



TEST REPORT

Test Report No. : UL-RPT-RP10012646JD14A

Manufacturer : Bang & Olufsen a/s
Model No. : AW-AU397
FCC ID : TTUAW-AU397
Technology : *Bluetooth* – Low Energy
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.247

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2. The results in this report apply only to the sample(s) tested.
3. The 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 3.0 supersedes all previous versions.

Date of Issue: 23 March 2015

Checked by:

pp

Sarah Williams
Engineer, Radio Laboratory

Issued by :

John Newell
Group Quality Manager
UL VS LTD



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UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

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Table of Contents

1. Customer Information.....	4
2. Summary of Testing.....	5
2.1. General Information	5
2.2. Summary of Test Results	5
2.3. Methods and Procedures	6
2.4. Deviations from the Test Specification	6
3. Equipment Under Test (EUT)	7
3.1. Identification of Equipment Under Test (EUT)	7
3.2. Description of EUT	7
3.3. Modifications Incorporated in the EUT	7
3.4. Additional Information Related to Testing	8
3.5. Support Equipment	9
3.6. Antenna	10
4. Operation and Monitoring of the EUT during Testing	11
4.1. Operating Modes	11
4.2. Configuration and Peripherals	11
5. Measurements, Examinations and Derived Results.....	12
5.1. General Comments	12
5.2. Test Results	13
5.2.1. Transmitter AC Conducted Spurious Emissions	13
5.2.2. Transmitter Minimum 6 dB Bandwidth	16
5.2.3. Transmitter Maximum Peak Output Power	18
5.2.4. Transmitter Radiated Emissions – UAM Antenna	21
5.2.5. Transmitter Radiated Emissions – V100 Antenna	26
5.2.6. Transmitter Band Edge Radiated Emissions – UAM Antenna	31
5.2.7. Transmitter Band Edge Radiated Emissions – V100 Antenna	34
6. Measurement Uncertainty	37
7. Report Revision History	38

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:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 and 15.209
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	23 January 2014 to 27 February 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.207	Transmitter AC Conducted Emissions	
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	
Part 15.247(e)	Transmitter Power Spectral Density	Note 1
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	
Part 15.247(d)/15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d)/15.209(a)	Transmitter Band Edge Radiated Emissions	
Key to Results  = Complied  = Did not comply		

Note(s):

1. In accordance with FCC KDB 558074 Section 10.1, PSD is not required if the maximum conducted output power is less than the PSD limit of 8 dBm / 3 kHz. The PSD level is therefore deemed to be equal to the measured total output power.
2. KDB558074 v03 r01 was used at the time of testing, as this was the latest version of KDB available. This testing has subsequently been reviewed, to ensure that the test methods comply with the latest requirements of KDB558074 v03 r02, 05 June 2014.

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:	KDB 558074 D01 DTS Meas Guidance v03r02 June 5, 2014
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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:	AW-AU397
Test Sample MAC Address:	240A546D213
Hardware Version Number:	5-PP001942 1213 V05
Software Version Number:	USB8797-14.69.11.p179-M3X14348-GPL-(FP69)
FCC ID:	TTUAW-AU397

Brand Name:	Bang & Olufsen
Description:	Antenna
Model Name or Number:	UAM

Brand Name:	Bang & Olufsen
Description:	Antenna
Model Name or Number:	V100

3.2. Description of EUT

The equipment under test (EUT) is an IEEE 802.11a/b/g/n 2X2 MIMO WLAN, *Bluetooth* and Low Energy *Bluetooth* module.

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:	Bluetooth Low Energy (Digital Transmission System)		
Type of Unit:	Transceiver		
Channel Spacing:	2 MHz		
Modulation:	GFSK		
Data Rate:	1 Mbps		
Power Supply Requirement(s):	Nominal	5 VDC	
Maximum Conducted Output Power:	0.5 dBm		
Antenna Gain(s):	3.0 dBi (UAM Antenna) 0.3 dBi (V100 Antenna)		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	0	2402
	Middle	19	2440
	Top	39	2480

3.5. Support Equipment

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

Description:	Laptop PC
Brand Name:	Lenovo
Model Name or Number:	ThinkPad X61
Serial Number:	L3-C6073 07/12

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	D610
Serial Number:	UL Asset No. PC378NT

Description:	Test Jig
Brand Name:	AzureWave
Model Name or Number:	1213 adapter
Serial Number:	Not marked or stated

Description:	AC to DC adapter
Brand Name:	Goobay
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Router
Brand Name:	Linksys
Model Name or Number:	WAG54G
Serial Number:	CF610E100799

Description:	2 x 2 metre USB cables
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 that the customer intends to use with this product:

Manufacturer	Stated Gain (dBi)	Model	Part No.	Note(s)
Tyco	3.0	UAM	1513472-5	1 & 2
Bang & Olufsen	0.3	V100	6143988	1 & 2

Note(s):

1. The stated antenna gains are the highest gains for the frequency range 2400 MHz to 2483.5 MHz.
2. Transmitter Radiated Emissions and Transmitter Radiated Band Edge Emissions were tested on both antennas.

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Transmitting at maximum power in *Bluetooth* mode with modulation, maximum possible data length available, with a payload set to set Pseudorandom Bit Sequence 9.

4.2. Configuration and Peripherals

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

- The EUT was inserted onto the supplied test jig, the test jig was powered via 120 VAC 60 Hz to 5 VDC power supply, using the Goobay AC to DC adapter. The test jig then supplies the EUT with the required 3.3 VDC.
- The Lenovo ThinkPad X61 laptop PC is connected to the EUT via a USB cable, the EUT is initialised using a software application supplied by the customer. Once initialised the EUT is controlled on the Dell D610 laptop PC, which is connected to the ThinkPad X61 via an access point, using a software application supplied by the customer. The application was used to enable continuous transmission and to select the test channels as required.
- The EUT was transmitting with a 100% duty cycle.
- The EUT has two RF ports, labelled as Port 0 and Port 1. *Bluetooth* LE is only supported on Port 1.

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 AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Mark Percival	Test Date:	18 February 2014
MAC Address:	240A546D213		

FCC Reference:	Part 15.207
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	47

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.321	Live	49.2	59.7	10.5	Complied
0.474	Live	40.2	56.4	16.2	Complied
0.582	Live	38.3	56.0	17.7	Complied
1.068	Live	38.9	56.0	17.1	Complied
1.158	Live	38.3	56.0	17.7	Complied
1.801	Live	38.3	56.0	17.7	Complied
1.851	Live	38.3	56.0	17.7	Complied
1.860	Live	38.2	56.0	17.8	Complied
1.882	Live	38.0	56.0	18.0	Complied
2.571	Live	37.7	56.0	18.3	Complied

Results: Live / Average

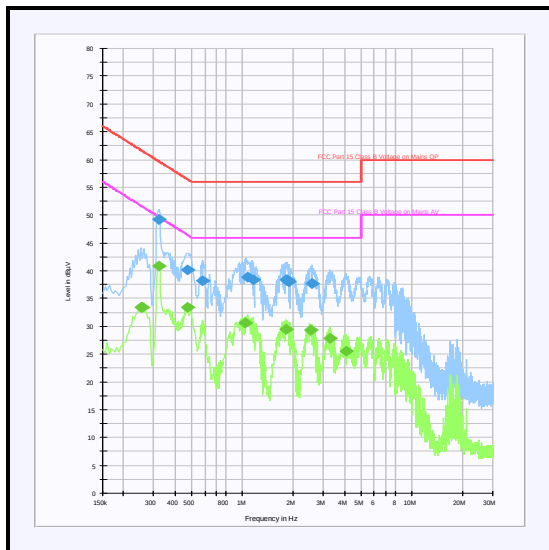
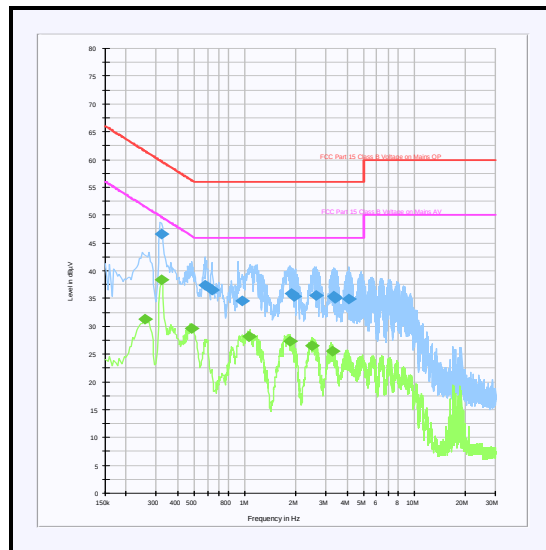
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.253	Live	33.4	51.6	18.2	Complied
0.258	Live	33.4	51.5	18.1	Complied
0.321	Live	40.9	49.7	8.8	Complied
0.478	Live	33.5	46.4	12.9	Complied
1.045	Live	30.7	46.0	15.3	Complied
1.806	Live	29.4	46.0	16.6	Complied
2.512	Live	29.3	46.0	16.7	Complied
3.277	Live	27.8	46.0	18.2	Complied
4.074	Live	25.6	46.0	20.4	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak**

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.321	Neutral	46.5	59.7	13.2	Complied
0.586	Neutral	37.3	56.0	18.7	Complied
0.640	Neutral	36.5	56.0	19.5	Complied
1.887	Neutral	35.9	56.0	20.1	Complied
2.638	Neutral	35.6	56.0	20.4	Complied
3.372	Neutral	35.4	56.0	20.6	Complied

Results: Neutral / Average

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.258	Neutral	31.2	51.5	20.3	Complied
0.321	Neutral	38.4	49.7	11.3	Complied
0.487	Neutral	29.6	46.2	16.6	Complied
1.063	Neutral	28.2	46.0	17.8	Complied
1.837	Neutral	27.3	46.0	18.7	Complied
2.494	Neutral	26.6	46.0	19.4	Complied
3.277	Neutral	25.6	46.0	20.4	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Live****Neutral**

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

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	14 May 2014	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	19 Feb 2014	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	14 Oct 2014	12

5.2.2. Transmitter Minimum 6 dB Bandwidth**Test Summary:**

Test Engineer:	David Doyle	Test Date:	27 February 2014
MAC Address:	240A546D213		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	As detailed in FCC KDB 558074 Section 8.1 Option 1

Environmental Conditions:

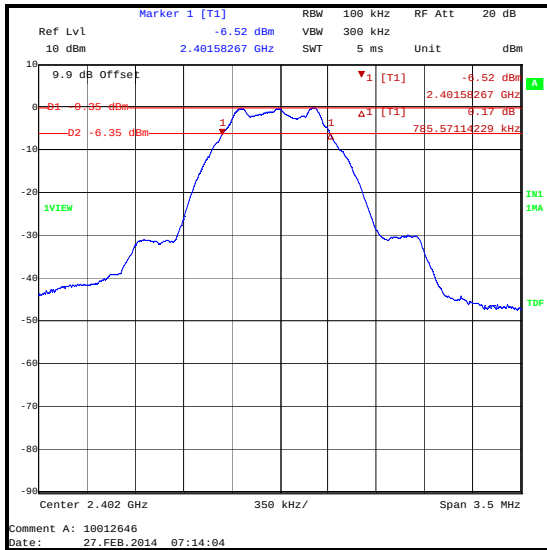
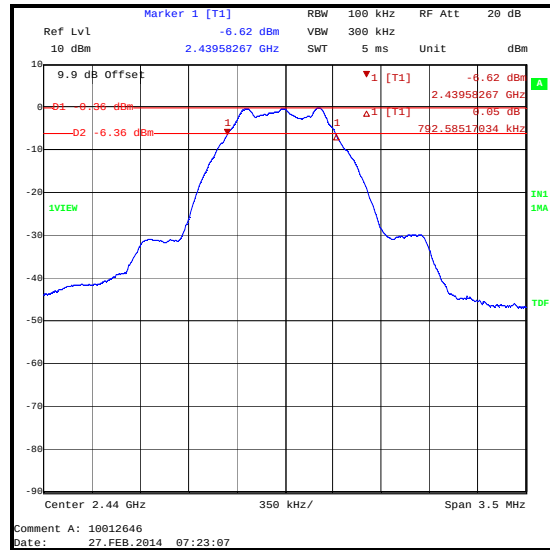
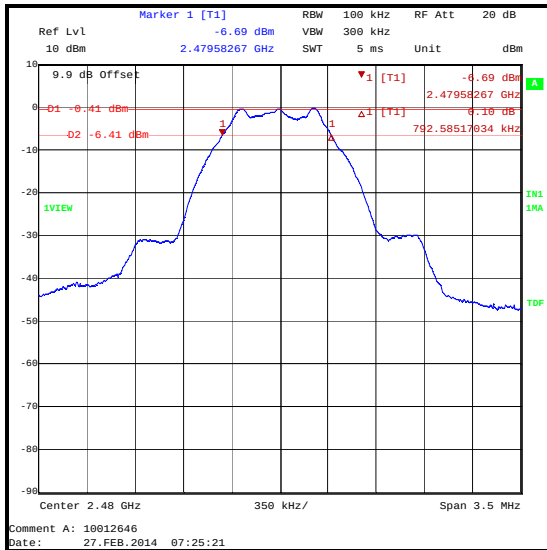
Temperature (°C):	24
Relative Humidity (%):	36

Note(s):

1. Transmitter minimum 6 dB bandwidth tests were performed using a test receiver in accordance with FCC KDB 558074 Section 8.1 Option 1 measurement procedure. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

Results:

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	785.571	≥500	285.571	Complied
Middle	792.585	≥500	292.585	Complied
Top	792.585	≥500	292.585	Complied

Transmitter Minimum 6 dB Bandwidth (continued)**Results:****Bottom Channel****Middle Channel****Top Channel****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
A2141	Attenuator	AtlanTecRF	AN18-10	090918-04	10 May 2014	12
M1379	Test Receiver	Rohde & Schwarz	ESIB7	100330	02 Dec 2014	12

5.2.3. Transmitter Maximum Peak Output Power**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	23 January 2014
MAC Address:	240A546D213		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	As detailed in FCC KDB 558074 Section 9.1.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	36

Note(s):

1. Conducted power tests were performed using a test receiver in accordance with FCC KDB 558074 Section 9.1.1 measurement procedure method $RBW \geq DTS \text{ Bandwidth}$. The resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. A peak detector was used, sweep time set to auto and trace mode was Max Hold. The span was set to greater than 3 times the resolution bandwidth.
2. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the test receiver to compensate for the loss of the attenuator and RF cable.

Transmitter Maximum Peak Output Power (continued)**Results:**

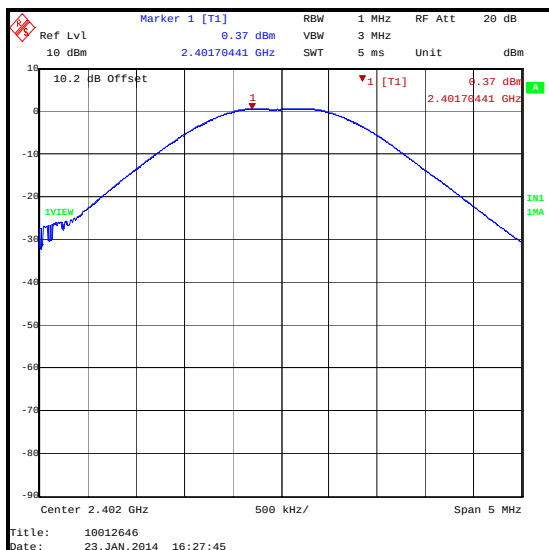
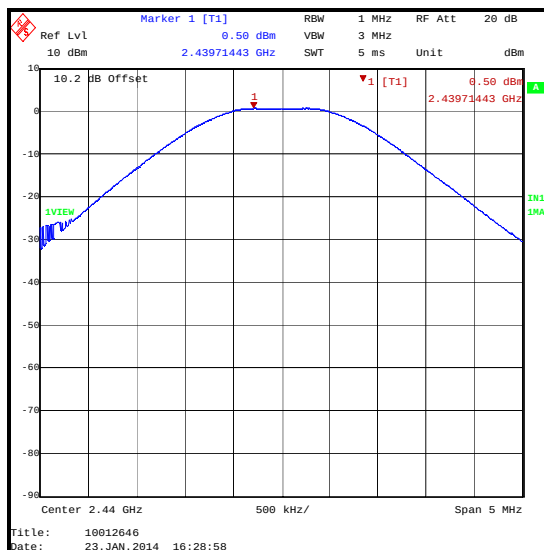
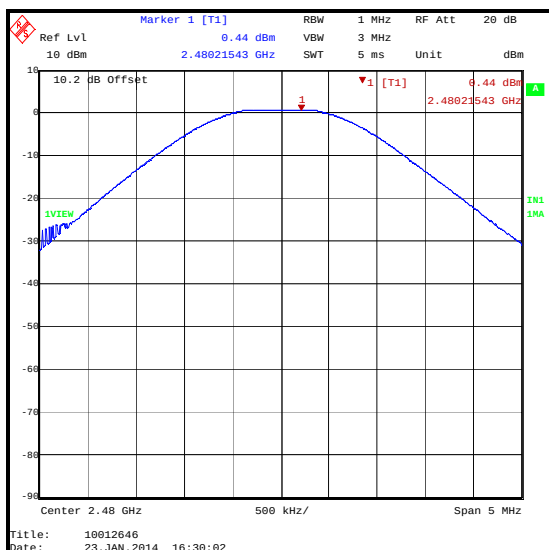
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	0.4	30.0	29.6	Complied
Middle	0.5	30.0	29.5	Complied
Top	0.4	30.0	29.6	Complied

De Facto EIRP Limit Comparison – UAM Antenna

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	0.4	3.0	3.4	36.0	32.6	Complied
Middle	0.5	3.0	3.5	36.0	32.5	Complied
Top	0.4	3.0	3.4	36.0	32.6	Complied

De Facto EIRP Limit Comparison – V100 Antenna

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	0.4	0.3	0.7	36.0	35.3	Complied
Middle	0.5	0.3	0.8	36.0	35.2	Complied
Top	0.4	0.3	0.7	36.0	35.3	Complied

Transmitter Maximum Peak Output Power (continued)**Bottom Channel****Middle Channel****Top Channel****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
A2141	Attenuator	AtlanTecRF	AN18-10	090918-04	10 May 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12

5.2.4. Transmitter Radiated Emissions – UAM Antenna**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	24 January 2014 &
MAC Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

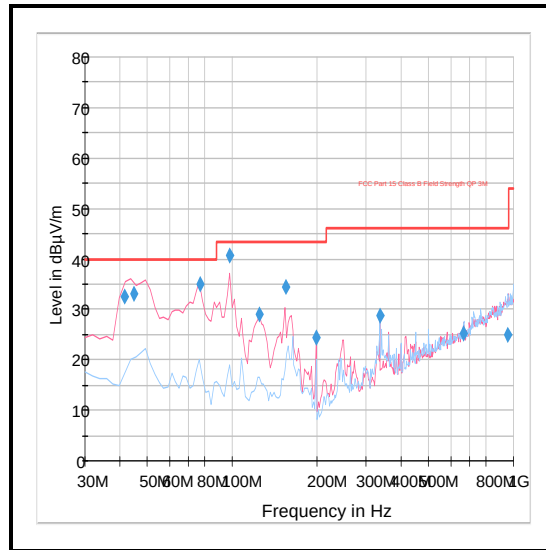
Temperature (°C):	20
Relative Humidity (%):	37

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. 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.
3. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (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.

Results: Top Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
125.005	Vertical	29.0	43.5	14.5	Complied

Transmitter Radiated Emissions – UAM Antenna (continued)

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

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	15 Feb 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12

Transmitter Radiated Emissions – UAM Antenna (continued)**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	31 January 2014
Mac Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

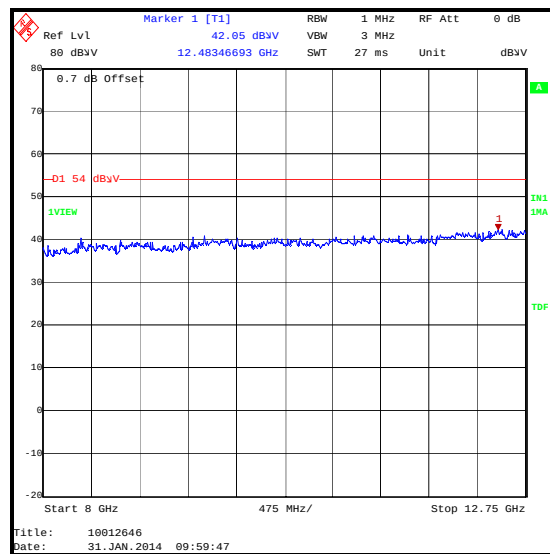
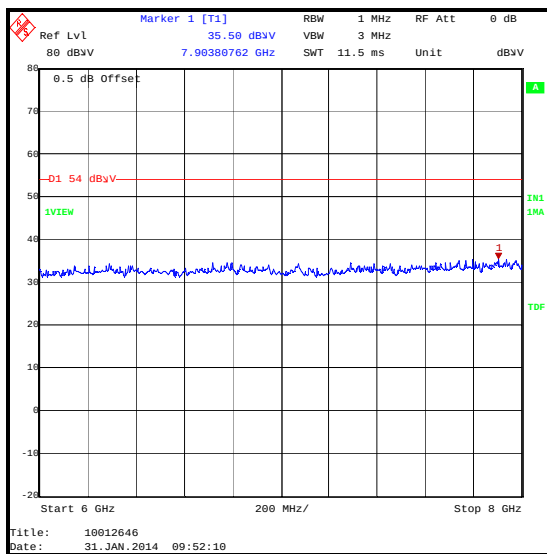
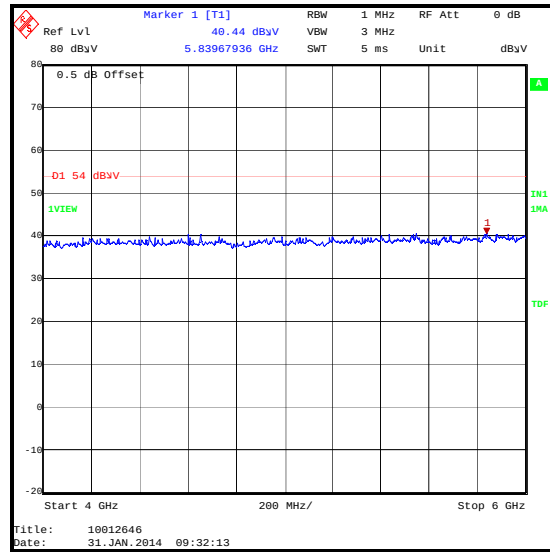
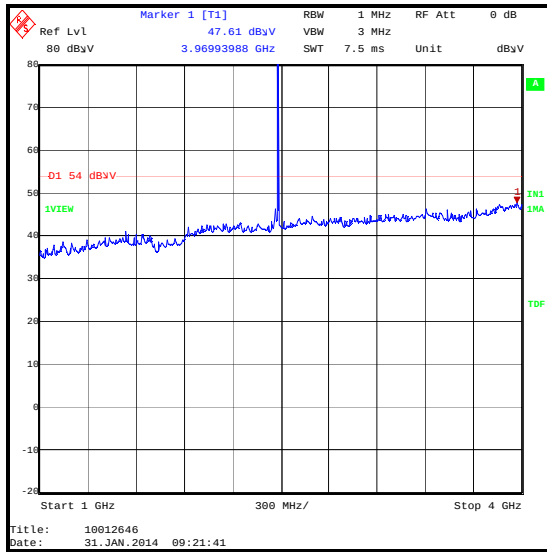
Temperature (°C):	22
Relative Humidity (%):	33

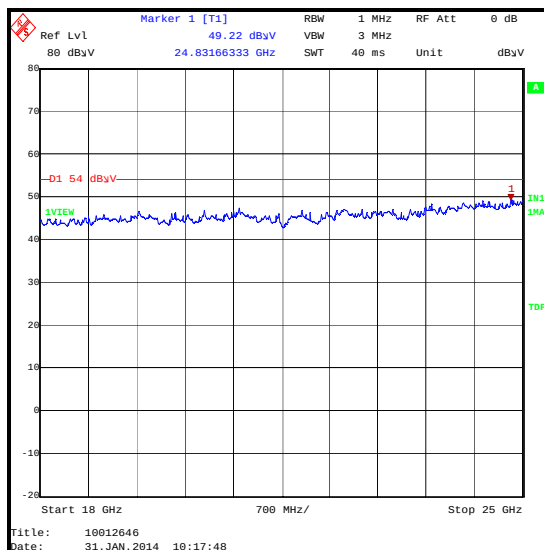
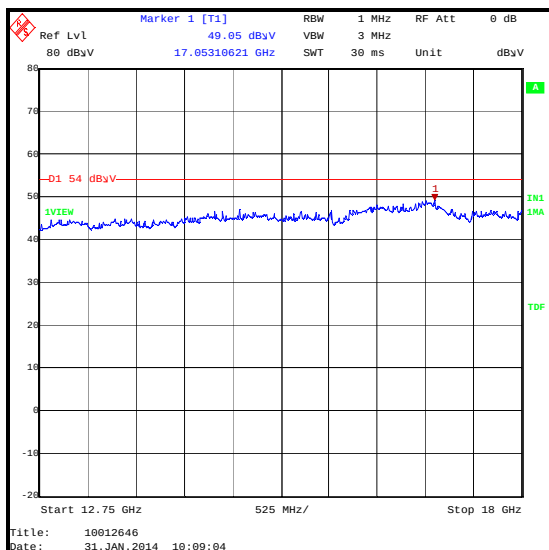
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. Pre-scans above 1 GHz were performed in a fully anechoic chamber (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 (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.

Results:

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
24831.663	Horizontal	49.2	54.0	4.8	Complied

Transmitter Radiated Emissions – UAM Antenna (continued)

Transmitter Radiated Emissions – UAM Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann	16240-20	519	14 Nov 2014	12
A256	Antenna	Flann	18240-20	400	14 Nov 2014	12
A436	Antenna	Flann	20240-20	330	14 Nov 2014	12
A1975	High pass filter	AtlanTecRF	AFH-03000	090424010	19 Apr 2014	12

5.2.5. Transmitter Radiated Emissions – V100 Antenna**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	27 January 2014
MAC Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

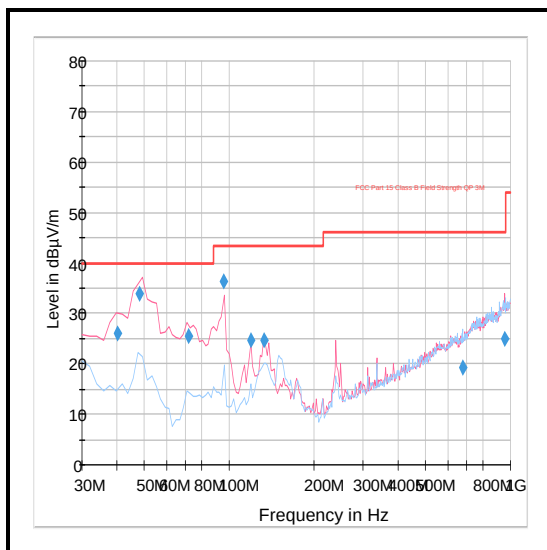
Temperature (°C):	18
Relative Humidity (%):	39

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. 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.
3. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (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.

Results: Top Channel

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
119.972	Vertical	24.6	43.5	18.9	Complied
133.329	Vertical	24.6	43.5	18.9	Complied

Transmitter Radiated Emissions – V100 Antenna (continued)

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

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	15 Feb 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12

Transmitter Radiated Emissions – V100 Antenna (continued)**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	31 January 2014
Mac Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

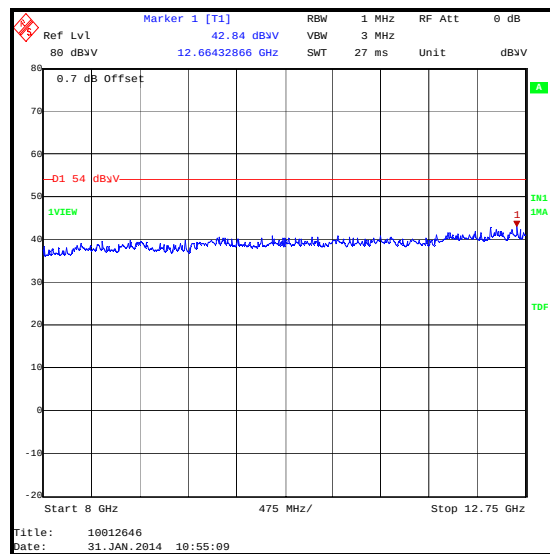
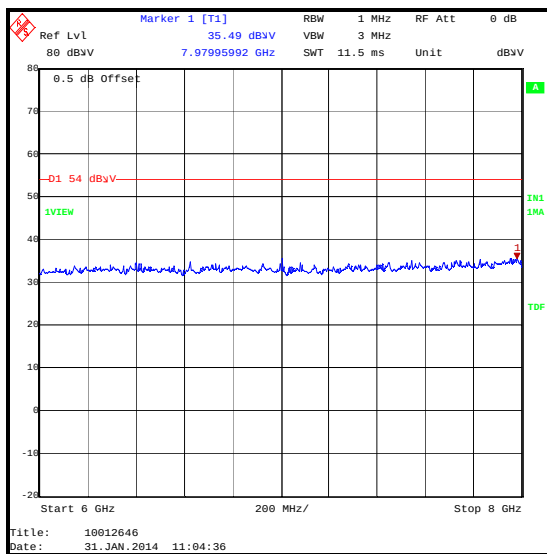
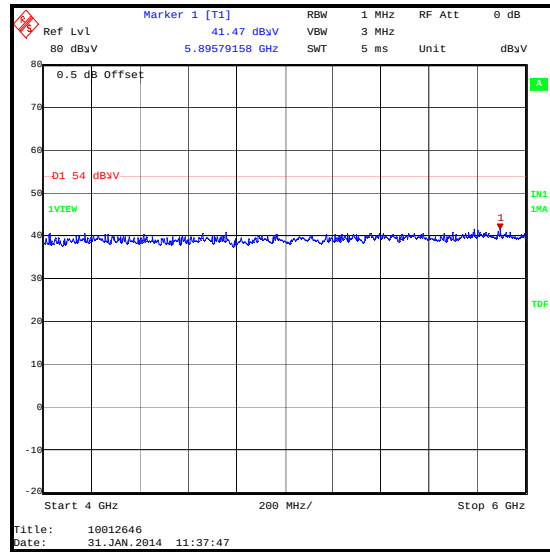
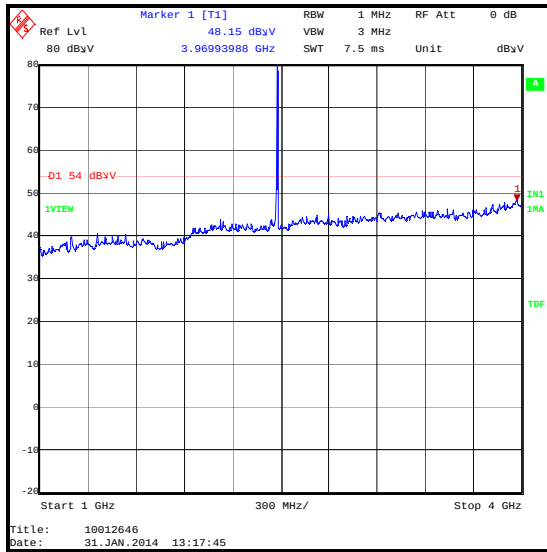
Temperature (°C):	22
Relative Humidity (%):	33

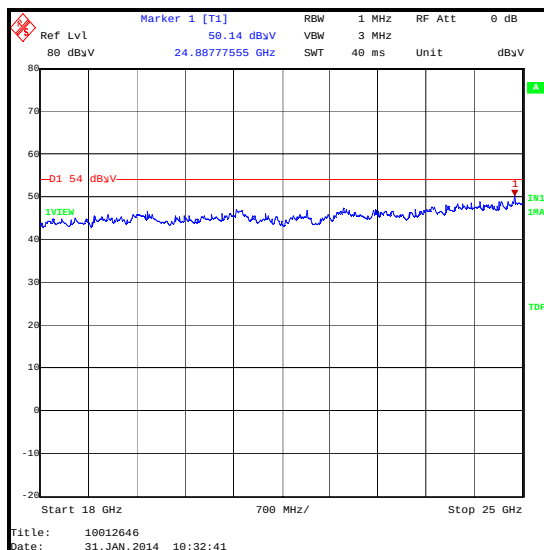
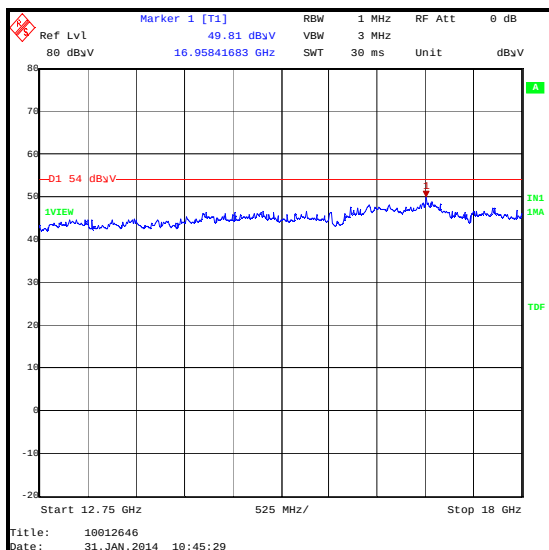
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
3. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. Pre-scans above 1 GHz were performed in a fully anechoic chamber (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 (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.

Results:

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
24887.776	Horizontal	50.1	54.0	3.9	Complied

Transmitter Radiated Emissions – V100 Antenna (continued)

Transmitter Radiated Emissions – V100 Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann	16240-20	519	14 Nov 2014	12
A256	Antenna	Flann	18240-20	400	14 Nov 2014	12
A436	Antenna	Flann	20240-20	330	14 Nov 2014	12
A1975	High pass filter	AtlanTecRF	AFH-03000	090424010	19 Apr 2014	12

5.2.6. Transmitter Band Edge Radiated Emissions – UAM Antenna**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	31 January 2014
MAC Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in FCC KDB 558074 Section 13.0 referencing ANSI C63.10 Section 6.9.2

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	33

Note(s):

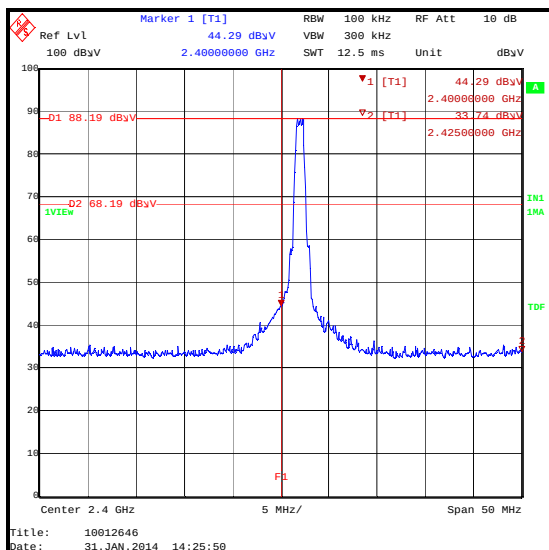
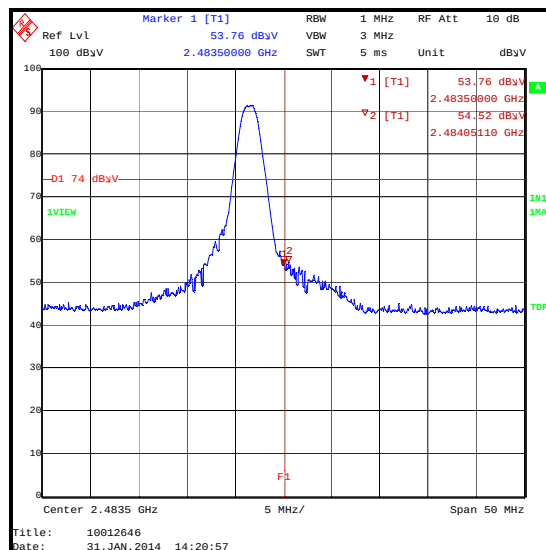
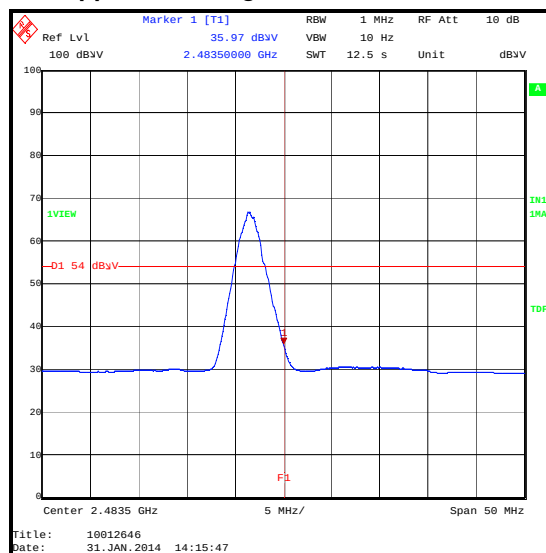
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. For the lower band edge measurements: As the lower band edge falls within the non-restricted band only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted output power was measured using a peak detector in accordance with FCC KDB 558074 Section 9.1.1 an out-of-band limit line was placed 20 dB below the peak level (FCC KDB 558074 Section 11.1(a)). A marker was placed on the band edge spot frequency. Marker frequency and level was recorded.
3. For the upper band edge measurements: As the upper band edge falls within restricted band both peak and average measurements were recorded by placing a marker at the edge of the band (2483.5 MHz). In accordance with FCC KDB 558074 Section 12.1, the test method in ANSI C63.10 Section 6.9.2 was followed: for peak measurements the test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and video bandwidth 10 Hz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
4. * -20 dBc limit.

Transmitter Band Edge Radiated Emissions – UAM Antenna (continued)**Results: Peak**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400.0	44.3	68.2*	23.9	Complied
2483.5	53.8	74.0	20.2	Complied
2484.051	54.5	74.0	19.5	Complied

Results: Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	36.0	54.0	18.0	Complied

Transmitter Band Edge Radiated Emissions – UAM Antenna (continued)**Lower Band Edge Peak Measurement****Upper Band Edge Peak Measurement****Upper Band Edge Average Measurement****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12

5.2.7. Transmitter Band Edge Radiated Emissions – V100 Antenna**Test Summary:**

Test Engineer:	Mark Percival	Test Date:	31 January 2014
MAC Address:	240A546D213		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	As detailed in FCC KDB 558074 Section 13.0 referencing ANSI C63.10 Section 6.9.2

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	33

Note(s):

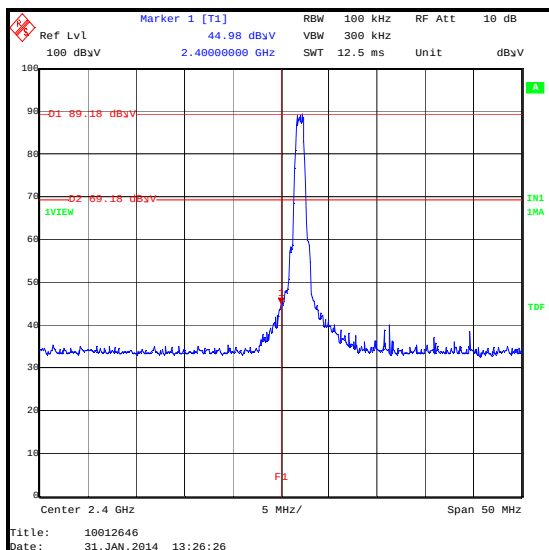
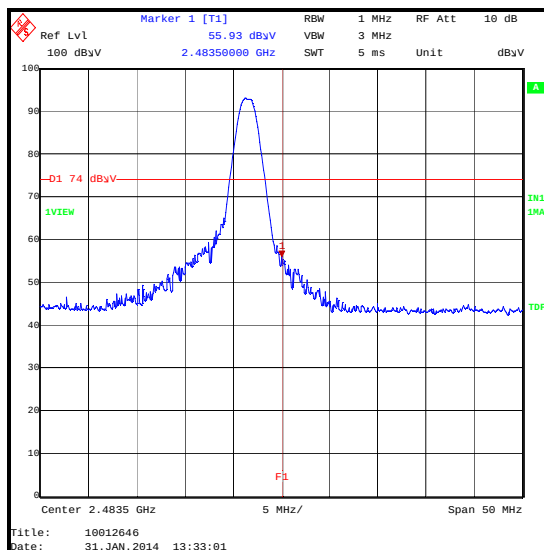
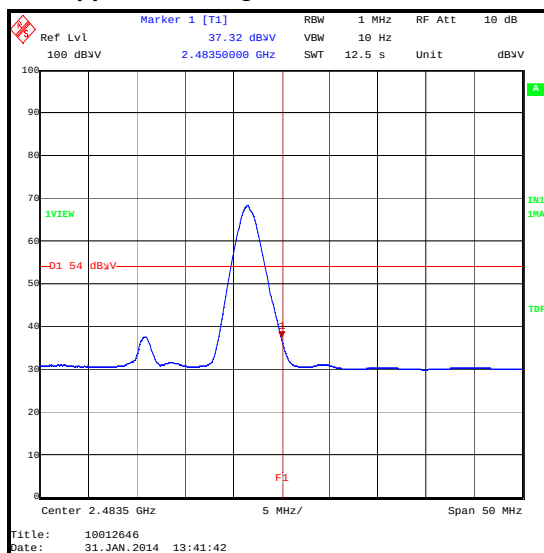
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. For the lower band edge measurements: As the lower band edge falls within the non-restricted band only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted output power was measured using a peak detector in accordance with FCC KDB 558074 Section 9.1.1 an out-of-band limit line was placed 20 dB below the peak level (FCC KDB 558074 Section 11.1(a)). A marker was placed on the band edge spot frequency. Marker frequency and level was recorded.
3. For the upper band edge measurements: As the upper band edge falls within restricted band both peak and average measurements were recorded by placing a marker at the edge of the band (2483.5 MHz). In accordance with FCC KDB 558074 Section 12.1, the test method in ANSI C63.10 Section 6.9.2 was followed: for peak measurements the test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and video bandwidth 10 Hz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker was placed on the band edge spot frequency. Marker frequency and level was recorded.
4. * -20 dBc limit.

Transmitter Band Edge Radiated Emissions – V100 Antenna (continued)**Results: Peak**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400.0	45.0	69.2*	24.2	Complied
2483.5	55.9	74.0	18.1	Complied

Results: Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	37.3	54.0	16.7	Complied

Transmitter Band Edge Radiated Emissions – V100 Antenna (continued)**Lower Band Edge Peak Measurement****Upper Band Edge Peak Measurement****Upper Band Edge Average Measurement****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12

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 measured (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
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Conducted Maximum Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 25 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.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	-	-	Model number updated
3.0	-	-	Updated KDB References