

# TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Wideband Modular Ubitag V2.3

To: FCC Part 15.249: 2009 Subpart C

**Test Report Serial No:**  
RFI/RPT3/RP76541JD03A

**Supersedes Test Report Serial No:**  
RFI/RPT2/RP76541JD03A

**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>	47CFR15.249
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 15 Subpart C (Radio Frequency Devices) - Section 15.249
<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
FCC Part 15.107	Idle Mode AC Conducted Emissions	AC Mains	✓
FCC Part 15.109	Idle Mode Radiated Spurious Emissions	Antenna	✓
FCC Part 15.207	Transmitter AC Conducted Emissions	AC Mains	✓
Part 15.249(a)	Transmitter Fundamental Field Strength	Antenna	✓
Part 2.1049	Transmitter 20 dB Bandwidth	Antenna	✓
Part 15.249(a)(d)(e) & 15.209	Transmitter Radiated Spurious Emissions	Antenna	✓
Part 15.249(d) & 15.209	Transmitter Band Edge Radiated Emissions	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>	Modular Wideband Tag
<b>Brand Name:</b>	Ubisense
<b>Model Name:</b>	Modular Ubitag V2.3
<b>Model Number:</b>	UBIMOD7023
<b>Serial Number:</b>	06
<b>Hardware Version Number:</b>	2.1
<b>Software Version Number:</b>	Test software
<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>	2480.5 MHz	
<b>Modulation Type:</b>	MSK	
<b>Duty Cycle</b>	100%	
<b>Antenna Connection Type:</b>	Integral	
<b>Antenna Type:</b>	Internal ceramic	
<b>Antenna Gain:</b>	1 dBi	
<b>Power Supply Requirement:</b>	Nominal	3.3V
<b>Transmit Frequency Range:</b>	2.4 GHz to 2.4835 GHz	
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Bottom	2402.5
	Centre	2442.0
	Top	2480.5
<b>Receive Frequency Range:</b>	2.4 GHz to 2.4835 GHz	
<b>Receive Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Frequency (MHz)</b>
	Bottom	2402.5
	Centre	2442.0
	Top	2480.5

### **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 and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

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

- Transmit Mode - Constantly transmitting on the top, centre or bottom channel at full power with 125 kbit/s MSK modulation.
- Idle mode.

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

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

- Powered from a DC power supply through the multi pin connector on the EUT.
- The power supply was connected to a 120 VAC 60 Hz source. A Light Emitting Diode on the multi pin connector was used to monitor the transmit channel or receive mode in accordance with Client's instructions.

## **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:

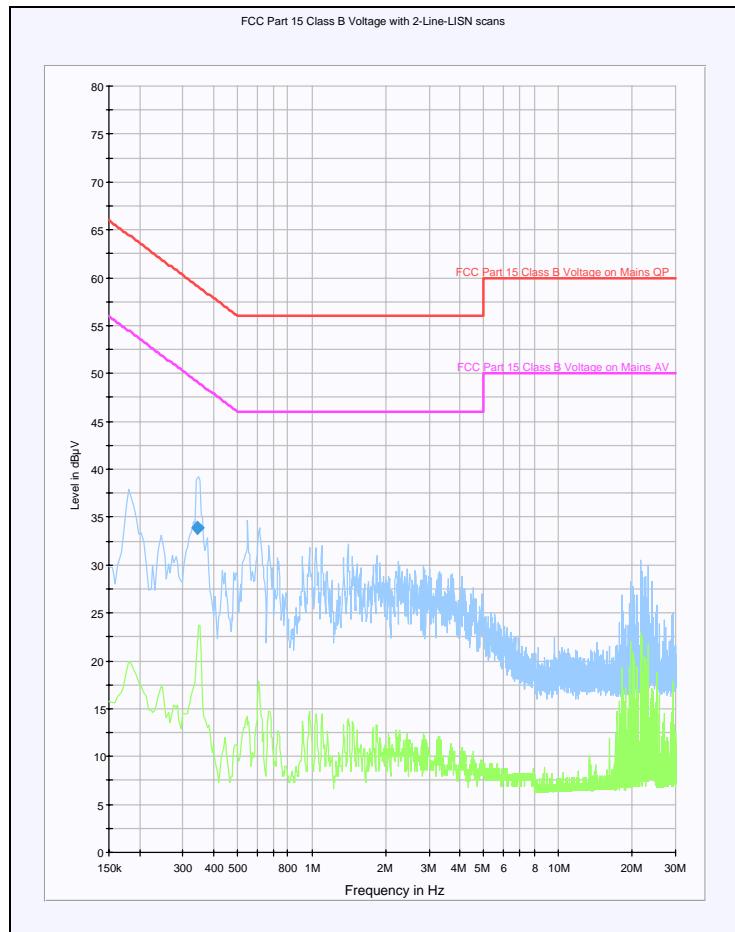
FCC Part:	15.107
Test Method Used:	As detailed in ANSI C63.4 Section 7 and relevant annexes

#### Environmental Conditions:

Temperature Range (°C):	20
Relative Humidity Range (%):	25

#### Note(s):

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



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

### **5.2.2. Idle Mode Radiated Spurious Emissions**

#### **Test Summary:**

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

#### **Environmental Conditions:**

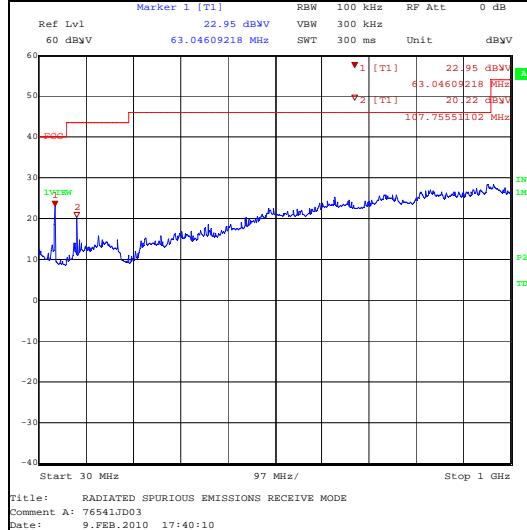
<b>Temperature Range (°C):</b>	20
<b>Relative Humidity Range (%):</b>	25

#### **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 at least 20 dB below the specification limit or below the measurement system noise floor.
2. Final measurements were performed with a quasi-peak detector.



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

**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:	1000MHz to 12.75 GHz

**Environmental Conditions:**

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

**Results: Peak**

Frequency (GHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
12.550	Vertical	53.5	74.0	20.5	Complied
Refer to note 1					

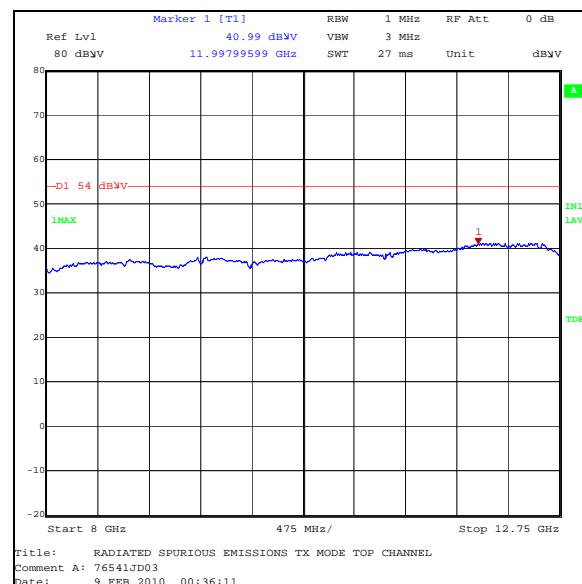
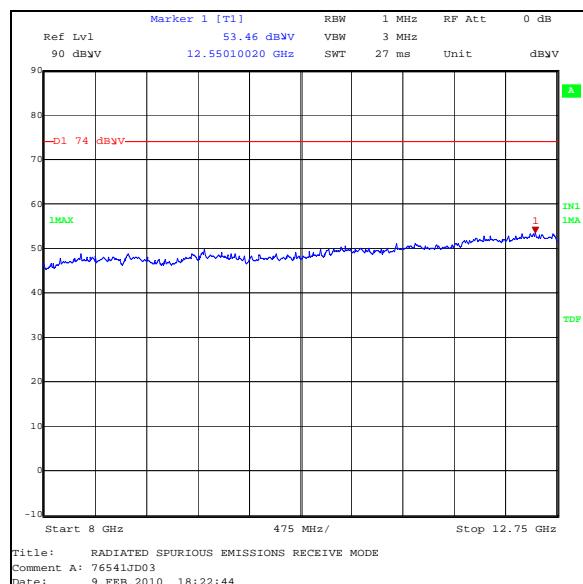
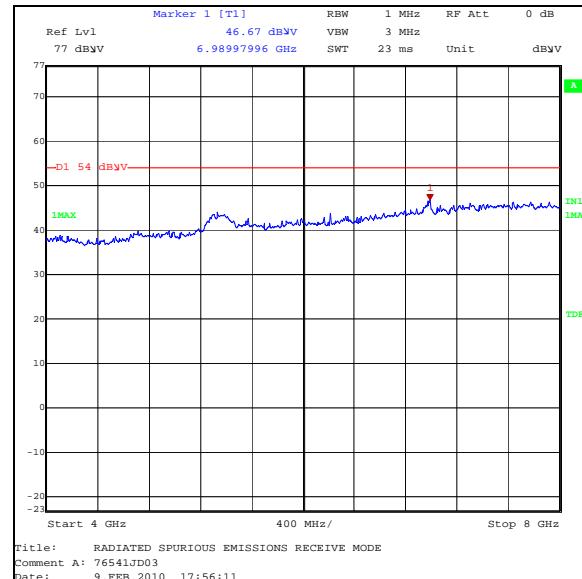
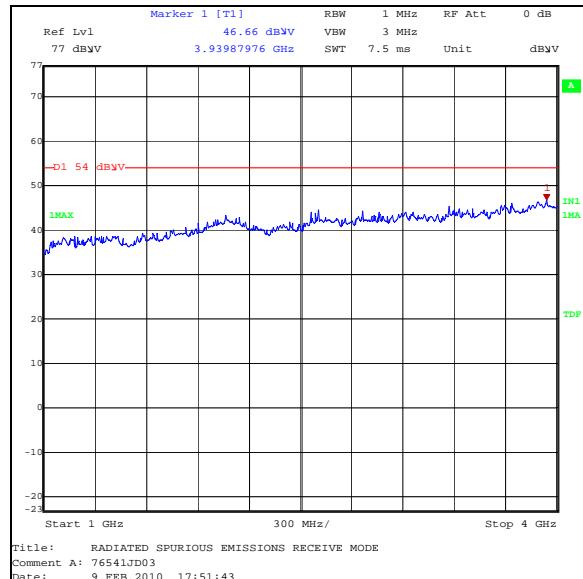
**Results: Average**

Frequency (GHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
11.998	Vertical	41.0	54.0	13.0	Complied

**Note(s):**

1. All emissions were at least 20 dB below the specification limit or below the measurement system noise floor.
2. The peak noise floor was recorded against average limits as this presented the worst case, where the peak noise floor exceeded the average limit peak and average scan were made in accordance with the standard and can be seen on the pre-scan plots.

### Idle Mode Radiated Spurious Emissions (continued)



Note: These plots are pre-scans 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 Range (°C):</b>	22
<b>Relative Humidity Range (%):</b>	26

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

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



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

#### **Environmental Conditions:**

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

#### **Results Bottom Channel: Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2402.5	Horizontal	88.9	114.0	25.1	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	88.5	94.0	5.5	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	89.4	114.0	24.6	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	89.3	94.0	4.7	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	90.2	114.0	23.8	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	90.1	94.0	3.9	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.

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

FCC Part:	2.1049
Test Method Used:	Rohde & Schwarz ESIB26 - Occupied Bandwidth function

**Environmental Conditions:**

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

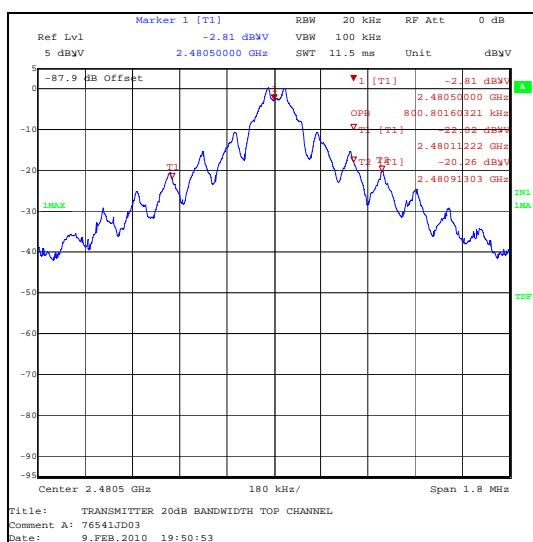
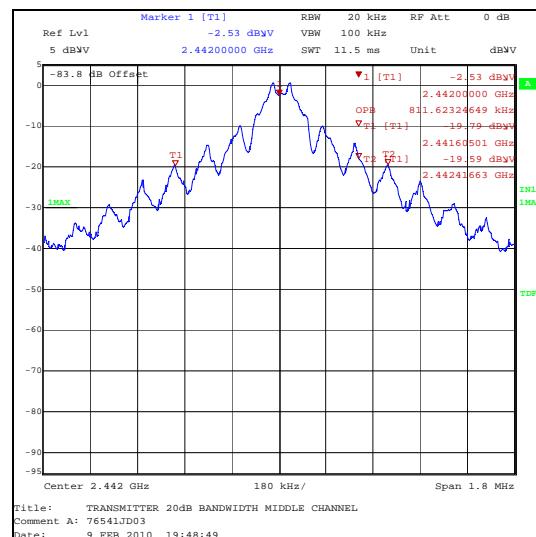
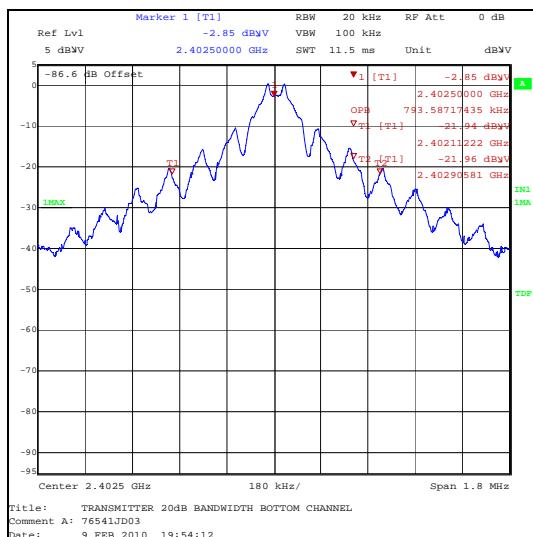
**Results: Bottom**

Channel	Transmitter 20 dB Bandwidth (MHz)	Emission Remained within frequency band
Bottom	0.793587	Complied
Middle	0.811623	Complied
Top	0.800802	Complied

**Limit:**

The 20dB bandwidth must remain within the designated frequency band 2400 to 2483.5 MHz.

## 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 GHz

#### **Environmental Conditions:**

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

#### **Results Bottom Channel:**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4804.490	Horizontal	47.6	54.0	6.4	Complied

#### **Results Middle Channel:**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4884.050	Horizontal	48.2	54.0	5.8	Complied

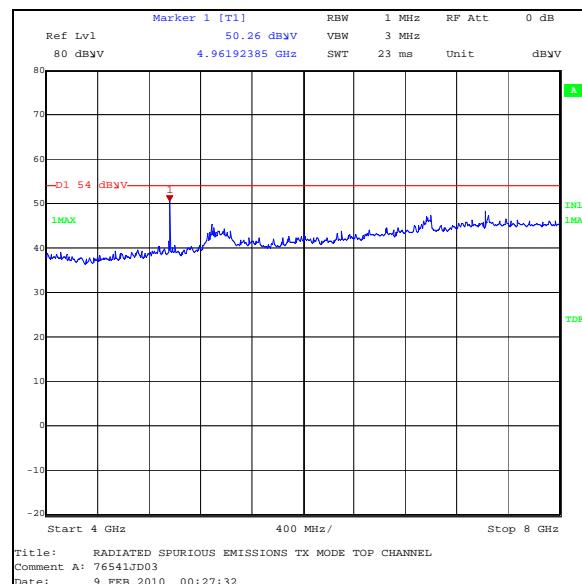
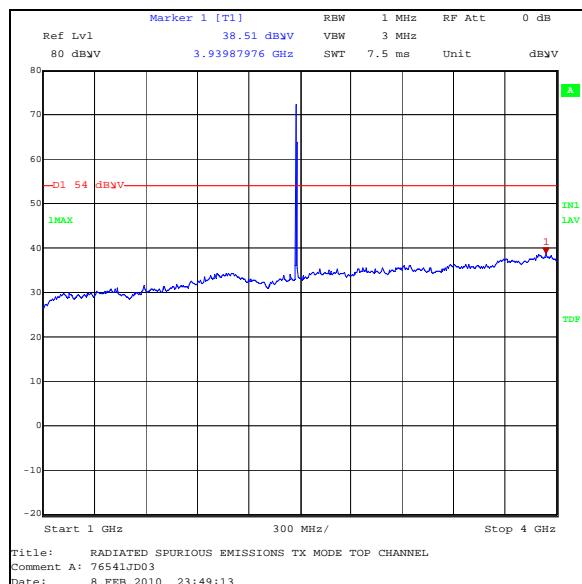
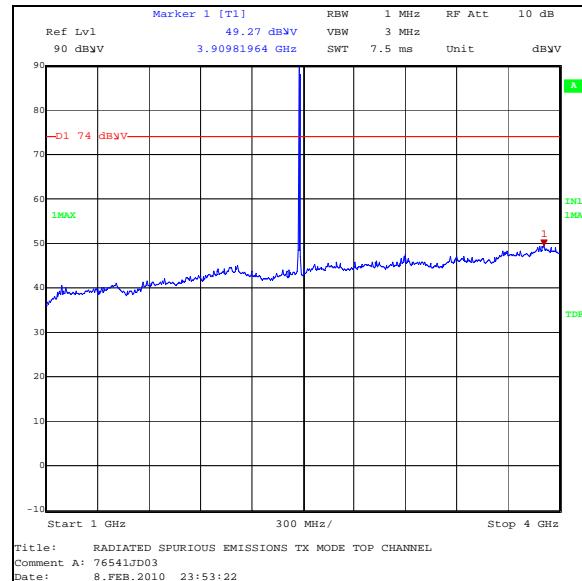
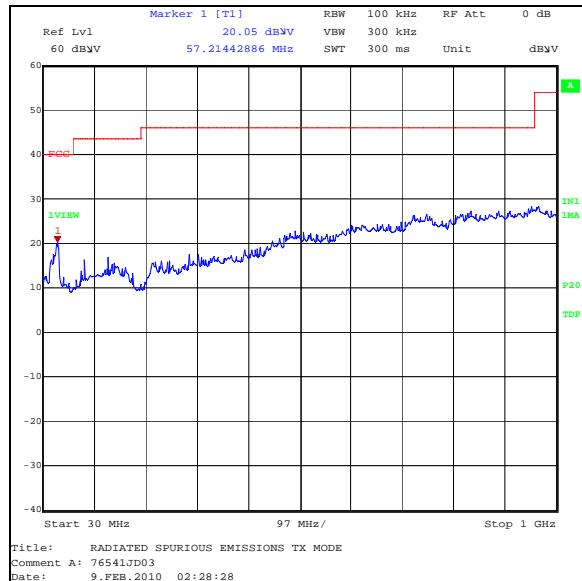
#### **Results Top Channel:**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4960.982	Horizontal	49.3	54.0	4.7	Complied

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

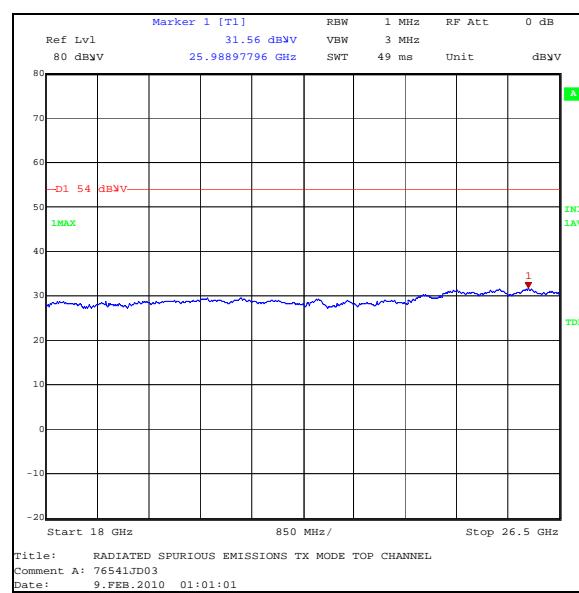
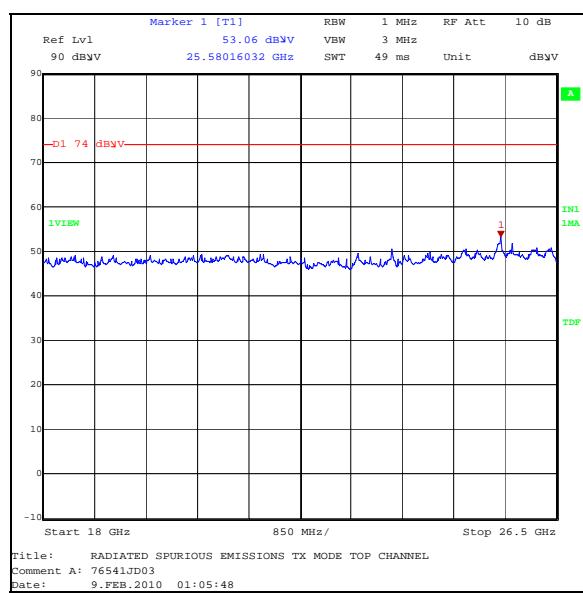
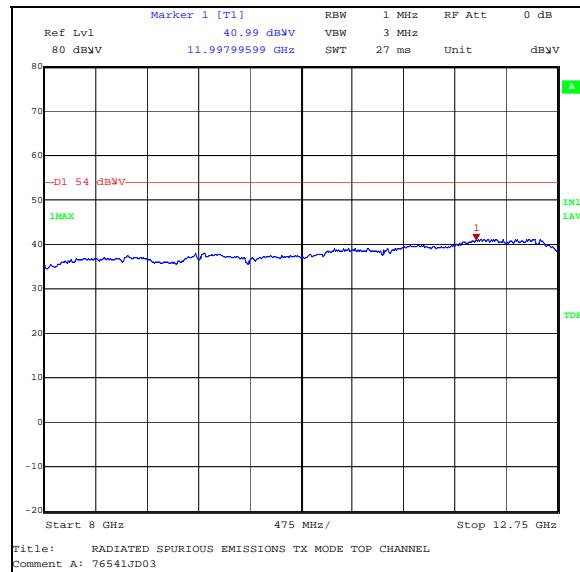
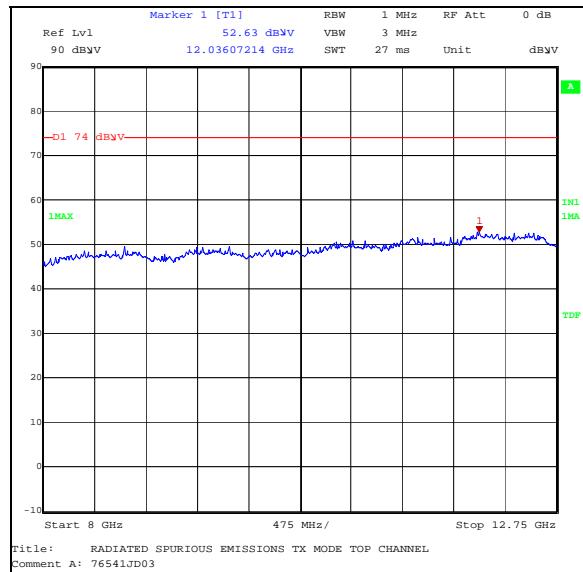
1. Measurements were made with the test system antenna in the vertical and horizontal planes. The highest levels were recorded in the above tables.
2. The emission shown at approximately 2480 MHz on the 1 GHz to 4 GHz pre-scan is the EUT carrier.
3. Final measurements were made using appropriate filters and attenuators where required.
4. The peak noise floor was recorded against average limits as this presented the worst case, where the peak noise floor exceeded the average limit peak and average scan were made in accordance with the standard and can be seen on the pre-scan plots.
5. As the emissions in the tables above were measured with a peak detector complied with the average limit, no average measurements were performed.

## Transmitter Radiated Spurious Emissions (continued)



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

## Transmitter Radiated Spurious Emissions (continued)



**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 (%):	22

**Results: Bottom Band Edge - Peak**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400	57.9	74.0	16.1	Complied

**Results: Bottom Band Edge - Average**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400	49.3	54.0	4.7	Complied

**Results: Top Band Edge - Peak**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	58.3	74	15.7	Complied

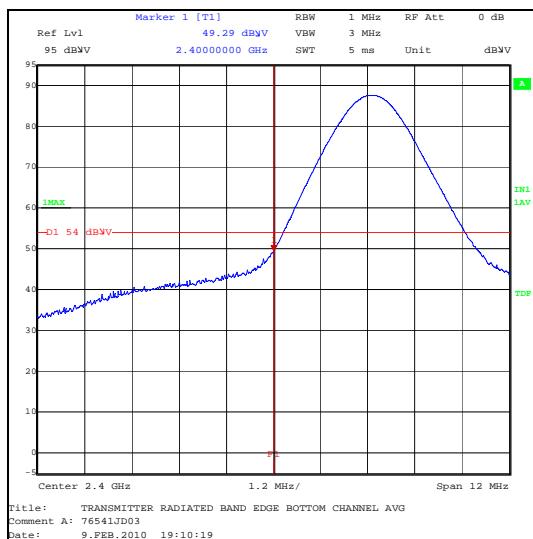
**Results: Top Band Edge - Average**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	49.5	54	4.5	Complied

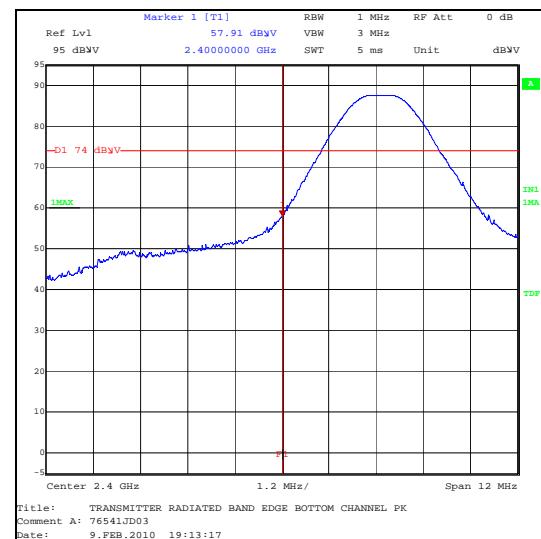
**Note(s):**

1. \*-20dBc Limit.

## Transmitter Radiated Emissions at Band Edges (continued)



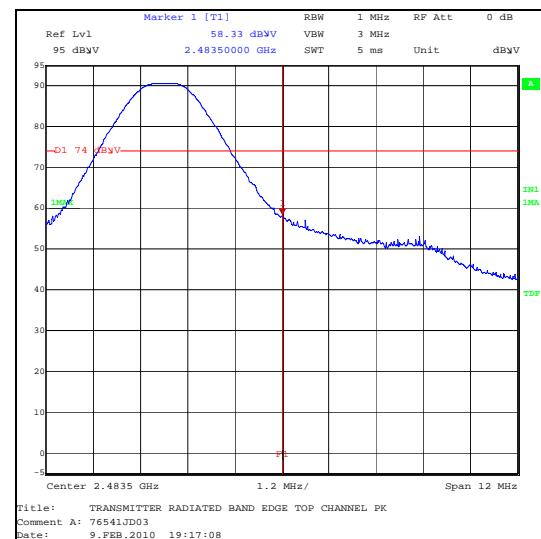
Average detector



Peak detector



Average detector



Peak detector

## **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	Confidence Level (%)	Calculated Uncertainty
20 dB Bandwidth	95%	$\pm 0.92$ ppm
Radiated Spurious Emissions	95%	$\pm 3.53$ dB
Radiated Spurious Emissions	95%	$\pm 4.64$ dB
Transmitter Fundamental Field Strength	95%	$\pm 4.64$ 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.