

**Nemko Test Report:** 133553-3TRFWL

**Applicant:** SMART Technologies ULC  
3636 Research Road NW  
Calgary, AB  
Canada, T2L 1Y1

**Apparatus:** Wireless Module (Banff)

**FCC ID:** QCIWC601

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

**Authorized By:**   
Andrey Adelberg, Senior Wireless/EMC Specialist

**Date:** October 8, 2009

**Total Number of Pages:** 25

## TABLE OF CONTENTS

<b>Section 1 : Report Summary .....</b>	<b>3</b>
<b>Section 2 : Equipment Under Test.....</b>	<b>4</b>
2.1 Identification of Equipment Under Test (EUT).....	4
2.2 Accessories.....	4
2.3 EUT Description.....	4
2.4 Technical Specifications of the EUT.....	5
2.5 EUT Setup diagram.....	5
2.6 Operation of the EUT during testing.....	5
2.7 Modifications incorporated in the EUT.....	5
<b>Section 3 : Test Conditions.....</b>	<b>6</b>
3.1 Specifications.....	6
3.2 Deviations From Laboratory Test Procedures.....	6
3.3 Test Environment.....	6
3.4 Measurement Uncertainty.....	6
3.5 Test Equipment.....	7
<b>Section 4 : Results Summary .....</b>	<b>8</b>
4.1 FCC Part 15 Subpart C : Test Results.....	8
<b>Appendix A : Test Results.....</b>	<b>9</b>
Clause 15.207(a) Powerline Conducted Emissions.....	9
Clause 15.209(a) Radiated Emissions within Restricted Bands.....	11
Clause 15.247(a)(1) Frequency hopping systems.....	14
Clause 15.247(a)(1)(iii) Frequency hopping systems operating in the 2400–2483.5 MHz band.....	17
Clause 15.247(a)(1)(iii) Frequency hopping systems operating in the 2400–2483.5 MHz band.....	17
Clause 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.....	19
Clause 15.247(d) Radiated Emissions Not in Restricted Bands.....	21
<b>Appendix B : Setup Photographs .....</b>	<b>24</b>
<b>Appendix C : Block Diagram of Test Setups.....</b>	<b>25</b>

## Section 1 : 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.

The assessment summary is as follows:

<b>Apparatus Assessed:</b>	Wireless Module (Banff)
<b>Specification:</b>	FCC Part 15 Subpart C, 15.247
<b>Compliance Status:</b>	Complies
<b>Exclusions:</b>	None
<b>Non-compliances:</b>	None
<b>Report Release History:</b>	Original Release
<b>Test Location:</b>	Nemko Canada Inc. 303 River Road Ottawa, Ontario K1V 1H2
<b>Registration Number:</b>	176392 (3 m Semi-Anechoic Chamber)
<b>Tests Performed By:</b>	Kevin Ma, Wireless/EMC Specialist
<b>Test Dates:</b>	September 20 to 24, 2009

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 contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

---

## Section 2 : Equipment Under Test

### 2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	Bluetooth Wireless Module (Banff)
Brand Name:	SMART Technologies
Model Name or Number:	GU3706
Serial Number:	N/A
Nemko Sample Number:	3
FCC ID:	QCIWC601
Date of Receipt:	September 17 2009

### 2.2 Accessories

The following information identifies accessories used to exercise the EUT during testing:

Description:	Adapter	Interactive Whiteboard
Brand Name:	Sound Design Technologies	Smart Technologies
Model Name or Number:	3A-161DB07	SB680
Serial Number:	ETS070214U-P5P-SZ	SB680-R2-366502
Connection Port:	DC port	20 Pin Port

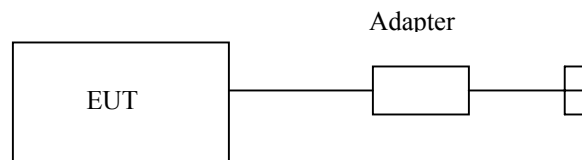
### 2.3 EUT Description

The EUT is a Bluetooth transceiver designed to operate in the 2.4–2.4835 GHz band. The Banff Module is a part of WC6 system.

## 2.4 Technical Specifications of the EUT

<b>Operating Band:</b>	2400–2483.5 MHz
<b>Operating Frequency:</b>	2402–2480 MHz
<b>Modulation:</b>	GFSK
<b>Occupied Bandwidth:</b>	897 kHz
<b>Emission Designator:</b>	8K97F1D
<b>Antenna Data:</b>	Integrated SMD antenna, max. 2.1 dBi
<b>Power Supply Requirements:</b>	Powered by Switching Power Supply

## 2.5 EUT Setup diagram



## 2.6 Operation of the EUT during testing

The EUT was controlled to transmit at desired frequency from laptop.

## 2.7 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment. The Banff Module is a part of WC6 system.

## **Section 3 : Test Conditions**

### **3.1 Specifications**

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247

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

### **3.2 Deviations From Laboratory Test Procedures**

No deviations were made from laboratory test procedures.

### **3.3 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

### **3.4 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.

### 3.5 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal. Date	Next Cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/09	May 06/10
Bilog	Sunol	JB3	FA002108	Jan. 27/09	Jan. 27/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR	NCR
Controller	Sunol	SC104V	FA002060	NCR	NCR
Mast	Sunol	TLT2	FA002061	NCR	NCR
International Power Supply	California Inst.	3001i	FA001021	Jan. 13/09	Jan. 13/10
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/08	Dec. 16/09
LISN	Rohde & Schwarz	ENV216	FA002023	Sept. 08/10	LISN
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/09	Jan. 21/10
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08	Oct 2/09
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 40	FA002071	Nov. 25/08	Nov. 25/09
Horn 18 – 26.5 GHz	Electro-Metrics	SH-50/60-1	FA000479	COU	COU
18.0 – 26.0 GHz Amplifier	NARDA	BBS-1826N612	FA001550	COU	COU
Multimeter	Fluke	16	FA001831	Jan 13/09	Jan 13/10
Notch Filter	Microwave Circuits	2400-2483MHz	FA001940	COU	COU
Attenuator	Narda	776B-20	FA001153	COU	COU

COU – Calibrate on Use

NCR – No Calibration Required

## 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 Report Summary)

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

Part 15	Test Description	Required	Result
15.31(e)	Variation of power supply	Y	PASS
15.207(a)	Powerline Conducted Emissions	Y	PASS
15.209(a)	Radiated Emissions within Restricted Bands	Y	PASS
15.247(a)(1)	Frequency hopping systems	Y	PASS
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	Y	PASS
15.247(a)(2)	Systems using digital modulation techniques	N	
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	Y	PASS
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	N	
15.247(b)(4)	Maximum peak output power	N	
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	N	
15.247(f)	Time of Occupancy for Hybrid Systems	N	



## Appendix A : Test Results

### Clause 15.207(a) Powerline Conducted Emissions

Frequency of Conducted limit (dB $\mu$ V)		
Emission (MHz)	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.

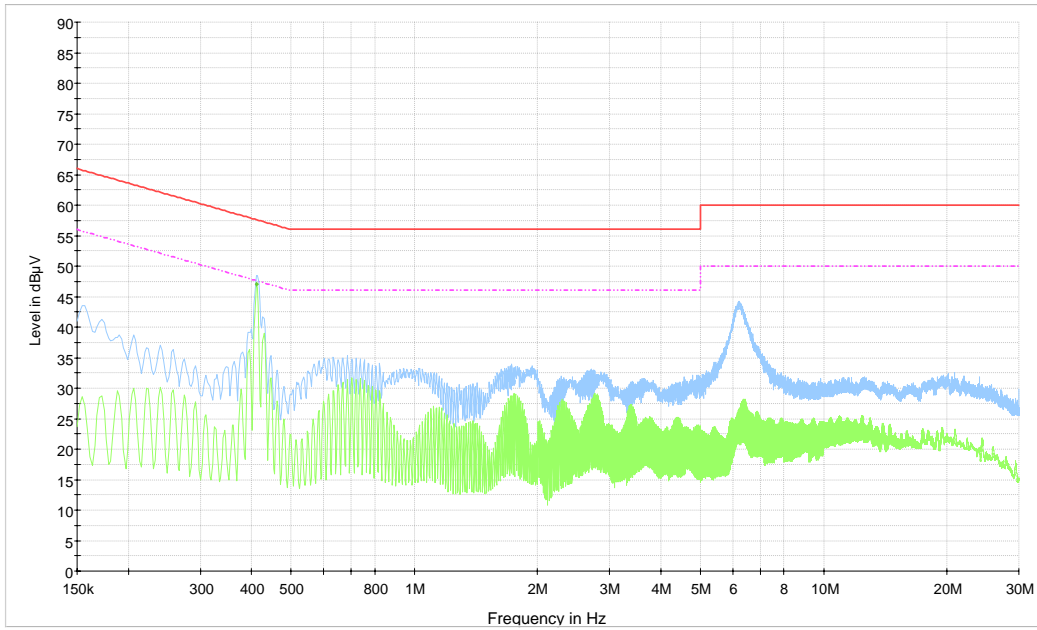
**Test Results:** Pass

#### Additional Observations:

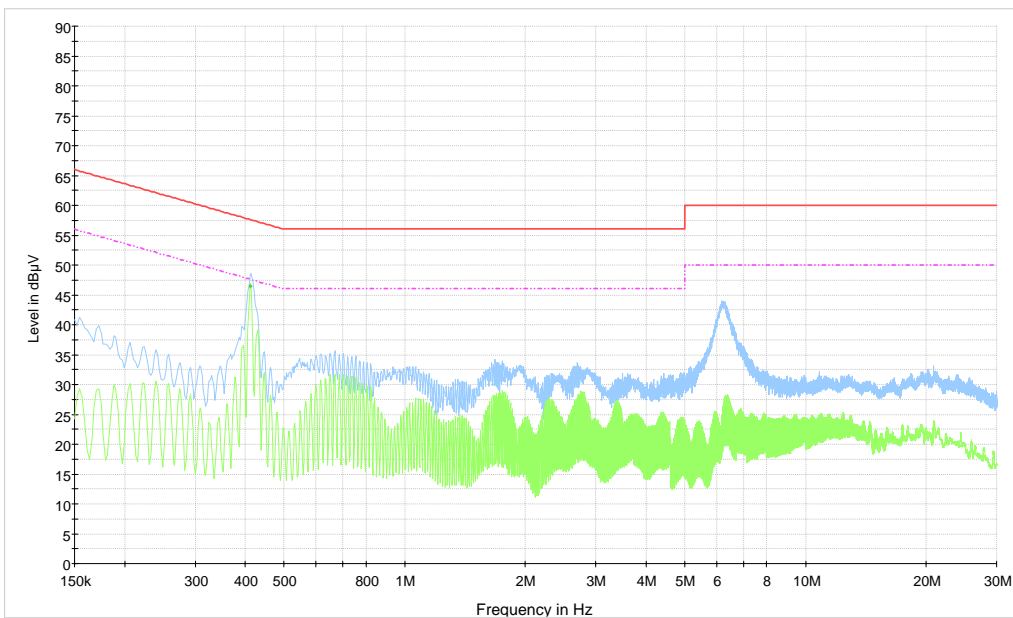
All plots were obtained using a sweeping receiver with an IF of 9 kHz using a Peak and Average detector. The plots have been corrected with the cable loss and LISN loss to show compliance.

Frequency (MHz)	Average Result (dB $\mu$ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dB $\mu$ V)
0.411000	46.5	100.0	9.000	On	N	10.0	1.1	47.6
0.411000	47.0	100.0	9.000	On	L1	10.0	0.6	47.6

**Phase**



**Neutral**



**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		Measurement Distance (meters)
	( $\mu$ V/m)	(dB $\mu$ V/m)	
0.009–0.490	2400/F	67.6–20log(F)	300
0.490–1.705	24000/F	87.6–20log(F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
Above 960	500	54.0	3

Note: F = fundamental frequency in kHz

**Test Results:** Pass

**Additional Observations:**

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

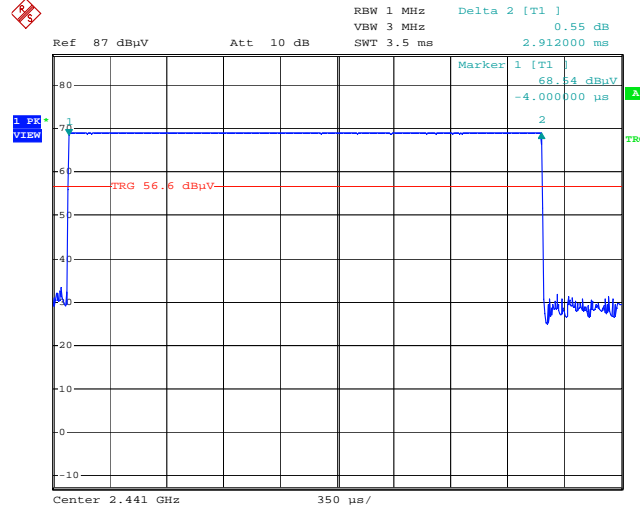
These results apply to emissions found in the Restricted bands defined in FCC Part 15 Subpart C, 15.205.

All measurements were performed at the distance of 3 m. Peak detector was used with 100 kHz RBW/300 kHz VBW below 1 GHz and 1 MHz/3 MHz RBW/VBW above 1 GHz.

Channel	Freq. MHz	Pol.	Peak Field Strength dB $\mu$ V/m	Peak Limit dB $\mu$ V/m	Margin dB	Average Factor dB	Average Field Strength dB $\mu$ V/m	Average Limit dB $\mu$ V/m	Margin dB
0	4804.5	V	52.5	74.00	21.5	-21.17	31.33	54.00	22.67
0	4804.5	H	51.6	74.00	22.4	-21.17	30.43	54.00	23.57
39	4882.0	V	59.3	74.00	14.7	-21.17	38.13	54.00	15.87
39	4882.0	H	58.2	74.00	15.8	-21.17	37.03	54.00	16.97
78	4960.5	V	54.7	74.00	19.3	-21.17	33.53	54.00	20.47
78	4960.5	H	54.6	74.00	19.4	-21.17	33.43	54.00	20.57

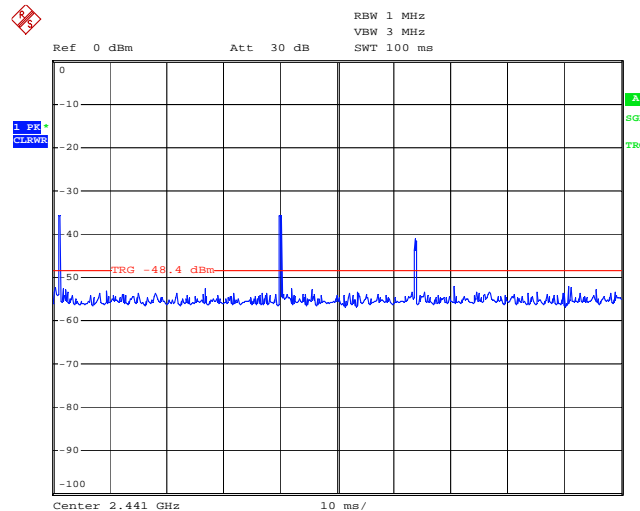
Note: Antenna Factor, cable loss and amplifier gain are included in the Peak Field Strength result.

**Duty Cycle:  
Transmission On Time**



Date: 24.SEP.2009 16:46:10

**Transmission within 100 ms**



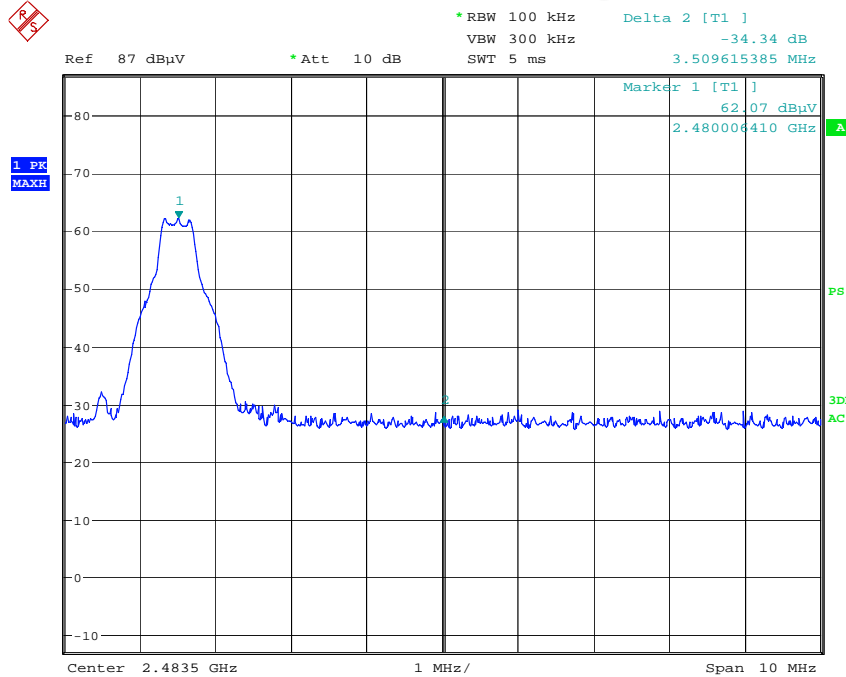
Date: 23.SEP.2009 08:41:56

<b>T<sub>ON</sub> (ms)</b>	<b>Maximum Number of pulses within 100 ms</b>	<b>T<sub>ON</sub> (ms) within 100 ms</b>	<b>Average factor (dB)</b>
2.912	3	8.736	-21.17

Duty Cycle Correction (Average Factor) =  $20 \log_{10}(T / 100\text{ms}) = -21.17 \text{ dB}$

$20 \log_{10}(8.736 \text{ ms} / 100 \text{ ms}) = -21.17 \text{ dB}$

**Delta Marker Measurement for 2.4835 GHz Band Edge**



Date: 22.SEP.2009 14:18:25

Measured Field Strength for High Channel in 1 MHz RBW = 103.58 dBμV/m

Delta Marker = -34.34 dB

Therefore, Peak Field Strength = 103.58 dBμV/m - 34.34 dB = 69.24 dBμV/m

Limit = 74 dBμV/m

Average Field Strength = 69.24 dBμV/m - 21.17 dB (Duty Cycle) = 48.07 dBμV/m

Limit = 54 dBμV/m

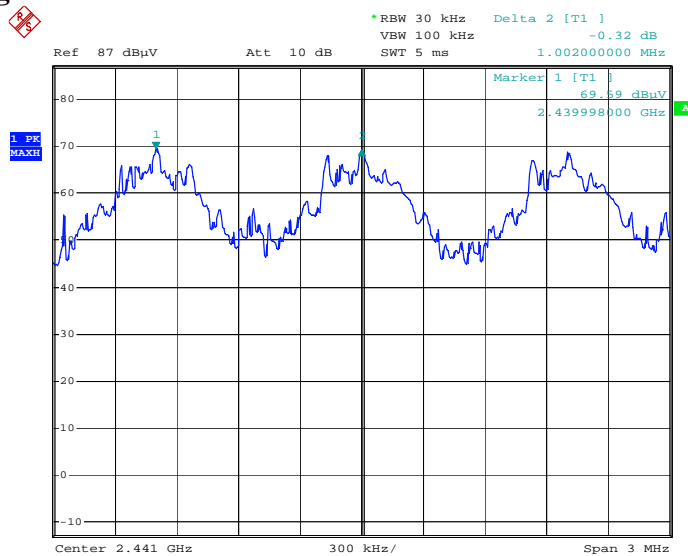
Peak Field Strength (dBμV/m)	Peak Field Strength Limit (dBμV/m)	Margin (dB)
69.24	74.00	4.76
Average Field Strength (dBμV/m)	Average Field Strength Limit (dBμV/m)	Margin (dB)
48.07	54.00	5.93

**Clause 15.247(a)(1) Frequency hopping systems**

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.

**Test Results:** Pass

**Channel Spacing:**



Date: 29.SEP.2009 10:55:24

**Limit calculation:**

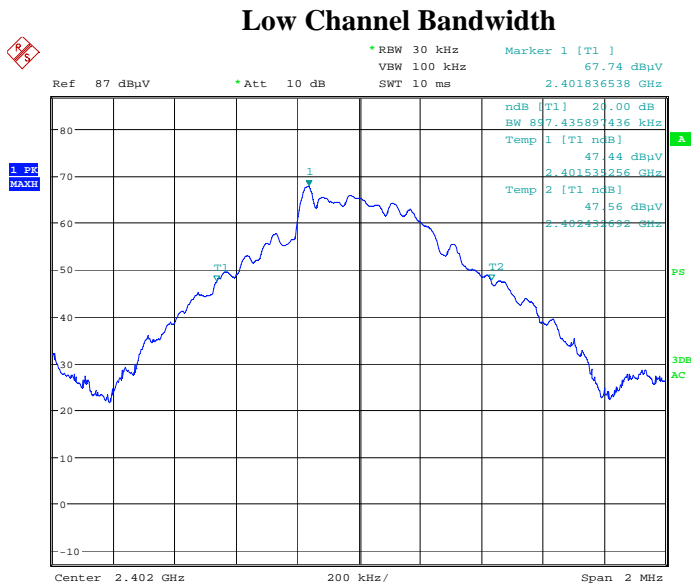
$$0.801 \text{ MHz (20 dB BW)} \times 2/3 = 0.534 \text{ MHz}$$

Channel Spacing (MHz)	Limit (MHz)	Margin (MHz)
1.002	0.897*2/3	0.404

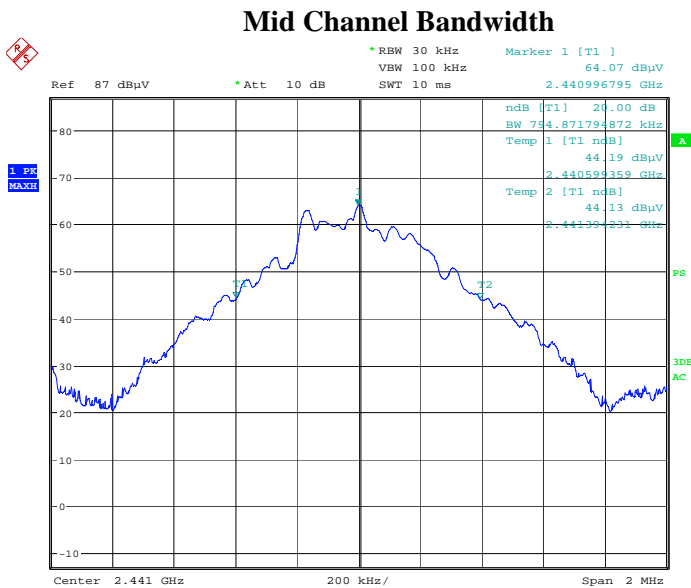


Nemko Canada Inc.

20dB Bandwidth:

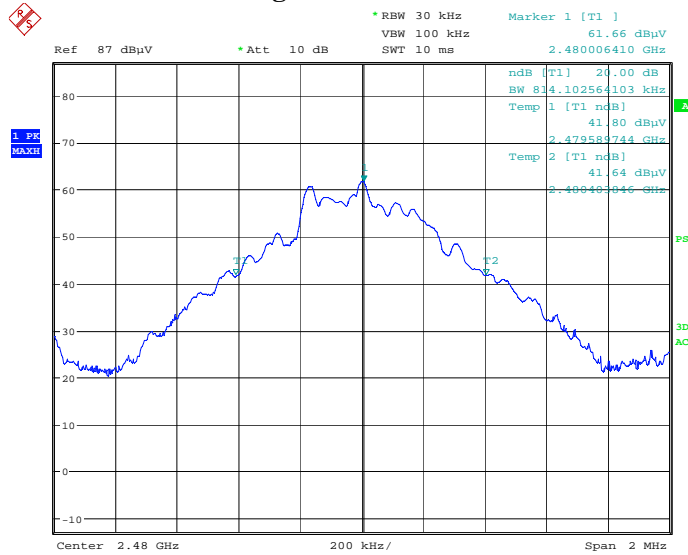


Date: 22.SEP.2009 14:23:39



Date: 22.SEP.2009 14:22:25

### High Channel Bandwidth



Date: 22.SEP.2009 14:20:35

Low Channel 20 dB Bandwidth (MHz)	Mid Channel 20 dB Bandwidth (MHz)	High Channel 20 dB Bandwidth (MHz)
0.897	0.794	0.814

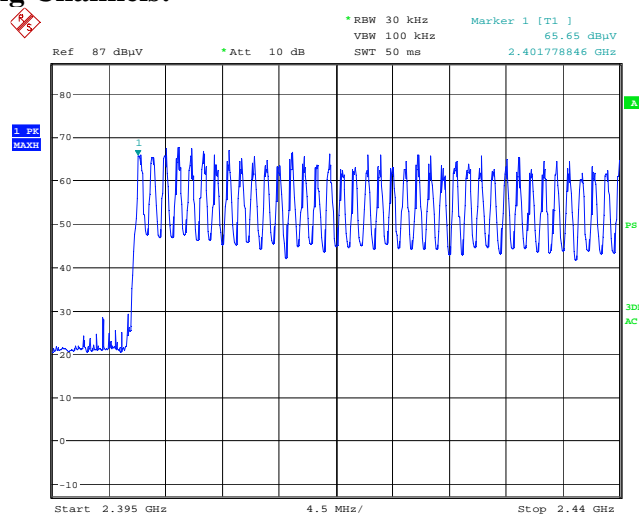


**Clause 15.247(a)(1)(iii) Frequency hopping systems operating in the 2400–2483.5 MHz band**

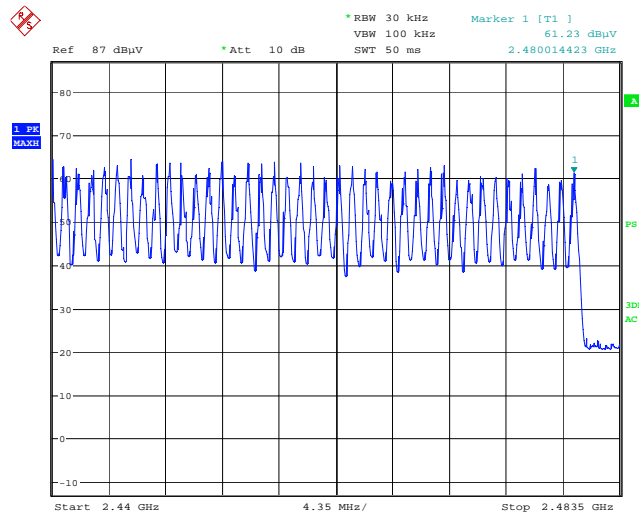
Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used

**Test Results:** Pass

**Number of Hopping Channels:**



Date: 22.SEP.2009 14:39:53



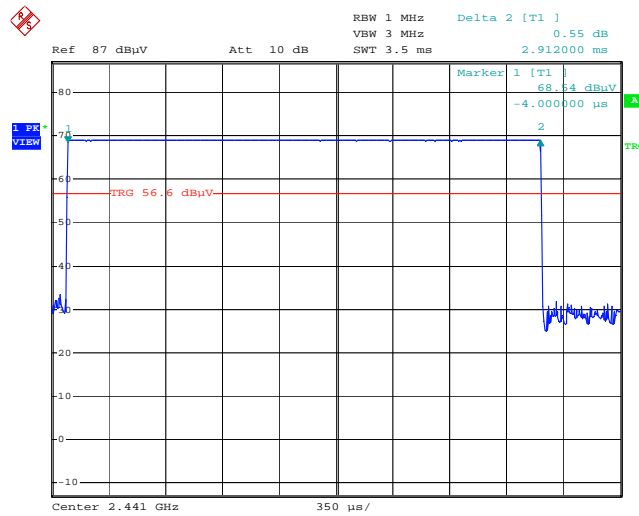
Date: 22.SEP.2009 14:43:07

Number of channels: 37 + 41 = 79

**Time of Occupancy:**

For DH5 Packets it needs 5 time slots for transmission and 1 for reception, so the system makes in worst case  $1600_{\text{hops}} / 5 = 320$  hops per second with 79 channels. Therefore each channel has 4.05 times per second; it yields 128 times of appearance within 31.6 seconds (79 channels times 0.4 sec).

Time of occupancy:  $128 \times 2.912 \text{ ms} = 372.7 \text{ ms}$  per 31.6 sec < 400 ms



Date: 24.SEP.2009 16:46:10

**Clause 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**

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 W. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 W.

**Test Results:** Pass

The supplied voltage was altered by ±15%. No noticeable difference was observed. Field Strength measurements were performed using peak detector function of Spectrum Analyzer.

EUT Antenna Gain = 2.1dBi

All Measurements were performed at 3 m using a 3 MHz RBW/VBW.

**Radiated Output Power:**

Channel	Frequency (MHz)	Polarity V/H	Antenna type	Rx (dBµV)	Cable loss(dB)	Ant Factor (dB/m)	F.S. (dBµV/m)
Low	2402.000	V	Horn	70.68	4.6	28.3	103.58
	2402.000	H	Horn	69.60	4.6	28.1	102.30
Mid	2441.000	V	Horn	67.27	4.6	28.4	100.27
	2441.000	H	Horn	65.69	4.6	28.2	98.49
High	2480.000	V	Horn	65.15	4.6	28.5	98.21
	2480.000	H	Horn	65.11	4.6	28.3	98.01

$$E \text{ (V/m)} = \frac{10^{(FS/20)}}{1 \times 10^6} = \left( 10^{\left( \frac{103.58}{20} \right)} \right) \times 10^{-6} = 0.151 \text{ V/m}$$

$$G \text{ (numeric)} = 10^{(Ag/10)} = 10^{\left( \frac{2.1}{10} \right)} = 1.62$$

$$P \text{ (W)} = \frac{E^2 R^2}{30G} = 0.004222 \text{ W} = 4.222 \text{ mW}$$

- FS = Field Strength (dBµV/m)
- Ag = Antenna gain (dBi)
- E = Measured Value (V/m)
- R = Measurement distance (m)
- G = Antenna Gain (numeric)
- P = Output power (W)

Output Power (dBm) =  $10 \times \log(\text{Output Power}(mW)) = 10 \times \log(4.222) = 6.26 \text{ dBm}$

Conducted Output Power Limit = 30 dBm

EIRP: Conducted Output power + antenna Gain =  $6.26 + 2.1 = 8.36 \text{ dBm}$ .

EIRP limit = 36 dBm.

Chan.	Freq. MHz	Pol.	Peak Field Strength dB $\mu$ V/m	Conducted Output power dBm	Conducted Power Limit dBm	Margin dB
<b>Low</b>	2402.000	V	103.58	6.26	30	23.74
	2402.000	H	102.30	4.97	30	25.03
<b>Mid</b>	2441.000	V	100.27	2.94	30	27.06
	2441.000	H	98.49	1.16	30	28.84
<b>High</b>	2480.000	V	98.21	0.88	30	29.12
	2480.000	H	98.01	0.68	30	29.32

---

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

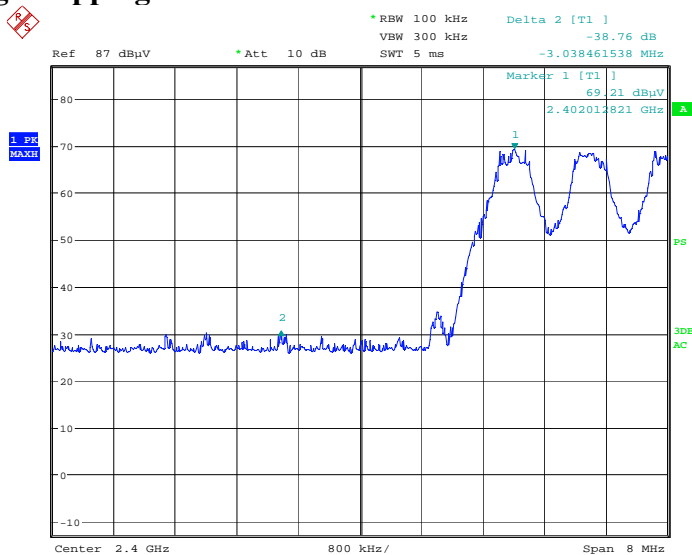
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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 Results:** Pass

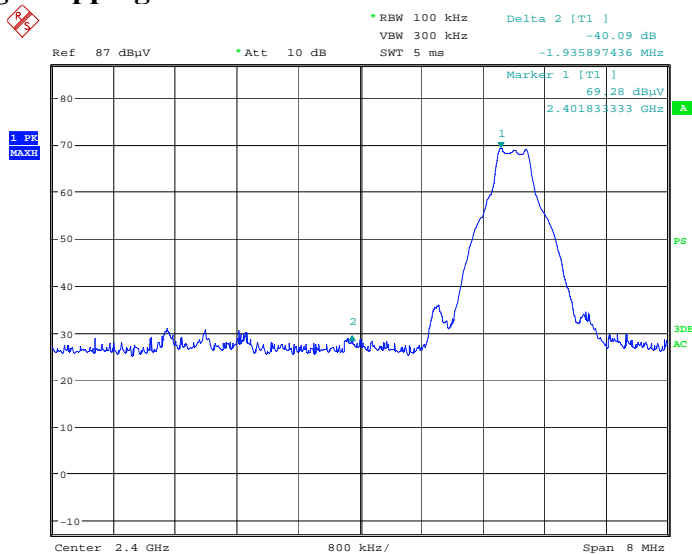
The Spectrum was searched from 30 MHz to the 10<sup>th</sup> Harmonic.

These results apply to emissions found not in the restricted bands defined in FCC Part 15 Subpart C, 15.205.

No emissions were found less than 20 dB below the fundamental emission with 100 kHz RBW/300 kHz VBW.

**Lower Band Edge Hopping On:**


Date: 22.SEP.2009 14:28:23

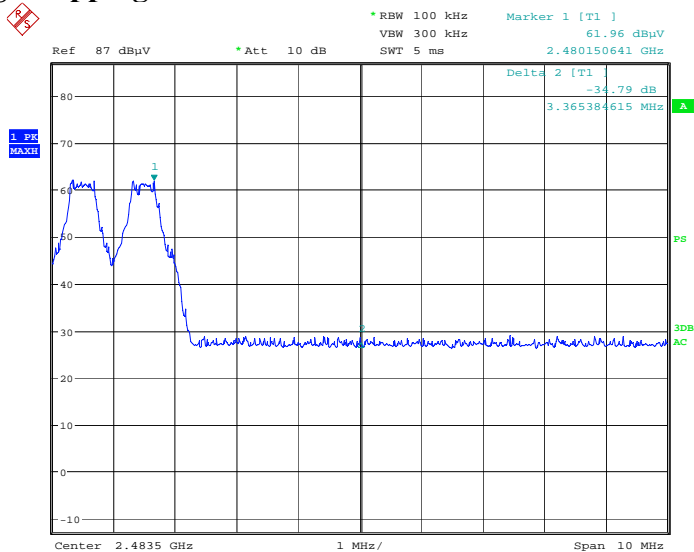
**Lower Band Edge Hopping Off:**


Date: 22.SEP.2009 14:25:54



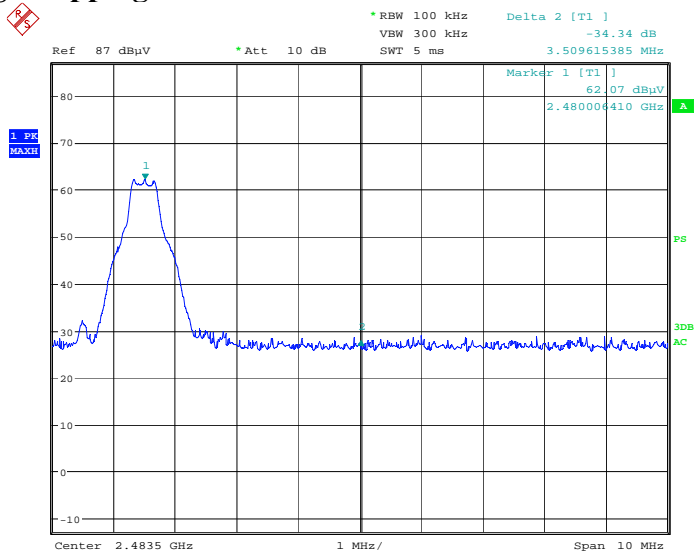
Nemko Canada Inc.

### Upper Band Edge Hopping On:



Date: 22.SEP.2009 14:30:33

### Upper Band Edge Hopping Off:



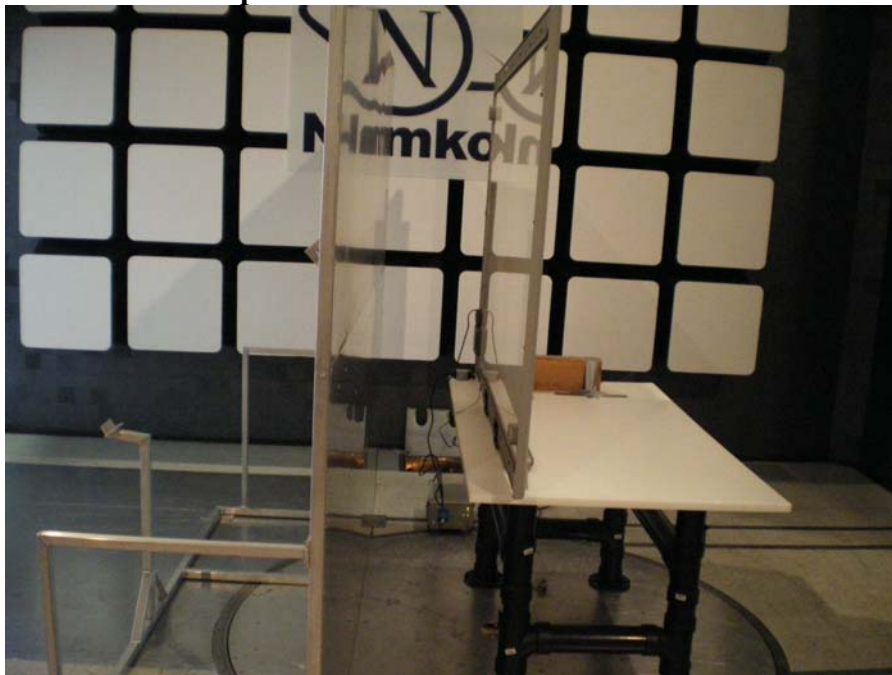
Date: 22.SEP.2009 14:18:25

## Appendix B : Setup Photographs

### Spurious Emissions Setup:



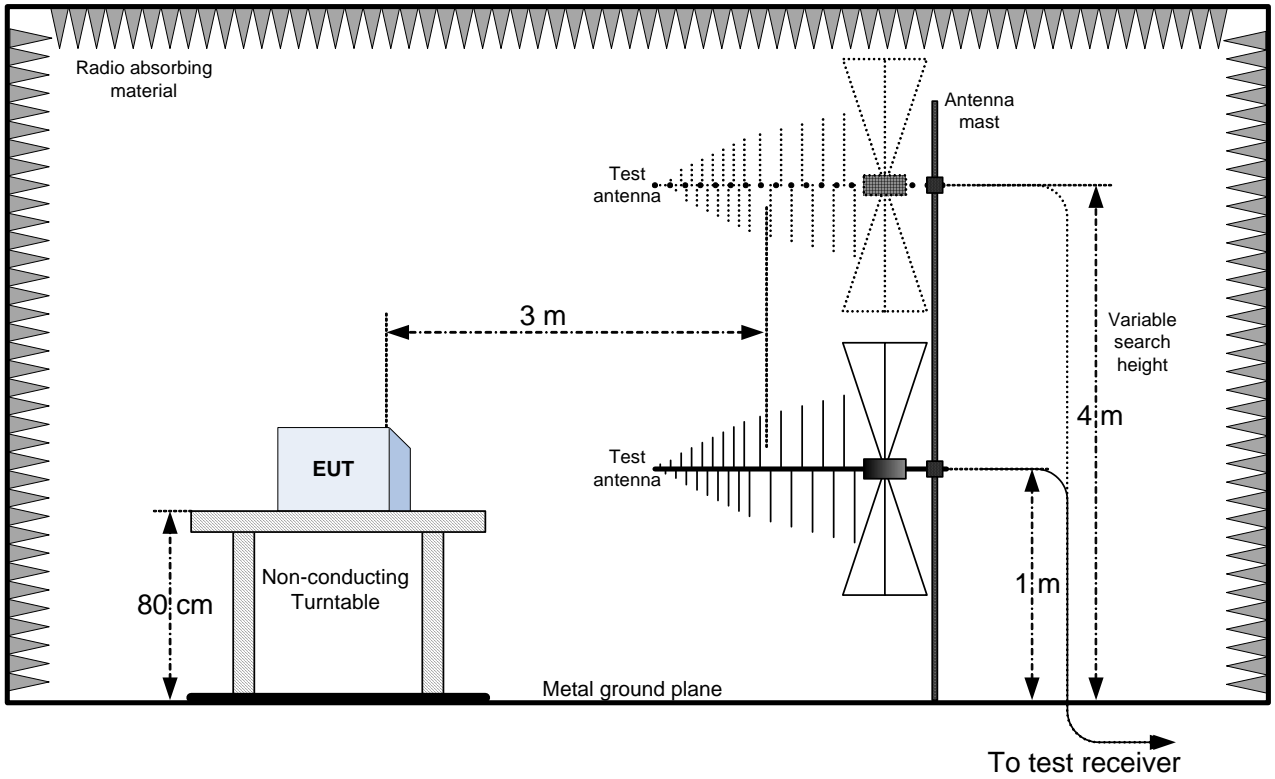
### Conducted Emissions Setup:





### Appendix C : Block Diagram of Test Setups

#### Radiated Emissions above 30 MHz Test Site



#### Conducted Emissions

