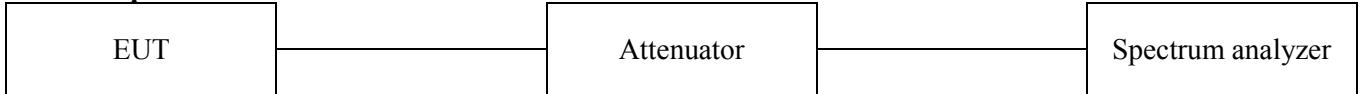


3.3. 6 dB bandwidth

Test setup



Test procedure

KDB 558074_v03r01 – section 8.2 option 1 or option 2.

Option 1:

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

Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the X bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

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.



Test results

- UFL type PCB antenna

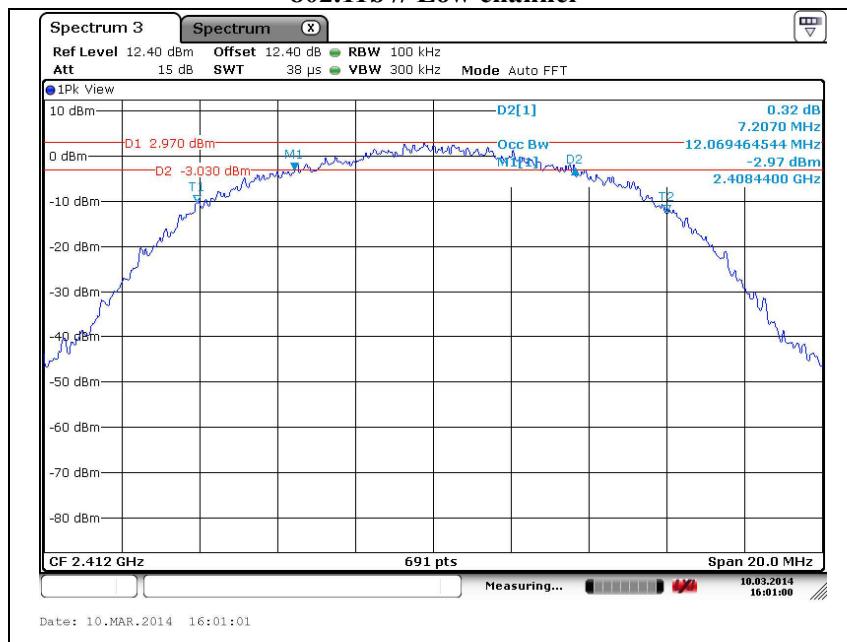
Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
802.11b	2 412	7.21	0.5
	2 437	7.35	
	2 462	7.79	
802.11g	2 412	15.08	0.5
	2 437	15.08	
	2 462	15.08	
802.11n (HT20)	2 412	15.08	0.5
	2 437	15.11	
	2 462	15.08	

- PCB antenna

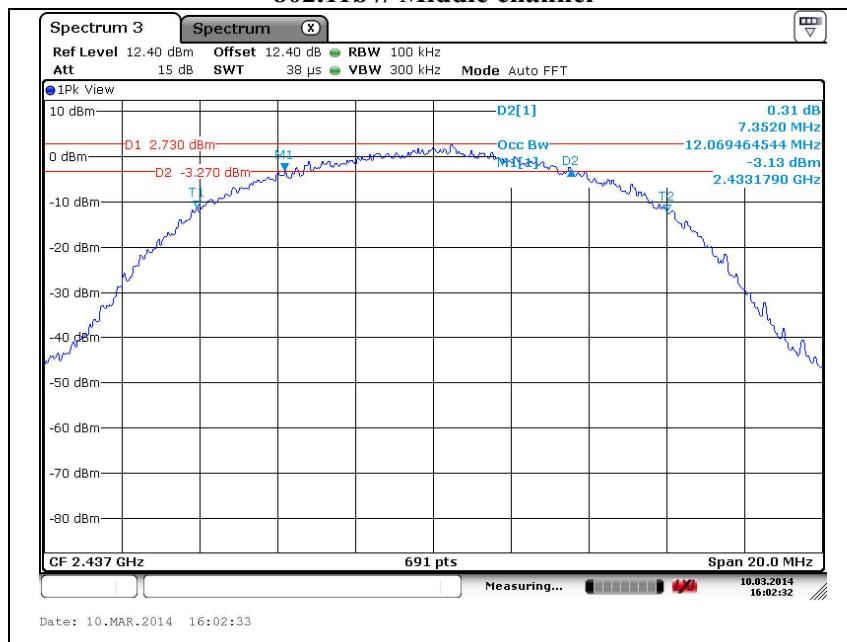
Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
802.11b	2 412	7.70	0.5
	2 437	7.79	
	2 462	7.82	
802.11g	2 412	15.31	0.5
	2 437	15.11	
	2 462	15.08	
802.11n (HT20)	2 412	15.11	0.5
	2 437	15.11	
	2 462	15.11	

- UFL type PCB antenna

802.11b // Low channel

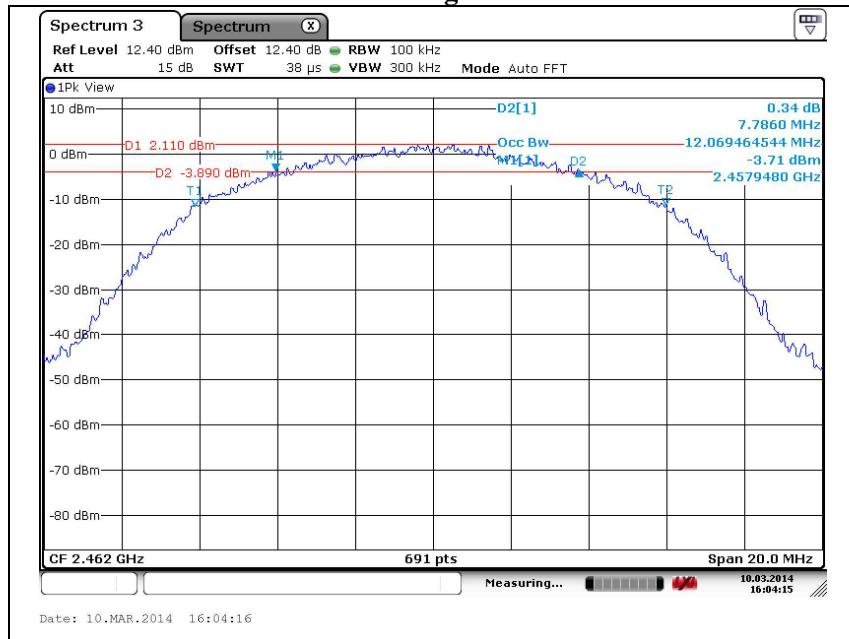


802.11b // Middle channel

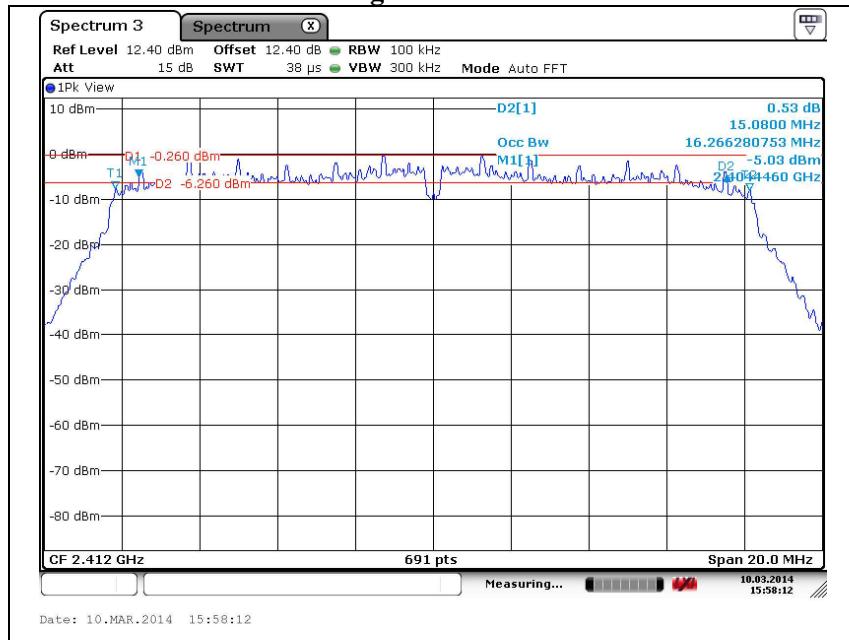


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802.11b // High channel

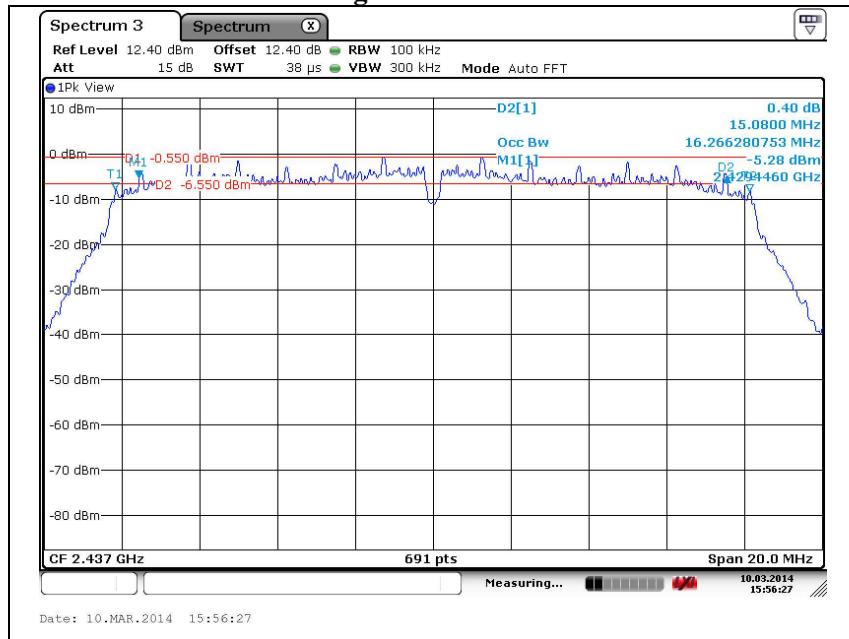


802.11g // Low channel

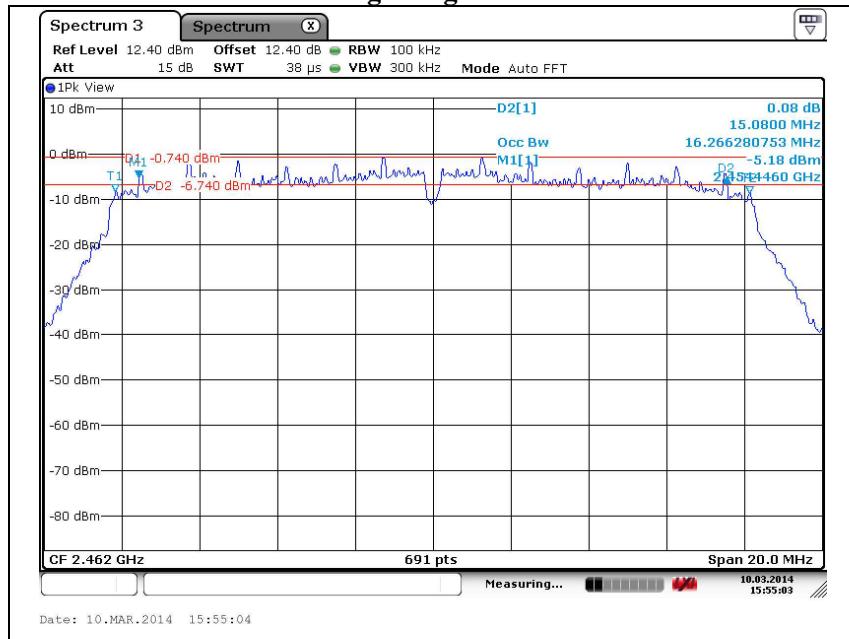


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802.11g // Middle channel

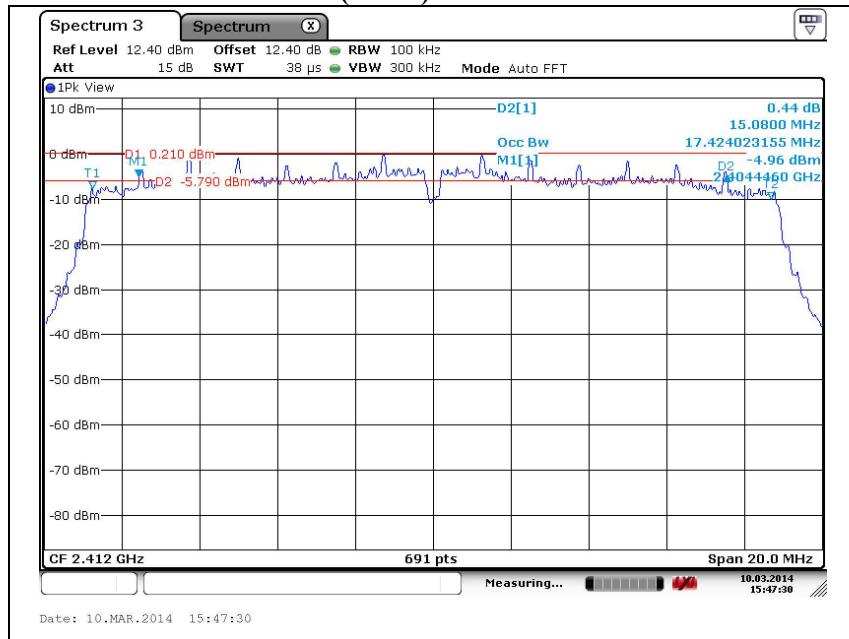


802.11g // High channel

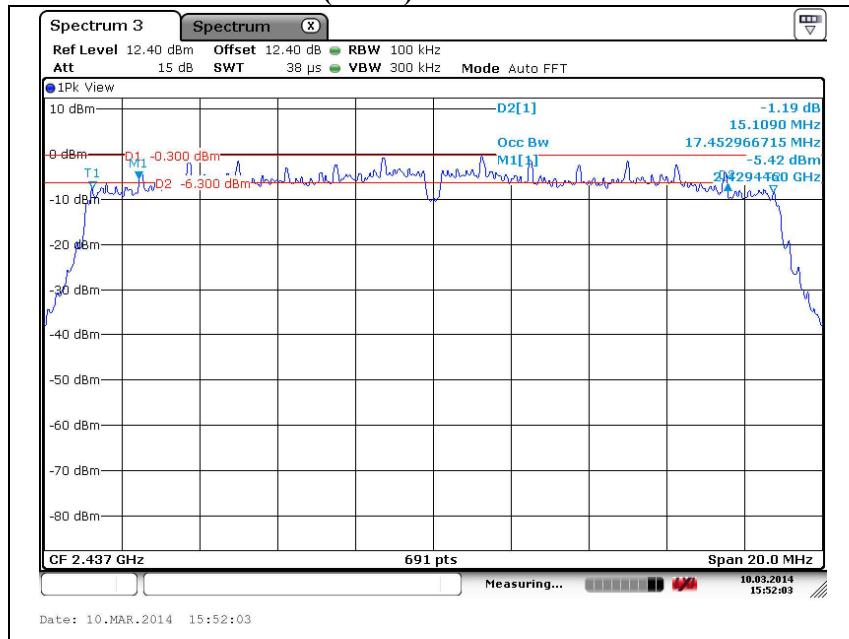


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802.11n(HT20) // Low channel

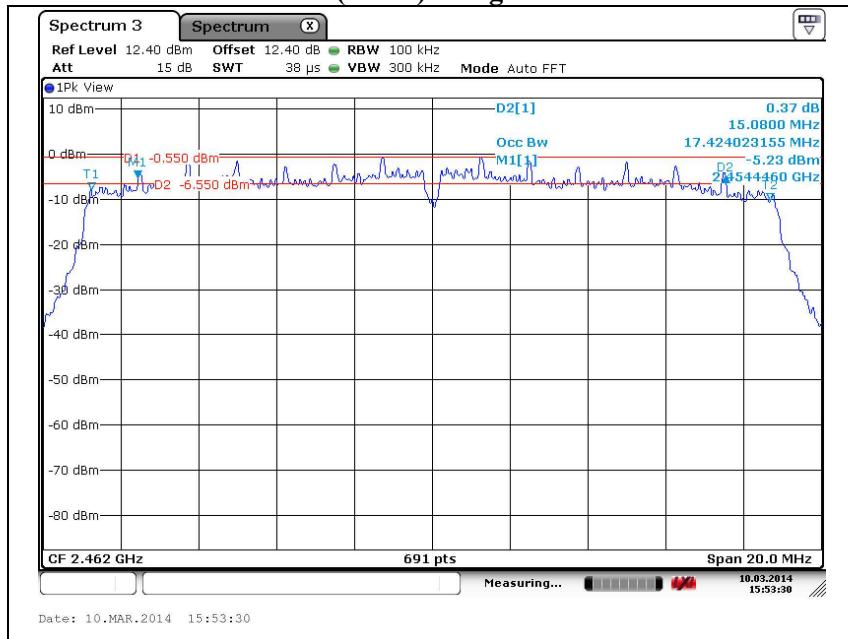


802.11n(HT20) // Middle channel



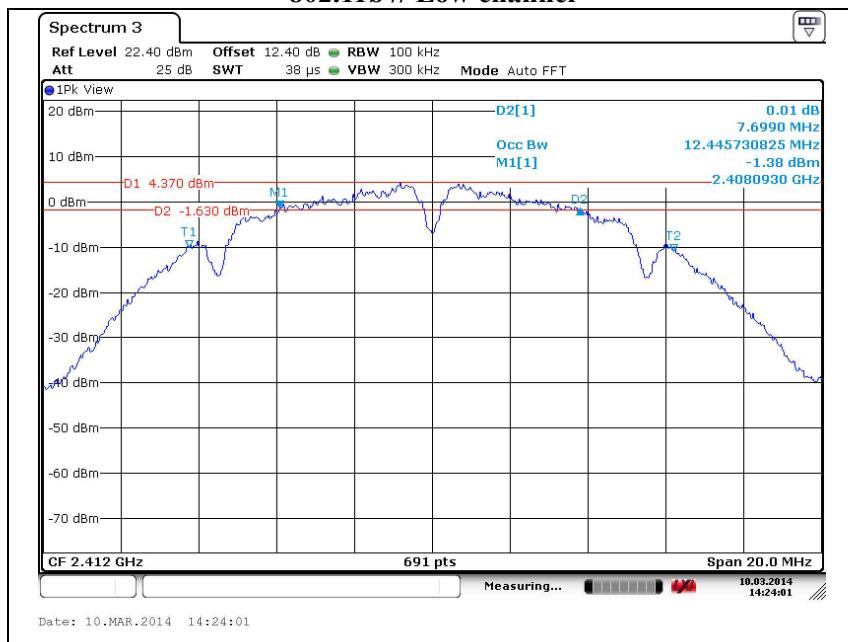
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802.11n(HT20) // High channel



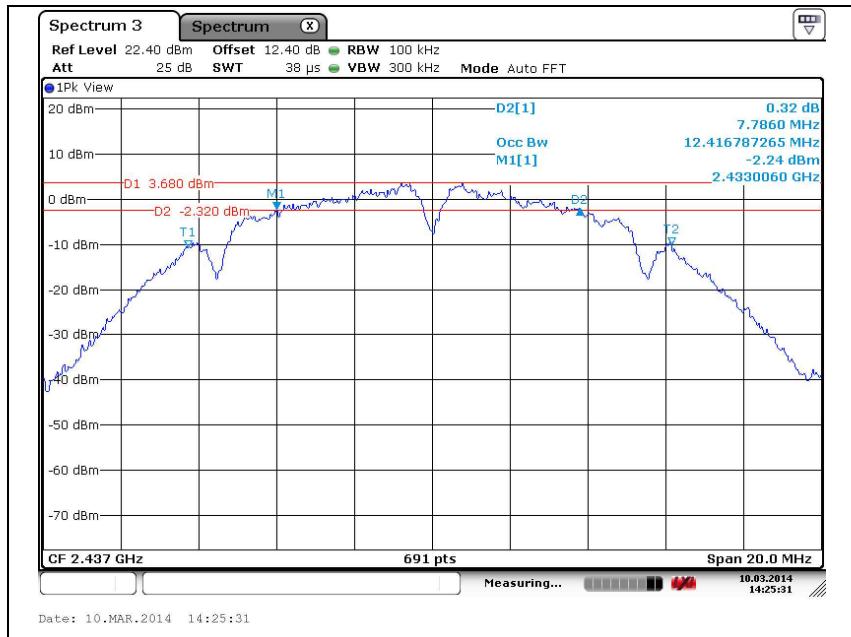
- PCB antenna

802.11b // Low channel

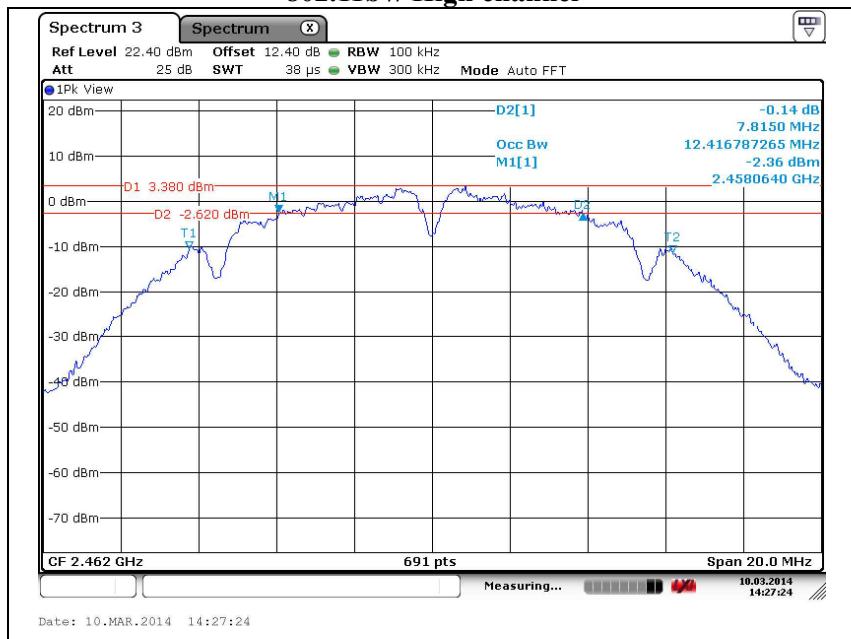


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 The test results in the report only apply to the tested sample.

802.11b // Middle channel

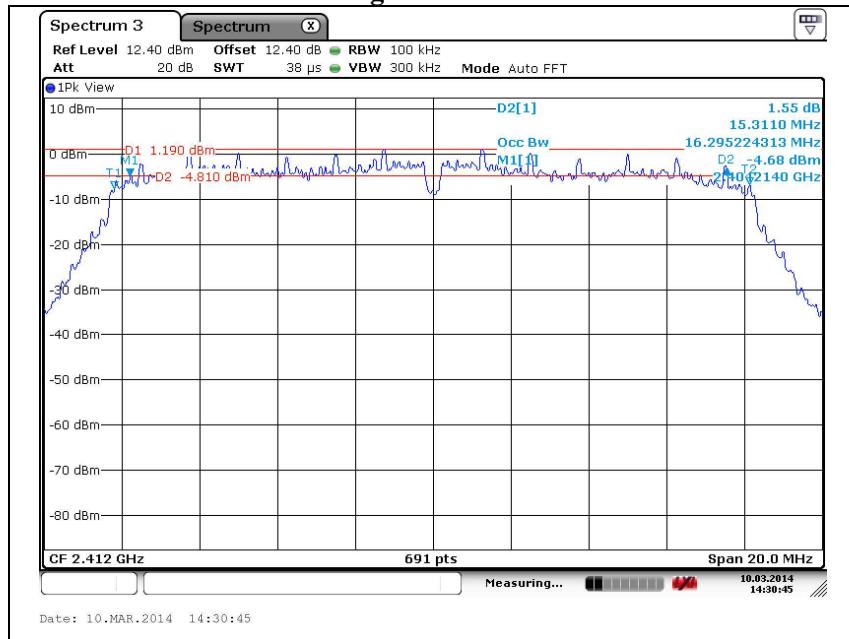


802.11b // High channel

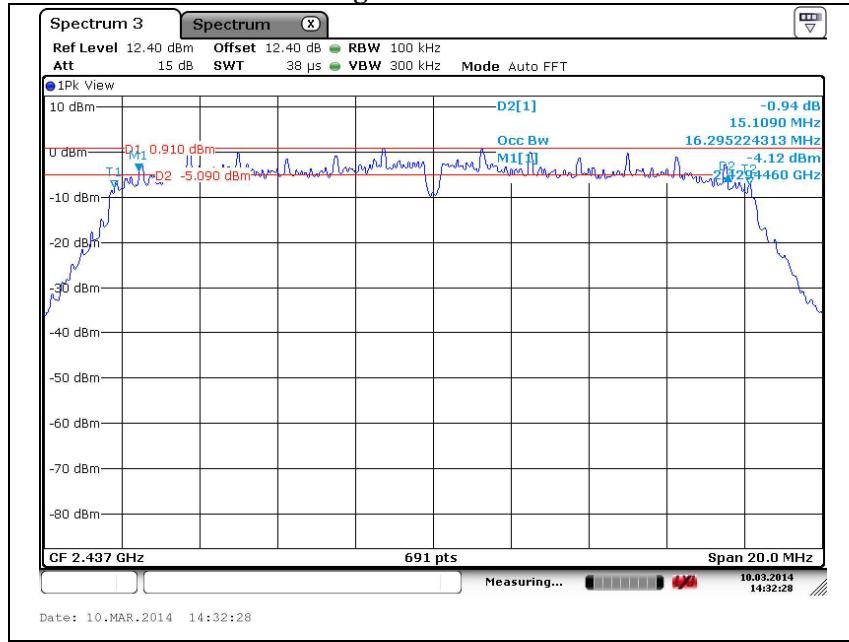


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 The test results in the report only apply to the tested sample.

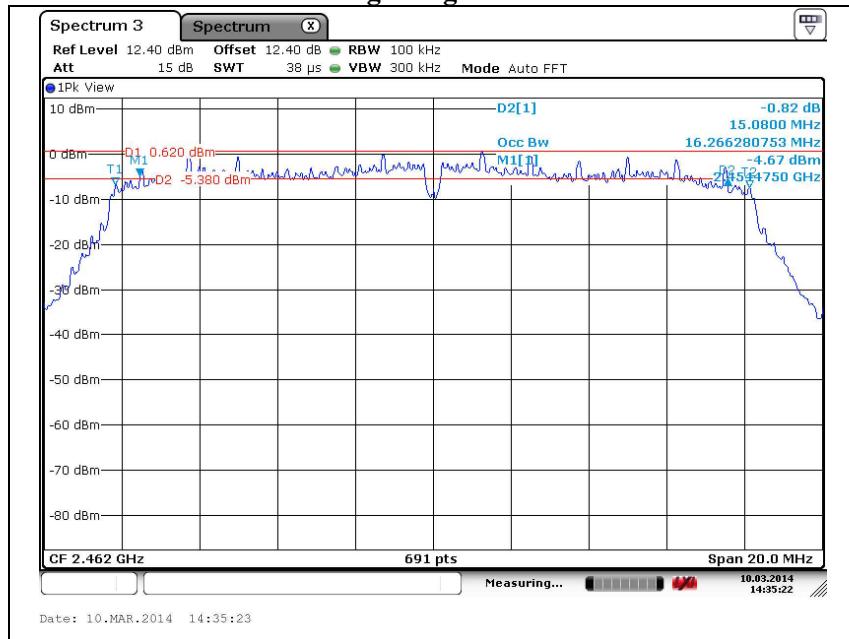
802.11g // Low channel



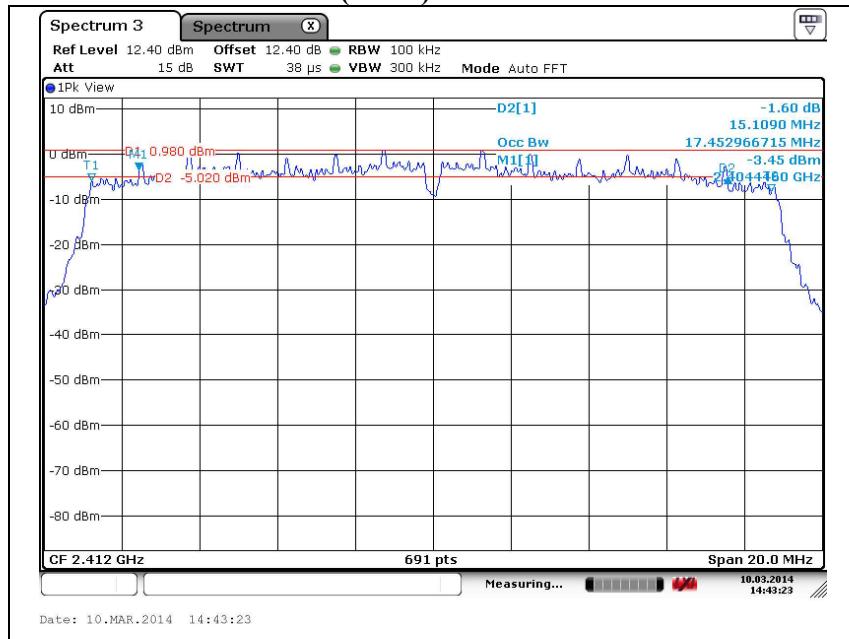
802.11g // Middle channel



802.11g // High channel

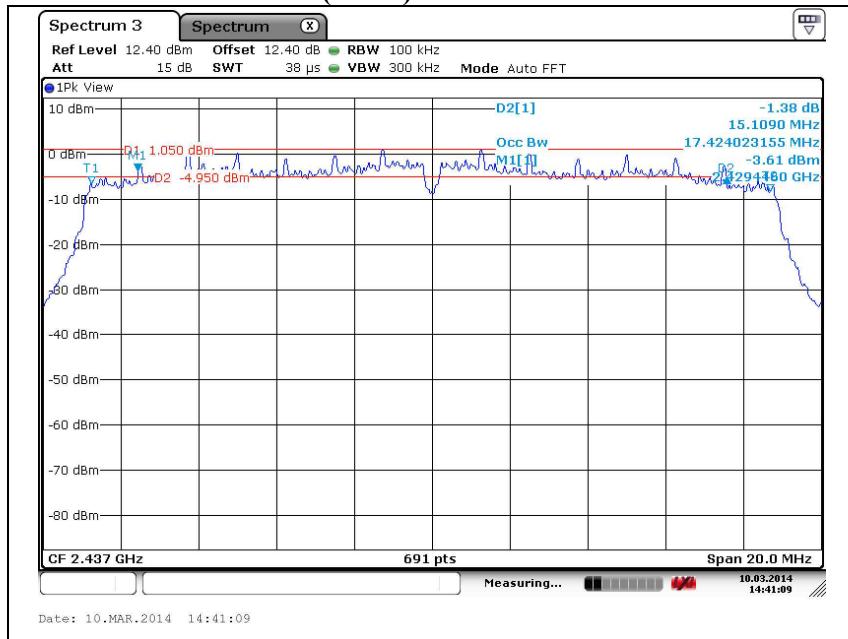


802.11n(HT20) // Low channel

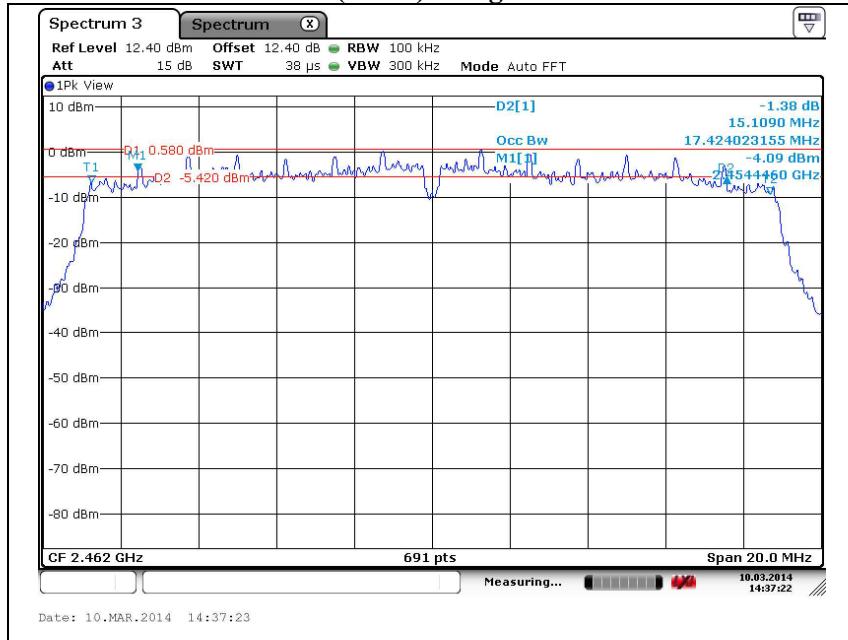


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 The test results in the report only apply to the tested sample.

802.11n(HT20) // Middle channel

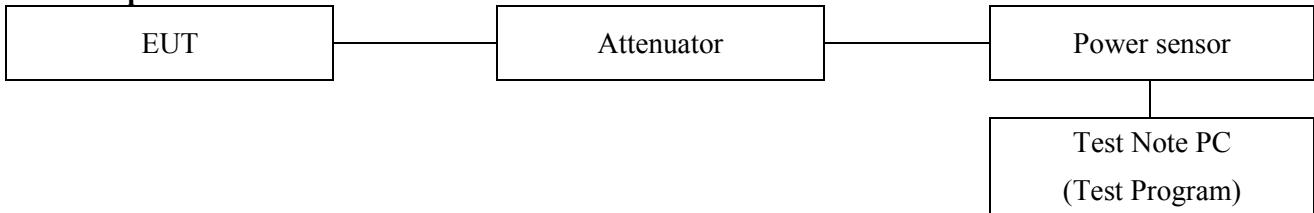


802.11n(HT20) // High channel



3.4. Output power

Test setup



Test procedure

KDB 558074_v03r01 – section 9.0

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.



Test results

- UFL type PCB antenna

Test mode	Frequency(MHz)	Detector mode	Results (dBm)	Limit(dBm)
802.11b	2 412	Peak	14.67	30
		Average	12.05	
	2 437	Peak	14.38	
		Average	11.74	
	2 462	Peak	14.08	
		Average	11.53	
802.11g	2 412	Peak	19.32	30
		Average	11.19	
	2 437	Peak	18.76	
		Average	11.00	
	2 462	Peak	18.86	
		Average	10.89	
802.11n(HT20)	2 412	Peak	19.25	30
		Average	11.07	
	2 437	Peak	18.93	
		Average	10.96	
	2 462	Peak	19.04	
		Average	10.81	

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The test results in the report only apply to the tested sample.

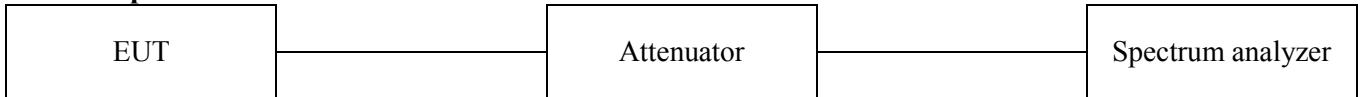


- PCB antenna

Test mode	Frequency(MHz)	Detector mode	Results (dBm)	Limit(dBm)
802.11b	2 412	Peak	17.22	30
		Average	12.89	
	2 437	Peak	15.96	
		Average	12.52	
	2 462	Peak	15.41	
		Average	12.21	
802.11g	2 412	Peak	20.15	30
		Average	12.68	
	2 437	Peak	20.14	
		Average	12.33	
	2 462	Peak	19.86	
		Average	11.73	
802.11n(HT20)	2 412	Peak	20.09	30
		Average	12.55	
	2 437	Peak	20.08	
		Average	12.25	
	2 462	Peak	19.70	
		Average	11.54	

3.5. Power spectral density

Test setup



Test procedure

KDB 558074_v03r01 – section 10.2

Measurement procedure

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

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.



Test results

- UFL type PCB antenna

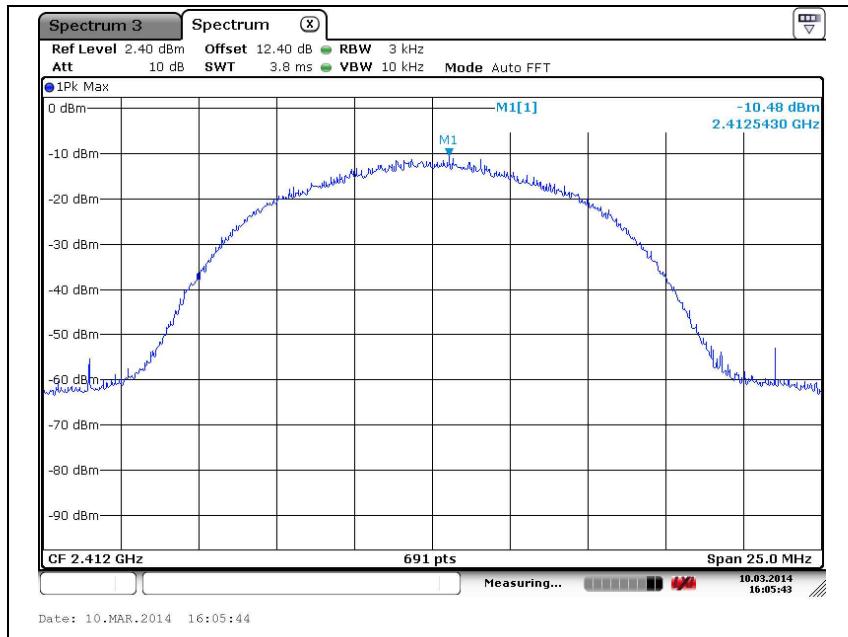
Operation mode	Frequency(MHz)	Measured PSD(dBm)	Limit(dBm)
802.11b	2 412	-10.48	8
	2 437	-11.42	
	2 462	-11.47	
802.11g	2 412	-13.19	8
	2 437	-13.67	
	2 462	-13.45	
802.11n (HT20)	2 412	-13.49	8
	2 437	-13.77	
	2 462	-13.86	

- PCB antenna

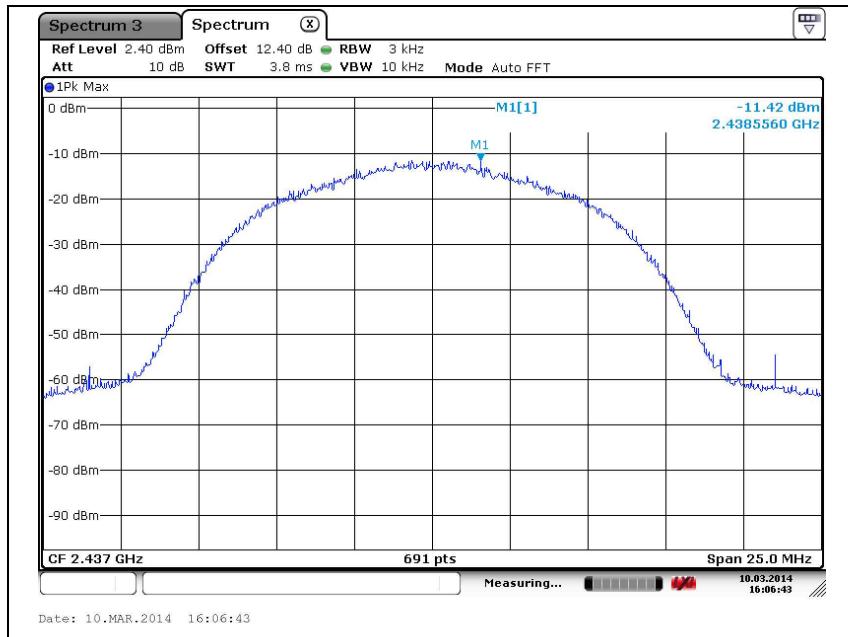
Operation mode	Frequency(MHz)	Measured PSD(dBm)	Limit(dBm)
802.11b	2 412	-10.48	8
	2 437	-11.42	
	2 462	-11.47	
802.11g	2 412	-13.19	8
	2 437	-13.67	
	2 462	-13.45	
802.11n (HT20)	2 412	-13.49	8
	2 437	-13.77	
	2 462	-13.86	

- UFL type PCB antenna

802.11b // Low channel

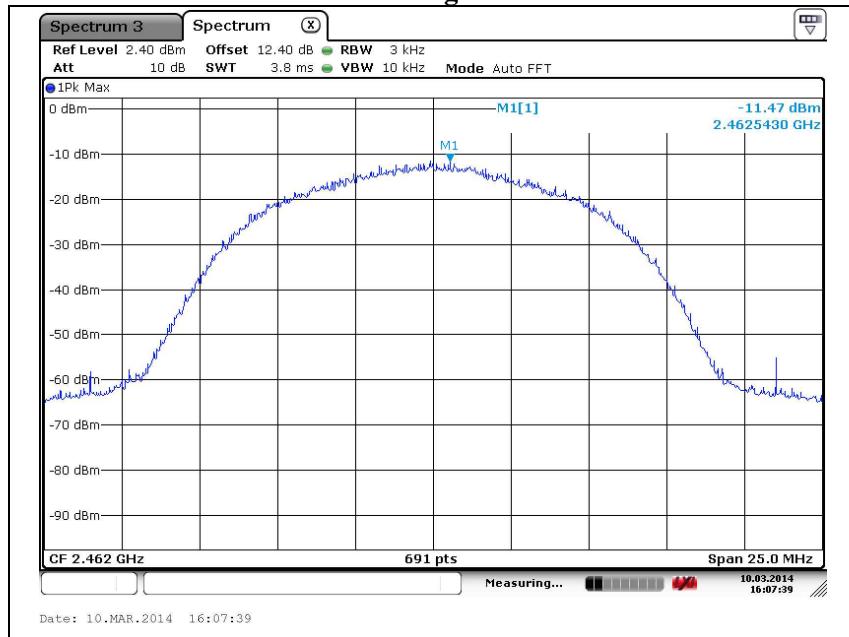


802.11b // Middle channel

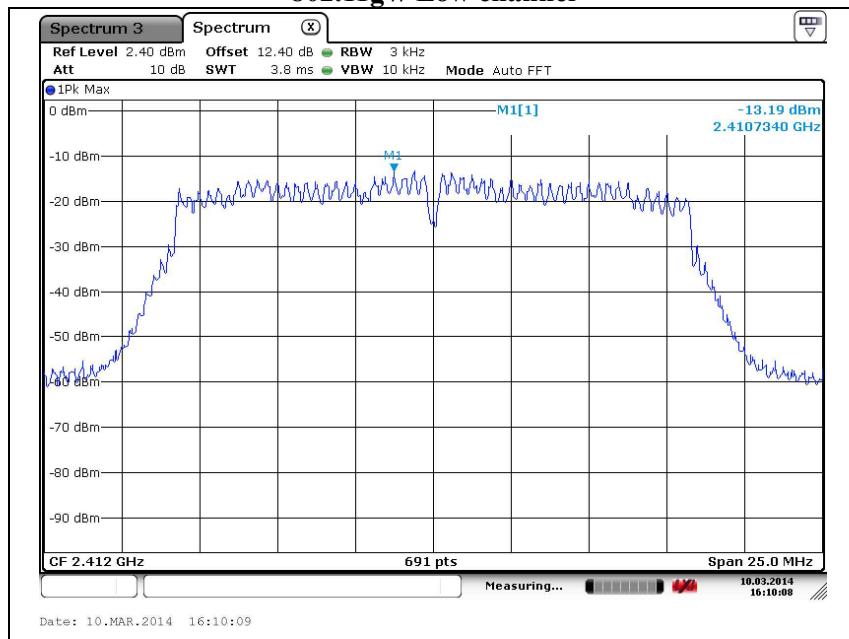


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802.11b // High channel

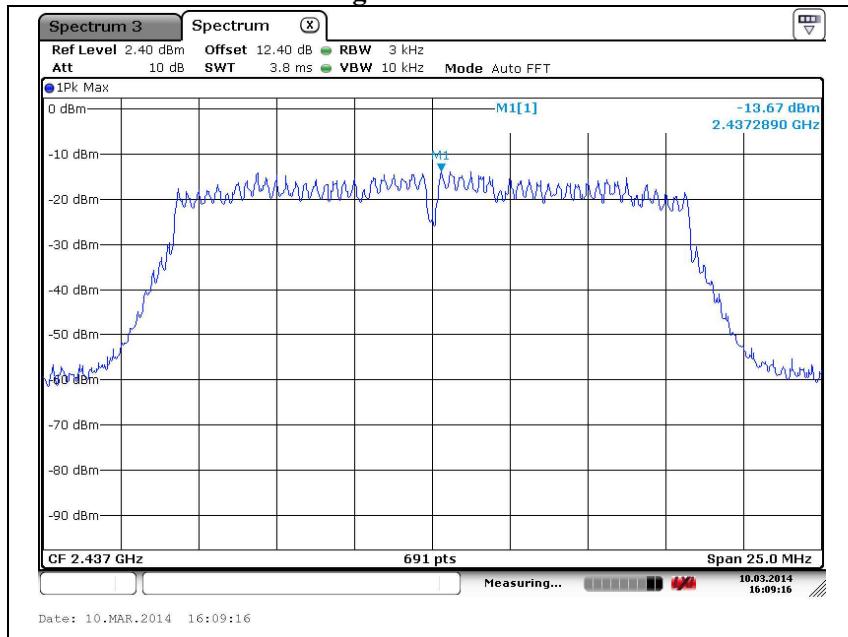


802.11g // Low channel

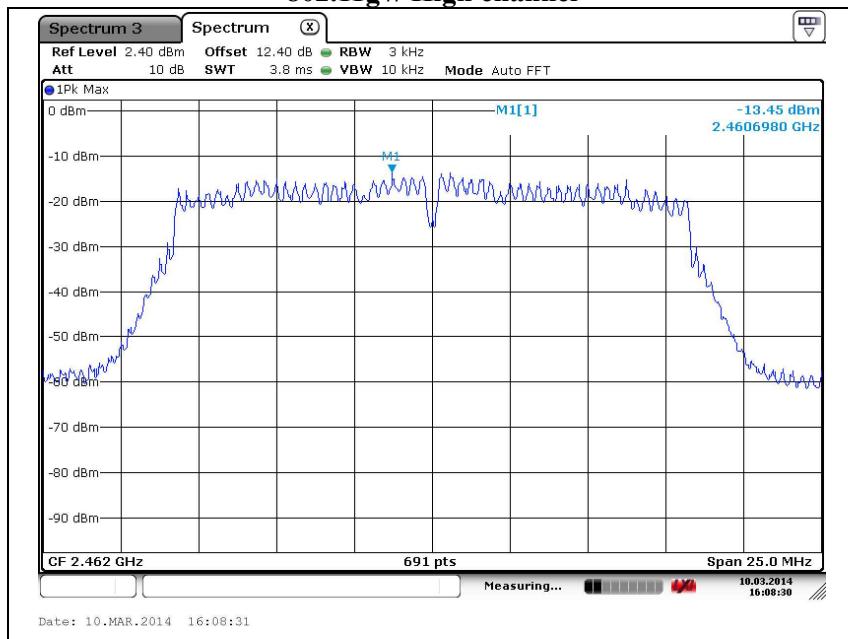


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802.11g // Middle channel

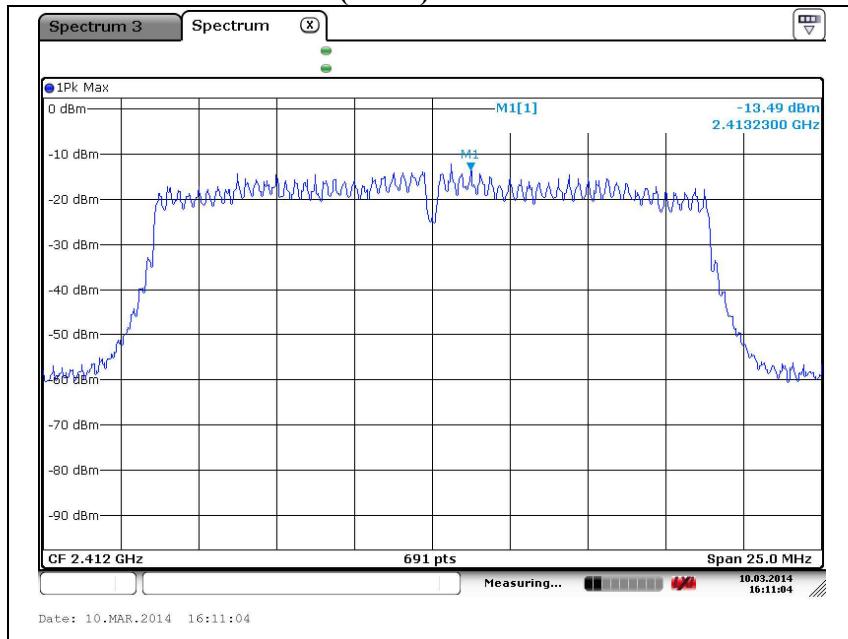


802.11g // High channel

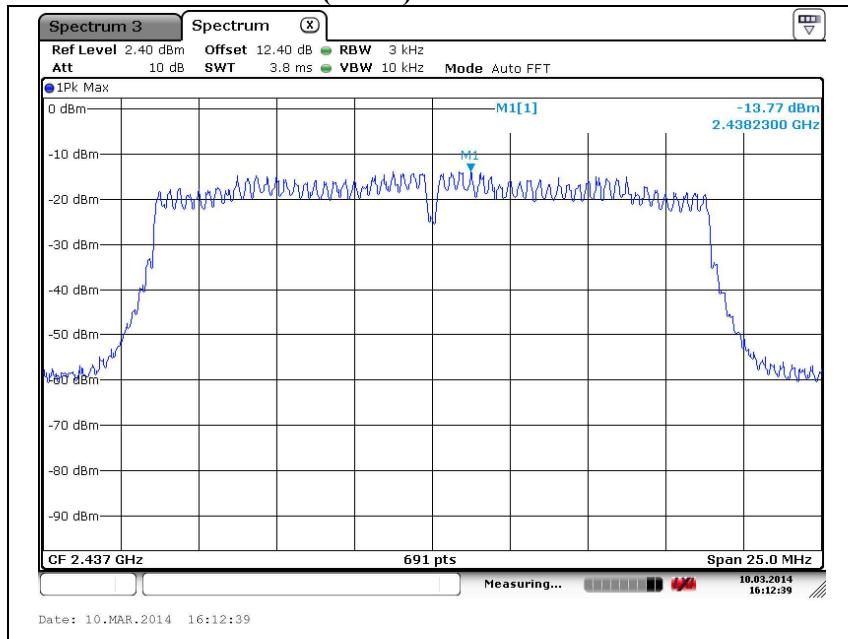


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 The test results in the report only apply to the tested sample.

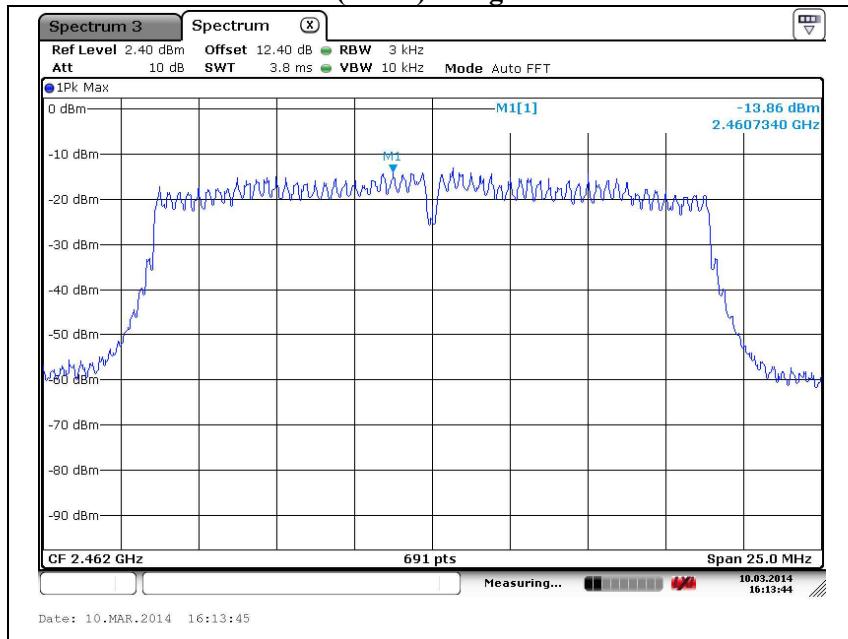
802.11n(HT20) // Low channel



802.11n(HT20) // Middle channel

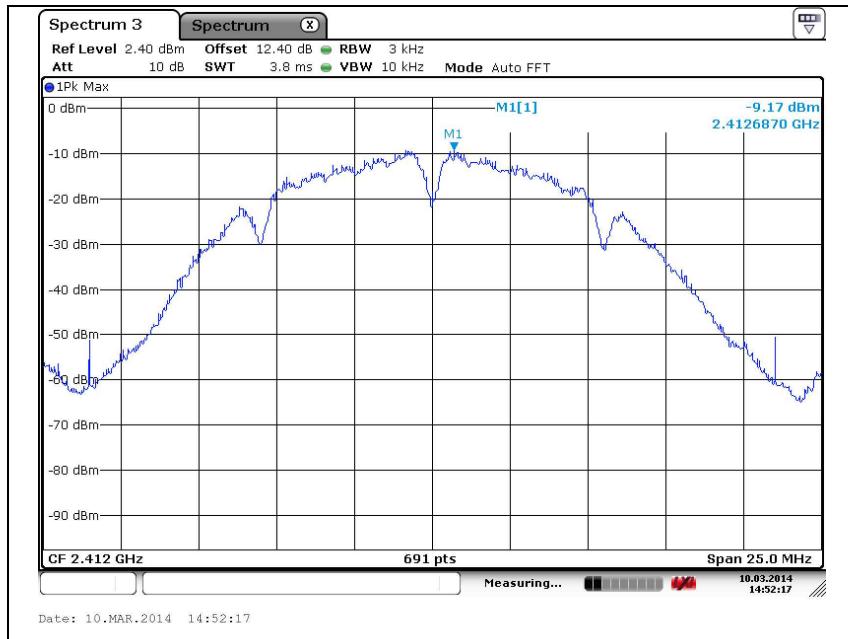


802.11n(HT20) // High channel

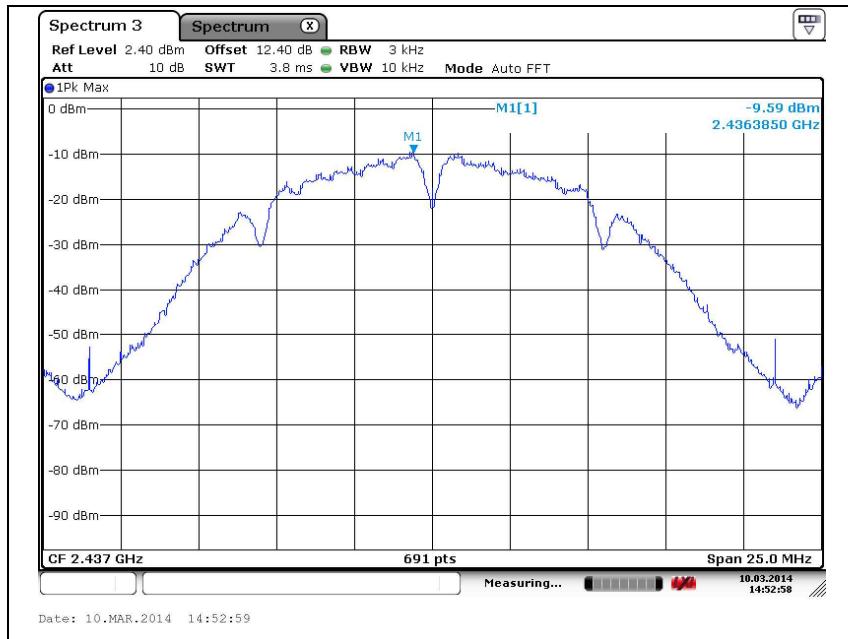


- PCB antenna

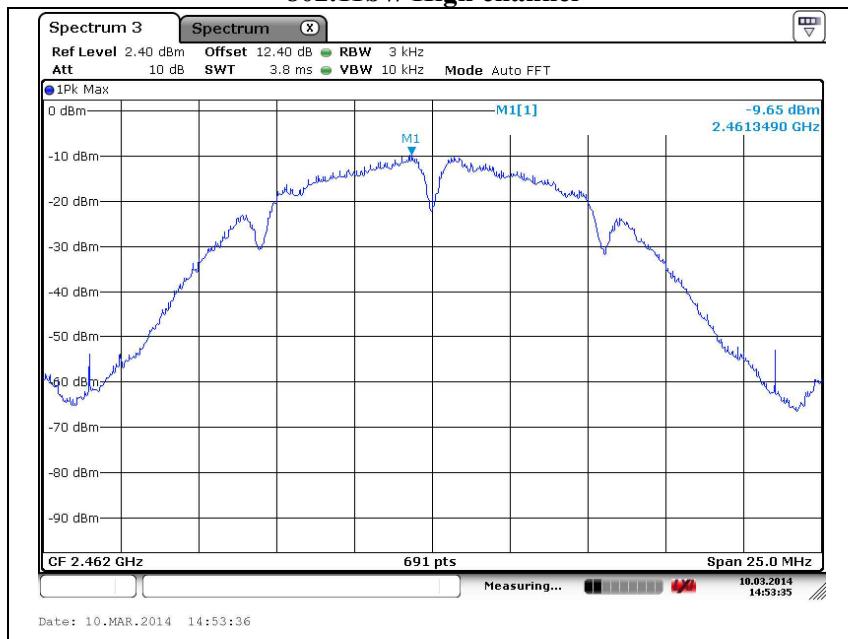
802.11b // Low channel



802.11b // Middle channel

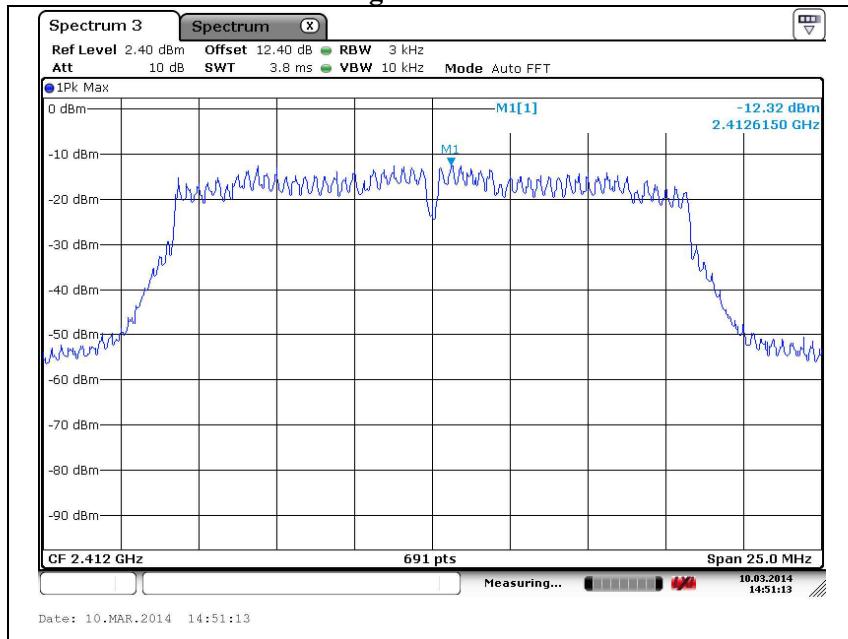


802.11b // High channel

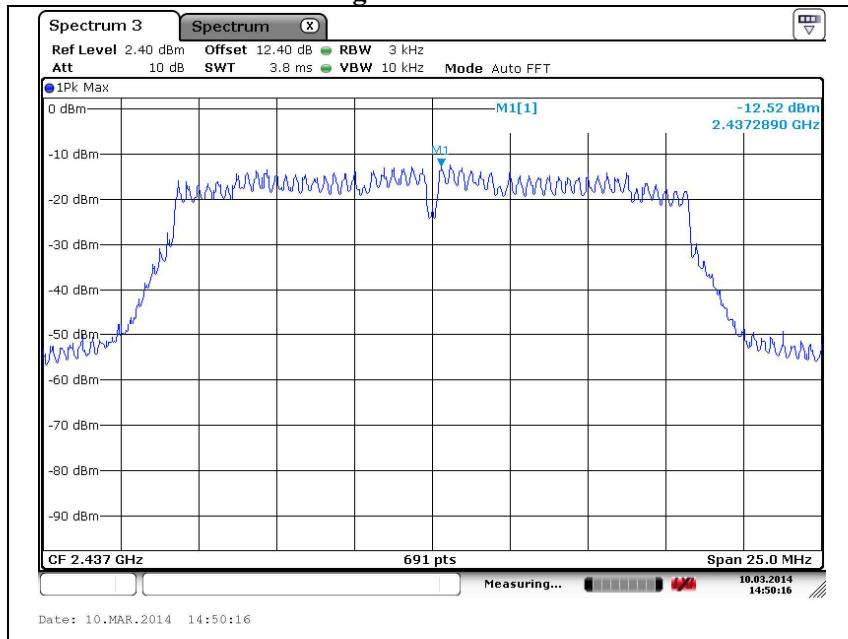


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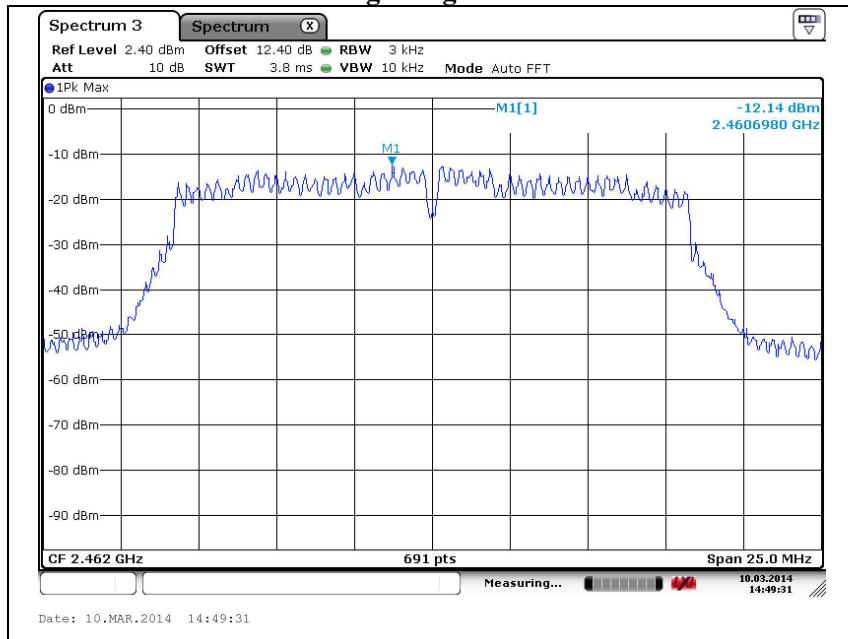
802.11g // Low channel



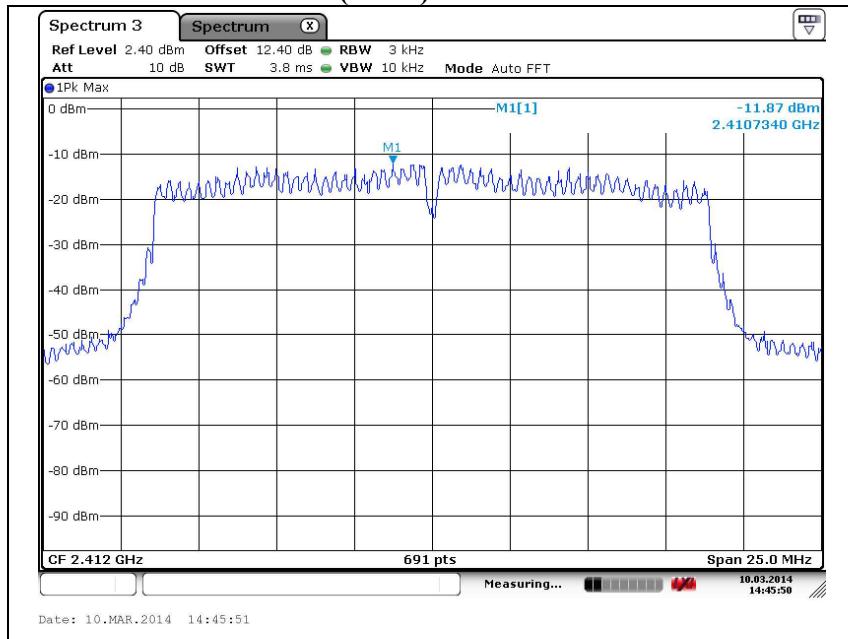
802.11g // Middle channel



802.11g // High channel

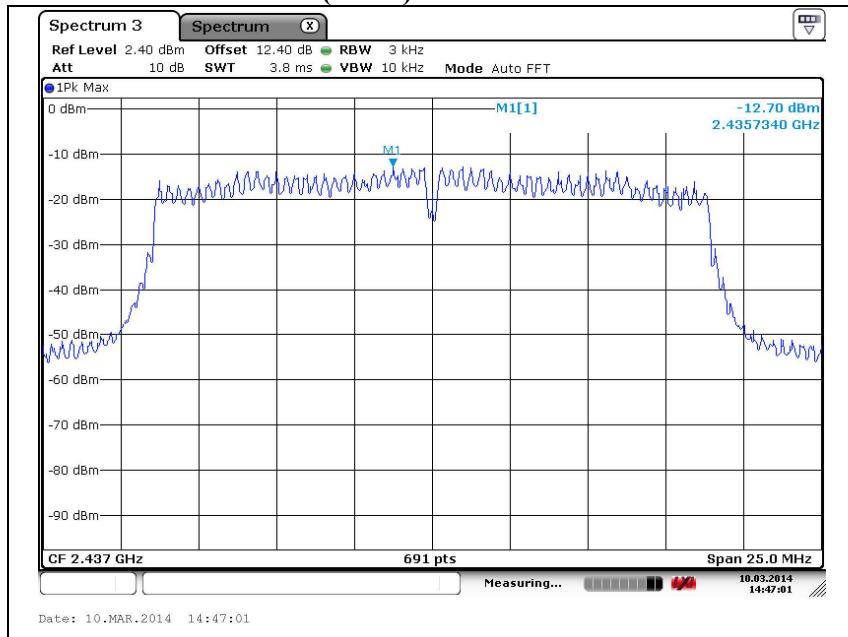


802.11n(HT20) // Low channel

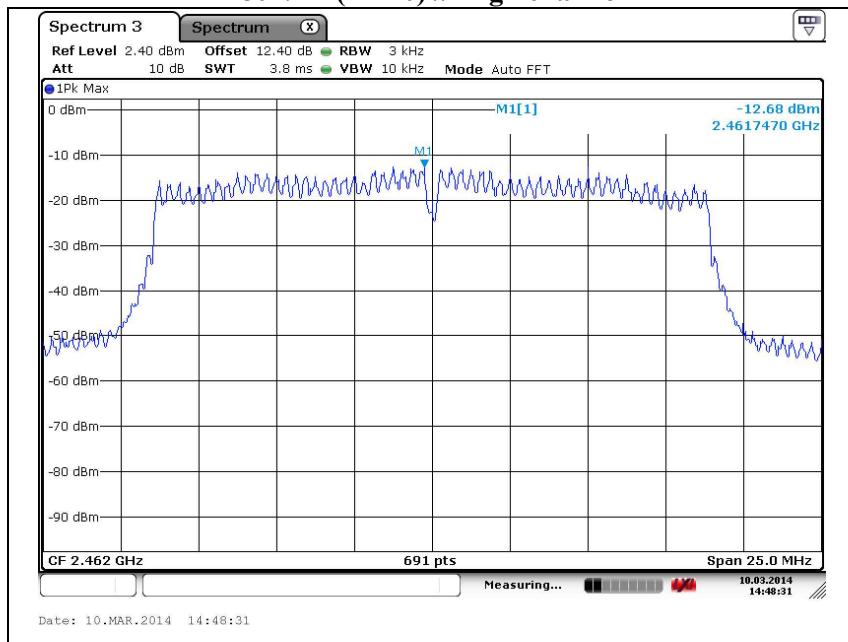


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802.11n(HT20) // Middle channel



802.11n(HT20) // High channel



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3.6. 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.

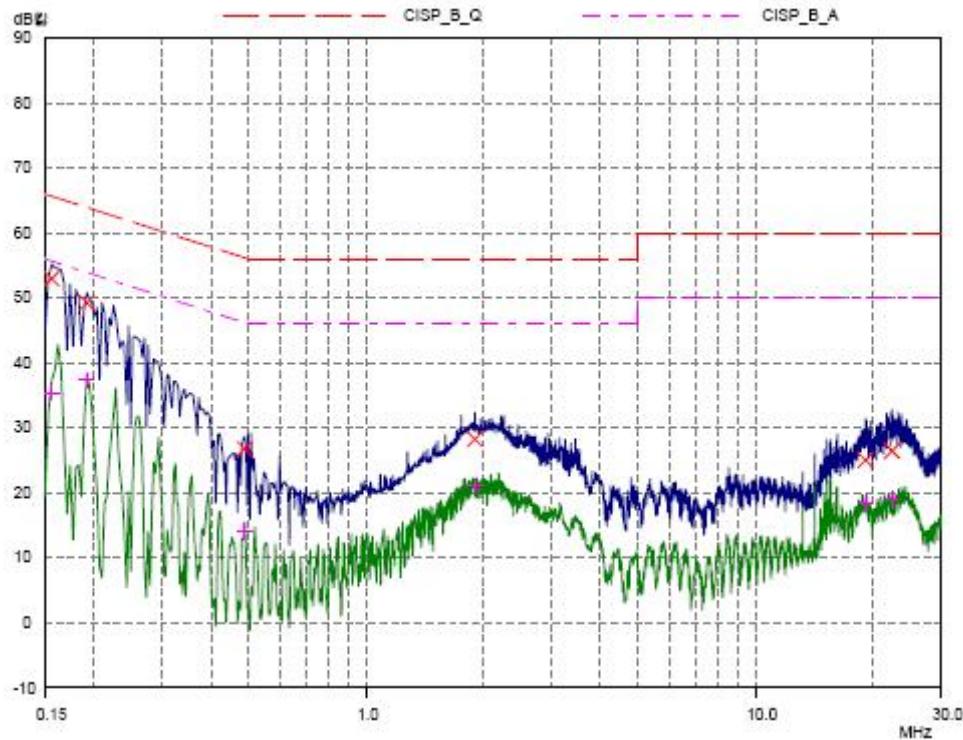
Frequency of Emission (MHz)	Conducted limit (dB μ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Note.

- a) Decreases with the logarithm of the frequency.
- b) Worst case configuration: 802.11 g
- c) All AC Conducted emission at channels are almost the same, so that low channel was chosen at representative in final test.

Test results

- UFL type PCB antenna



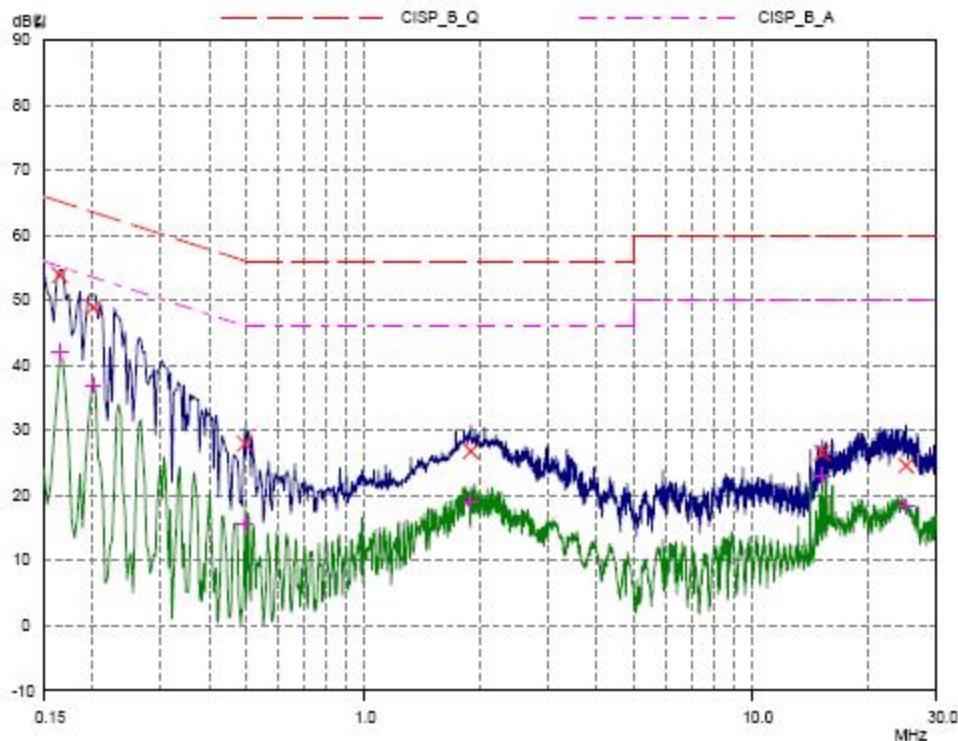
Final Measurement Results

Frequency MHz	QP Level dB _Q	QP Limit dB _Q	QP Delta dB
0.156	52.97	65.67	12.70
0.192	49.25	63.95	14.70
0.489	26.76	56.18	29.42
1.905	28.26	56.00	27.74
19.2	25.05	60.00	34.95
22.458	26.47	60.00	33.53

Frequency MHz	AV Level dB _Q	AV Limit dB _Q	AV Delta dB
0.156	35.45	55.67	20.22
0.192	37.34	53.95	16.61
0.489	14.18	46.18	32.00
1.905	21.01	46.00	24.99
19.2	18.42	50.00	31.58
22.458	19.07	50.00	30.93

Note.

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



Final Measurement Results

Frequency MHz	QP Level dB _{LP}	QP Limit dB _{LP}	QP Delta dB
------------------	------------------------------	------------------------------	----------------

0.165	53.86	65.21	11.35
0.201	48.90	63.57	14.67
0.495	27.96	56.08	28.12
1.893	26.80	56.00	29.20
15.249	26.57	60.00	33.43
25.059	24.61	60.00	35.39

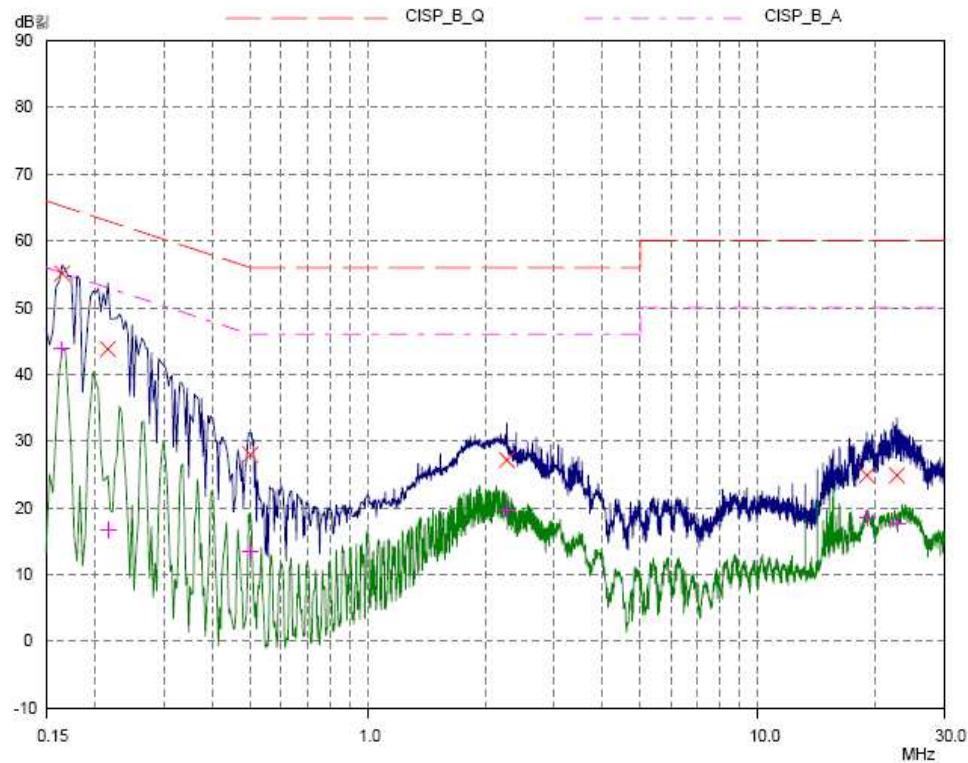
Frequency MHz	AV Level dB _{LP}	AV Limit dB _{LP}	AV Delta dB
------------------	------------------------------	------------------------------	----------------

0.165	42.02	55.21	13.19
0.201	36.94	53.57	16.63
0.495	15.71	46.08	30.37
1.893	18.94	46.00	27.06
15.249	22.97	50.00	27.03
25.059	18.30	50.00	31.70

Note.

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

- PCB antenna



Final Measurement Results

Frequency MHz	QP Level dB _{REF}	QP Limit dB _{REF}	QP Delta dB
------------------	-------------------------------	-------------------------------	----------------

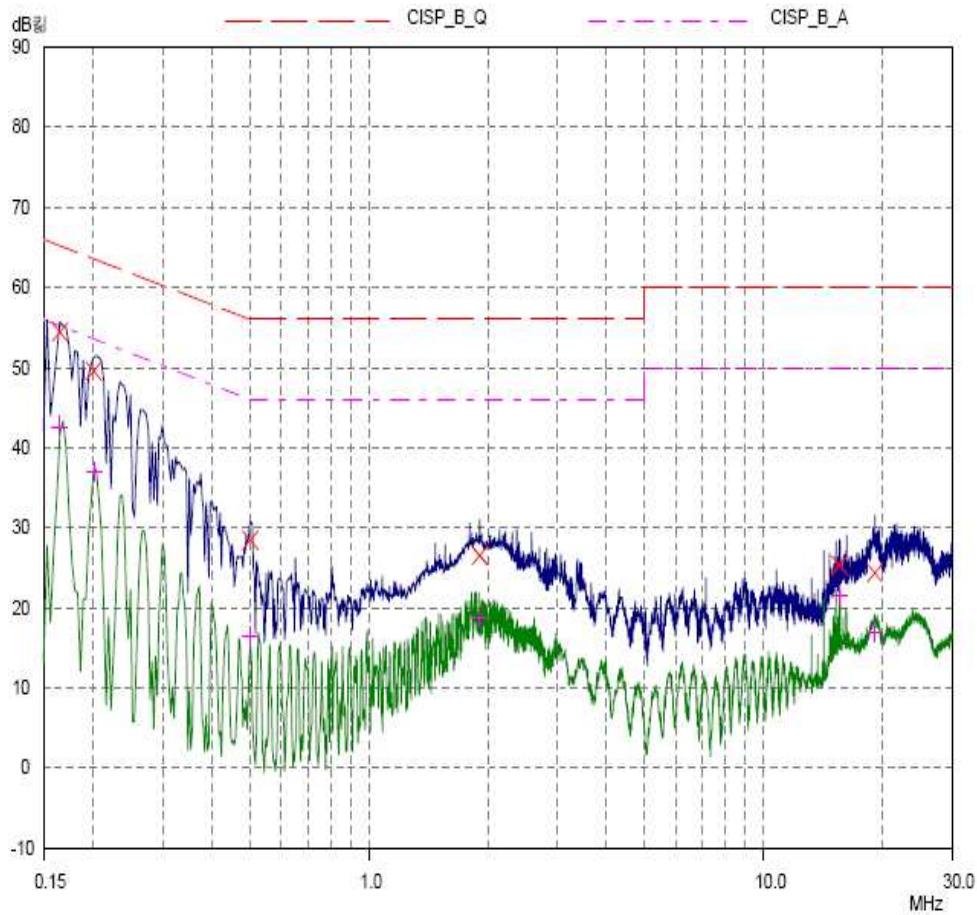
0.165	55.10	65.21	10.11
0.216	43.75	62.97	19.22
0.501	27.99	56.00	28.01
2.274	27.16	56.00	28.84
19.029	24.88	60.00	35.12
22.71	24.86	60.00	35.14

Frequency MHz	AV Level dB _{REF}	AV Limit dB _{REF}	AV Delta dB
------------------	-------------------------------	-------------------------------	----------------

0.165	43.77	55.21	11.44
0.216	16.63	52.97	36.34
0.501	13.55	46.00	32.45
2.274	19.63	46.00	26.37
19.029	18.55	50.00	31.45
22.71	17.69	50.00	32.31

Note.

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



Final Measurement Results

Frequency MHz	QP Level dB _{RE}	QP Limit dB _{RE}	QP Delta dB
0.165	54.43	65.21	10.78
0.201	49.56	63.57	14.01
0.501	28.43	56.00	27.57
1.908	26.52	56.00	29.48
15.555	25.32	60.00	34.68
19.128	24.35	60.00	35.65

Frequency MHz	AV Level dB _{RE}	AV Limit dB _{RE}	AV Delta dB
0.165	42.62	55.21	12.59
0.201	36.87	53.57	16.70
0.501	16.43	46.00	29.57
1.908	18.81	46.00	27.19
15.555	21.58	50.00	28.42
19.128	16.94	50.00	33.06

Note.

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



Appendix A. Measurement equipment

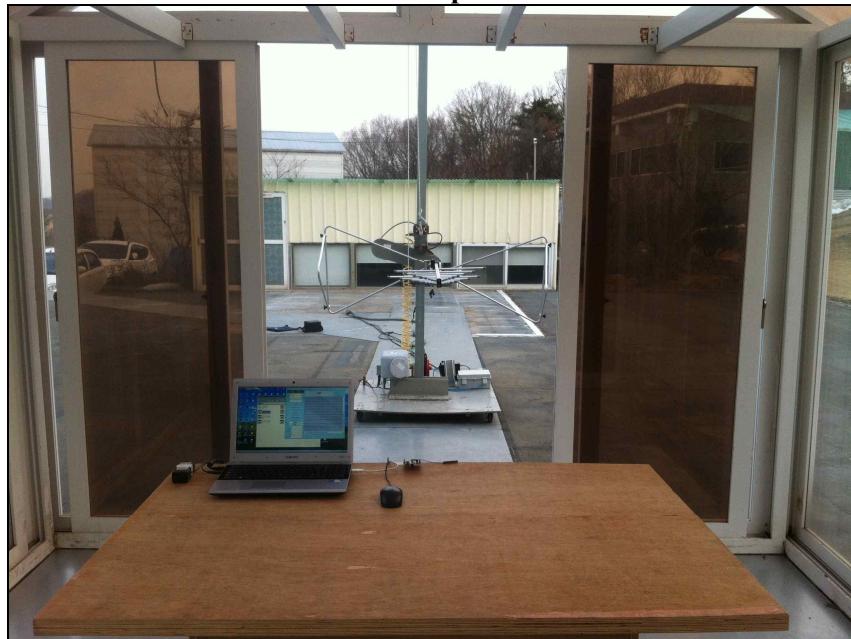
Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	100736	1 year	2014.05.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2014.05.06
Attenuator	HP	8494B	2630A12857	1 year	2014.05.06
Wideband Power Sensor	R&S	NRP-Z81	1137.9009.02-101886-ds	1 year	2015.01.07
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2015.04.25
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-385	2 years	2015.05.09
Horn Antenna	A.H. System	SAS-571	414	2 years	2015.02.28
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	1	1 year	2014.11.11
Preamplifier	Schwarzbeck Mess-Elektronik	BBV-571	781	1 year	2014.09.23
Preamplifier	MITEQ	AFS43-01002600	1374382	1 year	2014.10.04
EMI Test Receiver	LIG NEX1	ISA-80	L0912K014	1 year	2014.11.15
EMI Test Receiver	R & S	ESVS10	826008/014	1 year	2014.04.09
EMI Test Receiver	R & S	ESHS10	862970/018	1 year	2014.05.06
LISN	SCHWARZBECK	2823-568-1	8126157	1 year	2015.01.29

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook(Laptop)	Samsung Electronics	RV518	HTK991NC600207R

Appendix B. Test setup photo

Radiated spurious



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AC conducted emission



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