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RADIO TEST REPORT – 410188-1TRFWL

Type of assessment:

Final product testing

Applicant:

Donaldson Company, Inc.

Product:

Donaldson Universal Transmitter

Model:

X220138

Model name variant:

Digital Universal Transmitter

FCC ID:

2AUOQ-220138

IC Registration number:

26859-220138

Specifications:

- ◆ **FCC 47 CFR Part 15, Subpart C, §15.231**
- ◆ **RSS-210 Annex A.1, Issue 10, December 2019**

Date of issue:

January 27, 2021

Andrey Adelberg, Senior EMC/RF Specialist

Tested by

Signature

David Duchesne, EMC/RF Lab Manager

Reviewed by

Signature



Company name	Nemko Canada Inc.			
Facilities	<i>Ottawa site:</i> 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	<i>Montréal site:</i> 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	<i>Cambridge site:</i> 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	<i>Almonte site:</i> 1500 Peter Robinson Road West Carleton, Ontario Canada KOA 1L0 Tel: +1 613 256-9117
Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

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

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Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Test specifications	4
1.2 Test methods.....	4
1.3 Exclusions	4
1.4 Statement of compliance	4
1.5 Test report revision history	4
Section 2. Engineering considerations	5
2.1 Modifications incorporated in the EUT for compliance	5
2.2 Technical judgment	5
2.3 Deviations from laboratory tests procedures	5
Section 3. Test conditions	6
3.1 Atmospheric conditions	6
3.2 Power supply range.....	6
Section 4. Measurement uncertainty	7
4.1 Uncertainty of measurement	7
Section 5. Information provided by the applicant	8
5.1 Disclaimer.....	8
5.2 Applicant/Manufacture	8
5.3 EUT information	8
5.4 Radio technical information	8
5.5 EUT setup details.....	9
Section 6. Summary of test results	10
6.1 Testing location	10
6.2 Testing period	10
6.3 Sample information.....	10
6.4 FCC Part 15 Subpart A and C, general requirements test results.....	10
6.5 FCC Part 15 Subpart C, intentional radiators test results.....	10
6.6 ISED RSS-Gen, Issue 5, test results.....	11
6.7 ISED RSS-210, Issue 10, test results	11
Section 7. Test equipment	12
7.1 Test equipment list.....	12
Section 8. Testing data	13
8.1 Variation of power source	13
8.2 Number of frequencies	14
8.3 Antenna requirement.....	15
8.4 Conditions for intentional radiators to comply with periodic operation	16
8.5 Emission bandwidth of momentary signals.....	18
8.6 Field strength of emissions for periodic radiators (reduced).....	20
Section 9. Block diagrams of test set-ups	24
9.1 Radiated emissions set-up for frequencies below 1 GHz.....	24
9.2 Radiated emissions set-up for frequencies above 1 GHz.....	24

Section 1. Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.231	Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
RSS-210 Annex A.1, Issue 10, December 2019	Licence-Exempt Radio Apparatus: Category I Equipment. Momentarily operated devices

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus
RSS-102, Issue 5, March 19, 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. 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.

1.5 Test report revision history

Table 1.5-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	January 27, 2021	Original report issued

Section 2. Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

None

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3. Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (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.

3.2 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 $\pm 5\%$, for which the equipment was designed.

Section 4. Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

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

Table 4.1-1: Measurement uncertainty calculations

Test name	Measurement uncertainty, \pm dB
Occupied bandwidth	4.45
Radiated spurious emissions	3.78

Section 5. Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Applicant name	Donaldson Company, Inc.
Applicant address	2940 Airport Blvd. Waterloo, IA 50703 USA
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

Product	Donaldson Universal Transmitter
Model	X220138
Model variant(s)	Digital Universal Transmitter
Serial number	N/A E-Builds
Part number	X220138
Power supply requirements	Car Battery: 12 V(DC)
Product description and theory of operation	Unit receives digital signal data from connected sensor devices and transmits this information and its relevant components wirelessly using a pulse-modulated signal.

5.4 Radio technical information

Operation type	<input checked="" type="checkbox"/> Periodic <input type="checkbox"/> Non-periodic
Frequency band	260–470 MHz
Frequency Min (MHz)	434.3
Frequency Max (MHz)	434.3
RF power Max (W), Conducted	N/A
Field strength, dBµV/m @ 3 m	81.96 (peak)
Measured BW (kHz), 99% OBW	852.56
Type of modulation	Pulse
Emission classification	P1D
Transmitter spurious, dBµV/m @ 3 m	42.31 at 159.9 MHz
Antenna information	434 MHz SMT Loop Antenna, Ste Industries model:435355-02, 0dBi

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	Firmware used on DUT for Digital UTX device: UTX-Digital-V1-6.hex (revision date: 5/25/2020)
Transmitter state	Transmitter duty cycle was modified for testing to transmit every 500 ms once the EUT is energized.

5.5.2 EUT setup configuration

Table 5.5-1: EUT sub assemblies

Description	Brand name	Model, Part number, Serial number, Revision level
Universal Transmitter (digital device)	Donaldson	SN: n/a, PCB PN: 290090, MN: X220138, Rev. 01 (Engineering-builds)

Table 5.5-2: EUT interface ports

Description	Qty.
DC input	1
Digital Signal Input Port (for CAN2.0B signals)	1

Table 5.5-3: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
OPS1 Fluid Property Sensor	TE Sensors	SN: FPP800A110, PN: X220147, MN: FPS2800B12C4, Rev. 02

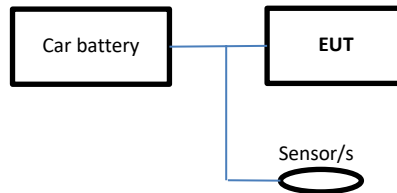


Figure 5.5-1: Test setup block diagram

Section 6. Summary of test results

6.1 Testing location

Test location (s) Ottawa

6.2 Testing period

Test start date December 14, 2020 Test end date December 16, 2020

6.3 Sample information

Receipt date December 14, 2020 Nemko sample ID number(s) 1, 2

6.4 FCC Part 15 Subpart A and C, general requirements test results

Table 6.4-1: FCC general requirements results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass

Notes: EUT is a battery operated device, the testing was performed using fresh batteries.

6.5 FCC Part 15 Subpart C, intentional radiators test results

Table 6.5-1: FCC requirements results

Part	Test description	Verdict
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	Not applicable
§15.231(b)	Field strength of emissions	Pass
§15.231(c)	Emission bandwidth	Pass
§15.231(d)	Frequency tolerance for devices operating within 40.66–40.70 MHz band	Not applicable ¹
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Pass

Notes: ¹EUT does not operate in 40.66–40.70 MHz band

6.6 ISED RSS-Gen, Issue 5, test results

Table 6.6-1: RSS-Gen requirements results

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable

Notes: ¹According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
EUT is a battery operated device, the testing was performed using fresh batteries.

6.7 ISED RSS-210, Issue 10, test results

Table 6.7-1: ISED requirements results

Section	Test description	Verdict
A.1.1	Technical requirements	Pass
A.1.2	Field strengths	Not applicable
A.1.3	Bandwidth of momentary signals	Pass
A.1.4	Reduced field strengths	Pass

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.
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	April 31, 2021
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	November 6, 2021
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	April 30, 2021
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	January 25, 2021
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	October 13, 2021
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130	FA002674	1 year	September 23, 2021

Section 8. Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

FCC §15.31:

- (e) 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.

8.1.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 14, 2020

8.1.3 Observations, settings and special notes

None

8.1.4 Test data

EUT Power requirements:

- | | | | |
|---|---|-----------------------------|---|
| | <input type="checkbox"/> AC | <input type="checkbox"/> DC | <input checked="" type="checkbox"/> Battery |
| If EUT is an AC or a DC powered, was the noticeable output power variation observed? | <input type="checkbox"/> YES | <input type="checkbox"/> NO | <input checked="" type="checkbox"/> N/A |
| If EUT is battery operated, was the testing performed using fresh batteries? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | <input type="checkbox"/> N/A |
| If EUT is rechargeable battery operated, was the testing performed using fully charged batteries? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | <input type="checkbox"/> N/A |

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or 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.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: Frequency Range of Operation

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 14, 2020

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

EUT transmits on one frequency only: 434.3 MHz

8.3 Antenna requirement

8.3.1 References, definitions and limits

FCC §15.203:

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. 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.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list. For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 14, 2020

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

Must the EUT be professionally installed? YES NO
Does the EUT have detachable antenna(s)? YES NO
 If detachable, is the antenna connector(s) non-standard? YES NO N/A

8.4 Conditions for intentional radiators to comply with periodic operation

8.4.1 References, definitions and limits

FCC §15.231:

- (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.

RSS-210 A.1.1:

Devices shall comply with the following for momentary operation:

- a. A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.
- b. A transmitter that has been activated automatically shall cease transmission within 5 seconds of activation.
- c. Periodic transmissions at regular, predetermined intervals are not permitted, except as specified in Section A.1.4. However, polling or supervision transmissions that determine system integrity of transmitters used in security or safety applications are permitted, provided the total duration of transmission does not exceed 2 seconds per hour for each transmitter.
- d. Intentional radiators used for radio control 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.

8.4.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 16, 2020

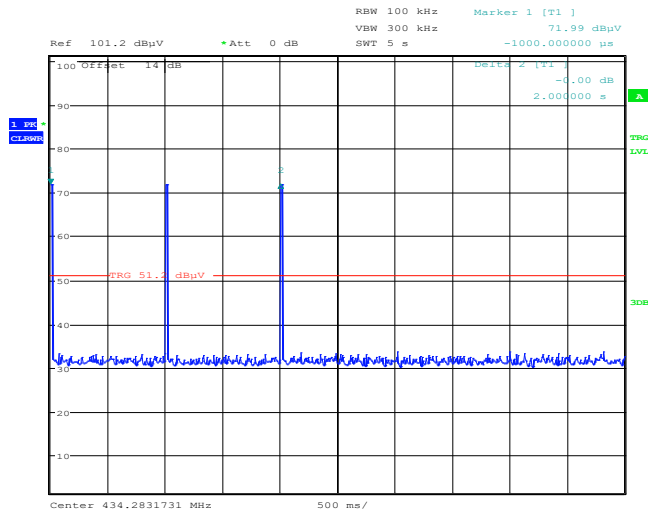
8.4.3 Observations, settings and special notes

None

8.4.4 Test data

- EUT is a manually triggered transmitter.
- EUT is an automatically triggered transmitter and ceases the transmission within 5 seconds.
- EUT is a periodic transmitter, therefore complies with reduced field strength requirements.
- The EUT usage is for radio control purposes during emergencies.
- The EUT usage is not for radio control purposes during emergencies.

- The EUT transmits set-up information.
- The EUT does not transmit set-up information.



Date: 16.DEC.2020 11:31:10

Figure 8.4-1: Transmission duration

8.5 Emission bandwidth of momentary signals

8.5.1 References, definitions and limits

FCC §15.231:

- (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.

RSS-210 A.1.3:

The occupied bandwidth of momentarily operated devices shall be less than or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the centre frequency.

8.5.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 15, 2020

8.5.3 Observations, settings and special notes

Limit: 0.25 % of 434.3 MHz is 1085.75 kHz

Spectrum analyser settings:

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

8.5.4 Test data

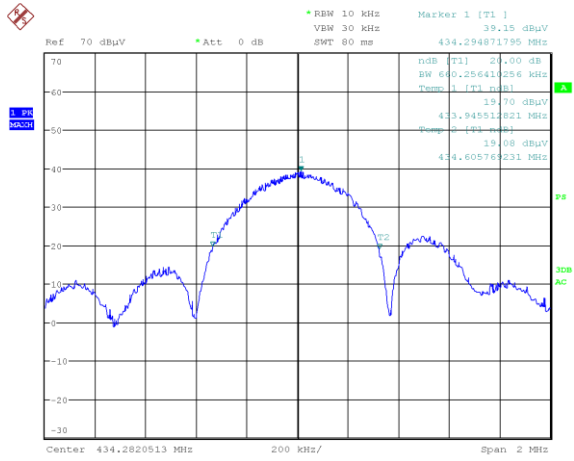
Table 8.5-1: 20 dB bandwidth measurement result

20 dB bandwidth, kHz	Limit, kHz	Margin, kHz
660.25	1085.75	425.5

Table 8.5-2: 99 % occupied bandwidth measurement result

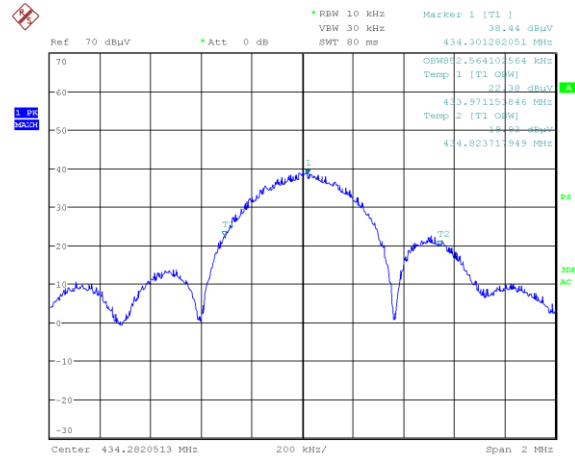
99 % occupied bandwidth, kHz	Limit, kHz	Margin, kHz
852.56	1085.75	425.5

Test data, continued



Date: 15.DEC.2020 13:43:33

Figure 8.5-1: 20 dB occupied bandwidth



Date: 15.DEC.2020 13:40:25

Figure 8.5-2: 99 % occupied bandwidth

8.6 Field strength of emissions for periodic radiators (reduced)

8.6.1 References, definitions and limits

FCC §15.231:

- (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

- (b)(1) The field strength limits in the table below are specified at a distance of 3 meters. The tighter limits apply at the band edges.
 (b)(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 table below, based on the average value of the measured emissions. As an alternative, compliance with the limits in the table below 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.

RSS-210 A.1.4:

Following are the requirements for devices with reduced field strengths:

- Devices may not meet the requirements in section A.1.1 and may be employed for any type of operation, provided the device complies with the requirements of section A.1.3 and the field strength corresponds with the limits specified in table below.
- In addition, devices operated under the provisions of this section shall be capable of automatically limiting their operation so that the duration of each transmission is not greater than 1 second and the silent period between transmissions is at least 30 times the duration of the transmission, but not less than 10 seconds under any circumstances. However, devices that are designed for limited use for the purpose of initial programming, reprogramming or installing, and not for regular operations, may operate for up to 5 seconds, provided such devices are used only occasionally in connection with each unit being programmed or installed.
- The field strength limits shown in table below are based on the average value of the measured emissions. Alternatively, compliance with the limits in table below may be demonstrated using a CISPR quasi-peak detector.
- Unwanted emissions shall be 10 times below the fundamental emissions field strength limits in table below or comply with the general field strength limits specified in RSS-Gen, whichever is less stringent.

Table 8.6-1: Reduced Field Strength Limits for Momentarily Operated Devices

Fundamental frequency (MHz)	Field strength of fundamental (µV/m)	Field strength of fundamental (dBµV/m)	Field strength of spurious emissions (µV/m)	Field strength of spurious emissions (dBµV/m)
40.66–40.70 ¹	1,000	60	100	40
70–130	500	53.9	50	33.9
130–174	500 to 1,500*	53.9 to 63.5*	50 to 150*	33.9 to 43.5*
174–260 ²	1,500	63.5	150	43.5
260–470 ²	1,500 to 5,000*	63.5 to 73.9*	150 to 500*	43.5 to 53.9*
Above 470	5,000	73.9	500	53.9

* Linear interpolation with frequency F in MHz:

For 130–174 MHz: Field Strength (µV/m) = (22.73 × F) – 2454.55

For 260–470 MHz: Field Strength (µV/m) = (16.67 × F) – 2833.33

Notes:

¹The levels applicable to FCC only.

²Frequency bands 225–328.6 MHz and 335.4–399.9 MHz are designated for the exclusive use of the Government of Canada. Manufacturers should be aware of possible harmful interference and degradation of their licence-exempt radio equipment in these frequency bands.

References, definitions and limits, continued

Table 8.6-2: 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 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × 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: 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 8.6-3: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	Above 38.6
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in this table and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Table 8.6-4: 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			

8.6.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	December 15, 2020

8.6.3 Observations, settings and special notes

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

Fundamental emission average field strength limit at 434.3 MHz was calculated using extrapolation as follows:

$$20 \times \text{Log}_{10} ((16.67 \times 434.3) - 2833.33) = 72.88 \text{ dB}\mu\text{V/m}$$

Spurious emissions average limit at 434.3 MHz is 10 times (20 dB) below the fundamental emission average field strength limit: $72.88 - 20 = 52.88 \text{ dB}\mu\text{V/m}$

Radiated measurements were performed at a distance of 3 m.

Average radiated emissions were obtained by subtracting duty cycle / correction factor from the peak measurement results.

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

8.6.4 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. Longest frame size has the Digital model transmitter: max 17 ms.

$$\text{Duty cycle or average factor} = 20 \times \text{log}_{10} \left(\frac{T_{X100ms}}{100ms} \right) = 20 \times \text{log}_{10} \left(\frac{17ms}{100ms} \right) = -15.39 \text{ dB.}$$

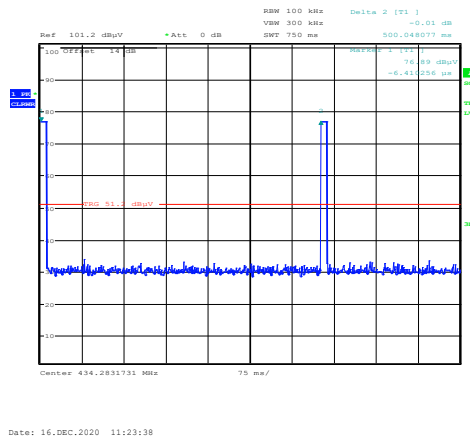


Figure 8.6-1: One transmission within 100 ms

Test data, continued

Table 8.6-5: Radiated field strength measurement results

Frequency, MHz	Peak field strength, dBμV/m	Peak limit, dBμV/m	Margin, dB	Duty cycle factor, dB	Average/QP field strength, dBμV/m	Average/QP limit, dBμV/m	Margin, dB
111.96	32.18	N/A	N/A	N/A	32.18	43.50	11.32
159.98	42.31	N/A	N/A	N/A	42.31	43.50	1.19
255.96	39.43	N/A	N/A	N/A	39.43	46.00	6.57
434.30	81.96	92.88	10.92	15.39	66.57	72.88	6.31
868.66	41.48	N/A	N/A	N/A	41.48	54.00	12.52
1302.50	59.27	72.88	13.61	15.39	43.88	52.88	9.00
1737.50	45.95	72.88	26.93	15.39	30.56	52.88	22.32
4777.50	53.68	72.88	19.20	15.39	38.29	52.88	14.59

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

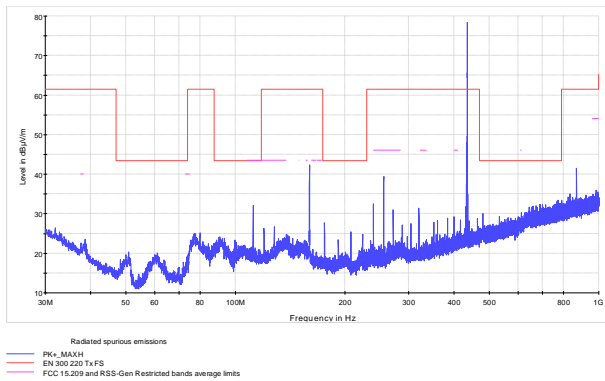


Figure 8.6-2: Spurious emissions below 1 GHz

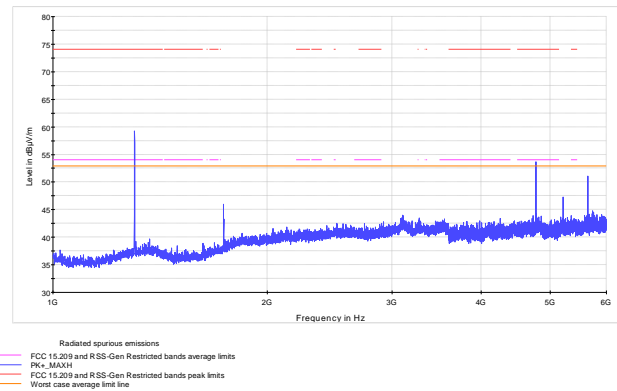
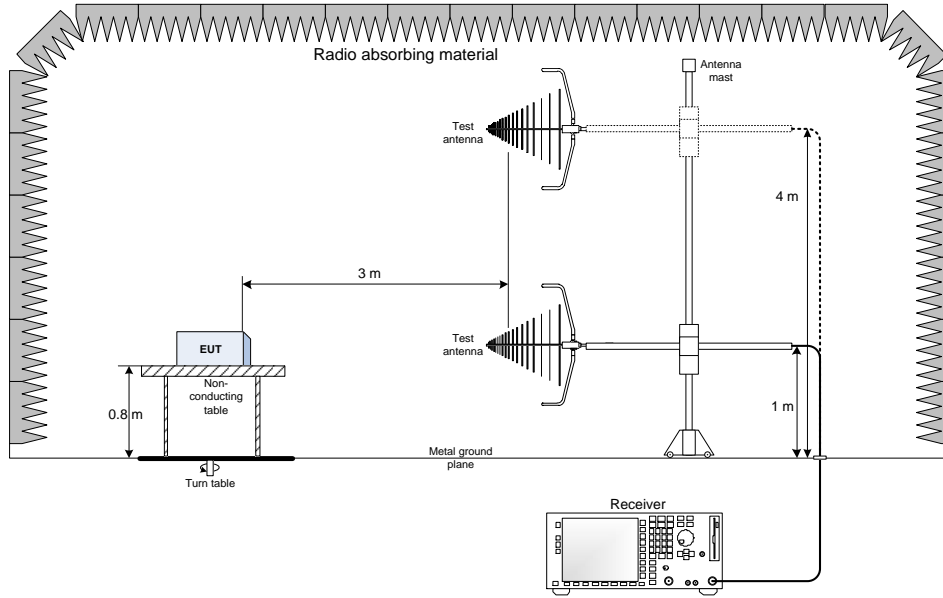


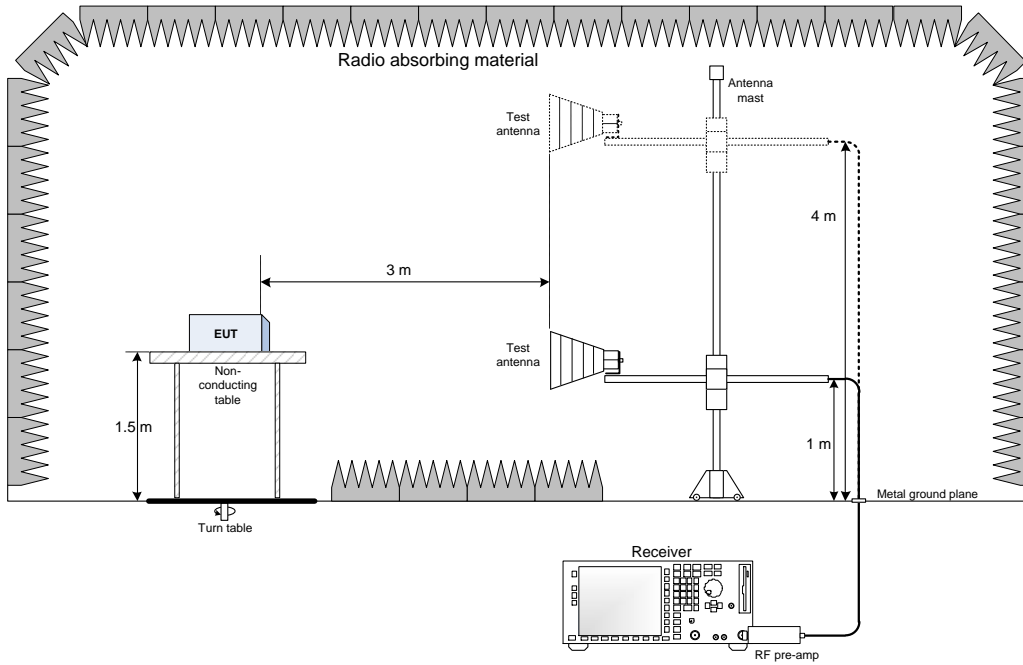
Figure 8.6-3: Spurious emissions above 1 GHz

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



End of report