



Report No.SH13080021R01

FCC RF TEST REPORT

Issued to

PeopleNet Communications Corporation

For

PeopleNet Display.4

Model Name : L019-0506
 Trade Name : PeopleNet Display.4
 Brand Name : PeopleNet
 FCC ID : NKS-PD4
 Standard : 47 CFR Part 15,Subpart C
 ANSI C63.4-2009
 Test date : Sep.03,2013 to Sep.04,2013
 Issue date : Sep.06,2013

by

Shanghai MORLAB Communication Technology Co., Ltd.

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Change History

Issue	Date	Reason for change
1.0	Sep.6, 2013	First edition

1. **General Information**

1.1 Applicant

PeopleNet Communications Corporation
4400 Baker Road, Minnetonka, Minnesota, USA

1.2 Manufacturer

Waysion Technology (Xiamen) Co., LTD
3E, Rihua Building, No. 8, Xinfeng 2nd Road, Torch High-Tech Zone, Xiamen, Fujian, China

1.3 Description of EUT

EUT Name.....: PeopleNet Display.4
Model Name.....: L019-0506
Brand Name.....: PeopleNet
Trade Name: PeopleNet Display.4
Hardware Version.....: V1.0
Software Version: V1.0
Modulation Technology.....: DSSS,OFDM
Frequency Range.....: 2400MHz~2483.5MHz
Number of Channels.....: 11
Antenna Type.....: PIFA
Antenna Gain.....: 2.0 dBi

NOTE 1: The EUT supports 802.11b, 802.11g and 802.11n, the 802.11b, 802.11g, and 802.11n was tested in this report.

NOTE 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacture.

2. Facilities and Accreditations

2.1 Test Facility

Shanghai MORLAB Communications Technology Co., Ltd. is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659.

A 9*6*6(m) fully anechoic chamber was used for the radiated spurious emissions test.

2.2 Environmental Conditions

Ambient temperature: 20~25°C

Relative humidity: 40~60%

Atmosphere pressure: 96kPa

2.3 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Uncertainty of Conducted Emission: $\pm 1.76\text{dB}$

Uncertainty of Radiated Emission: $\pm 3.16\text{dB}$

2.4 List of Equipments Used

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Test Receiver	Rohde & Schwarz	ESIB26	A0304218	2013.06.14	1year
Test Receiver	Schwarzbeck	FCKL1528	A0304230	2013.08.26	1year
Spectrum Analyzer	Rohde & Schwarz	FSP13	M-030176	2013.06.22	1year
Spectrum Analyzer	Rohde & Schwarz	FSU26	200880	2013.06.18	1year
Spectrum Analyzer	Agilent	E4440A	MY46187763	2013.07.26	1year
Power Meter	Agilent	E4416A	MY45101575	2013.07.14	1year
Power Sensor	Agilent	E9327A	MY44421258	2013.07.14	1year
LISN	Schwarzbeck	NSLK8127	A0304233	2013.08.22	1year
Loop Antenna	Rohde & Schwarz	HFH2-Z2	A0304220	2013.06.18	1year
Ultra Broadband Ant.	Rohde & Schwarz	HL562	A0304224	2013.06.18	1year
Horn Ant.	Rohde & Schwarz	HF906	100150	2013.06.18	1year
Horn Ant.	Schwarzbeck	BBHA9170	BBHA9170171	2013.07.22	1year

NOTE:

Equipments listed above have been calibrated and are in the period of validation.

3. Test Standards and Results

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.4-2009

Note:

1. *All test items were verified and recorded according to the standards and without any deviation during the test.*
2. *This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.*

Test items and the results are as bellow:

No.	FCC Rules	Test Type	Limits	Result
1	§15.207	Conducted Emission	15.207(a)	NA
2	§15.209 §15.247(d)	Radiated Emission	§15.209 §15.247(d)	PASS
3	§15.247(a)(2)	6dB Bandwidth	≥0.5MHz	PASS
4	§15.247(b)	Maximum Peak Output Power	≤30dBm	PASS
5	§15.247(d)	Band Edge	<20dBc	PASS
6	§15.247(d)	Conducted Spurious Emission	<20dBc	PASS
7	§15.247(e)	Power Spectrum Density	≤8dBm	PASS
8	§15.203 15.247(b)	Antenna Requirement	NA	PASS

4. Test Conditions Setting

Modulation technology	Modulation Type	Transfer Rate (Mbps)	The Frequency Equal to the Transmission Rate of Modulation Signal
DSSS (802.11b)	DBPSK	1	1MHz
	DQPSK	2	
	CCK	5.5/ 11	1.375MHz
OFDM (802.11g)	BPSK	6 / 9	1MHz
	QPSK	12 / 18	
	16QAM	24 / 36	
	64QAM	48 / 54	
OFDM (802.11n-20MHz)	BPSK	6.5	1MHz
	QPSK	13/19.5	
	16QAM	26/39	
	64QAM	52/58.5/65	

Note: Preliminary tests were performed in different data rate in above table to find the worst radiated emission.

5. Test Result

5.1 Radiated Emission Test

5.1.1 Requirement of the standard

According to FCC §15.247(c), radiated emission outside the frequency band attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

According to FCC §15.209 (a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

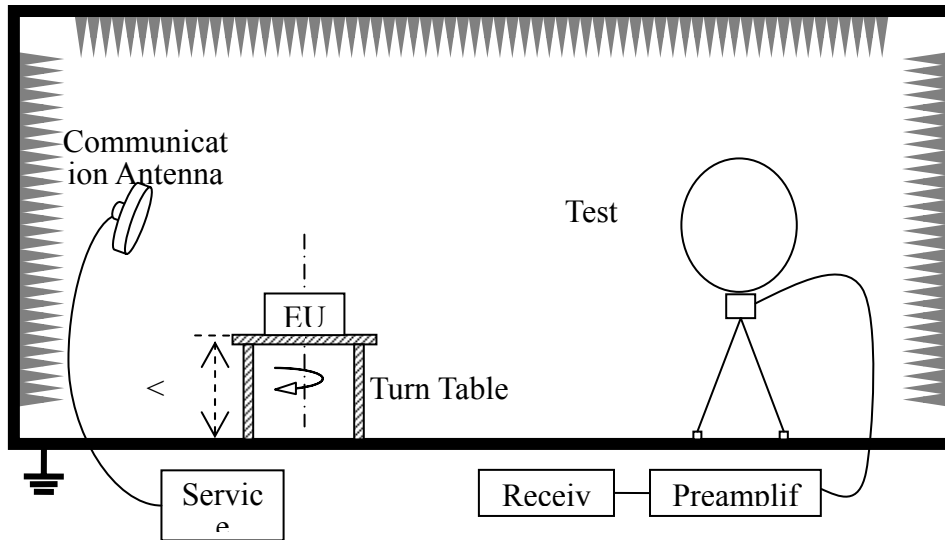
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

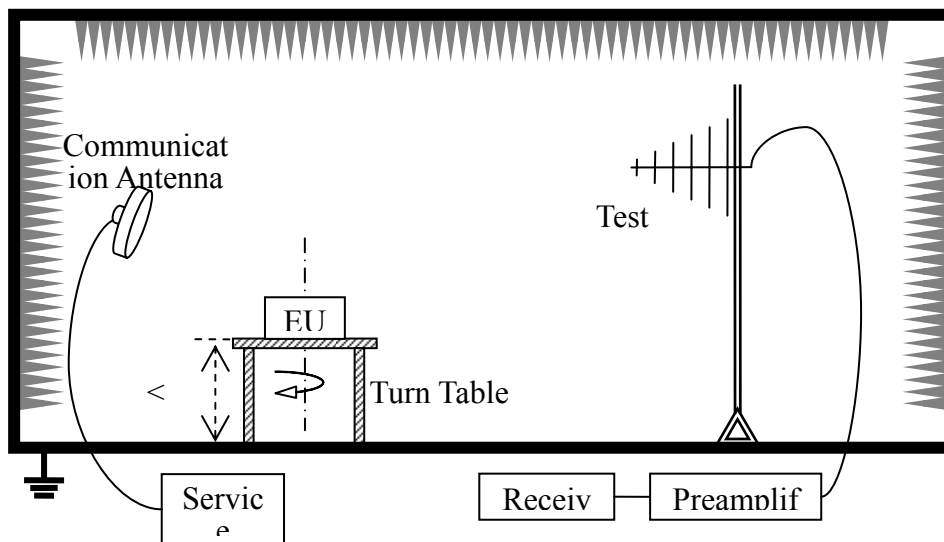
5.1.2 Test Procedure

1. The EUT was placed on the top of a ratable 0.8 meters above the ground at a semi-anechoic chamber. In the frequency range of 9 kHz to 30 MHz, magnetic field was measured with loop antenna.
2. The antenna was positioned with its plane vertical at 1 m distance from the EUT. The center of the loop was 1 m above the ground. During the measurement the loop antenna rotated about its vertical axis for maximum response at each azimuth about the EUT.
3. In the frequency range above 30MHz, ultra-broadband bi-log antenna (30 MHz to 1 GHz) and horn antenna (above 1GHz) were used. Antenna was 3 meters away from the EUT. Antenna height was varied from one meter to four meter above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. The test-receiver system was set to Peak Detector Function and Specified Bandwidth with Maximum Hold Mode.
5. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emission that did not have 10 dB margins would be retested one by one using the quasi-peak method.

5.1.3 Test Setup



Radiated emissions below 30MHz



Radiated emissions

above 30MHz

For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

5.1.4 Test Results

Test Results of Radiated Emissions (9 kHz ~ 30 MHz)

Frequency(MHz)	Level(dBuV)	Margin(dB)	Limit(dBuV)	Remark
--	--	>10	--	See note

Note:

The amplitude of spurious emissions that are attenuated by more than 10dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log(\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

Test Result of Radiated Emission (30 MHz ~ 10th Harmonic)

Channel 1 (2412MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
114.581	--	43.5	--	Horizontal	PASS
147.458	--	43.5	--	Horizontal	PASS
289.458	--	46	--	Horizontal	PASS
351.554	--	46	--	Horizontal	PASS
4824.000	--	54	--	Horizontal	PASS
88.481	--	40	--	Vertical	PASS
108.481	--	43.5	--	Vertical	PASS
148.154	--	43.5	--	Vertical	PASS
330.548	--	46	--	Vertical	PASS
4824.000	--	54	--	Vertical	PASS

Channel 6 (2437MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
116.543	--	43.5	--	Horizontal	PASS
150.014	--	43.5	--	Horizontal	PASS
333.698	--	46	--	Horizontal	PASS
350.486	--	46	--	Horizontal	PASS
4874.000	--	54	--	Horizontal	PASS
41.675	--	40	--	Vertical	PASS
116.483	--	43.5	--	Vertical	PASS
149.829	--	43.5	--	Vertical	PASS
316.579	--	46	--	Vertical	PASS
4874.000	--	54	--	Vertical	PASS

Channel 11 (2462MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
108.154	--	43.5	--	Horizontal	PASS
149.058	--	43.5	--	Horizontal	PASS
331.456	--	46	--	Horizontal	PASS
355.987	--	46	--	Horizontal	PASS
4924.000	--	54	--	Horizontal	PASS
38.157	--	40	--	Vertical	PASS
188.154	--	43.5	--	Vertical	PASS
201.458	--	43.5	--	Vertical	PASS
486.115	--	46	--	Vertical	PASS
4924.000	--	54	--	Vertical	PASS

Note:

The amplitude of spurious emissions that are attenuated by more than 10dB below the permissible value has no need to be reported.

5.2 6dB Bandwidth Measurement

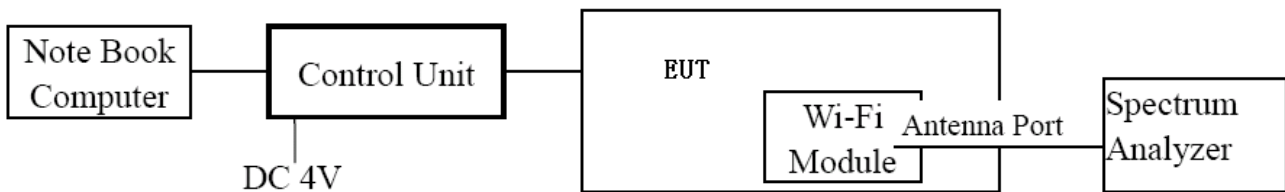
5.2.1 Definition

According to FCC §15.247 (a) (2), Systems using digital modulation techniques 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.

5.2.2 Test Procedure

- The EUT temporary antenna port was coupled to the spectrum analyzer. The lost of the cables the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was set to at least 1% of the EUT emission bandwidth. RBW=100 kHz, VBW=300 kHz.

5.2.3 Test Setup



For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

5.2.4 Setup and Operating Conditions

The EUT was connected to and controlled by a control unit provided by the applicant.

The EUT was set to continuous Wi-Fi transmitting at maximum power and maximum data rate, e.g., 11 Mbps for IEEE802.11b and 6 Mbps for IEEE802.11g and 65 Mbps for IEEE802.11n.

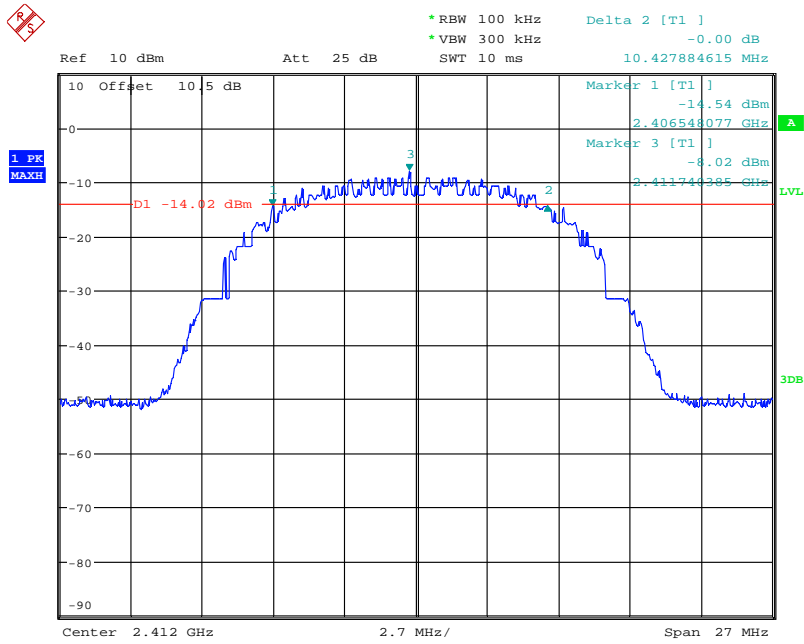
At each operating mode, lowest, middle and highest channels were measured respectively.

5.2.5 Test Results

EUT Modulation	EUT Operating Frequency (MHz)	6dB Bandwidth (MHz)	FCC Requirement
802.11b	2412	10.428	>500 kHz
	2437	10.255	
	2462	10.125	
802.11g	2412	16.399	
	2437	16.313	
	2462	16.313	
802.11n	2412	17.005	
	2437	17.221	
	2462	17.567	

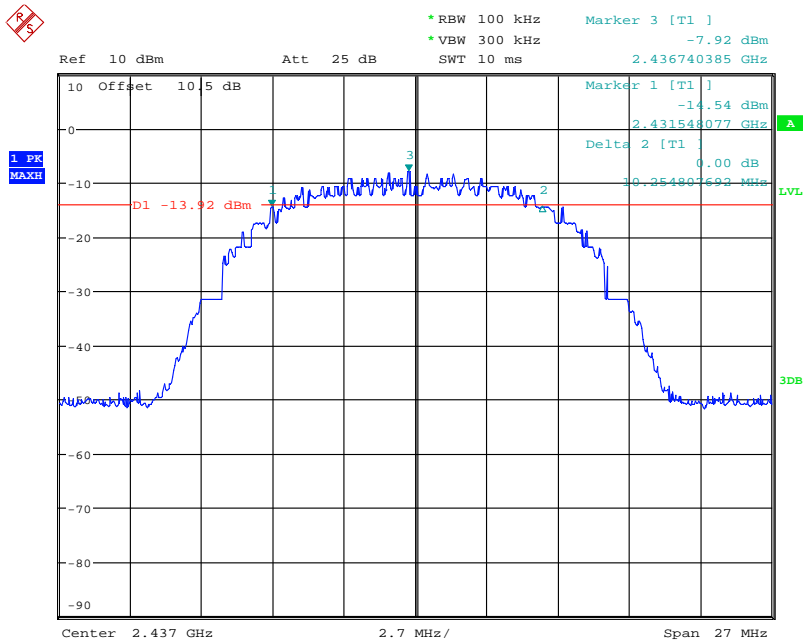
Test Plots:

1. 802.11b -2412MHz



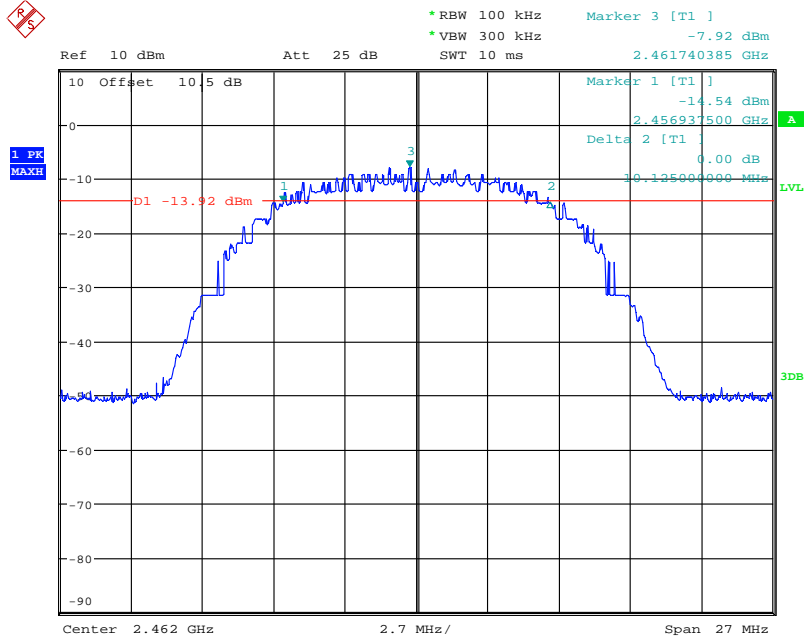
Date: 3.SEP.2013 17:44:07

2. 802.11b -2437MHz



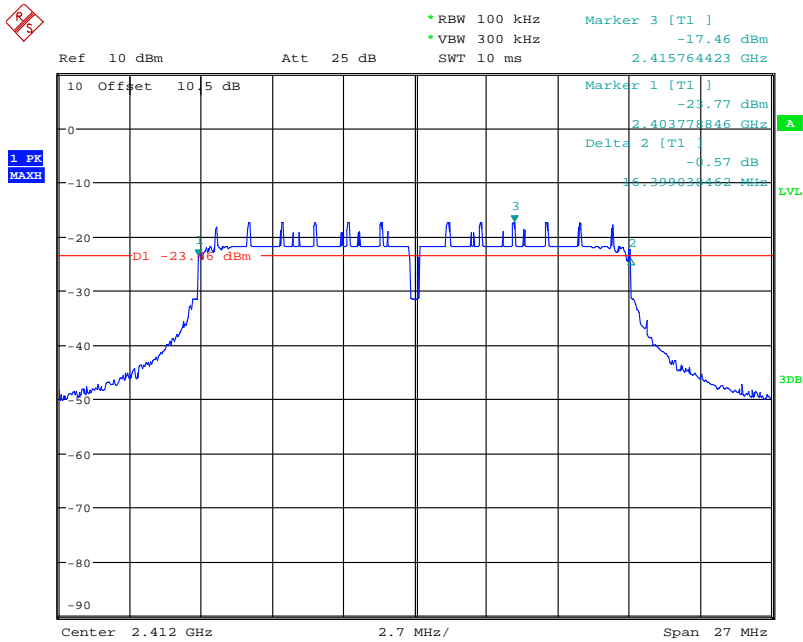
Date: 3.SEP.2013 17:46:12

3. 802.11b -2462MHz



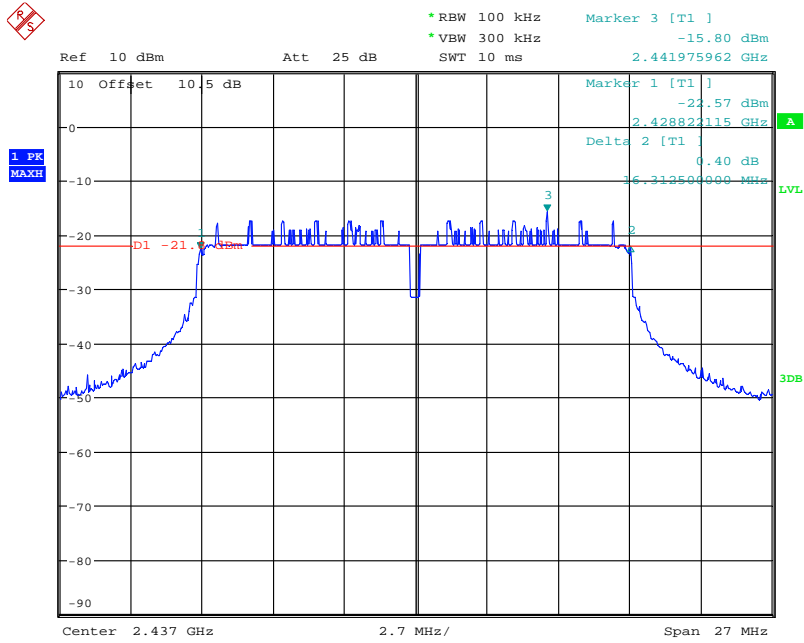
Date: 3.SEP.2013 17:48:55

4. 802.11g -2412MHz



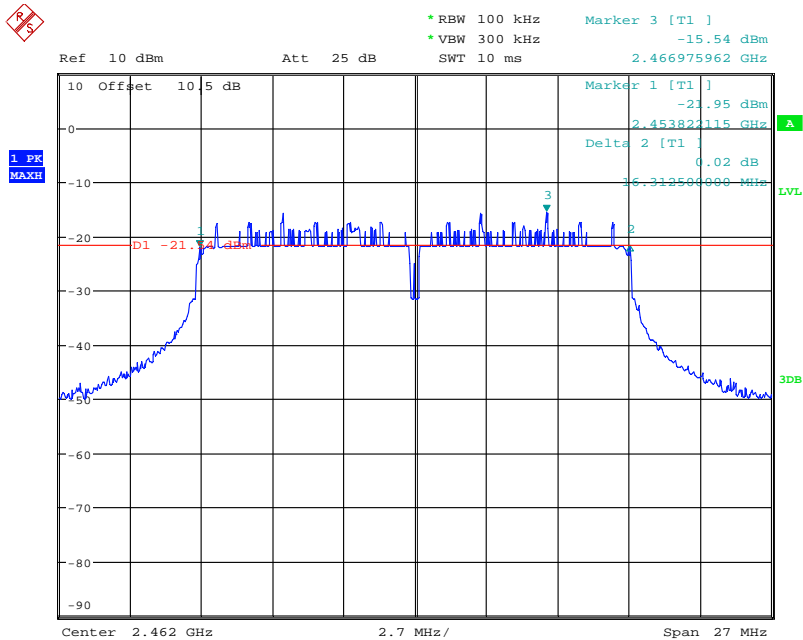
Date: 3.SEP.2013 17:52:08

5. 802.11g -2437MHz



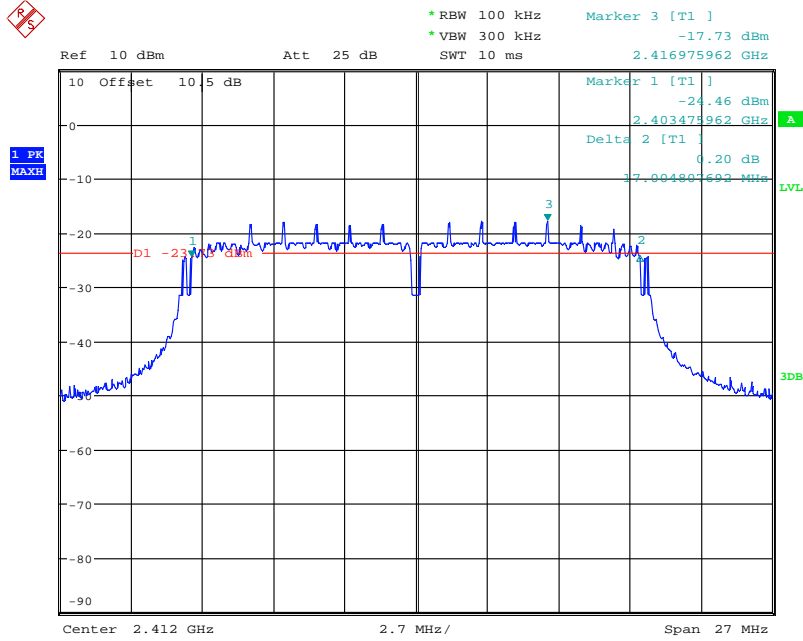
Date: 3.SEP.2013 17:56:19

6. 802.11g-2462MHz



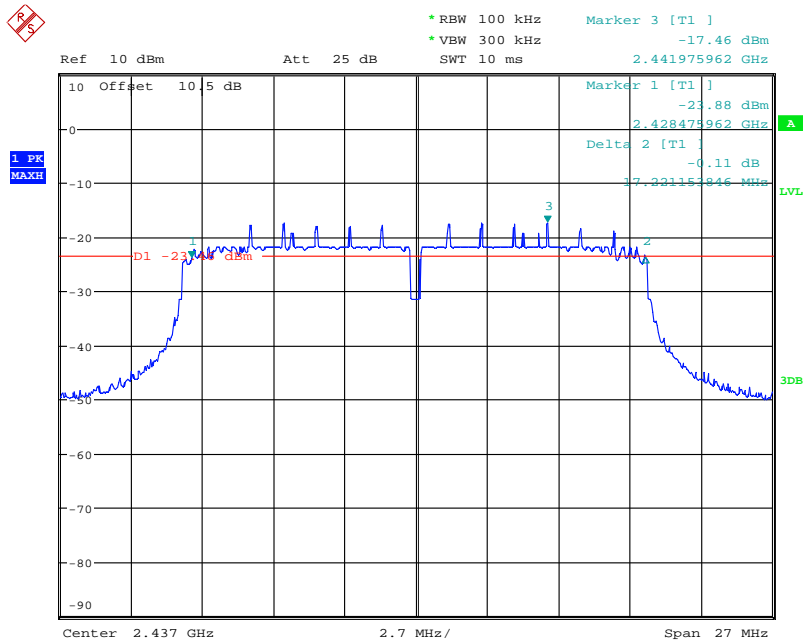
Date: 3.SEP.2013 17:58:08

7. 802.11n-2412MHz



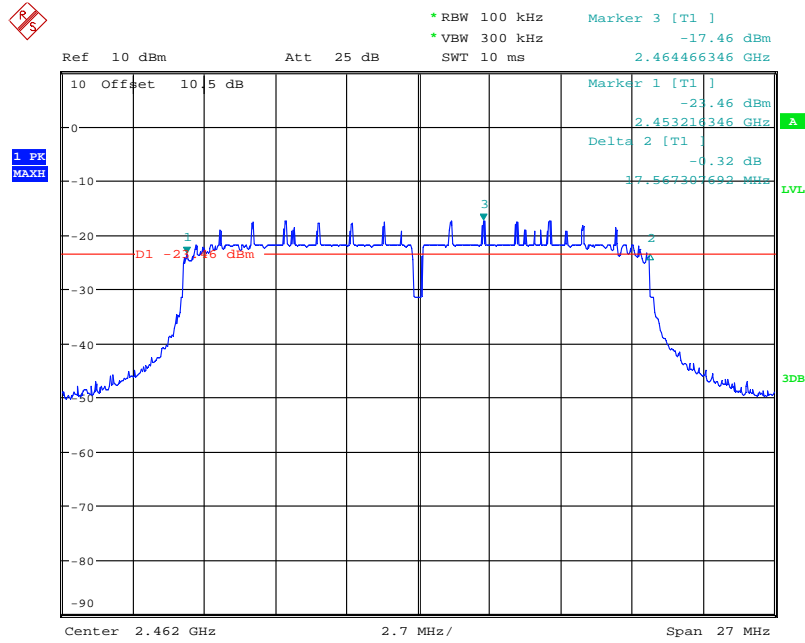
Date: 3.SEP.2013 18:06:59

8. 802.11n-2437MHz



Date: 3.SEP.2013 18:09:15

9. 802.11n-2462MHz



Date: 3.SEP.2013 18:12:06

5.3 Maximum Peak Output Power

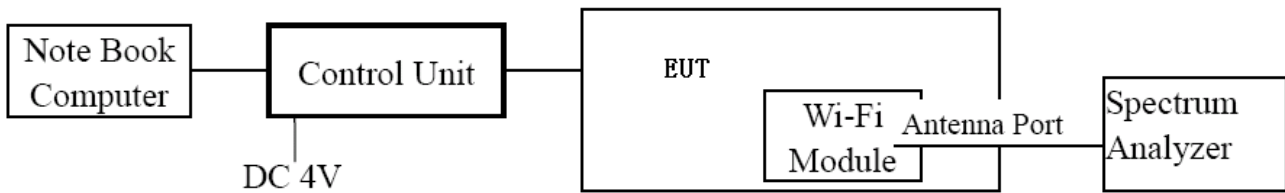
5.3.1 Requirement of the standard

According to FCC §15.247 (b) (3), the maximum peak output power of systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands is 1 Watt.

5.3.2 Test Procedure

The EUT temporary antenna port was coupled to the power meter. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.

5.3.3 Test Setup



5.3.4 EUT Setup and Operating Conditions

Same as 3.3.4

5.3.5 Test Results

Modulation	Operating Frequency (MHz)	Peak Output Power		Limit (W)
		(dBm)	(mW)	
802.11b	2412	7.31	5.38	1
	2437	7.68	5.86	1
	2462	7.85	6.10	1
802.11g	2412	3.21	2.09	1
	2437	3.65	2.32	1
	2462	3.81	2.40	1
802.11n	2412	1.60	1.45	1
	2437	2.02	1.59	1
	2462	2.40	1.74	1

5.4 Band Edge

5.4.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, based on either an RF conducted or a radiated measurement.

5.4.2 Test Procedure

1. For RF Conducted Measurement:

The EUT was tested according to DTS test procedure of Oct 2002 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Span greater than RBW.

2. For RF Radiated Measurement:

The EUT was setup according to ANSI C63.4, 2003 and tested according to DTS test procedure of Oct 2002 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

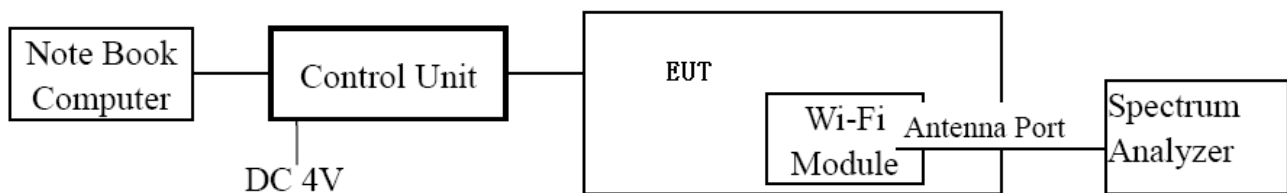
For measurements above 1GHz the resolution bandwidth is set to 1MHz, then the video bandwidth is set to 1MHz for peak measurements and 10Hz for average measurements.

The spectrum from 30MHz to 26GHz is investigated with the transmitter set to the lowest, middle and highest channels in the 2.4GHz band.

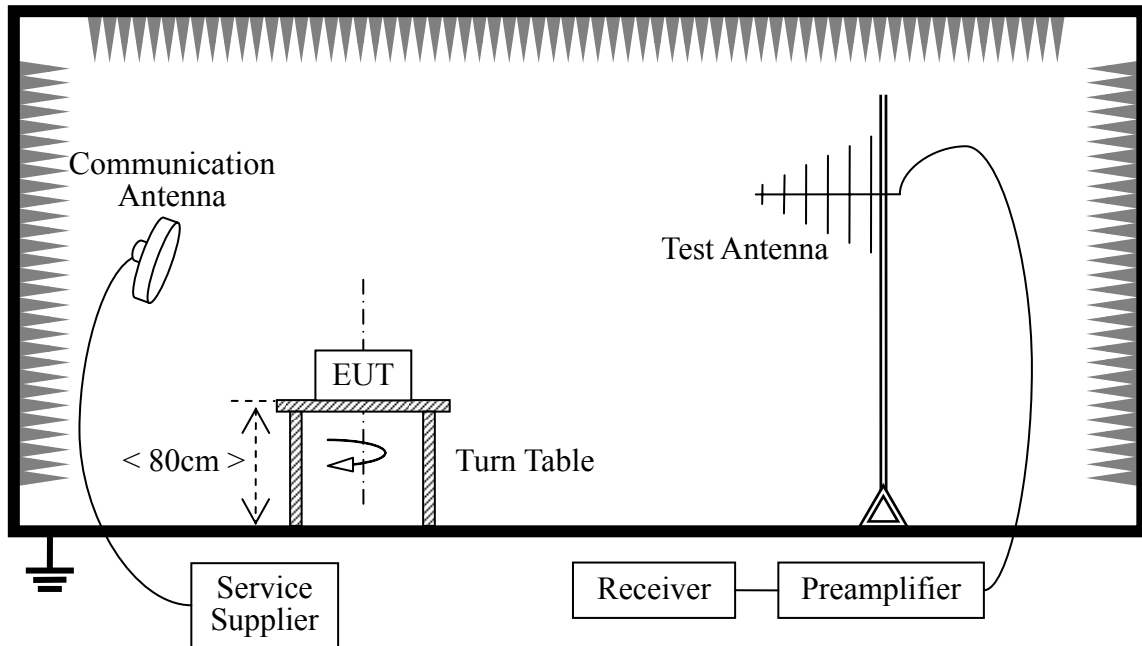
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are Made with the antenna polarized in both the vertical and the horizontal positions.

5.4.3 Test Setup

Conducted Band Edge



Radiated Band Edge



5.4.4 EUT Setup and Operating Conditions

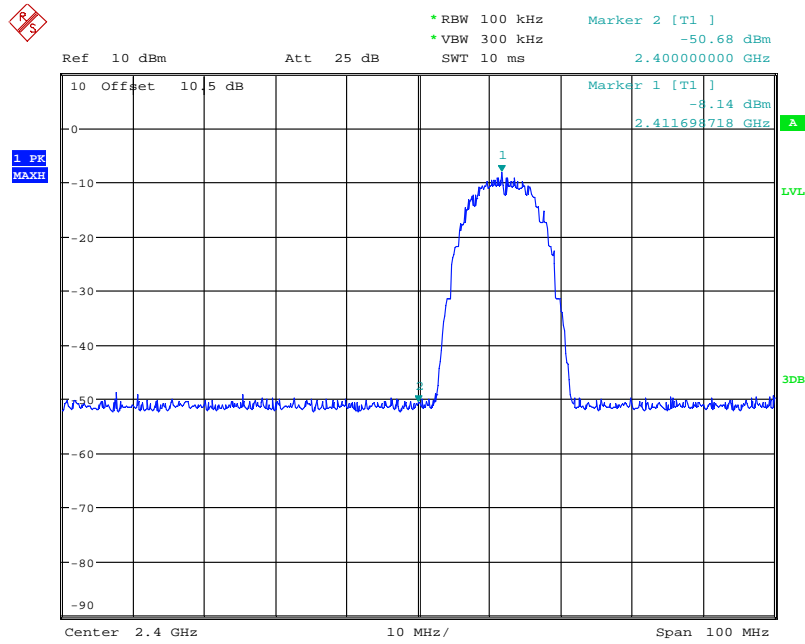
Same as 5.3.4

5.4.5 Test Results

The radio frequency power beyond the band edges was 20dB below the peak output power, measured with 100 kHz resolution bandwidth. Refer to the following test plots.

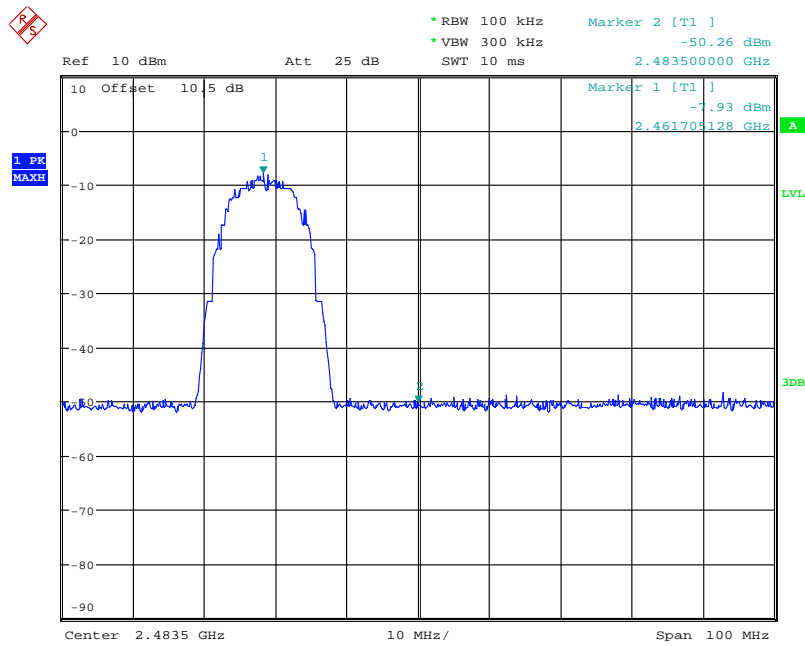
Test Plots:

1. 802.11g b-2412MHz Max Peak Detector



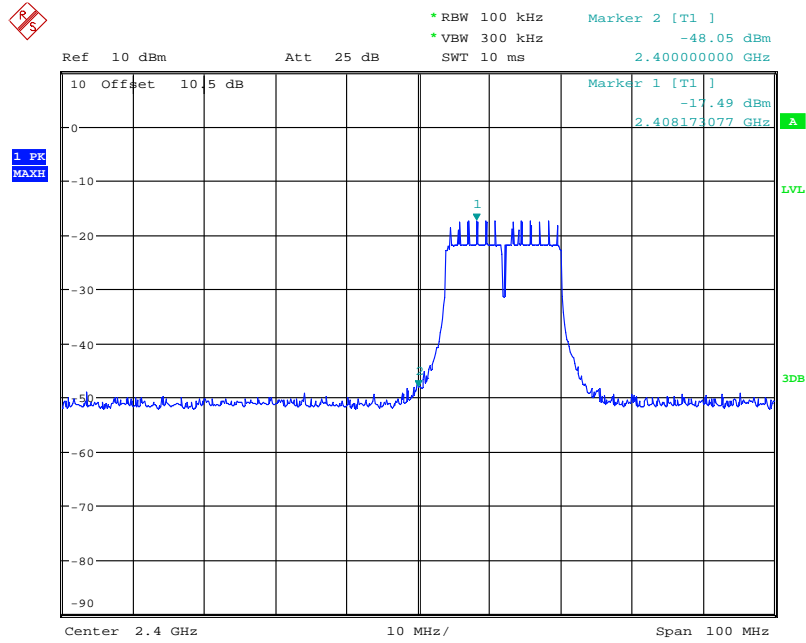
Date: 3.SEP.2013 19:50:52

2. 802.11b -2462MHz Max Peak Detector



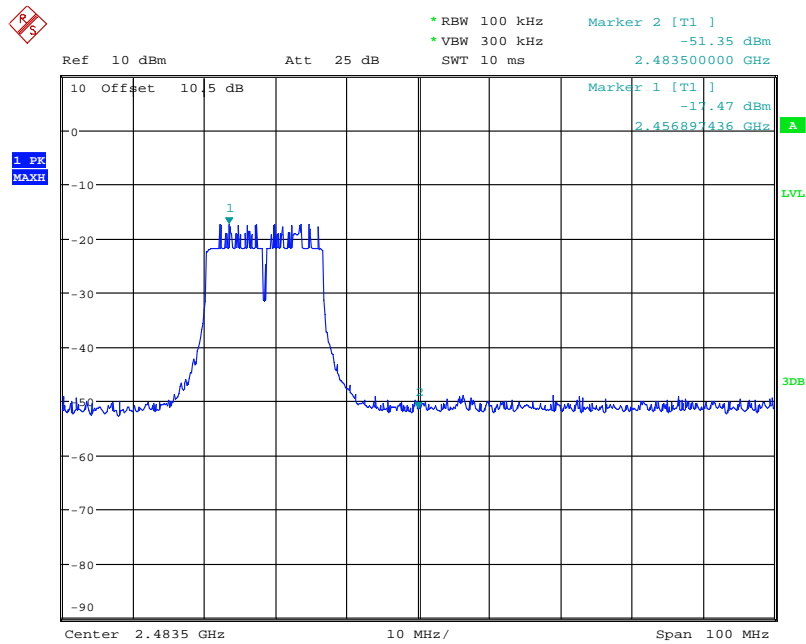
Date: 3.SEP.2013 19:50:18

3. 802.11g -2412MHz Max Peak Detector



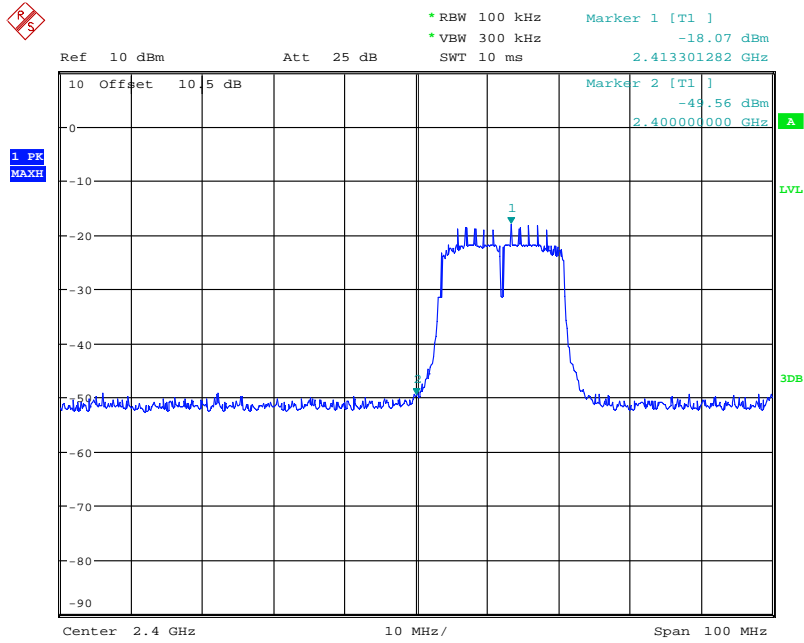
Date: 3.SEP.2013 19:51:42

4. 802.11g -2462MHz Max Peak Detector



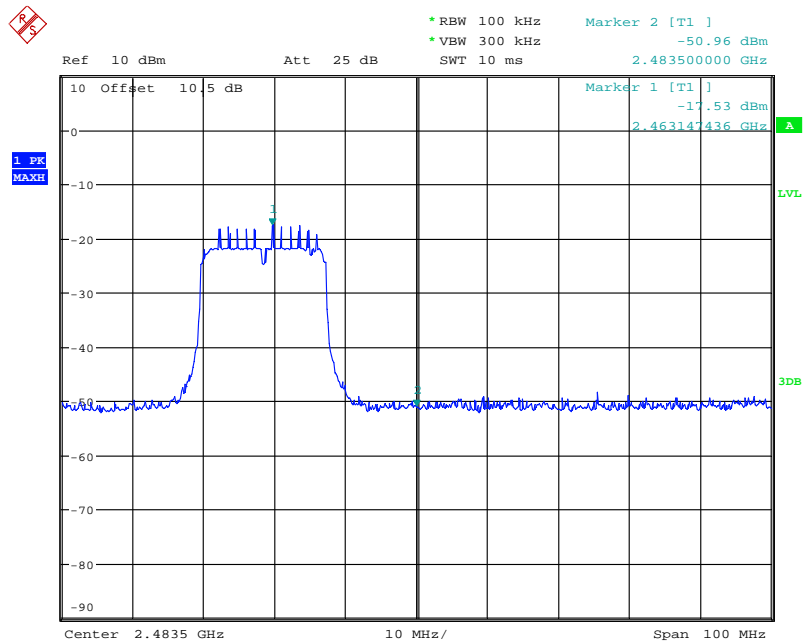
Date: 3.SEP.2013 19:52:10

5. 802.11n -2412MHz Max Peak Detector



Date: 3.SEP.2013 19:52:39

6. 802.11n -2462MHz Max Peak Detector



Date: 3.SEP.2013 19:53:05

5.5 Conducted Spurious Emission

5.5.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, based on either an RF conducted or a radiated measurement.

5.5.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. The spurious Emissions from 9 KHz to 10th harmonic of the fundamental frequency were researched.
- d. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to RBW=100 kHz, VBW=300 kHz.

5.5.3 Test Setup

Same as 5.3.3

5.5.4 EUT Setup and Operating Conditions

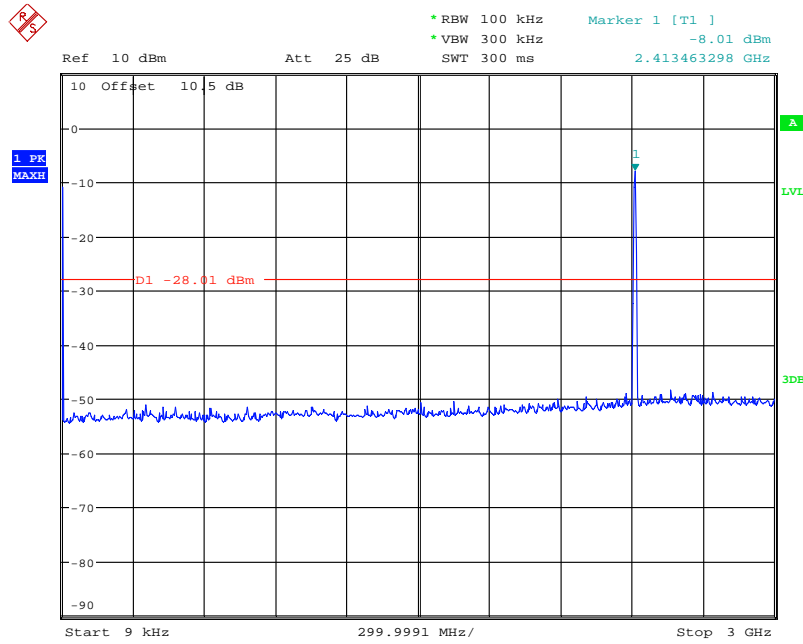
Same as 5.3.4

5.5.5 Test Results

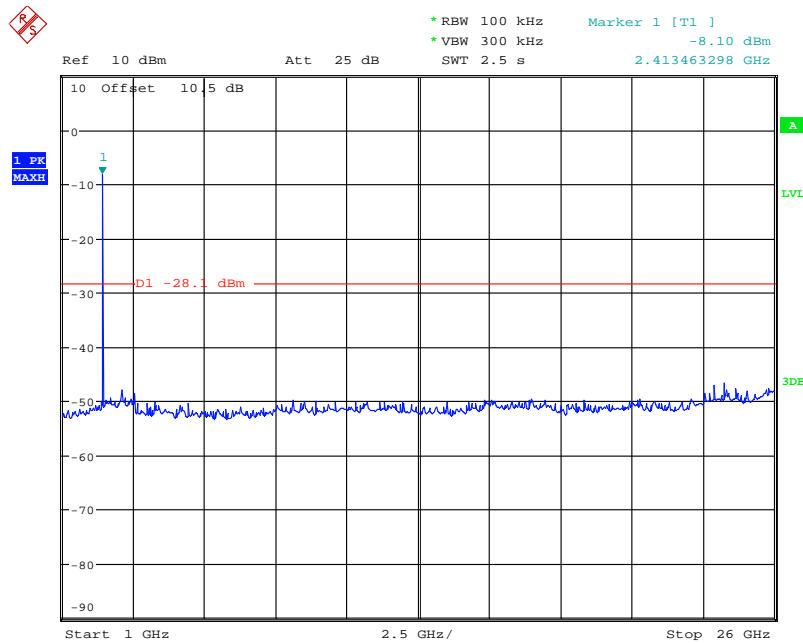
The following test plots shows that spurious emissions in the whole frequency range were below the 20dBc limit line.

Test Plots:

1. 802.11b -2412MHz

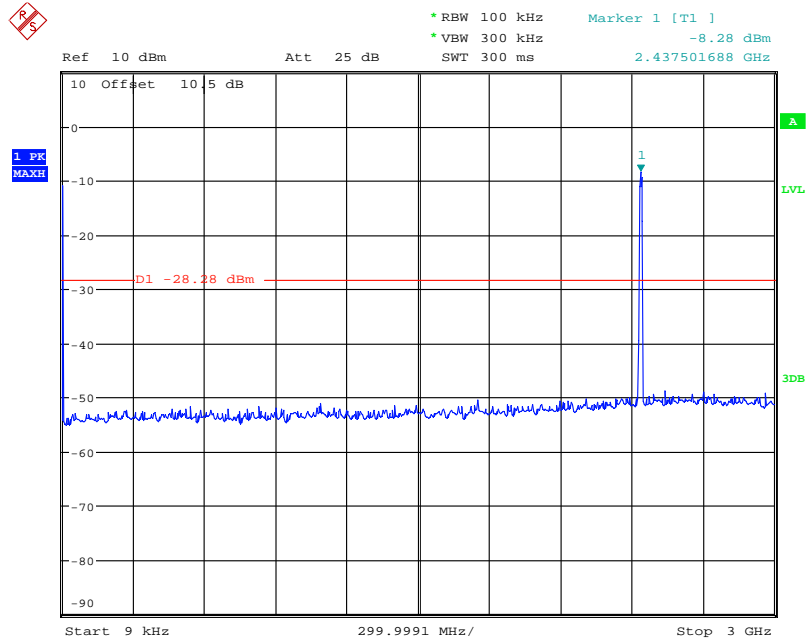


Date: 3.SEP.2013 19:24:42

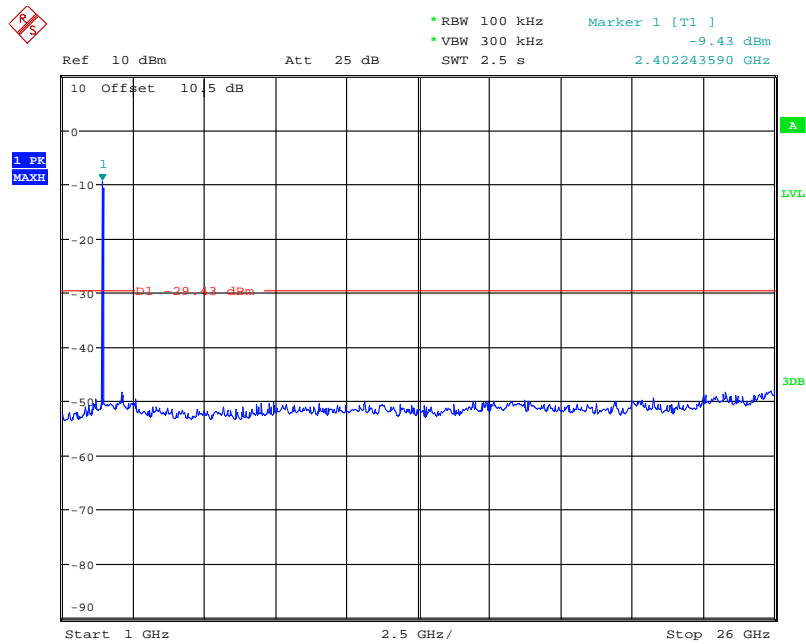


Date: 3.SEP.2013 19:26:36

2. 802.11b -2437MHz

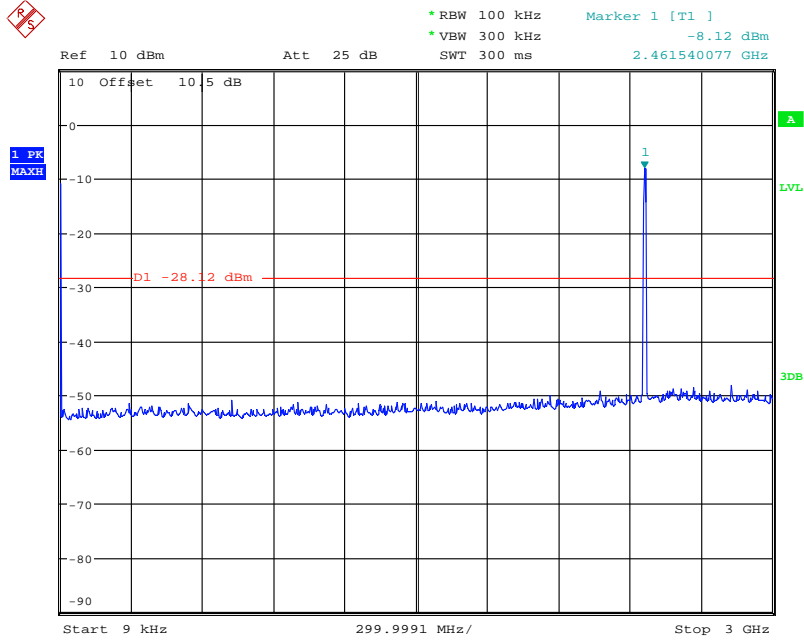


Date: 3.SEP.2013 19:27:13

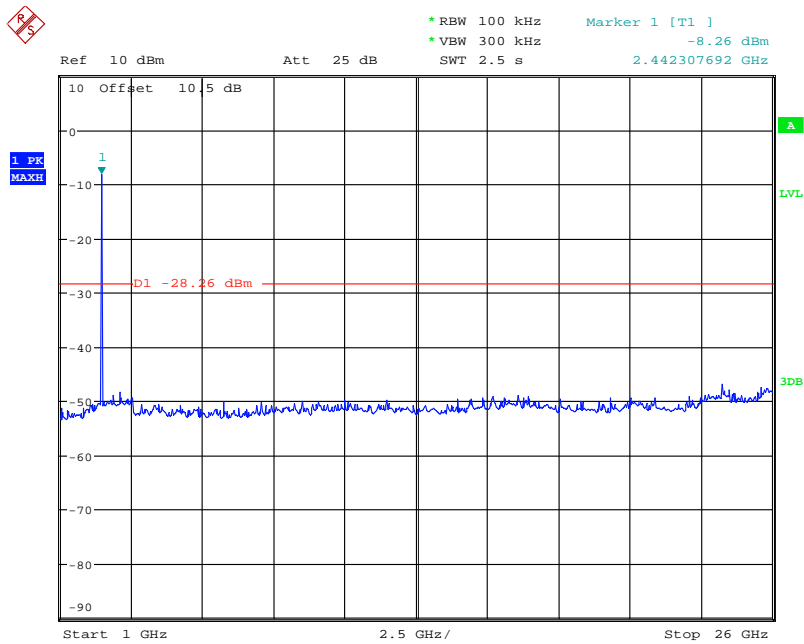


Date: 3.SEP.2013 19:28:05

3. 802.11b -2462MHz

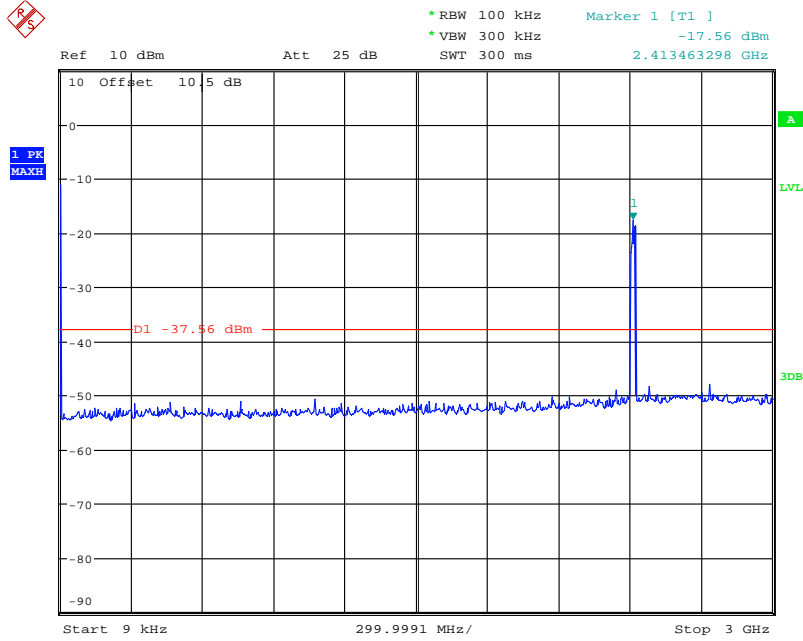


Date: 3.SEP.2013 19:28:49

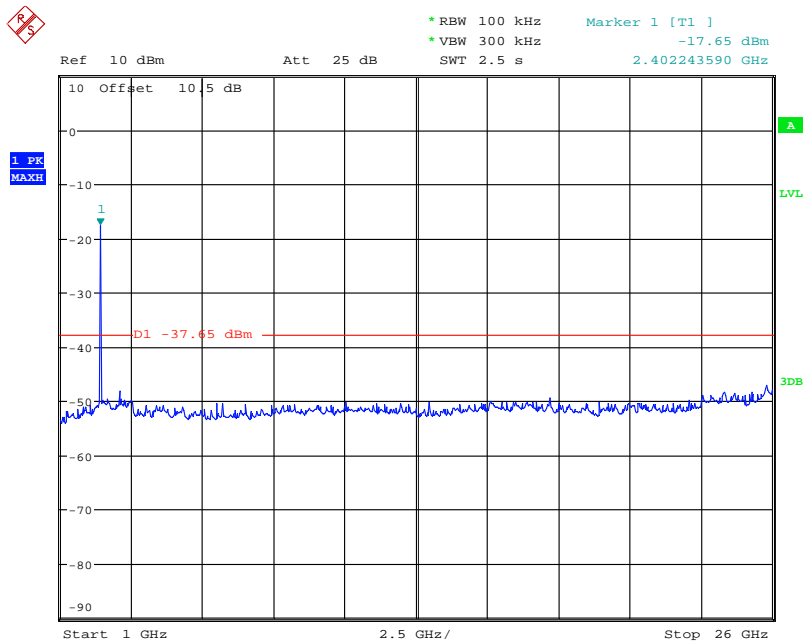


Date: 3.SEP.2013 19:29:49

4. 802.11g -2412MHz

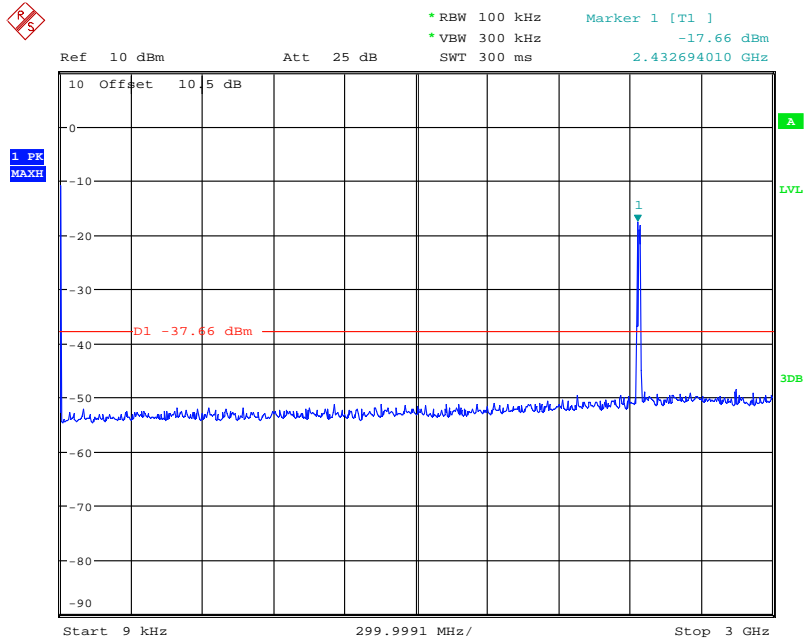


Date: 3.SEP.2013 19:31:09

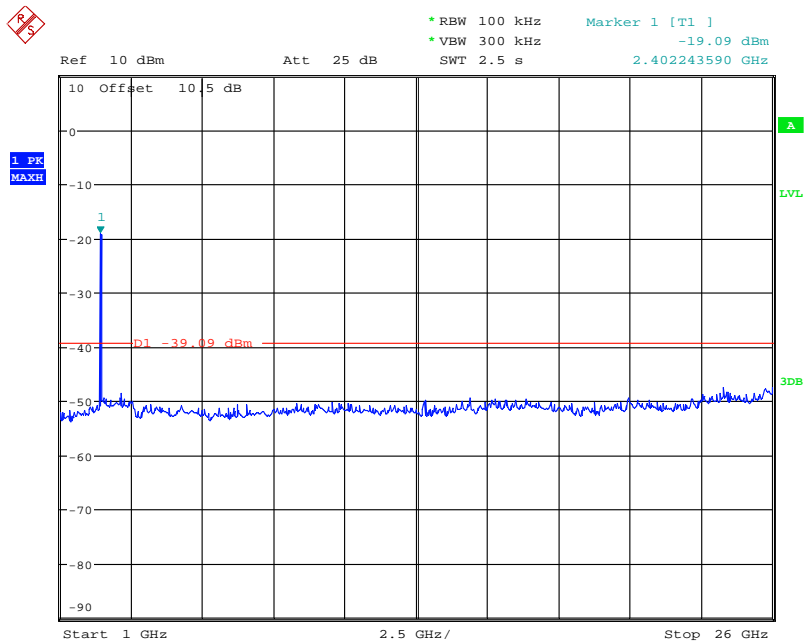


Date: 3.SEP.2013 19:31:42

5. 802.11g -2437MHz

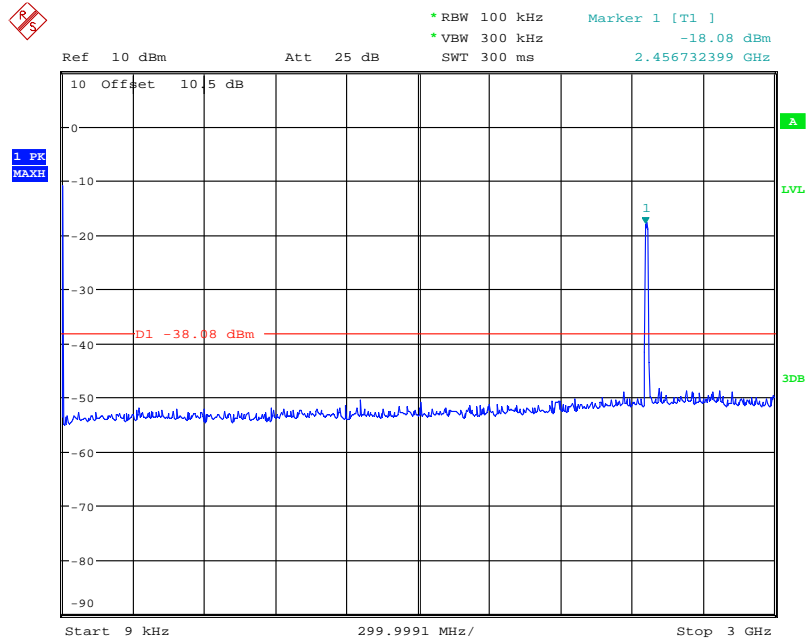


Date: 3.SEP.2013 19:32:24

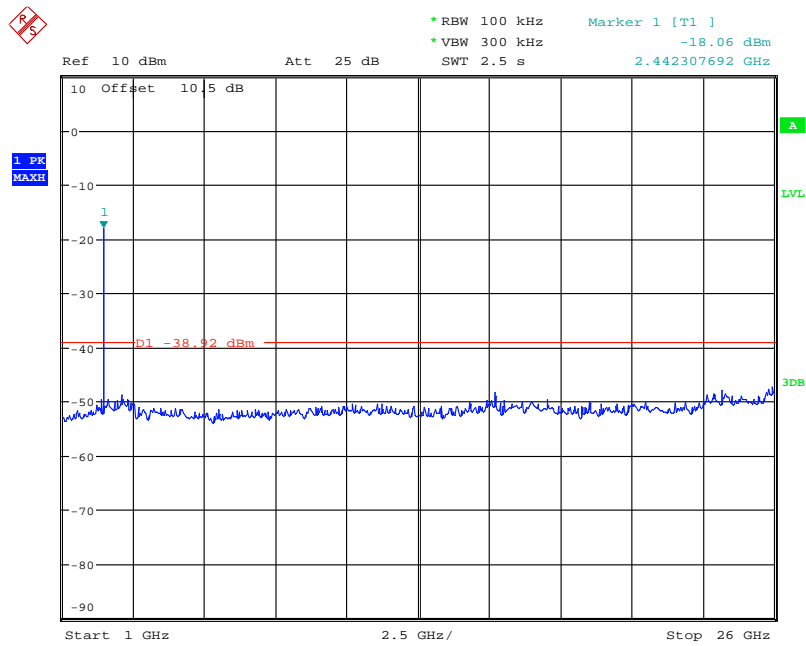


Date: 3.SEP.2013 19:33:52

6. 802.11g-2462MHz

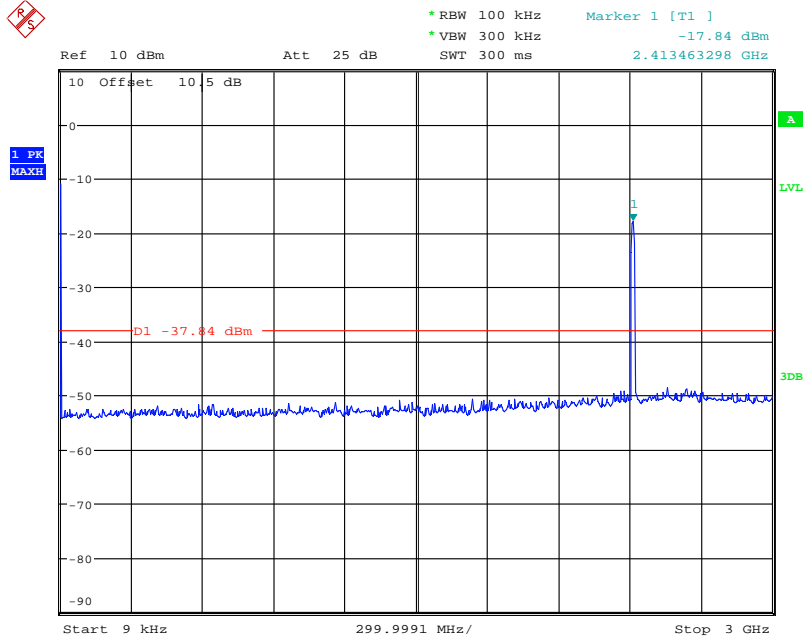


Date: 3.SEP.2013 19:34:27

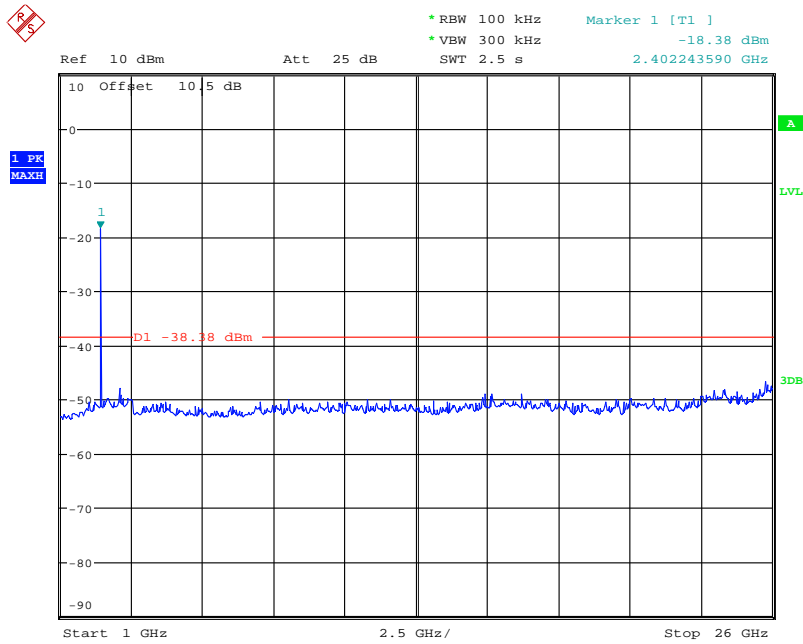


Date: 3.SEP.2013 19:34:52

7. 802.11n-2412MHz

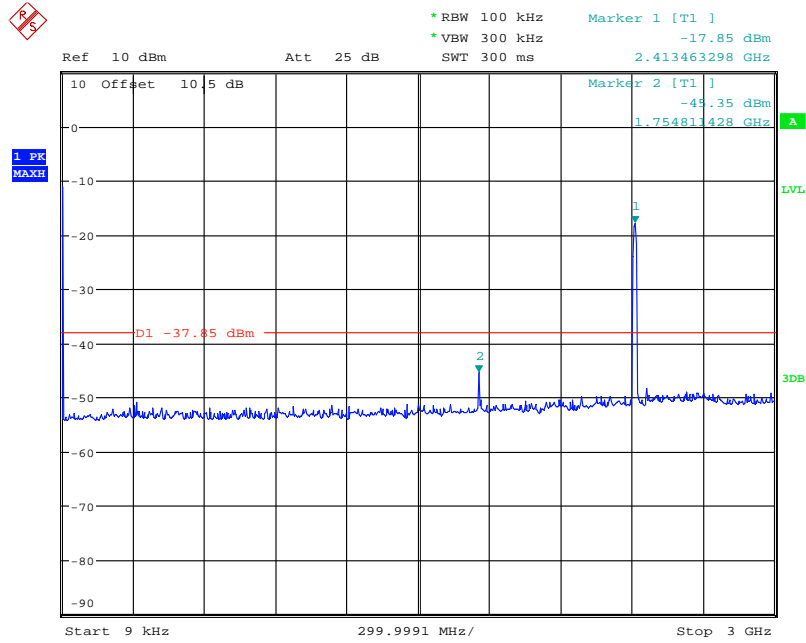


Date: 3.SEP.2013 19:37:46

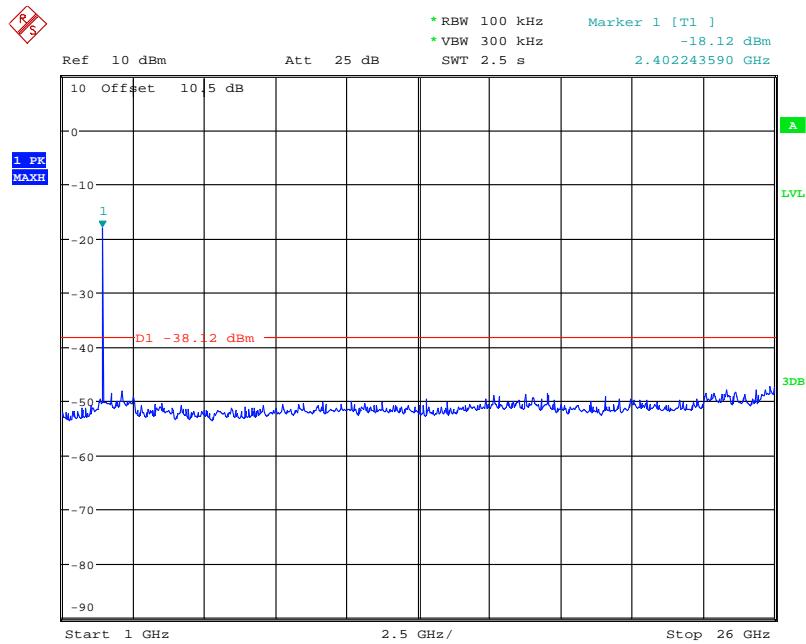


Date: 3.SEP.2013 19:38:21

8. 802.11n-2437MHz

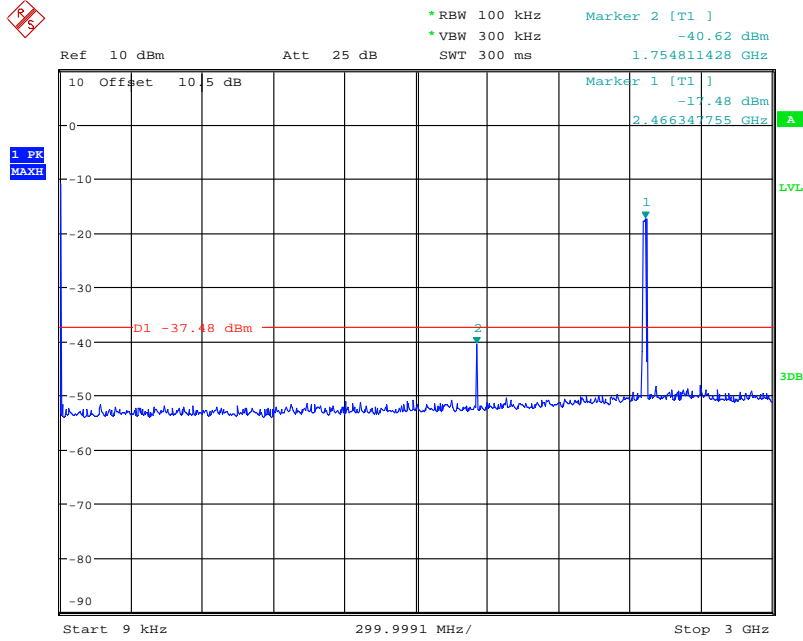


Date: 3.SEP.2013 19:40:15

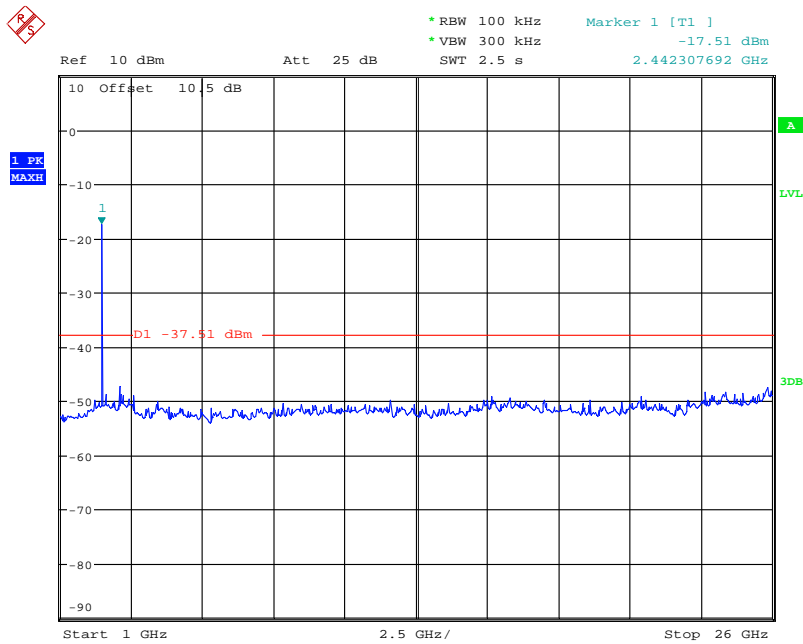


Date: 3.SEP.2013 19:40:58

9. 802.11n-2462MHz



Date: 3.SEP.2013 19:41:56



Date: 3.SEP.2013 19:42:24

5.6 Power Spectrum Density Measurement

5.6.1 Limits of Power Spectrum Density

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

5.6.2 Test Procedure

- a. The test follows FCC KDB Publication No.558074 (Measurement Guidelines of DTS).
- b. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
- c. Take the measured data from spectrum analyzer.

5.6.3 Test Setup

Same as 5.3.3

5.6.4 EUT Setup and Operating Conditions

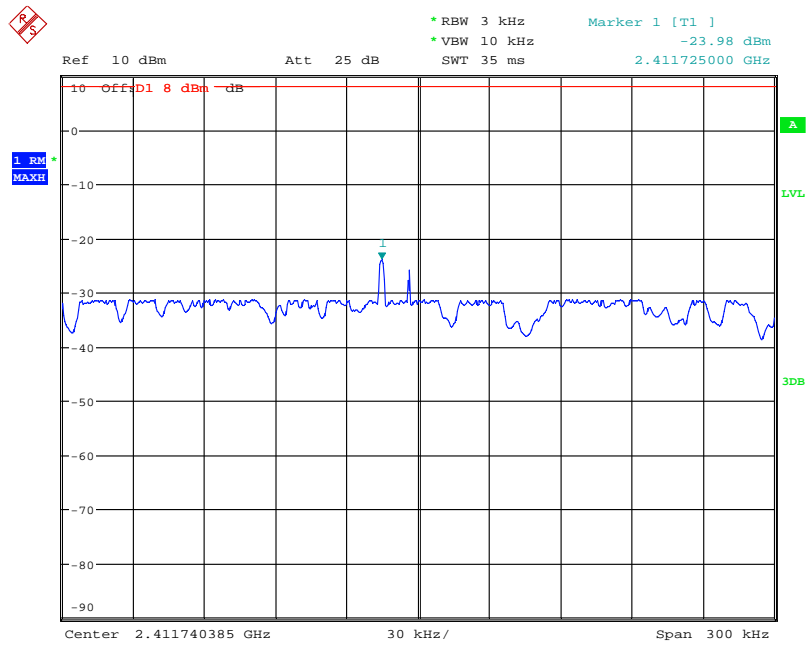
Same as 5.3.4

5.6.5 Test Results

EUT Modulation	Operating Frequency (MHz)	Power spectrum density (dBm/100kHz)	Limit (dBm/3kHz)
802.11b	2412	-23.98	8
	2437	-23.56	
	2462	-23.47	
802.11g	2412	-31.63	
	2437	-31.84	
	2462	-31.43	
802.11n	2412	-31.64	
	2437	-31.43	
	2462	-31.41	

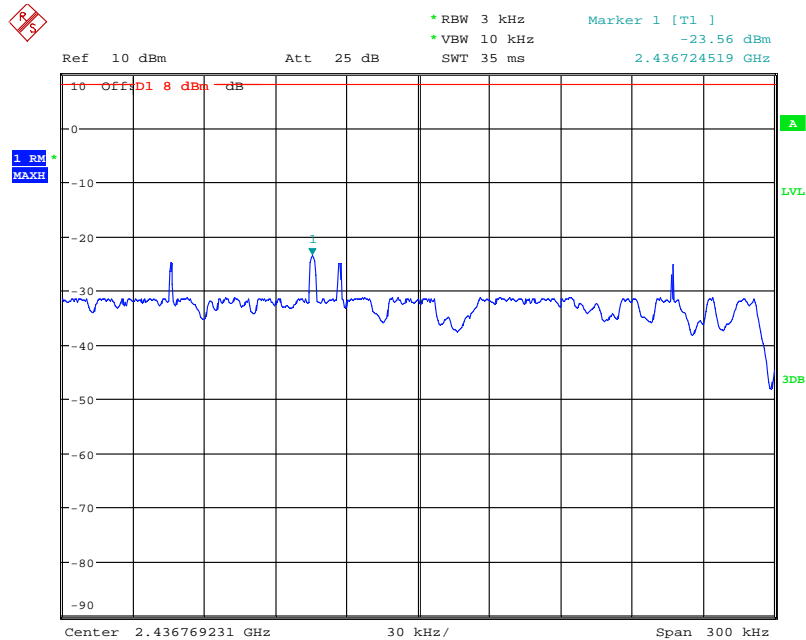
Test Plots:

1. 802.11b - 2412MHz



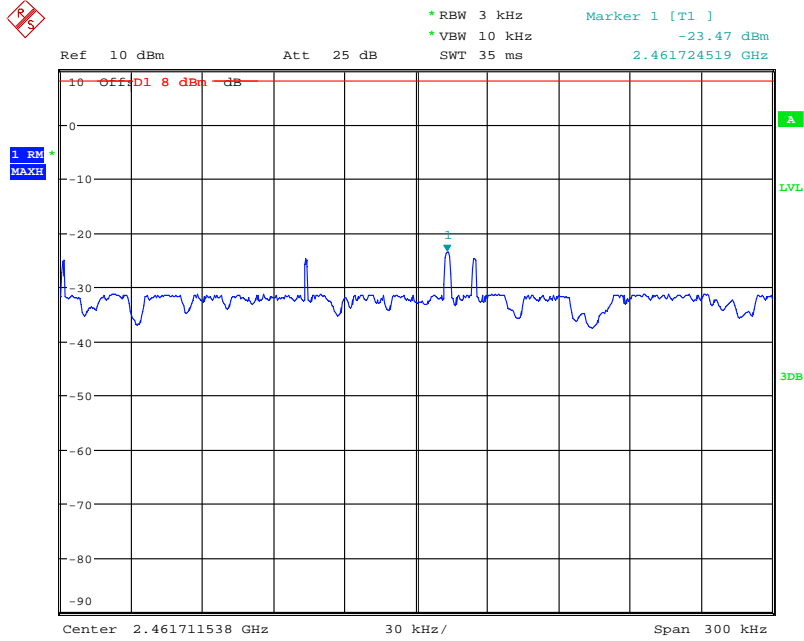
Date: 3.SEP.2013 19:00:49

2. 802.11b - 2437MHz



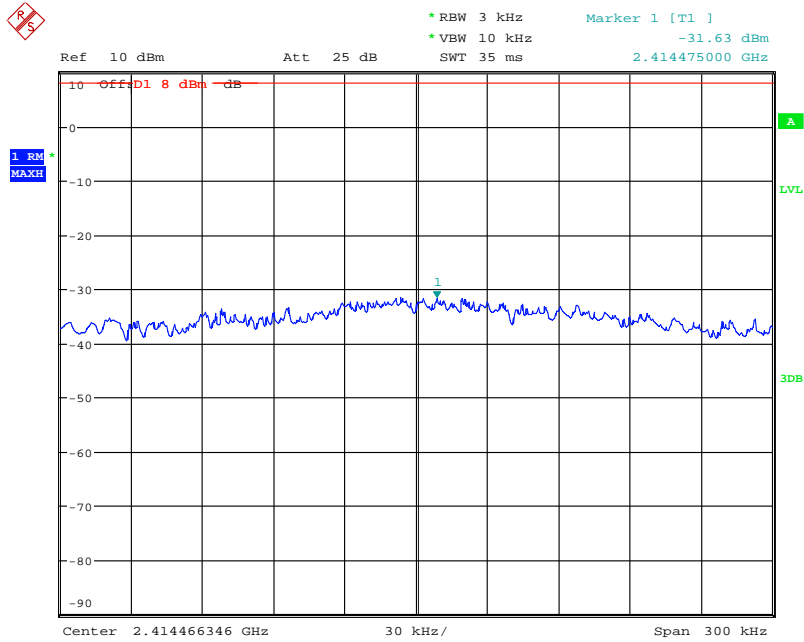
Date: 3.SEP.2013 19:02:18

3. 802.11b - 2462MHz



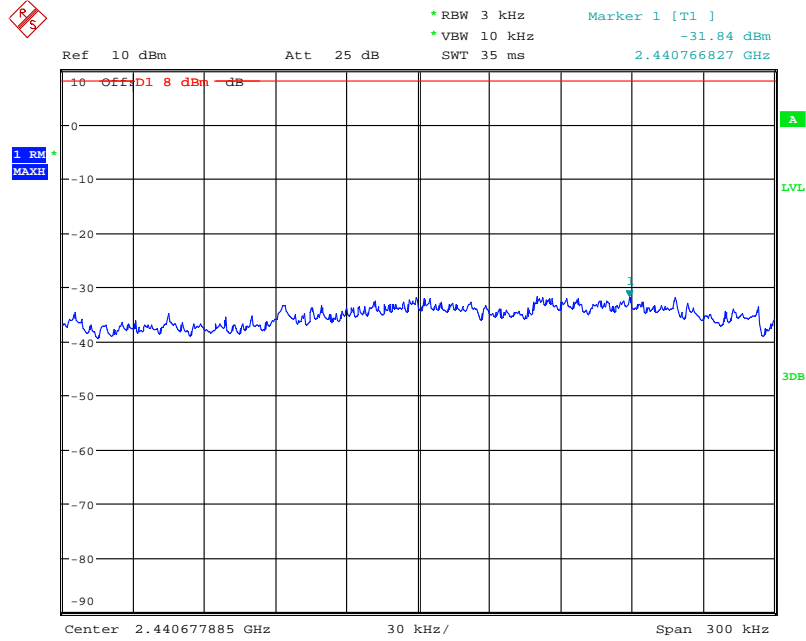
Date: 3.SEP.2013 19:03:45

4. 802.11g - 2412MHz



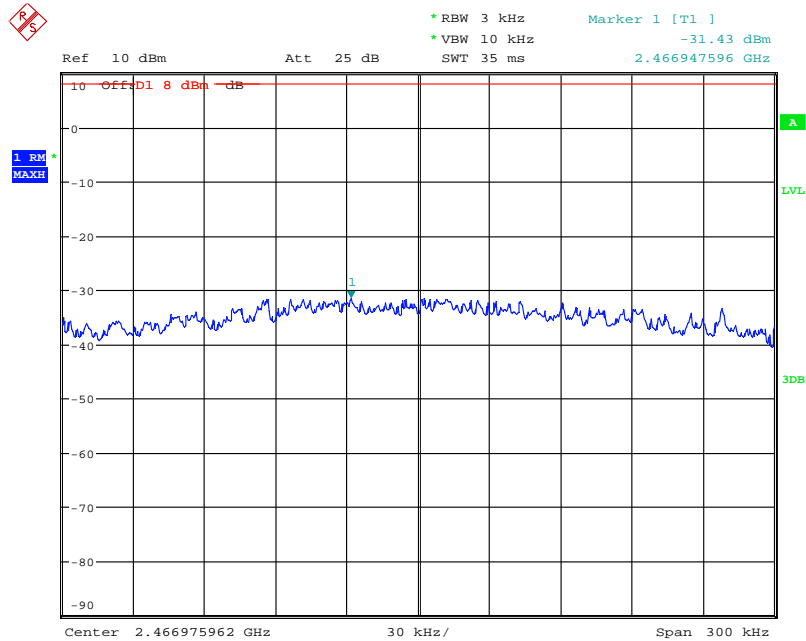
Date: 3.SEP.2013 19:09:36

5. 802.11g - 2437MHz



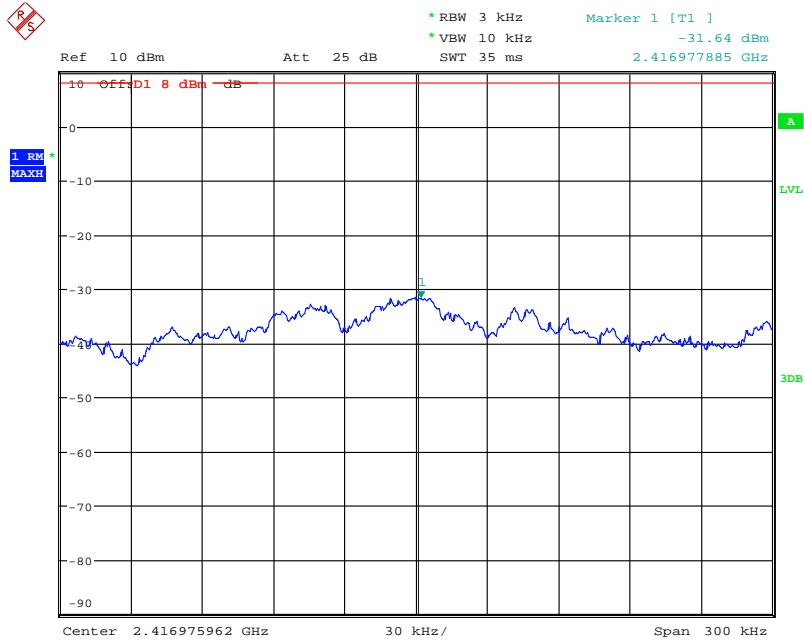
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6. 802.11g- 2462MHz



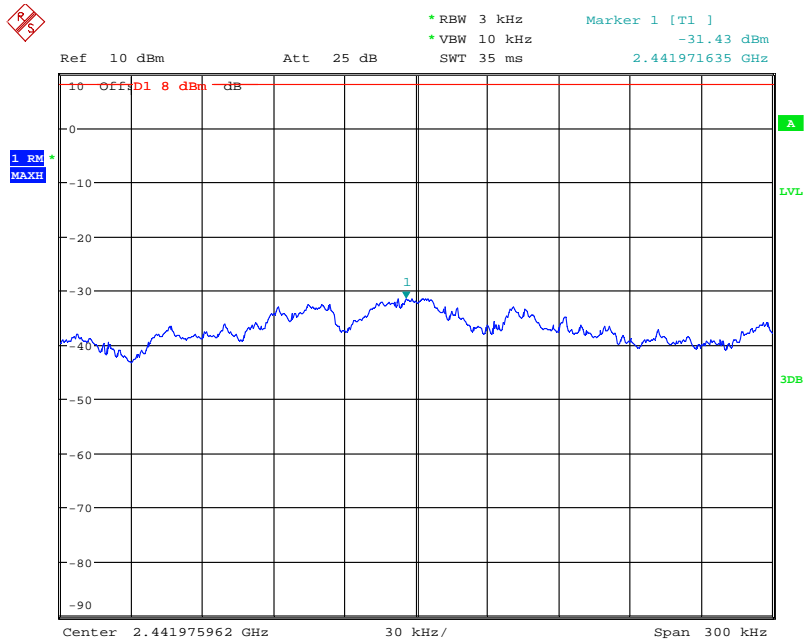
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7. 802.11n- 2412MHz



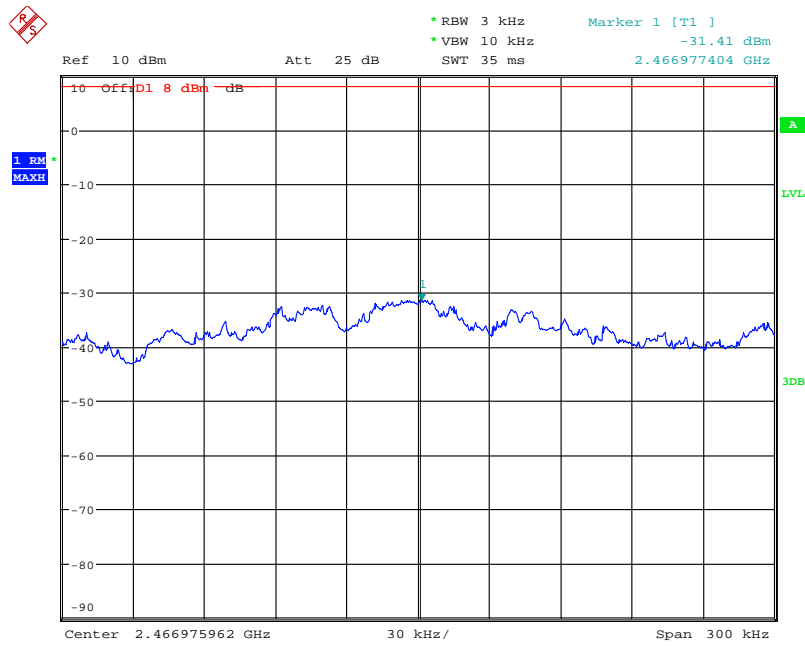
Date: 3.SEP.2013 19:14:04

8. 802.11n- 2437MHz



Date: 3.SEP.2013 19:15:26

9. 802.11n- 2462MHz



Date: 3.SEP.2013 19:16:42

**** END OF REPORT ****