TEST REPORT

Test Report No. : UL-RPT-RP89056JD13F V2.0

Manufacturer	:	Bang & Olufsen a/s
Model No.	:	LBWA1ZZPDZ-385
FCC ID	:	TTULBWA1ZZPD
IC Certification No.	:	3775B-LBWA1ZZPD
Test Standard(s)	:	FCC Parts 15.403(i), 15.407(a)(1),(2)&(3), Industry Canada RSS-210 Issue 8 December 2010 A9.2(1),(2)&(3) & RSS-Gen Issue 3 December 2010 4.6.1 & 4.8

1. This test report shall not be reproduced in full or partial, without the written approval of RFI Global Services Ltd trading as UL.
2. The results in this report apply only to the sample(s) tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 25 January 2013

Checked by:

Sarah Williams
WiSE Laboratory Engineer

Issued by :

Pp

John Newell
Group Quality Manager, WiSE
Basingstoke,
UL Verification Services

This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its' terms of accreditation.

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1. Customer Information

Company Name:	Bang & Olufsen a/s
Address:	Peter Bangs Vej 15 7600 Struer Denmark

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.407
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Section 15.407
Specification Reference:	RSS-Gen Issue 3 December 2010
Specification Title:	General Requirements and Information for the Certification of Radio Apparatus
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735; Industry Canada: 3245B-2
Location of Testing:	RFI Global Services Ltd., RFI Global Services Ltd trading as ULWade Road, Basingstoke, Hampshire, RG24 8AH.
Test Dates:	04 January 2012 to 17 March 2012

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
Part 15.403(i)	N/A	Transmitter 26 dB Emission Bandwidth	✓
N/A	RSS-Gen 4.6.1 / RSS-210 A9.2	Transmitter 99% Emission Bandwidth	✓
Part 15.407(a)(1)	N/A	Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band)	✓
Part 15.407(a)(2)	RSS-Gen 4.8 / RSS-210 A9.2(2) & A9.2(3)	Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)	✓
N/A	RSS-Gen 4.8 / RSS-210 A9.2(1)	Transmitter Maximum Equivalent Isotropically Radiated Power (EIRP) (5.15-5.25 GHz band)	✓
N/A	RSS-Gen 4.8 / RSS-210 A9.2(2) & A9.2(3)	Transmitter Maximum Equivalent Isotropically Radiated Power (EIRP) (5.25-5.35 GHz & 5.47-5.725 GHz bands)	✓

Key to Results

✓ = Complied ✗ = Did not comply

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2009)
Title:	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
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	FCC KDB 789033 D01 v01r01 3/5/2012
Title:	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E
Reference:	FCC KDB 662911 D01 v01r01 10/25/2011
Title:	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
Reference:	FCC Response To Inquiry
Title:	Tracking Number 969369 Date: 21 February 2012

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specifications identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Bang & Olufsen
Model Number:	Murata LBWA1ZZPDZ-385
Specification Number:	JEBMM0-0505
Firmware Version:	2.4.0.0 ,Size: 371412 bytes, date: 20110223
Serial Number:	Not marked or stated
FCC ID:	TTULBWA1ZZPD
Industry Canada Certification Number:	3775B-LBWA1ZZPD

3.2. Description of EUT

The equipment under test was an IEEE 802.11a,b,g,n WLAN module operating in the 2.4 GHz and 5 GHz bands. The module is normally incorporated into a 40” television. The EUT has three external antenna ports, two transmit chains and three receive chains, MIMO is supported. For 802.11n operation the device uses MIMO (2 transmitters and 3 receivers). Depending on the 802.11 MCS, the device transmits 1 or 2 spatial stream. The device uses spatial multiplexing and from an RF point of view the streams are uncorrelated.

The Customer supplied a Video Engine which contains the WLAN Module and is part of the television. The Video Engine contained input and output ports (serial, Ethernet, HDMI, USB and RF ports). The Video Engine was powered from 5 V and 12 VDC supplies. The Video Engine allowed conducted measurements to be performed.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	IEEE 802.11		
Type of Unit:	Transceiver		
Modulation:	CCK, BPSK, QPSK, 16QAM, 64QAM		
Data rates:	802.11a	6, 9, 12, 18, 24, 36 ,48 & 54 Mbps	
	802.11n	6.5, 13, 19.5, 26, 39, 52, 58.5, 65, 78, 104, 117 & 130 Mbps	
TV Power Supply Requirement(s):	Nominal	120 VAC 60 Hz	
Channel Spacing:	20 MHz		
Transmit & Receive Frequency Band:	5150 MHz to 5250 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	36	5180
	Middle	40	5200
	Top	48	5240
Transmit & Receive Frequency Band:	5250 MHz to 5350 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	52	5260
	Middle	56	5280
	Top	64	5320
Transmit & Receive Frequency Band:	5470 MHz to 5725 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	100	5500
	Middle	116	5580
	Top	140	5700

Additional Information Related to Testing (continued)

Channel Spacing:	40 MHz		
Transmit & Receive Frequency Band:	5150 MHz to 5250 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	38	5190
	Top	46	5230
Transmit & Receive Frequency Band:	5250 MHz to 5350 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	54	5270
	Top	62	5310
Transmit & Receive Frequency Band:	5470 MHz to 5725 MHz		
Transmit & Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	102	5510
	Middle	110	5550
	Top	134	5670

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop
Brand Name:	Dell
Model Name or Number:	D610
Serial Number:	RFI Asset No. PC343NT

Description:	Internal Antenna
Brand Name:	TE Connectivity Ltd
Model Name or Number:	PUCK

Description:	Internal Antenna
Brand Name:	TE Connectivity Ltd
Model Name or Number:	UAM

Description:	Serial to Ethernet cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

3.6. Antenna

The table below lists the antennas used with this product:

Type	**Stated Gain (dBi)**	**Model**	**Part No.**
Dual-band	4.0	PUCK	1551868-1
Dual-band	3.0	UAM	1513472-7

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Continuously transmitting with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation types.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Transmitting in test mode with 100% duty cycle and controlled using a bespoke application on a laptop PC using Hyperterminal PC application. The application was used to enable continuous transmission and to select the test channels, data rates and modulation schemes as required. The Customer supplied instructions on how to configure the EUT for test purposes.
- RF conducted measurements were performed with the EUT fitted to the Video Engine and tests made with the measurement equipment connected to antenna ports (Port 0 & Port 1). Short internal RF cables were fitted between the Video Engine and the SMA antenna ports. The loss of the internal cable is incorporated into the RF offset on the spectrum analyser. The Customer declared the antenna gain was 4.0 dBi in the 5 GHz bands. DC voltage to the Video Engine (5.0 VDC and 12.0 VDC) was supplied by two bench power supplies. Voltage was monitored using two calibrated voltmeters.
- The EUT has three RF ports, two transmit/receive RF ports (labelled as Port 0 and Port 1) and an additional receive RF port (labelled as Port 2). Conducted measurements were performed on Port 0 and Port 1. RF cables and attenuators connecting the test equipment to the EUT ports were calibrated before use and the calibration data incorporated into the conducted measurement results.
- The 3 internal antennas are connected to the WLAN module ports within the television as follows:

Module Port	Antenna Type	TX	RX
ANT0	PUCK	Yes	Yes
ANT1	UAM	Yes	Yes
ANT2	PUCK	No	Yes

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section* 6 *Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter 26 dB Emission Bandwidth

Test Summary:

Test Engineers:	Andrew Edwards	**Test Dates:**	17 March 2012
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.403(i)
Industry Canada Reference:	N/A
Test Method Used:	FCC KDB 789033 Section D)

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	25

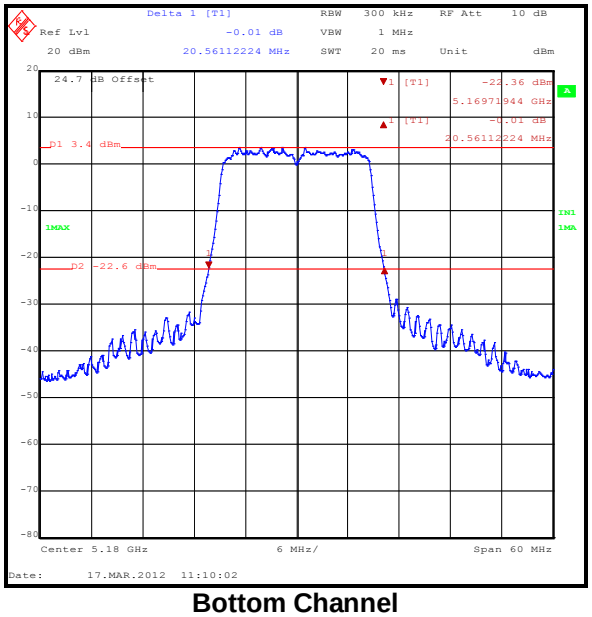
Note(s):

1. For the power measurements in this test report, the highest power output level was recorded when the EUT was configured as BPSK / MCS8 / 13 Mbps in both supported channel widths. Emission bandwidth plots in this configuration have been included as 'Reference plots' and the results used for calculations in Sections 5.2.3 and 5.2.4.
2. All bandwidth measurements were performed on Port 0 as both ports were initially checked and Port 0 was found to have the highest RF output power.

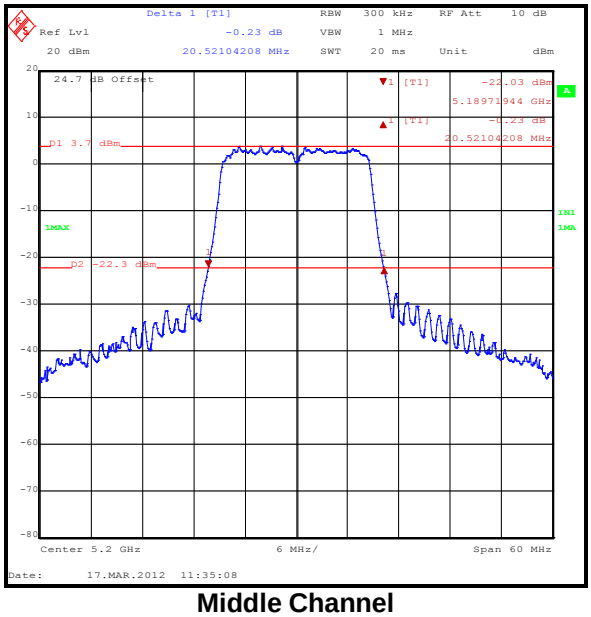
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.15-5.25 GHz band (Reference plots)

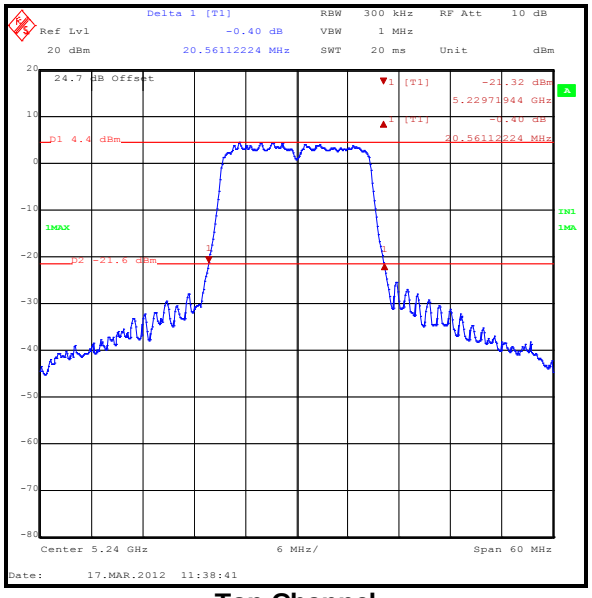
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5180	BPSK	13 / 8	20.561
Middle	5200	BPSK	13 / 8	20.521
Top	5240	BPSK	13 / 8	20.561



Bottom Channel



Middle Channel

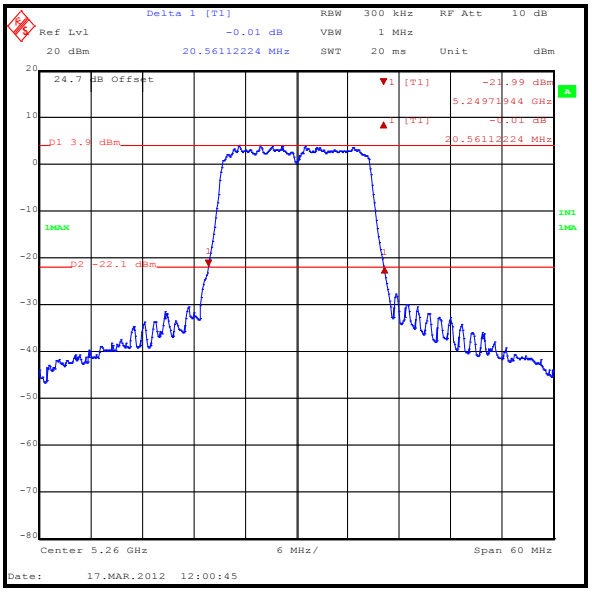


Top Channel

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.25-5.35 GHz band (Reference plots)

Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5260	BPSK	13 / 8	20.561
Middle	5280	BPSK	13 / 8	20.681
Top	5320	BPSK	13 / 8	20.321



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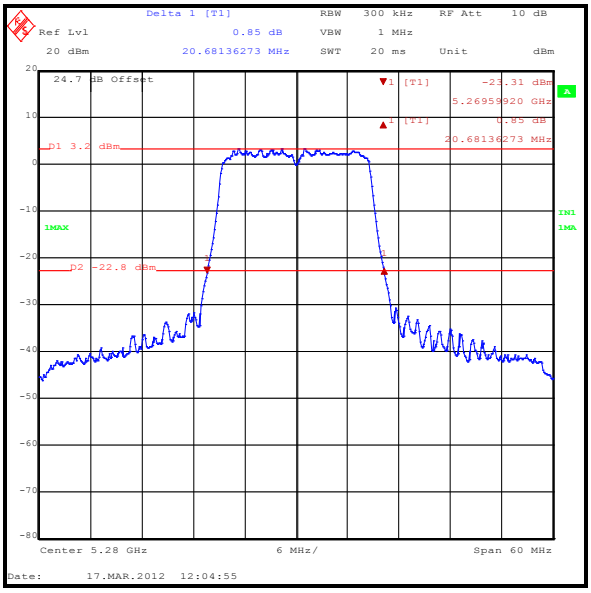

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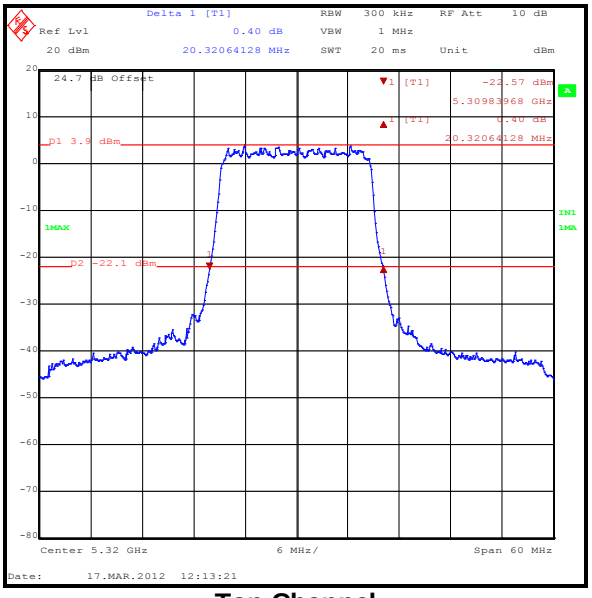
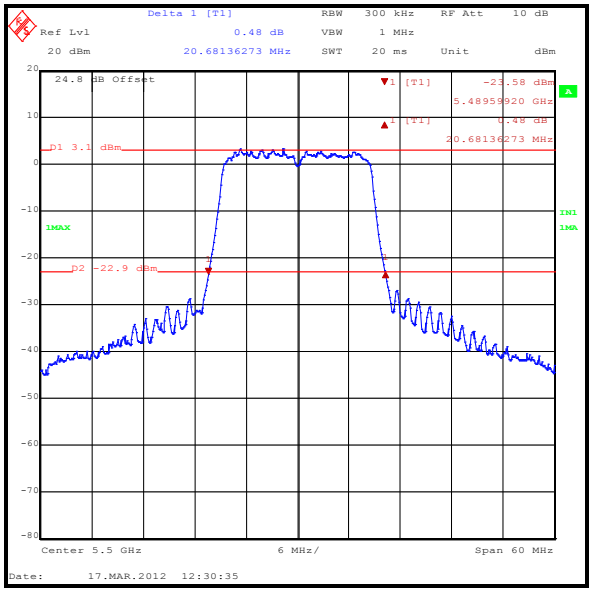


Top Channel

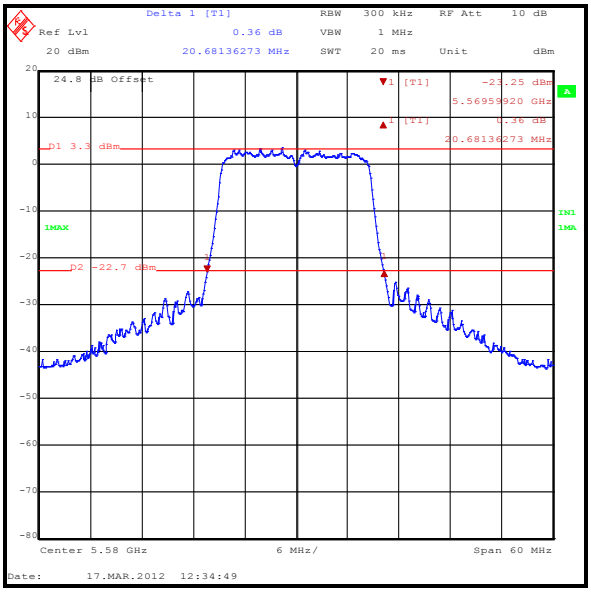
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.47-5.725 GHz band (Reference plots)

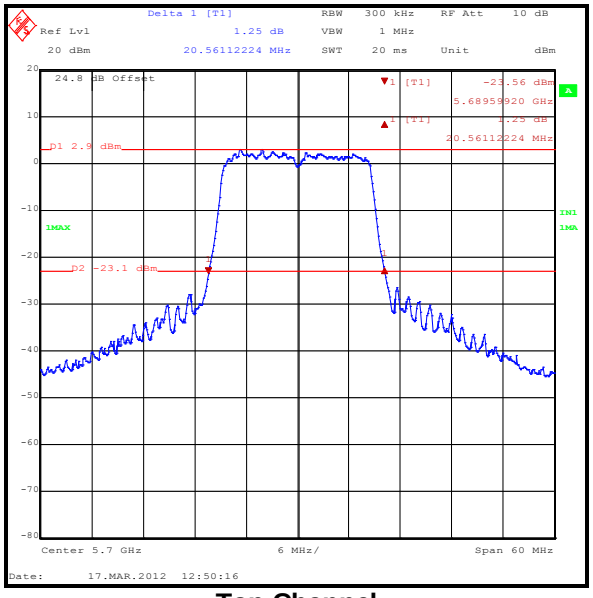
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5500	BPSK	13 / 8	20.681
Middle	5580	BPSK	13 / 8	20.681
Top	5700	BPSK	13 / 8	20.561



Bottom Channel



Middle Channel

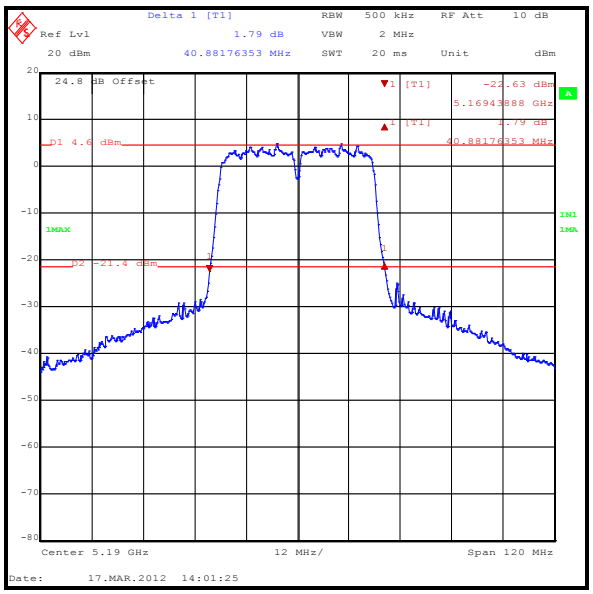


Top Channel

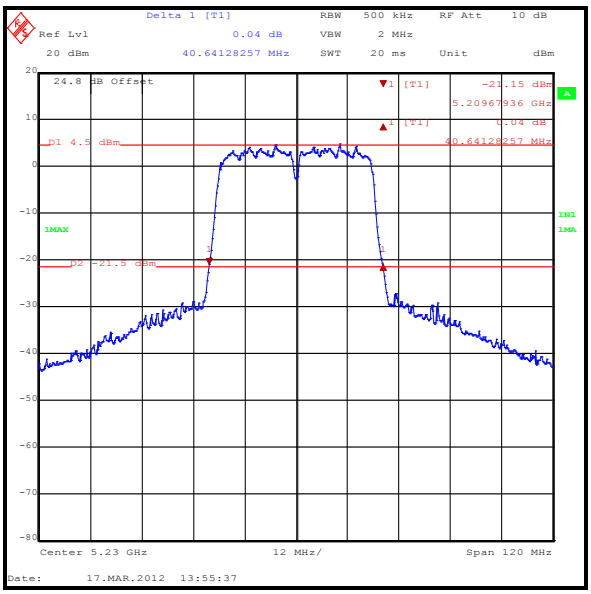
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.15-5.25 GHz band (Reference plots)

Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5190	BPSK	13 / 8	40.882
Top	5230	BPSK	13 / 8	40.641



Bottom Channel

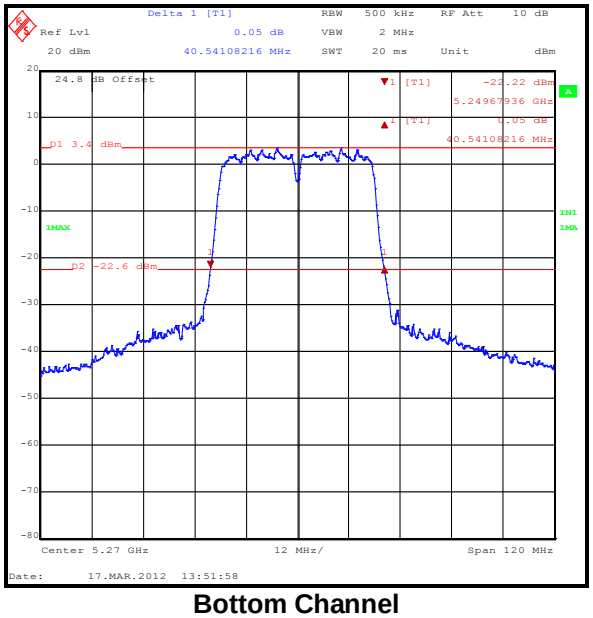


Top Channel

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.25-5.35 GHz band (Reference plots)

Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5270	BPSK	13 / 8	40.541
Top	5310	BPSK	13 / 8	40.641



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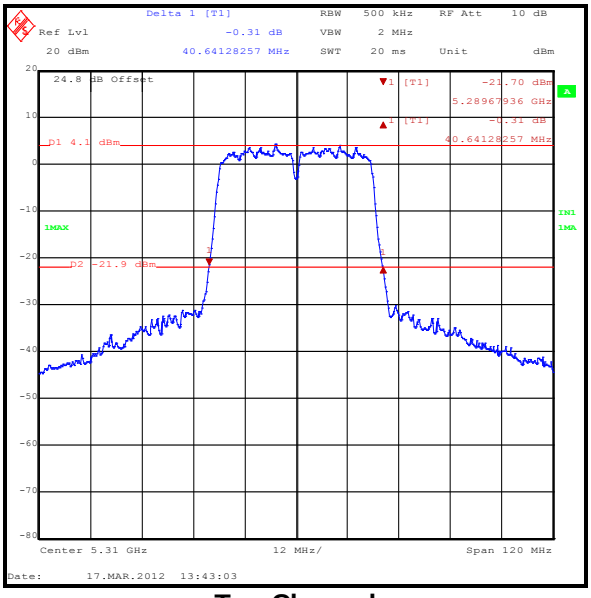
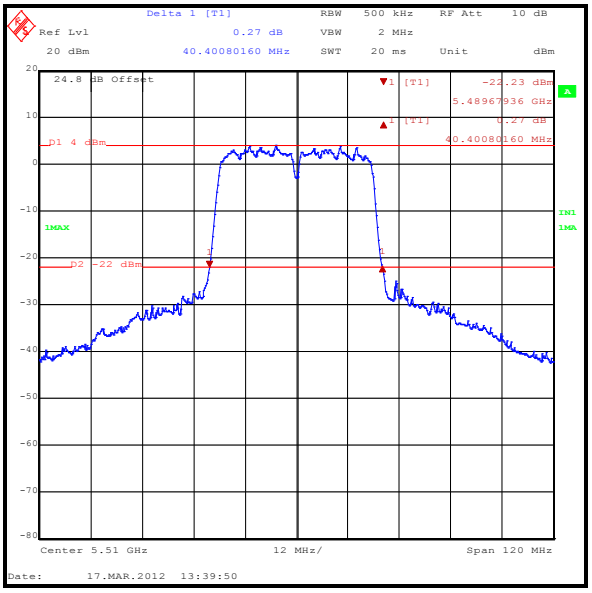


Top Channel

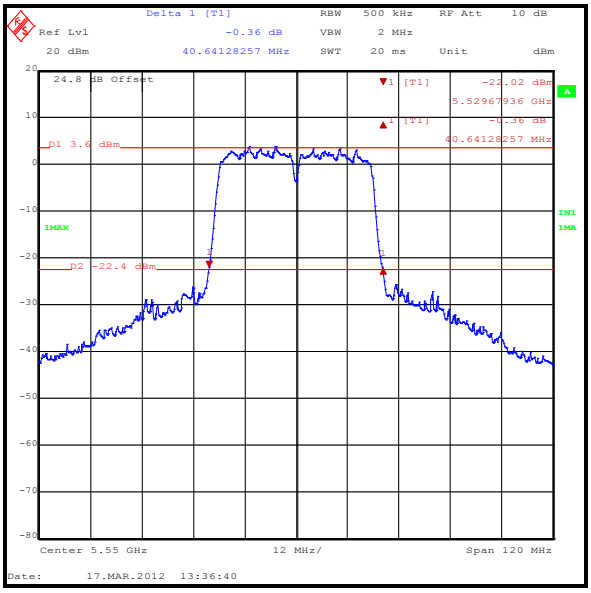
Transmitter 26dB Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.47-5.725 GHz band (Reference plots)

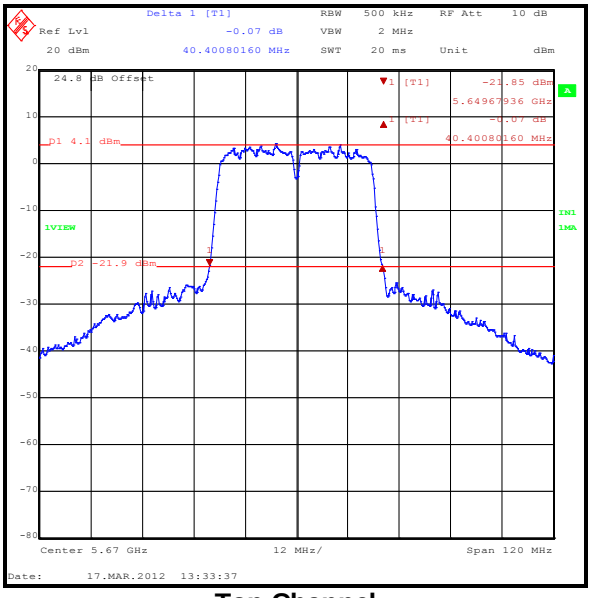
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5510	BPSK	13 / 8	40.401
Middle	5550	BPSK	13 / 8	40.641
Top	5670	BPSK	13 / 8	40.401



Bottom Channel



Middle Channel



Top Channel

Transmitter 26dB Emission Bandwidth (continued)

Test Equipment Used:

RFI ID	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1998	Attenuator	6820.17.B	Calibrated Before Use	-
M127	Spectrum Analyser	FSEB 30	08 Nov 2012	12
M1229	DMM	179	21 Jun 2012	12
M1251	DMM	175	29 Jul 2012	12
S011	Power Supply	PR-3010H	Calibrated before use	-
S0537	Dual Power Supply	EL302D	Calibrated before use	-

5.2.2. Transmitter 99% Emission Bandwidth

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	30 January 2012, 31 January 2012 & 17 March 2012
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	N/A
Industry Canada Reference:	RSS-210 A9.2
Test Method Used:	RSS-Gen 4.6.1 & FCC KDB 789033 D)

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	29

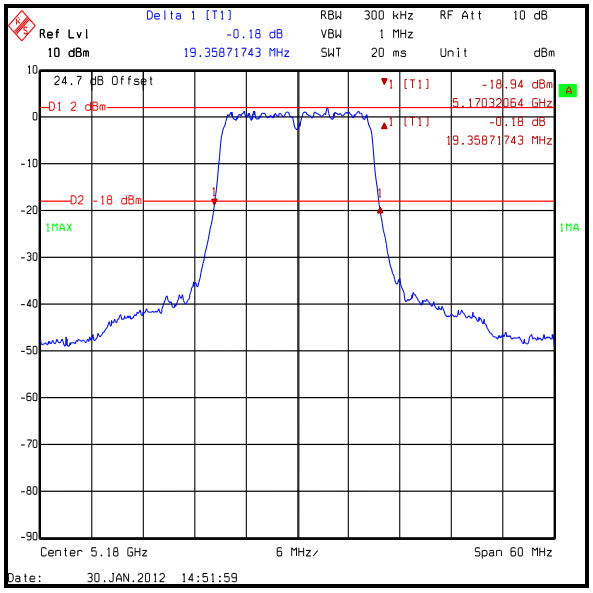
Note(s):

1. For the power measurements in this test report, the highest power output level was recorded when the EUT was configured as BPSK / MCS8 / 13 Mbps in both supported channel widths. Emission bandwidth plots in this configuration have been included as 'Reference plots' and the results used for calculations in Sections 5.2.3 and 5.2.4.
2. All bandwidth measurements were performed on Port 0 as both ports were initially checked and Port 0 was found to have the highest RF output power.

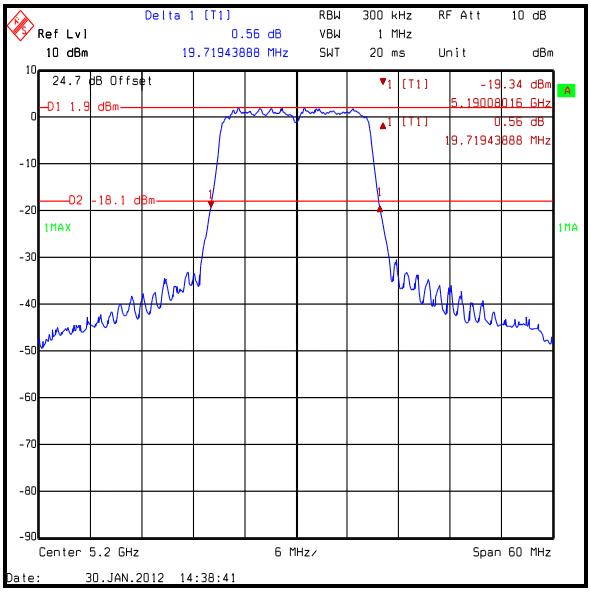
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.15-5.25 GHz band (Reference plots)

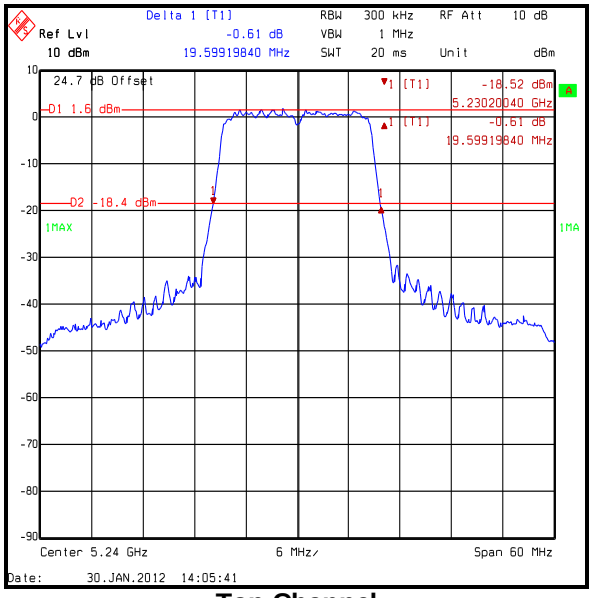
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	99 % Emission Bandwidth (MHz)
Bottom	5180	BPSK	13 / 8	19.359
Middle	5200	BPSK	13 / 8	19.719
Top	5240	BPSK	13 / 8	19.599



Bottom Channel



Middle Channel

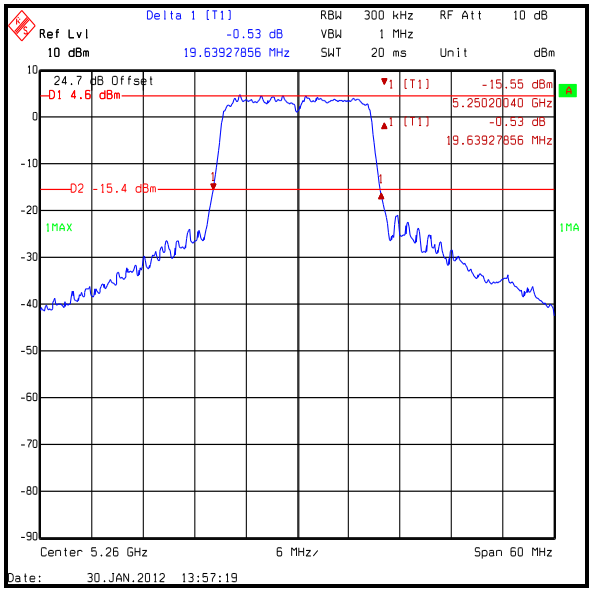


Top Channel

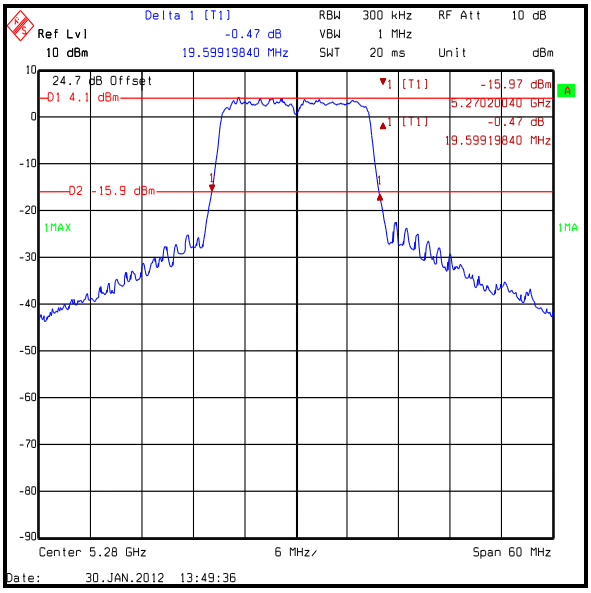
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.25-5.35 GHz band (Reference plots)

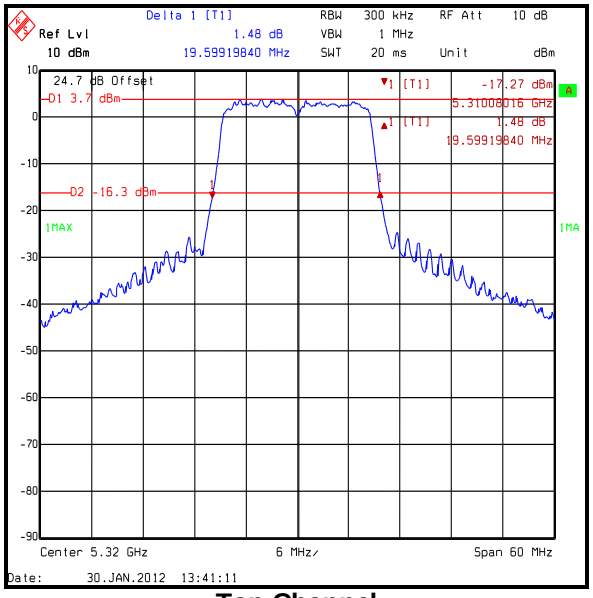
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	99 % Emission Bandwidth (MHz)
Bottom	5260	BPSK	13 / 8	19.639
Middle	5280	BPSK	13 / 8	19.599
Top	5320	BPSK	13 / 8	19.599



Bottom Channel



Middle Channel

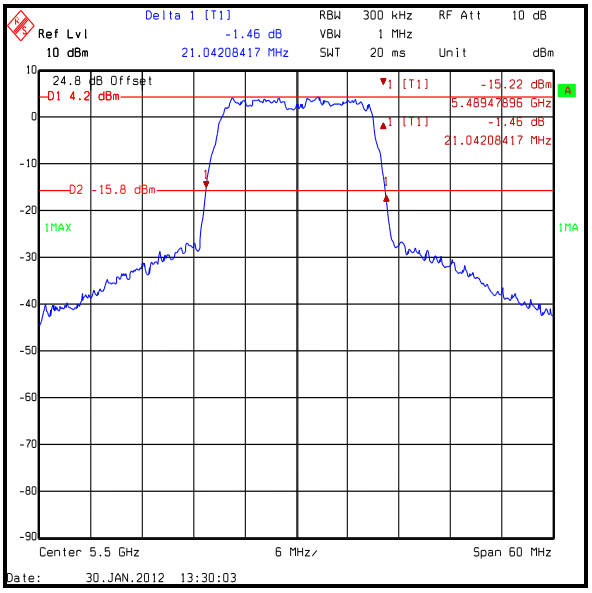


Top Channel

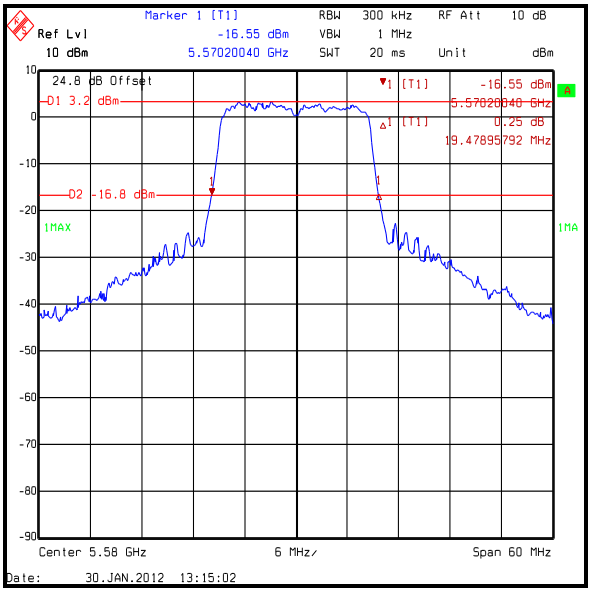
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 20 MHz / 5.47-5.725 GHz band (Reference plots)

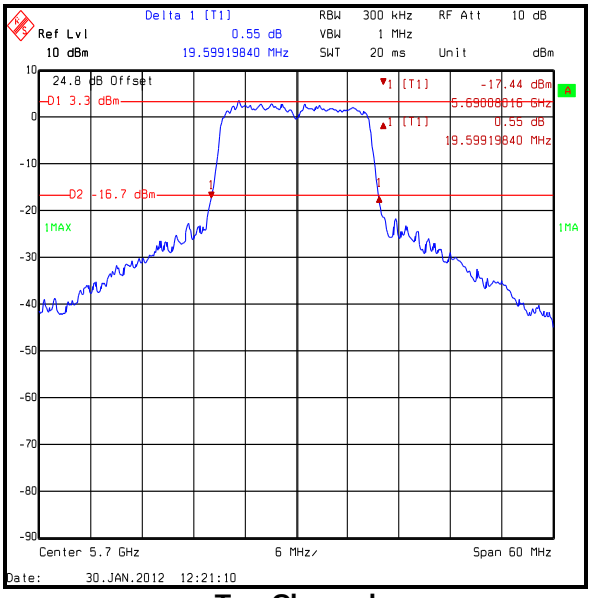
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	99 % Emission Bandwidth (MHz)
Bottom	5500	BPSK	13 / 8	21.042
Middle	5580	BPSK	13 / 8	19.479
Top	5700	BPSK	13 / 8	19.599



Bottom Channel



Middle Channel

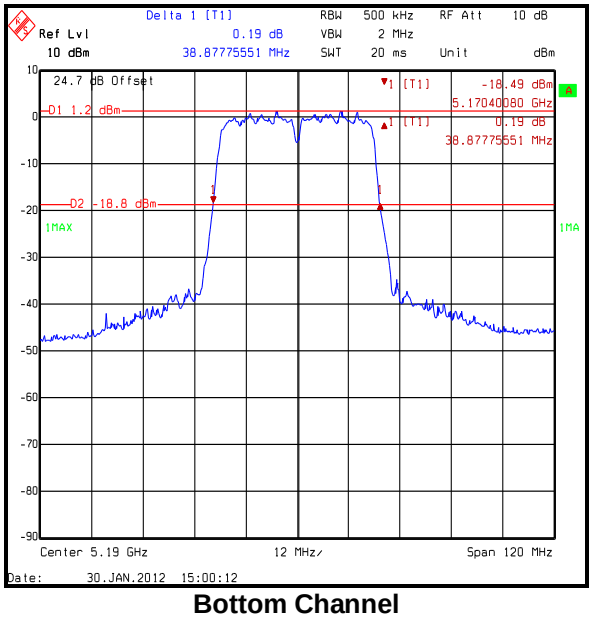


Top Channel

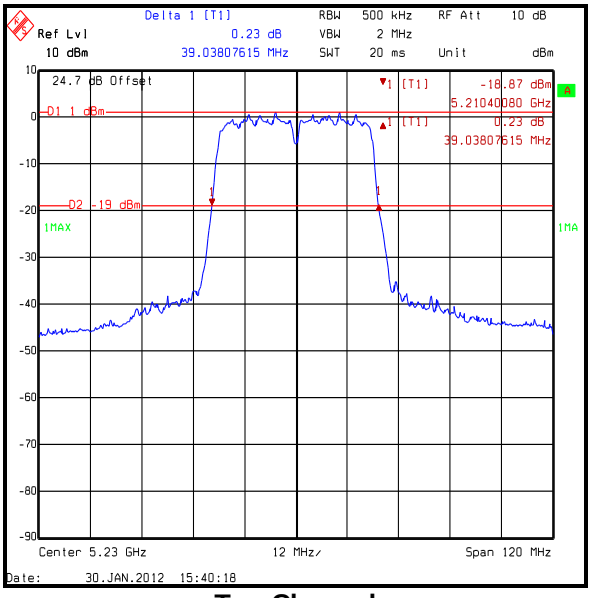
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.15-5.25 GHz band (Reference plots)

Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	99 % Emission Bandwidth (MHz)
Bottom	5190	BPSK	13 / 8	38.878
Top	5230	BPSK	13 / 8	39.038



Bottom Channel

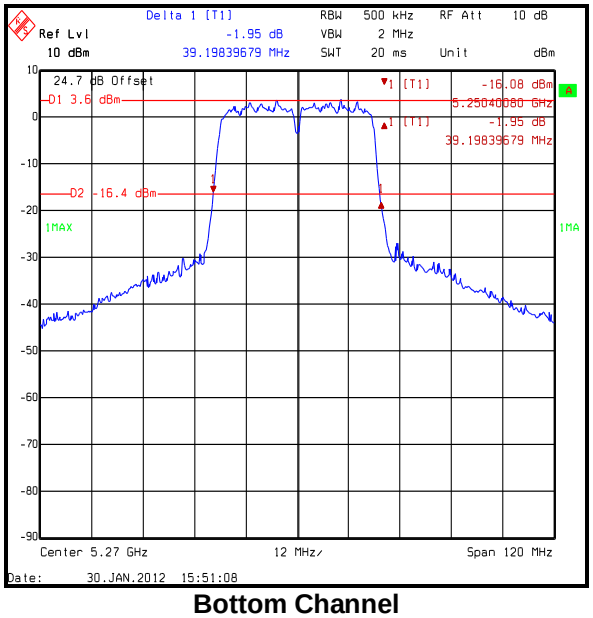


Top Channel

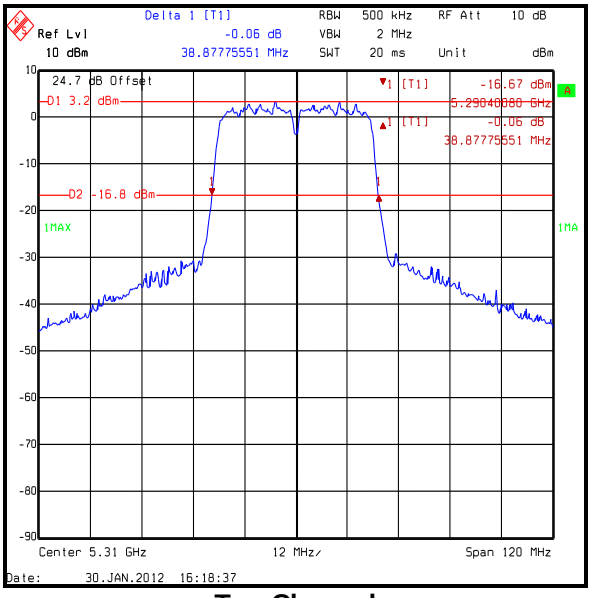
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.25-5.35 GHz band (Reference plots)

Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	26 dB Emission Bandwidth (MHz)
Bottom	5270	BPSK	13 / 8	39.198
Top	5310	BPSK	13 / 8	38.878



Bottom Channel

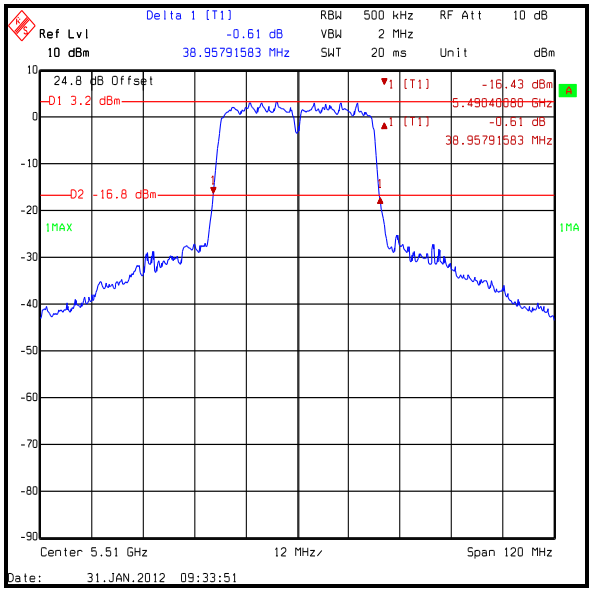


Top Channel

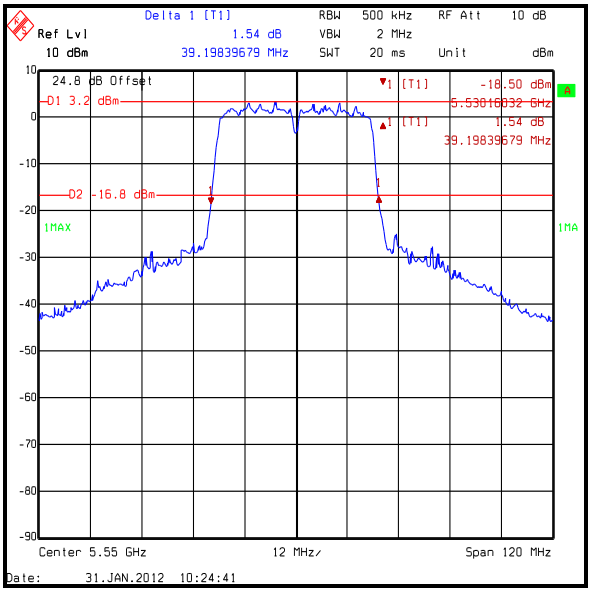
Transmitter 99 % Emission Bandwidth (continued)

Results: 802.11n / 40 MHz / 5.47-5.725 GHz band (Reference plots)

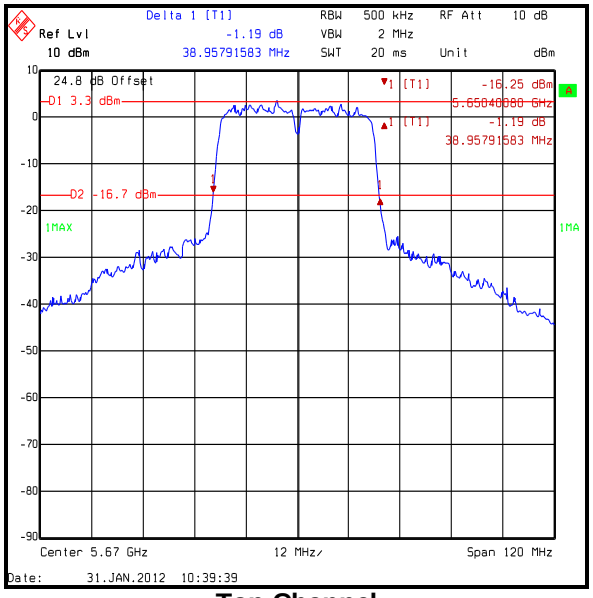
Channel	Frequency (MHz)	Modulation scheme	Data Rate Mbps / MCS	99 % Emission Bandwidth (MHz)
Bottom	5510	BPSK	13 / 8	38.958
Middle	5550	BPSK	13 / 8	39.198
Top	5670	BPSK	13 / 8	38.958



Bottom Channel



Middle Channel



Top Channel

Transmitter 99 % Emission Bandwidth (continued)

Test Equipment Used:

RFI ID	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1998	Attenuator	6820.17.B	Calibrated Before Use	-
M127	Spectrum Analyser	FSEB 30	08 Nov 2012	12
M1229	DMM	179	21 Jun 2012	12
M1251	DMM	175	29 Jul 2012	12
S011	Power Supply	PR-3010H	Calibrated before use	-
S0537	Dual Power Supply	EL302D	Calibrated before use	-

5.2.3. Transmitter Maximum Conducted Output Power

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	04 January 2012 & 05 January 2012
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	Part 15.407(a)(1)
Industry Canada Reference:	N/A
Test Method Used:	FCC KDB 789033 D01 Section C) 4) & FCC KDB 662911 D01

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	25

Note(s):

1. All conducted power tests in all bands were performed using a wideband power meter with associated thermal power head in accordance with FCC KDB 789033 D01 C)4) Method PM.
2. The EUT has two RF ports, Port 0 and Port 1. Power from both ports was measured and combined using the measure-and-sum method stated in FCC KDB 662911 D01.
3. The EUT was transmitting at 100% duty cycle.
4. The EUT antenna has a gain of <6 dBi.
5. All supported modes and channel widths were initially investigated on one channel. The mode that produced the highest power i.e. closest to the limit, (BPSK / 13 Mbps / MCS8) was deemed to be worst case. Measurements were then performed in this mode on bottom, middle and top channels on both ports, both channel widths in all operating bands. For all modes/channel widths initially investigated, results are available upon request.
6. The Part 15.407(a)(1) limit is the lesser of 50 mW (17.0 dBm) or 4 dBm + 10 $\log_{10}$ B, where B is the previously measured 26 dB emission bandwidth in MHz for BPSK / 13 Mbps / MCS8 configuration. The limit for each channel was calculated as below:

20 MHz channel width / Bottom channel = *4 dBm + 10 $\log_{10}$ 20.6 = 17.1 dBm*
20 MHz channel width / Middle channel = *4 dBm + 10 $\log_{10}$ 20.5 = 17.1 dBm*
20 MHz channel width / Top channel = *4 dBm + 10 $\log_{10}$ 20.46 = 17.1 dBm*
40 MHz channel width / Bottom channel = *4 dBm + 10 $\log_{10}$ 40.9 = 20.1 dBm*
40 MHz channel width / Top channel = *4 dBm + 10 $\log_{10}$ 40.6= 20.1 dBm*

Therefore the lesser of the two limits is the fixed limit of 50 mW (17 dBm). This was applied to the results.

Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (Continued)

Results: FCC Part 15.407 / 802.11n / 20 MHz

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	11.6	9.2	13.6	17.0	3.4	Complied
Middle	5200	12.8	10.7	14.9	17.0	2.1	Complied
Top	5240	12.2	10.0	14.2	17.0	2.8	Complied

Results: FCC Part 15.407 / 802.11n / 40 MHz

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5190	11.5	9.0	13.4	17.0	3.6	Complied
Top	5230	12.1	10.1	14.2	17.0	2.8	Complied

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	04 January 2012 & 05 January 2012
Test Sample Serial Number:	22582545		

FCC Reference:	Part 15.407(a)(2)
Industry Canada Reference:	RSS-Gen 4.8, RSS-210 A9.2(2) & A9.2(3)
Test Method Used:	FCC KDB 789033 D01 Section C) 4) & FCC KDB 662911 D01

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	25

Note(s):

1. The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or 11 dBm + 10 $\log_{10}$ B, where B is the previously measured 26 dB emission bandwidth in MHz for BPSK / 13 Mbps / MCS8 configuration. The limit for each channel was calculated as below:

5.25-5.35 GHz band

20 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 20.6 = 24.1 dBm*
20 MHz channel width / Middle channel = *11 dBm + 10 $\log_{10}$ 20.7 = 24.2 dBm*
20 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 20.3 = 24.1 dBm*
40 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 40.5 = 27.1 dBm*
40 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 40.6 = 27.1 dBm*

5.47-5.725 GHz band

20 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 20.7 = 24.2 dBm*
20 MHz channel width / Middle channel = *11 dBm + 10 $\log_{10}$ 20.7 = 24.2 dBm*
20 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 20.6 = 24.1 dBm*
40 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 40.4 = 27.1 dBm*
40 MHz channel width / Middle channel = *11 dBm + 10 $\log_{10}$ 40.6 = 27.1 dBm*
40 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 40.4 = 27.1 dBm*

The lesser of the two limits is the fixed limit of 250 mW (24.0 dBm). This was applied to the FCC Part 15.407 results.

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands) (continued)

2. The Industry Canada RSS-210 limit is the lesser of 250 mW (24.0 dBm) or 11 dBm + 10 $\log_{10}$ B, where B is the previously measured 99% emission bandwidth in MHz for BPSK / 13 Mbps / MCS8 configuration. The limit for each channel was calculated as below:

5.25-5.35 GHz band

20 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 19.6 = 23.9 dBm*
20 MHz channel width / Middle channel = *11 dBm + 10 $\log_{10}$ 19.6 = 23.9 dBm*
20 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 19.6 = 23.9 dBm*
40 MHz channel width / Bottom channel = *11 dBm + 10 $\log_{10}$ 39.2 = 26.9 dBm*
40 MHz channel width / Top channel = *11 dBm + 10 $\log_{10}$ 38.9 = 26.9 dBm*

5.47-5.725 GHz band

20 MHz channel width / Bottom channel = *11 + 10 $\log_{10}$ 21.0 = 24.2 dBm*
20 MHz channel width / Middle channel = *11 + 10 $\log_{10}$ 19.5 = 23.9 dBm*
20 MHz channel width / Top channel = *11 + 10 $\log_{10}$ 19.6 = 23.9 dBm*
40 MHz channel width / Bottom channel = *11 + 10 $\log_{10}$ 39.0 = 26.9 dBm*
40 MHz channel width / Middle channel = *11 + 10 $\log_{10}$ 39.2 = 26.9 dBm*
40 MHz channel width / Top channel = *11 + 10 $\log_{10}$ 39.0 = 26.9 dBm*

The lesser of the two limits was applied to the Industry Canada RSS-210 results.

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands) (continued)

Results: FCC Part 15.407 / 802.11n / 20 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	13.0	11.6	15.4	24.0	8.6	Complied
Middle	5280	12.8	10.8	14.9	24.0	9.1	Complied
Top	5320	12.2	10.7	14.5	24.0	9.5	Complied

Results: FCC Part 15.407 / 802.11n / 40 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5270	11.9	9.8	14.0	24.0	10.0	Complied
Top	5310	11.6	9.8	13.8	24.0	10.2	Complied

Results: FCC Part 15.407 / 802.11n / 20 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	13.0	12.4	15.7	24.0	8.3	Complied
Middle	5550	11.7	11.7	14.7	24.0	9.3	Complied
Top	5700	11.6	10.5	14.1	24.0	9.9	Complied

Results: FCC Part 15.407 / 802.11n / 40 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5510	11.6	11.3	14.5	24.0	9.5	Complied
Middle	5550	10.3	10.8	13.6	24.0	10.4	Complied
Top	5670	11.3	10.7	14.0	24.0	10.0	Complied

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands) (continued)

Results: Industry Canada RSS-210 / 802.11n / 20 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	13.0	11.6	15.4	23.9	8.6	Complied
Middle	5280	12.8	10.8	14.9	23.9	9.1	Complied
Top	5320	12.2	10.7	14.5	23.9	9.4	Complied

Results: Industry Canada RSS-210 / 802.11n / 40 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5270	11.9	9.8	14.0	24.0	10.0	Complied
Top	5310	11.6	9.8	13.8	24.0	10.2	Complied

Results: Industry Canada RSS-210 / 802.11 n / 20 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	13.0	12.4	15.7	24.0	8.3	Complied
Middle	5550	11.7	11.7	14.7	23.9	9.2	Complied
Top	5700	11.6	10.5	14.1	23.9	9.8	Complied

Results: Industry Canada RSS-210 / 802.11 n / 40 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5510	11.6	11.3	14.5	24.0	9.5	Complied
Middle	5550	10.3	10.8	13.6	24.0	10.4	Complied
Top	5670	11.3	10.7	14.0	24.0	10.0	Complied

Transmitter Maximum Conducted Output Power (continued)

Test Equipment Used:

RFI ID	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1998	Attenuator	6820.17.B	Calibrated Before Use	-
A1999	Attenuator	6820.17.B	Calibrated Before Use	-
M199	Power Meter	NRVS	11 May 2012	12
M1229	DMM	179	21 Jun 2012	12
M1251	DMM	175	29 Jul 2012	12
M1267	Thermal Power Sensor	NRV-Z52	17 May 2012	12
S011	Power Supply	PR-3010H	Calibrated before use	-
S0537	Dual Power Supply	EL302D	Calibrated before use	-

5.2.4. Transmitter Maximum Equivalent Isotropically Radiated Power

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	04 January 2012 & 05 January 2012
Test Sample Serial Number:	Not marked or stated		

FCC Reference:	N/A
Industry Canada Reference:	RSS-210 A9.2(1)
Test Method Used:	FCC KDB 789033 D01 Section C) 4) & FCC KDB 662911 D01

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	25

Note(s):

1. All power tests in all bands were performed using a wideband power meter with associated thermal power head in accordance with FCC KDB 789033 D01 C)4) Method PM.
2. The EUT has two RF ports, Port 0 and Port 1. Power from both ports was measured and combined using the measure-and-sum method stated in FCC KDB 662911 D01.
3. The EUT was transmitting at 100% duty cycle.
4. The Customer declared the antenna gain as 4.0 dBi in the 5 GHz bands. The loss of the internal RF cable is incorporated in the RF offset on the spectrum analyser. The antenna gain was added to the combined power of both ports to calculate the EIRP.
5. All supported modes and channel widths were initially investigated on one channel. The mode that produced the highest power i.e. closest to the limit (BPSK / 13 Mbps / MCS8) was deemed to be worst case. Measurements were then performed in this mode on bottom, middle and top channels on both ports, both channel widths in all operating bands. For all modes/channel widths initially investigated, results are available upon request.
6. The Industry Canada RSS-210 Section A9.2(1) EIRP limit is the lesser of 200 mW (23.0 dBm) or 10 + 10 $\log_{10}$ B, where B is the previously measured 99% emission bandwidth in MHz for BPSK / 13 Mbps / MCS8 configuration. The limit for each channel was calculated as below:

20 MHz channel width / Bottom channel = $10 + 10 \log_{10} 19.4 = 22.9$ dBm
20 MHz channel width / Middle channel = $10 + 10 \log_{10} 19.7 = 22.9$ dBm
20 MHz channel width / Top channel = $10 + 10 \log_{10} 19.6 = 22.9$ dBm
40 MHz channel width / Bottom channel = $10 + 10 \log_{10} 38.9 = 25.9$ dBm
40 MHz channel width / Top channel = $10 + 10 \log_{10} 39.0 = 25.9$ dBm

The lesser of the two limits was applied to the Industry Canada RSS-210 results.

Transmitter Maximum Equivalent Isotropically Radiated Power (5.15-5.25 GHz band) (continued)

Results: Industry Canada RSS-210 / 802.11n / 20 MHz

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	11.6	9.2	13.6	4.0	17.6	22.9	5.3	Complied
Middle	5200	12.8	10.7	14.9	4.0	18.9	22.9	4.0	Complied
Top	5240	12.2	10.0	14.2	4.0	18.2	22.9	4.7	Complied

Results: Industry Canada RSS-210 / 802.11n / 40 MHz

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5190	11.5	9.0	13.4	4.0	17.4	23.0	5.6	Complied
Top	5230	12.1	10.1	14.2	4.0	18.2	23.0	4.8	Complied

Transmitter Maximum Equivalent Isotropically Radiated Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	04 January 2012 & 05 January 2012
Test Sample Serial Number:	22582545		

FCC Reference:	N/A
Industry Canada Reference:	RSS-210 A9.2(2) & A9.2(3)
Test Method Used:	FCC KDB 789033 D01 Section C) 4) & FCC KDB 662911 D01

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	25

Note(s):

1. The Industry Canada RSS-210 A9.2(2) & A9.2(3) EIRP limit is the lesser of 1 W (30.0 dBm) or 17 + 10 $\log_{10}$ B, where B is the previously measured 99% emission bandwidth in MHz for BPSK / 13 Mbps / MCS8 configuration. The limit for each channel was calculated as below:

5.25-5.35 GHz band

20 MHz channel width / Bottom channel = $17 + 10 \log_{10} 19.6 = 29.9$ dBm
20 MHz channel width / Middle channel = $17 + 10 \log_{10} 19.6 = 29.9$ dBm
20 MHz channel width / Top channel = $17 + 10 \log_{10} 19.6 = 29.9$ dBm
40 MHz channel width / Bottom channel = $17 + 10 \log_{10} 39.2 = 32.9$ dBm
40 MHz channel width / Top channel = $17 + 10 \log_{10} 38.9 = 32.9$ dBm

5.47-5.725 GHz band

20 MHz channel width / Bottom channel = $17 + 10 \log_{10} 21.0 = 30.2$ dBm
20 MHz channel width / Middle channel = $17 + 10 \log_{10} 19.5 = 29.9$ dBm
20 MHz channel width / Top channel = $17 + 10 \log_{10} 19.6 = 29.9$ dBm
40 MHz channel width / Bottom channel = $17 + 10 \log_{10} 39.0 = 32.9$ dBm
40 MHz channel width / Middle channel = $17 + 10 \log_{10} 39.2 = 32.9$ dBm
40 MHz channel width / Top channel = $17 + 10 \log_{10} 39.0 = 32.9$ dBm

The lesser of the two limits was applied to the Industry Canada RSS-210 results.

2. Maximum calculated EIRP was <500 mW (27 dBm) in both operating bands, therefore there is no requirement to implement TPC.

Transmitter Maximum Equivalent Isotropically Radiated Power (5.25-5.35 GHz & 5.47-5.725 GHz bands) (continued)

Results: Industry Canada RSS-210 / 802.11n / 20 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	13.0	11.6	15.4	4.0	19.4	29.9	10.5	Complied
Middle	5280	12.8	10.8	14.9	4.0	18.9	29.9	11.0	Complied
Top	5320	12.2	10.7	14.5	4.0	18.5	29.9	11.4	Complied

Results: Industry Canada RSS-210 / 802.11n / 40 MHz / 5.25-5.35 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5270	11.9	9.8	14.0	4.0	18.0	30.0	12.0	Complied
Top	5310	11.6	9.8	13.8	4.0	17.8	30.0	12.2	Complied

Results: Industry Canada RSS-210 / 802.11n / 20 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	13.0	12.4	15.7	4.0	19.7	30.0	10.3	Complied
Middle	5550	11.7	11.7	14.7	4.0	18.7	29.9	11.2	Complied
Top	5700	11.6	10.5	14.1	4.0	18.1	29.9	11.8	Complied

Results: Industry Canada RSS-210 / 802.11n / 40 MHz / 5.47-5.725 GHz band

Channel	Frequency (MHz)	Port 0 Power (dBm)	Port 1 Power (dBm)	Combined Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5510	11.6	11.3	14.5	4.0	18.5	30.0	11.5	Complied
Middle	5550	10.3	10.8	13.6	4.0	17.6	30.0	12.4	Complied
Top	5670	11.3	10.7	14.0	4.0	18.0	30.0	12.0	Complied

Transmitter Maximum Equivalent Isotropically Radiated Power (continued)

Test Equipment Used:

RFI ID	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1998	Attenuator	6820.17.B	Calibrated Before Use	-
A1999	Attenuator	6820.17.B	Calibrated Before Use	-
M199	Power Meter	NRVS	11 May 2012	12
M1229	DMM	179	21 Jun 2012	12
M1251	DMM	175	29 Jul 2012	12
M1267	Thermal Power Sensor	NRV-Z52	17 May 2012	12
S011	Power Supply	PR-3010H	Calibrated before use	-
S0537	Dual Power Supply	EL302D	Calibrated before use	-

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Maximum Conducted Output Power	5.15 GHz to 5.825 GHz	95%	±0.27 dB
99% / 26 dB Emission Bandwidth	5.15 GHz to 5.825 GHz	95%	±0.92 ppm

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	-	-	Antenna information added