www.nemko.com

Report Reference ID:	179167TRFWL

Test specification:	Title 47 - Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart C - Intentional Radiators **§15.247** - Operation within the bands 2400–2483.5 MHz

Applicant:	Telsey Spa Via Mattei,29 31055 Quinto di Treviso TV, Italy
Apparatus:	Set Top Box for IP television with WiFi
Model:	STNE4C7A82GDL (STME4C1A82T2M)
FCC ID:	ZPA-TELSEY3070

Testing laboratory:	**Nemko Spa** Via del Carroccio, 4 I 20853 Biassono (Italy) Telephone: +039 039 2201201 Facsimile: +39 039 220 1221

	Name and title	Date
Tested by:	Daniele Guarnone, Wireless/EMC Specialist	2011-07-08
Reviewed by:	Gabriele Curioni Wireless/EMC Specialist	2011-07-08

Nemko Spa authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko Spa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

Table of contents

Section 1: Report summary 3
1.1 Test specification 3
1.2 Statement of compliance 3
1.3 Exclusions 3
1.4 Registration number 3
1.5 Test report revision history 3
1.6 Limits of responsibility 3
Section 2: Summary of test results 4
2.1 FCC Part 15 Subpart C – Intentional Radiators, test results 4
Section 3: Equipment under test (EUT) and application details 5
3.1 Applicant details 5
3.2 Modular equipment 5
3.3 Product details 5
3.4 Application purpose 5
3.5 Composite/related equipment 5
3.6 Sample information 6
3.7 EUT technical specifications 6
3.8 Operation of the EUT during testing 6
3.9 EUT setup diagram 7
Section 4: Engineering considerations 8
4.1 Modifications incorporated in the EUT 8
4.2 Deviations from laboratory tests procedures 8
4.3 Technical judgment 8
Section 5: Test conditions 9
5.1 Power source and ambient temperatures 9
Section 6: Measurement uncertainty 10
Section 7: Test equipment 11
7.1 Test equipment list 11
Section 8: Testing data 12
8.1 Clause 15.31(e) Variation of power source 12
8.2 Clause 15.31(m) Number of operating frequencies 13
8.3 Clause 15.203 Antenna requirement 14
8.4 Clause 15.207(a) Conducted limits 15
8.5 Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques 20
8.6 Clause 15.247(b) Maximum peak conducted output power 24
8.7 Clause 15.247(d) Spurious emissions 31
8.8 Clause 15.247(e) Power spectral density for digitally modulated devices 54
Section 8: Block diagrams of test set-ups 58
Section 9: EUT photos 59

Section 1: Report summary

1.1 Test specification

Specifications	**FCC Part 15 Subpart C, 15.247** Operation within the bands 2400–2483.5 MHz

1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003.

1.3 Exclusions

Exclusions	None

1.4 Registration number

Test site FCC ID number	481407

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	XXX

1.6 Limits of responsibility

The date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

Nemko S.p.A. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko S.p.A.. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Section 2: Summary of test results

2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

General requirements for FCC Part 15

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of operating frequencies	Pass
§15.203	Antenna requirement	Pass
§15.207(a)	Conducted limits	Pass

Specific requirements for FCC Part 15 Subpart C, 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	N/A
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	N/A
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	N/A
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band	N/A
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	N/A
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 2400–2483.5 MHz	Pass
§15.247(b)(4)	Maximum peak output power	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	N/A
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	N/A
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	N/A

Notes: None

Section 3: Equipment under test (EUT) and application details

3.1 Applicant details

Applicant complete business name	Name:	Telsey Spa
	Federal Registration Number (FRN):	0020969713
	Grantee code	ZPA
Mailing address	Address: City: Province/State: Post code: Country:	Via Mattei 29 Quinto di Treviso I Treviso 31055 Italy

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details

FCC ID	Grantee code:	ZPA
	Product code:	-TELSEY3070
Equipment class	DTS – Digital Transmission system	
Description of product as it is marketed	Set Top Box for IP television with WiFi	
	Model name/number:	STNE4C7A82GDL (STME4C1A82T2M)
	Serial number:	NA

3.4 Application purpose

Type of application	☒ Original certification ☐ Change in identification of presently authorized equipment Original FCC ID: Grant date: ☐ Class II permissive change or modification of presently authorized equipment

3.5 Composite/related equipment

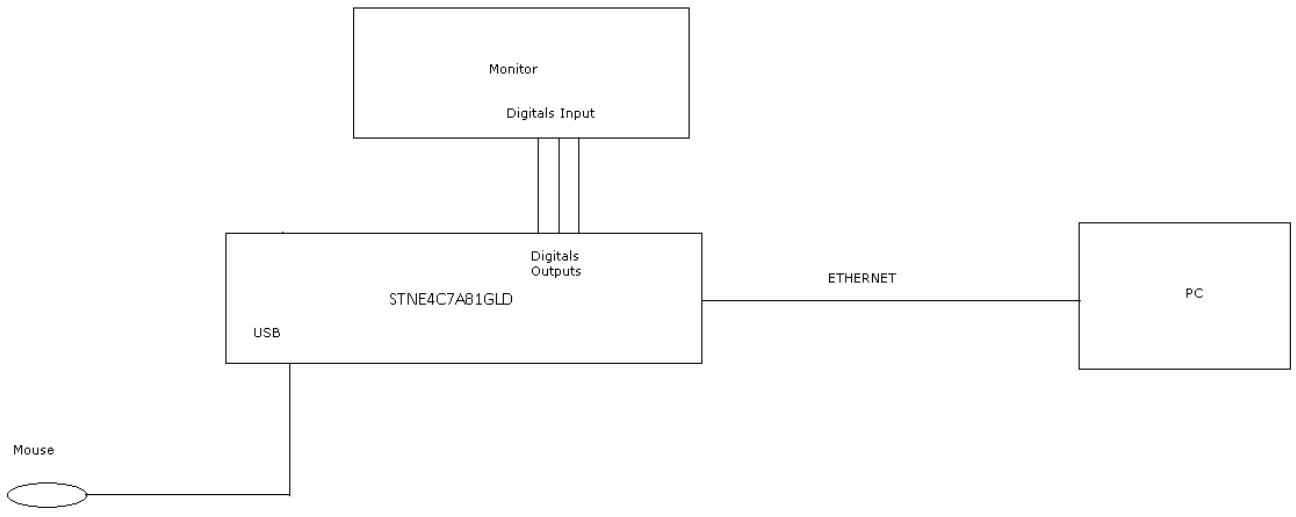
a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes ☐ No ☒
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes ☐ No ☒
c) Related FCC ID	If either of the above is “yes”: ☐ has been granted under the FCC ID(s) listed below: ☐ is in the process of being filled under the FCC ID(s) listed below: ☐ is pending with the FCC ID(s) listed below: ☐ has a mix of pending and granted statues under the FCC ID(s) listed below: i FCC ID: ii FCC ID:

3.6 Sample information	
Receipt date:	2011-06-24
Nemko sample ID number:	179167

3.7 EUT technical specifications	
Operating band:	2400 MHz ÷ 2483.5 MHz
Operating frequency:	2412 MHz ÷ 2462 MHz
Modulation type:	protocol 802.11b, use modulation technology DSSS and modulation type DBPSK; protocol 802.11g use modulation technology OFDM and modulation type BPSK protocol 802.11n use modulation technology OFDM and modulation type BPSK
Occupied bandwidth:	20 MHz
Channel spacing:	20 MHz
Emission designator:	20M00X7F
Antenna type:	Integral, 2.5 dBi gain maximum
Power source:	120 V, 60 Hz

3.8 Operation of the EUT during testing	
Details:	Transmitting to maximum power at 2412 MHz, 2437 MHz, 2462 MHz with the following modulation: protocol 802.11b, use modulation technology DSSS and modulation type DBPSK; protocol 802.11g use modulation technology OFDM and modulation type BPSK protocol 802.11n use modulation technology OFDM and modulation type BPSK

3.9 EUT setup diagram



Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT	
Modifications	Modifications performed to the EUT during this assessment None ☒ Yes ☐, performed by Client ☐ or Nemko ☐ Details:

4.2 Deviations from laboratory tests procedures	
Deviations	Deviations from laboratory test procedures None ☒ Yes ☐ - details are listed below:

4.3 Technical judgment	
Judgment	None

Section 5: Test conditions

5.1 Power source and ambient temperatures	
Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 ℃ Relative humidity: 20–75 % Air pressure: 86–106 kPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6: Measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Section 7: Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Emi Test Receiver 20 Hz ÷ 5 GHz	R&S	ESBI	828038/003	08/2011
Spectrum Analizer 9 KHz ÷ 40 GHz	R&S	FSEK	848255/005	09/2011
Trilog Broad Band Antenna 25 MHz÷2 GHz	Schwarzbeck	VULB 9168	VULB 9168-242	08/2013
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	08/2011
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	08/2013
Shielded room	Siemens	10m control room	1947	08/2013
Broadband preamplifier	Schwarzbeck	BBV 9718	9718-137	05/2013
Bilog antenna 1 ÷18 GHz	Schwarzbeck	STLP 9148-123	123	09/2011
Double Ridged Waveguide Horn	RF SPIN	DRH40	061106a40	08/2013
Wide band Amplifier 18 GHz ÷ 40 GHz	MITEQ	AMF-5F-18004000-37-8P	128061	08/2011

Note: N/A = Not applicable, NCR = No cal required, COU = Cal on use

Section 8: Testing data

8.1 Clause 15.31(e) Variation of power source

§ 15.31 Measurement standards.

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery.

Special notes

None

Test data

Transmit output power was measured while supply voltage was varied from 102 VAC to 138 VAC (85 % to 115 % of the nominal rated supply voltage). No change in transmit output power was observed.

8.2 Clause 15.31(m) Number of operating frequencies

§ 15.31 Measurement standards.

(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz and less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Special notes

The frequency range over which the device operates is greater than 10 MHz. The tests were performed on three operating channels (low, mid, high)

Test data

The frequency band is 2412 MHz (channel 1) to 2462 MHz (channel 11) MHz therefore number of operating frequencies is 3.

Low frequency / channel 1	2412 MHz
Mid frequency / channel 6	2437 MHz
High frequency / channel 11	2462 MHz

8.3 Clause 15.203 Antenna requirement

§ 15.203 Antenna requirement.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Special notes

None

Test data

– The EUT uses a non-detachable antenna to the intentional radiator.

Detailed photo of RF connector:
E.U.T didn’t have antenna connector but integral antenna.

8.4 Clause 15.207(a) Conducted limits

§ 15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

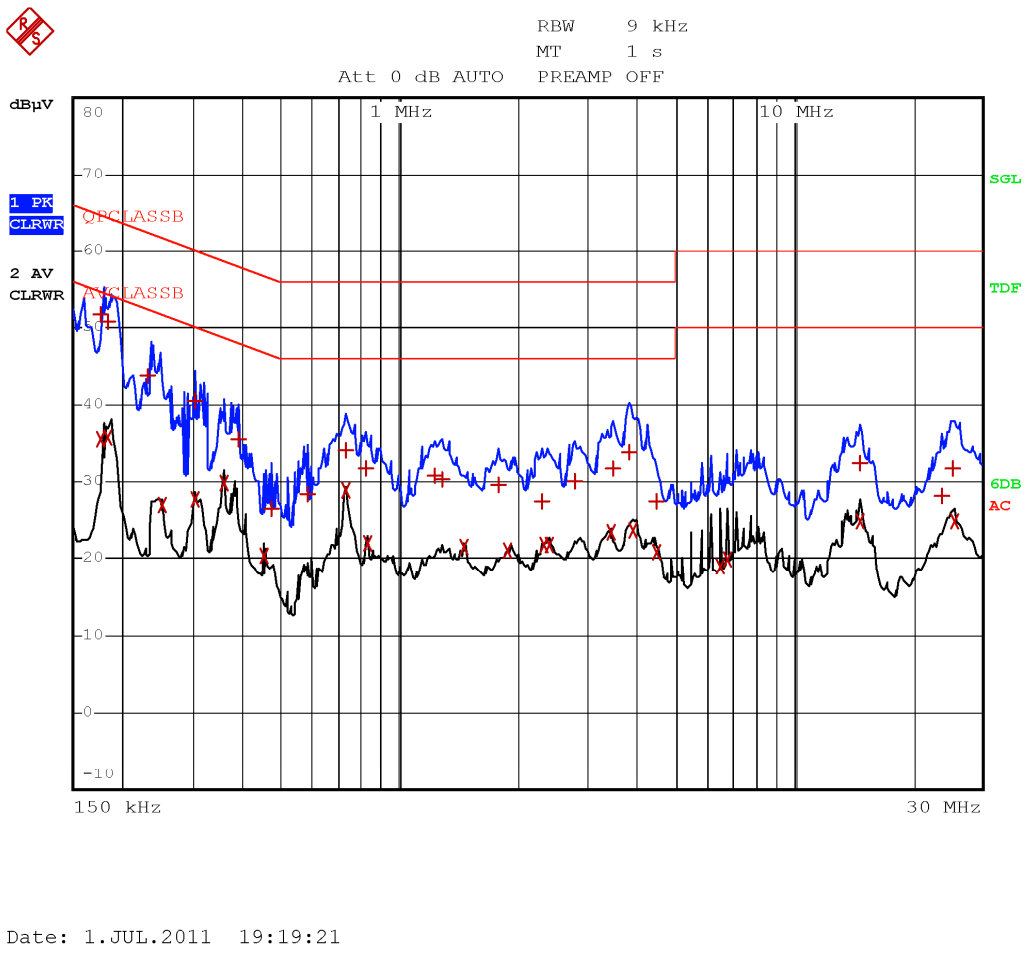
*-Decreases with the logarithm of the frequency.

Special notes

None

Test data

Neutral line



The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/Spectrum analyzer settings:	
0.15 MHz to 30 MHz	
Preview measurements	**Final measurement**
Receiver: 9 kHz RBW, Peak and Average detector, max hold	Receiver: 9 kHz RBW, Quasi-peak and Average detector
Measurement time 100 ms	

Tabular data

Frequency (MHz)	Quasi Peak result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.17800	51.8	1000	120		Neutral	10	-12.8	64.6
0.18600	50.9	1000	120		Neutral	10	-13.3	64.2
0.23400	43.8	1000	120		Neutral	10	-18.5	62.3
0.30200	40.3	1000	120		Neutral	10	-19.9	60.2
0.39000	35.5	1000	120		Neutral	10	-22.5	58.1
0.47400	26.6	1000	120		Neutral	10	-29.8	56.4
0.58200	28.4	1000	120		Neutral	10	-27.6	56.0
0.73400	34.0	1000	120		Neutral	10	-22.0	56.0
0.82600	31.7	1000	120		Neutral	10	-24.3	56.0
1.23800	30.7	1000	120		Neutral	10	-25.3	56.0
1.28600	30.2	1000	120		Neutral	10	-25.8	56.0
1.79400	29.5	1000	120		Neutral	10	-26.5	56.0
2.31400	27.5	1000	120		Neutral	10	-28.5	56.0
2.79400	30.0	1000	120		Neutral	10	-26.0	56.0
3.49800	31.6	1000	120		Neutral	10	-24.4	56.0
3.84600	33.8	1000	120		Neutral	10	-22.2	56.0
4.49800	27.6	1000	120		Neutral	10	-28.4	56.0
14.72200	32.5	1000	120		Neutral	10	-27.5	60.0
23.87400	28.1	1000	120		Neutral	10	-31.9	60.0
25.31000	31.8	1000	120		Neutral	10	-28.2	60.0

Note: Correction factor includes cable loss, LISN, and attenuator.

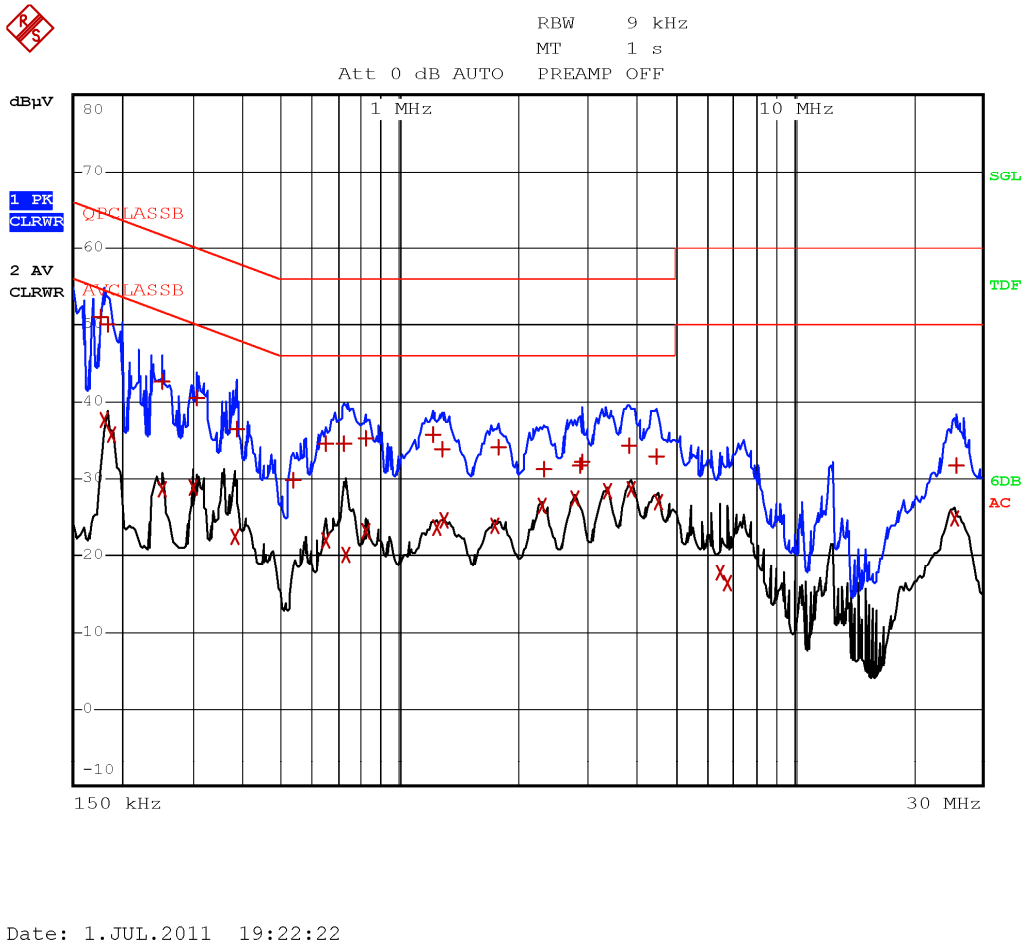
Tabular data

Frequency (MHz)	**Average** result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.17800	35.4	1000	120		Neutral	10	-19.2	54.6
0.18600	35.7	1000	120		Neutral	10	-18.5	54.2
0.25000	26.9	1000	120		Neutral	10	-24.9	51.8
0.30200	27.8	1000	120		Neutral	10	-22.4	50.2
0.35800	29.7	1000	120		Neutral	10	-19.1	48.8
0.45400	20.2	1000	120		Neutral	10	-26.6	46.8
0.73000	28.8	1000	120		Neutral	10	-17.2	46.0
0.83400	22.1	1000	120		Neutral	10	-23.9	46.0
1.45400	21.4	1000	120		Neutral	10	-24.6	46.0
1.87800	21.0	1000	120		Neutral	10	-25.0	46.0
2.33800	21.7	1000	120		Neutral	10	-24.3	46.0
2.39800	21.8	1000	120		Neutral	10	-24.2	46.0
3.43400	23.4	1000	120		Neutral	10	-22.6	46.0
3.93400	23.6	1000	120		Neutral	10	-22.4	46.0
4.47800	20.9	1000	120		Neutral	10	-25.1	46.0
6.49800	18.9	1000	120		Neutral	10	-31.1	50.0
6.82200	19.9	1000	120		Neutral	10	-30.1	50.0
14.78200	24.9	1000	120		Neutral	10	-25.1	50.0
25.56200	24.8	1000	120		Neutral	10	-25.2	50.0

Note: Correction factor includes cable loss, LISN, and attenuator.

Test data, continued

Phase line



The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/Spectrum analyzer settings:	
0.15 MHz to 30 MHz	
Preview measurements	**Final measurement**
Receiver: 9 kHz RBW, Peak and Average detector, max hold	Receiver: 9 kHz RBW, Quasi-peak and Average detector
Measurement time 100 ms	

Tabular data

Frequency (MHz)	Quasi Peak result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.17800	51.1	1000	120		Phase	10	-13.5	64.6
0.18600	50.1	1000	120		Phase	10	-14.1	64.2
0.25000	42.7	1000	120		Phase	10	-19.1	61.8
0.30600	40.5	1000	120		Phase	10	-19.6	60.1
0.38600	36.5	1000	120		Phase	10	-21.6	58.1
0.53400	29.9	1000	120		Phase	10	-26.1	56.0
0.65000	34.4	1000	120		Phase	10	-21.6	56.0
0.72600	34.4	1000	120		Phase	10	-21.6	56.0
0.82200	35.3	1000	120		Phase	10	-20.7	56.0
1.21800	35.8	1000	120		Phase	10	-20.2	56.0
1.28600	33.9	1000	120		Phase	10	-22.1	56.0
1.79400	33.9	1000	120		Phase	10	-22.1	56.0
2.32200	31.1	1000	120		Phase	10	-24.9	56.0
2.87400	31.6	1000	120		Phase	10	-24.4	56.0
2.92600	32.1	1000	120		Phase	10	-23.9	56.0
3.85000	34.2	1000	120		Phase	10	-21.8	56.0
4.49400	32.9	1000	120		Phase	10	-23.1	56.0
25.74600	31.6	1000	120		Phase	10	-28.4	60.0

Note: Correction factor includes cable loss, LISN, and attenuator.

Frequency (MHz)	**Average** result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.18200	37.5	1000	120		Phase	10	-16.9	54.4
0.19000	35.7	1000	120		Phase	10	-18.3	54.0
0.25000	28.6	1000	120		Phase	10	-23.1	51.8
0.29800	28.8	1000	120		Phase	10	-21.5	50.3
0.38200	22.4	1000	120		Phase	10	-25.8	48.2
0.65000	21.9	1000	120		Phase	10	-24.1	46.0
0.73000	20.1	1000	120		Phase	10	-25.9	46.0
0.82600	23.1	1000	120		Phase	10	-22.9	46.0
1.24600	23.7	1000	120		Phase	10	-22.3	46.0
1.29400	24.5	1000	120		Phase	10	-21.5	46.0
1.75800	23.8	1000	120		Phase	10	-22.2	46.0
2.30600	26.5	1000	120		Phase	10	-19.5	46.0
2.78200	27.5	1000	120		Phase	10	-18.5	46.0
3.37400	28.3	1000	120		Phase	10	-17.7	46.0
3.86600	28.7	1000	120		Phase	10	-17.3	46.0
4.54200	26.9	1000	120		Phase	10	-19.1	46.0
6.49000	17.8	1000	120		Phase	10	-32.2	50.0
6.81400	16.3	1000	120		Phase	10	-33.7	50.0
25.62600	24.8	1000	120		Phase	10	-25.2	50.0

Note: Correction factor includes cable loss, LISN, and attenuator.

8.5 Clause 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

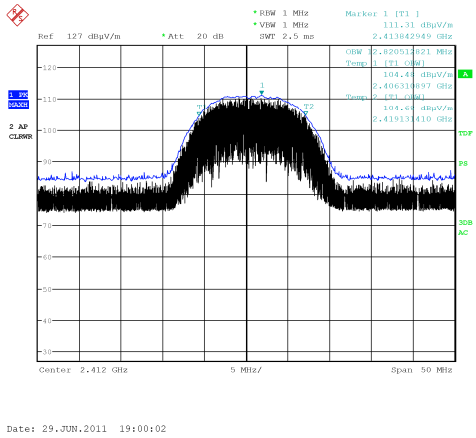
(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Special notes
None

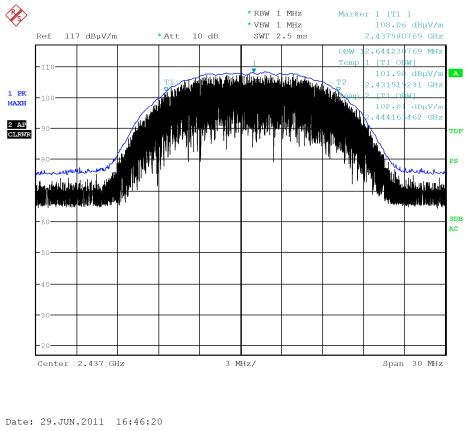
Test data

Radiated measurement protocol 802.11b

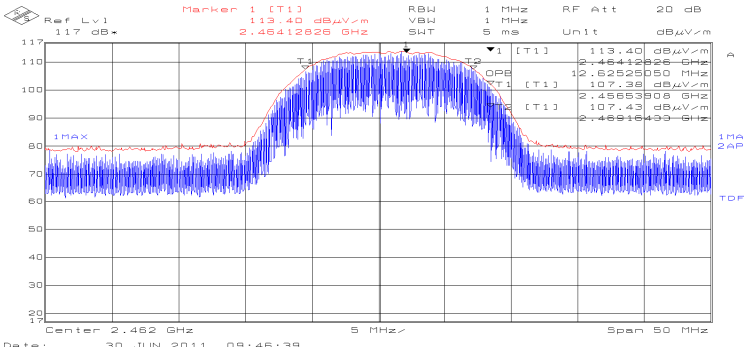
Low channel 6 dB bandwidth



Mid channel 6 dB bandwidth



High channel



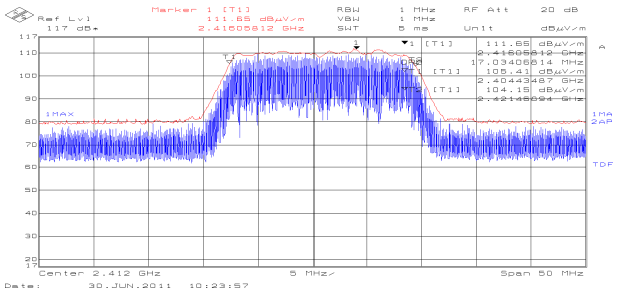
Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
2412	12.8	> 0.5	12.3
2437	12.6	> 0.5	12.1
2462	12.6	> 0.5	12.1

– The peak detector was used with 1000 kHz/1 MHz RBW/VBW
– The span was wider than RBW.

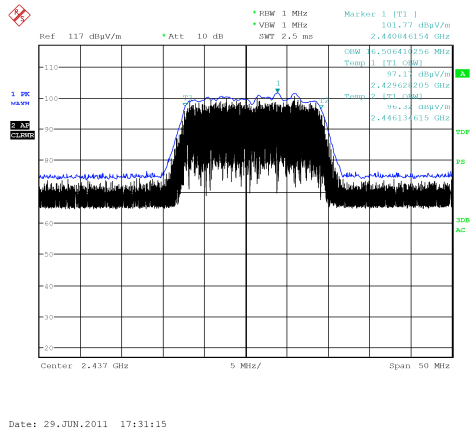
Test data

Radiated measurement protocol 802.11g

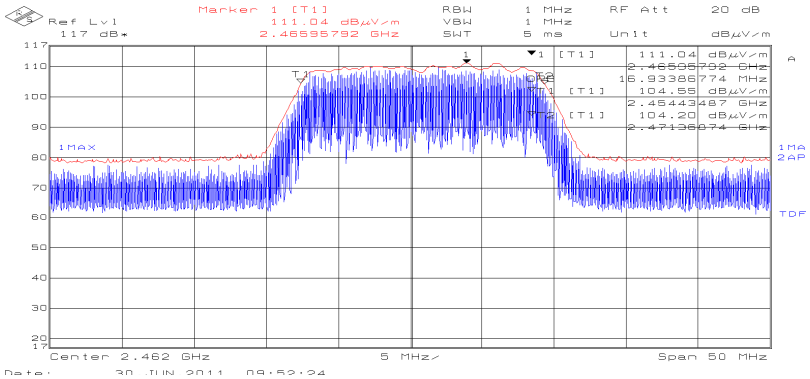
Low channel 6 dB bandwidth



Mid channel 6 dB bandwidth



High channel



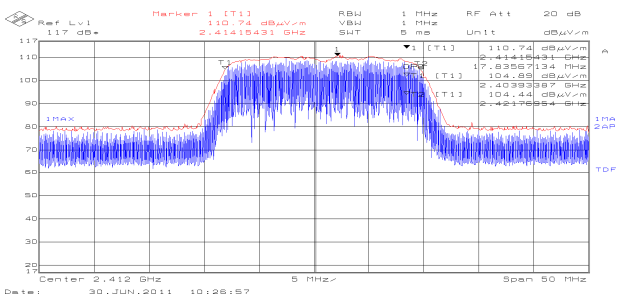
Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
2412	17.0	> 0.5	16.5
2437	16.5	> 0.5	16.0
2462	16.9	> 0.5	16.4

– The peak detector was used with 1000 kHz/1 MHz RBW/VBW
– The span was wider than RBW.

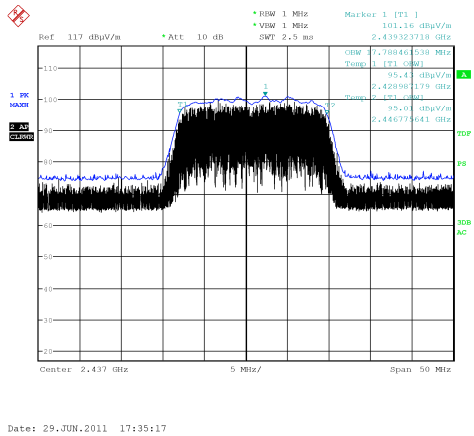
Test data

Radiated measurement protocol 802.11n

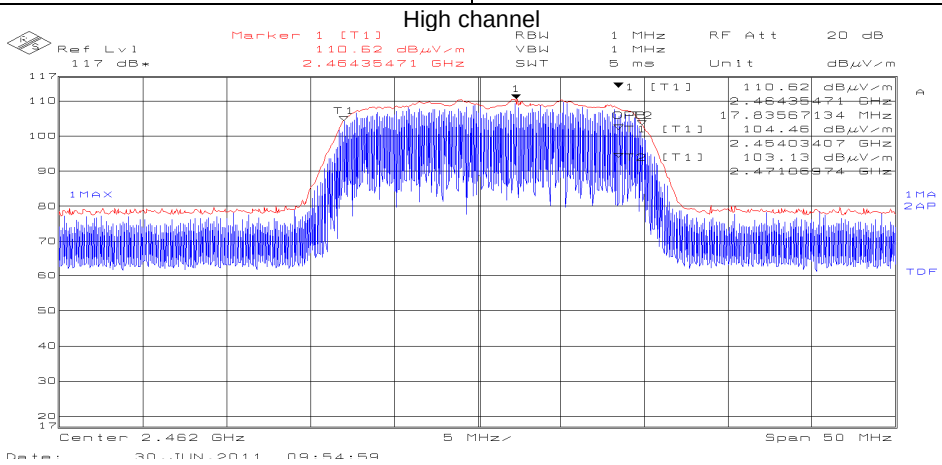
Low channel 6 dB bandwidth



Mid channel 6 dB bandwidth



High channel



Frequency (MHz)	6 dB bandwidth (MHz)	Limit (MHz)	Margin (MHz)
2412	17.9	> 0.5	17.4
2437	17.8	> 0.5	17.3
2462	17.9	> 0.5	17.4

– The peak detector was used with 1000 kHz/1 MHz RBW/VBW
– The span was wider than RBW.

8.6 Clause 15.247(b) Maximum peak conducted output power

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) 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.

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Special notes

None

Test data, continued

Section (3) Results, continued protocol 802.11b

Radiated measurements

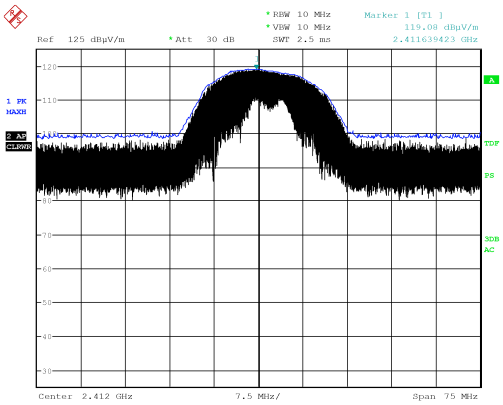
Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz: (*)
- Only the worst data presented in the test report.

Notes: RBW of 10 MHz is less than the main lobe width (20 MHz).

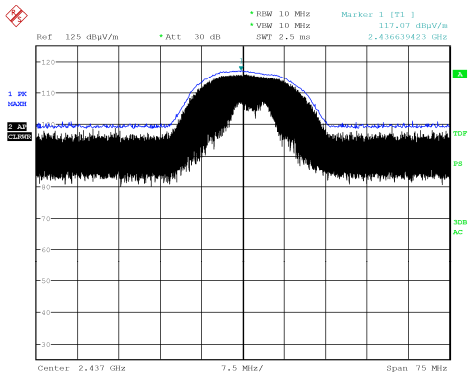
A correction factor 20log(10M/measured 6dBbandwidth) for field strength correction factor has been applied to ensure the whole emission bandwidth was covered

Low channel



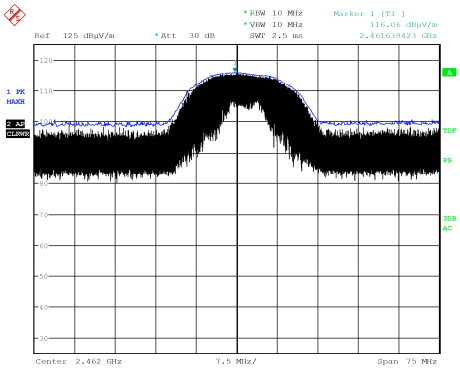
Date: 8.JUL.2011 13:03:12

Mid channel



Date: 8.JUL.2011 13:04:45

High channel



Date: 8.JUL.2011 13:09:09

Test data, continued

Section (3) Results, continued

Radiated measurements

Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz: field level corrected according to table (see note)
- Only the worst data presented in the test report.

Frequency (MHz)	Field strength (dBµV/m)	Output power (dBm)	Limit (dBm)	Margin (dBm)
2412	121.2	23.5	30	-6.5
2437	119.1	21.4	30	-8.6
2462	118.1	20.4	30	-9.6

Note:.

Frequency (MHz)	6 dB bandwidth (MHz)	Correction factor 20*LOG10 (6dB/10)
2412	12.8	2.1
2437	12.6	2.0
2462	12.6	2.0

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

From which we obtain

dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

Output power [dBm] = Field Strength [dBµV/m] − 95.23 [dB] − Antenna gain [dBi]

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dBm)
2412	26.0	36	-10.0
2437	23.9	36	-12.1
2462	22.9	36	-13.1

EIRP [dBm] = Output power [dBm] + Antenna gain [dBi]

Test data, continued

Section (3) Results, continued protocol 802.11g

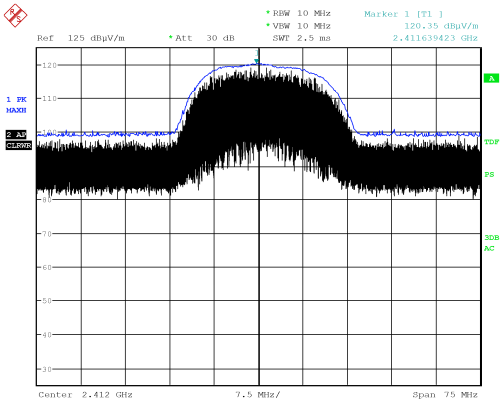
Radiated measurements

Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz
- Only the worst data presented in the test report.

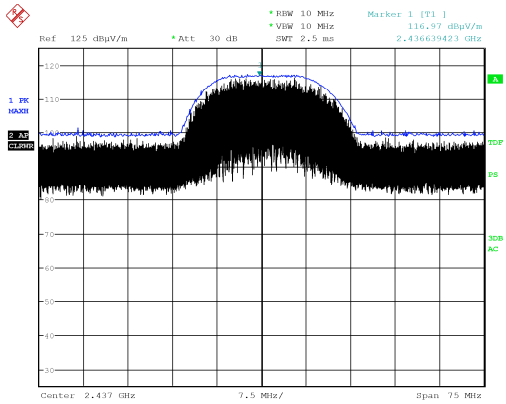
Notes: RBW of 10 MHz is less than the main lobe width (20 MHz).
A correction factor 20log(10M/measured 6dBbandwidth) for field strength correction factor has been applied to ensure the whole emission bandwidth was covered

Low channel



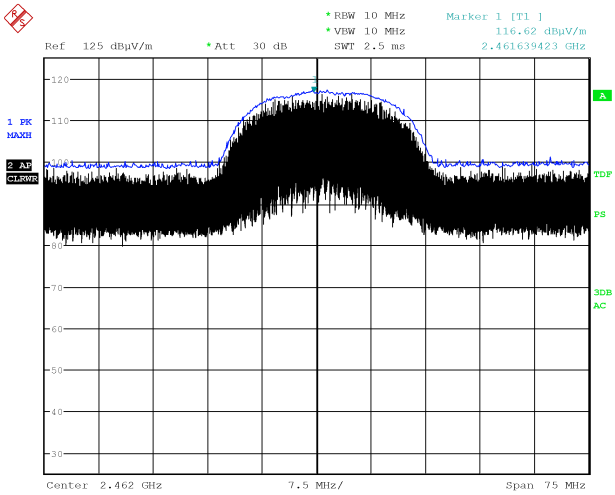
Date: 8.JUL.2011 12:59:30

Mid channel



Date: 8.JUL.2011 13:06:18

High channel



Date: 8.JUL.2011 13:10:10

Test data, continued

Section (3) Results, continued

Radiated measurements

Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz
- Only the worst data presented in the test report.

Frequency (MHz)	Field strength (dBµV/m)	Output power (dBm)	Limit (dBm)	Margin (dBm)
2412	125.0	27.3	30	-2.7
2437	121.3	23.6	30	-6.4
2462	121.2	23.4	30	-6.6

Note:

Frequency (MHz)	6 dB bandwidth (MHz)	Correction factor 20*Log10(6dB/10)
2412	17	4.6
2437	16.5	4.3
2462	16.9	4.6

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

From which we obtain

dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

Output power [dBm] = Field Strength [dBµV/m] − 95.23 [dB] − Antenna gain [dBi]

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dBm)
2412	29.8	36	-6.2
2437	26.1	36	-9.9
2462	25.9	36	-10.1

EIRP [dBm] = Output power [dBm] + Antenna gain [dBi]

Test data, continued

Section (3) Results, continued protocol 802.11n

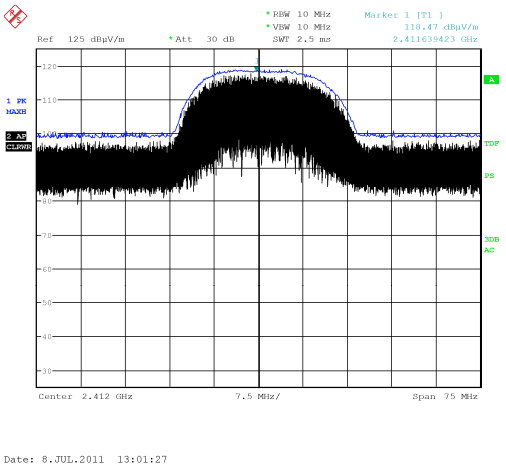
Radiated measurements

Radiated measurements were performed:

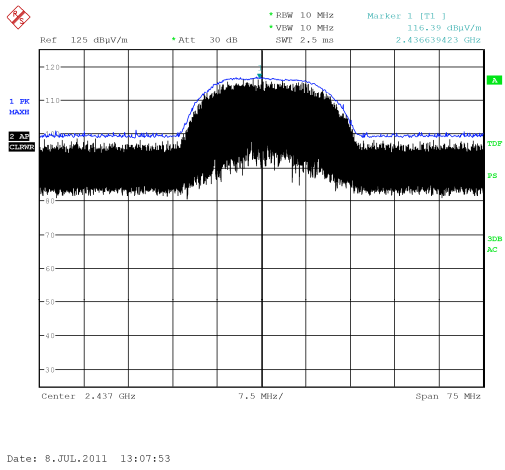
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz
- Only the worst data presented in the test report.

Notes: RBW of 10 MHz is less than the main lobe width (20 MHz).
A correction factor 20log(10M/measured 6dBbandwidth) for field strength correction factor has been applied to ensure the whole emission bandwidth was covered

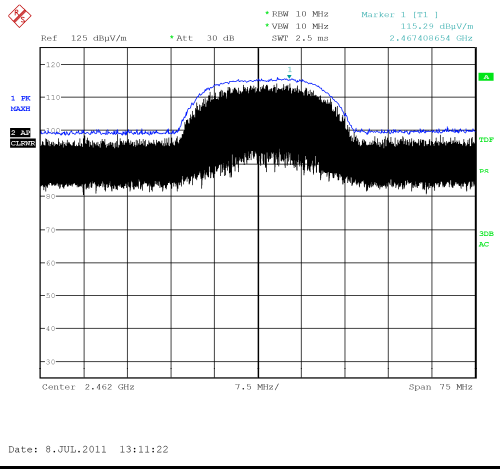
Low channel



Mid channel



High channel



Test data, continued

Section (3) Results, continued

Radiated measurements

Radiated measurements were performed:

- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - using a peak detector with RBW 10 MHz
- Only the worst data presented in the test report.

Frequency (MHz)	Field strength (dBµV/m)	Output power (dBm)	Limit (dBm)	Margin (dBm)
2412	123.6	25.8	30	-4.2
2437	121.4	23.7	30	-6.3
2462	120.4	22.6	30	-7.4

Note:

Frequency (MHz)	6 dB bandwidth (MHz)	Correction factor 20*Log10(6dB/10)
2412	17.9	5.1
2437	17.8	5.0
2462	17.9	5.1

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

From which we obtain

dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

Output power [dBm] = Field Strength [dBµV/m] − 95.23 [dB] − Antenna gain [dBi]

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dBm)
2412	28.3	36	-7.7
2437	26.2	36	-9.8
2462	25.1	36	-10.9

EIRP [dBm] = Output power [dBm] + Antenna gain [dBi]

8.7 Clause 15.247(d) Spurious emissions

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(d) 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)).

Special notes

§15.209 – Radiated emission limits

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009–0.490	2400/F	67.6−20log(F)	300
0.490–1.705	24000/F	87.6−20log(F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes:
- F = fundamental frequency in kHz
- In the emission table above, the tighter limit applies at the band edges.
- For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

§15.205 – Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results

Test data

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

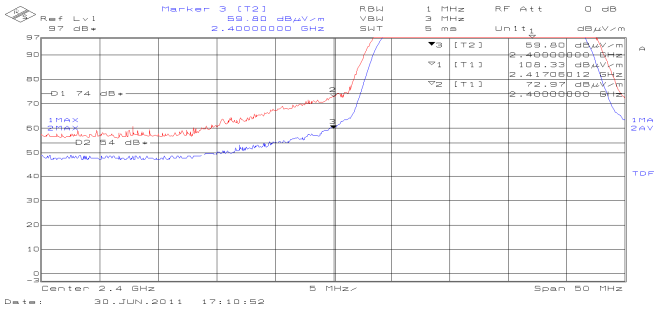
Duty cycle/average factor calculations: duty cycle =100%

$$Duty\,cycle/average\ factor = 20\times\log_{10}\left(\frac{Tx_{100\,ms}}{100\,ms}\right)$$ = not applicable

Test data, continued

Marker-delta measurement for 2.400 GHz Band Edge: protocol 802.11n

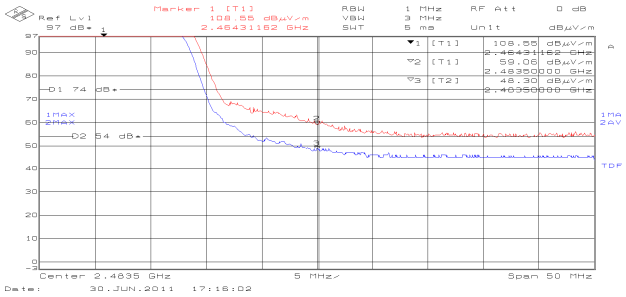
Measured field strength for high channel in 1 MHz/3 MHz RBW/VBW = 108.4dBµV/m



Delta marker = 35.3dB

Marker-delta measurement for 2.4835 GHz Band Edge protocol 802.11n

Measured field strength for high channel in 1 MHz/3 MHz RBW/VBW = 108.55 dBµV/m

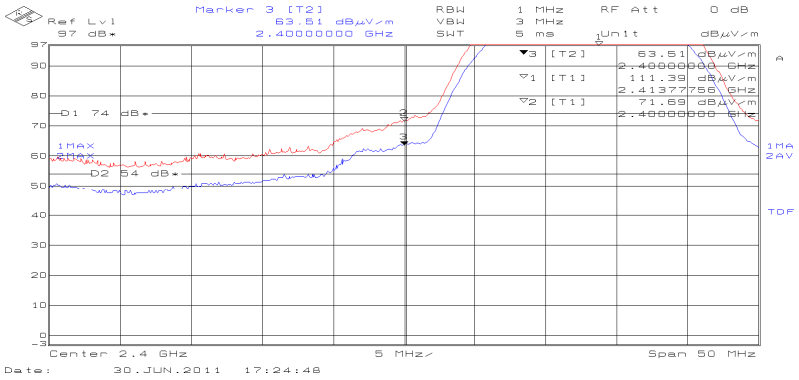


Delta marker = 49.4dB

Test data, continued

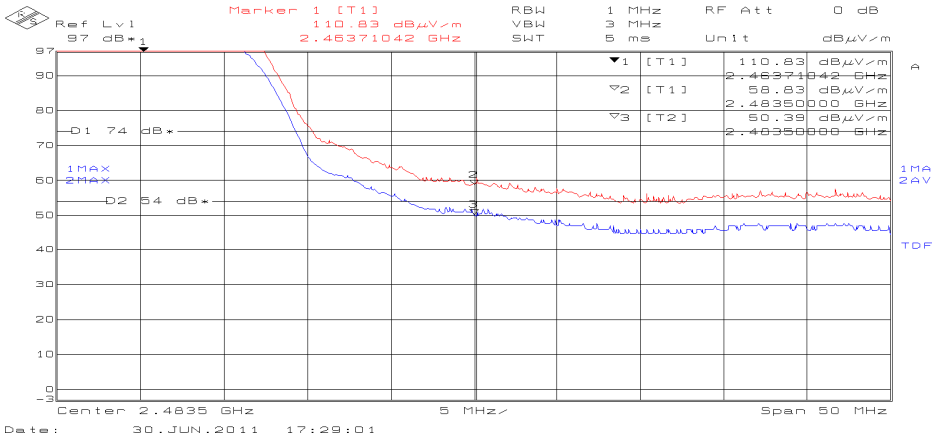
Marker-delta measurement for 2.400 GHz Band Edge protocol 802.11b

Measured field strength for high channel in 1 MHz/3 MHz RBW/VBW = 108.55 dBµV/m



Delta marker = 39.7dB

Marker-delta measurement for 2.4385 GHz Band Edge protocol 802.11b

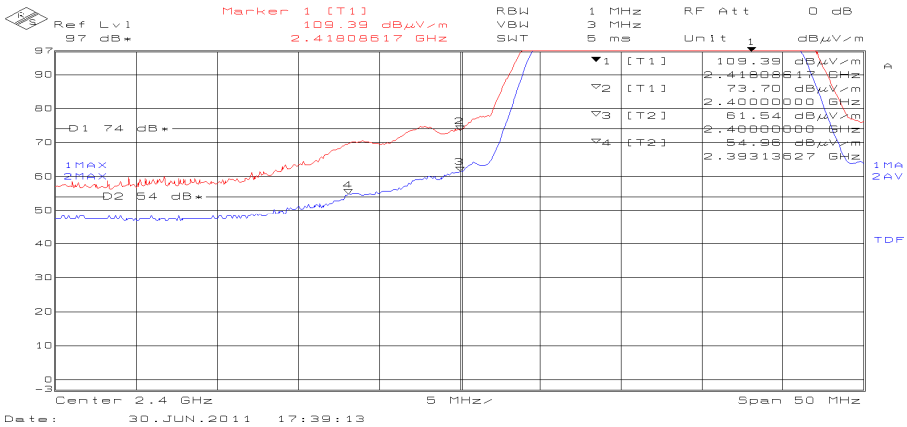


Delta marker = 52 dB

Test data, continued

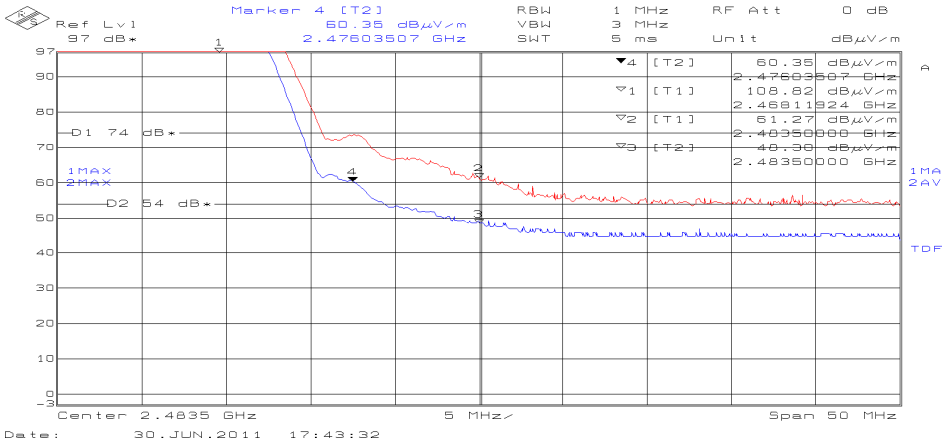
Marker-delta measurement for 2.400 GHz Band Edge protocol 802.11g

Measured field strength for high channel in 1 MHz/3 MHz RBW/VBW = 108.55 dBµV/m



Delta marker = 35.7 dB

Marker-delta measurement for 2.4385 GHz Band Edge protocol 802.11g

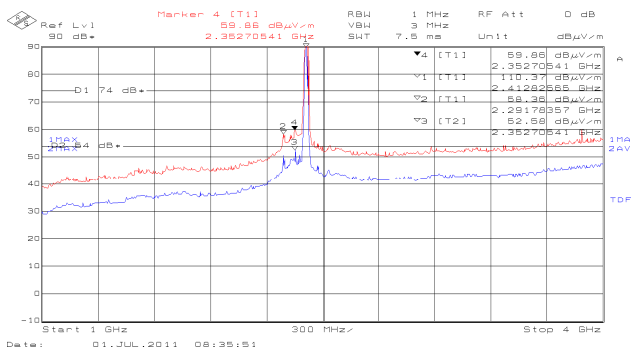


Delta marker = 47.55 dB

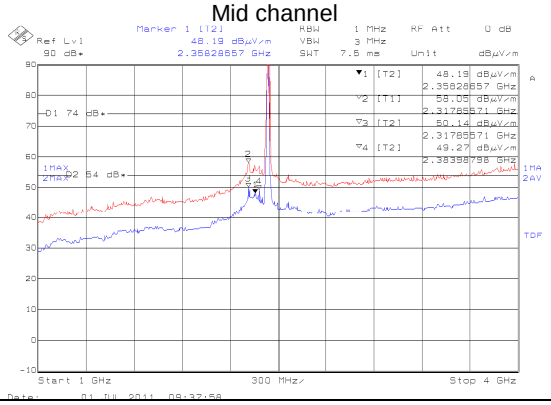
Test data, continued

Radiated measurement protocol 802.11b

Low channel



Mid channel



High channel

Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2352	h	59.8	25.0	74	-14.2	--	52.6	54	-1.4
2291	h	58.3	24.4	74	-15.7	--	50.0	54	-4.0

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2352	h	59.8	25.0	74	-14.2	--	52.6	54	-1.4
2291	h	58.3	24.4	74	-15.7	--	50	54	-4.0
2383	h	--	25.0	74	--	--	49.3	54	-4.7

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Only worst results were reported (horizontal polarization)

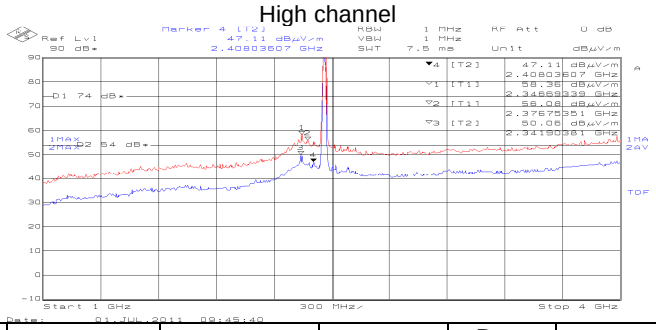
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

Radiated measurement protocol 802.11b

High channel



Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2346	h	58.3	24.7	74	-15.7	--	50.0	54	4
2376	h	56	25	74	-18	--	--	--	--
2408	h	--	25.4	--	--	--	47.0	54	7

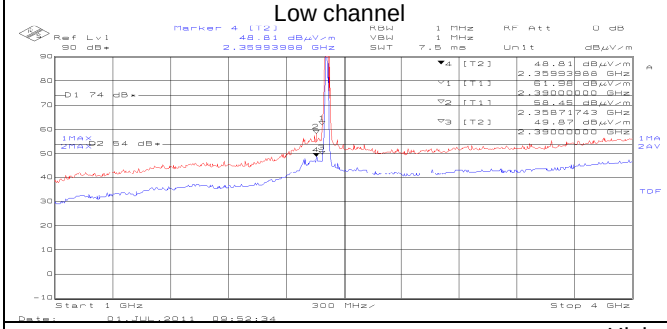
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

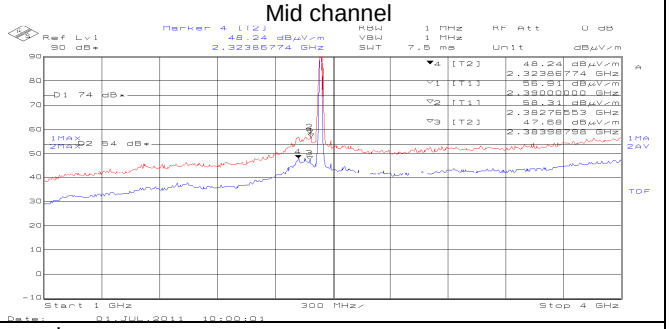
Test data, continued

Radiated measurement protocol 802.11g

Low channel



Mid channel



High channel

Freq. (MHz)	P l. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2390	h	62	25	74	-12	--	49.9	54	-4.1
2359	h	58.4	25	74	-15.6	--	48.8	54	-5.2

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2390	h	56.9	25	74	-17.1	--	--	54	--
2382	h	58.3	25	74	-15.7	--	--	54	--
2383	h	--	25	--	--	--	47.7	54	-6.3
2323	h	--	24.7	--	--	--	48.2	54	-5.8

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Only worst results were reported (horizontal polarization)

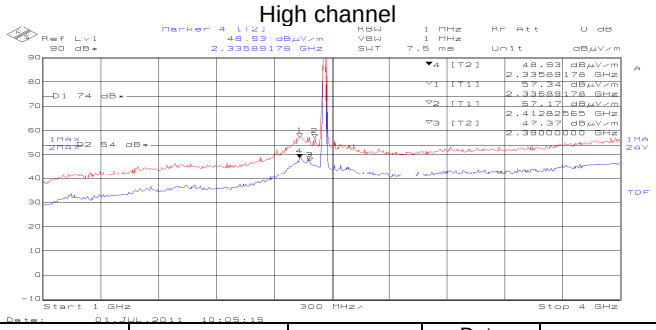
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

Radiated measurement protocol 802.11g

High channel



Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2335	h	57.3	24.7	74	-16.7	--	48.9	54	-5.1
2412	h	57.2	25.4	74	-16.8	--	--	--	--
2408	h	--	25.4	--	--	--	47.0	54	-7
2390	h	--	25	--	--	--	47.4	54	-6.6

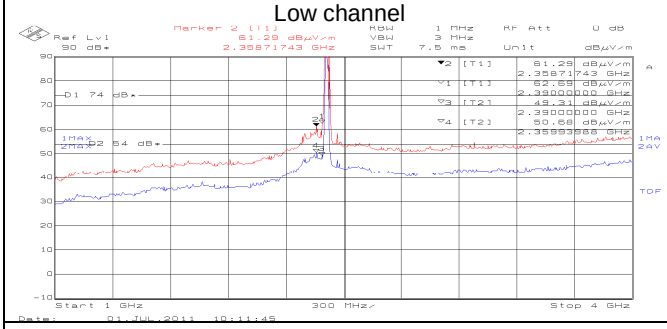
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

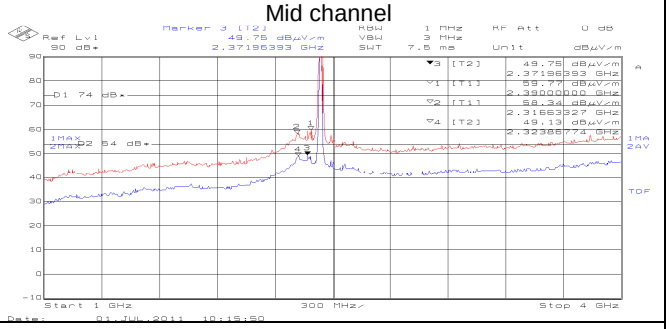
Test data, continued

Radiated measurement protocol 802.11n

Low channel



Mid channel



Freq. (MHz)	P l. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2358	h	61.3	25	74	-12.7	--	50.7	54	-3.3
2390	h	62.7	25	74	-11.3	--	49.3	54	-4.7

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2390	h	59.7	25	74	-14.3	--	--	54	--
2371	h	--	25	74	--!	--	49.5	54	-4.5
2316	h	58.3	24.7	74	-15.7		--	54	--
2323	h	--	24.7	74	--		49.1	54	-4.9

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Only worst results were reported (horizontal polarization)

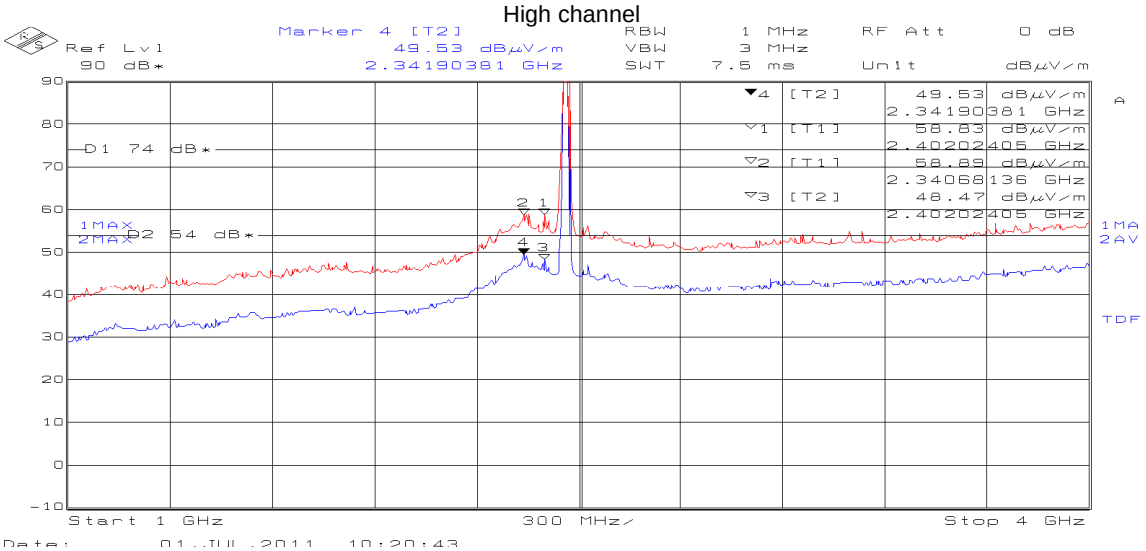
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

Radiated measurement protocol 802.11n

High channel



Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
2402	h	58.8	25.4	74	-15.2	--	48.5	54	-5.5
2340	h	58.9	24.7	74	-15.1	--	49.5	54	-4.5

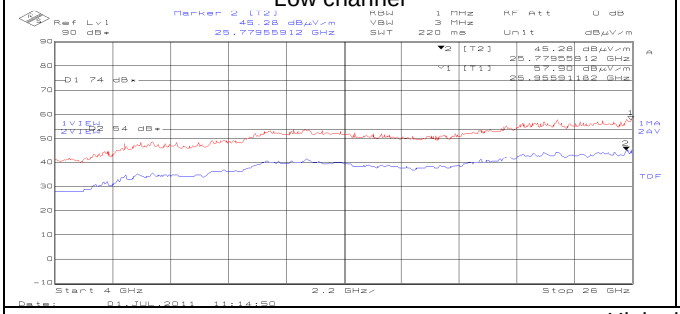
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

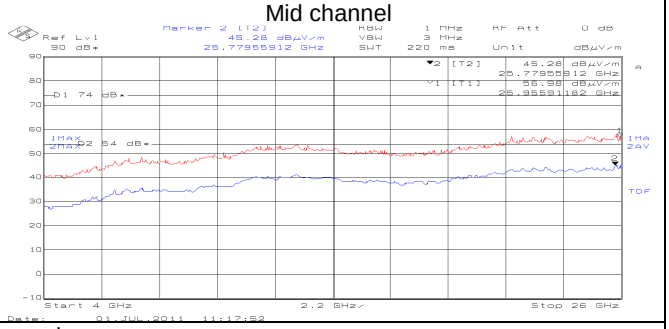
Test data, continued

Radiated measurement protocol 802.11b

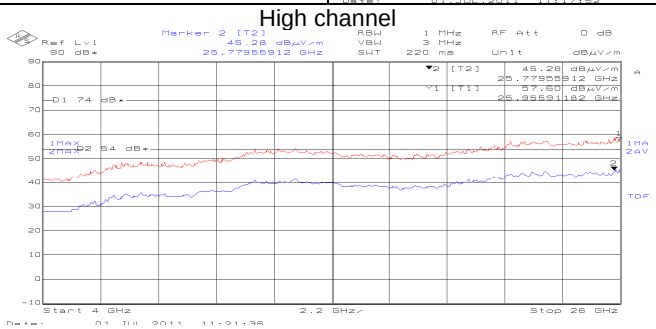
Low channel



Mid channel



High channel



Freq. (MHz)	P I . V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
--	h	--	--	--	--	--	--	--	
Note: Correction factor includes antenna, cable loss, amplifier, and attenuators. Only worst results were reported (horizontal polarization)									

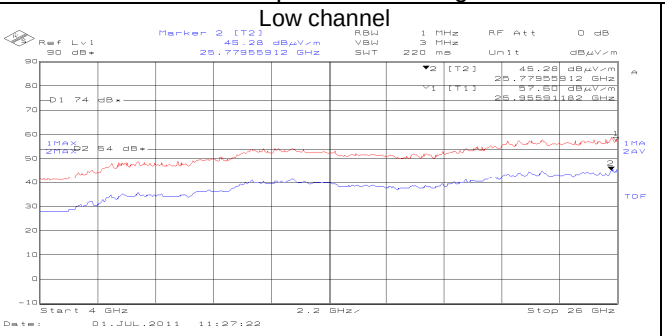
Radiated Measurements

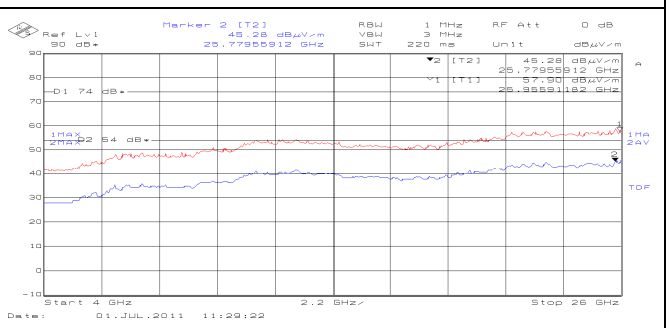
- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

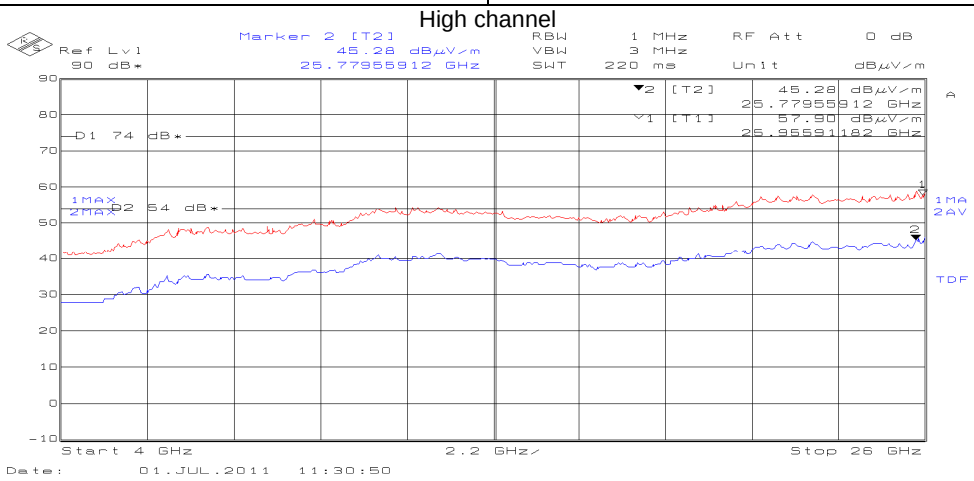
Radiated measurement protocol 802.11g

Low channel





High channel



Freq. (MHz)	P I . V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
--	h	--	--	--	--	--	--	--	

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Only worst results were reported (horizontal polarization)

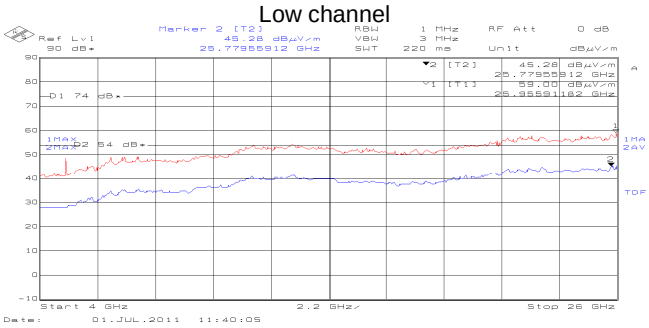
Radiated Measurements

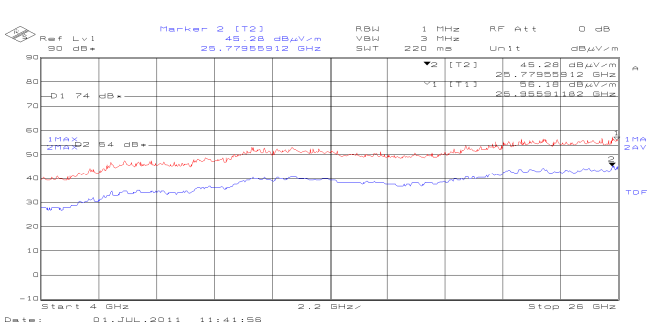
- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

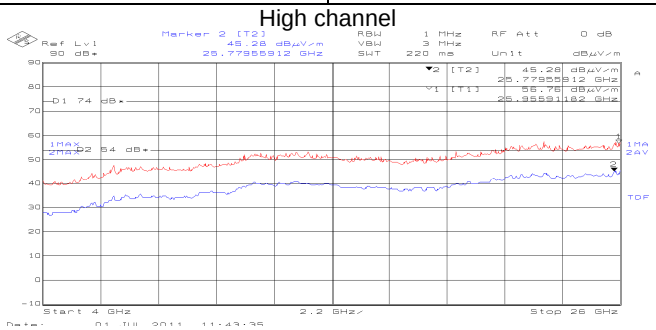
Radiated measurement protocol 802.11n

Low channel





High channel



Freq. (MHz)	Pol. V/H	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
--	h	--	--	--	--	--	--	--	

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Only worst results were reported (horizontal polarization)

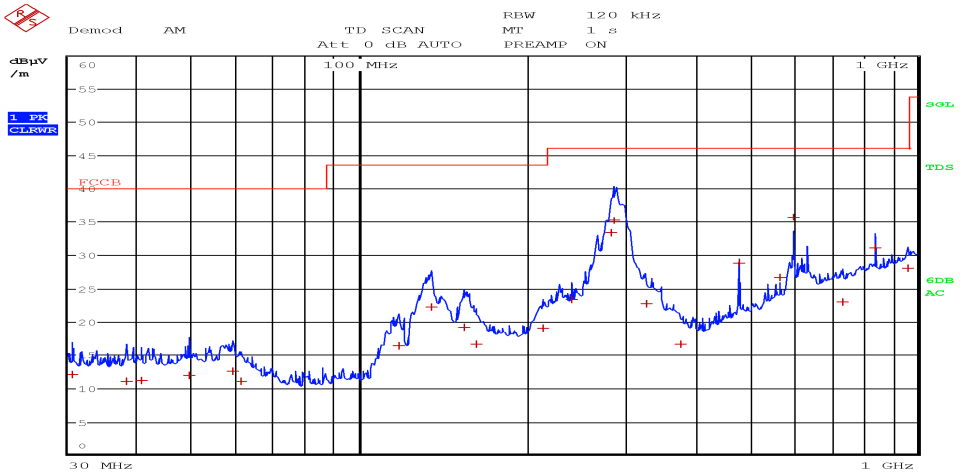
Radiated Measurements

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data, continued

Radiated measurement protocol 802.11b, horizontal polarization, low channel

Low channel



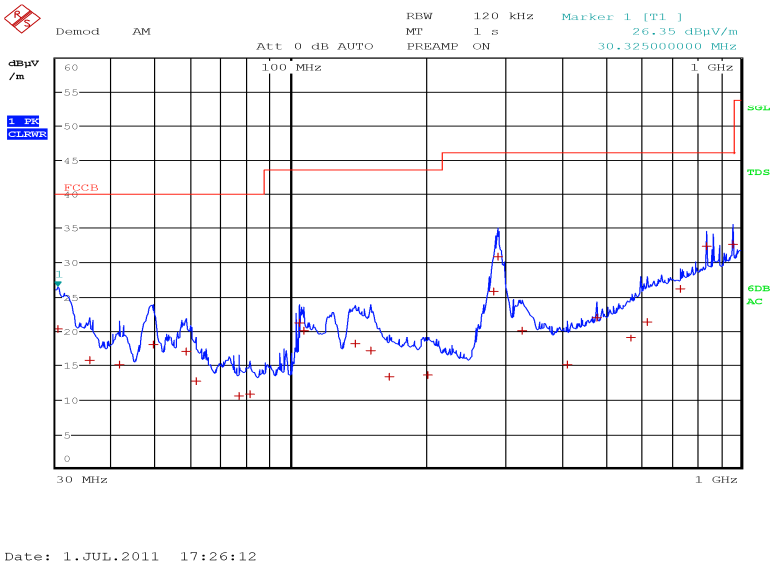
Date: 1.JUL.2011 16:59:26

Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.50000	h	12.0	13.2	40.0	-28.0	--	--	--	--
38.25000	h	11.1	13.4	40.0	-28.9	--	--	--	--
40.62500	h	11.1	14.2	40.0	-28.9	--	--	--	--
49.57500	h	11.8	13.8	40.0	-28.2	--	--	--	--
59.17500	h	12.5	13.5	40.0	-27.5	--	--	--	--
61.17500	h	11.0	13.1	40.0	-29.0	--	--	--	--
117.60000	h	16.4	11.7	43.5	-27.1	--	--	--	--
134.45000	h	22.2	13.3	43.5	-21.3	--	--	--	--
154.15000	h	19.3	14.7	43.5	-24.2	--	--	--	--
161.50000	h	16.6	14.7	43.5	-26.9	--	--	--	--
213.47500	h	19.1	10.8	43.5	-24.4	--	--	--	--
240.07500	h	23.4	12.4	46.0	-22.6	--	--	--	--
282.97500	h	33.4	13.5	46.0	-12.6	--	--	--	--
285.52500	h	35.3	13.5	46.0	-10.7	--	--	--	--
326.82500	h	22.7	14.7	46.0	-23.3	--	--	--	--
376.25000	h	16.6	15.7	46.0	-29.4	--	--	--	--
480.02500	h	28.8	17.8	46.0	-17.2	--	--	--	--
566.67500	h	26.7	19.0	46.0	-19.4	--	--	--	--
600.00000	h	35.8	20.0	46.0	-10.3	--	--	--	--
733.32500	h	23.1	21.4	46.0	-23.0	--	--	--	--
840.00000	h	31.0	22.5	46.0	-15.0	--	--	--	--
959.97500	h	28.0	24.0	46.0	-18.0	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Low channel radiated measured in vertical and horizontal mpolarization with protocol 802.11b

Test data, continued

Radiated measurement protocol 802.11b, vertical polarization, low channel

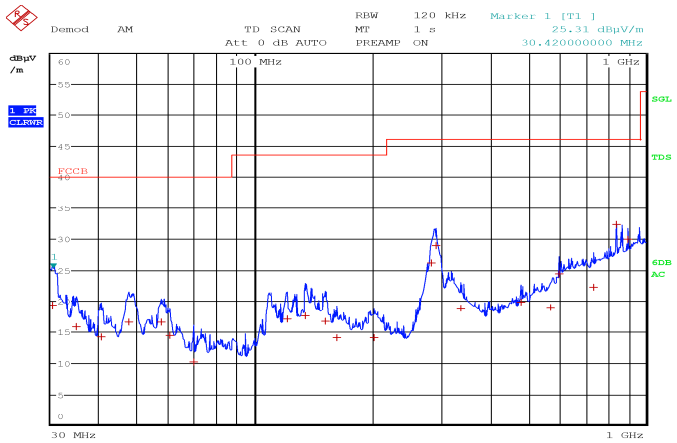


Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.32500	v	20.4	13.2	40.0	-19.6	--	--	--	--
35.72500	v	15.7	13.3	40.0	-24.3	--	--	--	--
41.57500	v	15.1	14.2	40.0	-24.9	--	--	--	--
49.47500	v	18.0	13.8	40.0	-22.0	--	--	--	--
58.37500	v	17.0	13.5	40.0	-23.0	--	--	--	--
61.47500	v	12.7	13.1	40.0	-27.3	--	--	--	--
76.50000	v	10.6	10.6	40.0	-29.4	--	--	--	--
81.20000	v	10.7	9.8	40.0	-29.3	--	--	--	--
104.45000	v	21.2	10.7	43.5	-22.3	--	--	--	--
106.67500	v	20.1	10.7	43.5	-23.4	--	--	--	--
139.25000	v	18.1	13.3	43.5	-25.5	--	--	--	--
150.27500	v	17.1	14.7	43.5	-26.4	--	--	--	--
166.00000	v	13.3	14.7	43.5	-30.2	--	--	--	--
201.92500	v	13.6	10.6	43.5	-29.9	--	--	--	--
282.47500	v	25.7	13.5	46.0	-20.3	--	--	--	--
288.95000	v	30.8	13.5	46.0	-15.2	--	--	--	--
326.27500	v	20.1	14.7	46.0	-25.9	--	--	--	--
410.67500	v	15.1	16.2	46.0	-30.9	--	--	--	--
480.00000	v	22.0	17.8	46.0	-24.1	--	--	--	--
570.12500	v	19.0	19.0	46.0	-27.0	--	--	--	--
621.47500	v	21.3	20.0	46.0	-24.7	--	--	--	--
733.35000	v	26.1	21.4	46.0	-19.9	--	--	--	--
840.02500	v	32.4	22.5	46.0	-13.6	--	--	--	--
959.67500	v	32.6	24.0	46.0	-13.4	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Low channel radiated measured in vertical and horizontal mpolarization with protocol 802.11b

Test data, continued

Radiated measurement protocol 802.11g, vertical polarization, mid channel

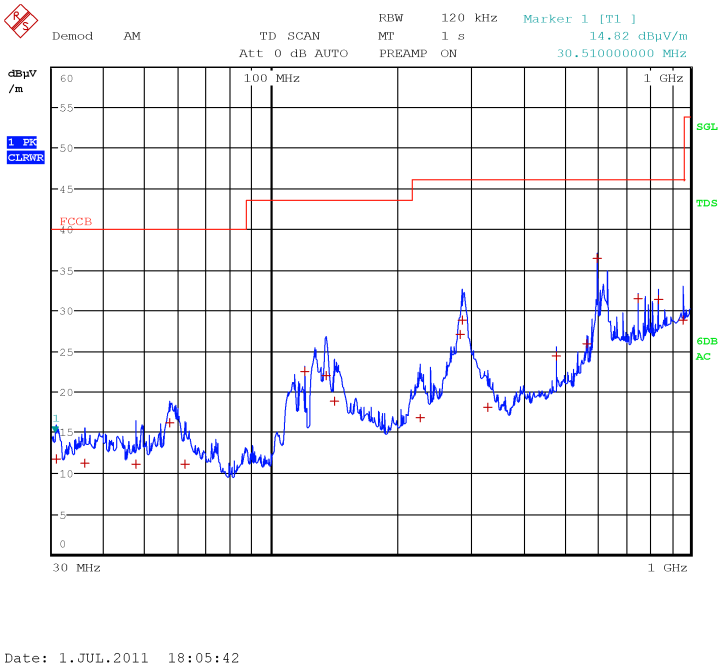


Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.39000	v	19.3	13.2	40.0	-20.7	--	--	--	--
34.80000	v	15.9	13.2	40.0	-24.1	--	--	--	--
40.35000	v	14.2	14.2	40.0	-25.8	--	--	--	--
47.40000	v	16.6	13.8	40.0	-23.4	--	--	--	--
57.45000	v	16.6	13.4	40.0	-23.4	--	--	--	--
60.63000	v	14.4	13.1	40.0	-25.6	--	--	--	--
69.63000	v	10.1	12.3	40.0	-29.9	--	--	--	--
120.57000	v	17.0	12.8	43.5	-26.5	--	--	--	--
134.25000	v	17.6	13.3	43.5	-25.9	--	--	--	--
151.14000	v	16.7	14.7	43.5	-26.9	--	--	--	--
161.58000	v	14.0	14.7	43.5	-29.5	--	--	--	--
201.18000	v	14.1	10.6	43.5	-29.4	--	--	--	--
282.54000	v	26.1	13.5	46.0	-19.9	--	--	--	--
290.37000	v	28.9	13.7	46.0	-17.1	--	--	--	--
335.61000	v	18.8	14.7	46.0	-27.2	--	--	--	--
480.03000	v	19.9	17.8	46.0	-26.1	--	--	--	--
568.98000	v	19.0	19.0	46.0	-27.1	--	--	--	--
600.00000	v	24.4	20.0	46.0	-21.7	--	--	--	--
732.42000	v	22.3	21.4	46.0	-23.7	--	--	--	--
840.03000	v	32.3	22.5	46.0	-13.7	--	--	--	--
900.00000	v	29.9	23.5	46.0	-16.1	--	--	--	--
30.39000	v	19.3	13.2	40.0	-20.7	--	--	--	--
34.80000	v	15.9	13.2	40.0	-24.1	--	--	--	--
40.35000	v	14.2	14.2	40.0	-25.8	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Mid channel radiated measured in vertical and horizontal mpolarization with protocol 802.11g

Test data, continued

Radiated measurement protocol 802.11g, Horizontal polarization, mid channel

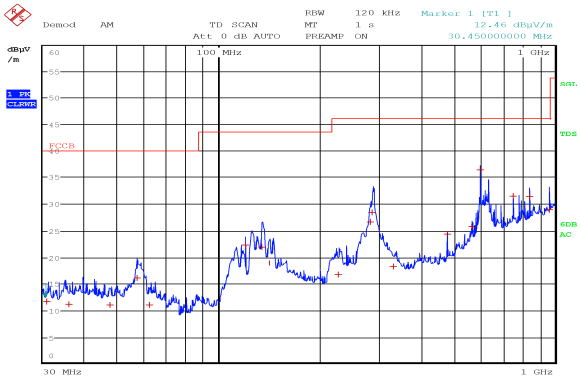


Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.72000	h	11.7	13.2	40.0	-28.3	--	--	--	--
35.94000	h	11.1	13.3	40.0	-28.9	--	--	--	--
47.58000	h	11.1	13.8	40.0	-28.9	--	--	--	--
57.36000	h	16.1	13.4	40.0	-23.9	--	--	--	--
62.40000	h	11.1	13.1	40.0	-28.9	--	--	--	--
120.00000	h	22.5	12.8	43.5	-21.1	--	--	--	--
135.21000	h	22.0	13.3	43.5	-21.5	--	--	--	--
141.75000	h	18.8	14.1	43.5	-24.7	--	--	--	--
226.23000	h	16.7	11.5	46.0	-29.3	--	--	--	--
282.39000	h	27.0	13.5	46.0	-19.0	--	--	--	--
286.32000	h	28.8	13.5	46.0	-17.2	--	--	--	--
329.13000	h	18.1	14.7	46.0	-27.9	--	--	--	--
480.00000	h	24.4	17.8	46.0	-21.6	--	--	--	--
566.67000	h	25.9	19.0	46.0	-20.2	--	--	--	--
600.00000	h	36.5	20.0	46.0	-9.6	--	--	--	--
750.00000	h	31.4	22.1	46.0	-14.6	--	--	--	--
840.03000	h	31.4	22.5	46.0	-14.6	--	--	--	--
959.97000	h	28.9	24.0	46.0	-17.2	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
Mid channel radiated measured in vertical and horizontal polarization with protocol 802.11g

Test data, continued

Radiated measurement protocol 802.11n, Horizontal polarization, high channel



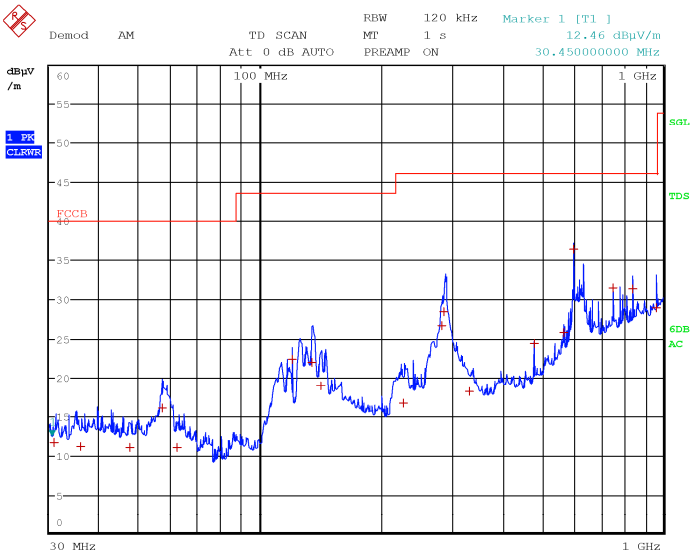
Date: 1.JUL.2011 18:12:28

Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.72000	h	11.7	13.2	40.0	-28.3	--	--	--	--
35.94000	h	11.1	13.3	40.0	-28.9	--	--	--	--
47.58000	h	11.0	13.8	40.0	-29.0	--	--	--	--
57.36000	h	16.0	13.4	40.0	-24.0	--	--	--	--
62.40000	h	11.1	13.1	40.0	-28.9	--	--	--	--
120.00000	h	22.4	12.8	43.5	-21.1	--	--	--	--
135.21000	h	22.1	13.3	43.5	-21.5	--	--	--	--
141.75000	h	19.0	14.1	43.5	-24.6	--	--	--	--
226.23000	h	16.7	11.5	46.0	-29.3	--	--	--	--
282.39000	h	26.7	13.5	46.0	-19.3	--	--	--	--
286.32000	h	28.4	13.5	46.0	-17.6	--	--	--	--
329.13000	h	18.2	14.7	46.0	-27.8	--	--	--	--
480.00000	h	24.4	17.8	46.0	-21.6	--	--	--	--
566.67000	h	25.8	19.0	46.0	-20.2	--	--	--	--
600.00000	h	36.4	20.0	46.0	-9.6	--	--	--	--
750.00000	h	31.4	22.1	46.0	-14.6	--	--	--	--
840.03000	h	31.4	22.5	46.0	-14.6	--	--	--	--
959.97000	h	28.9	24.0	46.0	-17.1	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
High channel radiated measured in vertical and horizontal mpolarization with protocol 802.11n

Test data, continued

Radiated measurement protocol 802.11n, vertical polarization, high channel

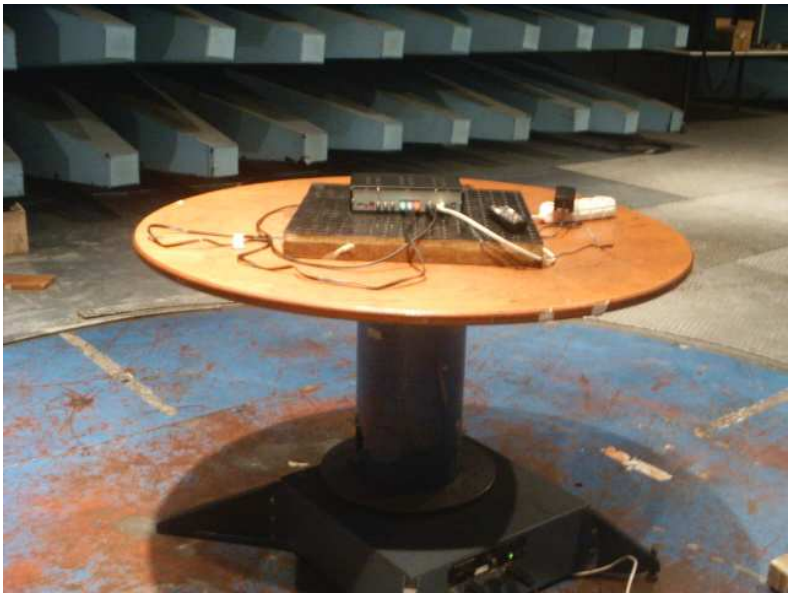


Date: 1.JUL.2011 18:20:17

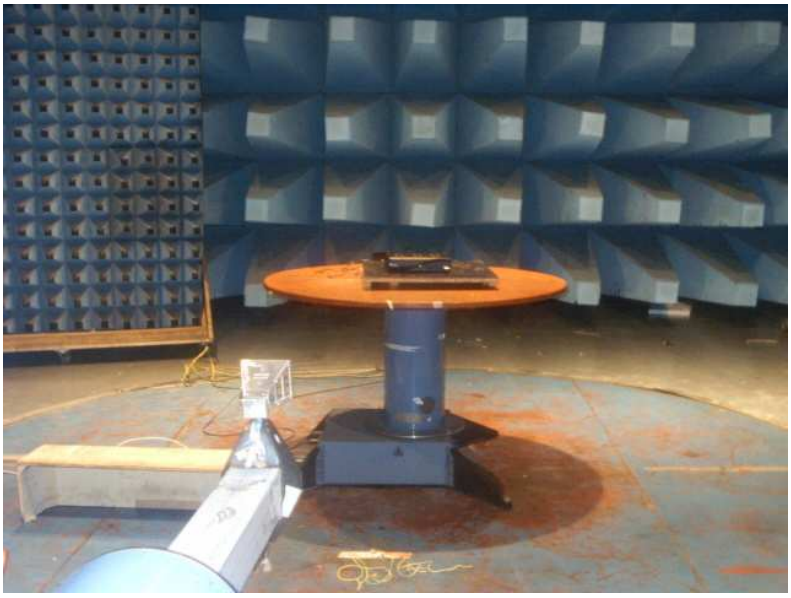
Freq. (MHz)	Pol. V/H	Quasi Peak field strength (dBµV/m)	Correction (dB)	Quasi Peak limit (dBµV/m)	Quasi Peak margin (dB)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
30.72000	v	11.7	13.2	40.0	-28.3	--	--	--	--
35.94000	v	11.1	13.3	40.0	-28.9	--	--	--	--
47.58000	v	11.0	13.8	40.0	-29.0	--	--	--	--
57.36000	v	16.0	13.4	40.0	-24.0	--	--	--	--
62.40000	v	11.1	13.1	40.0	-28.9	--	--	--	--
120.00000	v	22.4	12.8	43.5	-21.1	--	--	--	--
135.21000	v	22.1	13.3	43.5	-21.5	--	--	--	--
141.75000	v	19.0	14.1	43.5	-24.6	--	--	--	--
226.23000	v	16.7	11.5	46.0	-29.3	--	--	--	--
282.39000	v	26.7	13.5	46.0	-19.3	--	--	--	--
286.32000	v	28.4	13.5	46.0	-17.6	--	--	--	--
329.13000	v	18.2	14.7	46.0	-27.8	--	--	--	--
480.00000	v	24.4	17.8	46.0	-21.6	--	--	--	--
566.67000	v	25.8	19.0	46.0	-20.2	--	--	--	--
600.00000	v	36.4	20.0	46.0	-9.6	--	--	--	--
750.00000	v	31.4	22.1	46.0	-14.6	--	--	--	--
840.03000	v	31.4	22.5	46.0	-14.6	--	--	--	--
959.97000	v	28.9	24.0	46.0	-17.1	--	--	--	--

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.
High channel radiated measured in vertical and horizontal mpolarization with protocol 802.11n

Setup photos



Setup photos



8.8 Clause 15.247(e) Power spectral density for digitally modulated devices

§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.

(e) For digitally modulated systems, the 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Special notes

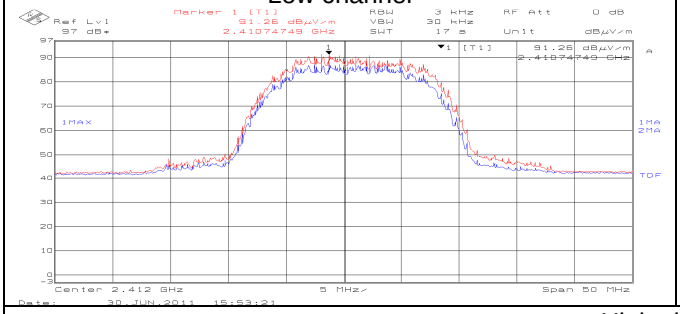
- The test was performed using guidelines of ANSI C63.10-2009, Clause 6.11.2.

- PSD option 1 was used since output power option 1 was used.
- Emission peak was located and zoomed in. RBW was set to 3 kHz, VBW was set > RBW. Sweep time was set to Span/3 kHz. Peak level was measured.

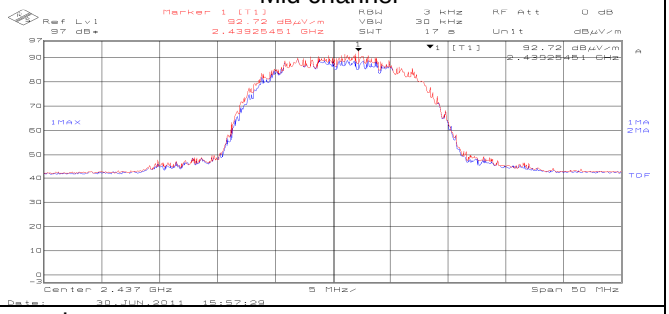
Test data

Radiated measurement protocol 802.11b

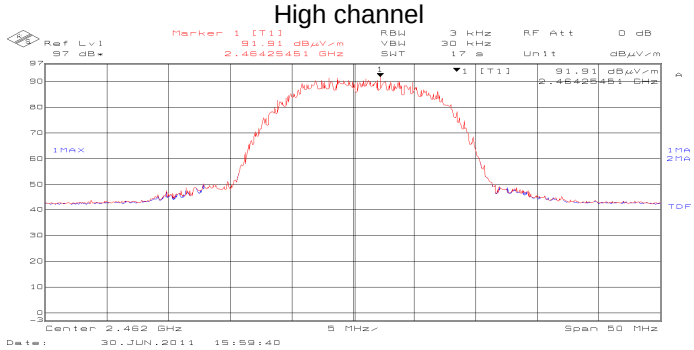
Low channel



Mid channel



High channel



Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2412	-6.47	8	-14.47
2437	-5.03	8	-13.03
2462	-6.63	8	-14.63

Sweep time = Span/RBW
Sweep time = (300 kHz/3 kHz)
Sweep time = 100 s

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m/3 kHz)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

From which we obtain

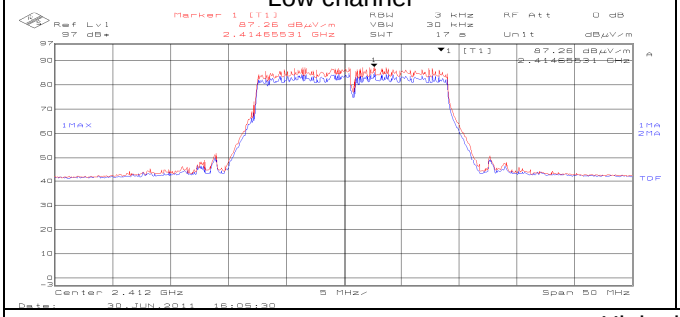
dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

PSD [dBm/3 kHz] = Field Strength [dBµV/m/3 kHz] − 95.23 [dB] − Antenna gain [dBi]

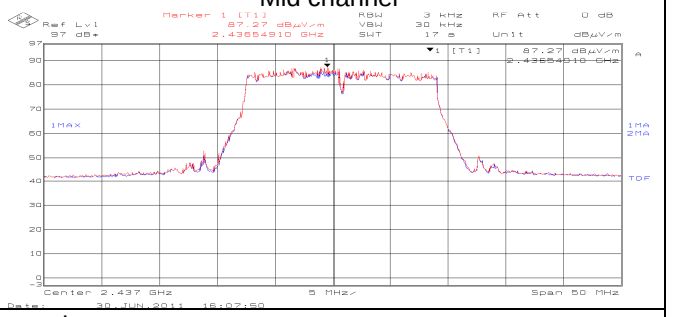
Test data

Radiated measurement protocol 802.11g

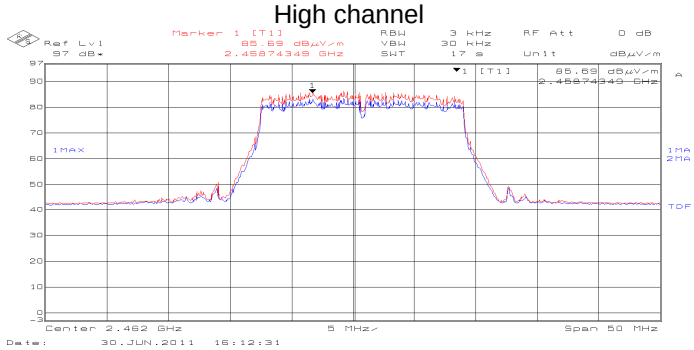
Low channel



Mid channel



High channel



Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2412	-10.47	8	-18.47
2437	-10.46	8	-18.46
2462	-12.03	8	-20.03

Sweep time = Span/RBW
Sweep time = (300 kHz/3 kHz)
Sweep time = 100 s

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m/3 kHz)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

From which we obtain

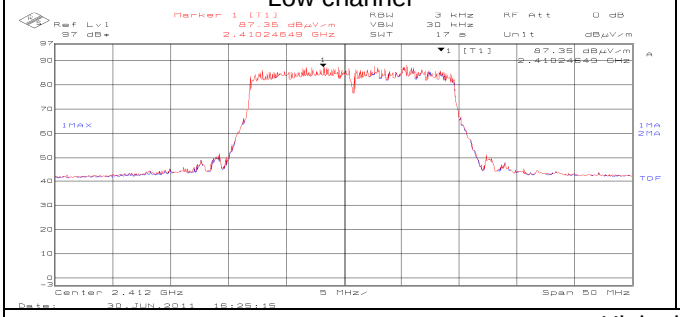
dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

PSD [dBm/3 kHz] = Field Strength [dBµV/m/3 kHz] − 95.23 [dB] − Antenna gain [dBi]

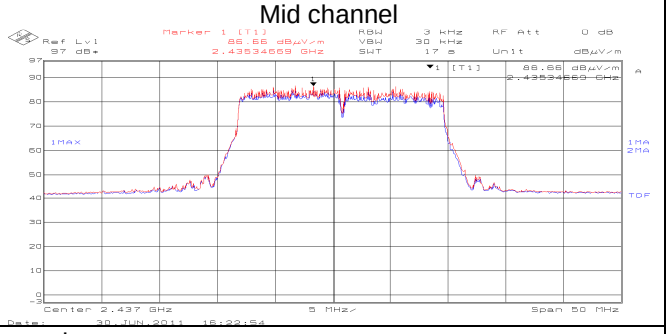
Test data

Radiated measurement protocol 802.11n

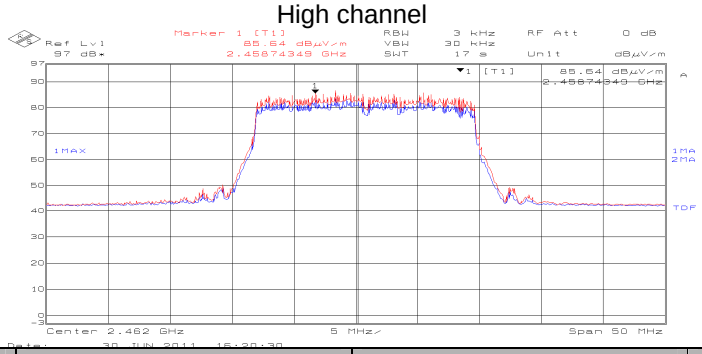
Low channel



Mid channel



High channel



Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2412	-10.53	8	-18.53
2437	-11.03	8	-19.03
2462	-12.13	8	-20.13

Sweep time = Span/RBW
Sweep time = (300 kHz/3 kHz)
Sweep time = 100 s

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P\ (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m/3 kHz)
R = Measurement distance (m)
G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) − 10Log(30) − 10Log(G)

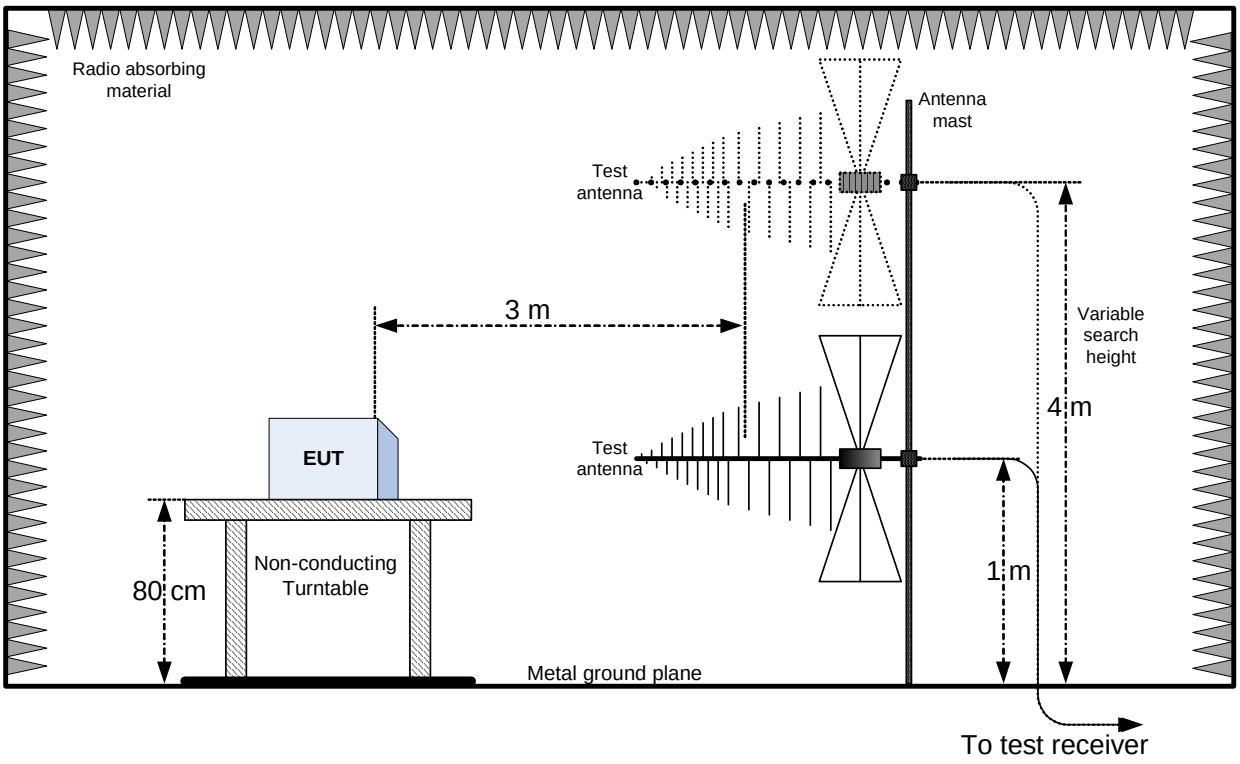
From which we obtain

dBmW = dBµV/m − 120 + 20Log(3) − 10Log(30) − 10Log(G) + 30
= dBµV/m − 95.23 − 10Log(G)

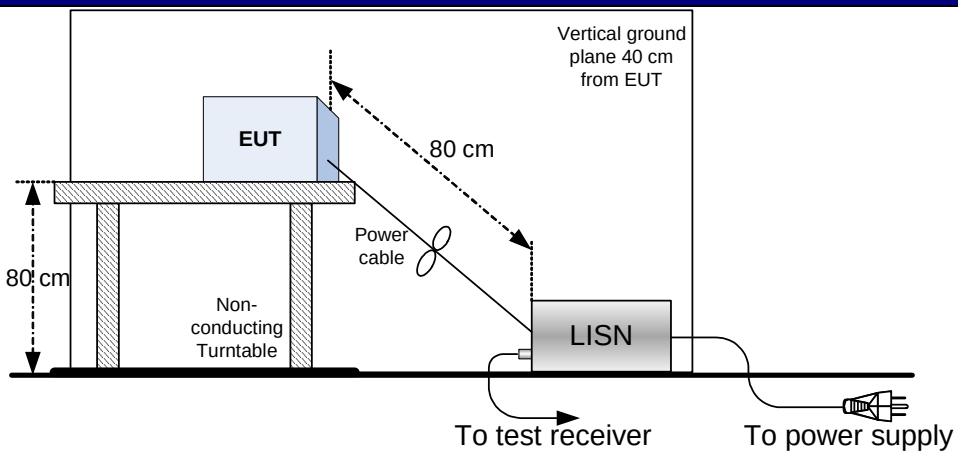
PSD [dBm/3 kHz] = Field Strength [dBµV/m/3 kHz] − 95.23 [dB] − Antenna gain [dBi]

Section 8: Block diagrams of test set-ups

Radiated emissions set-up



Conducted emissions set-up



Section 9: EUT photos

EUT

EUT

powerbox.
AC/DC POWER SUPPLY
Part number: PBSE1148
AC IN 100-240V 50/60Hz 25 Watts
DC OUT 12,0 VDC, 1,67 A max.
Serial number: 064810966
FC:11
www.powerbox.info
Made in China