

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 15.247(d), 15.209(a) & Industry Canada RSS-210 A8.5
and RSS-Gen 4.9

Test Report Serial No.:
RFI-RPT-RP84552JD02E V2.0

Version 2.0 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: | 47CFR15.247 |
| Specification Title: | Code of Federal Regulations Volume 47 (Telecommunications) 2011: Part 15 Subpart C (Intentional Radiators) - Section 15.247 |
| 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: | 24 February 2012 to 26 February 2012 |

2.2. Summary of Test Results

| FCC Reference (47CFR) | IC Reference | Measurement | Result |
|---|-----------------------------|--------------------------------|---|
| Part 15.247(d)/ 15.209(a) | RSS-Gen 4.9 RSS-210 A8.5 | Transmitter 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 558074 D01 v01 1/18/2012 |
| Title: | Guidance for Performing Compliance Measurements on Digital Transmission System (DTS) devices operating under §15.247 |
| 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 and one receive, 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 | | |
| Data Rate: | 13 Mbps | | |
| Power Supply Requirement(s): | Nominal | 120 VAC 60 Hz | |
| Transmit & Receive Frequency Band: | 5745 MHz to 5825 MHz | | |
| Transmit Channels Tested: | Channel ID | Channel Number | Channel Frequency (MHz) |
| | Bottom | 149 | 5745 |
| | Middle | 157 | 5785 |
| | Top | 165 | 5825 |

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 at maximum power on the bottom, centre and top channels as required using the supported data rates.

4.2. Configuration and Peripherals

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

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 radiated 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 with a channel bandwidth of 20 MHz. Initial measurements were carried out on one channel and this was found to have the highest power level and therefore deemed to be 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 Radiated Emissions

Test Summary:

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

| | |
|-----------------------------------|---|
| FCC Reference: | Parts 15.247(d) & 15.209(a) |
| Industry Canada Reference: | RSS-Gen 4.9 & RSS-210 A8.5 |
| Test Method Used: | FCC KDB 558074 D01 Section 5.4 & ANSI C63.10 Sections 6.3 and 6.5 |
| Frequency Range | 30 MHz to 1000 MHz |

Environmental Conditions:

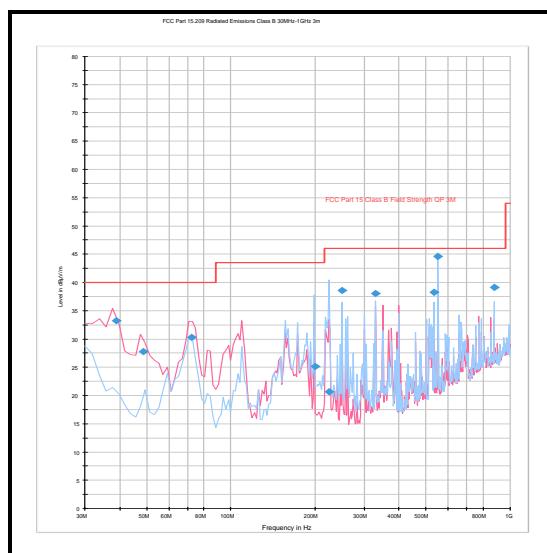
| | |
|-------------------------------|----|
| Temperature (°C): | 24 |
| Relative Humidity (%): | 26 |

Note(s):

1. The final measured value for the given emissions in the result table 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 (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 Radiated Emissions (continued)**Results: 13 Mbps / 20 MHz**

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 250.001 | Horizontal | 38.6 | 46.0 | 7.4 | Complied |
| 330.008 | Horizontal | 38.0 | 46.0 | 8.0 | Complied |



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

Transmitter Radiated Emissions (continued)**Test Summary:**

| | | | |
|-------------------------------|------------------------------|-------------------|-------------------------------------|
| Test Engineer: | Andrew Edwards & Nick Steele | Test Date: | 25 February 2012 & 26 February 2012 |
| Test Sample Serial No: | 22586321 | | |

| | |
|-----------------------------------|---|
| FCC Reference: | Parts 15.247(d) & 15.209(a) |
| Industry Canada Reference: | RSS-Gen 4.9 & RSS-210 A8.5 |
| Test Method Used: | FCC KDB 558074 D01 Section 5.4 & ANSI C63.10 Sections 6.3 and 6.6 |
| Frequency Range | 1 GHz to 40 GHz |

Environmental Conditions:

| | |
|-------------------------------|----|
| Temperature (°C): | 22 |
| Relative Humidity (%): | 24 |

Note(s):

1. The final measured value for the given emissions in the result tables incorporates the calibrated antenna factor and cable loss.
2. The emission shown at approximately 5825 MHz on the 4 GHz to 6 GHz plot is the EUT fundamental.
3. 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.
4. 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 Radiated Emissions (continued)**Results: Peak Bottom Channel**

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4595.807 | Vertical | 46.7 | 74.0 | 27.3 | Complied |
| 11496.507 | Horizontal | 43.1 | 74.0 | 30.9 | Complied |

Results: Average Bottom Channel

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4595.951 | Vertical | 44.4 | 54.0 | 9.6 | Complied |
| 11496.507 | Horizontal | 29.7 | 54.0 | 24.3 | Complied |

Results: Peak Middle Channel

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4627.989 | Vertical | 48.5 | 74.0 | 25.5 | Complied |
| 11571.524 | Horizontal | 42.8 | 74.0 | 31.2 | Complied |

Results: Average Middle Channel

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4627.917 | Vertical | 46.1 | 54.0 | 7.9 | Complied |
| 11571.524 | Horizontal | 29.3 | 54.0 | 24.7 | Complied |

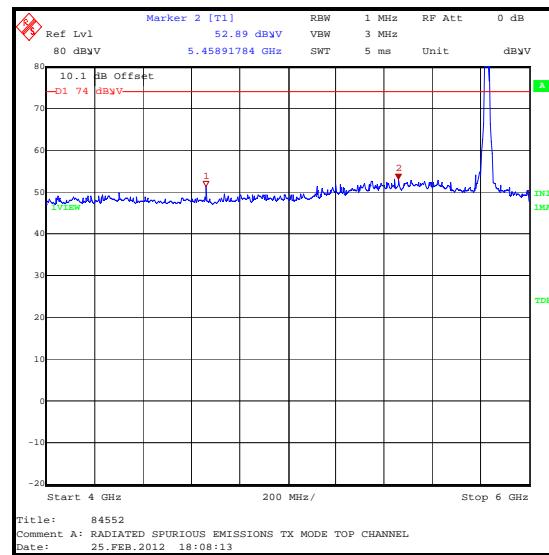
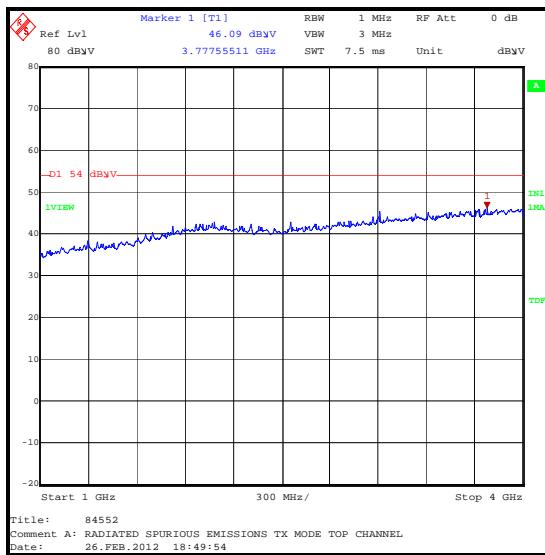
Results: Peak Top Channel

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4660.033 | Vertical | 46.3 | 74.0 | 27.7 | Complied |
| 11648.910 | Horizontal | 46.3 | 74.0 | 27.7 | Complied |

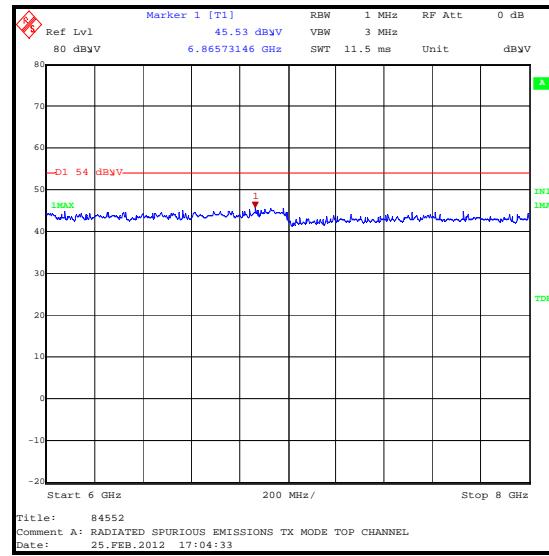
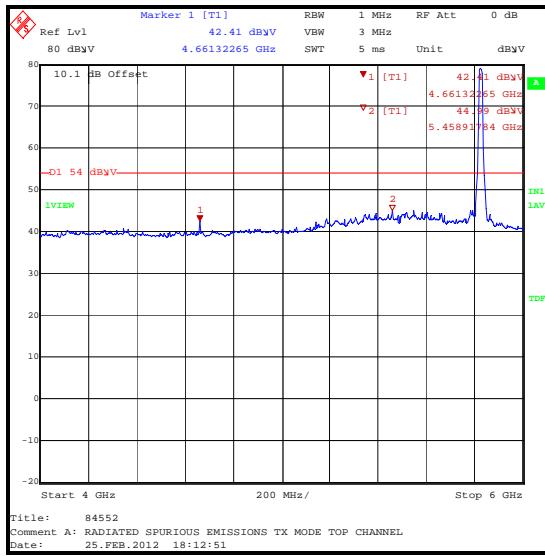
Results: Average Top Channel

| Frequency (MHz) | Antenna Polarity | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Result |
|-----------------|------------------|----------------------|----------------------|-------------|----------|
| 4659.895 | Vertical | 48.3 | 54.0 | 5.7 | Complied |
| 11648.910 | Horizontal | 33.7 | 54.0 | 20.3 | Complied |

Transmitter Radiated Emissions (continued)

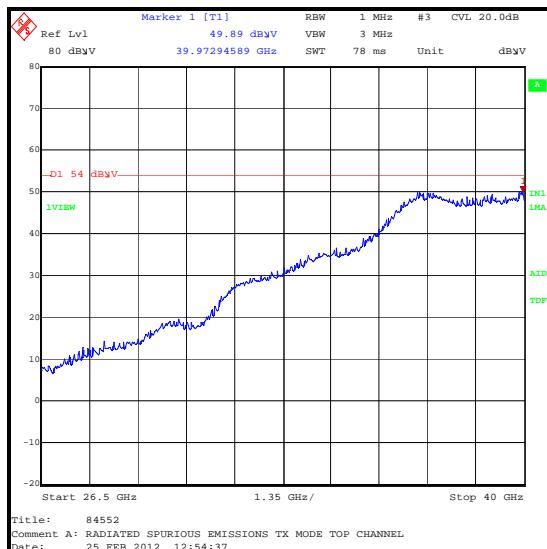
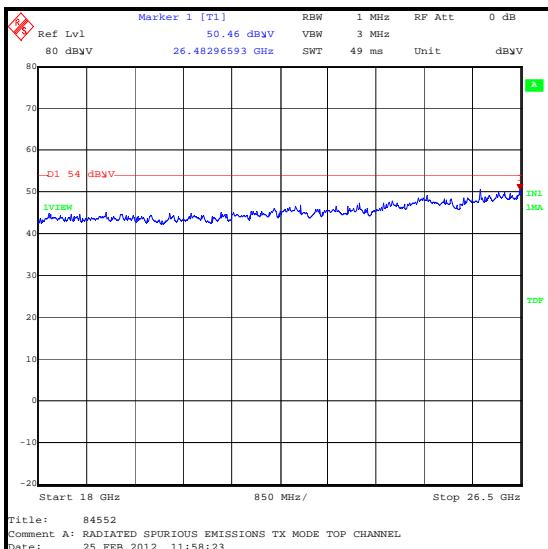
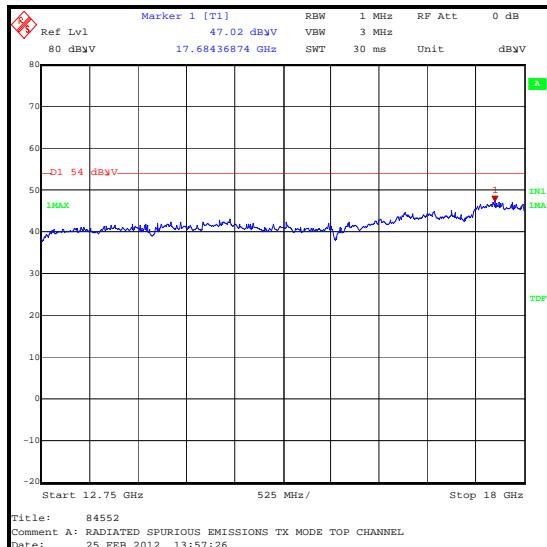
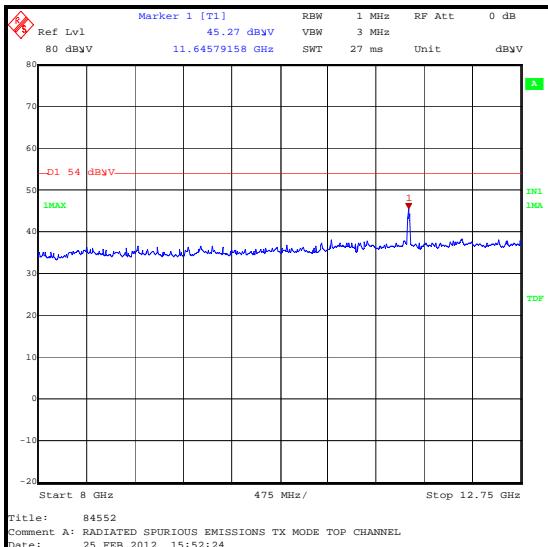


Peak Detector



Average Detector

Transmitter Radiated Emissions (continued)



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

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 |
| A1818 | Antenna | EMCO | 3115 | 00075692 | 09 Oct 2012 | 12 |
| A1834 | Attenuator | Hewlett Packard | 8491B | 10444 | 29 Jan 2013 | 12 |
| A202 | Antenna | Flann Microwave | 24240-20 | 116 | 11 May 2013 | 36 |
| 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 |
| A436 | Antenna | Flann | 20240-20 | 330 | 09 Oct 2012 | 12 |
| A553 | Antenna | Chase | CBL6111A | 1593 | 15 Feb 2013 | 12 |
| G085 | Signal Generator | Hewlett Packard | 83650L | 3614A00104 | 09 Nov 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 |
| M1273 | Test Receiver | Rohde & Schwarz | ESIB26 | 100275 | 03 Feb 2013 | 12 |
| M1390 | Harmonic Mixer | Farran Technology | WHMP 28 | FTL1677B | Calibrated Before Use | - |

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