Test Report No. 8912307343

Applicant: ***Wavion Ltd.***

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

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

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

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Test Report No.: 8912307343 **Page 1 of 45 Pages**
Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-5800 **FCC ID: UGM-WBS5800-2S**

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): 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 45 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
April 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-WBS5800-2S) 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-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 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-5800 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	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-463009CV	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 per output		At transmitter 50 Ω RF output connector		25.2dBm				
Is transmitter output power variable?			**Transmitter output power per output (declared)**					
		Yes	minimum RF power		4dBm			
			maximum RF power		18.7dBm			
Antenna connection								
V	unique coupling		standard connector		integral		with temporary RF connector	
						V	without temporary RF connector	

External antenna/s technical characteristics

Type	Manufacturer	Model number	Gain / Frequency range
Sector	MTI	MT-463009CV	12.5dBi / 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.

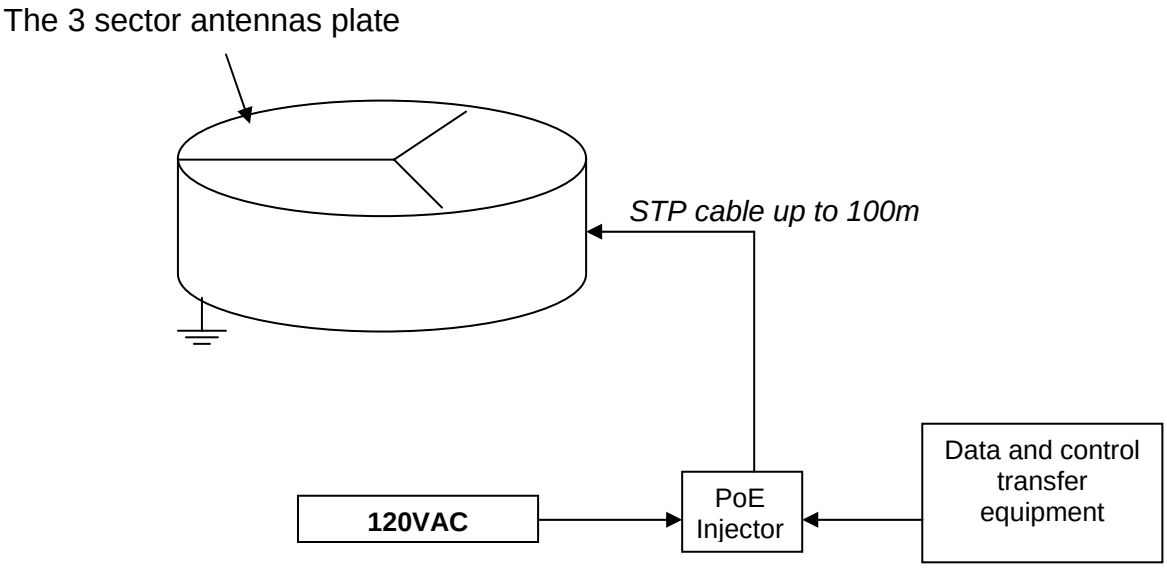


Figure 1. Radiated emission test setup

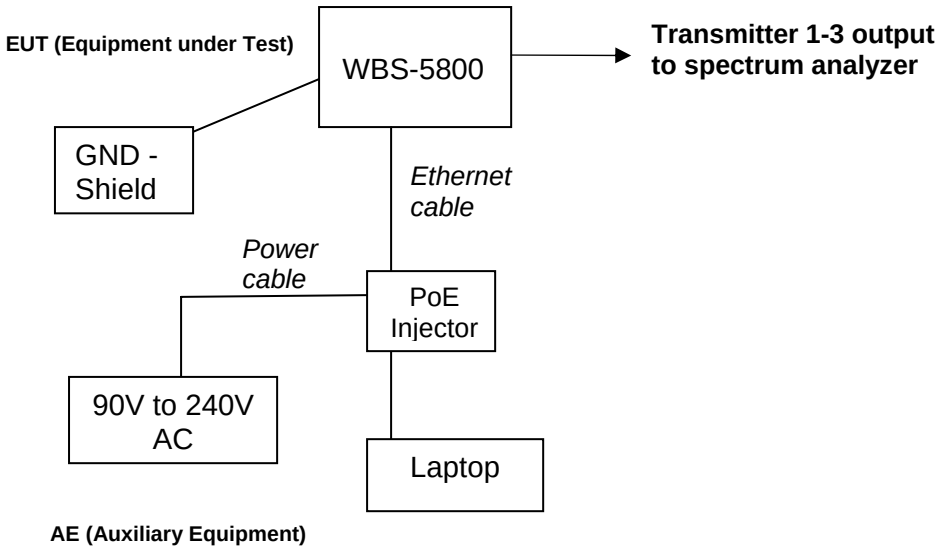


Figure 2. Transmitter measurements test setup

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 which is equal to the output power 25.2 dBm plus maximum antenna gain – 12.5 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 = 37.7 dBm = 5888.44mW

r = sqrt(5888.44/4π) = 21.65 cm

For aggregate Pt- the transmitted power whish is equal to the output power 30 dBm plus maximum directional antenna gain – 17.27 dBi

The maximum aggregate EIRP = 47.27 dBm = 53333.5 mW:

r = sqrt(53333.5/4π) = 65.15 cm

The allowed distance “r”, where RF exposure limits may not be exceeded, is 51.75 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:

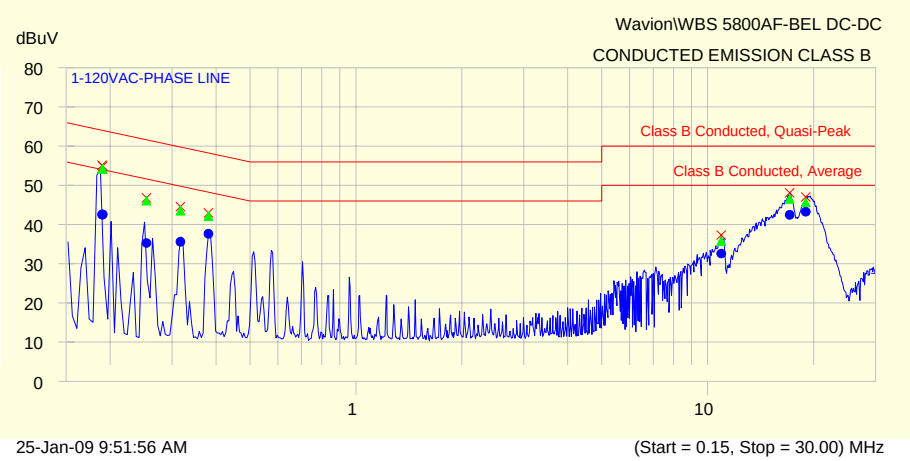
The EUT was operated to transmitting through the customer software.
The measurements were performed on the auxiliary PoE injector AC/DC PS 120 VAC mains input. The EUT was placed on a non-metallic table in a shielded chamber at a height of 80 cm from the floor and 40 cm from the nearest wall.
Test equipment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

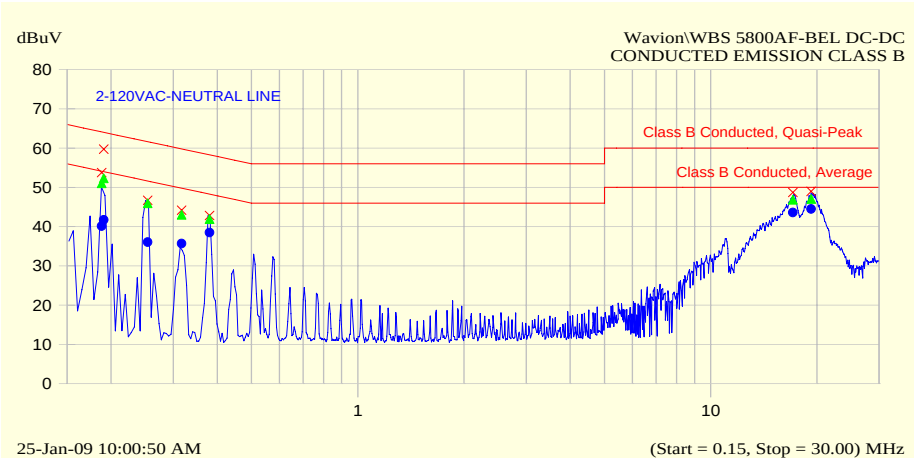
Scans of pre-test scanning for 4 units are presented in Plots #1-8.
Final test results are shown in Plots #9-10.
The test results were found complies with relevant standard requirements.

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

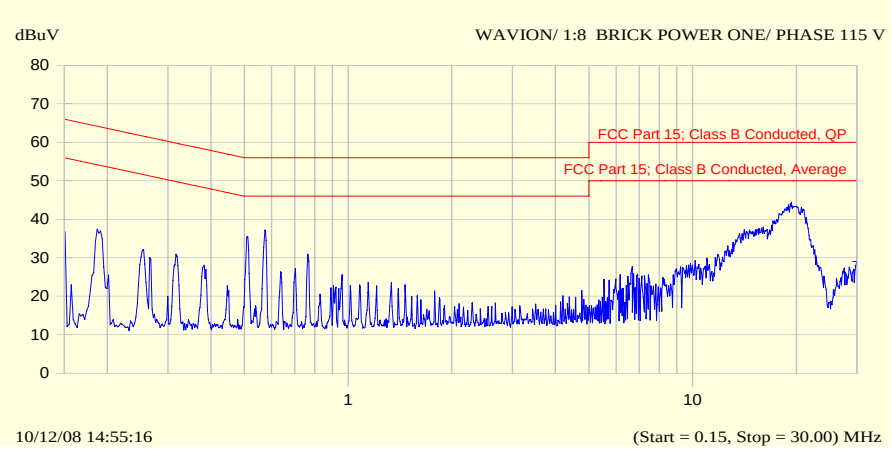
Plot # 1. Conducted emissions measurement result on 120 VAC power. Line- phase.



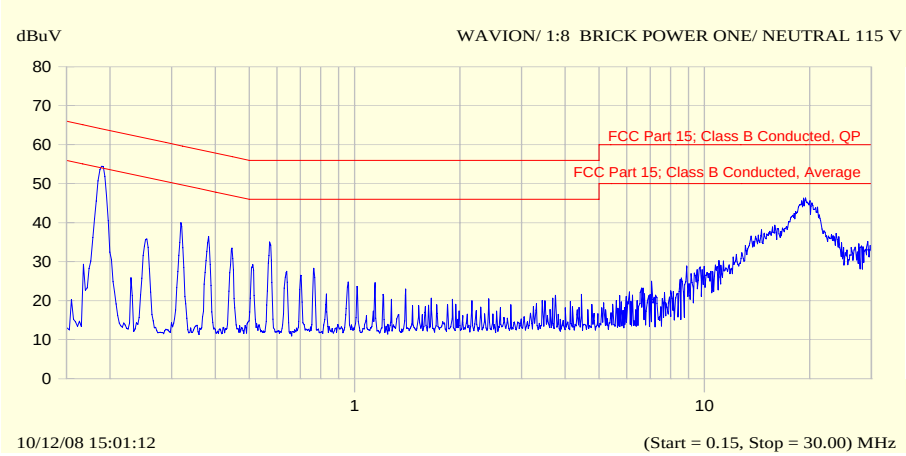
Frequency	Peak	QP	QP Limit	QP-QP Limit	Avg	AVG-Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.188	53.8	51.0	64.1	-13.1	40.1	54.1	-14.0

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

PowerOne 1/8 Power supply

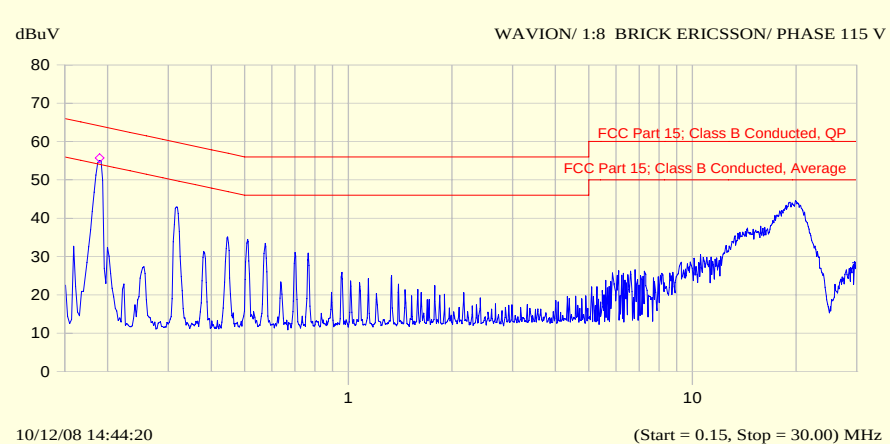


Plot # 3. Conducted emissions measurement result on 120 VAC power. Line - phase.



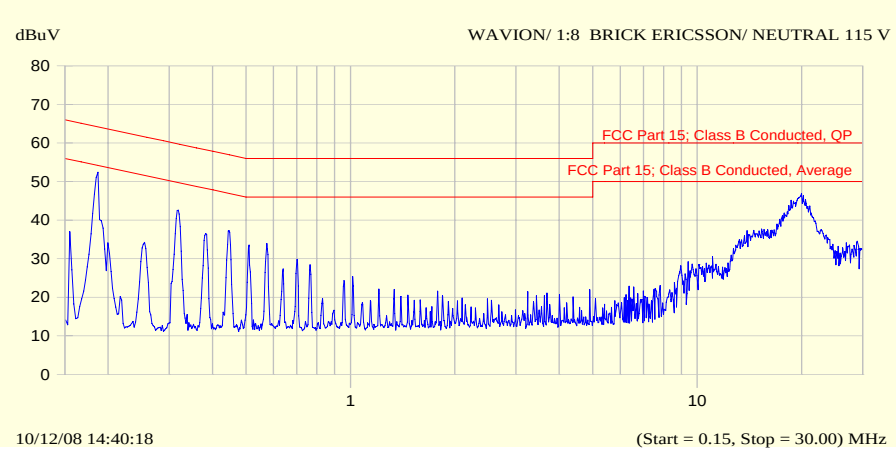
Plot # 4. Conducted emissions measurement result on 120 VAC power. Line - neutral.

Ericsson Power supply



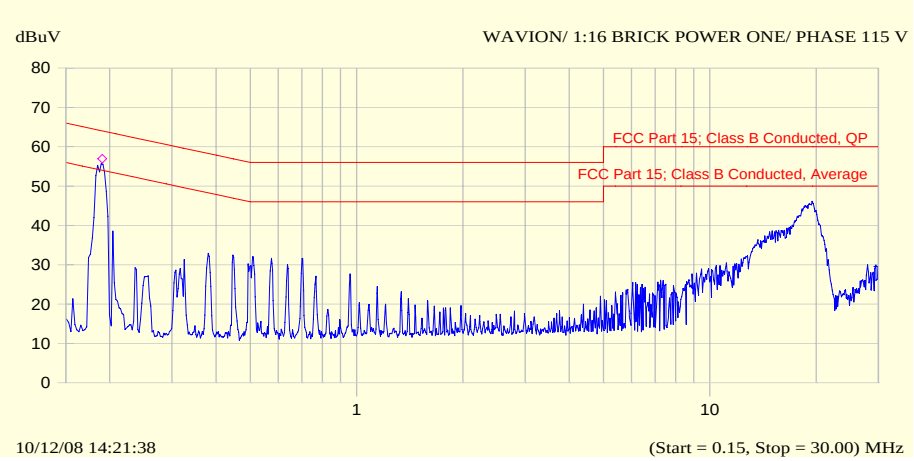
Frequency	Peak	QP	Avg	QP-QP Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dBuV	dB	dB
0.189	55.7	54.6	45.2	-9.5	-8.8

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



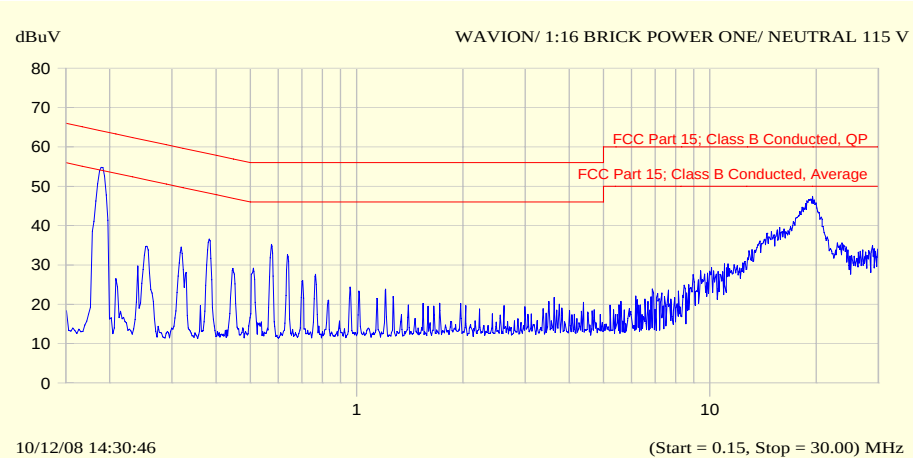
Plot # 6. Conducted emissions measurement result on 120 VAC power. Line - neutral.

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.

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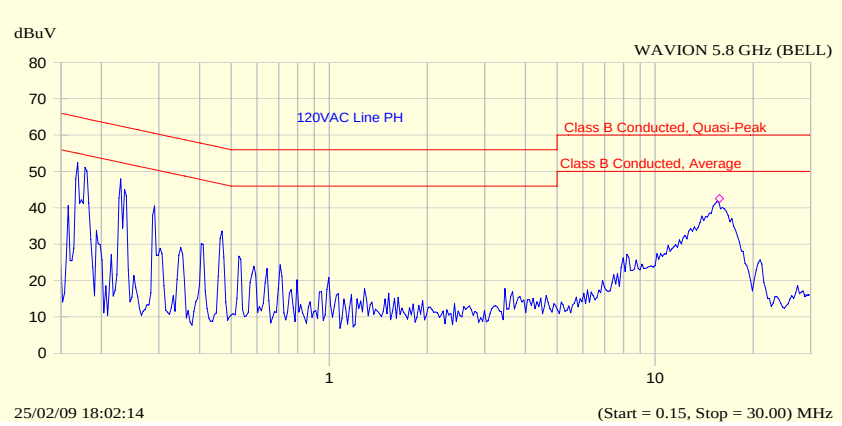
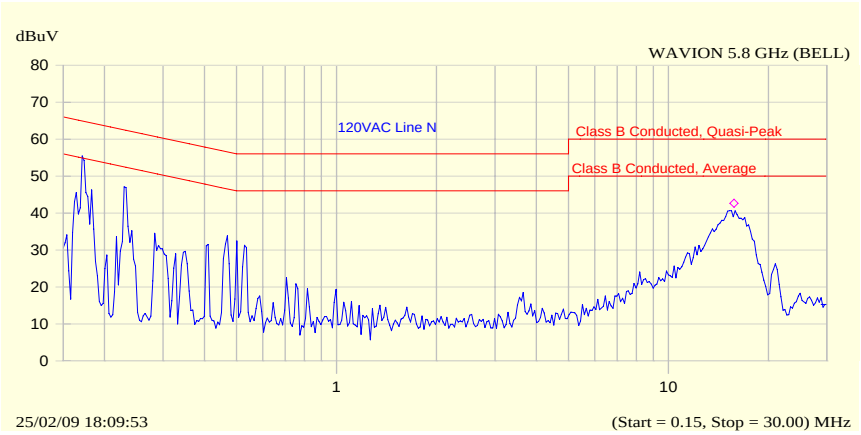


Frequency	Peak	QP	QP Limit	QP-QP Limit	Avg	Avg Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.176	56.8	55.4	64.7	-9.3	45.8	54.7	-8.9
0.235	48.6	47.5	62.3	-14.7	38.6	52.3	-13.7
0.294	41.2	39.9	60.4	-20.5	31.8	50.4	-18.6
0.472	37.4	36.1	56.5	-20.4	32.1	46.5	-14.4
0.592	28.7	26.8	56.0	-29.2	22.9	46.0	-23.1
15.755	42.6	38.3	60.0	-21.7	30.4	50.0	-19.6

Plot # 9. Bell DC/DC PS; LINE Phase



Frequency	Peak	QP	QP Limit	QP-QP Limit	Avg	Avg Limit	Avg-Avg Limit
MHz	dBuV	dBuV	dB	dB	dBuV	dB	dB
0.176	56.5	55.4	64.7	-9.3	48.1	54.7	-6.6
0.235	47.9	47.1	62.3	-15.1	39.9	52.3	-12.4
0.294	41.9	40.8	60.4	-19.6	33.5	50.4	-16.9
0.471	37.8	36.5	56.5	-19.9	34.2	46.5	-12.3
0.532	34.7	33.2	56.0	-22.8	30.6	46.0	-15.4
15.755	42.7	38.5	60.0	-21.5	30.1	50.0	-19.9

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.

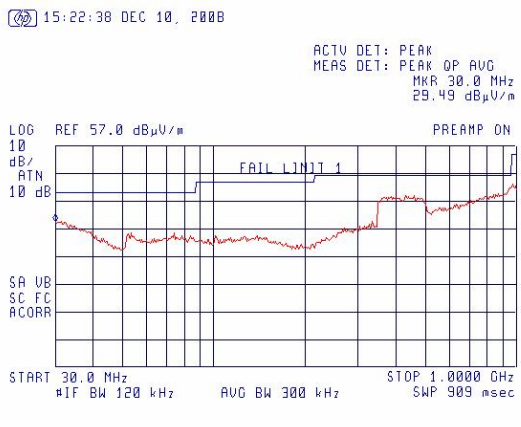
7.4.3. Test description:

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:

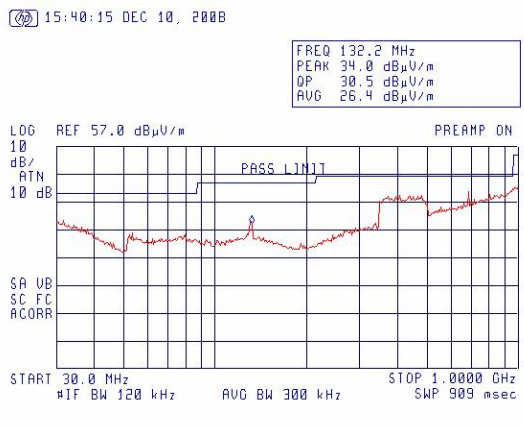
Initial scan:	
Detector type	Peak
Mode	Max hold
Bandwidth	120 kHz
Step size	Continuous sweep
Sweep time	>1 seconds/MHz
Measurements:	
Detector type	Quasi-peak (CISPR 16)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz
Observation	>15 seconds

7.4.4. Radiated emission test results:

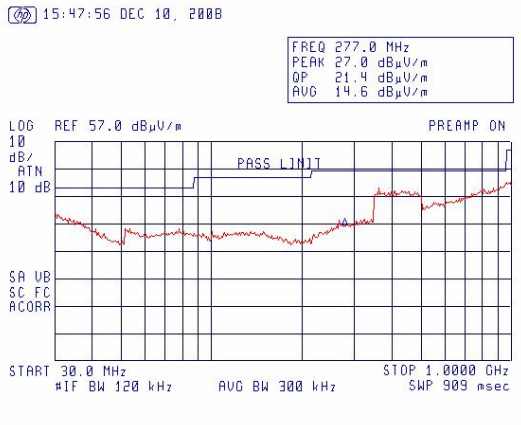
Scans of pre-test scanning for 4 units are presented in Plots # 11-14.
Test results are presented in Table 5.
The test results were found complies with relevant standard requirements.



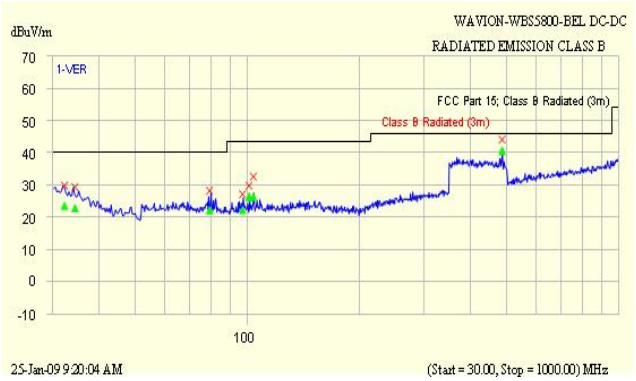
Plot # 11.
Power One 1/8 DC/DC PS



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 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
48.7	V	150	168	20.26	40.0	19.74	Complies
79.9	V	130	180	25.94	40.0	14.06	Complies
113.4	H	260	290	20.22	43.5	23.28	Complies
133.5	V	110	93	23.06	43.5	20.44	Complies
185.6	V	320	223	22.14	43.5	21.36	Complies
226.67	V	120	136	21.38	46.0	24.62	Complies
277.1	H	380	312	27.83	46.0	18.17	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(c). In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Sec. 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a) (see Sec. 15.205(c)).
Due to the conducted power was measured based on the use of RMS averaging over a time interval, the attenuation required here shall be 30 dB instead of 20 dB.

7.5.2. 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 30MHz to 40GHz is investigated with the transmitter set to the low, middle and high frequencies.

7.5.3. Test Results:

All test results met the requirements.
The tests were performed with the worst case, which is higher power level.
All harmonics/spurs are at least 30 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
The results are shown in plots # 15-38.

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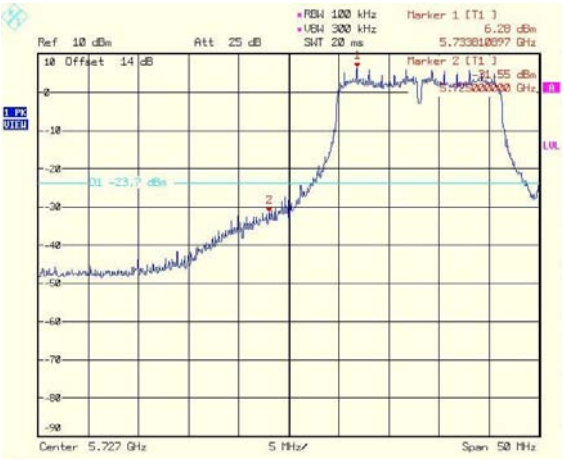
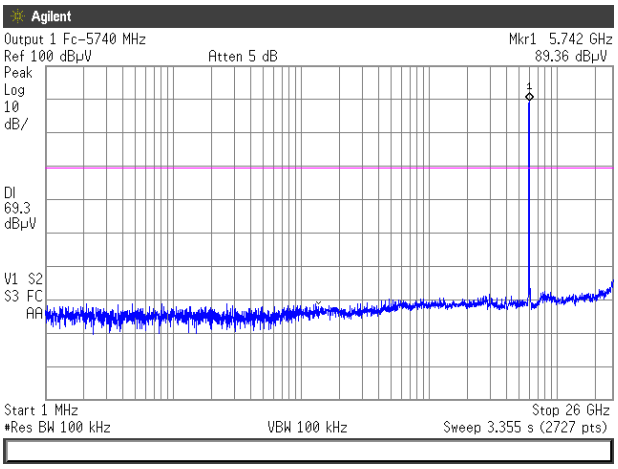


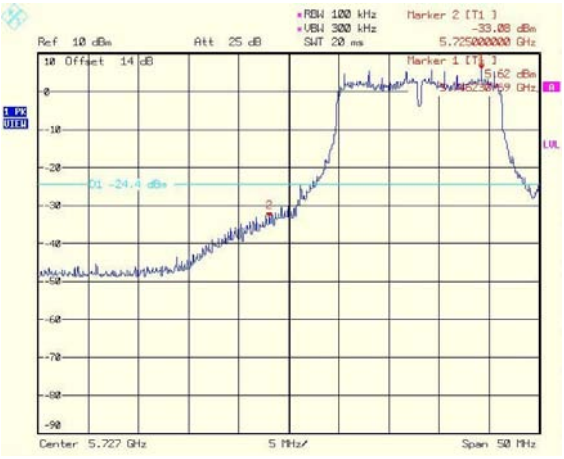
Plot # 15.

Output 1. Low frequency band edge.



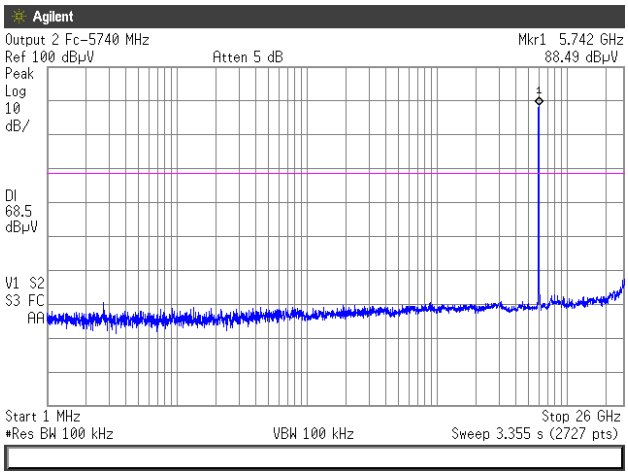
Plot # 16.

Output 1. Low frequency spurious.



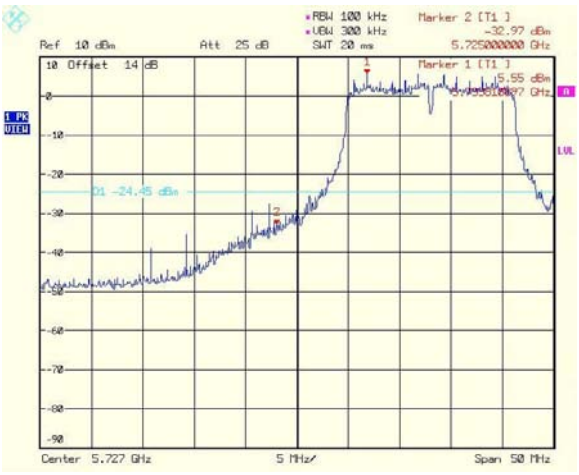
Plot # 17.

Output 2. Low frequency band edge.



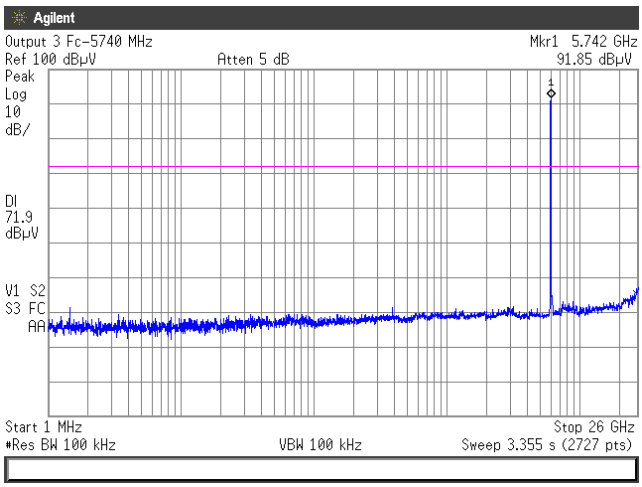
Plot # 18.

Output 2. Low frequency spurious.



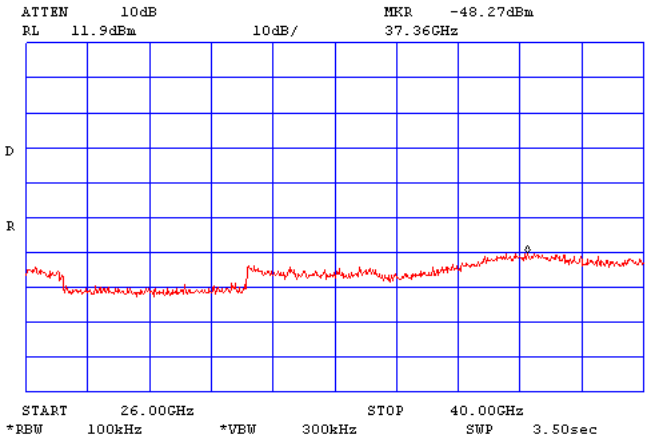
Plot # 19.

Output 3. Low frequency band edge.

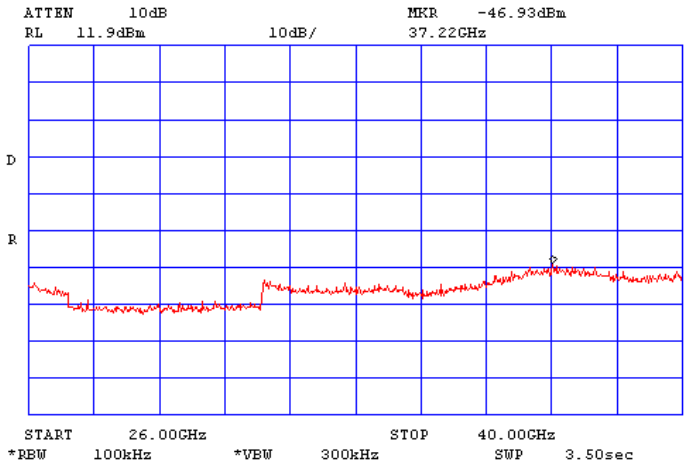


Plot # 20.

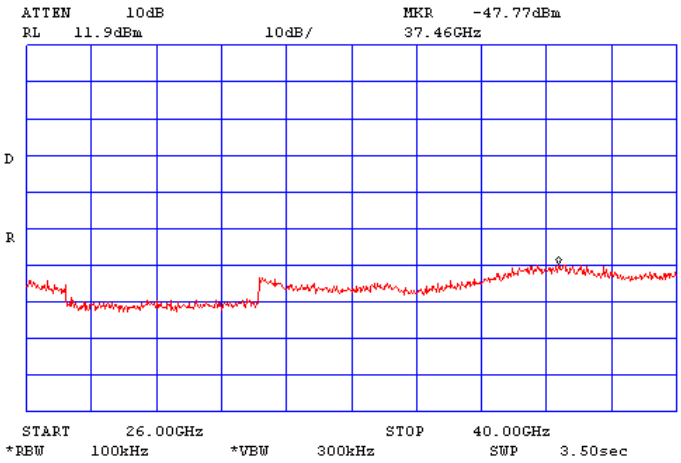
Output 3. Low frequency spurious.



Plot # 21.
Output 1. Low frequency spurious.



Plot # 22.
Output 2. Low frequency spurious.



Plot # 23.
Output 3. Low frequency spurious.

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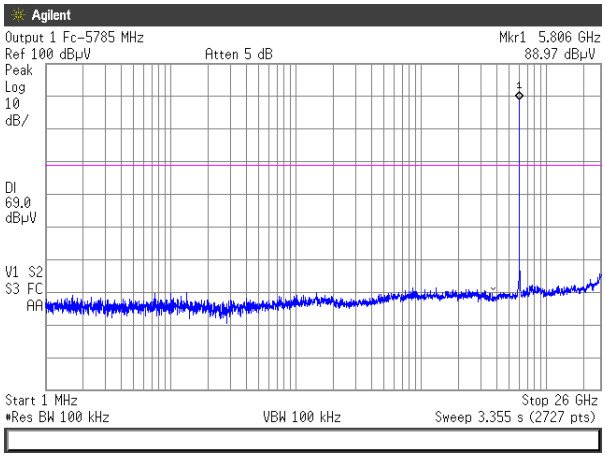
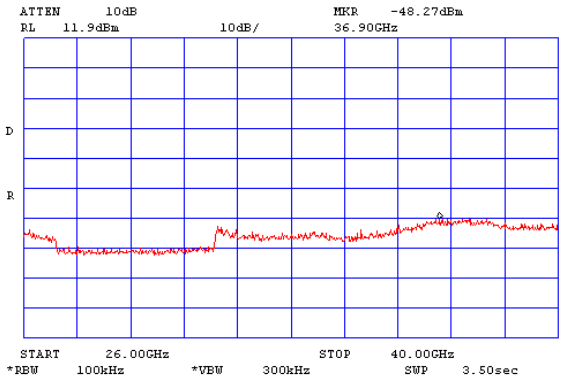
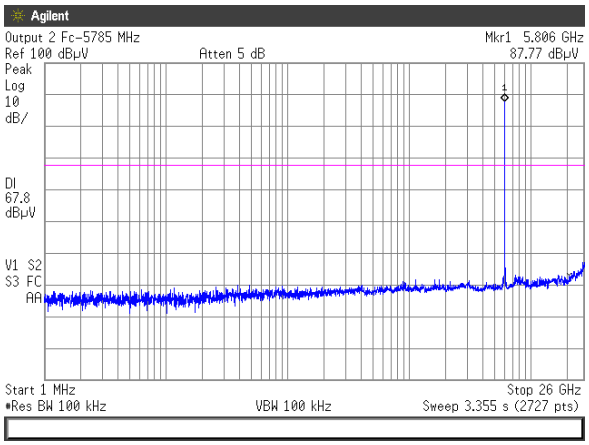
Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-5800 **FCC ID: UGM-WBS5800-2S**



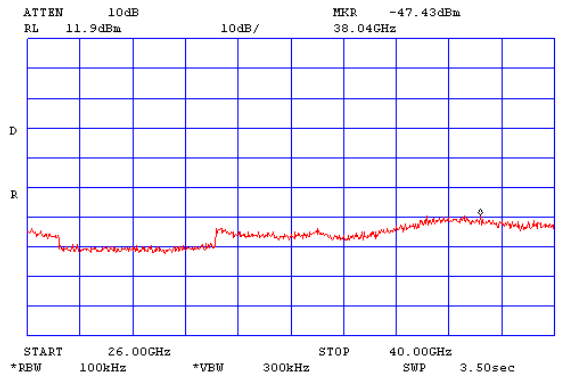
Plot # 24.
Output 1. Middle frequency spurious.



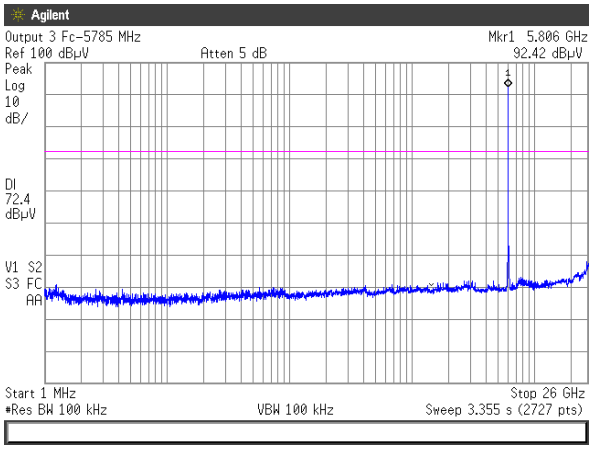
Plot # 25.
Output 1. Middle frequency spurious.



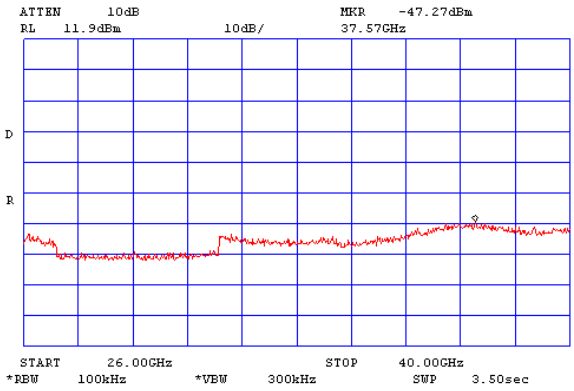
Plot # 26.
Output 2. Middle frequency spurious.



Plot # 27.
Output 2. Middle frequency spurious.



Plot # 28.
Output 3. Middle frequency spurious.



Plot # 29.
Output 3. Middle frequency spurious.

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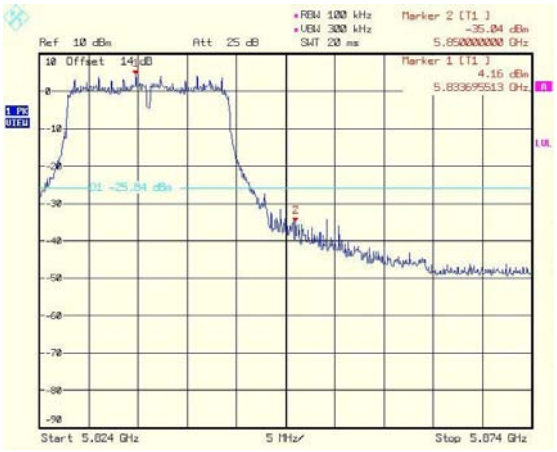
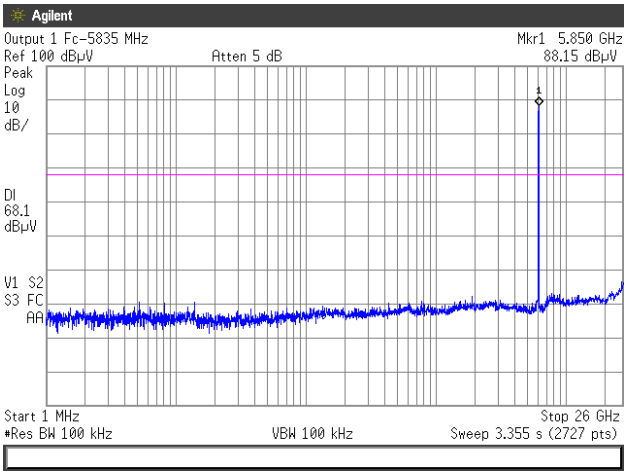
Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-5800 **FCC ID: UGM-WBS5800-2S**



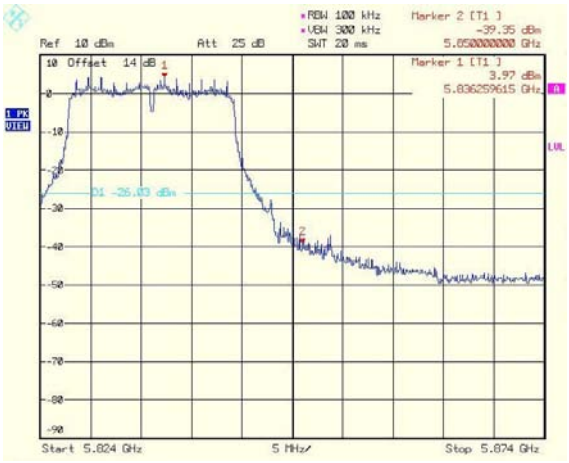
Plot # 30.

Output 1. High frequency band edge.



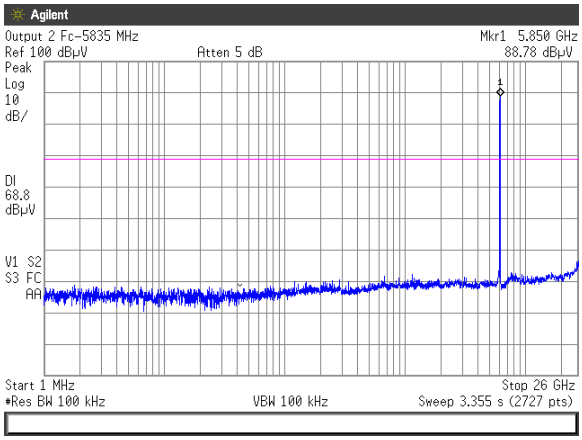
Plot # 31.

Output 1. High frequency spurious.



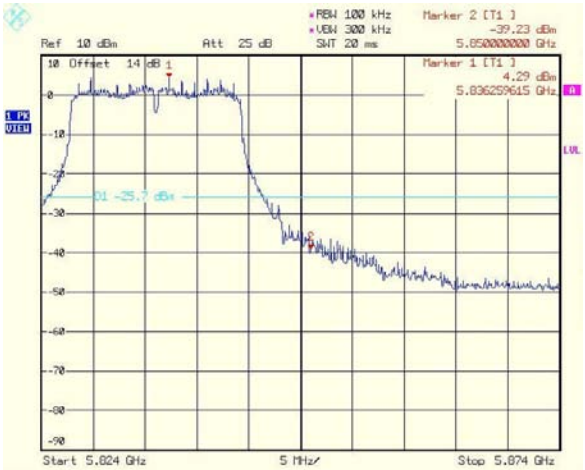
Plot # 32.

Output 2. High frequency band edge.



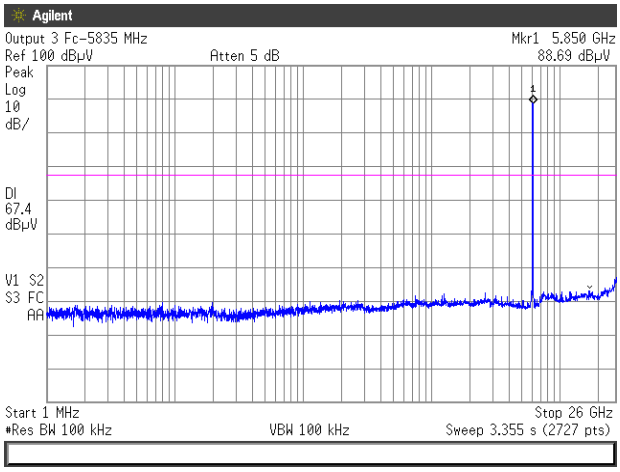
Plot # 33.

Output 2. High frequency spurious.



Plot # 34.

Output 3. High frequency band edge.



Plot # 35.

Output 3. High frequency spurious.

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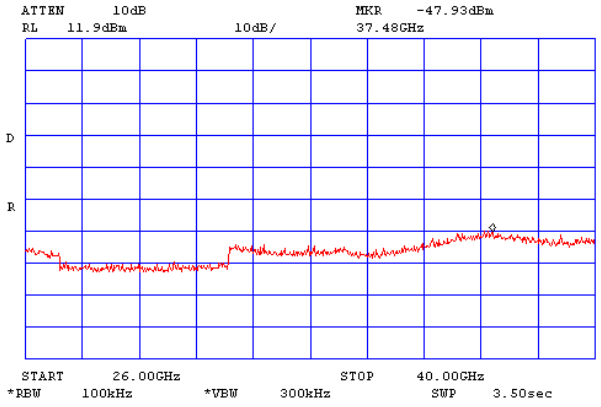
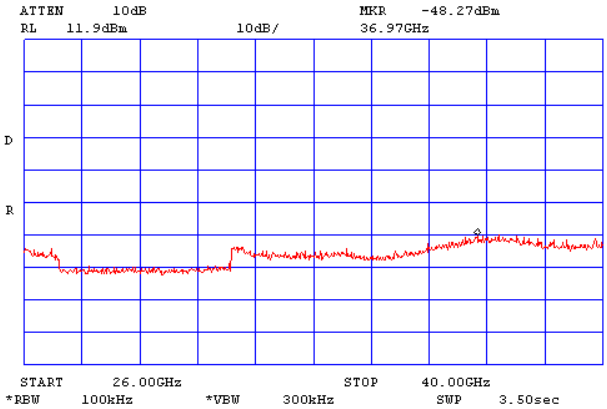
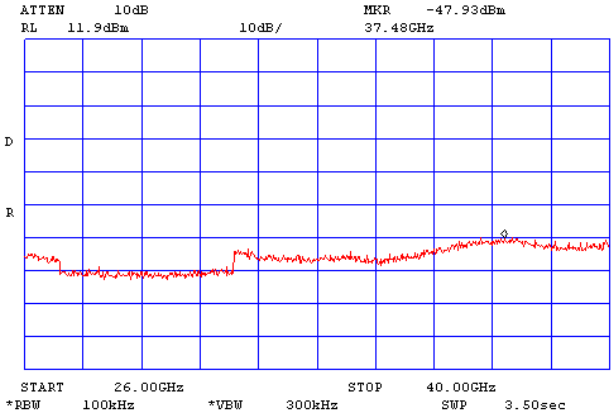
Model: WBS-5800 **FCC ID: UGM-WBS5800-2S**



Plot # 36.
Output 1. High frequency spurious.



Plot # 37.
Output 2. High frequency spurious.



Plot # 38.
Output 3. High frequency spurious.

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 EUT was tested with three sector antennas model MT-463009CV.

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 for the operation frequency and frequency band edge are shown in Plots 39-42.

Note: All measurements at the frequency band edge lie far from the restricted bands and not exceed the SA noise floor level; so the plots are informative only.

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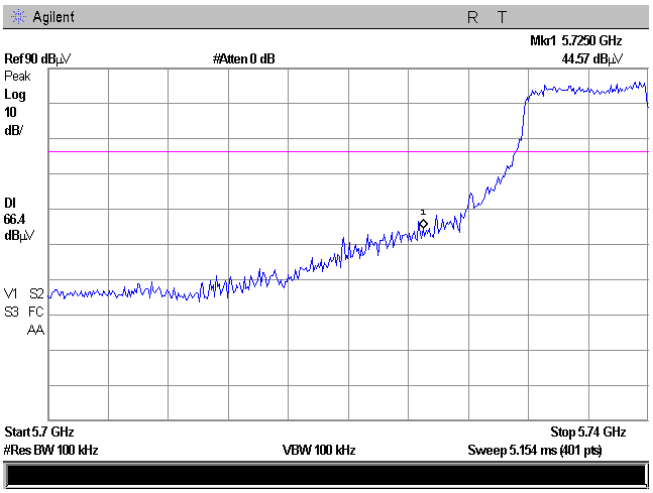
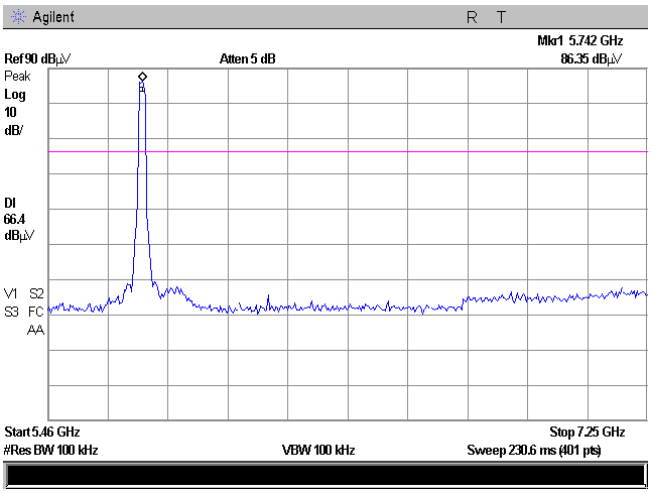
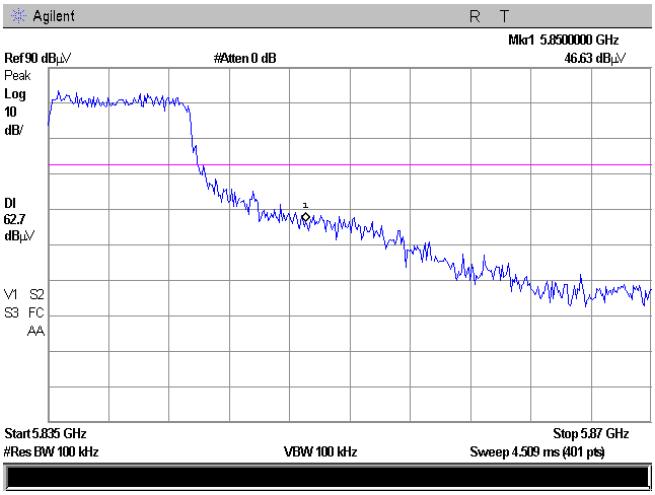
Title: Test on 5.8 GHz Band Outdoor WiFi (802.11b/g) Wireless Base Station
Model: WBS-5800 **FCC ID: UGM-WBS5800-2S**



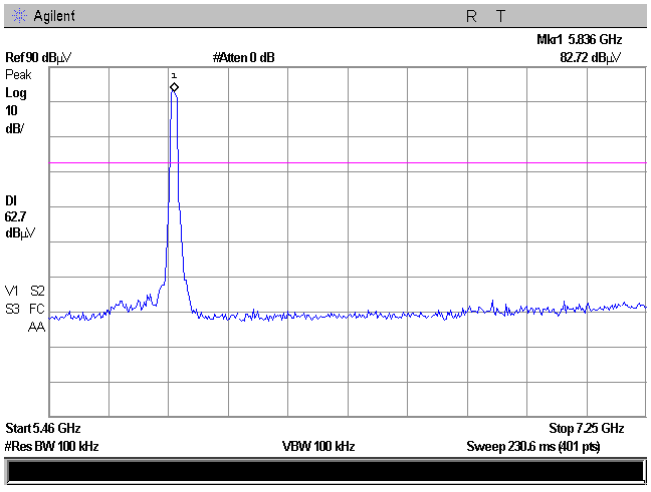
Plot # 39. Low frequency band edge.
Vertical polarization.



Plot # 40. Low frequency.
Vertical polarization.



Plot # 41. High frequency band edge.
Vertical polarization.



Plot # 42. High frequency.
Vertical polarization.

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 5.740-5.835 GHz

7.7.2. EUT configuration:

The EUT was tested with all three sector antennas (model MT-463009CV) connected to EUT, as it shown on the photos 4-5.

7.7.3. 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 calculation.
First, initial scans were performed in normal (transmitting) mode of operation for carrier (channel) frequency at the low and the high of the 5.740-5.835 MHz frequency range.
The Output Power (18.7dBm) was adjusted from the data and control transfer equipment with the system integrator access only (following to Important Safety Instruction of Installation Guide).

Antenna height = 1 m.
Measurement distance = 1m.
Measuring detector function and bandwidths:

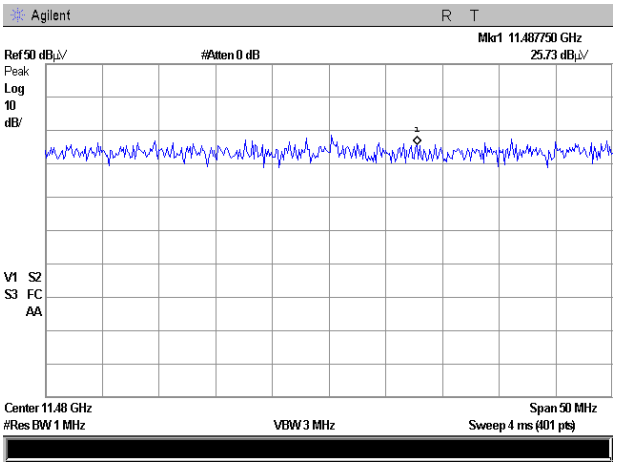
Detector type	Avg.	Peak
Resolution bandwidth	1MHz	1MHz
Video bandwidth	30Hz	1MHz

7.7.4. Test results and calculation ratio:

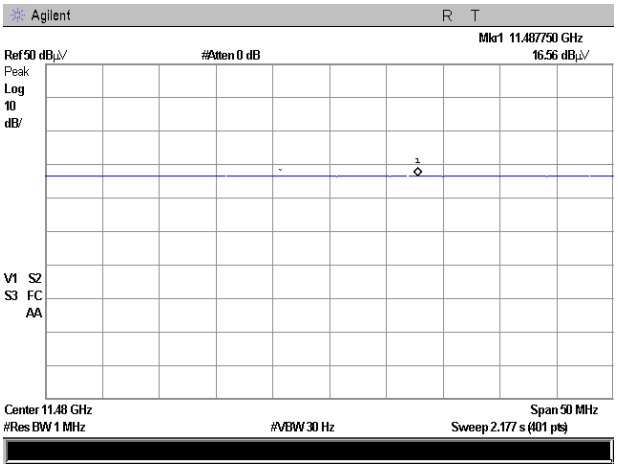
The test results were found complies with relevant standard requirements.
Test results are presented in table 6 and Plots 43-48.
The emission level was calculated as:
E Reading (dBμV) + measuring cable loss (dB) + measuring antenna factor (=39.4 dB/m)
For measuring antenna factor refer to Appendix 2.

Frequency (GHz)	Emission Level (dBμV)		Limit @ 1m (dBμV/m)		Margin (dB)		Results
	Average	Peak	Average	Peak	Average	Peak	
LOW 5.740 GHz							
11.480	16.56	25.73	64	84	8.04	17.87	Complies
22.960	Noise floor	Noise floor			10 dB at least	10 dB at least	Complies
MIDDLE 5.790 GHz							
11.580	16.51	24.05	64	84	8.09	20.55	Complies
HIGH 5.835 GHz							
11.670	16.58	25.37	64	84	8.02	19.23	Complies

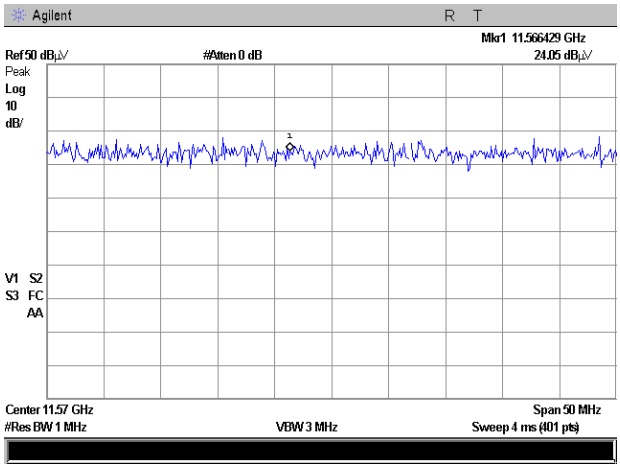
Table 6. Spurious emissions test results.



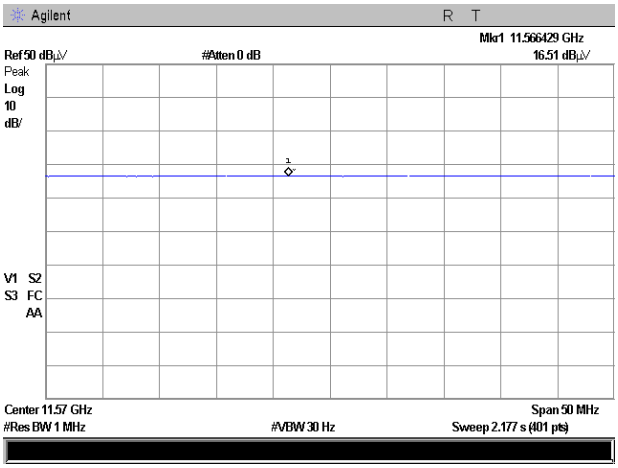
Plot # 43. The 2-hd harmonic of the Low frequency. Peak detector



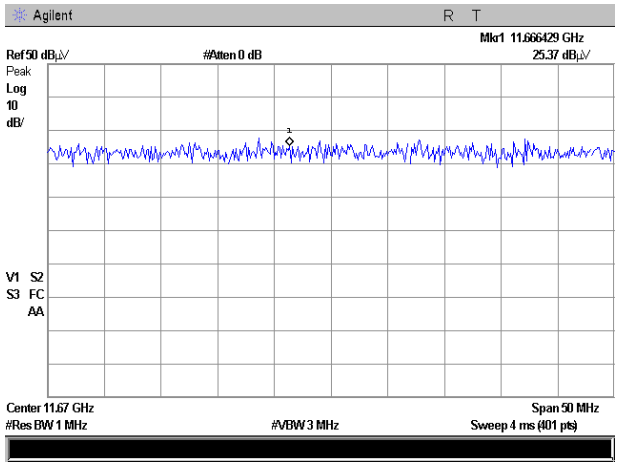
Plot # 44. The 2-hd harmonic of the Low frequency. Avg. detector



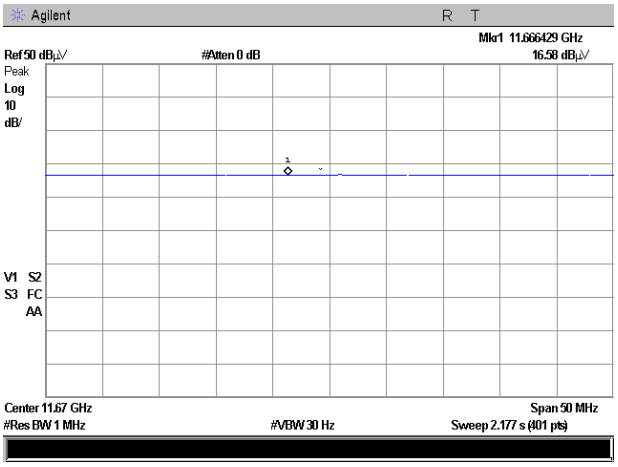
Plot # 45. The 2-hd harmonic of the Middle frequency. Peak detector



Plot # 46. The 2-hd harmonic of the Middle frequency. Avg. detector



Plot # 47. The 2-hd harmonic of the High frequency. Peak detector



Plot # 48. The 2-hd harmonic of the High frequency. Avg. detector

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. Test procedure:

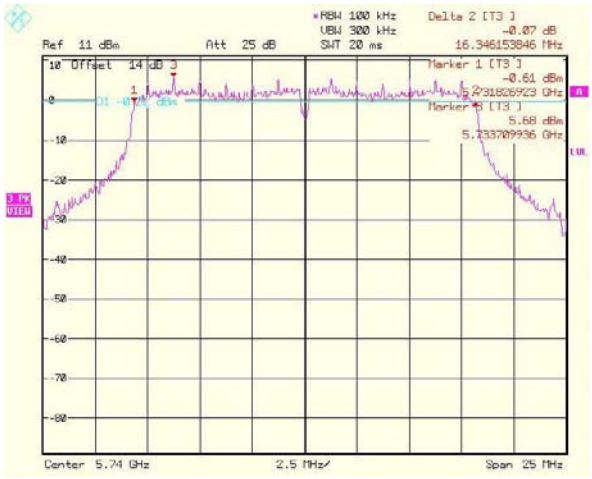
The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low, middle and the high of the 5.740-5.835 GHz frequency range that reflect to the worst test results. All final tests were performed on Output 3 that is the worst case between all outputs.
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.

7.8.3. Test results:

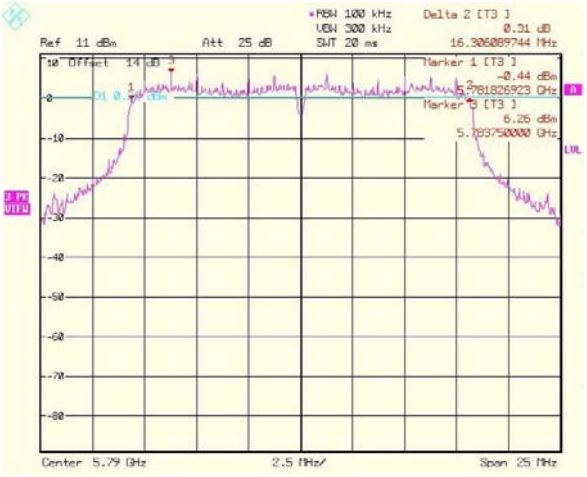
The summaries of final minimum bandwidth measurements from output 3 are shown in Table 7.
The minimum measured bandwidth for all configurations is 16306 kHz that is comply with standard required bandwidth.

Frequency MHz	Rate Mbps	Modulation Mode	6dB Bandwidth [kHz]	Minimum Limit [kHz]	Verdict	Plot number
5740	6	802.11g	16346	500	Pass	49
5790	6	802.11g	16306	500	Pass	50
5835	6	802.11g	16346	500	Pass	51

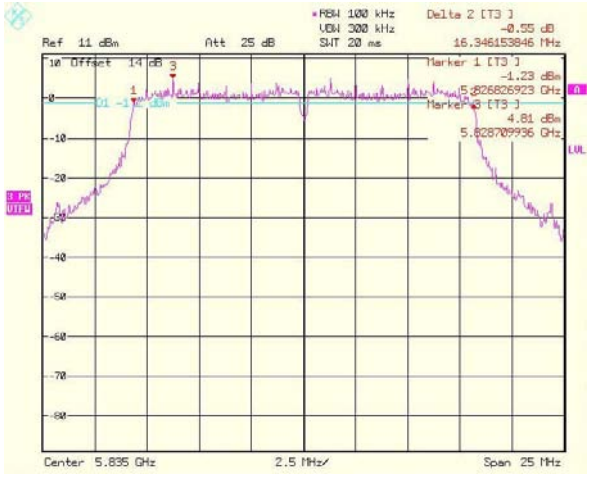
Table 7. 6 dB bandwidth results



Plot # 49. 6 dB Bandwidth. Low frequency.



Plot # 50. 6 dB Bandwidth. Middle frequency.



Plot # 51. 6 dB Bandwidth. High frequency.

7.9. Maximum peak output power

7.9.1. Requirements:

The maximum peak output power shall not exceed 1 Watt as required in sec. 15.247 (b). 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 transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. Applying the restrictions from (c)(2)(ii), the conducted output powers derived as follows:

- The maximum aggregate peak output limit is 30 dBm.
- The maximum peak output limit for each transmit output for each beam is $30 - 10*\log_{10}(3)=25.2$ dBm.

7.9.2. Test procedure:

The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at low, middle and the high of the 5.740-5.835 GHz frequency range at each transmit output that reflect to the worst test results.
Additionally, combined maximum peak output power was calculated and presented in table 9.

7.9.3. Test results:

All test results met the requirements.
The summaries of Peak Power measurements are shown in Tables 8-9.

Frequency MHz	Rate Mbps	Modulation mode	Output 1 Peak Power [dBm]	Output 2 Peak Power [dBm]	Output 3 Peak Power [dBm]	FCC Limit Per 15.247(b) [dBm]	Calculated Limit [dBm]	Margin [dB] Output 1	Plot number	Margin [dB] Output 2	Plot number	Margin [dB] Output 3	Plot number
5740	6	802.11g	17.06	17.07	16.77	30	25.7	8.64	52	8.63	53	8.93	58
5790	6	802.11g	16.96	16.32	16.81	30	25.7	8.74	54	9.38	55	8.89	59
5835	6	802.11g	16.17	15.72	16.17	30	25.7	9.53	56	9.98	57	9.53	60

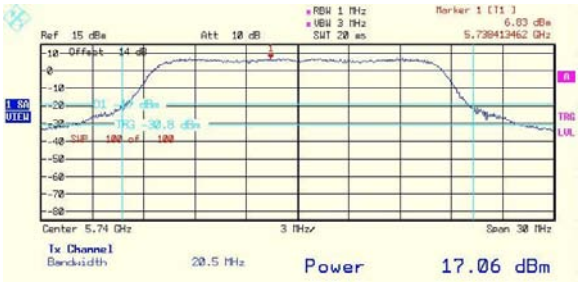
Table 8.
Peak Power (Outputs 1-3) test results.

Frequency MHz	Rate Mbps	Modulation mode	FCC Limit Per 15.247(b) [dBm]	FCC Limit Per 15.247(b) [W]	Calculated Combined (max) Output *, Peak Power [W]	Margin [W]
5740	6	802.11g	30	1	0.150	0.850
5790	6	802.11g	30	1	0.141	0.859
5835	6	802.11g	30	1	0.119	0.881

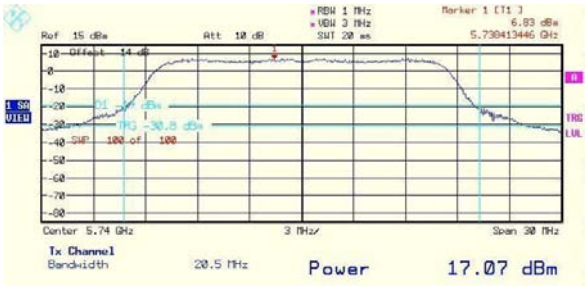
Table 9.
Peak Power (combined output) test results.

(*) - Calculated Combined (max) Output, Peak Power [W] is the sum of the measured Power from all Output terminals, where each result (output power from separate output terminal) mathematically conversed from Logarithm to linear units. The results were present in Watt.
For example, the calculation for 5835 MHz frequency is the following:

1. 16.17dBm = 0.041W; 15.72dBm = 0.037W; 16.17dBm = 0.041W
2. 0.041+0.037+0.041=0.119[W]



Plot # 52. Output 1 peak power.
Lower frequency. 6Mbps rate.



Plot # 53. Output 2 peak power.
Lower frequency. 6Mbps rate.

Plot # 54. Output 1 peak power.
Middle frequency. 6Mbps rate.

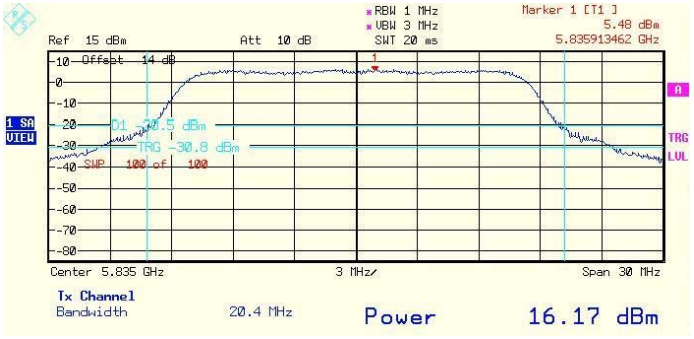
Plot # 55. Output 2 peak power.
Middle frequency. 6Mbps rate.

Plot # 56. Output 1 peak power.
High frequency. 6Mbps rate.

Plot # 57. Output 2 peak power.
High frequency. 6Mbps rate.

Plot # 58. Output 3 peak power.
Lower frequency. 6Mbps rate.

Plot # 59. Output 3 peak power.
Middle frequency. 6Mbps rate.



Plot # 60. Output 3 peak power.
High frequency. 6Mbps rate.

7.10. Peak power spectral density of digital modulated systems according to § 15.247(d)

7.10.1. Requirements:

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission

7.10.2. Test Procedure:

The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at bottom, middle and the top of the 5.740-5.835 GHz frequency range. The EUT RF output was connected to the Spectrum Analyzer and accounted with cable loss in measurement. The maximum level in a 3kHz bandwidth is measured with: RBW=3kHz; VBW>3kHz, sweep time=span/3kHz and video averaging is turned off. The PSD is the highest level found across the emission in any 3kHz band.
Additionally, the peak power spectral density from combined (max.) output was calculated and presented in table 11.

7.10.3. Test Results:

All test results met the requirements.
The summaries of Peak Power measurements are shown in Tables 10-11.

Frequency MHz	Rate Mbps	Modulation mode	Output 1 PSD [dBm]	Output 2 PSD [dBm]	Output 3 PSD [dBm]	Limit [dBm]	Margin [dB] Output 1	Plot number	Margin [dB] Output 2	Plot number	Margin [dB] Output 3	Plot number
5740	6	802.11g	-8.00	-7.65	-7.82	8	16.00	61	15.65	62	15.82	67
5790	6	802.11g	-6.74	-6.37	-5.85	8	14.74	63	14.37	64	13.85	68
5835	6	802.11g	-7.37	-7.54	-7.55	8	15.37	65	15.54	66	15.55	69

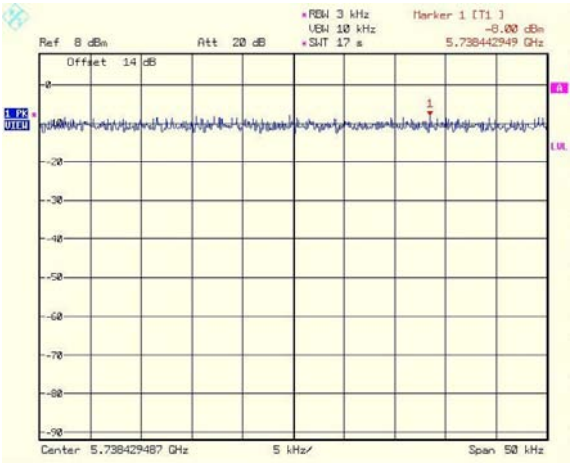
Table 10.
PSD (Outputs 1-3) test results.

Frequency MHz	Rate Mbps	Modulation mode	Limit [dBm]	Calculated Combined (max) Output *, PSD [dBm]	Margin [dB]
5740	6	802.11g	8	-3.05	11.05
5790	6	802.11g	8	-1.53	9.53
5835	6	802.11g	8	-2.71	10.71

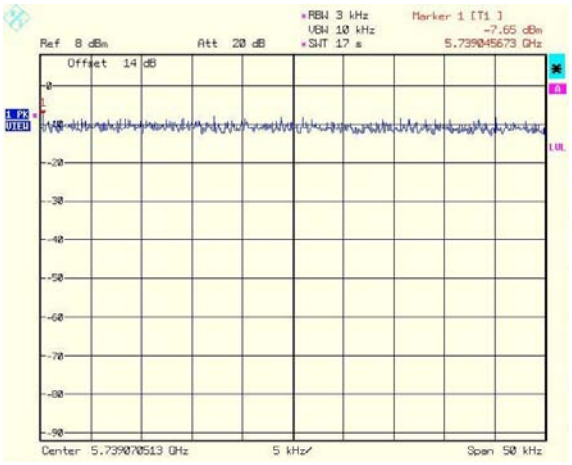
Table 11.
PSD (Combined Output) test results.

(*)- Calculated Combined (max) Output, PSD [dBm] is the sum of the measured PSD from all Output terminals, where each result (PSD from separate output terminal) mathematically conversed from Logarithm to linear units. The results were present in dBm.
For example, the calculation for 5835 MHz frequency is the following:

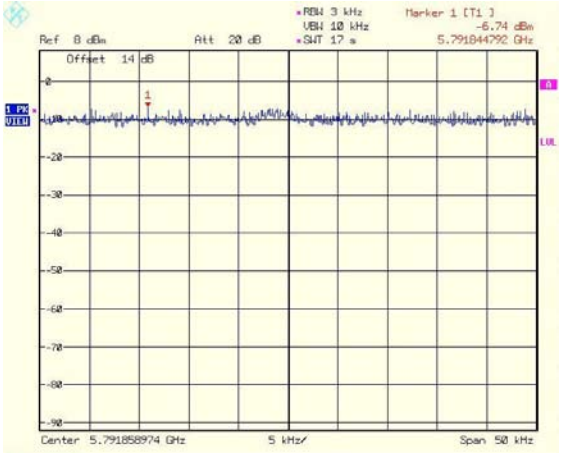
1. (-7.37) dBm = 0.18mW; (-7.54) dBm = 0.18mW; (-7.55) dBm = 0.18mW;
2. 0.18+0.18+0.18=0.54 [mW]
3. 0.54 mW = -2.71 dBm



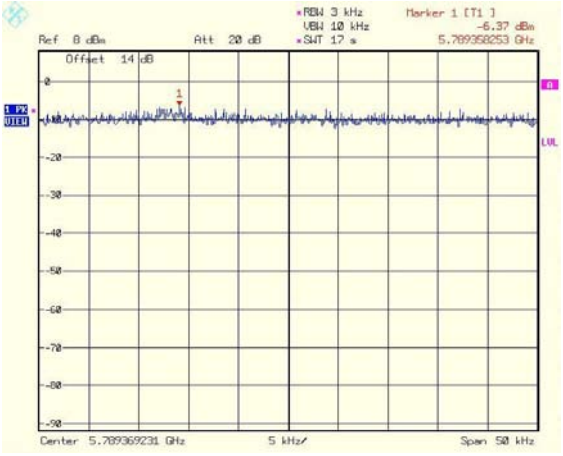
Plot # 61. Transmitter output 1.
Low frequency.



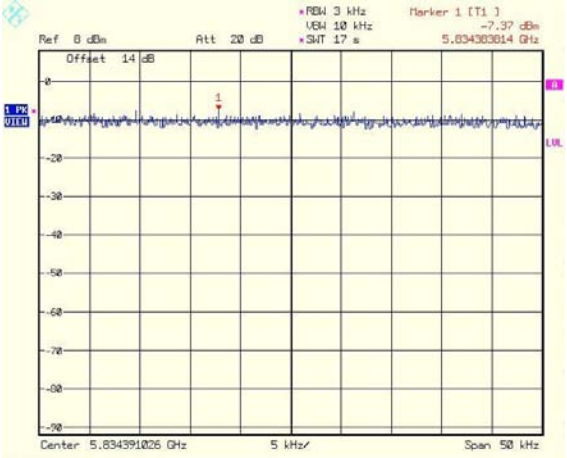
Plot # 62. Transmitter output 2.
Low frequency.



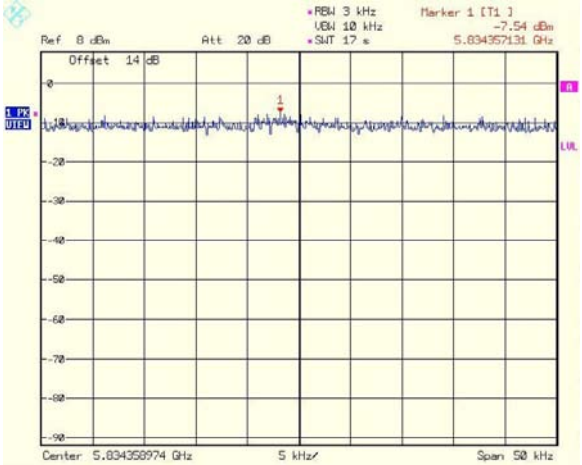
Plot # 63. Transmitter output 1.
Middle frequency.



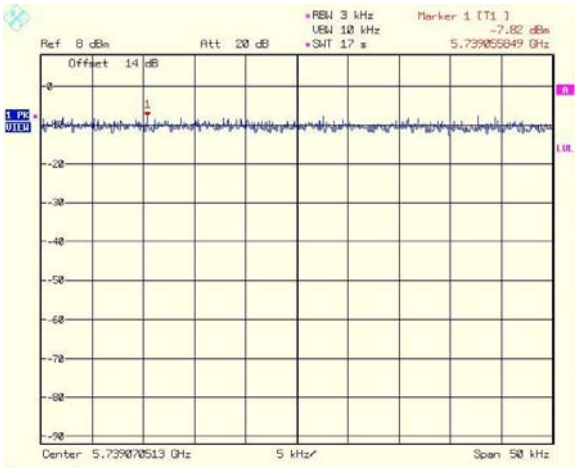
Plot # 64. Transmitter output 2.
Middle frequency.



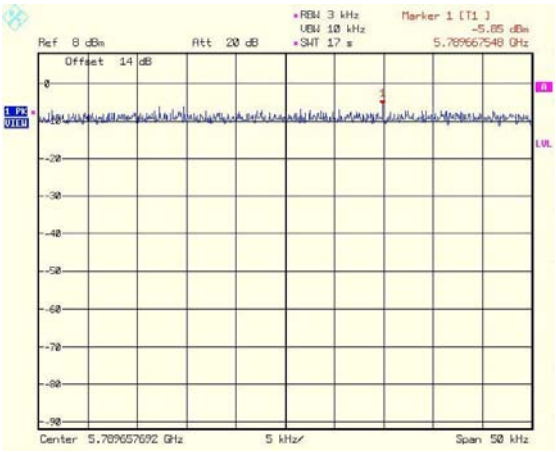
Plot # 65. Transmitter output 1.
High frequency.



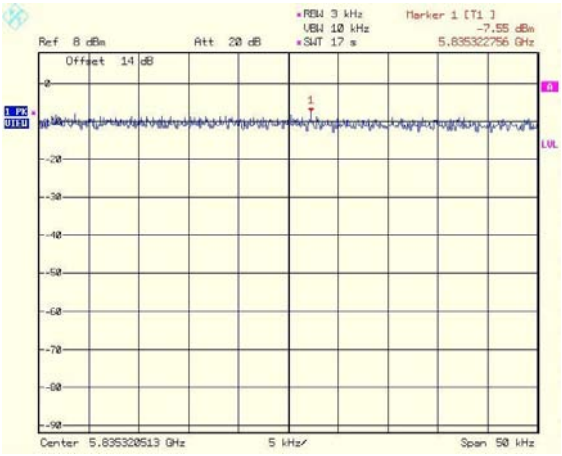
Plot # 66. Transmitter output 2.
High frequency.



Plot # 67. Transmitter output 3.
Low frequency.



Plot # 68. Transmitter output 3.
Middle frequency.



Plot # 69. Transmitter output 3.
High frequency.

8. Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding once a year.

Instrument	Manufacturer	Model	Serial No.	Due calibration date
Spectrum Analyzer	Rohde&Schwarz	FSL	-	07/09
Spectrum Analyzer	HP	8565E	3835A01359	06/09
EMI Analyzer	HP	E7405A	SII 4944	11/09
Antenna Double Ridge 1-18 GHz	EMCO	3115	SII 4873	09/09
Antenna SHF-EHF Horn 14-40 GHz	Schwarzbeck	BBHA 9170	SII 5854	09/09
Biconilog Antenna 30 – 2000 MHz	Schaffner-Chase	CBL-6112D	S/N 23181	09/09
Antenna Mast	R&S	HCM	-	N/A
Metallic turntable	R&S	HCT12	100001	N/A
Positioning controller	R&S	HCC	-	N/A
LISN 9 kHz – 30 MHz	FCC	LISN-50/250-32-4-16	SII 5023	03/09
Transient limiter 0.009-200 MHz	HP	11947A	31074A3105	03/09

9. Appendix 2. Antenna Factor and Cable Loss

Cable Loss (10m cable + Mast)

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.201	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

Antenna Factors:

For Bilog Antenna, Model Number: CBL 6112D, S/N: 23181

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	30	19.1	160	10.0
2	35	16.0	180	9.5
3	40	13.4	200	9.4
4	45	10.4	250	12.0
5	50	8.3	300	13.1
6	60	6.8	400	15.7
7	70	6.3	500	17.2
8	80	6.8	600	18.3
9	90	8.7	700	19.1
10	100	10.8	800	19.8
11	120	12.2	900	20.7
12	140	11.3	1000	21.2

For Double Ridged Guide Antenna mfr EMCO model 3115

No.	F MHz	AF dB/m	F MHz	AF dB/m	F MHz	AF dB/m
1	1000	23.9	7000	36	13000	39.8
2	1500	25.4	7500	37.4	13500	40.9
3	2000	27.7	8000	37.8	14000	42.5
4	2500	28.8	8500	38.1	14500	41.5
5	3000	30.5	9000	38.2	15000	39.3
6	3500	32	9500	38.3	15500	38.5
7	4000	32.9	10000	38.5	16000	38.7
8	4500	32.9	10500	38.4	16500	39.5
9	5000	33.9	11000	38.7	17000	41.6
10	5500	34.7	11500	39.4	17500	45
11	6000	35.3	12000	39.4	1800	46.8
12	6500	34.5	12500	39.1		

For SHF-EHF Horn Antenna Model Number: BBHA 9170, S/N: 5854
1m Calibration (Vertical and Horizontal polarizations)

Point	Frequency (GHz)	Antenna Factor (dB/m)
1	15	38.5
2	16	37.7
3	17	38.1
4	18	37.9
5	19	38.0
6	20	38.0
7	21	37.9
8	22	38.2
9	23	39.6
10	24	39.6
11	25	39.3
12	26	39.5
13	28	39.6
14	30	40.1
15	32	41.2
16	34	41.5
17	35	41.9
18	36	42.2
19	38	43.8
20	40	43.2

10. Appendix 3: Test configuration illustration

Photo # 1.
Radiated emission test set up.
Front side view.

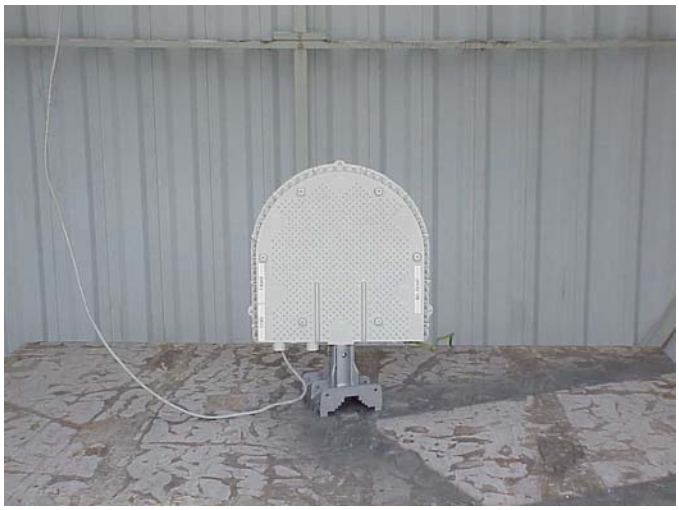


Photo # 2.
Radiated emission test set up.
Rear side view.

Photo # 3.
Radiated emission test set up.

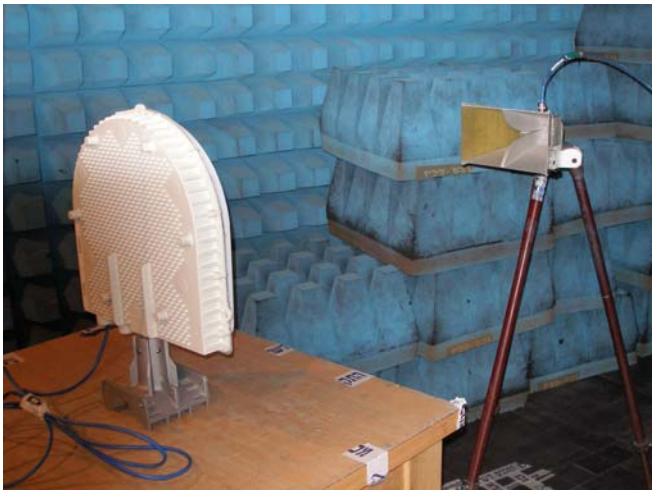


Photo # 4.
Radiated emission test. General view

Photo # 5. Radiated emission test on Outdoor Radio Unit: spurious & restricted bands.

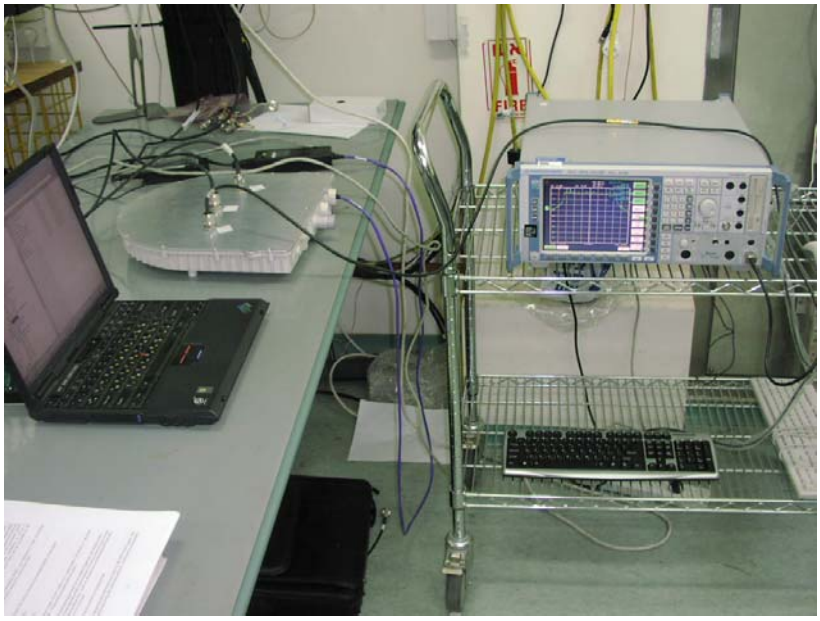


Photo # 6.
Transmitter conducted measurements.