

TEST REPORT

Part 15 Subpart B&C 15.247

Equipment under test Wireless Network Device

Model name SP520N

FCC ID Q5FSP520N

Applicant Baekchun I&C Co., Ltd.

Manufacturer Datamax Electronics Co., Ltd.

Date of test(s) 2012.09.24 ~ 2012.10.10

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Revision history

Revision	Date of issue	Test report No.	Description
-	2012.10.15	KES-RF-120071	Initial

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1.0 General product description

Equipment under test	Wireless Network Device
Model name	SP520N
Serial number	N/A
Frequency Range	2 412 MHz ~ 2 462 MHz(802.11 b/g/n_HT20) // 2 422 MHz ~ 2 452 MHz(802.11 n_HT40)
Modulation technique	DSSS, OFDM
Number of channels	11(802.11 b/g/n_HT20) // 7(802.11 n_HT40)
Antenna type & gain	Fixed type(Dipole antenna) // 7.01 dBi ^{note1}
Power source	AC 120 V

Note 1. Any transmit signals are correlated, directional gain = $G_{ANT} + 10\log(N)$ dBi.

1.1 Test frequency

- 802.11 b/g/n_HT20

	Low channel	Middle channel	High channel
Frequency (MHz)	2 412	2 442	2 462

- 802.11 n_HT40

	Low channel	Middle channel	High channel
Frequency (MHz)	2 422	2 442	2 452

1.2 Information about variant model

N/A

1.3 Device modifications

N/A



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1.4 Test facility

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477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003.

1.5 Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1



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2.0 Summary of tests

Section in FCC Part 15	Parameter	Status
15.247(a)(2)	6 dB bandwidth and 99 % occupied bandwidth	C
15.247(b)(3)	Output power	C
15.247(e)	Power spectral density	C
15.205, 15.209	Radiated spurious emission and conducted spurious emission	C
15.207	AC conducted emissions	C

Note: C=Complies NC=Not complies NT=Not tested NA=Not applicable

Statement;

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in KDB 558074 were used in the measurement of the DUT.

2.1 Test data

2.1.1 Pre-scanned output power

Preliminary tests were performed in different data rate as below table and the highest power data rates(802.11b, 802.11g, 802.11n(HT20 // HT40)) were chosen for full test in the following section to demonstrate compliance to the FCC limit line.

Test mode	Detector mode	Conducted power(dB m)			
		Data rate(Mbps)			
		1	2	5.5	11
802.11b	Peak	13.22	13.76	13.17	13.14
	Average	10.57	11.14	10.67	10.47

Test mode	Detector mode	Conducted power(dB m)							
		Data rate(Mbps)							
		6	9	12	18	24	36	48	54
802.11g	Peak	15.60	15.07	15.78	14.51	15.87	15.02	14.75	16.44
	Average	5.59	5.52	5.50	5.43	5.52	5.47	5.52	5.67

Test mode	Detector mode	Conducted power(dB m)								
		Data rate(Mbps)								
		MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	
802.11n_HT20 (Ant. Port 1)	Peak	14.18	13.81	13.61	13.98	13.78	13.44	14.60	14.32	
	Average	4.29	4.40	4.05	4.24	3.97	4.27	4.17	3.97	
		MCS 8	MCS 9	MCS 10	MCS 11	MCS 12	MCS 13	MCS 14	MCS 15	
	Peak	12.79	13.71	13.69	13.34	15.52	13.13	13.50	15.27	
	Average	3.93	4.03	3.87	4.19	4.63	4.06	4.04	4.17	

Test mode	Detector mode	Conducted power(dB m)								
		Data rate(Mbps)								
		MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	
802.11n_HT20 (Ant. Port 2)	Peak	0.23	0.06	0.04	-0.07	0.36	0.05	-0.26	0.07	
	Average	-12.42	-12.39	-12.40	-12.50	-11.97	-12.33	-14.44	-12.40	
		MCS 8	MCS 9	MCS 10	MCS 11	MCS 12	MCS 13	MCS 14	MCS 15	
	Peak	-0.27	-0.32	-0.70	-0.15	-0.33	-0.11	0.00	-0.33	
	Average	-12.35	-12.69	-12.20	-12.00	-12.51	-12.56	-12.20	-12.50	



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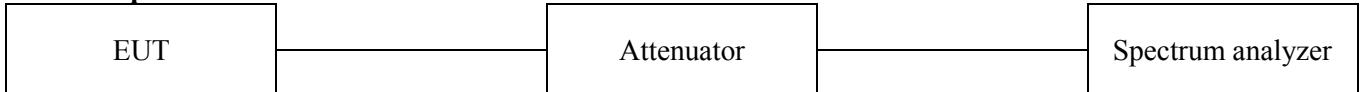
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Test mode	Detector mode	Conducted power(dB m)							
		Data rate(Mbps)							
		MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
802.11n_HT40 (Ant. Port 1)	Peak	14.16	13.97	13.28	13.64	13.21	14.12	14.47	13.92
	Average	3.75	3.61	3.73	3.59	3.55	3.63	3.81	3.72
		MCS 8	MCS 9	MCS 10	MCS 11	MCS 12	MCS 13	MCS 14	MCS 15
	Peak	13.17	13.84	13.57	13.85	14.09	13.40	13.45	14.19
	Average	3.64	3.53	3.70	3.64	3.73	3.78	3.66	3.74

Test mode	Detector mode	Conducted power(dB m)							
		Data rate(Mbps)							
		MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
802.11n_HT40 (Ant. Port 2)	Peak	0.30	-0.30	0.10	0.25	0.70	-0.02	0.93	-0.23
	Average	-11.96	-12.12	-12.57	-11.97	-12.00	-12.16	-11.44	-12.49
		MCS 8	MCS 9	MCS 10	MCS 11	MCS 12	MCS 13	MCS 14	MCS 15
	Peak	0.36	-0.23	-0.81	-0.14	0.41	-0.26	-0.23	0.82
	Average	-12.08	-12.31	-12.33	-12.51	-12.18	-12.16	-12.41	-12.34

2.1.2 6 dB bandwidth & 99 % occupied bandwidth

Test setup



Test procedure

The testing follows KDB publication No. 558074 D01 DTS measurement.

1. Set resolution bandwidth (RBW) = 1~5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1~5 %.

Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.



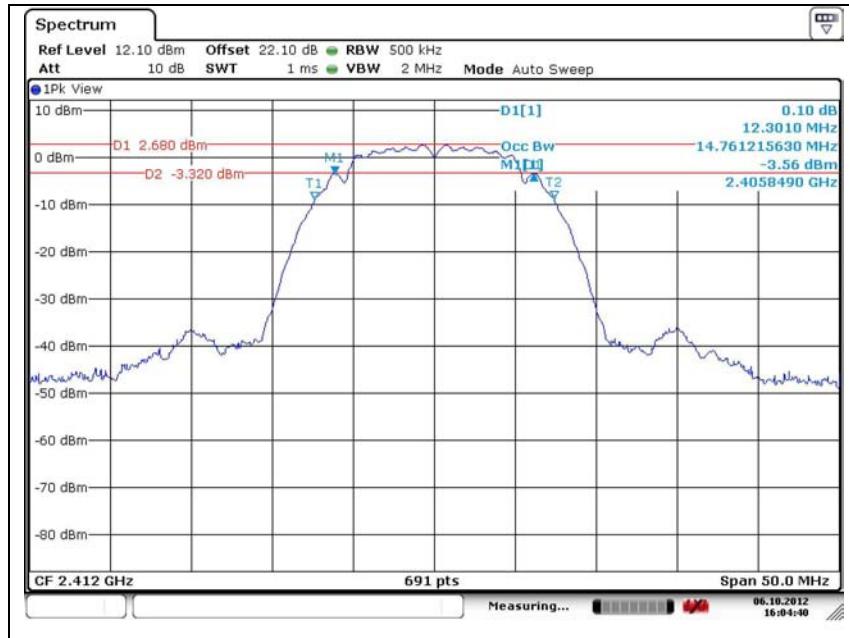
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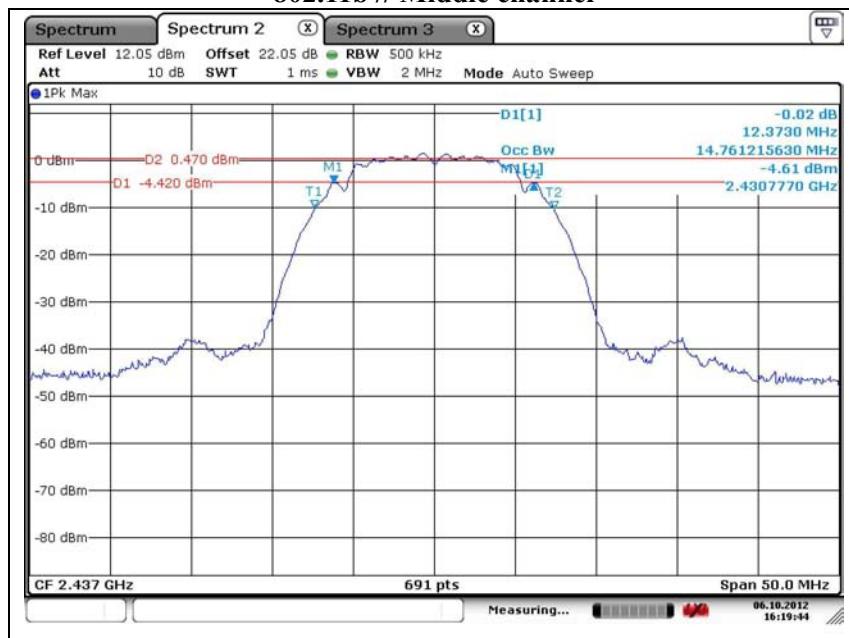
Test results

Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
802.11b	2 412	12.30	0.5
	2 442	12.37	
	2 462	12.52	
802.11g	2 412	15.12	0.5
	2 442	14.91	
	2 462	15.20	
802.11n_HT20 (Ant. Port 1)	2 412	14.98	0.5
	2 442	15.12	
	2 462	15.34	
802.11n_HT20 (Ant. Port 2)	2 412	14.83	0.5
	2 442	15.49	
	2 462	15.63	
802.11n_HT40 (Ant. Port 1)	2 422	27.50	0.5
	2 442	27.64	
	2 452	27.58	
802.11n_HT40 (Ant. Port 2)	2 422	29.88	0.5
	2 442	27.71	
	2 452	27.22	

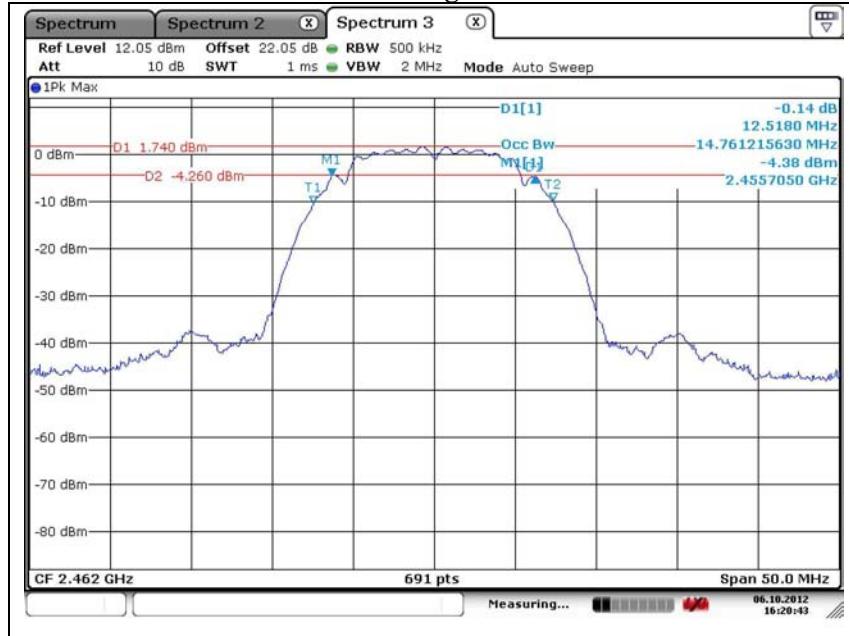
802.11b // Low channel



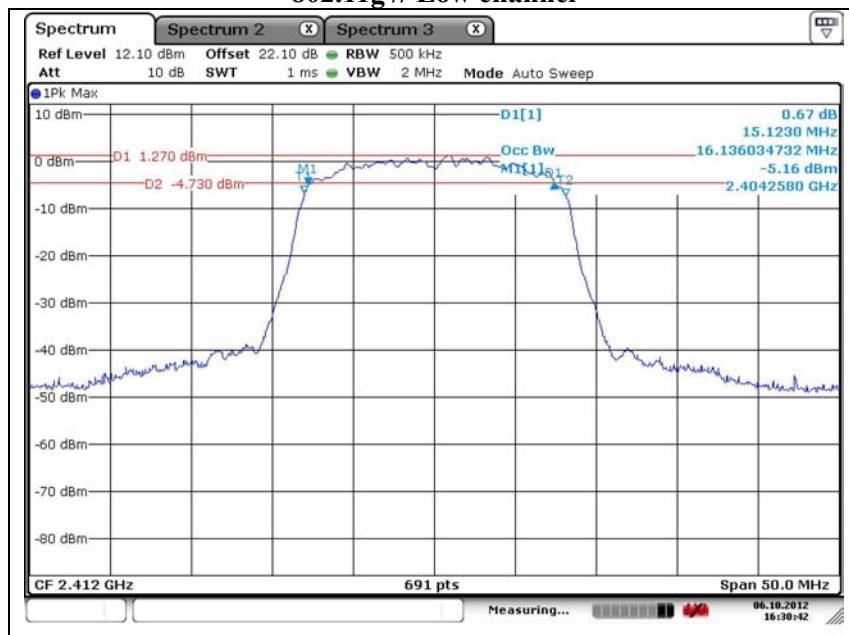
802.11b // Middle channel



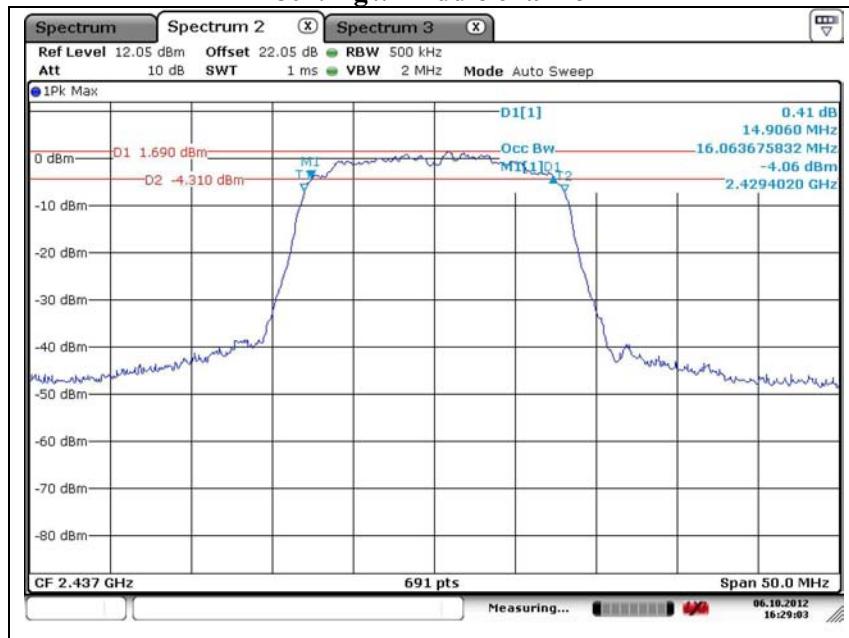
802.11b // High channel



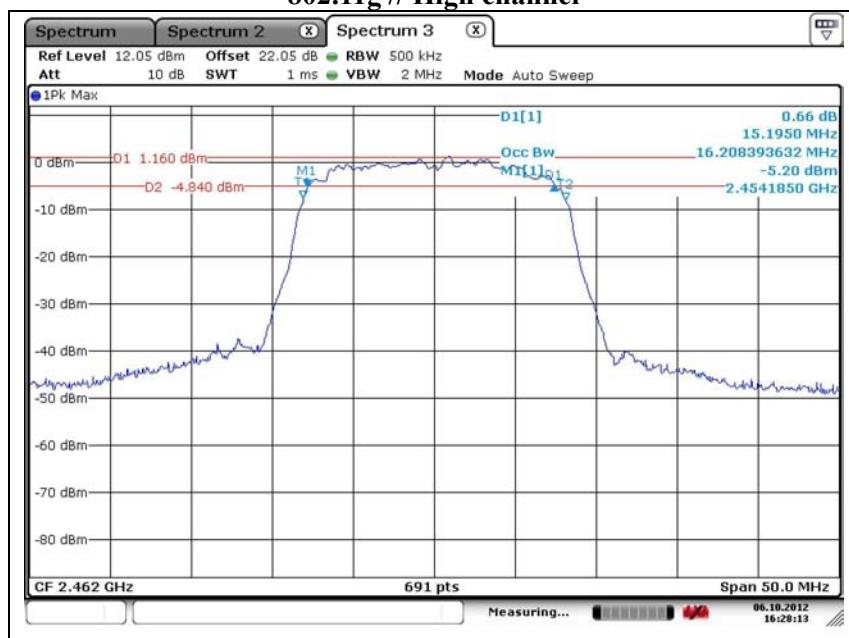
802.11g // Low channel



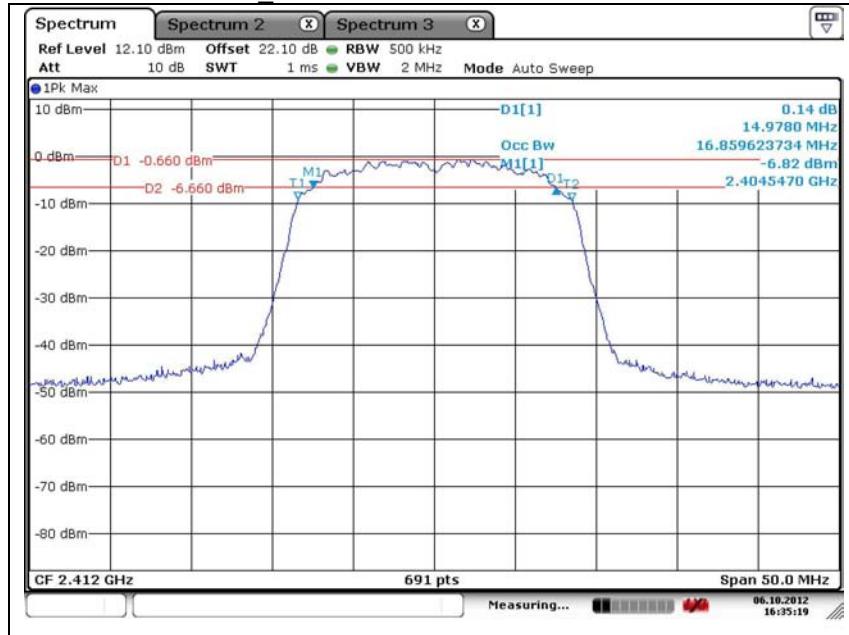
802.11g // Middle channel



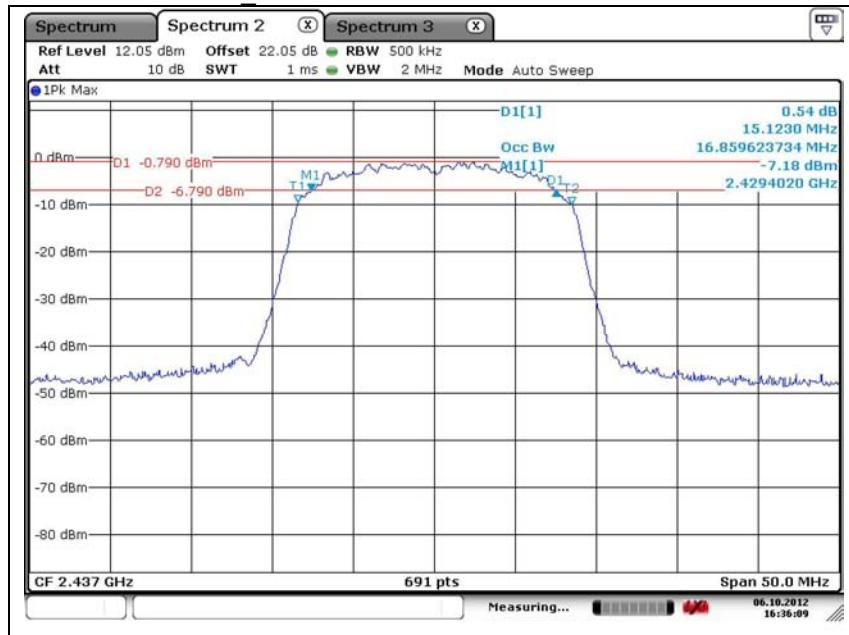
802.11g // High channel



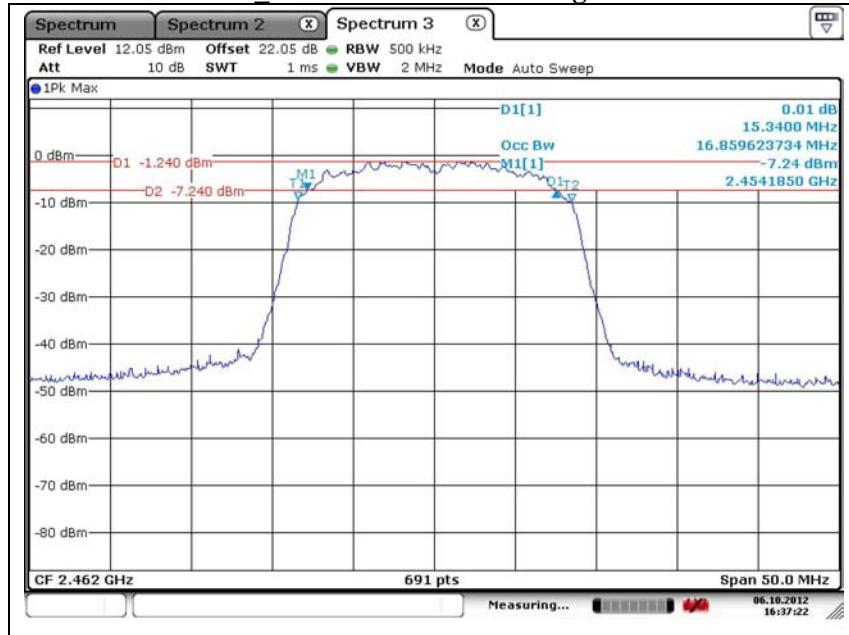
802.11n HT20 // Ant. Port 1 // Low channel



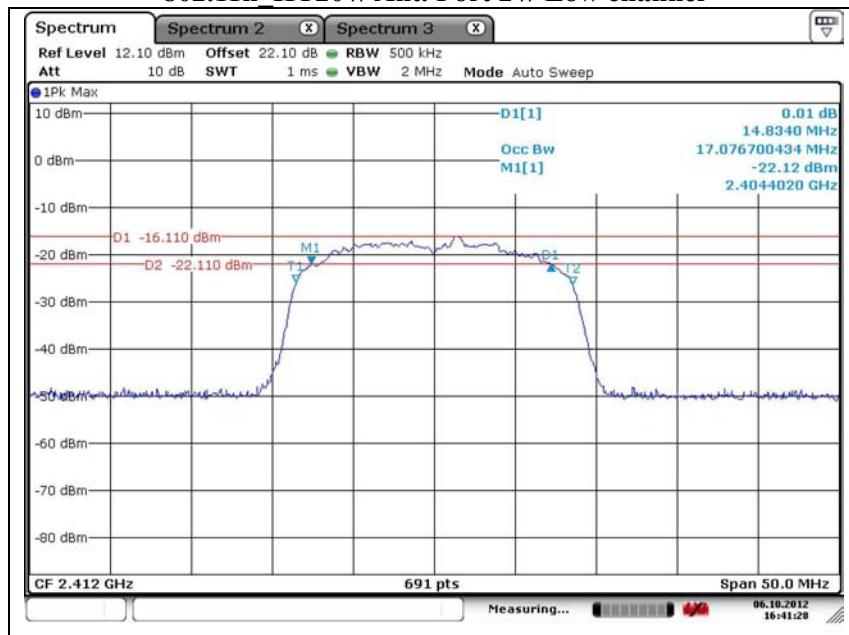
802.11n HT20 // Ant. Port 1 // Middle channel



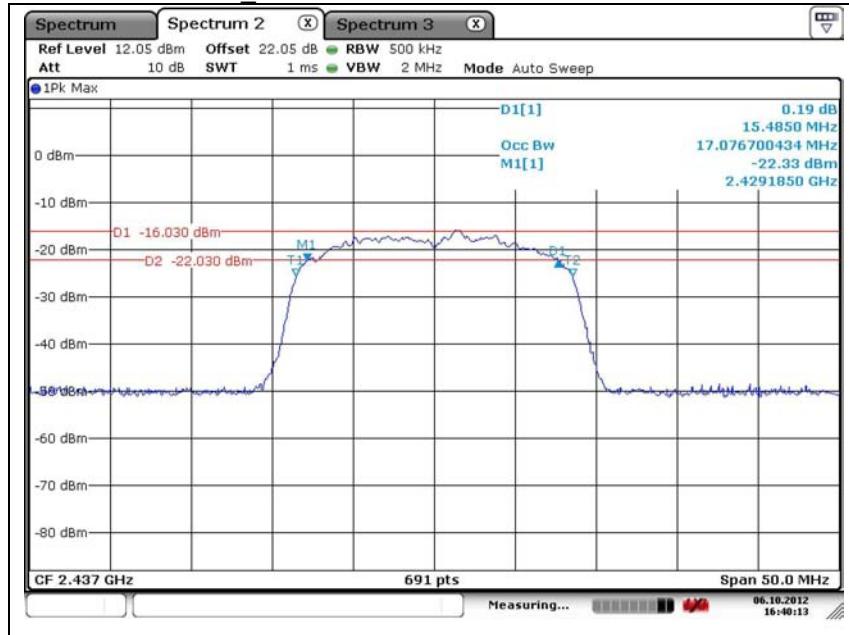
802.11n HT20 // Ant. Port 1 // High channel



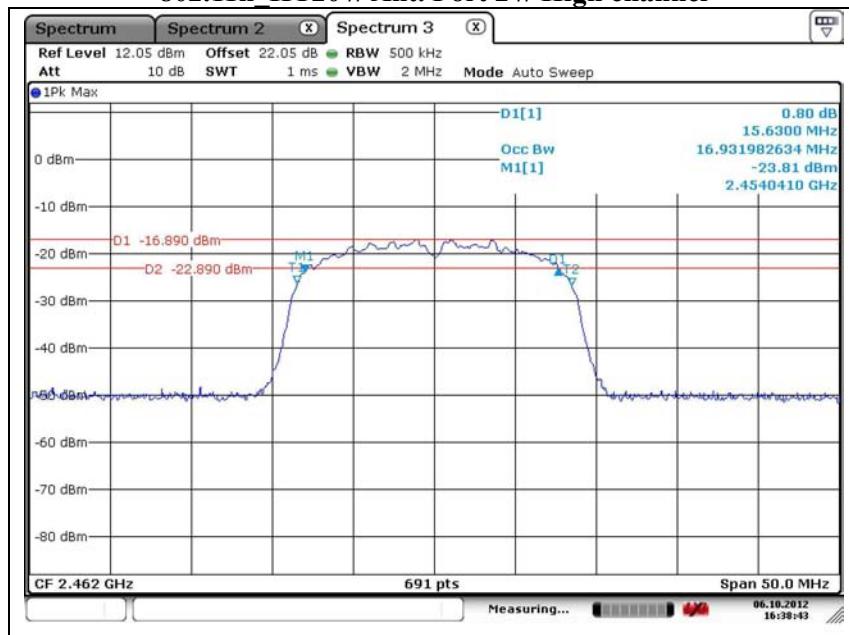
802.11n HT20 // Ant. Port 2 // Low channel



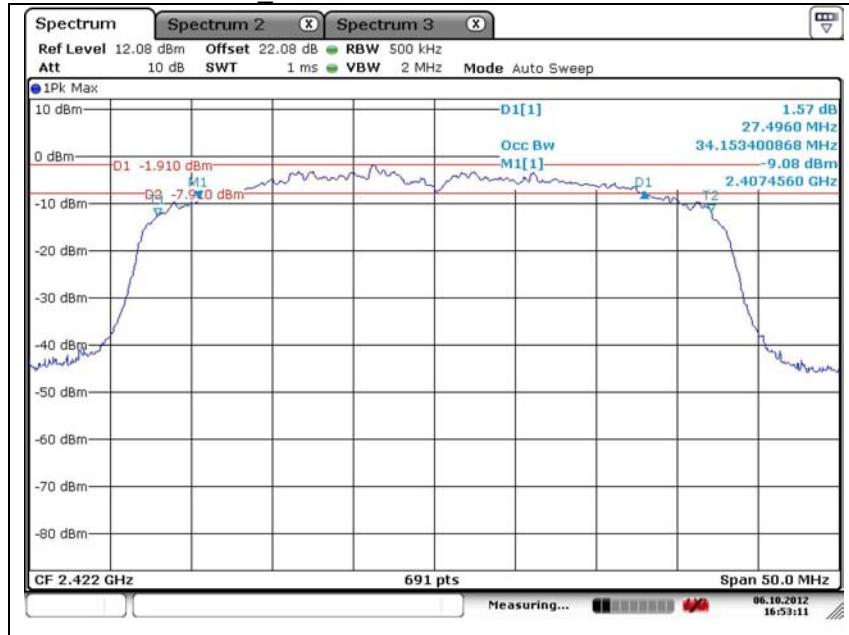
802.11n HT20 // Ant. Port 2 // Middle channel



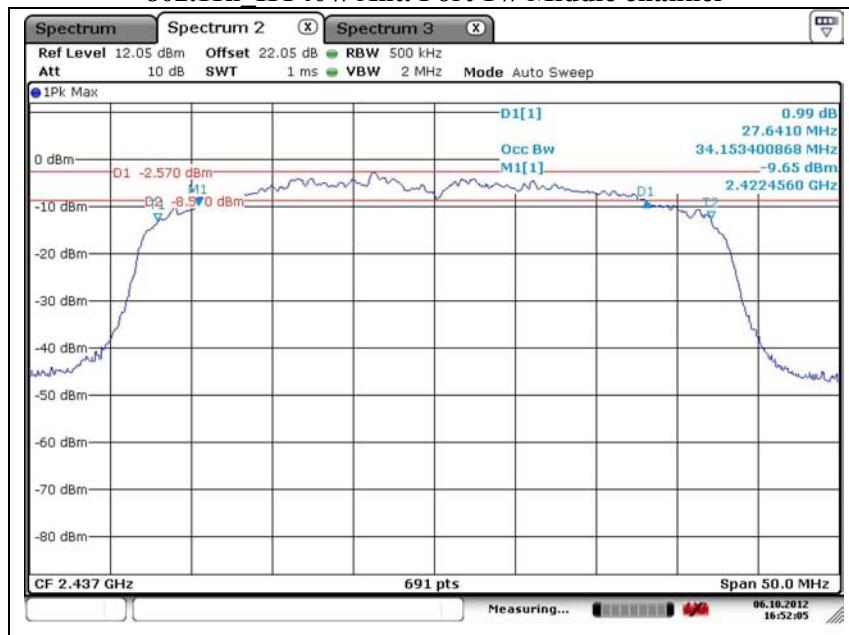
802.11n HT20 // Ant. Port 2 // High channel



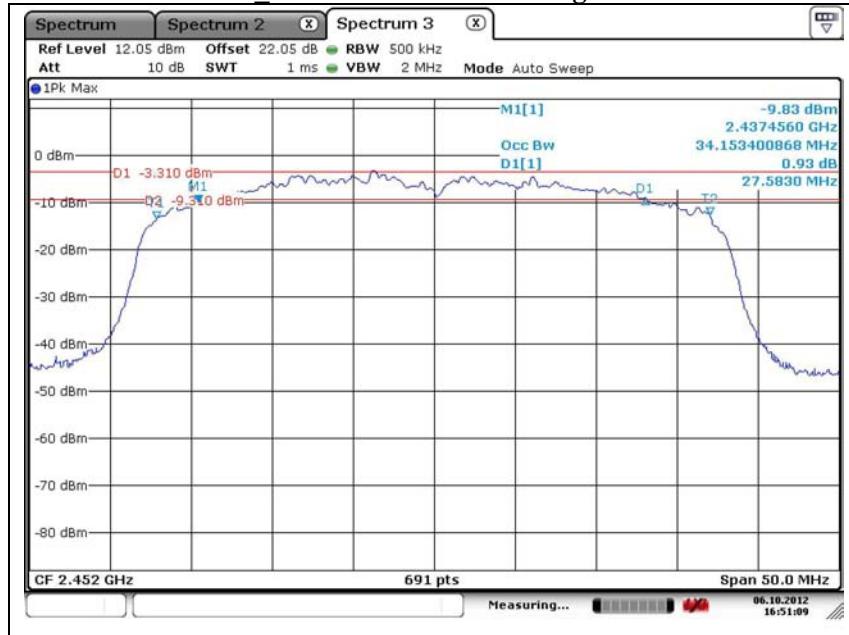
802.11n HT40 // Ant. Port 1 // Low channel



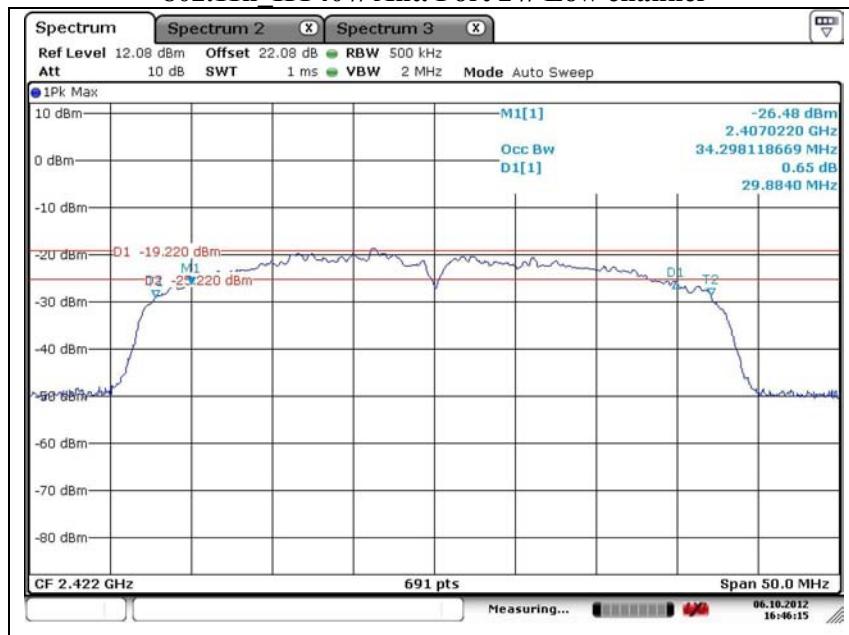
802.11n HT40 // Ant. Port 1 // Middle channel



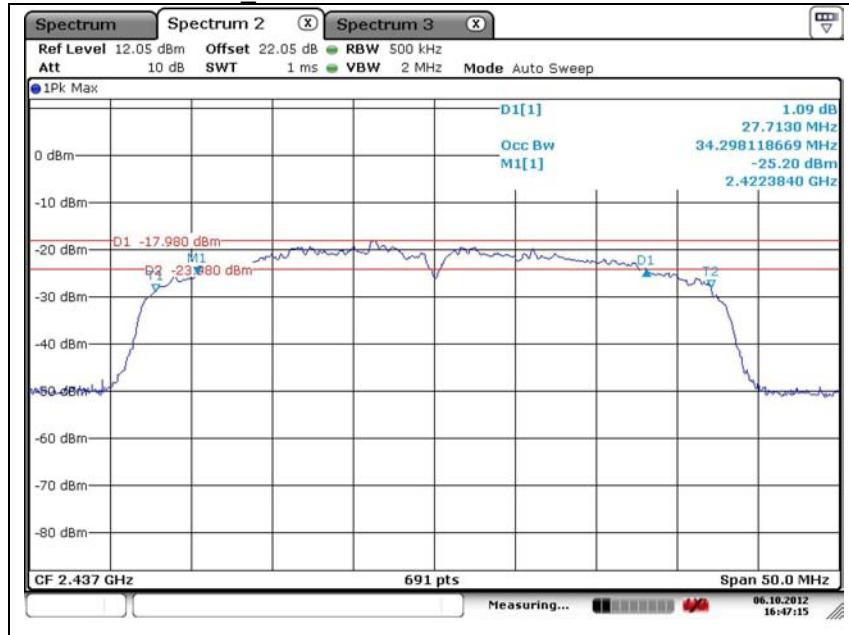
802.11n HT40 // Ant. Port 1 // High channel



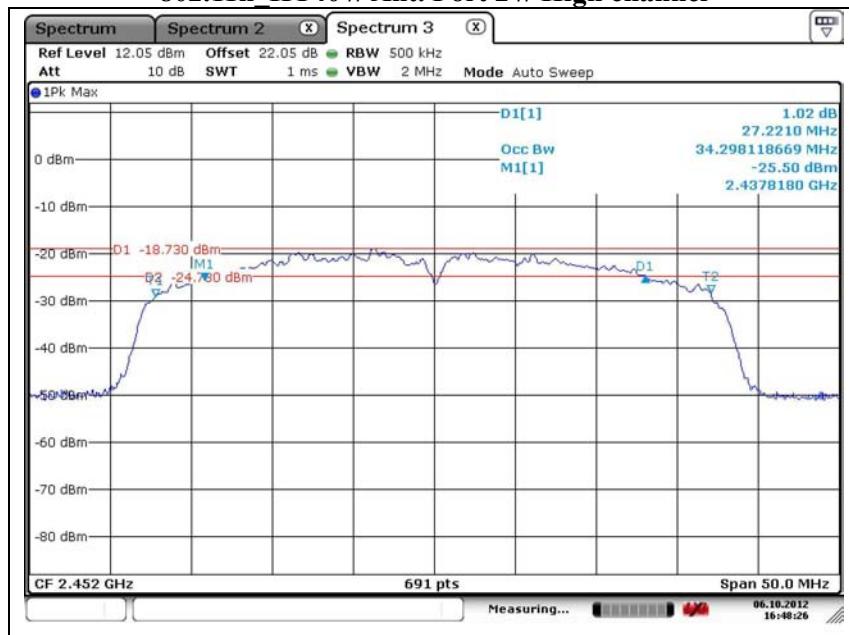
802.11n HT40 // Ant. Port 2 // Low channel



802.11n HT40 // Ant. Port 2 // Middle channel

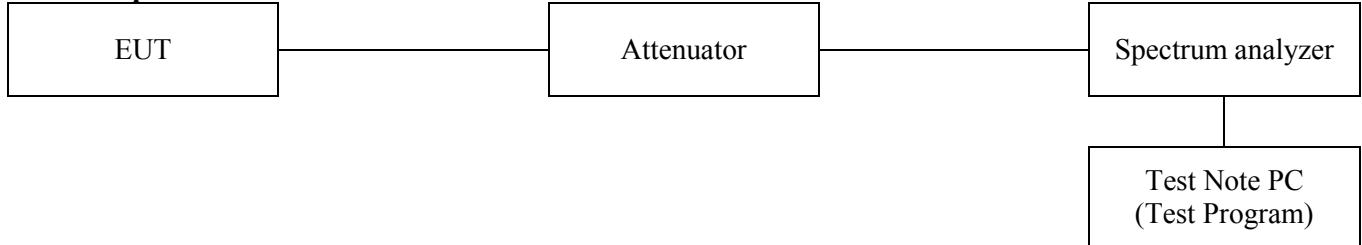


802.11n HT40 // Ant. Port 2 // High channel



2.1.3 Output power

Test setup



Limit

According to §15.247(b)(3), For systems using digital modulation in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 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 out-put power. Maximum Conducted Out-put 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.

According to §15.247(b)(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 transmit-ting 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.



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Test results

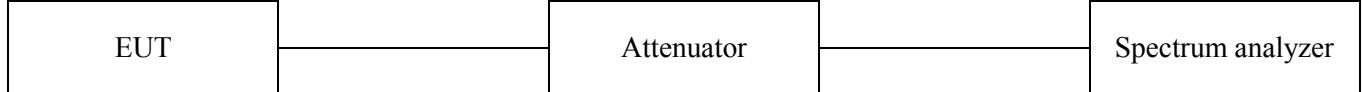
Test mode	Frequency(MHz)	Detector mode	Results (dBm)	Limit(dBm)
802.11b	2 412	Peak	13.67	28.99 ^{Note 1}
		Average	10.82	
	2 442	Peak	13.76	
		Average	11.14	
	2 462	Peak	11.84	
		Average	8.84	
802.11g	2 412	Peak	17.09	28.99 ^{Note 1}
		Average	6.18	
	2 442	Peak	16.44	
		Average	5.67	
	2 462	Peak	14.41	
		Average	3.99	
802.11n_HT20 (Ant. Port 1)	2 412	Peak	15.88	28.99 ^{Note 1}
		Average	4.66	
	2 442	Peak	15.52	
		Average	4.63	
	2 462	Peak	14.07	
		Average	3.57	
802.11n_HT20 (Ant. Port 2)	2 412	Peak	-3.40	28.99 ^{Note 1}
		Average	-9.60	
	2 442	Peak	0.36	
		Average	-11.97	
	2 462	Peak	-2.057	
		Average	-11.66	
802.11n_HT40 (Ant. Port 2)	2 422	Peak	15.10	28.99 ^{Note 1}
		Average	4.55	
	2 442	Peak	14.47	
		Average	3.81	
	2 452	Peak	14.80	
		Average	4.36	
802.11n_HT40 (Ant. Port 2)	2 422	Peak	0.58	28.99 ^{Note 1}
		Average	-11.94	
	2 442	Peak	0.93	
		Average	-11.44	
	2 452	Peak	-0.15	
		Average	-12.06	

Note 1. Any transmit signals are correlated, directional gain = $G_{ANT} + 10\log(N)$ dBi.
 $= 4 + 10\log(2) = 7.01$ dBi.

So, Output power limit = $30 - (7.01 - 6) = 28.99$ dBm

2.1.4 Power spectral density

Test setup



Test procedure

The testing follows KDB publication No. 558074 D01 DTS measurement.

Measurement procedure PKPSD

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW \geq 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where $BWCF = 10\log(3 \text{ kHz}/100 \text{ kHz}) = -15.2 \text{ dB}$.
11. The resulting peak PSD level must be $\leq 8 \text{ dBm}$.

Limit

According to §15.247(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.



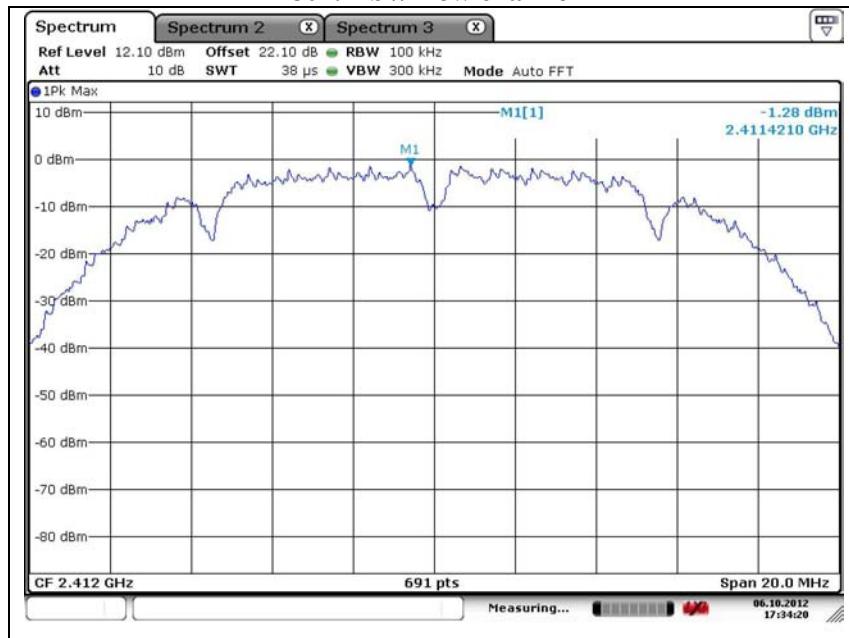
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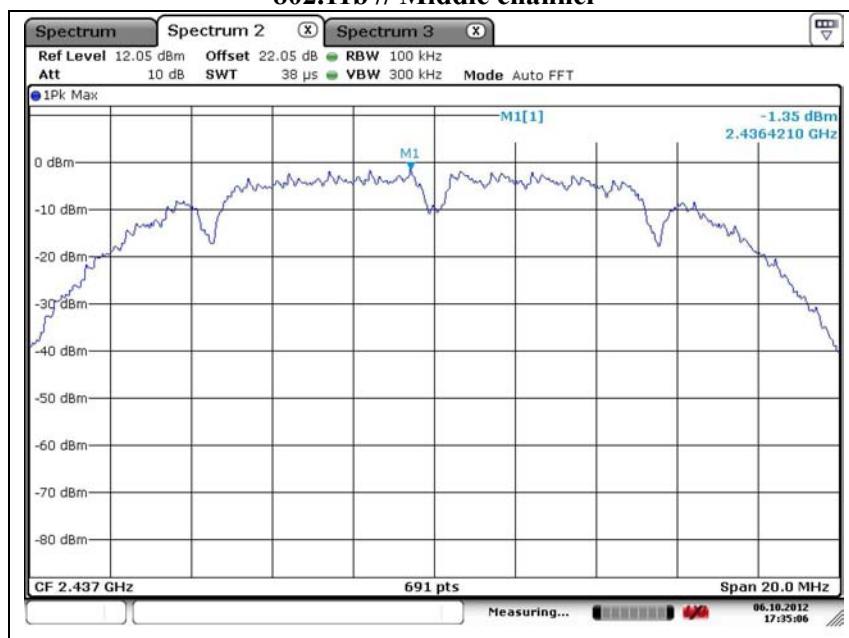
Test results

Operation mode	Frequency(MHz)	Measured PSD(dBm)	BWCF(dB)	Corrected PSD(dBm)	Limit(dBm)
802.11b	2 412	-1.28	-15.2	-16.48	8
	2 442	-1.35		-16.55	
	2 462	-1.32		-16.52	
802.11g	2 412	-6.16		-21.36	
	2 442	-6.35		-21.55	
	2 462	-6.69		-21.89	
802.11n_HT20 (Ant. Port 1)	2 412	-7.89	-15.2	-23.09	8
	2 442	-8.37		-23.57	
	2 462	-8.42		-23.62	
802.11n_HT20 (Ant. Port 2)	2 412	-24.28		-39.48	
	2 442	-23.98		-39.18	
	2 462	-24.67		-39.87	
802.11n_HT40 (Ant. Port 1)	2 422	-9.39	-15.2	-24.59	8
	2 442	-10.91		-26.11	
	2 452	-11.44		-26.64	
802.11n_HT40 (Ant. Port 2)	2 422	-27.50		-42.70	
	2 442	-26.66		-41.86	
	2 452	-26.92		-42.12	

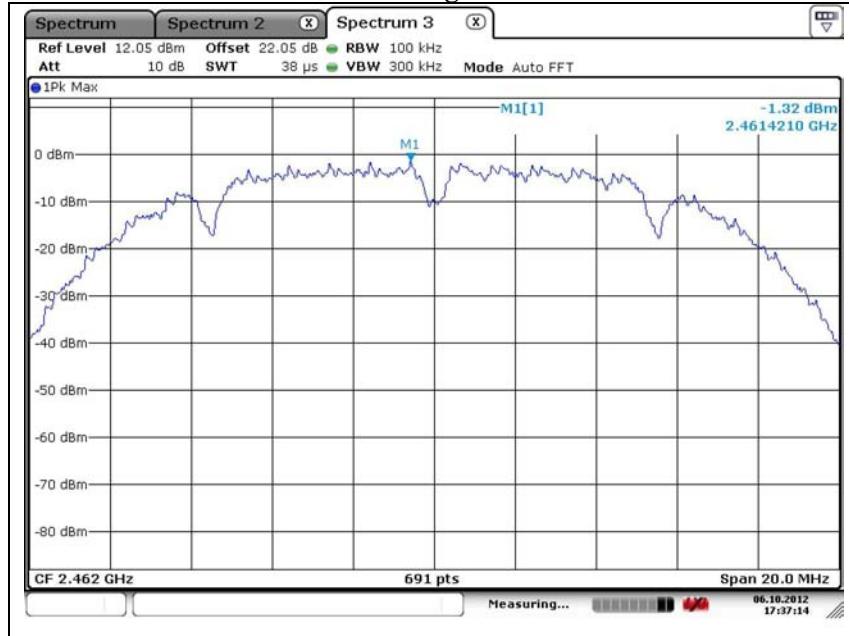
802.11b // Low channel



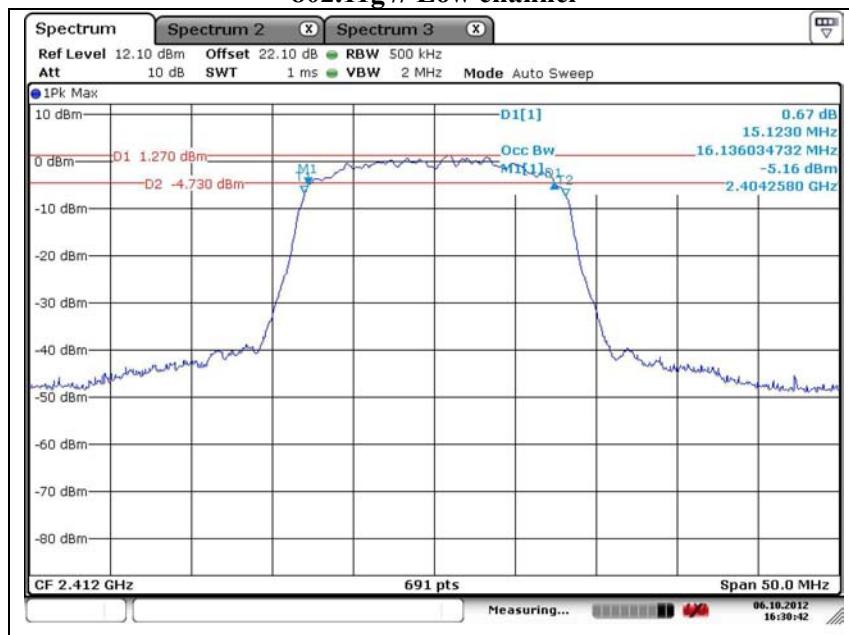
802.11b // Middle channel



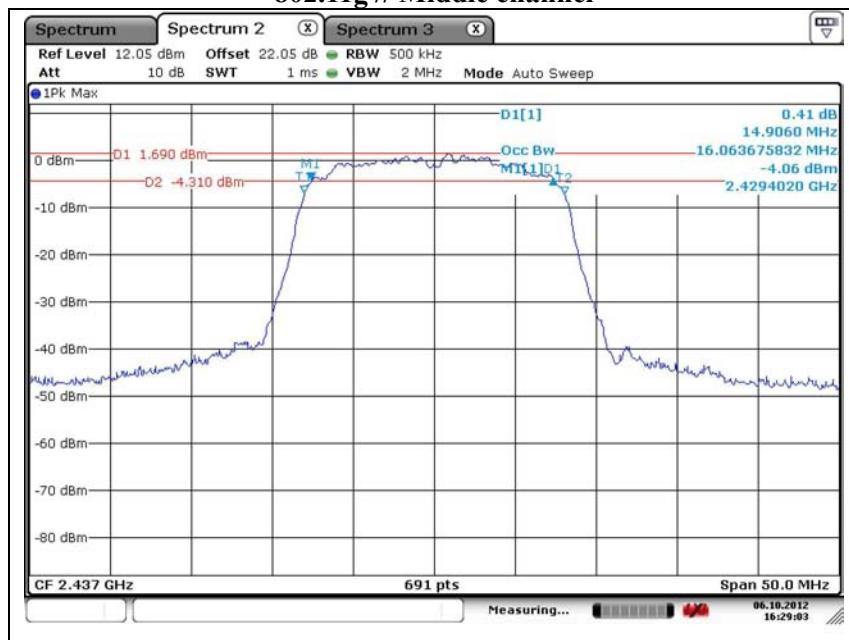
802.11b // High channel



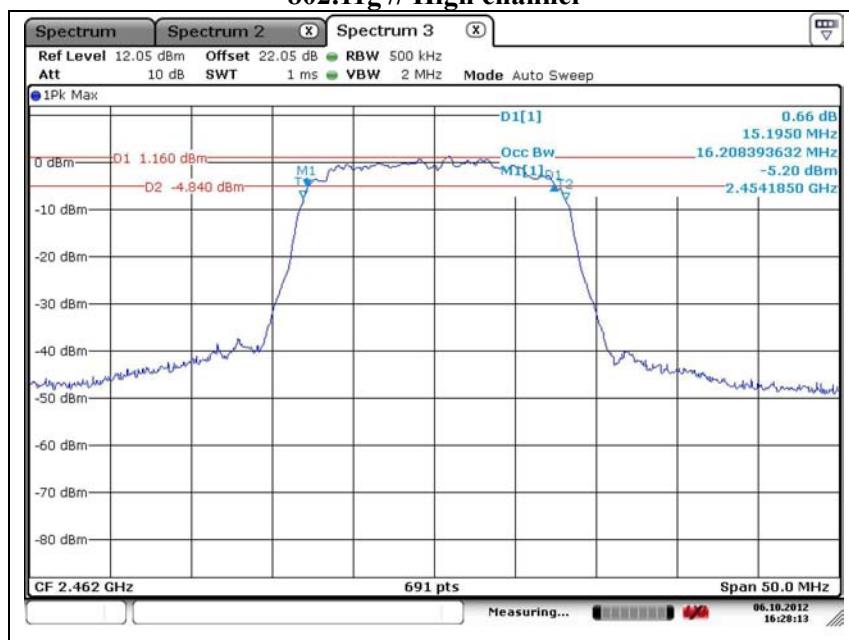
802.11g // Low channel



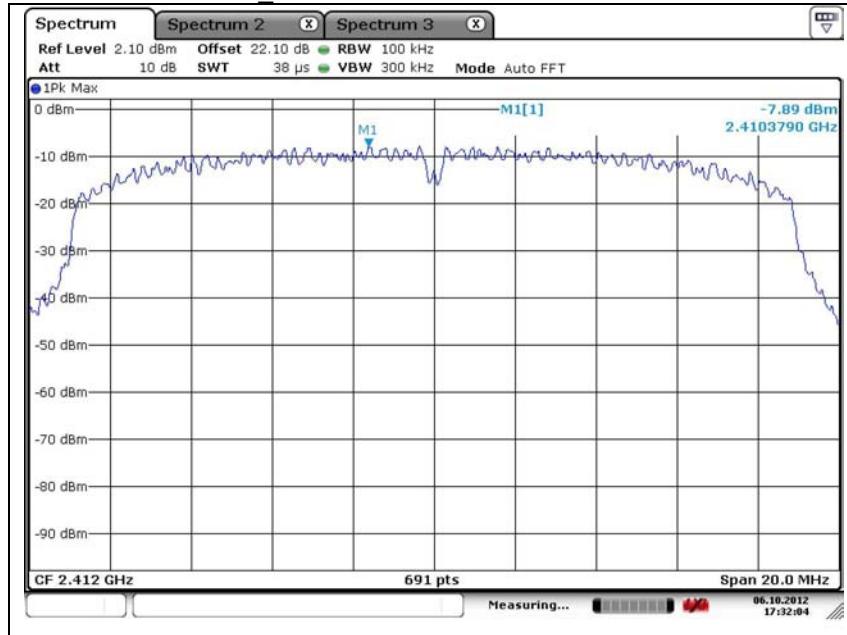
802.11g // Middle channel



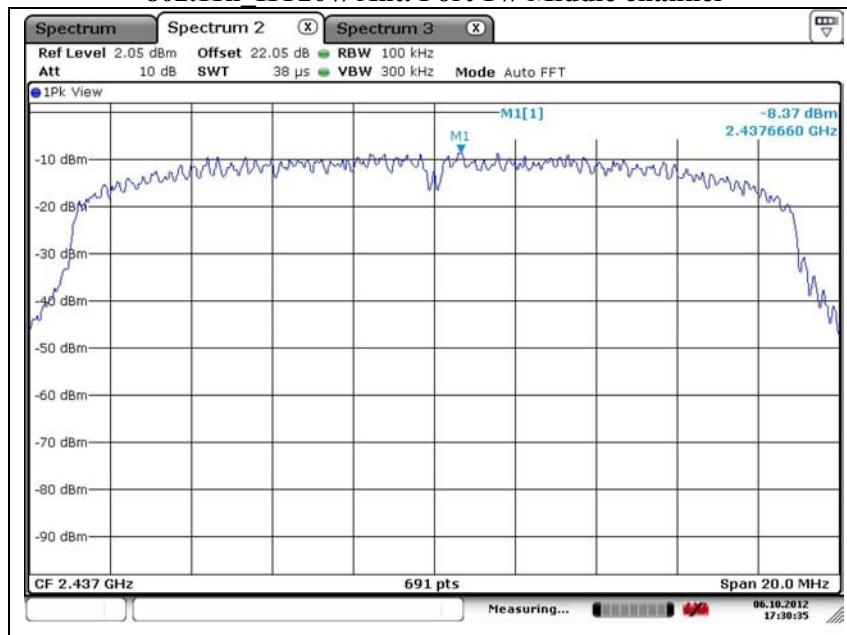
802.11g // High channel



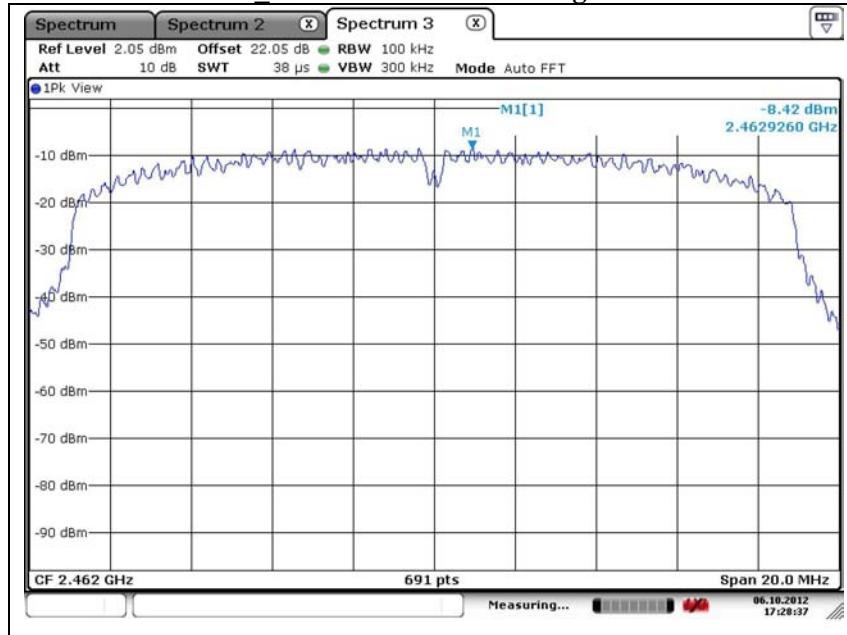
802.11n HT20 // Ant. Port 1 // Low channel



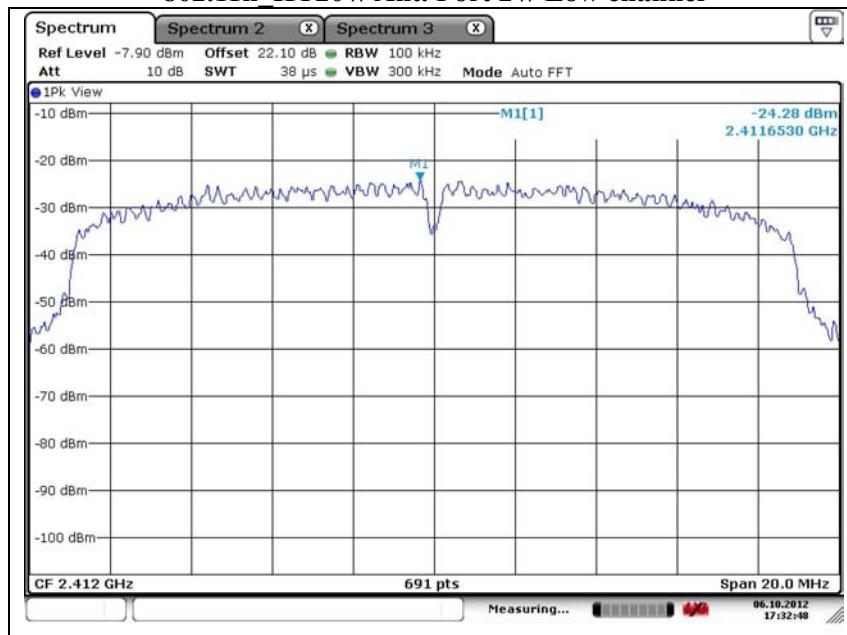
802.11n HT20 // Ant. Port 1 // Middle channel



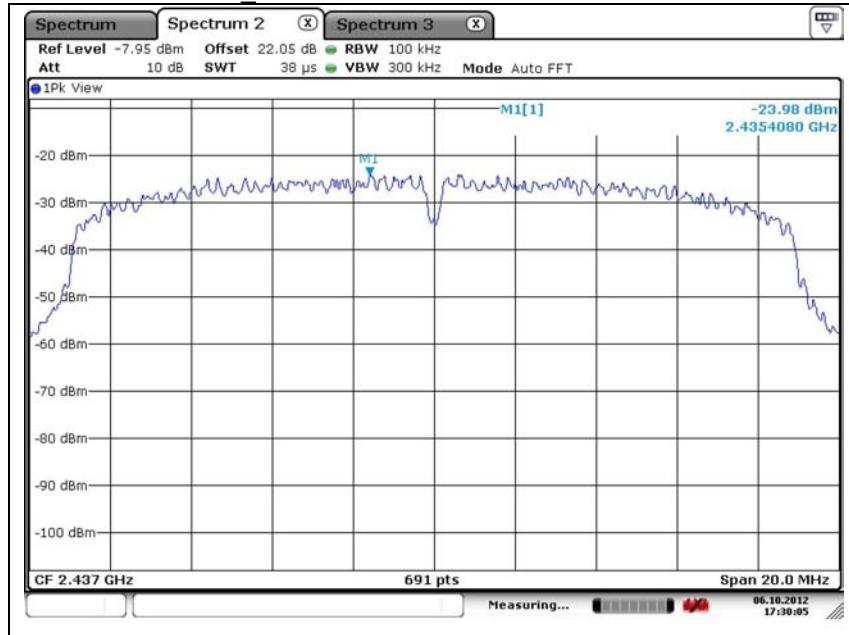
802.11n HT20 // Ant. Port 1 // High channel



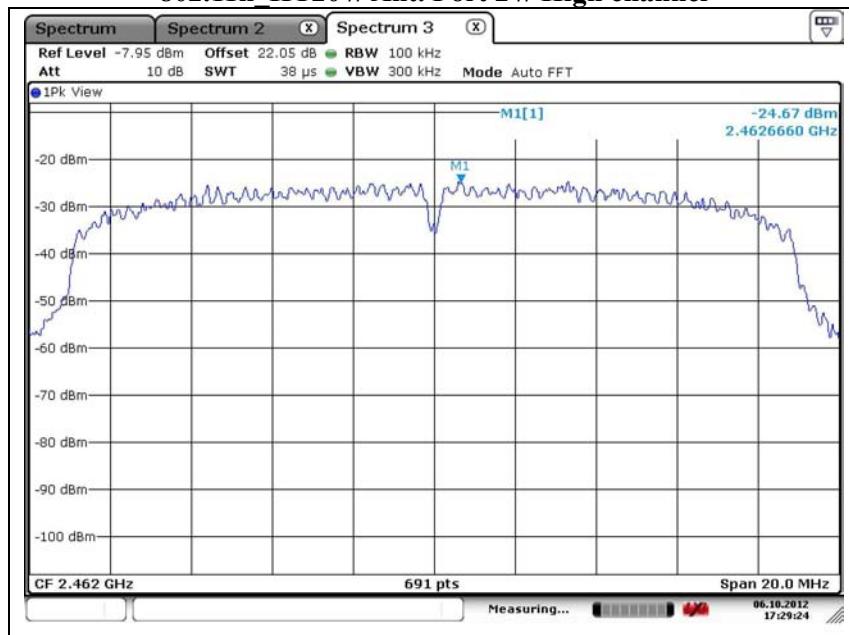
802.11n HT20 // Ant. Port 2 // Low channel



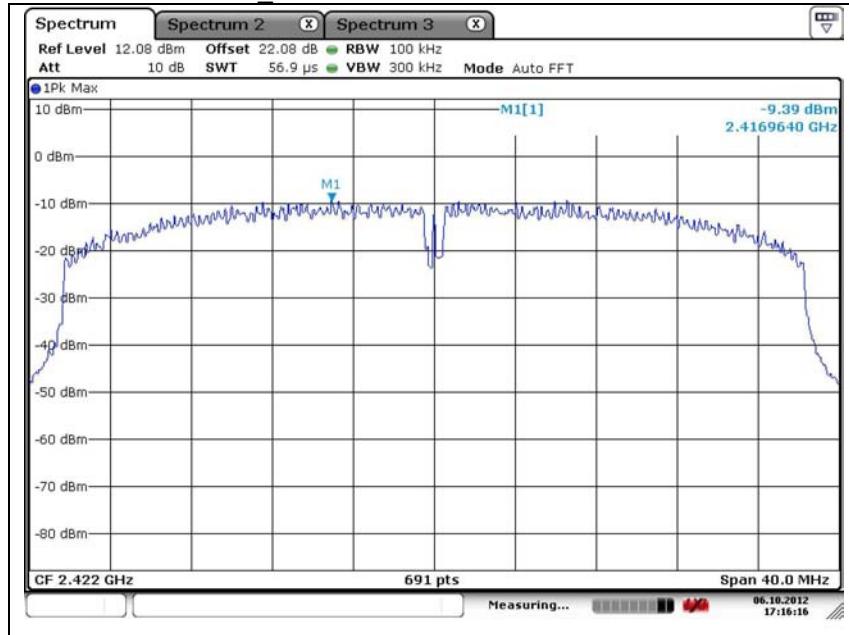
802.11n HT20 // Ant. Port 2 // Middle channel



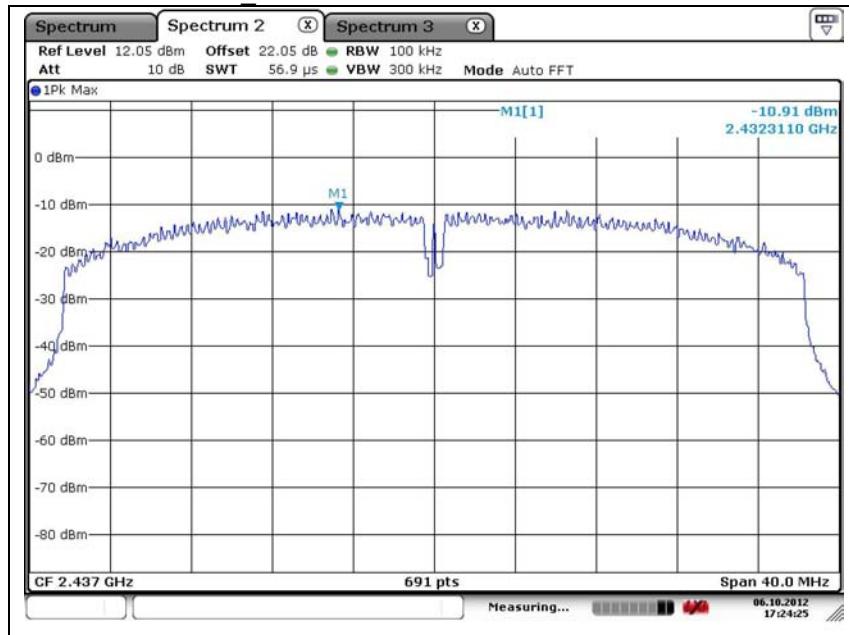
802.11n HT20 // Ant. Port 2 // High channel



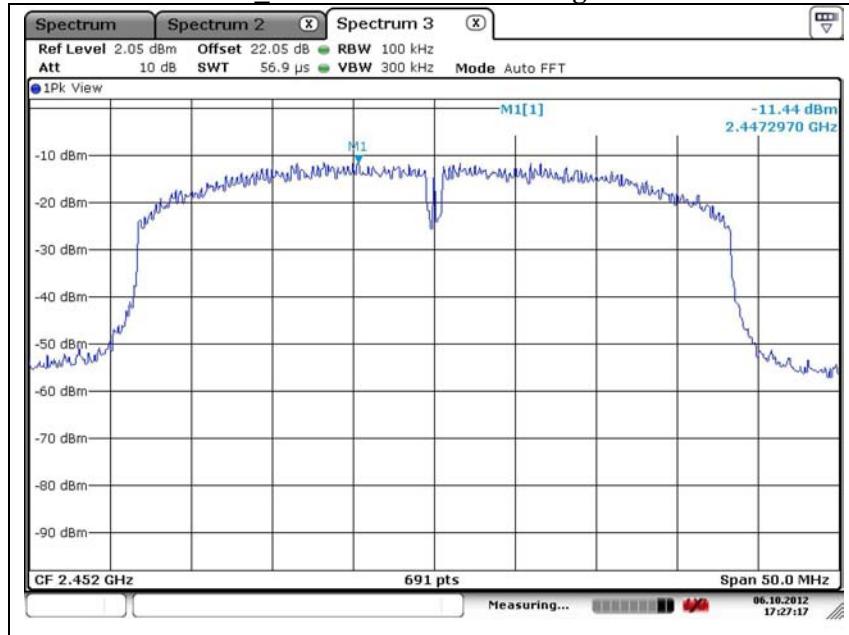
802.11n HT40 // Ant. Port 1 // Low channel



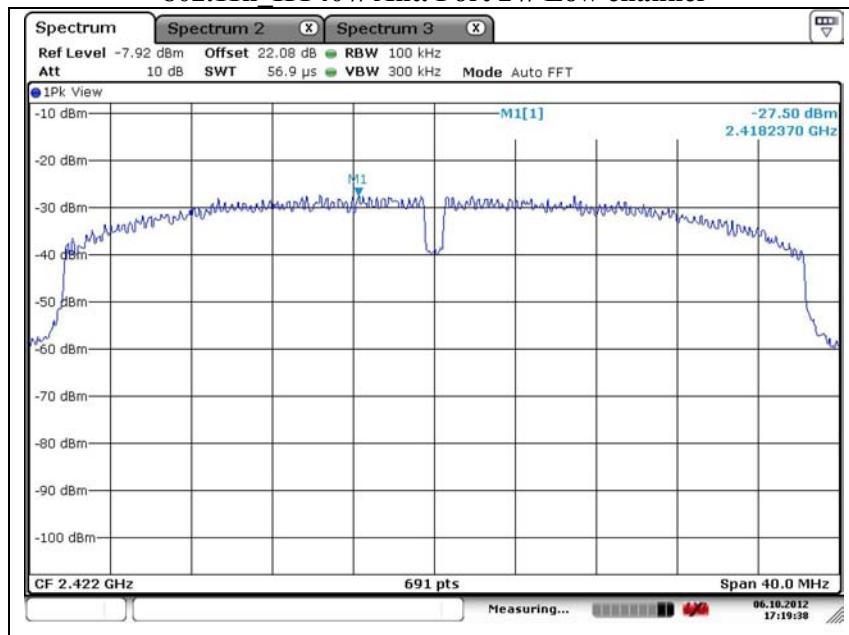
802.11n HT40 // Ant. Port 1 // Middle channel



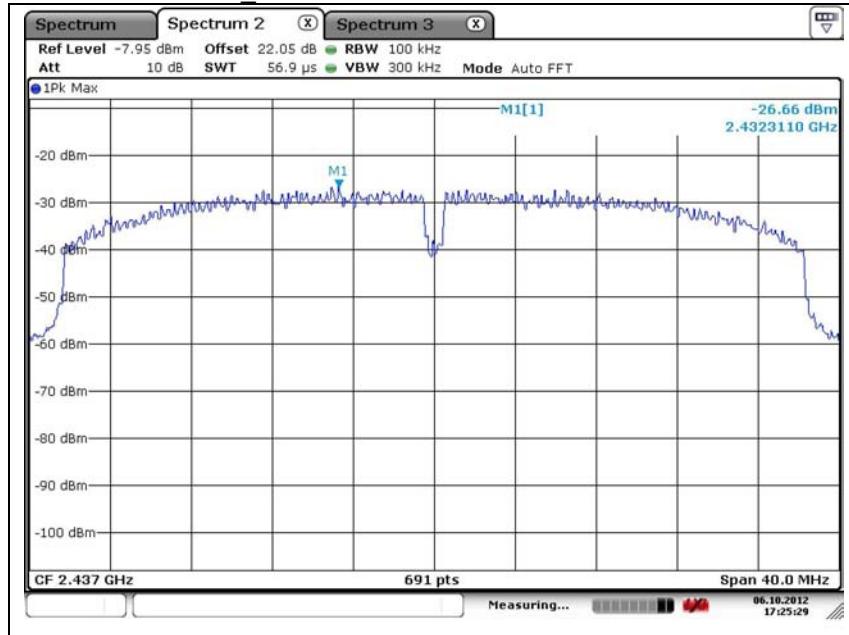
802.11n HT40 // Ant. Port 1 // High channel



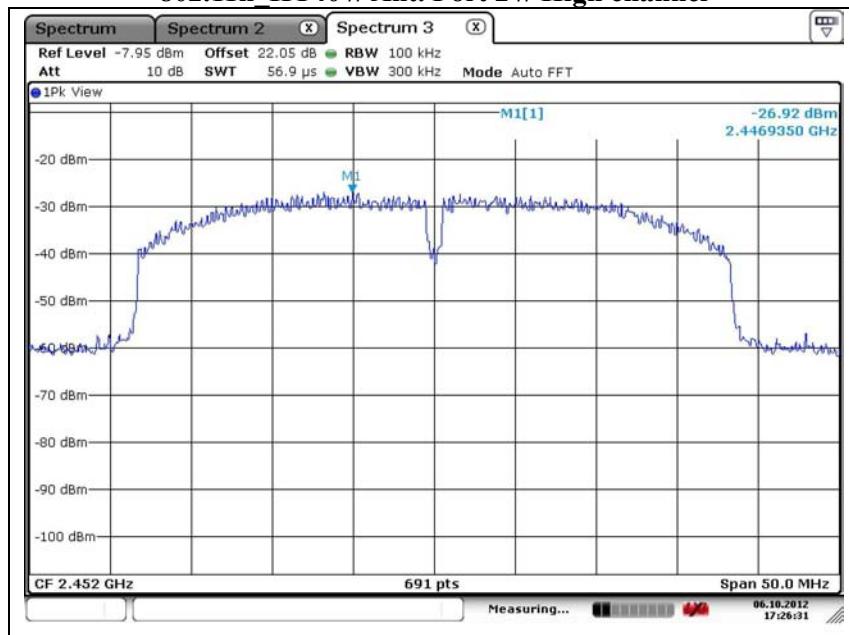
802.11n HT40 // Ant. Port 2 // Low channel



802.11n HT40 // Ant. Port 2 // Middle channel



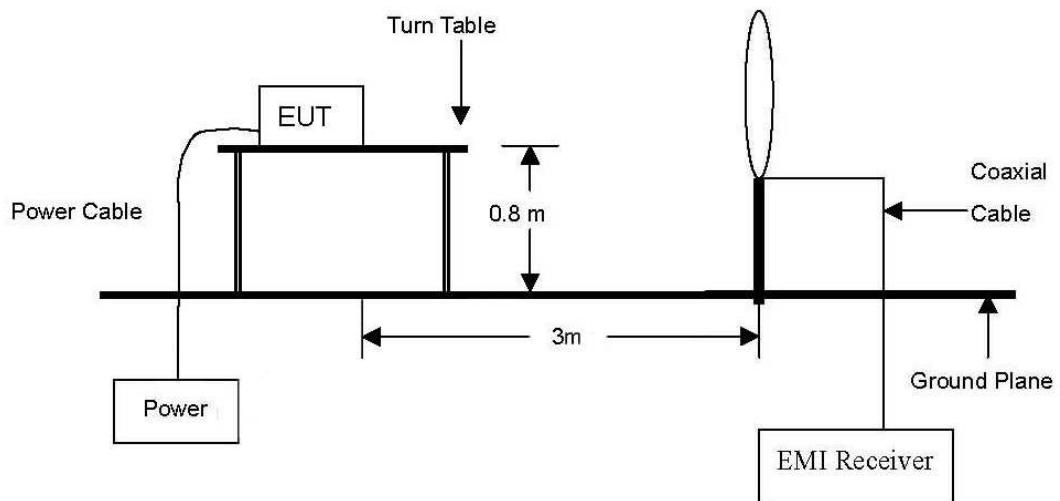
802.11n HT40 // Ant. Port 2 // High channel



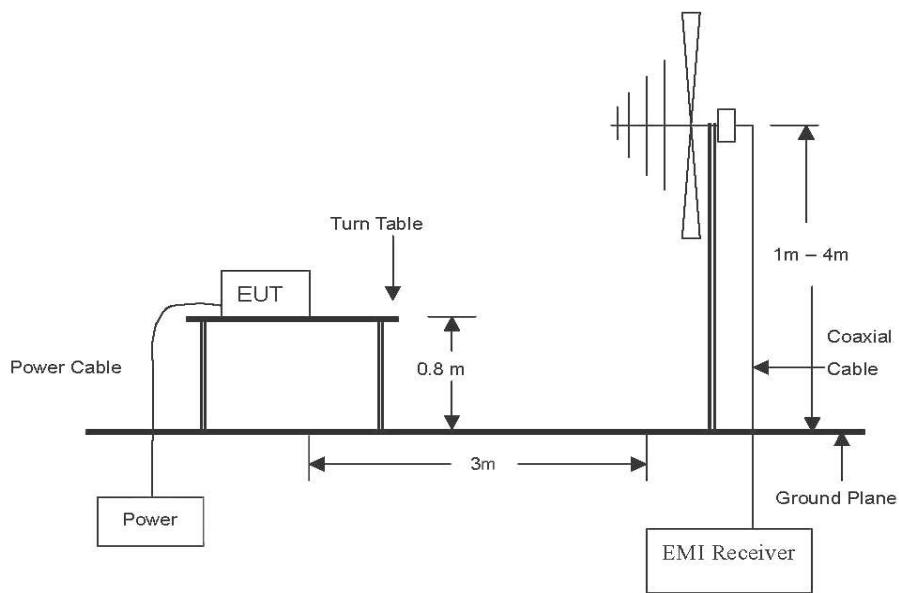
2.1.5 Radiated spurious emissions and conducted spurious emissions

Test setup for radiated spurious emissions

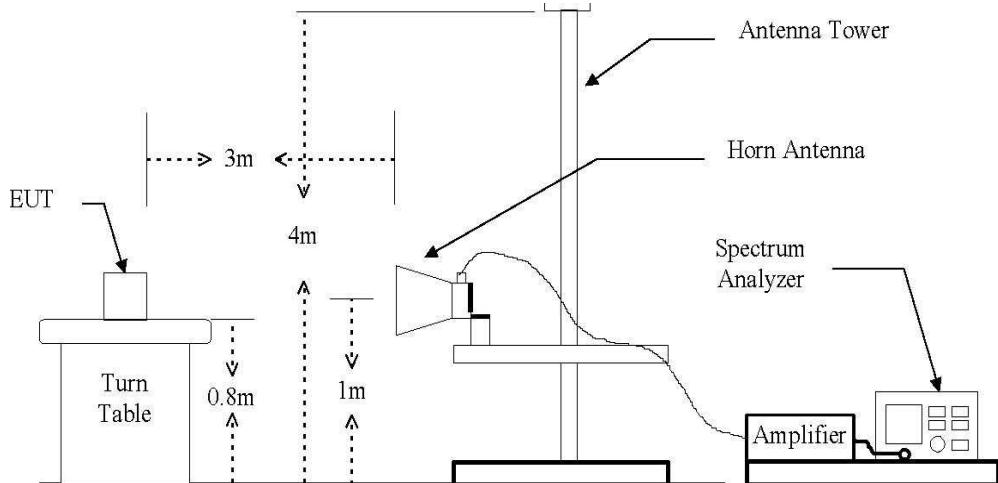
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



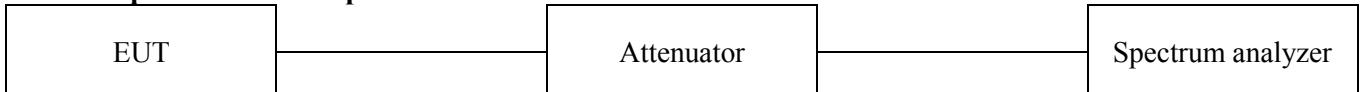
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



Test setup for conducted spurious emissions



Test procedures for radiated spurious emissions

Radiated emissions from the EUT were measured according to the dictates in section 5.4 of KDB 558074

[9 kHz to 30 MHz]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 Hz for Quasi-peak detection (QP) at frequency below 9 kHz~ 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 kHz for Quasi-peak detection (QP) at frequency below 150 kHz~ 30 MHz.

[30 MHz to 1 GHz and 1 GHz to 24 GHz]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

Note;

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

Test procedure for conducted spurious emissions

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in page 48 of the test report. The limit for out of band spurious emission at the band edge is 20dB below the fundamental emission level measured in a 100 kHz bandwidth.



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Limit for radiated spurious emissions

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated (μ V/m)
0.009 ~ 0.490	300	2400 / F(kHz)
0.490 ~ 1.705	30	24000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Limit for conducted spurious emission

According to 15.247(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 section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))



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Test results (Below 30 MHz) – Worst case configuration: 11g

The frequency spectrum from 9 kHz to 30 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	F _d (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Below 30	Not detected							

※ Remark

1. All spurious emission at channels are almost the same below 30 MHz, so that low channel was chosen at representative in final test.

2. Actual = Reading + Ant. factor + Cable loss + F_d

3. F_d = 40log(D_m / D_s)

Where:

F_d = Distance factor in dB

D_m = Measurement distance in meters

D_s = Specification distance in meters



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Test results (Below 1 000 MHz) – Worst case configuration: 11g

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
185.200	19.38	H	11.20	2.68	33.26	43.50	10.24
211.900	19.10	V	10.35	2.97	32.42	43.50	11.08
219.200	21.95	H	10.60	3.03	35.58	46.00	10.42
233.700	18.91	H	11.11	3.15	33.17	46.00	12.83
250.700	19.02	H	11.69	3.29	34.00	46.00	12.00
250.700	15.71	V	11.69	3.29	30.69	46.00	15.31
262.800	20.74	H	12.10	3.37	36.21	46.00	9.79
282.200	15.64	V	12.76	3.50	31.90	46.00	14.10
435.000	15.78	V	16.35	4.44	36.57	46.00	9.43
529.600	15.76	H	18.32	4.98	39.06	46.00	6.94
529.600	16.38	V	18.32	4.98	39.68	46.00	6.32
665.400	13.99	V	20.46	5.64	40.09	46.00	5.91

※ Remark

1. All spurious emission at channels are almost the same below 1 GHz, so that low channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.



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Test results (Above 1 000 MHz)

802.11b // Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 328.000	43.47	Peak	H	28.19	-28.10	43.56	74.00	30.44
2 311.560	46.62	Peak	V	28.15	-28.14	46.63	74.00	27.37

802.11b // Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
Above 1 000	Not detected							

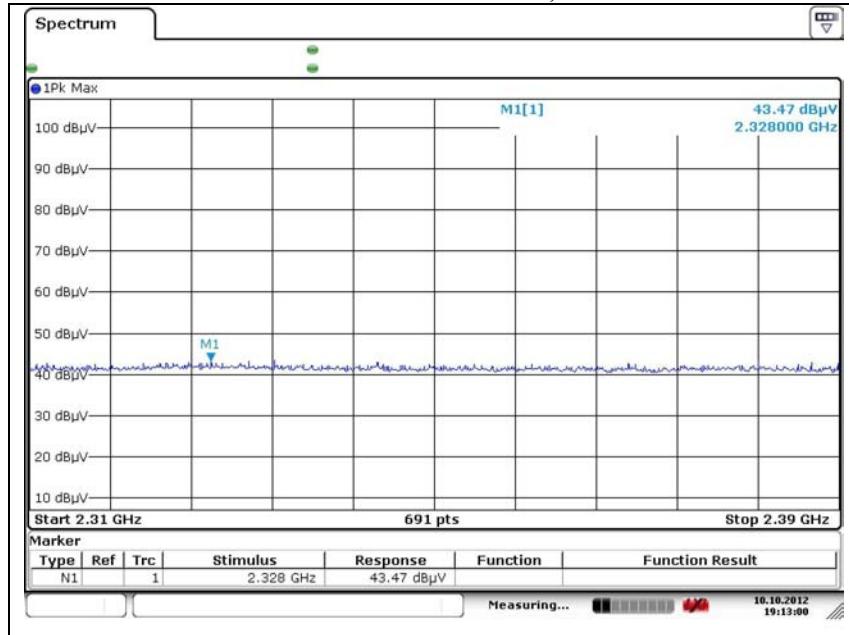
802.11b // High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 510.145	42.00	Peak	H	28.56	-27.63	42.92	74.00	31.08
2 484.389	46.20	Peak	V	28.50	-27.70	47.01	74.00	26.99

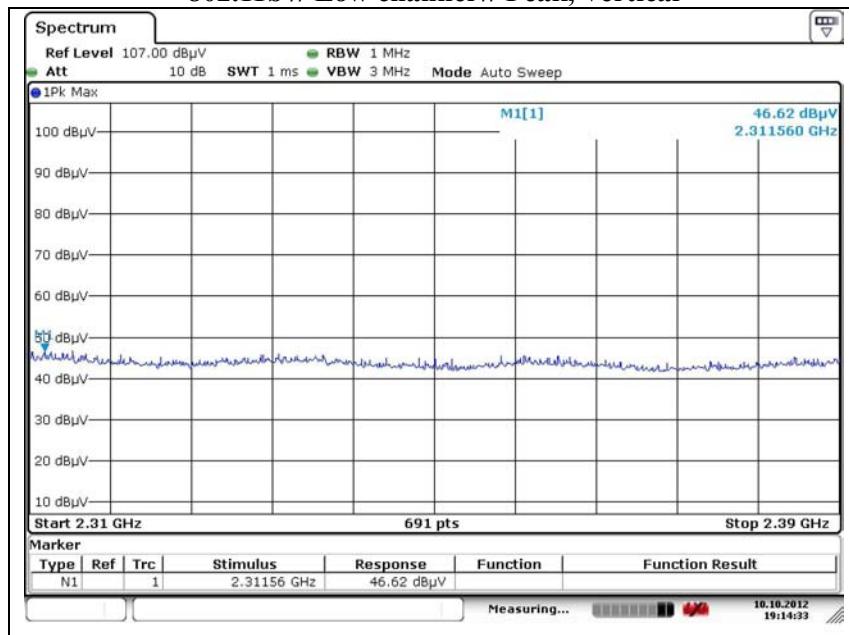
※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

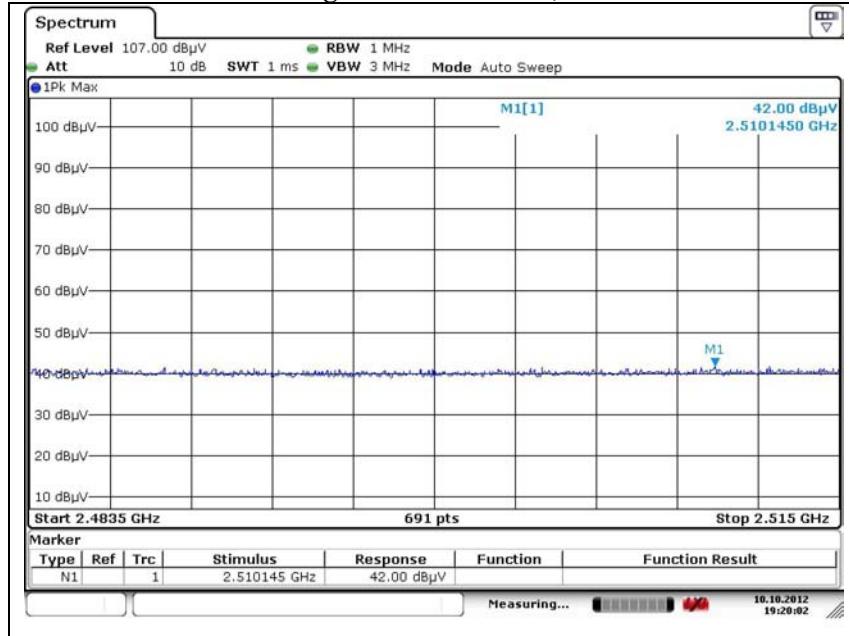
802.11b // Low channel // Peak, Horizontal



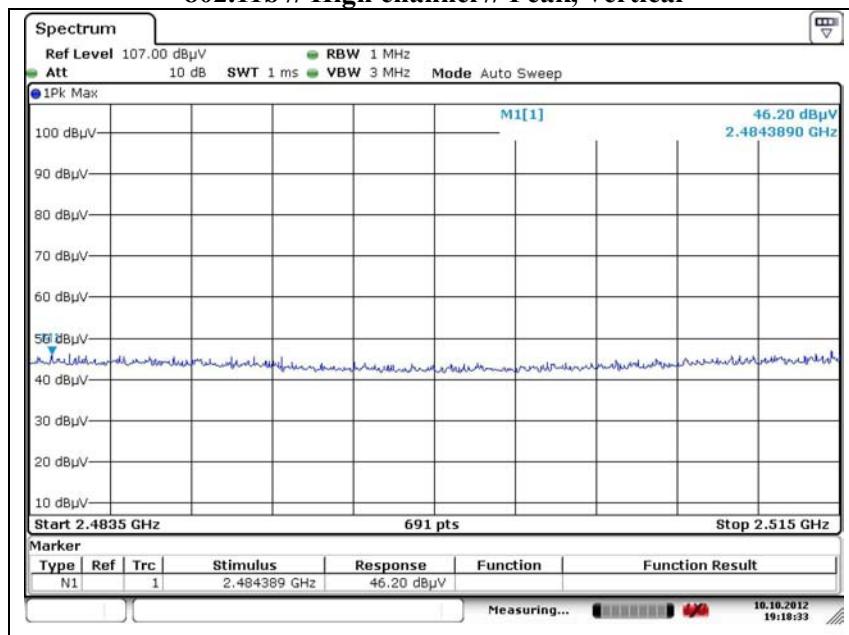
802.11b // Low channel // Peak, Vertical



802.11b // High channel // Peak, Horizontal



802.11b // High channel // Peak, Vertical





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802.11g // Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 324.760	42.74	Peak	H	28.18	-28.10	42.82	74.00	31.18
2 331.940	45.76	Peak	V	28.19	-28.08	45.87	74.00	28.13

802.11g // Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
Above 1 000	Not detected							

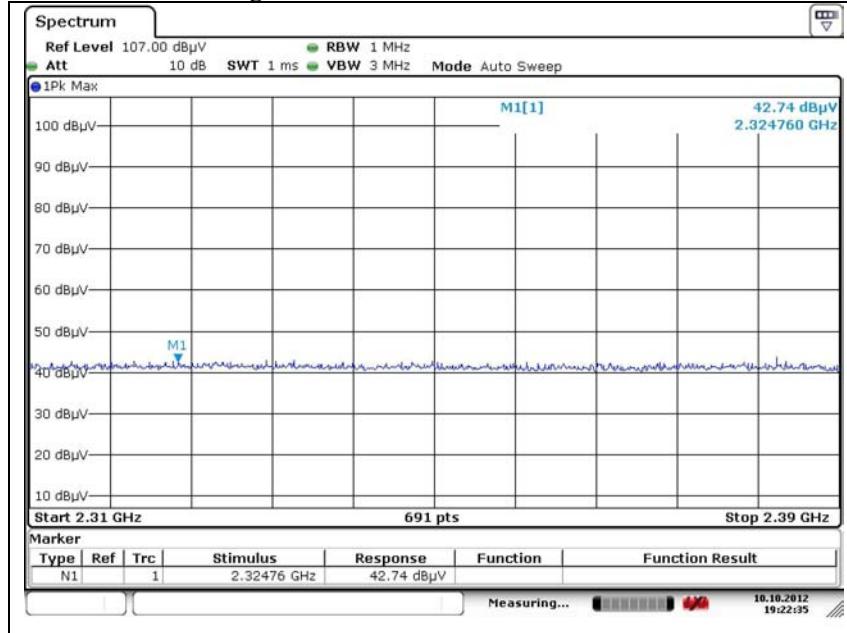
802.11g // High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 503.854	42.51	Peak	H	28.54	-27.65	43.40	74.00	30.60
2 489.950	45.41	Peak	V	28.51	-27.68	46.24	74.00	27.76

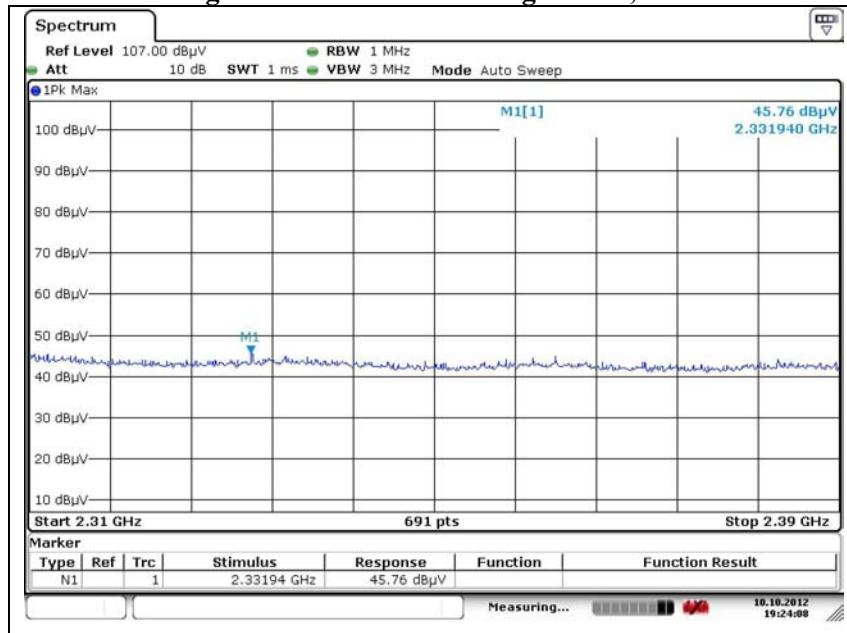
※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

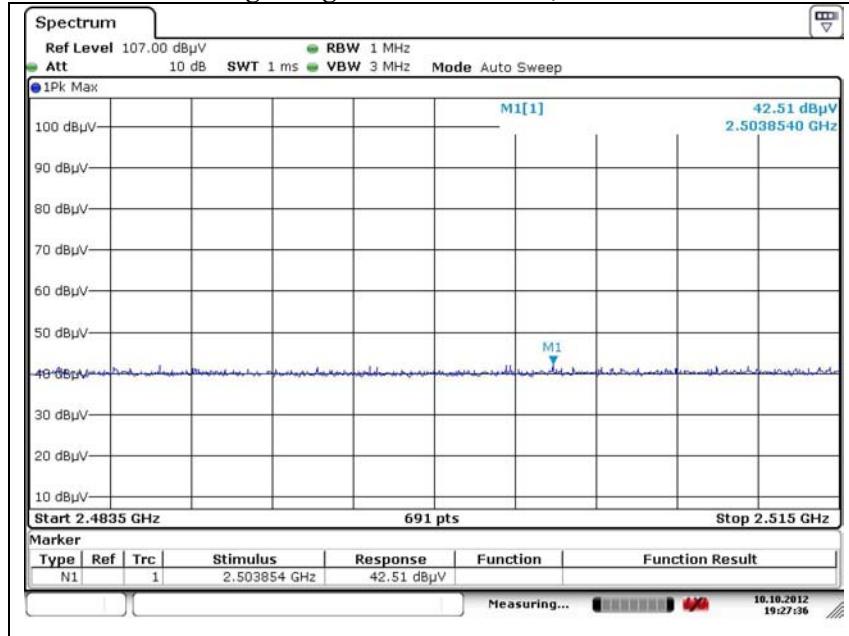
802.11g // Low channel // Peak, Horizontal



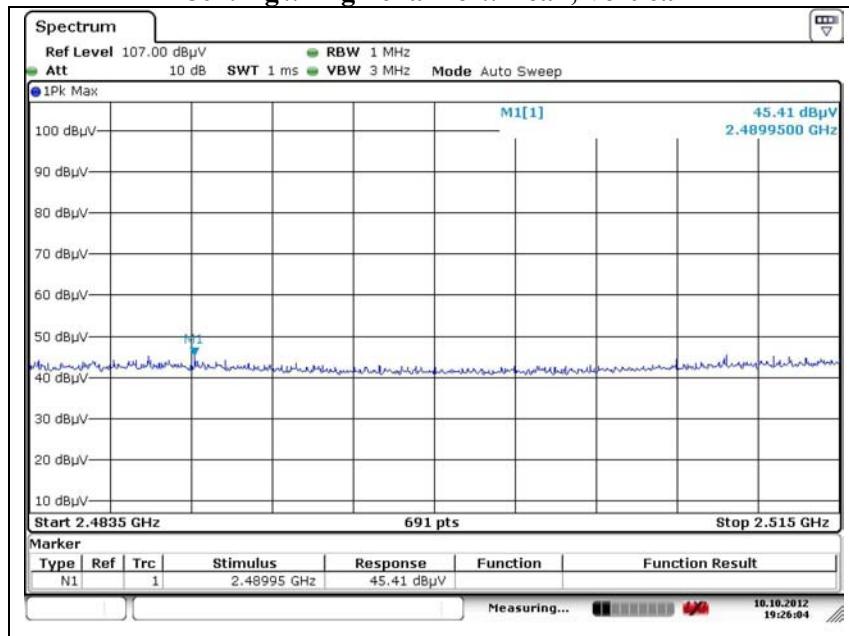
802.11g // Low channel // 802.11g // Peak, Vertical



802.11g // High channel // Peak, Horizontal



802.11g // High channel // Peak, Vertical





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802.11n HT20 // Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 340.510	43.23	Peak	H	28.21	-28.06	43.38	74.00	30.62
2 310.870	45.96	Peak	V	28.15	-28.14	45.97	74.00	28.03

802.11n HT20 // Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
Above 1 000	Not detected							

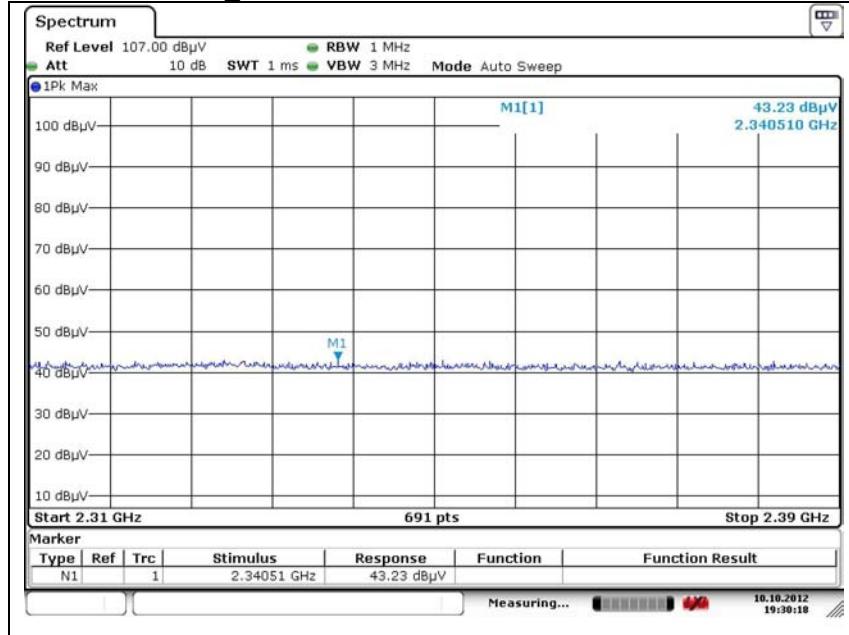
802.11n HT20 // High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 507.319	41.94	Peak	H	28.55	-27.64	42.85	74.00	31.15
2 514.157	44.97	Peak	V	28.56	-27.62	45.91	74.00	28.09

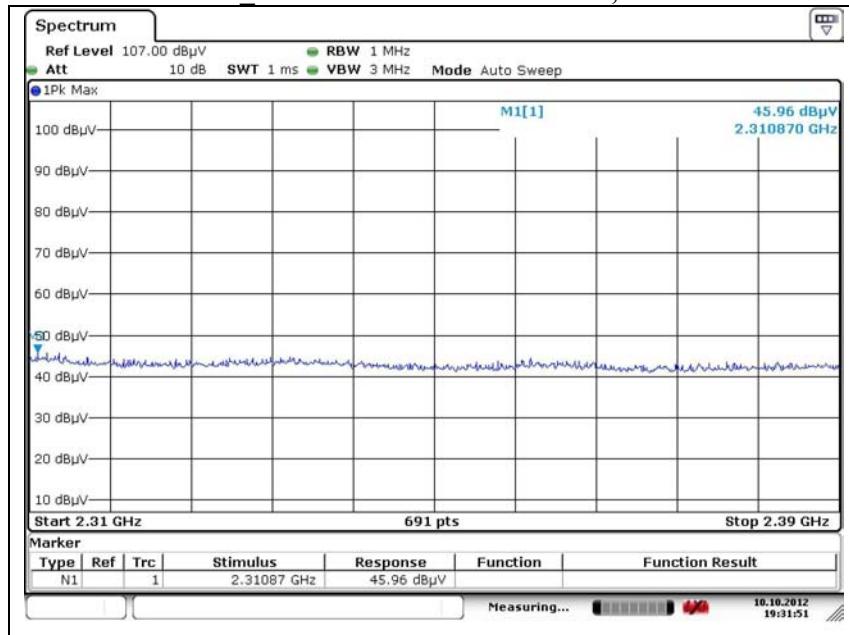
* Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

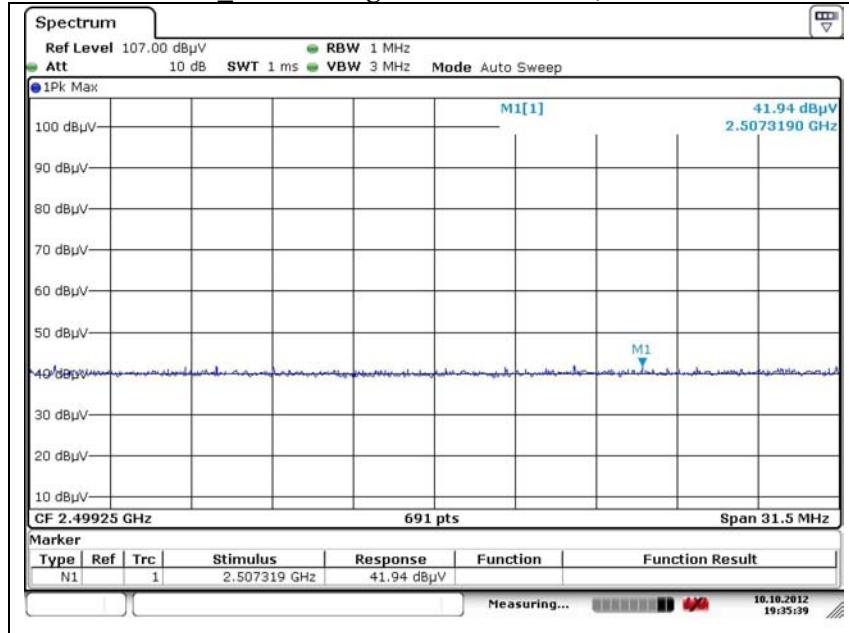
802.11n HT20 // Low channel // Peak, Horizontal



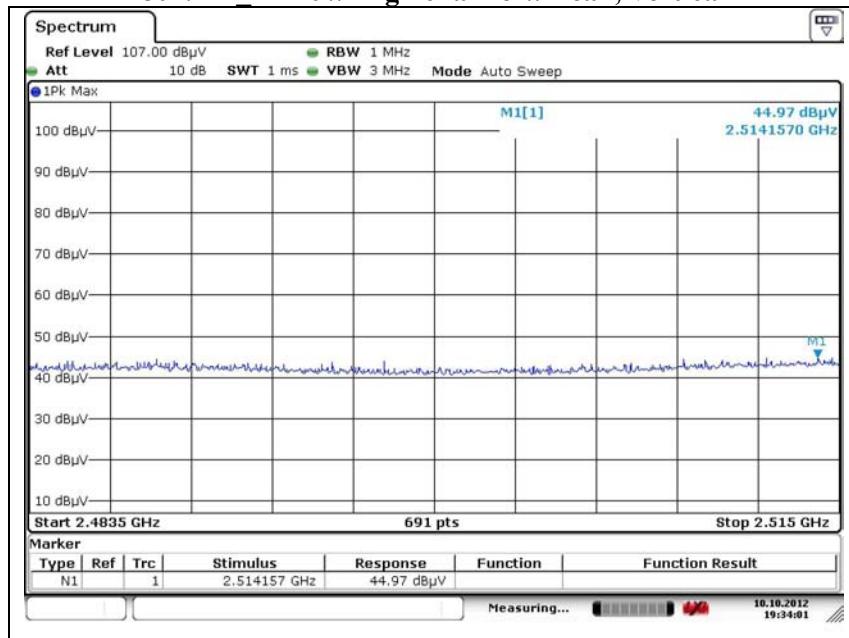
802.11n HT20 // Low channel // Peak, Vertical



802.11n HT20 // High channel // Peak, Horizontal



802.11n HT20 // High channel // Peak, Vertical





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802.11n HT40 // Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 338.650	43.40	Peak	H	28.21	-28.07	43.54	74.00	30.46
2 312.840	46.57	Peak	V	28.16	-28.14	46.59	74.00	27.41

802.11n HT40 // Middle channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
Above 1 000	Not detected							

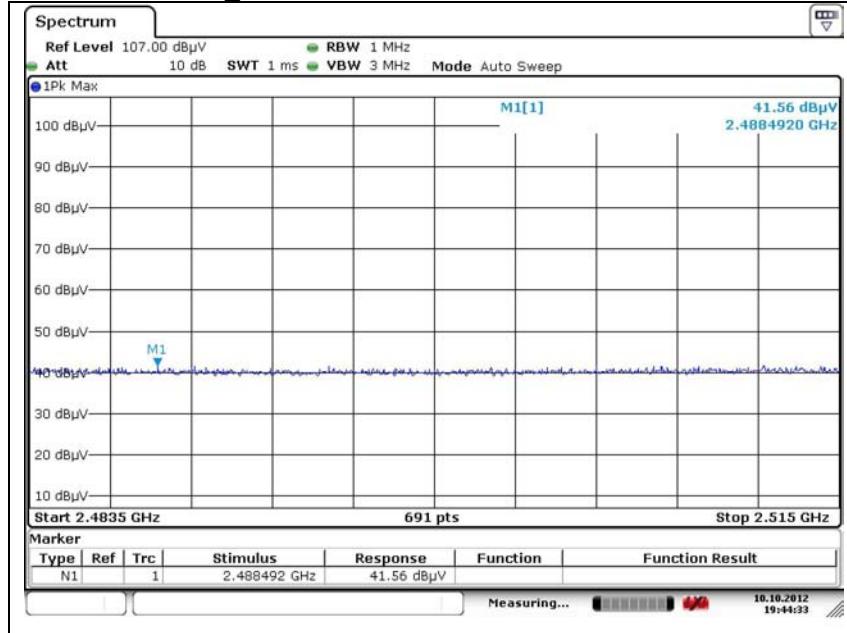
802.11n HT40 // High channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ N/m)	Limit (dB μ N/m)	Margin (dB)
2 488.492	41.56	Peak	H	28.51	-27.69	42.39	74.00	31.61
2 488.264	45.35	Peak	V	28.51	-27.69	46.17	74.00	27.83

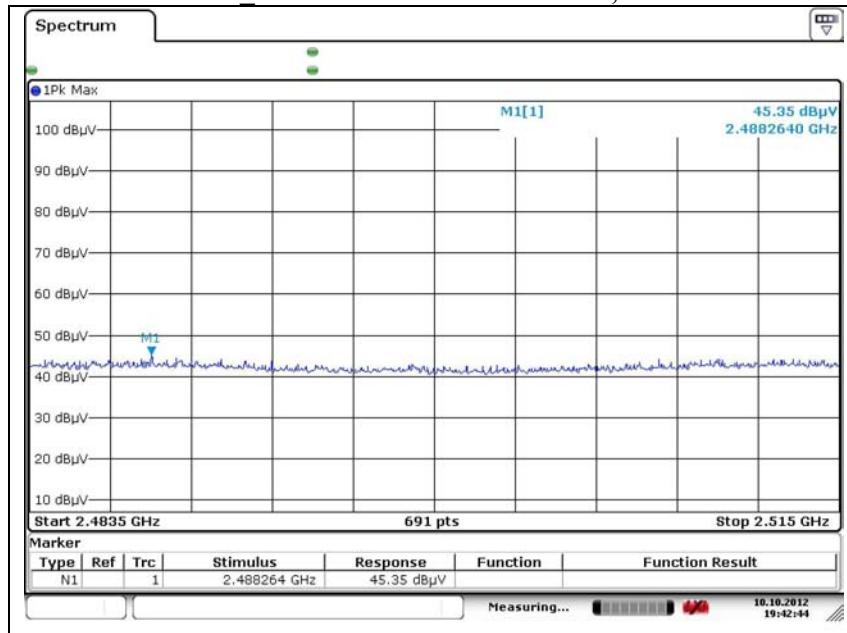
※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

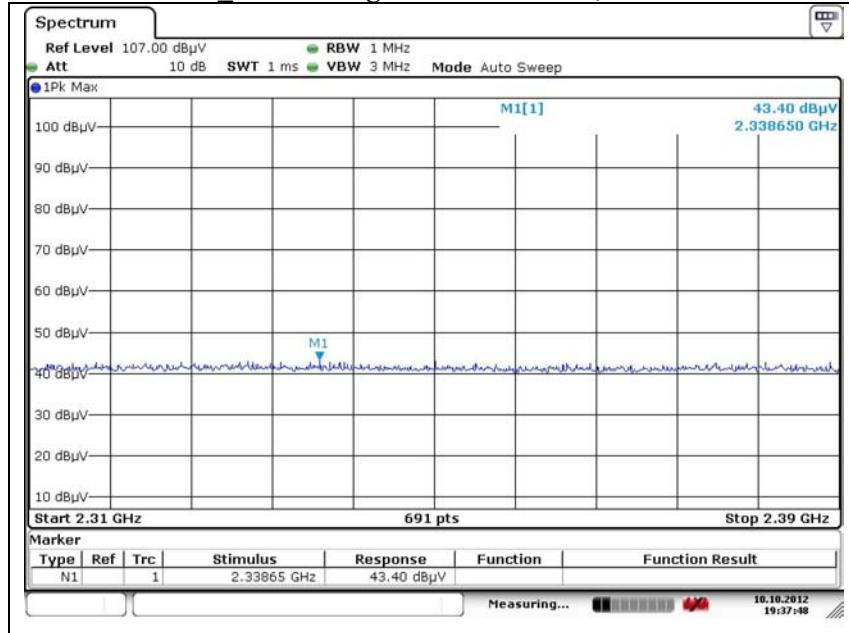
802.11n HT40 // Low channel // Peak, Horizontal



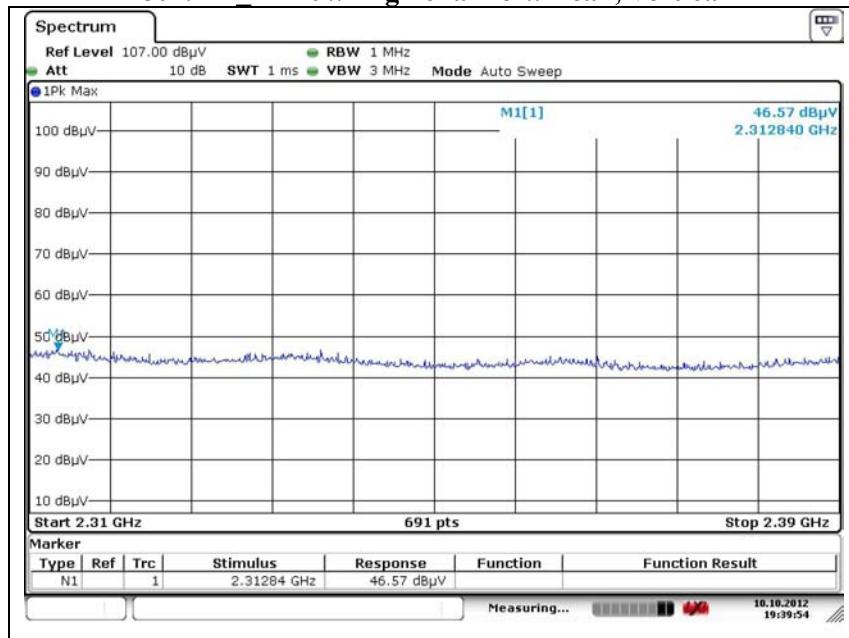
802.11n HT40 // Low channel // Peak, Vertical



802.11n HT40 // High channel // Peak, Horizontal

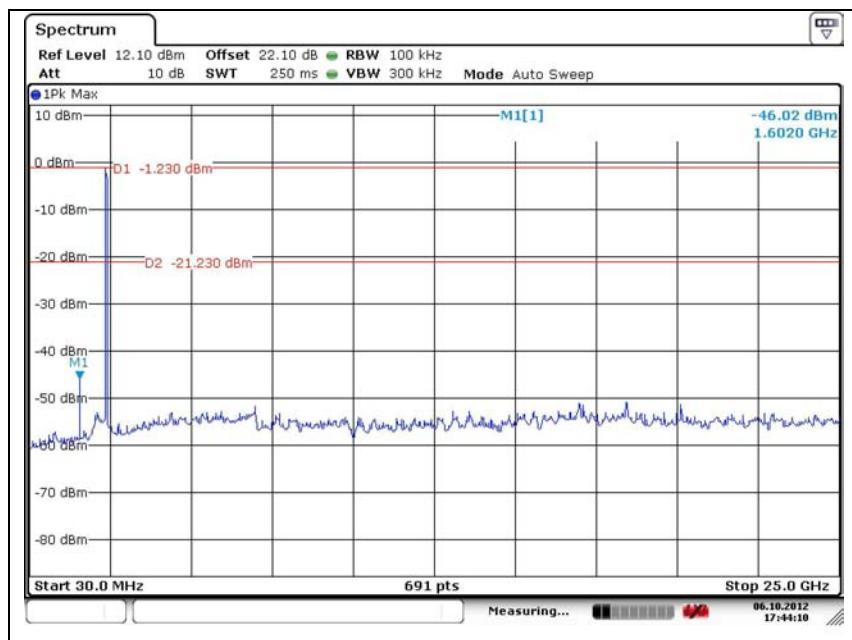
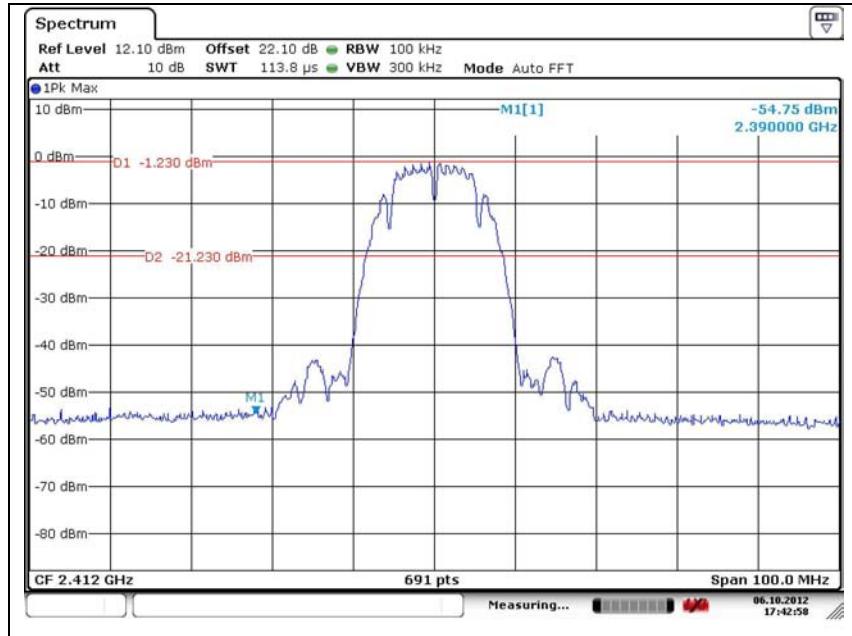


802.11n HT40 // High channel // Peak, Vertical

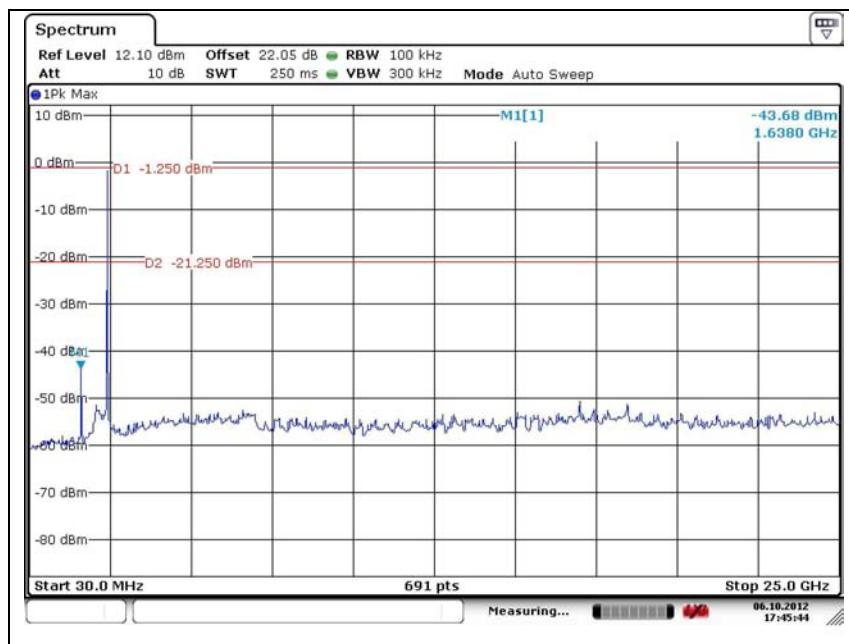
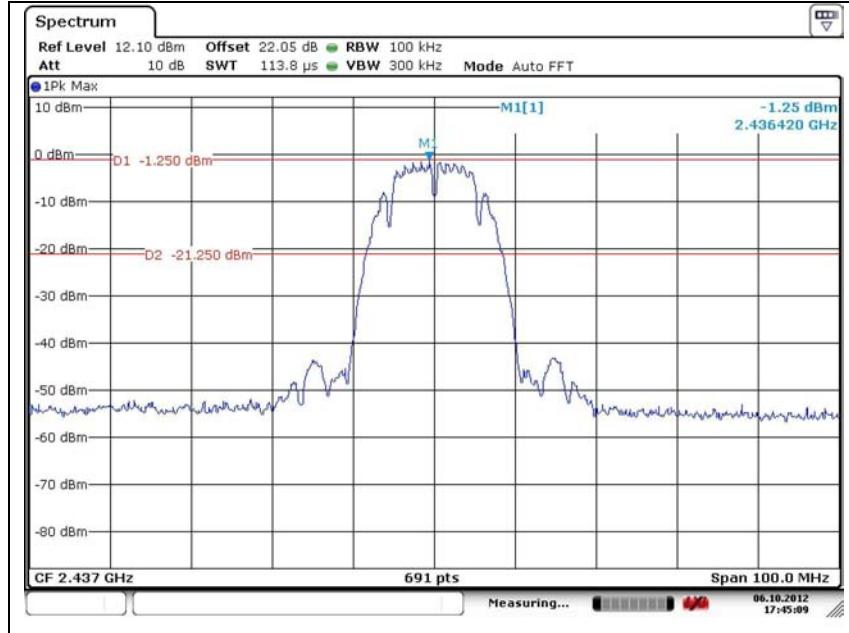


Test results: conducted spurious emission

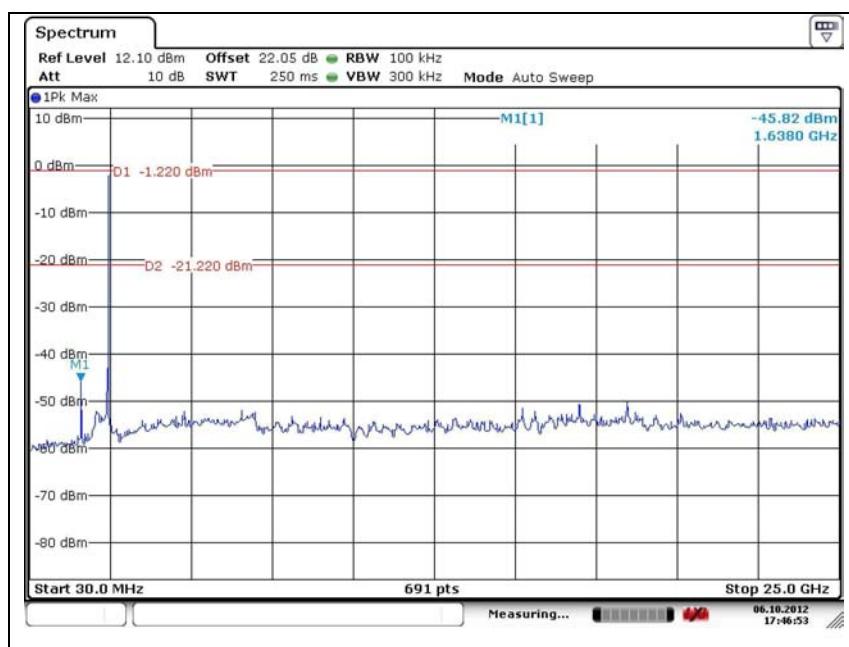
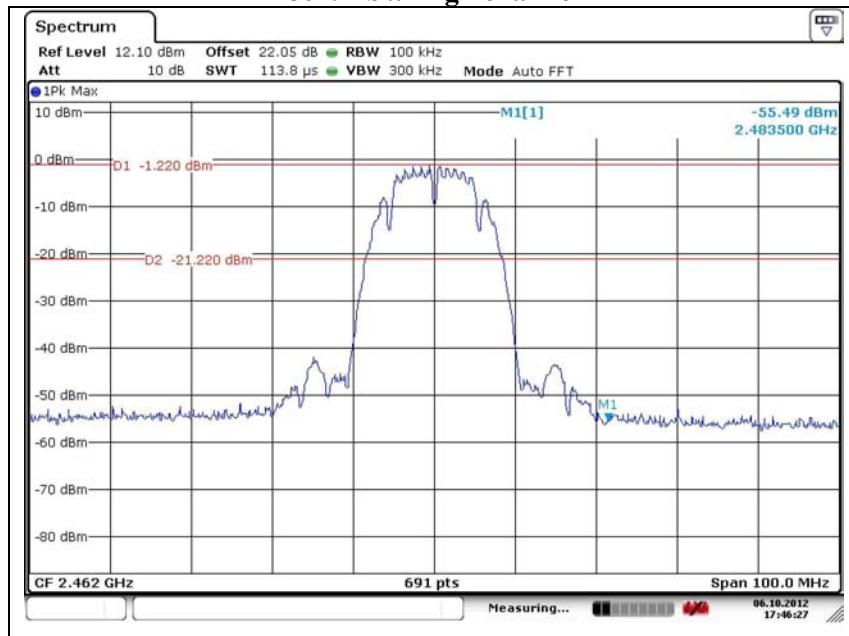
802.11b // Low channel

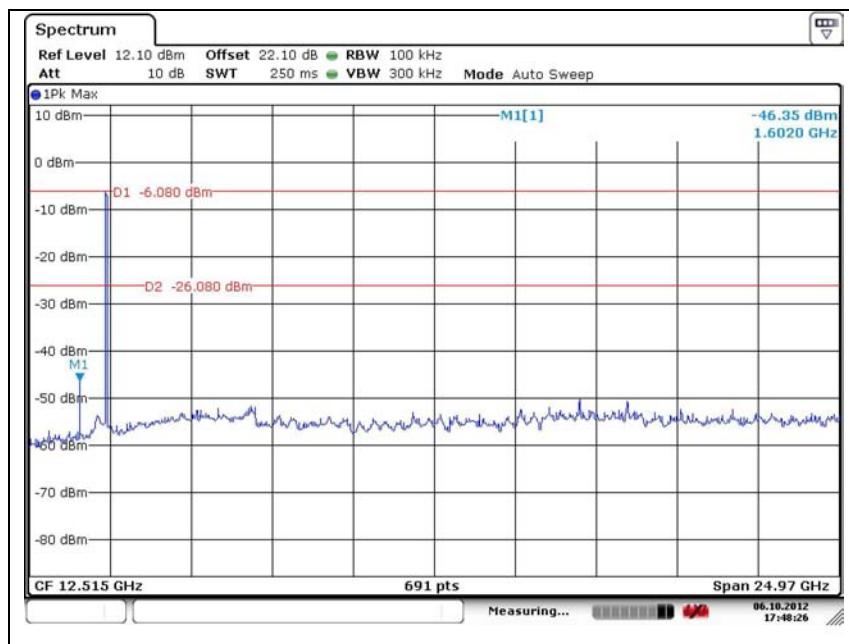
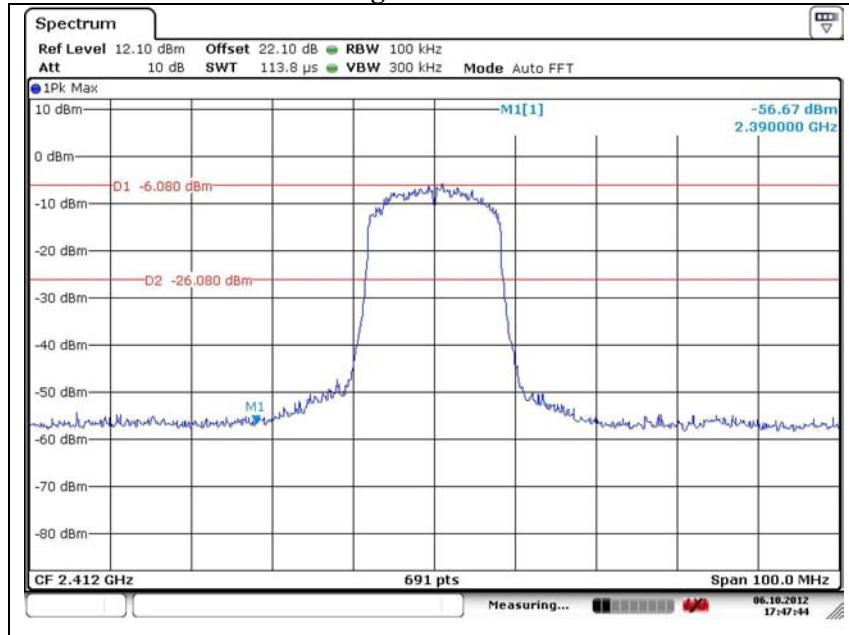


802.11b // Middle channel

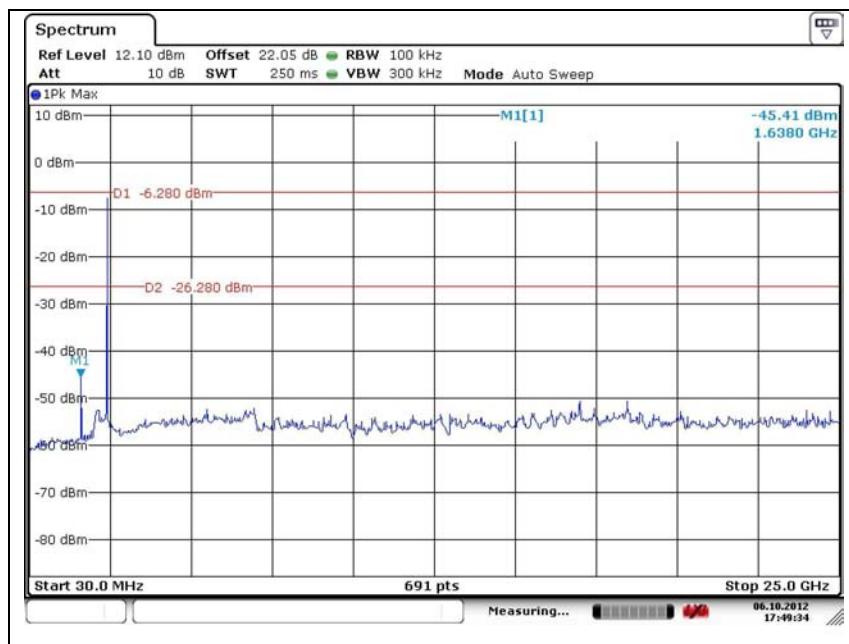
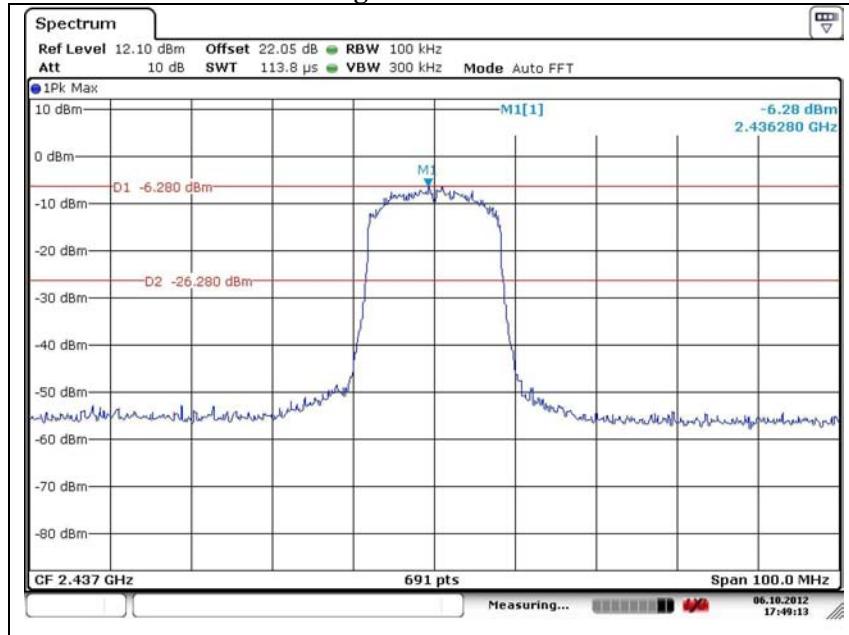


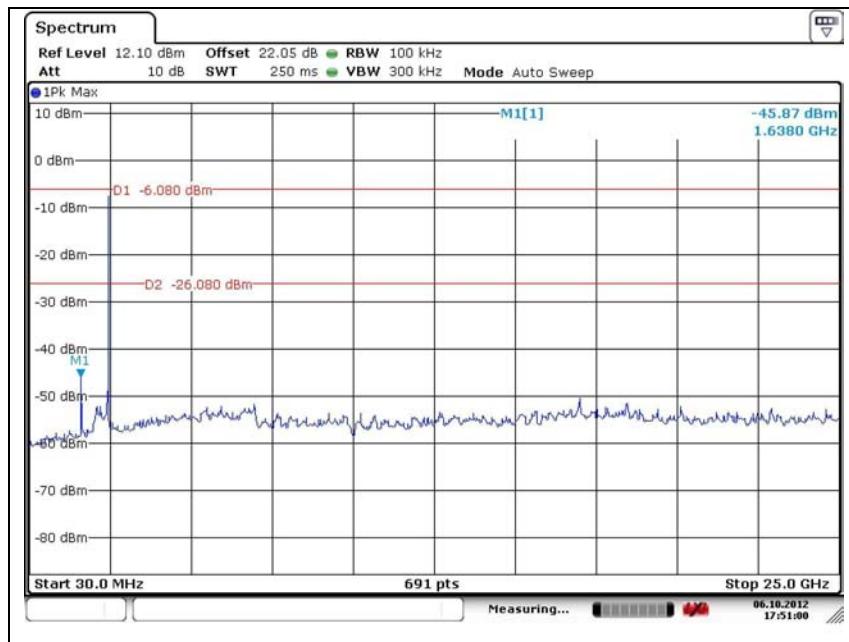
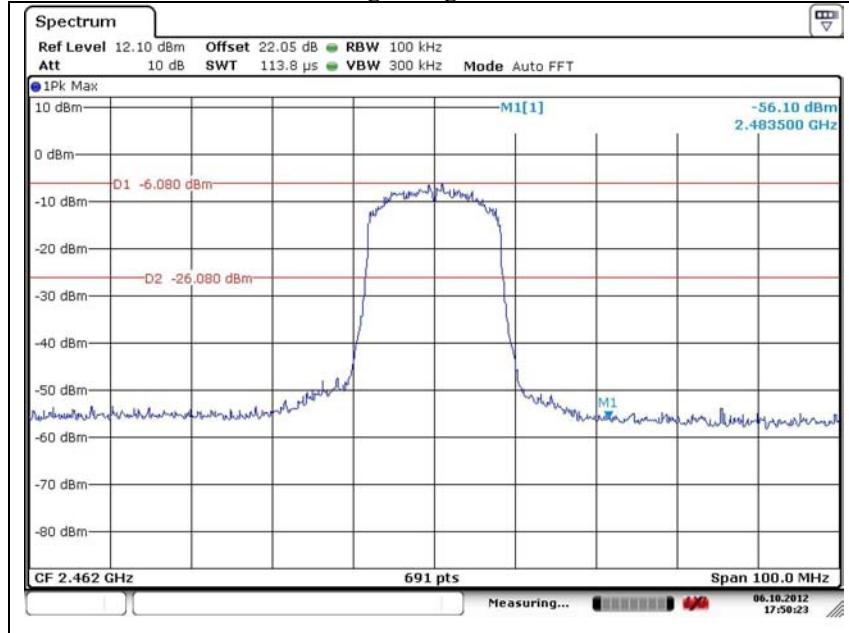
802.11b // High channel

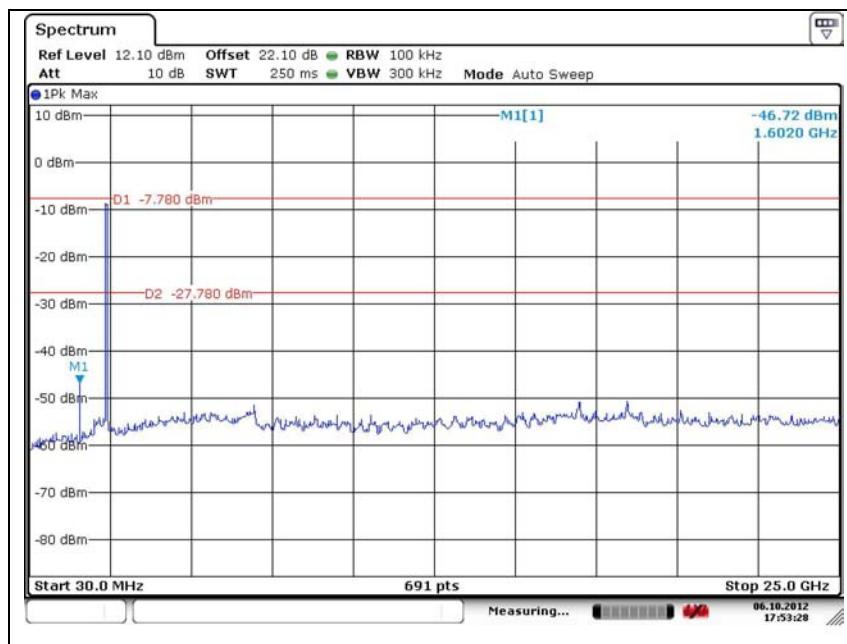
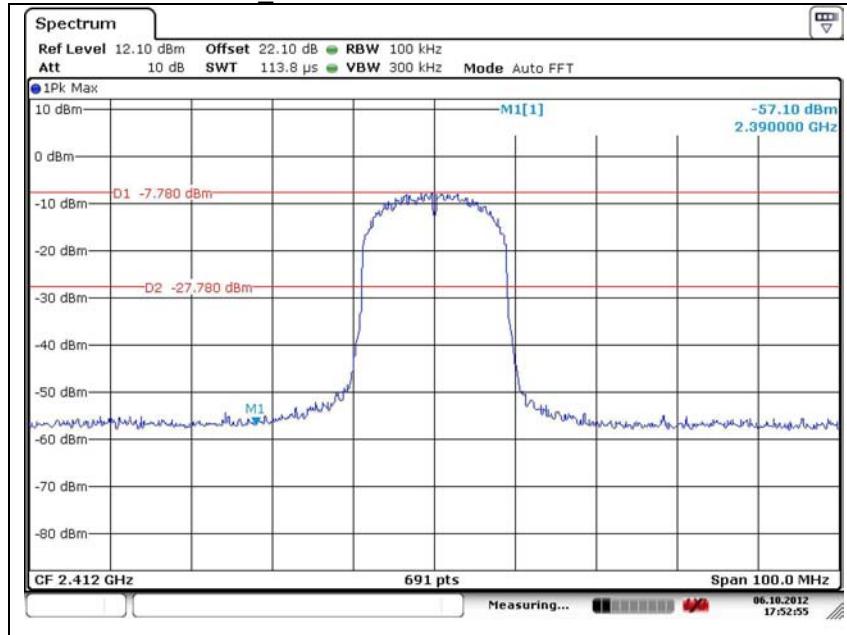


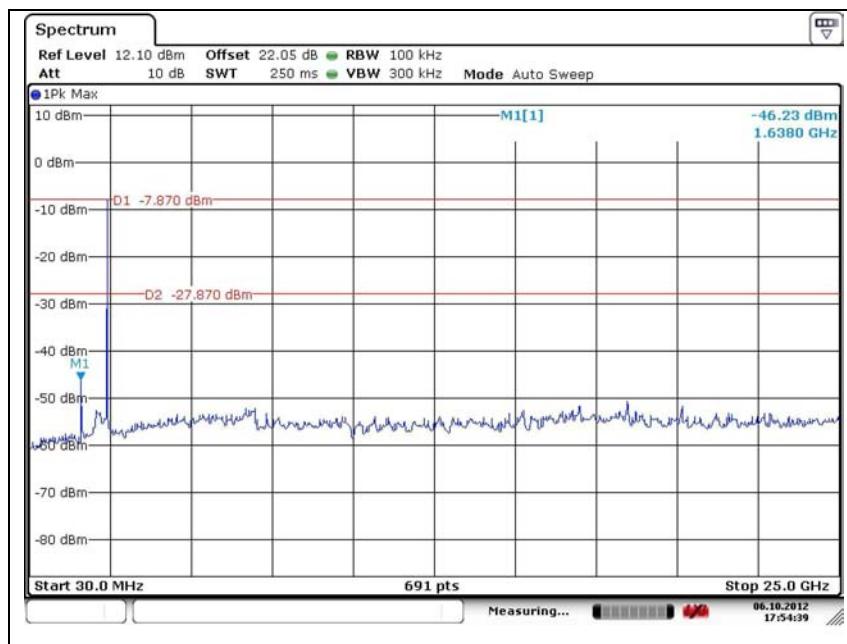
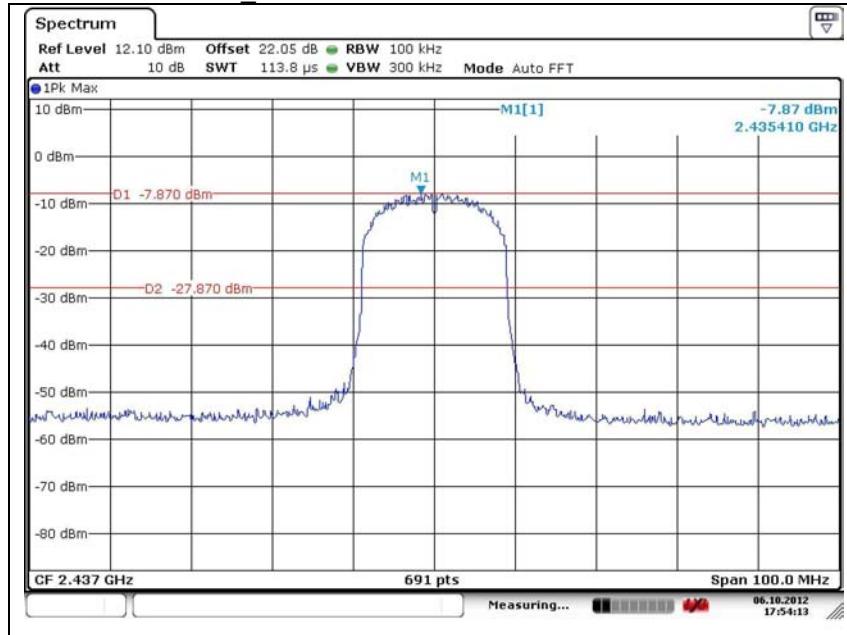
802.11g // Low channel


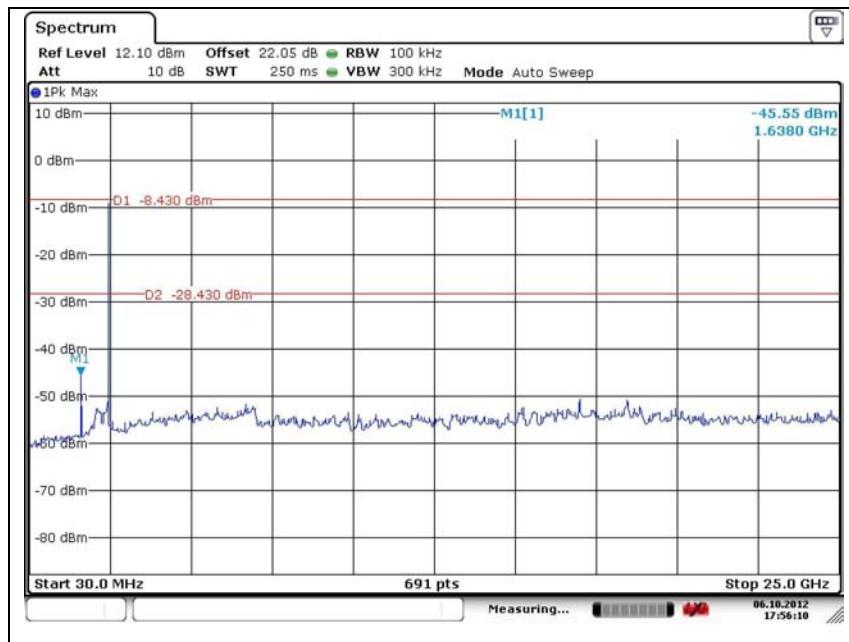
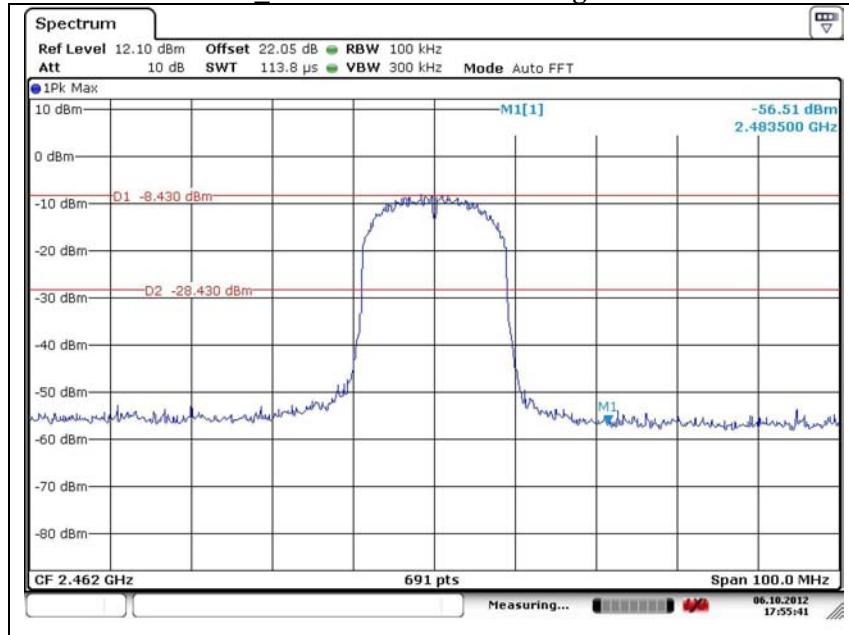
802.11g // Middle channel

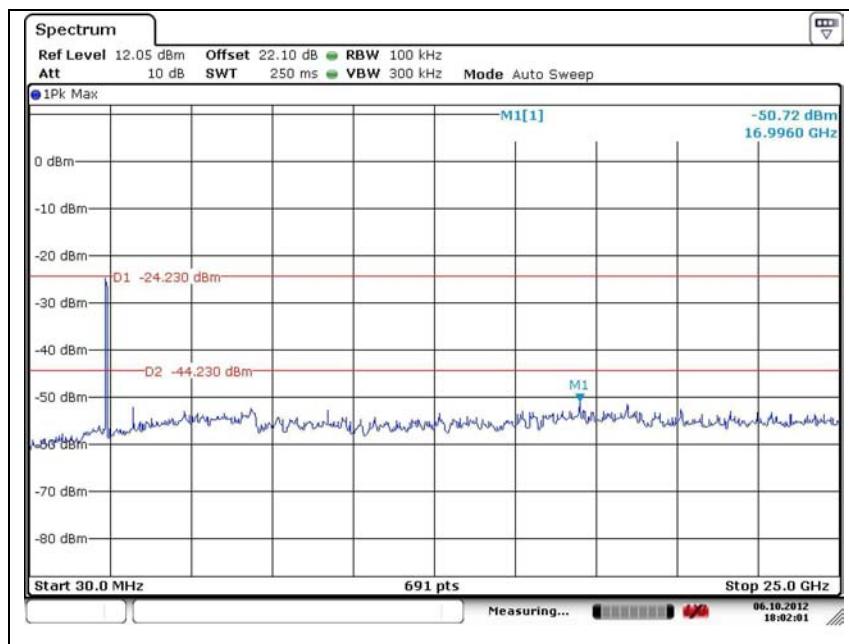
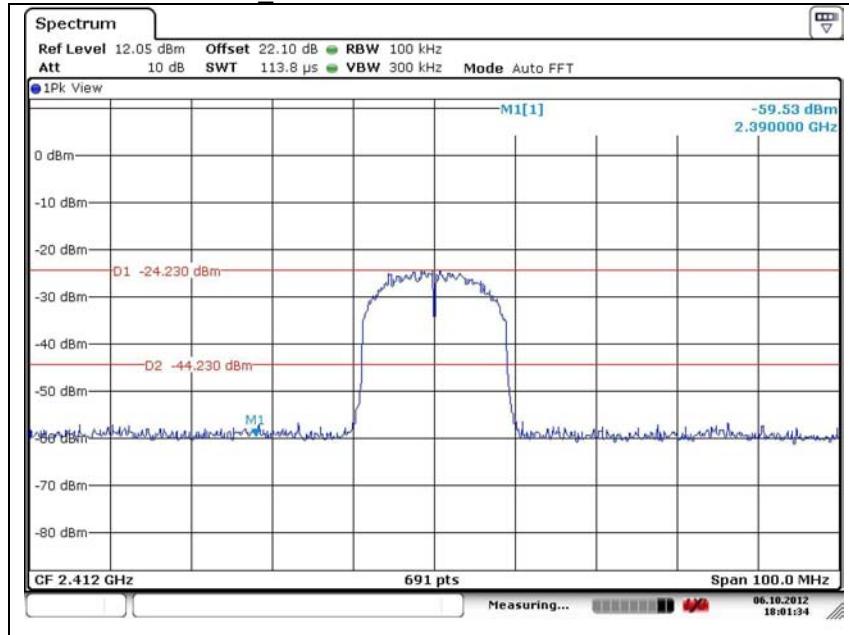


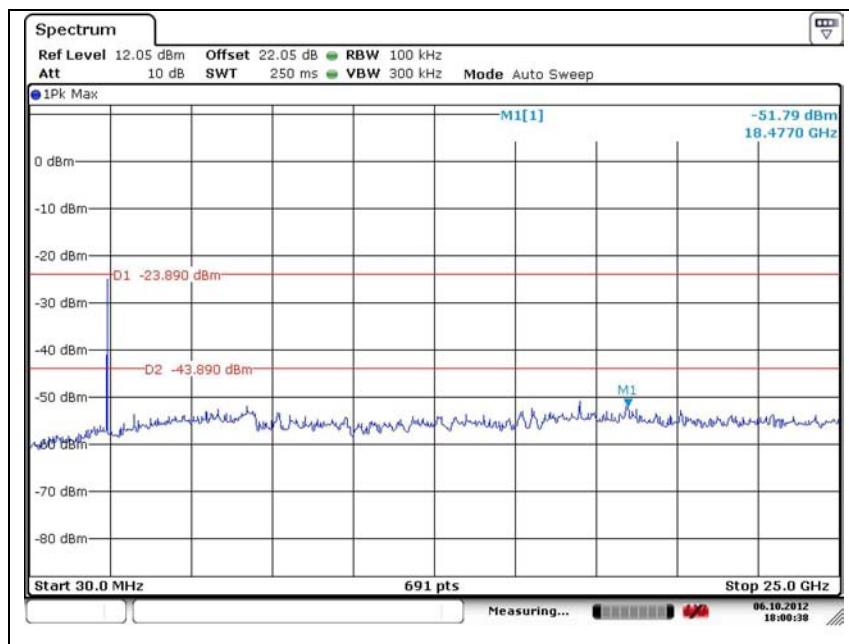
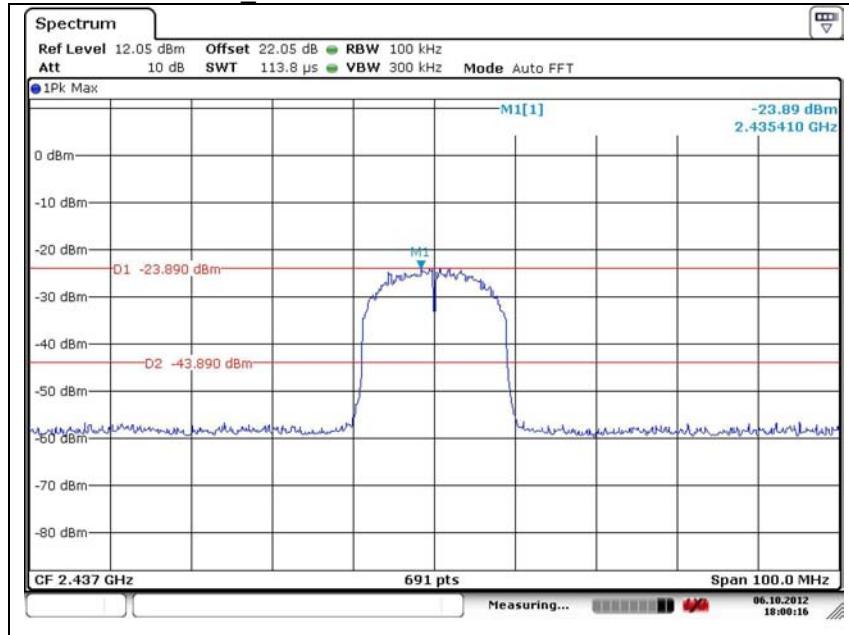
802.11g // High channel


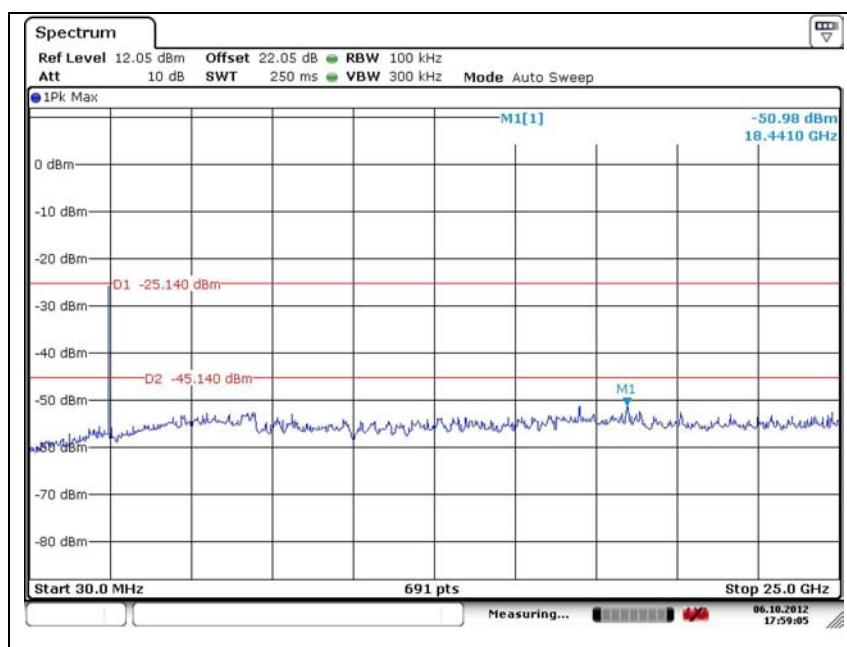
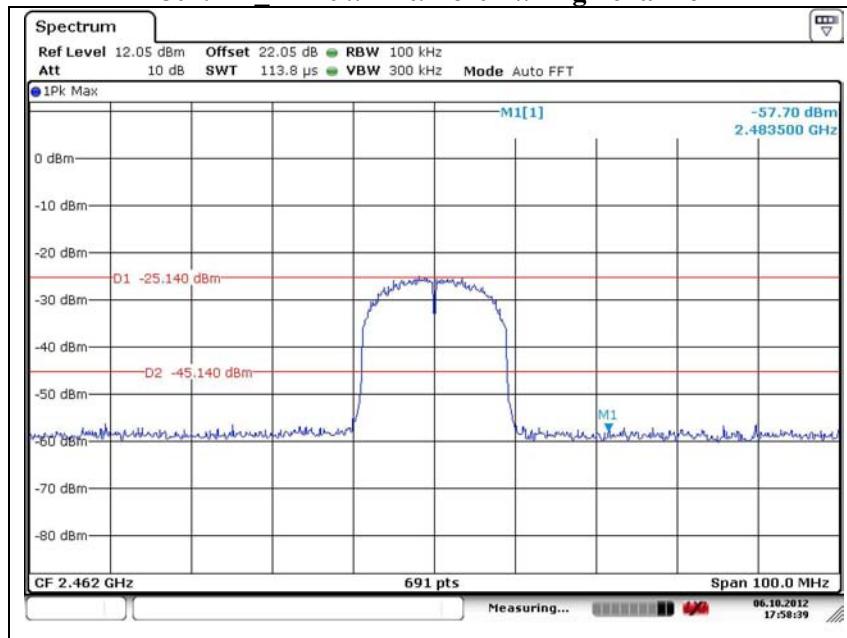
802.11n HT20 // Ant. Port 1 // Low channel


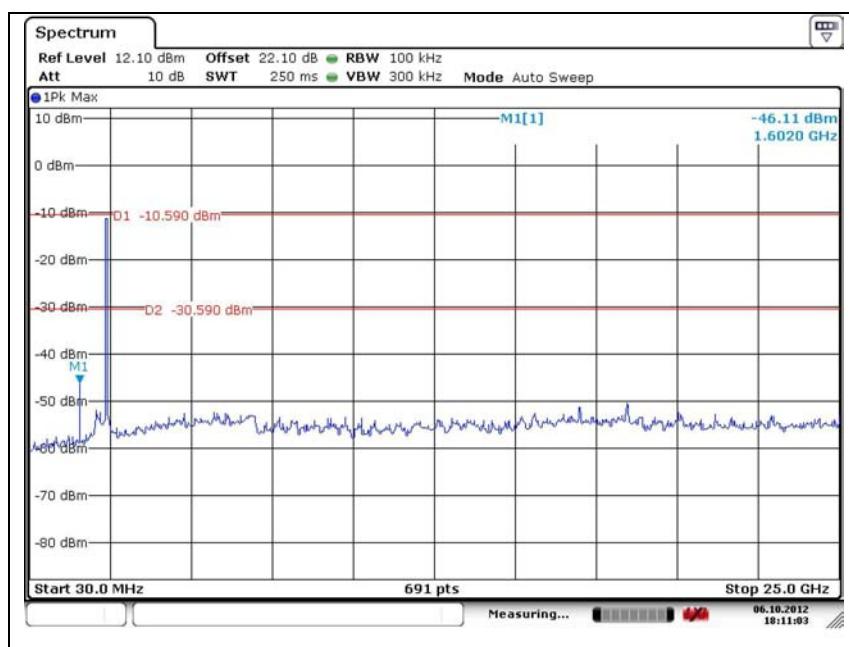
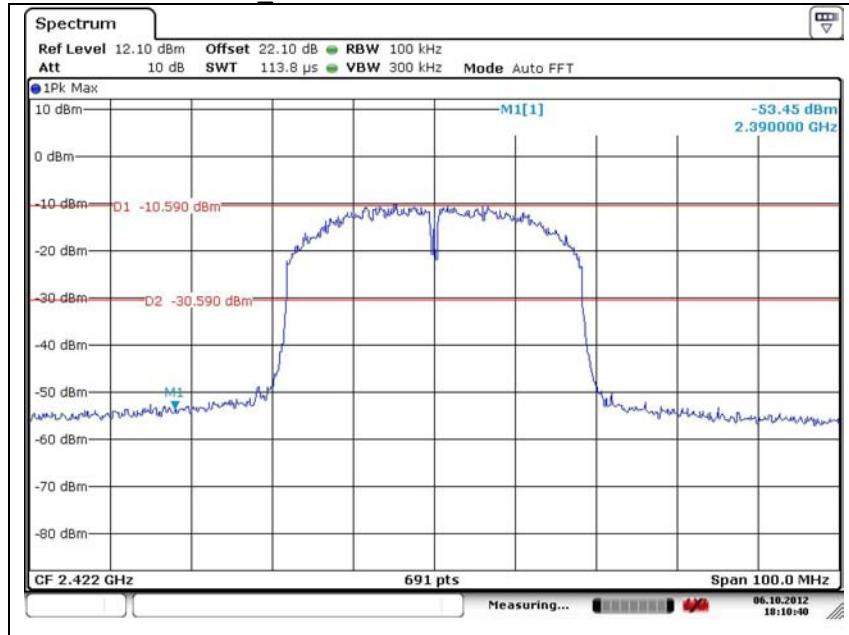
802.11n HT20 // Ant. Port 1 // Middle channel


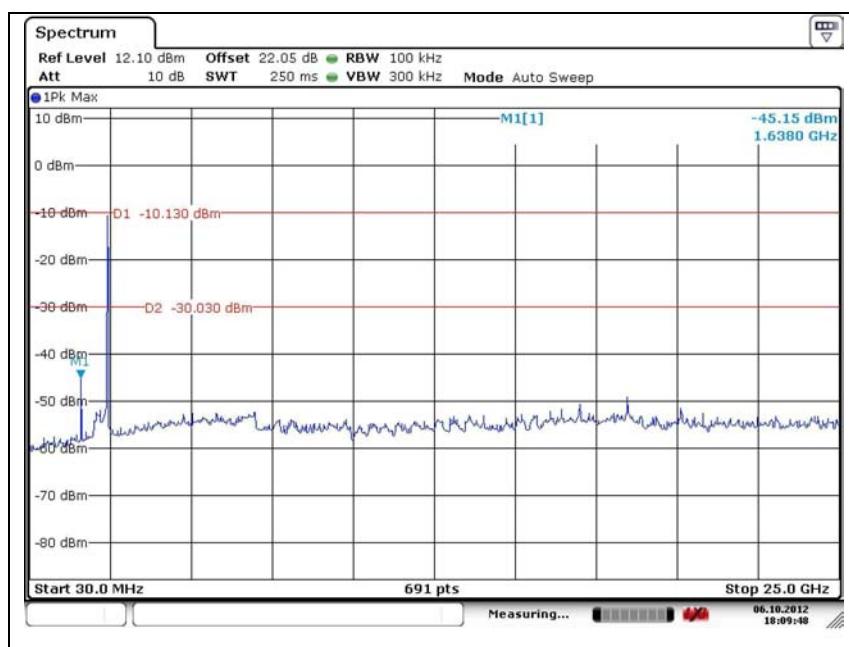
802.11n HT20 // Ant. Port 1 // High channel


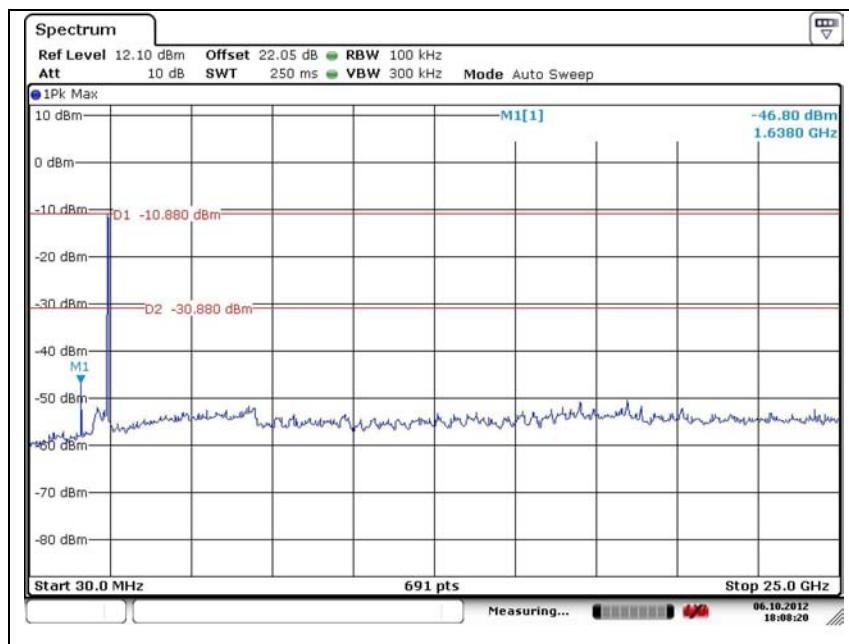
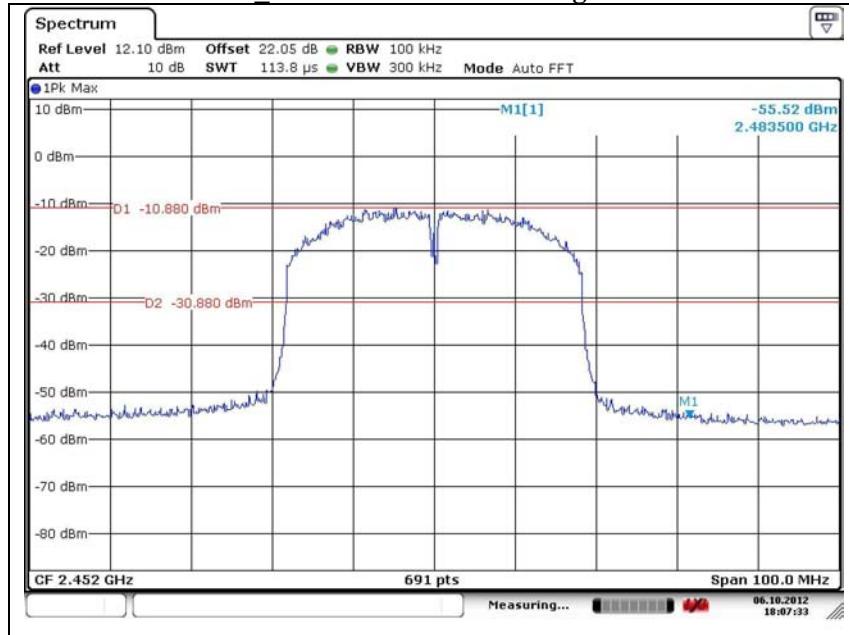
802.11n HT20 // Ant. Port 2 // Low channel


802.11n HT20 // Ant. Port 2 // Middle channel


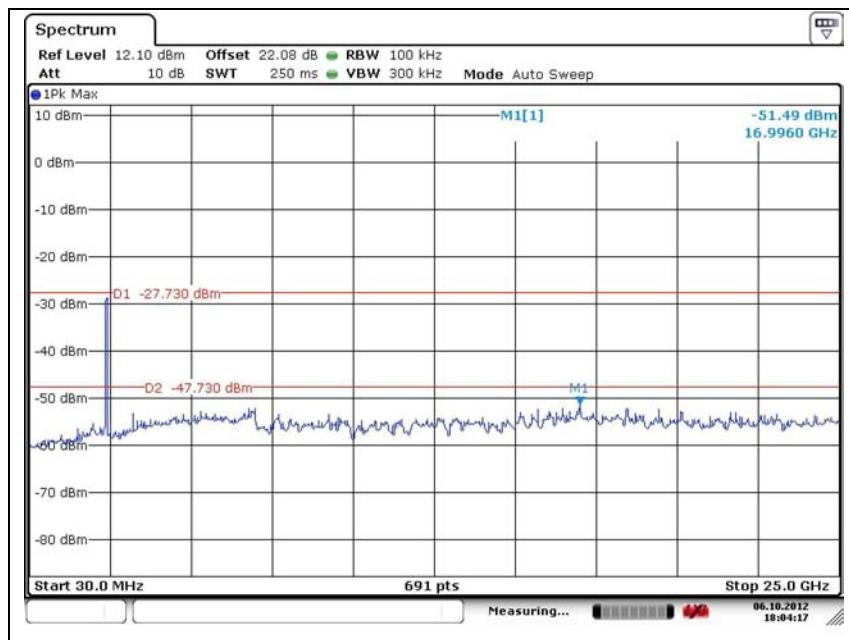
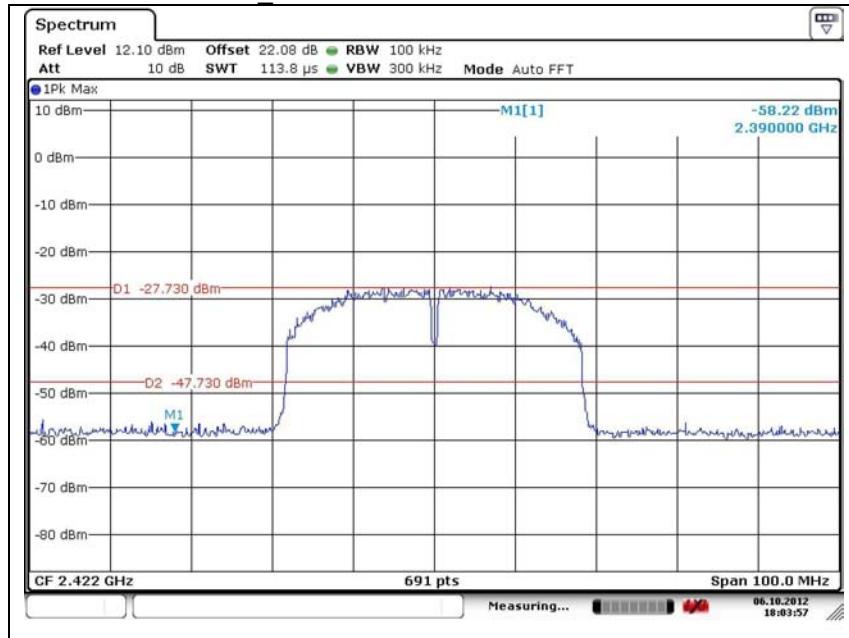
802.11n HT20 // Ant. Port 2 // High channel


802.11n HT40 // Ant. Port 1 // Low channel


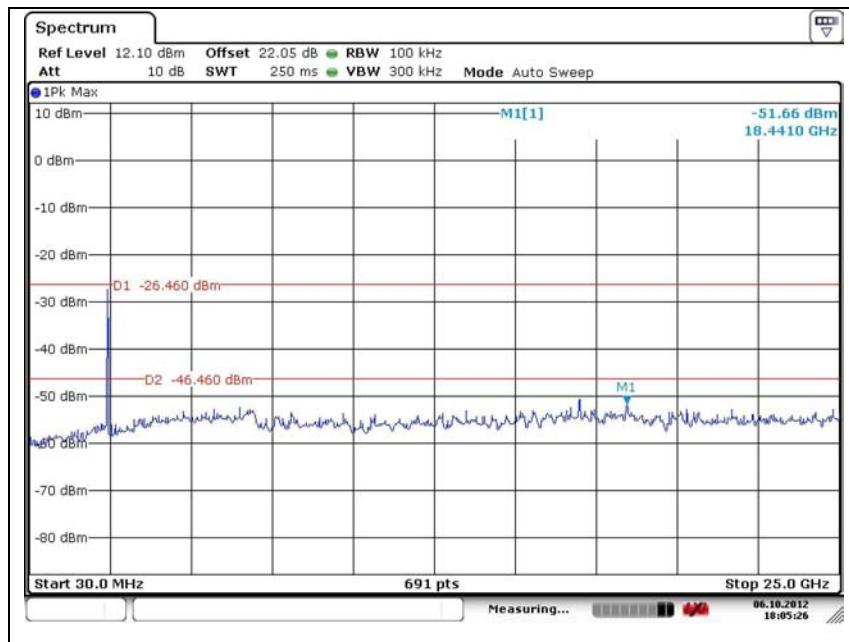
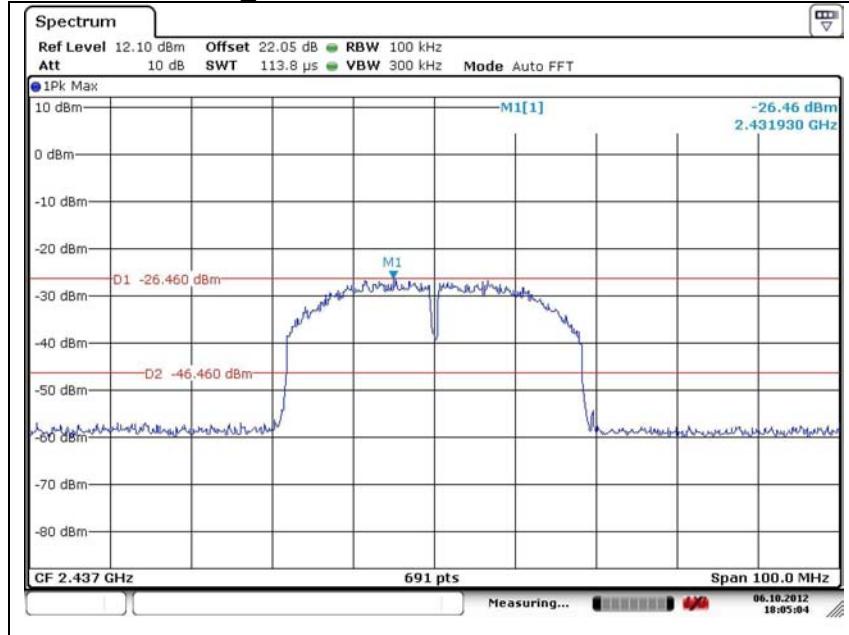
802.11n HT40 // Ant. Port 1 // Middle channel


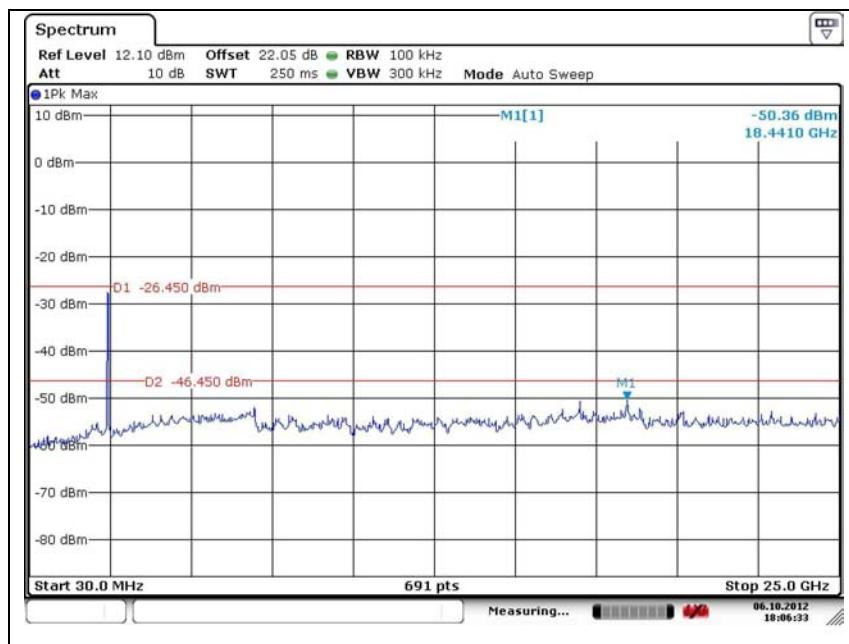
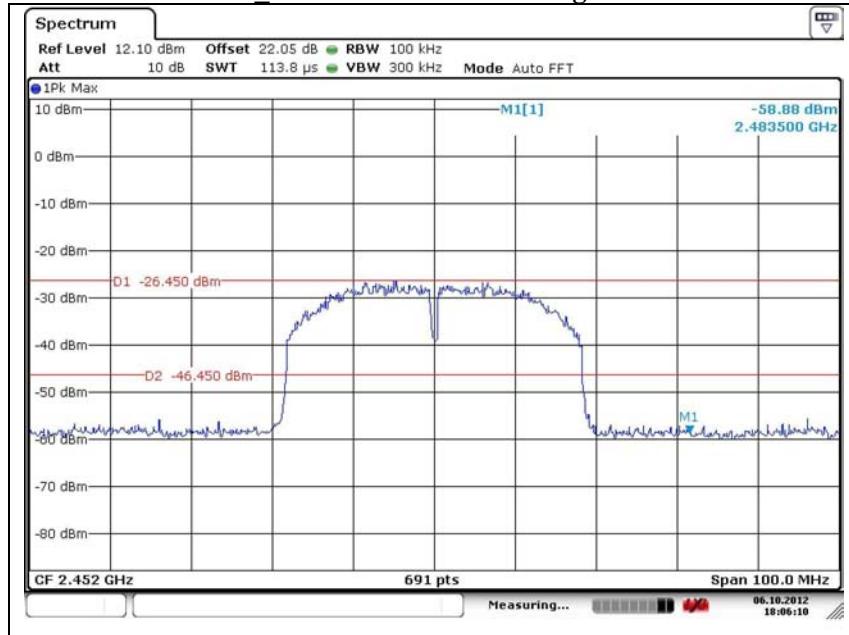
802.11n HT40 // Ant. Port 1 // High channel


802.11n HT40 // Ant. Port 2 // Low channel



802.11n HT40 // Ant. Port 2 // Middle channel



802.11n HT40 // Ant. Port 2 // High channel


2.1.6 AC conducted emissions

Frequency range of measurement

150 kHz to 30 MHz

Instrument settings

IF Band Width: 9 kHz

Test procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

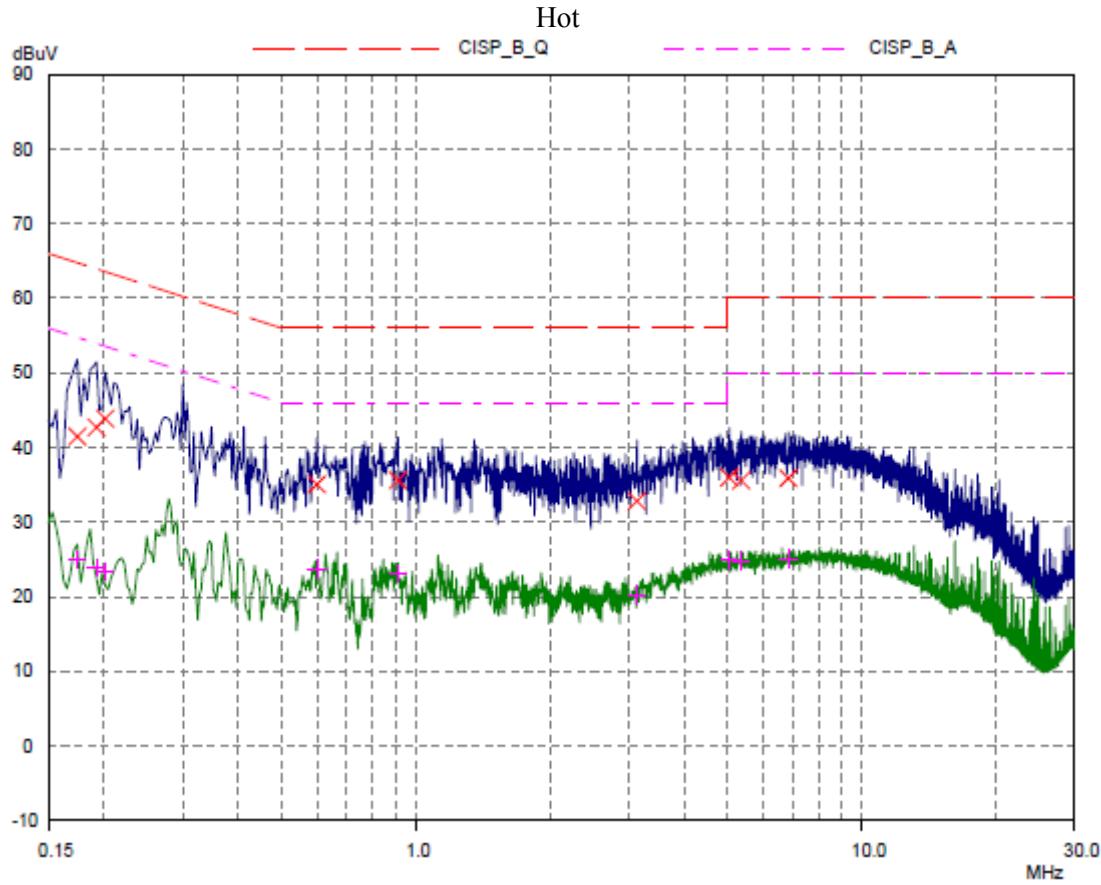
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dB μ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Remark

Decreases with the logarithm of the frequency.

Test results



Final Measurement Results

Frequency MHz	QP Level dBuV	QP Limit dBuV	QP Delta dB
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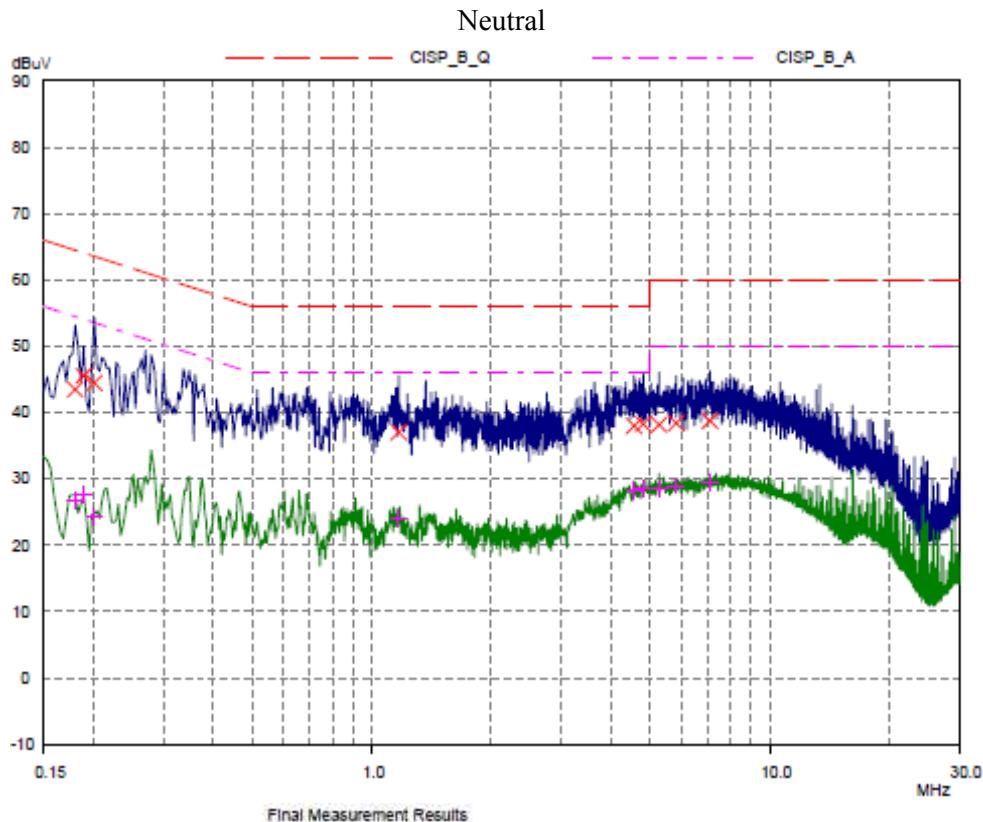
0.174	41.48	64.77	23.29
0.192	42.69	63.95	21.26
0.201	43.87	63.57	19.70
0.6	35.06	56.00	20.94
0.912	35.60	56.00	20.40
3.135	32.82	56.00	23.18
5.052	35.97	60.00	24.03
5.376	35.59	60.00	24.41
6.861	35.88	60.00	24.12

Frequency MHz	AV Level dBuV	AV Limit dBuV	AV Delta dB
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0.174	24.99	54.77	29.78
0.192	23.87	53.95	30.08
0.201	23.35	53.57	30.22
0.6	23.76	46.00	22.24
0.912	23.10	46.00	22.90
3.135	20.24	46.00	25.76
5.052	24.90	50.00	25.10
5.376	24.84	50.00	25.16
6.861	25.12	50.00	24.88

Note:

Both Cable loss and LISN factor are included in measurement level. (QP Level or AV Level)



Frequency MHz	QP Level dBuV	QP Limit dBuV	QP Delta dB
------------------	------------------	------------------	----------------

0.18	43.51	64.49	20.98
0.189	45.56	64.08	18.52
0.201	44.49	63.57	19.08
1.17	37.04	56.00	18.96
4.566	37.98	56.00	18.02
4.818	36.30	56.00	17.70
5.277	38.19	60.00	21.81
5.826	38.40	60.00	21.60
7.086	38.75	60.00	21.25

Frequency MHz	AV Level dBuV	AV Limit dBuV	AV Delta dB
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0.18	26.83	54.49	27.66
0.189	27.70	54.08	26.38
0.201	24.34	53.57	29.23
1.17	24.00	46.00	22.00
4.566	28.31	46.00	17.69
4.818	28.48	46.00	17.52
5.277	28.62	50.00	21.38
5.826	28.96	50.00	21.04
7.086	29.56	50.00	20.44

Note:

Both Cable loss and LISN factor are included in measurement level. (QP Level or AV Level)



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www.kes.co.kr

Appendix A. Test equipment used for test

Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2013.01.10
Vector Signal Generator	R&S	SMBV2100A	2013.01.10
Signal Generator	HP	83630B	2013.06.06
Power sensor	R&S	NRP-Z81	2012.12.21
Attenuator	HP	8495B	2013.05.04
Attenuator	HP	8494B	2013.05.04
AC Power Supply	Taegwang	Jeon-3-5-1292	2013.08.04
Loop Antenna	R&S	HFH2-Z2.335.4711.52	2013.03.10
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	2013.10.25
Horn Antenna	A.H. System	SAS-571	2013.03.22
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	2013.01.10
Preamplifier	A.H. System	PAM-0118	2013.05.04
EMC Analyzer	Agilent	E7405A	2013.08.16
EMI TEST Receiver	R & S	ESHS10	2013.05.04
LISN	R & S	ENV216	2013.02.27
LISN	EMCO	3810/2	2013.04.18

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook	Samsung electronics	NT-R410Y	Z9YJ93CS300631H
Netbook	Lenovo	S10-2	2957N5K

Appendix B. Test setup photos

Radiated field emissions



AC conducted emission

