

# TEST REPORT FROM RFI GLOBAL SERVICES LTD

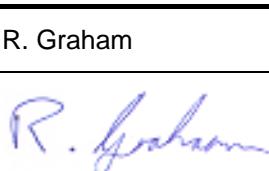
Test of: Modular Ubitag V2.0HH

To: FCC Part 15.249: 2008 Subpart C, RSS-210 Issue 7 June 2007  
& RSS-Gen Issue 2 June 2007

**Test Report Serial No:**  
RFI/RPT1/RP75860JD08B

**This Test Report Is Issued Under The Authority  
Of Brian Watson, Operations Director:**

A handwritten signature in blue ink that reads "R. Graham".

<b>Checked By:</b>	R. Graham
<b>Signature:</b>	 A handwritten signature in blue ink that reads "R. Graham".
<b>Date of Issue:</b>	27 November 2009

This report is issued in Adobe Acrobat portable document format (PDF). It is only a valid copy of the report if it is being viewed in PDF format with the following security options not allowed: Changing the document, Selecting text and graphics, Adding or changing notes and form fields.

This report may not be reproduced other than in full, except with the prior written approval of RFI Global Services Ltd. The results in this report apply only to the sample(s) tested.

This page has been left intentionally blank.

**Table of Contents**

1. Customer Information .....	4
2. Summary of Testing .....	5
3. Equipment Under Test (EUT) .....	7
4. Operation and Monitoring of the EUT during Testing .....	9
5. Measurements, Examinations and Derived Results .....	10
6. Measurement Uncertainty .....	26
Appendix 1. Test Equipment Used.....	27

## **1. Customer Information**

<b>Company Name:</b>	Ubisense Ltd.
<b>Address:</b>	St Andrew's House St Andrew's Road Chesterton, Cambridge Cambridgeshire CB4 1DL United Kingdom

## 2. Summary of Testing

### 2.1. General Information

<b>Specification Reference:</b>	47CFR15.249
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2008: Part 15 Subpart C (Radio Frequency Devices) - Section 15.249
<b>Specification Reference:</b>	RSS-210 Issue 7 June 2007
<b>Specification Title:</b>	Low-power Licence-exempt Radio communication Devices (All Frequency Bands): Category I Equipment.
<b>Specification Reference:</b>	RSS-GEN Issue 2 June 2007
<b>Specification Title:</b>	General Requirements and Information for the Certification of Radio communication Equipment
<b>Site Registration:</b>	FCC: 209735; Industry Canada: 3245B-2
<b>Location of Testing:</b>	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	14 September to 09 November 2009

### 2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Port Type	Result
Part 15.107	RSS-Gen 7.2.2	Idle Mode AC Conducted Emissions	AC Mains	✓
Part 15.109	RSS-Gen 4.10 RSS-Gen 6.0	Receiver/Idle Mode Radiated Spurious Emissions	Antenna	✓
Part 15.207	RSS-Gen 7.2.2	Transmitter AC Conducted Emissions	AC Mains	✓
Part 15.249(a)	RSS-Gen 4.8 RSS-210 A2.9	Transmitter Fundamental Field Strength	Antenna	✓
Part 2.1049	RSS-Gen 4.6.1	Transmitter 20 dB Bandwidth	Antenna	✓
Part 15.249(a)(d)(e) & 15.209	RSS-Gen 4.9 RSS-210 A2.9	Transmitter Radiated Spurious Emissions	Antenna	✓
Part 15.249(d) & 15.209	RSS-Gen 4.9 RSS-210 A2.9	Transmitter Band Edge Radiated Emissions	Antenna	✓
<b>Key to Results</b>				
✓	= Complied	✗	= Did not comply	

### **2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.4 (2003)
<b>Title:</b>	American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

### **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)**

<b>Brand Name:</b>	Ubisense
<b>Model Name or Number:</b>	Modular Ubitag V2.0HH
<b>Serial Number:</b>	2
<b>FCC ID Number:</b>	SEAMOD21HH
<b>Industry Canada Certification Number:</b>	8673A-MOD21HH

#### **3.2. Description of EUT**

The equipment under test was a location tag.

#### **3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

#### **3.4. Additional Information Related to Testing**

<b>Tested Technology:</b>	Short Range Device (SRD)	
<b>Type of Radio Device:</b>	Transceiver	
<b>Power Supply Requirement(s):</b>	Nominal	3.3 V DC
<b>Modulation Type:</b>	125 kbit/s MSK	
<b>Channel Spacing:</b>	Wideband	
<b>Transmit Frequency Range:</b>	2400 MHz to 2483.5 MHz	
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Bottom	2402.5
	Middle	2442.0
	Top	2480.5
<b>Receive Frequency Range:</b>	2400 MHz to 2483.5 MHz	
<b>Receive Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Bottom	2402.5
	Middle	2442.0
	Top	2480.5

### **3.5. Support Equipment**

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

<b>Description:</b>	Power Supply Unit
<b>Brand Name:</b>	Stontronics
<b>Model Name or Number:</b>	3A-061WP03
<b>Serial Number:</b>	T3915ST

## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

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

- Constantly transmitting on the top, centre or bottom channel.

### **4.2. Configuration and Peripherals**

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

- Powered from an AC/DC power supply.  
This power supply was connected to a 120 VAC 60 Hz source.

## **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. Idle Mode AC Conducted Spurious Emissions**

#### **Test Summary:**

<b>FCC Part:</b>	15.107
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 7 and relevant annexes

#### **Environmental Conditions:**

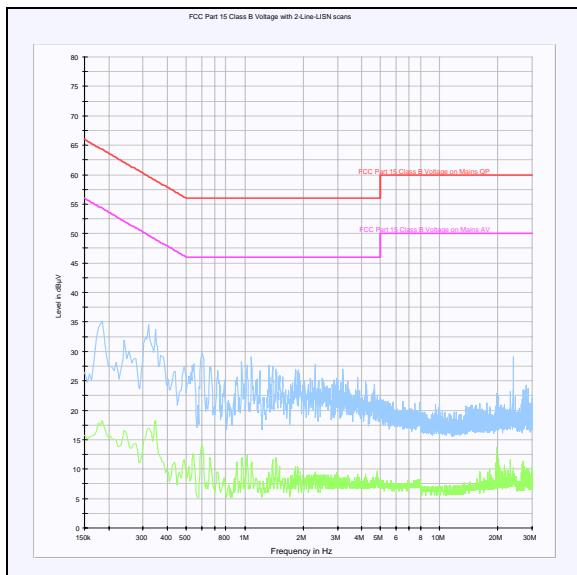
<b>Temperature (°C):</b>	27
<b>Relative Humidity (%):</b>	35

#### **Results:**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
Refer to Note 1					

#### **Note(s):**

1. All emissions were greater than 20 dB below the applicable limit.



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

**5.2.2. Receiver/Idle Mode Radiated Spurious Emissions****Test Summary:**

FCC Part:	15.109
Test Method Used:	As detailed in ANSI C63.4 Section 8 and relevant annexes
Frequency Range:	30 MHz to 1000 MHz

**Environmental Conditions:**

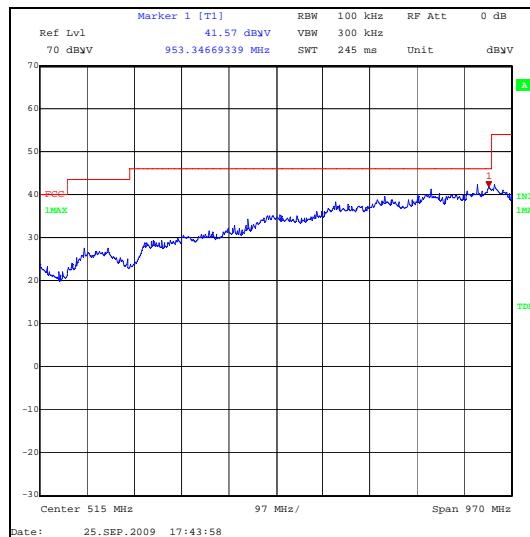
Temperature Range (°C):	25
Relative Humidity Range (%):	32

**Results:**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
Refer to Note 1					

**Note(s):**

1. All emissions were greater than 20 dB below the applicable limit.

**Receiver/Idle Mode Radiated Spurious Emissions (continued)**

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

**Receiver/Idle Mode Radiated Spurious Emissions (continued)****Test Summary:**

FCC Part:	15.109
Test Method Used:	As detailed in ANSI C63.4 Section 8 and relevant annexes
Frequency Range:	1000 MHz to 26.5 GHz

**Environmental Conditions:**

Temperature Range (°C):	25
Relative Humidity Range (%):	31

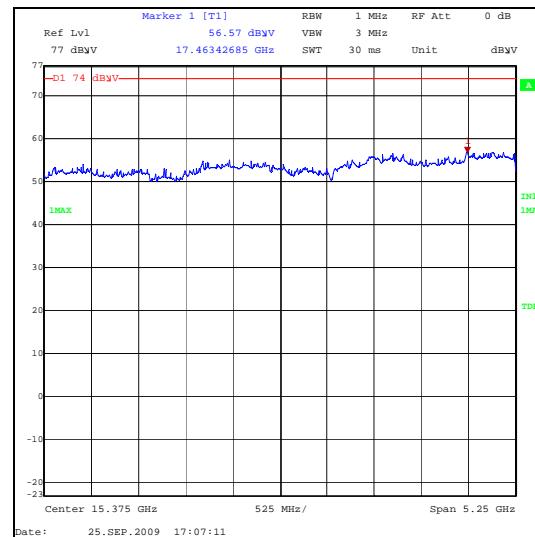
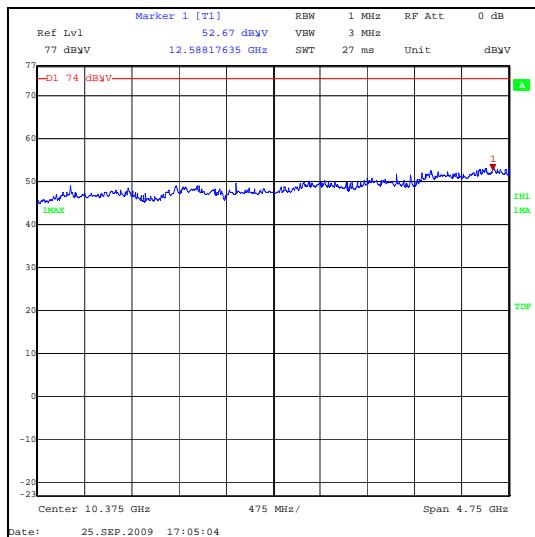
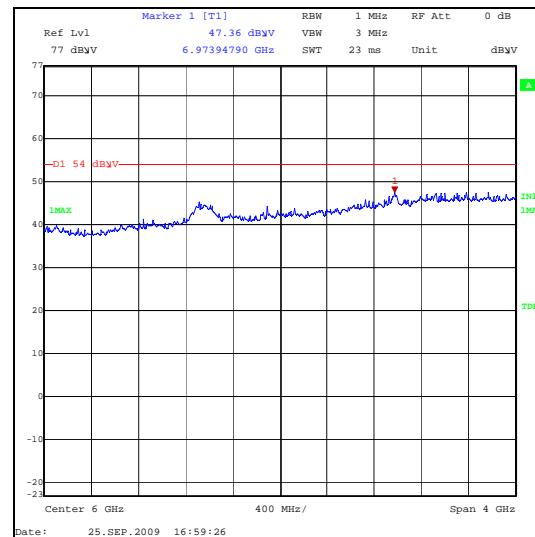
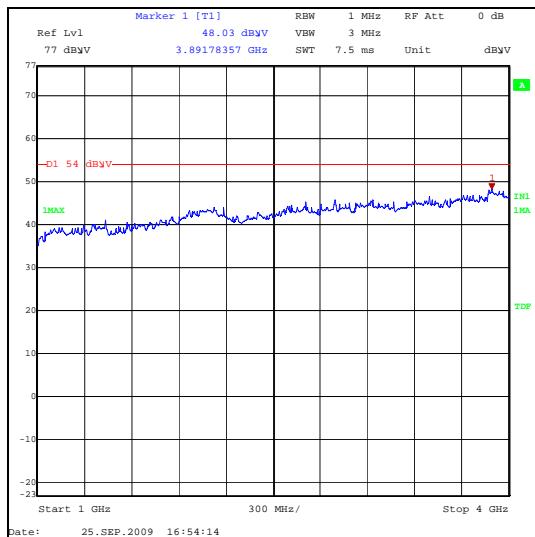
**Results:**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
Refer to Note 1					

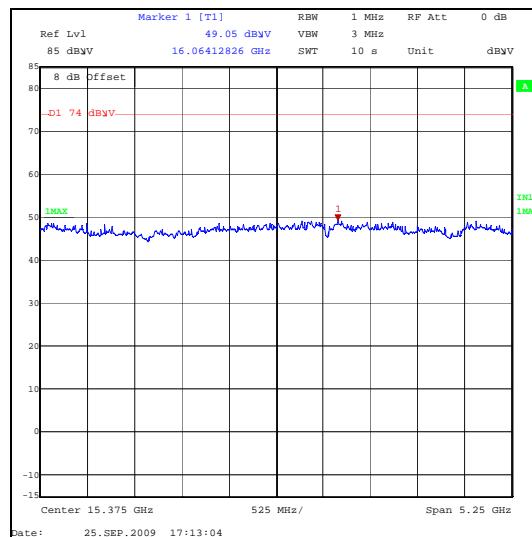
**Note(s):**

1. All emissions were greater than 20 dB below the applicable limit.

## Receiver/Idle Mode Radiated Spurious Emissions (continued)



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

**Receiver/Idle Mode Radiated Spurious Emissions (continued)**

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

### **5.2.3. Transmitter AC Conducted Spurious Emissions**

#### **Test Summary:**

<b>FCC Part:</b>	15.207
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 7 and relevant annexes

#### **Environmental Conditions:**

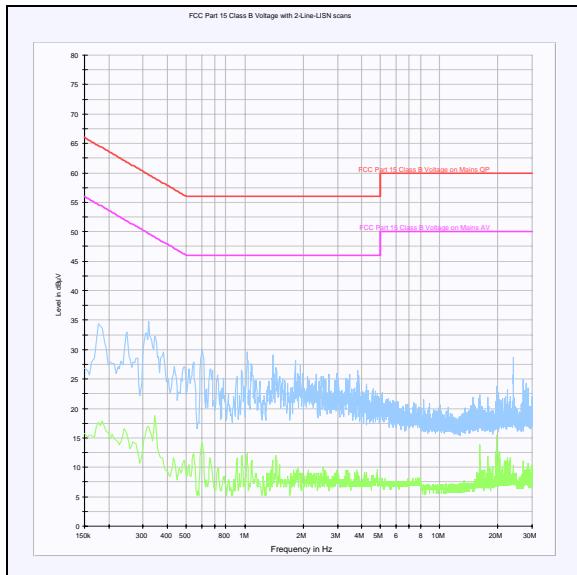
<b>Temperature (°C):</b>	27
<b>Relative Humidity (%):</b>	35

#### **Results:**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
Refer to Note 1					

#### **Note(s):**

1. All emissions were greater than 20 dB below the applicable limit.



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

**5.2.4. Transmitter Fundamental Field Strength****Test Summary:**

<b>FCC Part:</b>	15.249(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 8 and relevant annexes

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	37

**Results Bottom Channel: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2402.5	Horizontal	90.9	114.0	23.1	Complied

**Results Bottom Channel: Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2402.5	Horizontal	90.1	94.0	3.9	Complied

**Results Centre Channel: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2442.0	Horizontal	90.0	114.0	24.0	Complied

**Results Centre Channel: Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2442.0	Vertical	89.5	94.0	4.5	Complied

**Results Top Channel: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2480.5	Vertical	90.4	114.0	23.6	Complied

**Results Top Channel: Average**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2480.5	Vertical	90.2	94.0	3.8	Complied

**Note(s):**

1. Measurements were made with the test system antenna in the vertical and horizontal polarisation. The highest levels were recorded in the above tables.

**5.2.5. Transmitter 20 dB Bandwidth****Test Summary:**

<b>FCC Part:</b>	2.1049
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 13.1.7 and relevant annexes (see note below)

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	37

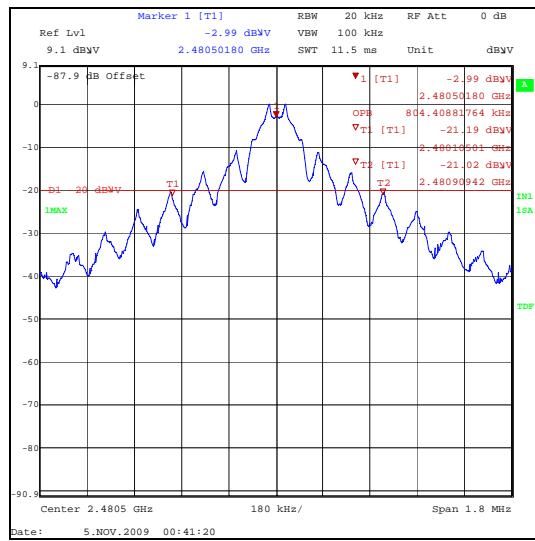
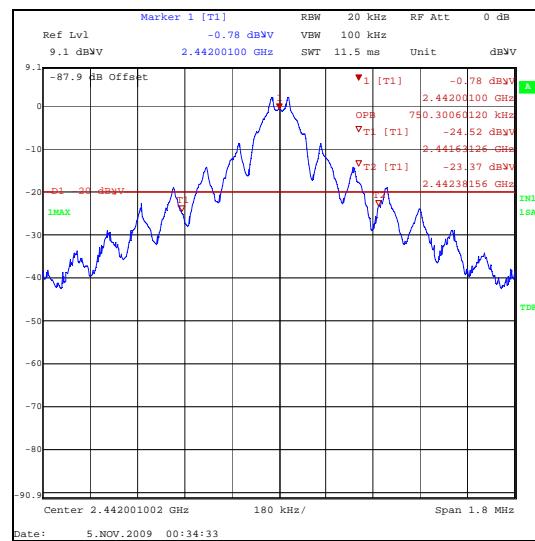
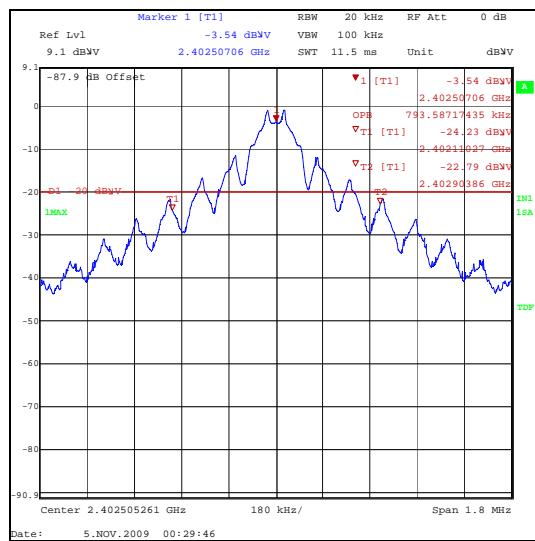
**Results:**

<b>Channel</b>	<b>20 dB Bandwidth (kHz)</b>
Bottom	0.793587
Middle	0.750300
Top	0.804409

**Note(s):**

1. In lieu of the test method detailed in ANSI C63.4 Section 13.1.7 the 99% occupied bandwidth was measured using the Occupied Bandwidth function of the spectrum analyser

## Transmitter 20 dB Bandwidth (continued)



**5.2.6. Transmitter Radiated Spurious Emissions****Test Summary:**

<b>FCC Part:</b>	15.249(a)(d)(e) & 15.209
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 8 and relevant annexes
<b>Frequency Range:</b>	30 MHz to 26.5 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	32

**Results Bottom Channel:**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
4804.490	Horizontal	33.6	54.0	20.4	Complied

**Results Middle Channel:**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
4884.050	Horizontal	36.5	54.0	17.5	Complied

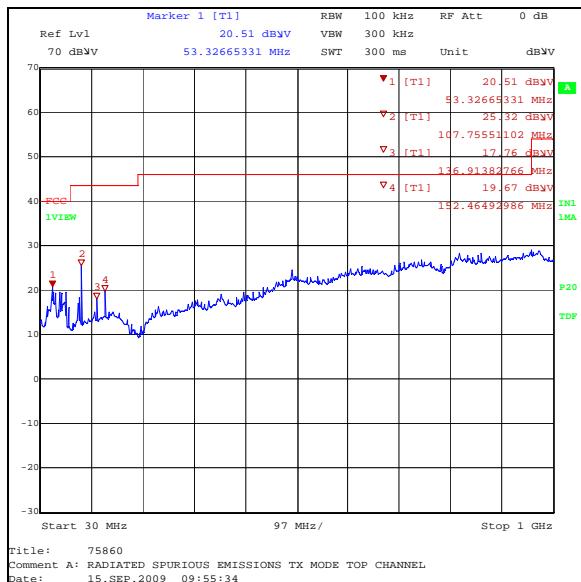
**Results Top Channel:**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dB<math>\mu</math>V/m)</b>	<b>Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
4960.982	Horizontal	36.5	54.0	17.5	Complied

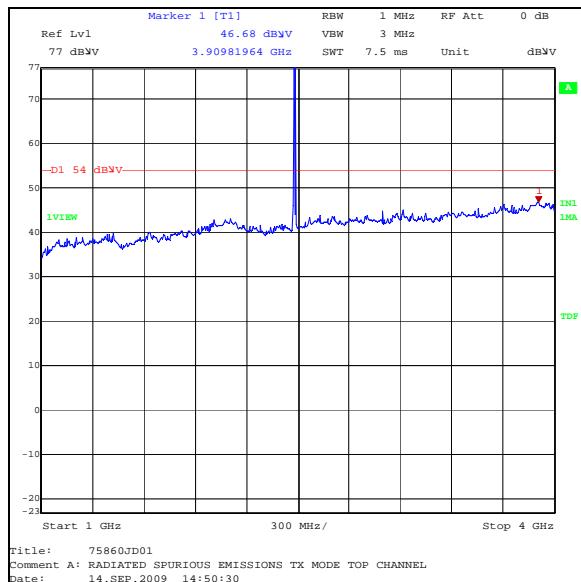
**Note(s):**

1. Measurements were made with the test system antenna in the vertical and horizontal planes. The highest levels were recorded in the above tables.
2. Final measurements were made using appropriate filters and attenuators where required.

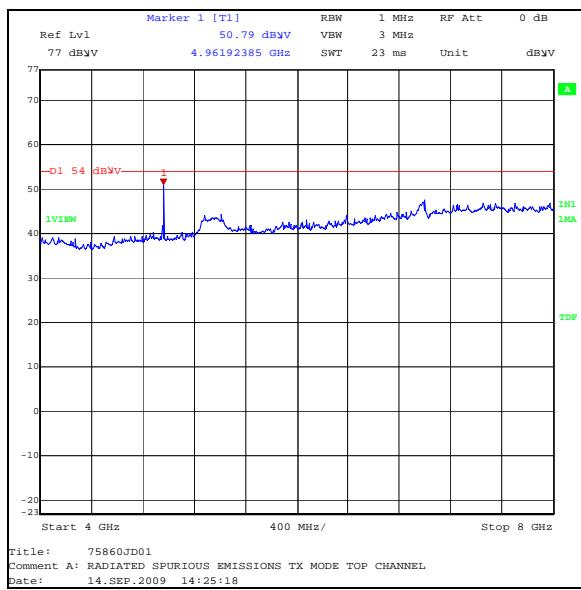
## Transmitter Radiated Spurious Emissions (continued)



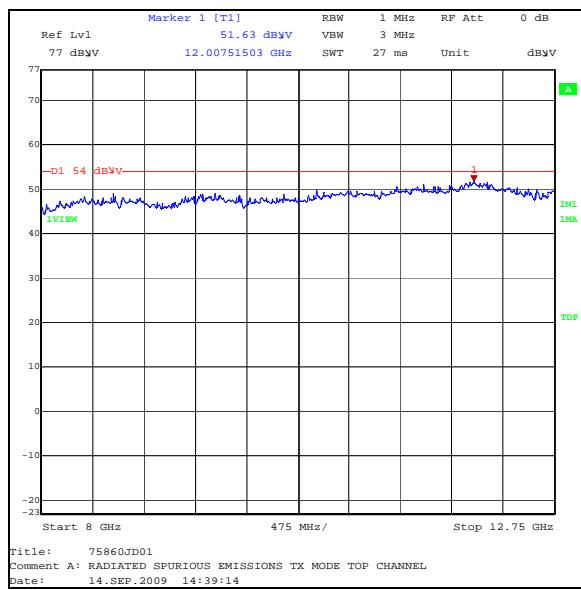
### 30 MHz to 1 GHz



### 1 GHz to 4 GHz



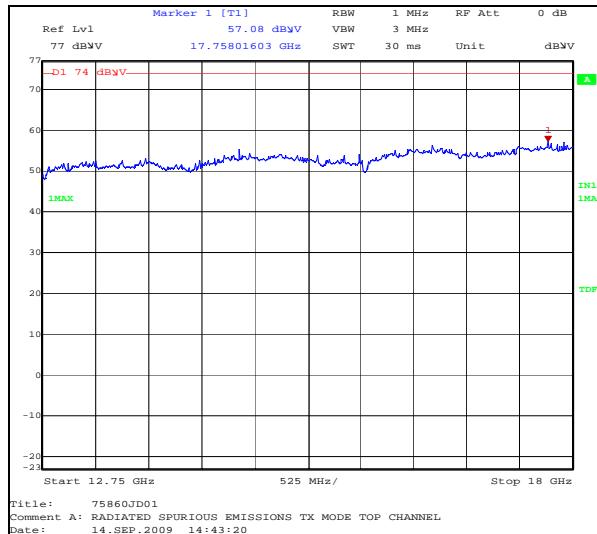
### 4 GHz to 8 GHz



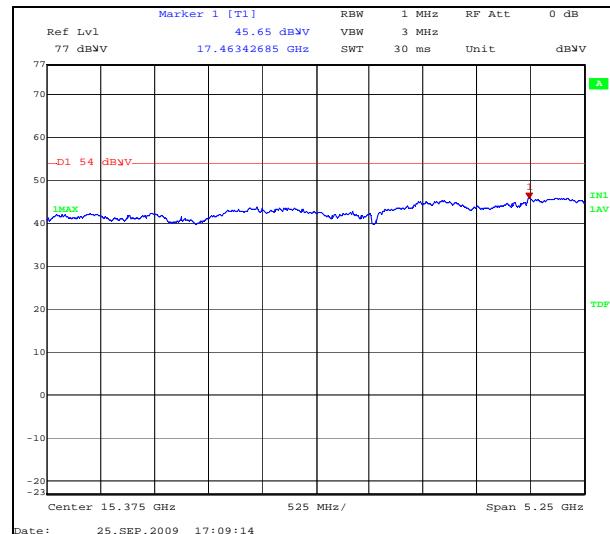
### 8 GHz to 12.75 GHz

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

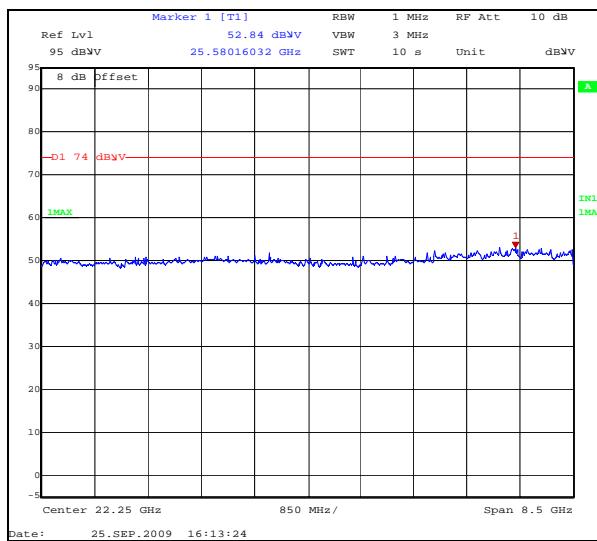
## Transmitter Radiated Spurious Emissions (continued)



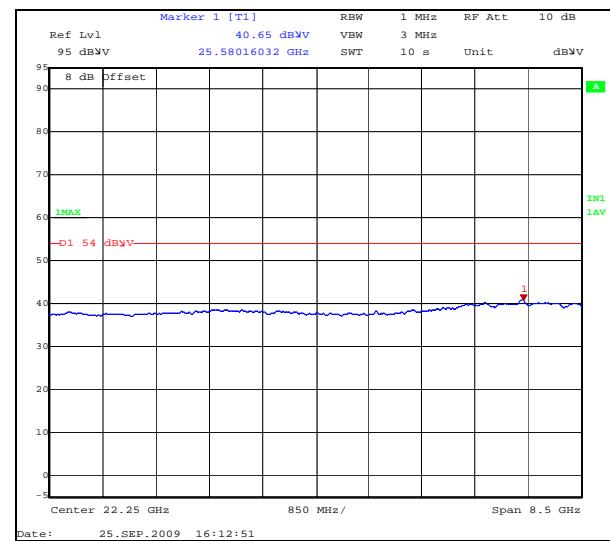
12.75 GHz to 18 GHz Pk Measurement



12.75 GHz to 18 GHz Avg Measurement



18 GHz to 26.5 GHz Pk Measurement



18 GHz to 26.5 GHz Avg Measurement

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

**5.2.7. Transmitter Radiated Emissions at Band Edges****Test Summary:**

FCC Part:	15.249(d) & 15.209
Test Method Used:	As detailed in ANSI C63.4 Section 8 and relevant annexes

**Environmental Conditions:**

Temperature (°C):	24
Relative Humidity (%):	33

**Results: Bottom Band Edge - Peak**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400	59.3	74.0	14.7	Complied

**Results: Bottom Band Edge - Average**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400	50.6	54.0	3.4	Complied

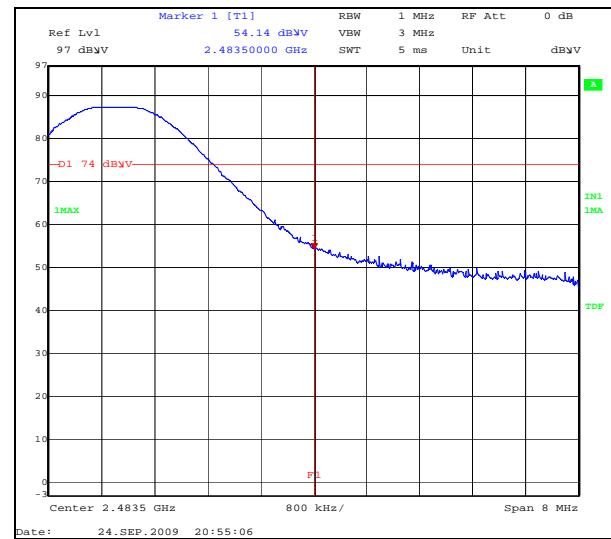
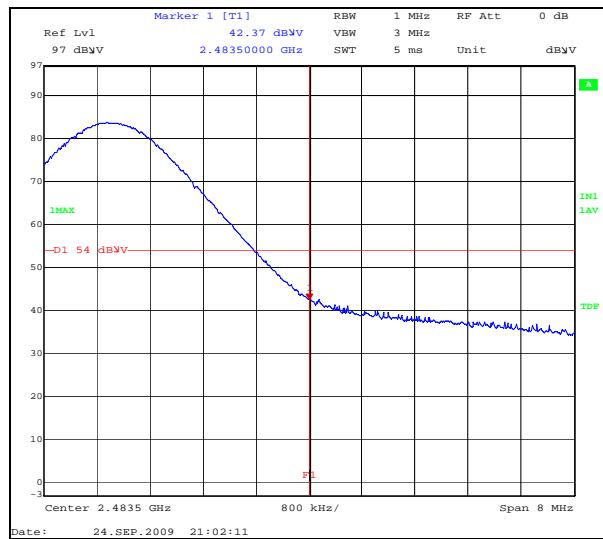
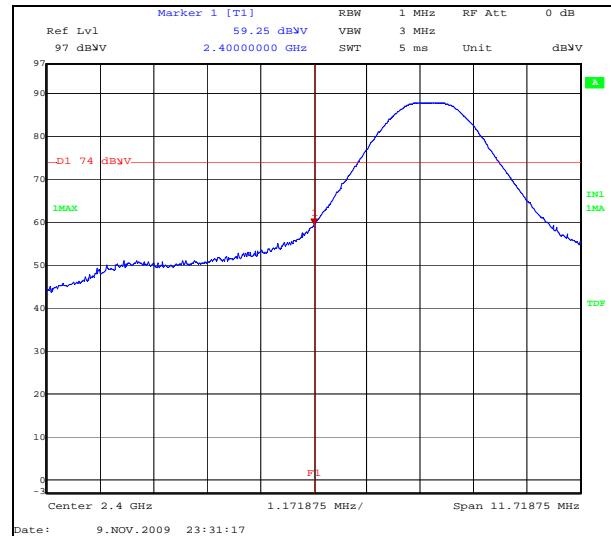
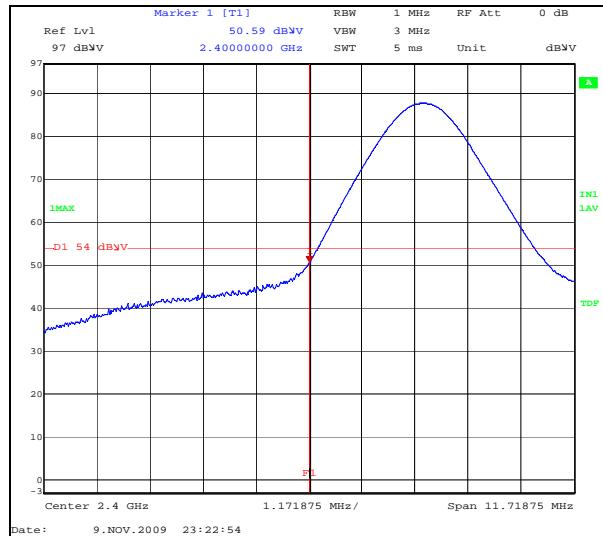
**Results: Top Band Edge - Peak**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	54.1	74.0	19.9	Complied

**Results: Top Band Edge - Average**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	42.4	54.0	11.6	Complied

### Transmitter Radiated Emissions at Band Edges (continued)



## **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
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.72 dB
Fundamental Fieldstrength	Not Applicable	95%	±2.94 dB
Transmitter 20 dB Bandwidth	Not Applicable	95%	±0.92 ppm
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 Last Calibrated	Cal. Interval (Months)
A1534	Pre Amplifier	Hewlett Packard	8449B OPT H02	3008A00405	Calibrated before use	-
A1818	Antenna	EMCO	3115	00075692	25 Oct 2008	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	05 Jan 2009	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	Calibrated before use	-
A288	Antenna	Chase	CBL6111A	1589	13 Mar 2009	12
A436	Antenna	Flann	20240-20	330	24 Apr 2009	36
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	19 Mar 2009	12
K0001	5m Semi-Anechoic Chamber	Rainford EMC	N/A	N/A	04 May 2009	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
K0008	Site Reference 4422	RFI Global Services Ltd	N/A	N/A	26 Aug 2009	12
M1124	Test Receiver	Rohde & Schwarz	ESIB26	100046K	09 Mar 2009	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	22 Apr 2009	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.