H	339.08	13.50	30.10	46.00	15.90	QP
H	362.18	*	*	*	*	QP
V	33.89	17.61	33.50	40.00	6.50	QP
V	78.60	9.00	23.40	40.00	16.60	QP
V	101.92	10.20	25.60	43.50	17.90	QP
V	247.78	*	*	*	*	QP
V	282.64	*	*	*	*	QP
V	327.13	*	*	*	*	QP

Remark: 1.Correct Factor = Antenna Factor + Cable Loss
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit - Corrected Reading
4. If the margin higher than 20dB, it would marked as *.
5. For more details, please refer to the test data.

Spurious emission for test above 1GHz, highest reading related to the limit

Channel	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	H	2412.35	2.20	99.70	Fundamental	/	PK
1	H	4824.81	-0.90	51.40	54.00	2.60	PK
1	V	2412.35	2.20	112.20	Fundamental	/	PK
1	V	4824.81	-0.90	52.30	54.00	1.70	PK
2	H	2439.01	2.20	98.60	Fundamental	/	PK
2	H	4879.24	-0.90	51.50	54.00	2.50	PK
2	V	2439.01	2.20	110.80	Fundamental	/	PK
2	V	4879.24	-0.90	52.00	54.00	2.00	PK
3	H	2463.69	2.20	99.10	Fundamental	/	PK
3	H	4927.43	-0.90	51.20	54.00	2.80	PK
3	V	2463.69	2.20	111.70	Fundamental	/	PK
3	V	4927.43	-0.90	52.50	54.00	1.50	PK

Remark: 1.Correct Factor = Antenna Factor + Cable Loss - Gain of Preamplifier
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit - Corrected Reading
4. Here the PK value is evaluated with AV limit. As a result, the AV test can be elided.
5. The spurious emissions among 1GHz ~ 25GHz are all submerged in the floor noise except the data listed above.

6.5 Measurement uncertainty

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty of radiated emission is: ± 5.31dB
The measurement uncertainty is given with a confidence of 95%, k=2.
The measurement uncertainty is traceable to internal procedure TI-036.

7. Restrict band radiated emission

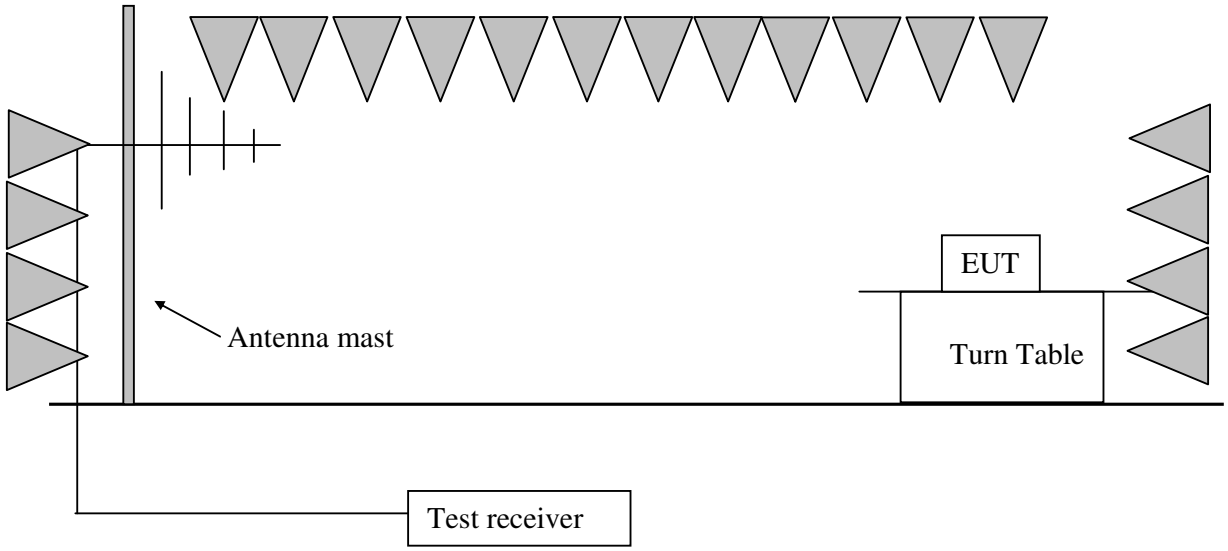
Test result: PASS

7.1 Test limit

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

7.2 Test Configuration



7.3 Test procedure and test setup

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge.
5. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

7.4 Test protocol

Highest reading on restrict band 2310MHz ~ 2390MHz, test on the lowest channel

Detector	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)
PK	2389.04	2.20	67.06	74
AV	2388.40	2.20	32.05	54

Highest reading on restrict band 2483.5MHz ~ 2500MHz, test on the highest channel

Detector	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)
PK	2483.83	2.20	63.90	74
AV	2483.86	2.20	30.75	54

7.5 Measurement uncertainty

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty of radiated emission is: ± 5.31dB
The measurement uncertainty is given with a confidence of 95%, k=2.
The measurement uncertainty is traceable to internal procedure TI-036.

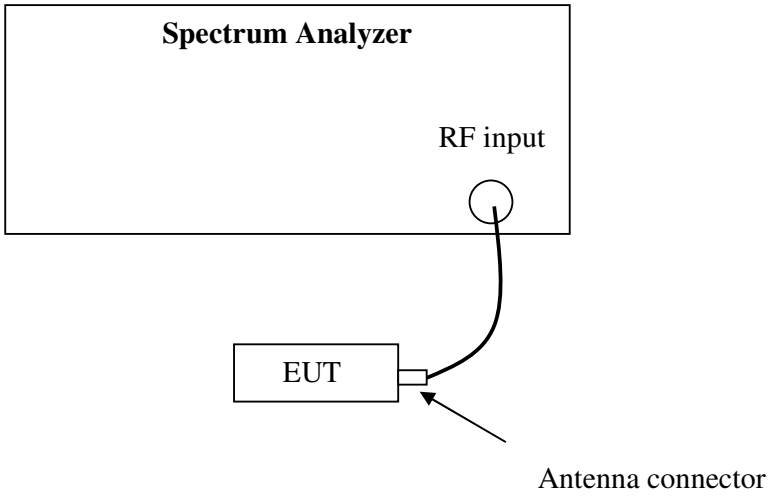
8. Emission outside the frequency Band

Test result: **PASS**

8.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

8.2 Test Configuration



8.3 Test procedure and test setup

The Emission outside the frequency Band per FCC §15.247(d) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW.

8.4 Test protocol

Highest level outside the band edge (dBuV)	Highest emission within the band edge (dBuV)	Delta (dB)	Limit
70.16 (frequency lower than 2.4GHz)	110.80	40.64	≥ 20dB
62.88 (frequency higher than 2.4835GHz)	109.50	46.62	≥ 20dB

8.5 Measurement uncertainty

The measurement uncertainty is ±1dB.

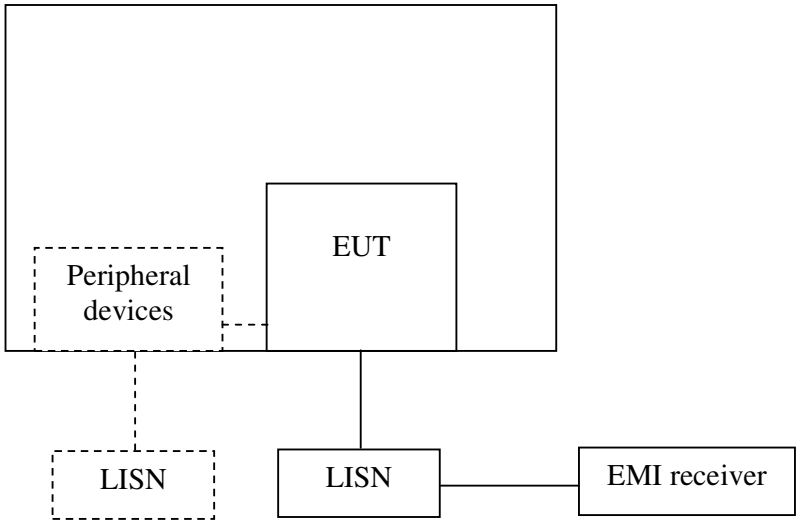
9. Power line conducted emission

Test result: **Pass**

9.1 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.		

9.2 Test configuration



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

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

9.3 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.

9.4 Test protocol

Power line: L

Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.16	3.00	47.13	38.98	65.54	55.54	18.41	16.56
0.29	3.00	45.99	36.98	60.64	50.64	14.65	13.66
0.40	3.00	39.77	36.93	57.93	47.93	18.16	11.00
1.19	3.00	*	*	*	*	*	*
6.71	3.00	*	*	*	*	*	*
11.45	3.00	49.77	39.88	60.00	50.00	10.23	10.12

Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).
2. Margin (dB) = Limit - Corrected Reading.
3. If the margin higher than 20dB, it would marked as *.

Power line: N

Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.15	3.00	45.91	37.85	65.87	55.87	19.96	18.02
0.29	3.00	42.63	39.95	60.64	50.64	18.01	10.69
0.40	3.00	38.61	35.68	57.93	47.93	19.32	12.25
1.18	3.00	36.18	33.25	56.00	46.00	19.82	12.75
6.71	3.00	*	*	*	*	*	*
11.45	3.00	49.32	39.36	60.00	50.00	10.68	10.64

Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).
2. Margin (dB) = Limit - Corrected Reading.
3. If the margin higher than 20dB, it would marked as *.

9.5 Measurement Uncertainty

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty at mains terminal: ± 1.99dB
The measurement uncertainty is given with a confidence of 95%, k=2.
The measurement uncertainty is traceable to internal procedure TI-036.

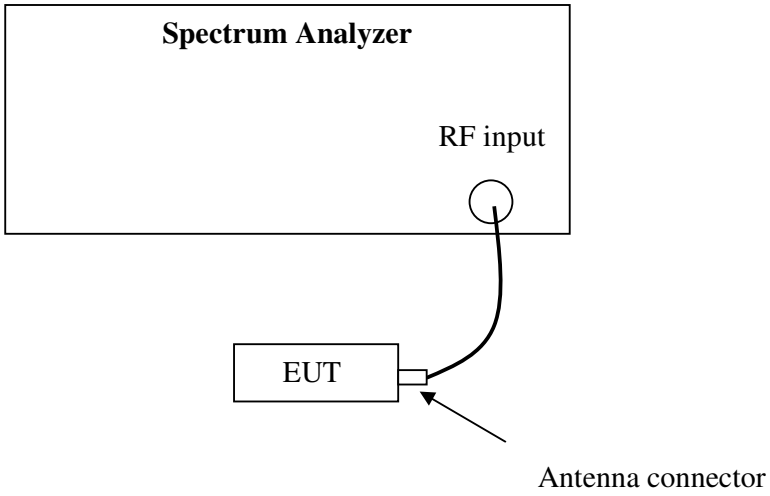
10. Channel Number of hopping system

Test result: **NA**

10.1 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

10.2 Test Configuration



10.3 Test procedure and test setup

The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN>>RBW.
The RF passband of the EUT was divided into 3 appropriate bands to test.

10.4 Test protocol

Channel Number	Limit
-	≥15

10.5 Measurement uncertainty

The measurement uncertainty is ±1dB.

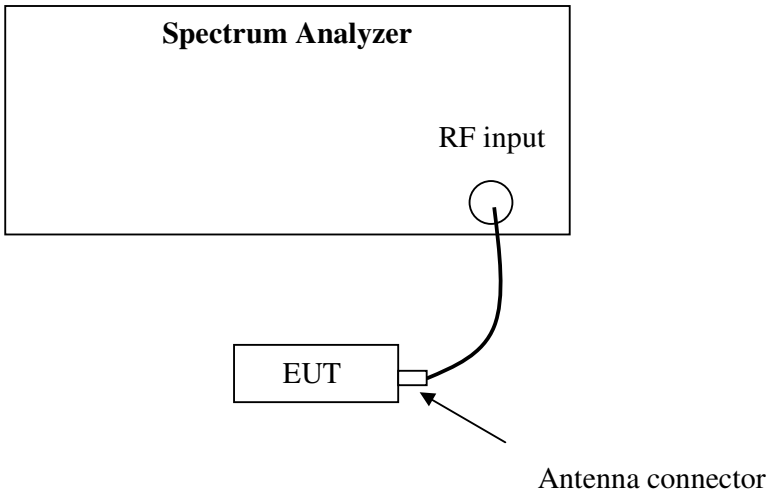
11. Average time of occupancy in any channel

Test result: **NA**

11.1 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2 Test Configuration



11.3 Test procedure and test setup

Average time of occupancy in any channel per FCC § 15.247(a)(1)(iii)
is measured using the Spectrum Analyzer with the resolutions bandwidth set at 100kHz, the video bandwidth set at 300kHz, and the SPAN set to be 0Hz to test in time domain. The test is performed at the middle channel.

11.4 Test protocol

Packet	Observed period (s) **P**	Time of occupancy for single hopping (ms) **O**	Hops among the interval of 3.6 s **I**	Average time of occupancy (s) **T**	Limit (s)
Packet Type 4	-	-	-	-	≤0.4
Packet Type 11	-	-	-	-	≤0.4
Packet Type 15	-	-	-	-	≤0.4

Remark: 1. There are 79 channels in all. So the observed period P = 0.4 * 79 = 31.6 s.
2. Average time of occupancy **T = O *I * P / 3.6**

11.5 Measurement uncertainty

The measurement uncertainty is ± 10μs.

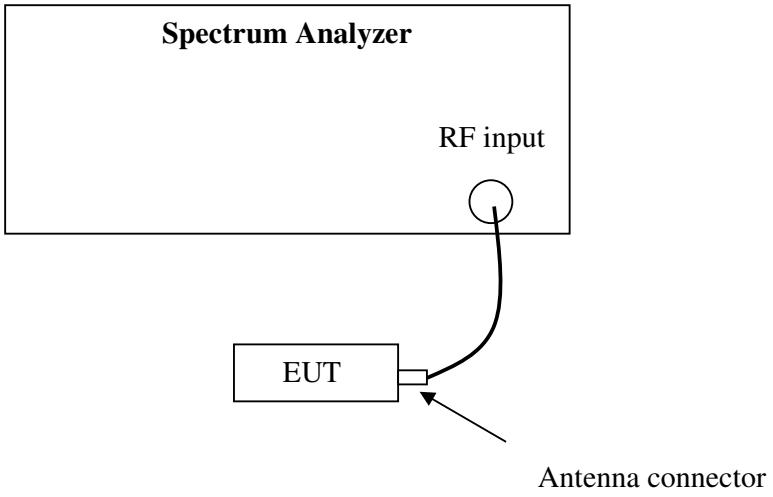
12. Occupied Bandwidth

Test Status: Tested

12.1 Test limit

None

12.2 Test Configuration



12.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 2 Clause 4.6.1 was measured using the Spectrum Analyzer with the resolutions bandwidth set at 1MHz, the video bandwidth set at 3MHz. The test was performed at 3 channels (lowest, middle and highest channel).

12.4 Test protocol

Temperature : 22 °C
Relative Humidity : 43 %

Channel	Occupied Bandwidth (MHz)	Max. Value (MHz)
1	17.88	18.25
2	18.25	
3	18.13	

Remark: "Max. Value" is the maximum test result of the three measured occupied bandwidth.

12.5 Measurement uncertainty

The measurement uncertainty is ±100Hz.

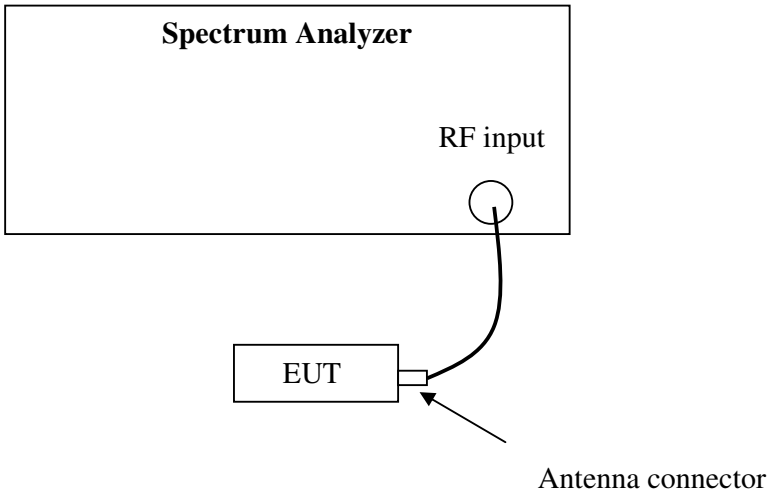
13. Spurious emission for receiver

Test result: **PASS**

13.1 Test limit

The spurious emission shall test through 3 times tuneable or local oscillator frequency whichever is the higher, without exceeding 40 GHz. 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.

13.2 Test Configuration



13.3 Test procedure and test setup

The receiver spurious emission per RSS-210 Issue 7 Clause 2.3 is measured using the Spectrum Analyzer with the resolution bandwidth / video bandwidth set at 5kHz for 30MHz ~ 1GHz and with the resolution bandwidth / video bandwidth set at 1MHz for higher than 1GHz.

13.4 Test protocol

Highest reading related to the limit

Detector	Frequency (MHz)	Corrected Receiver Reading (dBm)	Limit (dBm)
PK	≤1GHz	<-70	-57
PK	>1GHz	<-60	-53

Note: For frequency higher than 1GHz, the PK detector is employed while the limit is AV limit.

13.5 Measurement uncertainty

The measurement uncertainty is ±1dB.