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Report Reference ID	163855-2TRFWL
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Test specification	Title 47 - Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart C - Intentional Radiators §15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
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Applicant	Cattron Group International 58 West Shenango St Sharpsville, PA, USA 16150
Product name	Toggle Controller
Product category	SRD
Model	7700T15
Part number	T01-67651018
FCC ID	CN27700T15

Testing laboratory	Nemko Canada Inc. 303 River Road Ottawa, ON, Canada K1V 1H2 Telephone: (613) 737-9680 Facsimile: (613) 737-9691
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	Name and title	Date
Tested by:	David Duchesne, Senior Wireless/EMC Specialist	February 22, 2011
Reviewed by:	 Sim Jagpal, General Manager	February 22, 2011



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The tests included in this report are within the scope of this accreditation.

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Section 1: Report summary

1.1 Test specification

FCC Part 15 Subpart C, 15.231

Periodic operation in the band 40.66–40.70 MHz and above 70 MHz

1.2 Statement of compliance

In the configuration tested the EUT was found compliant

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.

See “Summary of test results” for full details.

1.3 Exclusions

None

1.4 Registration number

Test site FCC ID number: 176392 (3 m Semi anechoic chamber)

1.5 Test report revision history

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

1.6 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.

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Section 2: Summary of test results

2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

General requirements for FCC Part 15

Part	Test description	Verdict
§15.31(e)	Variation of power source	See Note 1
§15.31(m)	Number of operating frequencies	See Note 2
§15.203	Antenna requirement	See Note 3
§15.207(a)	Conducted limits	Not applicable (See Note 4)

Specific requirements for FCC Part 15 Subpart C, 15.231

Part	Test description	Verdict
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	---
§15.231(a)(1)	Manually operated transmitter	Pass
§15.231(a)(2)	Automatically activated transmitter	Not applicable (See Note 5)
§15.231(a)(3)	Periodic transmissions at regular predetermined intervals	Not applicable (See Note 6)
§15.231(a)(4)	Radiators used in cases of emergency	Not applicable (See Note 7)
§15.231(a)(5)	Set-up information transmission for security systems	Not applicable (See Note 8)
§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 (See Note 9)
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Not applicable (See Note 10)

Notes:

1. Transmitter was measured while supply voltage was varied from 10.2 to 13.8 VDC (85 to 115 % of the nominal rated supply voltage). No change in transmit output power was observed. All tests were performed with a fully charged battery.
2. The frequency range over which the device operates is greater than 10 MHz. Tests were performed on three operating channels. (low, mid and high)
3. Antenna is an integral.
4. EUT is battery powered only.
5. The EUT is not activated automatically.
6. EUT does not support periodic transmissions at regular predetermined intervals.
7. The EUT is not intended for use in case of emergencies.
8. The EUT does not transmit set-up information for security systems.
9. The EUT does not operate within 40.66–40.70 MHz band
10. Requirement not applicable as the EUT was assessed to §15.231(a).

Section 3: Equipment under test (EUT) and application details

3.1 Product details

Product name	Toggle Controller
Model	7700T15
Part number	T01-67651018
Serial number	67651018

3.2 Sample information

Receipt date:	December 22, 2010
Nemko sample ID number:	Item # 2

3.3 EUT technical specifications

Operating band	447 – 473 MHz
Operating frequency	447 – 473 MHz
Modulation type	GFSK
Channel spacing	12.5 kHz
Occupied bandwidth	9.78 kHz
Antenna data	Integral
Power source	12 VDC

3.4 EUT description

The unit is a Industrial telecommand system used to control cranes and machines.

Switch functions are encoded into a secure digital serial data frame that is transmitted via RF to a corresponding decoder mounted on the crane or machine, this decoder converts the serial data back to relay output commands for the machines electrical control.

3.5 Operation of the EUT during testing

EUT was set for continuous transmission

3.6 EUT 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 test procedures.

Section 5: Test conditions

5.1 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 ± 5 %, for which the equipment was designed.

Section 6: 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.

Section 7: Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/11
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	April. 14/11
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Dec.06/11
1–18 GHz amplifier	JCA	JCA118-503	FA002091	1 year	Sept. 23/11
Horn antenna #2	Emco	3115	FA000825	1 year	Jan. 18/11
Horn antenna #1	Emco	3115	FA000649	1 year	Feb 09/11
Bilog antenna	Sunol	JB3	FA002108	1 year	Jan. 18/11

Note: N/A = Not applicable, NCR = No cal required, COU = Cal on use

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Toggle Controller	
	Test name: Clause 15.231 (a) Conditions for intentional radiators to comply with periodic operation			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

Section 8: Testing data

8.1 Clause 15.231(a) Conditions for intentional radiators to comply with periodic operation

- (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.

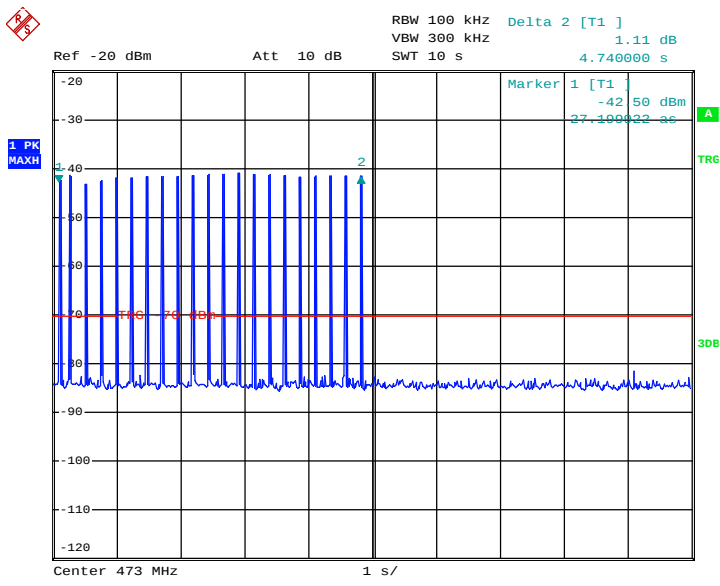
Special notes

None

Test data

The EUT transmitter is manually operated. The EUT is equipped with momentary or spring return type switches that automatically release after use.

Plot for the timing of a manually trigger event.



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Manually operated transmitter, deactivates within 5 seconds after being enabled

8.2 Clause 15.231(b) Field strength of emissions

- (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:

Fundamental frequency (MHz)	Field strength of fundamental		Field strength of spurious emissions	
	($\mu\text{V/m}$)	(dB $\mu\text{V/m}$)	($\mu\text{V/m}$)	(dB $\mu\text{V/m}$)
40.66–40.70	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

* Linear interpolations

- (1) The above field strength limits 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 above table 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.

Special notes

§15.209 – Radiated emission limits; general requirements.

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

§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			

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Toggle Controller	
	Test name: Clause 15.231(b) Field strength of emissions			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

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.

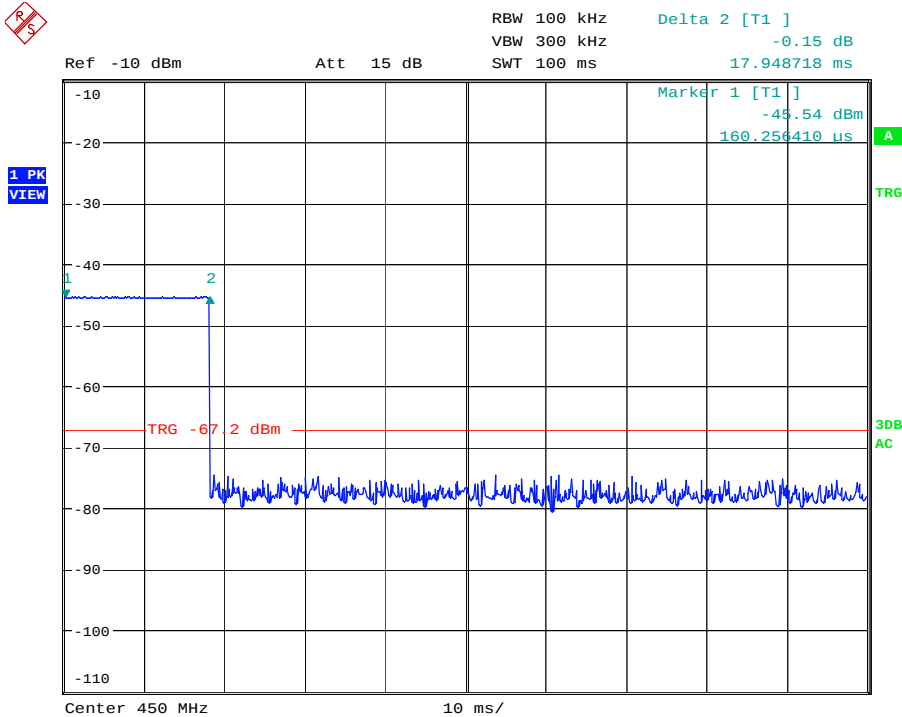
Duty cycle correction factor calculation:

Total on-time of transmitter within 100 ms = 17.948 ms

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

Duty Cycle correction factor = -14.91 dB

Sample plot



Ref -10 dBm Att 15 dB RBW 100 kHz Delta 2 [T1] -0.15 dB
VBW 300 kHz 17.948718 ms
SWT 100 ms

Marker 1 [T1] -45.54 dBm 160.256410 us

TRG -67.2 dBm 3DB AC

Center 450 MHz 10 ms/

Date: 11.JAN.2011 18:17:00

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	Test name: Clause 15.231(b) Field strength of emissions			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

Test data continued

Field strength of fundamental

Channel	Fundamental freq. (MHz)	Antenna Pol.	Peak field strength (dB μ V/m)	Peak field strength limit (dB μ V/m)	Peak margin (dB)	Duty cycle correction factor (dB)	Average field strength (dB μ V/m)	Average field strength limit (dB μ V/m)	Average margin (dB)
Low	447	V	90.90	101.1	10.20	-14.91	75.99	81.1	5.11
		H	84.00	101.1	17.10	-14.91	69.09	81.1	12.01
Middle	460	V	92.60	101.5	8.90	-14.91	77.69	81.5	3.81
		H	89.80	101.5	11.70	-14.91	74.89	81.5	6.61
High	473	V	94.00	101.9	7.90	-14.91	79.09	81.9	2.81
		H	92.30	101.9	9.60	-14.91	77.39	81.9	4.51

Field strength of spurious emissions (harmonics)

Channel	Freq. (MHz)	Antenna Pol.	Peak field strength (dB μ V/m)	Peak field strength limit (dB μ V/m)	Peak margin (dB)	Duty cycle correction factor (dB)	Average field strength (dB μ V/m)	Average field strength limit (dB μ V/m)	Average margin (dB)
Low	894	V	56.50	81.1	24.60	-14.91	41.59	61.1	19.51
Low	1788	V	42.00	81.1	39.10	-14.91	27.09	61.1	34.01
Low	2682	V	45.17	81.1	35.83	-14.91	30.26	61.1	30.84
Low	3129	V	44.53	81.1	36.57	-14.91	29.62	61.1	31.48
Low	3576	V	48.00	81.1	33.1	-14.91	33.09	61.1	28.01
Low	4470	V	46.80	81.1	34.30	-14.91	31.89	61.1	29.21
Mid	920	V	51.39	81.5	30.11	-14.91	36.48	61.5	25.02
Mid	1840	H	42.71	81.5	38.79	-14.91	27.80	61.5	33.70
Mid	3220	V	45.00	81.5	36.50	-14.91	30.09	61.5	31.41
High	946	H	60.20	81.9	21.70	-14.91	45.29	61.9	16.61
High	1892	H	42.00	81.9	39.90	-14.91	27.09	61.9	34.81
High	3311	V	43.48	81.9	38.42	-14.91	28.57	61.9	33.33

- Test distance = 3 m
- Peak field strength measurement has been corrected with transducer factors (i.e. antenna factor, and cable loss)
- The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.
- All test were performed with transmitter set to maximum power.
- Spectrum analyzer settings 30 MHz to 1000MHz:
 - Peak detector RBW = 100 kHz, VBW = 300 kHz
 - Measurement time 100 ms
- Spectrum analyzer settings above 1 GHz:
 - Peak detector RBW = 1 MHz, VBW = 3 MHz
 - Measurement time 100 ms
- Average result was calculated from duty cycle/average factor.
- Only the worst case emissions have been presented in the test report.
- EUT was tested in three orthogonal positions.

Sample calculation for peak field strength (dB μ V/m):

Correction factor (dB) = antenna factor ACF (dB) + cable loss (dB)

Peak field strength (dB μ V/m) = **XX** dB μ V (reading from receiver/spectrum analyzer) + **XX** dB (Correction factor)

Sample calculation for Average field strength (dB μ V/m):

Average field strength (dB μ V/m) = Peak field strength (dB μ V/m) + Duty cycle correction factor (dB)

 Nemko Canada Inc., 303 River Rd. Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Toggle Controller	
	Test name: Clause 15.231(b) Field strength of emissions			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

Test data continued

Field strength of spurious emissions (harmonics) within restricted bands as defined §15.205

Channel	Freq. (MHz)	Antenna Pol.	Peak field strength (dBμV/m)	Peak field strength limit (dBμV/m)	Peak margin (dB)	Duty cycle correction factor (dB)	Average field strength (dBμV/m)	Average field strength limit (dBμV/m)	Average margin (dB)
Low	1341	V	39.00	74	35.00	-14.91	24.09	54	29.91
Low	2235	H	43.23	74	30.77	-14.91	28.32	54	25.68
Low	4023	V	47.50	74	26.50	-14.91	32.59	54	21.41
Mid	1380	H	40.80	74	33.20	-14.91	25.89	54	28.11
Mid	2300	V	42.71	74	31.29	-14.91	27.80	54	26.20
Mid	2760	V	44.25	74	29.75	-14.91	29.34	54	24.66
Mid	3680	H	45.85	74	28.15	-14.91	30.94	54	23.06
Mid	4140	V	47.30	74	26.70	-14.91	32.39	54	21.61
Mid	4600	V	48.10	74	25.90	-14.91	33.19	54	20.81
High	1419	H	44.00	74	30.00	-14.91	29.09	54	24.91
High	2365	V	41.98	74	32.02	-14.91	27.07	54	26.93
High	2838	H	45.00	74	29.00	-14.91	30.09	54	23.91
High	3784	H	45.68	74	28.32	-14.91	30.77	54	23.23
High	4257	H	49.30	74	24.70	-14.91	34.39	54	19.61
High	4730	H	47.09	74	26.91	-14.91	32.18	54	21.82

- Test distance = 3 m
- Peak field strength measurement has been corrected with transducer factors (i.e. antenna factor, and cable loss)
- The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.
- All test were performed with transmitter set to maximum power.
- Spectrum analyzer settings 30 MHz to 1000MHz:
 - Peak detector RBW = 100 kHz, VBW = 300 kHz
 - Measurement time 100 ms
- Spectrum analyzer settings above 1 GHz:
 - Peak detector RBW = 1 MHz, VBW = 3 MHz
 - Measurement time 100 ms
- Average result was calculated from duty cycle/average factor.
- Only the worst case emissions have been presented in the test report.
- EUT was tested in three orthogonal positions.

Sample calculation for peak field strength (dBμV/m):

Correction factor (dB) = antenna factor ACF (dB) + cable loss (dB)

Peak field strength (dBμV/m) = **XX** dBμV (reading from receiver/spectrum analyzer) + **XX** dB (Correction factor)

Sample calculation for Average field strength (dBμV/m):

Average field strength (dBμV/m) = Peak field strength (dBμV/m) + Duty cycle correction factor (dB)

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Toggle Controller	
	Test name: Clause 15.231(b) Field strength of emissions			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

Test data, continued

Spurious emissions 30 to 1000 MHz

Low channel: No emissions detected within 10 dB of Limit.

Mid channel: No emissions detected within 10 dB of Limit.

High channel: No emissions detected within 10 dB of Limit.

- All test were performed with transmitter set to maximum power.
- Test distance = 3 m
- Receiver settings:
 - Q-Peak detector RBW = 120 MHz, VBW = 300 kHz
 - Measurement time 100 ms

Spurious emissions 1000 to 5000 MHz

Low channel: No emissions detected within 10 dB of Limit.

Mid channel: No emissions detected within 10 dB of Limit.

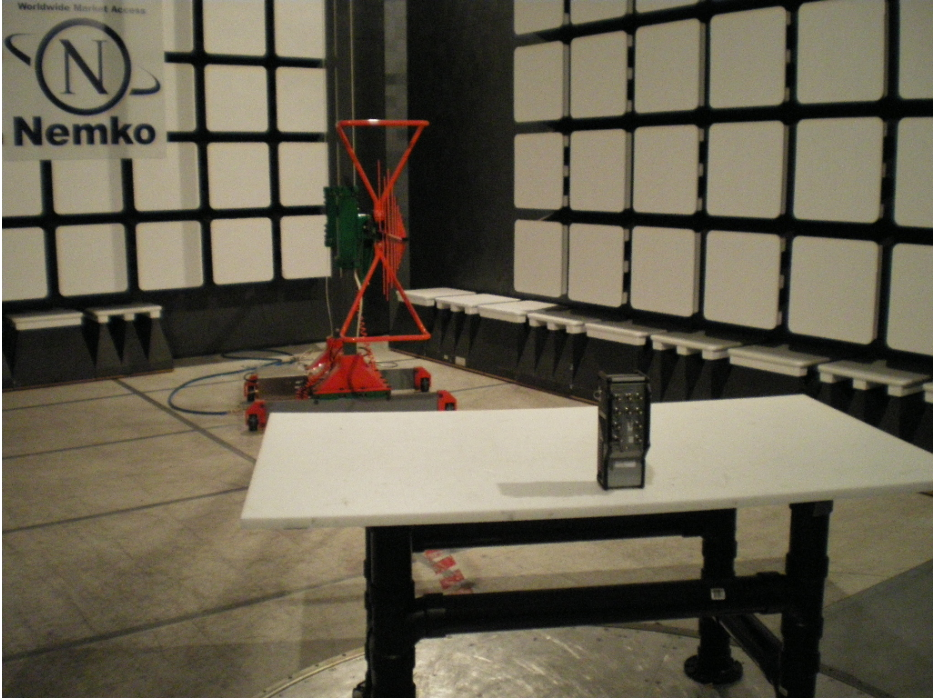
High channel: No emissions detected within 10 dB of Limit.

- All test were performed with transmitter set to maximum power.
- Test distance = 3 m
- Receiver settings:
 - Peak detector RBW = 1 MHz, VBW = 3 MHz
 - Average detector RBW = 1 MHz, VBW = 10 Hz
 - Measurement time 100 ms

 Nemko Canada Inc., 303 River Rd, Ottawa, ON, Canada, K1V 1H2	Section 8: Testing data		Product: Toggle Controller	
	Test name: Clause 15.231(b) Field strength of emissions			
	Test date: January 18, 2011		Test engineer: David Duchesne	Verdict: Pass
	Specification: FCC Part 15 Subpart C			

Test data, continued

Setup photos




8.3 Clause 15.231 (c) Emission bandwidth

(c) 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.

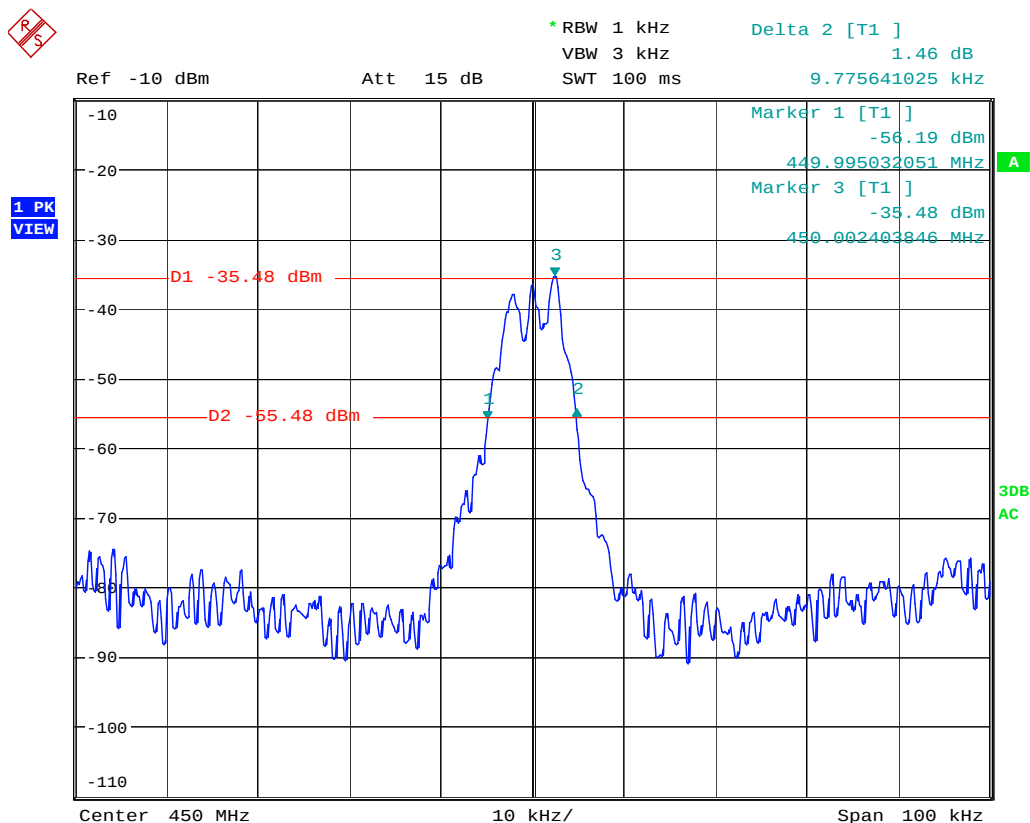
Special notes

The test was performed using peak detector of the spectrum analyzer with RBW no narrower than 1 % of the emission bandwidth.

Test data

Frequency Tx (MHz)	Measured 20 dB bandwidth (kHz)	Limit (MHz)
450	9.78	1.125
Limits 0.25 % of 450 MHz is 1.125 MHz		

Sample spectral plots



Date: 11.JAN.2011 18:33:48

Section 8: Block diagrams of test set-ups

Radiated emissions set-up

