



www.nemko.com

Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Report number: 144079-1TRFWL
Apparatus: Calamp Sentry 4G Pico Base
Applicant: Calamp Corporation
101-5500 Ferrier St.
Town of Mont-Royal, QC
Canada H4P 1M2
FCC ID: EOT-1409290100

Test specification:

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**

Reviewed by: _____
Signature
Andrey Adelberg, Senior Wireless/EMC Specialist

May 3, 2010
Date

Tested by: Kevin Ma, Wireless/EMC Specialist

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.

This report shall not be reproduced except in full without the written approval of the testing laboratory.



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.



Table of contents

Section 1: Report summary	3
Section 2: Equipment under test	4
2.1 Identification of equipment under test (EUT)	4
2.2 Accessories and support equipment	4
2.3 EUT description	5
2.4 Technical specifications of the EUT	5
2.5 EUT setup diagram.....	6
2.6 Operation of the EUT during testing	6
2.7 Modifications incorporated in the EUT.....	6
Section 3: Test conditions	7
3.1 Deviations from laboratory tests procedures	7
3.2 Test conditions, power source and ambient temperatures.....	7
3.3 Measurement uncertainty	8
3.4 Test equipment.....	8
Section 4: Result summary	9
4.1 FCC Part 15 Subpart C, 15.247: Test results.....	9
Appendix A: Test results	10
Clause 15.31(e) Variation of the power source	10
Clause 15.31(m) Number of operating frequencies	11
Clause 15.203 Antenna requirement.....	12
Clause 15.207(a) Conducted limits	13
Clause 15.111 Antenna power conduction limits for receivers.....	17
Clause 15.247(a)(2) Minimum 6 dB bandwidth for digital modulation systems.....	19
Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation.....	22
Clause 15.247(d) Spurious emissions.....	28
Clause 15.247(e) Power spectral density.....	36
Appendix B: Block diagrams of test set-ups.....	40

 Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2	Section 1: Report summary
	Report Number: 144079-1TRFWL
	Specification: FCC 15.247

Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. 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.

Test specification:
FCC Part 15 Subpart C, 15.247
Operation within the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz.

Compliance status:	Complies
Exclusions:	None
Non-compliances:	None
Report release history:	Original release
Test location:	Nemko Canada Inc. 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2
Registration number:	176392 (3 m Semi anechoic chamber)

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:	Wireless 802.16e Base Station
Product marketing name:	CalAmp
Brand name:	Sentry 4G
Model number:	140-9290
Serial number:	N/A
Nemko sample number:	1
FCC ID:	EOT-1409290100
Date of receipt:	February 18, 2010

2.2 Accessories and support equipment

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

Item # 1	
Type of equipment:	ISM band antennas
Brand name:	PCTEL
Model name or number:	MFB9155
Nemko sample number:	3, 4
Connection port:	N
Cable length and type:	0.5 m
Item # 2	
Type of equipment:	AC power adaptor
Brand name:	DCPS006
Model name or number:	0334B5555
Nemko sample number:	2
Connection port:	DC/Ethernet
Cable type:	Ethernet cable

Section 2: Equipment under test, continued

2.3 EUT description

The Sentry 4G 900 pico Base is a 2x2 MIMO broadband base station operating in the 900 MHz ISM band. It is aimed at industrial, monitoring and control market as well as mobile public safety market. The WWAN interface is provided through an 802.16e-2005 interface.

2.4 Technical specifications of the EUT

Operating band:	902–928 MHz
Operating frequency:	903.90–926.10 MHz (3.5 MHz channel) 904.65–925.30 MHz (5 MHz channel) 905.75–924.20 MHz (7 MHz channel) 907.25–922.70 MHz (10 MHz channel)
Modulation type:	QPSK, 16-QAM, 64-QAM
Channel spacing:	3.5 MHz; 5 MHz; 7 MHz; 10 MHz
99 % bandwidth:	3.294 MHz (3.5 MHz channel) 4.628 MHz (5 MHz channel) 6.586 MHz (7 MHz channel) 9.230 MHz (10 MHz channel)
Emission designator:	3M29W7D (3.5 MHz channel) 4M62W7D (5 MHz channel) 6M58W7D (7 MHz channel) 9M23W7D (10 MHz channel)
Antenna data:	5 dBd
Antenna type:	External Antenna Removable antenna supplied and type tested with the radio equipment (Equipment that has an external 50 Ω RF connector)
Power source	48 VDC

Section 2: Equipment under test, continued

2.5 EUT setup diagram



To Antenna 2

To Control PC

To AC Power
Adaptor

To GPS Antenna

To Antenna 1

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.

 Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2	Section 3: Test conditions
	Report Number: 144079-1TRFWL
	Specification: FCC 15.247

Section 3: Test conditions

3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

3.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	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.
Power supply range:	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.

Section 3: Test conditions, continued

3.3 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.

3.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Bilog	Sunol	JB3	FA002108	Jan. 18/11
Controller	Sunol	SC104V	FA002060	NCR
Mast	Sunol	TLT2	FA002061	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/10
International Power Supply	California Inst.	3001i	FA001021	Jan. 13/11
Spectrum Analyzer	Rohde & Schwarz	FSU46	FA001877	Sep. 29/10
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/11
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 07/10
LISN	Rohde & Schwarz	ENV216	FA002023	Sept. 02/10
Attenuator	Narda	776B-20	FA001153	COU
Combiner	Mini-circuits	ZA3PD-4	FA001156	COU
Notch Filter	Microwave Circuits	902-928MHz	FA002096	COU

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

Section 4: Result summary

4.1 FCC Part 15 Subpart C, 15.247: 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)

Part	Test description	Required	Result
General requirements for FCC Part 15			
§15.31(e)	Variation of power source	Y	Pass
§15.31(m)	Number of operating frequencies	Y	Pass
§15.203	Antenna requirement	Y	Pass
§15.111	Antenna power conduction limits for receivers	Y	Pass
§15.207(a)	Conducted limits	Y	Pass
Specific requirements for FCC Part 15 Subpart C, 15.247			
§15.247(a)(1)	Frequency hopping systems	---	---
§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 for digital modulation systems	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)	Spurious emissions	Y	Pass

Notes: None



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Appendix A: Test results

Clause 15.31(e) Variation of the power source

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery.

Test date: April, 2010

Test results: Pass

Test data

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



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.31(m) Number of operating frequencies

Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz and less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Test date: April, 2010

Test results: Pass

Test data

The frequency band is 26 MHz therefore number of testing frequencies is as follows:

3.5 MHz channel:

Low frequency / channel	903.90 MHz
Mid frequency / channel	915.00 MHz
High frequency / channel	926.10 MHz

5 MHz channel:

Low frequency / channel	904.65 MHz
Mid frequency / channel	915.00 MHz
High frequency / channel	925.30 MHz

7 MHz channel:

Low frequency / channel	905.75 MHz
Mid frequency / channel	915.00 MHz
High frequency / channel	924.20 MHz

10 MHz channel:

Low frequency / channel	907.25 MHz
Mid frequency / channel	915.00 MHz
High frequency / channel	922.70 MHz



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Clause 15.203 Antenna requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Test date: February, 2010

Test results: Pass

Test data

- The EUT is professionally installed.



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.207(a) Conducted limits

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ 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 date: March, 2010

Test results: Pass

Special notes

Port under test: AC Mains port of external power supply.

Preview measurements:

0.15 MHz to 30 MHz

Receiver settings:

- Peak and average detector
- 9 kHz RBW

Final measurement:

0.15 MHz to 30 MHz

Receiver settings:

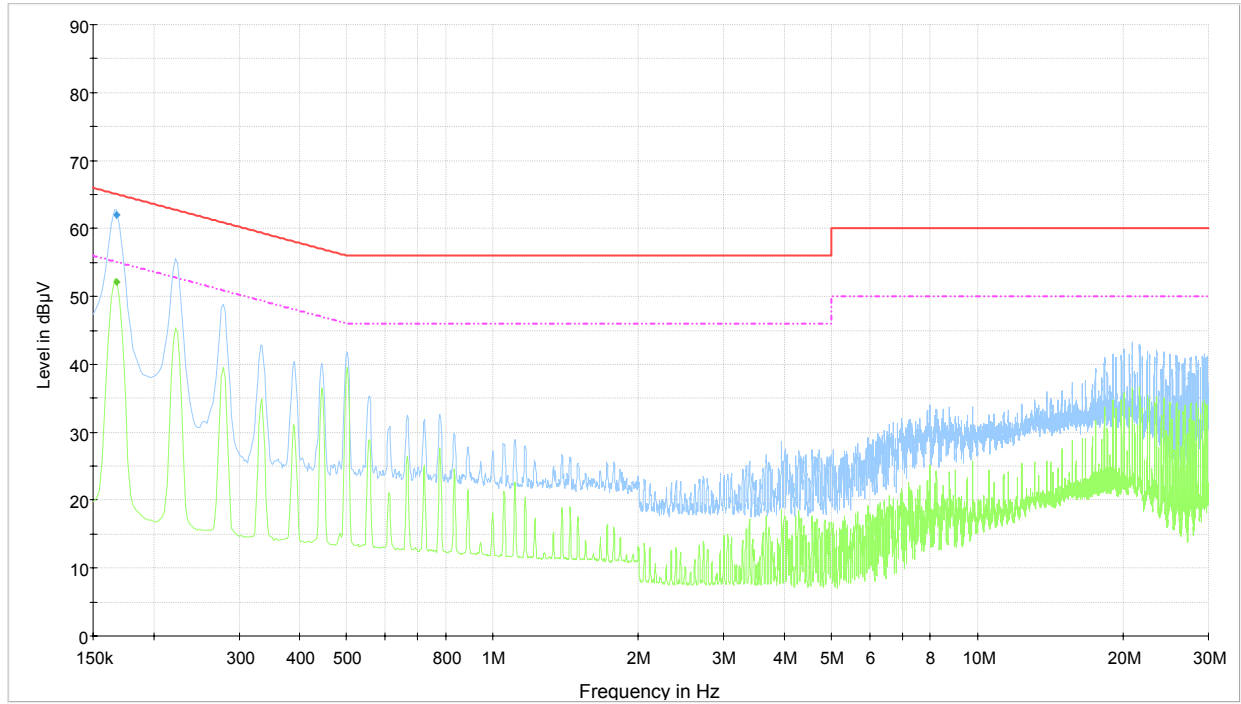
- Q-Peak and average detector
- 9 kHz RBW

- Spectral plots have been corrected for transducer factors; cable loss, LISN, and attenuators.
- Emissions detected within 6 dB of limit were re-measured with a quasi peak or average detector for a final measurement.

Clause 15.207(a) Conducted limits, continued

Test data

Neutral:



— CISPR 22 Mains QP Class B.LimitLine
 - - - CISPR 22 Mains AV Class B.LimitLine
 — Preview Result 1
 — Preview Result 2
♦ Final Result 1
 ♦ Final Result 2

Tabular data

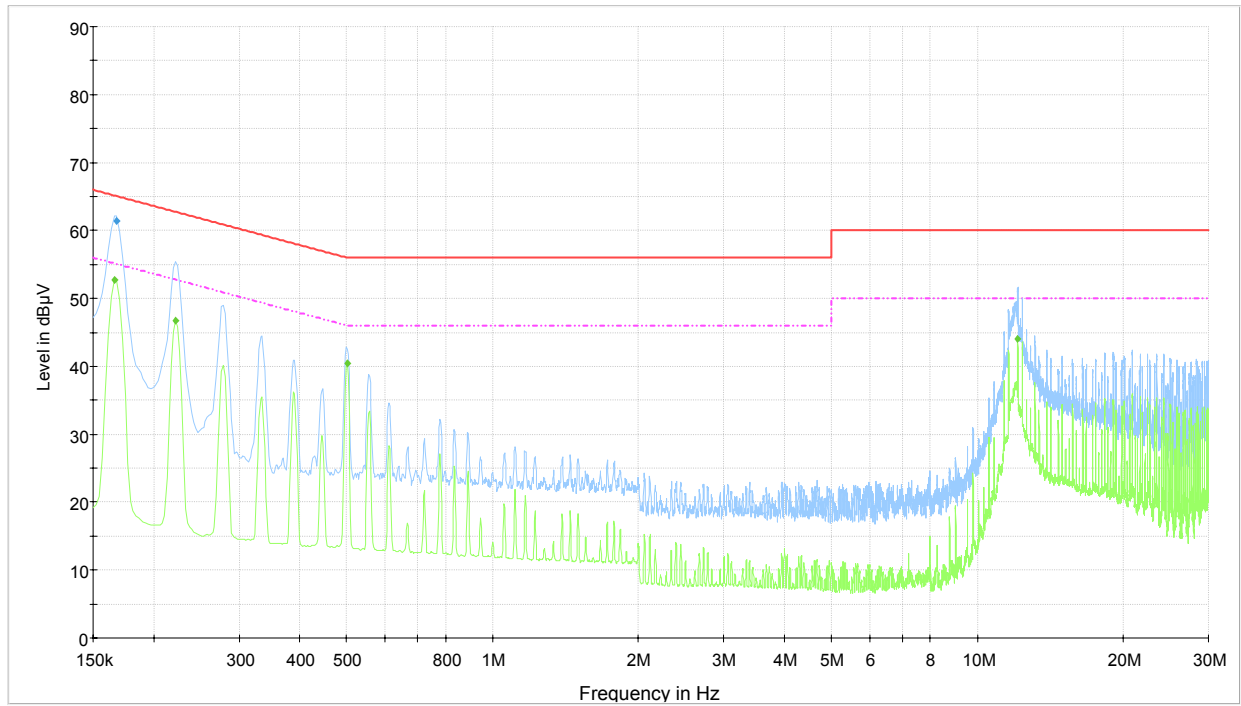
Frequency (MHz)	Q-Peak result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.168000	61.9	100.0	9.000	On	N	10.1	3.2	65.1
Frequency (MHz)	Average result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.168000	52.2	100.0	9.000	On	N	10.1	2.9	55.1

Note: Correction factor includes cable loss, LISN, and attenuator.

Clause 15.207(a) Conducted limits, continued

Test data, continued

Phase:



— CISPR 22 Mains QP Class B.LimitLine
 - - - CISPR 22 Mains AV Class B.LimitLine
 — Preview Result 1
— Preview Result 2
 ♦ Final Result 1
 ♦ Final Result 2

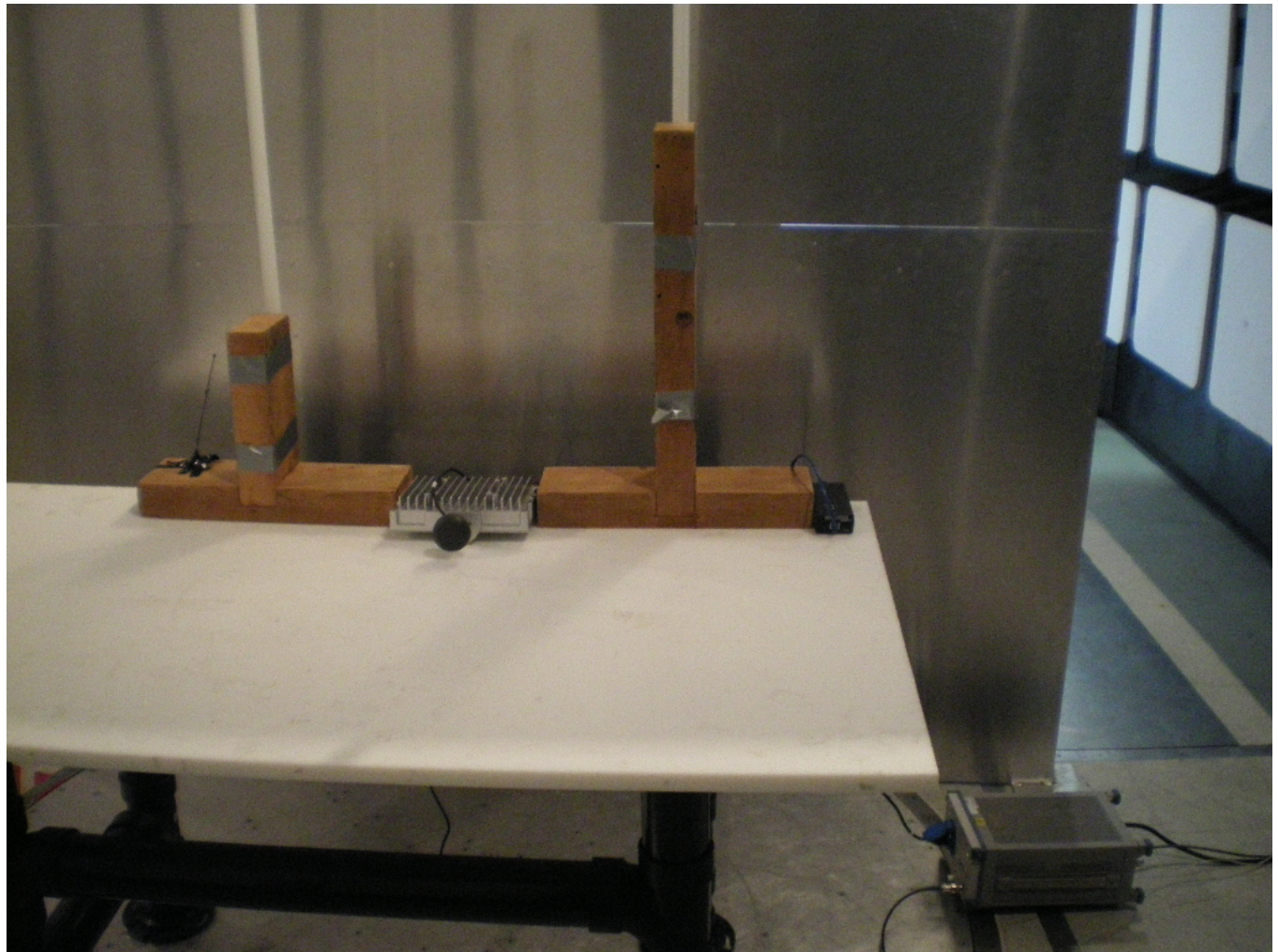
Tabular data

Frequency (MHz)	Q-Peak result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.168000	61.4	100.0	9.000	On	L1	10.1	3.7	65.1
Frequency (MHz)	Average result (dBµV)	Meas. time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
0.165750	52.6	100.0	9.000	On	L1	10.1	2.6	55.2
0.222000	46.7	100.0	9.000	On	L1	10.0	6.0	52.7
0.501000	40.5	100.0	9.000	On	L1	10.1	5.5	46.0
12.126250	44.1	100.0	9.000	On	L1	10.4	5.9	50.0

Note: Correction factor includes cable loss, LISN, and attenuator.

Clause 15.207(a) Conducted limits, continued

Set up photo





Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Clause 15.111 Antenna power conduction limits for receivers

(a) In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of §15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in §15.33 shall not exceed 2.0 nW.

(b) CB receivers and receivers that operate (tune) in the frequency range 30 to 960 MHz that are provided only with a permanently attached antenna shall comply with the radiated emission limitations in this part, as measured with the antenna attached.

Test date: April, 2010

Test results: Pass

Test data

The test was performed using a peak detector with 5 kHz RBW.

Where applicable measurements were performed using a peak detector with 5 kHz RBW. The bandwidth correction factor of -1.75 dB was added to the result in order to compensate the higher RBW than required.

Only worst case results presented.

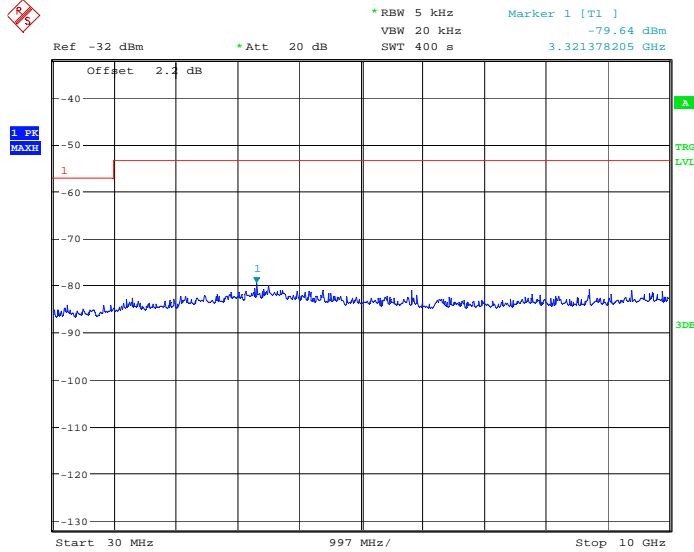


Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

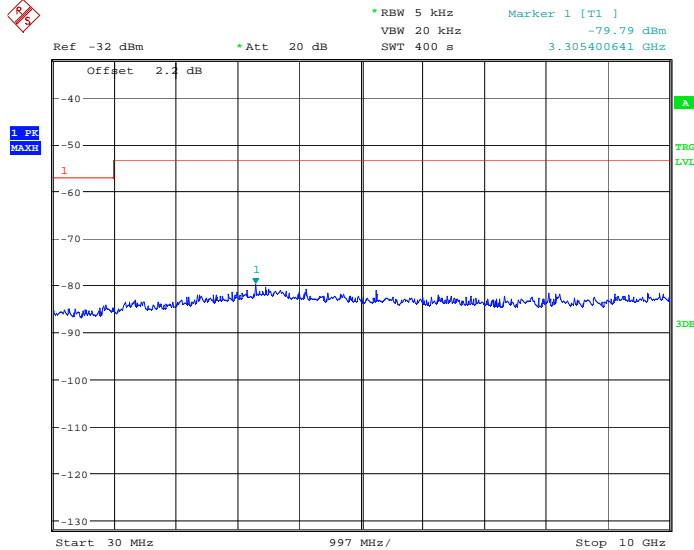
Clause 15.111 Antenna power conduction limits for receivers, continued

Test data

Antenna port 1 on middle channel:



Antenna port 2 on middle channel:





Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Clause 15.247(a)(2) Minimum 6 dB bandwidth for digital modulation systems

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

Test date: April 2010

Test results: Pass

Special notes

- The peak detector was used with 100 kHz/300 kHz RBW/VBW
- The span was wider than RBW.
- Only the worst-case results presented.

Clause 15.247(a)(2) Minimum 6 dB bandwidth for digital modulation systems, continued

Test data

Occupied bandwidth measurement

Frequency, MHz	6 dB bandwidth, MHz	Limit, MHz	Margin, MHz
3.5 MHz channel			
QPSK			
903.90	3.042	0.5	2.542
915.00	3.022	0.5	2.522
926.10	3.068	0.5	2.568
16-QAM			
903.90	3.038	0.5	2.538
915.00	3.020	0.5	2.520
926.10	3.044	0.5	2.544
64-QAM			
903.90	3.036	0.5	2.536
915.00	3.020	0.5	2.520
926.10	3.068	0.5	2.568
5 MHz channel			
64-QAM			
904.65	4.518	0.5	4.018
915.00	4.500	0.5	4.000
925.30	4.512	0.5	4.012
7 MHz channel			
64-QAM			
905.75	6.510	0.5	6.010
915.00	6.502	0.5	6.002
924.20	6.522	0.5	6.022
10 MHz channel			
64-QAM			
907.25	9.210	0.5	8.710
915.00	9.206	0.5	8.706
922.70	9.226	0.5	8.726
99 % OBW measurement:			
Channel bandwidth, MHz		99 % bandwidth, MHz	
3.5		3.294	
5.0		4.628	
7.0		6.586	
10.0		9.230	



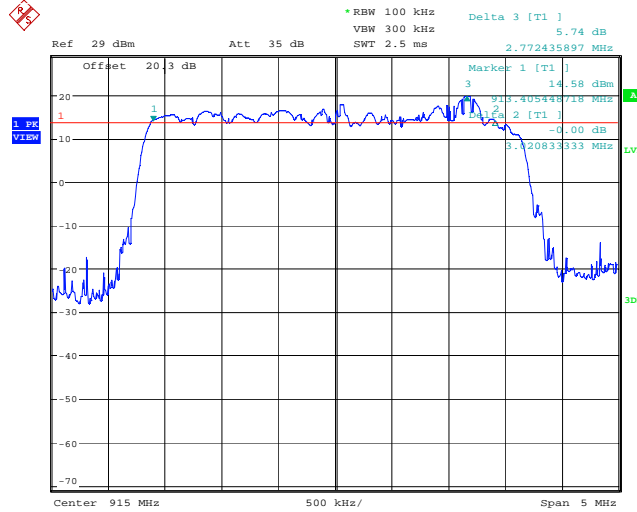
Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(a)(2) Minimum 6 dB bandwidth for digital modulation systems, continued

Test data, continued

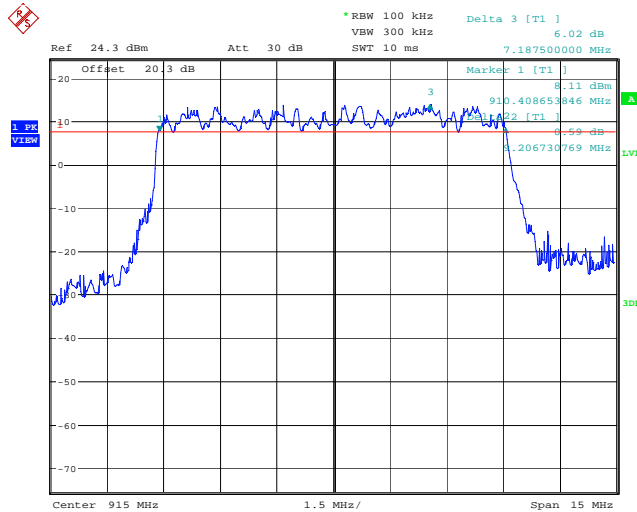
Sample plots:

6 dB bandwidth on Mid 3.5 MHz channel:



Date: 29.APR.2010 16:21:39

6 dB bandwidth on Mid 10 MHz channel:



Date: 29.APR.2010 16:19:21



Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation

The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands: 1 W. As an alternative to a peak power measurement, compliance with the 1 W 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 signaling 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.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

- (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.
- (ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.
- (iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test date: April, 2010

Test results: Pass

Special notes

- The test was performed using FCC guidelines of “Measurement of digital transmission systems operating under section 15.247”, from March 23, 2005.
- Power option 2 was used for the power output measurements.
- Test method 2 was chosen for the average power measurements
- The output RF power was measured on the antenna port 1 and 2 by means of a spectrum analyzer, and the total output power equal to the summary of the output RF power was measured on the antenna port 1 and 2.

Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation, continued

Test data

Conducted output power measurement

Frequency, MHz	Antenna 1 Cond. (mW)	Antenna 2 Cond. (mW)	Total output power, dBm	Limit, dBm	Margin, dB
3.5 MHz channel					
QPSK					
903.90	521.50	390.72	29.60	30.00	0.40
915.00	535.40	402.63	29.72	30.00	0.28
926.10	523.52	391.64	29.61	30.00	0.39
16-QAM					
903.90	508.26	336.17	29.26	30.00	0.74
915.00	512.62	376.61	29.49	30.00	0.51
926.10	481.40	378.86	29.34	30.00	0.66
64-QAM					
903.90	530.23	454.52	29.93	30.00	0.07
915.00	546.23	424.81	29.87	30.00	0.13
926.10	534.67	402.24	29.71	30.00	0.29
5 MHz channel					
QPSK					
904.65	477.45	417.27	29.51	30.00	0.49
915.00	513.87	412.28	29.66	30.00	0.34
925.30	520.14	436.62	29.80	30.00	0.20
16-QAM					
904.65	463.42	407.13	29.39	30.00	0.61
915.00	502.14	408.26	29.59	30.00	0.41
925.30	492.26	402.54	29.51	30.00	0.49
64-QAM					
904.65	494.25	449.14	29.74	30.00	0.26
915.00	538.11	436.47	29.88	30.00	0.12
925.30	540.89	427.63	29.86	30.00	0.14

Note: The EUT is professionally installed and requires cables between base and antennas. The cable loss is required to be 1.15 dB during installation. The antenna gain is 5 dBd (7.15 dBi), antenna gain + cable loss = 6 dBi, output power limit is equal to 30 dBm.

Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation, continued

Test data, continued

Conducted output power measurement, continued

Frequency, MHz	Antenna 1 Cond. (mW)	Antenna 2 Cond. (mW)	Total output power, dBm	Limit, dBm	Margin, dB
7 MHz channel					
QPSK					
905.75	554.24	423.27	29.90	30.00	0.10
915.00	526.48	444.04	29.87	30.00	0.13
924.20	509.46	428.49	29.72	30.00	0.28
16-QAM					
905.75	481.15	403.79	29.46	30.00	0.54
915.00	469.52	459.41	29.67	30.00	0.33
924.20	449.97	421.42	29.40	30.00	0.60
64-QAM					
905.75	544.28	416.49	29.82	30.00	0.18
915.00	531.25	438.84	29.86	30.00	0.14
924.20	525.56	439.42	29.84	30.00	0.16
10 MHz channel					
QPSK					
907.25	534.90	447.19	29.92	30.00	0.08
915.00	529.88	431.87	29.83	30.00	0.17
922.70	542.61	451.65	29.97	30.00	0.03
16-QAM					
907.25	512.36	433.40	29.75	30.00	0.25
915.00	500.02	429.13	29.68	30.00	0.32
922.70	496.23	426.97	29.65	30.00	0.35
64-QAM					
907.25	543.29	451.26	29.97	30.00	0.03
915.00	535.74	434.72	29.86	30.00	0.14
922.70	532.60	438.77	29.87	30.00	0.13

Note: The EUT is professionally installed and requires cables between base and antennas. The cable loss is required to be 1.15 dB during installation. The antenna gain is 5 dBd (7.15 dBi), antenna gain + cable loss = 6 dBi, output power limit is equal to 30 dBm.



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation, continued

Test data, continued

EIRP calculation

Frequency, MHz	EIRP, dBm	Limit, dBm	Margin, dB
3.5 MHz channel			
QPSK			
903.90	35.60	36.00	0.40
915.00	35.72	36.00	0.28
926.10	35.61	36.00	0.39
16-QAM			
903.90	35.26	36.00	0.74
915.00	35.49	36.00	0.51
926.10	35.34	36.00	0.66
64-QAM			
903.90	35.93	36.00	0.07
915.00	35.87	36.00	0.13
926.10	35.71	36.00	0.29
5 MHz channel			
QPSK			
904.65	35.51	36.00	0.49
915.00	35.66	36.00	0.34
925.30	35.80	36.00	0.20
16-QAM			
904.65	35.39	36.00	0.61
915.00	35.59	36.00	0.41
925.30	35.51	36.00	0.49
64-QAM			
904.65	35.74	36.00	0.26
915.00	35.88	36.00	0.12
925.30	35.86	36.00	0.14

Note: The EUT is professionally installed and requires cables between base and antennas. The cable loss is required to be 1.15 dB during installation. The antenna gain is 5 dBd (7.15 dBi), antenna gain + cable loss = 6 dBi.

$$\text{EIRP [dBm]} = \text{Total output power [dBm]} + \text{cable loss} + \text{antenna gain [dBi]}$$



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation, continued

Test data, continued

EIRP calculation, continued

Frequency, MHz	EIRP, dBm	Limit, dBm	Margin, dB
7 MHz channel			
QPSK			
905.75	35.90	36.00	0.10
915.00	35.87	36.00	0.13
924.20	35.72	36.00	0.28
16-QAM			
905.75	35.46	36.00	0.54
915.00	35.67	36.00	0.33
924.20	35.40	36.00	0.60
64-QAM			
905.75	35.82	36.00	0.18
915.00	35.86	36.00	0.14
924.20	35.84	36.00	0.16
10 MHz channel			
QPSK			
907.25	35.92	36.00	0.08
915.00	35.83	36.00	0.17
922.70	35.97	36.00	0.03
16-QAM			
907.25	35.75	36.00	0.25
915.00	35.68	36.00	0.32
922.70	35.65	36.00	0.35
64-QAM			
907.25	35.97	36.00	0.03
915.00	35.86	36.00	0.14
922.70	35.87	36.00	0.13

Note: The EUT is professionally installed and requires cables between base and antennas. The cable loss is required to be 1.15 dB during installation. The antenna gain is 5 dBd (7.15 dBi), antenna gain + cable loss = 6 dBi.

$EIRP [dBm] = Total\ output\ power [dBm] + cable\ loss + antenna\ gain [dBi]$



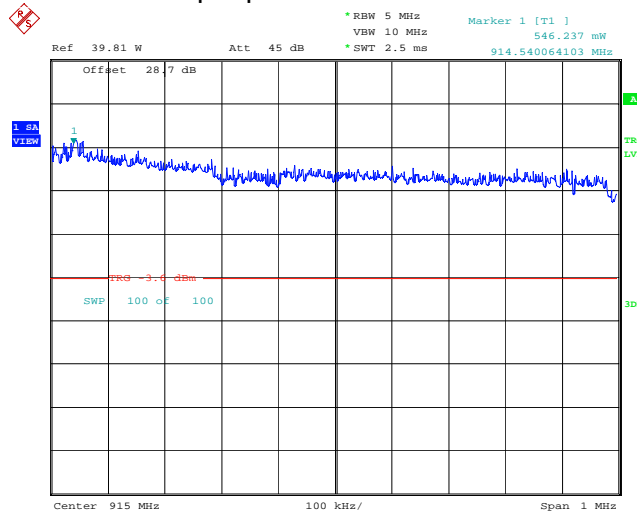
Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(b)(3) and (4) Maximum peak conducted output power for systems using digital modulation, continued

Test data, continued

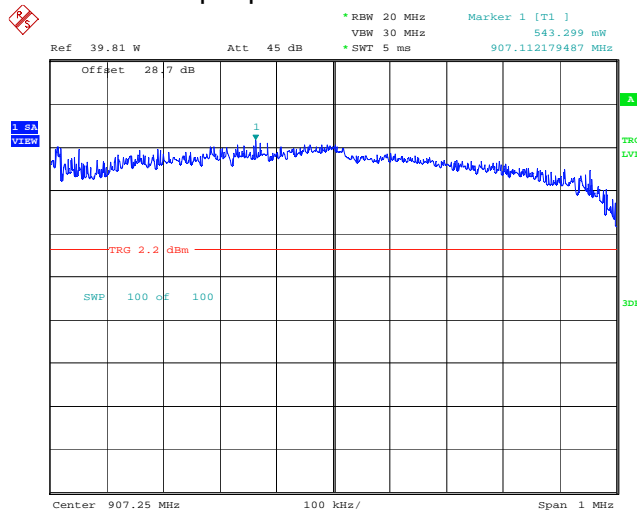
Sample plots:

Output power of 3.5 MHz channel:



Date: 29.APR.2010 15:43:46

Output power of 10 MHz channel:



Date: 29.APR.2010 14:55:26



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(d) Spurious emissions

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)):

Frequency (MHz)	Field strength		Measurement distance (m)
	($\mu\text{V}/\text{m}$)	($\text{dB}\mu\text{V}/\text{m}$)	
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

Notes:

- F = fundamental frequency in kHz
- In the emission table above, the tighter limit applies at the band edges.
- For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Test date: April, 2010

Test results: Pass

Clause 15.247(d) Spurious emissions, continued

Special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- Radiated measurements were performed at a distance of 3 m.
- Radiated measurements were performed:
 - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
 - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results and using a duty cycle/average factor for average results calculations.
- Only the worst data presented in the test report.
- Conducted measurements were performed using peak detector with 100 kHz/300 kHz RBW/VBW.

§ 15.205 Restricted bands of operation.

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

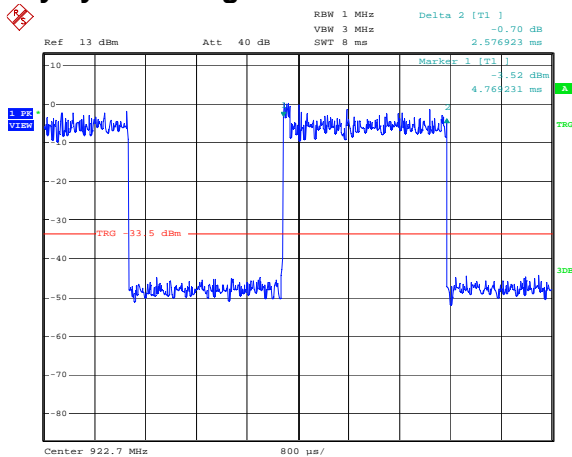
Clause 15.247(d) Spurious emissions, continued

Test data

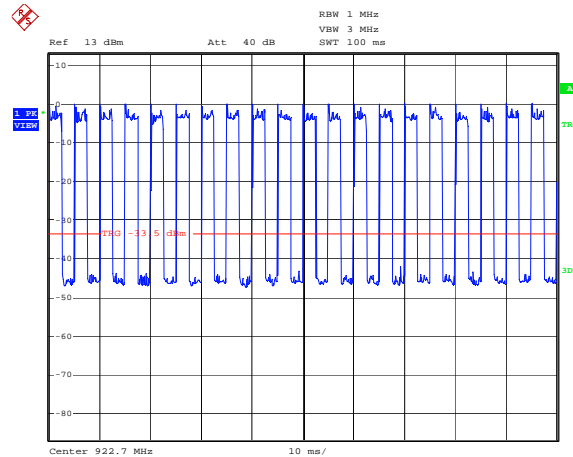
Duty cycle/average factor calculations

§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.

Duty cycle/average factor measurements:



Date: 27.APR.2010 15:50:34



Date: 27.APR.2010 15:51:54

$$Tx_{100[ms]} = 2.57 \times 20 = 51.4[ms]$$

$$Duty\ cycle / average\ factor = 20 \times \log_{10} \left(\frac{Tx_{100[ms]}}{100[ms]} \right) = 20 \times \log_{10} \left(\frac{51.4}{100.00} \right) = -5.78[dB]$$

Clause 15.247(d) Spurious emissions, continued

Test data, continued

3.5 MHz Channel

Channel MHz	Frequency, MHz	FS Peak, dB μ V/m	FS Peak Limit, dB μ V/m	Margin, dB	Duty cycle corr. (dB)	FS Avg, dB μ V/m	FS Avg Limit, dB μ V/m	Margin, dB
Low	2711.97	49.55	74.00	24.45	-5.78	43.77	54.00	10.23
Mid	2744.74	53.53	74.00	20.47	-5.78	47.75	54.00	6.25
High	2779.56	54.53	74.00	19.47	-5.78	48.75	54.00	5.25

5 MHz Channel

Channel MHz	Frequency, MHz	FS Peak, dB μ V/m	FS Peak Limit, dB μ V/m	Margin, dB	Duty cycle corr. (dB)	FS Avg, dB μ V/m	FS Avg Limit, dB μ V/m	Margin, dB
Low	2719.42	47.17	74.00	26.83	-5.78	41.39	54.00	12.61
Mid	2744.50	52.38	74.00	21.62	-5.78	46.60	54.00	7.40
High	2775.44	54.87	74.00	19.13	-5.78	49.09	54.00	4.91

7 MHz Channel

Channel MHz	Frequency, MHz	FS Peak, dB μ V/m	FS Peak Limit, dB μ V/m	Margin, dB	Duty cycle corr. (dB)	FS Avg, dB μ V/m	FS Avg Limit, dB μ V/m	Margin, dB
Low	2724.51	50.05	74.00	23.95	-5.78	44.27	54.00	9.73
Mid	2743.91	51.78	74.00	22.22	-5.78	46.00	54.00	8.00
High	2773.27	52.04	74.00	21.96	-5.78	46.26	54.00	7.74

10 MHz Channel

Channel MHz	Frequency, MHz	FS Peak, dB μ V/m	FS Peak Limit, dB μ V/m	Margin, dB	Duty cycle corr. (dB)	FS Avg, dB μ V/m	FS Avg Limit, dB μ V/m	Margin, dB
Low	2726.13	50.26	74.00	23.74	-5.78	44.48	54.00	9.52
Mid	2743.11	49.22	74.00	24.78	-5.78	43.44	54.00	10.56
High	2770.64	50.84	74.00	23.16	-5.78	45.06	54.00	8.94

Note: Field Strength (FS) result includes antenna factor, cable losses and amplifier gain where applicable.

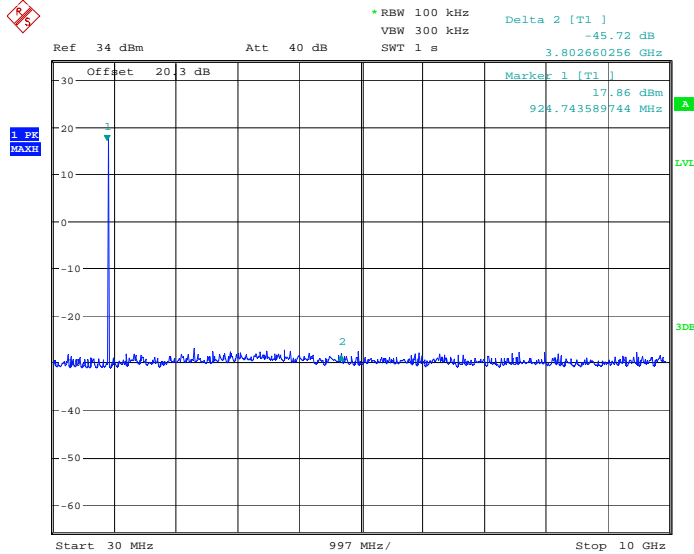


Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(d) Spurious emissions, continued

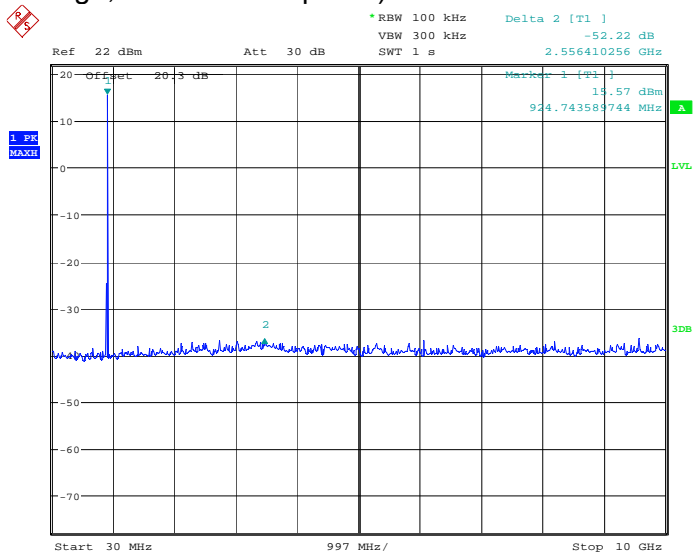
Test data, continued

3.5 MHz channel (Channel low, measured on port 1)



Date: 28.APR.2010 14:12:27

5 MHz channel (Channel high, measured on port 1)



Date: 28.APR.2010 13:22:34

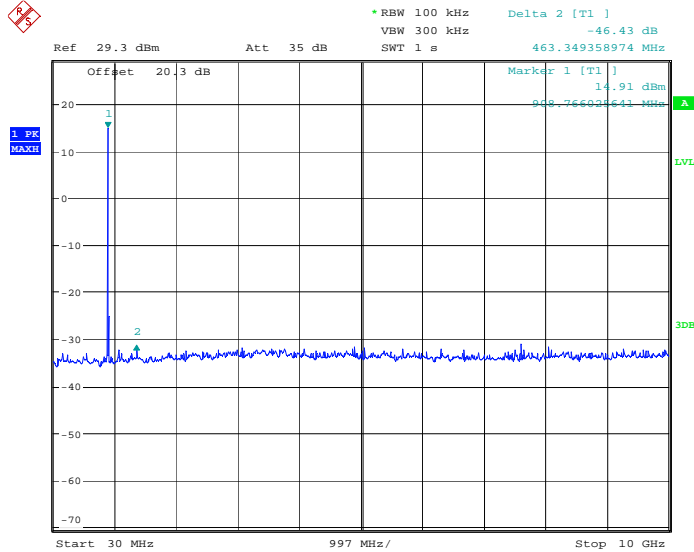


Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(d) Spurious emissions, continued

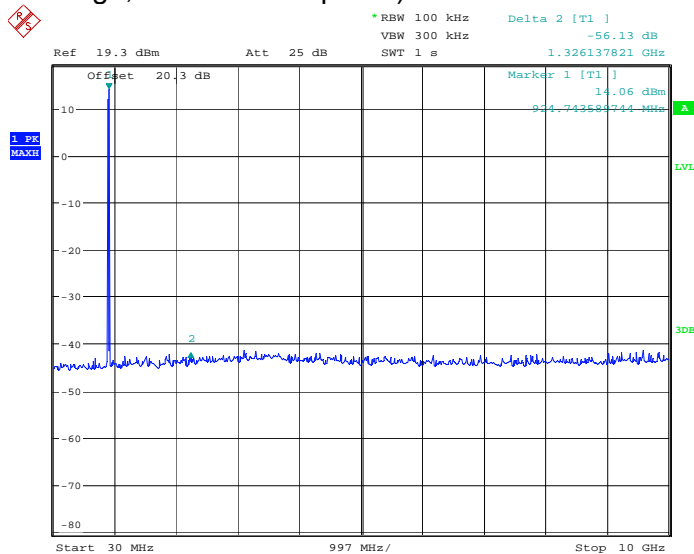
Test data, continued

7 MHz channel (Channel mid, measured on port 1)



Date: 28.APR.2010 13:08:21

10 MHz channel (Channel high, measured on port 1)



Date: 28.APR.2010 11:45:16



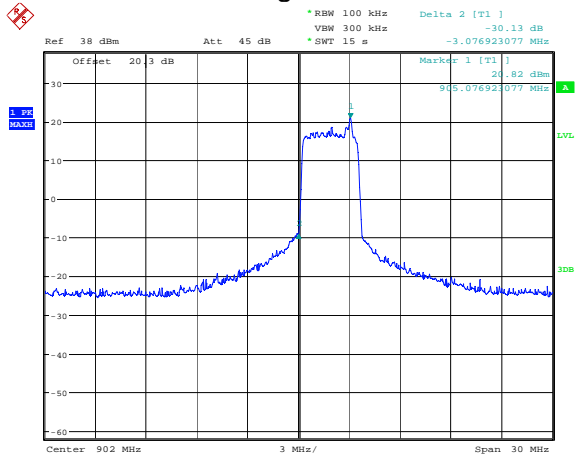
Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(d) Spurious emissions, continued

Test data, continued

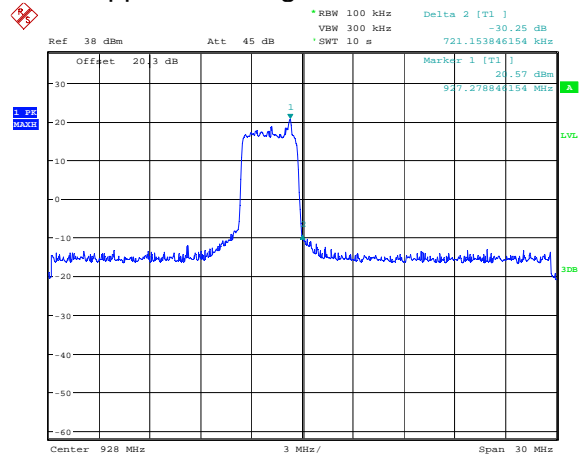
Band edge measurement:

Lower band edge for 3.5 MHz channel



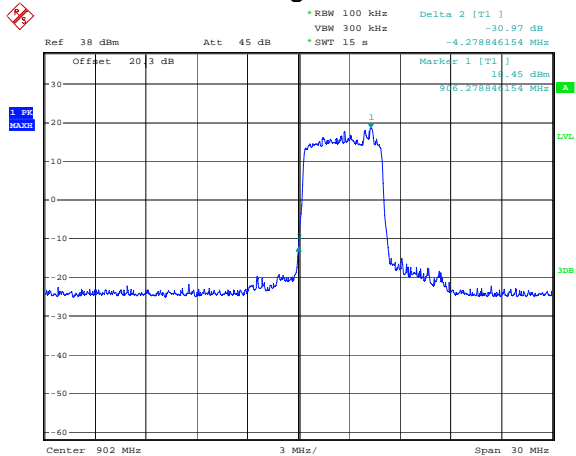
Date: 27.APR.2010 10:20:55

Upper band edge for 3.5 MHz channel



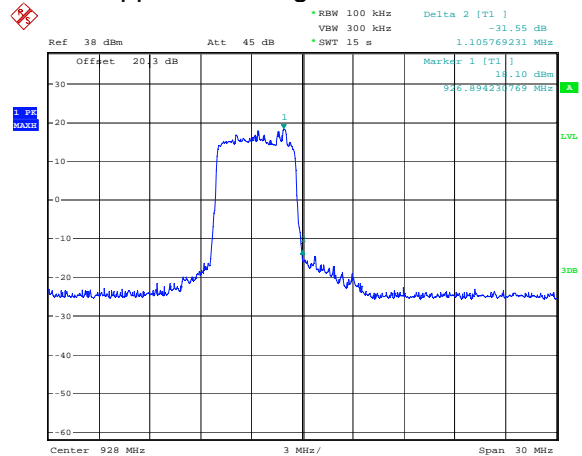
Date: 27.APR.2010 10:11:31

Lower band edge for 5 MHz channel



Date: 27.APR.2010 10:18:38

Upper band edge for 5 MHz channel



Date: 27.APR.2010 10:16:07



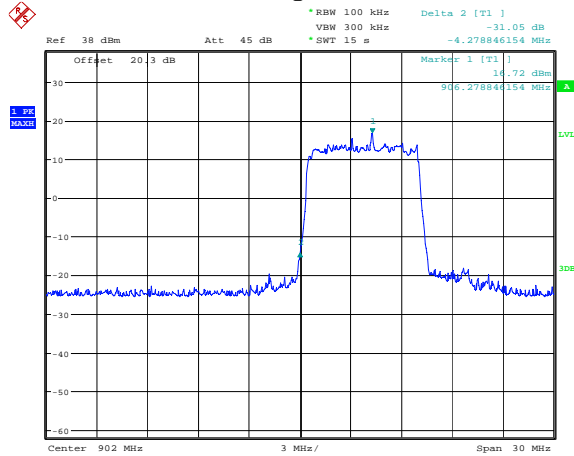
Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(d) Spurious emissions, continued

Test data, continued

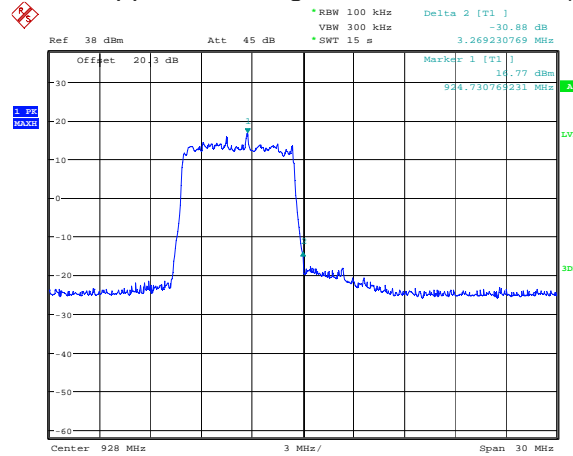
Band edge measurement, continued:

Lower band edge for 7 MHz channel



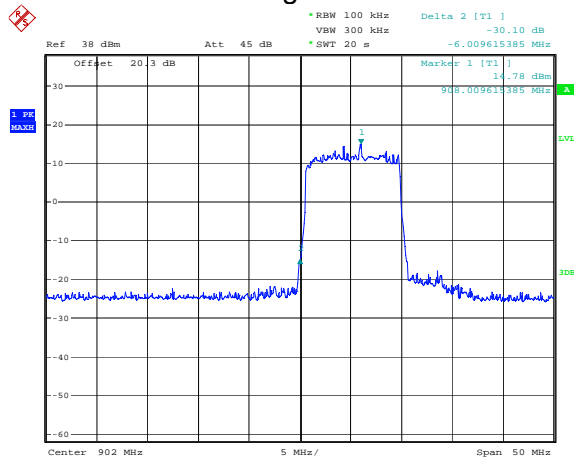
Date: 27.APR.2010 10:23:31

Upper band edge for 7 MHz channel



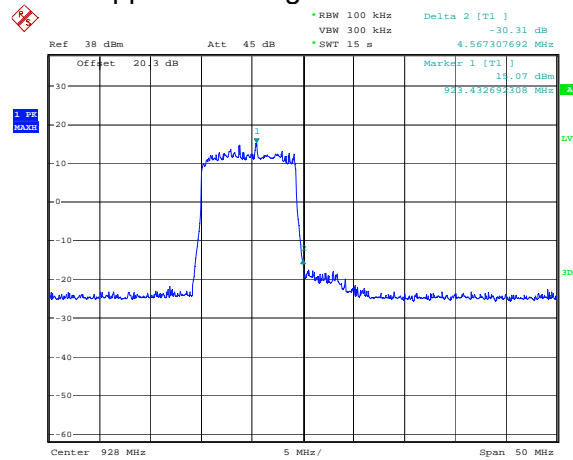
Date: 27.APR.2010 10:25:48

Lower band edge for 10 MHz channel



Date: 27.APR.2010 10:31:06

Upper band edge for 10 MHz channel



Date: 27.APR.2010 10:28:34



Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Appendix A: Test results

Report Number: 144079-1TRFWL

Specification: FCC 15.247

Clause 15.247(e) Power spectral density

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 date: April, 2010

Test results: Pass

Special notes

- Emission peak was located and zoomed in. RBW was set to 3 kHz, VBW was set > 3RBW. Sweep time was set to automatic. Peak level was measured.

Clause 15.247(c) Power spectral density, continued

Test data, continued

Frequency, MHz	Antenna 1 Cond. mW/3 kHz	Antenna 2 Cond. mW/3 kHz	Total PSD Cond. dBm/3 kHz	Limit, dBm/3 kHz	Margin, dB
3.5 MHz channel					
QPSK					
903.90	1.811	1.356	5.00	8.00	3.00
915.00	1.885	1.264	4.98	8.00	3.02
926.10	3.033	1.027	6.08	8.00	1.92
16-QAM					
903.90	1.809	1.237	4.83	8.00	3.17
915.00	1.661	1.125	4.44	8.00	3.56
926.10	2.946	1.174	6.14	8.00	1.86
64-QAM					
903.90	1.886	1.550	5.36	8.00	2.64
915.00	2.129	1.663	5.78	8.00	2.22
926.10	3.243	1.322	6.59	8.00	1.41
5 MHz channel					
QPSK					
904.65	1.356	1.043	3.80	8.00	4.20
915.00	1.262	0.986	3.51	8.00	4.49
925.35	1.326	1.058	3.77	8.00	4.23
16-QAM					
904.65	1.307	1.034	3.69	8.00	4.31
915.00	1.224	0.828	3.12	8.00	4.88
925.35	1.282	0.969	3.52	8.00	3.48
64-QAM					
904.65	1.475	1.398	4.58	8.00	3.42
915.00	1.291	1.069	3.72	8.00	4.28
925.35	1.397	1.182	4.11	8.00	3.89

Clause 15.247(c) Power spectral density, continued

Test data, continued

Frequency, MHz	Antenna 1 Cond. mW/3 kHz	Antenna 2 Cond. mW/3 kHz	Total PSD Cond. dBm/3 kHz	Limit, dBm/3 kHz	Margin, dB
7 MHz channel					
QPSK					
905.75	1.208	0.999	3.43	8.00	4.57
915.00	1.098	0.846	2.88	8.00	5.12
924.20	1.120	1.165	3.58	8.00	4.42
16-QAM					
905.75	1.126	1.164	3.59	8.00	4.41
915.00	1.065	1.226	3.60	8.00	4.40
924.20	1.098	1.115	3.44	8.00	4.56
64-QAM					
905.75	1.320	1.176	3.97	8.00	4.03
915.00	1.163	1.436	4.14	8.00	3.86
924.20	1.205	1.221	3.84	8.00	4.16
10 MHz channel					
QPSK					
907.25	0.685	0.724	1.48	8.00	6.52
915.00	0.786	1.018	2.56	8.00	5.44
922.70	0.745	0.641	1.41	8.00	6.59
16-QAM					
907.25	0.612	0.697	1.16	8.00	6.84
915.00	0.693	0.992	2.26	8.00	5.74
922.70	0.657	0.583	0.93	8.00	7.07
64-QAM					
907.25	0.756	0.809	1.94	8.00	6.06
915.00	0.828	1.276	3.23	8.00	4.77
922.70	0.827	0.646	1.68	8.00	6.32



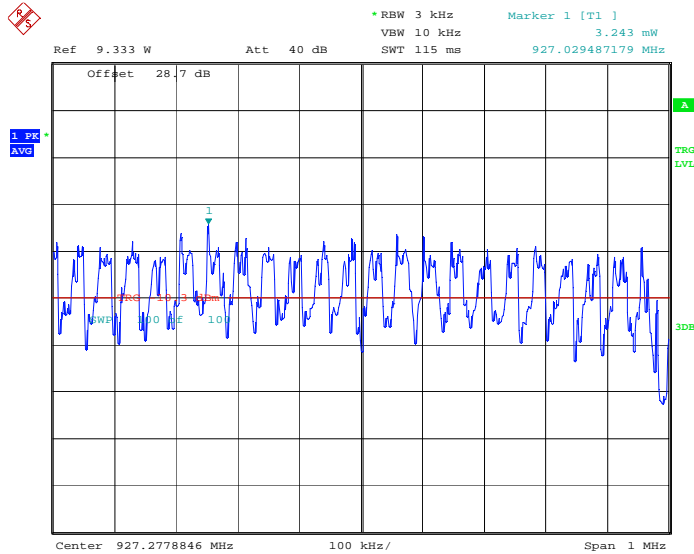
Nemko Canada Inc.,
303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Clause 15.247(c) Power spectral density, continued

Test data

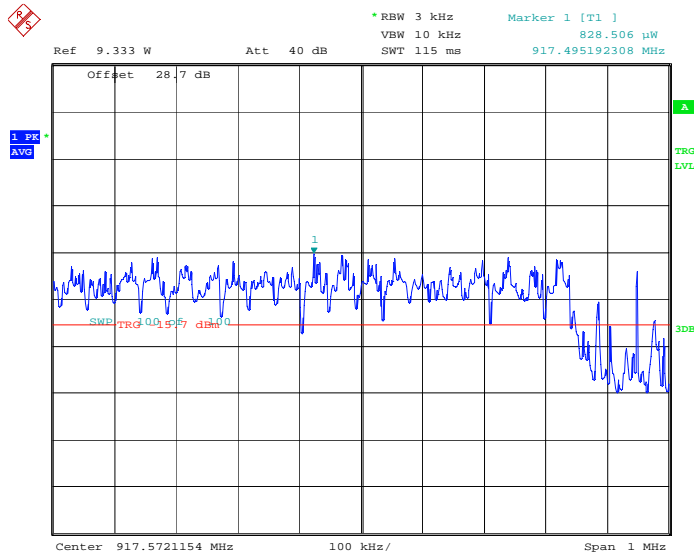
Sample plot:

3.5 MHz Channel



Date: 29.APR.2010 13:51:52

10 MHz Channel



Date: 29.APR.2010 14:45:52

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up

