ONE WORLD ○ OUR APPROVAL

Test report

303424-3TRFWL

Date of issue: March 14, 2016

Applicant:

Digital Security Controls, a division of Tyco Safety Products Canada Ltd.

Product:

Wireless CO Detector

Model:

WS4933

FCC ID: F5316WS4933

IC Registration number: 160A-WS4933

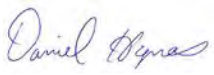
Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.231
  Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.
- RSS-210, Issue 8, December 2010, Annex 1.1
  Momentarily operated devices

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

SCC Accredited LAB
LAB Accrédité CCN

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	David Duchesne, Senior EMC/Wireless Specialist
Reviewed by	Daniel Hynes, Senior EMC Specialist
Date	March 14, 2016
Signature of reviewer	

Limits of responsibility

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.

Copyright notification

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.
© Nemko Canada Inc.

Table of contents

Section 1. Report summary

1.1 Applicant

Company name	Digital Security Controls a div. of Tyco Safety Products Ltd.
Address	3301 Langstaff Road, Concord, ON, Canada, L4K 4L2

1.2 Manufacturer

Company name	Digital Security Controls a div. of Tyco Safety Products Ltd.
Address	95 Bridgeland Ave., Toronto, ON, Canada, M6A1Y7

1.1 Test methods

ANSI C63.10 - 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.2 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.3 Exclusions

None

1.4 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C test results

Table 2.1-1: *FCC Part 15 – Radio frequency devices results*

Part	Test description	Verdict
§15.31(e)	Variation of power source	See Notes [1]
§15.203	Antenna requirement	See Notes [2]
§15.207(a)	Conducted limits	Not applicable [3]
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	Pass
§15.231(b)	Field strength of emissions	Pass
§15.231(c)	Emission bandwidth	Pass
§15.231(d)	Requirements for devices operating within 40.66–40.70 MHz band	Not applicable [4]
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Not applicable [5]

Notes:
[1] Fundamental field strength was measured with a fresh battery.
[2] The EUT is equipped with an integral antenna.
[3] The EUT is battery powered.
[4] The EUT does not operate in the frequency range of 40.66–40.70 MHz.
[5] The EUT complies with requirement 15.231 (a).

2.2 IC RSS-GEN, Issue 4 test results

Table 2.2-1: *IC RSS-GEN Issue 4 results*

Part	Test description	Verdict
7.1.2	Receiver radiated emission limits	Not applicable [1]
7.1.3	Receiver conducted emission limits	Not applicable [1]
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not applicable [2]

Notes:
[1] The EUT does not contain a receiver.
[2] The EUT is battery powered.

2.3 IC RSS-210, Issue 8 test results

Table 2.3-1: *IC RSS-210 Issue 8 Annex 1 results*

Part	Test description	Verdict
A1.1.1	Types of momentary signals	Pass
A1.1.2	Field strength and frequency bands	Pass
A1.1.3	Bandwidth for momentary signals	Pass
A1.1.4	Frequency stability within 40.66–40.70 MHz band	Not applicable [1]
A1.1.5	Reduced field strengths	Not applicable [2]

Notes:
[1] The EUT does not operate in the frequency range of 40.66–40.70 MHz.
[2] The EUT complies with requirement RSS-210 A1.1.2.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 10, 2016
Nemko sample ID number	133-001678 and 133-001676

3.2 EUT information

Product name	Wireless CO Detector
Model	WS4933
Hardware revision	Rev 01
FW version	V1.00
Serial number	None

3.3 Technical information

Applicant IC company number	160A
IC UPN number	WS4933
All used IC test site(s) Reg. number	2040G
RSS number and Issue number	RSS-210 Annex A1.1, Issue 8, December 2010
Frequency Min (MHz)	433.92
Frequency Max (MHz)	433.92
RF power Min (W)	N/A
RF power Max (W)	N/A
Field strength, Units @ distance	96.10 dBµV/m Peak and 77.50 dBµV/m Average at 433.92 MHz @ 3 m
Measured BW (kHz) (99 %)	15.4
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	ASK
Emission classification (F1D, G1D, D1D)	K1D
Transmitter spurious, Units @ distance	64.61 dBµV/m Peak and 46.01 dBµV/m Average at 3905.28 MHz @ 3 m
Power requirements	3 V_{DC} (Lithium battery CR123A 3V)
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The EUT is a 3V battery powered wireless detector intended for use with a compatible wireless alarm system. The detector consists of an electrochemical carbon monoxide sensor assembly coupled to a wireless transmitter. The Wireless Carbon Monoxide Alarm communicates with the control panel and can send alarm, tamper and battery condition messages to the system's receiver.

3.5 EUT exercise details

A sample in continuous transmit mode was provided for testing along with a test sample that was transmitting when the tamper switch was activated (by removing the detector from its mounting bracket).

3.6 EUT setup diagram

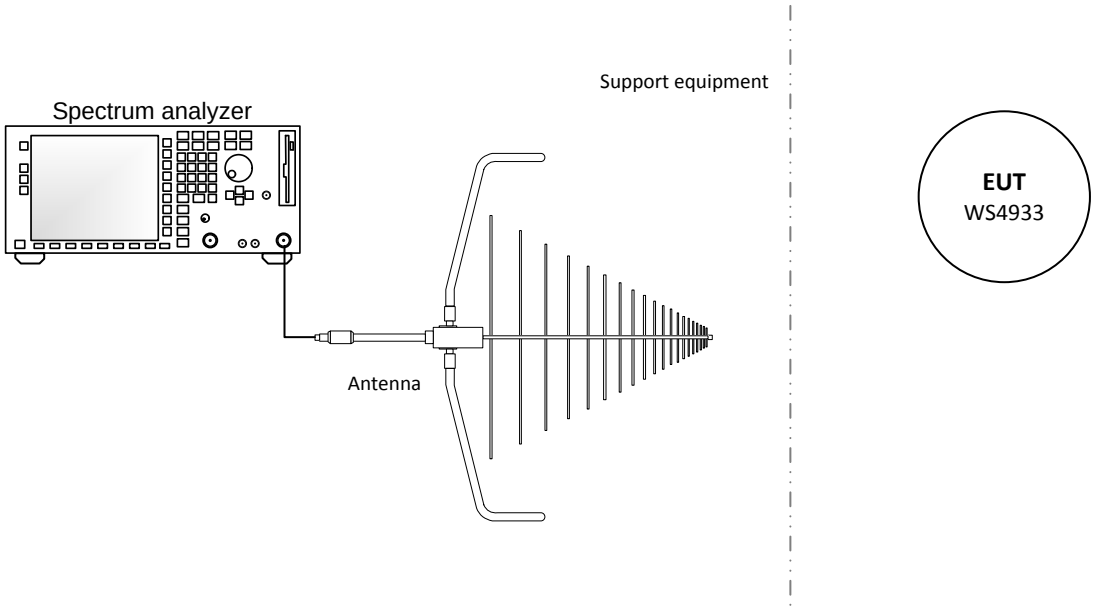


Figure 3.6-1: *Setup diagram*

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

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.

5.2 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 ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 01/16
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 07/17
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 12/16
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Apr. 01/16
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	May 05/16
50 Ω coax cable	C.C.A.	None	FA002555	1 year	May 05/16
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	May 05/16

Notes: None

Table 7.1-2: Test software details

Test description	Manufacturer of Software	Details
Radiated emissions	Rhode & Schwarz	EMC32, Software for EMC Measurements, Version 8.53.0

Notes: None

Section 8. Testing data

8.1 FCC 15.231(a) and RSS-210 A1.1.1 Conditions for intentional radiators to comply with periodic operation

8.1.1 Definitions and limits

FCC:

(a) The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

IC:

The following conditions shall be met to comply with the provisions for momentary operation:

(a) A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all transmission times. When released, the transmitter shall cease transmission (holdover time of up to 5 seconds is permitted).

(b) A transmitter activated automatically shall cease transmission within 5 seconds after activation (i.e. maximum 5 seconds of operation).

(c) Periodic transmissions at regular predetermined intervals are not permitted, except as provided in Section A.1.1.5. However, polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmission does not exceed 2 seconds per hour for each transmitter.

(d) Intentional radiators employed for radio control purposes during emergencies involving fire, security of goods (e.g. burglar alarms), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

8.1.2 Test summary

Verdict	Pass				
Test date	February 25, 2016	Test engineer	David Duchesne		
Temperature	22.2 °C	Relative humidity	974.3 %	Air pressure	42.1 mbar

8.1.3 Observations, settings and special notes

None

8.1.4 Test data

1) The EUT is not manual triggered.
2) The EUT generates automatic transmission when it is signaling an alarm. Transmission ceases within 5 seconds. (**See Figure 8.1-1)**
3) The EUT transmits periodic integrity polling messages, not exceeding 2 seconds of transmission per hour.
4) The EUT usage is for radio control purposes during emergencies. See client provided details below.
5) The EUT does not transmit set-up information

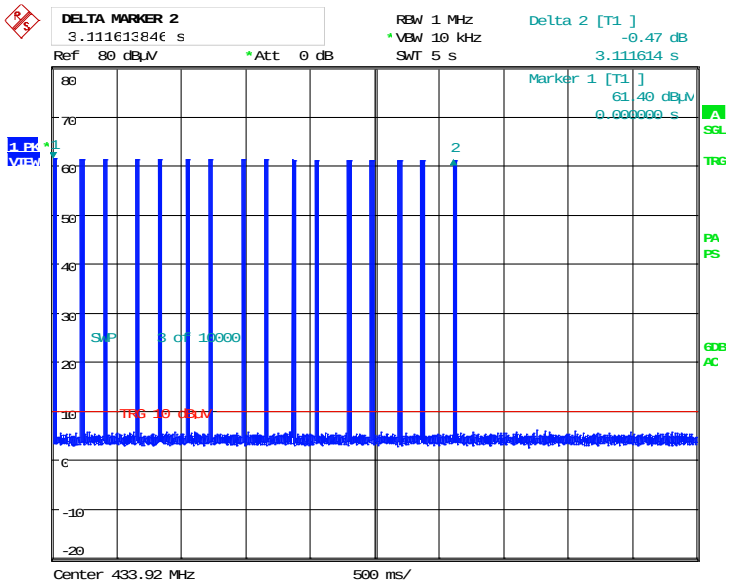


Figure 8.1-1: *Transmission time*

Details as provided by applicant.

The supervisory event is 2 transmissions every 60 minutes.
In case of alarm event or temper, 16 transmissions are transmitted in order to ensure alarm is received by the receiver. All these pulses are identical; repeating is to increase reliability of transmission protocol. All data transmitted by the device is using the same formatting of the pulse train.
Total duration is 2.5 ms header + 48 bit × 0.5 ms = 26.5 ms.
Total ON time worst case for each data train of pulses is:

- Header: 10 × 250 µs = 2.5 ms
- Sync bits: 4 × 250 µs = 1.0 ms
- Status byte: CF = 6 × 250 µs = 1.5 ms; Serial number: 8F FE FE = 19 × 250 µs = 4.75 ms
- CRC: TBD (maximum eight 1's)
- Total ON time per transmission: 37 × 0.25 ms + 2.5 ms = 11.75 ms

Within a typical hour we can assume 2 supervisory events:
2 × 11.75 ms = 23.5 ms per hour, less than 2 s of transmission per hour.

8.2 FCC 15.231(b) and RSS-210 A1.1.2 Field strength of emissions

8.2.1 Definitions and limits

FCC:

(b) In addition to the provisions of §15.205 the field strength of emissions from intentional radiators operated under this section shall not exceed the following table. (Table 8.2-1)

1) The field strength limits in the table are specified at a distance of 3 meters. The tighter limits apply at the band edges.
2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
3) The limits on the field strength of the spurious emissions in the table below are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

IC:

1) The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits in below. (Table 8.2-2)
2) Intentional radiators shall demonstrate compliance with the field strength limits shown in (Table 8.2-2), based on the average value of the measured emissions.
   Alternatively, compliance with the limit in (Table 8.2-2) may be demonstrated using a CISPR quasi-peak detector. If average measurements are employed, the requirements of Pulsed Operation of RSS-Gen apply regarding pulsed operation for averaging pulsed emissions and for limiting peak emissions.
3) The field strength limits shown in (Table 8.2-2) are based on the fundamental frequency of the intentional radiator. Unwanted emissions shall be attenuated to the limits listed in RSS-Gen or to the limits shown in table below, whichever are less stringent.

Table 8.2-1: *Field strength limits*

Fundamental frequency	Field strength of fundamental		Field strength of spurious emissions	
(MHz)	(µV/m)	(dBµV/m)	(µV/m)	(dBµV/m)
40.66–40.70[1]	2,250	67	225	47
70–130	1,250	61.9	125	41.9
130–174	1,250 to 3,750*	61.9 to 71.5*	125 to 375*	41.9 to 51.5*
174–260	3,750	71.5	375	51.5
260–470	3,750 to 12,500*	71.5 to 81.9*	375 to 1,250*	51.5 to 61.9*
Above 470	12,500	81.9	1,250	61.9

Notes: [1]The levels applicable to FCC only. For IC field strength shall not exceed 10 µV/m (80 dBµV/m) measured at 3 m with an average meter. Alternatively, it shall not exceed 233 mV/m measured with a quasi-peak meter. (Note: Do not use the above to convert average meter readings to quasi-peak values.)
Outside the 40.65–40.71 MHz band, the general field strength limits listed in RSS-Gen shall apply, except for harmonics, which shall not exceed 225 µV/m at 3 m.

* Linear interpolation with frequency F in MHz:
For 130–174 MHz: FS (microvolts/m) = (56.82 × F) – 6136
For 260–470 MHz: FS (microvolts/m) = (41.67 × F) – 7083

The frequency band 225–399.9 MHz is allocated for Government of Canada usage. There are different types of operations in different parts of this band of frequencies, including communications with aircraft and operations using high-power transmitters. Besides avoiding the restricted frequency bands listed in RSS-Gen, it is recommended that the entire 225–399.9 MHz band be avoided.

8.2.1 Definitions and limits, continued

Table 8.2-2: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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.

Table 8.2-3: *IC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Notes: Certain frequency bands listed in Table 8.2-3 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.2-4: *FCC restricted frequency bands*

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			

Notes: None

8.2.2 Test summary

Verdict	Pass				
Test date	February 25, 2016	Test engineer	David Duchesne		
Temperature	22.2 °C	Relative humidity	974.3 %	Air pressure	42.1 mbar

8.2.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

Setup details

EUT setup configuration	Table top
Test facility	3 m Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1–4 m
Turn table position	0–360°

8.2.4 Test data

§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.

$$Duty\ cycle\ or\ average\ factor = 20 \times \log_{10}\left(\frac{Tx_{100_{ms}}}{100_{ms}}\right)$$

Duty cycle/average factor calculations

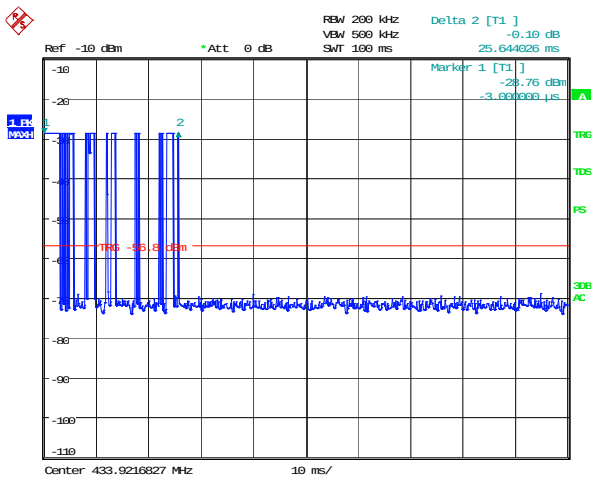


Figure 8.2-1: *Burst over 100 ms*

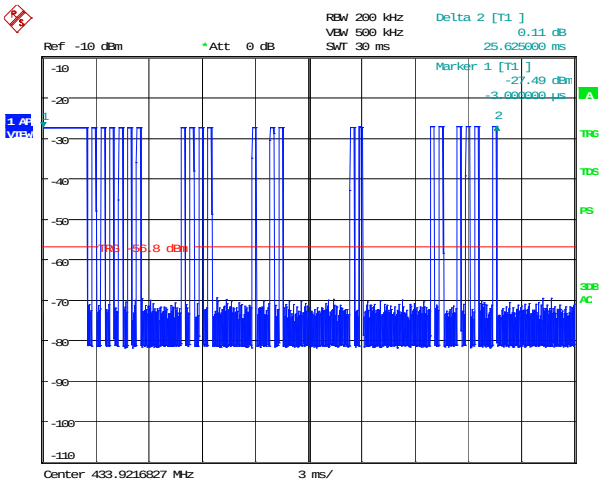


Figure 8.2-2: *Burst length*

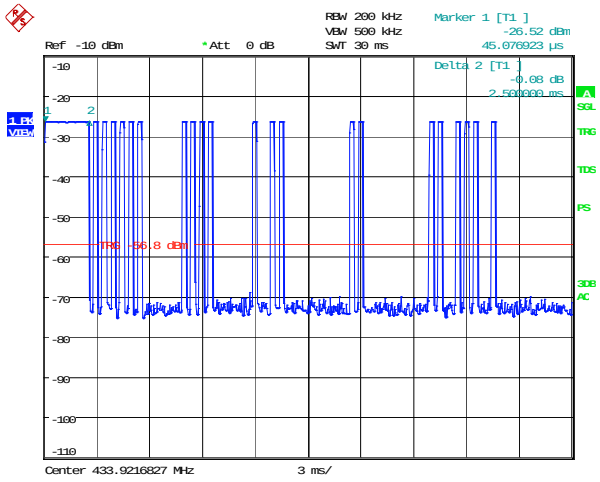


Figure 8.2-3: *Long pulse*

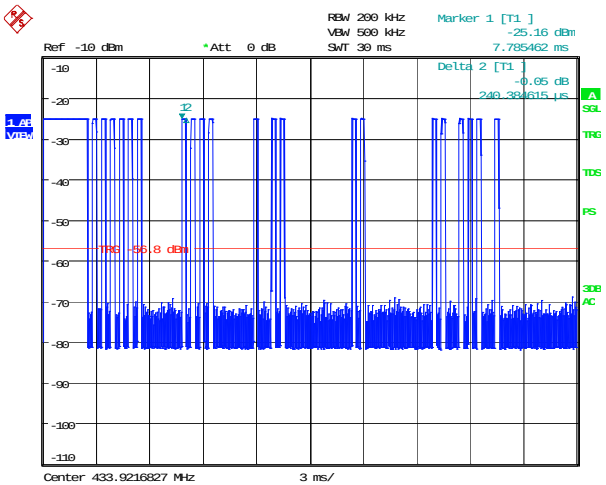


Figure 8.2-4: *Short pulse*

8.2.4 Test data, continued

Measured Duty cycle:
Total ON time for data train:

- Long pulse: 2.5 ms =2.50 ms (1x)
- Short pulse: 5.04 ms = 0.24 ms (x21)
- Total ON time per transmission: 7.54 ms = 2.5ms (long pulse) + 5.04 (short pulses)

$Tx_{100\ ms}$ = 7.54 ms

Duty cycle as provide by client:
Total duration is 2.5 ms header + 48 bit x 0.5 ms = 26.5 ms.
Total ON time worst case for each data train of pulses is:

- Header: 10 × 250 µs = 2.5 ms
- Sync bits: 4 × 250 µs = 1.0 ms
- Status byte: CF = 6 × 250 µs = 1.5 ms
- Serial number: 8F FE FE = 19 × 250 µs = 4.75 ms
- CRC: TBD (maximum eight '1's): 8 × 250 µs =2 ms
- Total ON time per transmission: 37 × 0.25 ms + 2.5 ms = 11.75 ms

$Tx_{100\ ms}$ = 11.75 ms

Therefor utilized the declared clients Duty cycle.

$$Duty\ cycle/average\ factor = 20 \times Log_{10}\left(\frac{Tx_{100\ ms}}{100\ ms}\right) = 20 \times Log_{10}\left(\frac{11.75\ ms}{100\ ms}\right) = -18.6\ dB$$

8.2.4 Test data, continued

Table 8.2-5: *Field Strength of Fundamental results*

Freq. (MHz)	Ant. Pol. (V/H)	Meas. peak field strength[1] (dBµV/m)	Peak field strength limit (dBµV/m)	Peak field strength margin[3] (dB)	Duty cycle correction factor (dB)	Calculated average field strength[2] (dBµV/m)	Average field strength limit (dBµV/m)	Average field strength margin[3] (dB)
433.92	V	90.2	100.8	10.6	-18.6	71.6	80.8	9.2
433.92	H	96.1	100.8	4.7	-18.6	77.5	80.8	3.3

Notes: [1] Field strength (dBµV/m) = spectrum analyzer value (dBµV) + correction factor (dB)

Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)
Sample calculation: 96.1 dBµV/m (field strength) = 76.2 dBµV (receiver reading) + 19.9 dB (Correction factor)

[2] Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle correction factor (dB). Duty cycle correction factor as calculated from §15.35 (c)

[3] Margin (dB) = field strength limit − field strength measurement

Table 8.2-6: *Field Strength of Spurious emissions (Harmonic) results*

Freq. (MHz)	Ant. Pol. (V/H)	Meas. peak field strength[1] (dBµV/m)	Peak field strength limit (dBµV/m)	Peak field strength margin[3] (dB)	Duty cycle correction factor (dB)	Calculated average field strength[2] (dBµV/m)	Average field strength limit (dBµV/m)	Average field strength margin[3] (dB)
3471.36	H	59.4	80.8	21.4	-18.6	40.8	60.8	20.0

Notes: [1] Field strength (dBµV/m) = spectrum analyzer value (dBµV) + correction factor (dB)

Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)
Sample calculation: 59.4 dBµV/m (field strength) = 70.3 dBµV (receiver reading) + (−10.9 dB) (Correction factor)

[2] Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle correction factor (dB). Duty cycle correction factor as calculated from §15.35 (c)

[3] Margin (dB) = field strength limit − field strength measurement

All other spurious emissions (Harmonics) were greater that 20 dB from limit.

Table 8.2-7: *Field Strength of Spurious emissions falling within restricted bands FCC and IC results*

Freq. (MHz)	Ant. Pol. (V/H)	Meas. peak field strength[1] (dBµV/m)	Peak field strength limit (dBµV/m)	Peak field strength margin[3] (dB)	Duty cycle correction factor (dB)	Calculated average field strength[2] (dBµV/m)	Average field strength limit (dBµV/m)	Average field strength margin[3] (dB)
3037.44	H	56.2	74.0	17.8	-18.6	37.6	54.0	16.4
3905.28	H	64.6	74.0	9.4	-18.6	46.0	54.0	8.0
4339.20	H	60.7	74.0	13.3	-18.6	42.1	54.0	11.9

Notes: [1] Field strength (dBµV/m) = spectrum analyzer value (dBµV) + correction factor (dB)

Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)
Sample calculation: 64.6 dBµV/m (field strength) = 74.5 dBµV (receiver reading) + (−9.9 dB) (Correction factor)

[2] Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle correction factor (dB). Duty cycle correction factor as calculated from §15.35 (c)

[3] Margin (dB) = field strength limit − field strength measurement

All other spurious emissions falling within restricted bands were greater that 20 dB from limit.

8.2.5 Setup photos

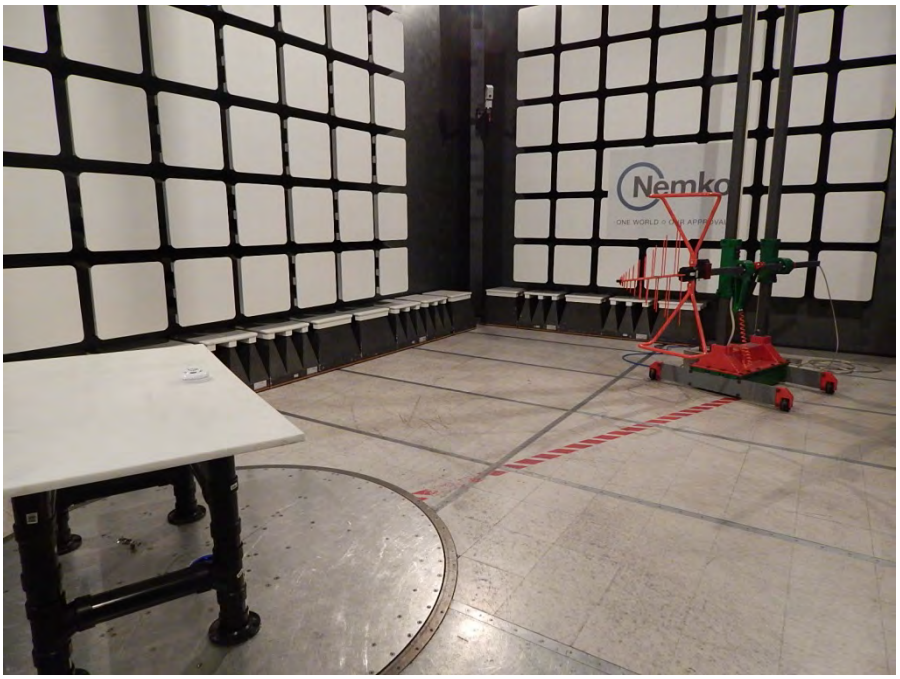


Figure 8.2-5: *Emissions setup photo – 30 to 1000 MHz*

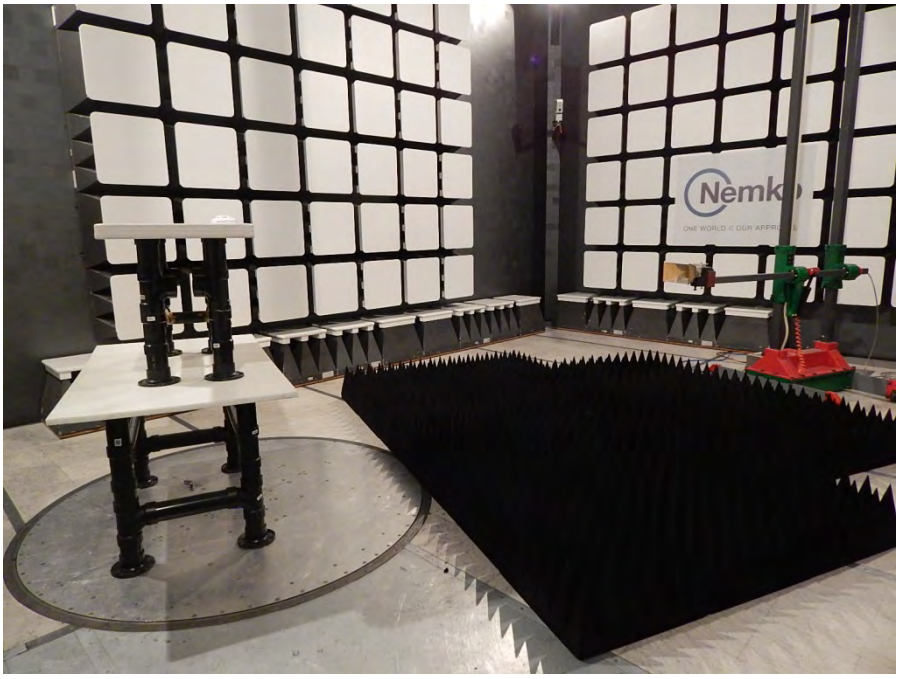


Figure 8.2-6: *Emissions setup photo – above 1 GHz*

8.3 FCC 15.231(c) and RSS-210 A1.1.3 Emission bandwidth of momentary signals

8.3.1 Definitions and limits

FCC:
The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

IC:
For the purpose of Section A1.1, the 99 % bandwidth shall be no wider than 0.25 % of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the centre frequency.

8.3.2 Test summary

Verdict	Pass				
Test date	February 25, 2016	Test engineer	David Duchesne		
Temperature	22.2 °C	Relative humidity	974.3 %	Air pressure	42.1 mbar

8.3.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	≥ 1 % of emission bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	Wider than emission bandwidth
Detector mode	Peak

8.3.4 Test data

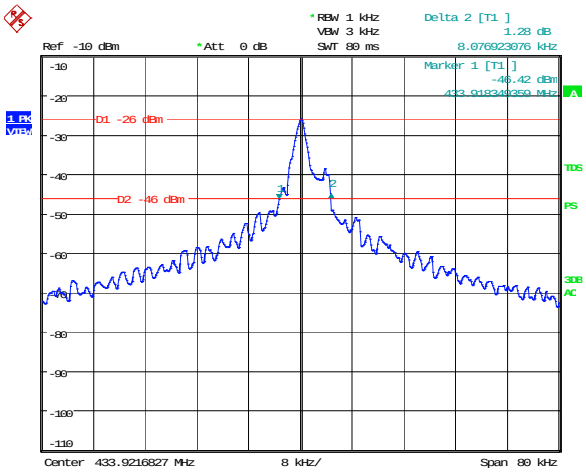


Figure 8.3-1: *20 dB bandwidth*

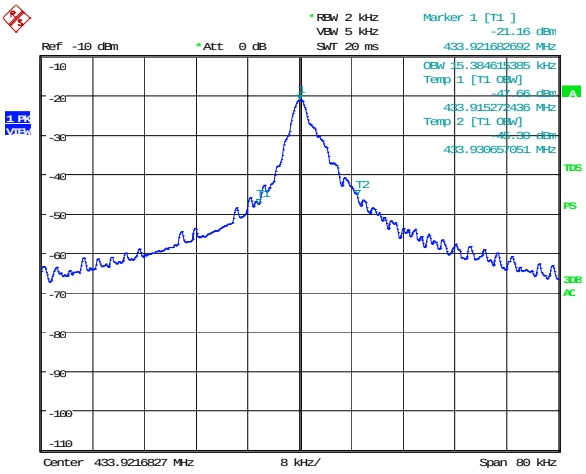


Figure 8.3-2: *99 % bandwidth*

Table 8.3-1: *20 dB bandwidth results*

20 dB bandwidth (kHz)	Limit (kHz)	Margin, kHz
8.0	1084.8	1076

Notes: Limit: 0.25 % of 433.92 MHz is 1084.8 kHz

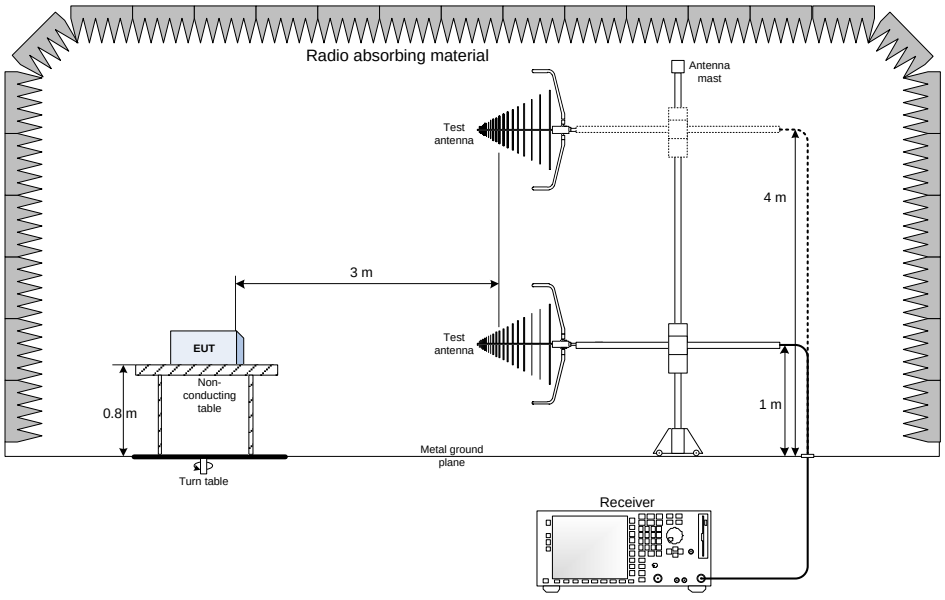
Table 8.3-2: *99 % bandwidth results*

99 % bandwidth (kHz)	Limit (kHz)	Margin, kHz
15.4	1084.8	1069.4

Notes: Limit: 0.25 % of 433.92 MHz is 1084.8 kHz

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz