EMC TEST REPORT for Intentional Radiator (Wi-Fi Function)
No. 131201748SHA-001

Applicant	:	LUMI LEGEND ELECTRICAL CO., LTD No.18,lane239,Beihai Road,Jiangbei,Ningbo,China|315032
Manufacturer	:	LUMI LEGEND ELECTRICAL CO., LTD No.18,lane239,Beihai Road,Jiangbei,Ningbo,China|315032
Product Name	:	WIFI Switch
Type/Model	:	SW5101

SUMMARY

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

47CFR Part 15 (2013): Radio Frequency Devices

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

Date of issue: April 27, 2014

Prepared by: Reviewed by:

Jackson Huang (*Project Engineer*) Daniel Zhao (*Reviewer*)

Description of Test Facility

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Content

1. General Information

1.1 Applicant Information

Applicant	:	LUMI LEGEND ELECTRICAL CO., LTD No.18,lane239,Beihai Road,Jiangbei,Ningbo,China|315032
Name of contact	:	Mr. Hank Zhang
Tel	:	86 0574 88165637
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Manufacturer	:	LUMI LEGEND ELECTRICAL CO., LTD No.18,lane239,Beihai Road,Jiangbei,Ningbo,China|315032

1.2 Identification of the EUT

Equipment:	WIFI Switch
Type/model:	SW5101
FCC ID:	2AB5K-SW5101

1.3 Technical specification

Frequency Range:	2412 - 2462 MHz
Modulation:	CCK,BPSK,QPSK,DSSS,OFDM
Gain of Antenna:	Integral, 2.0 dBi
Rating:	120VAC 60Hz , 15A
Description of EUT:	The EUT has only one model. The EUT is a switch controlled by RF signal.
Channel Description:	11Channel for 2412MHz~2462MHz.

1.4 Mode of operation during the test / Test peripherals used

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The lowest, middle and highest channel were tested as representatives.

Freq. Band	Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
2412-2462MHz	802.11b	2412	2437	2462
	802.11g	2412	2437	2462
	802.11n(HT20)	2412	2437	2462

Test software setting:
The test setting software for 802.11b/g/n(HT20) is offered by the manufactory.

Data rate VS Power

The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

2.4GHz Band:
After this pre-scan, we choose the following table of the data rata as the worst case.

Freq. Band	Modulation	Worst case data rate
2400-2483.5MHz	802.11b	11Mbps
	802.11g	1Mbps
	802.11 n(HT20)	65Mbp

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2013-10-21	2014-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2013-10-21	2014-10-20
Test Receiver	ESCI 7	R&S	EC4501	2013-12-29	2014-12-28
Spectrum Analyzer	N9010	Agilent	EC4890	2013-10-21	2014-10-20
Power meter	ML 2495A	Anritsu	EC 4895	2013-10-21	2014-10-20
A.M.N.	ESH2-Z5	R&S	EC 3119	2014-1-9	2015-1-8
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2013-5-16	2014-5-15
Horn antenna	HF 906	R&S	EC 3049	2013-5-13	2014-5-12
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2013-4-12	2014-4-11
Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2013-4-12	2014-4-11
Log-period antenna	AT 1080	AR	EC 3044-7	2013-5-22	2014-5-21
Biconical antenna	3109PX	ETS	EC3564	2013-8-25	2014-8-24
Semi-anechoic chamber	-	Albatross project	EC 3048	2013-5-21	2014-5-20
Shielded room	-	Zhongyu	EC 2838	2014-1-12	2016-1-11
Shielded room	-	Zhongyu	EC 2839	2014-1-12	2016-1-11
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2014-2-1	2015-1-31
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2014-2-1	2015-1-31
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2014-2-1	2015-1-31
Band Reject Filter	WRCGV 2400/2483-2390/2493-35/10SS	Wainwright	EC4297-4	2014-2-1	2015-1-31

2.2 Test Standard

47CFR Part 15 (2013)
ANSI C63.4 (2009)

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.

TEST ITEM	FCC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	Pass
Maximum peak output power	15.247(b)	Pass
Power spectrum density	15.247(e)	Pass
Radiated emission	15.205 & 15.209	Pass
Emission outside the frequency band	15.247(d)	Pass
Power line conducted emission	15.207	Pass

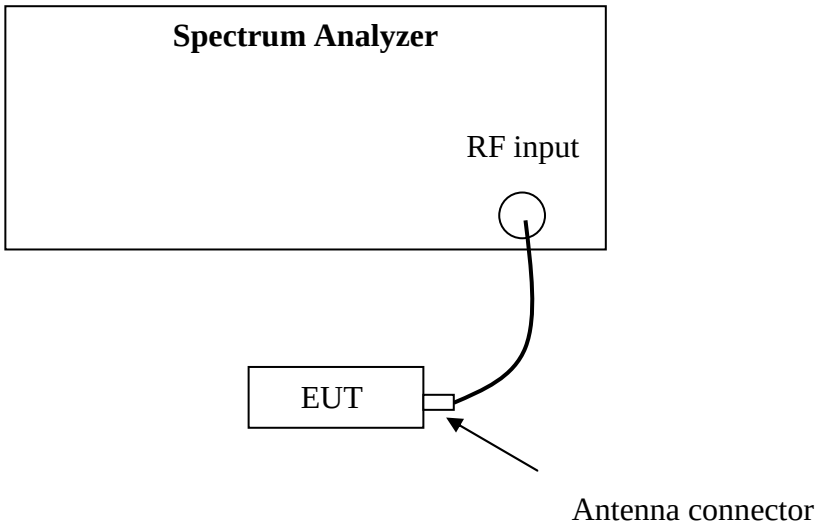
3. Minimum 6dB Bandwidth

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 according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r01" for compliance to FCC 47CFR 15.247 requirements.

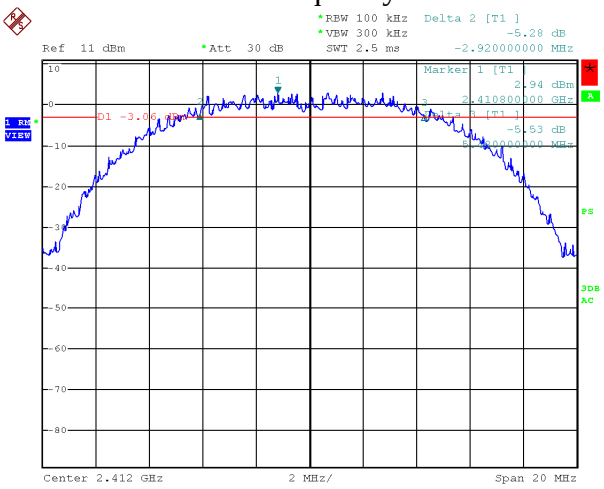
3.4 Test Protocol

Temperature : 25°C

Relative Humidity : 55%

Mode	CH	Bandwidth (MHz)	Limit (MHz)
802.11b	L	8.40	⩾0.5
	M	9.00	
	H	8.92	

Frequency L



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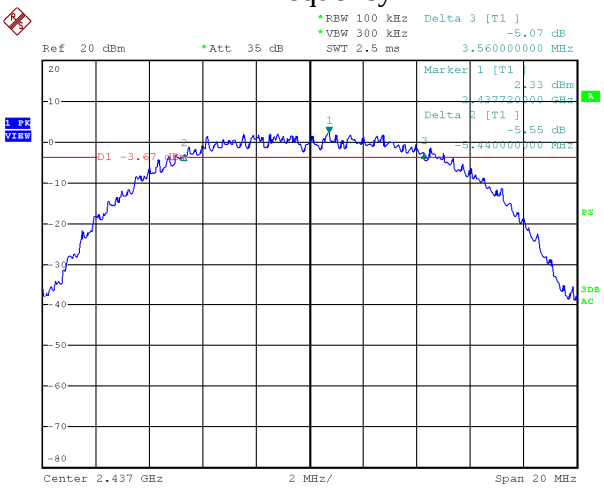
Frequency M



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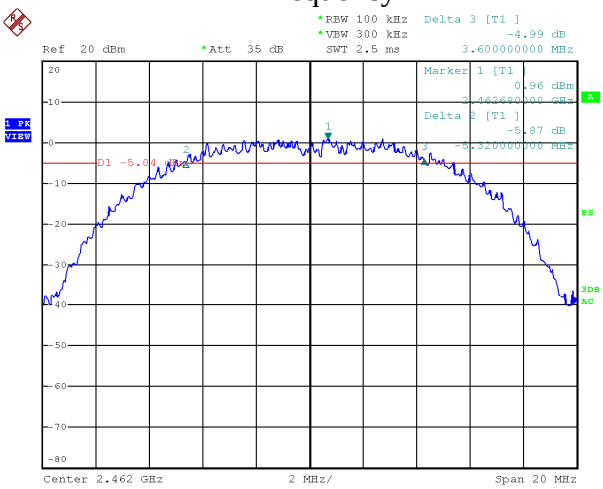
Frequency H



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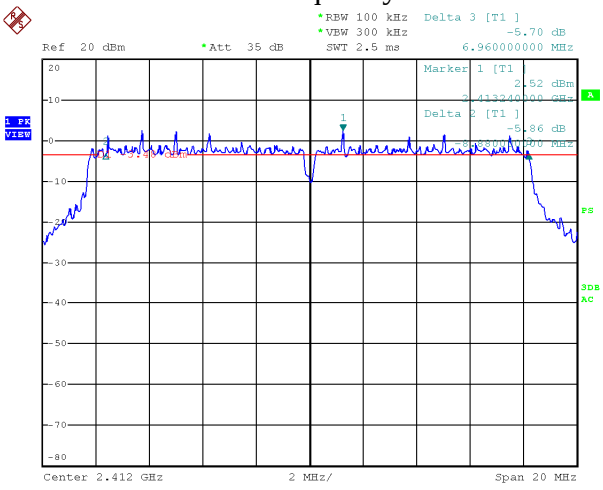
Mode	CH	Bandwidth (MHz)	Limit (MHz)
802.11g	L	15.84	⩾0.5
	M	16.36	
	H	16.40	

Frequency L



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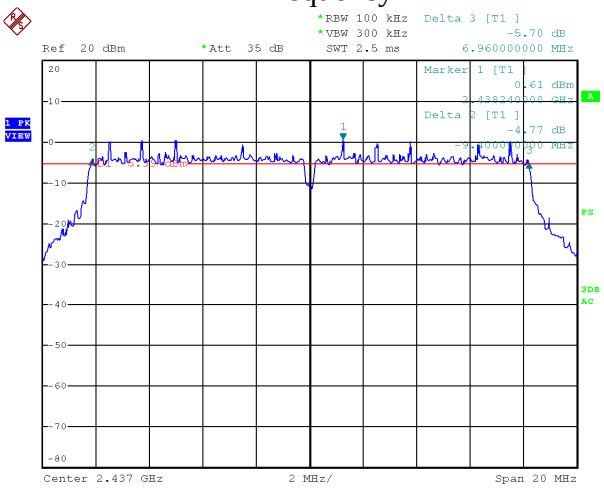
Frequency M



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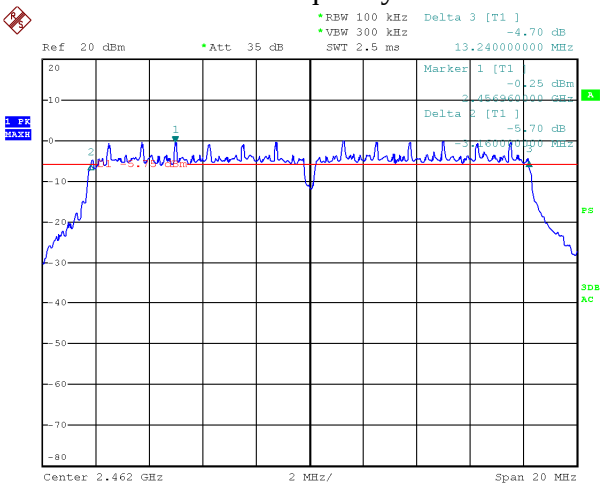
Frequency H



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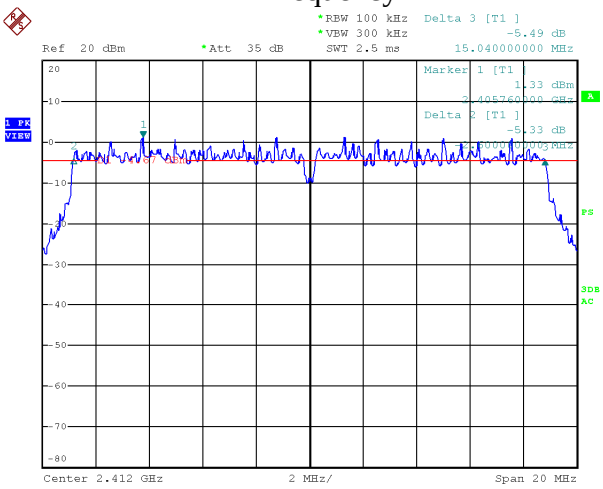
Mode	CH	Bandwidth (MHz)	Limit (MHz)
802.11n(HT20)	L	17.64	≥0.5
	M	17.72	
	H	17.68	

Frequency L



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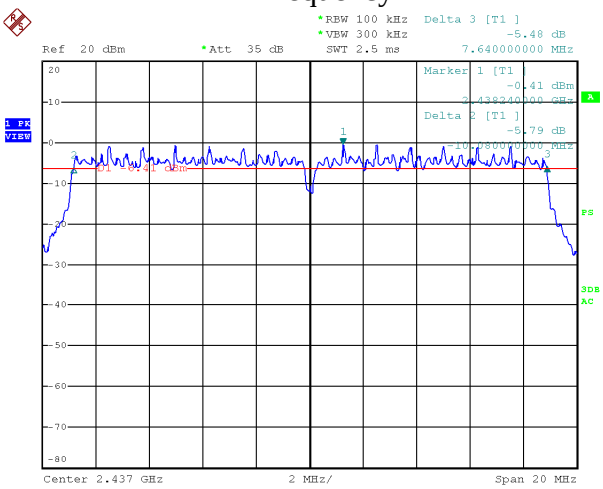
Frequency M



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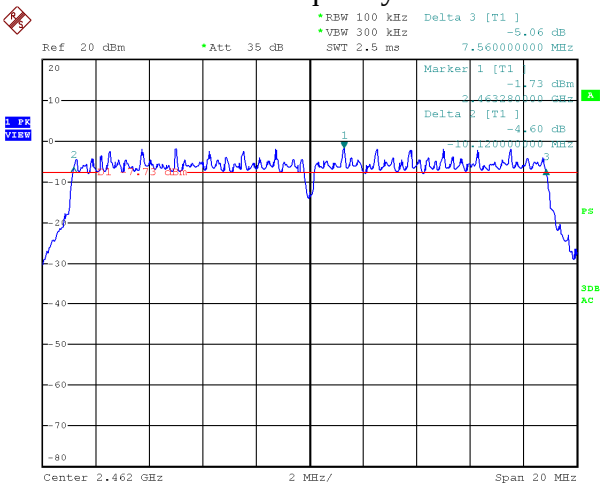
Frequency H



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4. Maximum peak output power

Test result: Pass

4.1 Test limit

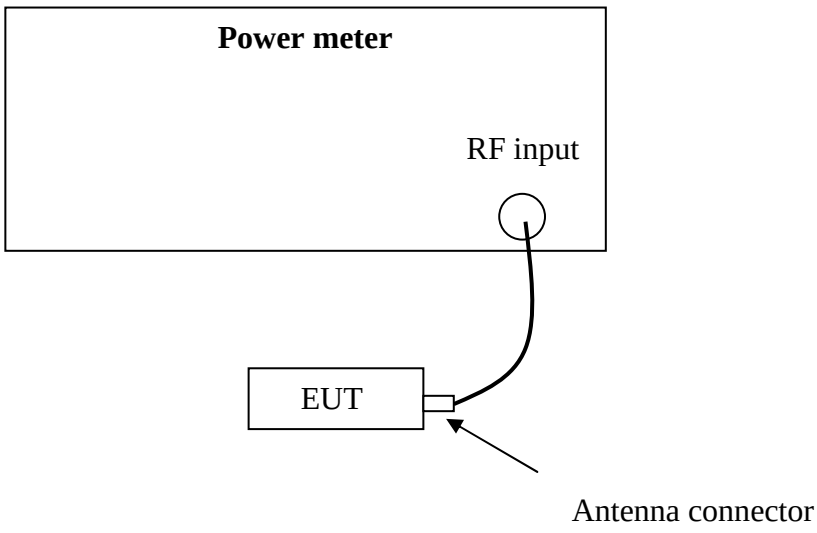
☐ For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

☐ For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

☒ For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

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.

4.2 Test Configuration



4.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r01" for compliance to FCC 47CFR 15.247 requirements (clause 9.1.2).

4.4 Test protocol

Temperature : 25 ℃

Relative Humidity : 55 %

Mode	Freq. (MHz)	Reading (dBm)	Limit (dBm)	Margin (dB)
802.11b	2412	18.32	30.00	11.68
	2437	17.88	30.00	12.12
	2462	17.14	30.00	12.86
802.11g	2412	22.23	30.00	7.77
	2412	23.38	30.00	6.62
	2412	22.82	30.00	7.18
802.11n(HT20)	2412	18.89	30.00	11.11
	2437	17.61	30.00	12.39
	2462	16.23	30.00	13.77

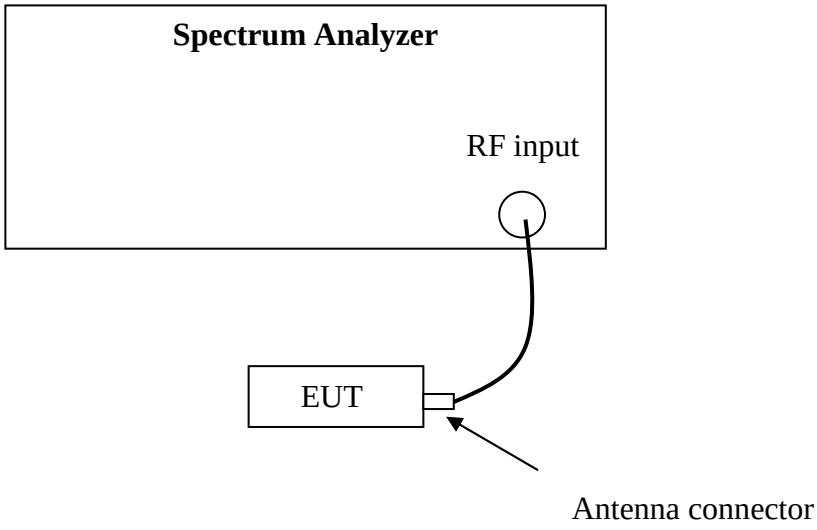
5. Power spectrum density

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 tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r01" (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

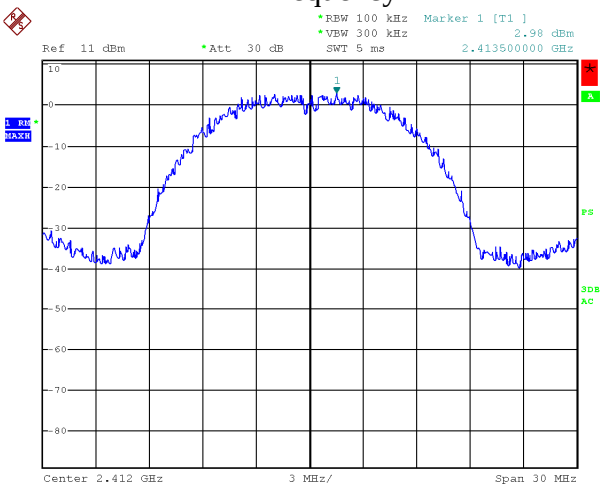
5.4 Test Protocol

Temperature : 25 °C

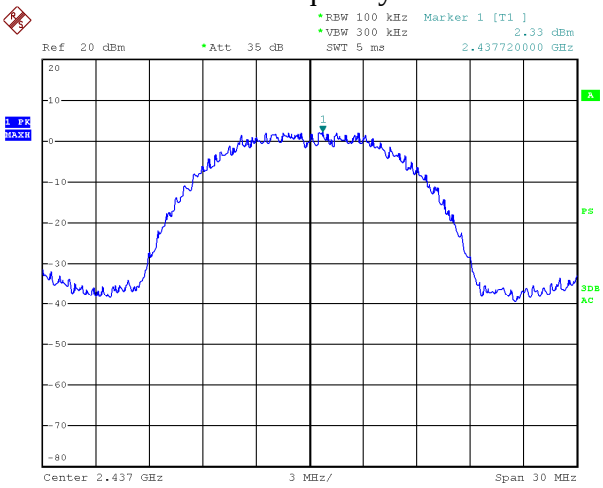
Relative Humidity: 55 %

Mode	CH	Cable loss (dB)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
802.11b	L	2.00	2.98	≤8.00
	M	2.00	2.33	
	H	2.00	0.96	

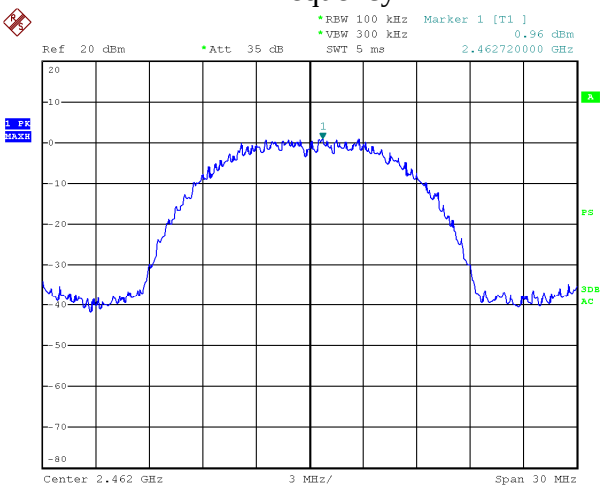
Frequency L



Frequency M



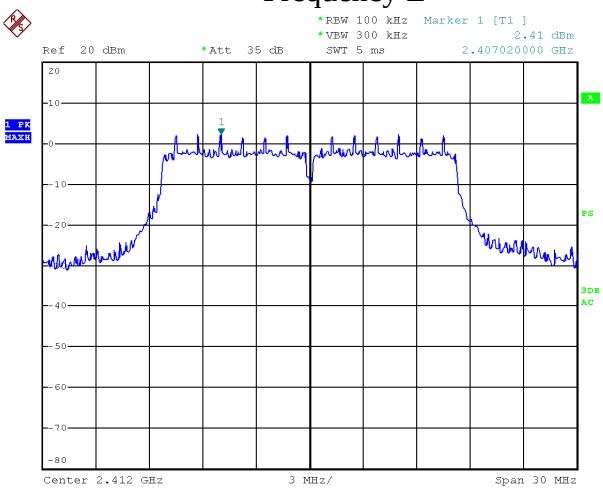
Frequency H



Date: 15.APR.2014 15:13:45

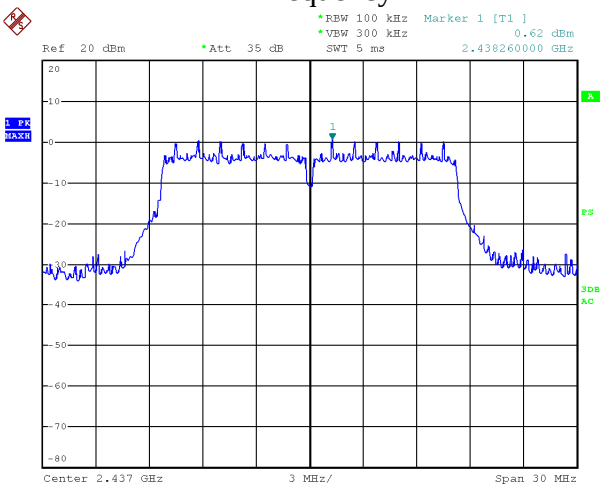
Mode	CH	Cable loss (dB)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
802.11g	L	2.00	2.41	≤8.00
	M	2.00	0.62	
	H	2.00	-0.18	

Frequency L

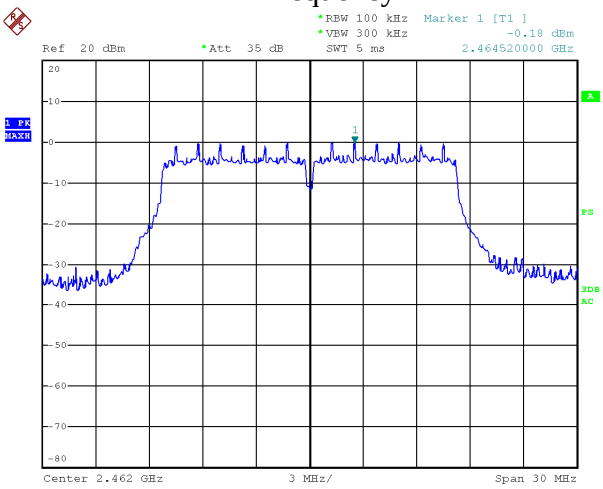


Date: 15.APR.2014 15:22:22

Frequency M

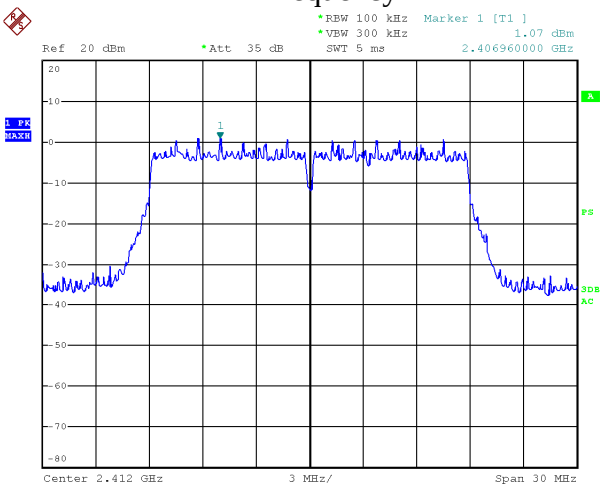


Frequency H



Mode	CH	Cable loss (dB)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
802.11n (HT20)	L	2.00	1.07	≤8.00
	M	2.00	-0.63	
	H	2.00	-1.73	

Frequency L



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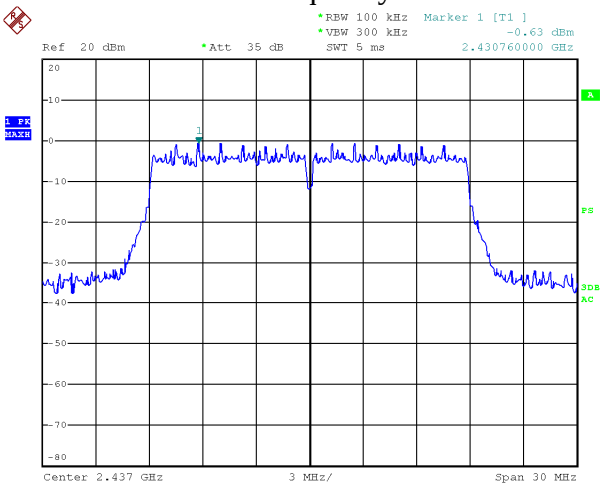
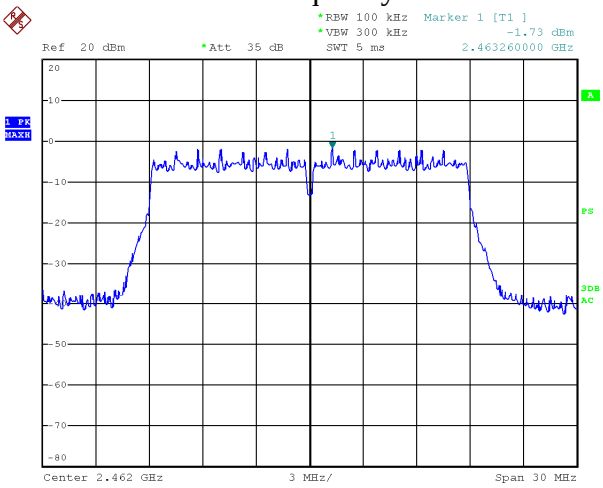
Frequency M



Date: 15.APR.2014 15:46:58

Frequency H



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6. Radiated emission

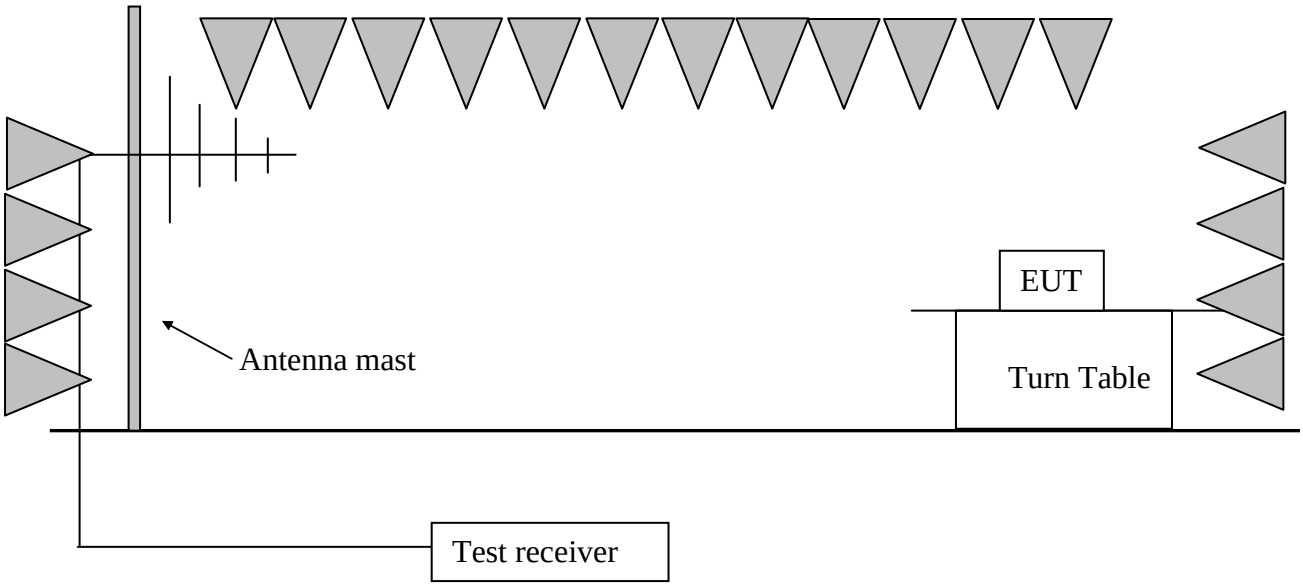
Test result: PASS

6.1 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

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, 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 EUT was tested according to DTS test procedure of KDB558074 D01 DTS “Meas Guidance v03r01” (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

6.4 Test protocol

Temperature : 18 °C
Relative Humidity : 54 %

Mode 802.11b

CH	Polarization	Frequency (MHz)	Factor	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
L	H	2412.0	-11.6	102.1	Fundamental	/	PK
	H	449.7	19.2	32.4	43.5	-11.1	QP
	V	926.1	25.2	32.1	46.0	-13.9	QP
	H	2070.5	-13.0	43.0	54.0	-11.0	PK
	V	2390.0	-11.7	60.9	74.0	-13.1	PK
	V	2390.0	-11.7	38.5	54.0	-15.5	AV
	H	4814.5	-3.6	63.8	74.0	-10.2	PK
	H	4814.5	-3.6	40.1	54.0	-13.9	AV
	V	12052.9	7.2	53.4	54.0	-0.6	PK
M	H	996.0	25.4	32.2	54.0	-21.8	QP
	V	1147.0	-18.7	41.1	54.0	-12.9	PK
	V	4875.2	-3.4	59.8	74.0	-14.2	PK
	V	4875.2	-3.4	38.9	54.0	-15.1	AV
	V	12180.0	7.4	50.0	54.0	-4.0	PK
H	V	2463.0	-11.5	98.8	Fundamental	/	PK
	V	969.9	25.4	34.7	54.0	-19.3	QP
	H	2079.1	-12.9	42.8	54.0	-11.2	PK
	H	2483.5	-11.4	56.8	74.0	-17.2	PK
	H	2483.5	-11.4	44.2	54.0	-9.8	AV
	V	4920.7	-3.3	59.4	74.0	-14.6	PK
	V	4920.7	-3.3	38.8	54.0	-15.2	AV
	H	12300.0	7.6	47.8	54.00	-6.2	PK

Mode 802.11g

CH	Polarization	Frequency (MHz)	Factor	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
L	H	2412.0	-11.6	99.8	Fundamental	/	PK
	H	952.0	25.4	35.1	46.0	-10.9	QP
	H	2390.0	-11.7	63.8	74.0	-10.2	PK
	H	2390.0	-11.7	37.9	54.0	-16.1	AV
	V	2079.3	-12.9	41.9	54.0	-12.1	PK
	H	4830.0	-5.2	52.5	54.0	-1.5	PK
	V	12052.1	7.2	53.5	54.0	-0.5	PK
M	H	895.8	25.0	35.0	46.0	-11.0	QP
	V	7309.9	2.4	50.8	54.0	-3.2	PK
	H	12180.0	7.4	49.9	54.0	-4.1	PK
H	H	2468.1	-11.5	96.7	Fundamental	/	PK
	H	985.97	25.4	35.1	54.0	-18.9	QP
	V	2483.5	-11.4	59.2	74.0	-14.8	PK
	V	2483.5	-11.4	38.0	54.0	-16	AV
	H	7385.1	2.6	50.0	54.0	-4.0	PK
	V	12308.2	7.6	47.5	54.0	-6.5	PK

Mode 802.11n(HT20)

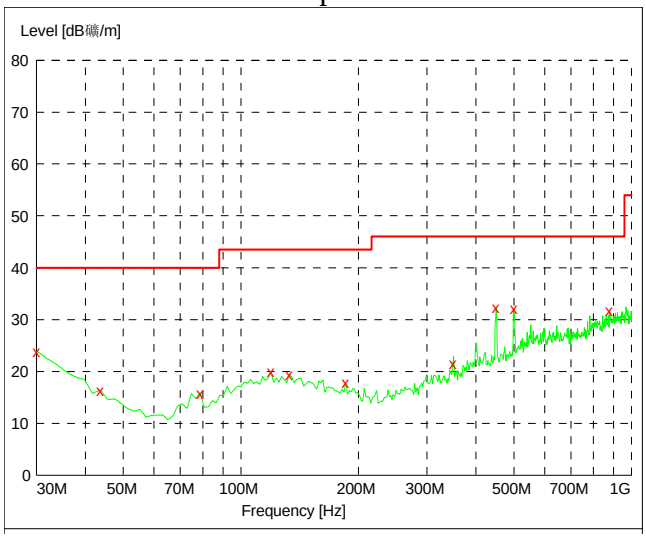
CH	Polarization	Frequency (MHz)	Factor	Measure Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Type
L	H	2412.0	-11.6	97.1	Fundamental	/	PK
	H	959.9	25.4	36.9	46.0	-9.1	QP
	V	2079.1	-12.9	41.8	54.0	-12.2	PK
	V	2390.0	-11.7	57.8	74.0	-16.2	PK
	H	2390.0	-11.7	35.8	54.0	-18.2	AV
	V	4815.1	-3.6	47.7	54.0	-6.3	PK
	V	12052.0	7.2	47.2	54.0	-6.8	PK
M	V	967.9	25.4	35.3	54.0	-18.7	QP
	V	2368.0	-11.8	43.1	54.0	-10.9	PK
	V	6722.8	0.9	46.2	54.0	-7.8	PK
	H	12179.7	7.4	45.2	54.0	-8.8	PK
H	V	2468.1	-11.5	94.9	Fundamental	/	PK
	H	990.0	25.4	34.9	54.0	-19.1	QP
	V	2483.5	-11.4	54.6	74.0	-19.4	PK
	V	2483.5	-11.4	34.0	54.0	-20.0	AV
	H	6858.6	1.2	46.0	54.0	-8.0	PK
	V	12309.0	7.6	43.8	54.0	-10.2	PK

Remark: 1. Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measure level = Original Receiver Reading Level+ Correct Factor
3. Over Limit = Measure level - limit
4. If the PK reading is lower than AV limit, the AV test can be elided.

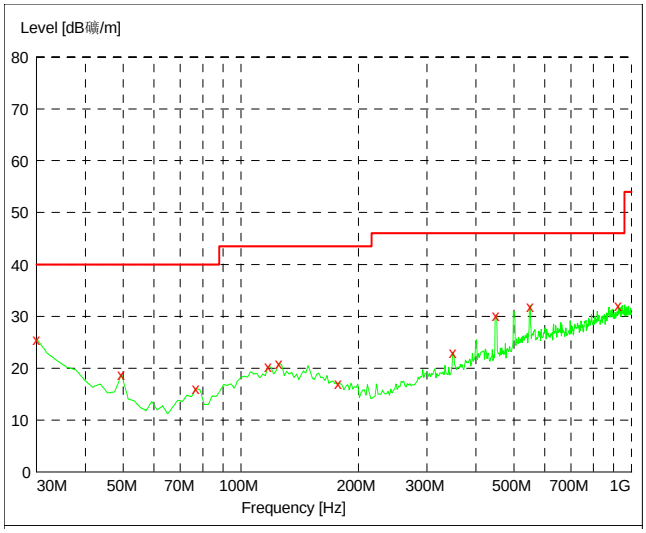
Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading level = 10dBuV.
Then Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Measure level = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Measure level = 10.20dBuV/m, then Over Limit = 10.20 - 54= -43.80dBuV/m

Test graph (Worst case):

Horizontal polarization



Vertical polarizaion



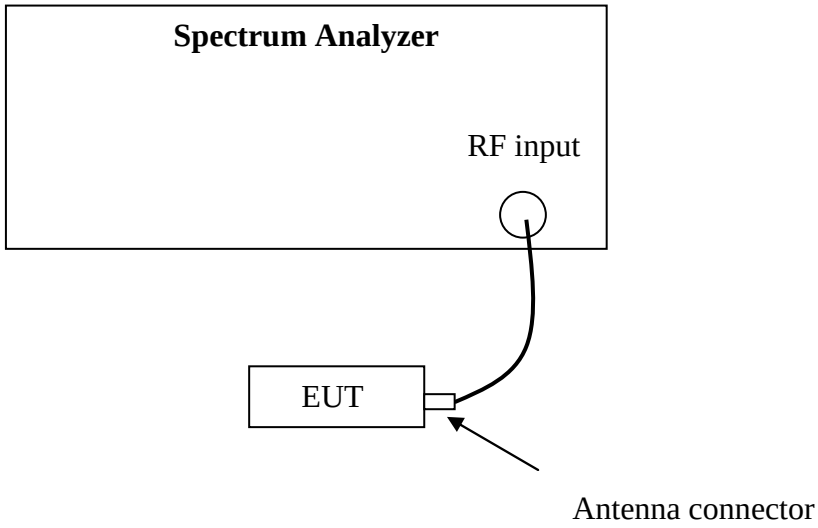
7. Emission outside the frequency Band

Test result: **PASS**

7.1 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.

7.2 Test Configuration



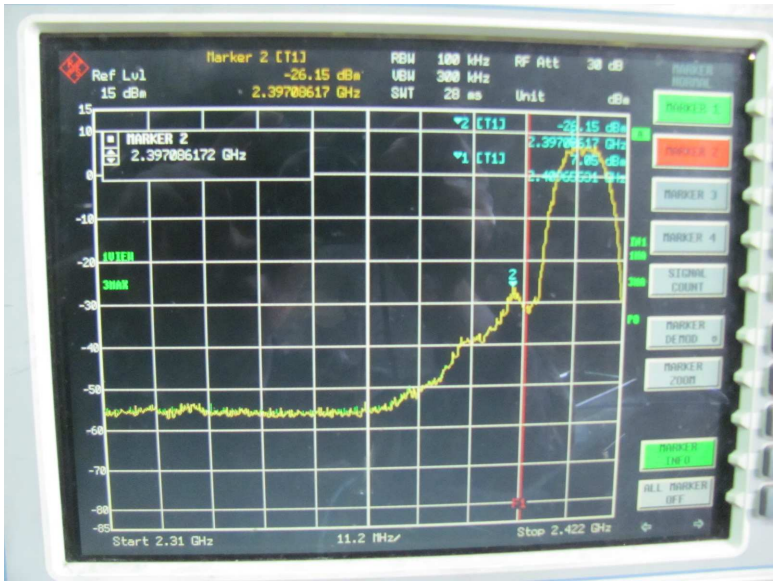
7.3 Test procedure and test setup

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.
The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance v03r01" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

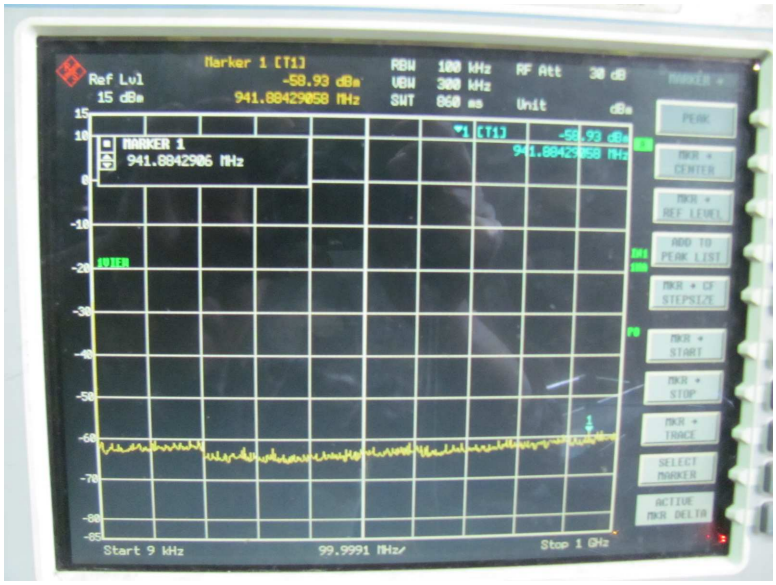
7.4 Test protocol

Mode	CH	Max reading among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
802.11b	L	-26.15	33.20	≥20
	M	-44.07	47.58	
	H	-41.65	45.45	

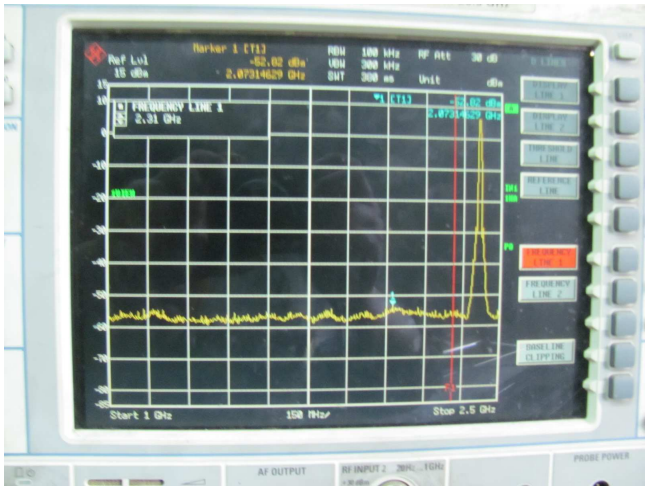
Low Band Edge - Frequency L



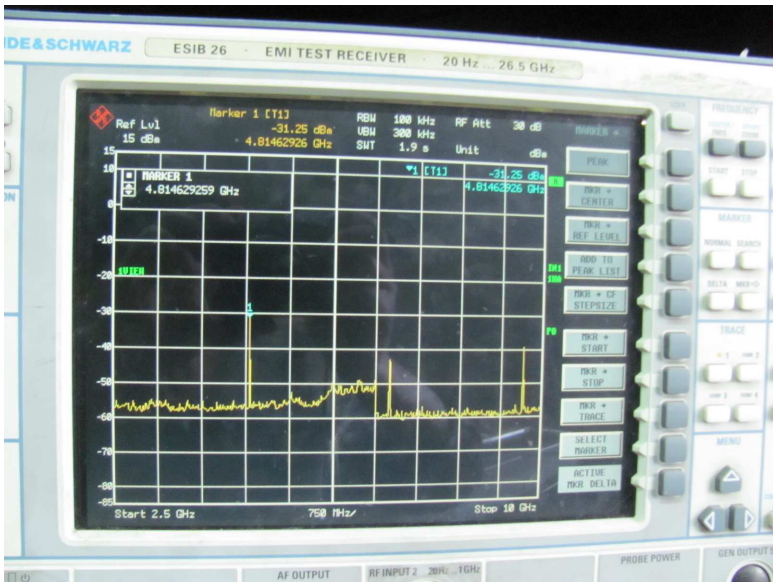
Spurious Emission 9kHz ~ 1GHz - Frequency L



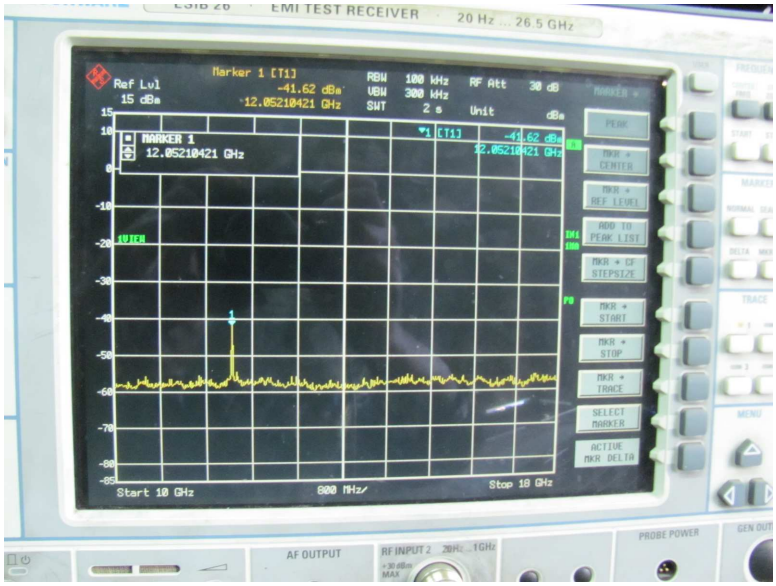
Spurious Emission 1GHz ~ 2.5GHz - Frequency L



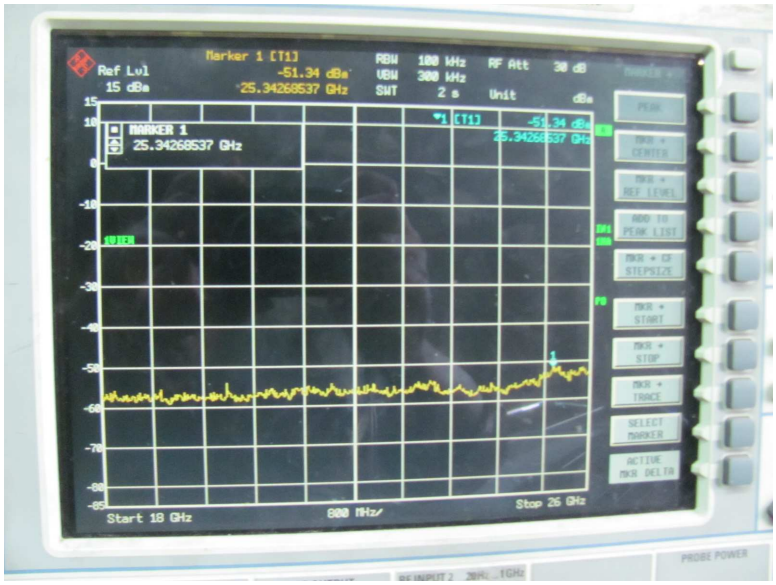
Spurious Emission 2.5GHz ~ 10GHz - Frequency L



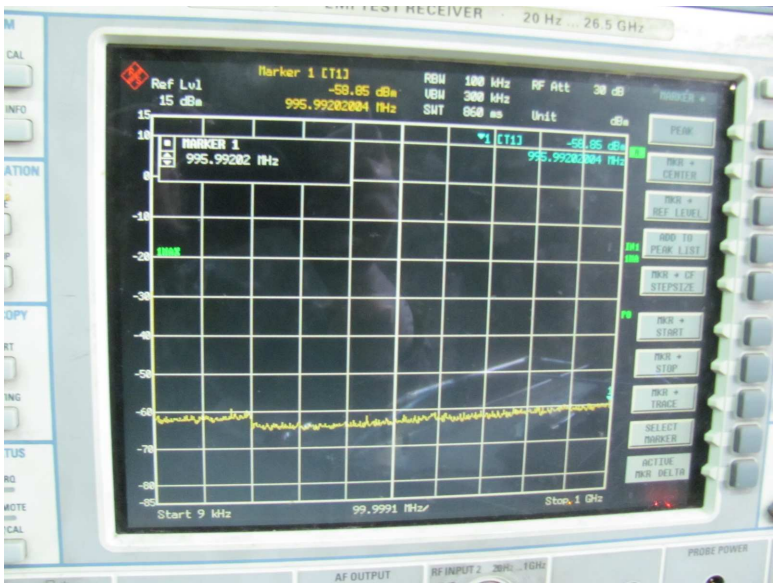
Spurious Emission 10GHz ~ 18GHz - Frequency L



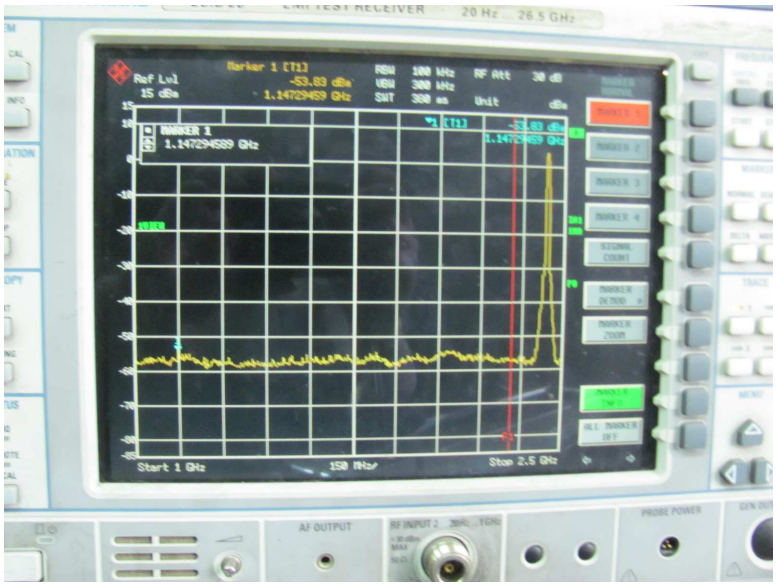
Spurious Emission 18GHz ~ 26GHz - Frequency L



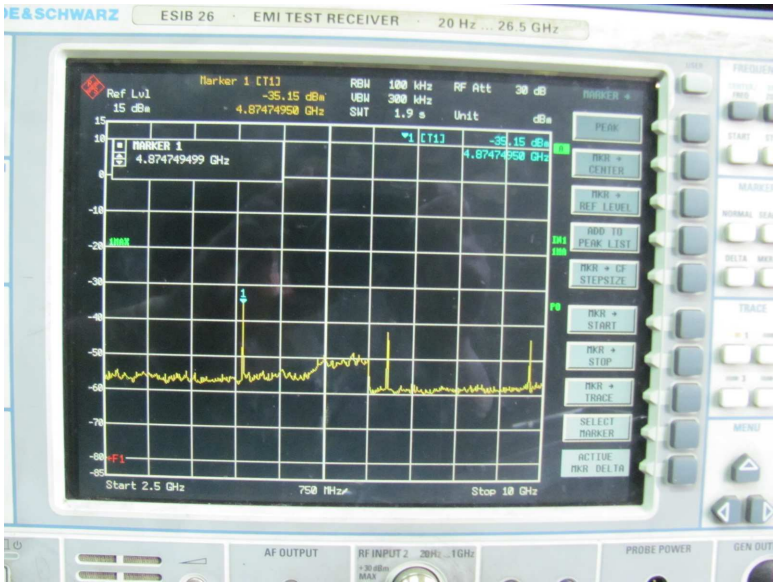
Spurious Emission 9k Hz ~ 1GHz - Frequency M



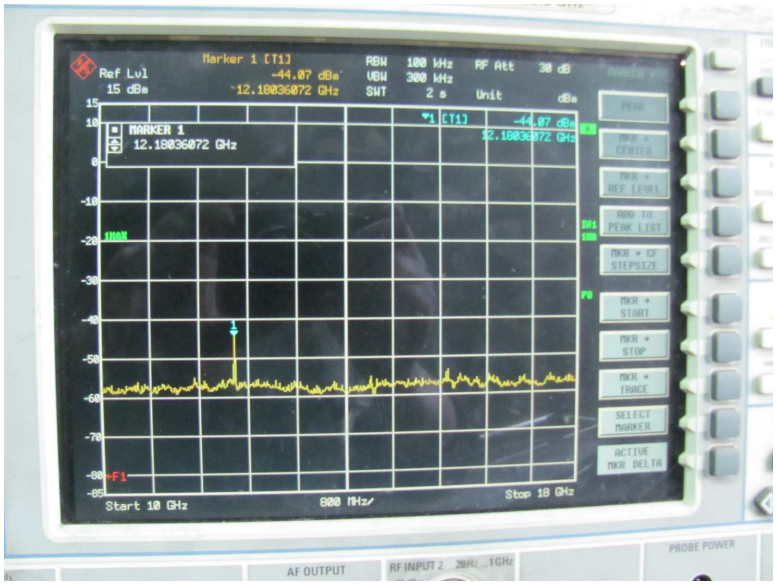
Spurious Emission 1GHz ~ 2.5GHz - Frequency M



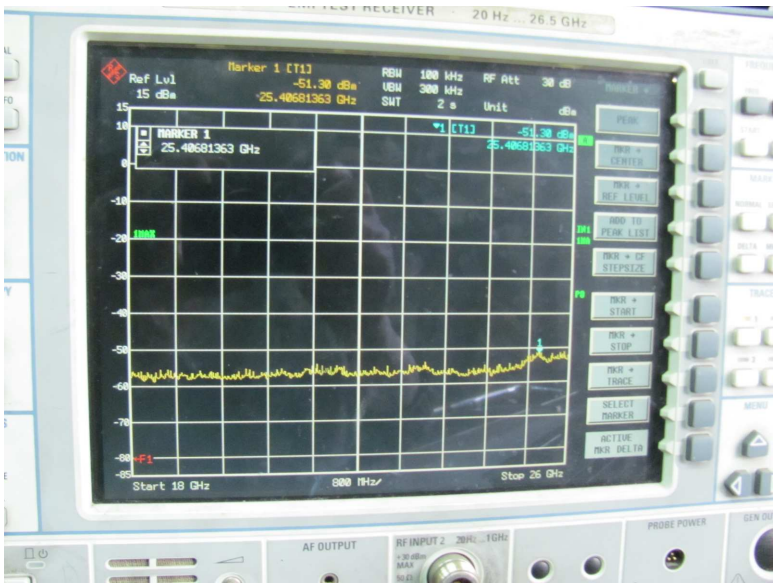
Spurious Emission 2.5GHz ~ 10GHz - Frequency M



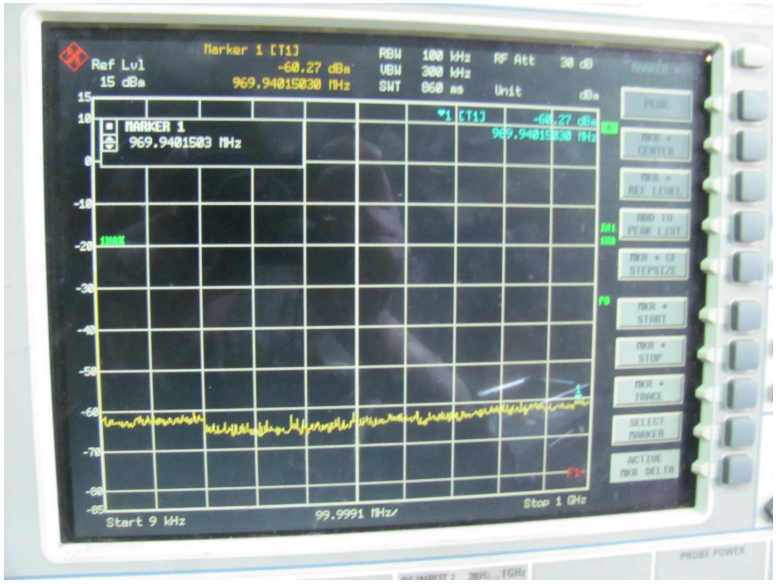
Spurious Emission 10GHz ~ 18GHz - Frequency M



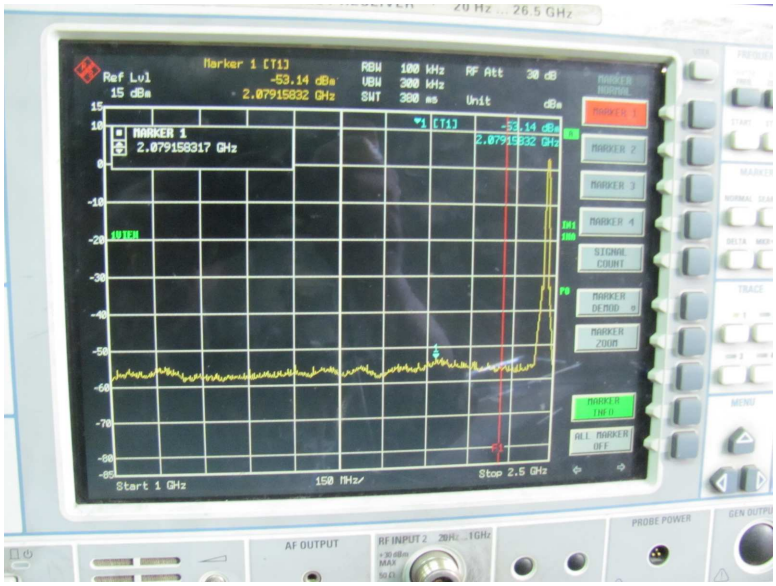
Spurious Emission 18GHz ~ 26GHz - Frequency M



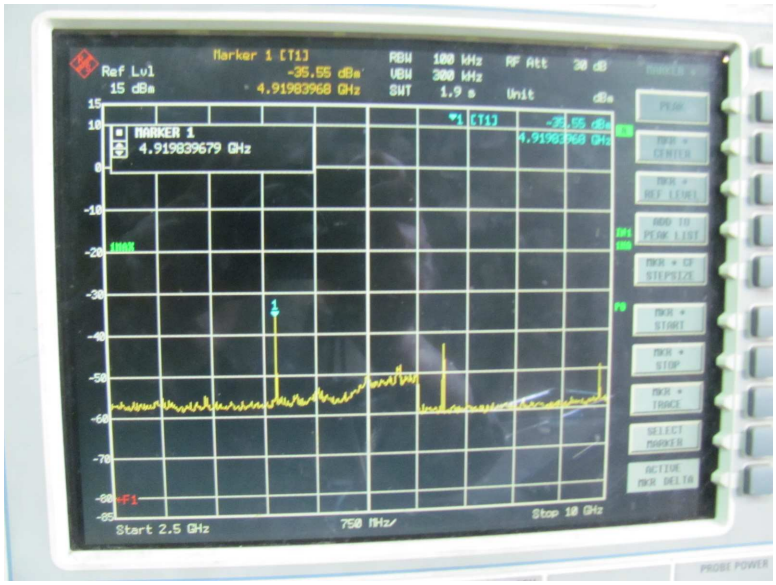
Spurious Emission 9k Hz ~ 1GHz - Frequency H



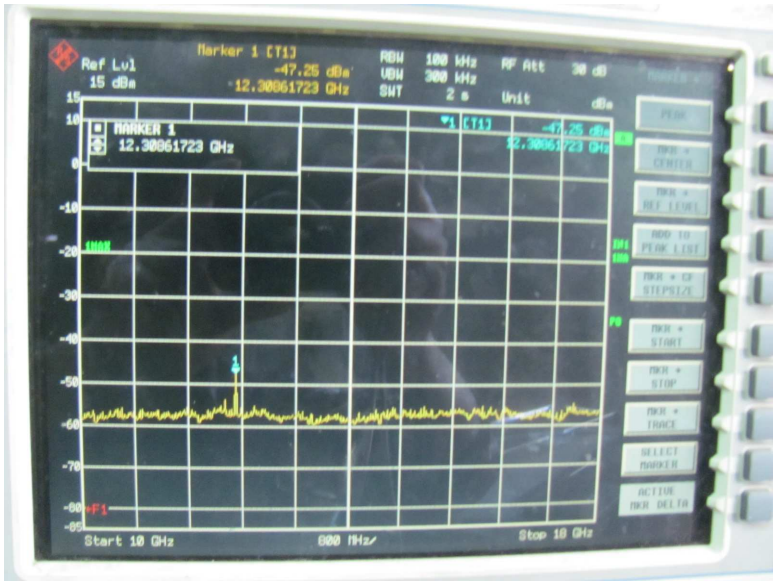
Spurious Emission 1GHz ~ 2.5GHz - Frequency H



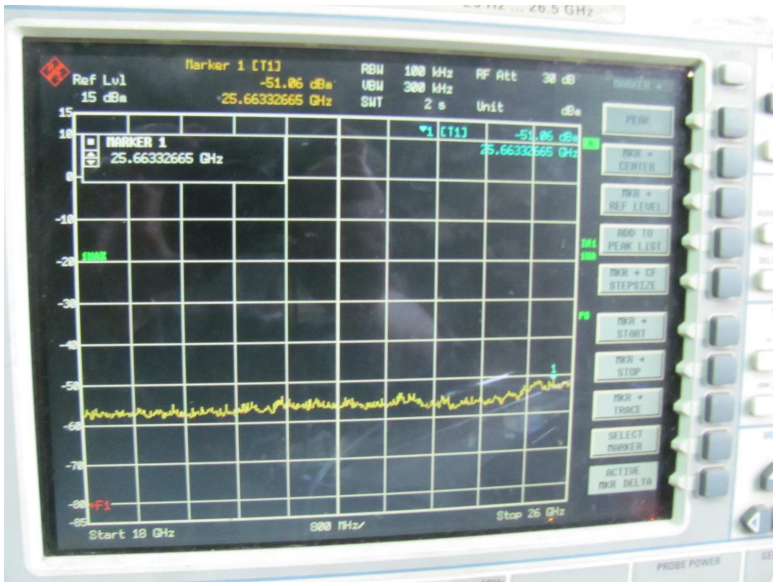
Spurious Emission 2.5GHz ~ 10GHz - Frequency H



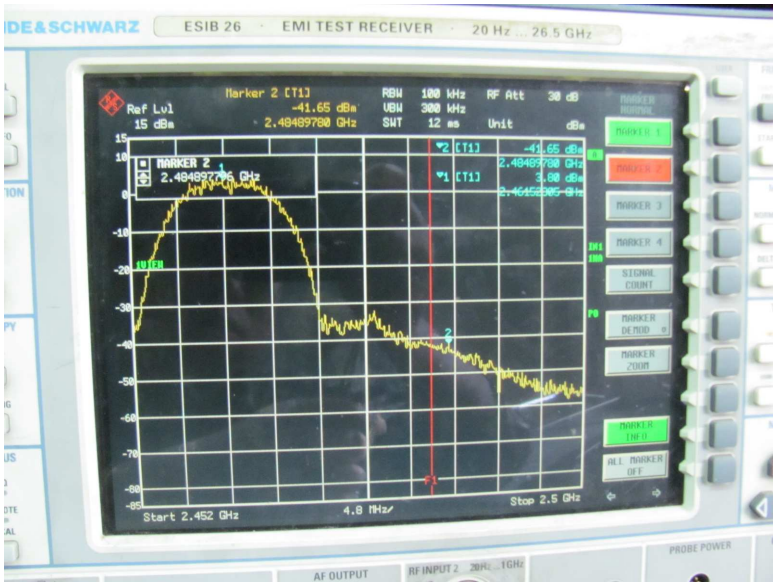
Spurious Emission 10GHz ~ 18GHz - Frequency H



Spurious Emission 18GHz ~ 26GHz - Frequency H



High Band Edge - Frequency H



Mode	CH	Max reading among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
802.11g	L	-22.81	27.60	≥20
	M	-44.20	44.92	
	H	-43.13	43.06	

Low Band Edge - Frequency L