Test Report No. 8912323629

Applicant: ***Wavion Ltd.***

Equipment Under Test:
2.4 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station

Model: ***WBS-2400***
FCC ID: ***UGM-WBS2400-2S***

From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Section

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Test Report No.: 8912323629 **Page 1 of 65 Pages**
Title: Test on 2.4 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-2400 **FCC ID: UGM-WBS2400-2S**

Applicant:	Wavion Ltd.
Address:	6 Ha'yetsira Street, Yoqne'am-Illit, 20692, Israel
Sample for test selected by:	The customer
The date of test:	February 2009

Description of Equipment Under Test (EUT):	2.4 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model:	WBS-2400
Manufactured by:	Wavion Ltd.

Reference Documents:

- **CFR 47 FCC:** Rules and Regulations; Part 15. “Radio frequency devices”; Subpart C: “Intentional radiators” (2007).

- **Test Results:** The EUT was found meeting with the relevant requirements of CFR 47 FCC Part 15 Sections: 15.107, 15.109, 15.205, 15.207, 15.209, 15.247.

This Test Report contains 65 Pages and may be used only in full.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.

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1. Applicant information

Company: Wavion Ltd.
Address : 6 Ha'yetsira Street
City: Yoqne'am-Illit
Country : Israel

2. Test performance

Location: SII EMC Section
Wavion Ltd.
Purpose of test: Apparatus compliance verification in according with CFR 47 FCC Requirement
Test specification: CFR 47 FCC Part 15 Sections: 15.205, 15.207, 15.209, 15.247

Test	FCC Part 15	Test result
Conducted emission on unintentional radiation	Sec.15.107	Complies
Radiated emission on unintentional radiation	Sec.15.109	Complies
Radiated emissions in restricted bands	Sec.15.205	Complies
Radiated Emission on Radio Unit: spurious	Sec.15.209	Complies
Conducted emission	Sec.15.207	Complies
Radiated emission – general requirements	Sec.15.209	Complies
Minimum bandwidth	Sec. 15.247 (a)	Complies
Maximum peak output power	Sec.15.247 (b)	Complies
Peak power spectral density	Sec.15.247 (e)	Complies
Conducted spurious emissions	Sec.15.247 (d)	Complies

Electronics &
Telematics Laboratory
April 2009

Approved by:
Eng. Yuri Rozenberg
Position:
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Tested by:
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3. Scope

This test report contains results measured on 2.4 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station (FCC ID: UGM-WBS2400-2S) according to the relevant requirements of CFR 47 FCC Part 15 Subparts B & C.

4. EUT (equipment under test) description.

4.1. General Description

The WBS-2400 is a new category of Wi-Fi Wireless Base Station designed from the ground up for metro-Wi-Fi deployments. It is based on three antennas and radios and custom-built ASICs, utilizes Wavion's powerful multi-antenna signal processing technologies, and provides significant performance gains to off-the-shelf 802.11 standards-based Wi-Fi clients.
The WBS-2400 Wi-Fi Wireless Base Station uses three sector antennas and beam-forming technology in order to provide significant performance gains to off-the-shelf 802.11 standards-based Wi-Fi clients.

4.2. EUT's sub-assemblies list.

The EUT ports and lines are detailed in Table 1.

No.	Description	P/N; Model	Manufacturer
1	Digital Board	PC00043	Wavion
2	RF Board	PC00045	Wavion
3	DC/DC PS	PKB4711PINB	Ericsson
4	DC/DC PS 1/8 brick	SQE48T20050	PowerOne
5	DC/DC PS 1/16 brick	SSQE48T13050	PowerOne
6	DC/DC PS	0RCY-85T050	Bel
7	Antenna	MT-343037/CV	MTI
8	RF filter	DFCH52G43HFHAA-TM1	Murata
9	RF filter	SRP2437K8N50SB	Bitel

Table 1. Sub-assemblies list

4.3. EUT ports and lines.

The EUT ports and lines are detailed in Table 2.

Port Type	Port Description	Connected from / to	Connector type	Qty.	Cable Type	Cable Length
Data	**Data/PoE**	**PD-Client**	**RJ-45 shielded**	**4**	**CAT-5e**	**Up to 100m**

Table 2. The EUT ports and lines

4.4. Potential emission source:

The potential emission sources are detailed in Table 3.

Frequency	Location	Remarks
40 MHz	On board	Crystal Oscillator

Table 3. Potential emission sources

4.5. Auxiliary equipment used:

The auxiliary equipment used is detailed in Table 4 4.

Function	Manufacturer	Model	Remarks
Laptop	IBM	ThinkPad T23	-
PoE injector	Telkoor	0525B5555	-

Table 4. Auxiliary equipment used

4.6. EUT technical characteristic

Type of equipment					
	Stand-alone (Equipment with or without its own control provisions)				
Intended use	**Condition of use**				
Fixed	Always at a distance more than 2 m from all people				
Assigned frequency range	2400MHz to 2483.5MHz				
Operating frequency range	2412MHz to 2462MHz (WLAN channels 1 to 11)				
RF channel spacing	5MHz				
Maximum rated output power	At transmitter 50 Ω RF output connector	22.1dBm@2412MHz			
		22.1dBm@2437MHz			
		22.1dBm@2462MHz			
Transmitter output power per output					
Minimum RF power	7dBm				
Maximum RF power	22dBm				

Internal antenna/s technical characteristics

Type	Manufacturer	Model number	Gain / Frequency range
Integral, sector	MTI	MT-343037/CV	10.5 dBi / 2.4-2.4835 GHz

Transmitter 99% power bandwidth	12 MHz to 16 MHz
Transmitter aggregate data rate/s (min-maximum)	1Mbps to 54Mbps
Type of modulation	OFDM, DSSS, CCK
Type of multiplexing	CSMA/CA
Modulating test signal (baseband)	PRBS
Maximum transmitter duty cycle in normal use	90%
Transmitter duty cycle supplied for test	99%

Transmitter power source

V	DC	**Nominal rated voltage**	From PoE 55VDC		
V	AC power for PoE injector	**Nominal rated voltage**	90-240VAC	Frequency: 50/60Hz	

Spread spectrum technique used	Frequency hopping (FHSS)	
	Digital transmission system (DTS)	V
	Hybrid	

Spread spectrum parameters for transmitters tested per FCC 15.247 only

DSSS	chip sequence length	11bits
	spectrum width	12MHz

5. Test configuration:

The WBS-2400 unit has 2 possible RF transmit filters and 4 DC/DC power supplies. The difference between all the RF transmit filters is the manufacturer of the transmit filter. Below is a list of all the supported filter manufacturers and DC/DC PS models:

RF board transmit filter manufacturers:
1) Murata;
2) Bitel

DC/DC power supply:
1) PowerOne1/8;
2) PowerOne 1/16;
3) Ericsson;
4) Bell

Both of the above filters have the same operating frequency range.
The transmission power of each RF board is calibrated during the production process to a predetermined level, which is independent of the transmit filter manufacturer.
To check compliance in every configuration and to use filters and boards in any combination for the WBS-2400 device the following tests have been performed:

1. Conducted intentional radiation test: the conducted test (Minimum bandwidth; Peak power spectral density and Conducted spurious emissions) was performed with all possible configurations of Murata and Bitel.
2. Conducted unintentional radiation test: conducted (per 15.205) and radiated (per 15.209) emissions tests were performed with all possible DC/DC PS configurations.
3. Find the worst case sample, where it is most critical at band edge for the RF filters and emissions for the PS.
4. Radiated (on the band edge) and repeat conducted intentional radiation tests of worst case sample.
5. Conducted/radiated unintentional radiation tests for the worst case sample.

In order to find the “worst case” sample, which can represent all kinds of RF filters & DC/DC PS, each of them was pre-tested as described above.
After all radio conducted tests the Bitel models were chosen as the “worst case”, all final measurements were performed with 3 Bitel filters.
After all unintentional emissions tests the Bell and PowerOne 1/8 models were chosen as the “worst case”, all final measurements were performed twice.

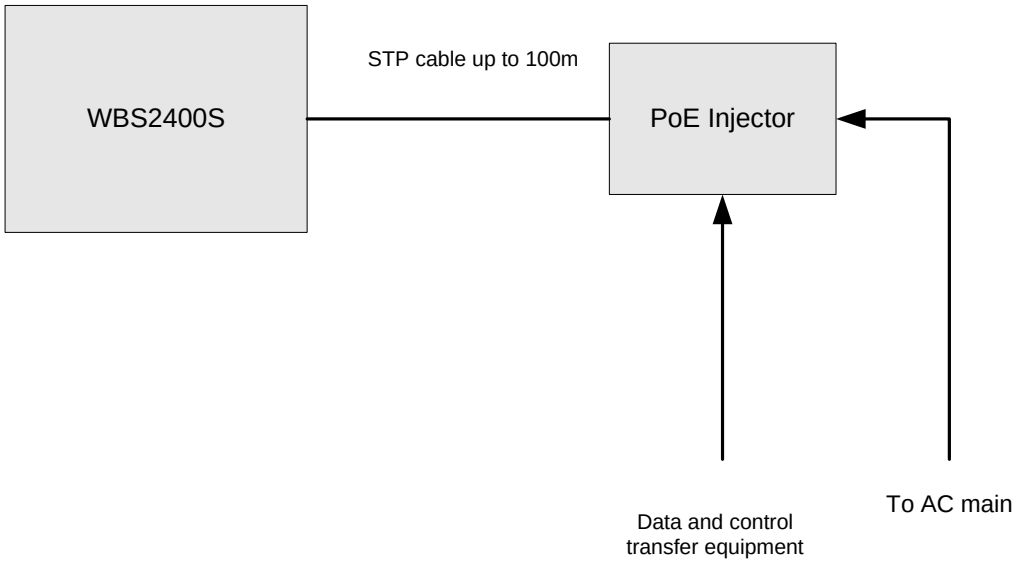


Figure 1. Radiated emission test setup

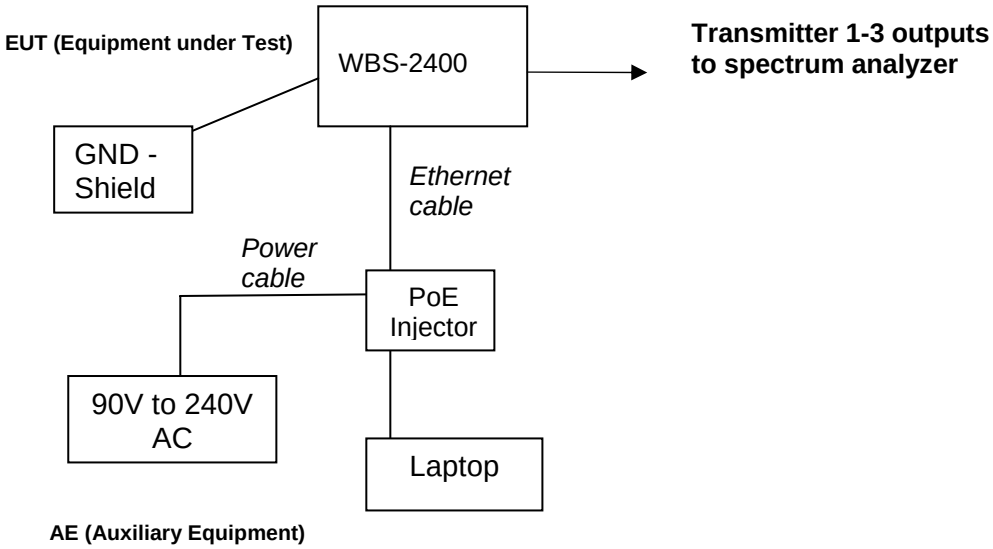


Figure 2. Conducted measurements test setup.

5.1. Environmental evaluation and exposure limit according to FCC CFR 47 part 1, §1.1307, §1.1310

Limit for power density for general population/uncontrolled exposure is 1 mW/cm^2.

The power density P (mW/cm^2) = Pt /4π r^2.

Where:

Pt – The transmitted power (EIRP) (mW)

For aggregate Pt- the transmitted power whish is equal to the output power 26.9 dBm plus maximum aggregate antenna gain – 15.3 dBi

The maximum aggregate EIRP = 42.2 dBm = 16596 mW:

r – The distance from the unit (cm)

r = sqrt(16596/4π) = 36.34 cm

The allowed distance “r”, where RF exposure limits may not be exceeded, is 36.34 cm from the unit antenna main lobe.

The EUT with the attached antenna are mounted only outside the building on the high level pole or wall, which are above general public, see the manufacturer instructions for installation provided in attached documentation.

6. Test specification, Methods and Procedures

Test Specification:

- CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";
  Subpart B: "Unintentional radiators";
  Subpart C: "Intentional radiators" (2007).

Methods and Procedures:

- ANSI C63/4/2003: "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz".

7. Measurements, examinations and derived results

7.1. Location of the Test Site:

The tests were conducted in the EMC laboratory of the Standards Institution of Israel in Tel-Aviv, in Wavion's laboratory and at open test site located at Kibbutz Native Halamed Hai in Emek HaEla, Israel.

7.2. Test condition:

Temperature: 20 °C
Humidity: 58 %

7.3. Conducted emission test (Subscriber Unit) (per Section 15.107 and 15.207):

7.3.1. Requirements:

The EUTs conducted emission within the band 150 kHz to 30 MHz shall not exceed value required in sections 15.107 Subpart B and 15.207 Subpart C.

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.

7.3.2. Pre-test scanning:

In order to find the "worst case" sample, which can represent WBS-2400, one sample of the device contains each DC/DC PS was pre-tested. After all conducted tests the model PowerOne 1/8 were chosen as the "worst case", all unintentional radiation measurements were performed on it.

7.3.3. Test procedure:

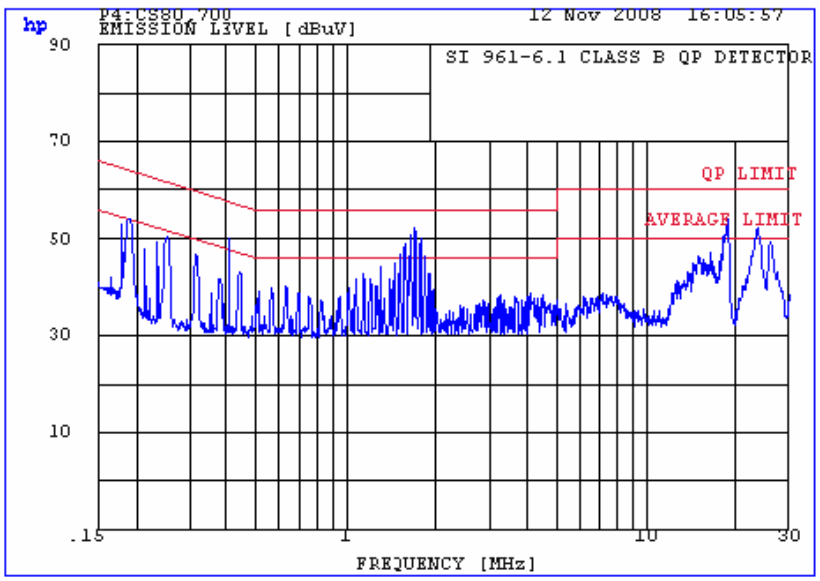
The EUT was operated to transmitting through the customer software.
First, initial scans were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low, middle and the high of the 2.412 – 2.462 GHz frequency range under 4 data transfer bit rates. The worst results from all measurements (2412MHz frequency, 6Mbps bit rate) are presented at the plots 1-8.
The measurements were performed on the auxiliary PoE injector AC/DC PS 120 VAC mains input. The EUT was placed on a non-metallic table in a shielded chamber at a height of 80 cm from the floor and 40 cm from the nearest wall.
Test equipment (EMI receiver) setup was as follow:

Initial scan:	
Detector type	Peak
Mode	Max hold
Bandwidth	9 kHz
Step size	Continuous sweep
Sweep time	>100 msec
Measurements	
Detector type	Quasi-peak, Avg (CISPR)
Bandwidth	9 kHz
Measurement time	200 seconds/MHz
Observation	>15 seconds

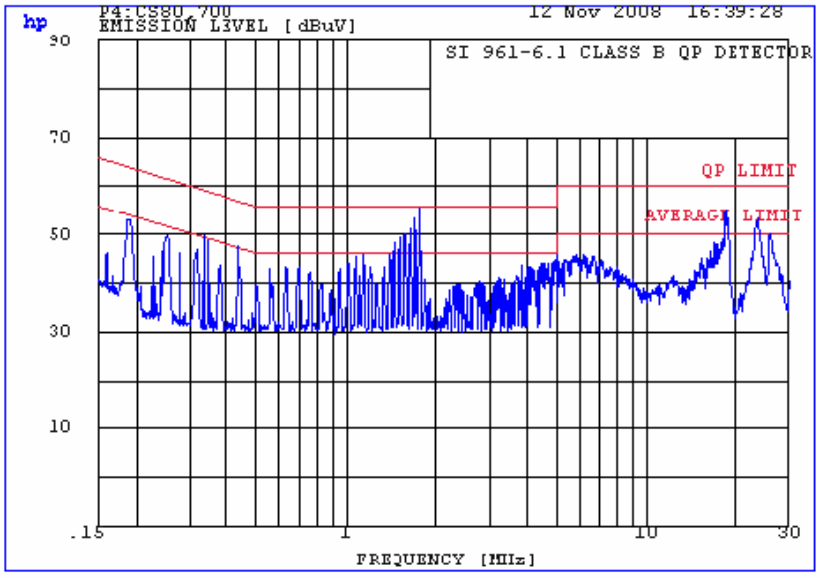
7.3.4. Test results:

Scans of pre-test scanning for 4 units are presented in Plots # 1-8.
Final test results are shown in Plots #9-12.
The test results were found complies with relevant standard requirements.

Bell Power Supply

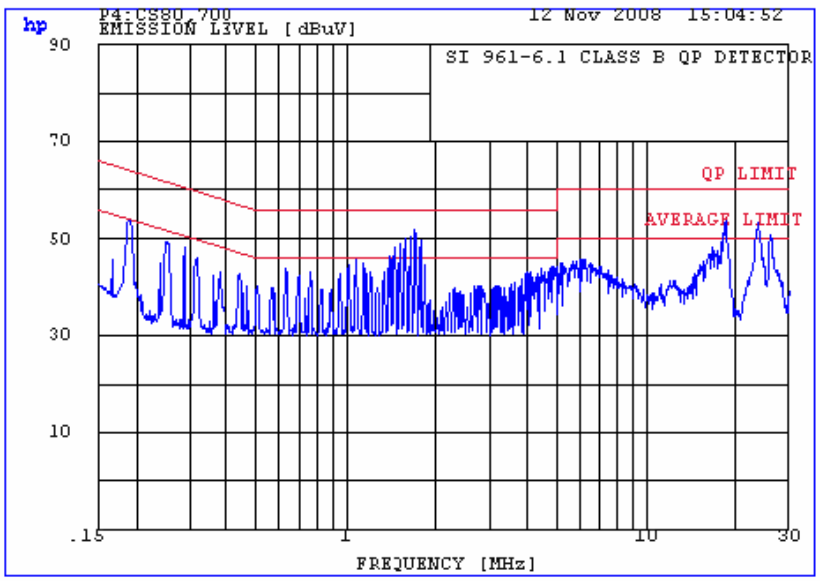


Plot # 1. Conducted emissions measurement result on 120 VAC power. Line- phase.

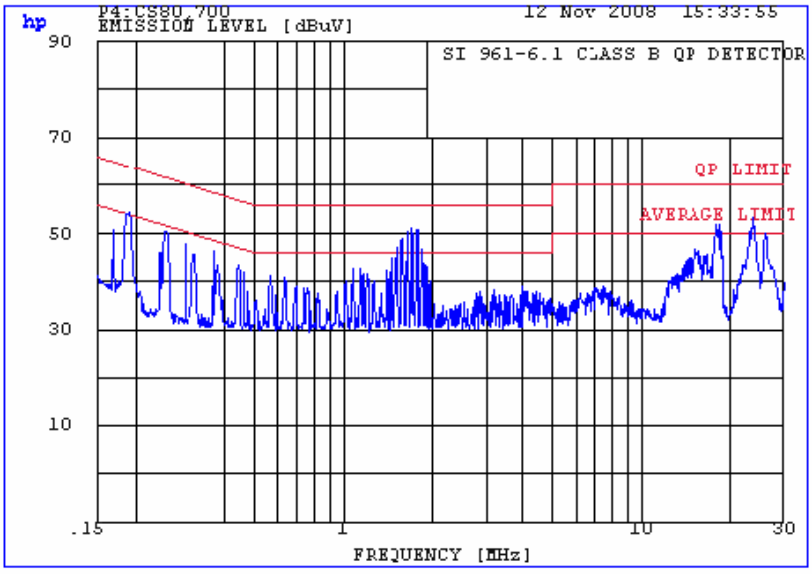


Plot # 2. Conducted emissions measurement result on 120 VAC power. Line- neutral.

Ericsson Power supply

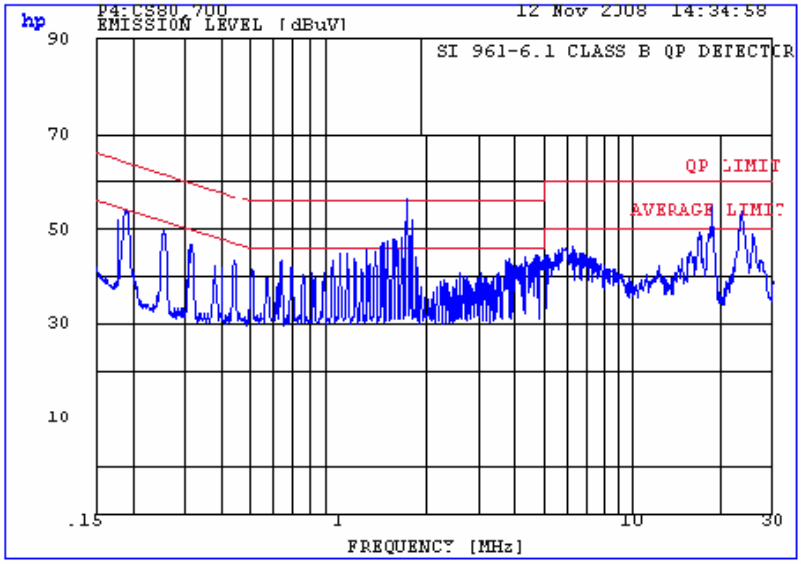


Plot # 3. Conducted emissions measurement result on 120 VAC power. Line- phase.

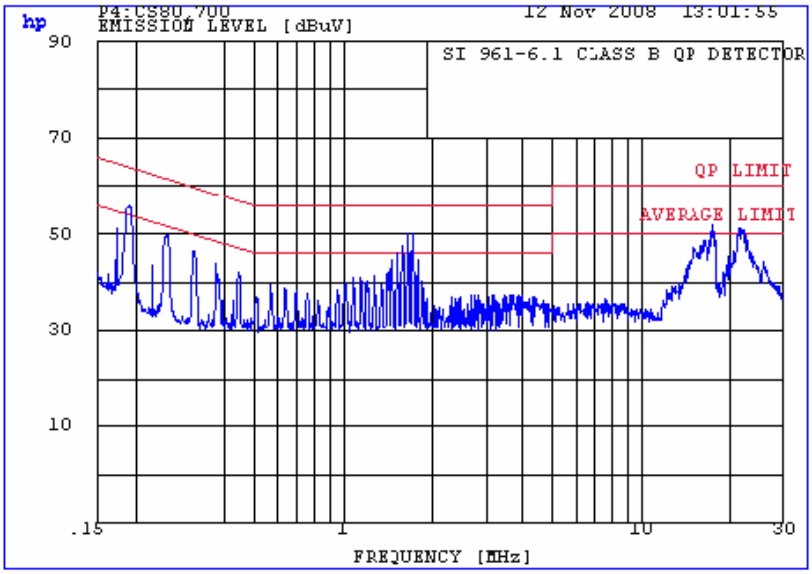


Plot # 4. Conducted emissions measurement result on 120 VAC power. Line- neutral.

PowerOne 1/8 Power supply

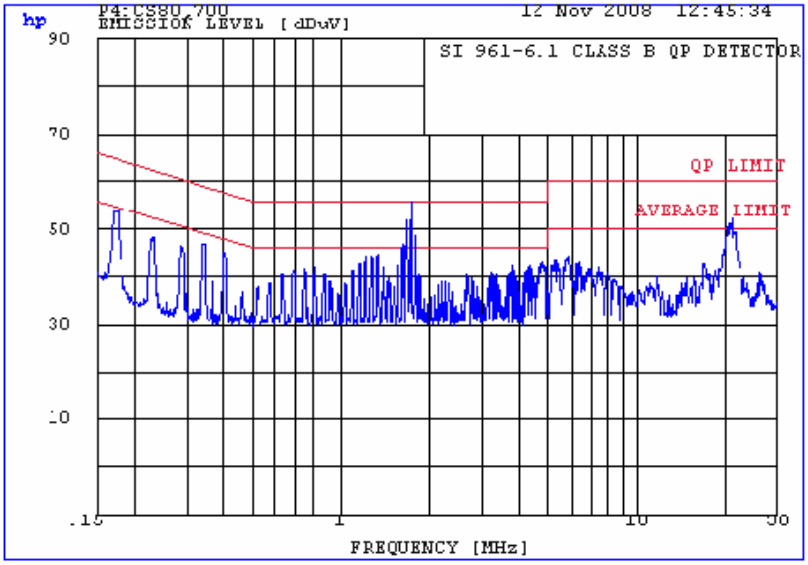


Plot # 5. Conducted emissions measurement result on 120 VAC power. Line- phase.

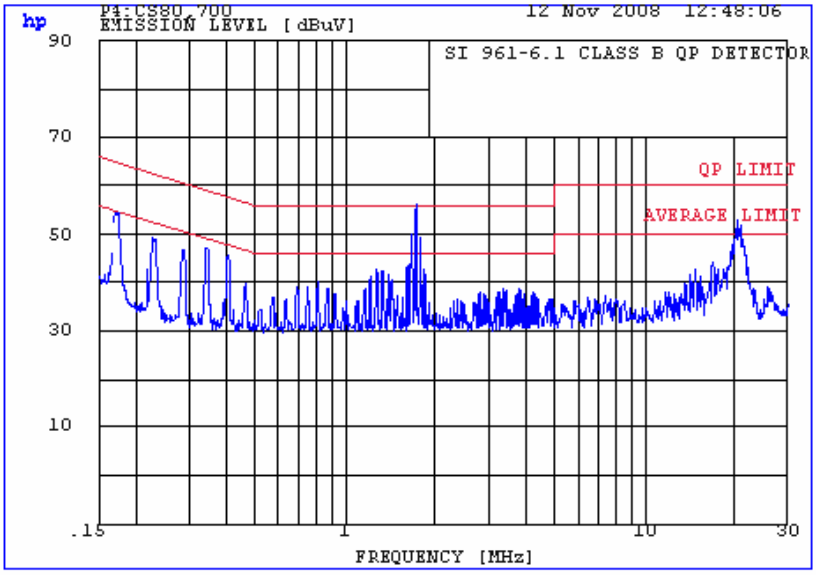


Plot # 6. Conducted emissions measurement result on 120 VAC power. Line- neutral.

PowerOne 1/16 Power supply



Plot # 7. Conducted emissions measurement result on 120 VAC power. Line- phase.



Plot # 8. Conducted emissions measurement result on 120 VAC power. Line- neutral.

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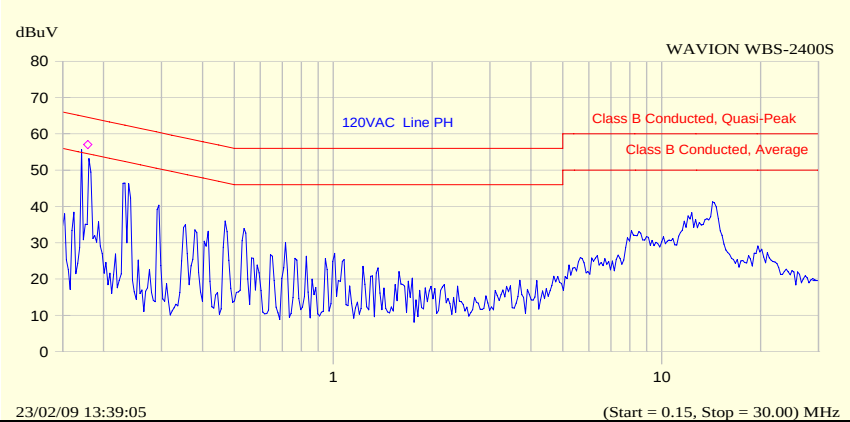
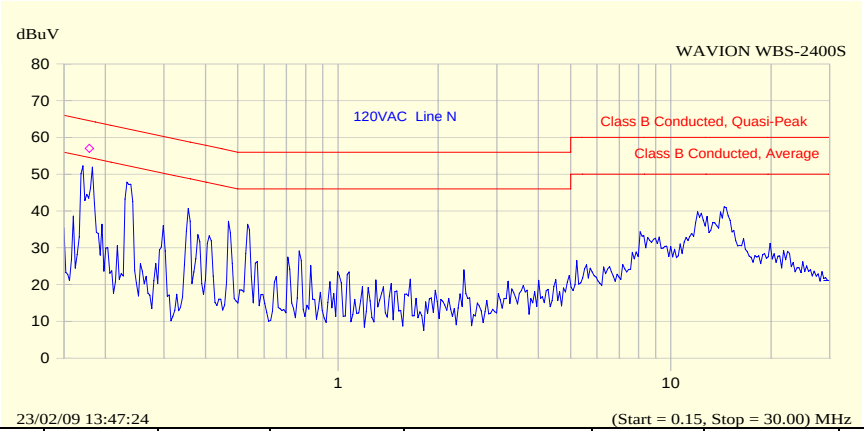
Model: WBS-2400 **FCC ID: UGM-WBS2400-2S**



Frequency MHz	Peak dBµV	QP dBµV	QP Limit dB	QP-QP Limit dB	Avg dBµV	Avg Limit dB	Avg-Avg Limit dB
0.179	57.0	56.2	64.5	-8.3	45.1	54.5	-9.5
0.238	48.9	47.7	62.2	-14.4	37.3	52.2	-14.9
0.361	41.3	40.0	58.7	-18.7	33.2	48.7	-15.5
0.477	40.4	37.8	56.4	-18.6	33.8	46.4	-12.6
0.540	36.7	35.4	56.0	-20.6	33.9	46.0	-12.1
14.308	43.3	38.6	60.0	-21.4	32.0	50.0	-18.0

Plot # 9. Conducted emissions measurement result. P.S. BELL. Line Phase



Frequency MHz	Peak dBµV	QP dBµV	QP Limit dB	QP-QP Limit dB	Avg dBµV	Avg Limit dB	Avg-Avg Limit dB
0.179	57.0	56.2	64.5	-8.3	45.1	54.5	-9.5
0.238	48.5	47.7	62.1	-14.5	39.4	52.1	-12.7
0.361	41.2	39.8	58.7	-18.9	34.1	48.7	-14.6
0.477	39.9	36.7	56.4	-19.6	32.2	46.4	-14.2
0.540	38.1	36.9	56.0	-19.1	35.6	46.0	-10.4
14.308	44.0	39.3	60.0	-20.7	33.2	50.0	-16.8

Plot # 10. Conducted emissions measurement result. P.S. BELL. Line- neutral.

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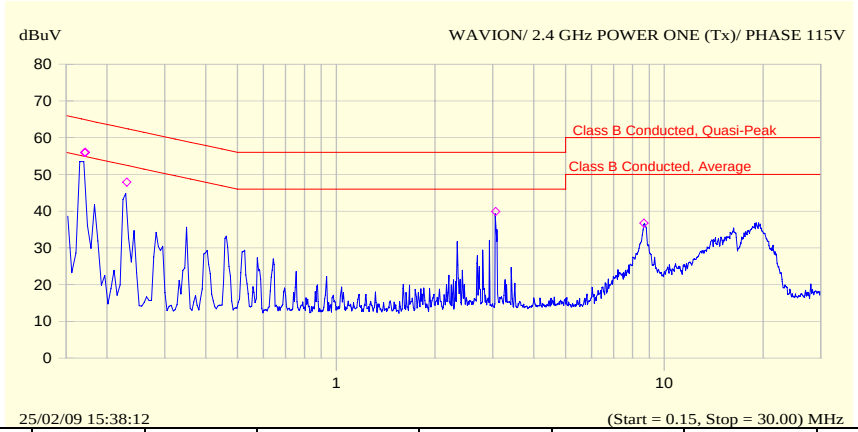
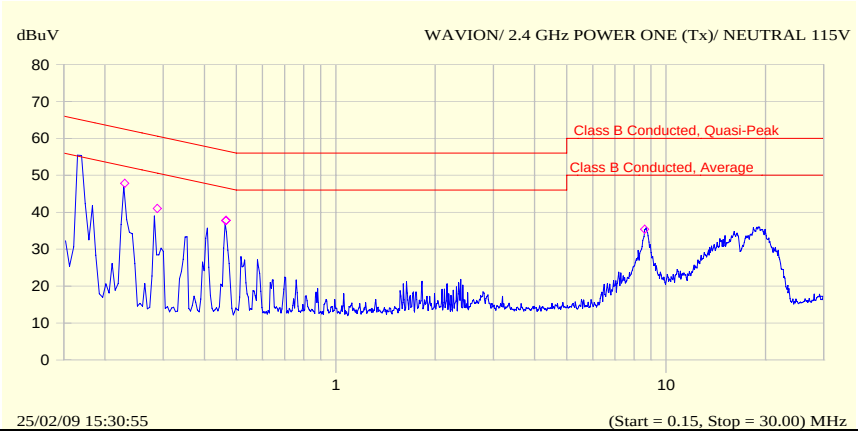


Frequency MHz	Peak dBuV	QP dBuV	QP Limit dB	QP-QP Limit dB	Avg dBuV	Avg Limit dB	Avg-Avg Limit dB
0.171	56.0	53.6	64.9	-11.3	42.8	54.9	-12.1
0.172	56.0	54.7	64.9	-10.2	44.8	54.9	-10.1
0.230	47.9	46.5	62.5	-16.0	36.4	52.5	-16.0
3.063	39.9	25.0	56.0	-31.0	4.4	46.0	-41.6
8.661	36.8	32.8	60.0	-27.2	23.6	50.0	-26.4

Plot # 11. Conducted emissions measurement result. P.S PowerOne 1/8. Line Phase



Frequency MHz	Peak dBuV	QP dBuV	QP Limit dB	QP-QP Limit dB	Avg dBuV	Avg Limit dB	Avg-Avg Limit dB
0.230	47.8	46.8	62.5	-15.7	38.8	52.5	-13.7
0.288	41.0	39.7	60.6	-20.9	30.7	50.6	-19.9
0.464	37.7	36.3	56.6	-20.3	34.4	56.6	-12.2
0.466	37.8	36.4	56.6	-20.2	34.0	56.6	-12.5
8.613	35.4	31.4	60.0	-28.6	22.5	50.0	-27.5

Plot # 12. Conducted emissions measurement result. P.S PowerOne 1/8. Line Neutral

7.4. Radiated emission test (per sections 15.109 and 15.209):

7.4.1. Requirements:

The EUTs radiated emission shall not exceed value required in sections 15.109 Subpart B and 15.209 Subpart C.

7.4.2. Pre-test scanning:

In order to find the "worst case" sample, which can represent WBS-2400, one sample of the device contains each DC/DC PS was pre-tested. After all radiated emission preliminary tests the model Bell was chosen as the "worst case", all unintentional radiation tests were performed on it.

7.4.3. Test description:

The measurements were performed at the Open Area Test Site.
The test configuration is shown in Fig.2.
The EUT was arranged on a non-metallic table 0.8 m placed on the turn-table.
The measurements were performed at a 10 m measurement distance.
The Biconilog 30 MHz-2 GHz antenna was used.
The frequency range was investigated from 30 MHz to 2 GHz.
The measurements were performed at each frequency at which the signal was 20 dB below the limit or less.
The level were maximized by initially rotating turntable through 360°, varying the antenna height between 1 m and 4 m, rerouting EUT cables and changing antenna polarization from vertical to horizontal. The measuring equipment settings were:

Initial scan:	
Detector type	Peak
Mode	Max hold
Bandwidth	120 kHz
Step size	Continuous sweep
Sweep time	>1 seconds/MHz
Measurements:	
Detector type	Quasi-peak (CISPR 16)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz
Observation	>15 seconds

7.4.4. Radiated emission test results:

Scans of pre-test scanning for 4 units are presented in Plots # 13-16.
Test results are presented in Table 5-6.
The test results were found complies with relevant standard requirements.

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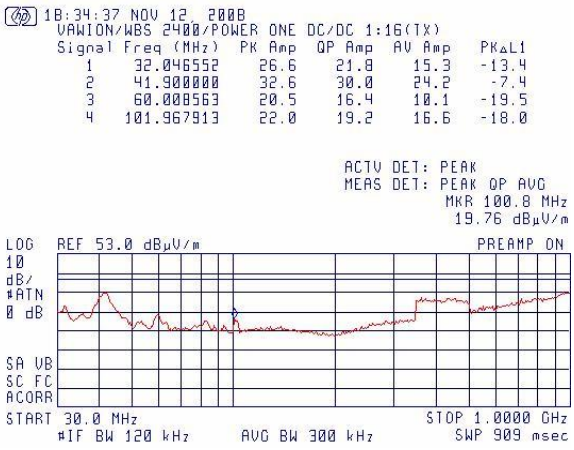
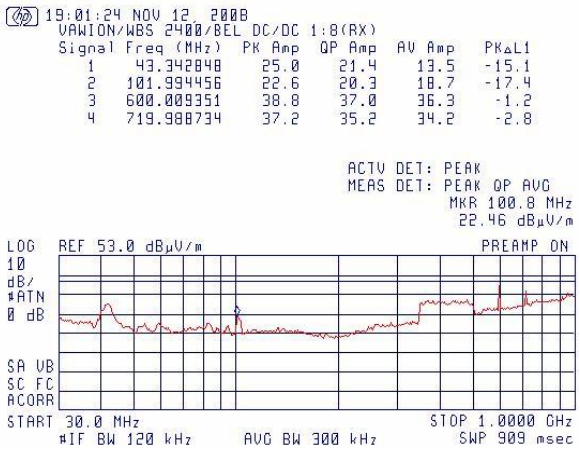
Plot # 13.
Power One 1/8 DC/DC PS

Frequency MHz	Peak dBuV/m	Limit Line dB	Peak-Limit dB	Comment
560.010	37.7	0.0	-13.3	

Plot # 14.
Ericsson DC/DC PS



Plot # 15.
Power One 1/16 DC/DC PS



Plot # 16.
Bel DC/DC PS

Table 5. Radiated emission test results
FCC Part 15 section 15.209. WBS2400S P.S BELL

Frequency (MHz)	Antenna Polariz. V/H	Antenna Height (m)	Turn-table Angle (°)	Emission Level Note 1 (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin Note 2 (dB)	Results
47.8	V	1.2	170	19.3	40.0	20.7	Complies
79.9	V	1.2	178	23.5	40.0	16.5	Complies
133.5	V	1.4	108	20.5	43.5	23.0	Complies
185.6	H	1.9	328	19.5	43.5	24.0	Complies
226.3	V	3.2	354	18.9	46.0	27.1	Complies
276.7	H	3.8	225	20.1	46.0	15.9	Complies

Table 6. Radiated emission test results
FCC Part 15 section 15.209. WBS2400S P.S PowerOne 1/8

Frequency (MHz)	Antenna Polariz. V/H	Antenna Height (m)	Turn-table Angle (°)	Emission Level Note 1 (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin Note 2 (dB)	Results
47.8	V	1.2	170	19.3	40.0	20.7	Complies
79.9	V	1.2	178	23.5	40.0	16.5	Complies
133.5	V	1.4	108	20.5	43.5	23.0	Complies
276.7	H	3.5	328	20.2	43.5	23.7	Complies

Note 1: Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m) + 10 dB
Where 10 dB is an extrapolation to 3m distance factor.
For Cable Loss and Antenna Factor refer to Appendix 2.

Note 2: Margin (dB) = Limit (dBμV/m) – Emission level (dBμV/m)

7.5. Conducted spurious emission

7.5.1. Requirements:

Clause 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.

7.5.2. Pre-test scanning:

In order to find the “worst case” sample, which can represent all kinds of RF filters, each filter (Murata and Bitel filters) was pre-tested.

After all conducted spurious emissions tests the Bitel model was chosen as the “worst case”, all final measurements were performed with 3 Bitel filters (see 7.5.4).

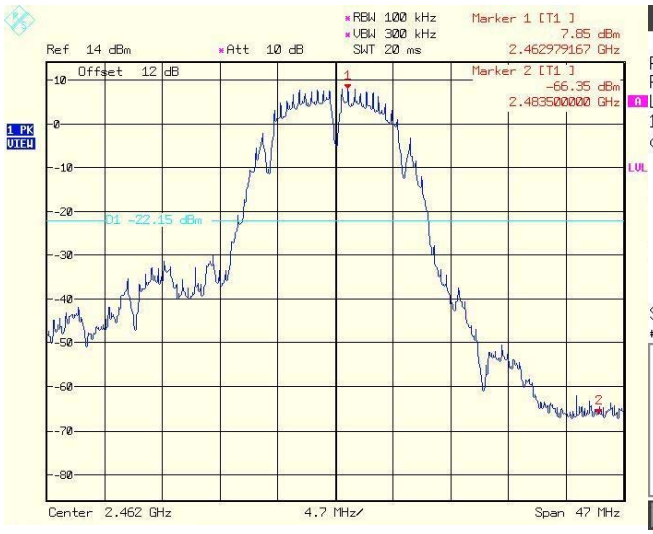
7.5.3. Test Procedure:

The transmitter output is connected to a spectrum analyzer.
The RBW is set to 100 kHz.
The VBW is set to 300 kHz.
The spectrum from 30 MHz to 26GHz is investigated with the transmitter set to the low, middle and high frequencies. The worse case result at data 6 Mbit rate is noted.

7.5.4. Test Results:

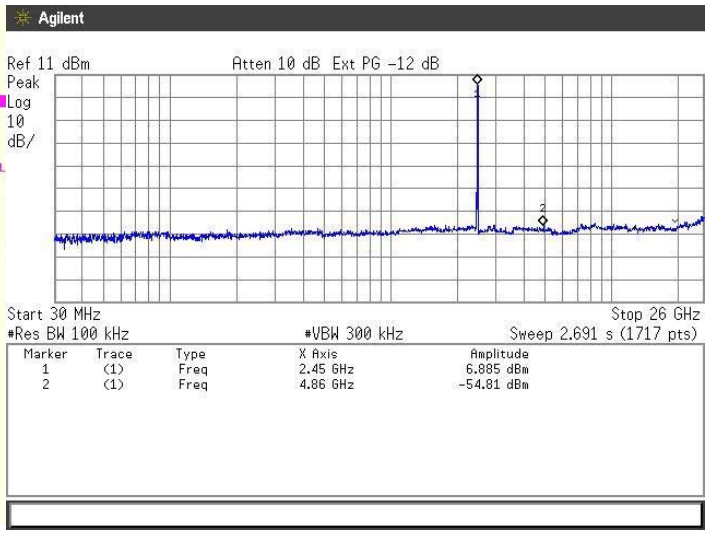
The WBS-2400 configurations for preliminary tests were as following: 2 RF filters Murata (outputs 1 & 2), 1 RF filter Bitel (output 3).
The plots of conducted spurious emissions pre-scan for each RF filters (outputs 1-3 accordantly) are presented on the plots # 17-36. The most differences in spurious emissions were found. Following pre-scan tests results the “worst case” from the point of view of spurious emissions is Bitel filter.

The final configuration has been built with 3 Bitel RF filters.
All test results met the requirements.
No differences in spurious emissions test results between 3 outputs were found.
The tests were performed at the output 3 (the worst case), which is higher power level.
All harmonics/spurs are at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
The results are shown in plots # 37-42.



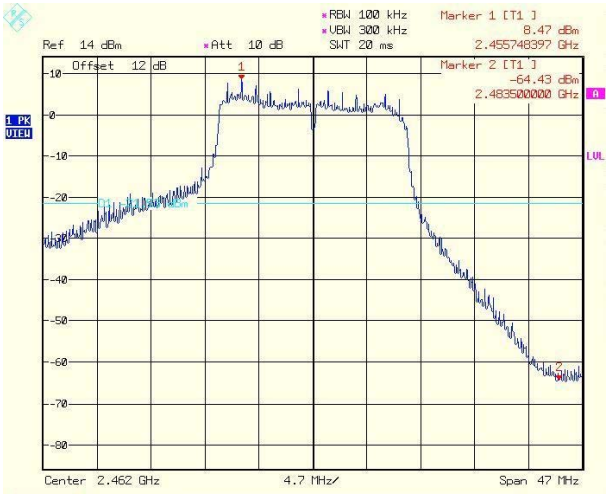
Plot # 17.

Output 1. High frequency bandedge.
802.11b mode. 1 Mbps rate.



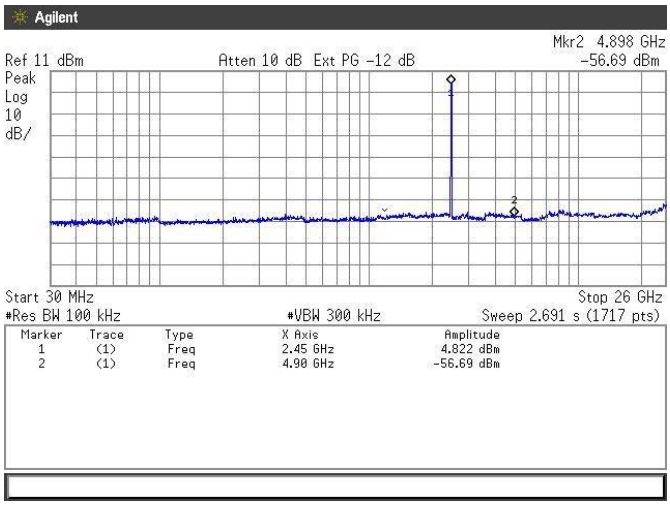
Plot # 18.

Output 1. High frequency spurious.
802.11b mode. 1 Mbps rate.



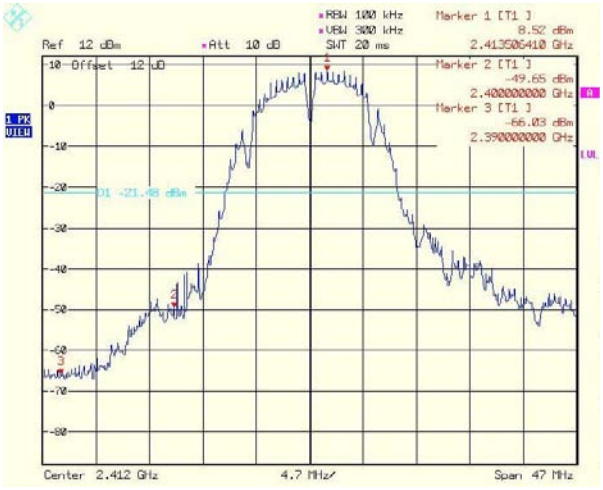
Plot # 19.

Output 1. High frequency bandedge.
802.11g mode. 6 Mbps rate.



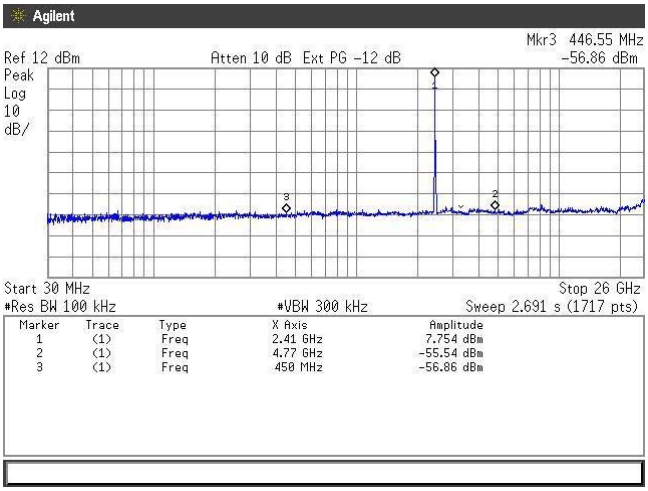
Plot # 20.

Output 1. High frequency spurious.
802.11g mode. 6 Mbps rate.



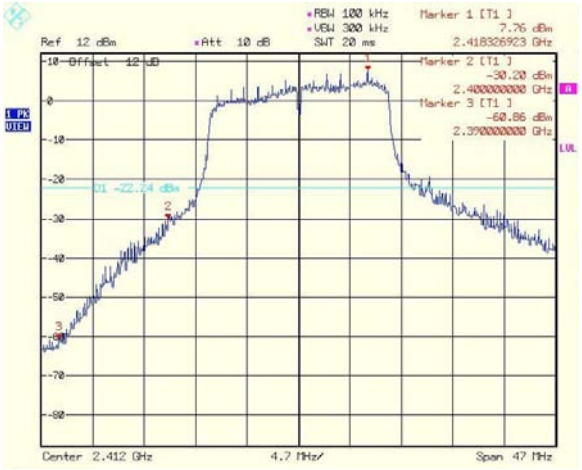
Plot # 21.

Output 2. Low frequency bandedge.
802.11b mode. 1 Mbps rate.



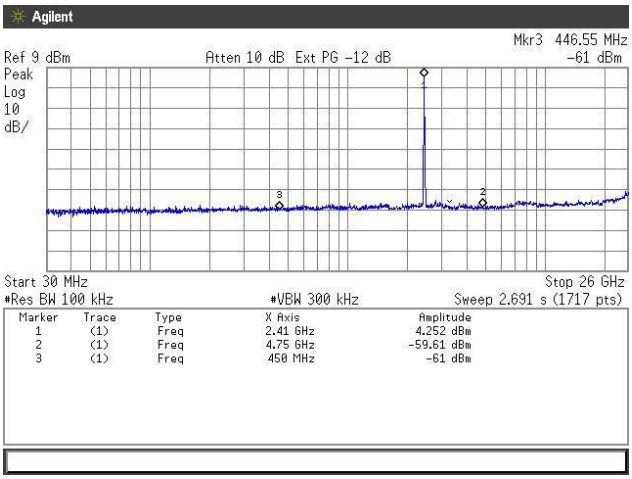
Plot # 22.

Output 2. Low frequency spurious.
802.11b mode. 1 Mbps rate.



Plot # 23.

Output 2. Low frequency bandedge.
802.11g mode. 6 Mbps rate.



Plot # 24.

Output 2. Low frequency spurious.
802.11g mode. 6 Mbps rate.

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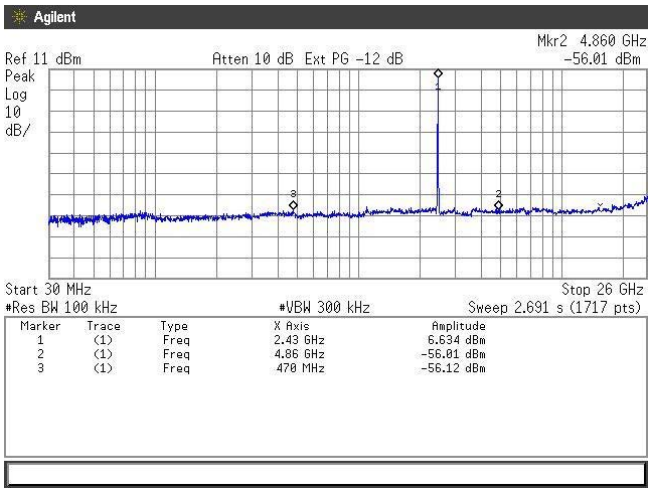
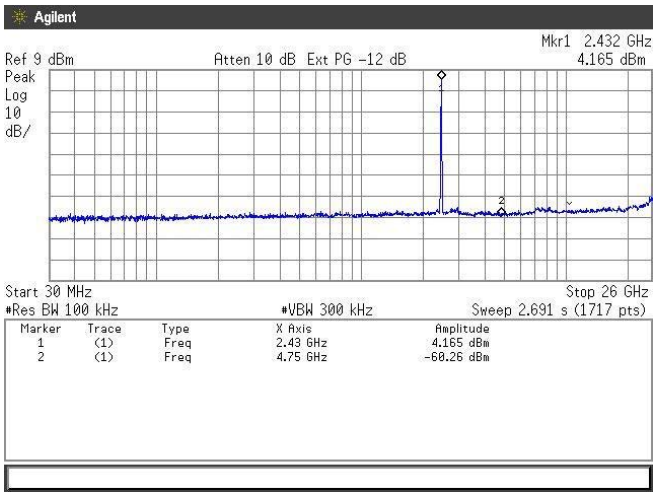


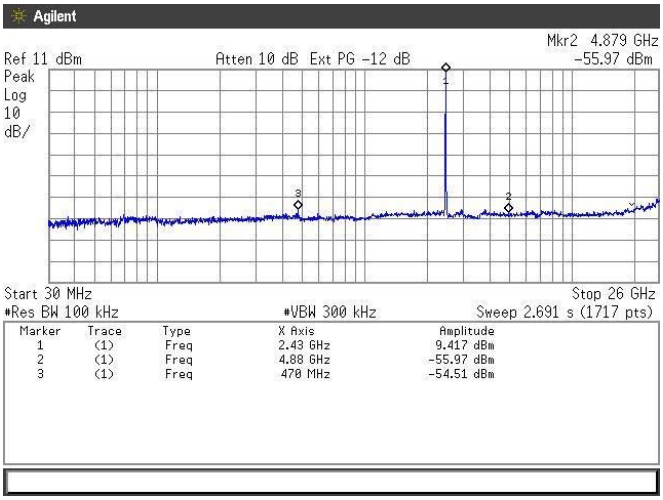
Plot # 25.

Output 2. Middle frequency spurious.
802.11b mode. 1 Mbps rate.



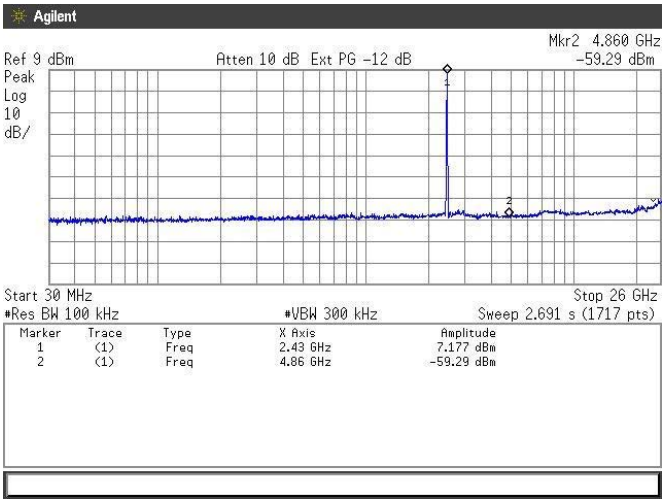
Plot # 26.

Output 2. Middle frequency spurious.
802.11g mode. 6 Mbps rate.



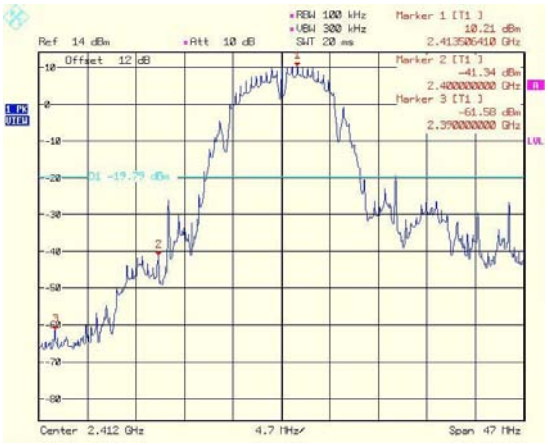
Plot # 27.

Output 3. Middle frequency spurious.
802.11b mode. 1 Mbps rate.



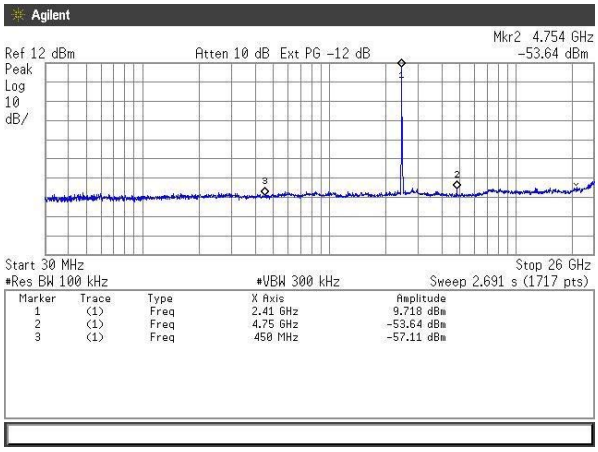
Plot # 28.

Output 3. Middle frequency spurious.
802.11g mode. 6 Mbps rate.



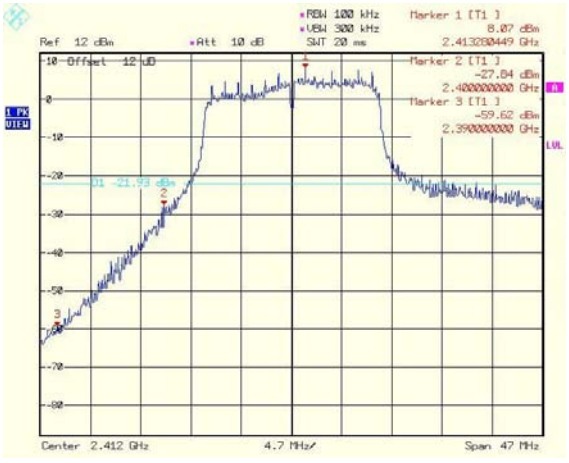
Plot # 29.

Output 3. Low frequency bandedge.
802.11b mode. 1 Mbps rate.



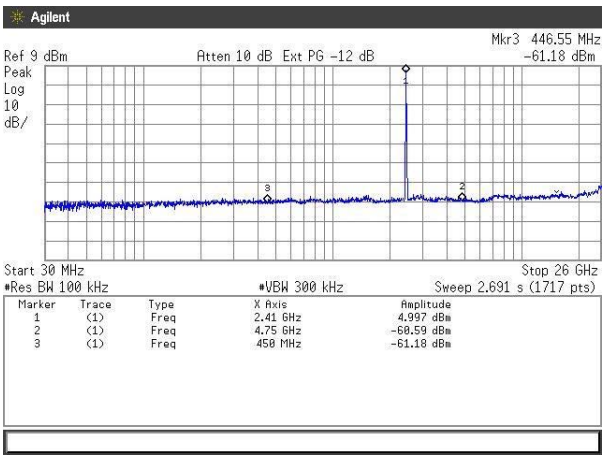
Plot # 30.

Output 3. Low frequency spurious.
802.11b mode. 1 Mbps rate.



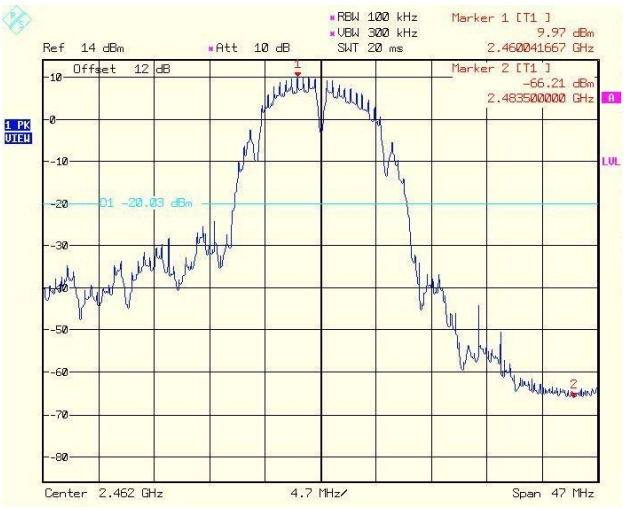
Plot # 31.

Output 3. Low frequency bandedge.
802.11g mode. 6 Mbps rate.



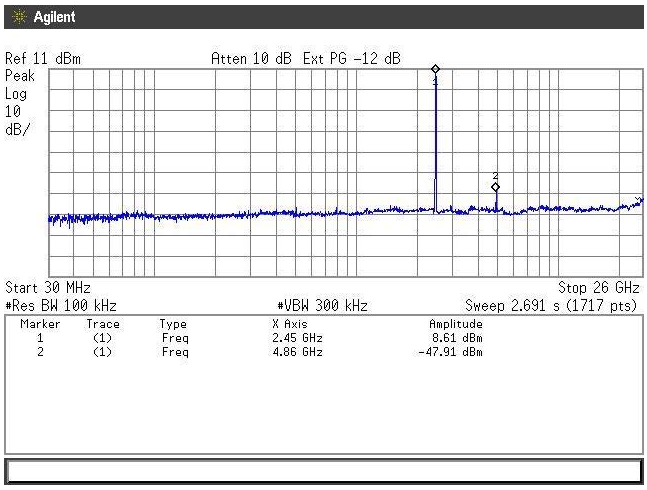
Plot # 32.

Output 3. Low frequency spurious.
802.11g mode. 6 Mbps rate.



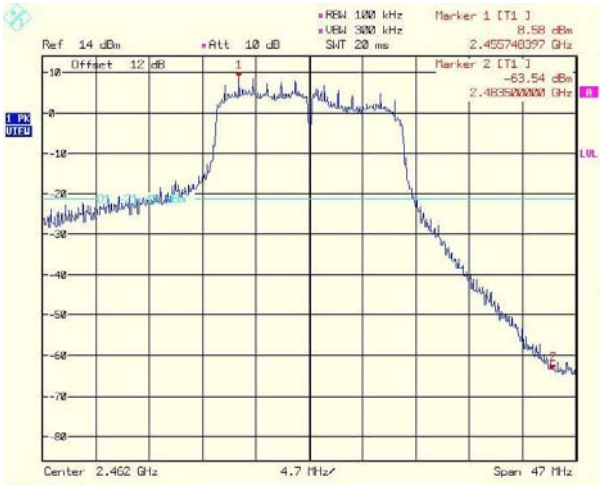
Plot # 33.

Output 3. High frequency bandedge.
802.11b mode. 1 Mbps rate.



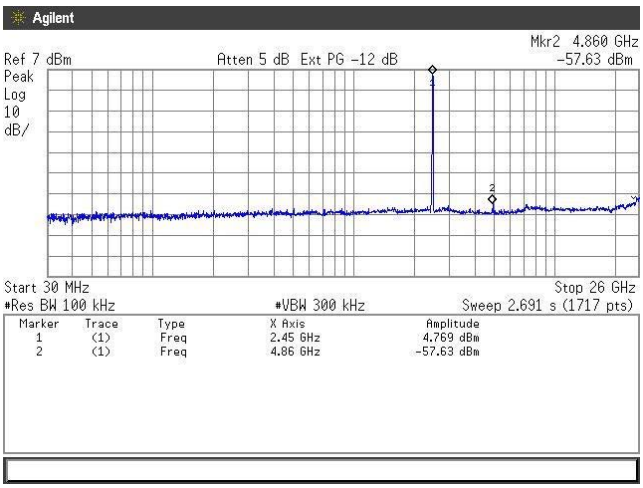
Plot # 34.

Output 3. High frequency spurious.
802.11b mode. 1 Mbps rate.



Plot # 35.

Output 3. High frequency bandedge.
802.11g mode. 6 Mbps rate.



Plot # 36.

Output 3. High frequency spurious.
802.11g mode. 6 Mbps rate.

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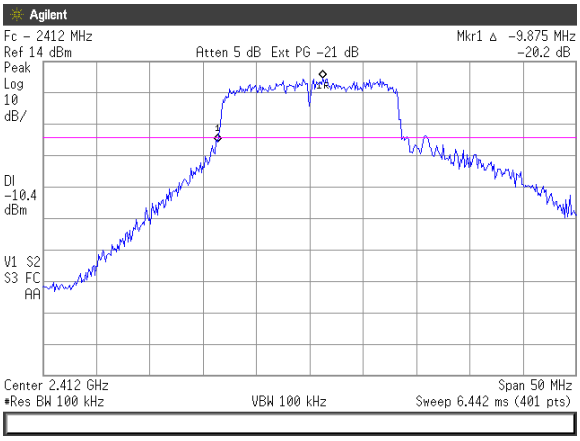
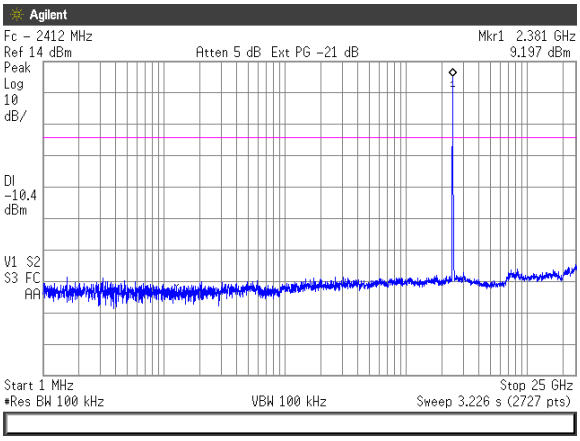


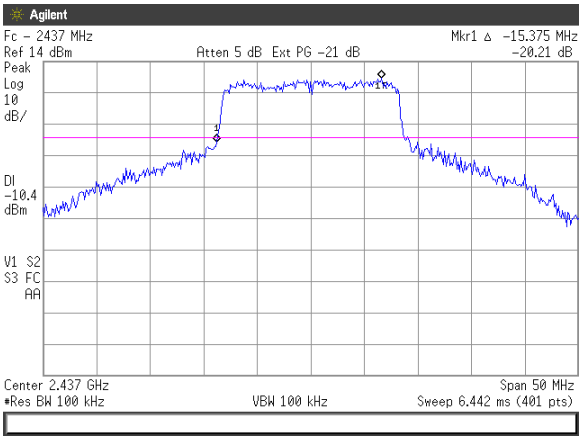
Plot # 37.

Carrier frequency 2412 MHz. 6Mbit rate.



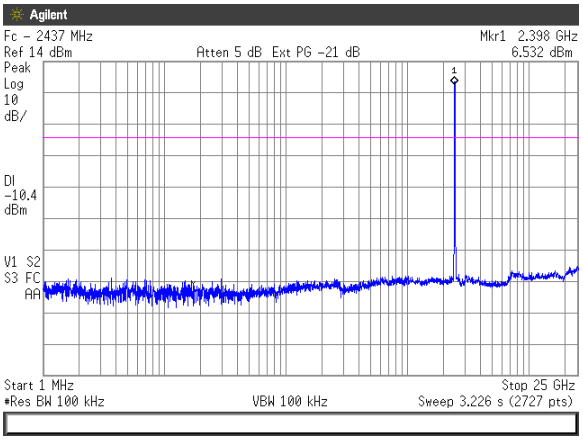
Plot # 38.

Carrier frequency 2412 MHz. 6Mbit rate.



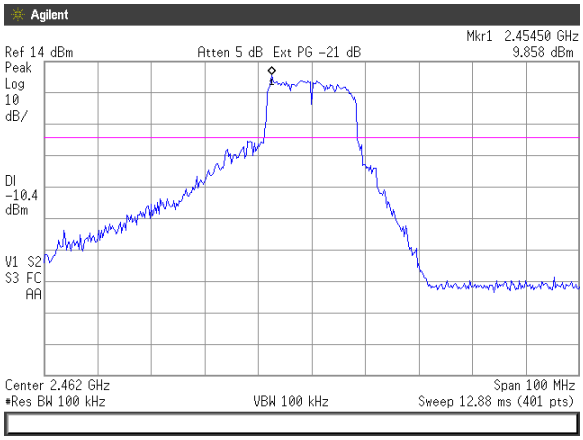
Plot # 39.

Carrier frequency 2437 MHz. 6Mbit rate.



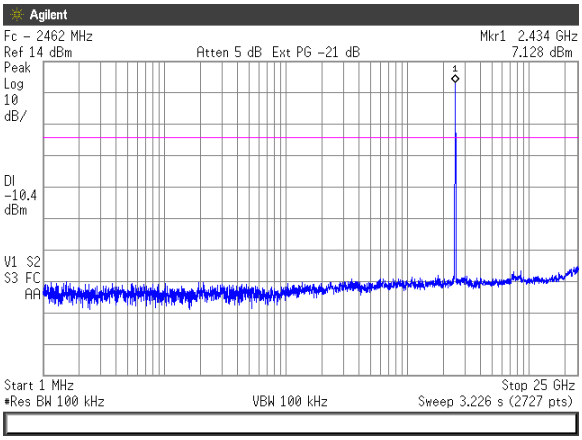
Plot # 40.

Carrier frequency 2437 MHz. 6Mbit rate.



Plot # 41.

Carrier frequency 2462 MHz. 6Mbit rate.



Plot # 42.

Carrier frequency 2462 MHz. 6Mbit rate.

7.6. Radiated emission test on Outdoor Radio Unit – spurious (per Section 15.209):

7.6.1. Requirements:

EUTs radiated emission shall not exceed value required in section 15.209 Subpart C.

7.6.2. EUT configuration:

The tested configuration has been built with 3 Bitel RF filters.
The EUT was tested with three sector antennas model MT-343037/CV.

7.6.3. Test procedure:

The measurements were performed in the anechoic chamber.
The EUT was arranged on a non-metallic table 0.8 m placed on the turntable.
Cable loss (in dB) is included in SA measurement setup.
The emission levels of the EUT more than 20 dB lower than the specified limit were not recorded in the tables. For the test results refer to relevant Plots.
Test results found in 30 – 2000 MHz are brought in section 7.4 of this test report.

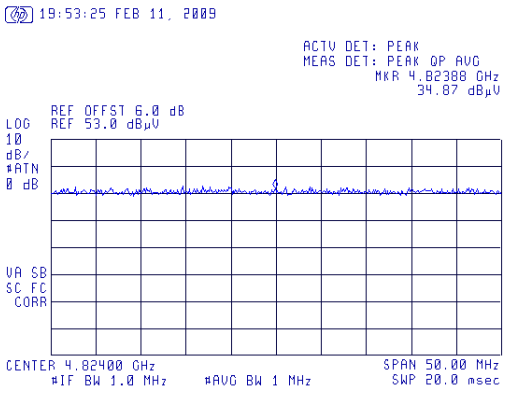
Antenna height = 1 m.
Polarization: Vertical/Horizontal
Measurement distance = 1m.
The frequency range was investigated up to 26 GHz.
The measurements were performed in vertical and horizontal polarization, the maximum reading recorded.

7.6.4. Radiated emission test results and calculation ratio:

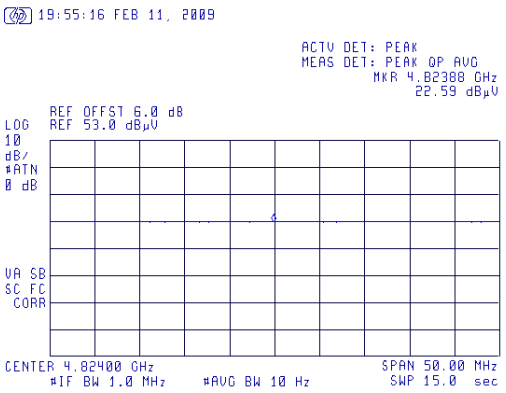
The test results were found complies with relevant standard requirements.
Test results are presented in Table 7. Spurious emissions test results
The emission level was calculated as:
E Reading (dBμV) + measuring cable loss (dB) + measuring antenna factor (dB/m).
For measuring antenna factor refer to Appendix 2.

Table 7. Spurious emissions test results

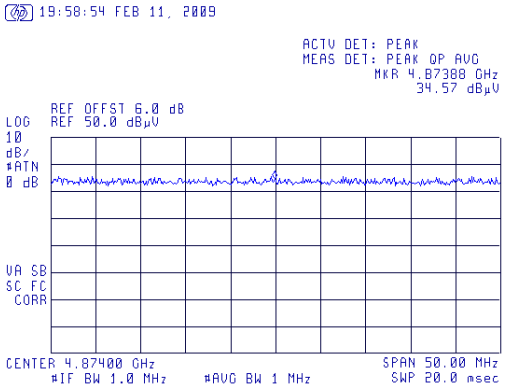
Frequency (GHz)	Emission Level (dBμV/m)		Limit @ 1m (dBμV/m)		Margin (dB)		Results
	Average	Peak	Average	Peak	Average	Peak	
LOW 2.412GHz							
4.824	55.6	Noise floor	64	84	8.4	10 dB at least	Complies
12.06	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
14.47	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
19.3	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
MIDDLE 2.437GHz							
4.874	55.5	Noise floor	64	84	8.5	10 dB at least	Complies
7.311	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
12.19	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
19.5	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
HIGH 2.462GHz							
4.924	55.4	Noise floor	64	84	8.6	10 dB at least	Complies
7.386	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
12.1	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
19.7	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
22.16	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies



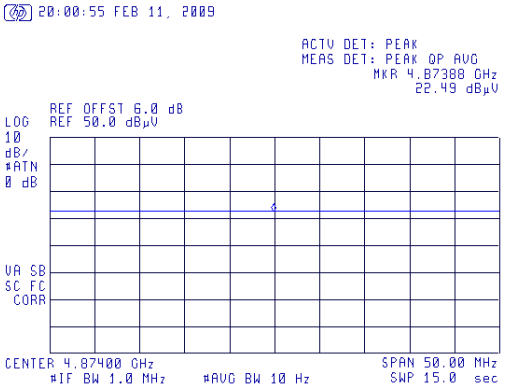
Plot # 43. Fc- 2412 MHz – 2-nd harmonic Peak Detector. Polarization – vertical.



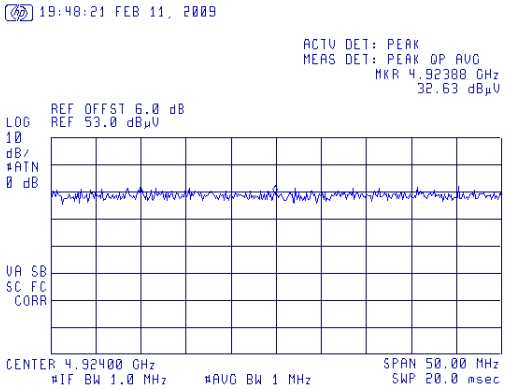
Plot # 44. Fc- 2412 MHz – 2-nd harmonic Average. Detector. Polarization – vertical.



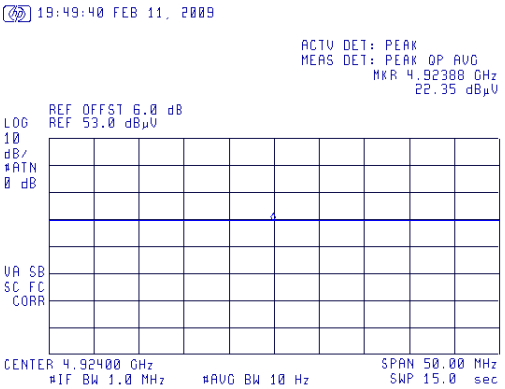
Plot # 45. Fc- 2437 MHz – 2-nd harmonic Peak Detector. Polarization – vertical.



Plot # 46. Fc- 2437 MHz – 2-nd harmonic Average. Detector. Polarization – vertical.



Plot # 47. Fc- 2462 MHz – 2-nd harmonic Peak Detector. Polarization – vertical.



Plot # 48. Fc- 2462 MHz – 2-nd harmonic Average. Detector. Polarization – vertical.

7.7. Radiated emission test on Outdoor Radio Unit - restricted bands (per Section 15.205):

7.7.1. Requirements:

Radiated emission in restricted bands should meet the requirements sec. 15.205 Subpart C.
Operating Frequency Range 2.412 – 2.462 GHz

7.7.2. EUT configuration:

The tested configuration has been built with 3 Bitel RF filters.
The EUT was tested with all three internal antennas connected to EUT
Test procedure:
The measurements were performed in the anechoic chamber.
The EUT was arranged on a non-metallic table 0.8 m placed on the turntable.
Cable loss (in dB) is included in SA measurement calculation.
First, initial scans were performed in normal (transmitting) mode of operation for carrier (channel) frequency at the low and the high of the 2412 - 2462 MHz frequency range under 2 data transfer bit rates. The Output Power (22dBm) was adjusted from the data and control transfer equipment with the system integrator access only (following to Important Safety Instruction of Installation Guide). The measurements were performed in vertical and horizontal polarization, the maximum reading recorded.
The worst results from all measurements (Low band edge frequency-2390MHz frequency, and High band edge frequency-2483.5MHz) are presented in summary table of clause 7.7.4 and at the plots 49 - 56.
Measuring antennas used: Double Ridge EMCO model 3115
Antenna height = 1 m.
Measurement distance = 3m.
Measuring detector function and bandwidths:

Detector type	Peak	Average
Resolution bandwidth	1 MHz	1 MHz
Video bandwidth	1 MHz	30 Hz

7.7.3. Test results and calculation ratio:

The test results are shown in Plots - as detailed in Table below.

Band edge Freq. MHz	Pol V/H	Rate, Mbps	Read Pk, dBµV	Read Avg, dBµV	AF, dB	Peak, dBµV/m	Avg, dBµV/m	Peak Limit, dB(µV/m)	Avg Limit, dB(µV/m)	Peak Margin dB	Avg Margin dB	Verdict	Plot Number
Transmitting on Low (2.412GHz) frequency.													
2390	V	1	33.0	22.3	28.8	61.8	51.1	74	54	12.2	1.9	Pass	49, 51
2390	V	6	42.7	22.4	28.8	71.5	51.2	74	54	2.5	1.8	Pass	50, 52
Transmitting on High (2.462GHz) frequency.													
2483.5	V	1	31.2	19.5	28.8	60.0	48.3	74	54	14	5.7	Pass	53, 55
2483.5	V	6	41.4	24.3	28.8	70.2	53.1	74	54	3.8	0.9	Pass	54, 56

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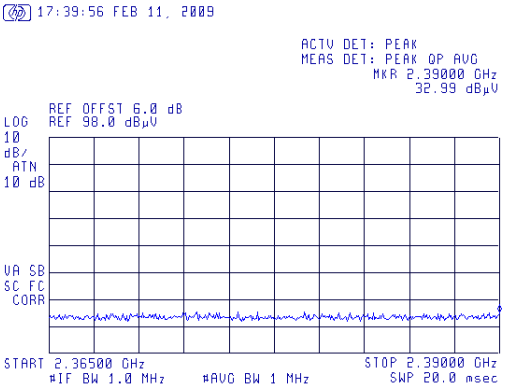
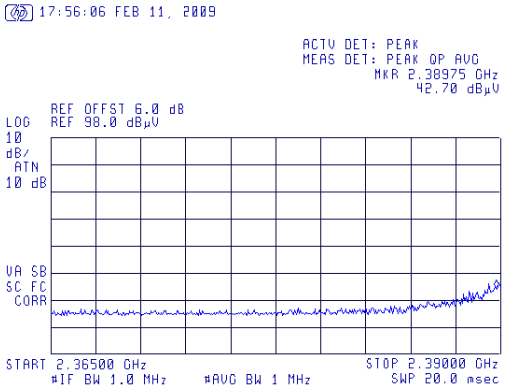
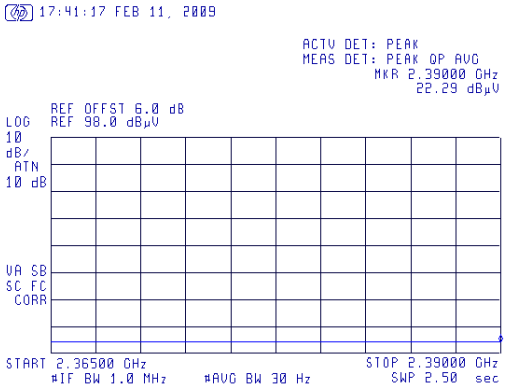


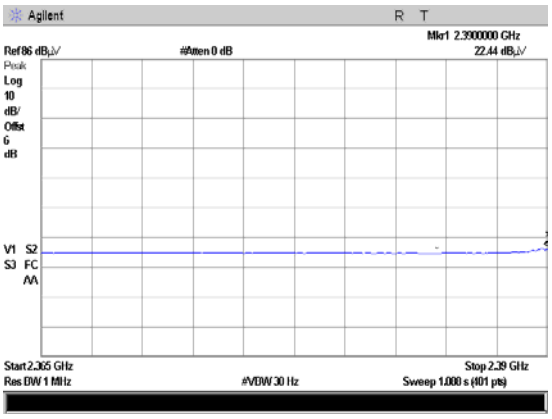
Plot # 49
Fc-2412 MHz. 1 Mbit, Detect. Peak.



Plot # 50
Fc-2412 MHz. 6 Mbit, Detect. Peak.



Plot # 51
Fc-2412 MHz. 1 Mbit, Detector Average.



Plot # 52
Fc-2412 MHz. 6 Mbit, Detector Average.

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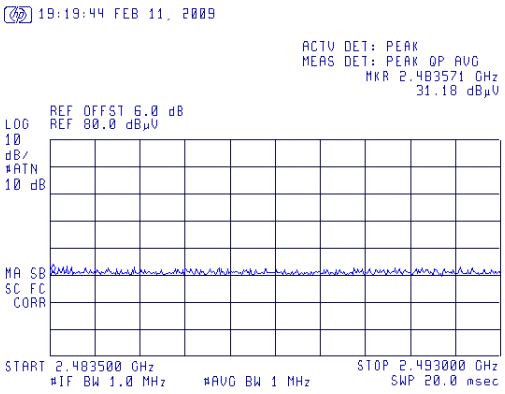
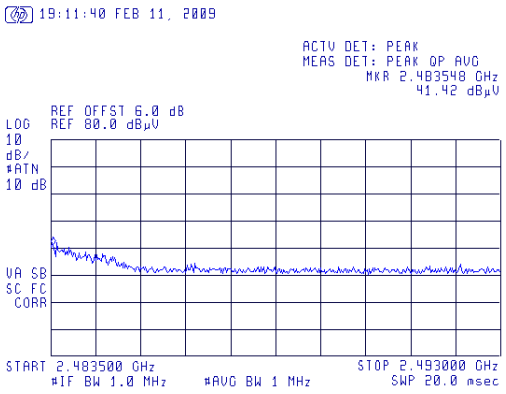
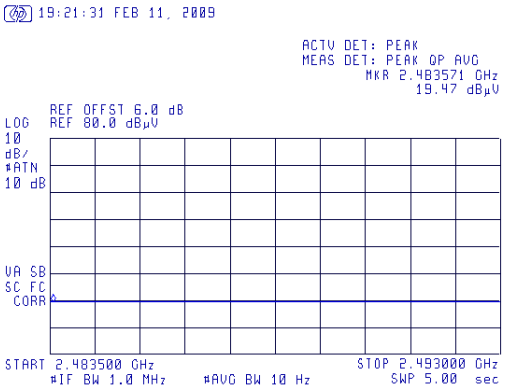
Title: Test on 2.4 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-2400 **FCC ID: UGM-WBS2400-2S**



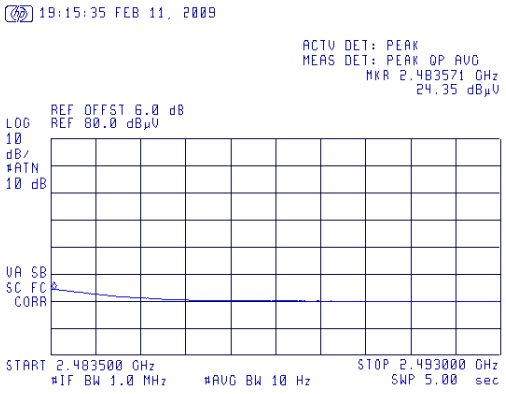
Plot # 53
Fc-2462 MHz. 1 Mbit, Detect. Peak.



Plot # 54
Fc-2462 MHz. 6 Mbit, Detect. Peak.



Plot # 55
Fc-2462 MHz. 1 Mbit, Detect. Average.



Plot # 56
Fc-2462 MHz. 6 Mbit, Detect. Average.

7.8. Minimum bandwidth

7.8.1. Requirements:

The minimum 6dB bandwidth shall be at least 500 KHz as required in sec. 15.247 (a)(2).

7.8.2. Pre-test scanning:

In order to find the "worst case" sample, which can represent all kinds of RF filters, each filter (Murata and Bitel filters) was pre-tested.
After all min. bandwidth tests the Bitel models were chosen as the "worst case", all final measurements were performed with 3 Bitel filters.

7.8.3. Test procedure:

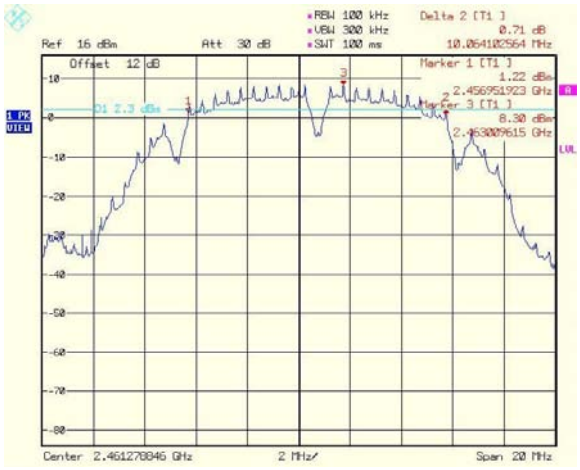
The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low, middle and the high of the 2.412 - 2.462 GHz frequency range under 2 data transfer bit rates that reflect to the worst test results. All final tests were performed on Output 3 that is the worst case between all outputs.
The EUT RF output was connected to the Spectrum Analyzer accounted with cable loss in SA settings.
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

7.8.4. Test results:

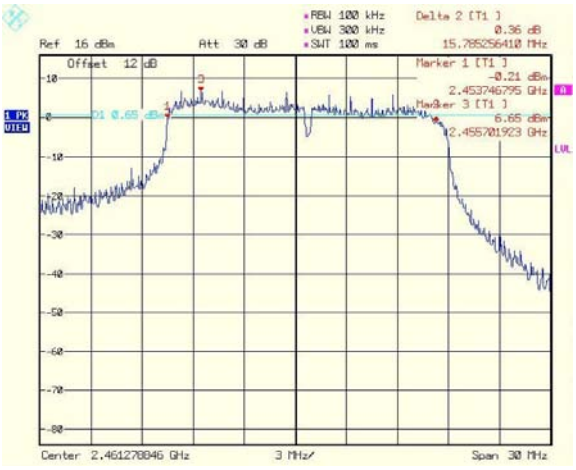
Pre-compliance measurements
The WBS-2400 configurations for preliminary tests were as following: 2 RF filters Murata (outputs 1 & 2), RF filter Bitel (output 3).
The summaries of preliminary minimum bandwidth measurements are shown in Table 7 and were found with large margin. The plots of pre-scan for each kind of 2 RF filters (outputs 1&3 accordantly) are presented on the plots 57-68.

			Output1	**Output3**
Freq.	Rate	Modulation	Murata	Bitel
MHz	Mbps	mode	kHz	kHz
2412	1	802.11b	9519	8526
	6	802.11g	15673	15337
2437	1	802.11b	10000	8526
	6	802.11g	16346	15000
2462	1	802.11b	10064	9006
	6	802.11g	15785	15304

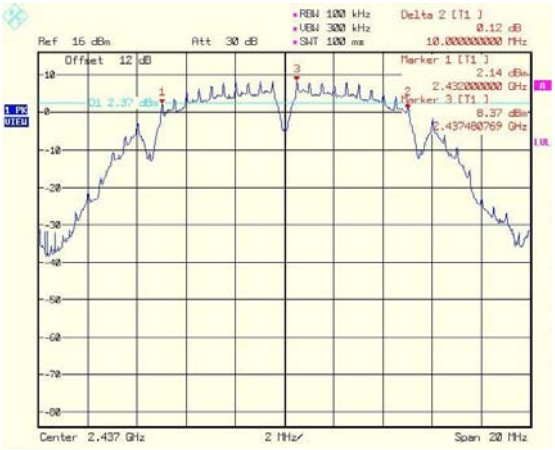
Table 8. 6dB bandwidth results



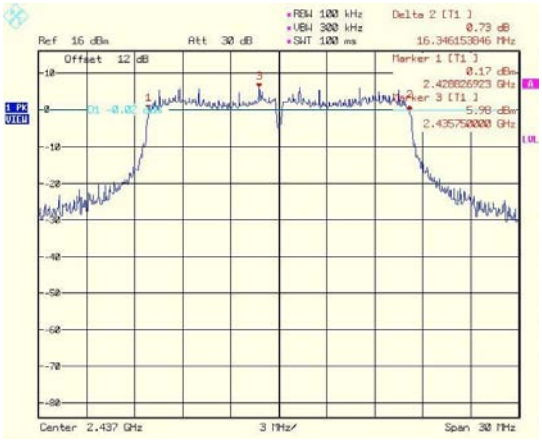
Plot # 57. Output 1. 6 dB Bandwidth. High frequency. 1Mbps rate.



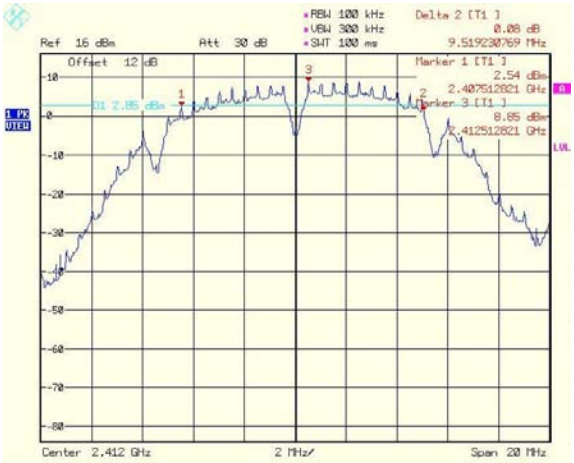
Plot # 58. Output 1. 6 dB Bandwidth. High frequency. 6Mbps rate.



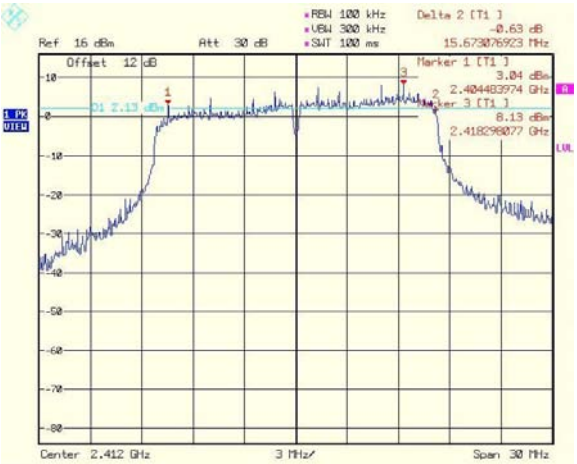
Plot # 59. Output 1. 6 dB Bandwidth. Middle frequency. 1Mbps rate.



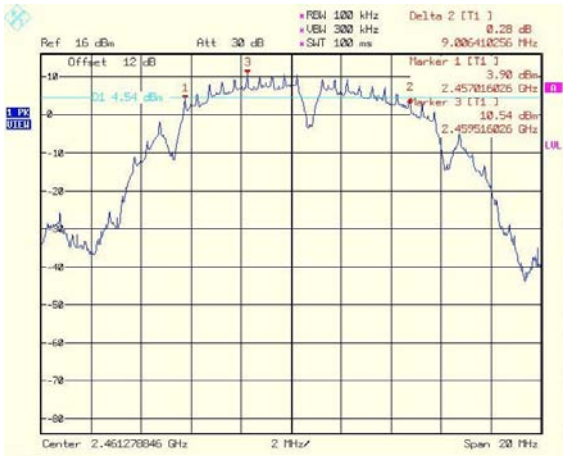
Plot # 60. Output 1. 6 dB Bandwidth. Middle frequency. 6Mbps rate.



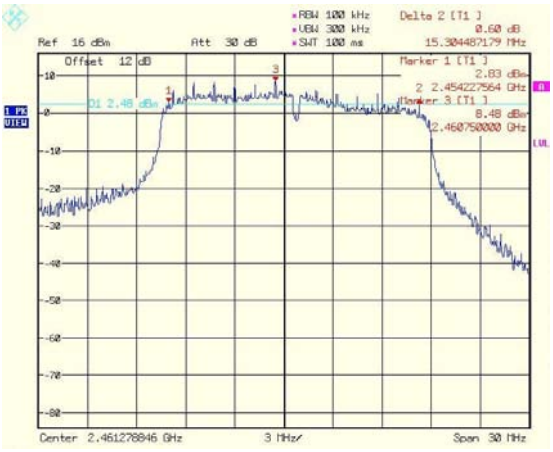
Plot # 61. Output 1. 6 dB Bandwidth. Low frequency. 1Mbps rate.



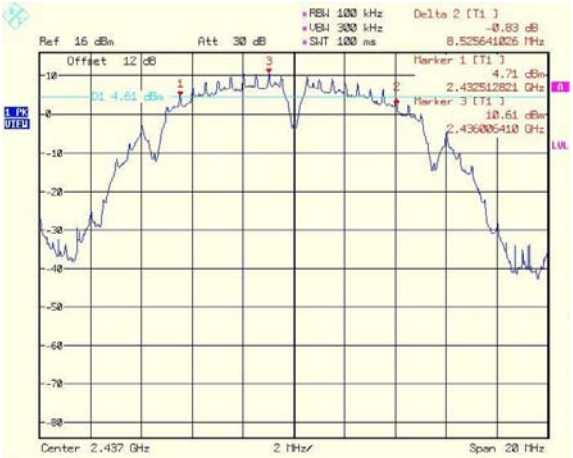
Plot # 62. Output 1. 6 dB Bandwidth. Low frequency. 6Mbps rate.



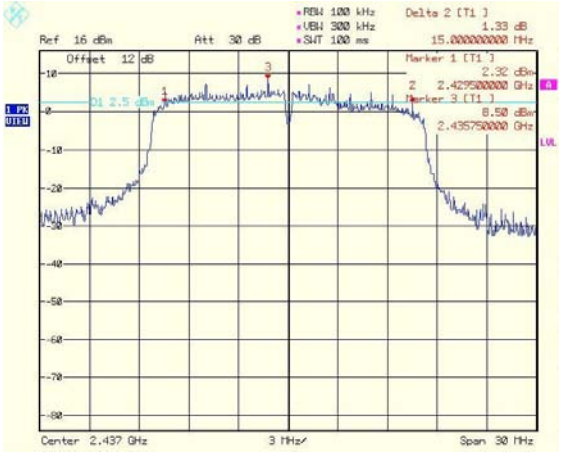
Plot # 63. Output 3. 6 dB Bandwidth. High frequency. 1Mbps rate.



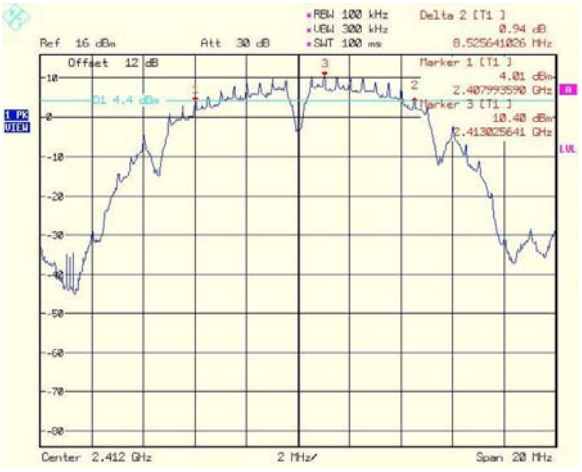
Plot # 64. Output 3. 6 dB Bandwidth. High frequency. 6Mbps rate.



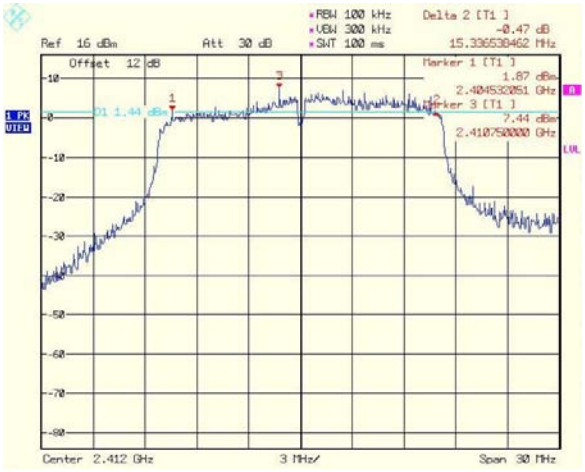
Plot # 65. Output 3. 6 dB Bandwidth. Middle frequency. 1Mbps rate.



Plot # 66. Output 3. 6 dB Bandwidth. Middle frequency. 6Mbps rate.



Plot # 67. Output 3. 6 dB Bandwidth. Low frequency. 1Mbps rate.



Plot # 68. Output 3. 6 dB Bandwidth. Low frequency. 6Mbps rate.

Final measurements

In a reason of large margin received in pre-compliance testing the final configuration was yet based on clause 7.5.4.

The final configuration has been built with 3 Bitel RF filters.

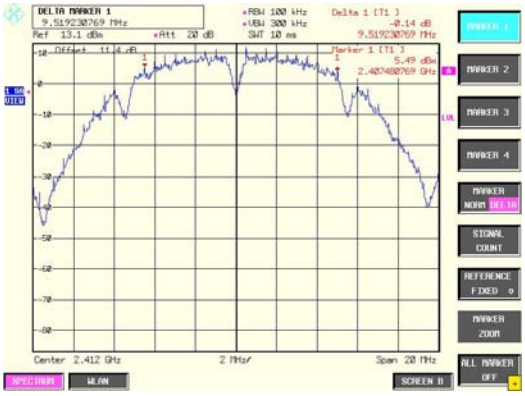
The summaries of final minimum bandwidth measurements from output 3 are shown in Table 9.

The minimum measured bandwidth for all configurations is 8653 kHz that is comply with standard required bandwidth

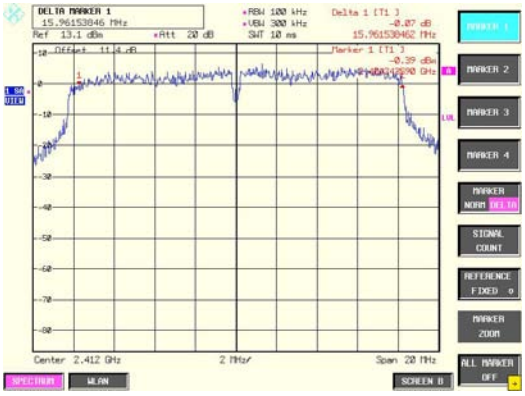
Frequency MHz	Rate Mbps	6dB Bandwidth [kHz]	Minimum Limit [kHz]	Verdict	Plot number
2412	1	9519	500	Pass	69
	6	15961	500	Pass	70
2437	1	9294	500	Pass	71
	6	16346	500	Pass	72
2462	1	8653	500	Pass	73
	6	16025	500	Pass	74

Table 9. 6dB bandwidth results

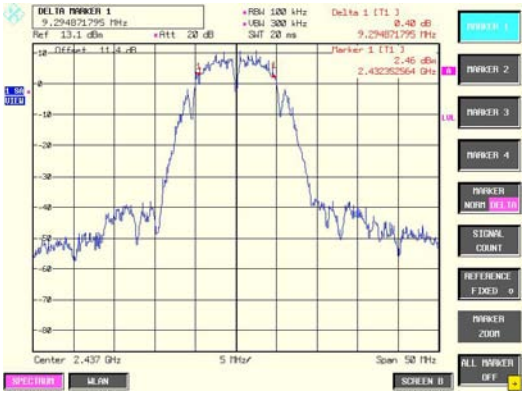
6dB bandwidth results



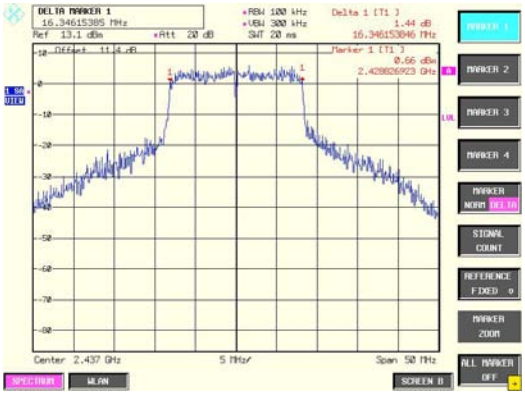
Plot # 69. Tx output 2. 6 dB bandwidth
Fc-2412 MHz. 1Mbps rate



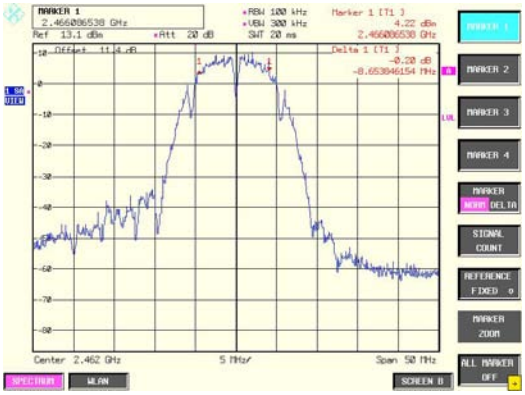
Plot # 70. Tx output 2. 6 dB Bandwidth.
Fc-2412 MHz. 6Mbps rate.



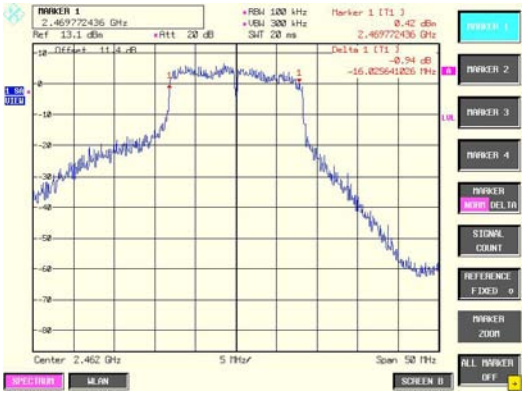
Plot # 71. Tx output 2. 6 dB bandwidth
Fc-2437 MHz. 1Mbps rate



Plot # 72. Tx output 2. 6 dB Bandwidth.
Fc-2437 MHz. 6Mbps rate.



Plot # 73. Tx output 2. 6 dB bandwidth
Fc-2462 MHz. 1Mbps rate



Plot # 74. Tx output 2. 6 dB Bandwidth.
Fc-2462 MHz. 6Mbps rate.