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**Test Report:** 100478-1TRFWL

**Applicant:** Alutron Modules Inc.  
420 Industrial Parkway South  
Aurora, ON  
L4G 3V7

**Apparatus:** CM91

**FCC ID:** S3PCM91

**In Accordance With:** FCC Part 15 Subpart C, 15.247  
FHSS System and Digitally Modulated Radiators  
902-928MHz, 2400 - 2483.5 MHz, 5725-5850MHz

**Tested By:** Nemko Canada Inc.  
303 River Road  
Ottawa, Ontario  
K1V 1H2

**Authorized By:**

A blue ink signature of the name Jason Nixon.

Jason Nixon, Wireless/Telecom Specialist

**Date:** June 10, 2008

**Total Number of Pages:** 24

## Report Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003. A description of the test facility is on file with the FCC.

The assessment summary is as follows:

**Apparatus Assessed:** CM91

**Specification:** FCC Part 15 Subpart C, 15.247

**Compliance Status:** Complies

**Exclusions:** None

**Non-compliances:** None

**Report Release History:** Original Release

Author: Andrey Adelberg EMC/Wireless Specialist

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.

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## **Section 1 : Equipment Under Test**

### **1.1 Product Identification**

The Equipment Under Test was identified as follows:

Two-way Radio Module

### **1.2 Samples Submitted for Assessment**

The following samples of the apparatus have been submitted for type assessment:

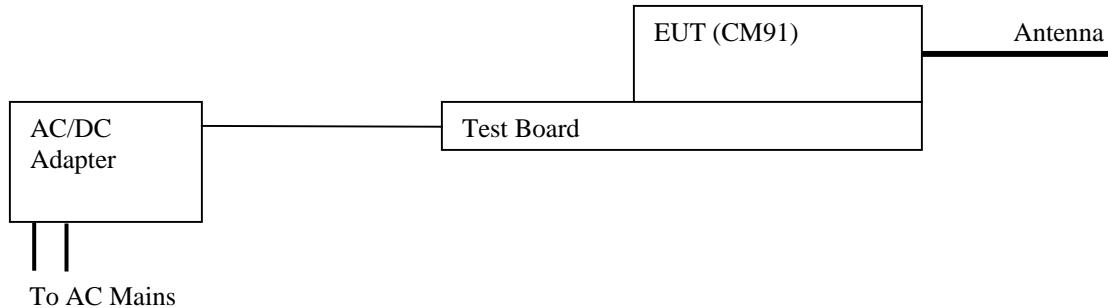
<b>Sample No.</b>	<b>Description</b>	<b>Serial No.</b>
1	CM91 (506 MHz bandwidth)	1A

The first samples were received on: May 1, 2008

### 1.3 Technical Specifications of the EUT

<b>Frequency Band</b>	902 MHz – 928 MHz
<b>Operating Frequency:</b>	914.9 MHz
<b>Peak Output Power:</b>	3.07 dBm
<b>Emission Designator</b>	F1D
<b>Rated Power:</b>	1 mW
<b>Modulation:</b>	FSK
<b>Antenna Gain:</b>	6 dBi
<b>Antenna Connector:</b>	N/A

### 1.4 Block Diagram of the EUT



## Section 2 : Test Conditions

### 2.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247

FHSS System and Digitally Modulated Radiators  
902-928MHz, 2400 - 2483.5 MHz, 5725-5850MHz

### 2.2 Deviations From Laboratory Test Procedures

No deviations were made from laboratory test procedures.

### 2.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range : 15 – 30 °C  
Humidity range : 20 - 75 %  
Pressure range : 86 - 106 kPa  
Power supply range : +/- 5% of rated voltages

### 2.4 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next Cal.
Log Periodic Antenna	Sunol	LP5	FA002077	July 25/08
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Mast	Sunol	TLT2	FA002061	NCR
LISN	Rohde & Schwarz	ENV216	FA002023	Sept. 04/08
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 07/08
50 Coax cable	HUBER + SUHNER	None	FA002022	Sept. 19/08
50 Coax cable	HUBER + SUHNER	None	FA002015	Sept. 19/08
International Power Supply	California Inst.	3001i	FA001021	Jan. 16/09
Horn Antenna #2	EMCO	3115	FA000825	Jan. 15/09
1.0 – 2.0 GHz Amplifier	JCA	12-400	FA001498	Aug. 21/08
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08

\* COU (Calibrate on Use)    \*\* NCR (No Calibration Required)

### 2.5 Measurement Uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95% and can be found in Nemko Canada document MU-003.

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## **Section 3 : Observations**

### **3.1 Modifications Performed During Assessment**

No modifications were performed during assessment.

### **3.2 Record Of Technical Judgements**

No technical judgements were made during the assessment.

### **3.3 EUT Parameters Affecting Compliance**

The user of the apparatus could not alter parameters that would affect compliance.

### **3.4 Test Deleted**

No Tests were deleted from this assessment.

### **3.5 Additional Observations**

There were no additional observations made during this assessment.

## **Section 4 : Results Summary**

This section contains the following:

### FCC Part 15 Subpart C : Test Results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N      No : not applicable / not relevant.

Y      Yes : Mandatory i.e. the apparatus shall conform to these tests.

N/T     Not Tested, mandatory but not assessed. (See section 3.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

**4.1 FCC Part 15 Subpart C : Test Results**

Part 15	Test Description	Required	Result
15.31(e)	Variation of power supply	Y	PASS
15.109(a)	Radiated Emissions	Y	PASS
15.207(a)	Powerline Conducted Emissions	Y	PASS
15.209(a)	Radiated Emissions within Restricted Bands	Y	PASS
15.247(a)(1)	Frequency hopping systems	N	-
15.247(a)(1)(i)	Frequency hopping systems operating in the 902-928 MHz band	N	-
15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725-5850 MHz band	N	-
15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400-2483.5 MHz band	N	-
15.247(a)(2)	Minimum 6 dB Bandwidth	Y	PASS
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	N	-
15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902-928 MHz band	N	-
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	Y	PASS
15.247(b)(4)	Maximum peak output power	Y	PASS
15.247(c)(1)	Fixed point-to-point Operation with directional antenna gains greater than 6 dBi	N	-
15.247(c)(2)	Transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams	N	-
15.247(d)	Radiated Emissions Not in Restricted Bands	Y	PASS
15.247(e)	Power Spectral Density for Digitally Modulated Devices	Y	PASS
15.247(f)	Time of Occupancy for Hybrid Systems	N	-

## Appendix A : Test Results

### Clause 15.109(a) Radiated Emissions

Frequency of Radiated limit (dB $\mu$ V/m) at 3 m distance

<b>Field Strength Limit</b>		
<b>Frequency range (MHz)</b>	<b>Quasi-peak (<math>\mu</math>V/m)</b>	<b>Quasi-peak (dB<math>\mu</math>V/m)</b>
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

<b>Field Strength Limit</b>	
<b>Frequency range (MHz)</b>	<b>Average (dB<math>\mu</math>V/m)</b>
Above 1000	54.0

### Test Conditions:

<b>Sample Number:</b>	1	<b>Temperature (°C):</b>	29
<b>Date:</b>	June 9, 2008	<b>Humidity (%):</b>	55
<b>Modification State:</b>	0	<b>Tester:</b>	Andrey Adelberg
		<b>Laboratory:</b>	SAC Ottawa

### Test Results: Complies

See Attached Plots.

### Additional Observations:

#### Preview measurements:

30 MHz to 1000 MHz

Receiver settings:

- Peak Detector, Max Hold
- 120 kHz RBW

#### Final measurement:

30 MHz to 1000 MHz

Receiver settings:

- Q-Peak Detector
- 120 kHz RBW

#### Preview measurements:

Above 1000 MHz

Receiver settings:

- Peak Detector, Max Hold
- 1000 kHz RBW

#### Final measurement:

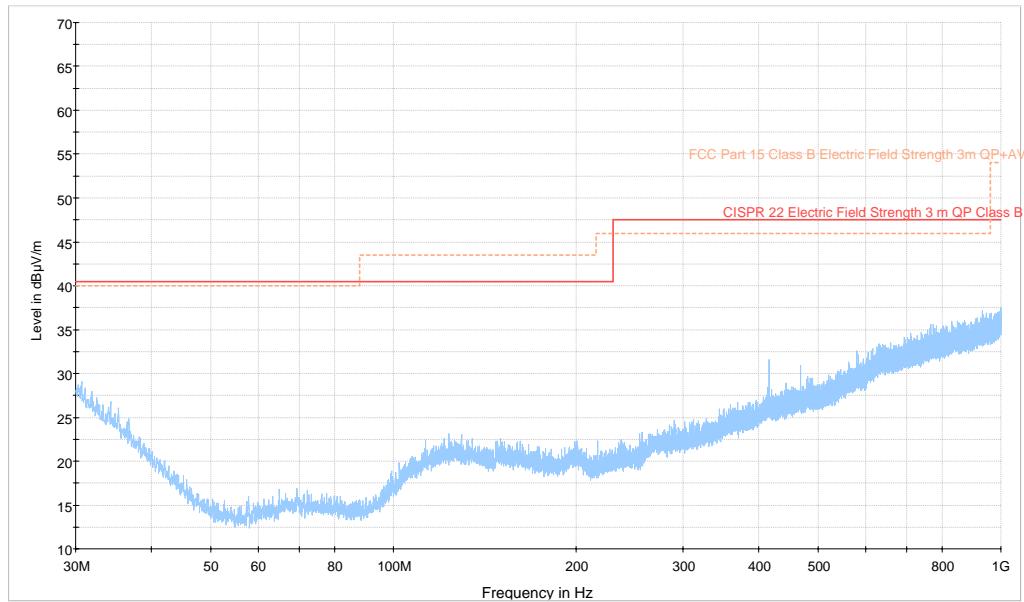
Above 1000 MHz

Receiver settings:

- Average Detector
- 1000 kHz RBW

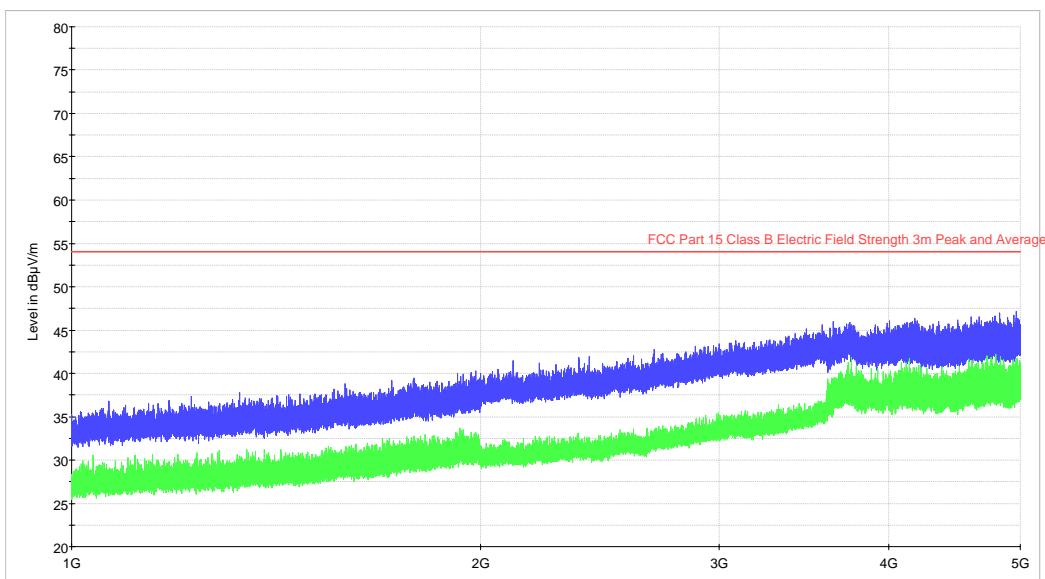
- All measurements were performed at the distance of 3m.
- Spectral plots have been corrected for transducer factors; cable loss, antenna factors and amplifiers.
- No emissions within 6dB of limit were detected.

## Radiated Emissions in 30 MHz to 1000 MHz range



Radiated Emissions in Receive Mode  
CISPR 22 Electric Field Strength 3 m QP Class B LimitLine  
FCC Part 15 Class B Electric Field Strength 3m QP+AV LimitLine  
Preview Peak Result

## Radiated Emissions in 1000 MHz to 5000 MHz range



Radiated Emissions in Receive Mode  
MaxPeak-MaxHold  
Average-MaxHold  
FCC Part 15 Class B Electric Field Strength 3m Peak and Average

**Clause 15.207(a) Powerline Conducted Emissions**Frequency of Conducted limit (dB $\mu$ V)

Frequency range (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

\* Decreases with the logarithm of the frequency.

**Test Conditions:**

Sample Number:	1	Temperature (°C):	22
Date:	May 8, 2008	Humidity (%):	48
Modification State:	0	Tester:	Andrey Adelberg
		Laboratory:	SAC Ottawa

**Test Results: Complies**

See Attached Plots.

**Additional Observations:****Preview measurements:**

0.15MHz to 30MHz

Receiver settings:

- Peak Detector, Max Hold and Average
- 10kHz RBW

**Final measurement:**

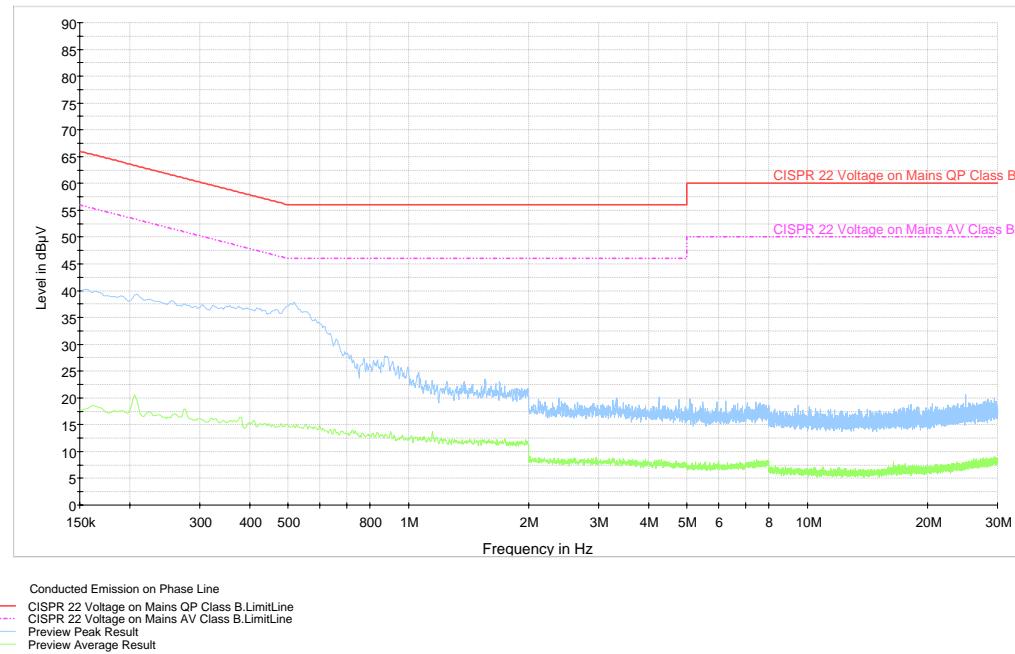
0.15MHz to 30MHz

Receiver settings:

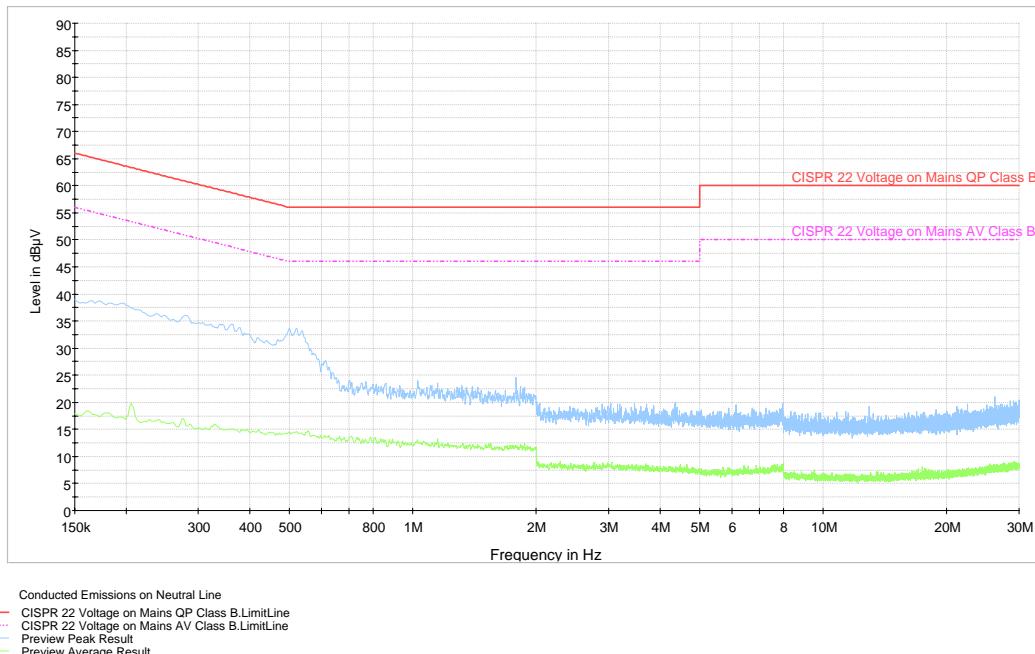
- Q-Peak Detector and Average
- 9kHz RBW

- Spectral plots have been corrected for transducer factors, cable loss, LISN, and attenuator.
- No emissions within 6dB of limit were detected.

## Conducted Emissions on Phase Line of Power Adapter



## Conducted Emissions on Neutral Line of Power Adapter



**Clause 15.209(a) Radiated Emissions within Restricted Bands**

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvoltsmeter)	Measurement Distance (meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Test Conditions:**

<b>Sample Number:</b>	1	<b>Temperature (°C):</b>	23
<b>Date:</b>	May 7, 2008	<b>Humidity (%):</b>	38
<b>Modification State:</b>	0	<b>Tester:</b>	Andrey Adelberg
		<b>Laboratory:</b>	SAC Ottawa

**Test Results: Complies**

See Attached Table for Results

**Additional Observations:**

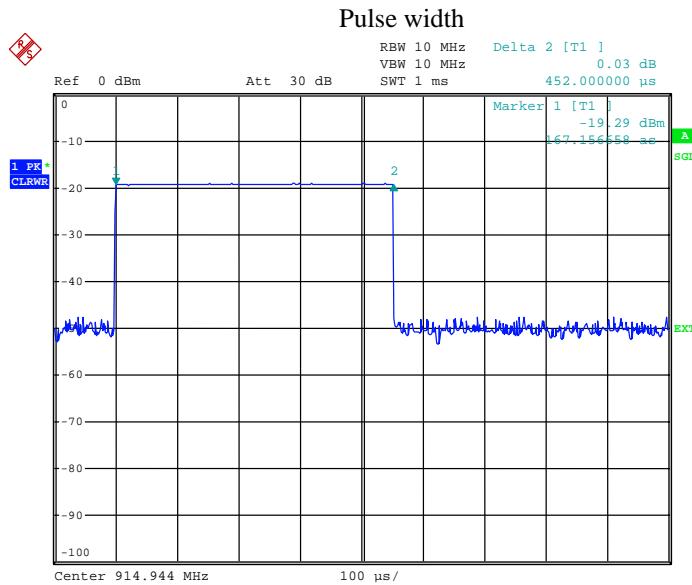
The Spectrum was searched from 30MHz to the 10<sup>th</sup> Harmonic (to 9200 MHz).

The results apply to emissions found in the Restricted bands defined in FCC Part 15 Subpart C, 15.205.

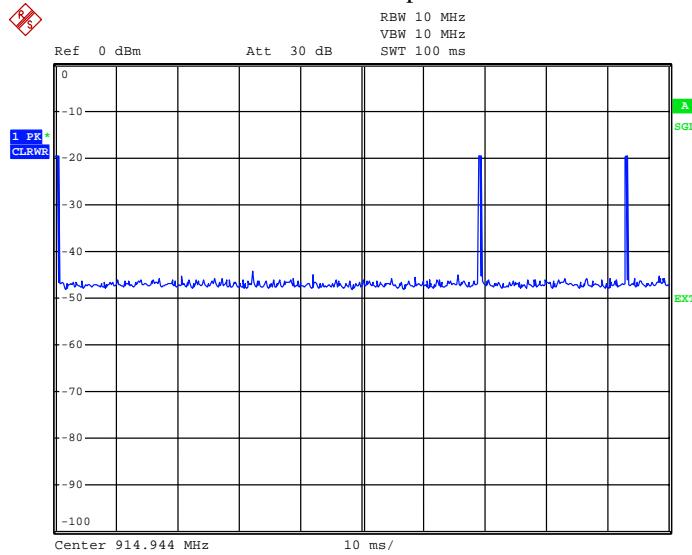
All measurements were performed at 3m distance.

No spurious emissions were found closer than 20 dB below specified limit

**Duty Cycle:**



Maximum number of pulses within 100 ms



Duty cycle factor (average factor) calculation:

Tx on within 100 ms =  $452\mu\text{s} \cdot 3 = 1.356\text{ms}$

Duty cycle factor within 100 ms =  $20\log(1.356/100) = -37.35 \text{ dB}$

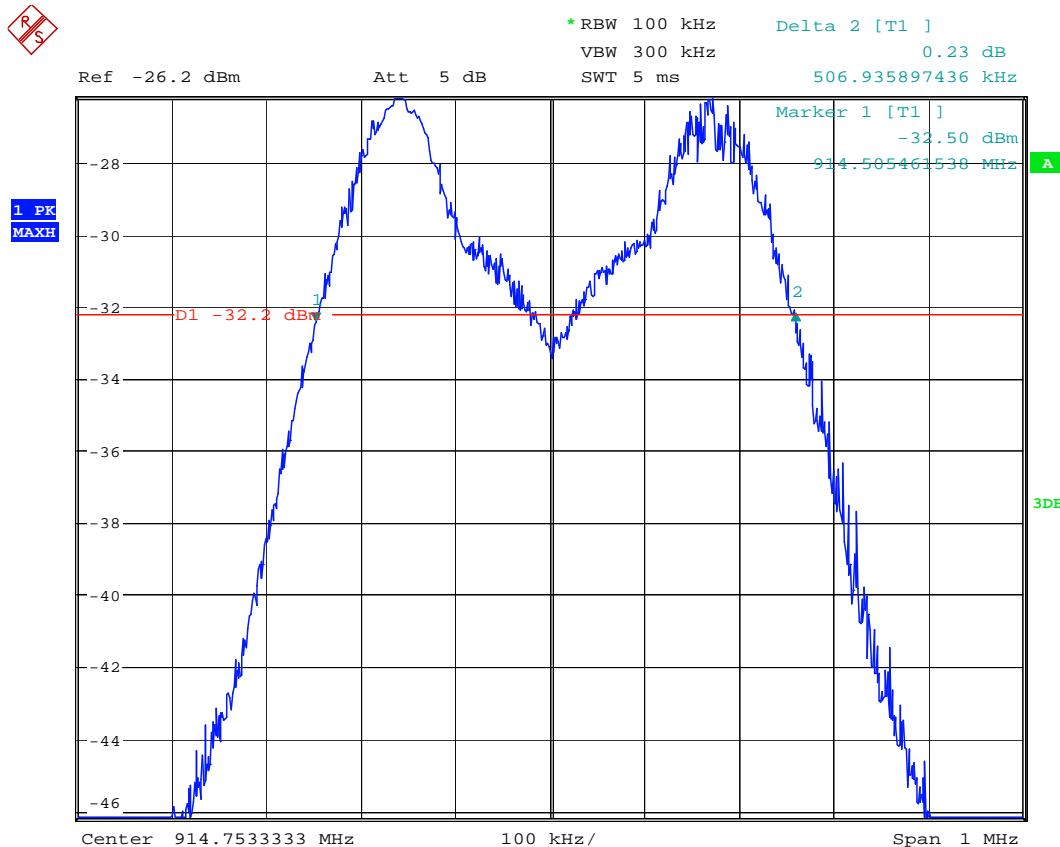
**Clause 15.247(a)(2) Minimum 6 dB Bandwidth**

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

**Test Conditions:**

Sample Number:	1	Temperature (°C):	24
Date:	May 2, 2008	Humidity (%):	39
Modification State:	0	Tester:	Andrey Adelberg

**Laboratory:** Wireless Ottawa

**Test Results: Complies****Minimum 6dB Bandwidth:**

Date: 2.MAY.2008 21:22:25

6 dB Bandwidth Measurement, kHz	Limit, kHz	Margin, kHz
506.936	500	0.936

**Clause 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**

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

**Test Conditions:**

<b>Sample Number:</b>	1	<b>Temperature (°C):</b>	24
<b>Date:</b>	May 8, 2008	<b>Humidity (%):</b>	50
<b>Modification State:</b>	0	<b>Tester:</b>	Andrey Adelberg

**Laboratory:** SAC Ottawa**Test Results: Complies**

See Attached Tables and Plots.

**Conducted Output Power:**

Measured Radiated output power = 9.071 dBm EIRP

Limit = 36 dBm EIRP

Calculated conducted output power = 3.071 dBm

Limit = 30 dBm

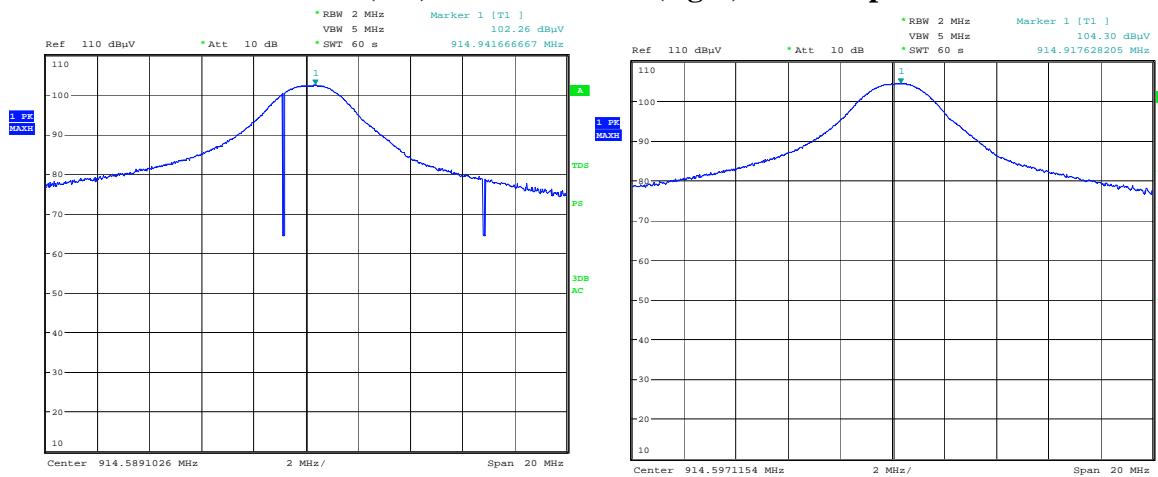
Transmit output power was measured while supply voltage was varied from 102 VAC to 138 VAC (85% to 115% of the nominal rated supply voltage). No change in transmit output power was observed.

The EUT was assessed in three orthogonal orientations and the worst case was recorded.

**Radiated Output Power (EIRP):**

Frequency, MHz	Polarization	Antenna	Rx*, dB $\mu$ V	Cable loss, dB	Ant Factor, dB/m	Field Strength, dB $\mu$ V/m
914.9	Vertical	BiconLog	102.26	2.8	22.3	102.26
914.9	Horizontal	BiconLog	104.30	2.8	22.8	104.30

\* - Rx result includes Cable Loss and Antenna Factor

**Peak Out Power in Vertical (left) and Horizontal (right) antenna polarizations:**


$$\text{Measured value (V/m)} = 10^{(FS/20)} = 164058.97 \mu\text{V/m} = 0.164 \text{ V/m}$$

$$\text{Antenna Gain (numeric)} = 10^{(Ag/10)} = 3.981 \text{ (with antenna gain (Ag) of 6 dBi)}$$

$$\text{Output Power (W)} = \frac{E^2 R^2}{30G} = 0.0020268 \text{ W} = 2.0268 \text{ mW}$$

$$\text{Output Power (dBm)} = 10\log(P) = 10\log(2.0268) = 3.07 \text{ dBm}$$

E = Measured Value (V/m)

R = Measurement distance (m)

G = Antenna Gain (numeric)

P = Output Power (mW)

Frequency, MHz	Output power, mW	Output power, dBm	Output power Limit, dBm	Margin, dB
914.9	2.0268	3.07	30.00	26.93

**EIRP calculation:**

Frequency, MHz	Output power, dBm	Antenna Gain, dBi	EIRP, dBm	EIRP Limit, dBm	Margin, dB
914.9	3.07	6.0	9.07	36.00	26.93

**Clause 15.247(d) Radiated Emissions Not in Restricted Bands**

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)).

**Test Conditions:**

Sample Number:	1	Temperature (°C):	24
Date:	May 8, 2008	Humidity (%):	50
Modification State:	0	Tester:	Andrey Adelberg
		Laboratory:	SAC Ottawa

**Test Results: Complies**

See Attached Table and Plots.

The Spectrum was searched from 30MHz to 10<sup>th</sup> harmonic (9.2 GHz).

All measurements for Spurious emissions not within the restricted bands were performed using a Peak Detector with 100kHz RBW and 300kHz VBW.

All measurements were performed at 3m distance.

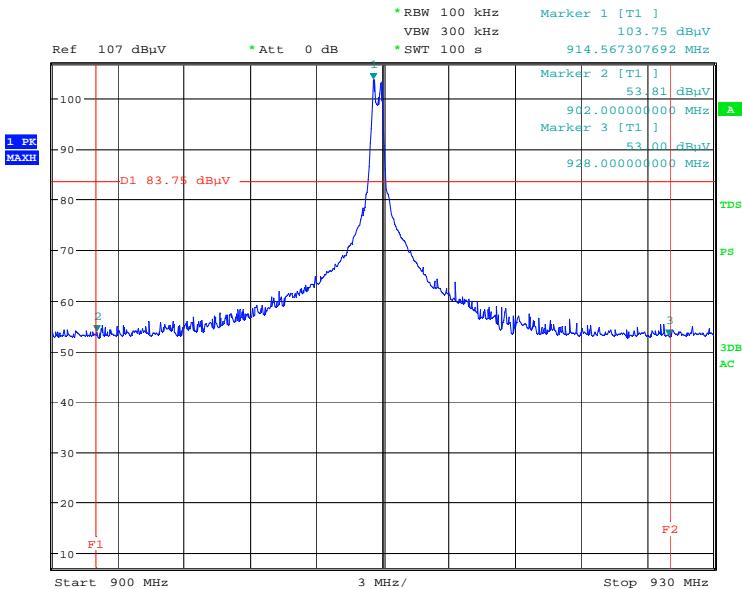
Freq. ,(MHz)	Antenna	Pol., V/H	Correction Factor, (dB)	Emission Level, (dB $\mu$ V/m)	Limit, (dB $\mu$ V/m)	Margin, (dB)
706.59	LP	H	23.0	33.55	83.99	50.44
877.35	LP	H	25.0	25.25	83.99	58.74
924.78	LP	V	25.1	26.01	83.99	57.98
946.38	LP	V	25.6	25.57	83.99	58.42
902.00	LP	H	25.0	53.81	83.99	30.18
928.00	LP	H	25.2	53.00	83.99	30.99
1829.19	Horn	H	-18.9	41.53	83.99	42.46

Note 1: Antenna Legend: BC = Biconical, BL = Bilog, LP = Log-Periodic, Horn = Horn, ED = EMCO Dipole

Note 2: Positive Peak detector used

Note 3: Emission Level includes Correction factor (consisted of Antenna Factor, Cable Losses and Amplifier Gain)

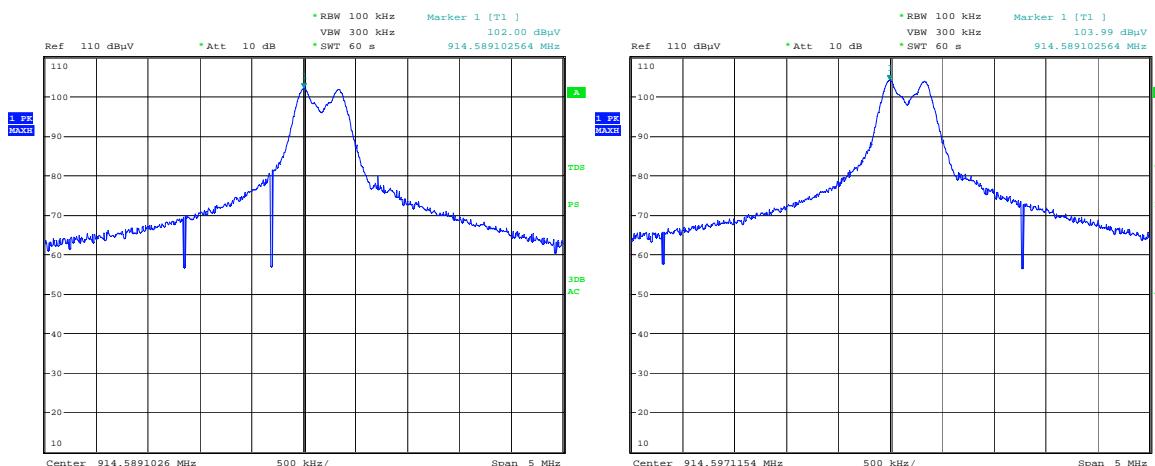
**Band Edges:**



Date: 8.MAY.2008 15:26:35

**Additional Observations:**

**Output power within the transmission band using RBW of 100 kHz**



Limit calculation:

$$\text{Output power (dBμV/m/100kHz)} - 20 \text{ dB} = 103.99 - 20 = 83.99 \text{ dBμV/m/100kHz}$$

**Clause 15.247(e) Power Spectral Density for Digitally Modulated Devices**

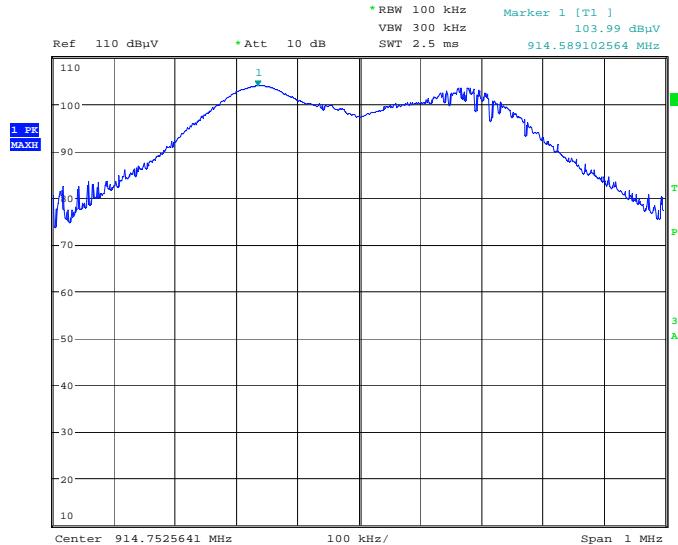
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

**Test Conditions:**

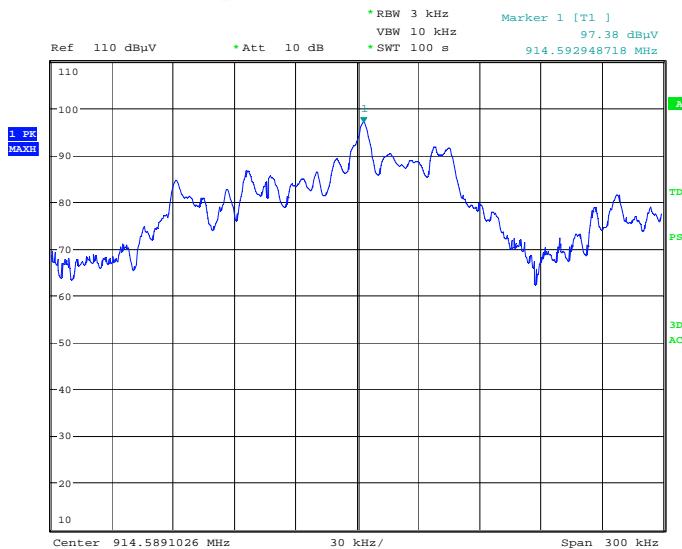
Sample Number:	1	Temperature (°C):	24
Date:	May 8, 2008	Humidity (%):	50
Modification State:	0	Tester:	Andrey Adelberg
		Laboratory:	SAC Ottawa

**Test Results: Complies****Additional Observations:**

Power Spectral Density, dBm/3kHz	Limit, dBm/3kHz	Margin, dB
-3.849	8.0	11.849

**PSD test with 100 kHz:**

Date: 8.MAY.2008 14:39:32

**PSD test with 3 kHz (zoomed on peak):**

Date: 8.MAY.2008 14:42:12

Field Strength: 97.38 dBμV/m/3kHz

Measured density value (V/m/3kHz) =  $10^{(FS/20)} = 73960.53 \mu\text{V}/\text{m} = 0.07396 \text{ V}/\text{m}/3\text{kHz}$ Antenna Gain (numeric) =  $10^{(Ag/10)} = 3.981$  (with antenna gain (Ag) of 6 dBi)

$$\text{Density Power (mW/3kHz)} = \frac{E^2 R^2}{30G} = 0.0004122 \text{ W} = 0.4122 \text{ mW/3kHz}$$

Power Spectral Density (dBm/3kHz) =  $10\log(Pd) = -3.849 \text{ dBm/3kHz}$ 

E = Measured density Value (V/m/3kHz)

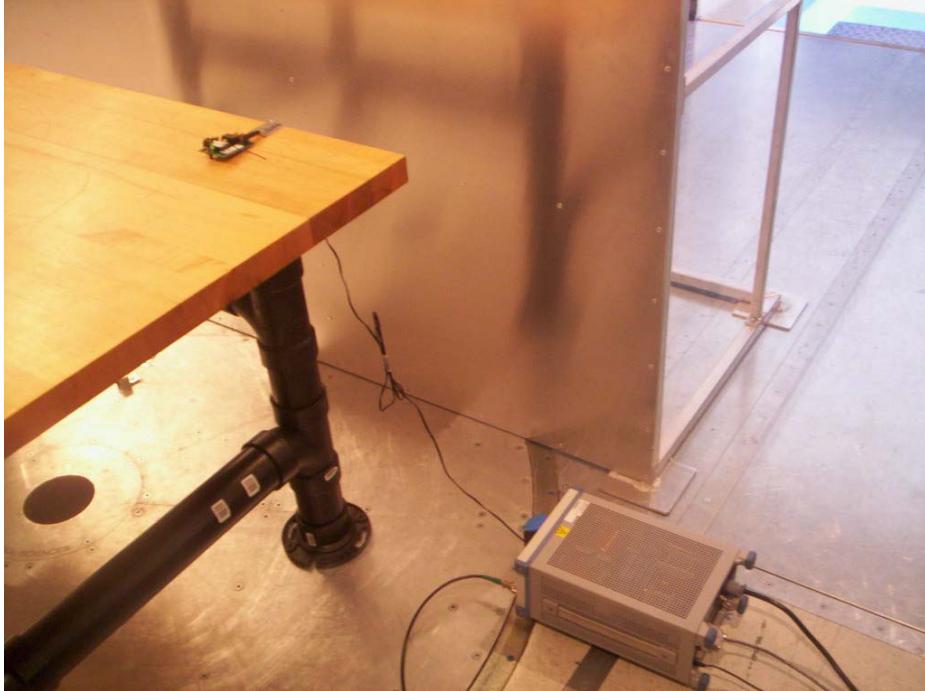
R = Measurement distance (m)

G = Antenna Gain (numeric)

Pd = Density Power (mW/3kHz)

## **Appendix B : Setup Photographs**

### **Conducted Emissions Setup:**

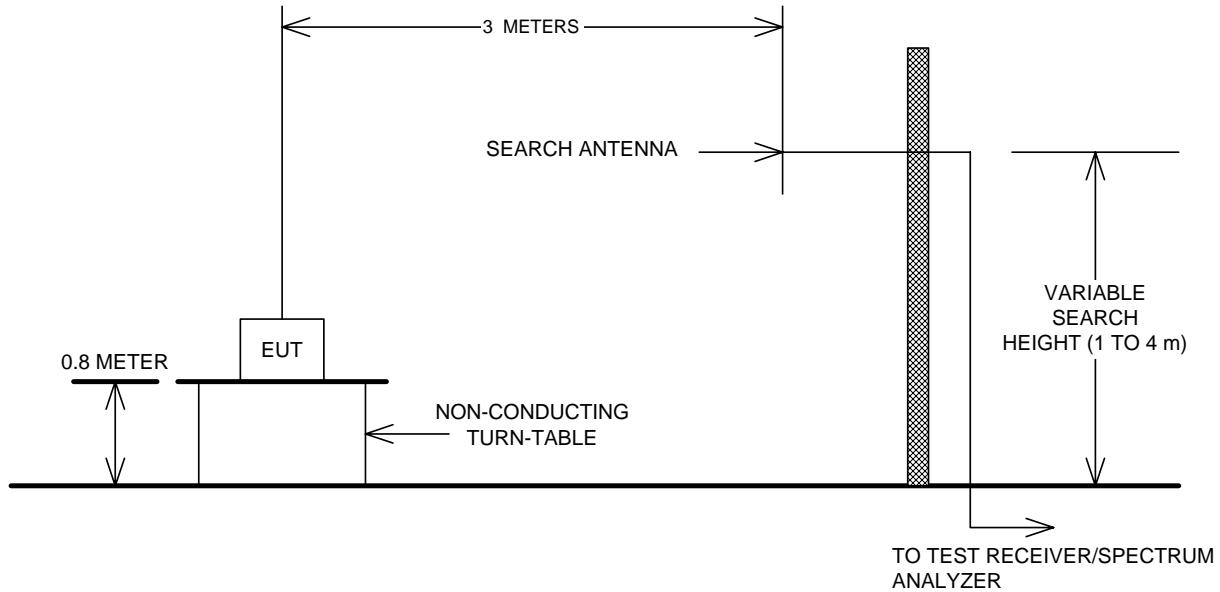


### **Spurious Emissions Setup:**



## Appendix C : Block Diagram of Test Setups

### Test Site For Radiated Emissions



### Conducted Emissions

