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

Report Number: 134010-1R1TRFWL

Apparatus: CM91

Applicant: Alutron Modules Inc.
420 Industrial Pkwy. South
Aurora, ON, Canada
L4G 3V7

Test Specification:

ETSI EN 300 220-2 V2.1.2 (2007-06)
Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive

Reviewed by: _____ September 22, 2009
Signature Date
Andrey Adelberg, Senior Wireless/EMC Specialist

Tested by: David Duchesne, Senior EMC/Wireless Specialist

SCC Accredited LAB
LAB Accrédité CCN

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

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

Test Specification:

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Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD);
Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive

and

ETSI EN 300 220-1 V2.1.1 (2006-04)
Electromagnetic compatibility and Radio spectrum Matters (ERM);
Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods

Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None
Report Release History:	Issue 2 *(Report updated to new specification)*
Test Location:	Nemko Canada Inc. 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

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.

Section 2: Equipment Under Test

2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	Transceiver to turn on or off a central vacuum system
Product Marketing Name:	CM91
Model Number:	CM91
Serial Number:	None
Nemko Sample Number:	Item #2
Date of Receipt:	August 28, 2009

2.2 Accessories and Support Equipment

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

No accessories were used during this assessment.

2.3 EUT Description

Module used in RF remote that is used mainly to turn on or off a central vacuum power unit.

2.4 Technical Specifications of the EUT

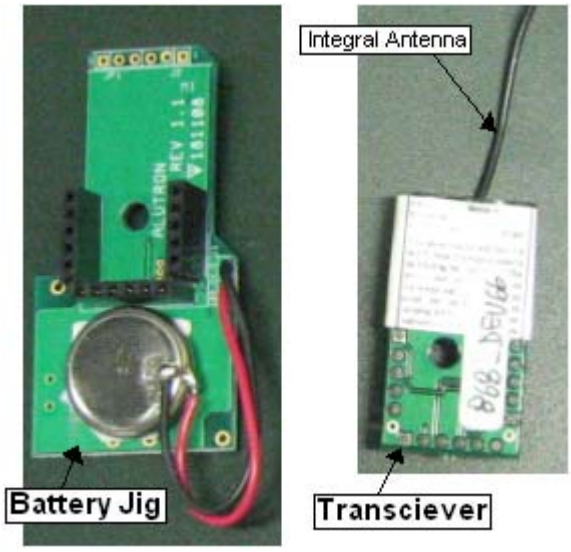
Designated Frequency Band:	868 to 868.6 MHz	
Operational frequency range	Transmitter: 868.3 MHz	Receiver: 868.3 MHz
Modulation Type	FSK	
Channel Spacing:	N/A	
Antenna Type:	Integral	
Power Source	3 VDC (Battery operated) Internal	

Section 2: Equipment Under Test, continued

2.5 Receiver Classification

Receiver Class	Relevant receiver clauses of ETSI EN 300-220-1	Risk assessment of receiver performance	Applicable
1	9.1, 9.3, 9.4, 9.5, 9.6, and 9.7	Safety critical SRD communication media; i.e. for devices serving systems where failure may result in a physical risk to a person.	☐
2	9.4 and 9.7	Function critical SRD communication media; i.e. when a failure to operate correctly causes loss of function but does not constitute a safety hazard.	☐
3	9.7	Non-critical SRD communication media whose failure to operate correctly causes loss of function which can be overcome by parallel means.	☒

2.6 EUT Setup Diagram



Section 2: Equipment Under Test, continued

2.7 Operation of the EUT During Testing

The EUT was modified to transmit continuously.

2.8 Modifications Incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

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 and Humidity Test Conditions	Temperature: 15 to 30 °C Relative Humidity: 20 to 75 % 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.
Mains voltage	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, for which the equipment was designed. The frequency of the test power source corresponding to the ac mains shall be between 49 Hz and 51 Hz.
Regulated lead-acid battery power sources	When the radio equipment is intended for operation from the usual types of regulated lead-acid battery power source the normal test voltage shall be 1.1 multiplied by the nominal voltage of the battery (6 V, 12 V, etc.).
Other power sources	For operation from other power sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment manufacturer and where appropriate agreed by the accredited test laboratory. Such values shall be recorded and stated.

Section 3: Test Conditions, continued

3.2 Test Conditions, Power Source and Ambient Temperatures, continued

Extreme temperature ranges	Category	Temperature Range	Applicable
	I (General)	-20 °C to 55 °C	☐
	II Portable equipment)	-10 °C to 55 °C	☐
	III (Equipment for normal indoor Use)	0 °C to 55 °C	☒

For special applications, the manufacturer can specify alternative temperature ranges. This shall be reflected in the providers' product literature, e.g. the user manual.

Extreme test voltages	Power sources	Range	Applicable
	AC Mains	Voltage ±10%	☐
	Lead-acid battery power sources	1.3 and 0.9 multiplied by the nominal voltage of the battery	☒
		Float charge applications using "gel-cell" type batteries 1.15 and 0.85 multiplied by the nominal voltage of the declared battery voltage	☐
	Leclanché or the lithium type of battery	0.85 multiplied by the nominal voltage of the battery (The lower extreme test voltage and the nominal voltage is considered to be the upper extreme test voltage in this case)	☐
	Nickel-cadmium type of battery	0.9 multiplied by the nominal voltage of the battery (The lower extreme test voltage and the nominal voltage is considered to be the upper extreme test voltage in this case)	☐

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed between the equipment manufacturer and the accredited test laboratory and shall be recorded and stated.

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.
Spectrum Analyzer	Rohde & Schwarz	FSP	FA001920	Apr. 24/10
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Mast	Sunol	TLT2	FA002061	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/09
Bilog	Sunol	JB3	FA002108	Jan. 27/10
Signal Generator	Rhode & Schwarz	SMR 40	FA001879	Aug. 14/10
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/10
1 – 18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/09

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

Section 4: Result Summary

4.1 ETSI EN 300 220-2 V2.1.2 (2007-06): 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)

Clause	Test Description	Required	Result
4.2.1	**Transmitter Requirements**		
4.2.1.1	Frequency error or frequency drift	Y	Pass
4.2.1.2	Carrier power (conducted)	N	N/A
4.2.1.3	Effective radiated power	Y	Pass
4.2.1.4	Transient power	Y	Pass
4.2.1.5	Adjacent channel power	N	N/A
4.2.1.6	Modulation bandwidth for wide band equipment (> 200kHz)	Y	Pass
4.2.1.7	Spurious emissions	Y	Pass
4.2.1.8	Frequency stability under low-voltage conditions	Y	Pass
4.2.1.9	Duty cycle	Y	Pass
4.2.1.10	Listen Before Talk (LBT)	N	N/A
4.2.1.11	Types of spread spectrum modulation	N	N/A
4.2	**Receiver Requirements**		
4.3.1	Maximum usable sensitivity (conducted)	N	N/A
4.3.2	Receiver LBT threshold and transmitter max on-time	N	N/A
4.3.3	Adjacent channel selectivity	N	N/A
4.3.4	Blocking or desensitization	N	N/A
4.3.5	Intermodulation response rejection	N	N/A
4.3.6	Spurious response rejection	N	N/A
4.3.7	Spurious radiations	Y	Pass

Notes: None

Appendix A: Test Results

Clause 4.2.1.1 Frequency error or frequency drift

One of the following shall be met:

- the frequency error or frequency drift, as defined in EN 300 220-1 [2] subclause 8.1.1, shall not exceed the limits in EN 300 220-1 clause 8.1.4, table 6a for narrow band or table 6b for wide band;

or

- for narrow band equipment not capable of producing an unmodulated carrier, the adjacent and alternate channel power, as defined in EN 300 220-1, clause 8.6.1, shall not exceed the limits in EN 300 220-1 [2], clause 8.6.3 under extreme conditions.

This requirement applies to all transmitters.

Test Date: September 9, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

The transmitter was considered to be wideband.

Clause 4.2.1.1 Frequency error or frequency drift, continued

Test Data

Limits

The frequency error and drift shall not exceed the values given in table below under normal and extreme conditions.

Table 6a: Frequency error or drift for narrowband

Frequency Separation (kHz)	Frequency error limit (kHz)				
	< 47 MHz	47 to 137 MHz	> 137 to 300 MHz	> 300 to 500 MHz	> 500 to 1 000 MHz
6.25	±0.75	±0.75	±0.75	±0.75	±0.75
10/12.5	±0.75	±1	±1.50	±1.50	±1.50
20/25	±2.5	±1.35	±2	±2	±2.5
50	±2.5	±2.5	±2.5	±3	±5
100	±5	±5	±5	±6	±10
200	±10	±10	±10	±12	±20
Additionally, it shall be noted that the transmitter frequency shall always be inside any allocated sub-band.					

Table 6b: Frequency error or drift for wideband (BW > 200 kHz)

Frequency error limit (ppm)
±100
Additionally, it shall be noted that the transmitter frequency shall always be inside any allocated sub-band.

Measured Results

Wide Band

Temperature	Battery Voltage	Frequency (Hz)	Offset* ppm	Limit ± ppm	Margin ppm
20 °C	3.0 VDC (Nominal)	868145500	N/A		
0 °C (Extreme)	3.9 VDC (Extreme)	868145500	0	±100	100
0 °C (Extreme)	2.7 VDC (Extreme)	868145500	0	±100	100
55 °C (Extreme)	3.9 VDC (Extreme)	868140500	-5.7	±100	94.3
55 °C (Extreme)	2.7 VDC (Extreme)	868140000	-6.3	±100	93.7

* Note: Offset calculation: $\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^{6}$

Maximum frequency drift is −5.5 kHz

Clause 4.2.1.3 Effective radiated power

The effective radiated power, as defined in EN 300 220-1 subclause 8.3.1, shall not exceed the limits in EN 300 220-1 subclause 8.3.3.

This requirement applies to transmitters with an integral or dedicated antenna.

Test Date: September 8, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

- These measurements shall be performed at the highest power level at which the transmitter is intended to operate.
- The measurement shall be made under normal test conditions (see clause 5.3 of EN 300 220-1)

Clause 4.2.1.3 Effective radiated power, continued

Test Data

Limits

The effective radiated power shall not exceed the power class value given in table below.

Power Class	Power level, e.r.p. (mW)
5a	0.025
7a	5
8	10W
9	25
11	100
12	500

Measured Results

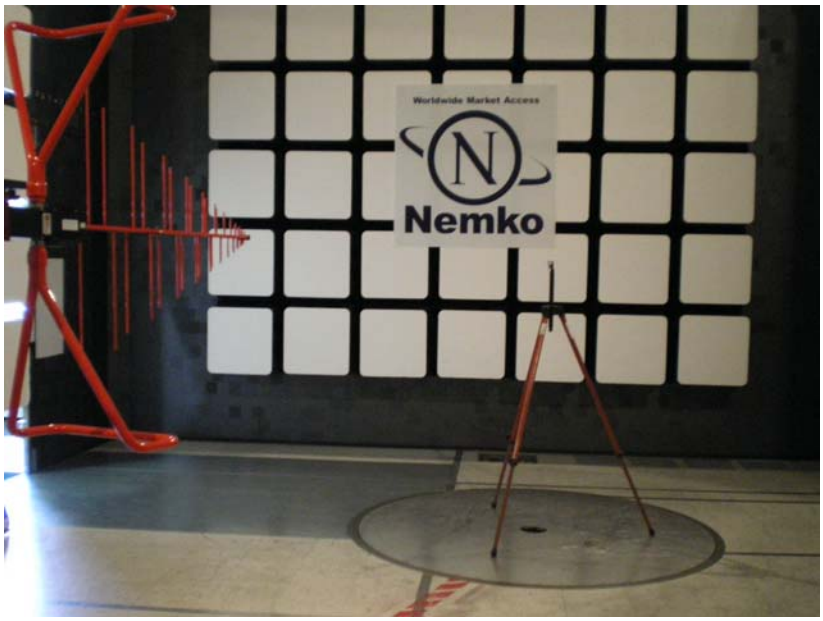
Product was tested to Power Class 9						
Frequency (MHz)	Ant.Pol.	Received signal, dBµV	Substitution Factor, dB	ERP (dBm)	ERP Limit (dBm)	Margin (dB)
868.3	V	76.1	-73.7	2.4	14	11.6
	H	68.8	-76.7	-7.9	14	21.9

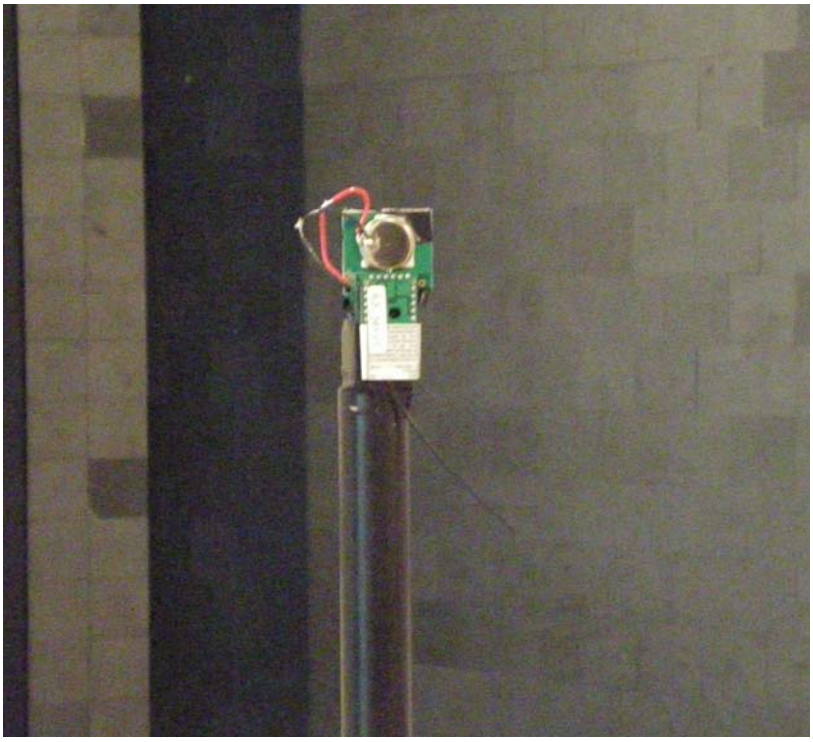
All measurements were performed a 3 m distance with a 120 kHz RBW and 300 kHz VBW, using Positive Peak detector and Bi-Log antenna.

- EUT was located 1.5 m above ground plane.
- The EUT was tested at 3 orthogonal positions. Only the worst data presented in the test report.
- Fresh battery was used throughout the test.

Clause 4.2.1.3 Effective radiated power, continued

Set up Photos





Clause 4.2.1.4 Transient Power

The transient power, as defined in EN 300 220-1, clause 8.5.1, shall not exceed the limits in EN 300 220-1, clause 8.5.4.

This requirement applies to all transmitters.

Test Date: September 15, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

Clause 4.2.1.4 Transient Power, continued

Test Data

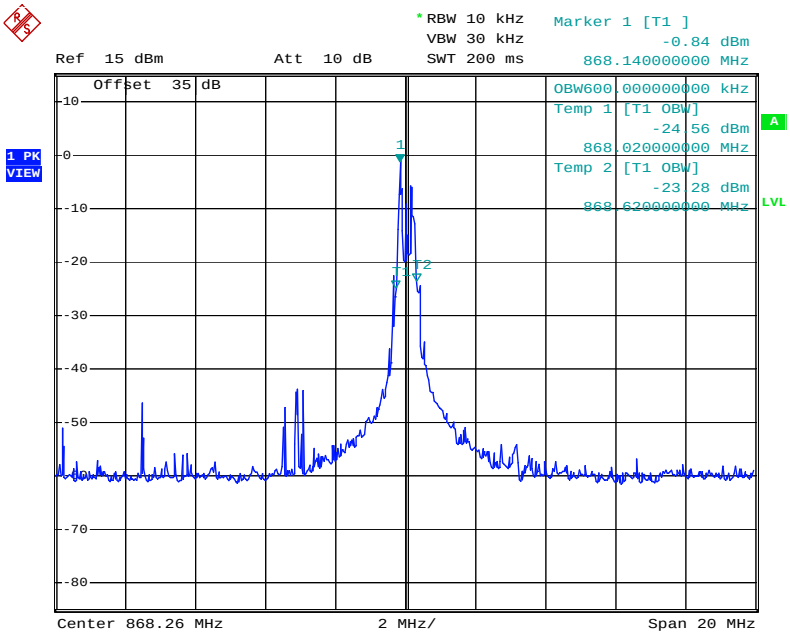
Limits

The transient power in the alternate channel shall not exceed a value of 40 dB below the power of the transmitter without the need to be below 2 µW (-27,0 dBm).

For measurements at 4 and 10 times the channel spacing the transient power shall not exceed 50 dB below power of the transmitter without the need to be below 250 nW (-36 dBm).

If the limit is exceeded the measurement in clause 8.5.2 shall be repeated with the attenuator value reduced by 6 dB to determine if transient effect is causing errors.

Measured Results



99% occupied bandwidth = 600 kHz

Clause 4.2.1.4 Transient Power, continued

Test Data, continued

Measured Results continued

Assessment	Channel	Measured Value (dBm)	Limit (dBm)	Margin (dB)
1	Alternate Channel	-32.43	-27	5.43
	4x Channel Spacing	-38.4	-36	2.4
	10x Channel Spacing	-43.1	-36	7.1
2	Alternate Channel	-32.32	-27	5.32
	4x Channel Spacing	-41.78	-36	5.78
	10x Channel Spacing	-45.58	-36	9.58
3	Alternate Channel	-32.28	-27	5.28
	4x Channel Spacing	-36.46	-36	0.46
	10x Channel Spacing	-43.37	-36	7.37
4	Alternate Channel	-33.5	-27	6.5
	4x Channel Spacing	-38.3	-36	2.3
	10x Channel Spacing	-42.9	-36	6.9
5	Alternate Channel	-35.05	-27	8.05
	4x Channel Spacing	-38.27	-36	2.27
	10x Channel Spacing	-43.54	-36	7.54

Notes:
- Five measurement samples were taken.
- Measurements are of the worst-case from either the low or high side emissions.
- Channel bandwidth and channel spacing was set to 600 kHz.

Clause 4.2.1.6 Modulation bandwidth for wide band equipment (> 200 kHz)

The range of modulation bandwidth, as defined in EN 300 220-1 subclause 8.7.1, shall not exceed the limits in EN 300 220-1 subclause 8.7.3.

This requirement applies to transmitters using wide band as defined in EN 300 220-1, subclause 3.1.

Test Date: September 9, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

- The measurement shall be made under normal test conditions (see clause 5.3 of EN 300 220-1)
- The unit was verified to ensure that spurious levels were compliant when the EUT was within the extreme conditions as defined in clause 5.4 of EN 300 220-1 (i.e. frequency drift of transmitter)

Clause 4.2.1.6 Modulation bandwidth for wide band equipment (> 200 kHz), continued

Test Data

Limits

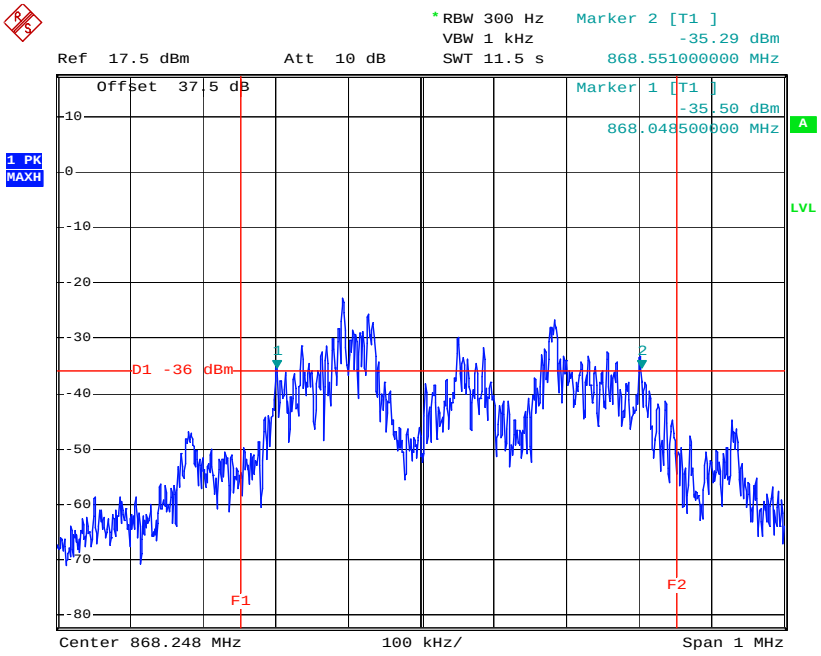
The permitted range of modulation bandwidth including the frequency error or drift as measured in clause 8.1.4 or the occupied bandwidth plus the frequency error whichever is the greatest shall be within the limits of the assigned wide-band channel, subband or frequency band, as appropriate.

The occupied bandwidth is such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the total mean power of a given emission.

Where an assigned frequency band has been subdivided into channels with bandwidths greater than 200 kHz, the 250 nW limit shall apply to the adjacent channel. Where the band is divided into subbands the 250 nW limit shall apply to the subband edge frequencies.

Measured Results

Tx signal was modulated with FSK



Maximum frequency drift for extreme test conditions was −5.5 kHz and +0 kHz
Range of modulation bandwidth is: 868048.5 kHz −5.5 kHz = 868043.0 kHz = 868.043 MHz to 868.551 MHz
Allocated Band Edges are: 868.0 and 868.6 MHz.
All emissions outside of allocated band were below 250 nW.

Clause 4.2.1.7 Spurious emissions

The spurious emissions, as defined in EN 300 220-1, clause 8.8.1, shall not exceed the limits in EN 300 220-1, clause 8.8.5.

This requirement applies to all transmitters.

Test Date: September 8, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

- The measuring receiver shall be tuned over the frequency range 25 MHz to 4 GHz, for equipment operating on frequencies below 470 MHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

- The measurements shall be repeated with the transmitter on stand-by.

Clause 4.2.1.7 Spurious emissions, continued

Test Data

Frequency being measured: f	Measuring receiver bandwidth (6 dB)	Spectrum analyser bandwidth (3 dB)
f < 150 kHz	200 Hz or	300 Hz
150 kHz ≤ f < 25 MHz	9 kHz or	10 kHz
25 MHz ≤ f < 1 000 MHz	120 kHz or	100 kHz
1 000 MHz ≤ f		1 MHz
For measurements below 1 000 MHz a measuring receiver with quasi-peak detector was used. For measurements above 1 000 MHz a spectrum analyzer with a peak detector was used.		

Limits

The power of any spurious emission, conducted or radiated, shall not exceed the following values given in table below.

Frequency **State**	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Operating	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

Measured Results

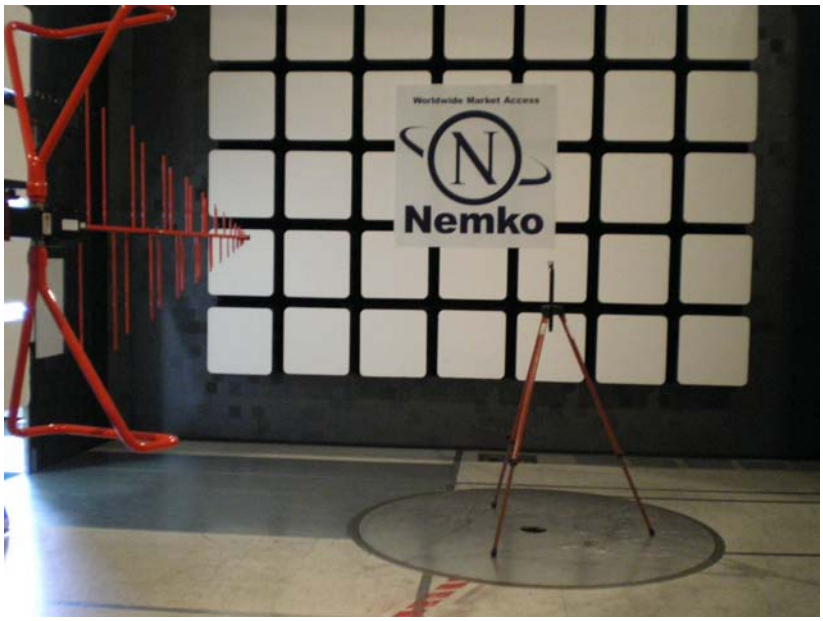
Effective radiated power when radiated by the cabinet and structure of the equipment spurious emissions

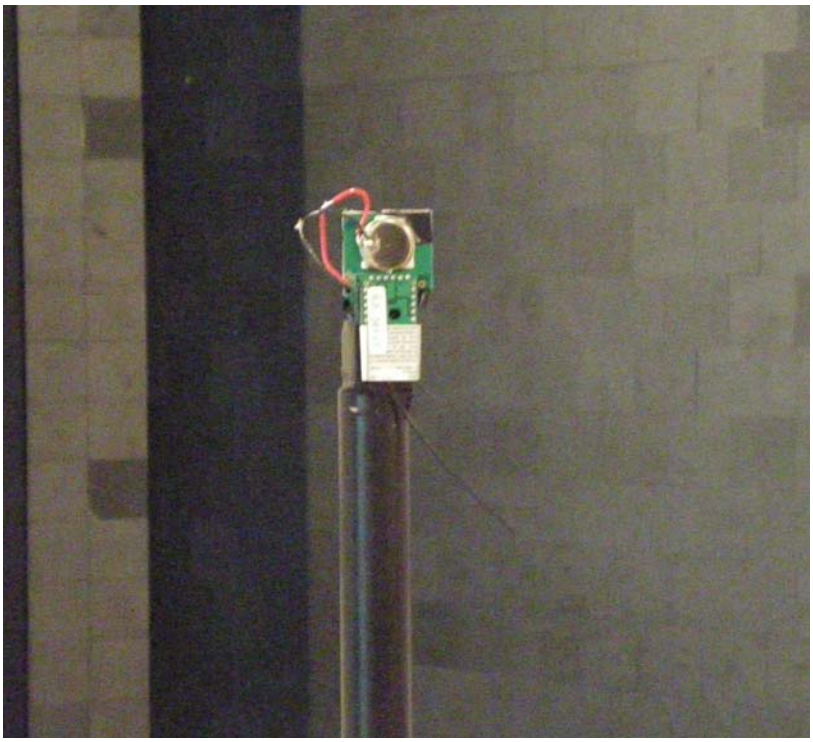
Transmit State, All spurious emissions were more than 10 dB below limit
Idle State, All spurious emissions were more than 10 dB below limit

- The spectrum was searched from 25 MHz to 12.75 GHz.
- All measurements were performed at 3 m distance.
- The EUT was scanned in 3 orthogonal positions.
- Fresh battery was used throughout the test.

Clause 4.2.1.7 Spurious emissions, continued

Set up photos for effective radiated power





Clause 4.2.1.8 Frequency stability under low-voltage conditions

The frequency stability under low-voltage conditions, as defined in EN 300 220-1 subclause 8.9.1, shall not exceed the limits in EN 300 220-1 subclause 8.9.3.

This requirement applies to all battery-operated transmitters.

Test Date: September 9, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

The measurement shall be made under normal temperature and humidity conditions (see clause 5.3.1 of EN 300 220-1).

Clause 4.2.1.8 Frequency stability under low-voltage conditions, continued

Test Data

Limits

The equipment shall either:

a) remain on channel, for channelized equipment within the limits stated in clause 8.1.4 of EN 300 220-1 , or within the assigned operating frequency band, for non-channelized equipment, whilst the radiated or conducted power is greater than the spurious emission limits; or

b) the equipment cease to function below the providers declared operating voltage.

Frequency Separation (kHz)		Frequency error limit (kHz)				
		< 47 MHz	47 to 137 MHz	> 137 to 300 MHz	> 300 to 500 MHz	> 500 to 1 000 MHz
Narrowband	6.25	±0.75	±0.75	±0.75	±0.75	±0.75
	10/12.5	±0.75	±1	±1.50	±1.50	±1.50
	20/25	±2.5	±1.35	±2	±2	±2.5
	50	±2.5	±2.5	±2.5	±3	±5
	100	±5	±5	±5	±6	±10
	200	±10	±10	±10	±12	±20
Wideband		±100 ppm				
Additionally, it shall be noted that the transmitter frequency shall always be inside any allocated sub-band.						

Measured Results

Wideband

Measurement	Input Voltage	Frequency (Hz)	Offset*, ppm	Limit ± ppm	Margin, ppm
1	3 VDC (Nominal)	868143700	Reference		
2	2.65	868143700	0	±100	±100
3	2.30	868143700	0	±100	±100
4	1.95	868143700	0	±100	±100
5	1.6 VDC	The EUT ceased to operate			

- Note: Offset calculation: $\frac{F_{Measured} - F_{Reference}}{F_{Reference}} \times 1 \cdot 10^{6}$

Clause 4.2.1.9 Duty cycle

The duty cycle, as defined in EN 300 220-1subclause 8.10.1, shall not exceed the limits in EN 300 220-1 subclause 8.10.3.

This requirement applies to all transmitters excluding those with a listen before talk facility with AFA.

Test Date: September 2, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes
None

Clause 4.2.1.9 Duty cycle, continued

Test Data

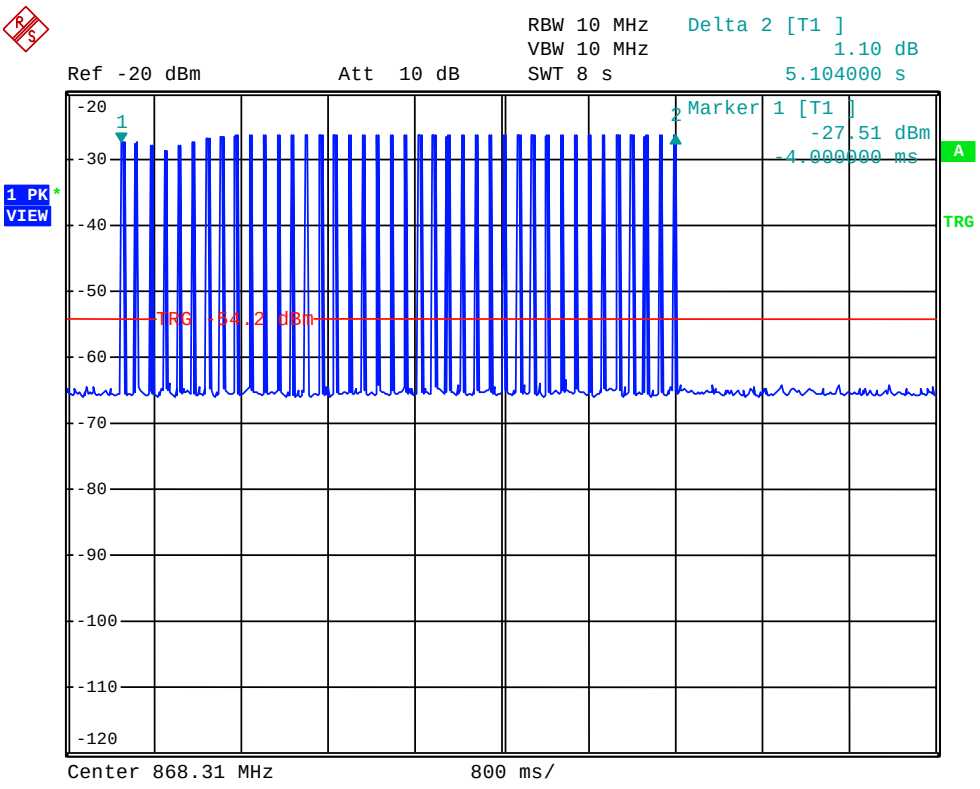
Limit

In a period of 1 hour the duty cycle shall not exceed the class values given in table below.

Duty cycle class	Duty cycle ratio
1	< 0.1 %
2	< 1.0 %
3	< 10 %
4	Up to 100 %

Measured Results

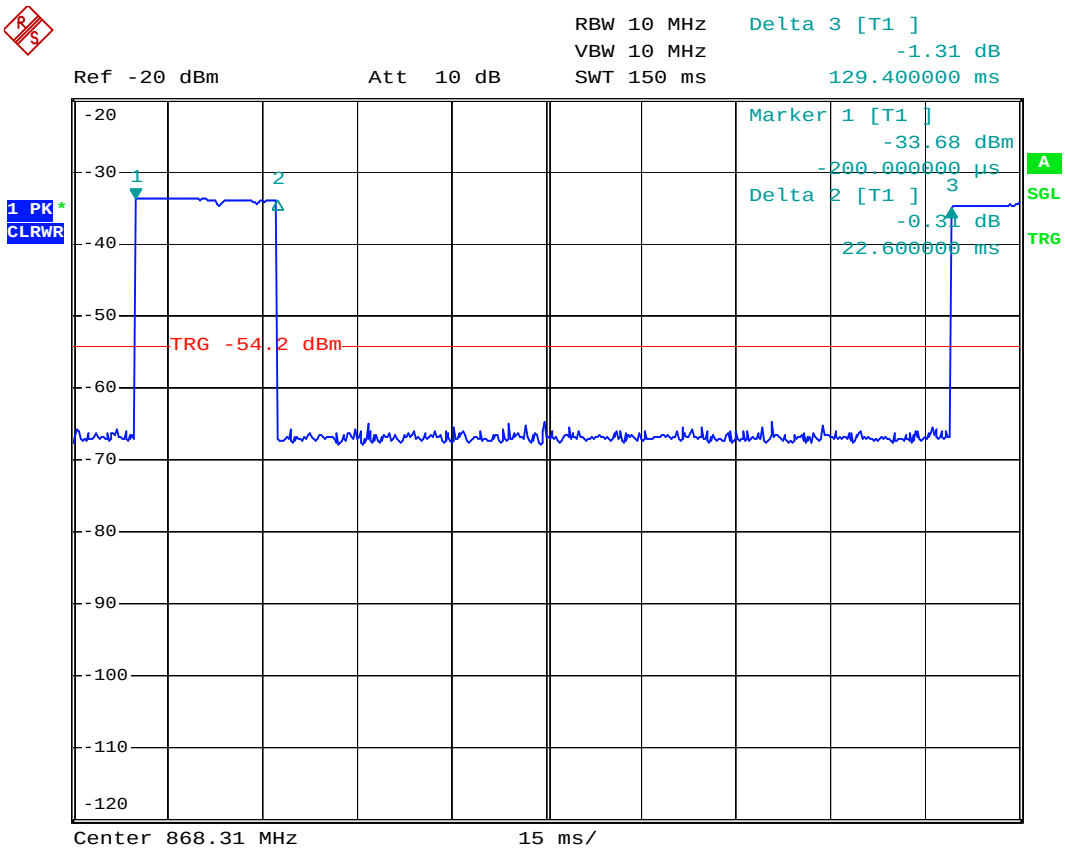
The EUT was tested for compliance with duty cycle class 2



Clause 4.2.1.9 Duty cycle, continued

Test Data, continued

Measured Results, continued



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A single transmission includes 40 Pulses (each pulse width = 22.6 ms)

Transmit on time = 40 x 22.6 = 904 ms (A single transmission)
Maximum Duty Cycle at 1 % of one an hour = 36000 ms.

Therefore transmitter cannot be enables more than 39 times per hour (36000 / 904). (Normally the EUT may transmit a few times per hour when in use.)

Clause 4.3.7 Spurious radiations

The spurious radiations, as defined in EN 300 220-1 subclause 9.7.1, shall not exceed the limits in EN 300 220-1 subclause 9.7.5.

This requirement applies to all classes of receivers.

Test Date: September 8, 2009
Engineer's Name: David Duchesne

Test Results: Pass

Special Notes

The measuring receiver shall be tuned over the frequency range 25 MHz to 4 GHz, for equipment operating on frequencies below 470 MHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

Test Data

Limits

The power of any spurious emission, radiated or conducted, shall not exceed the values given below: The limits are applicable to all receiver classes.

2 nW below 1 000 MHz;
20 nW above 1 000 MHz.

Measured Results

No spurious emissions detected within 10 dB of limit.

- The spectrum was searched from 25 MHz to 4 GHz.
- All measurements were performed at 3 m distance.
- The EUT was scanned in 3 orthogonal positions.
- Fresh battery was used throughout the test.

Clause 4.3.7 Spurious radiations, continued

Set up Photos