



# Nemko



**Test Report:** 6W71243

**Applicant:** BelAir Networks Inc.,  
603 March Road,  
Ottawa, ON  
K2K 2M5

**Apparatus:** 4.9 GHz Public Safety Band RF Module 1

**FCC ID:** RAR20004001

**In Accordance With:** FCC Part 90 Subpart Y

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

**Authorized By:**

Jason Nixon, Telecom Specialist

**Date:** February 6, 2007

**Total Number of Pages:** 31

## Report Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90, Subpart Y. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

The assessment summary is as follows:

**Apparatus Assessed:** 4.9 GHz Public Safety Band RF Module 1

**Specification:** FCC Part 90, Subpart Y

**Compliance Status:** Complies

**Exclusions:** None

**Non-compliances:** None

**Report Release History:** Original Release

Author: Xu Jin, 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: 4.9 GHz Public Safety Band RF Module1

### **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	4.9 GHz Public Safety Band RF module1	K001739253
2	LPM Card	K001017419

The first samples were received on: Nov.21, 2006

### 1.3 Technical Specifications of the EUT

<b>Manufacturer:</b>	BelAir Networks Inc.
<b>Frequency Band</b>	4940-4990MHz
<b>Operation Frequency</b>	4950-4980MHz
<b>Modulation:</b>	OFDM
<b>Antenna Information:</b>	<ol style="list-style-type: none"><li>1. Maxrad Omni Antenna: 9dBi</li><li>2. MTI MT Antenna: 8.5dBi</li><li>3. MTI External Directional Antenna: 21dBi</li><li>4. MTI MT 120degree Antenna: 15.5dBi</li></ol>
<b>Antenna Connector:</b>	MCX

## Section 2: Test Conditions

### 2.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 90, Subpart Y

### 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.
Spectrum Analyzer	Rohde & Schwarz	FSP	FA001920	March 17/07
Spectrum Analyzer	Hewlett-Packard	8566B	FA001309	May 16/07
Spectrum Analyzer Display	Hewlett-Packard	85662A	FA001309	May 16/07
Biconical (1) Antenna	EMCO	3109	FA000805	May 03/07
Log Periodic Antenna #2	EMCO	3148	FA001355	May 16/07
Horn Antenna #2	EMCO	3115	FA000825	Dec. 16/06
18.0 – 40.0GHz Horn Antenna	EMCO	3116	FA001847	May 03/07
1.0 – 2.0 GHz Amplifier	JCA	12-400	FA001498	Aug 02/07
2.0 – 4.0 GHz Amplifier	JCA	24-600	FA001496	Aug 02/07
4.0 – 8.0 GHz Amplifier	JCA	48-600	FA001497	Aug 02/07
5.0 - 18GHz Amplifier	Narda	DWT-186N23U40	FA001409	COU
18.0 – 26.0 GHz Amplifier	NARDA	BBS-1826N612	FA001550	COU
26 – 40.0 GHz Amplifier	NARDA	DBL-2640N610	FA001556	COU
Power Meter	HP	4418B	FA001678	May 16/07
Power Probe	HP	8487A	FA001741	May 22/07
Climate Chamber	Thermotron	SM-16C	15649-S	COU

\* COU (Calibrate on Use)

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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.

## Section 4: Results Summary

This section contains the following:

FCC Part 90, Subpart Y: Test Result

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 90 Subpart Y: Test Results**

Section	Clause	Test Description	Required	Result
1	90.1215	Occupied Bandwidth	Y	PASS
2	90.1215	Peak Output Power	Y	PASS
3	90.1215	Peak Power Spectrum Density	Y	PASS
4	90.210(m)	Spurious Emissions at the Antenna Terminals	Y	PASS
5	90.210(m)	Radiated Spurious Emissions	Y	PASS
6	90.213	Frequency Stability	Y	PASS

## Appendix A: Test Results

### Section 1. Occupied Bandwidth

**Criteria: Clause 90.1215**

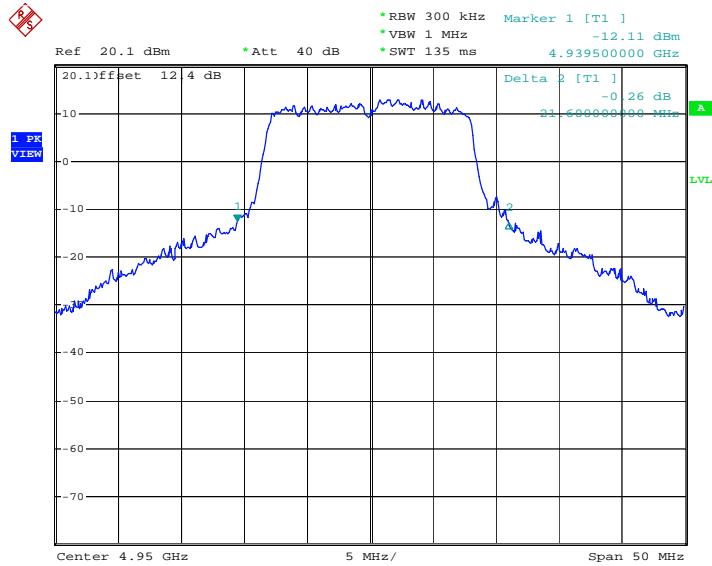
(d) The peak power spectral density is measured as conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of one MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth

**Test Conditions:**

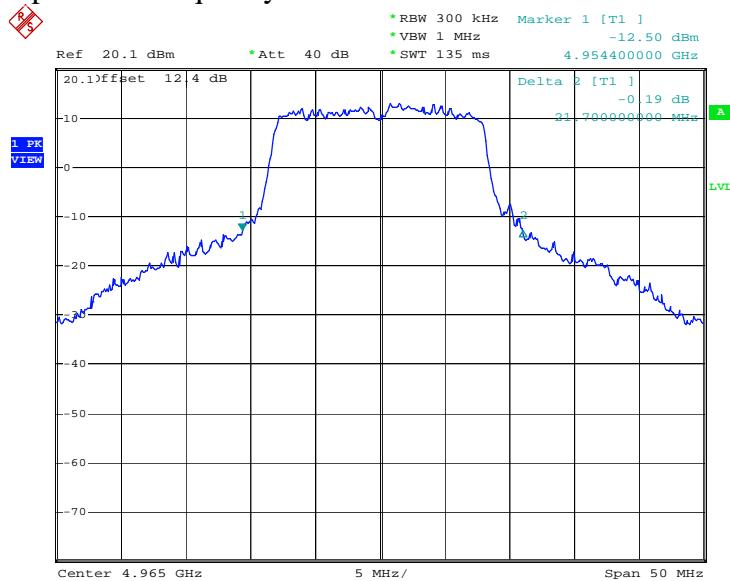
<b>Sample Number:</b>	1,2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov. 21, 2006	<b>Humidity:</b>	50 %
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin
		<b>Laboratory:</b>	Ottawa

**Test Results:** Complies**Test Data:** See attached table and graphics**26dB Occupied Bandwidth (MHz)**

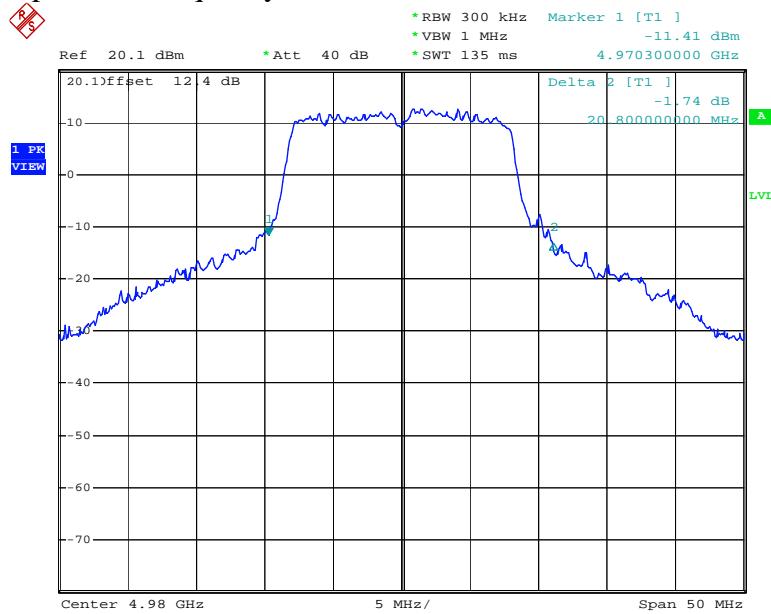
Frequency (MHz)	BW (MHz)
4950	21.6
4965	21.7
4980	20.8

**Operation Frequency 4950MHz**

Date: 21.NOV.2006 00:32:19

**Operation Frequency 4965MHz**

Date: 21.NOV.2006 00:37:17

**Operation Frequency 4980MHz**

Date: 21.NOV.2006 00:41:16

**Section 2. Peak Output Power****Criteria: 90.1215(a)**

Power limits. - The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel Bandwidth (MHz)	Low power peak transmitter power (dBm)	High power peak transmitter power(dBm)
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

**Test Conditions:**

<b>Sample Number:</b>	1,2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov.21, 2006	<b>Humidity:</b>	50 %
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin

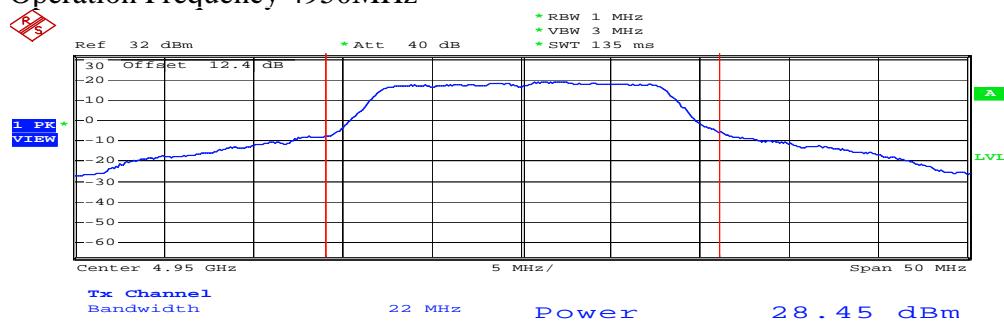
**Laboratory:** Ottawa**Test Results:** Complies**Test Data:** See attached table and graphics**Output Power Limit:** 33dBm

Note: Manufacturer declared that the maximum antenna gain is 21dBi. The EUT is used for high power point-to-point or point-to-multipoint operation.

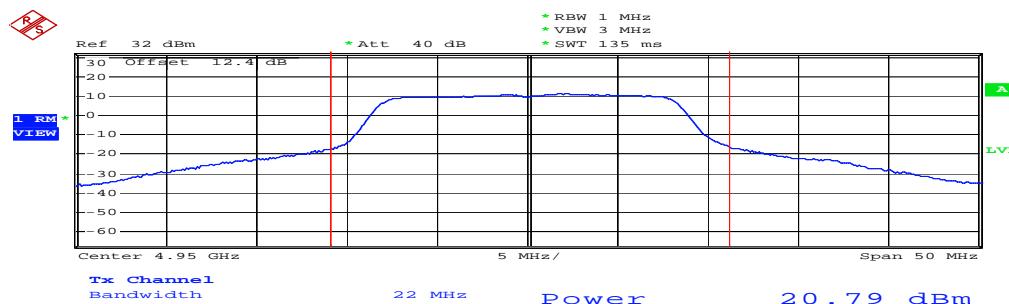
**Conducted Output Power Test Data (dBm)**

Frequency (MHz)	Output Power Peak (dBm)	Output Power Average (dBm)
4950	28.45	20.79
4965	29.58	21.83
4980	29.17	21.49

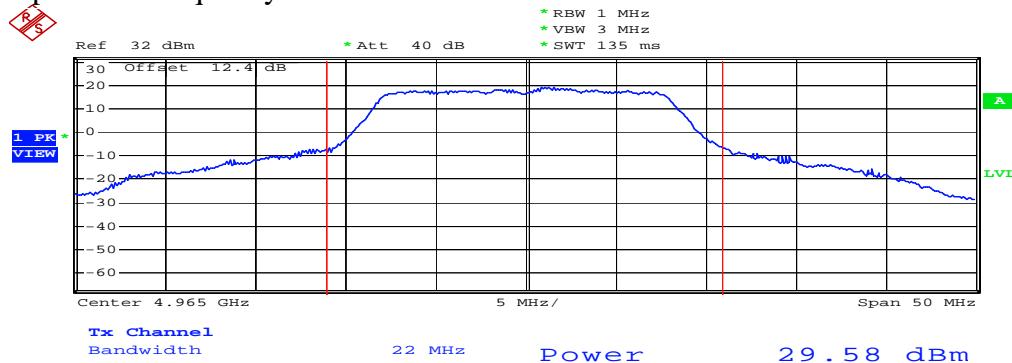
**Operation Frequency 4950MHz**



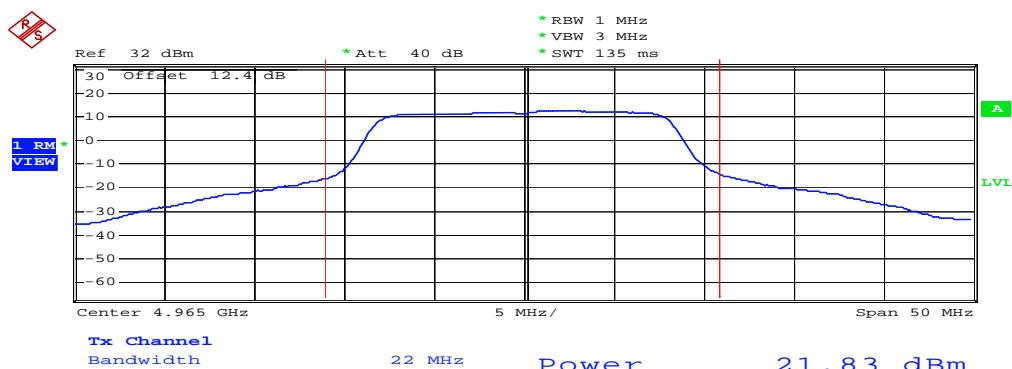
Date: 21.NOV.2006 01:00:42



Date: 21.NOV.2006 01:01:31

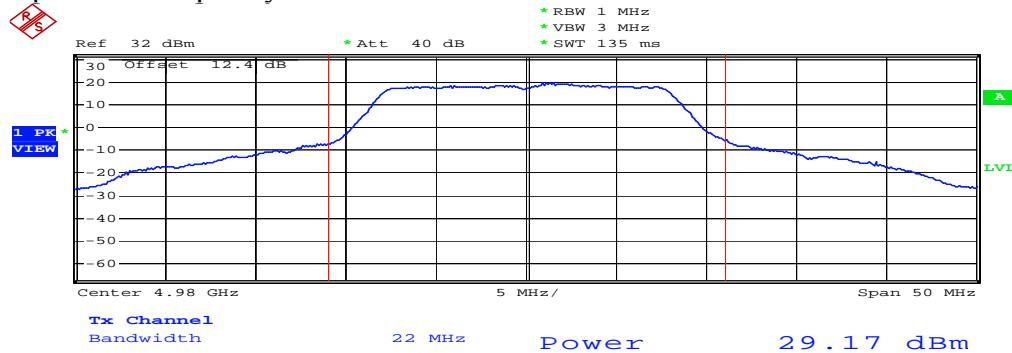
**Operation Frequency 4965MHz**

Date: 21.NOV.2006 17:53:59

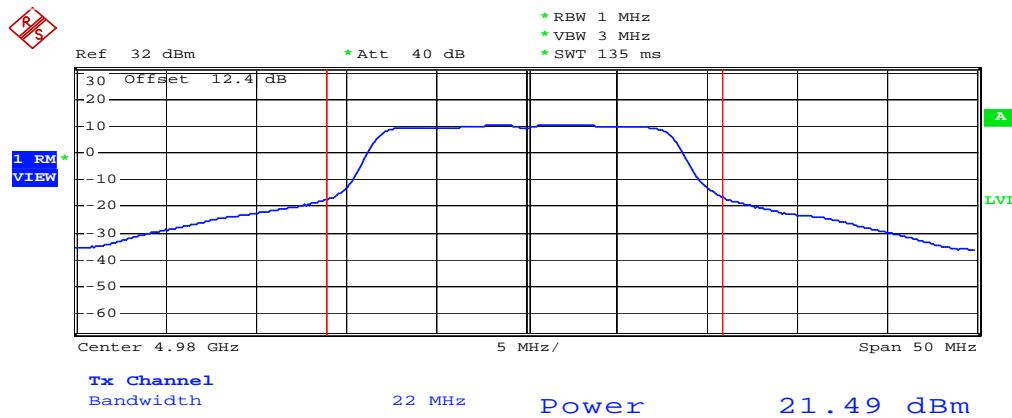


Date: 21.NOV.2006 17:54:33

Operation Frequency 4980MHz



Date: 21.NOV.2006 18:03:32



Date: 21.NOV.2006 18:04:05

**Section 3. Peak Power Spectrum Density****Criteria: Clause 90.1215**

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

(d) The peak power spectral density is measured as conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of one MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

**Test Conditions:**

<b>Sample Number:</b>	1,2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov.21, 2006	<b>Humidity:</b>	50 %
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin

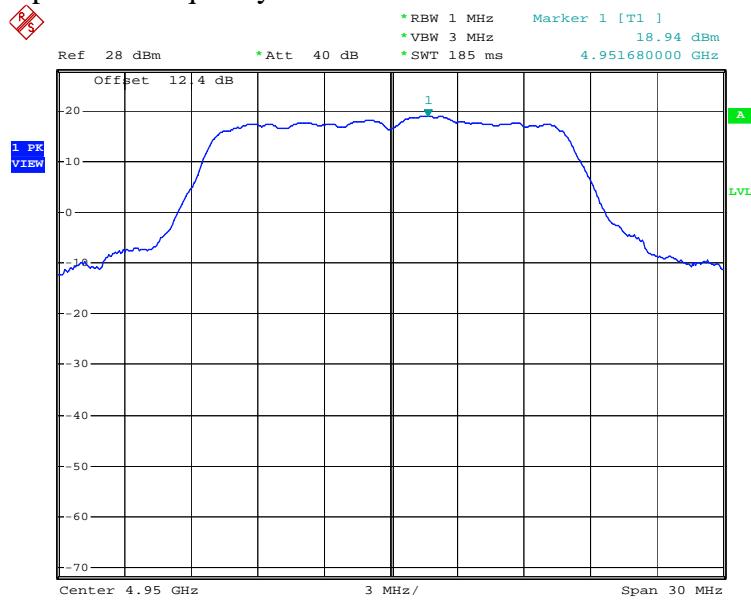
**Test Result:** Complies**Test Data:** See attached tables and graphics**Limit:** 21dBm/MHz

Note: Manufacturer declared that the maximum antenna gain is 21dBi. The EUT is used for high power point-to-point or point-to-multipoint operation.

**Peak Power Spectrum Density(dBm/MHz)**

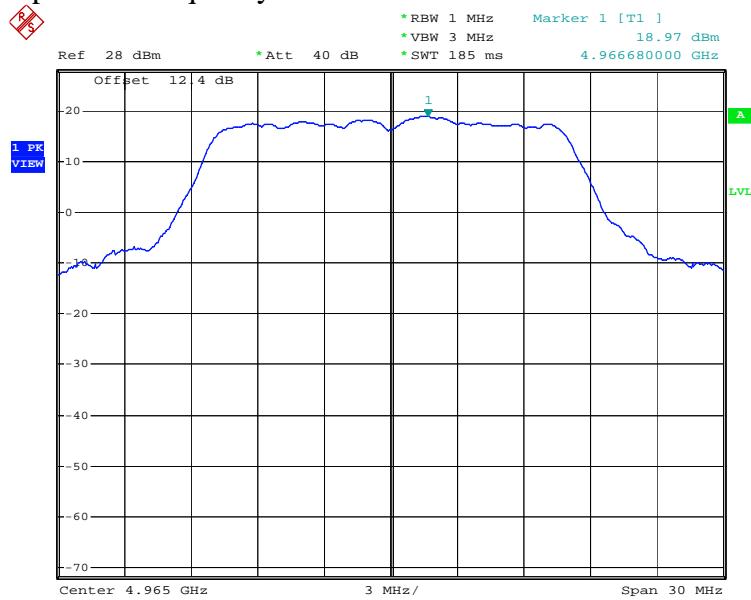
Frequency (MHz)	PPSD (dBm/MHz)
4950	18.94
4965	18.97
4980	18.67

**Operation frequency 4950MHz**



Date: 21.NOV.2006 19:26:15

**Operation frequency 4965MHz**



Date: 21.NOV.2006 19:28:16

## Nemko Canada Inc.

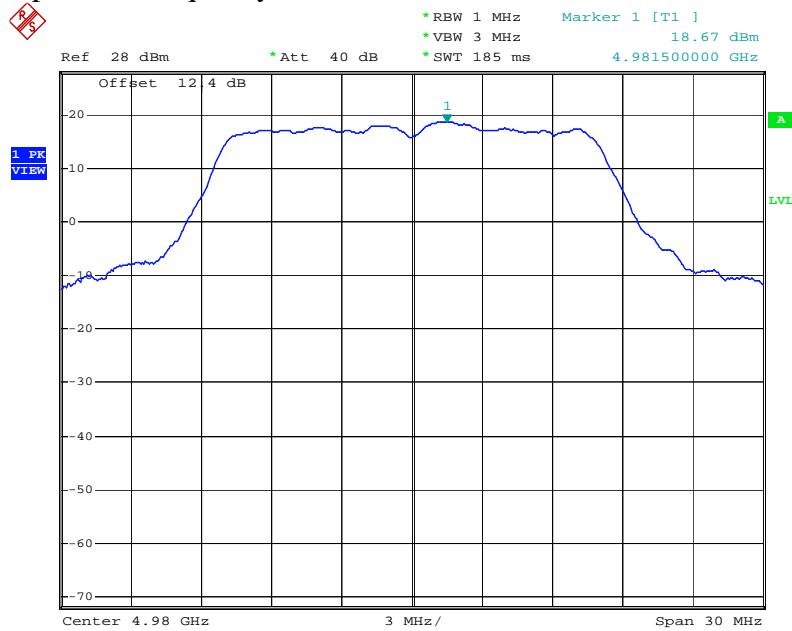
FCC ID: RAR20004001

## APPENDIX A: TEST RESULTS

Report Number:6W71243

## Specification: FCC Part 90 Subpart Y

Operation frequency 4980MHz



Date: 21.NOV.2006 19:30:27

**Section 4. Spurious Emissions at the Antenna Terminals****Criteria: Clause 90.210(m)**

(m) Emission Mask M. For high power transmitters (greater than 20 dBm) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

- (1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.
- (2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth:  $568 \log (\%) \text{ of (BW)/45}$  dB.
- (3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth:  $26 + 145 \log (\%) \text{ of BW/50}$  dB.
- (4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth:  $32 + 31 \log (\%) \text{ of BW/55}$  dB.
- (5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth:  $40 + 57 \log (\%) \text{ of (BW)/100}$  dB.
- (6) On any frequency removed from the assigned frequency between above 150% of the authorized bandwidth: 50 dB or  $55 + 10 \log (P)$  dB, whichever is the lesser attenuation.
- (7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

**Test Conditions:**

<b>Sample Number:</b>	1,2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov.21, 2006	<b>Humidity:</b>	50 %
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin
		<b>Laboratory:</b>	Ottawa

**Test Results:** Complies**Test Data:** See attached table and graphics

**Conducted Spurious Emissions**

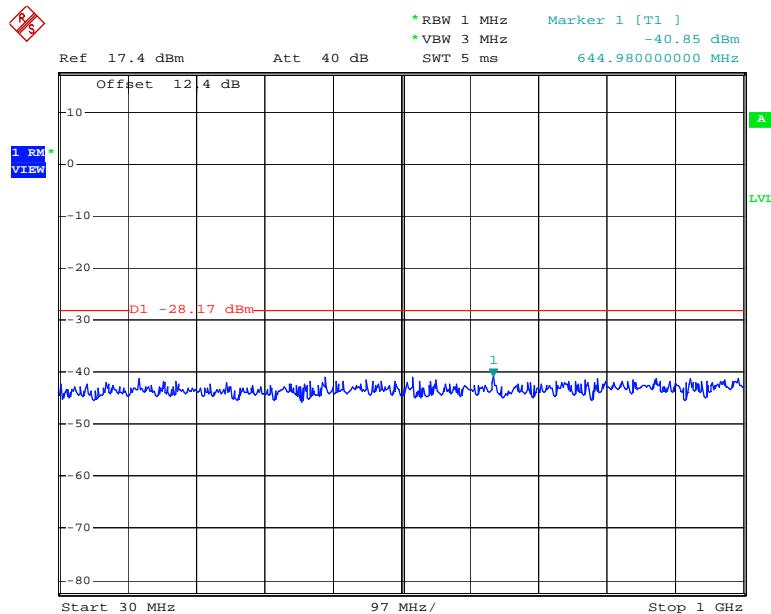
EUT was searched from 30MHz to 40GHz. The low, medium and high frequencies have been evaluated. Only worst-case data was presented.

The Measurement was performed with 1MHz RBW/VBW settings and RMS detector function.

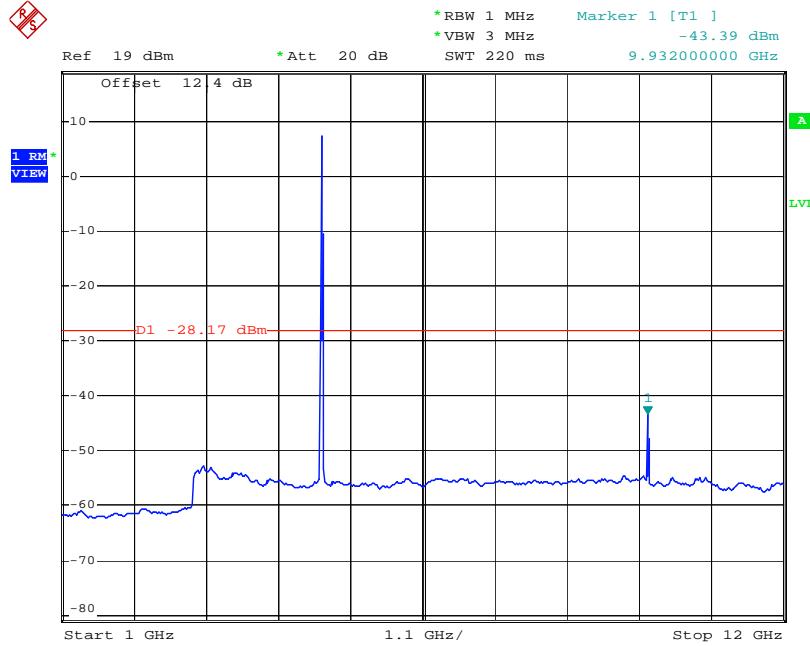
The spurious emissions limit is obtained by the following:

The average power is 21.83dBm for operation frequency 4965MHz.

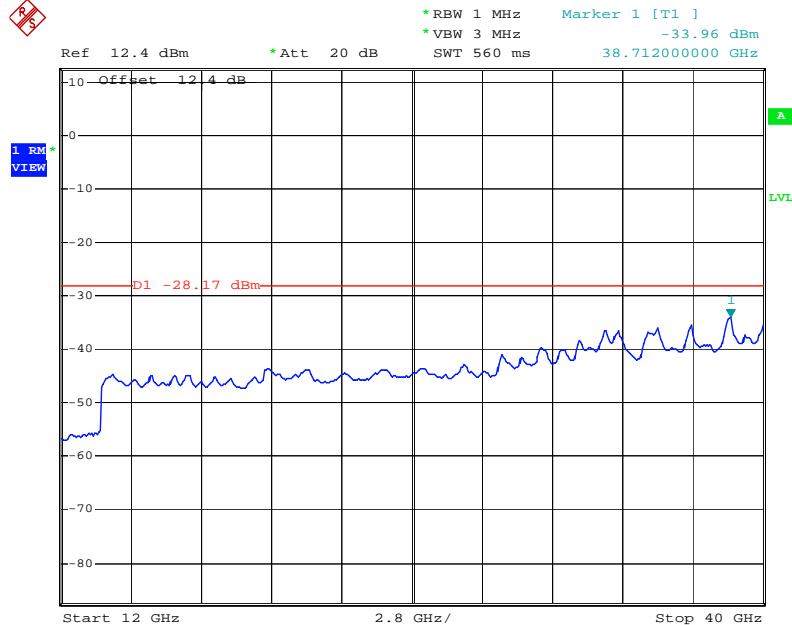
Spurious limit =21.83dBm-50dB=-28.17dBm



Date: 21.NOV.2006 23:46:27



Date: 21.NOV.2006 23:57:40



Date: 21.NOV.2006 23:50:31

**Reference Power Level for Emission Mask**

Frequency (MHz)	Reference Power Level (dBm)
4950	20.52
4965	20.50
4980	20.26

Spectrum Analyzer settings:

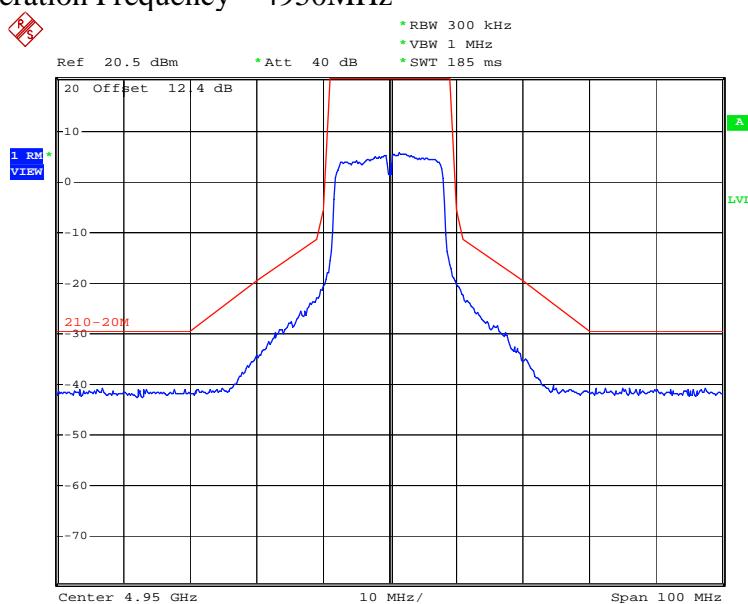
RBW: 300KHz

VBW: 30KHz

Detector: RMS

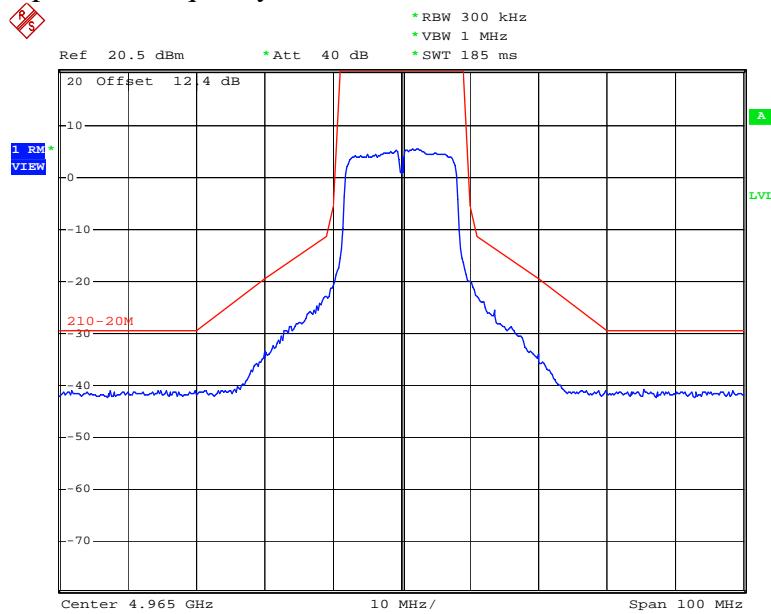
**Emission Mask**

Operation Frequency---4950MHz



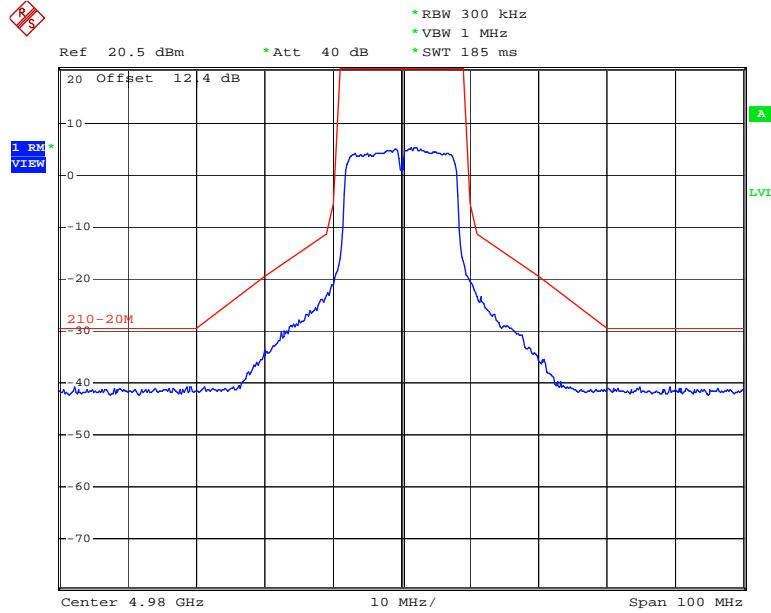
Date: 21.NOV.2006 19:01:03

**Operation frequency—4965MHz**



Date: 21.NOV.2006 19:02:23

**Operation frequency—4980MHz**



Date: 21.NOV.2006 19:03:37

**Section 5. Radiated Spurious Emissions****Criteria: Clause 90.210(m)**

(m) Emission Mask M. For high power transmitters (greater than 20 dBm) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

- (1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.
- (2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth:  $568 \log (\%) \text{ of (BW)/45} \text{ dB}$ .
- (3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth:  $26 + 145 \log (\%) \text{ of (BW)/50} \text{ dB}$ .
- (4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth:  $32 + 31 \log (\%) \text{ of (BW)/55} \text{ dB}$ .
- (5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth:  $40 + 57 \log (\%) \text{ of (BW)/100} \text{ dB}$ .
- (6) On any frequency removed from the assigned frequency between above 150% of the authorized bandwidth: 50 dB or  $55 + 10 \log (P) \text{ dB}$ , whichever is the lesser attenuation.
- (7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

**Test Conditions:**

<b>Sample Number:</b>	1, 2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov.24, 2006	<b>Humidity:</b>	50 %
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin
		<b>Laboratory:</b>	Ottawa

**Test Results:** Complies**Test Data:** See attached table.

The DUT was searched to from 30MHz to 40GHz, and for low, medium and high frequencies.

All measurements were performed using a RMS detector with 1MHz RBW/VBW settings at a distance of 3 meters.

Only worst case data was reported

**Radiated Emissions**

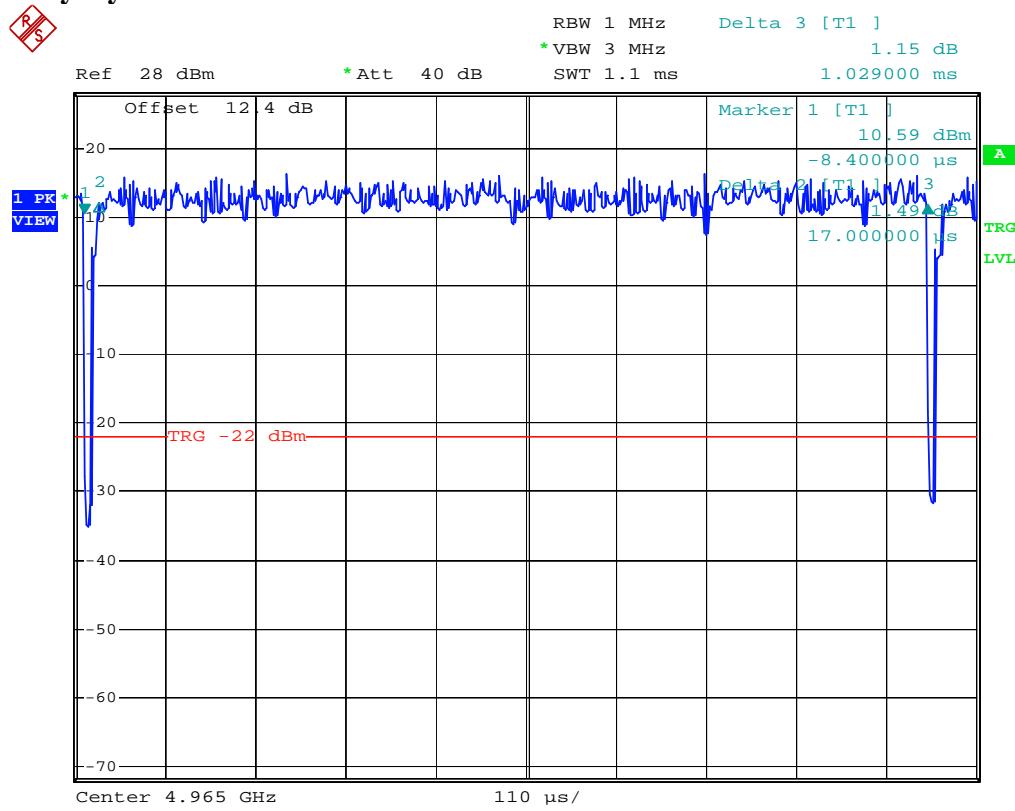
The spurious emissions limit is obtained by the following:

The average power is 21.83dBm

Spurious limit=21.83dBm-50dB=-28.17dBm

Freq. (MHz)	Ant.	Pol. V/H	RCVD Signal (dB $\mu$ V)	Sig Sub. Factor (dB)	Signal Substitution Power (dBm)	Limit (dBm)	Margin (dB)
165.0000	BC1	H	28.3	-88.5	-60.2	-28.17	32.03
165.0000	BC1	V	21.2	-85.4	-64.1	-28.17	35.93
231.0000	BC1	H	29.0	-84.3	-55.4	-28.17	27.23
231.0000	BC1	V	21.5	-81.6	-60.1	-28.17	31.93
250.0400	BC1	H	24.9	-83.6	-58.7	-28.17	30.53
250.0400	BC1	V	22.8	-81.2	-58.3	-28.17	30.13
297.0000	BC1	H	32.0	-81.7	-49.7	-28.17	21.53
297.0000	BC1	V	28.1	-76.9	-48.8	-28.17	20.63
330.0000	LP1	H	25.9	-83.3	-57.4	-28.17	29.23
330.0000	LP1	V	26.5	-82.7	-56.1	-28.17	27.93
627.2700	LP1	H	46.7	-78.3	-31.6	-28.17	3.43
627.2700	LP1	V	46.3	-76.2	-29.9	-28.17	1.73
1023.0000	Horn2	H	61.6	-119.0	-57.4	-28.17	29.23
1023.0000	Horn2	V	57.0	-119.3	-62.3	-28.17	34.13
1155.0000	Horn2	H	53.5	-119.2	-65.7	-28.17	37.53
1155.0000	Horn2	V	52.2	-118.7	-66.6	-28.17	38.43
1220.0000	Horn2	H	52.2	-119.1	-66.9	-28.17	38.73
1220.0000	Horn2	V	54.3	-118.9	-64.6	-28.17	36.43
1551.0000	Horn2	H	54.0	-119.0	-65.0	-28.17	36.83
1551.0000	Horn2	V	50.4	-118.9	-68.5	-28.17	40.33

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

**Duty Cycle**

Date: 21.NOV.2006 19:46:07

Duty Cycle=(1-17μs/1029μs)×100%=98.35%

**Section 6. Frequency Stability****Criteria: Clause 90.213**

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following Table. (Refer 90.213 for table)

**Test Conditions:**

<b>Sample Number:</b>	1,2	<b>Temperature:</b>	22 °C
<b>Date:</b>	Nov.22, 2006	<b>Humidity:</b>	50%
<b>Modification State:</b>	0	<b>Tester:</b>	Xu Jin

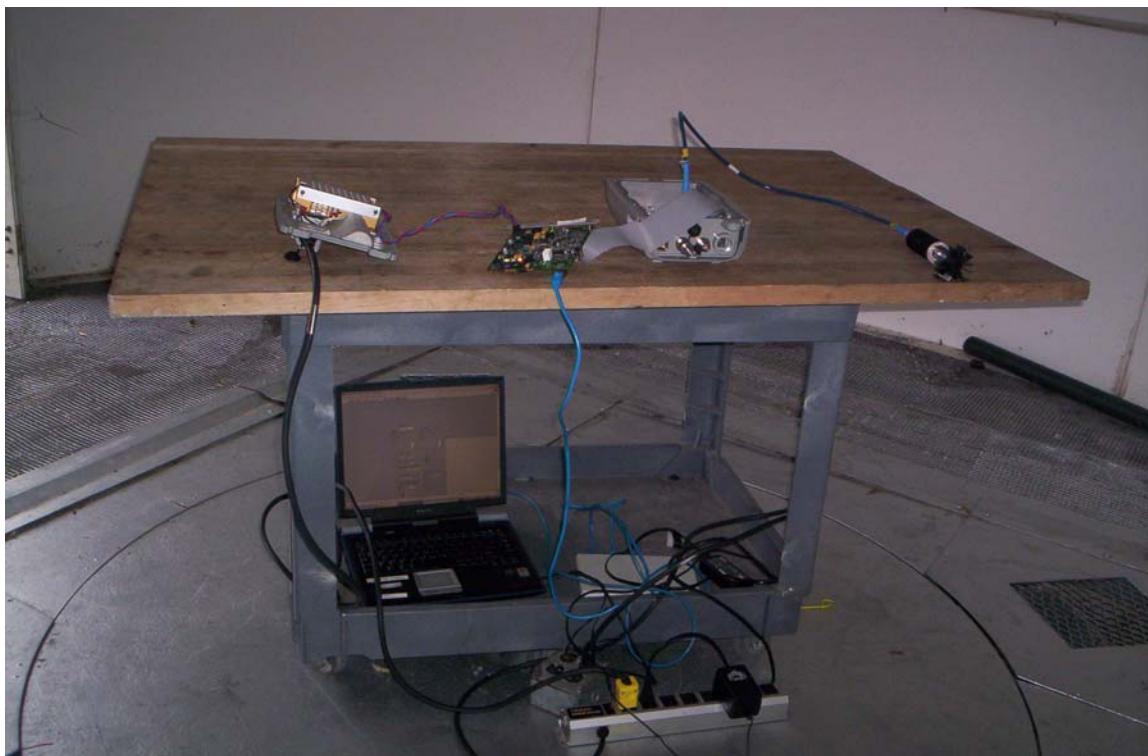
**Test Results:** Complies**Test Conditions** Ambient Temperature: 22°C  
Extreme Temperature: -30°C to +50°C  
Extreme Voltage Conditions: +/-15% of 120VAC**Test Data:** See attached tables

**Frequency Stability Test Data**

<b>Test Condition</b>	<b>Measured Frequency (GHz)</b>	<b>Frequency Drift (ppm)</b>
+22C, 120VAC	4.9799740	---
+22C, 138VAC	4.9799735	-0.10
+22C, 102VAC	4.9799745	0.10
+50°C, 120VAC	4.9799635	-2.11
+40°C, 120VAC	4.9799448	-5.86
+30°C, 120VAC	4.9799703	-0.74
+20°C, 120VAC	4.9799815	1.51
+10°C, 120VAC	4.9799967	4.56
0°C, 120VAC	4.9800102	7.27
-10°C, 120VAC	4.9800212	9.48
-20°C, 120VAC	4.9800252	10.28
-30°C, 120VAC	4.9800228	9.80

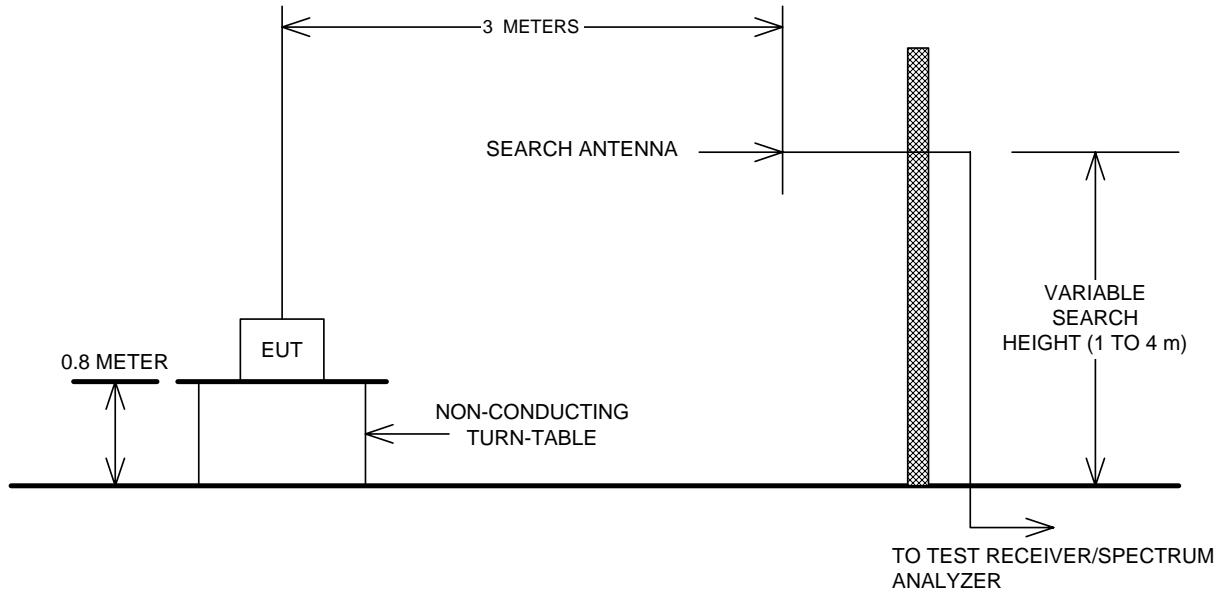
## **Appendix B : Setup Photographs**

### **Radiated Emission Setup Photos**



## **Appendix C : Block Diagram of Test Setups**

### **Test Site For Radiated Emissions**



### **Conducted Measurements**

