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

Report number: 140954-3TRFWL
Apparatus: GR ECU
Applicant: Alcohol Countermeasures System Corp.
60 International Boulevard
Toronto, Ontario
Canada, M9W 6J2
FCC ID: VYUALG2E
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

March 25, 2010
Date

Tested by: Kevin Ma, Wireless/EMC Specialist

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Section 1: Report summary

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

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Section 2: Equipment under test

Report Number: 140954-3TRFWL

Specification: FCC 15.247

Section 2: Equipment under test

2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

Type of equipment:	ECU
Product marketing name:	Alclock GR
Model number:	79-007097
Serial number:	ALG1E1J008000002
Nemko sample number:	2
FCC ID:	VYUALG2E
Date of receipt:	March 17, 2010

2.2 Accessories and support equipment

No accessories or support equipment was used during the test.

2.3 EUT description

EUT is an engine control device (ECU) - frequency-hopping transceiver designed to operate in the 902–928 MHz band. The EUT is an in-vehicle part of ignition interlock system.

2.4 Technical specifications of the EUT

Operating band:	902–928 MHz
Operating frequency:	902.2–927.2 MHz
Modulation type:	GFSK
Occupied bandwidth (20 dB):	245.1 kHz
Channel spacing:	399.0 kHz
Emission designator:	F1D
Antenna data:	0.5 dBi
Antenna type:	Integral Permanent fixed antenna, which may be built-in, (Equipment does not have an external 50 Ω RF connector)
Power source	12/24 VDC battery powered



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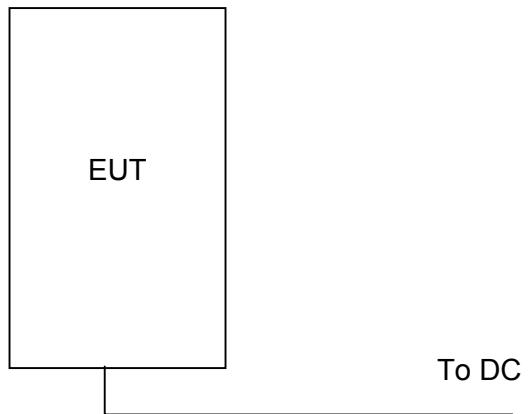
Section 2: Equipment under test

Report Number: 140954-3TRFWL

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Section 2: Equipment under test, continued

2.5 EUT setup diagram



2.6 Operation of the EUT during testing

The EUT was controlled to transmit at desired frequency

2.7 Modifications incorporated in the EUT

None



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Section 3: Test conditions

Report Number: 140954-3TRFWL

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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.



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Section 3: Test conditions
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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
Attenuator	Narda	776B-20	FA001153	COU

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

 Nemko Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2	Section 4: Result summary
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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
§15.207(a)	Conducted limits	N	
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	Y	Pass
§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)	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	N	
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Y	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	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)	Spurious emissions	Y	Pass
Notes: None			



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Appendix A: Test results

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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: March 17, 2010

Test results: Pass

Test data

- Transmit output power was measured by using a new battery.



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Appendix A: Test results

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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: March 17, 2010

Test results: Pass

Test data

The frequency band is 902-928 MHz therefore number of operating frequencies is as follows:

Low frequency / channel	902.2 MHz
Mid frequency / channel	914.6 MHz
High frequency / channel	927.2 MHz



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Appendix A: Test results

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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: March 17, 2010

Test results: Pass

Test data

- The EUT uses an integrated chip antenna to the intentional radiator.



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Appendix A: Test results

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Specification: FCC 15.247

Clause 15.247(a)(1) Frequency hopping requirements

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 date: March 17, 2010

Test results: Pass

Special notes

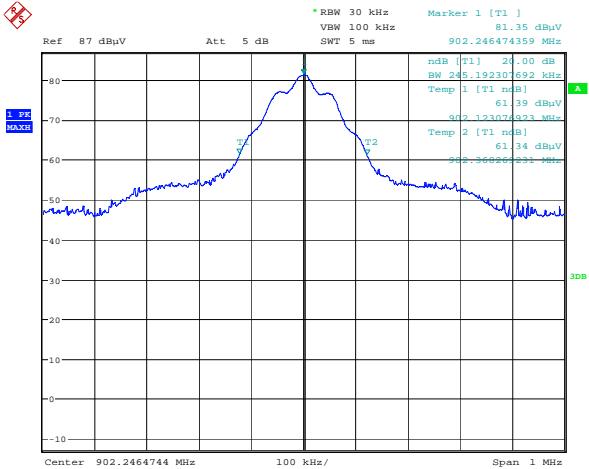
- The peak detector was used with 30 kHz/100 kHz RBW/VBW

Clause 15.247(a)(1) Frequency hopping requirements, continued

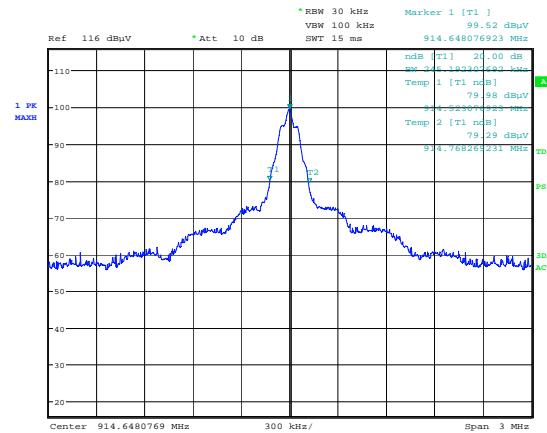
Test data

20 dB bandwidth:

Low channel:



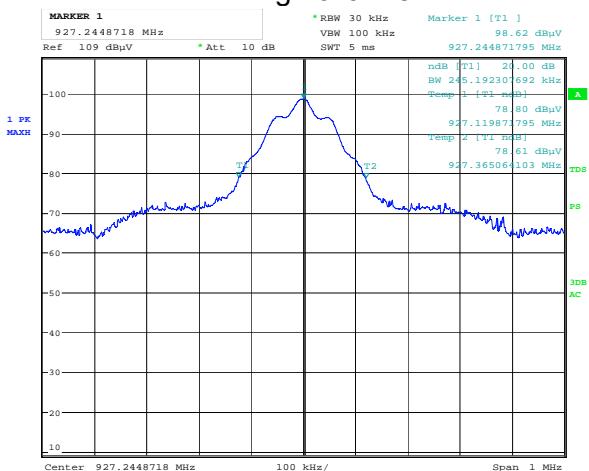
Mid channel:



Date: 17.MAR.2010 11:09:08

Date: 17.MAR.2010 15:10:38

High channel:



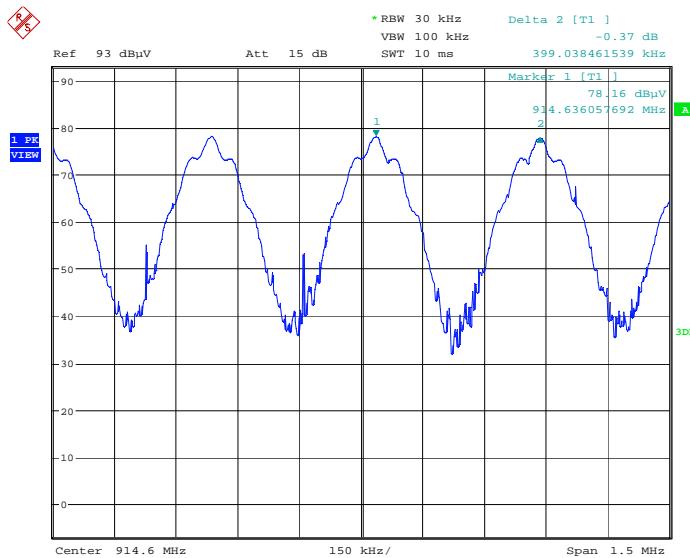
Frequency, MHz	20 dB bandwidth, kHz
902.2	245.19
914.6	245.19
927.2	245.19

Date: 17.MAR.2010 11:23:41

Clause 15.247(a)(1) Frequency hopping requirements, continued

Test data, continued

Channel Spacing:



Date: 17.MAR.2010 17:53:45

Channel Spacing (kHz)	Limit (kHz)	Margin (kHz)
399.03	245.19	153.84



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Appendix A: Test results

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Clause 15.247(a)(1)(i) Frequency hopping systems operating in the 902–928 MHz band

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test date: March 17, 2010

Test results: Pass

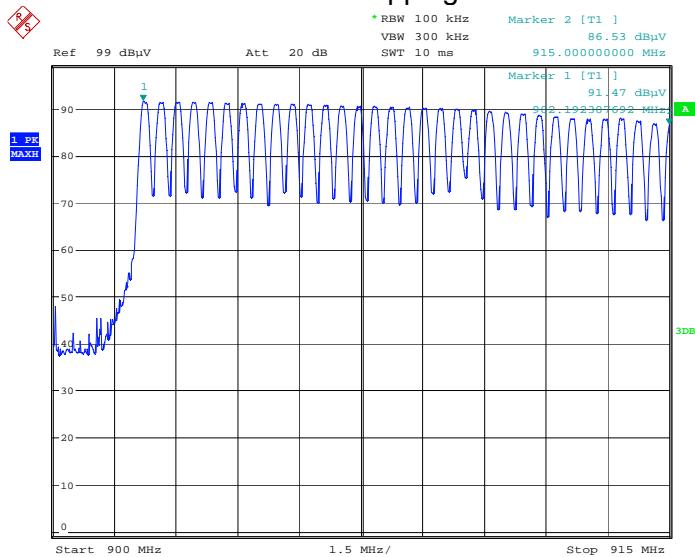
Special notes

- The peak detector was used with 100 kHz/300 kHz RBW/VBW

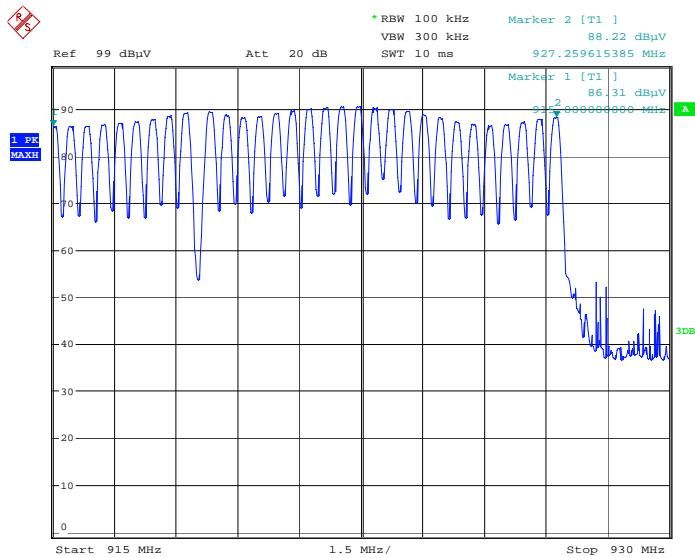
Clause 15.247(a)(1)(i) Frequency hopping systems operating in the 902–928 MHz band, continued

Test data

Number of hopping channels:



Date: 17.MAR.2010 18:06:35



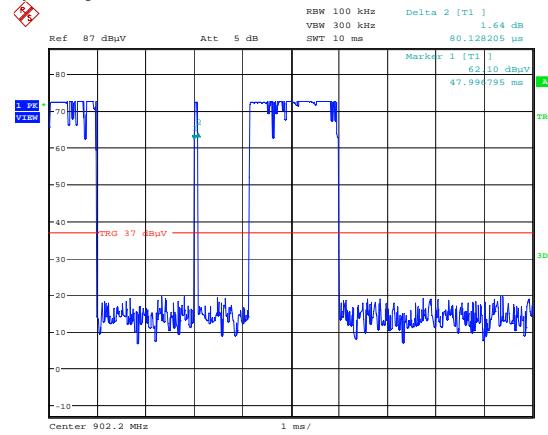
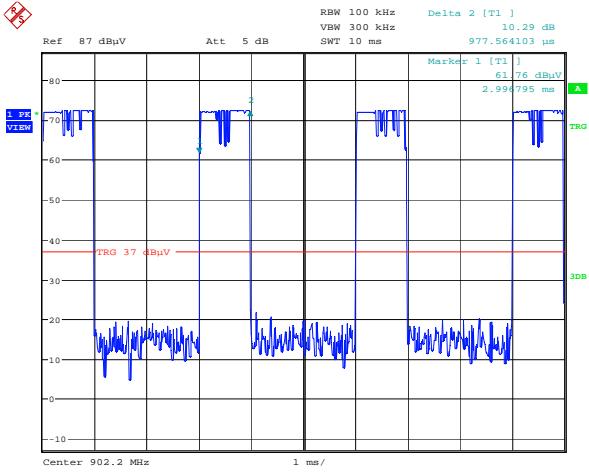
Date: 17.MAR.2010 18:08:36

Number of hopping channels = 32 + 31 = 63
 Limit: minimum of 50 hopping channels

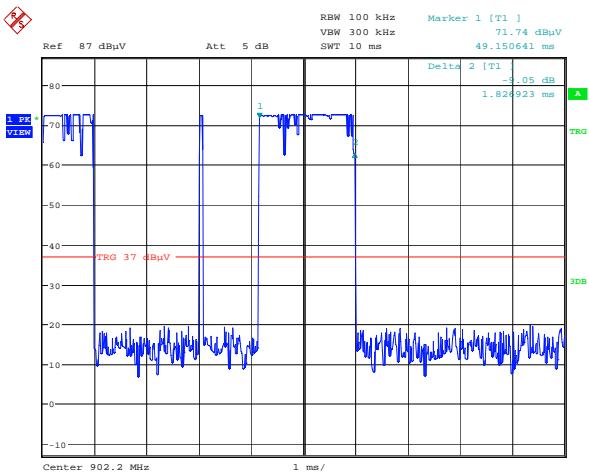
Clause 15.247(a)(1)(i) Frequency hopping systems operating in the 902–928 MHz band, continued

Test data, continued

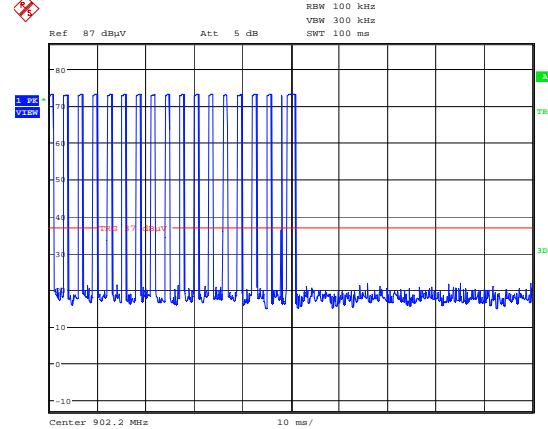
Time of occupancy:



Date: 17.MAR.2010 15:02:32



Date: 17.MAR.2010 15:05:01



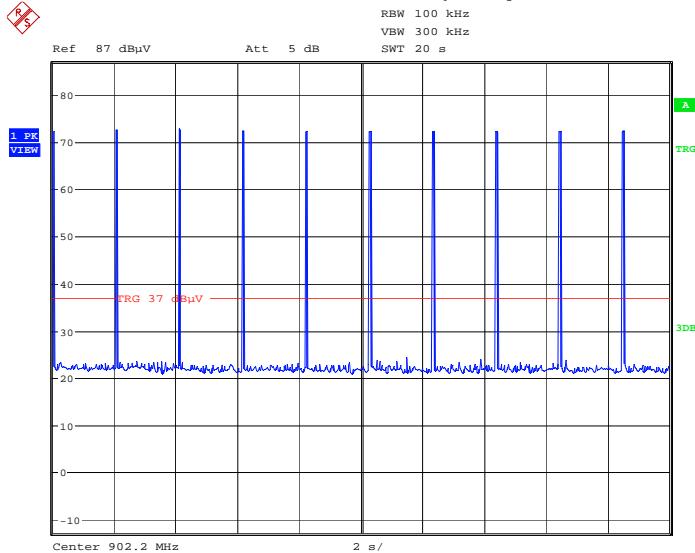
Date: 17.MAR.2010 15:05:55

Total transmitting time of each plus train:
 $0.977 \text{ ms} \times 16 + 0.08 \text{ ms} + 1.827 \text{ ms} = 17.539 \text{ ms}$

Clause 15.247(a)(1)(i) Frequency hopping systems operating in the 902–928 MHz band, continued

Test data, continued

Time of occupancy:



Time of occupancy within a 20 second period = $10 \times 17.539 \text{ ms} = 175.39 \text{ ms}$
Limit = 400 ms
Margin = 224.61 ms



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Appendix A: Test results

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Clause 15.247(b)(2) and (4) Maximum peak conducted output power for frequency hopping systems operating in 902–928 MHz band

The maximum peak conducted output power of the intentional radiator shall not exceed the following: (2) 1 W for systems employing at least 50 hopping channels; and, 0.25 W for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(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.

Test date: March 17, 2010

Test results: Pass

Special notes

- EUT Antenna Gain = 0.5 dBi
- Fresh battery was used throughout the test.
- All Measurements were performed at 3 m using a 1 MHz RBW/VBW



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Appendix A: Test results

Report Number: 140954-3TRFWL

Specification: FCC 15.247

Clause 15.247(b)(2) and (4) Maximum peak conducted output power for frequency hopping systems operating in 902–928 MHz band

Test data

Chan.	Freq. MHz	Pol.	Peak Field Strength dB μ V/m	Conducted Output power dBm	Conducted Power Limit dBm	Margin dB
Low	902.2	V	95.84	0.11	30	29.89
	902.2	H	107.92	12.19	30	17.81
Mid	914.6	V	94.02	-1.71	30	31.71
	914.6	H	104.21	8.48	30	21.52
High	927.2	V	92.92	-2.81	30	32.81
	927.2	H	103.51	7.78	30	22.22

$$E \text{ (V/m)} = \frac{10^{(FS/20)}}{1 \times 10^6} = \left(10^{\left(\frac{107.92}{20} \right)} \right) \times 10^{-6} = 0.2488 \text{ V/m}$$

$$G \text{ (numeric)} = 10^{(Ag/10)} = 10^{\left(\frac{0.5}{10} \right)} = 1.12$$

$$P \text{ (W)} = \frac{E^2 R^2}{30G} = 0.016592 \text{ W} = 16.592 \text{ mW}$$

FS = Field Strength (dB μ V/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) = $10 \times \log(\text{Output Power (mW)}) = 10 \times \log(16.592) = 12.19 \text{ dBm}$

Conducted Output Power Limit = 30 dBm

EIRP: Conducted Output power + antenna Gain = 12.19 + 0.5 = 12.69 dBm.

EIRP limit = 36 dBm.



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Appendix A: Test results

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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)
	(μ V/m)	(dB μ 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

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: March 17, 2010

Test results: Pass



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Appendix A: Test results

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Clause 15.247(d) Spurious emissions, continued

Special notes

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

§ 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			

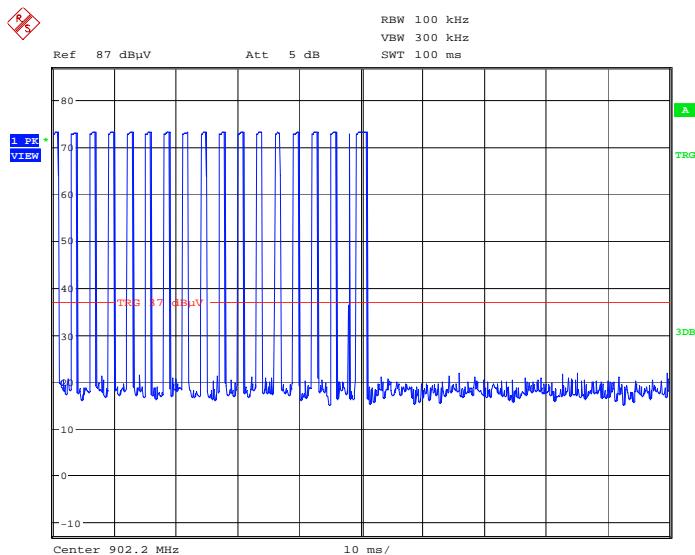
Clause 15.247(d) Spurious emissions, continued

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 calculations:



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Total transmitting time within 100 ms: $0.977 \text{ ms} \times 16 + 0.08 \text{ ms} + 1.827 \text{ ms} = 17.539 \text{ ms}$

$$\text{Duty cycle / average factor} = 20 \times \log_{10} \left(\frac{T_{100ms}}{100 \text{ ms}} \right) = 20 \times \log_{10} \left(\frac{17.539}{100} \right) = -15.11$$

Radiated Emissions within Restricted Bands:

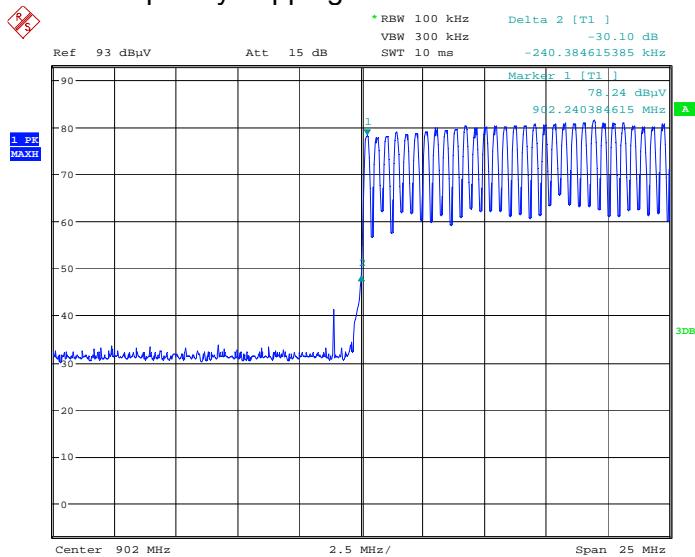
Channel	Freq. MHz	Pol.	Peak Field Strength dBpV/m	Peak Limit dBpV/m	Margin dB	Average Factor dB	Average Field Strength dBpV/m	Average Limit dBpV/m	Margin dB
Low	2706	H	49.19	74.00	24.81	-15.11	34.08	54.00	19.92
Mid	2744	H	48.99	74.00	25.01	-15.11	33.88	54.00	20.12
High	2782	H	49.49	74.00	24.51	-15.11	34.38	54.00	19.62

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

Clause 15.247(d) Spurious emissions, continued

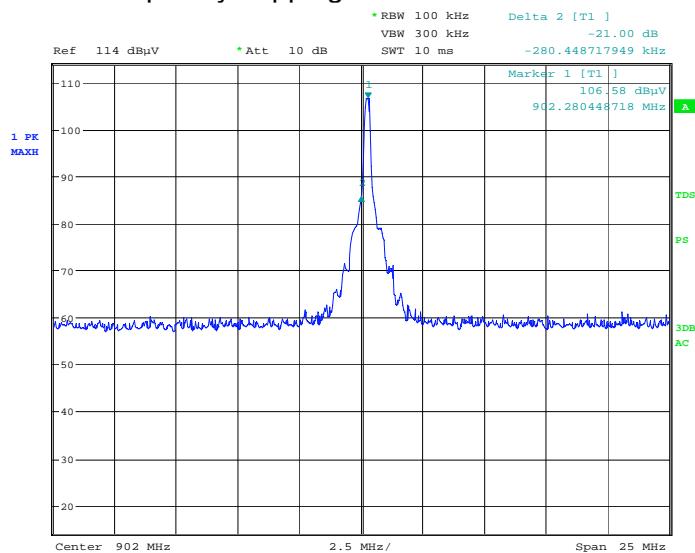
Test data, continued

Lower band edge check with frequency hopping on



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Lower band edge check with frequency hopping off

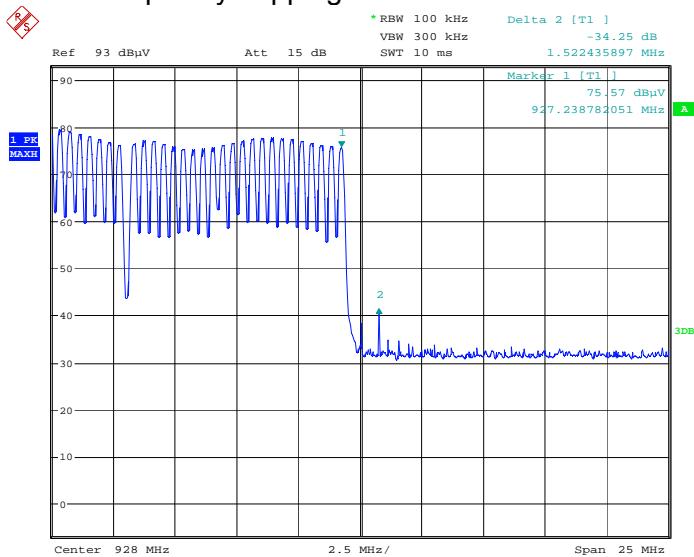


Date: 17.MAR.2010 10:23:19

Clause 15.247(d) Spurious emissions, continued

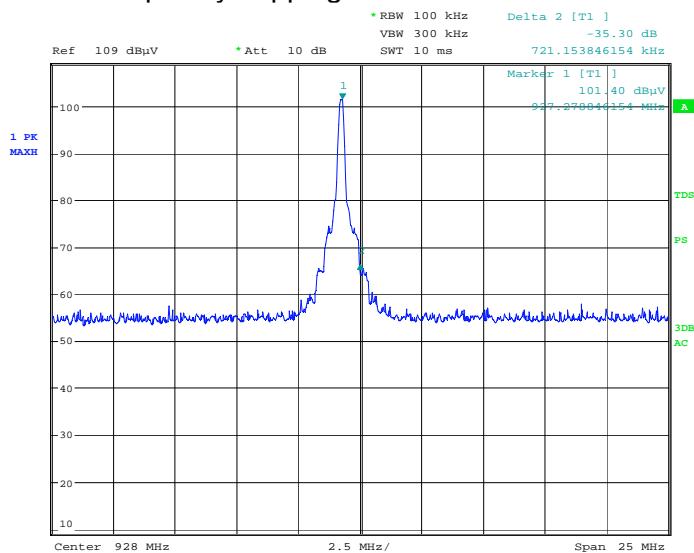
Test data, continued

Upper band edge check with frequency hopping on



Date: 17.MAR.2010 17:58:59

Upper band edge check with frequency hopping off



Date: 17.MAR.2010 11:26:29

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

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up

