

# TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Anoto Digital Pen ADP-501

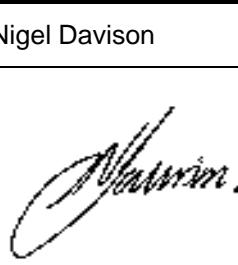
To: FCC Part 15.247: 2009 Subpart C, RSS-210 Issue 7 June 2007  
and RSS-Gen Issue 2 June 2007

**Test Report Serial No:**  
RFI-RPT-RP77266JD05A\_V2.0

**Version 2.0 supersedes all previous versions**

**This Test Report Is Issued Under The Authority  
Of Brian Watson, COO Payments and  
Consultancy**



<b>Checked By:</b>	Nigel Davison
<b>Signature:</b>	
<b>Date of Issue:</b>	04 May 2010

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## **1. Manufacturer Information**

<b>Company Name:</b>	Anoto AB
<b>Address:</b>	Traktorvägen 11 SE-226 60 LUND SWEDEN

## 2. Summary of Testing

### 2.1. General Information

<b>Specification Reference:</b>	47CFR15.247
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 15 Subpart C (Radio Frequency Devices) - Section 15.247
<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>	25 March 2010 to 31 March 2010

### 2.2. Summary of Test Results

FCC Reference (47CFR)	Industry Canada Reference	Measurement	Result
FCC 15.109	RSS-Gen 4.10 RSS-Gen 6.0	Receiver/Idle Mode Radiated Spurious Emissions	✓
FCC 15.247(a)(1)	RSS-Gen 4.6.1 RSS-210 A8.1(a)	Transmitter 20 dB Bandwidth	✓
FCC 15.247(a)(1)	RSS-210 A8.1(b)	Transmitter Carrier Frequency Separation	✓
FCC 15.247(a)(1)(iii)	RSS-210 A8.1(d)	Transmitter Average Time of Occupancy	✓
FCC 15.247(b)(3)	RSS-Gen 4.8 RSS-210 A8.4(2)	Transmitter Maximum Peak Output Power	✓
FCC 15.247(d) & 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Radiated Emissions	✓
FCC 15.247(d) & 15.209(a)	RSS-Gen 2.2 RSS-Gen 4.9 RSS-210 A8.5	Transmitter Band Edge Radiated Emissions	✓

**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.
<b>Reference:</b>	DA00-705 (2000)
<b>Title:</b>	Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

### **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>	Bluetooth Pen
<b>Brand Name:</b>	ADP-501
<b>Model Name or Number:</b>	Anoto ADP-501
<b>Serial Number:</b>	AR6-AAB-EFB-BX
<b>Hardware Version Number:</b>	1.x
<b>Software Version Number:</b>	Not stated
<b>FCC ID:</b>	WDN-ADP05
<b>Industry Canada ID:</b>	7776A-ADP05

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

The equipment under test was an advanced digital marker pen that used Anoto technology based whiteboards or flipcharts to stream pen coordinated via *Bluetooth* to a nearby host.

#### **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>	<i>Bluetooth</i>				
<b>Power Supply Requirement:</b>	Nominal	1.5 V			
<b>Type of Unit:</b>	Transceiver				
<b>Channel Spacing:</b>	1 MHz				
<b>Mode:</b>	Basic Rate				
<b>Modulation:</b>	GFSK				
<b>Packet Type: (Maximum Payload)</b>	DH5				
<b>Data Rate (Mbit/s):</b>	1				
<b>Maximum Transmit EIRP:</b>	2.8 dBm				
<b>Transmit Frequency Range:</b>	2402 MHz to 2480 MHz				
<b>Transmit Channels Tested:</b>	Channel ID	Channel Number	Channel Frequency (MHz)		
	Bottom	0	2402		
	Middle	39	2441		
	Top	78	2480		
<b>Receive Frequency Range:</b>	2402 MHz to 2480 MHz				
<b>Receive Channels Tested:</b>	Channel ID	Channel Number	Channel Frequency (MHz)		
	Bottom	0	2402		
	Middle	39	2441		
	Top	78	2480		

### **3.5. Support Equipment**

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

<b>Description:</b>	Laptop
<b>Brand Name:</b>	Dell
<b>Model Name or Number:</b>	Latitude D610
<b>Serial Number:</b>	CN-0C4708-48643-5C1-3783

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

### **4.1. Operating Modes**

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

- Idle Mode
- Transmit Mode with Basic Rate (DH5)

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

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

- For Transmit tests: Standalone, connected via a radio link to a Bluetooth Tester to provide a test mode and normal mode of operation for the sample.
- For Idle mode tests: Standalone, with the Bluetooth mode active but not transmitting.

## **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 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:**

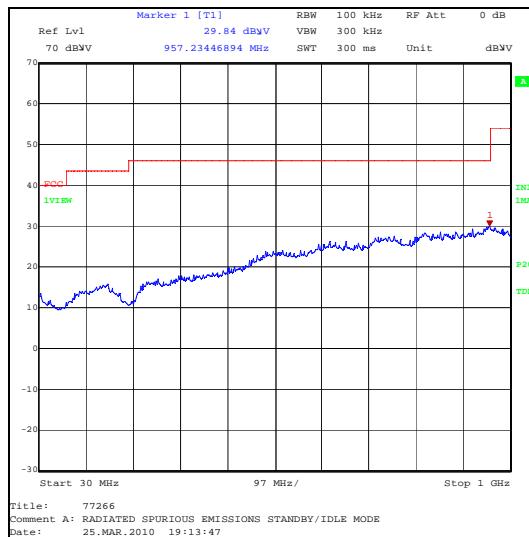
<b>Temperature Range (°C):</b>	26
<b>Relative Humidity Range (%):</b>	30

#### **Results:**

<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>
957.234	Vertical	29.6	46.0	16.4	Complied

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

1. 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 above.

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

*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:	1GHz to 12.75GHz

**Environmental Conditions:**

Temperature Range (°C):	26
Relative Humidity Range (%):	30

**Results: Peak**

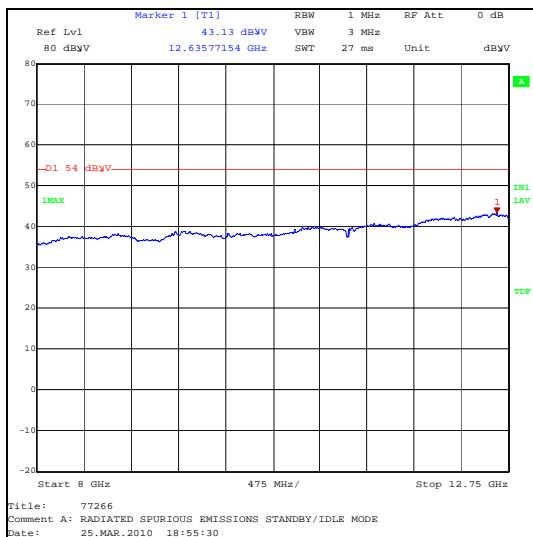
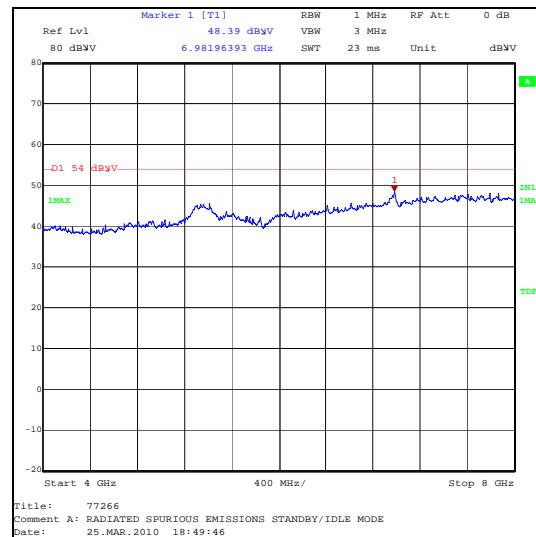
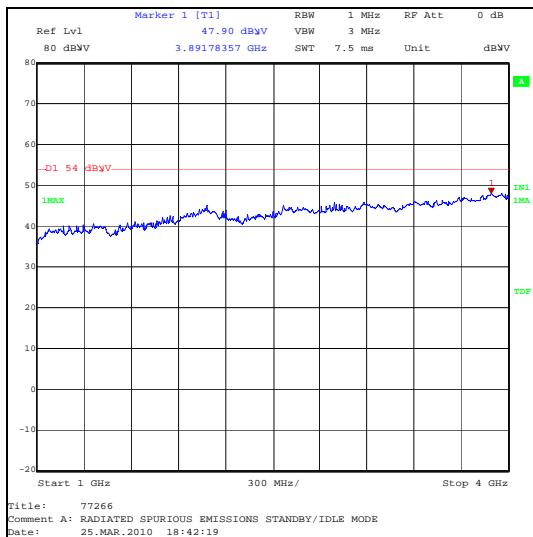
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
12550.100	Vertical	53.7	74.0	20.3	Complied

**Results: Average**

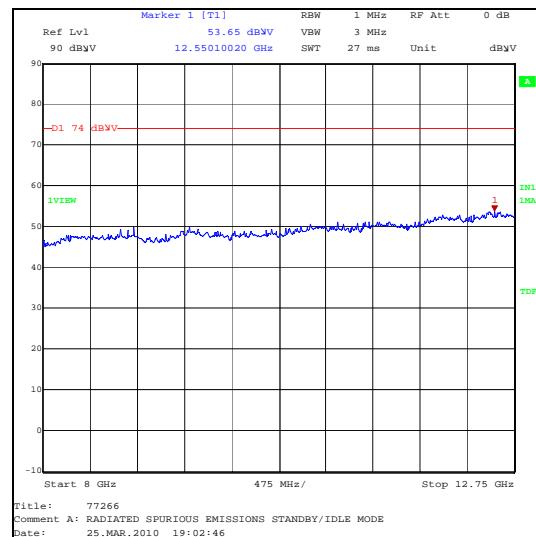
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
12635.772	Vertical	43.1	54.0	10.9	Complied

**Note(s):**

1. 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 above.
2. The measurements made in the range of 8 GHz to 12.75 GHz where pre-scans were performed with peak and average detector and the applicable limits apply. This was due to the noise floor exceeding the average limit when using the peak detector.

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

Average Detector



Peak Detector

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

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

<b>FCC Part:</b>	15.247(a)(1)
<b>Test Method Used:</b>	As detailed in Public Notice DA 00-705 (March 30, 2000) and ANSI C63.4 Section 13.1.7 and relevant annexes (see notes below)

**Environmental Conditions:**

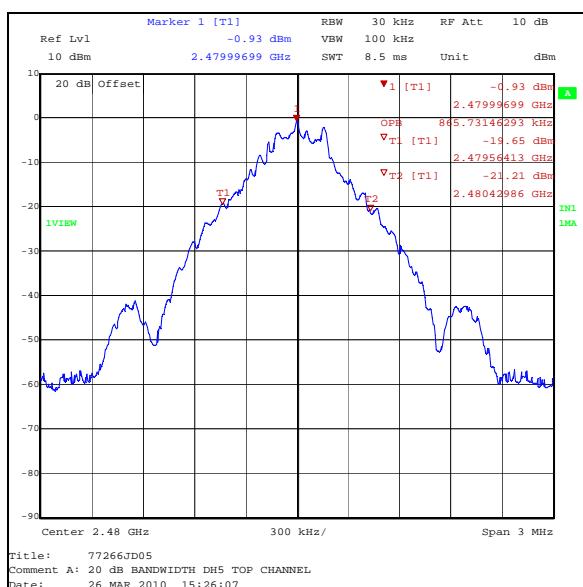
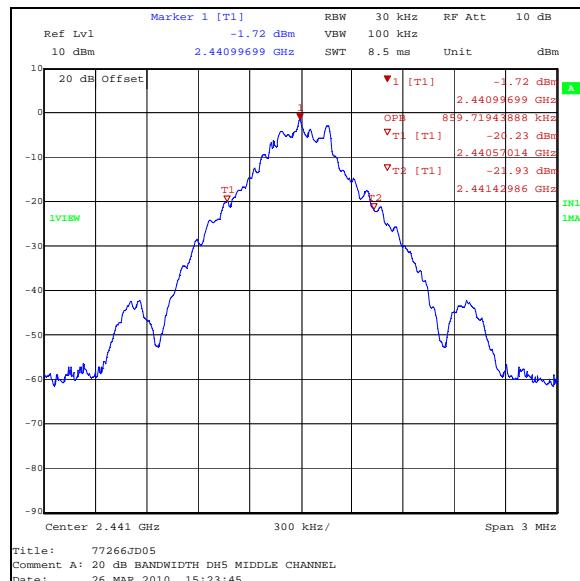
<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	28

**Results:**

<b>Channel</b>	<b>20 dB Bandwidth (KHz)</b>
Bottom	805.611
Middle	859.719
Top	865.731

**Note(s):**

1. In lieu of the test method detailed in ANSI C63.4 Section 13.1.7 the 20 dB bandwidth was measured using the Occupied Bandwidth function of the spectrum analyser.

**Transmitter 20 dB Bandwidth (continued)**

### 5.2.3. Transmitter Carrier Frequency Separation

#### Test Summary:

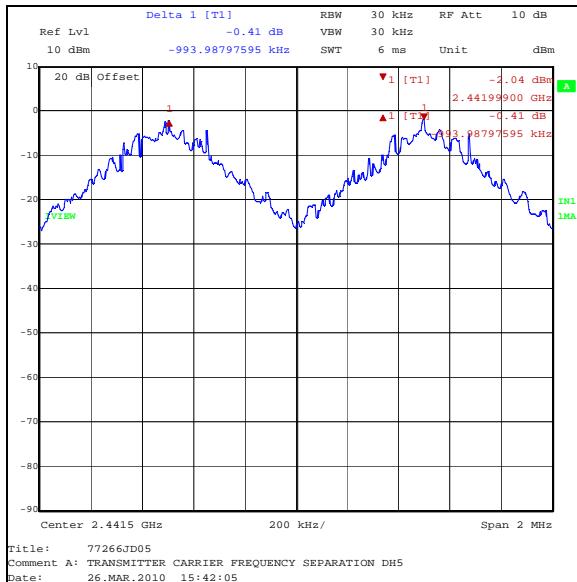
FCC Part:	15.247(a)(1)
Test Method Used:	As detailed in Public Notice DA 00-705 (March 30, 2000)

#### Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	28

#### Results:

Transmitter Carrier Frequency Separation (kHz)	Limit ( $\frac{2}{3}$ of 20 dB BW) (kHz)	Margin (kHz)	Result
993.988	573.146	420.842	Complied



#### Note(s):

1. The 20 dB bandwidth measured for the middle channel operating at 2441 was used to calculate the limit.

**5.2.4. Transmitter Average Time of Occupancy****Test Summary:**

FCC Part:	15.247(a)(1)(iii)
Test Method Used:	As detailed in Public Notice DA 00-705 (March 30, 2000)

**Environmental Conditions:**

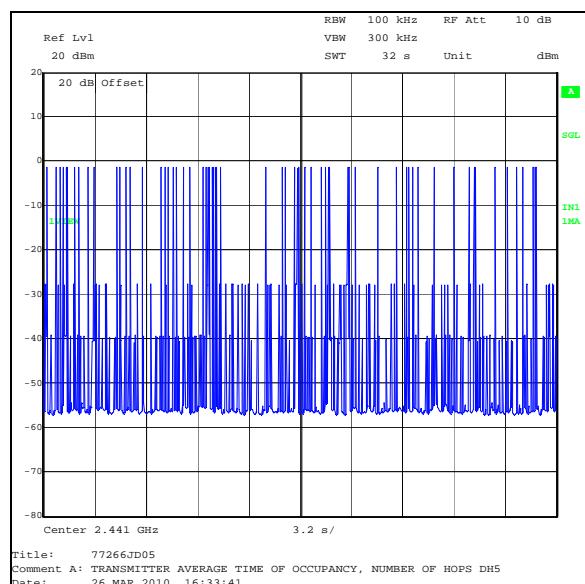
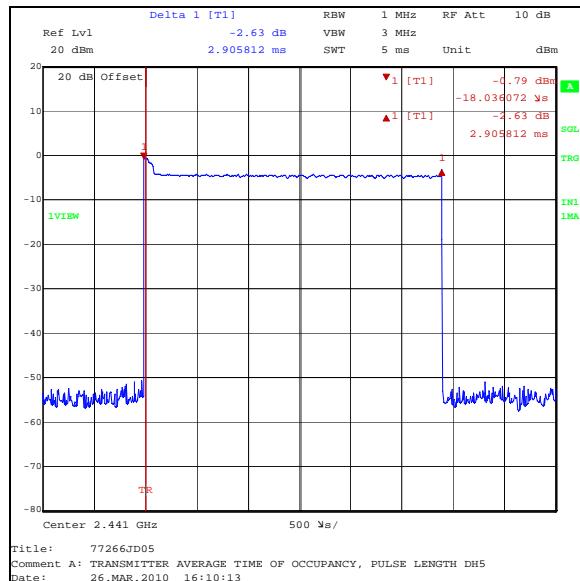
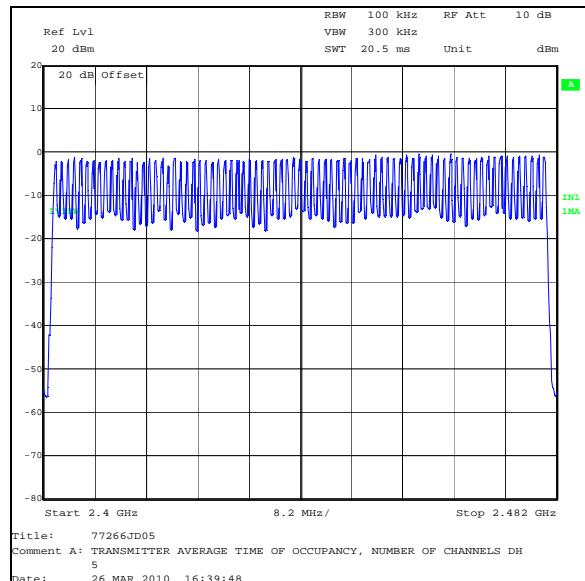
Temperature (°C):	26
Relative Humidity (%):	26

**Results:**

Emission Width (μs)	Number of Hops in 31.6 Seconds	Average Time of Occupancy (s)	Limit (s)	Margin (s)	Result
2905.812	55	0.160	0.4	0.24	Complied

**Note(s):**

1. Tests were performed to identify the average time of occupancy in number of channels (79) x 0.4 seconds. The calculated period is 31.6 seconds.

**Transmitter Average Time of Occupancy (continued)**

**5.2.5. Transmitter Maximum Peak Output Power (EIRP)****Test Summary:**

<b>FCC Part:</b>	15.247(b)(3)
<b>Test Method Used:</b>	As detailed in Public Notice DA 00-705 (March 30, 2000), ANSI TIA-603-C-2004 and FCC CFR Part 2

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	30

**Results: Battery Powered Devices**

Channel	EIRP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	2.8	30.0	27.2	Complied
Middle	1.0	30.0	29.0	Complied
Top	1.7	30.0	28.3	Complied

**Note(s):**

1. These tests were performed radiated; therefore the EUT antenna gain is encompassed in the final result and not measurable.
2. Measurements were performed with the test antenna in the vertical and horizontal planes. The highest level was recorded.

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

FCC Part:	15.247(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.4 Section 8 and Public Notice DA 00-705 (March 30, 2000)
Frequency Range	30 MHz to 1000 MHz

**Environmental Conditions:**

Temperature (°C):	25
Relative Humidity (%):	30

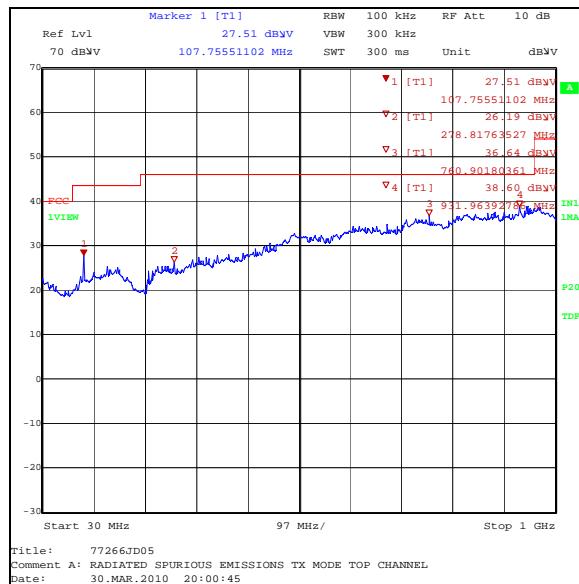
**Results: Top Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Quasi-Peak Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
107.582	Vertical	25.9	43.5	17.6	Complied
153.240	Horizontal	22.4	43.5	21.1	Complied
681.202	Vertical	27.9	46.0	18.1	Complied
945.539	Vertical	35.8	46.0	10.2	Complied

**Note(s):**

1. 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.

### Transmitter Radiated Emissions (continued)



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

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

<b>FCC Part:</b>	15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 8 and Public Notice DA 00-705 (March 30, 2000)
<b>Frequency Range</b>	1GHz to 26 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	29

**Results: Highest Peak Level. Bottom Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4803.992	Horizontal	45.4	-1.8	43.6	74.0	30.4	Complied

**Results: Highest Average Level. Bottom Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4803.970	Horizontal	39.4	-1.8	37.6	54.0	36.4	Complied

**Results: Highest Peak Level. Middle Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4578.161	Vertical	43.5	-2.6	40.9	74.0	33.1	Complied
4882.133	Horizontal	50.6	-1.2	49.4	74.0	24.6	Complied

**Transmitter Radiated Emissions (continued)****Results: Highest Average Level. Middle Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4578.111	Vertical	38.6	-2.6	36.0	54.0	18.0	Complied
4881.877	Horizontal	47.0	-1.2	45.8	54.0	8.2	Complied

**Results: Highest Peak Level. Top Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4694.906	Vertical	45.0	-1.9	43.1	74.0	30.9	Complied
4959.692	Horizontal	47.8	-1.6	46.2	74.0	27.8	Complied

**Results: Highest Average Level. Top Channel - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4694.928	Vertical	40.5	-1.9	38.6	54.0	15.4	Complied
4959.978	Horizontal	43.6	-1.6	42.0	54.0	12.0	Complied

**Results: Highest Peak Level. Hopping Mode - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4960.166	Horizontal	45.9	-1.4	45.5	74.0	28.5	Complied

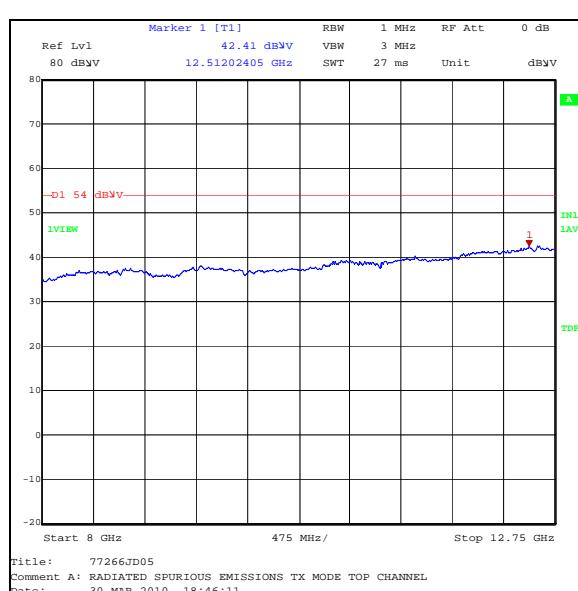
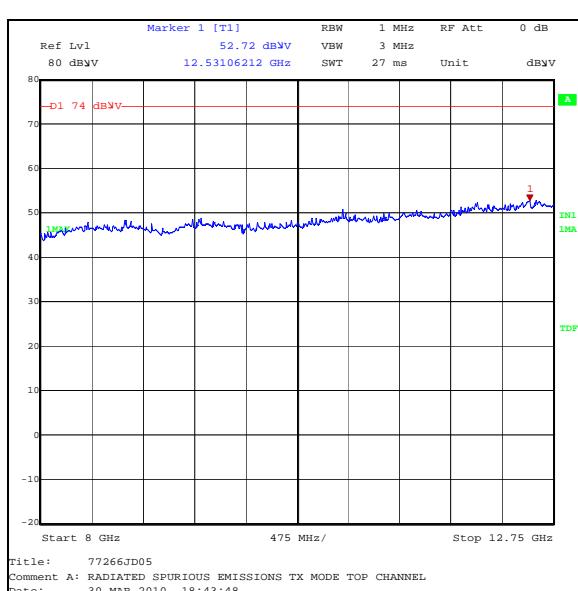
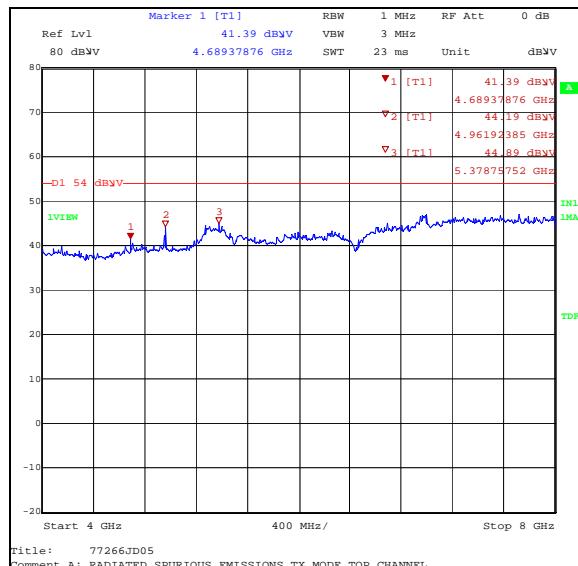
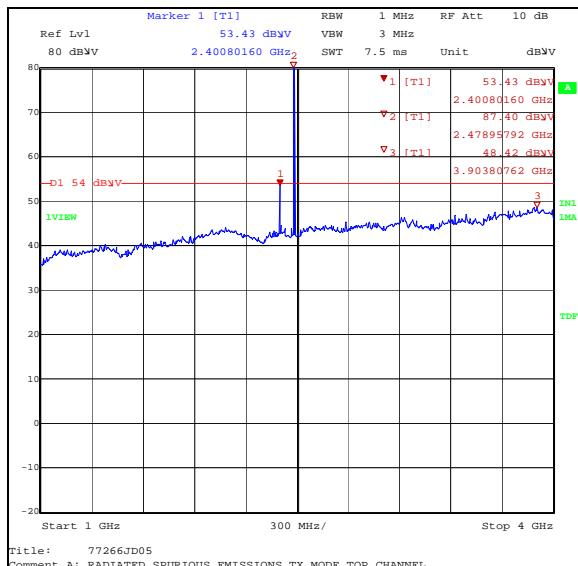
**Transmitter Radiated Emissions (continued)****Results: Highest Average Level. Hopping Mode - Emissions Occurring in the Restricted Bands**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4959.997	Horizontal	44.3	-1.4	42.9	54.0	11.1	Complied

**Note(s):**

1. All pre-scan were performed with the peak detector against average limit apart from the measurements made in the range of 8 GHz to 26.5 GHz where pre-scans were performed with peak and average detector and the applicable limits apply. This was due to the noise floor exceeding the average limit when using the peak detector.
2. The emission's shown on plot 1 GHz to 4 GHz is the EUT fundamental frequency at 2480 MHz. The other emission at approximately 2402 MHz is the unlink/downlink traffic channels coming from the test set.
3. The emission at 4694.906 MHz could only be seen on the top channel; therefore on channels bottom and hopping it was under the noise floor and could not be measured.
4. The emission shown in plot 4 GHz to 8 GHz at approximately 5378.758 is an ambient.

## Transmitter Radiated Emissions (continued)

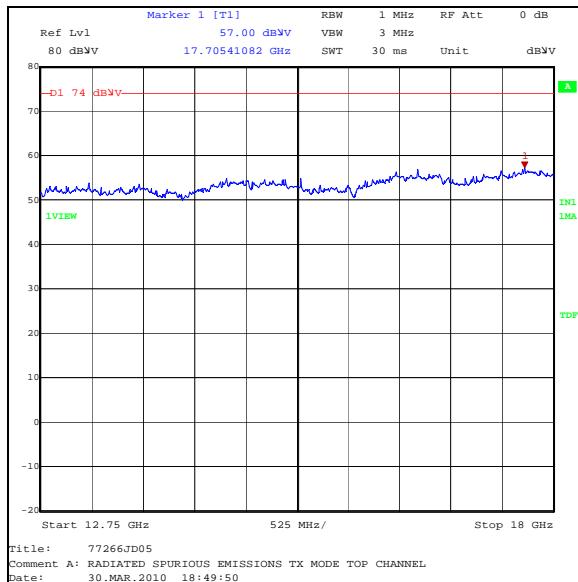


Peak Detector

Average Detector

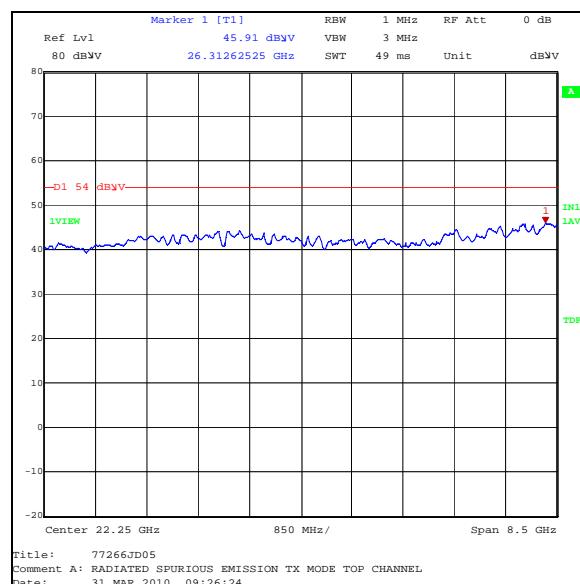
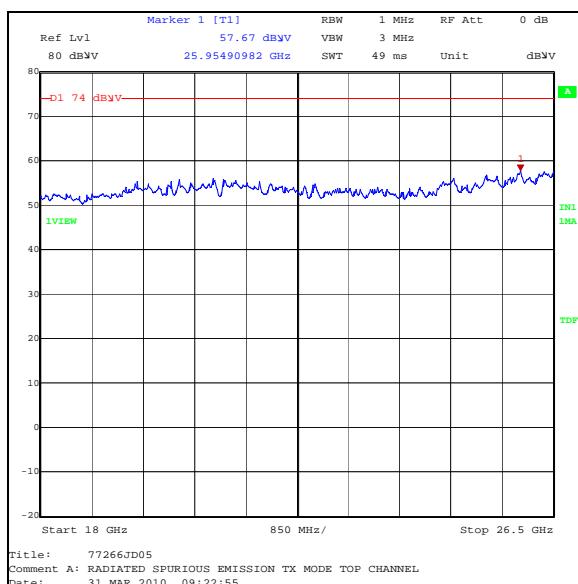
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

## Transmitter Radiated Emissions (continued)



Peak Detector

Average Detector



Peak Detector

Average Detector

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

**5.2.7. Transmitter Band Edge Radiated Emissions****Test Summary:**

<b>FCC Part:</b>	15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.4 Section 8 and Public Notice DA 00-705 (March 30, 2000)

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	29

**Results: Peak Power Level Hopping Mode**

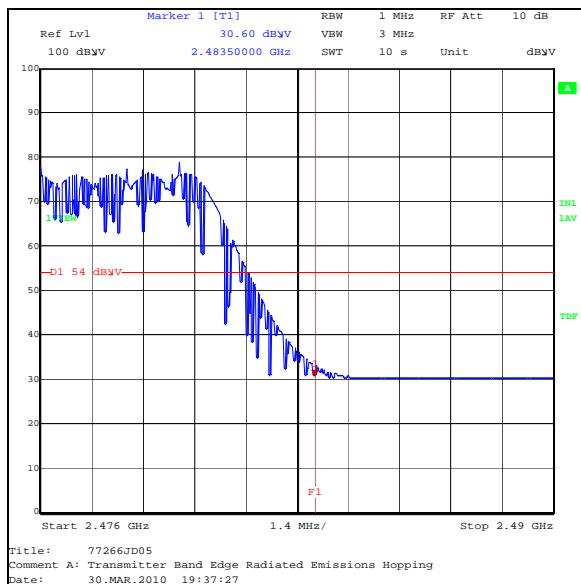
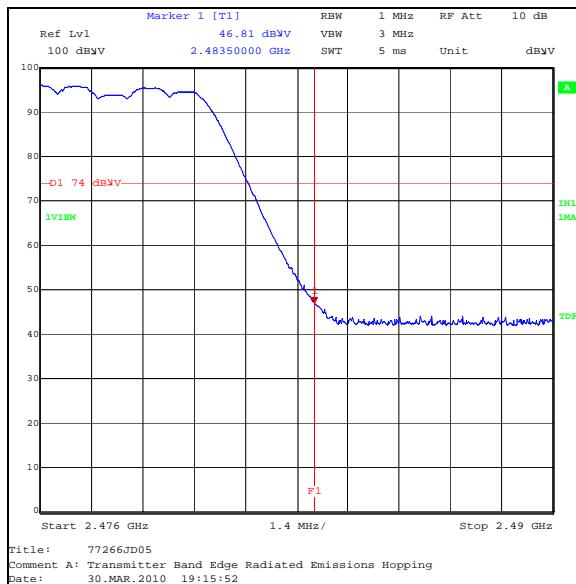
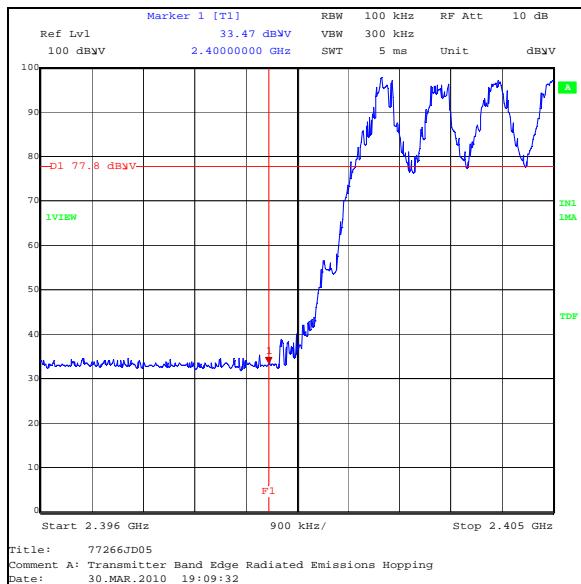
Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.0	Vertical	33.7	-0.2	33.5	77.8*	44.3	Complied
2483.5	Vertical	47.1	-0.3	46.8	74.0	27.2	Complied

**Results: Average Power Level Hopping Mode**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	Vertical	30.9	-0.3	30.6	54.0	23.4	Complied

**Note(s):**

1. \* -20 dBc limit

**Transmitter Band Edge Radiated Emissions (continued)**

**Transmitter Band Edge Radiated Emissions (continued)****Results: Peak Power Level Static Mode**

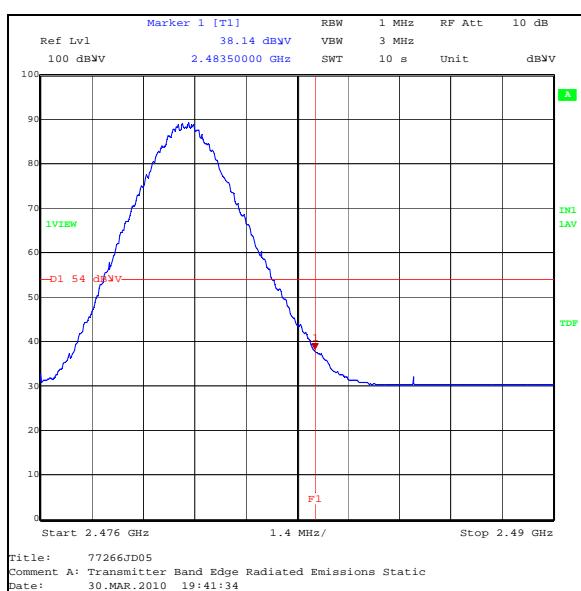
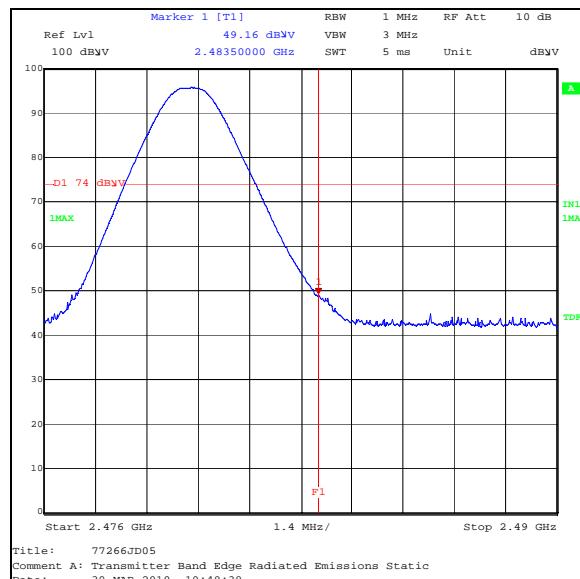
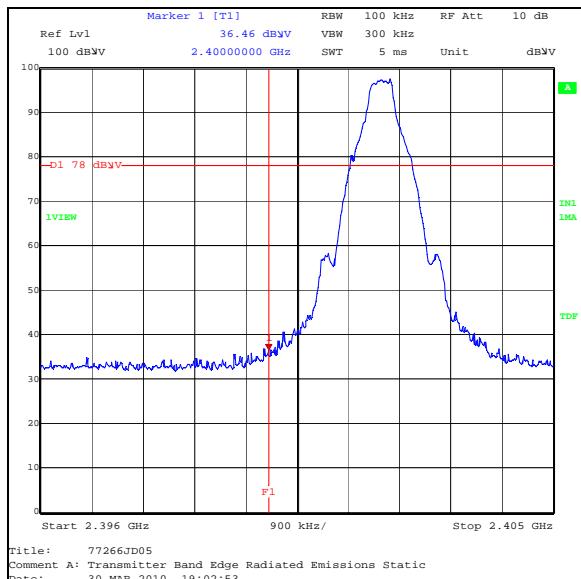
Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.0	Vertical	36.7	-0.2	36.5	78.0*	41.5	Complied
2483.5	Vertical	49.5	-0.3	49.2	74.0	24.8	Complied

**Results: Average Power Level Static Mode**

Frequency (MHz)	Antenna Polarity	Detector Level (dB $\mu$ V)	Transducer Factor (dB)	Actual Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	Vertical	38.4	-0.3	38.1	54.0	15.9	Complied

**Note(s):**

1. \* -20 dBc limit

**Transmitter Band Edge Radiated Emissions (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
Transmitter Maximum Peak Output Power	2402 MHz to 2480 MHz	95%	$\pm 2.94$ dB
Transmitter Carrier Frequency Separation	2402 MHz to 2480 MHz	95%	$\pm 0.92$ ppm
Transmitter Average Time of Occupancy	2402 MHz to 2480 MHz	95%	$\pm 0.3$ ns
20 dB Bandwidth	2402 MHz to 2480 MHz	95%	$\pm 0.92$ ppm
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	$\pm 4.68$ dB
Radiated Spurious Emissions	30 MHz to 26.5 GHz	95%	$\pm 2.94$ 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)
A1396	Attenuator	HUBER + SUHNER AG	757987	6810.17.B	Calibrated before use	-
A1534	Pre Amplifier	Hewlett Packard	8449B OPT H02	3008A00405	Calibrated before use	-
A1818	Antenna	EMCO	3115	00075692	27 Nov 2009	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	Calibrated before use	-
A288	Antenna	Chase	CBL6111A	1589	16 Mar 2010	12
A436	Antenna	Flann	20240-20	330	Calibrated before use	
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
K0001	5m Semi-Anechoic Chamber	Rainford EMC	N/A	N/A	04 May 2009	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	09 Mar 2009	14
M1149	Bluetooth Test Set	Anritsu	MT8852A	6K00001529	Calibration not required	-
M1239	N4010A	Agilent	N4010A	GB45140361	Calibration not required	-
M208	Thermometer/ Hygrometer	RS Components Ltd	RS212-124	M208-RS212-124	30 Apr 2009	12

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