

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Beo Play V1-40" TV containing an LBWA1ZZPDZ-385 Module

FCC ID: TTULBWA1ZZPD

IC Certification Number: 3775B-LBWA1ZZPD

To: FCC Parts 15.205, 15.209, 15.407(b) & Industry Canada RSS-
210 A9.2, and RSS-Gen 4.9

Test Report Serial No.:
RFI-RPT-RP84552JD02C V3.0

Version 3.0 Supersedes All Previous Versions

This Test Report Is Issued Under The Authority Of John Newell, Group Quality Manager: 	
Checked By:	Sarah Williams
Signature:	
Date of Issue:	06 July 2012

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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) 2011: Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) - Section 15.407
Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2011: Part 15 Subpart C (Intentional Radiators) - Section 15.209
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, Wade Road, Basingstoke, Hampshire, RG24 8AH.
Test Dates:	22 February 2012 to 13 March 2012

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
Part 15.407(b)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A9.2(1),(2),(3) & (4)	Transmitter Out of Band Radiated Emissions	
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

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 specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Bang & Olufsen
Model Name or Number:	Beo Play V1-40 40" TV containing a Murata LBWA1ZZPDZ-385 module
Serial Number:	22586321
Software Version Number:	0.0.0.23327
FCC ID:	TTULBWA1ZZPD
IC 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 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.

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 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 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 Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	100	5500
	Middle	116	5580
	Top	140	5700
Transmit & Receive Frequency Band:	5725 MHz to 5825 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	149	5745
	Middle	153	5765
	Top	161	5805

Additional Information Related to Testing (continued)

Channel Spacing:	40 MHz		
Transmit & Receive Frequency Band:	5150 MHz to 5250 MHz		
Transmit 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 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 Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	102	5510
	Middle	110	5550
	Top	134	5670
Transmit & Receive Frequency Band:	5725 MHz to 5825 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	151	5755
	Top	159	5795

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:	External Antenna
Brand Name:	Tyco
Model Name or Number:	1513711-1
Serial Number:	Not marked or stated

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

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

Description:	HDMI Cables / 2 metres length
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	HDMI Player
Brand Name:	Sumvision
Model Name or Number:	Cyclone
Serial Number:	SUM0911

Description:	USB Stick
Brand Name:	Integral
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Support Equipment (continued)

Description:	Digital Terrestrial Receiver
Brand Name:	Samsung
Model Name or Number:	DTB-B260V
Serial Number:	6RDLCOO101E

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 transmit mode 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.
- A Tyco Electronics TE Connectivity 1513711-1 antenna (supporting MIMO) was connected to the 3-way antenna port. The antenna was placed on the highest point of the television using a temporary bracket. The following accessories were representative of typical accessories that are normally used in conjunction with the television incorporating the EUT: HDMI player, USB memory stick, Digital Terrestrial Receiver and Wireless N Router. These were connected using suitable cables in order to terminate all ports during radiated testing. The television was powered from a 120 VAC 60 Hz single phase mains supply.
- For transmitter spurious emissions tests, the TV was configured to be transmitting on both ports which were then connected to the Tyco antenna. The EUT was transmitting with a data rate of 13 Mbps / MCS8 and a channel bandwidth of 20 MHz. Initial measurements were performed on one channel and this combination was found to have the highest power level and therefore deemed to be the worst case. Pre-scans were performed on the top channel and if any emissions seen, final measurements were carried out on bottom, middle and top channels.

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.

5.2. Test Results

5.2.1. Transmitter Out of Band Radiated Emissions

Test Summary:

Test Engineer:	Nick Steele	Test Date:	24 February 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(1),(6),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(1)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

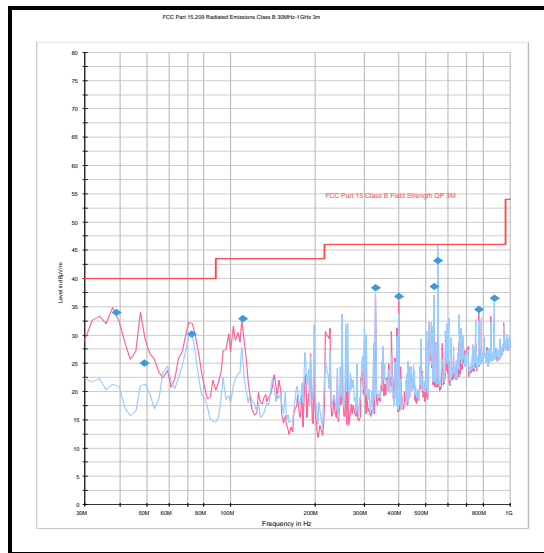
1. Pre-scans with the EUT transmitting on the top channel were measured according to FCC Part 15.407(b)(1). This states that for transmitters operating in the band 5.15 to 5.25 GHz: all emissions outside of the 5.15-5.35 GHz band will not exceed an EIRP of -27 dBm/MHz. Part15.407(b)(6) states unwanted emissions below 1 GHz must comply with the general field strength limits set forth in 15.209. Part15.407(b)(7) states the provisions of 15.205 apply, eg restricted bands of operation.
2. Industry Canada RSS-210 A9.2(1) states emissions outside the band 5150 to 5250 MHz shall not exceed -27 dBm/MHz EIRP. As the measurement was performed with a quasi-peak detector the results were converted from dBµV/m to EIRP (dBm) using the calculation as detailed in ANSI C63.10 Section 7.10.3.8.
3. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
4. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
5. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)**Results: Top Channel / Field Strength**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
109.993	Vertical	32.9	43.5	10.6	Complied
330.008	Horizontal	38.3	46.0	7.7	Complied
399.998	Vertical	36.8	46.0	9.2	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
109.993	Vertical	-62.3	-27.0	35.3	Complied
330.008	Horizontal	-56.9	-27.0	29.9	Complied
399.998	Vertical	-58.4	-27.0	31.4	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)**Test Summary:**

Test Engineers:	Nick Steele & Andrew Edwards	Test Dates:	26 February 2012 & 13 March 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(1),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(1)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

1. FCC Part 15.407(b)(1) states for devices operating in the 5.15 to 5.25 GHz band, all emissions outside the 5.15-5.35 GHz band shall not exceed and EIRP of -27 dBm/MHz. Part 15.407(b)(7) states the provisions of 15.205 apply, eg restricted bands of operation.
2. Industry Canada RSS-210 A9.2(1) states emissions outside the band 5150 to 5250 MHz shall not exceed -27 dBm/MHz EIRP.
3. Pre-scans above 1 GHz were performed with the EUT transmitting in the 5.47-5.725 GHz band as it produced the highest conducted output power in this band. However, final measurements were performed on any emission seen for each band as stated in FCC Response to Inquiry (Tracking Number 917954 / Date: 14th February 2012).
4. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
5. The field strength peak level was compared to the field strength average limit as opposed to being compared to the peak limit because this is the more onerous limit.
6. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
7. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)**Results: Bottom Channel / EIRP**

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10359.078	Horizontal	-49.7	-27.0	22.7	Complied

Results: Bottom Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4143.945	Horizontal	51.5	54.0	2.5	Complied

Results: Middle Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10397.635	Horizontal	-48.4	-27.0	21.4	Complied

Results: Middle Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4159.842	Horizontal	51.9	54.0	2.1	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10480.440	Horizontal	-48.2	-27.0	21.2	Complied

Results: Top Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4192.033	Horizontal	52.1	54.0	1.9	Complied

Transmitter Out of Band Radiated Emissions (5.25-5.35 GHz band operation)**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	25 February 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(2),(6),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(2)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

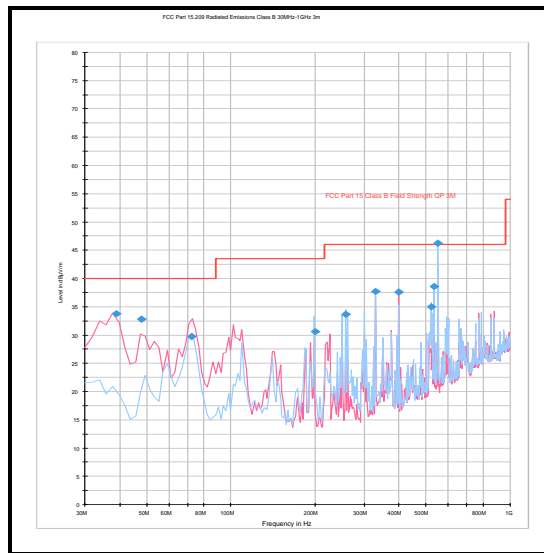
1. Pre-scans with the EUT transmitting on the top channel were measured according to FCC Part 15.407(b)(2). This states devices operating in the 5.25 to 5.35 GHz band that generate emissions in the 5.15 to 5.25 GHz band must meet all applicable technical requirements for operation in the 5.15 to 5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15 to 5.25 GHz band. Emissions below 1 GHz must comply with the general field strength limits set forth in FCC part 15.209.
2. Industry Canada RSS-210 A9.2(2) states emissions outside the band 5150 to 5250 MHz shall not exceed -27 dBm/MHz EIRP. As the measurement was performed with a quasi-peak detector the results were converted from dBμV/m to EIRP (dBm) using the calculation as detailed in ANSI C63.10 Section 7.10.3.8.
3. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
4. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
5. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.25-5.35 GHz band operation) (continued)**Results: Top Channel / Field Strength**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
258.046	Horizontal	33.6	46.0	12.4	Complied
329.998	Horizontal	37.7	46.0	8.3	Complied
400.017	Vertical	37.6	46.0	8.4	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
258.046	Horizontal	-61.6	-27.0	34.6	Complied
329.998	Horizontal	-57.5	-27.0	30.5	Complied
400.017	Vertical	-57.6	-27.0	30.6	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions (5.25-5.35 GHz band operation) (continued)**Test Summary:**

Test Engineer:	Nick Steele & Andrew Edwards	Test Date:	26 February 2012 & 13 March 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(2),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(2)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

1. FCC Part 15.407(b)(2) states for devices operating in the 5.25 to 5.35 GHz band that generate emissions in the 5.15 to 5.25 GHz band must meet all applicable technical requirements for operation in the 5.15 to 5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15 to 5.25 GHz band. Part 15.407(b)(7) states the provisions of 15.205 apply eg restricted bands of operation.
2. Industry Canada RSS-210 A9.2(2) states emissions outside the band 5250 to 5350 MHz shall not exceed -27 dBm/MHz EIRP.
3. Pre-scans were performed on the 5.47-5.725 GHz band as it produced the highest conducted output power. However, final measurements were performed on any emission seen for each band as stated in FCC Response to Inquiry (Tracking Number 917954 / Date: 14th February 2012).
4. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
5. The field strength peak level was compared to the field strength average limit as opposed to being compared to the peak limit because this is the more onerous limit.
6. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.25-5.35 GHz band operation) (continued)**Results: Bottom Channel / EIRP**

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10520.8422	Horizontal	-48.0	-27.0	21.0	Complied

Results: Bottom Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4207.955	Horizontal	51.7	54.0	2.3	Complied

Results: Middle Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10560.040	Horizontal	-49.8	-27.0	22.8	Complied

Results: Middle Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4223.967	Horizontal	51.9	54.0	2.1	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10638.756	Horizontal	-48.9	-27.0	21.9	Complied

Results: Top Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4256.131	Horizontal	52.0	54.0	2.0	Complied
10638.756	Horizontal	46.3	54.0	7.7	Complied

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation)**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	22 February 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(3),(6),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(3)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

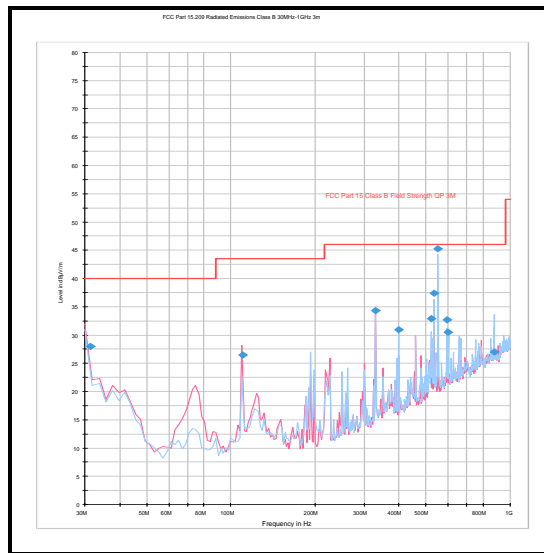
1. Pre-scans with the EUT transmitting on the top channel were measured according to FCC Part 15.407(b)(3) which states for transmitters operating in the band 5.47 to 5.725 GHz: all emissions outside of the band shall not exceed -27 dBm/MHz. Part(b)(6) states unwanted emissions below 1 GHz must comply with the general field strength limits set forth in 15.209. Part(b)(7) states the provisions of 15.205 apply, eg restricted bands of operation.
2. Industry Canada RSS-210 A9.2(3) states emissions outside the band 5470 to 5725 MHz shall not exceed -27 dBm/MHz EIRP. As the measurement was performed with a quasi-peak detector the results were converted from dBµV/m to EIRP (dBm) using the calculation as detailed in ANSI C63.10 Section 7.10.3.8.
3. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
4. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
5. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)**Results: Top Channel / Field Strength**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
110.012	Vertical	26.4	43.5	17.1	Complied
329.998	Horizontal	34.4	46.0	11.6	Complied
400.007	Horizontal	30.9	46.0	15.1	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
110.012	Vertical	-68.8	-27.0	41.8	Complied
329.998	Horizontal	-60.8	-27.0	33.8	Complied
400.007	Horizontal	-64.3	-27.0	37.3	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)**Test Summary:**

Test Engineers:	Andrew Edwards & Nick Steele	Test Dates:	25 February 2012, 26 February 2012 & 13 March 2012
Test Sample Serial No.:	22586321		

FCC Part:	15.407(b)(3),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(3)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	23

Note(s):

1. FCC Part 15.407(b)(3) states for transmitters operating in the band 5.47 to 5.725 GHz: all emissions outside of the band will not exceed -27 dBm/MHz. Part(b)(7) states the provisions of 15.205 apply eg restricted bands of operation.
2. Industry Canada RSS-210 A9.2(3) states emissions outside the band 5470 to 5725 MHz shall not exceed -27 dBm/MHz EIRP.
3. Pre-scans were performed on the 5.47-5.725 GHz band as it produced the highest conducted output power. However, final measurements were performed on any emission seen for each band as stated in FCC Response to Inquiry (Tracking Number 917954 / Date: 14th February 2012).
4. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
5. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
6. The field strength peak level was compared to the field strength average limit as opposed to being compared to the peak limit because this is the more onerous limit.
7. The emission shown on the 4 GHz to 6 GHz plot is the EUT fundamental.
8. Measurements were performed across the two restricted bands closest to the bands of operation with the EUT transmitting on the top channel in the 5.47 to 5.725 GHz band. Plots are included in this section of the test report. Peak and average measurements were made. No emissions were observed above the noise floor of the measurement system.
9. Pre-scans above 1 GHz were performed in a fully anechoic chamber (RFI Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)**Results: Bottom Channel / EIRP**

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
10998.998	Horizontal	-48.5	-27.0	21.5	Complied

Results: Bottom Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4399.843	Vertical	52.0	54.0	2.0	Complied
10998.998	Horizontal	46.7	54.0	7.3	Complied

Results: Middle Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
11160.446	Horizontal	-48.8	-27.0	21.8	Complied

Results: Middle Channel / Field strength / Peak

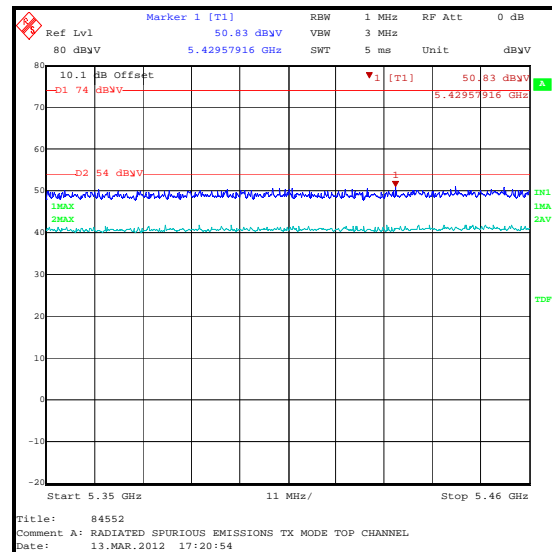
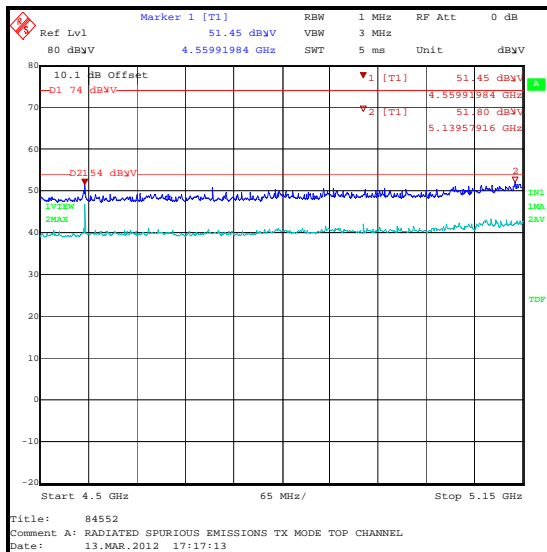
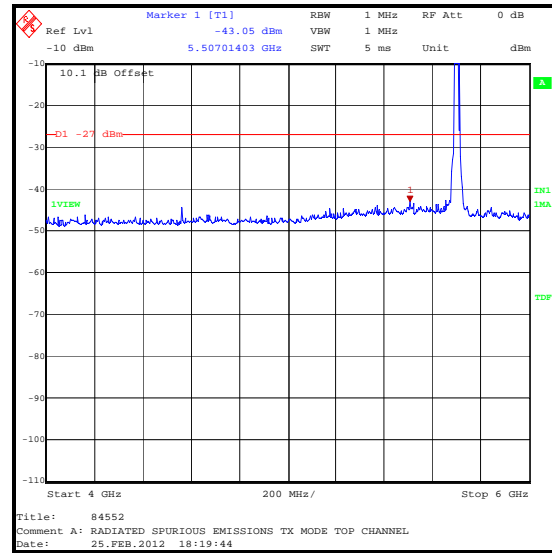
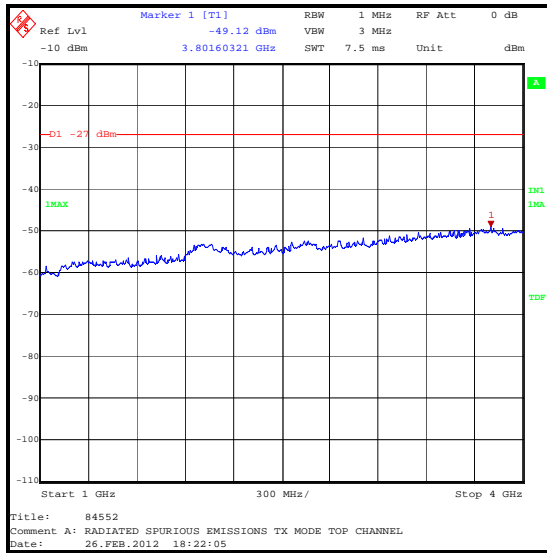
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
11160.446	Horizontal	46.4	54.0	7.6	Complied

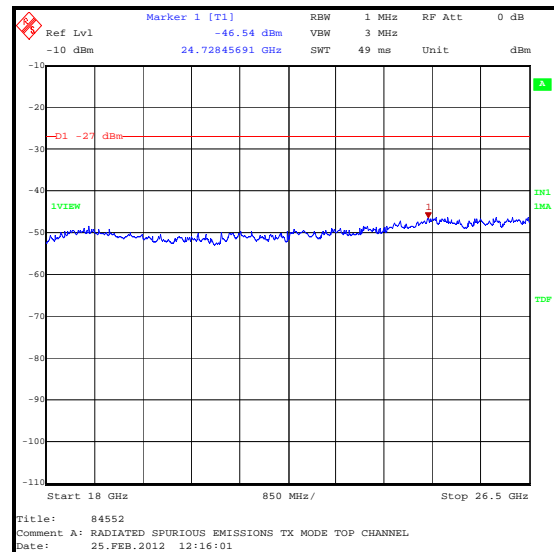
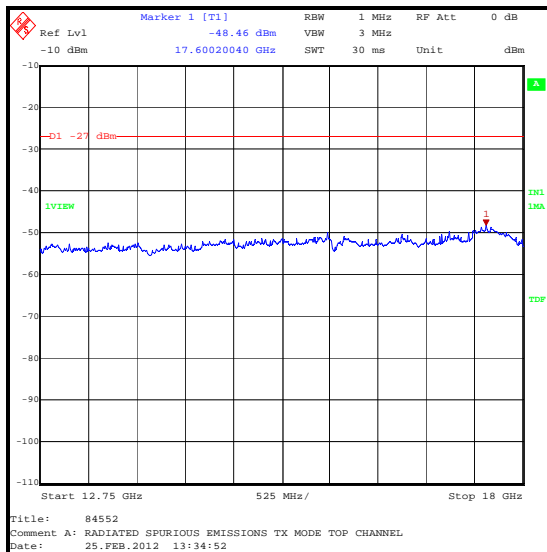
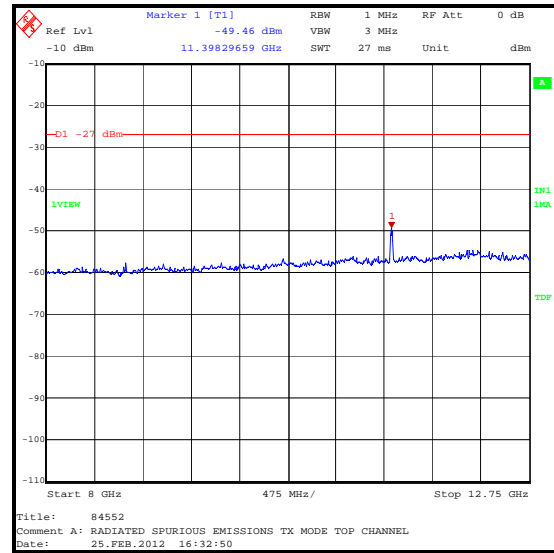
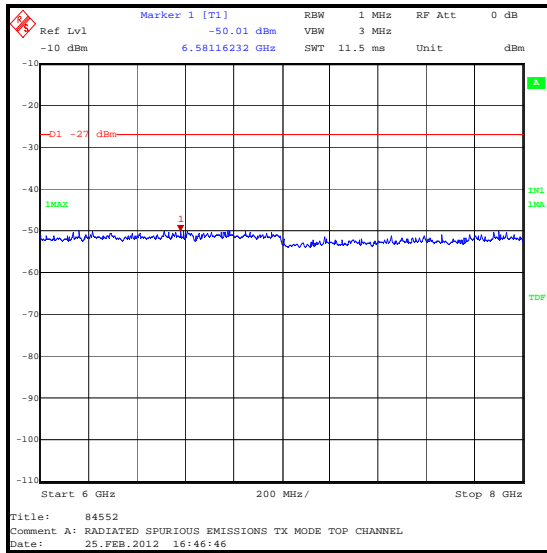
Results: Top Channel / EIRP

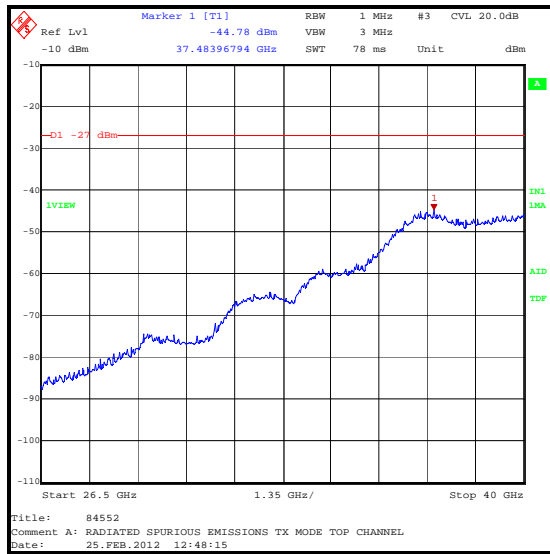
Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
11399.216	Horizontal	-47.8	-27.0	20.8	Complied

Results: Top Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4559.959	Vertical	52.5	54.0	1.5	Complied
11399.216	Horizontal	47.4	54.0	6.6	Complied

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)**Restricted Band 4.5 GHz to 5.15 GHz****Restricted Band 5.35 GHz to 5.46 GHz**

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation) (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions (5.725-5.825 GHz band operation)**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	22 February 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(4),(6),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(4)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

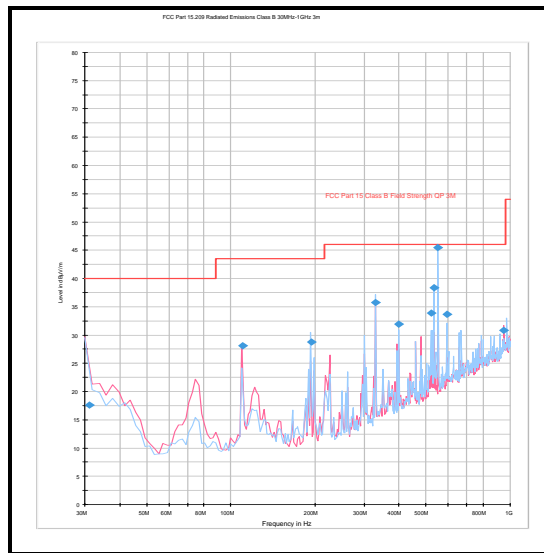
1. Measurements below 1 GHz were performed in accordance with FCC KDB 789033 G). Part 15.407 (b)(7) states the provisions of Part 15.205 also apply.
2. Industry Canada RSS-210 A9.2(4) states emissions outside the band 5725 to 5825 MHz and more than 10 MHz above or below the band edges shall not exceed -27 dBm/MHz EIRP. As the measurement was performed with a quasi-peak detector the results were converted from dBµV/m to EIRP (dBm) using the calculation as detailed in ANSI C63.10 Section 7.10.3.8.
3. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
4. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
5. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.725-5.825 GHz band operation) (continued)**Results: Top Channel / Field Strength**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
110.002	Vertical	28.1	43.5	15.4	Complied
329.998	Horizontal	35.7	46.0	10.3	Complied
399.988	Horizontal	31.9	46.0	14.1	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
110.002	Vertical	-67.1	-27.0	40.1	Complied
329.998	Horizontal	-59.5	-27.0	32.5	Complied
399.988	Horizontal	-63.3	-27.0	36.3	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Radiated Emissions (5.725-5.825 GHz band operation) (continued)**Test Summary:**

Test Engineer:	Nick Steele & Andrew Edwards	Test Date:	26 February 2012 & 13 March 2012
Test Sample Serial No.:	22586321		

FCC Reference:	Parts 15.407(b)(4),(7) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A9.2(4)
Test Method Used:	FCC KDB 789033 G) & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	23

Note(s):

1. FCC Part 15.407(b)(4) states for transmitters operating in the band 5.725 to 5.825 GHz: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions will not exceed -27 dBm/MHz. Part 15.407(b)(7) states the provisions of Part 15.205 apply.
2. Industry Canada RSS-210 A9.2(4) states for the band 5725 to 5825 MHz, emissions within the frequency range from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz EIRP. For frequencies more than 10 MHz above or below the band edges, emissions shall not exceed -27 dBm/MHz EIRP.
3. Pre-scans were performed on the 5.47-5.725 GHz band as the EUT produced the highest conducted output power in this band. Final measurements were performed on any emission seen for each band as stated in FCC Response to Inquiry (Tracking Number 917954 / Date: 14th February 2012).
4. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
5. The field strength peak level was compared to the field strength average limit as opposed to being compared to the peak limit because this is the more onerous limit.
6. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions (5.725-5.825 GHz band operation) (continued)**Results: Bottom Channel / EIRP**

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
11495.251	Horizontal	-50.3	-27.0	23.3	Complied

Results: Bottom Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4596.044	Horizontal	52.6	54.0	1.4	Complied
11495.251	Horizontal	44.9	54.0	9.1	Complied

Results: Middle Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
11522.184	Horizontal	-50.0	-27.0	23.0	Complied

Results: Middle Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4611.926	Horizontal	52.7	54.0	1.3	Complied
11522.184	Horizontal	45.2	54.0	8.8	Complied

Results: Top Channel / EIRP

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
11609.158	Horizontal	-47.1	-27.0	20.1	Complied

Results: Top Channel / Field strength / Peak

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
4643.870	Horizontal	53.5	54.0	0.5	Complied
11609.158	Horizontal	48.1	54.0	5.9	Complied

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
Radiated Spurious Emissions	30 MHz to 40 GHz	95%	±2.94 dB

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.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (months)
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Oct 2012	12
A1785	Low Noise Amplifier	Farran Technology	FLNA-28-30	FTL 6483	Calibrated before use	-
A1818	Antenna	EMCO	3115	00075692	09 Oct 2012	12
A1834	Attenuator	Hewlett Packard	8491B	10444	29 Jan 2013	12
A203	Antenna	Flann Microwave	22240-20	343	11 May 2013	36
A253	Antenna	Flann Microwave	12240-20	128	09 Oct 2012	12
A254	Antenna	Flann Microwave	14240-20	139	09 Oct 2012	12
A255	Antenna	Flann Microwave	16240-20	519	09 Oct 2012	12
A256	Antenna	Flann Microwave	18240-20	400	09 Oct 2012	12
A259	Antenna	Chase	CBL6111	1513	26 Mar 2012	12
A436	Antenna	Flann	20240-20	330	09 Oct 2012	12
A490	Antenna	Chase	CBL6111A	1590	11 Apr 2012	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	29 May 2012	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	09 Oct 2012	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESI26	100046K	29 Jun 2012	12
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	05 Oct 2012	12
M1390	Harmonic Mixer	Farran Technology	WHMP 28	FTL1677B	Calibrated before use	-
M1590	Test Receiver	Rohde & Schwarz	ESU26	100239	15 Jun 2012	12

NB In accordance with UKAS requirements all the measurement equipment is on a calibration schedule.