



# TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Telensa TC-A2-NM-XX-E

To: FCC Part 15.247: 2009 Subpart C

**Test Report Serial No:**  
RFI-RPT-RP76924JD12B

**Version 2.0 supersedes all previous versions**

<b>This Test Report Is Issued Under The Authority</b> pp  <b>Of Brian Watson,</b> <b>COO Payments and Consultancy:</b>	
<b>Checked By:</b>	R. Graham
<b>Signature:</b>	
<b>Date of Issue:</b>	19 May 2010

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.

**RFI Global Services Ltd**

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire RG23 8BG  
Telephone: +44 (0)1256 312000 Facsimile: +44 (0)1256 312001  
Email: [info@rfi-global.com](mailto:info@rfi-global.com) Website: [www.rfi-global.com](http://www.rfi-global.com)

Registered in England and Wales. Company number: 2117901

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 ..... 10**

**5. Measurements, Examinations and Derived Results ..... 11**

**6. Measurement Uncertainty ..... 36**

**Appendix 1. Test Equipment Used ..... 37**

**1. Customer Information**












<b>Company Name:</b>	Telensa Ltd
<b>Address:</b>	Plextek Building London Road Great Chesterford Essex CB10 1NY United Kingdom

## **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>	47CFR15.107 and 47CFR15.109
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 15 Subpart B (Unintentional Radiators) - Sections 15.107 and 15.109
<b>Specification Reference:</b>	47CFR15.207
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 15 Subpart C (Intentional Radiators) - Sections 15.107 and 15.109
<b>Site Registration:</b>	FCC: 209735
<b>Location of Testing:</b>	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	09 April 2010 to 13 April 2010

### **2.2. Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
Part 15.107	Receiver/Idle Mode AC Conducted emissions	
Part 15.109	Receiver/Idle Mode Radiated Spurious Emissions	
Part 15.207	Transmitter AC Conducted emissions	
Part 15.247(a)(1)(i)	Transmitter 20 dB Bandwidth	
Part 15.247(a)(1)	Transmitter Carrier Frequency Separation	
Part 15.247(a)(1)(i)	Transmitter Average Time of Occupancy	
Part 15.247(b)(2)	Transmitter Maximum Peak Output Power	
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	
<b>Key to Results</b>  = Complied  = Did not comply		

**2.3. Methods and Procedures**

<b>Reference:</b>	ANSI C63.4 (2009)
<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>	ANSI C63.10 (2009)
<b>Title:</b>	American National Standard for Testing Unlicensed Wireless Devices

**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>	Dimmer compatible multi voltage NEMA Telecell
<b>Brand Name:</b>	Telensa
<b>Model Name or Number:</b>	TC-A2-NM-XX-E
<b>Serial Number:</b>	LL3503
<b>Hardware Version Number:</b>	Build standard LLYB0302
<b>Software Version Number:</b>	2.6.2
<b>FCC ID Number:</b>	XYD-TCNM-E

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

The equipment under test was a streetlight control and monitoring device.

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

No modifications were applied to the EUT during testing.

**3.4. Additional Information Related to Testing**

Tested Technology:	Frequency Hopping Spread Spectrum device operating in the ISM band with a 20 dB bandwidth of less than 250 kHz and hopping on more than 50 frequencies		
120 Volt Power Supply Requirement:	Nominal	120 VAC 60 Hz	
	Minimum	102 VAC 60 Hz	
	Maximum	138 VAC 60 Hz	
240 Volt Power Supply Requirement:	Nominal	204 VAC 60 Hz	
	Minimum	240 VAC 60 Hz	
	Maximum	276 VAC 60 Hz	
Type of Unit:	Transceiver		
Channel Spacing:	25 kHz		
Modulation:	2 level FSK		
Data Rate (kBit/s):	62.5 bps or 500 bps		
Maximum Transmit ERP:	15.8 dBm		
Transmit Frequency Range:	902 MHz to 928 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	Sub-band 0 channel 0	910.500
	Middle	Sub-band 2 channel 58	915.000
	Top	Sub-band 5 channel 58	919.575
Receive Frequency Range:	902 MHz to 928 MHz		
Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	Sub-band 0 channel 0	910.500
	Middle	Sub-band 2 channel 58	915.000
	Top	Sub-band 5 channel 58	919.575



### **3.5. Support Equipment**

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

<b>Description:</b>	Streetlight Luminaire with NEMA socket
<b>Brand Name:</b>	Indal Industrial
<b>Model Name or Number:</b>	ASR150CGN
<b>Serial Number:</b>	2685.22012

<b>Description:</b>	Halogen Lamp
<b>Brand Name:</b>	Everspring Ind. Co. Ltd.
<b>Model Name or Number:</b>	SA122
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Dimming Module
<b>Brand Name:</b>	Telensa Ltd
<b>Model Name or Number:</b>	TDM-A
<b>Serial Number:</b>	LL2422

## **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 at maximum power.
- Transmitting at a data rate of 62.5 bps or 500 bps depending on the test case requirement.
- Receive / idle mode.

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

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

- A laptop computer with bespoke application was used to configure the EUT.
- The EUT was plugged into the Streetlight Luminaire with NEMA socket. This is representative of a typical user configuration. Power to the EUT is supplied via the NEMA socket on the streetlight.
- Power to the streetlight was supplied from a bench power supply. The voltage was monitored using a calibrated digital multimeter.
- A halogen lamp was connected to the luminaire in order to present a typical load current.
- All tests were performed with the EUT powered from a 120 VAC 60 Hz supply as preliminary checks showed there was no difference in the level of fundamental ERP or radiated spurious emissions.

AC conducted emissions tests and ERP measurements were performed with the EUT powered by 120 VAC 60 Hz and then repeated with the EUT powered by 240 VAC 60 Hz to demonstrate compliance with both supply voltages.

## **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(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

**Environmental Conditions:**

<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	29

**Results: Quasi Peak Detector Measurements**

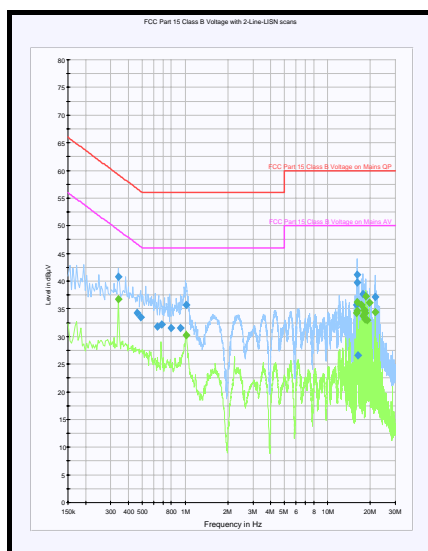
<b>Frequency (MHz)</b>	<b>Line</b>	<b>Level (dBμV)</b>	<b>Limit (dBμV)</b>	<b>Margin (dB)</b>	<b>Result</b>
0.339000	Neutral	40.8	59.2	18.4	Complied
0.460500	Neutral	34.2	56.7	22.5	Complied
0.487500	Neutral	33.5	56.2	22.7	Complied
0.636000	Live	31.8	56.0	24.2	Complied
0.685500	Neutral	32.1	56.0	23.9	Complied
0.793500	Neutral	31.6	56.0	24.4	Complied
0.924000	Live	31.5	56.0	24.5	Complied
1.014000	Live	35.7	56.0	20.3	Complied
15.999000	Neutral	35.7	60.0	24.3	Complied
16.165500	Neutral	39.7	60.0	20.3	Complied
16.228500	Live	41.2	60.0	18.8	Complied
16.377000	Live	26.6	60.0	33.4	Complied
17.691000	Neutral	37.6	60.0	22.4	Complied
21.660000	Neutral	37.1	60.0	22.9	Complied

**Idle Mode AC Conducted Spurious Emissions (continued)****Results: Average Detector Measurements**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.339000	Neutral	36.8	49.2	12.4	Complied
1.018500	Neutral	30.2	46.0	15.8	Complied
16.003500	Neutral	34.3	50.0	15.7	Complied
16.165500	Live	34.7	50.0	15.3	Complied
16.228500	Neutral	36.2	50.0	13.8	Complied
17.385000	Neutral	35.6	50.0	14.4	Complied
17.695500	Neutral	33.7	50.0	16.3	Complied
18.177000	Live	34.8	50.0	15.2	Complied
18.244500	Neutral	34.7	50.0	15.3	Complied
18.303000	Neutral	34.2	50.0	15.8	Complied
18.366000	Neutral	33.1	50.0	16.9	Complied
18.573000	Neutral	37.2	50.0	12.8	Complied
18.969000	Neutral	32.9	50.0	17.1	Complied
19.707000	Neutral	36.1	50.0	13.9	Complied
21.664500	Neutral	34.4	50.0	15.6	Complied

**Note(s):**

- The EUT transmitter was disabled during the test.



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

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

<b>FCC Part:</b>	15.109
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
<b>Frequency Range:</b>	30 MHz to 1000 MHz

**Environmental Conditions:**

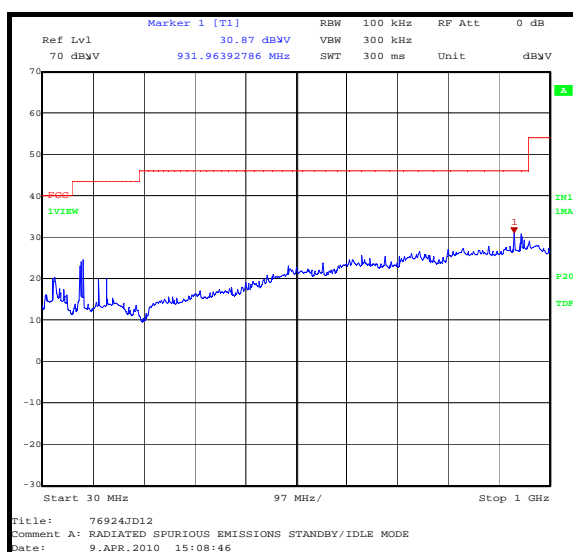
<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	21

**Results: Quasi Peak Detector Measurements**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
931.964	vertical	30.9	54.0	23.1	Complied

**Note(s):**

1. The EUT transmitter was disabled during the test.
2. All emissions shown on the pre-scan plots were investigated and found to be ambient, therefore the highest noise floor level was recorded.



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

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

<b>FCC Part:</b>	15.109
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
<b>Frequency Range:</b>	1 GHz to 4.6 GHz

**Environmental Conditions:**

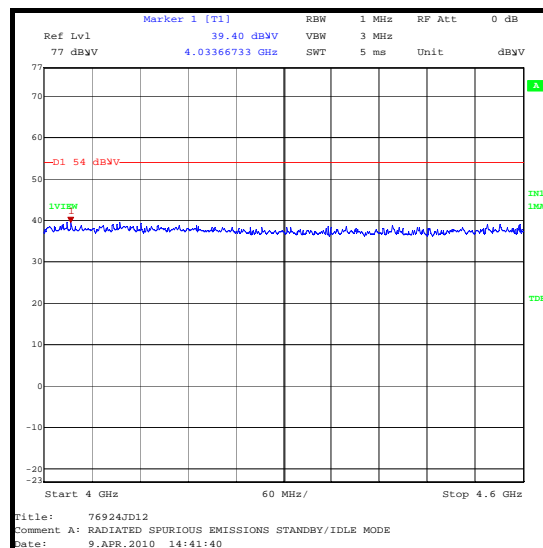
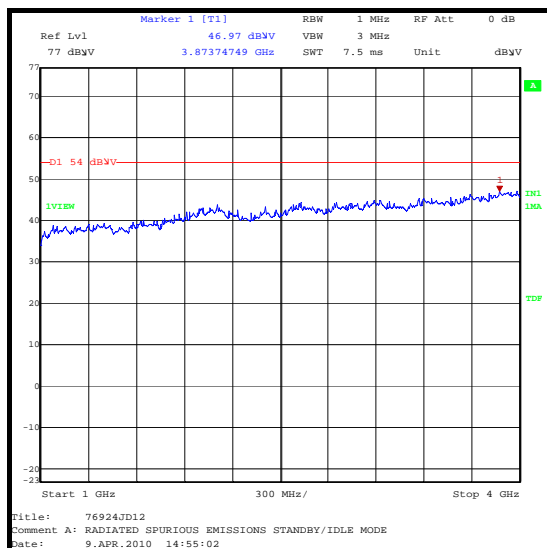
<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	22

**Results:**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
3873.747	Vertical	47.0	54.0	7.0	Complied

**Note(s):**

1. The EUT transmitter was disabled during the test.
2. No emissions were observed above the noise floor of the measurement system. The highest noise floor level was recorded in the above table.



**5.2.3. Transmitter AC Conducted Spurious Emissions****Test Summary:**

<b>FCC Part:</b>	15.207(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

**Environmental Conditions:**

<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	31

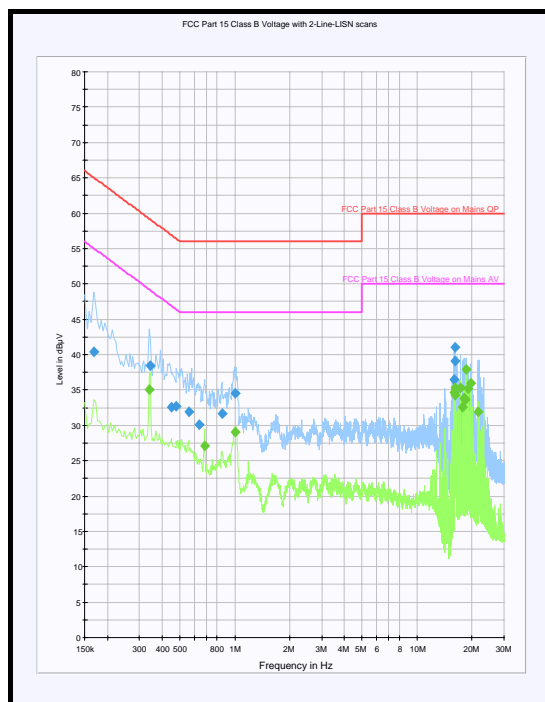
**Results: Quasi Peak Detector Measurements – 120 Volts**

<b>Frequency (MHz)</b>	<b>Line</b>	<b>Level (dBμV)</b>	<b>Limit (dBμV)</b>	<b>Margin (dB)</b>	<b>Result</b>
0.168000	Neutral	40.3	65.1	24.8	Complied
0.343500	Live	38.4	59.1	20.7	Complied
0.451500	Neutral	32.6	56.8	24.2	Complied
0.474000	Live	32.7	56.4	23.7	Complied
0.559500	Live	31.9	56.0	24.1	Complied
0.636000	Neutral	30.1	56.0	25.9	Complied
0.852000	Live	31.6	56.0	24.4	Complied
1.009500	Live	34.5	56.0	21.5	Complied
16.003500	Live	36.5	60.0	23.5	Complied
16.165500	Neutral	39.0	60.0	21.0	Complied
16.228500	Neutral	41.0	60.0	19.0	Complied



**Transmitter AC Conducted Spurious Emissions (continued)****Results: Average Detector Measurements – 120 Volts**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.339000	Live	35.1	49.2	14.1	Complied
0.681000	Neutral	27.1	46.0	18.9	Complied
1.000500	Neutral	29.1	46.0	16.9	Complied
16.003500	Neutral	34.6	50.0	15.4	Complied
16.165500	Live	34.3	50.0	15.7	Complied
16.228500	Live	35.3	50.0	14.7	Complied
17.389500	Live	35.3	50.0	14.7	Complied
17.695500	Live	32.5	50.0	17.5	Complied
18.177000	Live	33.8	50.0	16.2	Complied
18.244500	Live	33.7	50.0	16.3	Complied
18.303000	Live	33.6	50.0	16.4	Complied
18.573000	Neutral	38.0	50.0	12.0	Complied
18.969000	Neutral	35.1	50.0	14.9	Complied
19.707000	Live	35.9	50.0	14.1	Complied
21.664500	Live	31.9	50.0	18.1	Complied



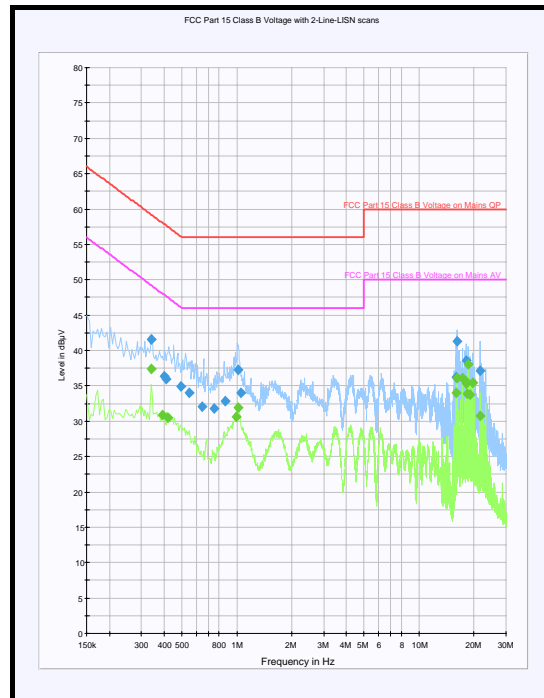
*Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.*

**Transmitter AC Conducted Spurious Emissions (continued) – 240 Volts****Results: Quasi Peak Detector Measurements – 240 Volts**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.339000	Neutral	41.6	59.2	17.6	Complied
0.402000	Neutral	36.3	57.8	21.5	Complied
0.411000	Neutral	36.0	57.6	21.6	Complied
0.492000	Live	34.9	56.1	21.2	Complied
0.546000	Neutral	34.0	56.0	22.0	Complied
0.645000	Neutral	32.1	56.0	23.9	Complied
0.753000	Neutral	31.8	56.0	24.2	Complied
0.861000	Live	32.9	56.0	23.1	Complied
1.014000	Live	37.2	56.0	18.8	Complied
1.054500	Live	34.0	56.0	22.0	Complied
16.003500	Neutral	36.2	60.0	23.8	Complied
16.228500	Neutral	41.3	60.0	18.7	Complied
18.244500	Live	38.6	60.0	21.4	Complied
21.664500	Live	37.1	60.0	22.9	Complied

**Results: Average Detector Measurements – 240 Volts**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.339000	Neutral	37.3	49.2	11.9	Complied
0.388500	Neutral	30.9	48.1	17.2	Complied
0.420000	Live	30.4	47.4	17.0	Complied
0.991500	Live	30.7	46.0	15.4	Complied
1.018500	Live	31.9	46.0	14.1	Complied
16.003500	Neutral	34.1	50.0	15.9	Complied
16.228500	Neutral	36.0	50.0	14.0	Complied
17.389500	Neutral	36.0	50.0	14.0	Complied
18.181500	Live	35.3	50.0	14.7	Complied
18.244500	Neutral	35.6	50.0	14.4	Complied
18.303000	Live	33.9	50.0	16.1	Complied
18.577500	Live	38.0	50.0	12.0	Complied
18.973500	Neutral	33.7	50.0	16.3	Complied
19.707000	Live	35.5	50.0	14.5	Complied
21.664500	Live	30.7	50.0	19.3	Complied

**Transmitter AC Conducted Spurious Emissions – 240 Volts (continued)**

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

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

<b>FCC Part:</b>	15.247(a)(1)(i)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.1

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	29

**Results 62.5 bps:**

<b>Channel</b>	<b>Transmitter 20 dB Bandwidth (kHz)</b>	<b>Limit (kHz)</b>
910.500	1.087	500
915.000	0.896	500
919.575	1.057	500

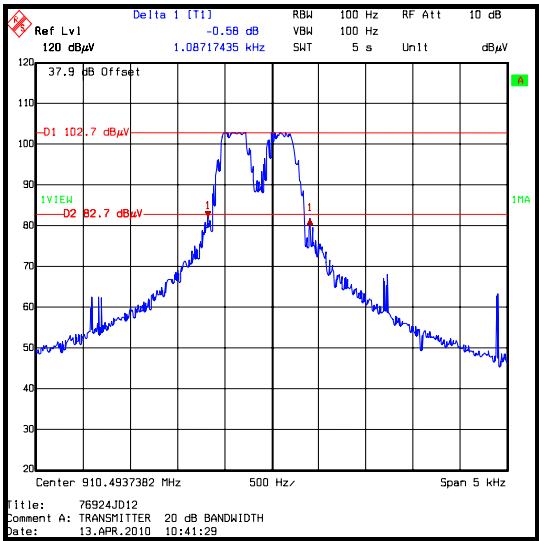
**Results 500 bps:**

<b>Channel</b>	<b>Transmitter 20 dB Bandwidth (kHz)</b>	<b>Limit (kHz)</b>
910.500	1.277	500
915.000	1.227	500
919.575	1.227	500

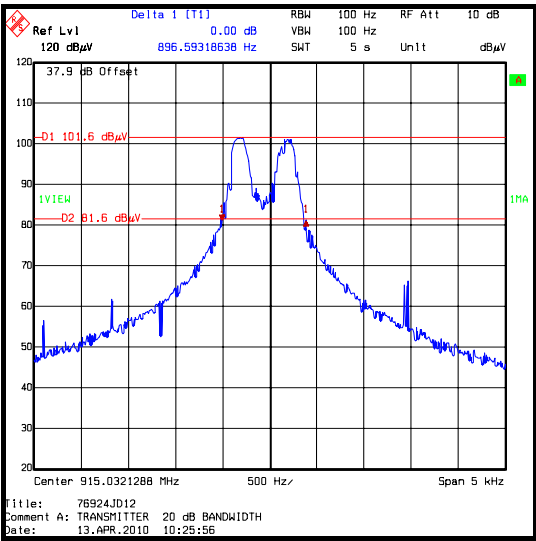
**Note(s):**

1. Tests were performed at both data rates supported by the EUT.

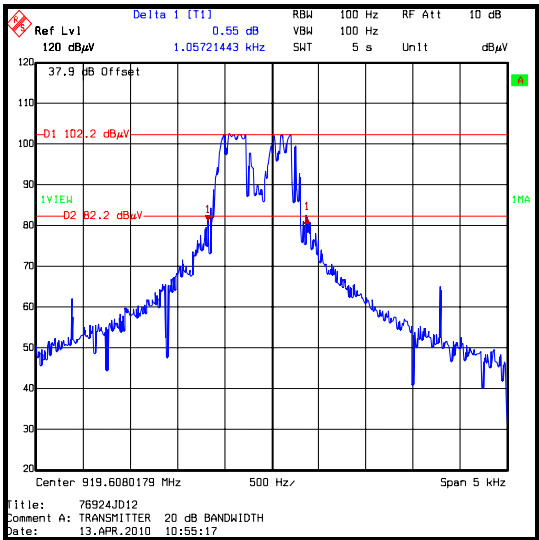
Transmitter 20 dB Bandwidth (continued)



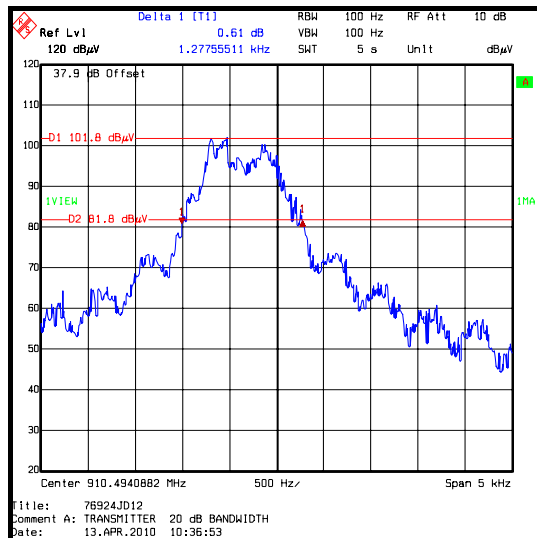
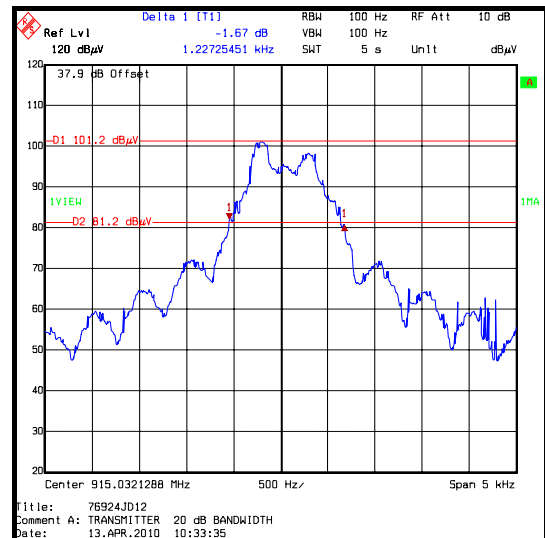
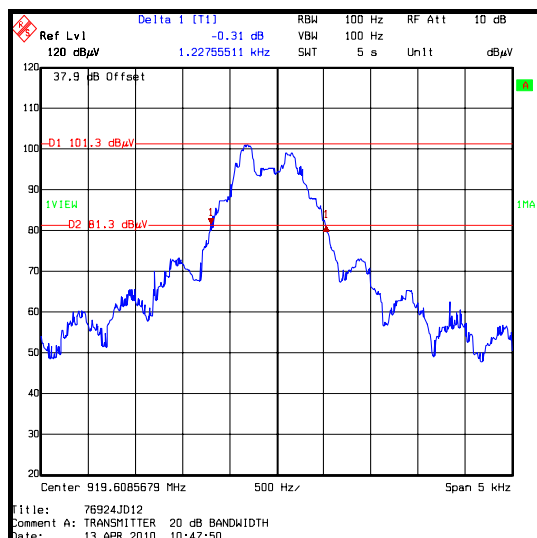
Bottom Channel / 62.5 bps



Centre Channel / 62.5 bps



Top Channel / 62.5 bps

**Transmitter 20 dB Bandwidth (continued)****Bottom Channel / 500 bps****Centre Channel / 500 bps****Top Channel / 500 bps**

**5.2.5. Transmitter Carrier Frequency Separation****Test Summary:**

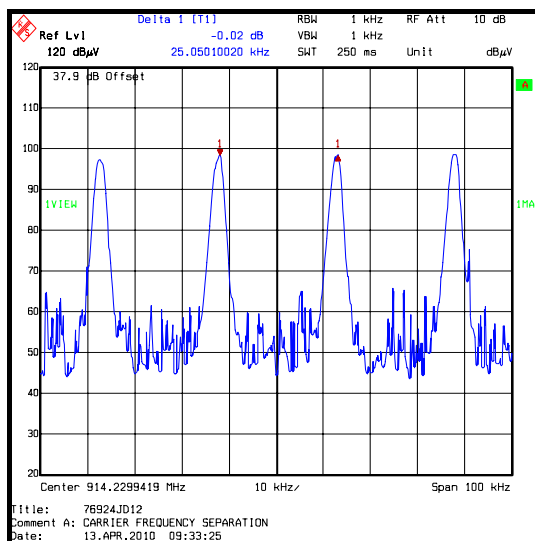
<b>FCC Part:</b>	15.247(a)(1)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 7.7.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	29

**Results:**

<b>Transmitter Carrier Frequency Separation (kHz)</b>	<b>Limit (kHz)</b>	<b>Margin (kHz)</b>	<b>Result</b>
25.05	25.0	0.05	Complied

**Note(s):**

1. The hopping function of the EUT was enabled. Markers were placed on the peaks of two adjacent channels and the frequency delta recorded.

**5.2.6. Transmitter Time of Occupancy****Test Summary:**

<b>FCC Part:</b>	15.247(a)(1)(i)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 7.7.4

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	28

Tests were performed to determine the transmission duration and the silent period time of the transmitter.

<b>Operating Mode</b>	<b>Transmit Duration Time (Burst Length) (seconds in 20 second period)</b>
Normal	0.3899

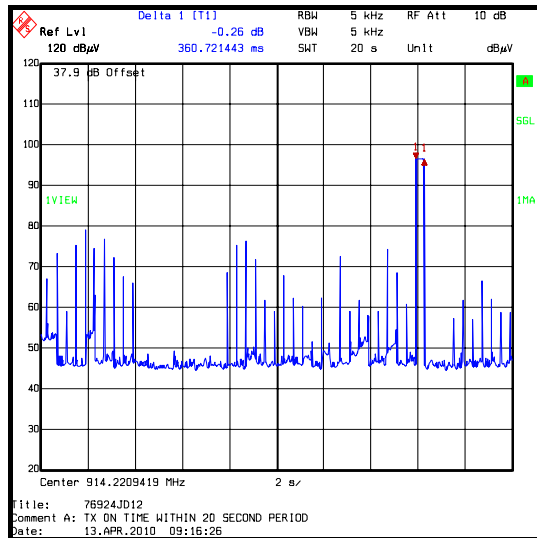
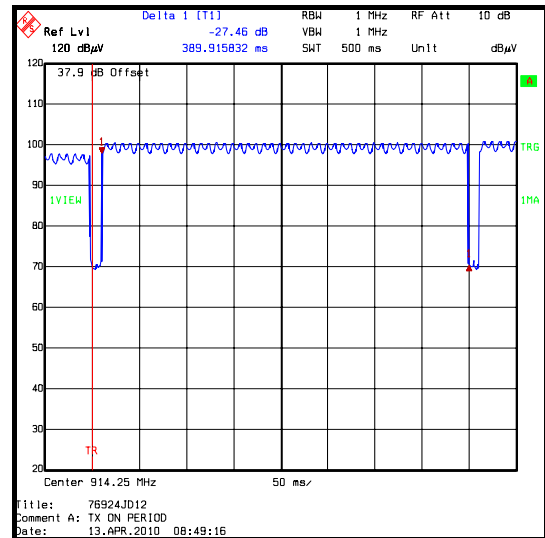
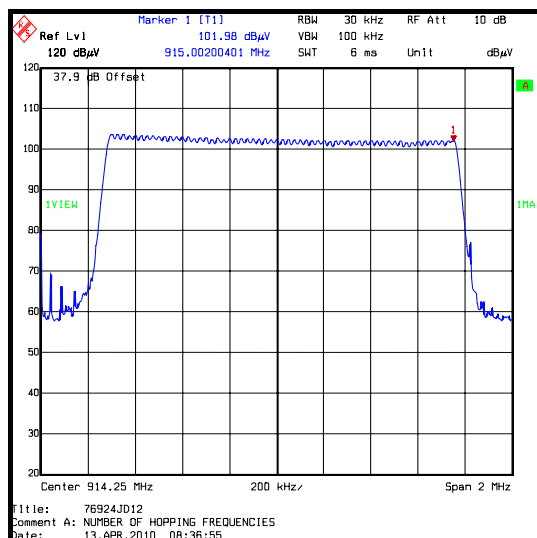
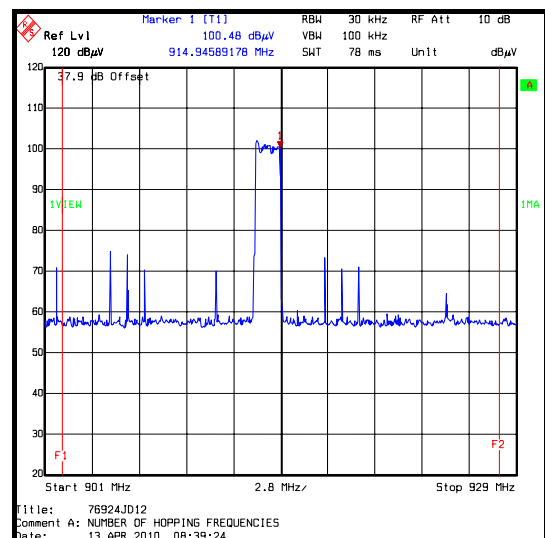
<b>Operating Mode</b>	<b>Transmit Off Time (seconds in 20 second period)</b>
Normal	19.61

<b>Operating Mode</b>	<b>Number of Hopping Channels in Sub-Band</b>
Normal	59

**Note(s):**

1. The hopping function of the EUT was enabled.
2. The EUT operates over six sub-bands in the 902-928 MHz band. Each sub-band has 59 channels and a bandwidth of 1.5 MHz. The Client stated that the hopping sequence is identical in each sub-band.
3. The test was performed with the EUT transmitting in sub-band 2 which is the only sub-band that incorporates the channel in the centre of the 902-928 MHz band. The EUT was transmitting 500 bps during the test, the Client confirmed there is no difference between any of the hopping characteristics or burst duration when transmitting 62.5 bps.
4. The channel width is 25 kHz. Time of occupancy measurements were made using a measurement bandwidth of 5 kHz in order to avoid emissions from adjacent channels.



**Transmitter Time of Occupancy (continued)****TX on time in 20 second period****TX on period****Number of hopping channels (sub-band)****Number of hopping channels  
(showing sub-band within operating band)**

**5.2.7. Transmitter Maximum Peak Output Power (ERP)****Test Summary:**

<b>FCC Part:</b>	15.247(b)(2)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4 (see note 2 below)

**Environmental Conditions:**

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

**Results: AC Powered Devices - 120V Nominal**

Channel	Input Voltage (AC)	ERP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	102	15.8	30.0	14.2	Complied
Bottom	120	15.8	30.0	14.2	Complied
Bottom	138	15.8	30.0	14.2	Complied
Middle	102	15.3	30.0	14.7	Complied
Middle	120	15.3	30.0	14.7	Complied
Middle	138	15.3	30.0	14.7	Complied
Top	102	15.0	30.0	15.0	Complied
Top	120	15.0	30.0	15.0	Complied
Top	138	15.0	30.0	15.0	Complied

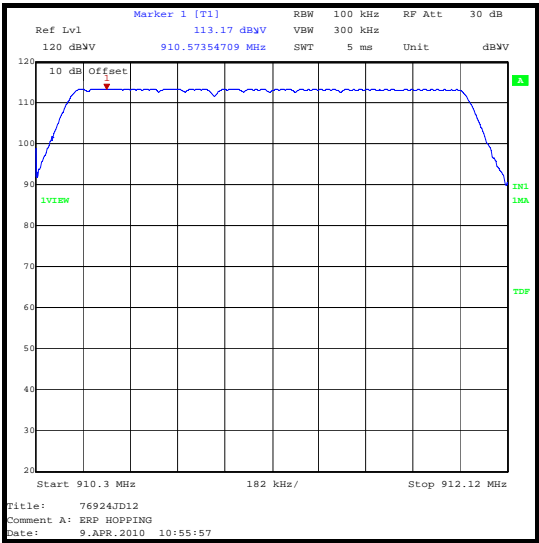
**Results: AC Powered Devices - 240V Nominal**

Channel	Input Voltage (AC)	ERP (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	204	15.8	30.0	14.2	Complied
Bottom	240	15.8	30.0	14.2	Complied
Bottom	276	15.8	30.0	14.2	Complied
Middle	204	15.3	30.0	14.7	Complied
Middle	240	15.3	30.0	14.7	Complied
Middle	276	15.3	30.0	14.7	Complied
Top	204	15.0	30.0	15.0	Complied
Top	240	15.0	30.0	15.0	Complied
Top	276	15.0	30.0	15.0	Complied

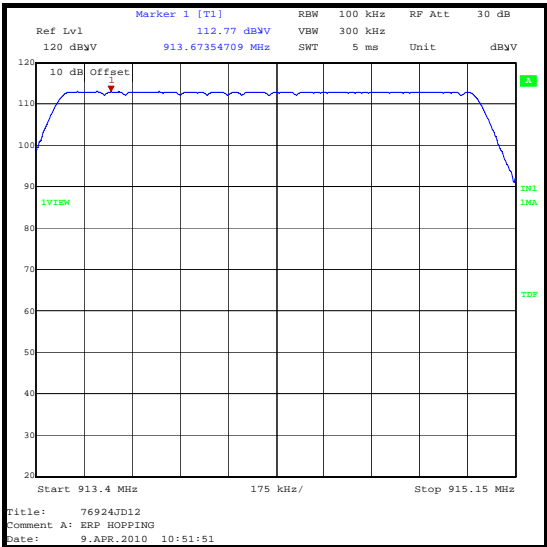
**Transmitter Maximum Peak Output Power (ERP) Continued.****Note(s):**

1. These tests were performed radiated; therefore the EUT antenna gain is encompassed in the final result and not measurable.
2. Tests were performed using the test methods described in ANSI C63.10 Sections 6.3 and 6.6 in lieu of the test method for a conducted measurement described in ANSI C63.10 Section 6.10.1.
3. The EUT operates at 120 VAC 60 Hz and also 240 VAC 60 Hz. Testing was performed at nominal, 85%, and 115% of both rated supply voltages as required in FCC Part 15.31(e).
4. Tests were performed with the EUT static on the bottom, centre and top channels and then repeated while frequency hopping across three sub-bands of operation. It can be seen from the plots on the following page that the power was the same across each of the three sub-bands tested when the EUT was in hopping mode.
5. 62.5 bps and 500 bps transmission rates were tested on bottom, centre and top channels. No difference in ERP levels was observed.
6. No correction was made for duty cycle as the EUT has a TX On period of >10 seconds when measured on the bottom, centre and top channels and not frequency hopping (worst case).

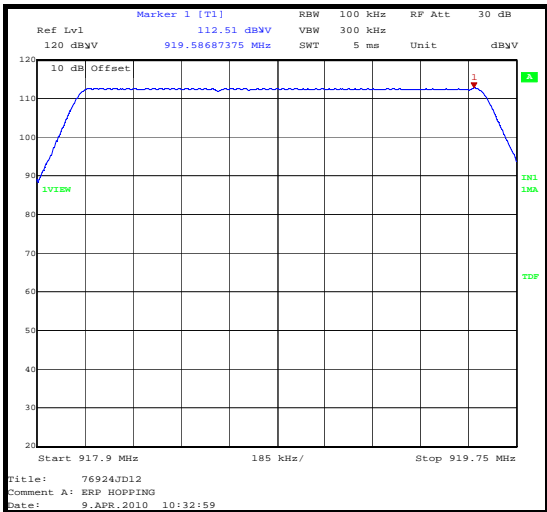
Transmitter Maximum Peak Output Power (ERP) (continued)



ERP Hopping / Lower Sub-Band



ERP Hopping / Centre Sub-Band



ERP Hopping / Upper Sub-Band

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

<b>FCC Part:</b>	15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
<b>Frequency Range</b>	30 MHz to 1000 MHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	23

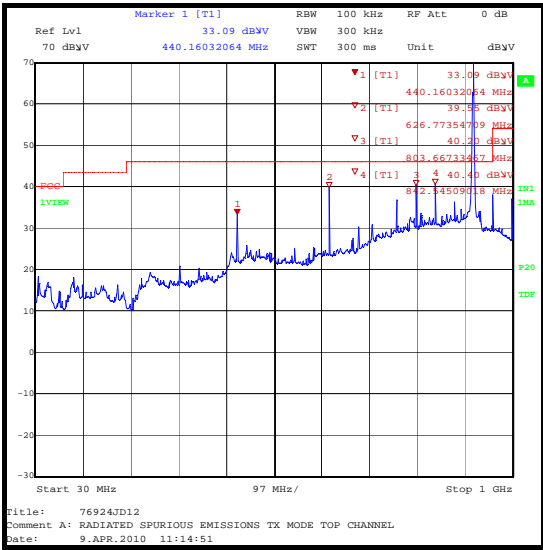
**Results: Top Channel**

<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>
440.323	Vertical	32.3	92.4*	60.1	Complied
622.014	Vertical	28.3	92.4*	64.1	Complied
763.935	Vertical	35.6	92.4*	56.8	Complied
802.847	Vertical	38.8	92.4*	53.6	Complied
841.762	Vertical	40.8	92.4*	51.6	Complied
958.504	Vertical	39.2	92.4*	53.2	Complied

**Note(s):**

1. \*-20 dBc limit
2. The carrier is shown on the pre-scan plot at approximately 920 MHz.
3. 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.
4. All other emissions shown on the pre-scan plot were investigated and found to be >20 dB below the applicable limits or below the noise floor of the measurement system.
5. No emissions were observed within the restricted bands.

Transmitter Radiated Emissions (continued)



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

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

<b>FCC Part:</b>	15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
<b>Frequency Range</b>	1 GHz to 9.20 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	21

**Results: Highest Peak Level. Bottom Channel**

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
1.820975	Vertical	43.3	-2.1	41.2	93.2*	52.0	Complied

**Results: Highest Peak Level. Middle Channel**

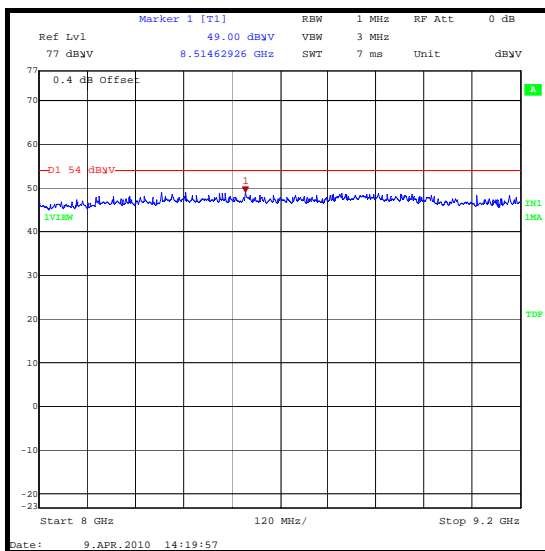
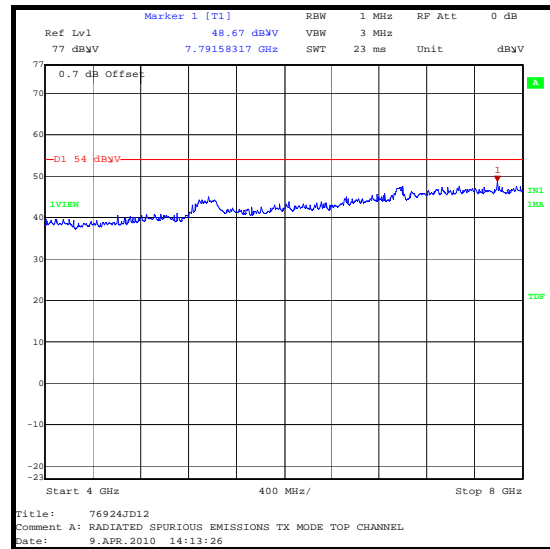
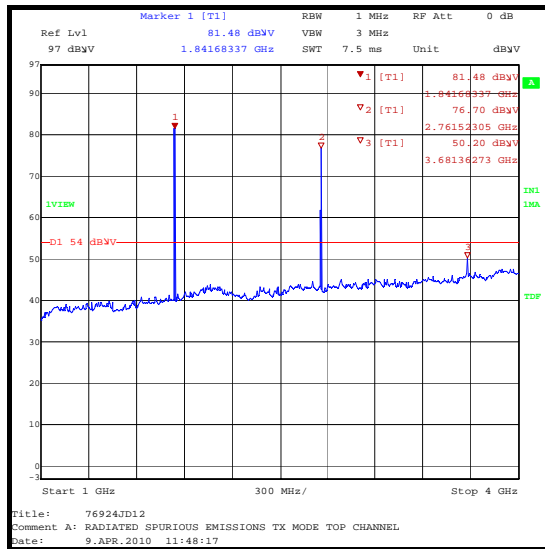
Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
1.830047	Vertical	43.8	-2.0	41.8	92.7*	50.9	Complied

**Results: Highest Peak Level. Top Channel**

Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
1.839199	Vertical	43.7	-1.9	41.8	92.4*	50.6	Complied

**Note(s):**

1. \*-20 dBc limit
2. The high level second, third and fourth harmonic emissions shown on the 1 GHz to 4 GHz pre-scan plot were caused by an overload on the spectrum analyser due to the high level of transmitter fundamental. Final measurements on the bottom, centre and top channels were performed using appropriate high pass RF filters and attenuators. Only the second harmonic was measurable, the third and fourth harmonics were below the noise floor of the measurement system.
3. Measurements were also performed with the EUT transmitting at data rates of 500 bps, 62.5 bps and frequency hopping. No difference in spurious emission levels was observed.
4. Emissions when the EUT was frequency hopping were investigated and found to be lower than those recorded in the above tables.

**Transmitter Radiated Emissions (continued)**

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



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

<b>FCC Part:</b>	15.247(d)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 6.9.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	26
<b>Relative Humidity (%):</b>	29

**Results: Peak Power Level Static Mode / 62.5 bps**

Frequency (MHz)	Emission Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	61.5	93.2	31.3	Complied
928	61.9	92.4	30.3	Complied

**Results: Peak Power Level Hopping Mode / 62.5 bps**

Frequency (MHz)	Emission Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	64.0	93.2	29.2	Complied
928	63.6	92.4	28.8	Complied

**Results: Peak Power Level Static Mode / 500 bps**

Frequency (MHz)	Emission Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	63.6	93.2	29.6	Complied
928	60.7	92.4	31.7	Complied

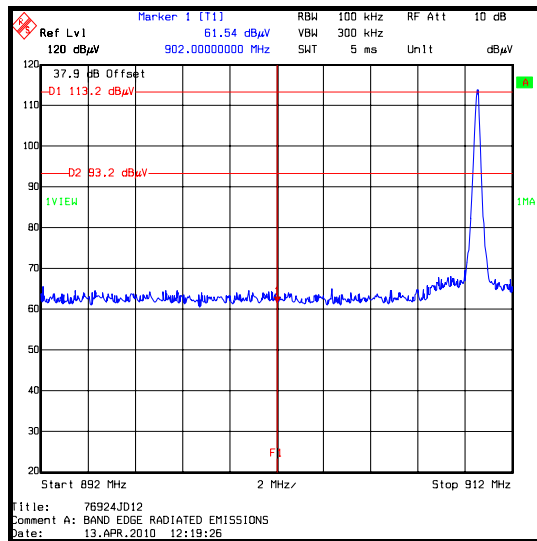
**Results: Peak Power Level Hopping Mode / 500 bps**

Frequency (MHz)	Emission Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	61.9	93.2	31.3	Complied
928	61.8	92.4	30.6	Complied

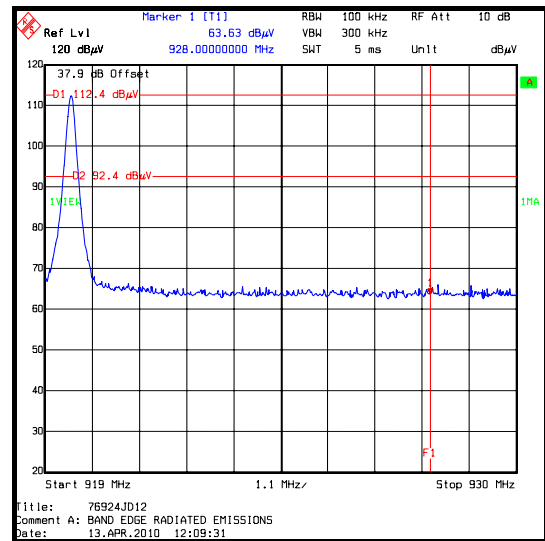
**Note(s):**

1. The limit lines shown in the static mode plots below are set to a level 20 dB below the measured fundamental peak power of the channel closest to the lower and upper band edges, in a 100 kHz measurement bandwidth.
2. The limit line shown in the hopping mode plots was set to a level 20 dB below the measured fundamental peak power of the highest power level contained within the band, in a 100 kHz measurement bandwidth.
3. Tests were performed with the EUT static on the bottom and top channels and repeated with the EUT frequency hopping using both supported data rates.

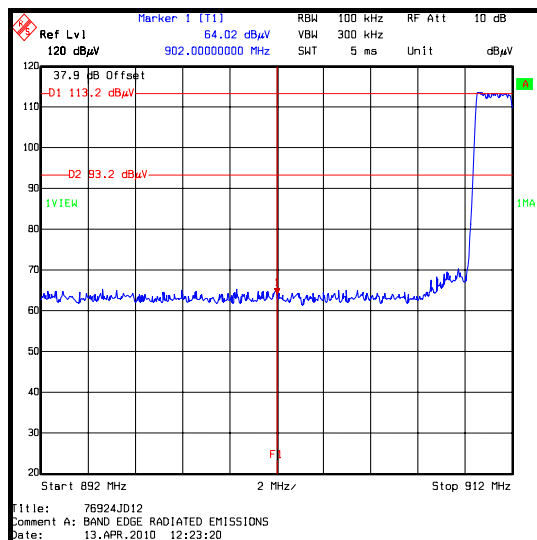
### Transmitter Band Edge Radiated Emissions (continued)



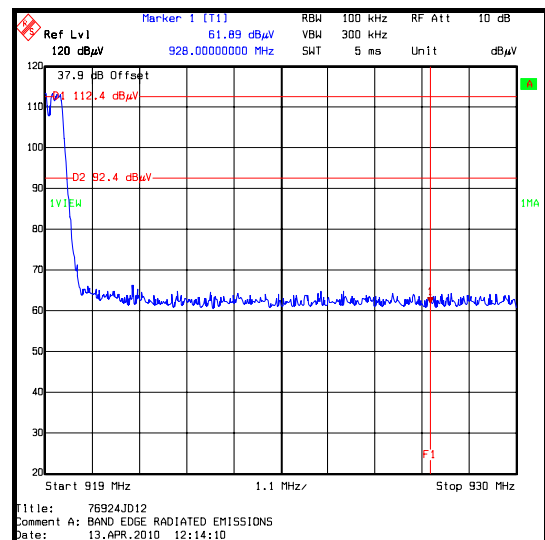
**Lower Band Edge / Bottom Channel /  
Static / 62.5 bps**



**Upper Band Edge / Top Channel /  
Static/ 62.5 bps**

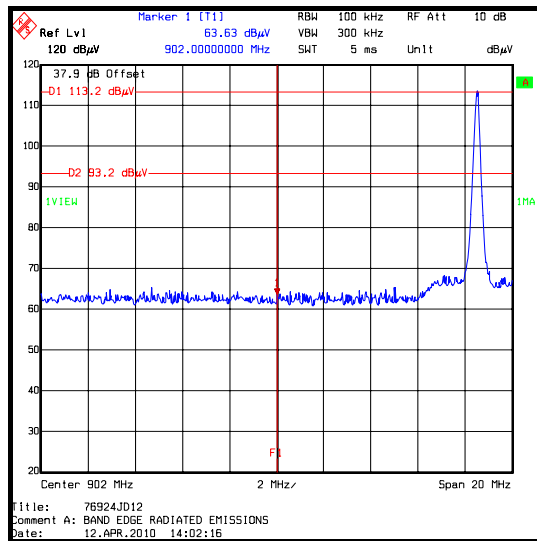


**Lower Band Edge / Bottom Channel /  
Hopping / 62.5 bps**

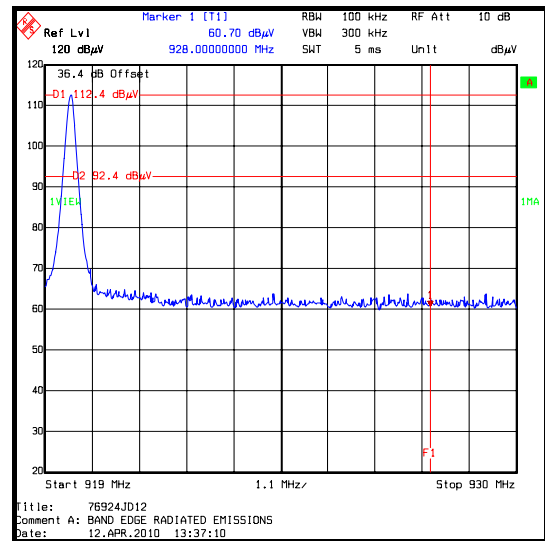


**Upper Band Edge / Top Channel /  
Hopping/ 62.5 bps**

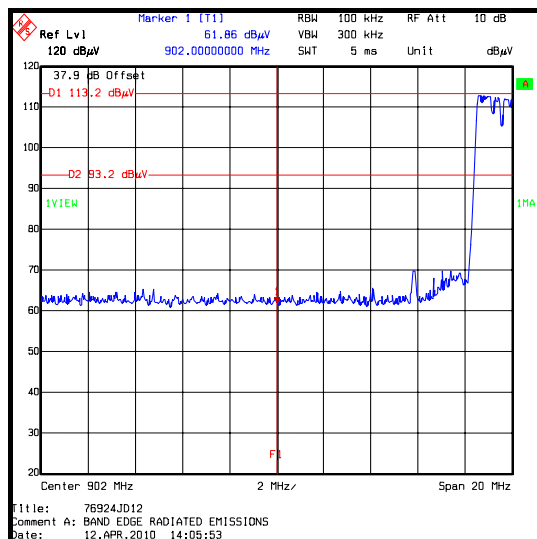
### Transmitter Band Edge Radiated Emissions (continued)



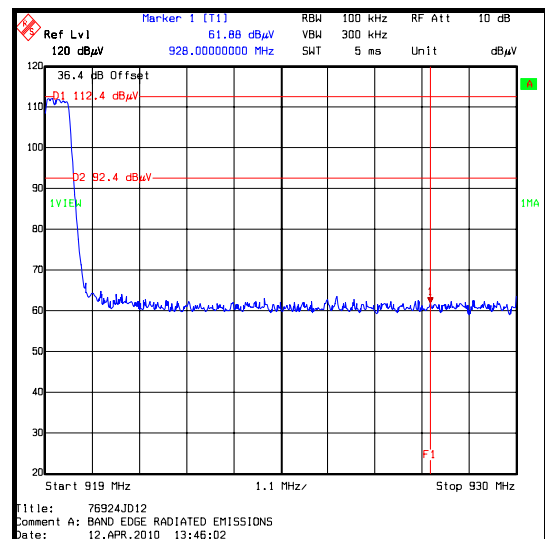
**Lower Band Edge / Bottom Channel /  
Static / 500 bps**



**Upper Band Edge / Top Channel /  
Static/ 500 bps**



**Lower Band Edge / Bottom Channel /  
Hopping / 500 bps**



**Upper Band Edge / Top Channel /  
Hopping/ 500 bps**

## **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
Transmitter Maximum Peak Output Power	902 to 928 MHz	95%	±2.94 dB
Transmitter Carrier Frequency Separation	N/A	95%	±0.92 ppm
Transmitter Average Time of Occupancy	N/A	95%	±0.3 ns
20 dB Bandwidth	N/A	95%	±0.92 ppm
Radiated Spurious Emissions	30 MHz to 9.2 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
A057	High Pass Filter	Aerial Facilities	HP-950-5N	4389B	Calibrated before use	-
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002	03 Jun 2009	12
A1393	Attenuator	Huber + Suhner	757456	6820.17.B	Calibrated before use	12
A1534	Pre Amplifier	Hewlett Packard	8449B OPT H02	3008A00405	Calibrated before use	12
A1818	Antenna	EMCO	3115	00075692	27 Nov 2009	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	01 Mar 2010	12
A288	Antenna	Chase	CBL6111A	1589	16 Mar 2010	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	06 April 2010	12
M1242	Spectrum Analyser	Rohde & Schwarz	FSEM30	845986/022	18 Mar 2010	12
M1269	Multimeter	Fluke	179	90250210	23 Jun 2009	12
M1379	Spectrum Analyser	Rohde & Schwarz	ESIB7	100330	20 Aug 2009	12
S0539	Power Supply Unit	Kikusui	PCR 1000L	13010170	Calibrated before use	-

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