



# TEST REPORT FROM RFI GLOBAL SERVICES LTD



Test of: Efficient Home Controller

FCC ID: DXV-EER21000

To: FCC Part 15.247: 2011 Subpart C,

**Test Report Serial No.:**  
RFI-RPT-RP78537JD17A V4.0

**Version 4.0 Supersedes All Previous Versions**

<b>This Test Report Is Issued Under The Authority Of John Newell, Group Quality Manager:</b>	
<b>Checked By:</b>	Ian Watch
<b>Signature:</b>	
<b>Date of Issue:</b>	08 August 2012

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 Website: www.rfi-global.com

Registered in England and Wales. Company number: 2117901



This page has been left intentionally blank.

## **Table of Contents**

<b>1. Customer Information .....</b>	<b>4</b>
<b>2. Summary of Testing .....</b>	<b>5</b>
2.1. General Information	5
2.2. Summary of Test Results	5
2.3. Methods and Procedures	6
2.4. Deviations from the Test Specification	6
<b>3. Equipment Under Test (EUT) .....</b>	<b>7</b>
3.1. Identification of Equipment Under Test (EUT)	7
3.2. Description of EUT	7
3.3. Modifications Incorporated in the EUT	7
3.4. Additional Information Related to Testing	7
3.5. Support Equipment	8
<b>4. Operation and Monitoring of the EUT during Testing .....</b>	<b>9</b>
4.1. Operating Modes	9
4.2. Configuration and Peripherals	9
<b>5. Measurements, Examinations and Derived Results .....</b>	<b>10</b>
5.1. General Comments	10
5.2. Test Results	11
5.2.1. Receiver/Idle Mode AC Conducted Spurious Emissions	11
5.2.2. Receiver/Idle Mode Radiated Spurious Emissions	13
5.2.3. Transmitter AC Conducted Spurious Emissions	17
5.2.4. Transmitter 6 dB Bandwidth	19
5.2.5. Transmitter 20 dB Bandwidth	21
5.2.6. Transmitter Power Spectral Density	23
5.2.7. Transmitter Maximum Peak Output Power	25
5.2.8. Transmitter Radiated Emissions	27
5.2.9. Transmitter Band Edge Radiated Emissions	33
5.2.10. Transmitter Duty Cycle	35
<b>6. Measurement Uncertainty .....</b>	<b>36</b>
<b>Appendix 1. Test Equipment Used .....</b>	<b>37</b>

**1. Customer Information**












<b>Company Name:</b>	Kerlink SA
<b>Address:</b>	Immeuble Germanium 80 Avenue des Buttes de Coësmes 35700 Rennes France

## **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>	FCC: 209735
<b>Location of Testing:</b>	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH.
<b>Test Dates:</b>	03 May 2011 to 15 June 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)(2)	Transmitter 6 dB Bandwidth	
Part 2.1049	Transmitter 20 dB Bandwidth	
Part 15.247(e)	Transmitter Power Spectral Density	
Part 15.247(b)(3)	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	
Part 15.35(c)	Transmitter Duty Cycle	Note 1
<b>Key to Results</b>		
 = Complied  = Did not comply		

*Note 1: The measurement was performed to assist in the calculation of the level of average field strength of radiated emissions as the EUT employs pulsed operation.*

### **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>	Schneider Electric
<b>Model Name or Number:</b>	Efficient Home Controller
<b>Serial Number:</b>	None stated
<b>Hardware Version Number:</b>	Schematics # V2.3 / PCB # k-0039-6 / =S= # S1A75094-0B
<b>Software Version Number:</b>	0013
<b>FCC ID:</b>	DXV-EER21000

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

The equipment under test was a Wireless gateway – Zigbee to Ethernet.

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

No modifications were applied to the EUT during testing.

#### **3.4. Additional Information Related to Testing**

<b>Technology Tested:</b>	IEEE 802.15.4 Digital Transmission System		
<b>Type of Unit:</b>	Transceiver		
<b>Modulation:</b>	O-QPSK		
<b>Data Rate:</b>	250 kb/s		
<b>Power Supply Requirement(s):</b>	Nominal	5.0 VDC	
<b>Maximum Peak Output Power:</b>	20.2 dBm		
<b>Transmit Frequency Range:</b>	2405 MHz to 2475 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	11	2405
	Middle	18	2440
	Top	25	2475
<b>Receive Frequency Range:</b>	2405 MHz to 2475 MHz		
<b>Receive Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	11	2405
	Middle	18	2440
	Top	25	2475

### **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>	D600
<b>Serial Number:</b>	RFI Asset number PC 353 NT

<b>Description:</b>	Switching Power Supply
<b>Brand Name:</b>	Phihong
<b>Model Name or Number:</b>	PSC 12R-050

<b>Description:</b>	USB cable 6 metres
<b>Brand Name:</b>	Nikkai
<b>Model Name or Number:</b>	Pure Connectivity

<b>Description:</b>	Ethernet cable 5meter
<b>Brand Name:</b>	Not Stated
<b>Model Name or Number:</b>	Not Stated



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

### **4.1. Operating Modes**

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

- Continuously transmitting at maximum power on the bottom, centre and top channels as required.
- Receive/Idle Mode.

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

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

- Controlled using a bespoke application on the laptop PC supplied by the client. The application was used to enable continuous transmission and idle mode (enabled but not transmitting) and to select the test channels as required.
- Connected to the support laptop via an Ethernet and a USB cable.

## **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 Mode AC Conducted Spurious Emissions

#### Test Summary:

Test Engineer:	Crawford Lindsay	Test Date:	11 May 2011
Test Sample Serial No.:	Not stated		

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):	26
Relative Humidity (%):	28

#### Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.150	Live	51.0	66.0	15.0	Complied
0.159	Live	47.7	65.5	17.9	Complied
0.168	Live	46.6	65.1	18.5	Complied
0.200	Live	47.1	63.6	16.5	Complied
0.213	Live	41.5	63.1	21.6	Complied

#### Results: Live / Average

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.150	Live	41.5	56.0	14.5	Complied
0.200	Live	39.9	53.6	13.7	Complied
0.249	Live	36.1	51.8	15.7	Complied
0.254	Live	33.3	51.6	18.3	Complied
0.402	Live	29.0	47.8	18.8	Complied
0.614	Live	32.5	46.0	13.5	Complied
0.825	Live	26.8	46.0	19.2	Complied

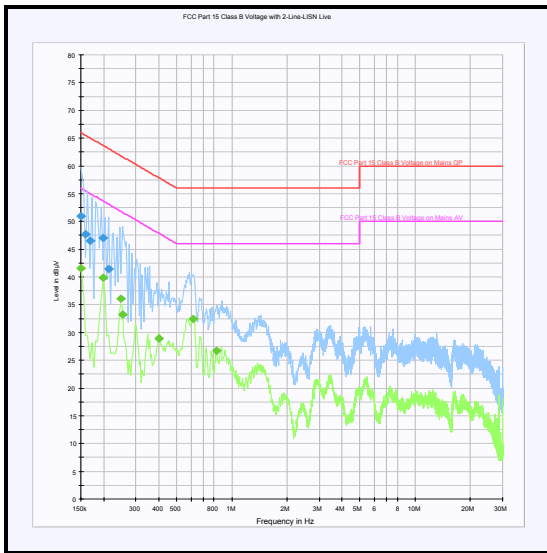
**Receiver/Idle Mode AC Conducted Spurious Emissions (continued)**

**Results: Neutral / Quasi Peak**

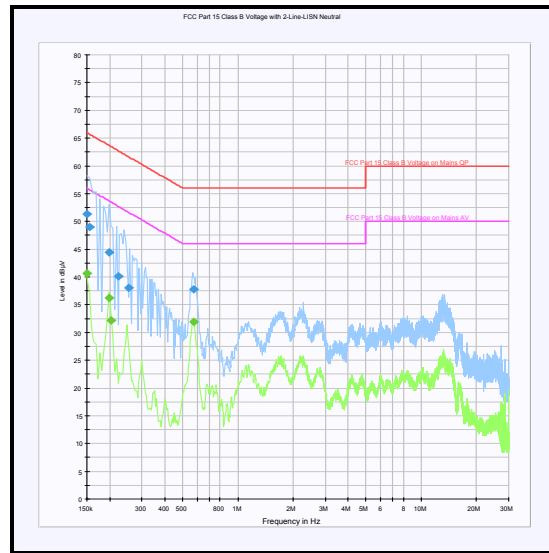
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Neutral	51.3	66.0	14.7	Complied
0.155	Neutral	49.0	65.8	16.8	Complied
0.200	Neutral	44.5	63.6	19.1	Complied
0.222	Neutral	40.1	62.7	22.6	Complied
0.254	Neutral	38.1	61.6	23.5	Complied
0.573	Neutral	37.8	56.0	18.2	Complied

**Results: Neutral / Average**

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Neutral	40.7	56.0	15.2	Complied
0.200	Neutral	36.2	53.6	17.4	Complied
0.204	Neutral	32.1	53.4	21.3	Complied
0.573	Neutral	32.0	46.0	14.0	Complied



**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>	Andrew Edwards	<b>Test Date:</b>	03 May 2011
<b>Test Sample Serial No.:</b>	Not stated		

<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>	22
<b>Relative Humidity (%):</b>	19

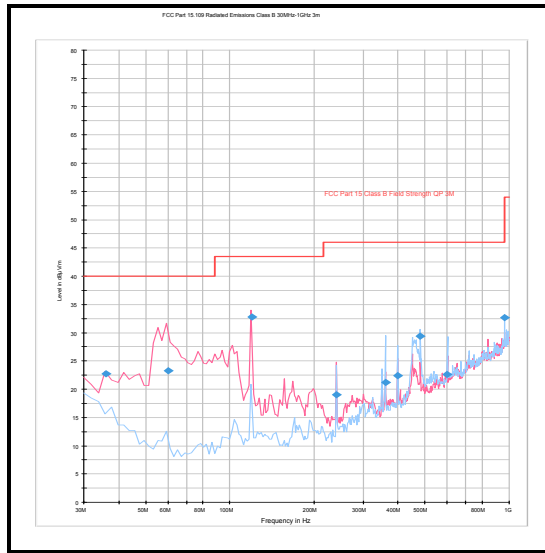
**Results: Quasi Peak**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
35.990	Vertical	22.8	40.0	17.2	Complied
60.010	Vertical	23.3	40.0	16.7	Complied
119.972	Vertical	32.8	43.5	10.7	Complied
239.993	Vertical	19.0	46.0	27.0	Complied
359.985	Horizontal	21.2	46.0	24.8	Complied
399.978	Horizontal	22.4	46.0	23.6	Complied
479.996	Horizontal	29.4	46.0	16.6	Complied
600.007	Horizontal	22.7	46.0	23.3	Complied
960.011	Horizontal	32.7	54.0	21.3	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 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.

**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 Dates:</b>	15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<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 12.5 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	45

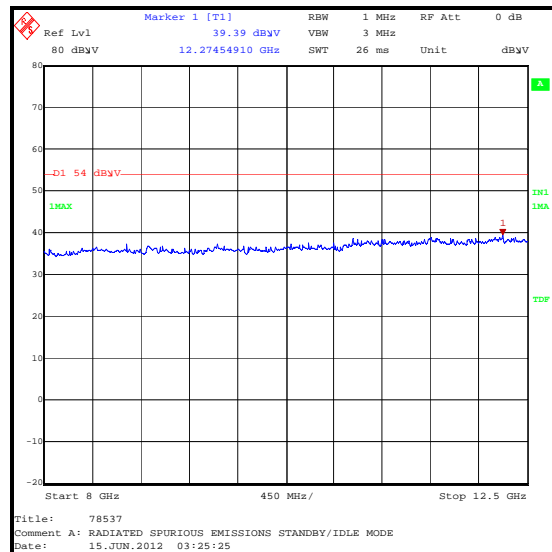
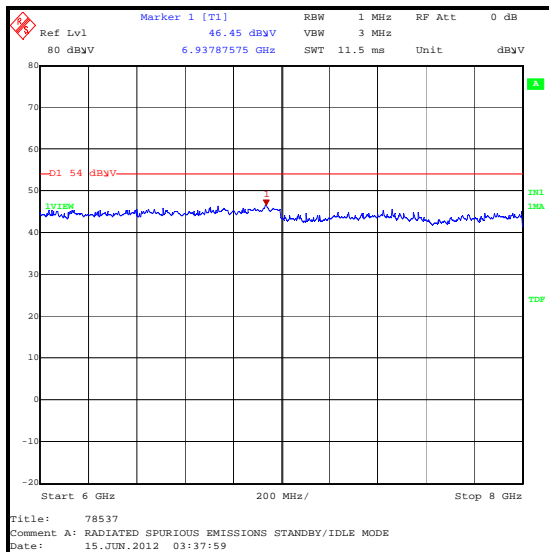
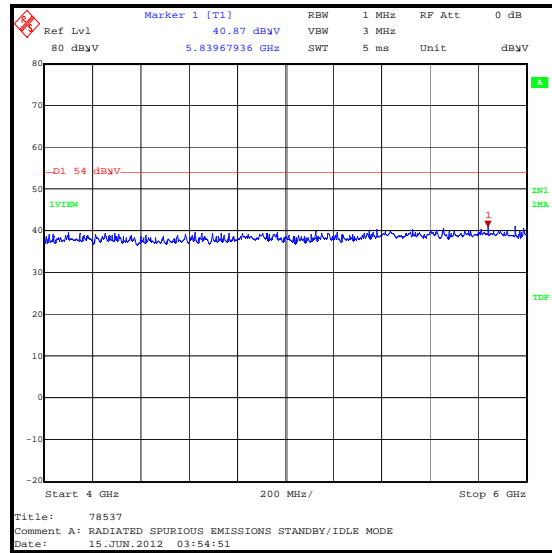
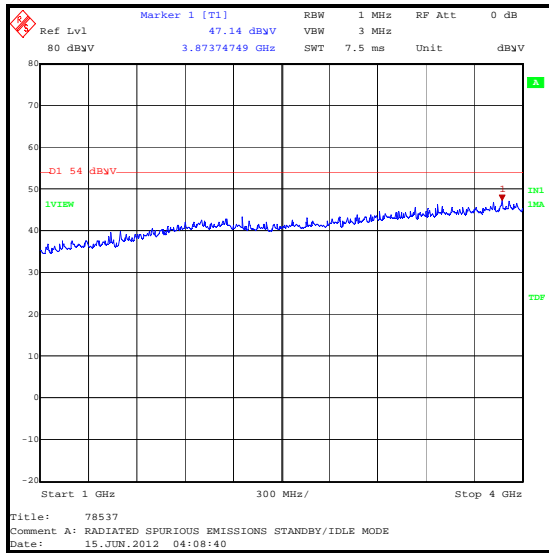
**Results:**

<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>
3873.747	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. 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.
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.

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





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

<b>Test Engineer:</b>	Crawford Lindsay	<b>Test Date:</b>	11 May 2011
<b>Test Sample Serial No.:</b>	Not stated		

<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>	26
<b>Relative Humidity (%):</b>	28

**Results: Live / Quasi Peak**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.150	Live	51.8	66.0	14.2	Complied
0.155	Live	47.4	65.8	18.4	Complied
0.204	Live	43.8	63.4	19.6	Complied
0.299	Live	38.7	60.3	21.6	Complied
0.587	Live	41.7	56.0	14.3	Complied
0.713	Live	33.6	56.0	22.4	Complied

**Results: Live / Average**

Frequency (MHz)	Line	Level (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Result
0.150	Live	43.1	56.0	12.9	Complied
0.200	Live	39.4	53.6	14.2	Complied
0.204	Live	35.1	53.4	18.3	Complied
0.299	Live	31.5	50.3	18.8	Complied
0.348	Live	31.0	49.0	18.0	Complied
0.582	Live	36.2	46.0	9.8	Complied
0.776	Live	29.1	46.0	16.9	Complied
1.252	Live	26.7	46.0	19.3	Complied

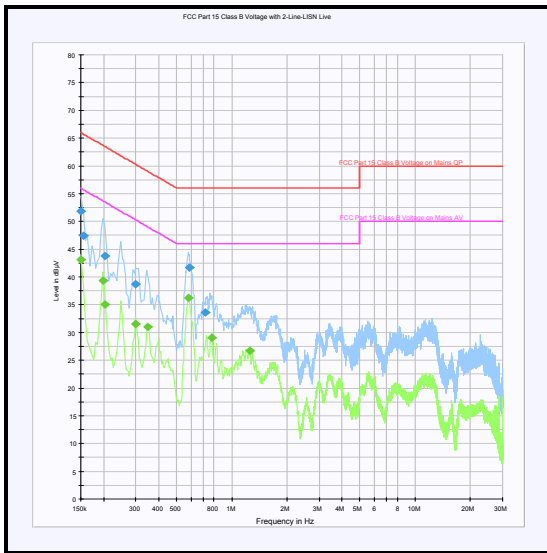
**Transmitter AC Conducted Spurious Emissions (continued)**

**Results: Neutral / Quasi Peak**

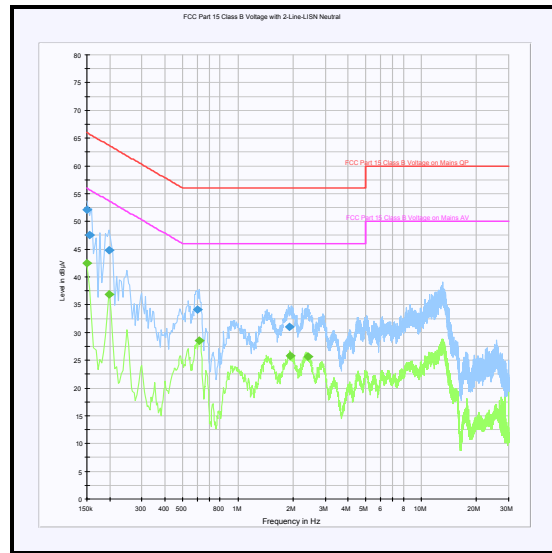
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Neutral	52.2	66.0	13.8	Complied
0.155	Neutral	47.6	65.8	18.2	Complied
0.200	Neutral	44.8	63.6	18.8	Complied
0.605	Neutral	34.2	56.0	21.8	Complied
1.901	Neutral	31.0	56.0	25.0	Complied

**Results: Neutral / Average**

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Neutral	42.5	56.0	13.5	Complied
0.200	Neutral	36.9	53.6	16.7	Complied
0.618	Neutral	28.5	46.0	17.5	Complied
1.928	Neutral	25.8	46.0	20.2	Complied
2.400	Neutral	25.6	46.0	20.4	Complied



**Live**



**Neutral**

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

**5.2.4. Transmitter 6 dB Bandwidth****Test Summary:**

<b>Test Engineers:</b>	Crawford Lindsay & David Doyle	<b>Test Dates:</b>	11 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	15.247(a)(2)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.1

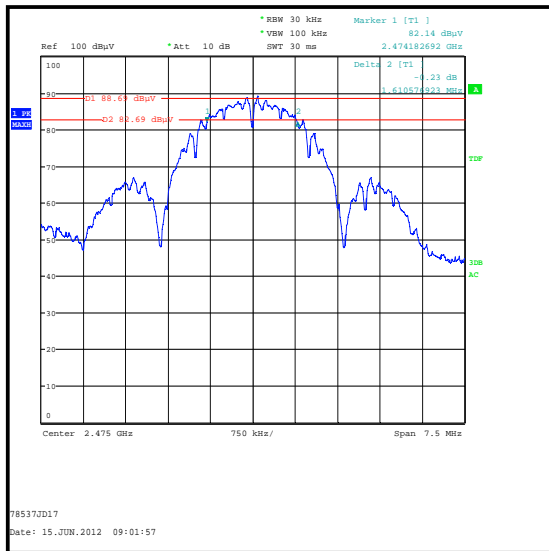
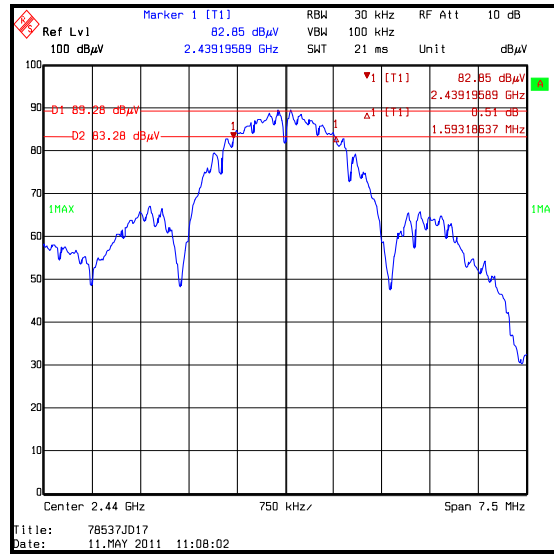
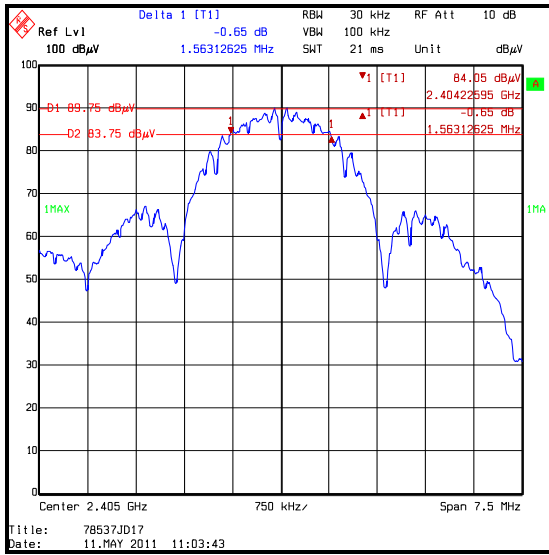
**Environmental Conditions:**

<b>Temperature (°C):</b>	25 to 27
<b>Relative Humidity (%):</b>	30 to 40

**Results:**

Channel	6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
Bottom	1.563	≥0.5	1.063	Complied
Middle	1.593	≥0.5	1.093	Complied
Top	1.611	≥0.5	1.111	Complied

### Transmitter 6 dB Bandwidth (continued)



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

<b>Test Engineers:</b>	Crawford Lindsay & David Doyle	<b>Test Dates:</b>	11 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	2.1049
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.1

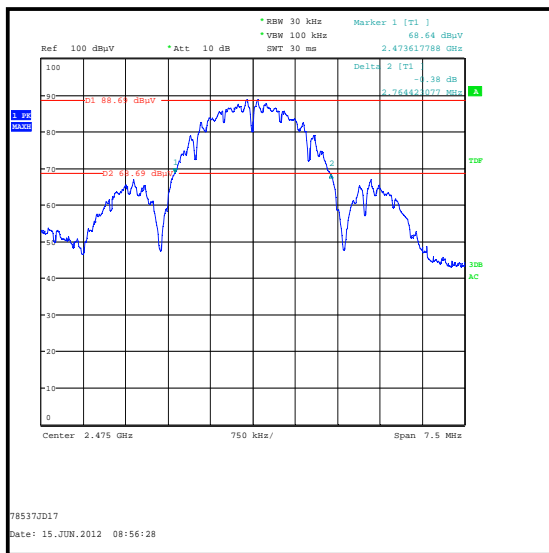
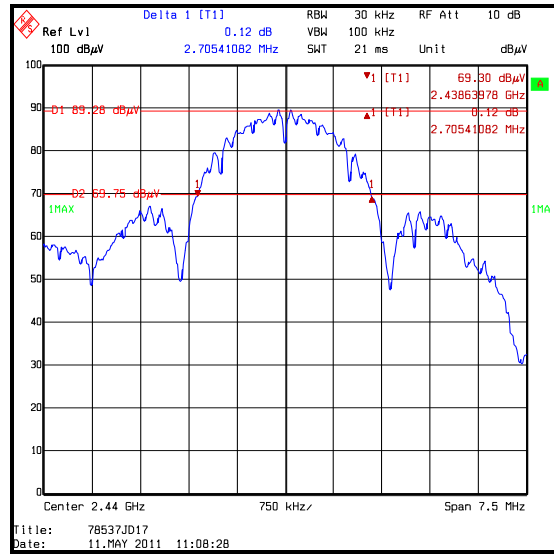
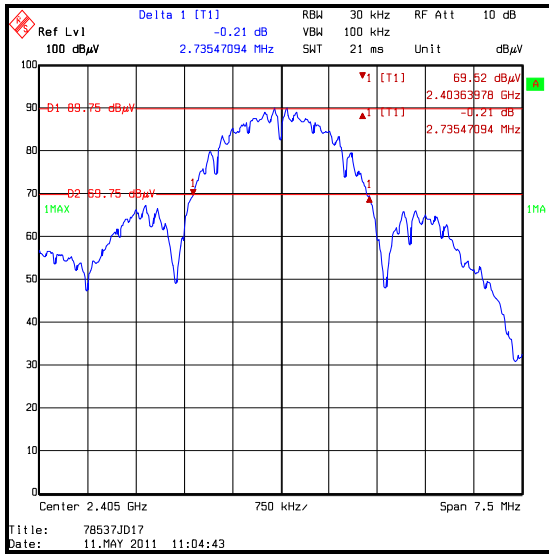
**Environmental Conditions:**

<b>Temperature (°C):</b>	25 to 27
<b>Relative Humidity (%):</b>	30 to 40

**Results:**

<b>Channel</b>	<b>20 dB Bandwidth (MHz)</b>
Bottom	2.735
Middle	2.705
Top	2.764

### Transmitter 20 dB Bandwidth (continued)



**5.2.6. Transmitter Power Spectral Density****Test Summary:**

<b>Test Engineers:</b>	Crawford Lindsay & David Doyle	<b>Test Dates:</b>	11 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	15.247(e)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.11.2

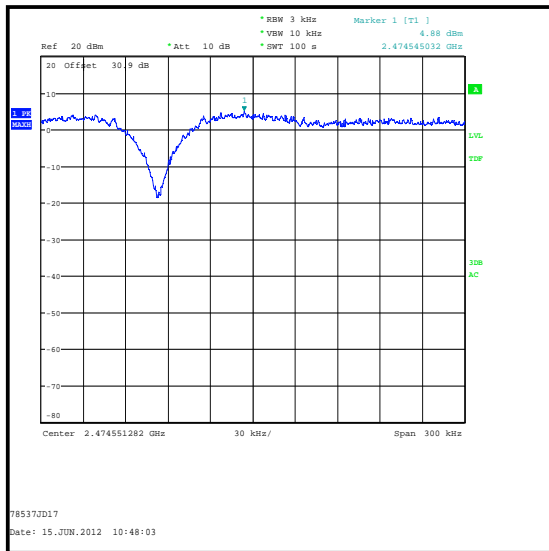
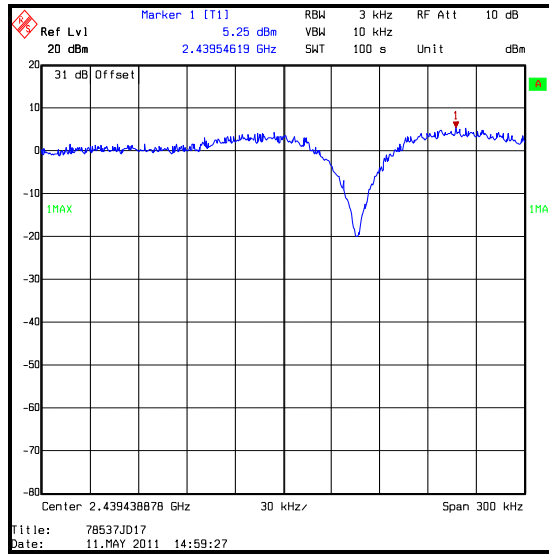
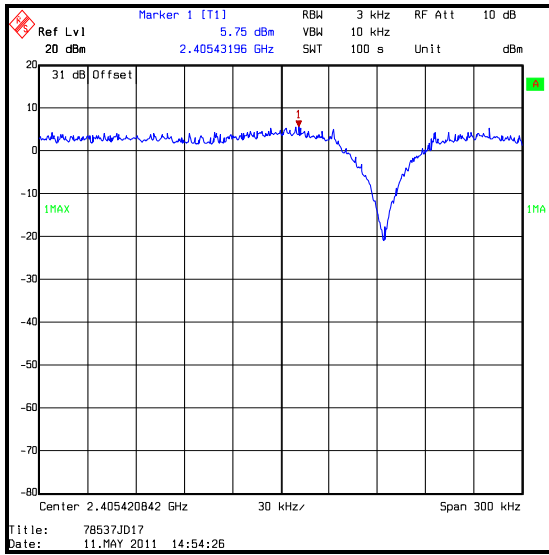
**Environmental Conditions:**

<b>Temperature (°C):</b>	25 to 27
<b>Relative Humidity (%):</b>	30 to 40

**Results:**

Channel	Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	5.8	8.0	2.2	Complied
Middle	5.3	8.0	2.7	Complied
Top	4.9	8.0	3.1	Complied

### Transmitter Power Spectral Density (continued)





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

<b>Test Engineers:</b>	Crawford Lindsay & David Doyle	<b>Test Dates:</b>	11 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	15.247(b)(3)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.10.2

**Environmental Conditions:**

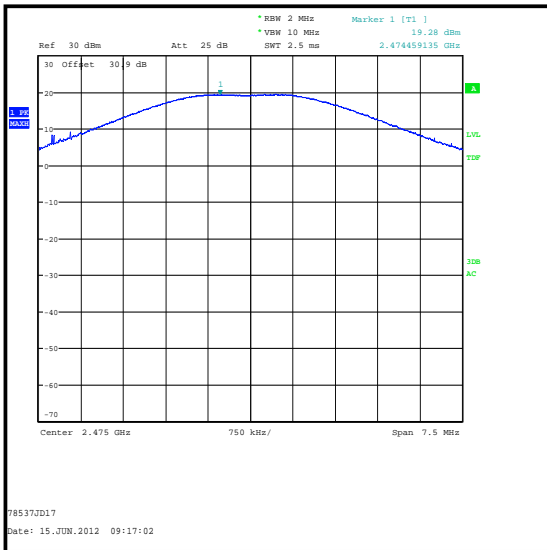
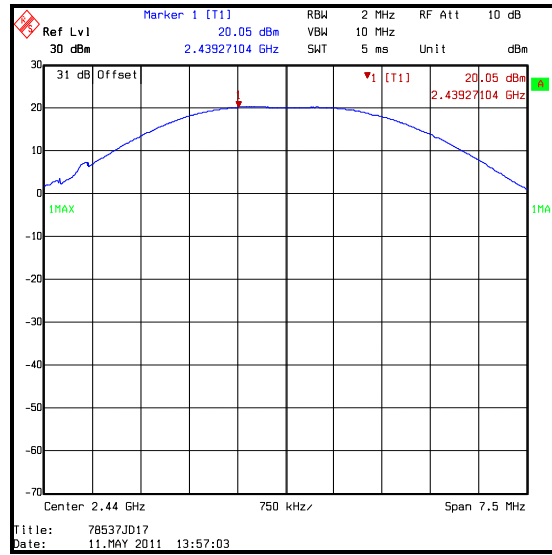
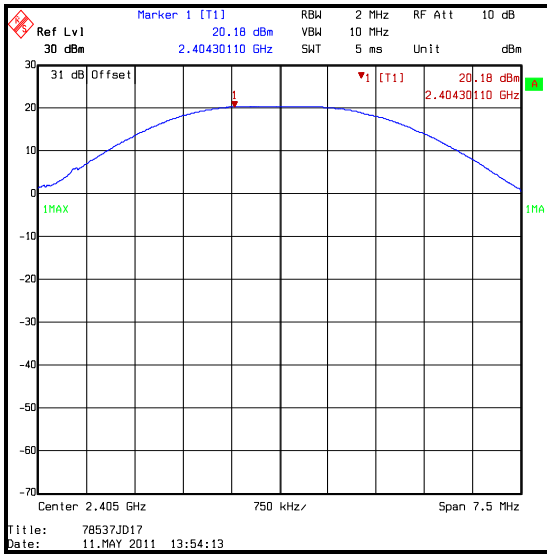
<b>Temperature (°C):</b>	24 to 27
<b>Relative Humidity (%):</b>	30 to 45

**Results:**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	20.2	30.0	9.8	Complied
Middle	20.1	30.0	9.9	Complied
Top	19.3	30.0	10.7	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	20.2	0.0	20.2	36.0	15.8	Complied
Middle	20.1	0.0	20.1	36.0	15.9	Complied
Top	19.3	0.0	19.3	36.0	16.7	Complied

### Transmitter Maximum Peak Output Power (continued)



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

<b>Test Engineer:</b>	Andrew Edwards	<b>Test Date:</b>	03 May 2011
<b>Test Sample Serial No.:</b>	Not stated		

<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>	22
<b>Relative Humidity (%):</b>	19

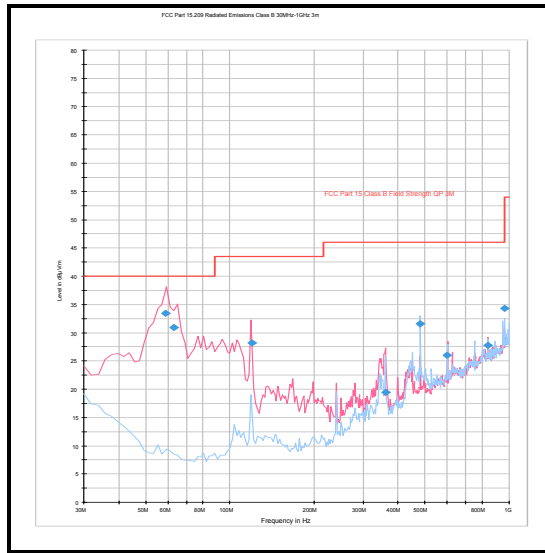
**Results: Top Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
58.711	Vertical	33.4	40.0	6.6	Complied
62.946	Vertical	30.9	40.0	9.1	Complied
120.001	Vertical	28.2	43.5	15.3	Complied
361.591	Vertical	19.5	46.0	26.5	Complied
479.977	Horizontal	31.6	46.0	14.4	Complied
599.978	Vertical	26.0	46.0	20.0	Complied
839.990	Vertical	27.7	46.0	18.3	Complied
959.992	Horizontal	34.3	46.0	11.7	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 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.
3. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. 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.*

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	04 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<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 25 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	24 to 27
<b>Relative Humidity (%):</b>	17 to 45

**Results: Peak Bottom Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4808.985	Horizontal	63.1	74.0	10.9	Complied
7213.523	Vertical	68.4	81.8*	13.4	Complied
12027.558	Vertical	62.2	74.0	11.8	Complied

\*20 dBc limit

**Results: Average Bottom Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4809.066	Horizontal	27.4	54.0	26.6	Complied
12027.558	Vertical	26.5	54.0	27.5	Complied

**Results: Peak Middle Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4878.996	Horizontal	63.8	74.0	10.2	Complied
7318.402	Vertical	63.2	74.0	10.8	Complied
12197.472	Vertical	63.7	74.0	10.3	Complied

**Results: Average Middle Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4879.013	Horizontal	28.1	54.0	25.9	Complied
7318.995	Vertical	27.5	54.0	26.5	Complied
12197.484	Vertical	28.0	54.0	26.0	Complied

**Transmitter Radiated Emissions (continued)****Results: Peak Top Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4950.917	Horizontal	59.1	74.0	14.9	Complied
7423.456	Vertical	60.8	74.0	13.2	Complied
12372.529	Vertical	58.9	74.0	15.1	Complied

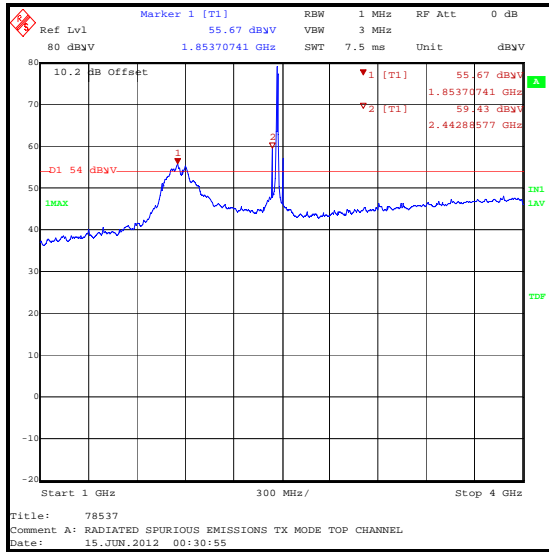
**Results: Average Top Channel**

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
4950.917	Horizontal	23.4	54.0	30.6	Complied
7423.456	Vertical	25.1	54.0	28.9	Complied
12372.529	Vertical	23.2	54.0	30.8	Complied

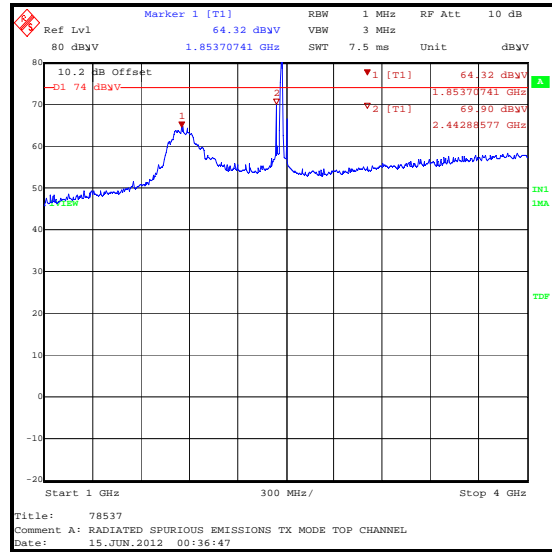
**Note(s):**

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. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. 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.
5. The average level was obtained by subtracting the duty cycle correction (35.7 dB) from the peak level measured with the EUT constantly transmitting.

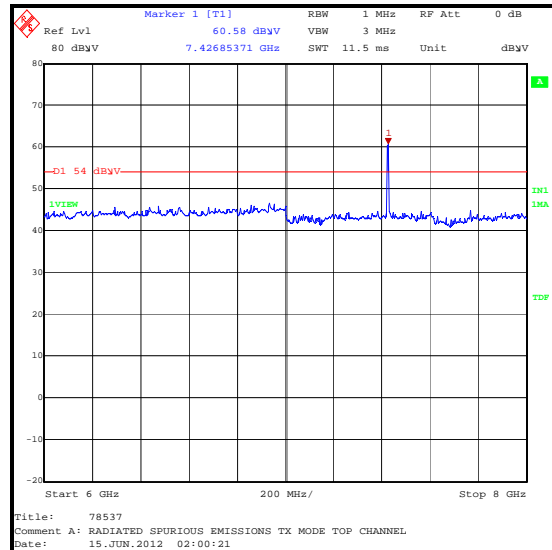
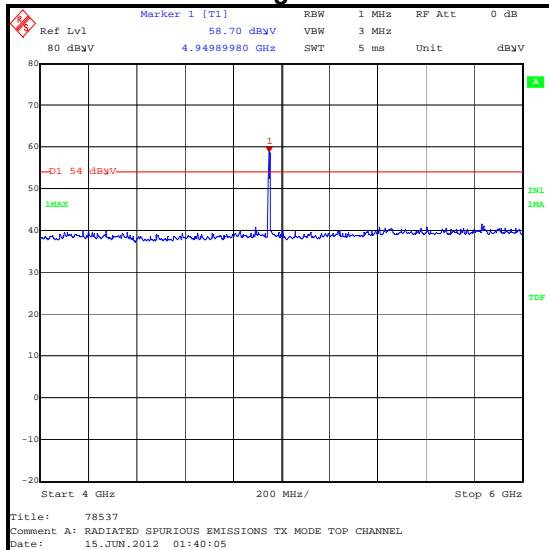
### Transmitter Radiated Emissions (continued)



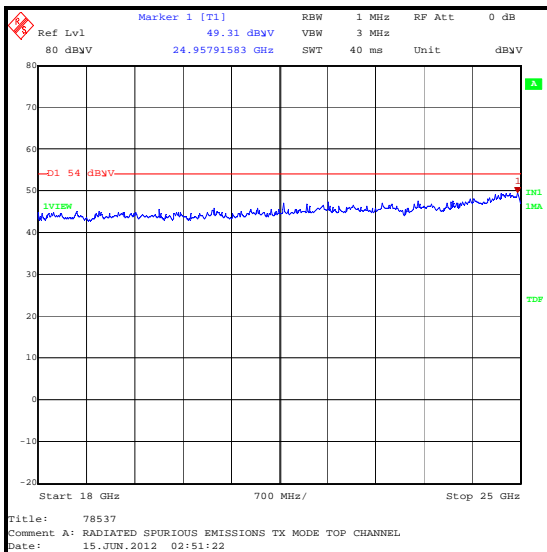
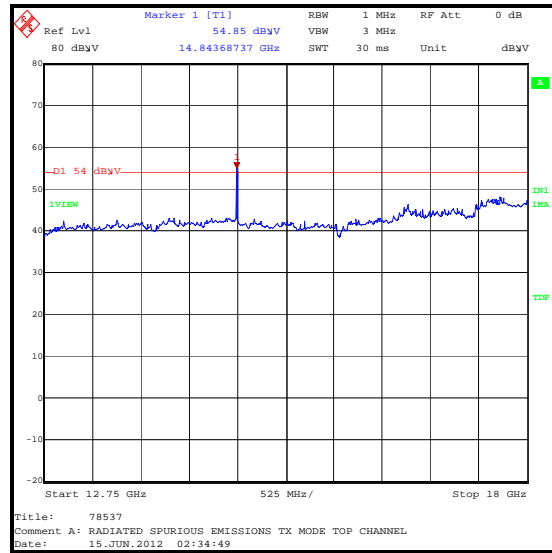
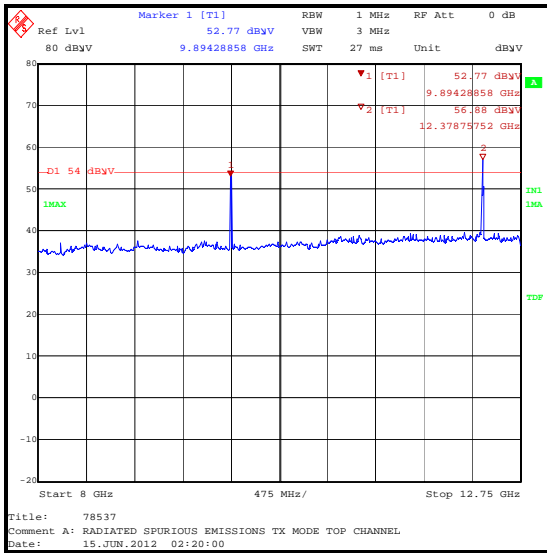
Average Plot



Peak Detector



### Transmitter Radiated Emissions (continued)





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

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	19 May 2011 & 15 June 2012
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	15.247(d) & 15.209(a)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 6.9.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	24 to 27
<b>Relative Humidity (%):</b>	17 to 45

**Results: Peak**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400	62.9	81.8*	18.9	Complied
2483.5	59.1	74.0	14.9	Complied

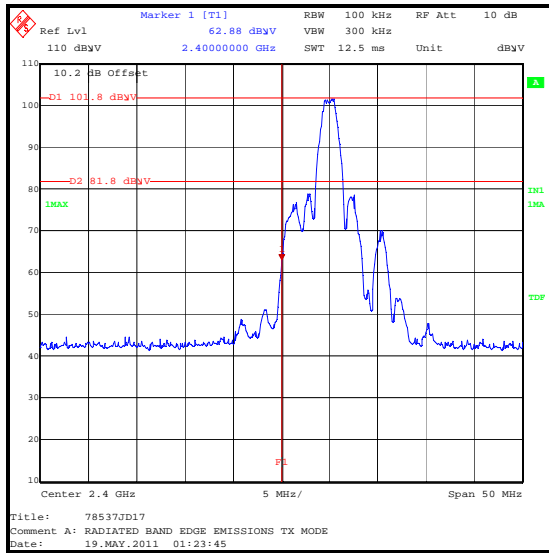
**Results: Average**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.5	23.4	54.0	30.6	Complied

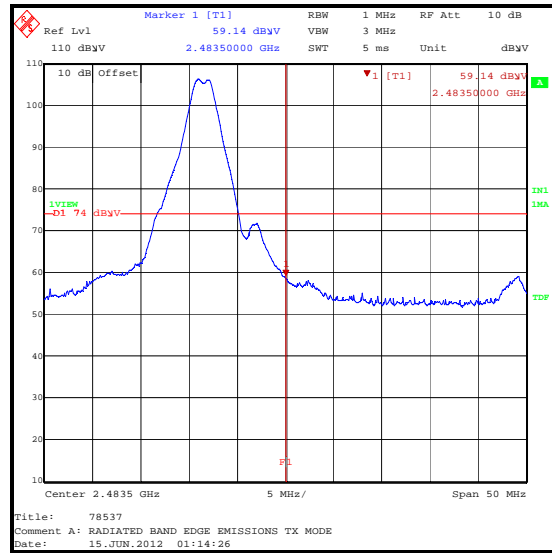
**Note(s):**

1. The final measured value, for the given emission, in the table above incorporates the calibrated antenna factor and cable loss.
2. \* -20 dBc limit.
3. The upper band edge average level was obtained by subtracting the duty cycle correction (35.7 dB) from the peak level measured with the EUT constantly transmitting.

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



**Lower Band Edge Peak Measurement**



**Upper Band Edge Peak Measurement**

**5.2.10. Transmitter Duty Cycle**

**Test Summary:**

<b>Test Engineer:</b>	Andrew Edwards	<b>Test Date:</b>	02 September 2011
<b>Test Sample Serial No.:</b>	Not stated		

<b>FCC Part:</b>	15.35(c)
<b>Test Method Used:</b>	As detailed in ANSI C63.10 Section 7.5

**Environmental Conditions:**

<b>Temperature (°C):</b>	28
<b>Relative Humidity (%):</b>	31

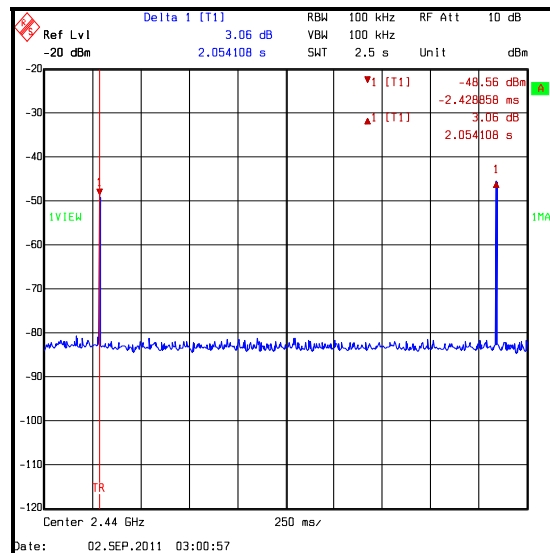
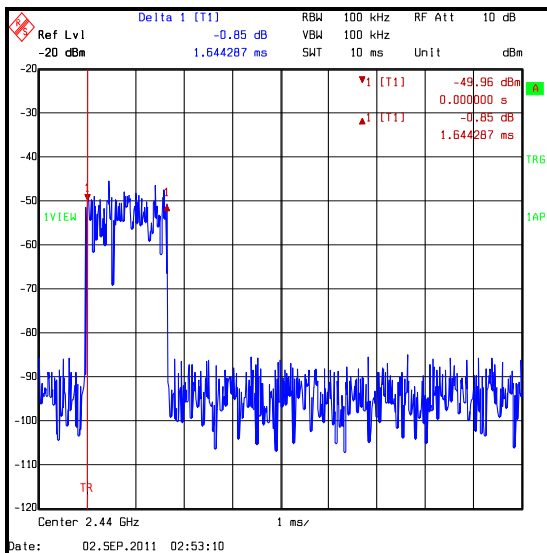
**Results:**

Pulse Duration (mS)	Duty Cycle (dB)
1.644	-35.7

Silent Period (seconds)
2.054

**Note(s):**

- In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by  $20 \log(\text{On Time} / [\text{Period or } 100\text{ms whichever is the lesser}])$  i.e.  $20 \log(1.644/100) = -35.7$  dB.



## **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".

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.25 dB
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±0.28 dB
Spectral Power Density	2.4 GHz to 2.4835 GHz	95%	±2.94 dB
6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
20 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
Radiated Spurious Emissions	30 MHz to 26.5 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**

<b>RFI No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval Months</b>
A1490	Attenuator	Weinschel Corp	23-30-34	BH9156	03 Apr 2013	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Oct 2012	12
A1818	Antenna	EMCO	3115	00075692	09 Oct 2012	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	25 Feb 2013	12
A1834	Attenuator	Hewlett Packard	8491B	10444	29 Jan 2013	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	15 Mar 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
A436	Antenna	Flann Microwave	20240-20	330	09 Oct 2012	12
A553	Antenna	Chase	CBL6111A	1593	15 Feb 2013	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	19 Feb 2013	12
G0543	Amplifier	Sonoma	310N	230801	13 Jul 2012	3
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	31 Aug 2012	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	09 Oct 2012	12
M1124	Test Receiver	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	03 Jan 2013	12
M1379	Test Receiver	Rohde & Schwarz	ESIB7	100330	20 Sep 2012	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	06 Feb 2013	12

All equipment was in calibration at the time testing took place.

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