



EMC TEST REPORT for Intentional Radiator No. 150101832SHA-001

Applicant : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Product Name : Wireless Sensor
Type/Model : LSIN0100

SUMMARY

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

47CFR Part 15 (2014): Radio Frequency Devices (Subpart C)

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

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

RSS-Gen Issue 4 (December 2014): General Requirements for Compliance of Radio Apparatus

Date of issue: January 15, 2015

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FCC ID: Q9DLSIN0100
IC: 4675A-LSIN0100

Description of Test Facility

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1. General Information

1.1 Applicant Information

Applicant : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089

Name of contact : Robert Hastings
Tel : (408) 990 2557
Fax : /
Email : rhastings@arubanetworks.com

Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089

1.2 Identification of the EUT

Product Name : Wireless Sensor
Type/model : LSIN0100
FCC ID : Q9DLSIN0100
IC : 4675A-LSIN0100



1.3 Technical specification

Operation Frequency : 2400 ~ 2483.5 MHz;
Band

Type of Modulation : QPSK

Protocol : Bluetooth 4.0 LE

Channel Number : 40 Channels

Description of EUT : The EUT is a Wireless Sensor and has only one model.

Port identification : power port 1;
USB port 1

Antenna : RFANT3216120A5T:
Integral, 0.3dBi

Rating : 100-240Vac, 50/60Hz, 0.3A or 5Vdc, 0.5A (USB)

Declared : 0°C ~ 50°C
Temperature range

Category of EUT : Class B

EUT type : Table top Floor standing

Sample received date : December 14, 2014

Sample Identification : /
No

Date of test : December 15, 2014 – January 15, 2014

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2014-10-21	2015-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2014-10-20	2015-10-19
Test Receiver	ESCI 7	R&S	EC4501	2014-12-29	2015-12-28
Spectrum Analyzer	N9010	Agilent	EC4890	2014-10-21	2015-10-20
Spectrum Analyzer	E4446	Agilent	/	2014-10-21	2015-10-20
Power meter	ML 2495A	Anritsu	EC 4895	2014-10-21	2015-10-20
A.M.N.	ESH2-Z5	R&S	EC 3119	2015-1-9	2016-1-8
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2014-5-15	2015-5-14
Horn antenna	HF 906	R&S	EC 3049	2014-5-12	2015-5-11
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2014-4-11	2015-4-10
Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2014-4-11	2015-4-10
Log-period antenna	AT 1080	AR	EC 3044-7	2014-5-21	2015-5-20
Biconical antenna	3109PX	ETS	EC3564	2014-8-25	2015-8-24
Semi-anechoic chamber	-	Albatross project	EC 3048	2014-5-20	2015-5-19
Shielded room	-	Zhongyu	EC 2838	2015-1-12	2016-1-11
Shielded room	-	Zhongyu	EC 2839	2015-1-12	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
MXG Analog Signal Generator	N5181A	KEYSIGHT	EC5338-2	2014-11-7	2015-11-6
MXG Vector Signal Generator	N51812B	KEYSIGHT	EC5175	2014-12-30	2015-12-29
Power sensor	U2021XA	KEYSIGHT	EC5338-1	2014-10-2	2015-10-1
PXA Signal Analyzer	N9030A	KEYSIGHT	EC5338	2014-11-18	2015-11-17



2.2 Test Standard

47CFR Part 15 (2014)
ANSI C63.4 (2009)
KDB 558074 (V03R02)
RSS-210 Issue 8 (December 2010)
RSS-Gen Issue 4 (December 2014)

2.3 Mode of operation during the test / Test peripherals used

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

EUT was tested with AC powered and USB powered and the worst data was recorded and listed in the report.

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

Freq. Band	Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
2400-2483.5 MHz	BLE	2402	2440	2480

Test software:

The EUT is set with SmartRF software offered by the manufactory.

Test peripherals used:

Item No	Name	Band and Model	Description	S/No
1	Laptop computer	HP ProBook 6470b	100-240V AC, 50/60Hz	NA

2.4 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 & Occupied bandwidth	15.247(a)(2)	RSS-210 Issue 8 Annex 8 RSS-Gen Issue 4 Clause 6.6	Pass
Maximum peak output power	15.247(b)	RSS-210 Issue 8 Annex 8	Pass
Power spectrum density	15.247(e)	RSS-210 Issue 8 Annex 8	Pass
Radiated emission	15.205 & 15.209	RSS-210 Issue 8 Clause 2	Pass
Emission outside the frequency band	15.247(d)	RSS-210 Issue 8 Annex 8	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	Pass

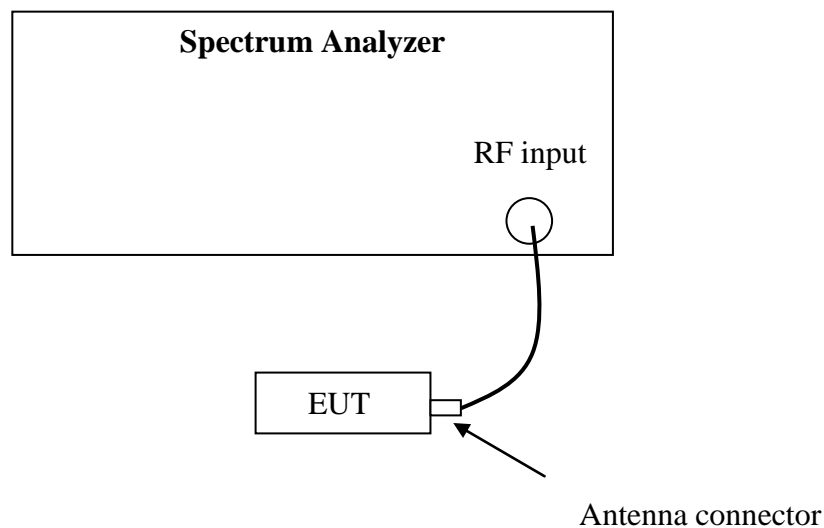
3. Minimum 6dB Bandwidth & Occupied bandwidth

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 v03r02” for compliance to FCC 47CFR 15.247 requirements(clause 8.2).

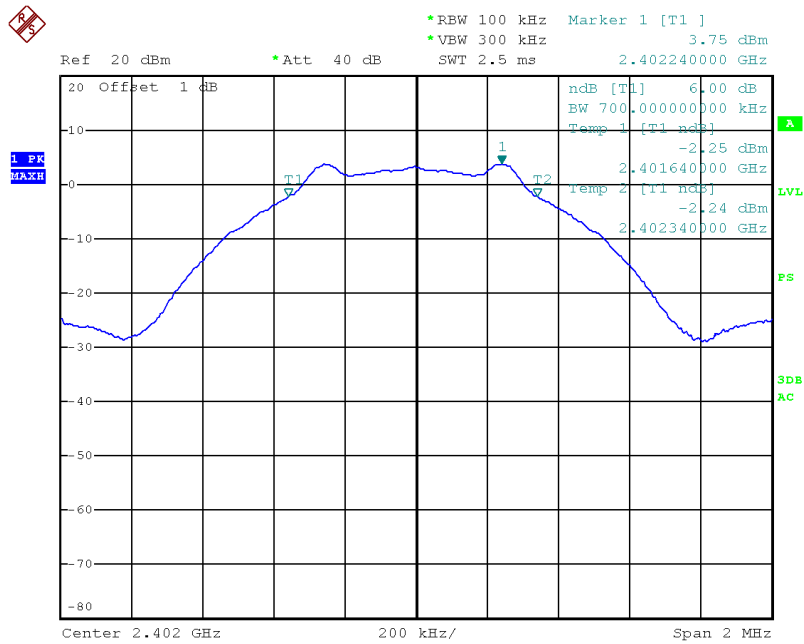
- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

3.4 Test Protocol

Temperature : 25°C
Relative Humidity : 55%

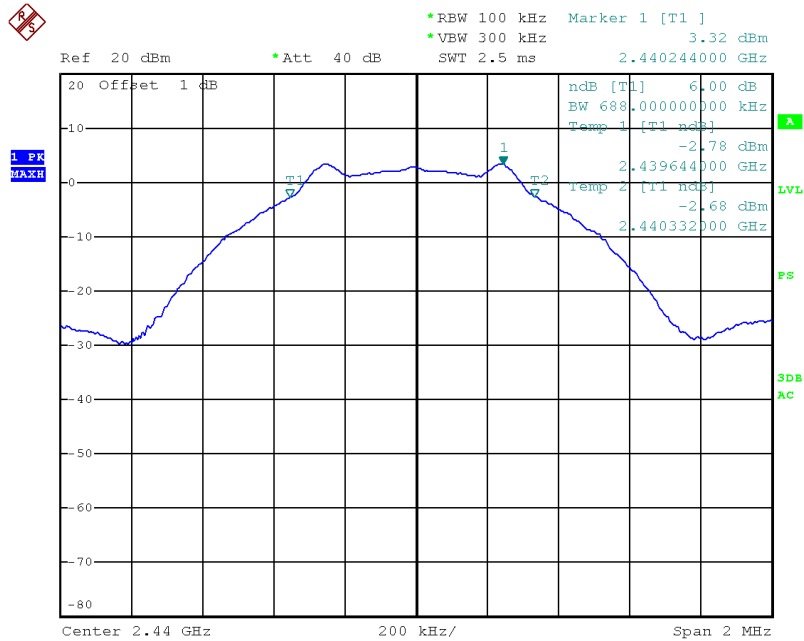
Mode	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)
BLE	L	0.700	1.062	≥0.5
	M	0.688	1.062	
	H	0.688	1.062	

Channel L – 6dB Bandwidth



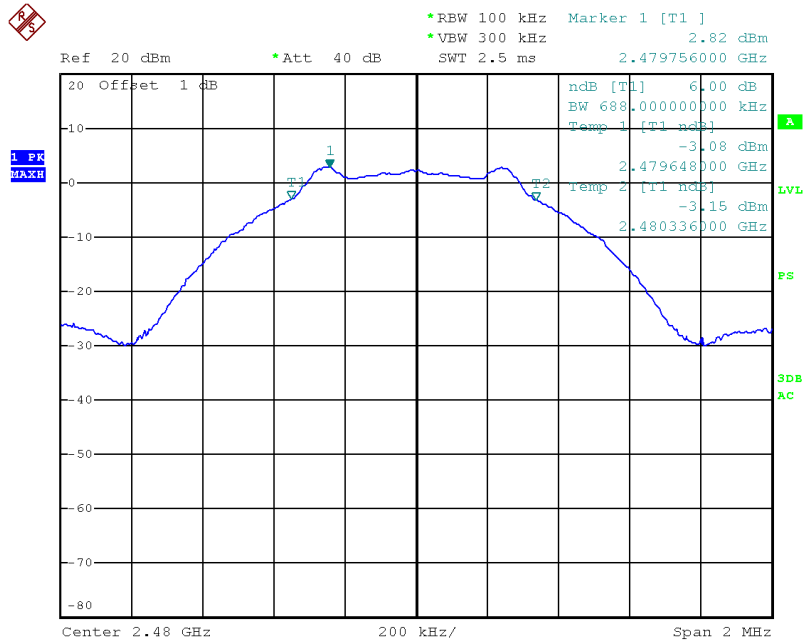
Date: 15.DEC.2014 13:27:24

Channel M – 6dB Bandwidth



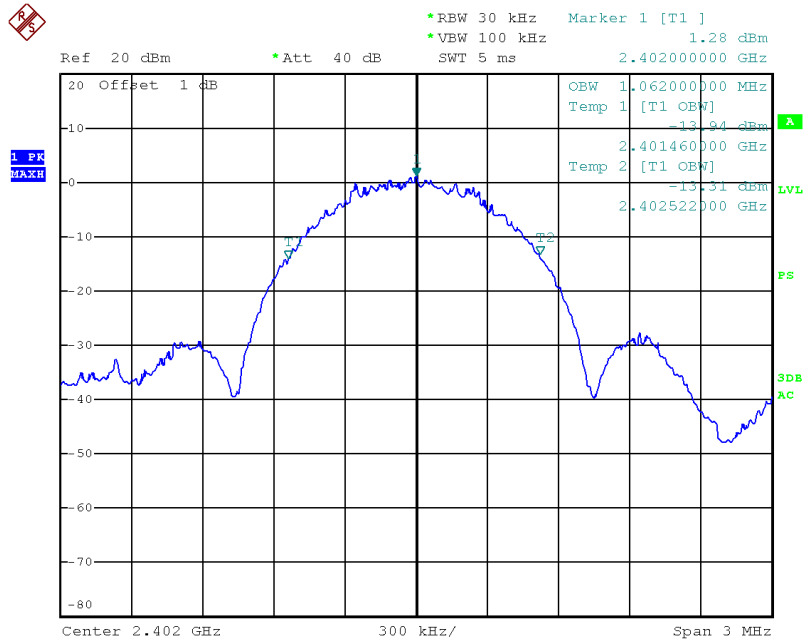
Date: 15.DEC.2014 13:28:48

Channel H – 6dB Bandwidth



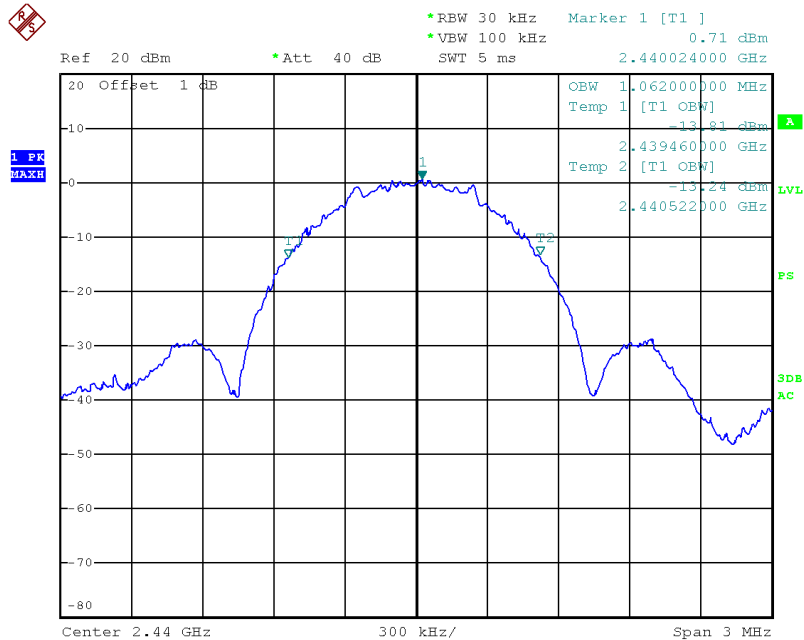
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Channel L – 99% Bandwidth



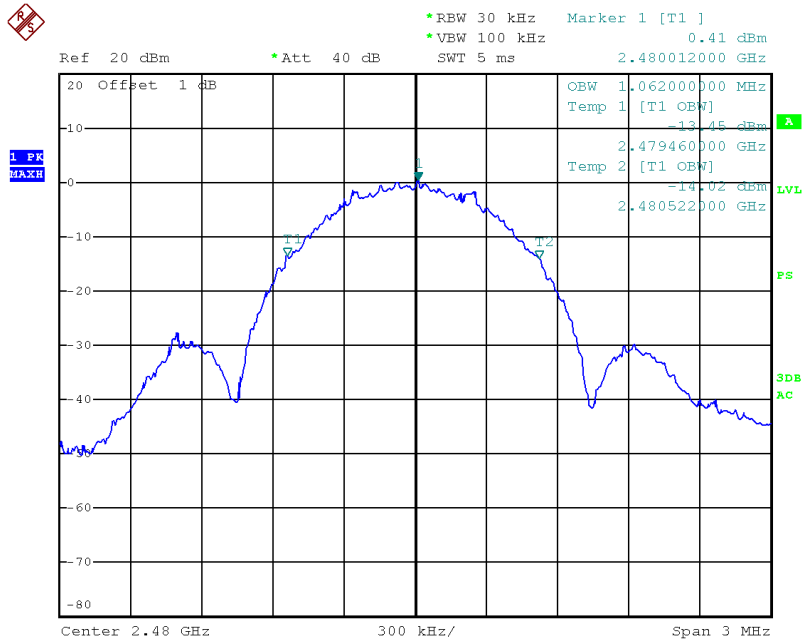
Date: 15.DEC.2014 13:52:03

Channel M – 99% Bandwidth



Date: 15.DEC.2014 13:53:55

Channel H – 99% Bandwidth



Date: 15.DEC.2014 13:54:43

4. Maximum peak output power

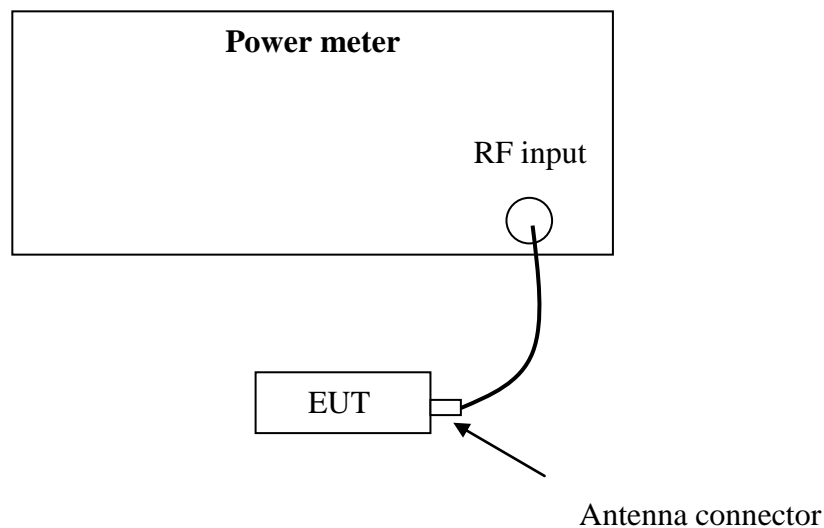
Test result: Pass

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 v03r02” for compliance to FCC 47CFR 15.247 requirements (clause 9.1.2).

4.4 Test protocol

Temperature : 25 °C

Relative Humidity : 55 %

Mode	Channel	Cable loss	Peak power (dBm)	Limit (dBm)
BLE	L	1.0	4.47	30.00
	M	1.0	4.26	30.00
	H	1.0	3.82	30.00

The maximum EIRP of the EUT = 4.47dBm + 0.30dBi = 4.77dBm = 3.00mW which is lower than the EIRP limit of RSS-210.

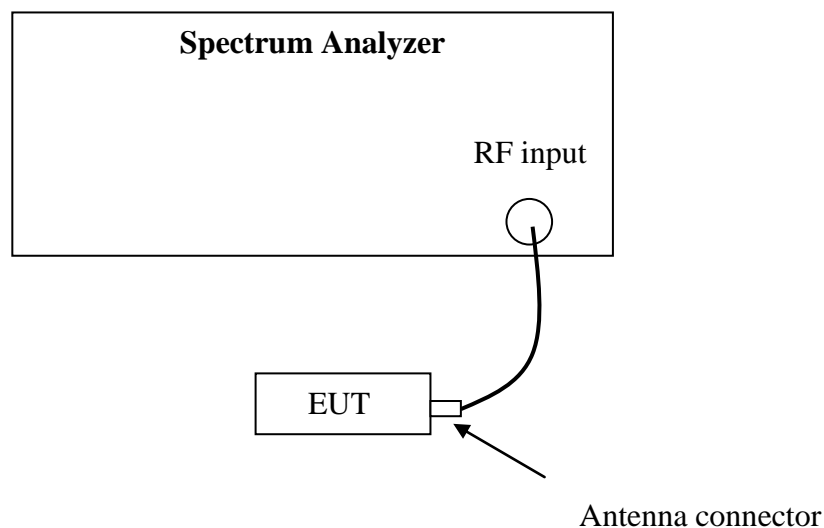
5. Power spectrum density

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 v03r02” (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

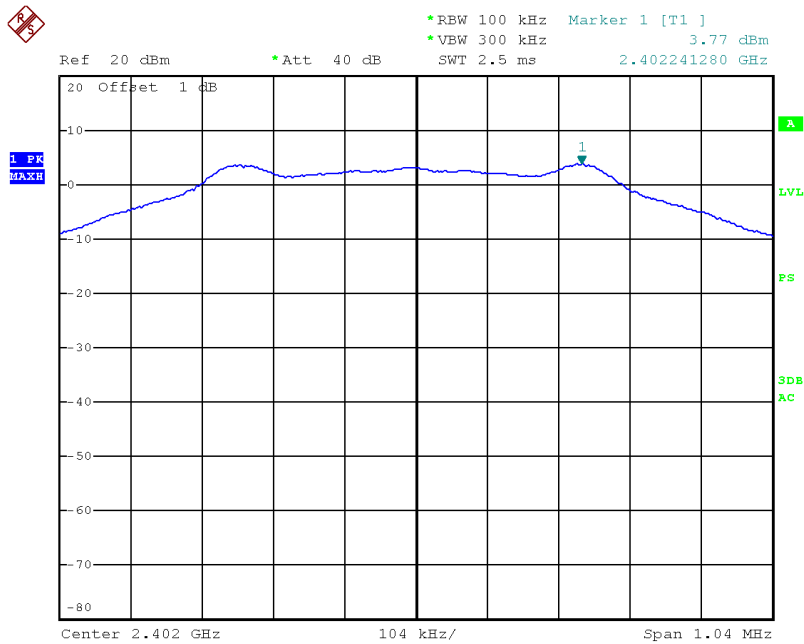
- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the *DTS bandwidth*.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.4 Test Protocol

Temperature : 25 °C
Relative Humidity: 55 %

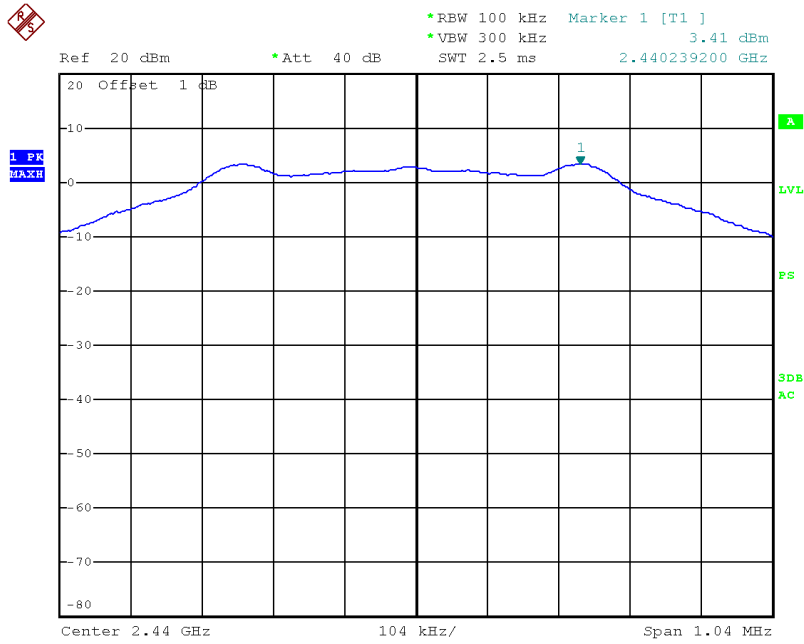
Mode	Channel	Cable loss	PSD (dBm/100kHz)	Limit (dBm/3kHz)
BLE	L	1.0	3.77	≤8.00
	M	1.0	3.41	
	H	1.0	3.02	

Channel L



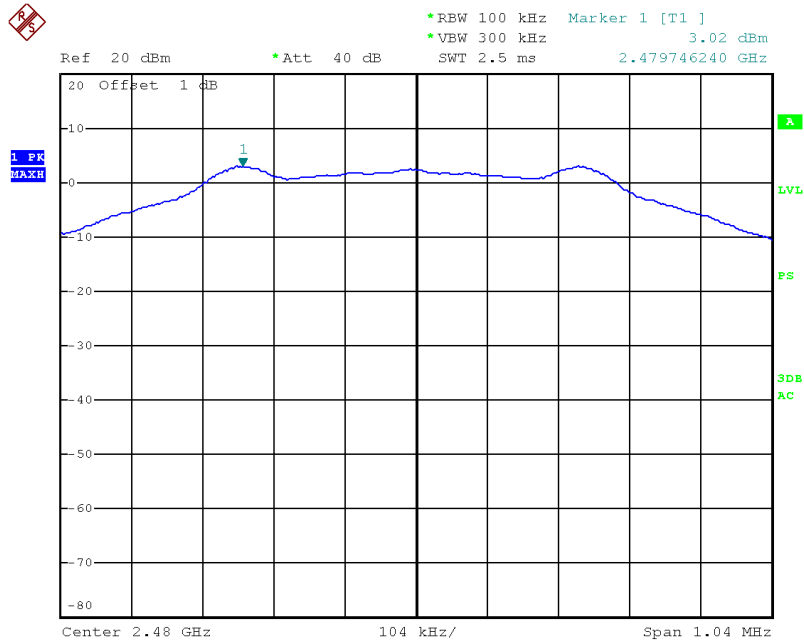
Date: 15.DEC.2014 13:32:49

Channel M



Date: 15.DEC.2014 13:35:50

Channel H



Date: 15.DEC.2014 13:36:51

6. Radiated emission in the restricted bands

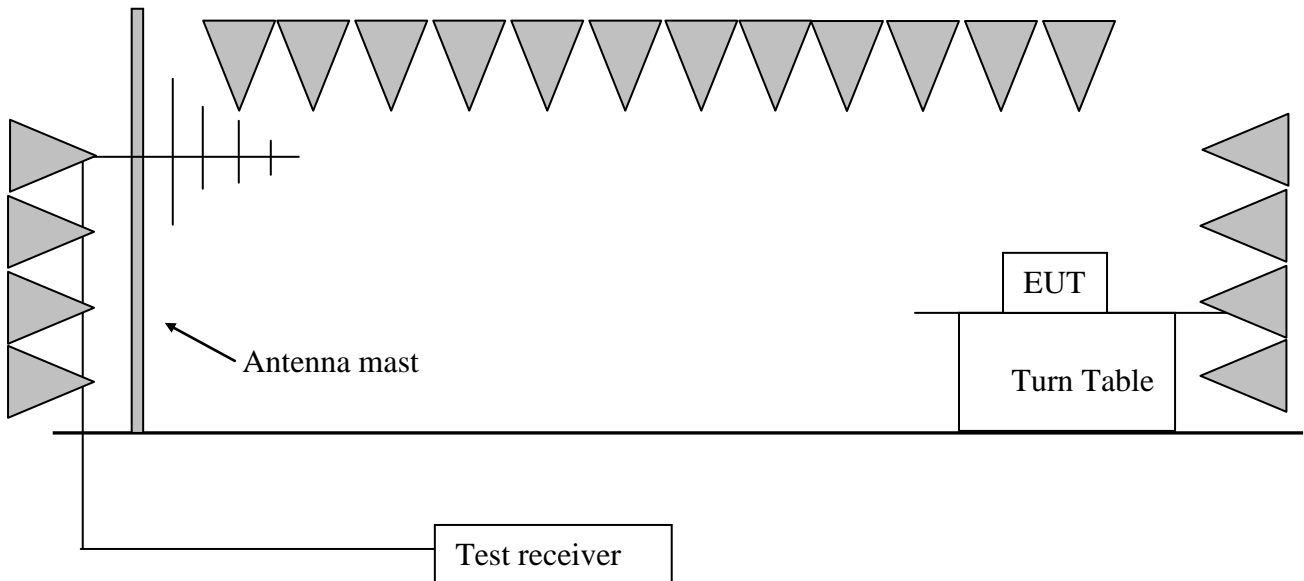
Test result: **PASS**

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 v03r02” (clause 12) for compliance to FCC 47CFR 15.247 requirements.

6.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

Test data:

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.81	91.60	34.30	Fundamental	/	PK
	H	276.01	39.40	14.60	46.00	6.60	QP
	H	299.89	37.40	15.40	46.00	8.60	QP
	H	346.35	35.90	16.60	46.00	10.10	QP
	V	74.71	29.10	9.70	40.00	10.90	QP
	V	276.01	36.00	14.60	43.50	7.50	QP
	V	346.35	39.00	16.60	46.00	7.00	QP
	H	2380.50	53.20	34.20	74.00	20.80	PK
	H	4804.80	44.70	-3.60	74.00	29.30	PK
M	H	2440.85	91.40	34.60	Fundamental	/	PK
	H	276.01	39.40	14.60	46.00	6.60	QP
	H	299.89	37.40	15.40	46.00	8.60	QP
	H	346.35	35.90	16.60	46.00	10.10	QP
	V	74.71	29.10	9.70	40.00	10.90	QP
	V	276.01	36.00	14.60	43.50	7.50	QP
	V	346.35	39.00	16.60	46.00	7.00	QP
	H	4880.10	44.90	-3.50	74.00	29.10	PK
H	H	2480.90	101.20	34.70	Fundamental	/	PK
	H	276.01	39.40	14.60	46.00	6.60	QP
	H	299.89	37.40	15.40	46.00	8.60	QP
	H	346.35	35.90	16.60	46.00	10.10	QP
	V	74.71	29.10	9.70	40.00	10.90	QP
	V	276.01	36.00	14.60	43.50	7.50	QP
	V	346.35	39.00	16.60	46.00	7.00	QP



	H	2485.50	52.50	34.80	74.00	21.50	PK
	H	4960.25	44.80	-3.30	74.00	29.20	PK

Remark:

1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measure level= Reading level + Factor
3. Over Limit = Limit – Measure level
4. If the PK measured level 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

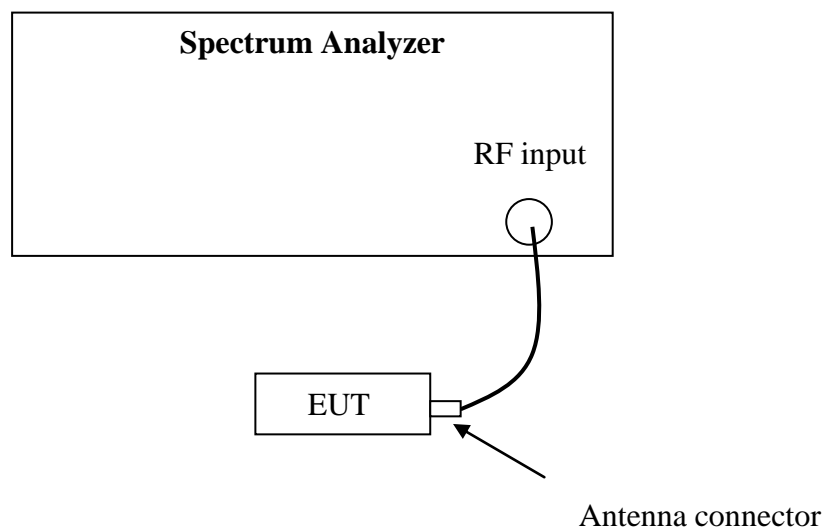
7. Emission outside the frequency Band

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 v03r02” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

Reference level measurement

Establish a reference level by using the following procedure:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set the span to ≥ 1.5 times the *DTS bandwidth*.
- c) Set the RBW = 100 kHz.
- d) Set the VBW $\geq 3 \times$ RBW.
- e) Detector = peak.

- f) Sweep time = auto couple.
 - g) Trace mode = max hold.
 - h) Allow trace to fully stabilize.
 - i) Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement

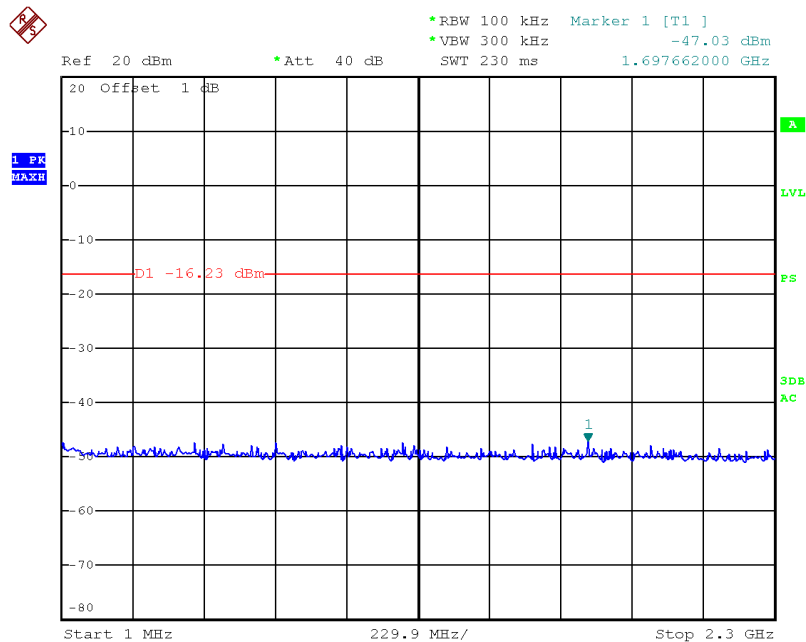
- a) Set the center frequency and span to encompass frequency range to be measured.
 - b) Set the RBW = 100 kHz.
 - c) Set the VBW $\geq 3 \times$ RBW.
 - d) Detector = peak.
 - e) Sweep time = auto couple.
 - f) Trace mode = max hold.
 - g) Allow trace to fully stabilize.
 - h) Use the peak marker function to determine the maximum amplitude level.
- Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit

7.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

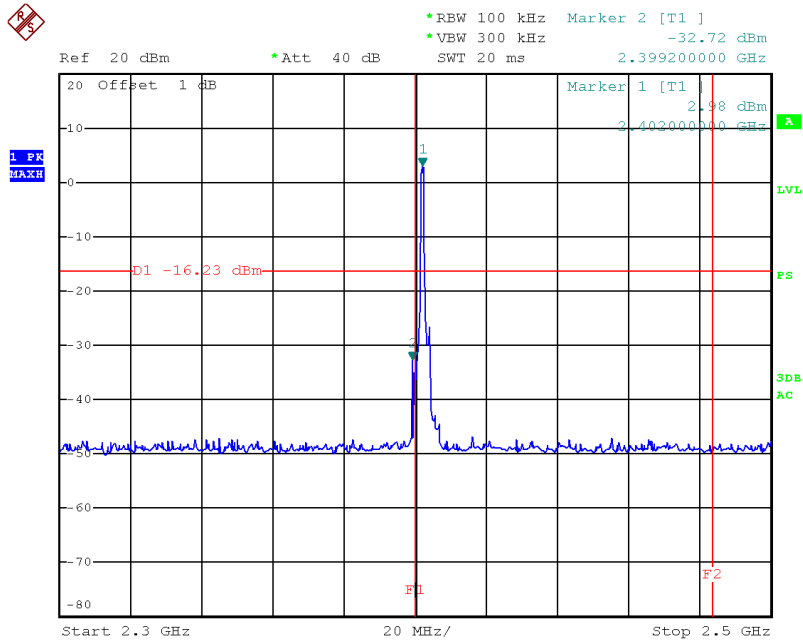
Channel	Max PSD among band (dBm)	The most restrict Attenuation outside band (dB)	Limit (dB)
L	3.77	36.46	≥20
M	3.41	46.05	
H	3.02	48.30	

Channel L - 1MHz ~ 2.3GHz



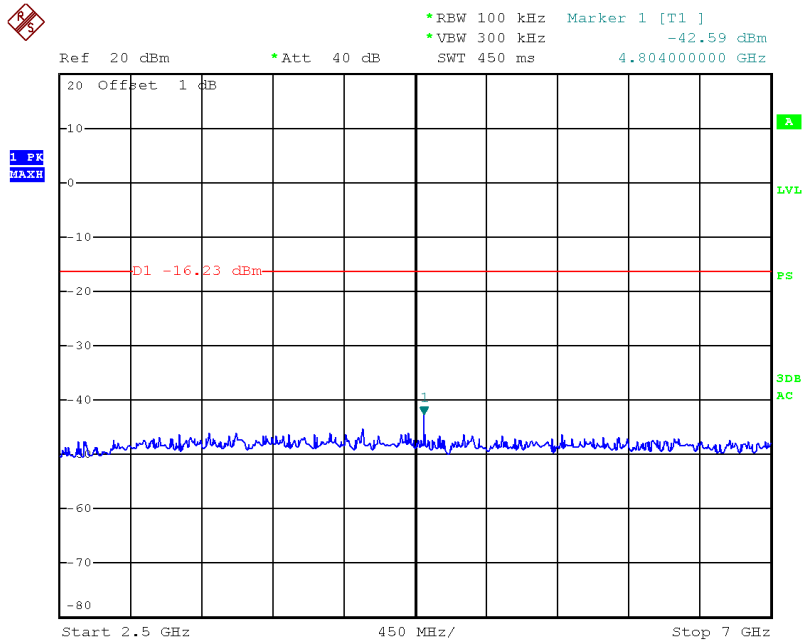
Date: 15.DEC.2014 14:38:22

Channel L – 2.3GHz ~ 2.5GHz



Date: 15.DEC.2014 14:39:18

Channel L – 2.5GHz ~ 7GHz

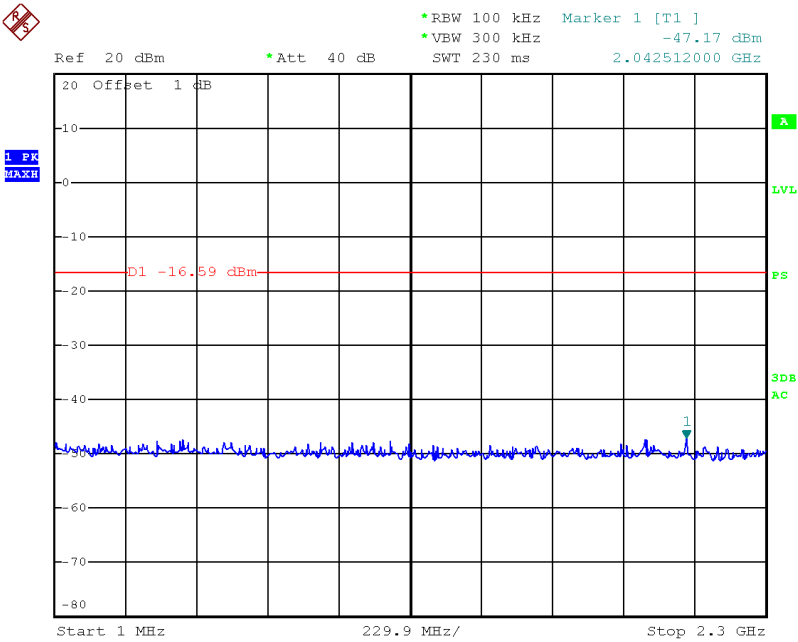


Date: 15.DEC.2014 14:40:08

Channel L – 7GHz ~ 25GHz

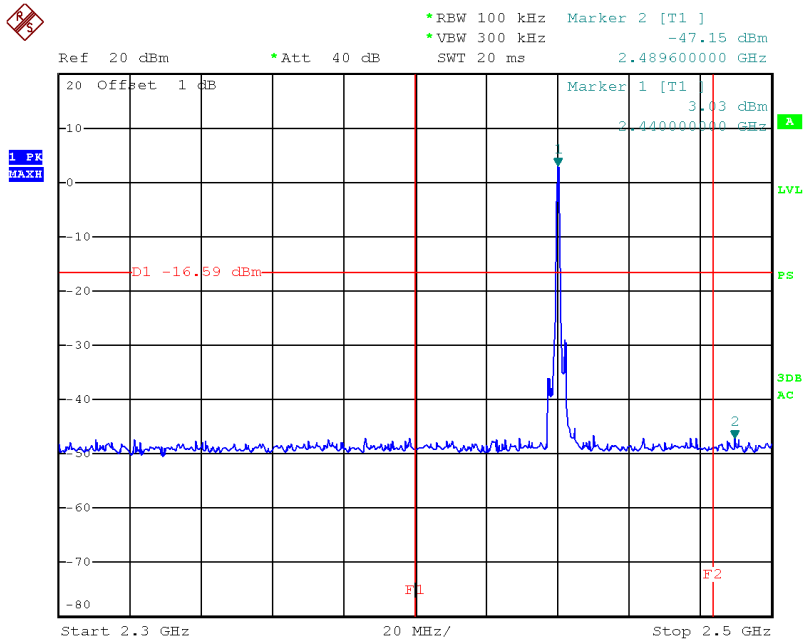


Channel M - 1MHz ~ 2.3GHz



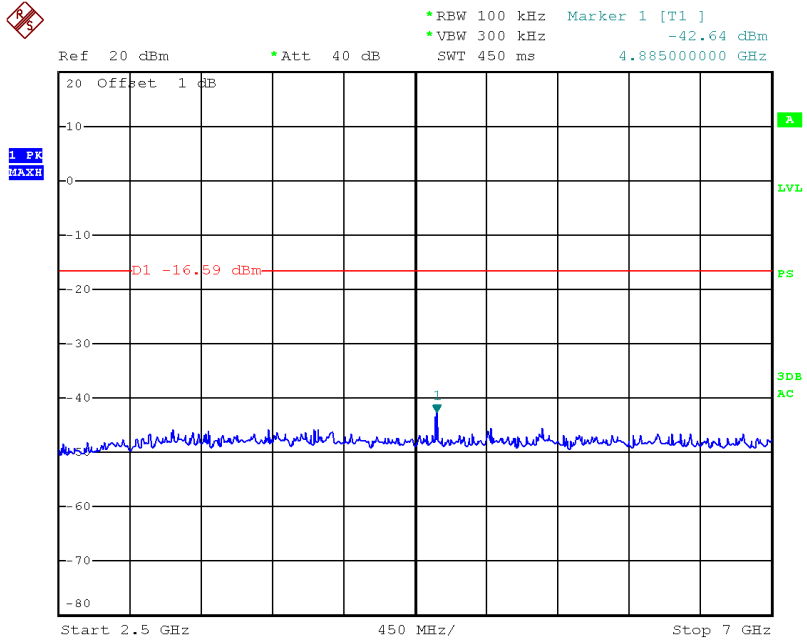
Date: 15.DEC.2014 14:41:18

Channel M – 2.3GHz ~ 2.5GHz



Date: 15.DEC.2014 14:42:12

Channel M – 2.5GHz ~ 7GHz

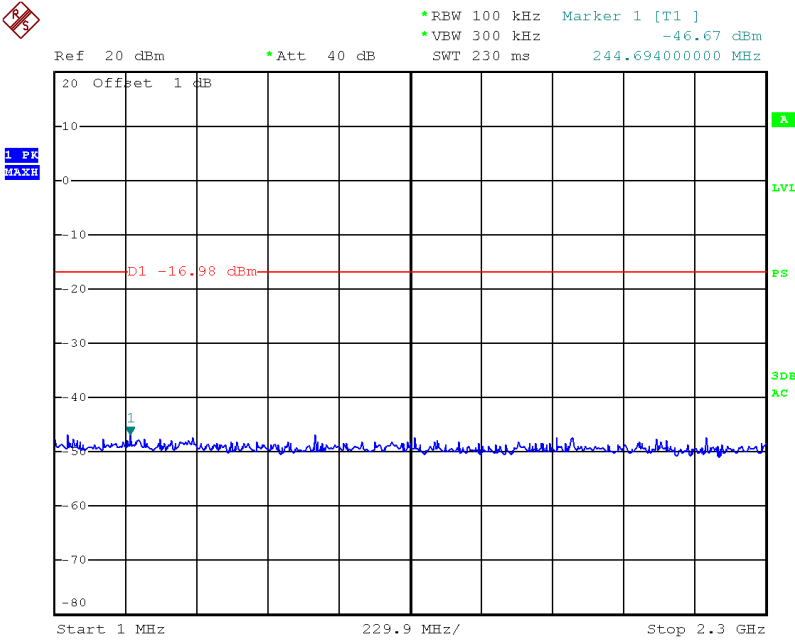


Date: 15.DEC.2014 14:42:49

Channel M – 7GHz ~ 25GHz

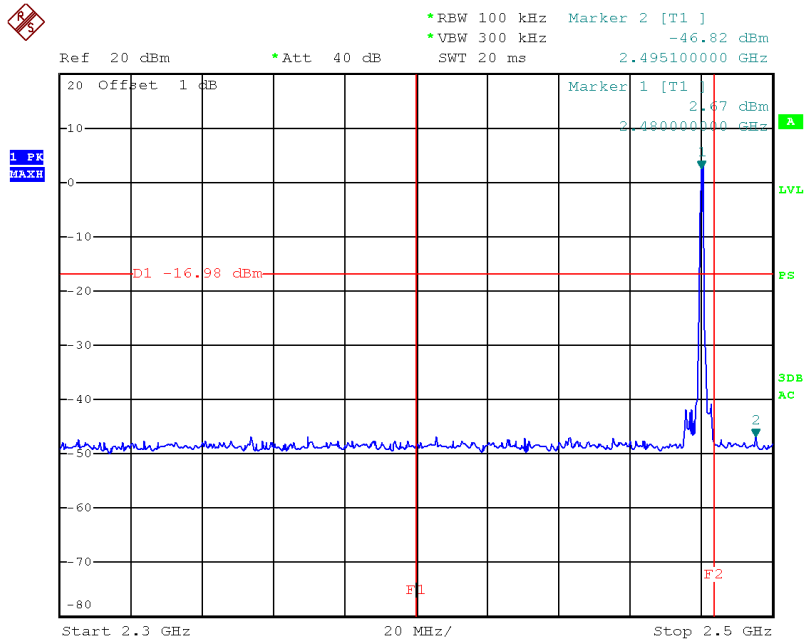


Channel H - 1MHz ~ 2.3GHz



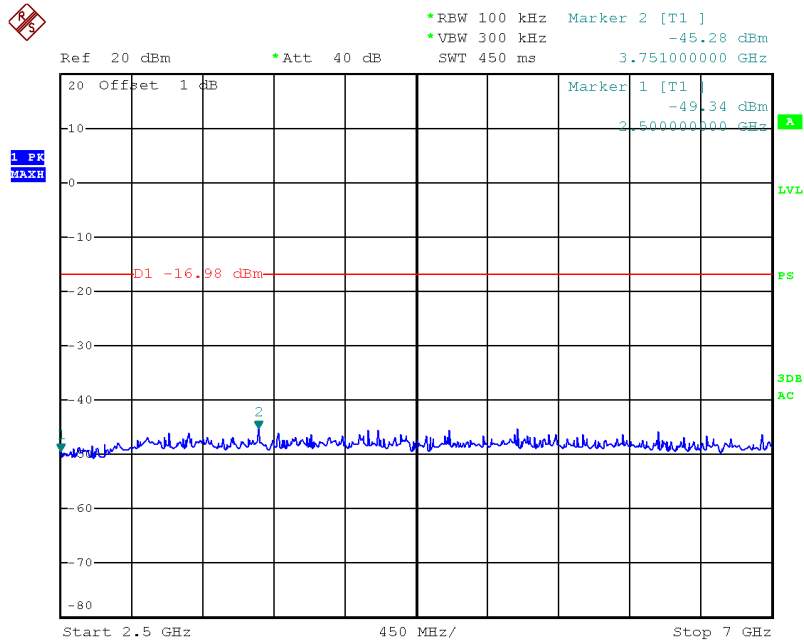
Date: 15.DEC.2014 14:43:57

Channel H – 2.3GHz ~ 2.5GHz



Date: 15.DEC.2014 14:45:31

Channel H – 2.5GHz ~ 7GHz



Date: 15.DEC.2014 14:46:16

Channel H – 7GHz ~ 25GHz



8. Power line conducted emission

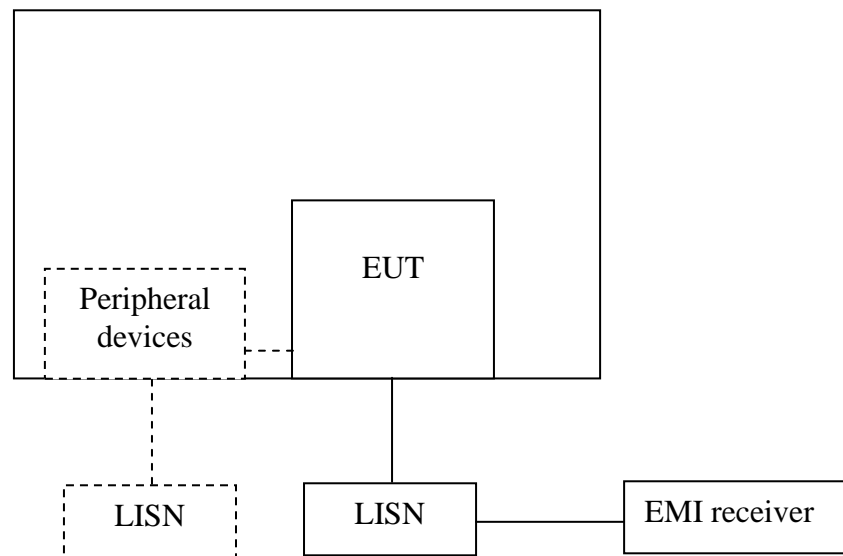
Test result: Pass

8.1 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.

8.2 Test configuration



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

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

8.3 Test procedure and test set up

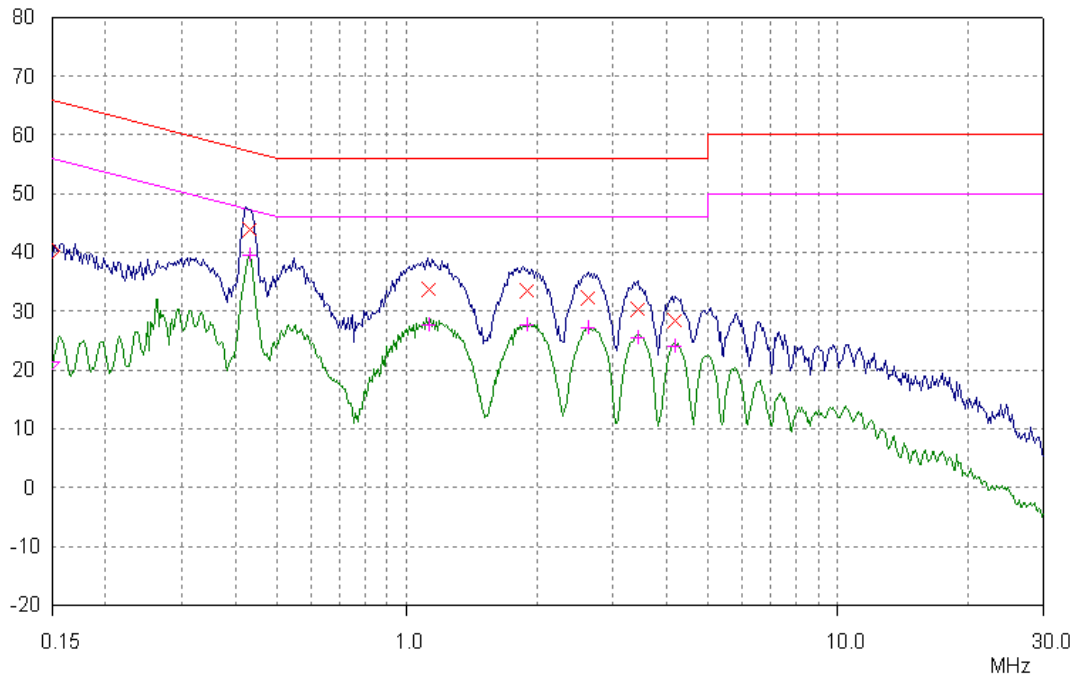
The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.

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.

8.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

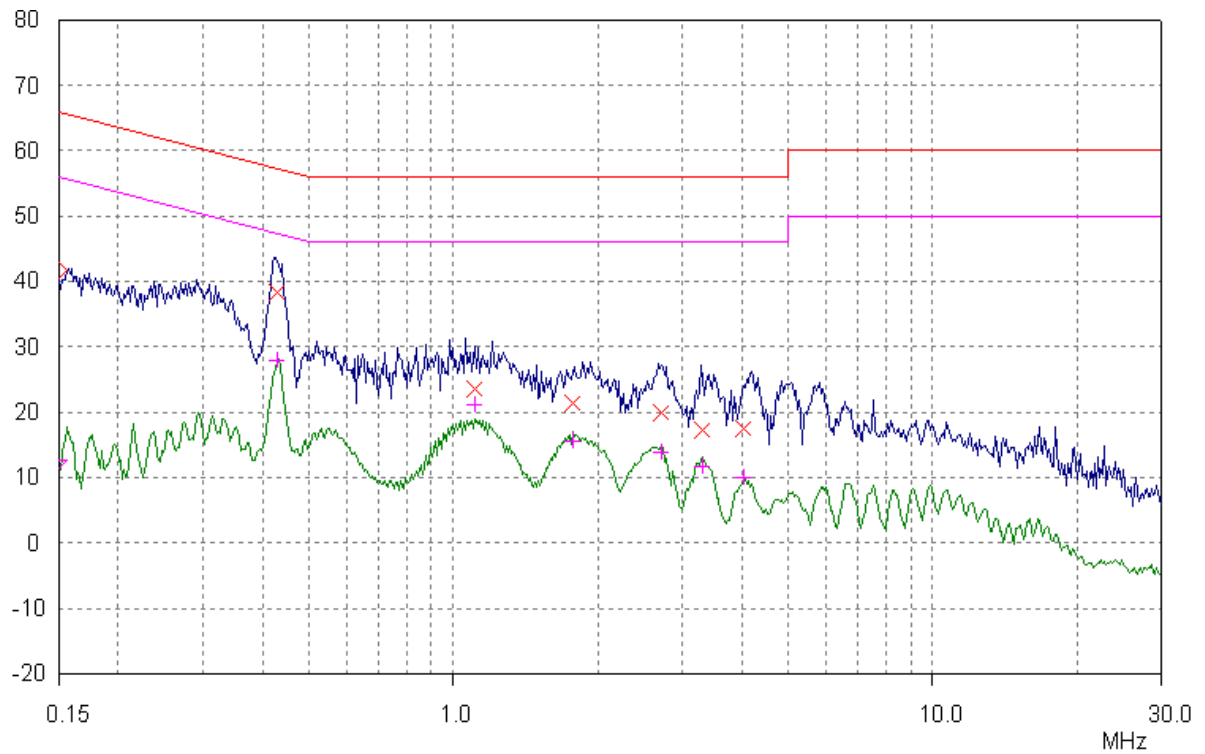
L Line



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.430	43.98	57.25	13.27	39.49	47.25	7.76
1.122	33.75	56.00	22.25	27.55	46.00	18.45
1.900	33.35	56.00	22.65	27.58	46.00	18.42
2.625	32.29	56.00	23.71	27.11	46.00	18.89
3.417	30.37	56.00	25.63	25.47	46.00	20.53
4.188	28.46	56.00	27.54	24.03	46.00	21.97

N Line



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.427	38.36	57.31	18.95	27.80	47.31	19.51
1.104	23.59	56.00	32.41	21.00	46.00	25.00
1.761	21.35	56.00	34.65	15.56	46.00	30.44
2.700	19.86	56.00	36.14	13.95	46.00	32.05
3.296	17.28	56.00	38.72	11.59	46.00	34.41
4.024	17.58	56.00	38.42	9.86	46.00	36.14