

# TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: DataRelay900

To: FCC Part 15.247: 2009 Subpart C

**Test Report Serial No:**  
RFI/RPT2/RP75974JD01A

**Supersedes Test Report Serial No:**  
RFI/RPT1/RP75974JD01A

|                                                                                                 |                                                                                            |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <b>This Test Report Is Issued Under The Authority<br/>Of Brian Watson, Operations Director:</b> |                                                                                            |
| pp          |                                                                                            |
| <b>Checked By:</b>                                                                              | Robert Graham                                                                              |
| <b>Signature:</b>                                                                               | <br>pp |
| <b>Date of Issue:</b>                                                                           | 16 February 2010                                                                           |

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**1. Customer Information**

|                      |                                                                                                         |
|----------------------|---------------------------------------------------------------------------------------------------------|
| <b>Company Name:</b> | Kenure Developments Ltd                                                                                 |
| <b>Address:</b>      | Springlakes Industrial Estate<br>Deadbrook Lane<br>Aldershot<br>Hampshire<br>GU12 4UH<br>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:<br>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:<br>Part 15 Subpart B (Radio Frequency Devices) - 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,<br>England                                                              |
| <b>Test Dates:</b>              | 25 January 2010 to 12 February 2010                                                                                                          |

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

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

**2.3. Methods and Procedures**

|                   |                                                                                                                                                                      |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b> | ANSI C63.4 (2003)                                                                                                                                                    |
| <b>Title:</b>     | American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| <b>Reference:</b> | DA00-705 (2000)                                                                                                                                                      |
| <b>Title:</b>     | Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.                                                                           |

**2.4. Deviations from the Test Specification**

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

### **3. Equipment Under Test (EUT)**

#### **3.1. Identification of Equipment Under Test (EUT)**

|                          |              |
|--------------------------|--------------|
| Brand Name:              | DataRelay900 |
| Model Name or Number:    | DS-R900      |
| Serial Number:           | 0001         |
| Hardware Version Number: | 7325/0 Iss 1 |
| Software Version Number: | 1.0          |
| FCC ID Number:           | MS8R9        |

|                       |                                                          |
|-----------------------|----------------------------------------------------------|
| Description:          | 2.2 dBi gain half-wave dipole antenna with SMA connector |
| Brand Name:           | Antenna Factor                                           |
| Model Name or Number: | ANT-916-CW-HWR-SMA                                       |
| Serial Number:        | Not marked or stated                                     |

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

The Equipment Under Test (EUT) was a Wireless Data Aggregator operating over the 902 MHz to 928 MHz band. The EUT uses total 51 channels for communications where the 36th channel (919.8976MHz) is a receive-only channel and the rest are bi-directional (transmit/receive) channels.

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

The EUT had been modified in order to select the bottom, centre or top channel during testing. A flying lead approximately 80 mm in length had been routed through the gap in the casing. A switch had been fitted to the end of the flying lead. Pressing the switch in a defined sequence allowed the desired channel to be selected.

**3.4. Additional Information Related to Testing**

|                                  |                                |                       |                                |
|----------------------------------|--------------------------------|-----------------------|--------------------------------|
| <b>Tested Technology:</b>        | FHSS                           |                       |                                |
| <b>Power Supply Requirement:</b> | 5.0 VDC via external DC supply |                       |                                |
| <b>Type of Unit:</b>             | Transceiver                    |                       |                                |
| <b>Channel Spacing:</b>          | 500 kHz                        |                       |                                |
| <b>Modulation:</b>               | 2-FSK                          |                       |                                |
| <b>Maximum Transmit ERP:</b>     | 23.35 dBm                      |                       |                                |
| <b>Transmit Frequency Range:</b> | 902 MHz to 928 MHz             |                       |                                |
| <b>Transmit Channels Tested:</b> | <b>Channel ID</b>              | <b>Channel Number</b> | <b>Channel Frequency (MHz)</b> |
|                                  | Bottom                         | 1                     | 902.3976                       |
|                                  | Middle                         | 26                    | 914.8976                       |
|                                  | Top                            | 51                    | 927.3976                       |
| <b>Receive Frequency Range:</b>  | 902 MHz to 928 MHz             |                       |                                |
| <b>Receive Channels Tested:</b>  | <b>Channel ID</b>              | <b>Channel Number</b> | <b>Channel Frequency (MHz)</b> |
|                                  | Bottom                         | 1                     | 902.3976                       |
|                                  | Middle                         | 26                    | 914.8976                       |
|                                  | Top                            | 51                    | 927.3976                       |

### **3.5. Support Equipment**

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

|                              |                    |
|------------------------------|--------------------|
| <b>Description:</b>          | Bench power supply |
| <b>Brand Name:</b>           | Agilent            |
| <b>Model Name or Number:</b> | E3640              |
| <b>Serial Number:</b>        | MY40001718         |

|                              |                                 |
|------------------------------|---------------------------------|
| <b>Description:</b>          | AC/DC 5v Power supply           |
| <b>Brand Name:</b>           | Power Pax                       |
| <b>Model Name or Number:</b> | 5V 8W Model 1008 / PA1008-0501B |
| <b>Serial Number:</b>        | 2K9S0769                        |

|                              |                                         |
|------------------------------|-----------------------------------------|
| <b>Description:</b>          | In circuit programmer USB BDM multilink |
| <b>Brand Name:</b>           | P&E Pemicro                             |
| <b>Model Name or Number:</b> | E2640A                                  |
| <b>Serial Number:</b>        | Not stated                              |

|                              |                    |
|------------------------------|--------------------|
| <b>Description:</b>          | Laptop PC          |
| <b>Brand Name:</b>           | Siemens            |
| <b>Model Name or Number:</b> | C series Life book |
| <b>Serial Number:</b>        | 02487389E05        |

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

### **4.1. Operating Modes**

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

- Transmitter tests were performed with the EUT transmitting at full power on the bottom, centre and top channels or frequency hopping across the band of operation.
- Receiver/idle tests were performed with the EUT in receive mode.

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

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

- AC conducted emissions tests were performed with the EUT powered from an AC/DC power supply with 120 VAC input and 5 VDC output. The power supply input was connected to a LISN and the LISN input connected to a 120 VAC 60 Hz supply.
- Radiated tests were performed with the EUT powered from an AC/DC power supply. The power supply input was connected to a 120 VAC 60 Hz supply.
- A bench power supply was used to provide power to the EUT for all tests apart from radiated and AC conducted.
- An external switch on the EUT was used to select bottom, centre or top channels. A bespoke application on a laptop PC was used to enable or disable frequency hopping mode when required. The PC was disconnected from the EUT once frequency hopping had been enabled or disabled.
- The dipole antenna was fitted for all radiated and AC conducted tests.

## **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:**

|                          |                                                          |
|--------------------------|----------------------------------------------------------|
| <b>FCC Part:</b>         | 15.107(a)                                                |
| <b>Test Method Used:</b> | As detailed in ANSI C63.4 Section 7 and relevant annexes |

**Environmental Conditions:**

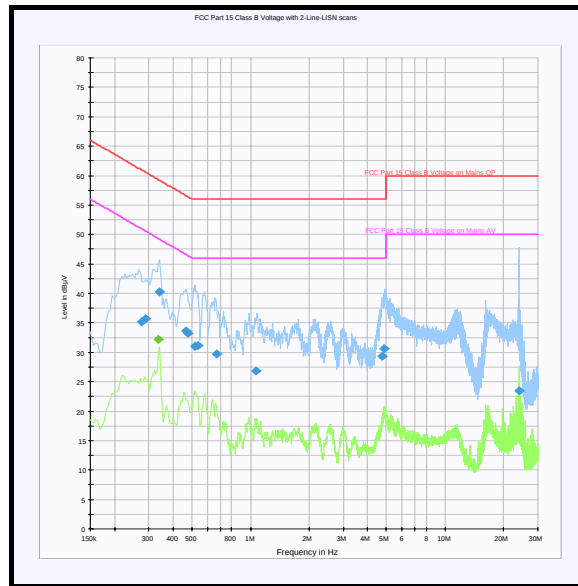
|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 24 |
| <b>Relative Humidity (%):</b> | 23 |

**Results: Quasi Peak Detector Measurements**

| Frequency (MHz) | Line | Quasi Peak Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|-------------------------|--------------|-------------|----------|
| 0.276000        | Live | 35.1                    | 60.9         | 25.8        | Complied |
| 0.289500        | Live | 35.6                    | 60.5         | 24.9        | Complied |
| 0.339000        | Live | 40.3                    | 59.2         | 18.9        | Complied |
| 0.465000        | Live | 33.6                    | 56.6         | 23.0        | Complied |
| 0.474000        | Live | 33.2                    | 56.4         | 23.2        | Complied |
| 0.519000        | Live | 31.1                    | 56.0         | 24.9        | Complied |
| 0.537000        | Live | 31.1                    | 56.0         | 24.9        | Complied |
| 0.667500        | Live | 29.7                    | 56.0         | 26.3        | Complied |
| 1.068000        | Live | 26.9                    | 56.0         | 29.1        | Complied |
| 4.735500        | Live | 29.3                    | 56.0         | 26.7        | Complied |
| 4.884000        | Live | 30.6                    | 56.0         | 25.4        | Complied |
| 24.000000       | Live | 23.5                    | 60.0         | 36.5        | Complied |

**Results: Average Detector Measurements**

| Frequency (MHz) | Line | Average Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|----------------------|--------------|-------------|----------|
| 0.334500        | Live | 32.2                 | 49.3         | 17.1        | Complied |

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

*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:**

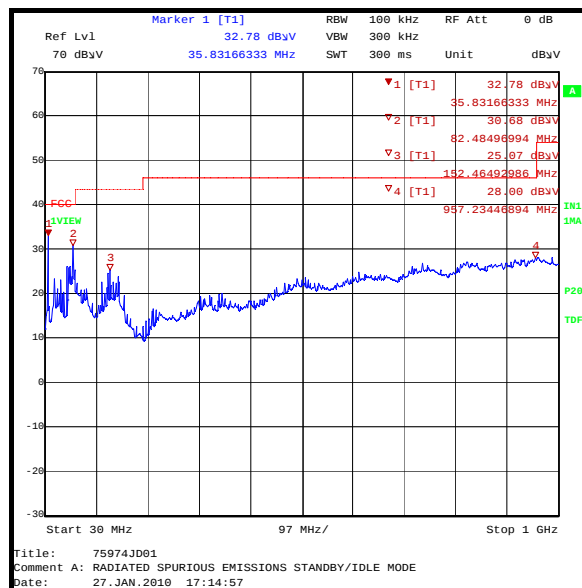
|                   |                                                          |
|-------------------|----------------------------------------------------------|
| FCC Part:         | 15.109                                                   |
| Test Method Used: | As detailed in ANSI C63.4 Section 8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

**Environmental Conditions:**

|                        |    |
|------------------------|----|
| Temperature (°C):      | 23 |
| Relative Humidity (%): | 22 |

**Results:**

| Frequency (MHz) | Antenna Polarity | Q-P Level (dB $\mu$ V/m) | Q-P Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------|--------------------------|--------------------------|-------------|----------|
| 35.883          | Vertical         | 33.1                     | 40.0                     | 6.9         | Complied |
| 71.802          | Horizontal       | 31.2                     | 40.0                     | 8.8         | Complied |
| 83.762          | Vertical         | 33.2                     | 40.0                     | 6.8         | Complied |
| 149.622         | Vertical         | 24.7                     | 43.5                     | 18.8        | Complied |
| 153.318         | Vertical         | 20.6                     | 43.5                     | 22.9        | Complied |



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 C63.4 Section 8 and relevant annexes |
| <b>Frequency Range:</b>  | 1 GHz to 4.7 GHz                                         |

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 23 |
| <b>Relative Humidity (%):</b> | 22 |

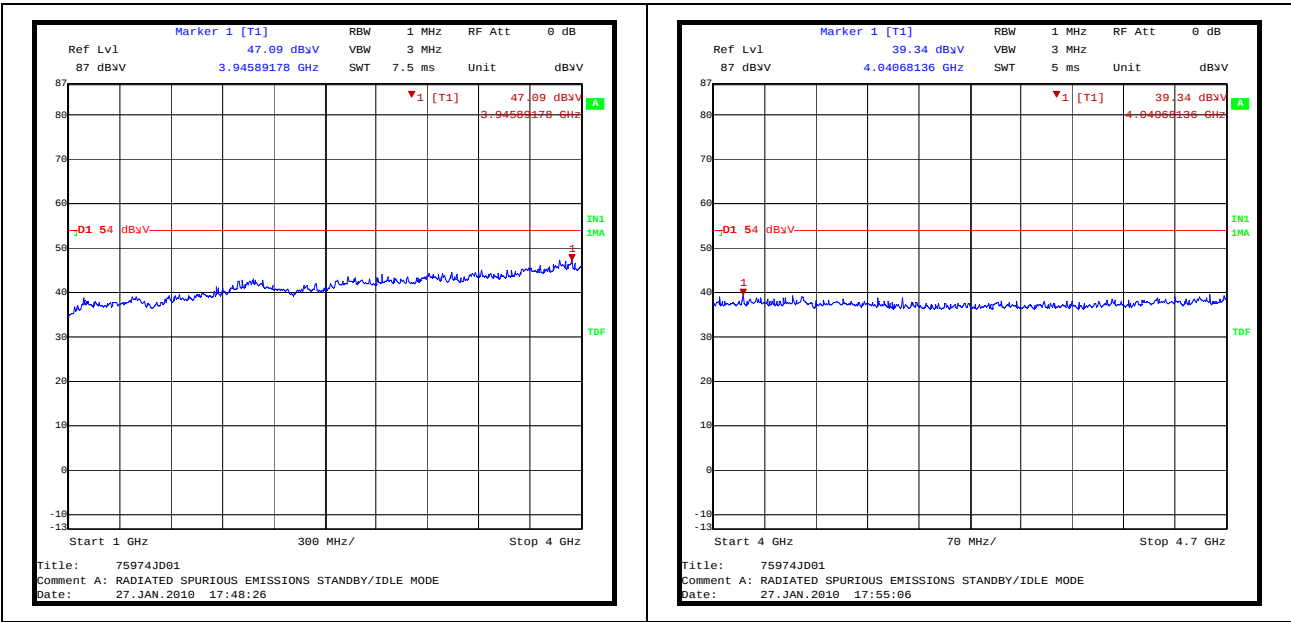
**Results:**

| <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> |
|------------------------|-------------------------|-------------------------------------------|----------------------------------------------|--------------------|---------------|
| 3945.892               | Vertical                | 47.1                                      | 54.0                                         | 6.9                | Complied      |

**Note(s):**

1. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table above. 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>FCC Part:</b>         | 15.207                                                   |
| <b>Test Method Used:</b> | As detailed in ANSI C63.4 Section 7 and relevant annexes |

**Environmental Conditions:**

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

**Results: Quasi Peak Detector Measurements**

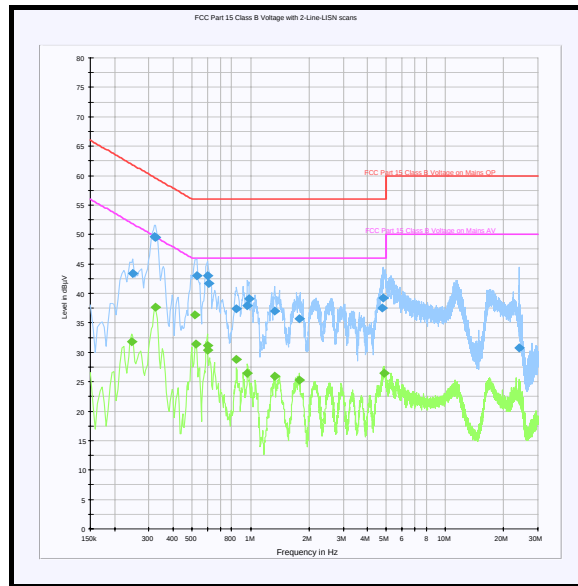
| <b>Frequency (MHz)</b> | <b>Line</b> | <b>Quasi Peak Level (dB<math>\mu</math>V)</b> | <b>Limit (dB<math>\mu</math>V)</b> | <b>Margin (dB)</b> | <b>Result</b> |
|------------------------|-------------|-----------------------------------------------|------------------------------------|--------------------|---------------|
| 0.249000               | Live        | 43.3                                          | 61.8                               | 18.5               | Complied      |
| 0.321000               | Live        | 49.7                                          | 59.7                               | 10.0               | Complied      |
| 0.325500               | Live        | 49.5                                          | 59.6                               | 10.1               | Complied      |
| 0.528000               | Live        | 43.1                                          | 56.0                               | 12.9               | Complied      |
| 0.600000               | Live        | 43.0                                          | 56.0                               | 13.0               | Complied      |
| 0.609000               | Live        | 41.7                                          | 56.0                               | 14.3               | Complied      |
| 0.843000               | Live        | 37.4                                          | 56.0                               | 18.6               | Complied      |
| 0.960000               | Live        | 38.0                                          | 56.0                               | 18.0               | Complied      |
| 0.978000               | Live        | 39.1                                          | 56.0                               | 16.9               | Complied      |
| 1.329000               | Live        | 37.0                                          | 56.0                               | 19.0               | Complied      |
| 1.783500               | Live        | 35.7                                          | 56.0                               | 20.3               | Complied      |
| 4.740000               | Live        | 37.6                                          | 56.0                               | 18.4               | Complied      |
| 4.825500               | Live        | 39.3                                          | 56.0                               | 16.7               | Complied      |
| 24.000000              | Live        | 30.7                                          | 60.0                               | 29.3               | Complied      |

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

| Frequency (MHz) | Line | Average Level (dB $\mu$ V) | Limit (dB $\mu$ V) | Margin (dB) | Result   |
|-----------------|------|----------------------------|--------------------|-------------|----------|
| 0.244500        | Live | 31.8                       | 51.9               | 20.1        | Complied |
| 0.325500        | Live | 37.7                       | 49.6               | 11.9        | Complied |
| 0.519000        | Live | 36.4                       | 46.0               | 9.6         | Complied |
| 0.523500        | Live | 31.3                       | 46.0               | 14.7        | Complied |
| 0.600000        | Live | 31.1                       | 46.0               | 14.9        | Complied |
| 0.604500        | Live | 30.4                       | 46.0               | 15.6        | Complied |
| 0.847500        | Live | 28.7                       | 46.0               | 17.3        | Complied |
| 0.964500        | Live | 26.5                       | 46.0               | 19.5        | Complied |
| 1.333500        | Live | 25.9                       | 46.0               | 20.1        | Complied |
| 1.779000        | Live | 25.2                       | 46.0               | 20.8        | Complied |
| 4.879500        | Live | 26.5                       | 46.0               | 19.5        | Complied |

**Note(s):**

1. The EUT was transmitting at full power on the top channel during the test.

**Transmitter AC Conducted Spurious Emissions (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 Public Notice DA 00-705 (March 30, 2000) |

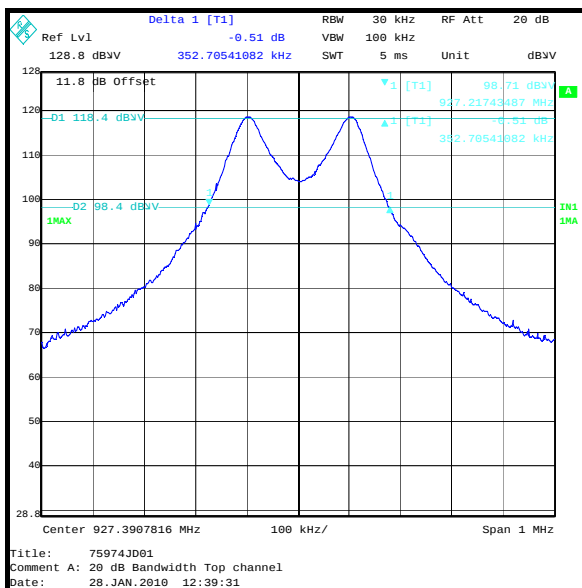
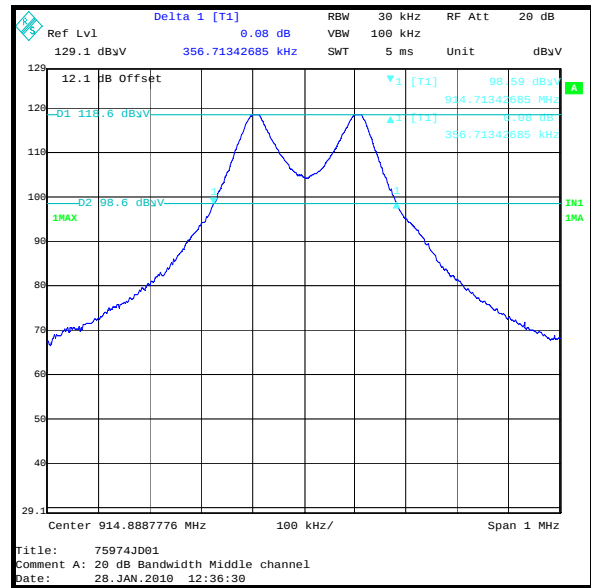
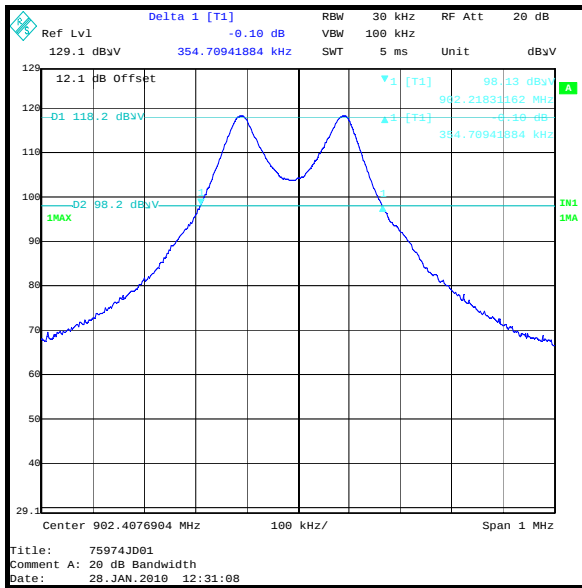
**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 22 |
| <b>Relative Humidity (%):</b> | 23 |

**Results:**

| <b>Channel</b> | <b>20 dB Bandwidth (kHz)</b> | <b>Limit (kHz)</b> | <b>Margin (kHz)</b> | <b>Result</b> |
|----------------|------------------------------|--------------------|---------------------|---------------|
| 902.3976       | 354.709                      | 500                | 145.291             | Complied      |
| 914.8976       | 356.713                      | 500                | 143.287             | Complied      |
| 927.3976       | 352.705                      | 500                | 147.295             | Complied      |

### Transmitter 20 dB Bandwidth (continued)



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

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

**Environmental Conditions:**

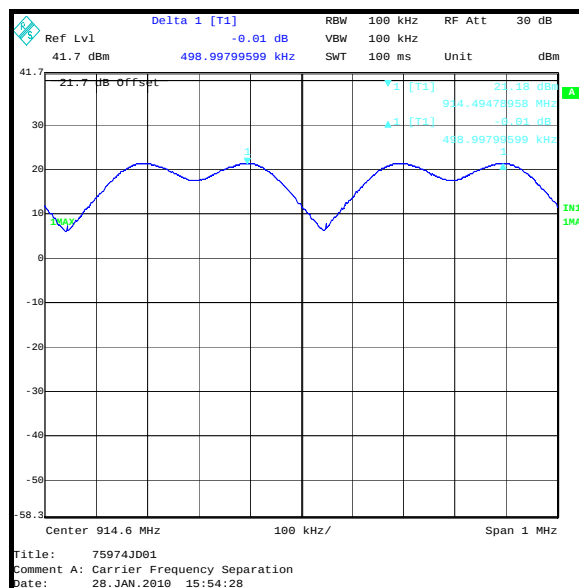
|                        |    |
|------------------------|----|
| Temperature (°C):      | 22 |
| Relative Humidity (%): | 23 |

**Results:**

| Transmitter Carrier Frequency Separation (kHz) | Limit (20 dB BW) (kHz) | Margin (kHz) | Result   |
|------------------------------------------------|------------------------|--------------|----------|
| 498.998                                        | 356.713                | 142.285      | Complied |

**Note(s):**

1. The hopping function of the EUT was enabled.



**5.2.6. Transmitter Time of Occupancy & Number of Hopping Channels****Test Summary:**

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

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 22 |
| <b>Relative Humidity (%):</b> | 23 |

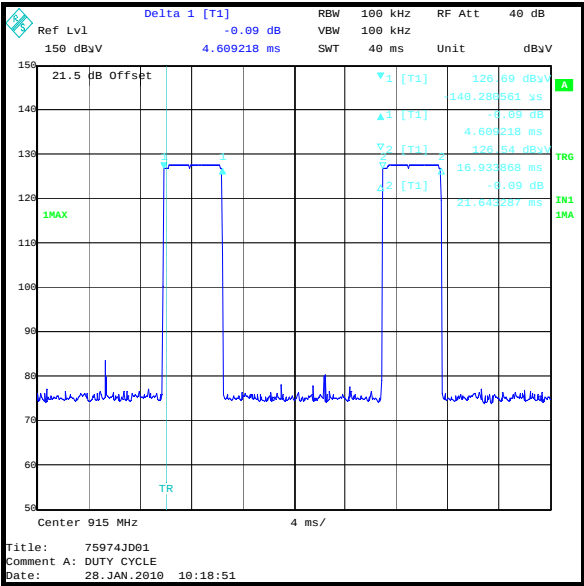
**Results:**

| <b>Emission Width (ms)</b> | <b>Number of Hops in 10 Seconds</b> | <b>Average Time of Occupancy (s)</b> | <b>Limit (s)</b> | <b>Margin (s)</b> | <b>Result</b> |
|----------------------------|-------------------------------------|--------------------------------------|------------------|-------------------|---------------|
| 4.609                      | 2                                   | 0.0092                               | 0.4              | 0.3908            | Complied      |

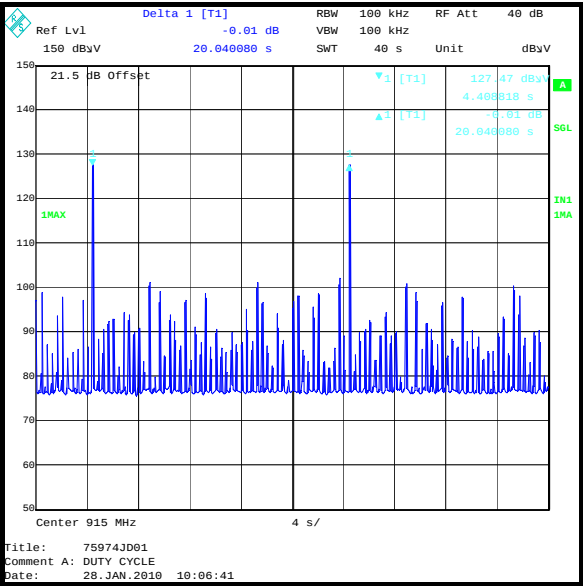
**Note(s):**

1. The EUT utilises 50 hopping channels as shown in the plot below.
2. The EUT transmits in two bursts of 4.609 milliseconds, before transmitting again after approximately 20 seconds.

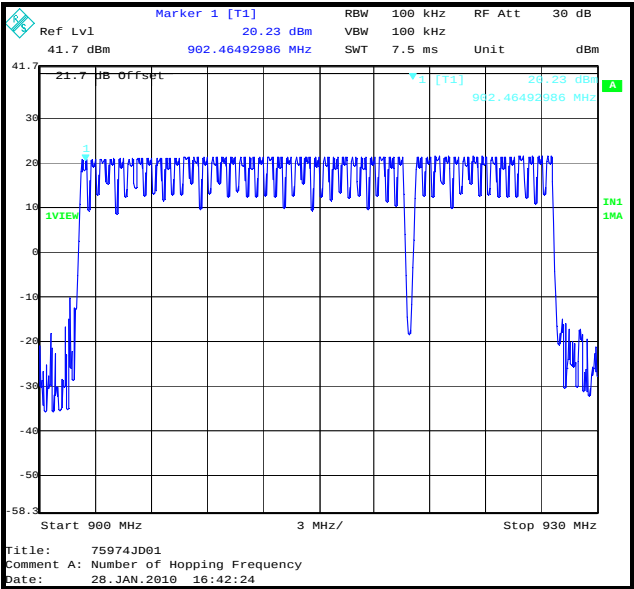
Transmitter Time of Occupancy & Number of Hopping Channels



TX on period



TX repetition period



Number of Hopping Frequencies

**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 Public Notice DA 00-705 (March 30, 2000),<br>ANSI C63.4-2003 and FCC CFR Part 2 |

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 21 |
| <b>Relative Humidity (%):</b> | 33 |

**Results:**

| Channel | Conducted RF O/P Power (dBm) | Conducted RF O/P Power Limit (dBm) | Margin (dB) | Result   |
|---------|------------------------------|------------------------------------|-------------|----------|
| Bottom  | 20.8                         | 30.0                               | 9.2         | Complied |
| Middle  | 21.2                         | 30.0                               | 8.8         | Complied |
| Top     | 21.0                         | 30.0                               | 9.0         | Complied |

| Channel | Conducted RF O/P Power (dBm) | Stated Antenna Gain (dB) | EIRP (dBm) | De Facto EIRP Limit (dBm) | Margin (dB) | Result   |
|---------|------------------------------|--------------------------|------------|---------------------------|-------------|----------|
| Bottom  | 20.8                         | 2.15                     | 22.95      | 36.0                      | 13.05       | Complied |
| Middle  | 21.2                         | 2.15                     | 23.35      | 36.0                      | 12.65       | Complied |
| Top     | 21.0                         | 2.15                     | 23.15      | 36.0                      | 12.85       | Complied |

**Note(s):**

1. As per the requirements of Public Notice DA 00-705, the stated antenna gain of the EUT is 2.15 dBi which, when added to the highest (worst case) measured conducted peak output power of 21.2 dBm (from the table above), gives a de facto EIRP of 23.35 dBm. This is in compliance with the de facto EIRP limitation, i.e. 4 Watt (36 dBm).

**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 Public Notice DA 00-705 (March 30, 2000) and ANSI C63.4 Section 8. |
| <b>Frequency Range</b>   | 30 MHz to 1000 MHz                                                                |

**Environmental Conditions:**

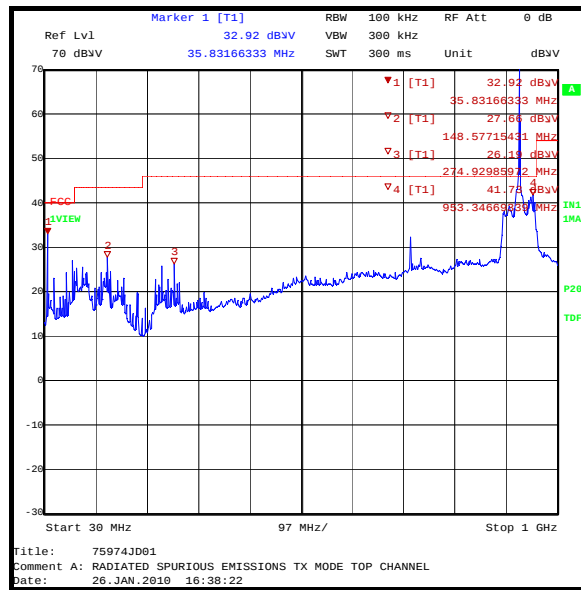
|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 24 |
| <b>Relative Humidity (%):</b> | 21 |

**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> |
|------------------------|-------------------------|--------------------------------------|--------------------------------------|--------------------|---------------|
| 35.904                 | Horizontal              | 33.5                                 | 100.5                                | 67.0               | Complied      |
| 83.766                 | Vertical                | 28.8                                 | 100.5                                | 71.7               | Complied      |
| 146.640                | Horizontal              | 24.0                                 | 100.5                                | 76.5               | Complied      |
| 167.554                | Vertical                | 23.7                                 | 100.5                                | 76.8               | Complied      |
| 251.352                | Vertical                | 25.7                                 | 43.5                                 | 17.8               | Complied      |
| 275.295                | Horizontal              | 27.0                                 | 43.5                                 | 16.5               | Complied      |
| 721.172                | Vertical                | 31.4                                 | 100.5                                | 69.1               | Complied      |
| 946.022                | Vertical                | 41.3                                 | 100.5                                | 59.2               | Complied      |

**Note(s):**

1. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
2. The carrier is shown on the pre-scan plot at approximately 927 MHz.

**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>FCC Part:</b>         | 15.247(d) & 15.209(a)                                                             |
| <b>Test Method Used:</b> | As detailed in Public Notice DA 00-705 (March 30, 2000) and ANSI C63.4 Section 8. |
| <b>Frequency Range</b>   | 1 GHz to 9.28 GHz                                                                 |

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 24 |
| <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   |
|-----------------|------------------|-----------------------|------------------------|-----------------------|----------------|-------------|----------|
| 1.804965        | Horizontal       | 86.6                  | -2.2                   | 84.4                  | 100.3          | 15.9        | Complied |
| 2.707506        | Vertical         | 60.4                  | 1.1                    | 61.5                  | 74.0           | 12.5        | Complied |
| 3.609925        | Vertical         | 55.6                  | 3.1                    | 58.7                  | 74.0           | 15.3        | Complied |
| 4.512470        | Horizontal       | 48.4                  | -3.5                   | 44.9                  | 74.0           | 29.1        | Complied |
| 5.415121        | Horizontal       | 53.5                  | 2.9                    | 56.4                  | 74.0           | 17.6        | Complied |
| 6.317438        | Vertical         | 58.4                  | 1.8                    | 60.2                  | 100.3          | 40.1        | Complied |
| 7.219923        | Horizontal       | 49.6                  | 6.6                    | 56.2                  | 100.3          | 44.1        | Complied |

**Highest Average Level. Bottom Channel**

| Frequency (GHz) | Antenna Polarity | Detector Level (dBμV) | Transducer Factor (dB) | Actual Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Result   |
|-----------------|------------------|-----------------------|------------------------|-----------------------|----------------|-------------|----------|
| 2.707506        | Vertical         | 39.7                  | 1.1                    | 40.8                  | 54.0           | 13.2        | Complied |
| 3.609925        | Vertical         | 34.9                  | 3.1                    | 38.0                  | 54.0           | 16.0        | Complied |
| 4.512470        | Horizontal       | 27.7                  | -3.5                   | 24.2                  | 54.0           | 29.8        | Complied |
| 5.415121        | Horizontal       | 32.8                  | 2.9                    | 35.7                  | 54.0           | 18.3        | Complied |

**Transmitter Radiated Emissions (continued)****Highest Peak Level. Middle Channel**

| Frequency (GHz) | Antenna Polarity | Detector Level (dB $\mu$ V) | Transducer Factor (dB) | Actual Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------|-----------------------------|------------------------|-----------------------------|----------------------|-------------|----------|
| 1.829952        | Horizontal       | 84.2                        | -2.0                   | 82.2                        | 100.7                | 18.5        | Complied |
| 2.744966        | Horizontal       | 55.7                        | 1.1                    | 56.8                        | 74.0                 | 17.2        | Complied |
| 3.659980        | Vertical         | 60.2                        | 4.6                    | 64.8                        | 74.0                 | 9.2         | Complied |
| 4.574918        | Horizontal       | 46.0                        | -3.0                   | 43.0                        | 74.0                 | 31.0        | Complied |
| 5.489920        | Horizontal       | 56.7                        | 0.6                    | 57.3                        | 100.7                | 43.4        | Complied |
| 6.404928        | Vertical         | 54.9                        | 1.8                    | 56.7                        | 100.7                | 44.0        | Complied |
| 7.319953        | Vertical         | 60.3                        | 6.9                    | 67.2                        | 74.0                 | 6.8         | Complied |

**Highest Average Level. Middle Channel**

| Frequency (GHz) | Antenna Polarity | Detector Level (dB $\mu$ V) | Transducer Factor (dB) | Actual Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------|-----------------------------|------------------------|-----------------------------|----------------------|-------------|----------|
| 2.744966        | Horizontal       | 35.0                        | 1.1                    | 36.1                        | 54.0                 | 17.9        | Complied |
| 3.659980        | Vertical         | 39.5                        | 4.6                    | 44.1                        | 54.0                 | 9.9         | Complied |
| 4.574918        | Horizontal       | 25.3                        | -3.0                   | 22.3                        | 54.0                 | 31.7        | Complied |
| 7.319953        | Vertical         | 39.6                        | 6.9                    | 46.5                        | 54.0                 | 7.5         | Complied |

**Highest Peak Level. Top Channel**

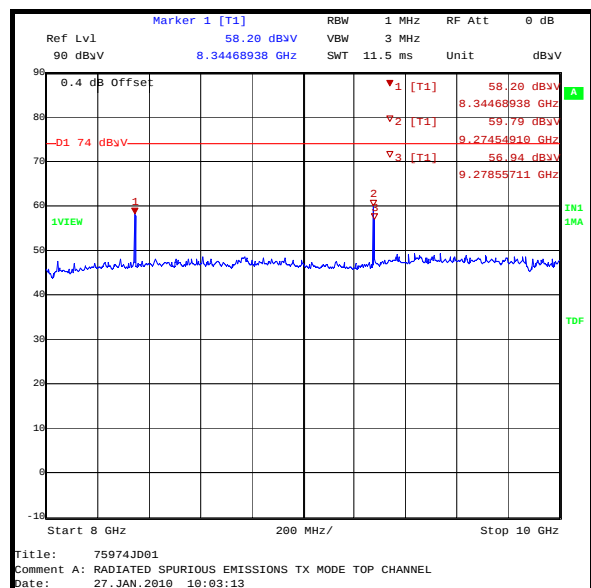
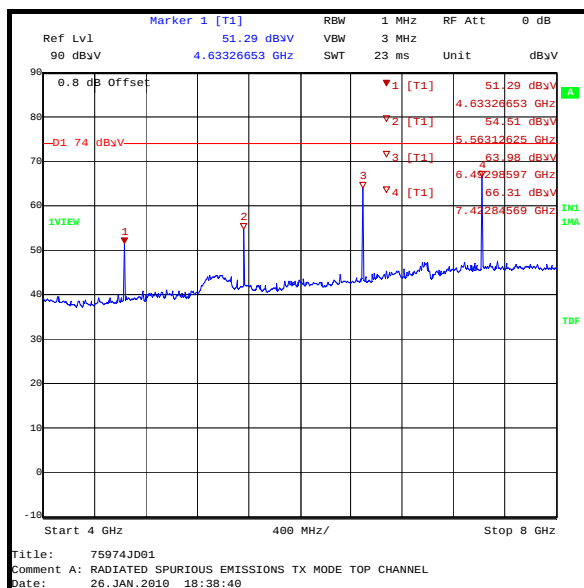
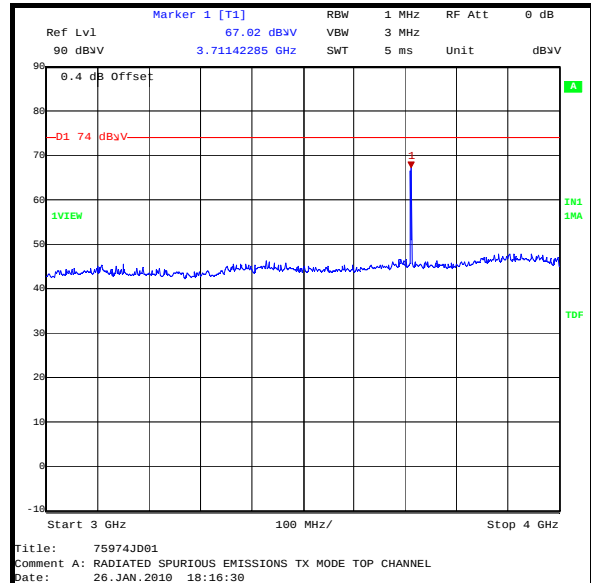
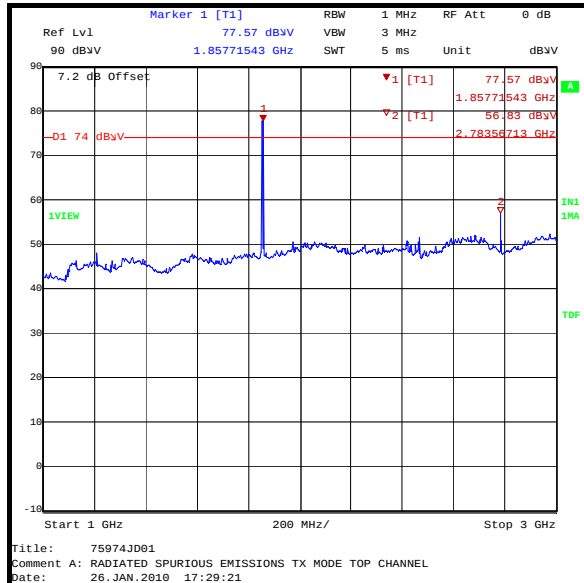
| Frequency (GHz) | Antenna Polarity | Detector Level (dB $\mu$ V) | Transducer Factor (dB) | Actual Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------|-----------------------------|------------------------|-----------------------------|----------------------|-------------|----------|
| 1.855020        | Horizontal       | 79.0                        | -1.8                   | 77.2                        | 100.5                | 23.3        | Complied |
| 2.782514        | Horizontal       | 56.3                        | 1.1                    | 57.4                        | 74.0                 | 16.6        | Complied |
| 3.709925        | Horizontal       | 63.3                        | 3.6                    | 66.9                        | 74.0                 | 7.1         | Complied |
| 4.637565        | Vertical         | 54.4                        | -2.1                   | 52.3                        | 74.0                 | 21.7        | Complied |
| 5.564934        | Horizontal       | 55.9                        | 0.7                    | 57.6                        | 100.5                | 42.9        | Complied |
| 6.492413        | Vertical         | 61.3                        | 2.0                    | 63.3                        | 100.5                | 37.2        | Complied |
| 7.419926        | Horizontal       | 61.6                        | 6.4                    | 68.0                        | 74.0                 | 6.0         | Complied |

**Highest Average Level. Top Channel**

| Frequency (GHz) | Antenna Polarity | Detector Level (dB $\mu$ V) | Transducer Factor (dB) | Actual Level (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------|-----------------------------|------------------------|-----------------------------|----------------------|-------------|----------|
| 2.782514        | Horizontal       | 35.6                        | 1.1                    | 36.7                        | 54.0                 | 17.3        | Complied |
| 3.709925        | Horizontal       | 42.6                        | 3.6                    | 46.2                        | 54.0                 | 7.8         | Complied |
| 4.637565        | Vertical         | 33.7                        | -2.1                   | 31.6                        | 54.0                 | 22.4        | Complied |
| 7.419926        | Horizontal       | 40.9                        | 6.4                    | 47.3                        | 54.0                 | 6.7         | Complied |

**Transmitter Radiated Emissions (continued)****Note(s):**

1. Average levels of emissions within the restricted bands were obtained using the test method and procedure stated in the Spurious Radiated Emissions section of FCC Public Notice DA 00-705. A duty cycle correction factor of 20.7 dB was used.
2. The calculation for the duty cycle is  $20 \log (9.219\text{ms}/100\text{ms}) = 20.7 \text{ dB}$
3. The level of peak emissions in hopping mode were equal to or less than those recorded in the results tables above.

**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 Duty Cycle

### Test Summary:

|                   |                                                         |
|-------------------|---------------------------------------------------------|
| Test Method Used: | As detailed in Public Notice DA 00-705 (March 30, 2000) |
|-------------------|---------------------------------------------------------|

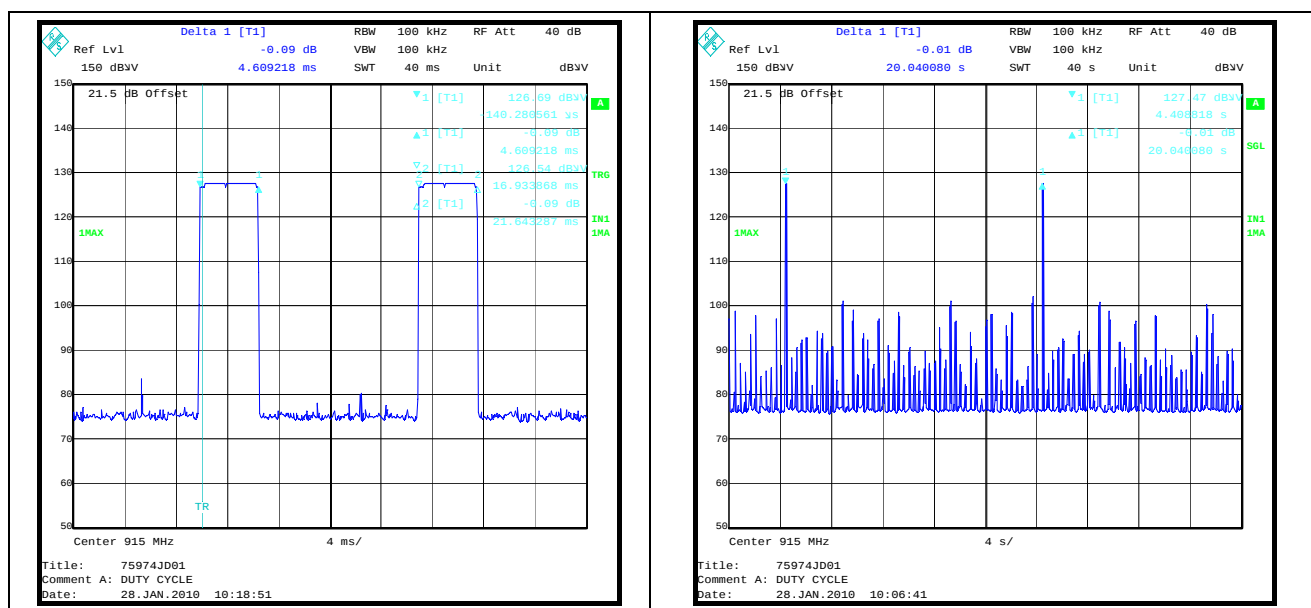
### Results:

| Total Pulse Duration (mS) | Duty Cycle (dB) |
|---------------------------|-----------------|
| 9.219ms (2x 4.609)        | 20.7            |

| Silent Period (seconds) |
|-------------------------|
| 20.040                  |

### Note(s):

1. 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.
2. The EUT transmits in two bursts of 4.609 milliseconds within the specified 100 mS period.



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

|                          |                                                                             |
|--------------------------|-----------------------------------------------------------------------------|
| <b>FCC Part:</b>         | 15.247(d)                                                                   |
| <b>Test Method Used:</b> | As detailed in Public Notice DA 00-705 (March 30, 2000) and FCC CFR Part 2. |

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 24 |
| <b>Relative Humidity (%):</b> | 21 |

**Results: Peak Power Level Static Mode**

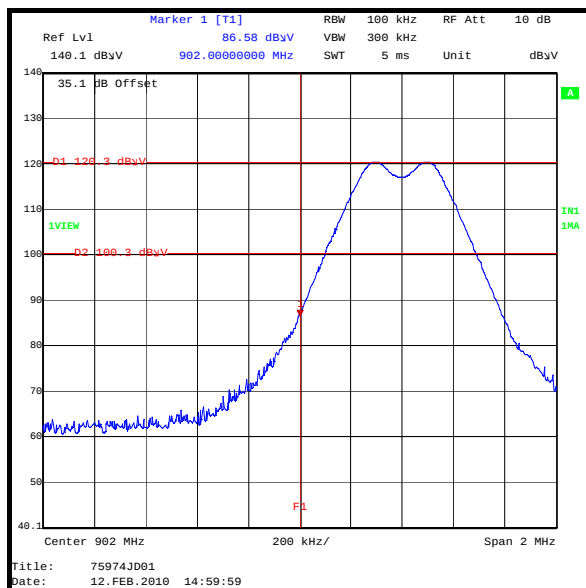
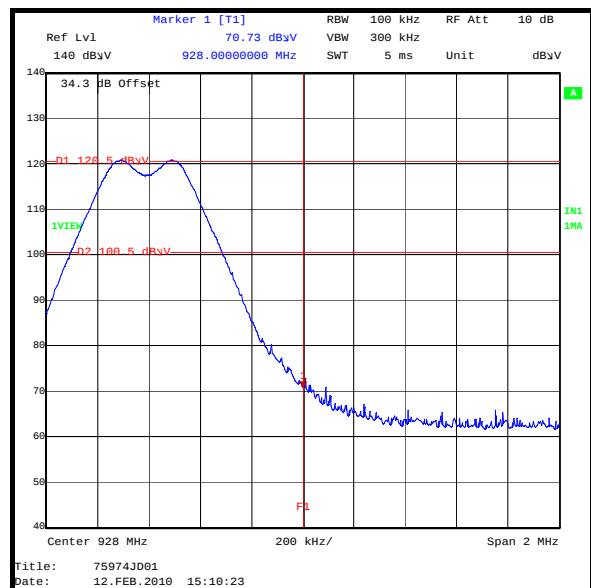
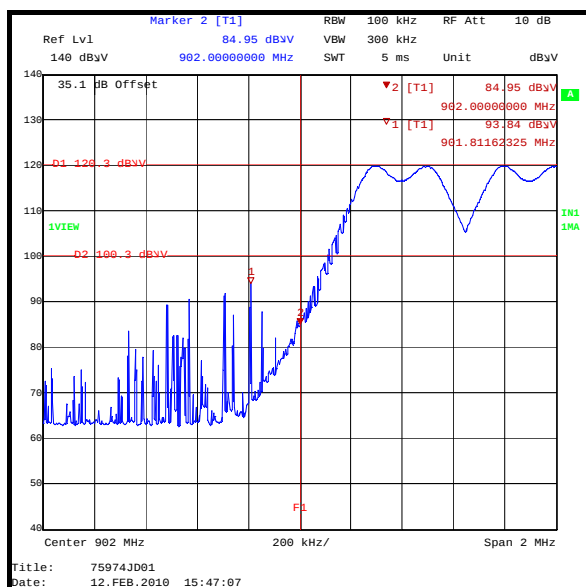
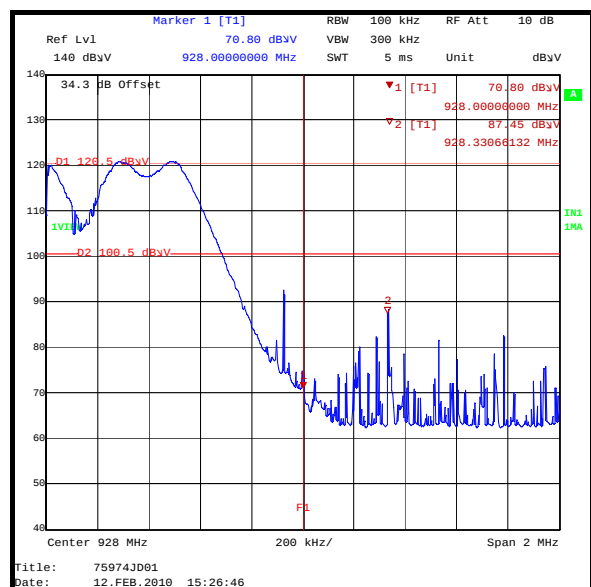
| Frequency (MHz) | Peak Emission Level (dB $\mu$ V/m) | -20 dBc Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------------------------|------------------------------|-------------|----------|
| 902.000         | 86.6                               | 100.3                        | 13.7        | Complied |
| 928.000         | 70.7                               | 100.5                        | 29.8        | Complied |

**Results: Peak Power Level Hopping Mode**

| Frequency (MHz) | Peak Emission Level (dB $\mu$ V/m) | -20 dBc Limit (dB $\mu$ V/m) | Margin (dB) | Result   |
|-----------------|------------------------------------|------------------------------|-------------|----------|
| 901.812         | 93.8                               | 100.3                        | 6.5         | Complied |
| 928.331         | 87.5                               | 100.5                        | 13.0        | Complied |

**Note(s):**

1. The limit lines shown on the plots are set to a level 20 dB below the fundamental peak field strength of the highest power level contained within the band when measured in a 100 kHz bandwidth.

**Transmitter Band Edge Radiated Emissions (continued)****Static- Bottom channel / lower band edge****Static - Top channel / upper band edge****Hopping - Bottom channel / lower band edge****Hopping - Top channel / upper band edge**

## 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 | 902 to 928 MHz     | 95%                  | ±0.92 ppm              |
| Transmitter Average Time of Occupancy    | 902 to 928 MHz     | 95%                  | ±0.3 ns                |
| 20 dB Bandwidth                          | 902 to 928 MHz     | 95%                  | ±0.92 ppm              |
| Radiated Spurious Emissions              | 30 MHz to 1000 MHz | 95%                  | ±4.64 dB               |
| Radiated Spurious Emissions              | 1 GHz 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 Last Calibrated  | Cal. Interval (Months) |
|---------|------------------|-------------------|-----------|------------|-----------------------|------------------------|
| A057    | High Pass Filter | Aerial Facilities | HP-950-5N | 4389B      | Calibrated before use | -                      |
| A1392   | Attenuator       | Huber + Suhner    | 757456    | 6820.17.B  | Calibrated before use | -                      |
| A1818   | Antenna          | EMCO              | 3115      | 00075692   | 27 Nov 2009           | 12                     |
| A1830   | Pulse Limiter    | Rhode & Schwarz   | ESH3-Z2   | 100668     | 05 Jan 2010           | 12                     |
| A288    | Antenna          | Chase             | CBL6111A  | 1589       | 13 Mar 2009           | 12                     |
| A649    | LISN             | Rohde & Schwarz   | ESH3-Z5   | 825562/008 | 19 Mar 2009           | 12                     |
| K0002   | 3m RSE Chamber   | Rainford EMC      | N/A       | N/A        | 01 Sep 2009           | 12                     |
| M1124   | Test Receiver    | Rohde & Schwarz   | ESIB26    | 100046K    | 09 Mar 2009           | 12                     |
| M1263   | Test Receiver    | Rohde & Schwarz   | ESIB7     | 100265     | 22 Apr 2009           | 12                     |
| M1379   | Test Receiver    | Rohde & Schwarz   | ESIB7     | 100330     | 20 Aug 2009           | 12                     |

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