

## TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Telensa Mini Base Station BS-A

FCC ID: XYD-TBSA1

To: FCC Part 15.247: 2011 Subpart C

**Test Report Serial No.:**  
RFI-RPT-RP79989JD05A V2.0

**Version 2.0 Supersedes All Previous Versions**

**This Test Report Is Issued Under The Authority  
Of Chris Guy, Head of Global Approvals:**

pp



**Checked By:**

Ian Watch

**Signature:**



**Date of Issue:**

03 April 2012

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**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

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**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) 2011: Part 15 Subpart C (Intentional Radiators) - Section 15.247
<b>Specification Reference:</b>	47CFR15.107 and 47CFR15.109
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2011: Part 15 Subpart B (Unintentional Radiators) - Sections 15.107 and 15.109
<b>Specification Reference:</b>	47CFR15.207 and 47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications) 2011: Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
<b>Site Registration:</b>	209735
<b>Location of Testing:</b>	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	01 February 2012 to 16 February 2012

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

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
Part 15.107(a)	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 Number of Hopping Frequencies and 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 Conducted 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 for Methods of Measurement of Radio-Noise 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>Brand Name:</b>	Telensa
<b>Model Name or Number:</b>	BS-A
<b>Serial Number:</b>	LL3541
<b>Hardware Version:</b>	2.0
<b>Software Version:</b>	V2.9
<b>FCC ID:</b>	XYD-TBSA1

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

The equipment under test was a Base Station for a Telecell Streetlight Control and Monitoring System. It contains a FHSS transceiver operating over five sub-bands in the 902-928 MHz band and is connected to a collinear antenna with 8 dBi gain.

#### **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 system operating in the ISM band with a 20 dB bandwidth of less than 250 kHz and hopping on at least 50 frequencies		
Power Supply Requirement:	Nominal	120 VAC 60 Hz	
Type of Unit:	Transceiver		
Channel Spacing:	25 kHz		
Modulation:	2 level FSK		
Data Rate	500 bps		
Maximum Conducted Output Power:	25.1 dBm		
Antenna Gain:	8 dBi		
Transmit Frequency Range:	902 MHz to 928 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	Sub-band 0 channel 0	910.5 MHz
	Middle	Sub-band 2 channel 58	915.0 MHz
	Top	Sub-band 5 channel 58	919.575 MHz
Receive Frequency Range:	902 MHz to 928 MHz		
Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	Sub-band 0 channel 0	910.5 MHz
	Middle	Sub-band 2 channel 58	915.0 MHz
	Top	Sub-band 5 channel 58	919.575 MHz



**3.5. Support Equipment**

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

<b>Description:</b>	Collinear antenna / 8 dBi gain
<b>Brand Name:</b>	Jaybeam
<b>Model Name or Number:</b>	7556910
<b>Serial Number:</b>	090107/0054-05 109952

<b>Description:</b>	Laptop PC with terminal emulation software
<b>Brand Name:</b>	Dell
<b>Model Name or Number:</b>	D610
<b>Serial Number:</b>	RFI Asset No. P401NT

## **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.
- Frequency hopping mode at maximum power.
- Receive mode.

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

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

- A laptop computer with terminal emulation software was used to configure the EUT for channel, modulation scheme and transmit/receive. The laptop was placed in a shielded box inside the chamber while testing was taking place.
- The Customer supplied a collinear antenna with a claimed gain of 8 dBi. The EUT and associated antenna was tested in an upright position only. This was confirmed by the Customer as its' only orientation when in normal use. The antenna was connected to the EUT during all radiated spurious emissions tests.
- The EUT was supported on a stand supplied by the Customer.
- The EUT was powered from a 120 VAC 60 Hz single phase supply during testing.
- AC conducted emissions tests in transmitter mode were performed with the EUT transmitting on the top channel at maximum power.
- AC conducted emissions tests in receiver mode were performed with the EUT receiving on the top channel.

## **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. Receiver/Idle AC Conducted Spurious Emissions

#### Test Summary:

Test Engineer:	Patrick Jones	Test Date:	09 February 2012
Test Sample Serial No:	LL3541		

FCC Part:	15.107(a)
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

#### Environmental Conditions:

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

#### Results: Quasi Peak (Live)

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.506	Live	49.0	56.0	7.0	Complied
1.163	Live	46.4	56.0	9.6	Complied
1.509	Live	46.6	56.0	9.4	Complied
2.270	Live	44.0	56.0	12.0	Complied
2.508	Live	40.6	56.0	15.4	Complied
3.345	Live	41.1	56.0	14.9	Complied

#### Results: Average (Live)

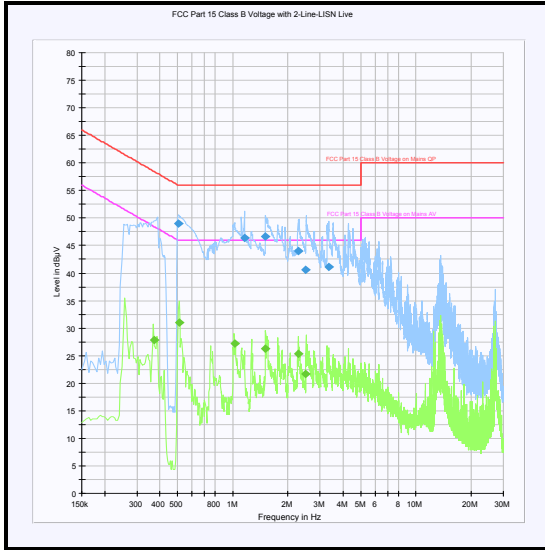
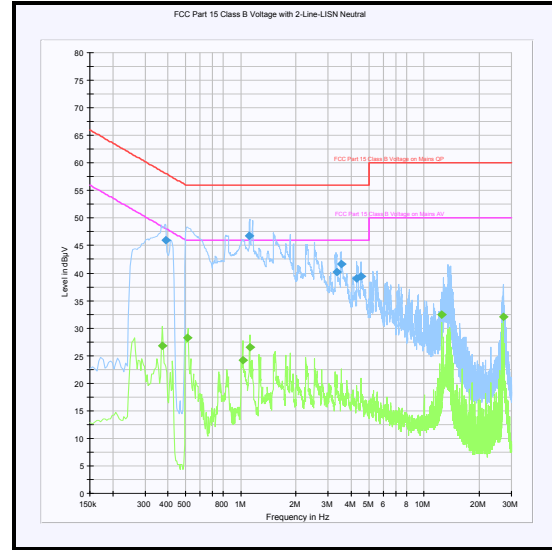
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.375	Live	27.9	48.4	20.5	Complied
0.510	Live	30.9	46.0	15.1	Complied
1.023	Live	27.2	46.0	18.8	Complied
1.514	Live	26.3	46.0	19.7	Complied
2.270	Live	25.4	46.0	20.6	Complied
2.499	Live	21.6	46.0	24.4	Complied

**Receiver/Idle Mode AC Conducted Spurious Emissions (continued)****Results: Quasi Peak (Neutral)**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.389	Neutral	46.0	58.1	12.1	Complied
1.113	Neutral	46.8	56.0	9.2	Complied
3.327	Neutral	40.2	56.0	15.8	Complied
3.521	Neutral	41.6	56.0	14.4	Complied
4.286	Neutral	39.0	56.0	17.0	Complied
4.538	Neutral	39.5	56.0	16.5	Complied

**Results: Average (Neutral)**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.375	Neutral	26.8	48.4	21.6	Complied
0.510	Neutral	28.2	46.0	17.8	Complied
1.023	Neutral	24.2	46.0	21.8	Complied
1.118	Neutral	26.5	46.0	19.5	Complied
12.521	Neutral	32.5	50.0	17.5	Complied
27.159	Neutral	32.1	50.0	17.9	Complied

**Receiver/Idle Mode AC Conducted Spurious Emissions (continued)****Live****Neutral**

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

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

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	01 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<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:**

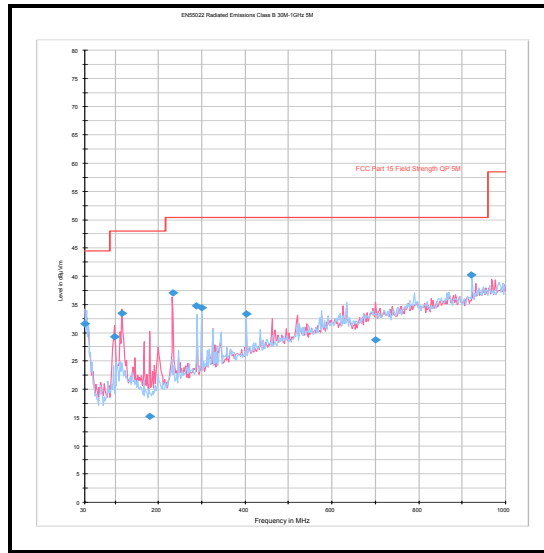
<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	29

**Results: Quasi-Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
30.675	Horizontal	31.6	44.4	12.8	Complied
98.920	Vertical	29.3	47.9	18.6	Complied
115.188	Vertical	33.4	47.9	14.5	Complied
233.315	Vertical	37.1	50.4	13.3	Complied
287.992	Horizontal	34.7	50.4	15.7	Complied
299.995	Horizontal	34.5	50.4	15.9	Complied
403.194	Horizontal	33.4	50.4	17.0	Complied
921.592	Horizontal	40.3	50.4	10.1	Complied

**Note(s):**

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
3. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

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

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



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

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	01 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<b>FCC Part:</b>	15.109
<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 5 GHz

**Environmental Conditions:**

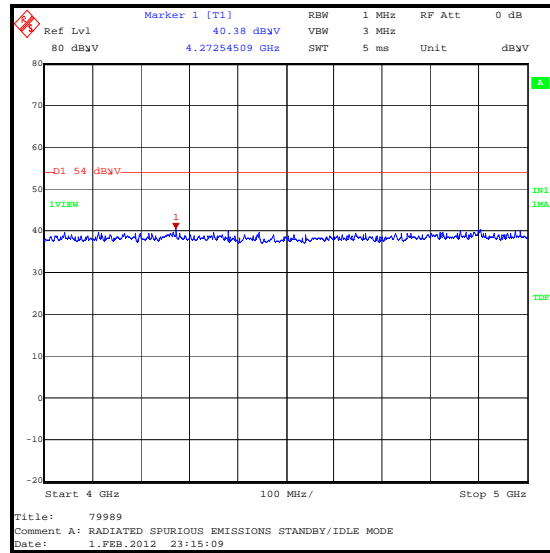
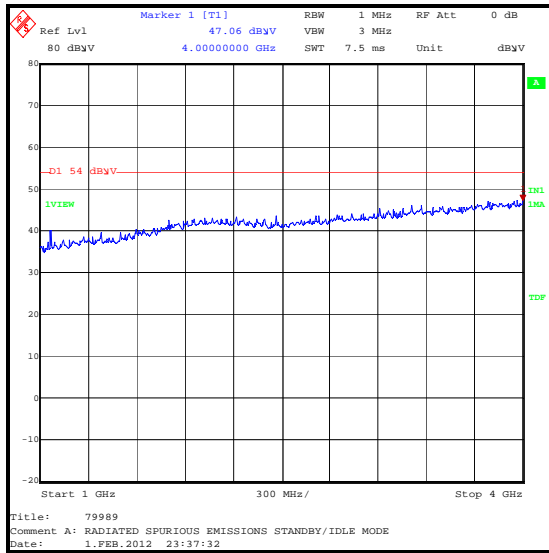
<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	19

**Results:**

<b>Frequency (MHz)</b>	<b>Antenna Polarity</b>	<b>Peak Level (dB<math>\mu</math>V/m)</b>	<b>Average Limit (dB<math>\mu</math>V/m)</b>	<b>Margin (dB)</b>	<b>Result</b>
4000.000	Vertical	47.1	54.0	6.9	Complied

**Note(s):**

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
2. Pre-scans above 1 GHz were performed in a fully anechoic chamber (RFI Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
3. 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. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.

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

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

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	13 February 2012
<b>Test Sample Serial No:</b>	LL3541		

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

**Environmental Conditions:**

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

**Results: Quasi Peak (Live)**

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
2.846	Live	48.5	56.0	7.5	Complied
3.503	Live	47.4	56.0	8.6	Complied
3.723	Live	48.6	56.0	7.4	Complied
4.389	Live	47.0	56.0	9.0	Complied
4.596	Live	47.9	56.0	8.1	Complied
5.249	Live	48.4	60.0	11.6	Complied
5.964	Live	45.8	60.0	14.2	Complied

**Results: Average (Live)**

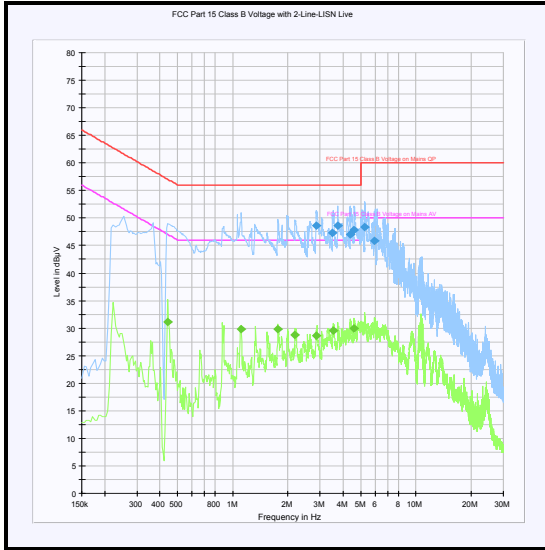
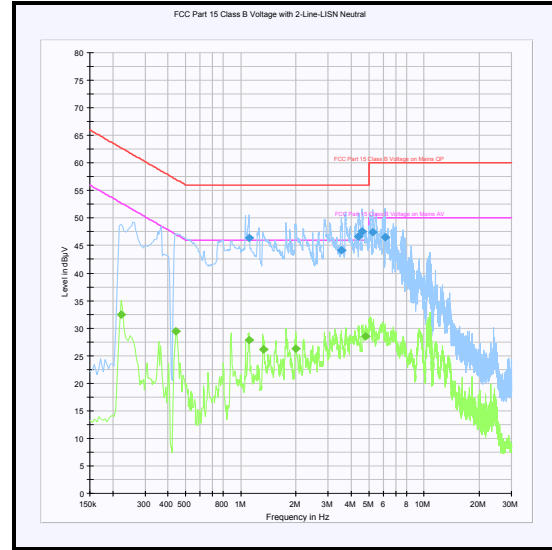
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.443	Live	31.1	47.0	15.9	Complied
1.109	Live	29.8	46.0	16.2	Complied
1.766	Live	29.8	46.0	16.2	Complied
2.193	Live	28.7	46.0	17.3	Complied
2.846	Live	28.6	46.0	17.4	Complied
3.534	Live	29.6	46.0	16.4	Complied
4.596	Live	30.0	46.0	16.0	Complied

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Quasi Peak (Neutral)**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
1.109	Neutral	46.4	56.0	9.6	Complied
3.521	Neutral	44.2	56.0	11.8	Complied
4.371	Neutral	46.6	56.0	9.4	Complied
4.596	Neutral	47.5	56.0	8.5	Complied
5.249	Neutral	47.4	60.0	12.6	Complied
6.117	Neutral	46.6	60.0	13.4	Complied

**Results: Average (Neutral)**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.222	Neutral	32.4	52.7	20.3	Complied
0.443	Neutral	29.4	47.0	17.6	Complied
1.109	Neutral	27.8	46.0	18.2	Complied
1.325	Neutral	26.2	46.0	19.8	Complied
1.986	Neutral	26.3	46.0	19.7	Complied
4.812	Neutral	28.5	46.0	17.5	Complied

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

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

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

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	16 February 2012
<b>Test Sample Serial No:</b>	LL3541		

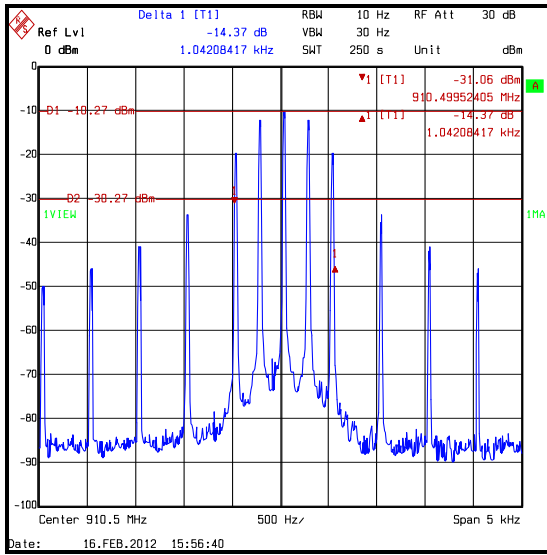
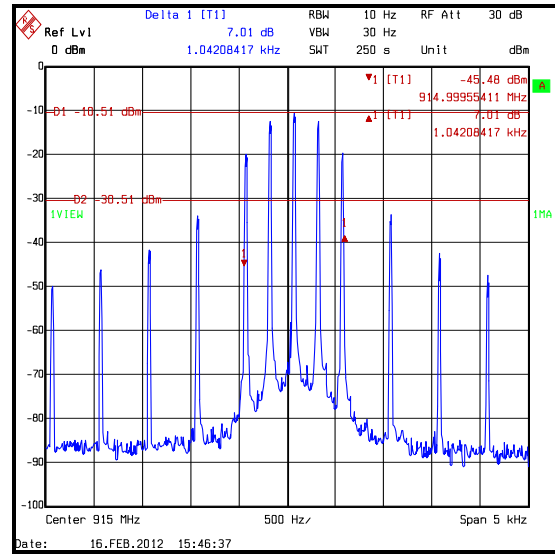
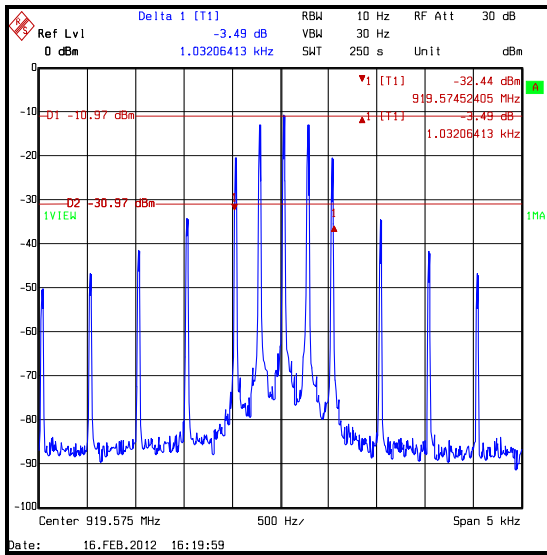
<b>FCC Part:</b>	15.247(a)(1)(i)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.1

**Environmental Conditions:**

<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	24

**Results:**

Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	1.042	≤500	498.958	Complied
Middle	1.042	≤500	498.958	Complied
Top	1.032	≤500	498.968	Complied

**Transmitter 20 dB Bandwidth (continued)****Bottom Channel****Middle Channel****Top Channel**

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

Test Engineer:	Patrick Jones	Test Date:	07 February 2012
Test Sample Serial No:	LL3541		

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

**Environmental Conditions:**

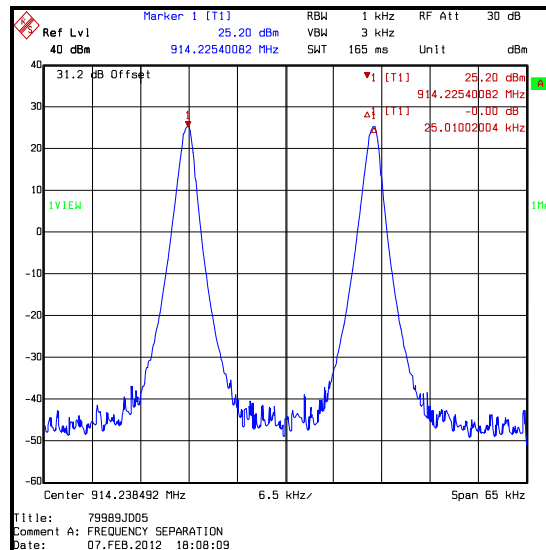
Temperature (°C):	24
Relative Humidity (%):	22

**Results:**

Carrier Frequency Separation (kHz)	Limit* (kHz)	Margin (kHz)	Result
25.010	25.0	0.010	Complied

**Note(s):**

1. The limit is a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The 20 dB bandwidth has been measured as <25 kHz, therefore the applicable limit is >25 kHz.
2. 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 Number of Hopping Frequencies and Average Time of Occupancy****Test Summary:**

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	07 February 2012
<b>Test Sample Serial No:</b>	LL3541		

**Test Summary:**

<b>FCC Part:</b>	15.247(a)(1)(i)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Sections 7.7.3 and 7.7.4

**Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	22

**Results: Number of Hopping Frequencies (in sub band 2):**

Number of Hops	Limit (Hops)	Note	Result
59	≥50	1	Complied

**Results: Average Time of Occupancy (sub band 2)**

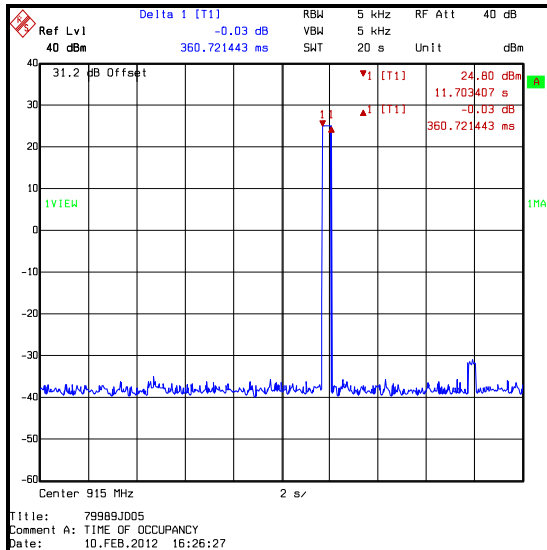
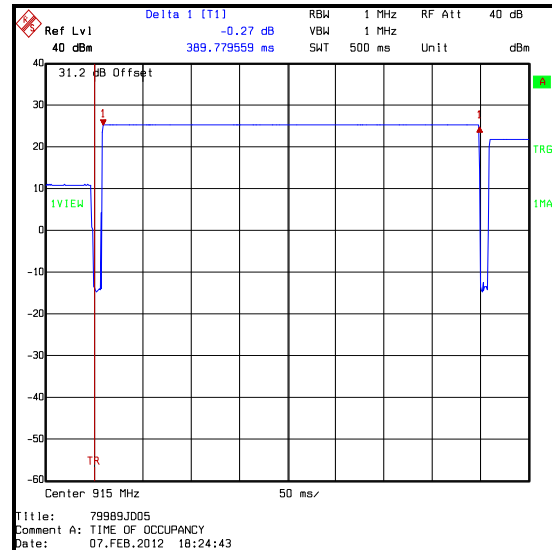
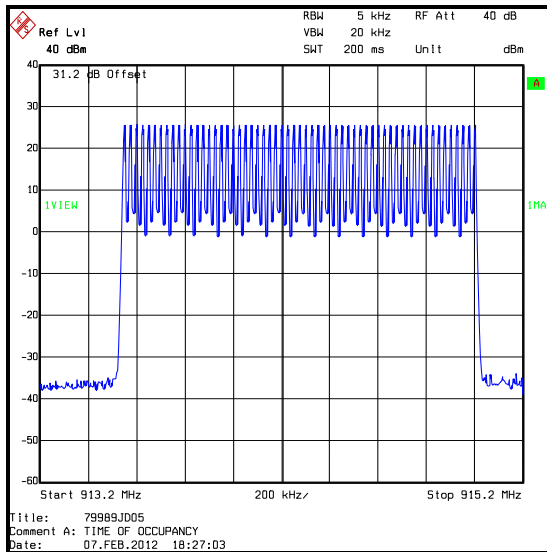
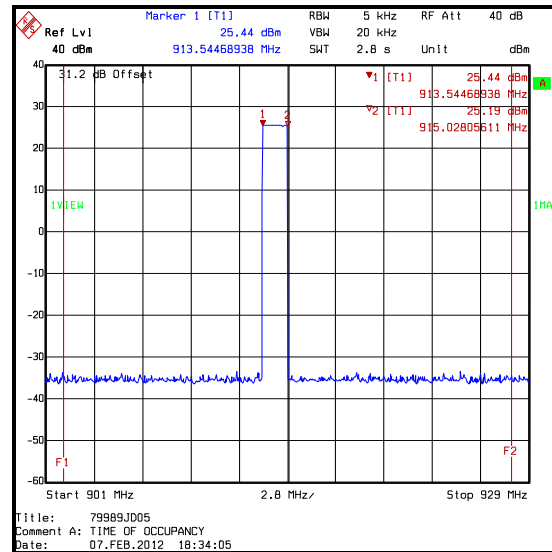
Emission Width (ms)	Average Time of Occupancy in a 20s period (s)	Limit (s)	Margin (s)	Note	Result
389.780	0.360	0.4	0.04	2	Complied

**Note(s):**

1. For a hopping channel with a 20 dB bandwidth of less than 250 kHz
2. The EUT could be set to hop in one of six hopping sub-bands. 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 at a data rate of 500 bps during the test.
3. The hopping function of the EUT was enabled.
4. The channel width is 25 kHz. Times of occupancy measurements were made using a measurement bandwidth of 5 kHz in order to avoid emissions from adjacent channels.

**Limit:**

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

**Transmitter Time of Occupancy (continued)****TX on time in 20 second period (Sub-band 2)****TX on period (Sub-band 2)****Number Of Hopping Channels (Sub-band 2)****Number of hopping channels  
(showing sub-band 2 within operating band)**

**5.2.7. Transmitter Maximum Peak Output Power****Test Summary:**

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	09 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<b>FCC Part:</b>	15.247(b)(2)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.10.1 and Sections 6.3 and 6.6 referencing ANSI C63.4 (see note below)

**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	24

**Results:**

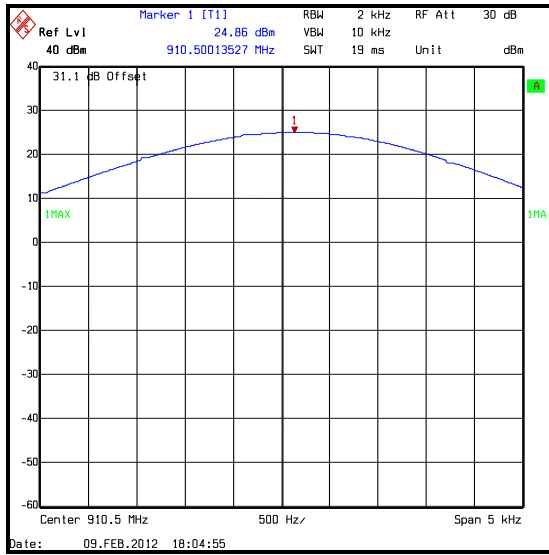
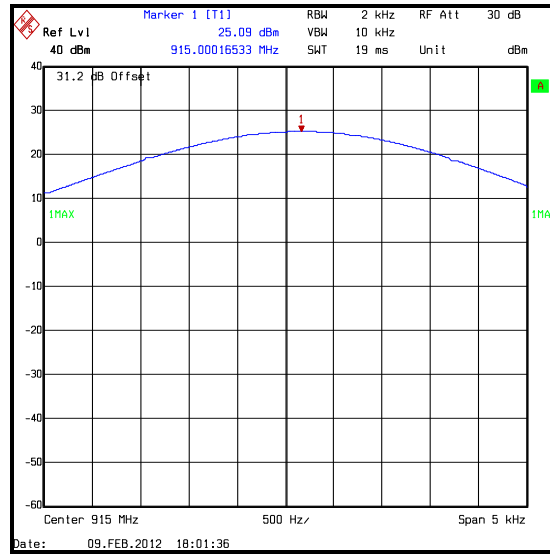
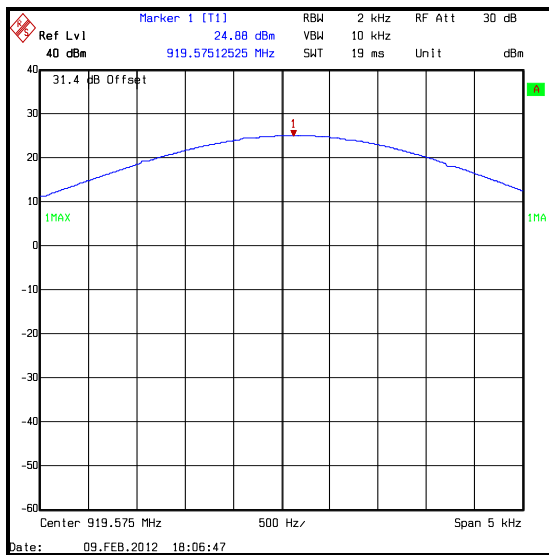
Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	24.9	28.0	3.1	Complied
Middle	25.1	28.0	2.9	Complied
Top	24.9	28.0	3.1	Complied

**De Facto EIRP Limit Comparison**

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	24.9	8.0	32.9	36.0	3.1	Complied
Middle	25.1	8.0	33.1	36.0	2.9	Complied
Top	24.9	8.0	32.9	36.0	3.1	Complied

**Note(s):**

1. The EUT is a frequency hopping device operating in the 902-928 MHz band employing more than 50 hopping channels in accordance with Part 15.247(b)(2).
2. As stated in Part 15.247(b)(2), the conducted output power limit of 1 Watt (30 dBm) applies when used in conjunction with a maximum permissible antenna gain of 6 dBi as stated in 15.247(b)(4). The Customer has declared an antenna gain of 8 dBi, therefore the conducted output power limit has been reduced by the amount in dB that the gain of the antenna exceeds 6 dBi in accordance with 15.247(b)(4). The conducted output power limit was reduced by 2 dB from 30 dBm to 28 dBm.
3. The test system was calibrated before the measurement was performed. An RF level offset is shown on the result plots on the following page. This offset is the calibrated path loss between EUT antenna port and test equipment, it includes losses for RF cables and RF attenuators.

**Transmitter Maximum Peak Output Power (continued)****Bottom Channel****Middle Channel****Top Channel**

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

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	01 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<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:**

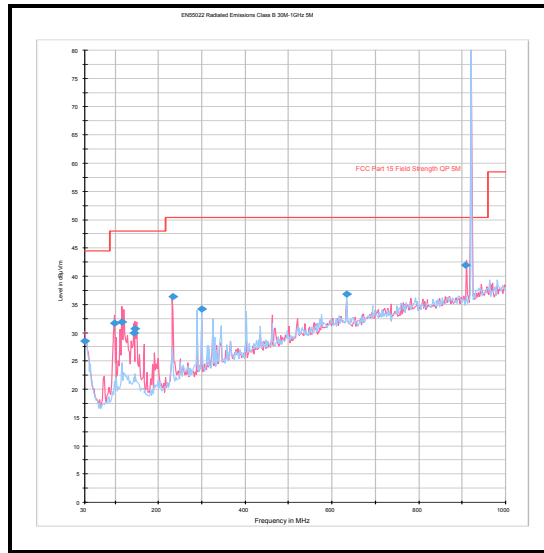
<b>Temperature (°C):</b>	25
<b>Relative Humidity (%):</b>	29

**Results: Quasi-Peak**

<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>
115.181	Vertical	32.0	47.9	15.9	Complied

**Note(s):**

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss
2. The emission at 919.575 MHz shown on the 30 MHz to 1 GHz plot is the EUT fundamental.
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 ambient or >20 dB below the applicable limit or below the measurement system noise floor.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

**Transmitter Radiated Emissions (continued)**

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

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	02 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<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 9.3 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	19

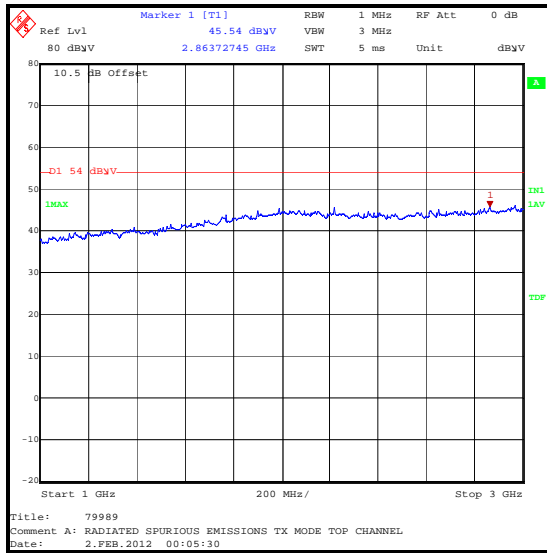
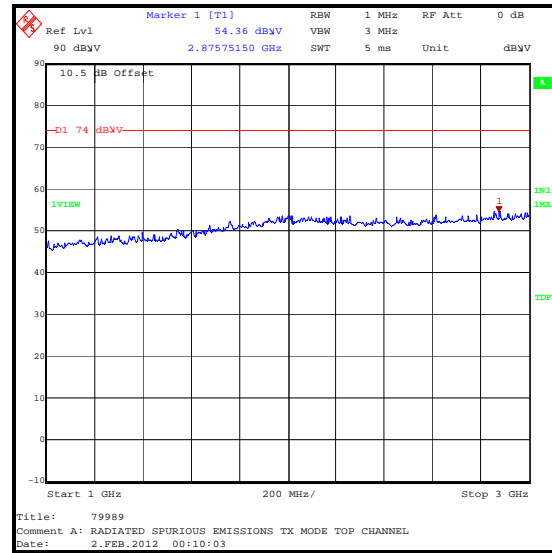
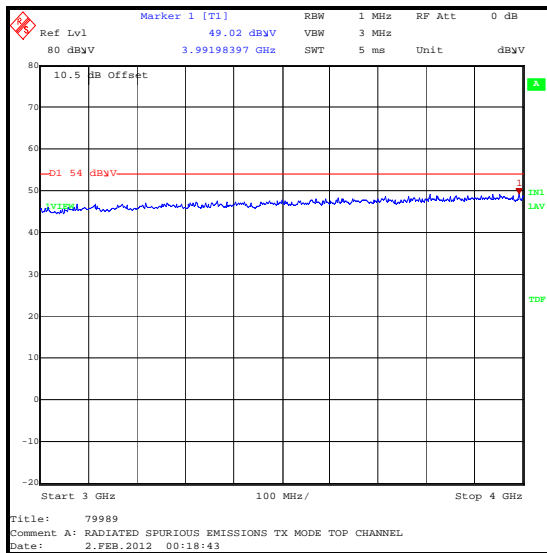
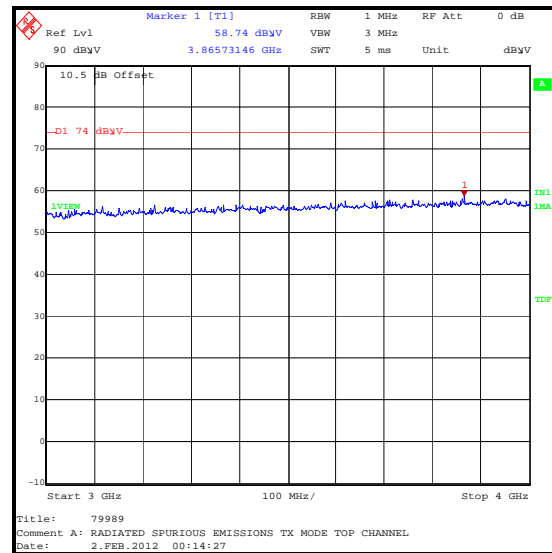
**Results:**

Frequency (MHz)	Antenna Polarity	Peak Level (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Margin (dB)	Result
3865.731	Horizontal	58.7	74.0	15.3	Complied

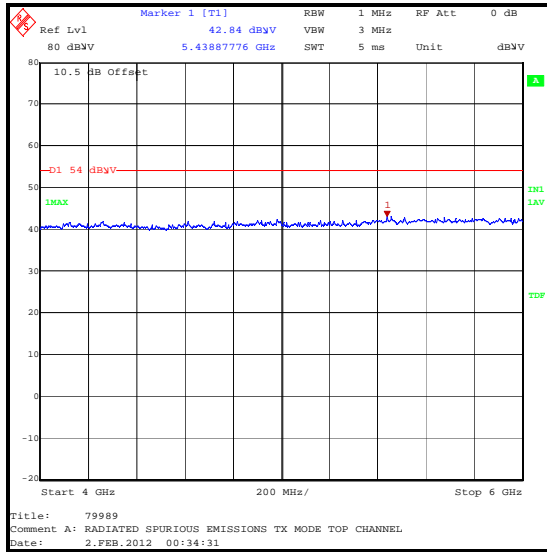
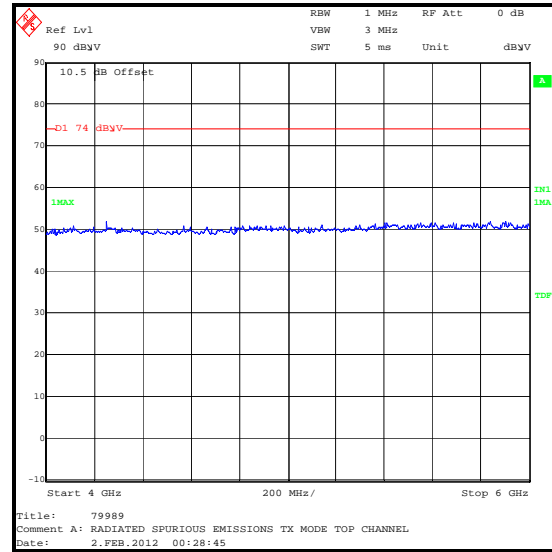
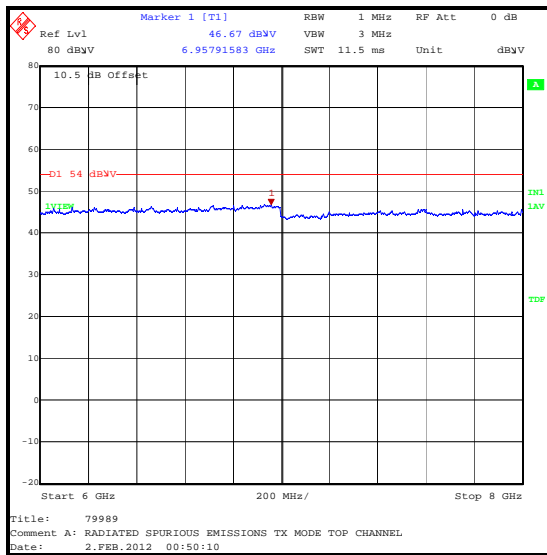
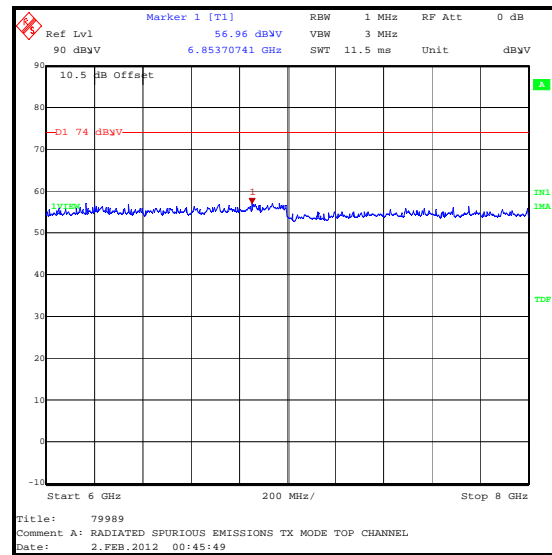
Frequency (MHz)	Antenna Polarity	Average Level (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)	Margin (dB)	Result
3991.984	Horizontal	49.0	54.0	5.0	Complied

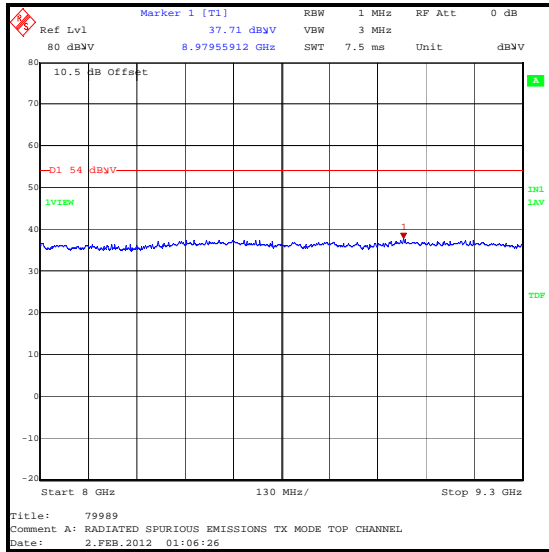
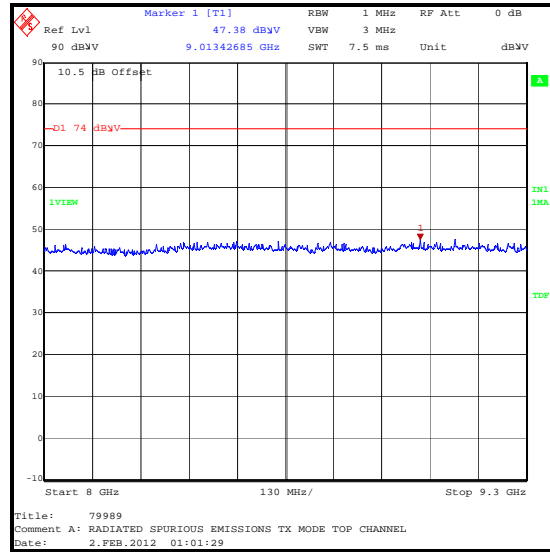
**Note(s):**

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded in the tables above.
3. Pre-scans above 1 GHz were performed in a fully anechoic chamber (RFI Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (RFI Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

**Transmitter Radiated Emissions (continued)****Average Detector****Peak Detector****Average Detector****Peak Detector**



**Transmitter Radiated Emissions (continued)****Average Detector****Peak Detector****Average Detector****Peak Detector**

**Transmitter Radiated Emissions (continued)****Average Detector****Peak Detector**

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

<b>Test Engineer:</b>	Patrick Jones	<b>Test Date:</b>	09 February 2012
<b>Test Sample Serial No:</b>	LL3541		

<b>FCC Part:</b>	15.247(d)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 7.7.9

**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	24

**Results: Static Mode**

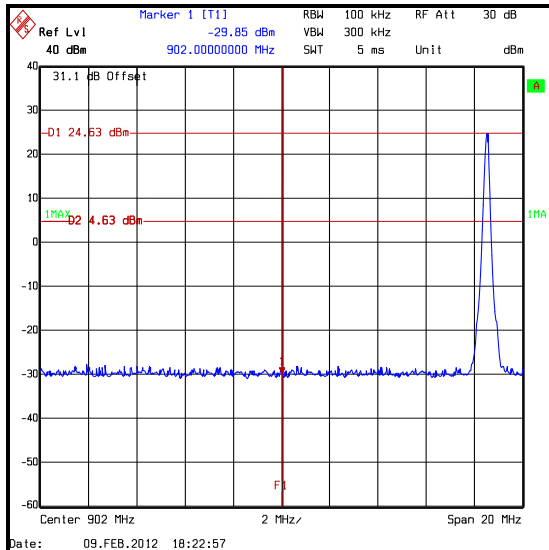
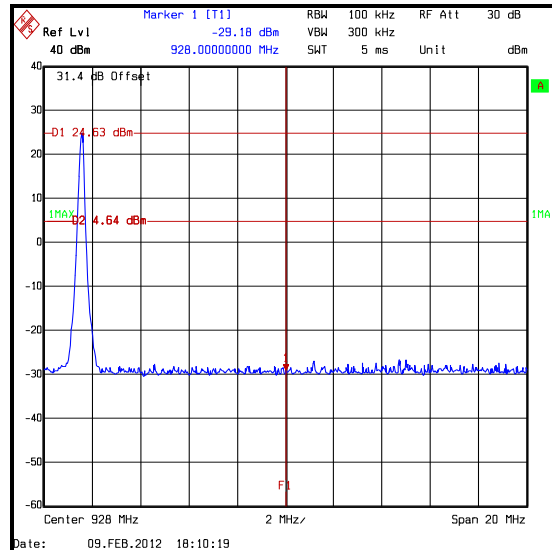
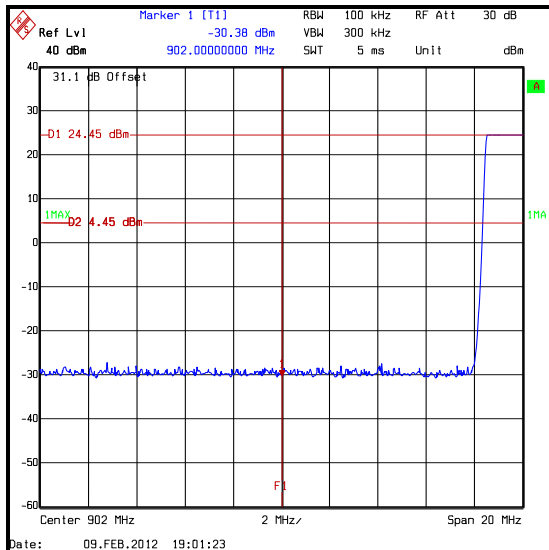
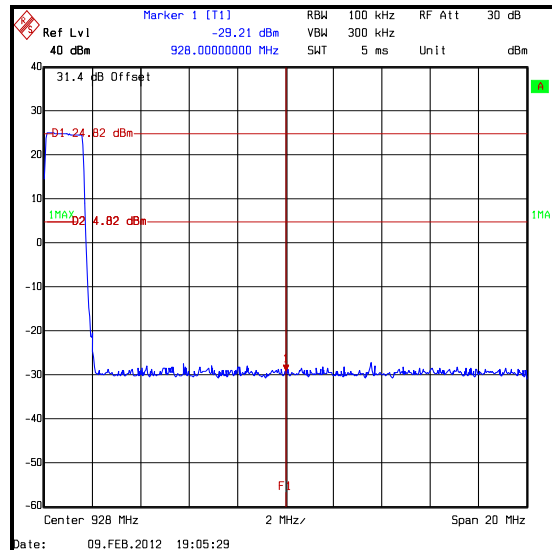
Frequency (MHz)	Emission Level (dBm)	-20 dBc Limit (dBm)	Margin (dB)	Result
902	-29.9	4.6	34.5	Complied
928	-29.2	4.6	33.8	Complied

**Results: Hopping Mode**

Frequency (MHz)	Emission Level (dBm)	-20 dBc Limit (dBm)	Margin (dB)	Result
902	-30.4	4.5	34.9	Complied
928	-29.2	4.8	34.0	Complied

**Note(s):**

1. The test was performed as a conducted measurement. The EUT antenna port was connected to a spectrum analyser using suitable RF cables and RF attenuation. The insertion loss of the cables and attenuation was entered as an RF level offset on the spectrum analyser. The EUT was placed into transmit mode and the peak power of the carrier was noted. A -20 dBc limit line placed below the peak of the carrier.
2. Tests were performed with the EUT transmitting in static (bottom and top channels) and hopping modes. A span of 20 MHz was used as the bottom and top channels are some distance from the lower and upper band edges.

**Transmitter Band Edge Conducted Emissions (continued)****Lower Band Edge / Bottom Channel / Static****Upper Band Edge / Top Channel / Static****Lower Band Edge / Bottom Channel / Hopping****Upper Band Edge / Top Channel / Hopping**

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	02 February 2012
<b>Test Sample Serial No:</b>	LL3541		

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

**Environmental Conditions:**

<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	19

**Results: Static Mode**

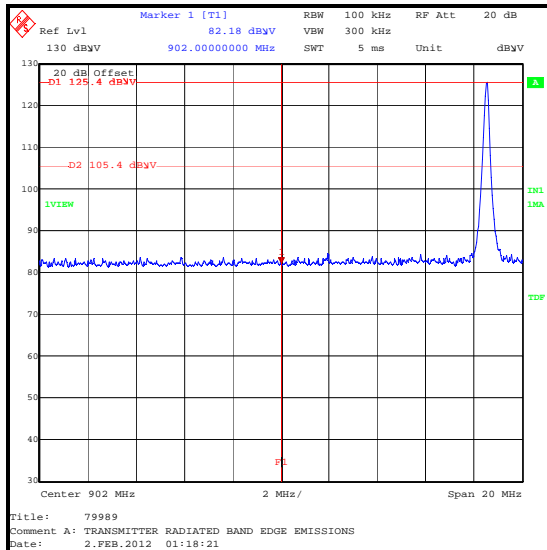
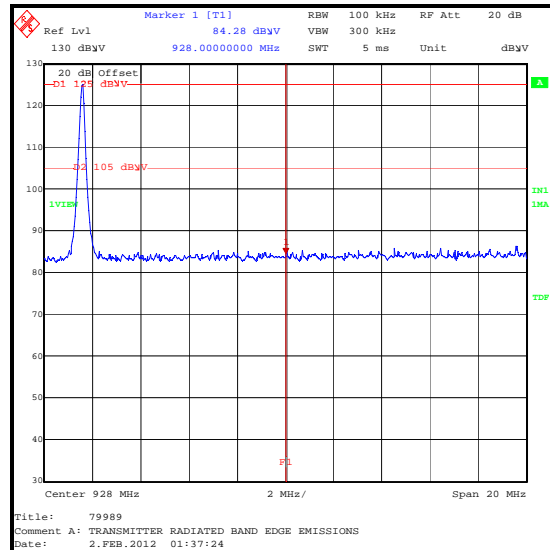
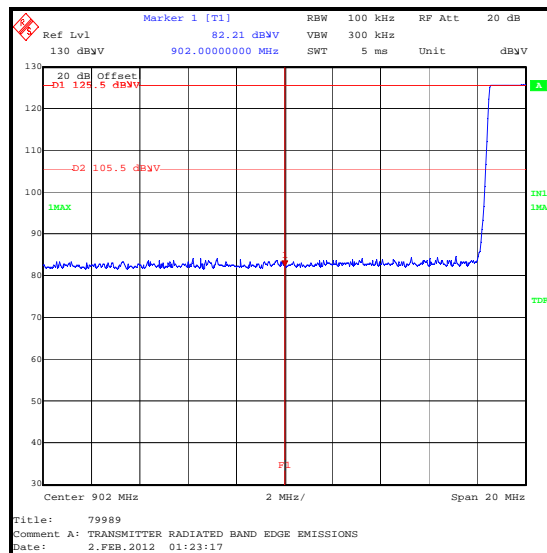
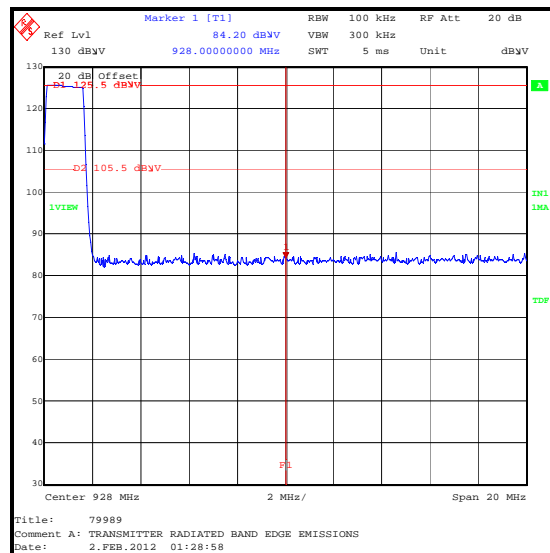
Frequency (MHz)	Peak Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	82.2	105.4	23.2	Complied
928	84.3	105.0	20.7	Complied

**Results: Hopping Mode**

Frequency (MHz)	Peak Level (dBµV/m)	-20 dBc Limit (dBµV/m)	Margin (dB)	Result
902	82.2	105.5	23.3	Complied
928	84.2	105.5	21.3	Complied

**Note(s):**

1. The limit lines shown in the static mode plots are set to a level 20 dB below the measured fundamental peak power of the channel closest to the lower and upper band edges when measured in a 100 kHz measurement bandwidth.
2. The limit lines shown in the hopping mode plots are set to a level 20 dB below the measured fundamental peak power of the highest power contained within the band when measured in a 100 kHz measurement bandwidth.
3. The final measured value, for the given emission in the table above, incorporates the calibrated antenna factor and cable loss.

**Transmitter Band Edge Radiated Emissions (continued)****Lower Band Edge / Bottom Channel / Static****Upper Band Edge / Top Channel / Static****Lower Band Edge / Bottom Channel / Hopping****Upper Band Edge / Top Channel / Hopping**

## **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%	±3.25 dB
Conducted Maximum Peak Output Power	902 MHz to 928 MHz	95%	±0.27 dB
Carrier Frequency Separation	902 MHz to 928 MHz	95%	±0.92 ppm
Average Time of Occupancy	902 MHz to 928 MHz	95%	±0.3 ns
20 dB Bandwidth	902 MHz to 928 MHz	95%	±0.92 ppm
Conducted Spurious Emissions	30 MHz to 10 GHz	95%	±2.62 dB
Radiated Spurious Emissions	30 MHz to 10 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 Calibration Due	Cal. Interval (Months)
A057	High Pass Filter	AFL	HP-950-5N	4389B	08 Jul 2013	24
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002	02 Jun 2012	12
A1391	Attenuator	Huber & Suhner	757987	6810.17.B	Calibrated Before Use	-
A1393	Attenuator	Huber & Suhner	757456	6820.17.B	08 Jul 2012	12
A1490	Attenuator	Weinschel Corp	23-30-34	BH9156	Calibrated Before Use	-
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Oct 2012	12
A1818	Antenna	EMCO	3115	00075692	09 Oct 2012	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	05 Mar 2012	12
A1834	Attenuator	Hewlett Packard	8491B	10444	26 Jul 2012	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	28 Feb 2012	12
A253	Antenna	Flann Microwave	12240-20	128	09 Oct 2012	12
A254	Antenna	Flann Microwave	14240-20	139	09 Oct 2012	12
A255	Antenna	Flann Microwave	16240-20	519	09 Oct 2012	12
A288	Antenna	Chase	CBL6111A	1589	19 Aug 2012	12
A553	Antenna	Chase	CBL6111A	1593	26 Mar 2012	12
K0001	5m RSEChamber	Rainford EMC	N/A	N/A	29 May 2012	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	09 Oct 2012	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESI26	100046K	29 Jun 2012	12
M1242	Spectrum Analyser	Rohde & Schwarz	FSEM30	845986/022	12 Dec 2012	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	08 Feb 2013	12
M1379	Test Receiver	Rohde & Schwarz	ESIB7	100330	20 Sep 2012	12

**NB** In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the current or previous calibration period on the date of testing.