

# TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Wideband Modular Ubitag V2.3

To: FCC Part 15.250: 2009

**Test Report Serial No:**  
RFI-RPT-RP76541JD05A\_V4.0

**Version 4.0 supersedes all previous versions**

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



<b>Checked By:</b>	Nigel Davison
<b>Signature:</b>	
<b>Date of Issue:</b>	26 March 2010

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## **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 England

## 2. Summary of Testing

### 2.1. General Information

<b>Specification Reference:</b>	47CFR15.250
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 15 Subpart C (Radio Frequency Devices) - Section 15.250 - Operation of Wideband systems within the band 5925-7250MHz
<b>Site Registration:</b>	209735
<b>Location of Testing:</b>	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	08 February 2010 to 09 February 2010

### 2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Port Type	Result
47CFR15.207	AC Conducted Spurious Emissions	AC Mains	✓
47CFR15.109	Radiated Spurious Emissions	Antenna	✓
47CFR15.250(b)	Transmitter 10dB Bandwidth	Antenna	✓
47CFR15.250(d) 47CFR15.209	Transmitter Radiated Spurious Emissions Below 960 MHz	Antenna	✓
47CFR15.250(d)	Transmitter Radiated Spurious Emissions Above 960 MHz	Antenna	✓
47CFR15.519(d)	Transmitter Emission Peak Level	Antenna	✓

**Key to Results**

✓ = 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>Description:</b>	Location Tag
<b>Brand Name:</b>	Ubisense
<b>Model Name or Number:</b>	Wideband Modular Ubitag V2.3
<b>Serial Number:</b>	Not stated or marked
<b>FCC ID Number:</b>	SEAMOD23

#### **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>	Wide Band (WB)	
<b>Category of Equipment:</b>	Transmitter	
<b>Type of Equipment</b>	Module	
<b>Intended Operating Environment:</b>	Industrial, Commercial and Domestic	
<b>Highest Internally Generated Clock or Oscillator Frequency:</b>	26 MHz	
<b>Modulation Type:</b>	Un-modulated pulse train	
<b>Duty Cycle</b>	100%	
<b>Antenna Connection Type:</b>	Integral	
<b>Antenna Type:</b>	Internal end-fed monopole	
<b>Antenna Gain:</b>	2 dBi	
<b>Power Supply Requirement:</b>	Nominal	3.3 VDC
<b>Transmit Frequency Range:</b>	5.925-7.25GHz	
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Single channel device	6.5GHz (approx)

### **3.5. Port Identification**

Port	Description	Type	Applicable
1	DC power	Multi-pin	Y

### **3.6. Support Equipment**

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

<b>Description:</b>	Mains Power Supply Unit (AC to DC converter)
<b>Brand Name:</b>	STONTRONICS
<b>Model Name or Number:</b>	3A-061WP03
<b>Serial Number:</b>	T3915ST
<b>Cable Length and Type:</b>	1 Metre / twin core
<b>Connected to Port:</b>	Power cable

<b>Description:</b>	Power cable with multi pin connector and Light Emitting Diode
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated
<b>Cable Length and Type:</b>	1.8 Metre / twin core
<b>Connected to Port:</b>	Multi pin connector on EUT and DC connector on Mains Power Supply Unit

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

### **4.1. Operating Modes**

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

- Transmit Mode - Constantly transmitting at full power

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

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

- Powered from an AC/DC power supply. The power supply was connected to a 120VAC 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 Uncertainties* for details.

Measurements above 1GHz used the RMS detector function on the spectrum analyzer, with a sweep time set to 500ms or less – the spectrum analyzer scan had 500 points, and so a sweep time of 500ms or less ensured that the averaging time per point was 1ms or less. The VBW was always greater than or equal to the RBW unless noted.

## **5.2. Test Results**

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

#### **Test Summary:**

FCC Part:	47CFR 15.207
Test Method Used:	As detailed in ANSI C63.4 Section 7 and relevant annexes

#### **Environmental Conditions:**

Temperature Range (°C):	24
Relative Humidity Range (%):	25

#### **Results: Quasi Peak Detector Measurements**

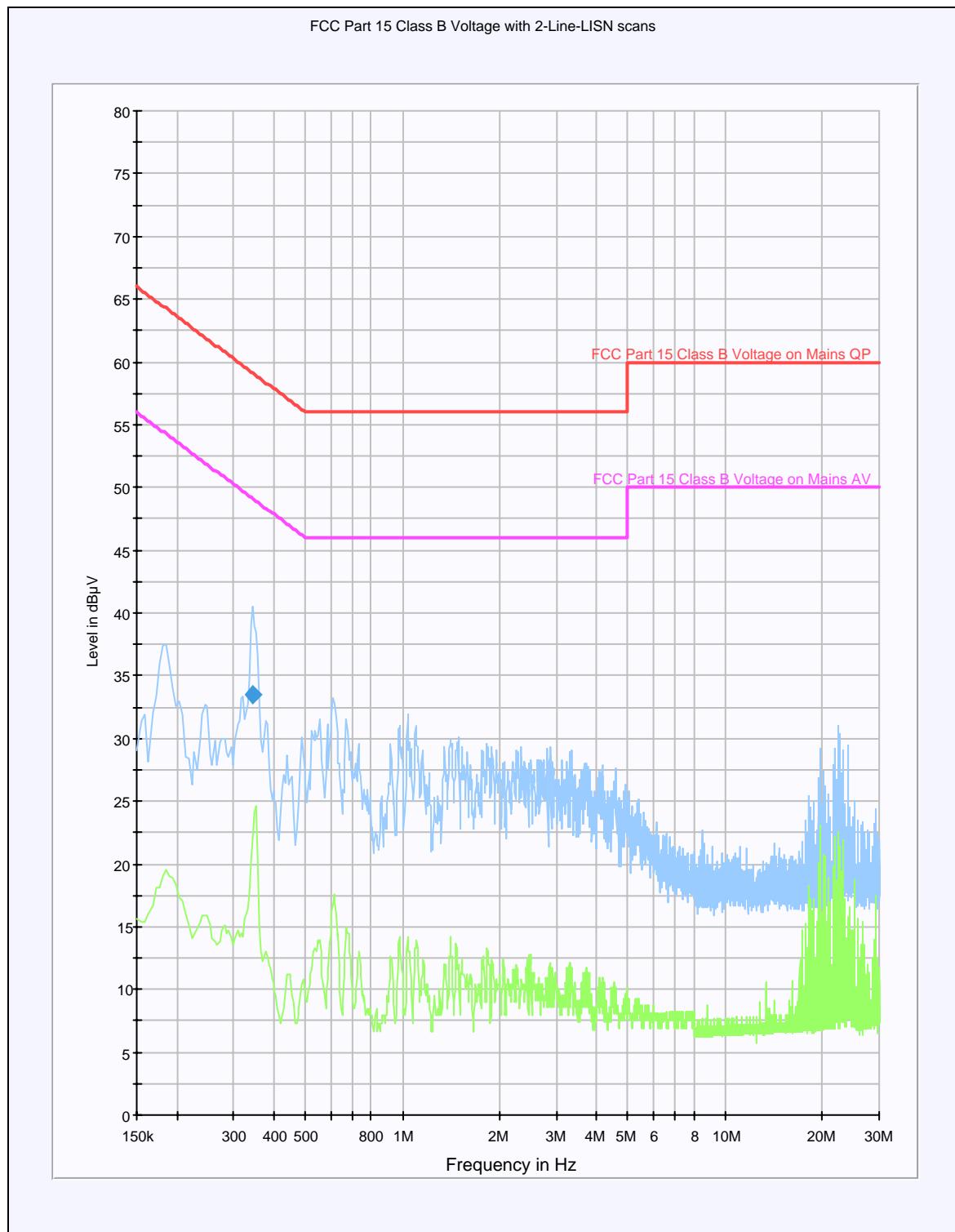
Frequency (MHz)	Line	Quasi Peak Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.343500	Live 1	33.5	59.1	25.6	Complied

#### **Results: Average Detector Measurements**

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

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

1. All emissions were greater than 20dB below the applicable limits therefore numerical results were not required or recorded.

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

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

**5.2.2. Transmitter 10dB Bandwidth (WB)****Test Summary:**

FCC Part:	47CFR15.250(a)(b)
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**Environmental Conditions:**

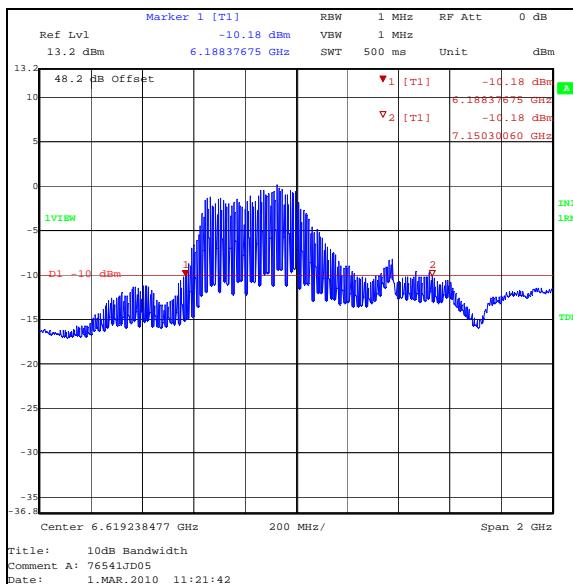
Temperature (°C):	23
Relative Humidity (%):	23

**Results: 15.250(a)**

Measured FL (MHz)	Measured FH (MHz)	Limit FL (MHz)	Limit FH (MHz)	Result
6188.376	7150.301	5925.0	7250.0	Complied

**Results: 15.250(b)**

Transmitter 10 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
961.925	>50.0	911.925	Complied



### **5.2.3. Transmitter Radiated Spurious Emissions Below 960 MHz**

#### **Test Summary:**

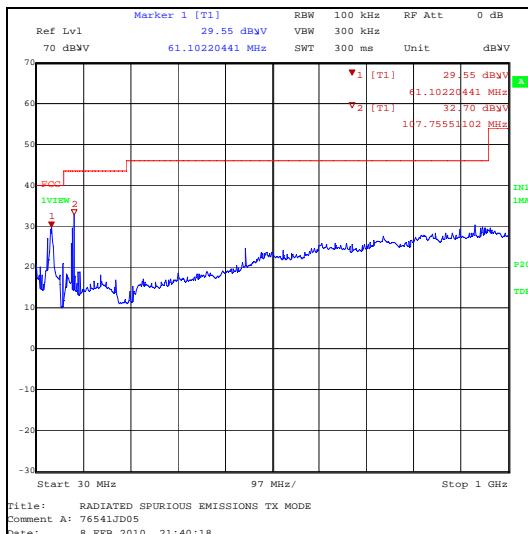
<b>FCC Part:</b>	47CFR15.250(d) and 47CFR15.209
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 8 and relevant annexes

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	24

#### **Results:**

Frequency (MHz)	Antenna Polarity	Q-P Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
61.276	Vertical	29.6	40.0	10.4	Complied



#### **Notes:**

1. This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.
2. Marker 2 at 107.755MHz is an ambient emission and remains on EUT switch off.

**5.2.4. Transmitter Radiated Spurious Emissions Above 960 MHz****Test Summary:**

FCC Part:	47CFR15.250(d)
Test Method Used:	As detailed in 47CFR15.250(e)

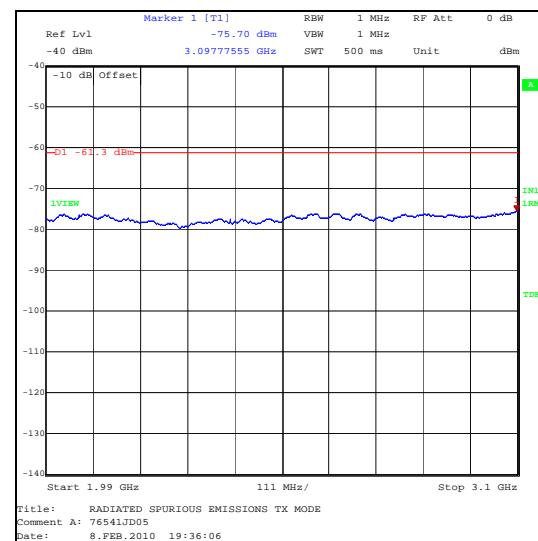
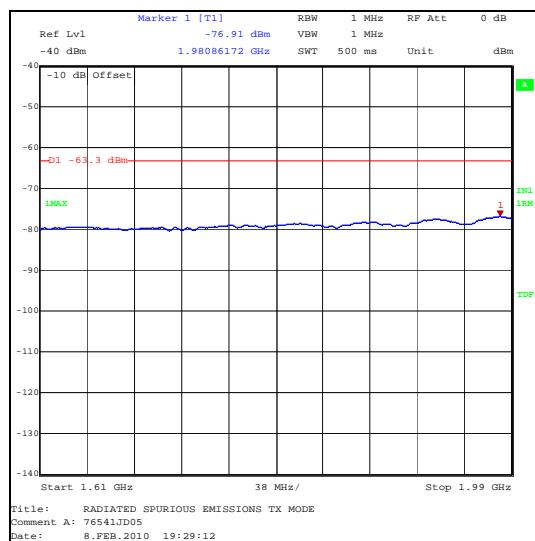
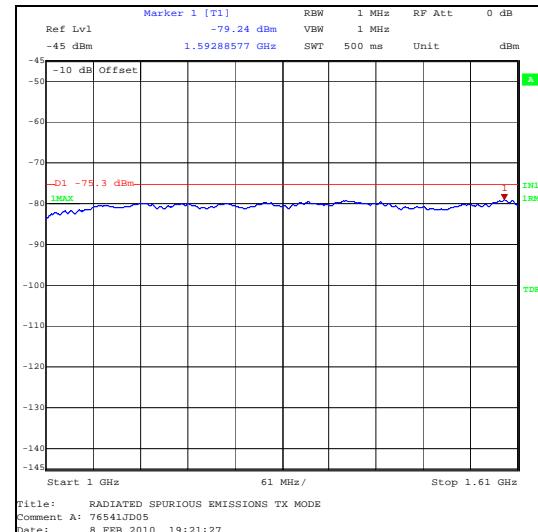
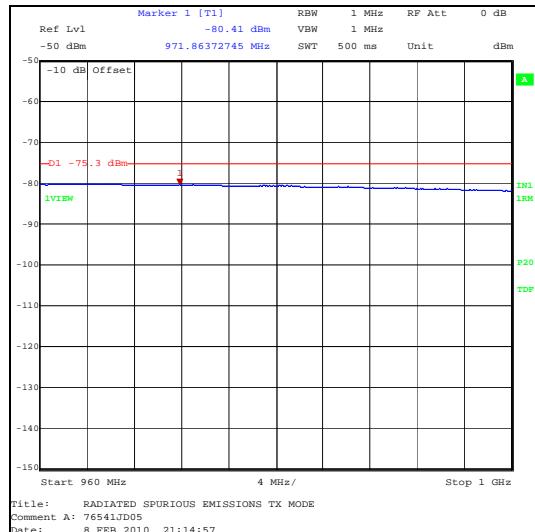
**Environmental Conditions:**

Temperature (°C):	27
Relative Humidity (%):	29

**Results:**

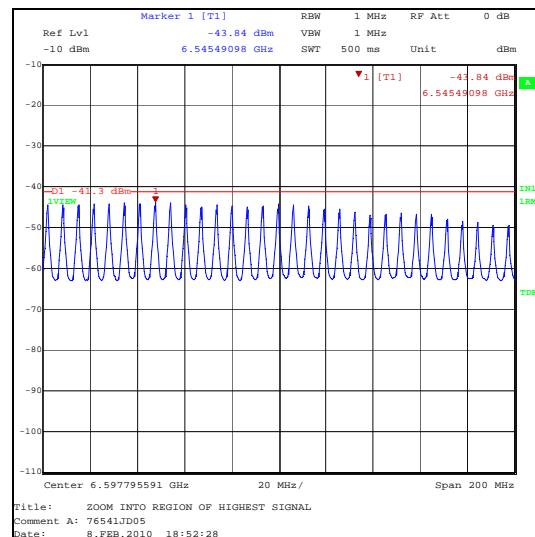
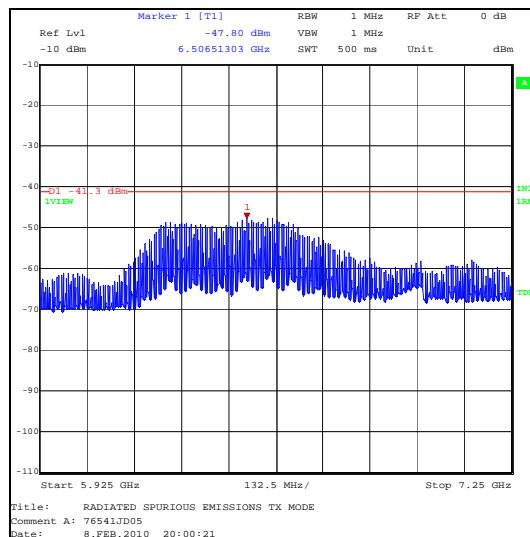
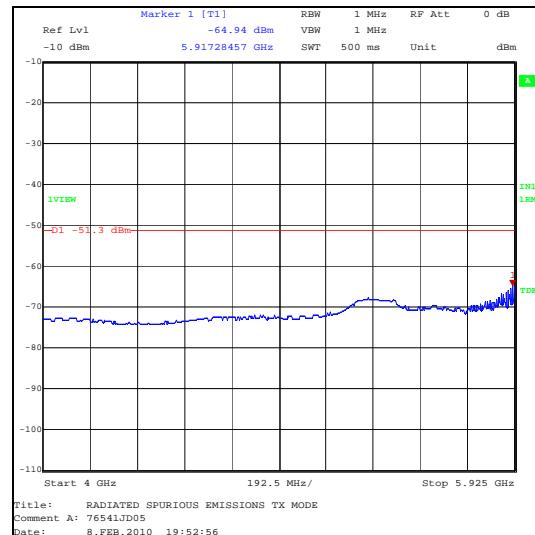
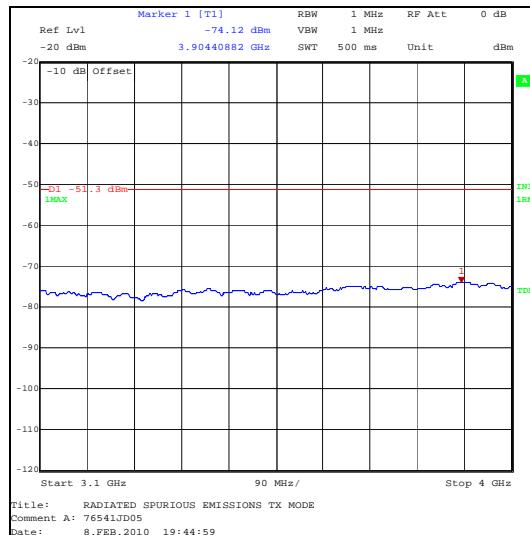
Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
971.864	Vertical	-80.4	-75.3	5.1	Complied
1592.886	Vertical	-79.2	-75.3	3.9	Complied
1908.081	Vertical	-76.9	-61.3	15.6	Complied
3097.776	Vertical	-75.7	-61.3	14.4	Complied
3904.410	Vertical	-74.1	-51.3	22.8	Complied
5917.285	Vertical	-64.9	-51.3	13.6	Complied
6545.491	Vertical	-43.8	-41.3	2.5	Complied
7286.072	Vertical	-60.5	-51.3	9.2	Complied
10600.000	Vertical	-65.7	-51.3	14.4	Complied
12431.162	Vertical	-67.5	-61.3	6.2	Complied
17800.100	Vertical	-64.6	-61.3	3.3	Complied
25971.944	Vertical	-72.8	-61.3	11.5	Complied
37348.697	Vertical	-64.3	-61.3	3.0	Complied

## Transmitter Radiated Spurious Emissions Above 960 MHz (continued)



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

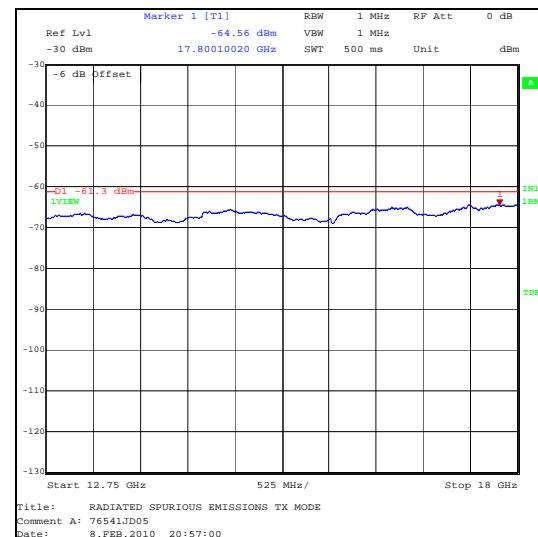
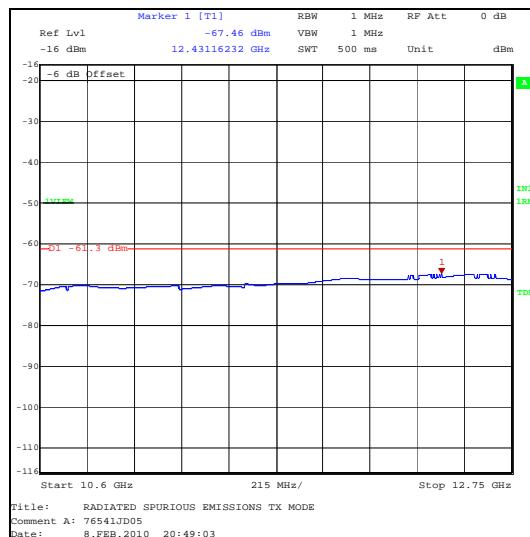
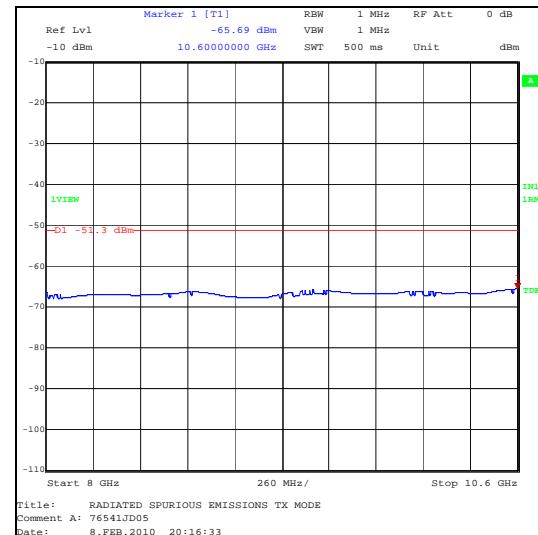
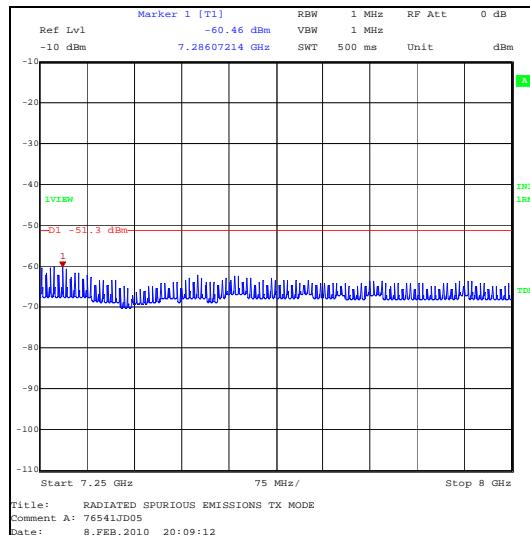
## Transmitter Radiated Spurious Emissions Above 960 MHz (continued)



Zoom in on region of highest signal

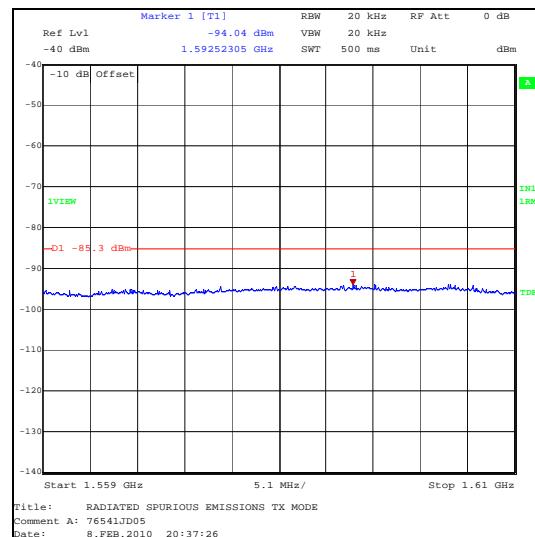
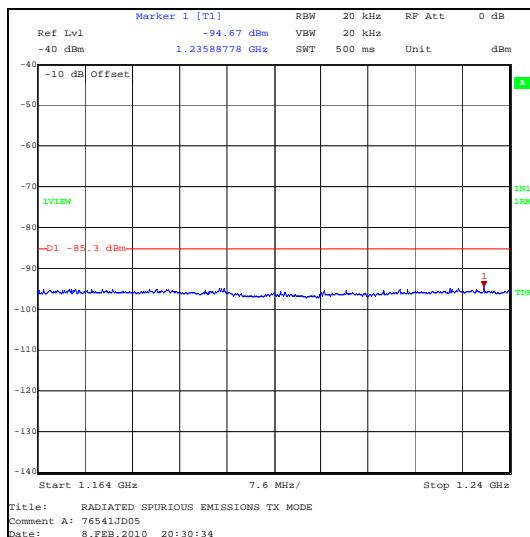
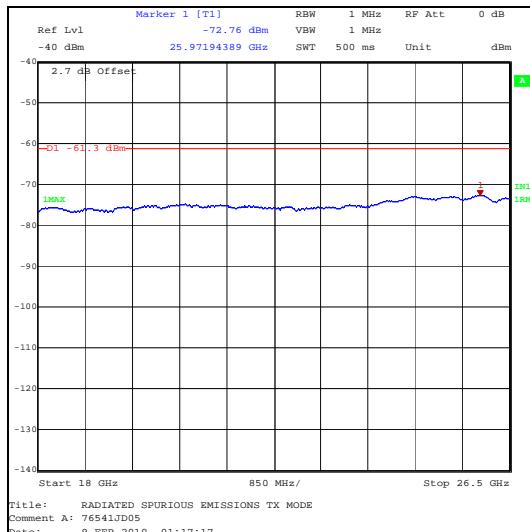
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

## Transmitter Radiated Spurious Emissions Above 960 MHz (continued)



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

## Transmitter Radiated Spurious Emissions Above 960 MHz (continued)



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

1. The standard states (15.250(2) (d) (2)) that the resolution bandwidth must not be less than 1 kHz for the 1.164 to 1.24GHz and 1.559 to 1.61GHz, In this case a 20 kHz resolution bandwidth filter was chosen.
2. On occasion where dynamic range was an issue the test distance was reduced and a correction factor introduced in the form of a reference level offset to correct for the increased levels.

### **5.2.5. Transmitter Emissions Peak Level**

#### **Test Summary:**

<b>FCC Part:</b>	47CFR15.250(d)
<b>Test Method Used:</b>	As detailed in 47CFR15.250(e)

#### **Environmental Conditions:**

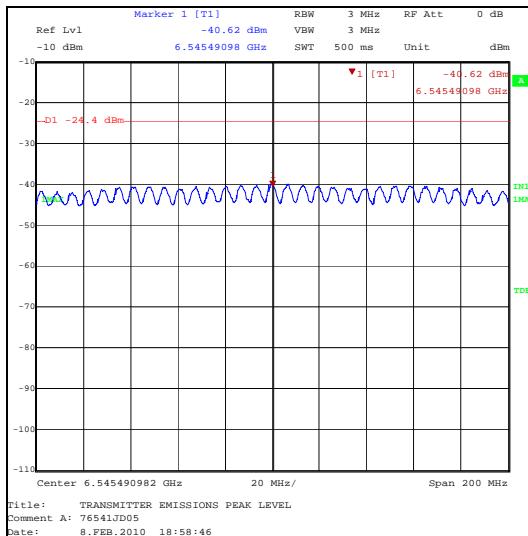
<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	23

#### **Results:**

<b>Frequency <math>F_M</math> (MHz)</b>	<b>Antenna Polarity</b>	<b>Level (dBm/3MHz)</b>	<b>Limit (dBm/3MHz)</b>	<b>Margin (dB)</b>	<b>Result</b>
6545.491	Vertical	-40.6	-24.4	16.2	Complied

#### **Notes**

1. A resolution bandwidth (RBW) of 3MHz was used and thus the limit was calculated as  $20 \times \log(3/50) = -24.4$  dBm/3MHz.



## **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	9 kHz to 30 MHz	95%	±3.53 dB
Radiated Spurious Emissions	30 MHz to 40000 MHz	95%	±2.94 dB
Transmitter Fundamental Field Strength	30 MHz to 40000 MHz	95%	±4.64 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	27 Nov 2009	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	01 Mar 2010	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
C363	Cable	Rosenberger	RG142	None	29 Mar 2009	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	09 Mar 2009	12
M1244	GSM Test Set	HP	8922M	4012U04465	Calibration not required	-
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	22 Apr 2009	12
M1390	Harmonic Mixer	Farran Technology	WHMP 28	FTL1677B	03 Aug 2006	12
M208	Thermometer /Hygrometer	RS Components	RS212-124	M208-RS212-124	30 Apr 2009	12

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