Test Report No. 8912307342

Applicant: Wavion Ltd.

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

Model: WBS-5800
FCC ID: UGM-WBS5800-2

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

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Test Report No.: 8912307342 **Page 1 of 51 Pages**
Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-5800 **FCC ID: UGM-WBS5800-2**

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

Description of Equipment Under Test (EUT): 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station

Model: WBS-5800

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 51 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.

Table of Contents

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: 15.107, 15.109, 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
28 January 2009

Approved by: Eng. Yuri Rozenberg
Position: Head of EMC Branch

Tested by: Albert Herzenshtein
Position: Test Engineer

3. Scope

This test report contains results measured on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station (FCC ID: UGM-WBS5800-2) 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-5800 is a new category of Wi-Fi Wireless Base Station designed from the ground up for metro-Wi-Fi deployments. It is based on six 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-5800 Wi-Fi Wireless Base Station uses six omni-directional 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	PC00042	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-462007	MTI

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	1	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 with PLL

Table 3. Potential emission sources

4.5. Auxiliary equipment used:

The auxiliary equipment used is detailed in Table 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		5725MHz to 5850MHz						
Operating frequency range		5740MHz to 5835MHz						
RF channel spacing		5MHz						
Maximum permitted output power		At transmitter 50 Ω RF output connector		22.2dBm				
Is transmitter output power variable?			**Transmitter output power per output (measured)**					
		Yes	minimum RF power		4dBm			
			maximum RF power		19.7dBm			
Antenna connection								
	unique coupling	V (N-Type)	standard connector		integral		with temporary RF connector	
						V	without temporary RF connector	

External antenna/s technical characteristics

Type	Manufacturer	Model number	Gain / Frequency range
Omni-directional	MTI	MT-462007	8.5dBi / 4.9-5.875 GHz

Transmitter 99% power bandwidth			12000kHz to 16000kHz			
Transmitter aggregate data rate/s (min-maximum)			6Mbps to 54Mbps			
Type of modulation			OFDM, DSSS, CCK			
Type of multiplexing			CSMA/CA			
Modulating test signal (baseband)			Random data			
Maximum transmitter duty cycle in normal use		90.%	Tx ON time	…X….msec	Period	…X….msec
Transmitter duty cycle supplied for test		100%	Tx ON time	…X….msec	Period	…X….msec

Transmitter power source					
V	DC	**Nominal rated voltage**	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-5800 unit has 4 possible DC/DC power supplies. Below is a list of all DC/DC PS models:

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

To check compliance in every configuration and to use DC/DC PS models in any combination for the WBS-5800 device the following tests have been performed:

1. Conducted unintentional radiation test: conducted (per 15.205) and radiated (per 15.209) emissions tests were performed with all possible DC/DC PS configurations.
2. Find the worst case sample, where it is most critical the emissions for the PS.
3. Conducted/radiated unintentional radiation tests for the worst case sample.

In order to find the “worst case” sample, which can represent all kinds DC/DC PS, each of them was pre-tested as described above.
After all unintentional emissions tests the Bell model was chosen as the “worst case”, all final measurements were performed.

RF output terminated by 50Ω

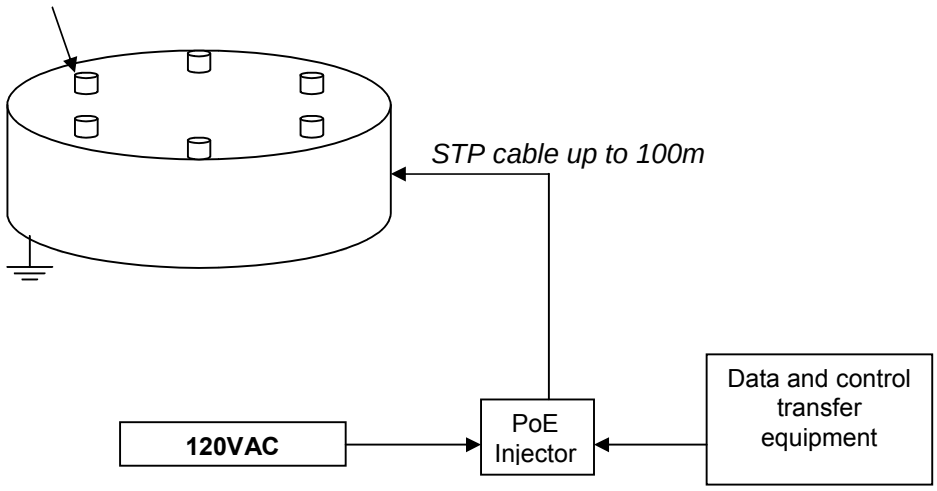


Figure 1. Radiated emission test setup

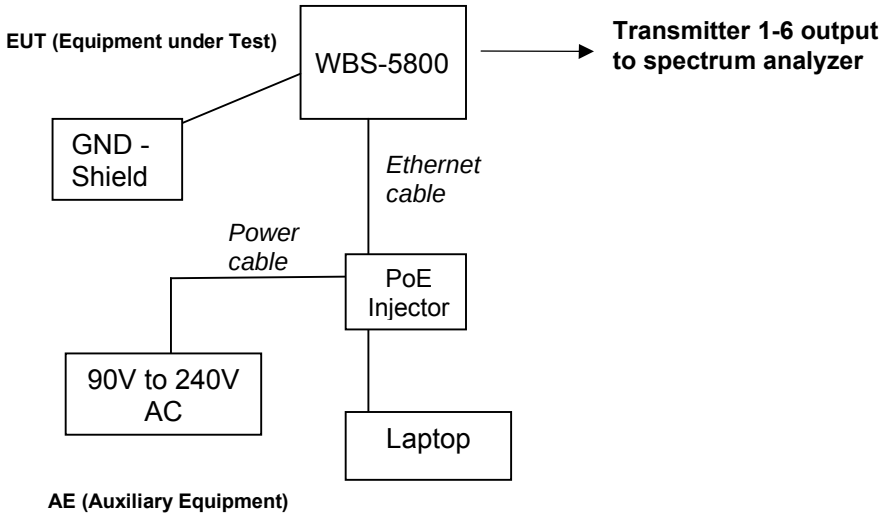


Figure 2. Transmitter measurements test setup

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)

Pt- the transmitted power whish is equal to the output power 22.2 dBm plus maximum antenna gain – 8.5 dBi

r – The distance from the unit (cm)

The 1(mW/cm^2) limit can be calculated from the above based on the following data:

The maximum EIRP for each transmit output = 30.7 dBm = 1174.9mW

r = sqrt(1174.9/4π) = 9.67cm

For aggregate Pt- the transmitted power whish is equal to the output power 30 dBm plus maximum directional antenna gain – 16.3 dBi

The maximum aggregate EIRP = 46.3 dBm = 42657.95 mW:

r = sqrt(42657.95/4π) = 58.26 cm

The allowed distance “r”, where RF exposure limits may not be exceeded, is 58.26 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: 22 °C
Humidity: 50 %

7.3. Conducted emission test (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-5800, one sample of the device contains each DC/DC PS was pre-tested. After all conducted tests the model Bel was chosen as the "worst case", all unintentional radiation measurements were performed on it.

7.3.3. Test procedure:

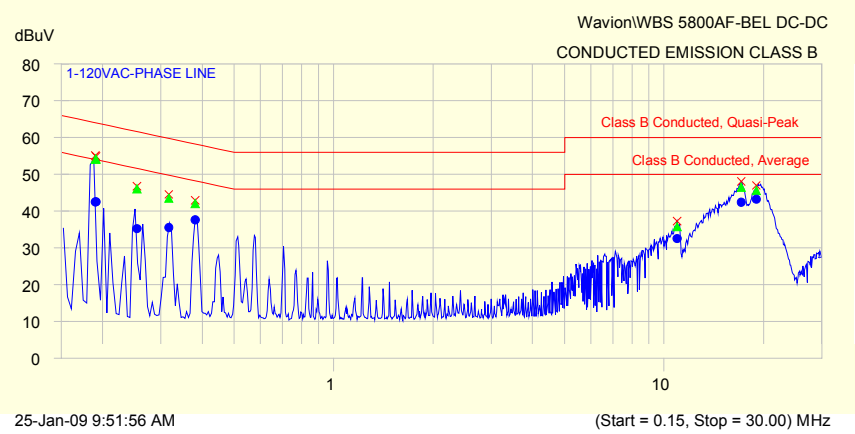
The EUT was operated to transmitting through the customer software.
The measurements were performed on the auxiliary PoE injector AC/DC PS 120 VAC mains input. The EUT was placed on a non-metallic table in a shielded chamber at a height of 80 cm from the floor and 40 cm from the nearest wall.
Test equipment (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:

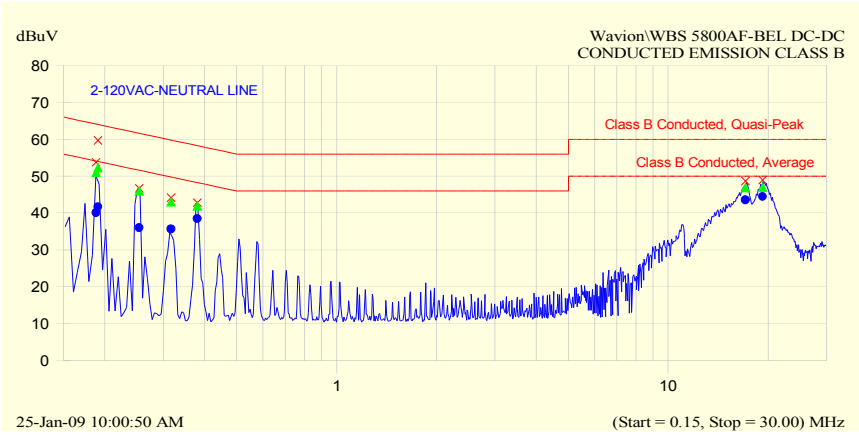
Scans of pre-test scanning for 4 units are presented in Pots #1-8.
Final test results are shown in Plots #9-10.
The test results were found complies with relevant standard requirements.

Bell Power Supply



Frequency	Peak	QP	QP Limit	QP-QP Limit	Avg	AVG-Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.190	55.1	54.2	64.1	-9.9	42.5	54.1	-11.5

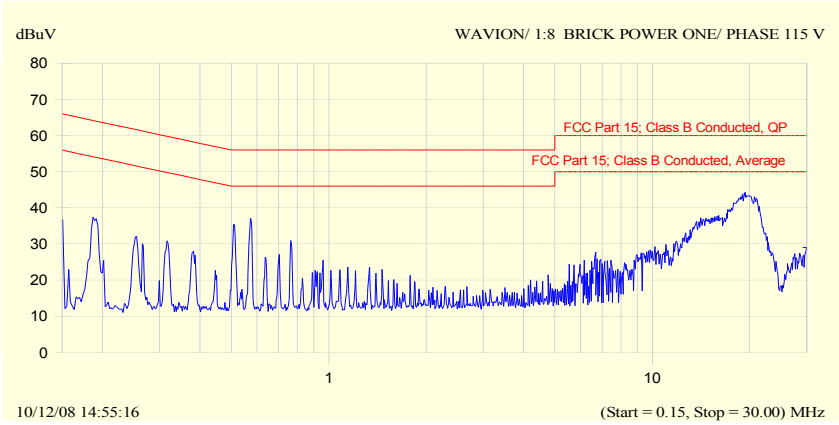
Plot # 1. Conducted emissions measurement result on 120 VAC power. Line- phase.



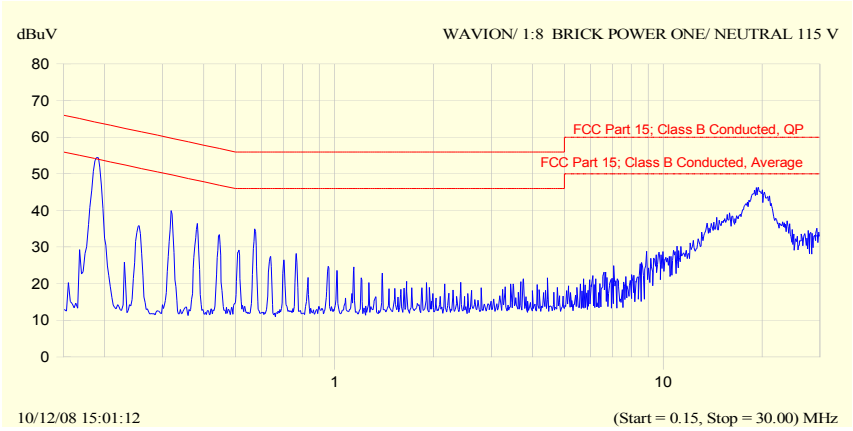
Frequency	Peak	QP	QP Limit	QP-QP Limit	Avg	AVG-Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.188	53.8	51.0	64.1	-13.1	40.1	54.1	-14.0

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

PowerOne 1/8 Power supply

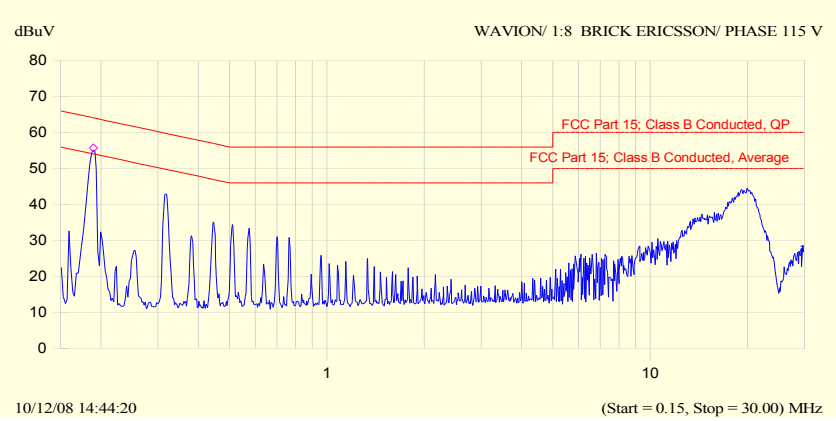


Plot # 3. Conducted emissions measurement result on 120 VAC power. Line- phase.



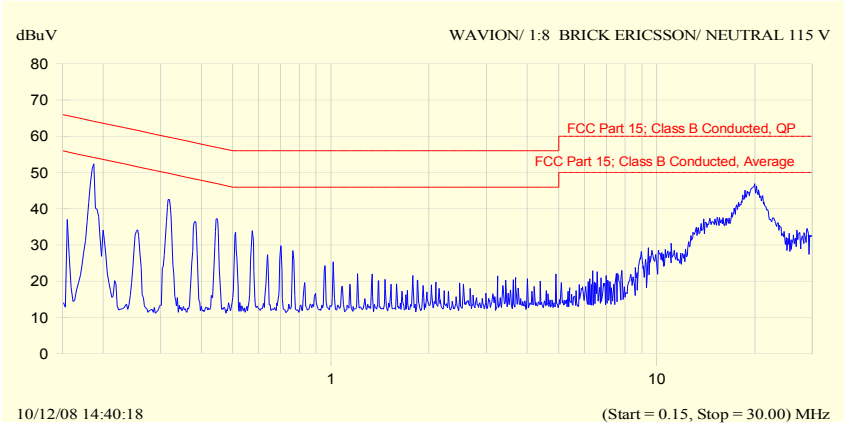
Plot # 4. Conducted emissions measurement result on 120 VAC power. Line- neutral.

Ericsson Power supply



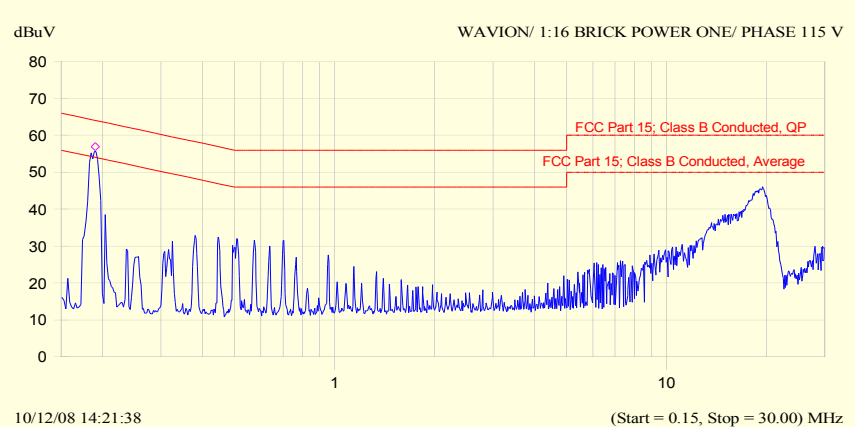
Frequency	Peak	QP	Avg	QP-QP Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dBuV	dB	dB
0.189	55.7	54.6	45.2	-9.5	-8.8

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



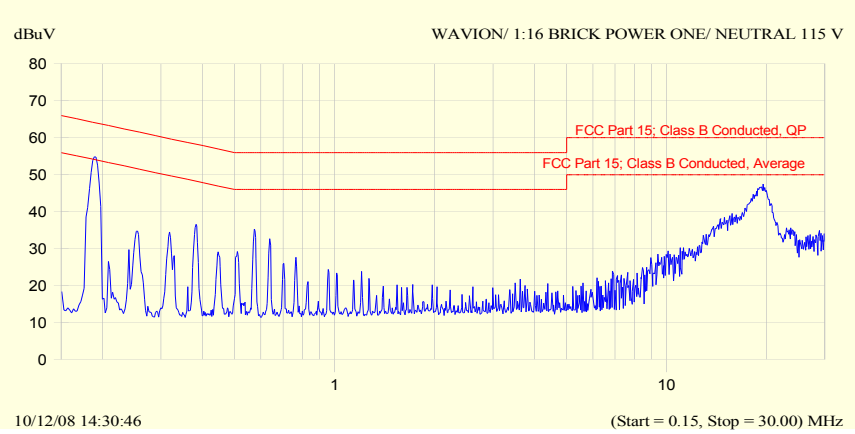
Plot # 6. Conducted emissions measurement result on 120 VAC power. Line- neutral.

PowerOne 1/16 Power supply

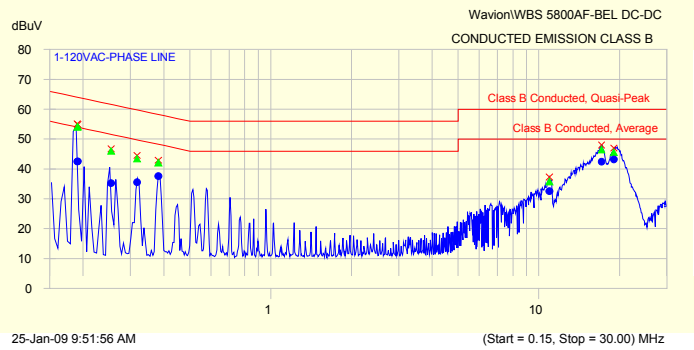


Frequency	Peak	QP	Avg	QP-QP Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dBuV	dB	dB
0.190	56.9	56.2	46.6	-7.8	-7.4

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

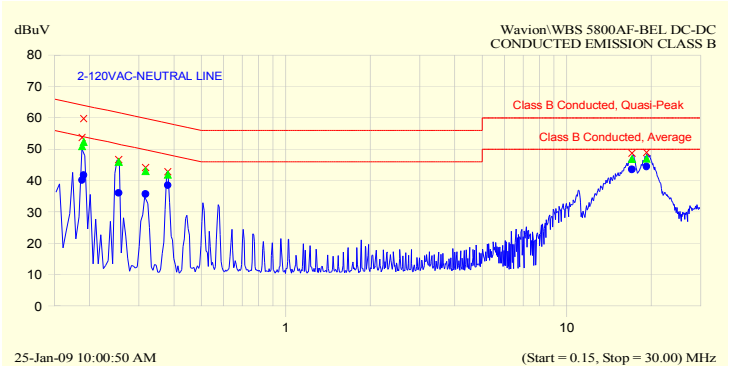


Plot # 8. Conducted emissions measurement result on 120 VAC power. Line- neutral.



Freq.	Peak	QP	QP Limit	QP-QP Limit	Avg	AVG-Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.190	55.1	54.2	64.1	-9.9	42.5	54.1	-11.5
0.254	46.8	46.1	61.6	-15.5	35.3	51.6	-16.4
0.317	44.6	43.5	59.8	-16.3	35.6	49.8	-14.2
0.381	43.0	42.1	58.3	-16.1	37.6	48.3	-10.6
17.098	48.1	46.5	60.0	-13.5	42.5	50.0	-7.5
19.002	47.0	45.7	60.0	-14.3	43.2	50.0	-6.8

Plot # 9. Bell DC/DC PS
LINE Phase



Freq.	Peak	QP	QP Limit	QP-QP Limit	Avg	AVG-Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.188	53.8	51.0	64.1	-13.1	40.1	54.1	-14.0
0.191	59.7	52.3	64.0	-11.7	41.7	54.0	-12.3
0.317	44.2	43.0	59.8	-16.8	35.7	49.8	-14.1
0.380	42.8	41.9	58.3	-16.3	38.5	48.3	-9.8
17.098	48.7	46.9	60.0	-13.1	43.6	50.0	-6.4
19.256	49.0	47.0	60.0	-13.0	44.5	50.0	-5.5

Plot # 10. Bell DC/DC PS
LINE NEUTRAL

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

7.4.1. Requirements:

The EUTs radiated emission shall not exceed value required in section 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-5800, one sample of the device contains each DC/DC PS was pre-tested. After all radiated emission preliminary tests the model Bel 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 1 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 Pots # 11-14.
Test results are presented in Table 5.
The test results were found complies with relevant standard requirements.

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Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
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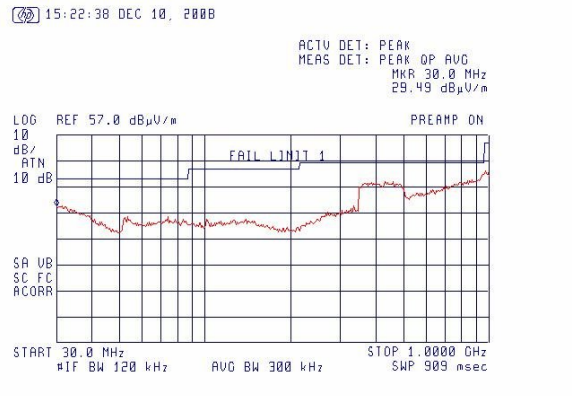
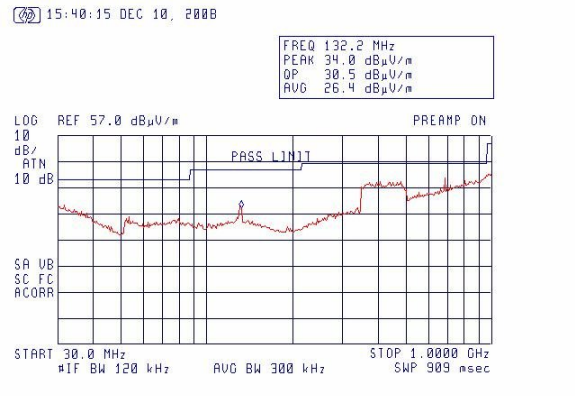
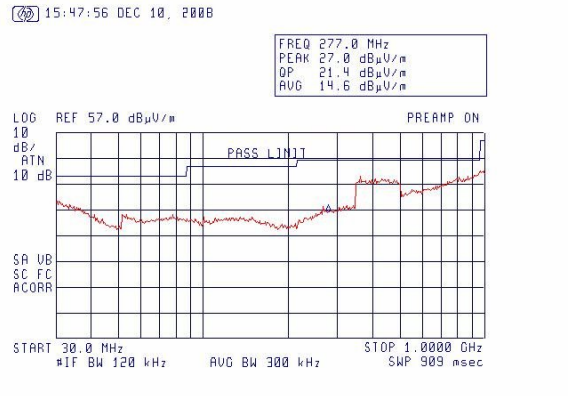


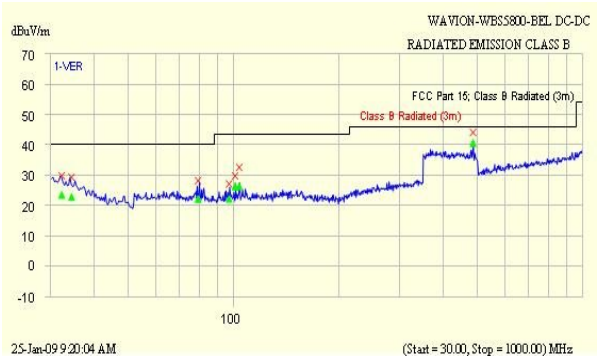
Plot # 11.
Power One 1/8 DC/DC PS



Plot # 12.
Ericsson DC/DC PS



Plot # 13.
Power One 1/16 DC/DC PS



Plot # 14.
Bel DC/DC PS

Table 5. Radiated emission test results
FCC Part 15 section 15.109, 15.209

Bell 1/8 PS

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
34.7	V	1.20	24	30.49	40.0	9.51	Complies
46.37	V	1.20	137	30.08	40.0	9.92	Complies
83.7	V	1.10	134	31.38	40.0	8.62	Complies
114.2	V	1.10	162	33.79	43.5	9.71	Complies
118.8	V	1.20	173	34.52	43.5	8.98	Complies
176.2	V	2.80	163	30.82	43.5	12.68	Complies
185.6	V	1.30	163	31.87	43.5	11.63	Complies
458.6	V	3.20	49.6	30.78	46.0	15.22	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)