

Test report

369219-1TRFWL

Date of issue: February 27, 2019

Applicant:

Blue Line Innovations Inc.

Product:

Wireless Meter Sensor (433 MHz)

Trademark:

PowerCost Monitor™

Model:

BLI-18100

FCC ID:

SUE-BLI-18100-06

ISED Registration number:

5614A-BLI-18100

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 9, August 2016, Annex A.1**

Momentarily operated devices

Test location

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Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2040; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	February 27, 2019
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.

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Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant	4
1.2 Manufacturer	4
1.3 Test specifications	4
1.4 Test methods	4
1.5 Statement of compliance	4
1.6 Exclusions	4
1.7 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 15 Subpart C test results	5
2.2 ISED RSS-Gen, Issue 5, test results	5
2.3 ISED RSS-210, Issue 9 test results	5
Section 3. Equipment under test (EUT) details	6
3.1 Sample information	6
3.2 EUT information	6
3.3 Technical information	6
3.4 Product description and theory of operation	6
3.5 EUT exercise details	7
3.6 EUT setup diagram	7
Section 4. Engineering considerations	8
4.1 Modifications incorporated in the EUT	8
4.2 Technical judgment	8
4.3 Deviations from laboratory tests procedures	8
Section 5. Test conditions	9
5.1 Atmospheric conditions	9
5.2 Power supply range	9
Section 6. Measurement uncertainty	10
6.1 Uncertainty of measurement	10
Section 7. Test equipment	11
7.1 Test equipment list	11
Section 8. Testing data	12
8.1 FCC 15.231(b) & (e) and RSS-210 A.1.4 Field strength of emissions for periodic radiators (reduced)	12
8.2 FCC 15.231(c) and RSS-210 A.1.3 Emission bandwidth of momentary signals	18
Section 9. Block diagrams of test set-ups	20
9.1 Radiated emissions set-up for frequencies below 1 GHz	20
9.2 Radiated emissions set-up for frequencies above 1 GHz	20



Section 1. Report summary

1.1 Applicant

Company name	Blue Line Innovations Inc.
Address	510 Topsail Rd., St. John's, Newfoundland & Labrador, A1E 2C2 Canada

1.2 Manufacturer

Company name	Blue Line Innovations Inc.
Address	510 Topsail Rd., St. John's, Newfoundland & Labrador, A1E 2C2 Canada

1.3 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, Issue 9, August 2016, Annex A.1	Momentarily operated devices

1.4 Test methods

ANSI C63.10 v 2013	American National Standard for Procedures for Compliance Testing of Unsilenced Wireless Devices
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1.5 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.

1.6 Exclusions

None

1.7 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

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²
§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)	Requirements for devices operating within 40.66–40.70 MHz band	Not applicable
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Pass

Notes: ¹ Testing was performed using fresh batteries

² The EUT has a non-detachable wire antenna.

2.2 ISED RSS-Gen, Issue 5, test results

Table 2.2-1: RSS-Gen 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: ¹ According 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.

EUT has only one frequency of operation

2.3 ISED RSS-210, Issue 9 test results

Part	Test description	Verdict
A.1.1	Types of momentary signals	Not applicable
A.1.2	Field strength of emissions	Not applicable ¹
A.1.3	Bandwidth of momentary signals	Pass
A.1.4	Reduced Field Strengths of emissions	Pass

Notes: EUT was tested for reduced field strength of emission

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 1, 2019
Nemko sample ID number	1

3.2 EUT information

Product name	Wireless Meter Sensor (433 MHz)
Model	BLI-18100
Serial number	None

3.3 Technical information

Applicant IC company number	5614A
IC UPN number	BLI-18100
All used IC test site(s) Reg. number	2040A-4
RSS number and Issue number	RSS-210 Annex A.1, Issue 9, August 2016
Frequency band (MHz)	260–470
Frequency Min (MHz)	433.865
Frequency Max (MHz)	433.865
RF power Min (W)	NA
RF power Max (W)	NA
Field strength, dB μ V/m @ 3 m	70.39 (average)
Measured BW (kHz) (99 %)	20.03
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	FSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, dB μ V/m @ 3 m	40.17 at 300 MHz
Power requirements	1.5 V _{DC} type "C" battery
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. Insulated wire, 220 mm

3.4 Product description and theory of operation

The Blue Line Innovations "PowerCost Monitor Meter Sensor" model BLI-18100 is a device that attaches to standard residential and light-commercial type electricity meters for the purposes of collecting electricity consumption information. This information is periodically transmitted to a receiving device which then uploads the data to a cloud-based electricity monitoring application. The device employs a PIC24-based 16-bit microcontroller connected to a Semtec SX1243 transmitter.

The device is approximately 4" wide x 1.75" tall x 2" deep. It is powered by a single C-cell format battery and is designed to operate in outdoor environments.

3.5 EUT exercise details

The EUT was set to transmit continuously

3.6 EUT setup diagram

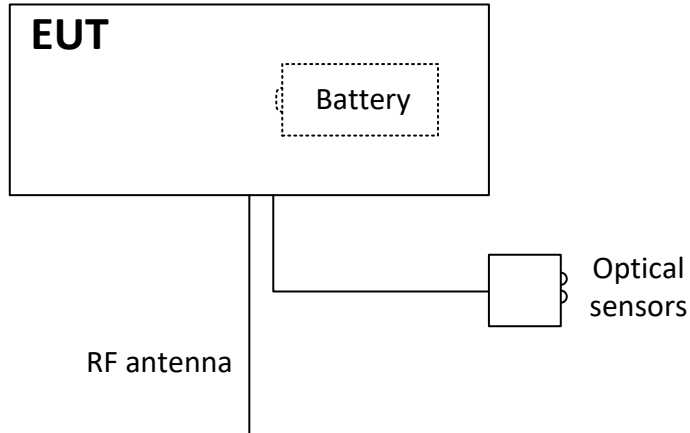


Figure 3.6-1: Setup diagram



Figure 3.6-2: Typical EUT installation

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

Section 6. Measurement uncertainty

6.1 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 6.1-1: Measurement uncertainty

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78

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	January 24, 2020
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	March 26, 2019
Bilog antenna (20–2000 MHz)	Sun AR	JB1	FA003009	1 year	September 6, 2019
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	January 16, 2020
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	November 4, 2019

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 15.231(b) & (e) and RSS-210 A.1.4 Field strength of emissions for periodic radiators (reduced)

8.1.1 Definitions and limits

FCC:
 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, except the field strength table in paragraph (b) of this section is replaced with the table below.

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.

- ISED:**
- a. 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 the table below.
 - b. 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.
 - c. The field strength limits shown in the table below are based on the average value of the measured emissions. As an alternative, compliance with the limits in this table may be based on the use of measurement instruments with an International Special Committee on Radio Interference (CISPR) quasi-peak detector.
 - d. Unwanted emissions shall comply with the general field strength limits specified in RSS-Gen or 10 times below the fundamental emissions field strength limit in the table below whichever is less stringent.

Table 8.1-1: Reduced Field Strength Limits for Momentarily Operated Devices

Fundamental frequency (MHz)	Field strength of fundamental @ 3 m		Field strength of spurious emissions @ 3 m	
	(µV/m)	(dBµV/m)	(µV/m)	(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	1,500	63.5	150	43.5
260–470	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

Note: ¹The band and levels are applicable to FCC only.

* 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



Table 8.1-2: 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 8.1-3: 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	Above 38.6
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.1-3 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 8.1-4: 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			

8.1.2 Test summary

Test date January 23, 2018

8.1.3 Observations, settings and special notes

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

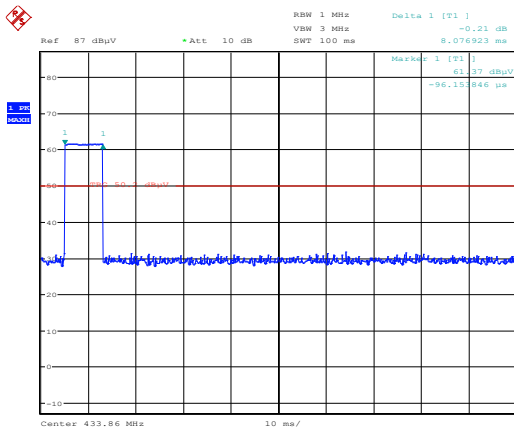
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Duty cycle/average factor calculations

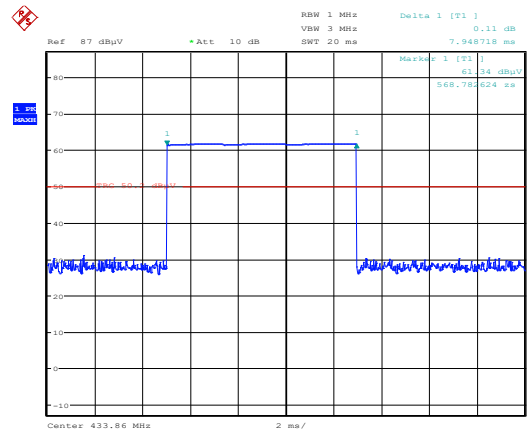
§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed; the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

$$\text{Duty cycle or average factor} = 20 \times \log_{10} \left(\frac{T_{X100ms}}{100ms} \right) = 20 \times \log_{10} (7.9487 / 100) = -21.99 \text{ dB}$$



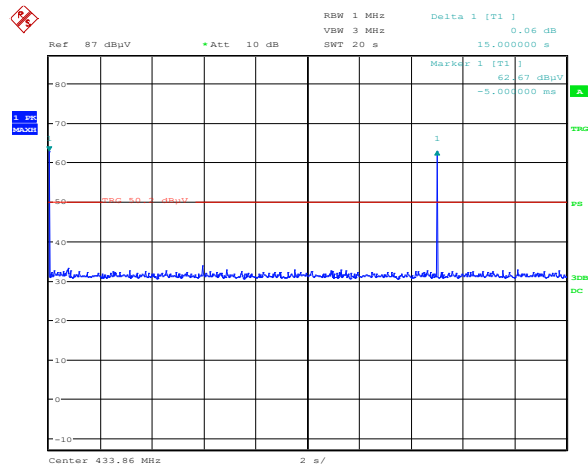
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Figure 8.1-1: Transmission within 100 ms



Date: 21.FEB.2019 17:03:41

Figure 8.1-2: Transmission length



Date: 21.FEB.2019 17:06:51

Figure 8.1-3: Transmission interval (silent period)

Table 8.1-5: Duration of single transmission compliance

Max duration of each transmission, s	Maximum limit, s	Margin, s
0.0079487	1.0000000	0.9920513

Table 8.1-6: Silent period compliance

Max duration of transmission, ms	Silent period, s	Minimum limit*, s	Margin, s
7.9487	15.000	10.000	5.000

Note: *Minimum silent period limit is at least 10 s or 30 times the duration of the transmission = $30 \times 7.9487 \text{ ms} = 0.238 \text{ s} < 10 \text{ s}$, therefore the minimum limit is 10 s.

Average limit calculation for 433.87 MHz: $20 + \log_{10}((16.67 \times 433.87) - 2833.33) = 72.87 \text{ dB}\mu\text{V/m} @ 3 \text{ m}$

Peak limit calculation $20 + \text{Average limit} = 72.87 + 20 = 92.87 \text{ dB}\mu\text{V/m} @ 3 \text{ m}$

Table 8.1-7: Radiated field strength measurement results of fundamental and harmonics

Frequency, MHz	Peak field strength, dBµV/m	Peak limit, dBµV/m	Margin, dB	Duty cycle correction factor, dB	Average field strength*, dBµV/m	Average limit, dBµV/m	Margin, dB
Fundamental:							
433.87	92.38	92.87	0.49	-21.99	70.39	72.87	2.48
Harmonics:							
867.76	50.78	72.87	22.09	-21.99	28.79	52.87	24.08
4338.69	47.00	74.00**	27.00	-21.99	25.01	54.00	28.99

Notes: * Average field strength was calculated as follows: Peak field strength measurement result + DCCF.

** Spurious emissions shall be attenuated to the average limits or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Table 8.1-8: Radiated field strength measurement results of spurious emissions

Frequency, MHz	Peak field strength, dB μ V/m	Quasi-Peak limit, dB μ V/m	Margin, dB
300.00	40.17	46.00	5.83
323.98	38.52	46.00	7.48

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

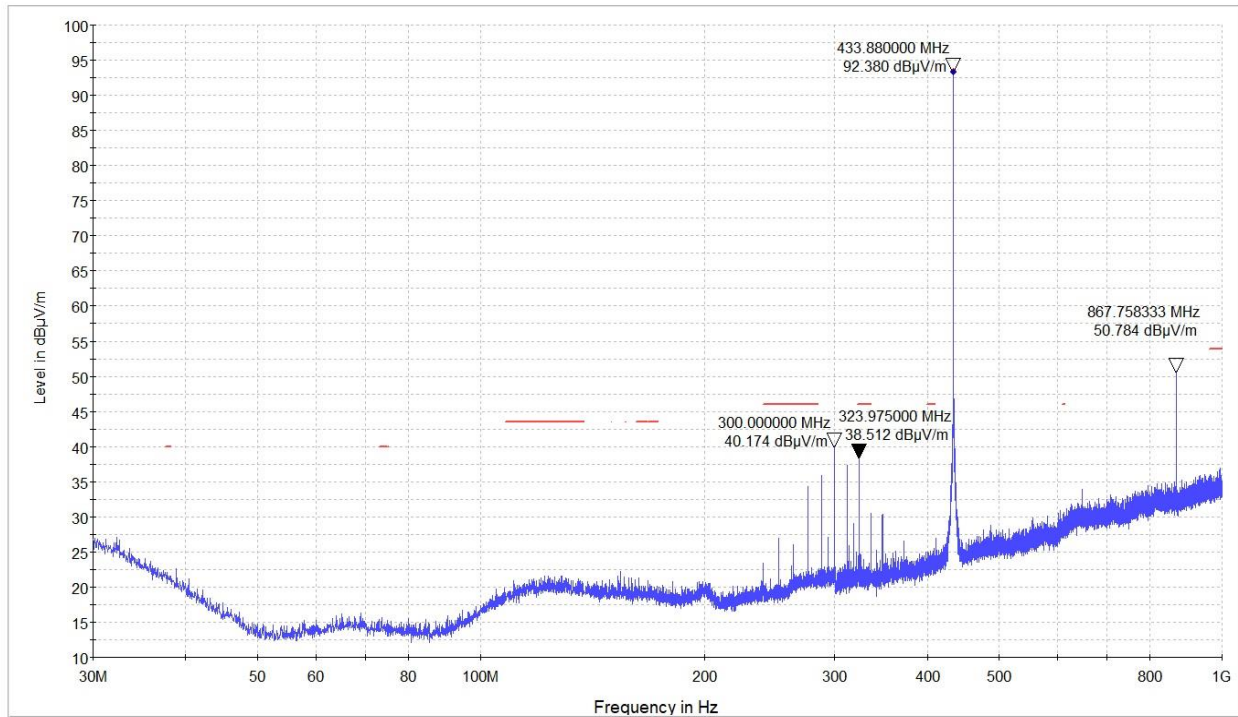


Figure 8.1-4: Spurious emissions below 1 GHz

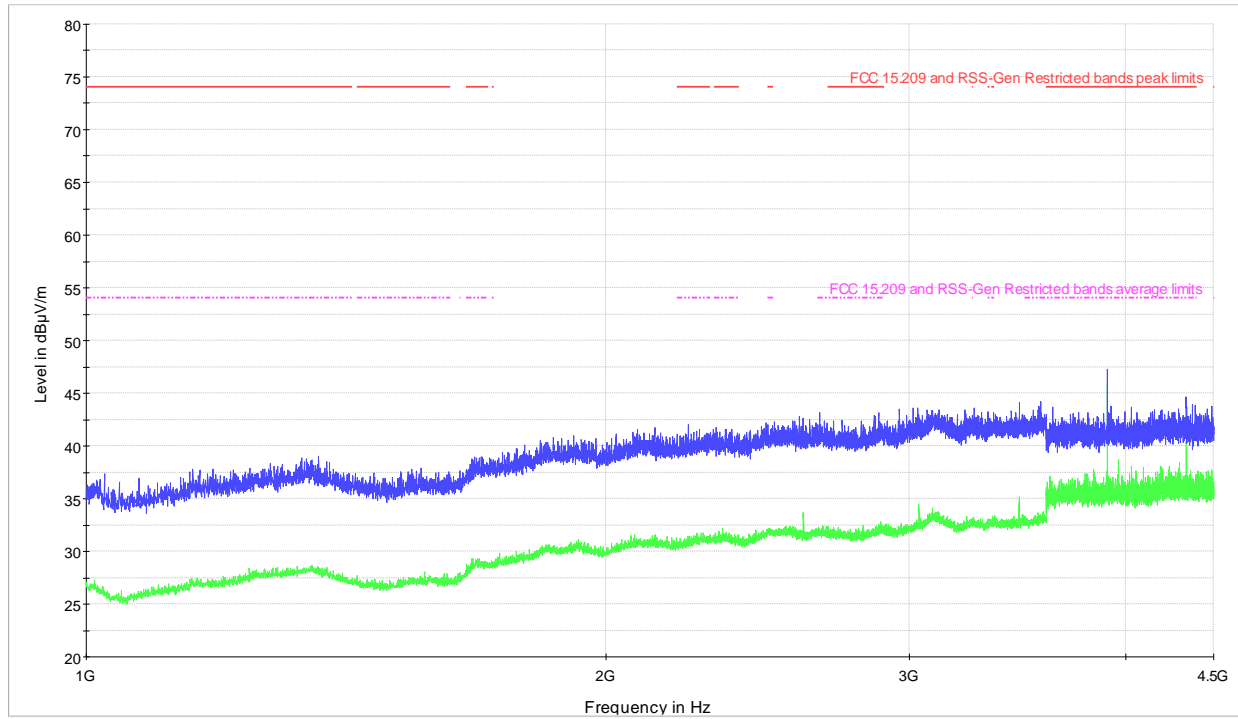


Figure 8.1-5: Spurious emissions above 1 GHz

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

8.2.1 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.

ISED:

The 99% bandwidth of momentarily operated devices shall be less 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 99% bandwidth shall be less or equal to 0.5% of the centre frequency.

8.2.2 Test summary

Test date January 23, 2018

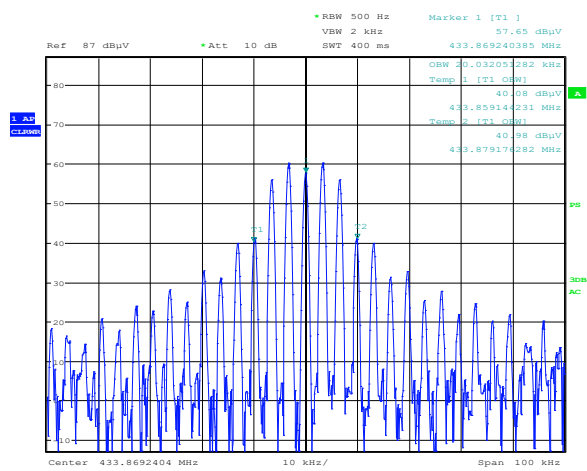
8.2.3 Observations, settings and special notes

Emission bandwidth limit calculation: 0.25% of 433.87 MHz = 1.085 MHz

Spectrum analyser settings:

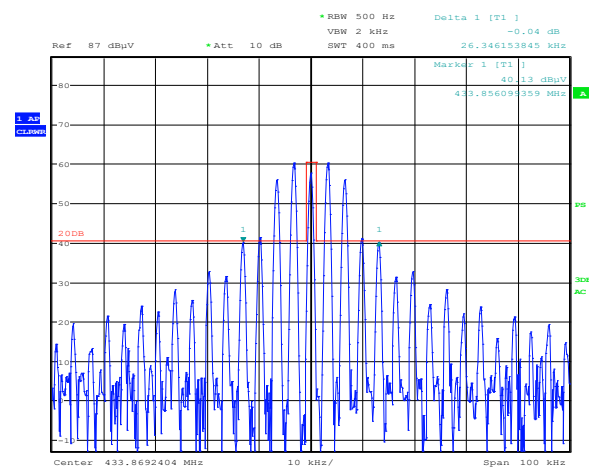
Resolution bandwidth	500 Hz
Video bandwidth	2 kHz
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data



Date: 14.FEB.2019 13:13:06

Figure 8.2-1: 99% occupied bandwidth



Date: 14.FEB.2019 13:18:14

Figure 8.2-2: 20 dB bandwidth

Section 8
Test name
Specification

Testing data
FCC 15.231(c) and RSS-210 A.1.3 Emission bandwidth of momentary signals
FCC Part 15 Subpart C and RSS-210, Issue 9



Table 8.2-1: Emission bandwidth measurement results for FCC

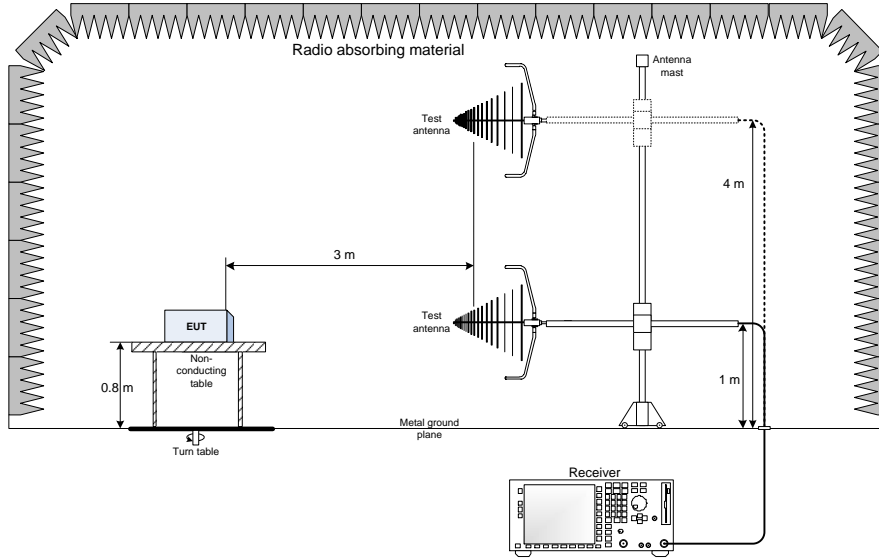
20 dB bandwidth, kHz	Minimum limit, kHz	Margin, kHz
26.35	1085.00	1058.65

Table 8.2-2: Emission bandwidth measurement results for ISED

99% occupied bandwidth, kHz	Minimum limit, kHz	Margin, kHz
20.03	1085.000	1064.97

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

