



**Nemko**

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Compliance test report ID: 178156-1TRFWL

Date of issue  
September 15, 2011

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## Title 47-Telecommunication

Chapter I - Federal Communications Commission  
Subchapter A - General  
Part 15 - Radio Frequency Devices  
Subpart C - Intentional Radiators

### **§15.247 – Operation within the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz**

Applicant **4126254 Canada Inc.**  
Product **Autonomous TAG-Transceiver**  
Product category **Transceiver tag**  
Model **TAG-X**  
FCC ID **T9RTAGX**

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Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation



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**Reviewed by**



Andrey Adelberg, Senior Wireless/EMC Specialist

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September 15, 2011

Date:

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**Limits of responsibility**

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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## Section 1: Report summary

### 1.1 Test specifications

#### **FCC Part 15 Subpart C, 15.247**

Operation within the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz.

### 1.2 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See *“Summary of test results” for full details.*

### 1.3 Registration number

Test site FCC ID number: 176392 (3 m Semi anechoic chamber)

### 1.4 Exclusions

None

### 1.5 Test report revision history

None

## Section 2: Summary of test results

### 2.1 FCC Part 15 Subpart C – Intentional radiators, test results

Part	Test description	Verdict
§15.31(e)	Variation of power source	<sup>1</sup>
§15.31(m)	Number of operating frequencies	<sup>2</sup>
§15.203	Antenna requirement	Pass <sup>3</sup>
§15.207(a)	Conducted limits	Not applicable <sup>4</sup>
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable <sup>5</sup>
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable <sup>5</sup>
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable <sup>5</sup>
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicable <sup>5</sup>
§15.247(b)(4)	Maximum peak output power	<sup>6</sup>
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable <sup>7</sup>
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable <sup>5</sup>
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not applicable <sup>5</sup>
§15.247(f)	Time of occupancy for hybrid systems	Not applicable <sup>8</sup>

Notes: <sup>1</sup> For battery-operated equipment, the equipment tests were performed using a new battery.

<sup>2</sup> The operating frequency band of the EUT is larger than 10 MHz; Therefore a minimum of three operating frequencies were assessed (low, mid, high).

<sup>3</sup> The EUT is equipped with a permanently attached antenna.

<sup>4</sup> The EUT is battery powered.

<sup>5</sup> The EUT is a frequency hopping systems that transmits from 902–928 MHz.

<sup>6</sup> Applicable to devices that have directional antennas with gains of greater than 6 dBi.

<sup>7</sup> The EUT is not a fixed point-to-point device operating with directional antenna gain greater than 6 dBi.

<sup>8</sup> The EUT is not a hybrid system.

## Section 3: Equipment under test (EUT) details

### 3.1 Applicant

4126254 Canada Inc.  
5605 St-Francois  
St-Laurent, QC, Canada  
H4S 1W6

### 3.2 Sample information

**Receipt date** June 9, 2011  
**Nemko sample ID number** Item # 1

### 3.3 EUT information

**Product** Autonomous TAG-Transceiver  
**Model** TAG-X  
**Serial number** None (prototype samples)  
**Power requirements** 3.6 V<sub>DC</sub>  
**Manufacturer** 4126254 Canada Inc.  
5605 St-Francois  
St-Laurent, QC, Canada  
H4S 1W6

#### Product description and theory of operation

The EUT autonomous and self-contained battery operated asset management, identification and tracking tag.

### 3.4 EUT technical information

**Operating band** 902–928 MHz  
**Operating frequency** 902.24–927.76 MHz  
**Modulation type** FSK  
**20 dB bandwidth** 29.64 kHz  
**Channel spacing** 40.64 kHz  
**Antenna data** Whip antenna (non-detachable)

### 3.5 EUT exercise details

Client provided modified sample that could be set for continuous transmission.

### 3.6 EUT setup



**Photo 3.6-1: EUT setup**

## Section 4: Engineering considerations

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### 4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

### 4.2 Technical judgment

None

### 4.3 Deviations from laboratory tests procedures

None

## Section 5: Test conditions

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### 5.1 Atmospheric conditions

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Temperature: 15–30 °C

Relative humidity: 20–75 %

Air pressure: 86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

### 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages  $\pm 5\%$ , for which the equipment was designed.

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## Section 6: Measurement uncertainty

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### 6.1 Uncertainty of measurement

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Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

## Section 7: Test equipment

### 7.1 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/12
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	April 27/12
Bilog antenna	Sunol	JB3	FA002108	1 year	Jan. 31/12
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 04/12
1-18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	Sept. 23/11
Power Source	California Instruments	5001ix	FA001770	1 year	May 03/12
50 coax cable	Huber + Suhner	None	FA002013	1 year	Sept. 01/11

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## Section 8: Testing data

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### 8.1 § 15.247(a) (1) (i) Frequency hopping requirements

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(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

#### 8.1.1 Test summary

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**Verdict** Pass

#### 8.1.2 Observations/special notes

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- Tests performed with modulation enabled.
- Client provided a temporary antenna connector.

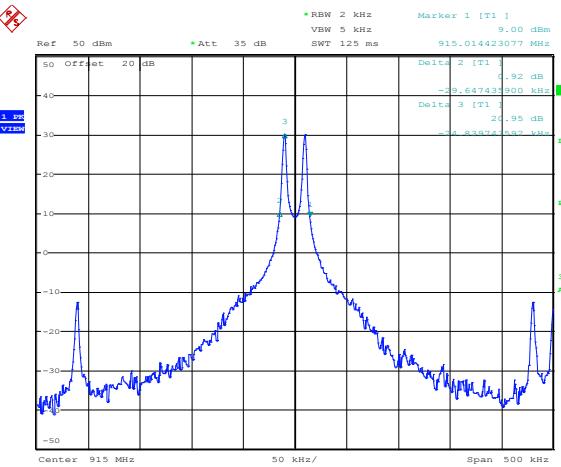
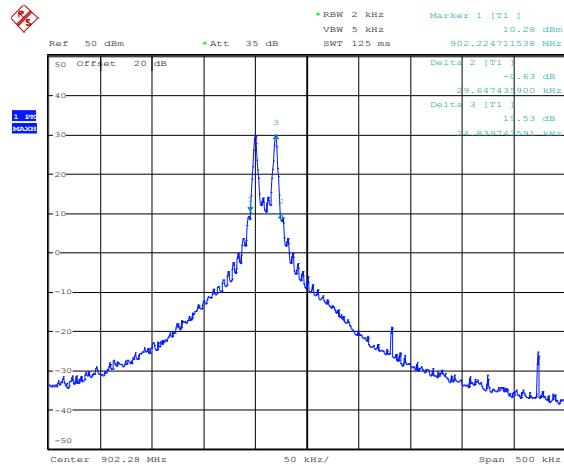
**8.1.3 Test data**
**Test date** June 9, 2011  
**Temperature** 22.5 °C

**Test engineer** David Duchesne  
**Air pressure** 994 mbar

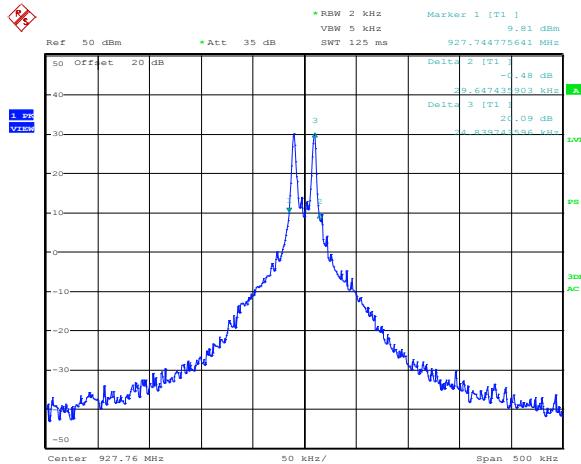
**Relative humidity** 66.4 %

**Table 8.1-1: 20 dB bandwidth results**

Frequency (MHz)	20 dB bandwidth (kHz)
902.24	29.64
915.00	29.64
927.76	29.64



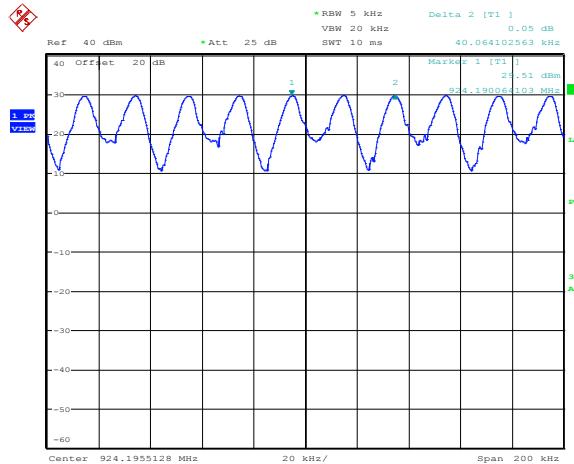
Date: 9.JUN.2011 15:54:03

**Spectral plot 8.1-1: Low channel 20 dB bandwidth**


Date: 9.JUN.2011 16:00:07

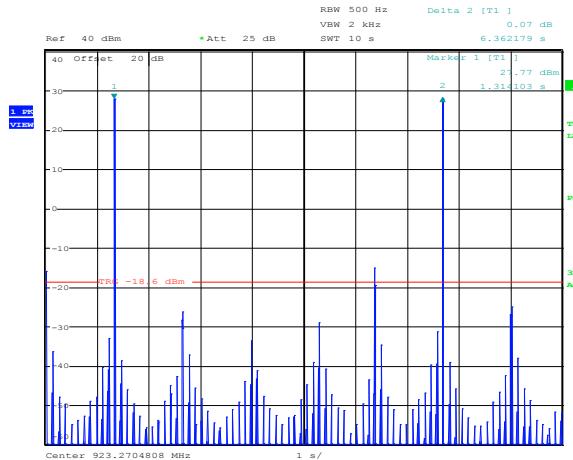
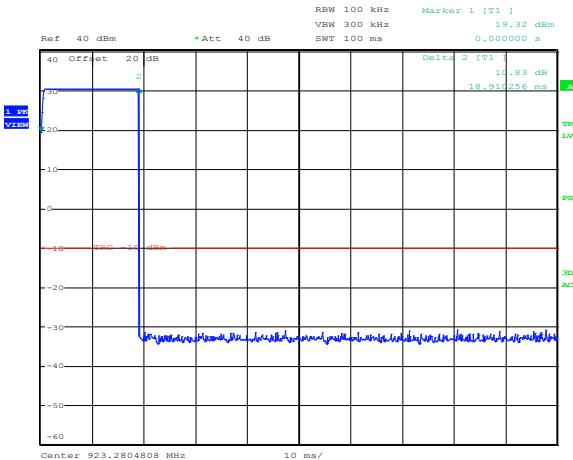
**Spectral plot 8.1-3: High channel 20 dB bandwidth**

Date: 9.JUN.2011 15:57:42

**Spectral plot 8.1-2: Mid channel 20 dB bandwidth**


Date: 9.JUN.2011 14:42:58

**Spectral plot 8.1-4: Channel separation**

**8.1.3 Test data, continued**


Date: 14.JUL.2011 07:08:57

**Spectral plot 8.1-5: Dwell Time**

Notes:

The 20 dB bandwidth is 29.64 kHz that is less than 250 kHz; therefore the minimum number of hopping frequencies is 50. The EUT utilizes 53 channels (See spectral plots 8.1-7, 8.1-8, and 8.1-9)

Dwell time = 18.9102 ms per channel

Hop interval = 6.3621 seconds

Time of occupancy within 20 seconds =  $(20 \text{ s}/6.362 \text{ s}) \times 18.9102 \text{ ms} = 59.45 \text{ ms}$

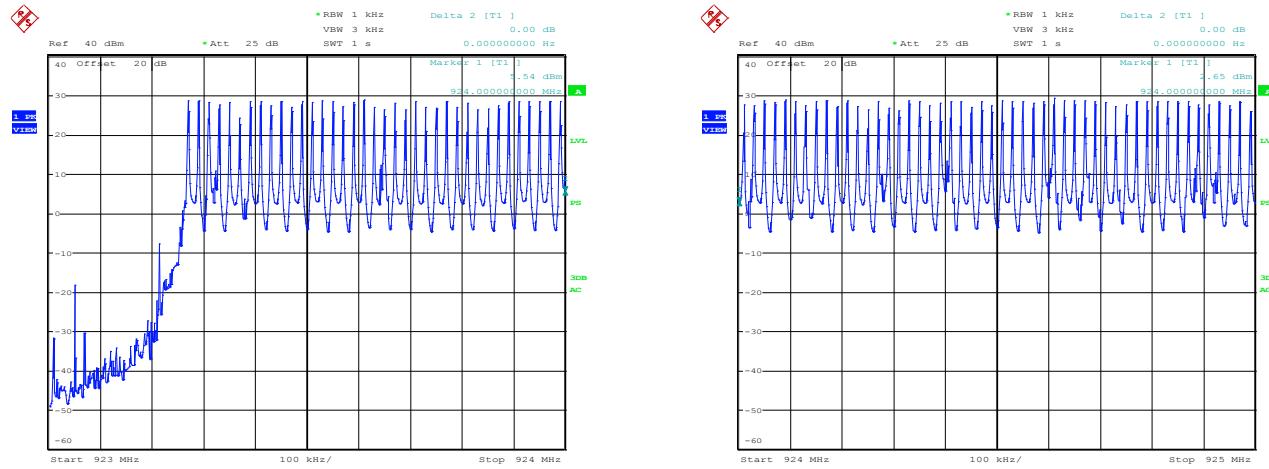
Time of occupancy 59.45 ms is less than 400 ms (the limit).

Date: 14.JUL.2011 07:44:58

**Spectral plot 8.1-6: Hop interval**

### 8.1.3 Test data, continued

#### Number of channels

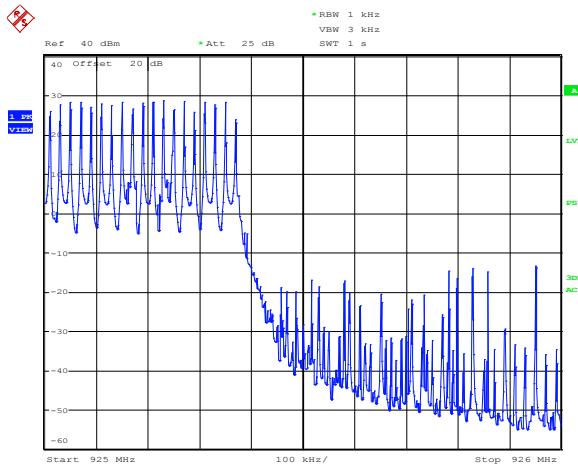


Date: 9.JUN.2011 14:55:14

**Spectral plot 8.1-7: 923 to 924 MHz (18 channels)**

Date: 9.JUN.2011 15:02:36

**Spectral plot 8.1-8: 924 to 925 MHz (25 channels)**



Date: 9.JUN.2011 15:06:44

**Spectral plot 8.1-9: 925 to 926 MHz (10 channels)**

**EUT utilizes total of 53 operating channels.**

**8.2 § 15.247(b) (2) Maximum peak conducted output power**

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

**8.2.1 Test summary**

**Verdict** Pass

**8.2.2 Observations/special notes**

- Test performed with modulation enabled.
- Client provided a temporary antenna connector.

**8.2.3 Test data**

<b>Test date</b>	June 9, 2011	<b>Test engineer</b>	David Duchesne		
<b>Temperature</b>	22.5 °C	<b>Air pressure</b>	994 mbar	<b>Relative humidity</b>	66.4 %

**Table 8.2-1:** Conducted output power

Frequency (MHz)	Conducted output power (dBm)	Limit (dBm)	Margin (dB)
902.24	29.76	30	0.24
915.00	29.67	30	0.33
927.76	29.63	30	0.37

Notes

Antenna gain is less than = 6 dBi

Maximum EIRP Limit = 36 dBm

- The peak detector was used with RBW wider than 20 dB bandwidth. (RBW = 100 kHz)
- VBW was set to 3 times the RBW. (VBW = 300 kHz)
- The span was wider than RBW.

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## 8.3 § 15.247(d) Spurious emissions

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(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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### 8.3.1 Test Summary

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**Verdict** Pass

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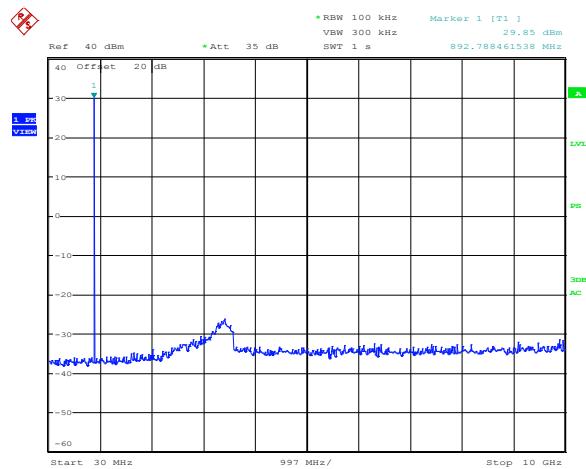
### 8.3.2 Observations/special notes

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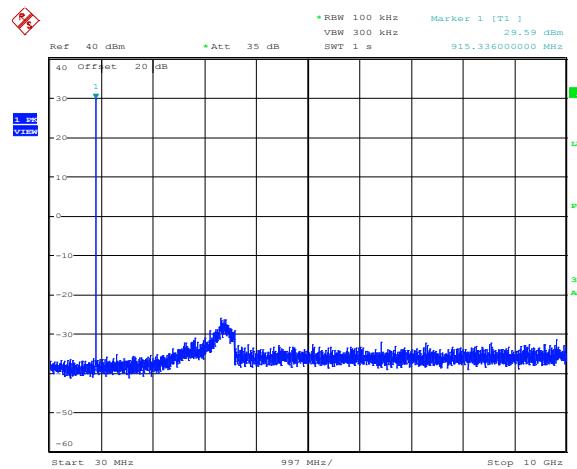
- Test performed with modulation enabled.
- The spectrum was searched from 30 MHz to the 10<sup>th</sup> harmonic.
- Client provided a temporary antenna connector for conducted measurements
- Test site FCC ID number: 176392 (3 m Semi anechoic chamber)

**8.3.3 Test data**
**Test date** June 9, 2011  
**Temperature** 23.5 °C

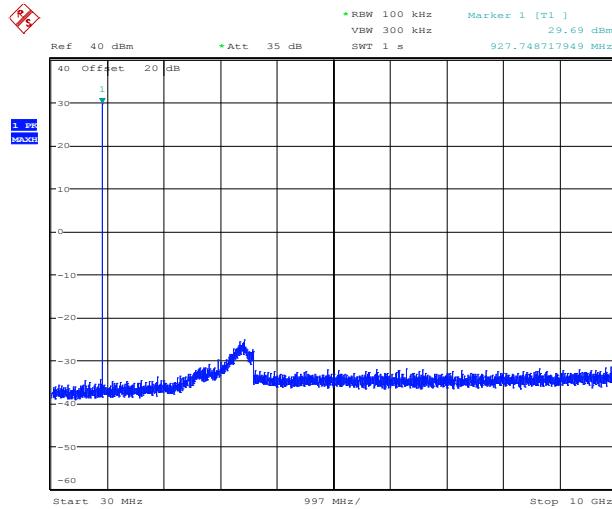
**Test engineer**  
**Air pressure**
**David Duchesne**  
**1004 mbar**
**Relative humidity** 51 %

**Conducted measurements**


Date: 9.JUN.2011 14:16:12

**Spectral plot 8.3-1: Low channel**


Date: 9.JUN.2011 13:35:34

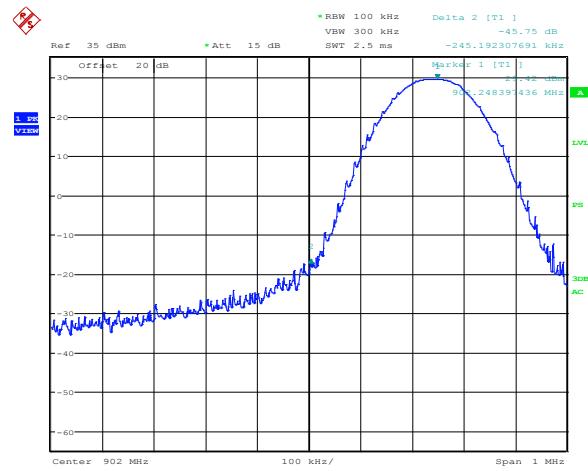
**Spectral plot 8.3-2: Mid Channel**


Date: 9.JUN.2011 14:12:14

**Spectral plot 8.3-3: High Channel**

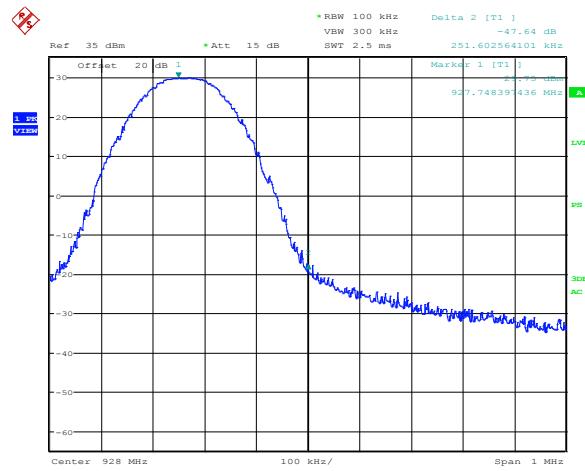
### 8.3.3 Test data, continued

#### Conducted measurements, continued



Date: 9.JUN.2011 14:22:35

**Spectral plot 8.3-4:** Lower band edge with hopping turned off



Date: 9.JUN.2011 14:25:48

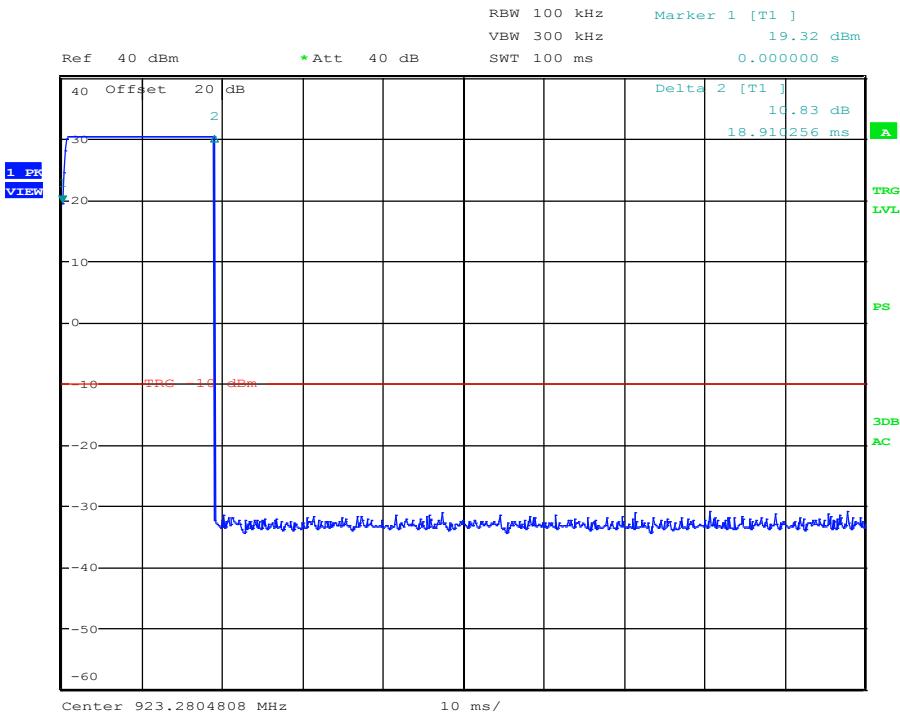
**Spectral plot 8.3-5:** Upper band edge with hopping turned off

### 8.3.3 Test data, continued

#### Radiated measurements

**Test date** July 14, 2011      **Test engineer** David Duchesne  
**Temperature** 22.4 °C      **Air pressure** 1006.4 mbar      **Relative humidity** 42.6 %

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.



Date: 14.JUL.2011 07:08:57

**Spectral plot 8.3-8: 100 ms sweep time**

Duty cycle/average factor calculations

$$Tx_{100\text{ ms}} = 18.9102 \text{ ms}$$

$$\text{Duty cycle/ average factor} = 20 \times \log_{10} \left( \frac{Tx_{100ms}}{100 \text{ ms}} \right)$$

$$\text{Duty cycle/ average factor} = 20 \times \log_{10} \left( \frac{18.9102 \text{ ms}}{100 \text{ ms}} \right) = -14.46 [\text{dB}]$$

### 8.3.3 Test data, continued

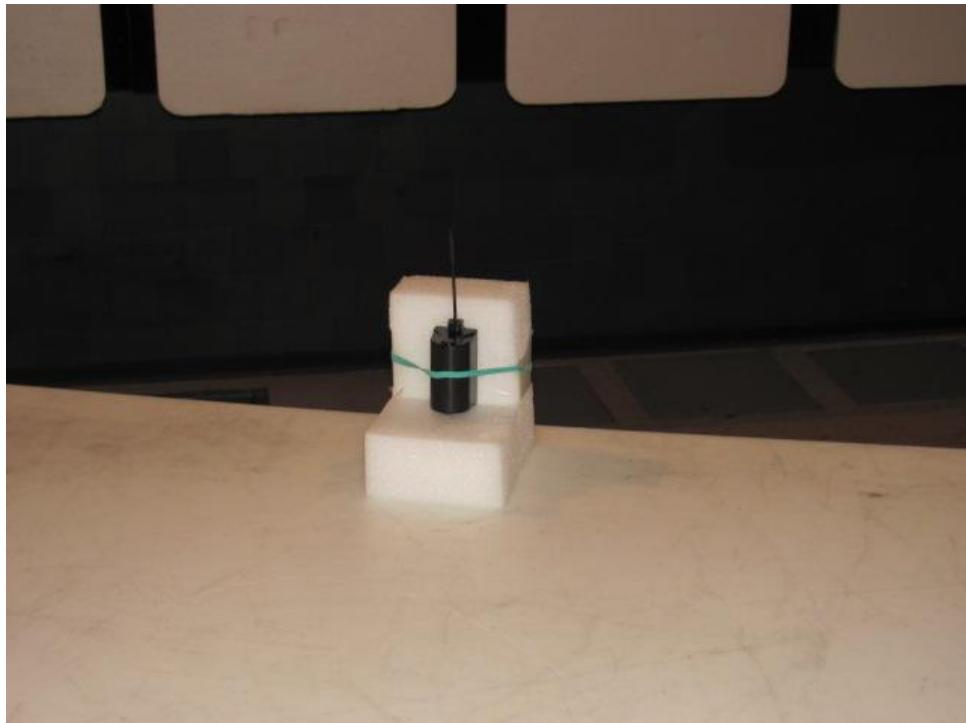
#### Radiated measurements, continued

**Table 8.3-1: Radiated emissions falling within restricted bands as defined in §15.205(a), results**

Channel	Freq. (MHz)	Ant. Pol. (V/H)	Peak field strength (dB $\mu$ V/m)	Peak field strength Limit (dB $\mu$ V/m)	Peak field strength Margin (dB)	Duty cycle correction factor (dB)	Average field strength (dB $\mu$ V/m)	Average field strength Limit (dB $\mu$ V/m)	Average field strength Margin (dB)
Low	2706.72	V	65.80	74.00	8.20	-14.46	51.34	54.00	2.66
	2706.72	H	67.36	74.00	6.64	-14.46	52.90	54.00	1.10
	3608.96	V	63.50	74.00	10.50	-14.46	49.04	54.00	4.96
	3608.96	H	66.90	74.00	7.10	-14.46	52.44	54.00	1.56
	4511.20	V	62.11	74.00	11.89	-14.46	47.65	54.00	6.35
	4511.20	H	62.27	74.00	11.73	-14.46	47.81	54.00	6.19
	5413.44	V	58.90	74.00	15.10	-14.46	44.44	54.00	9.56
	5413.44	H	61.20	74.00	12.80	-14.46	46.74	54.00	7.26
	8120.16	H	59.91	74.00	14.09	-14.46	45.45	54.00	8.55
	9022.40	H	59.76	74.00	14.24	-14.46	45.30	54.00	8.70
Mid	2745.00	V	66.10	74.00	7.90	-14.46	51.64	54.00	2.36
	2745.00	H	66.91	74.00	7.09	-14.46	52.45	54.00	1.55
	3660.00	V	66.20	74.00	7.80	-14.46	51.74	54.00	2.26
	3660.00	H	66.61	74.00	7.39	-14.46	52.15	54.00	1.85
	4575.00	V	60.29	74.00	13.71	-14.46	45.83	54.00	8.17
	4575.00	H	60.80	74.00	13.20	-14.46	46.34	54.00	7.66
	7320.00	V	58.95	74.00	15.05	-14.46	44.49	54.00	9.51
	7320.00	H	62.92	74.00	11.08	-14.46	48.46	54.00	5.54
	8235.00	H	60.92	74.00	13.08	-14.46	46.46	54.00	7.54
	9150.00	V	58.69	74.00	15.31	-14.46	44.23	54.00	9.77
High	9150.00	H	59.80	74.00	14.20	-14.46	45.34	54.00	8.66
	2783.28	V	63.60	74.00	10.40	-14.46	49.14	54.00	4.86
	2783.28	H	67.20	74.00	6.80	-14.46	52.74	54.00	1.26
	3711.04	V	64.00	74.00	10.00	-14.46	49.54	54.00	4.46
	3711.04	H	67.80	74.00	6.20	-14.46	53.34	54.00	0.66
	4338.80	H	60.20	74.00	13.80	-14.46	45.74	54.00	8.26
	7422.08	V	58.90	74.00	15.10	-14.46	44.44	54.00	9.56
	7422.08	H	60.51	74.00	13.49	-14.46	46.05	54.00	7.95
	8349.84	H	58.95	74.00	15.05	-14.46	44.49	54.00	9.51

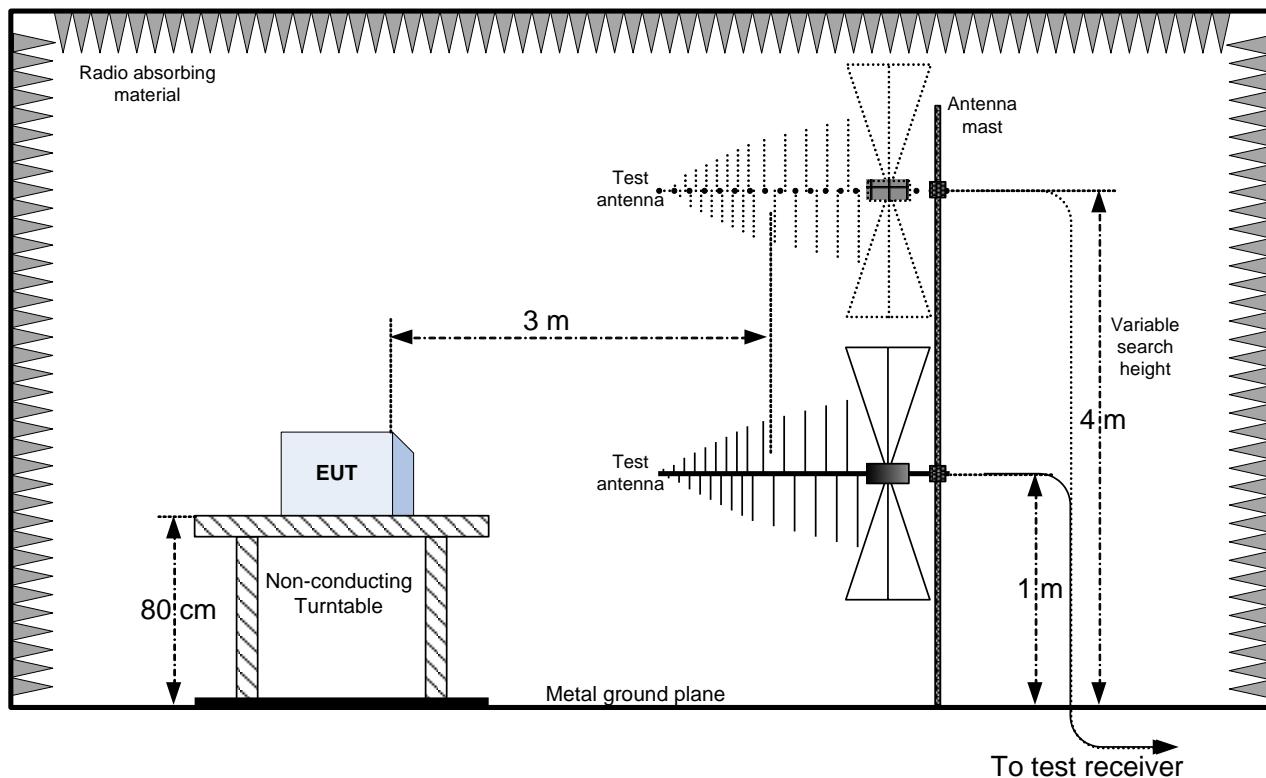
#### Notes:

- Spectrum analyzer setting:
  - 30 MHz to 1000 MHz: quasi-peak detector, RBW = 120 kHz, VBW = 300 kHz, Measurement time = 100 ms
  - Above 1 GHz: peak detector, RBW = 1000 kHz, VBW = 3000 kHz, Measurement time = 100 ms
- Duty cycle correction factor as calculated from §15.35 (c)
- Average field strength (dB $\mu$ V/m) = Peak field strength (dB $\mu$ V/m) + Duty cycle correction factor (dB)
- Measuring distance (m): 3
- Test facility: 3 m Semi anechoic chamber
- Antenna height variation (m): 1–4
- Turn table position (°): 0–360
- Field strength includes antenna factor, cable loss and amplifier gain were possible.
- EUT was tested in three orthogonal positions.
- All emission within 10 dB of limit has been recorded.

**8.3.4 Setup photos****Photo 8.3-1: RE setup****Photo 8.3-2: RE setup**

## Section 9: Block diagrams of test set-ups

### 9.1 Radiated emissions set-up



## Section 10: EUT photos

### External photos

