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Test report

248160-3TRFWL

Date of issue: July 7, 2014

Applicant:

TireStamp Inc.

Product:

TireVigil™ Tire Data Monitoring

Model:

OST-NGEN-001

FCC ID: 2ABNQ-OST-NGEN-001

IC Registration number: 11636A-OSTNGEN001

Specifications:

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

Test location

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
FCC site ID:	176392
IC site ID:	2040A
Website:	www.nemko.com

Tested by:	Kevin Rose, Wireless/EMC Specialist
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist
Date:	July 7, 2014
Signature:	

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

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Section 1 Report summary

1.1 Manufacturer

Company name:	TireStamp Inc.
Address:	320-350 Terry Fox Dr.
City:	Ottawa
Province/State:	Ontario
Postal/Zip code:	K2K 2W5
Country:	Canada

1.2 Applicant

Company name:	TireStamp Inc.
Address:	320-350 Terry Fox Dr.
City:	Ottawa
Province/State:	Ontario
Postal/Zip code	K2K 2W5
Country:	Canada

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C, Chapter 15.231	Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
RSS-210, Issue 8 Annex 1.1	Momentarily Operated Devices

1.4 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.

1.5 Test report revision history

Table 1.5-1: 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 – Intentional Radiators, test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	Pass
§15.231(e)	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: None

2.2 RSS-210, Issue 8 Annex 1.1, test results

Part	Test description	Verdict
RSS-Gen 4.6.1	Occupied BW	Pass
RSS-Gen 6.1	Receiver spurious emissions limits (radiated)	Not applicable
RSS-Gen 6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
RSS-Gen 7.2.4	AC power lines conducted emission limits	Not applicable
RSS-210 A1.1.1	Types of momentary signals	Pass
RSS-210 A1.1.2	Field strength and frequency bands	Not applicable
RSS-210 A1.1.3	Bandwidth for momentary signals	Pass
RSS-210 A1.1.4	Frequency stability within 40.66–40.70 MHz band	Not applicable
RSS-210 A1.1.5	Reduced Field Strengths	Pass

Notes: 1 According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 11, 2013
Nemko sample ID number	1, 2

3.2 EUT information

Product name	TireVigil™ Tire Data Monitoring
Model	OST-NGEN-001
Part number	OST-V4
Serial number	NA: pre-production unit
Software version	4
99% Bandwidth	106.57 kHz
Modulation	FSK
Power requirements	9–27 V_{DC} (Vehicle Battery)
Product description	The OST is part of a Tire Pressure Monitoring System.

3.3 EUT technical specifications

Operating frequency range	433.92 MHz
Modulation type	Frequency Shift Keying (FSK)
Number of channels	Not applicable
Channel spacing	Not applicable
Antenna data	Integral

3.4 Operation of the EUT during testing

Applicant provided a normal operating sample and a modified sample (test mode) that continuously transmits.

3.5 EUT setup details

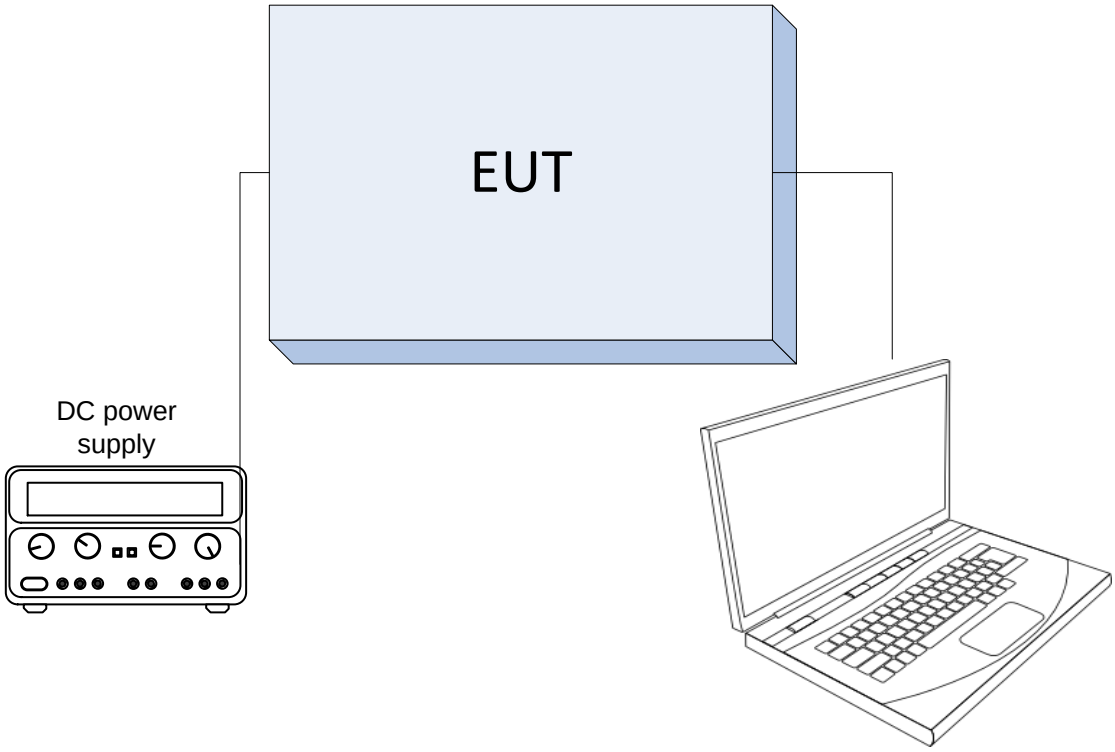


Figure 3.5-1: Setup diagram

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: 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.

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

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

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	Mar. 18/15
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	June 14/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
50 Ω coax cable	Huber + Suhner	NONE	FA002392	1 year	July. 17/14
50 Ω coax cable	C.C.A.	None	FA002555	1 year	Oct. 07/14
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14

Notes: NCR - no calibration required

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

Section 8 Testing data

8.1 Clause 15.231(e) RSS-210 A1.1 Conditions for intentional radiators to comply with periodic operation

8.1.1 Definitions and limits

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:

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

a. A manually operated transmitter shall employ 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. 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 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

Test date:	June 10, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	38 %

8.1.3 Observations/special notes

None

8.1.4 Test data

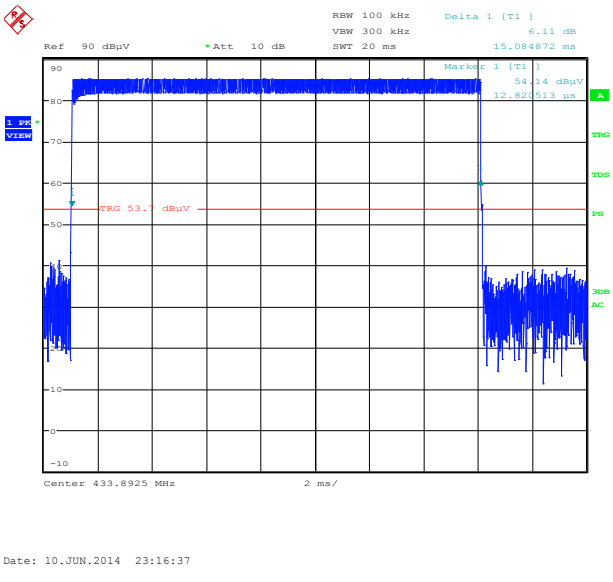


Figure 8.1-1: LPOST_OST duration (15.08 ms)

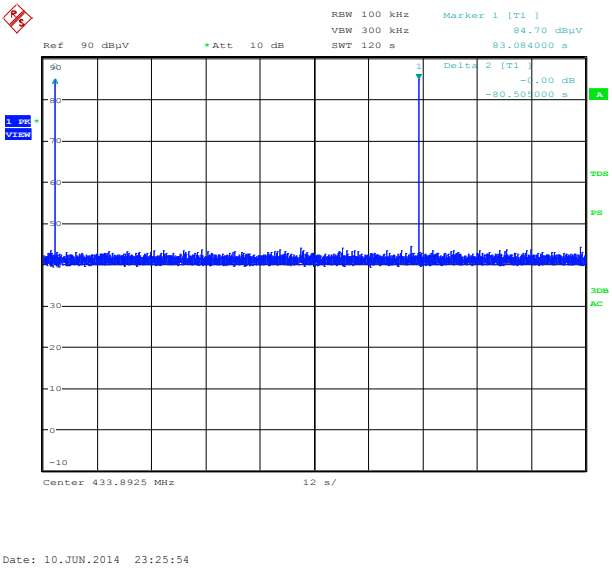


Figure 8.1-2: LPOST_OST silent period (80.3 sec)

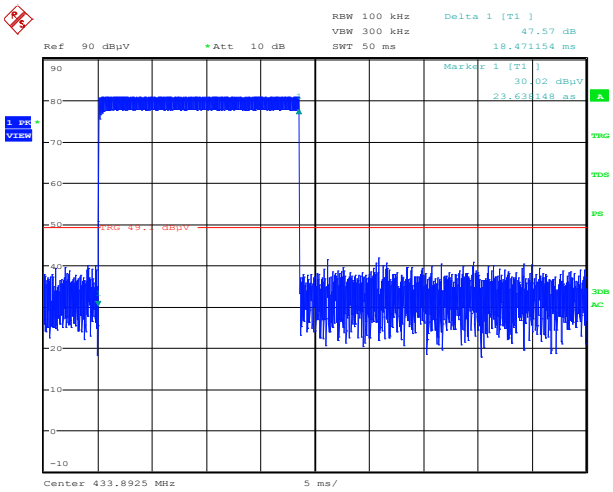


Figure 8.1-3: LPOST_TPS duration max payload (18.47 ms)

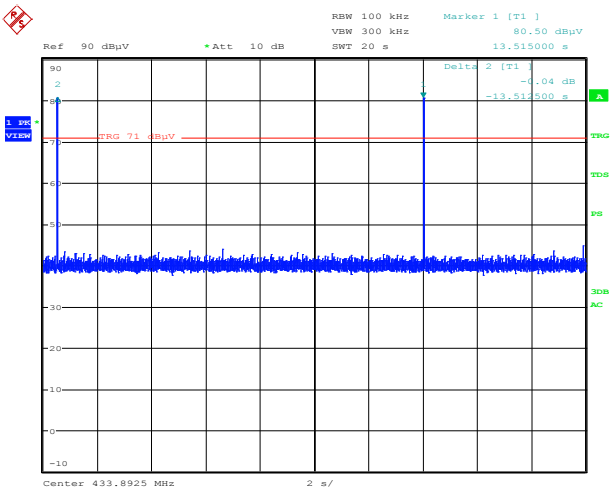


Figure 8.1-4: 5 LPOST_TPS silent period (13.51 sec)

Note: An unpaired OST will transmit a message (message type LPOST_OST)

8.1.4 Test data continued

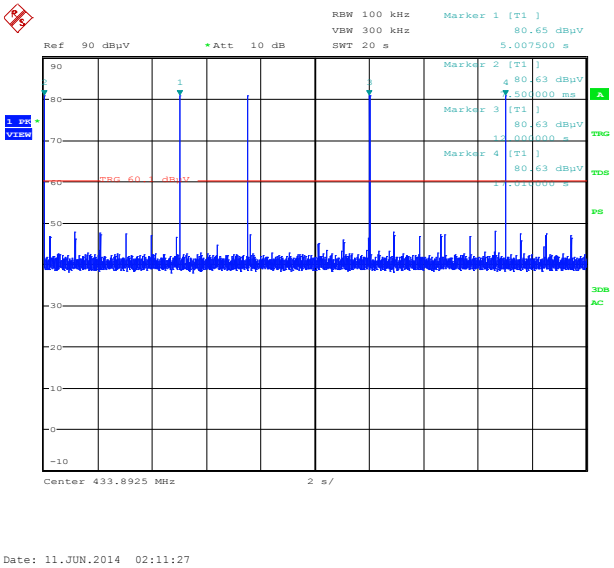


Figure 8.1-5: LPOST_TPS silent when sensor in alert mode

Table 8.1-1: Test summary

FCC / IC	1 / a	2 / b	3 / c	4 / d	5
FCC	Comply (see table below)	N/A	Comply*	N/A	N/A
IC	Comply (see table below)	N/A	Comply*	N/A	–

* - As per manufacturer's declaration supervision transmission does not exceed 2 seconds per hour of operation

Table 8.1-2: On-time measurement results

Pulse width, ms	Number of Pulses[1]	Total transmission On-time, ms	Limit, ms	Margin, ms
18.47	1	18.47	5000	4981

[1]As per manufacturer's declaration nominal transmission includes only one 18.47 ms pulse. Maximum payload

8.2 Clause 15.231(e) RSS-210 A1.1.5 Field strength of emissions

8.2.1 Definitions and limits

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 8.2-1: Reduced Field strength limits

Fundamental frequency (MHz)	Field strength of fundamental (µV/m)	Field strength of spurious emissions (µV/m)
70–130	50	500
130–174	500 to 1,500*	50 to 150
174–260	1,500	150
260–470	1,500 to 5,000*	150 to 500
Above 470	5,000	500

* 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.

8.2.2 Test summary

Test date:	June 10, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	38 %

8.2.3 Observations/special notes

Table 8.2-2: §15.209 and RSS 210 A1.1 – Radiated emission limits

Frequency (MHz)	Field strength (µV/m)	Measurement distance (dBµV/m)	(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

- 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.

8.2.3 Observations/special notes, continued

Table 8.2-3: §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			

Table 8.2-4: RSS-Gen – Restricted bands of operation

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

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
- below 30 MHz: using a quasi-peak detector with 9 kHz/30 kHz RBW/VBW,
- within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
- above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
- and using a duty cycle/average factor for average results calculations.
- Transmit output power was measured while supply voltage was varied from 9–27 V_{DC} (85 % to 115 % of the nominal rated supply voltage). No change in transmit output power was observed.

8.2.4 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.

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

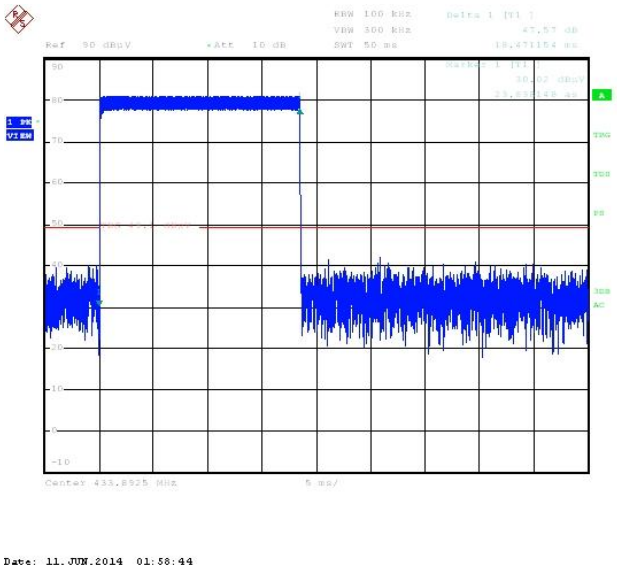


Figure 8.2-1: Duty Cycle correction = 20 × $\log_{10}$(18.47 ms /100 ms) = −14.67dB

The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Table 8.2-5: Field strength measurement results

Frequency (MHz)	Polarization V/H	Peak Field strength (dBµV/m)	Duty cycle factor (dB)	Corrected field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
433.92	H	82.28	-14.67	67.61	72.86	5.25
867.84	H	51.10	-14.67	36.43	54.00	17.57
1301.75	V	42.60	-14.67	27.93	54.00	26.07
2169.57	V	48.00	-14.67	33.33	54.00	20.67
2603.48	V	48.60	-14.67	33.93	54.00	20.07
3471.30	V	52.50	-14.67	37.83	54.00	16.17

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

8.3 Clause 15.231(c) RSS-Gen 4.6.1 Emission bandwidth

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

Test date:	November 11, 2013	Temperature:	22 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	34 %

8.3.3 Observations/special notes

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

8.3.4 Test data

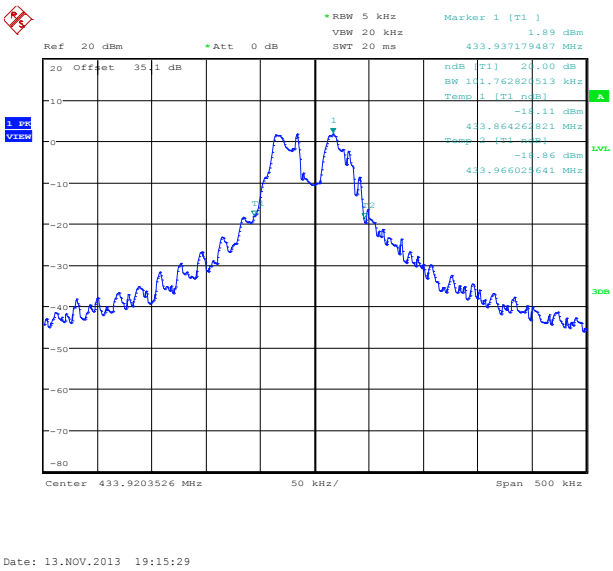


Figure 8.3-1: 20 dB bandwidth

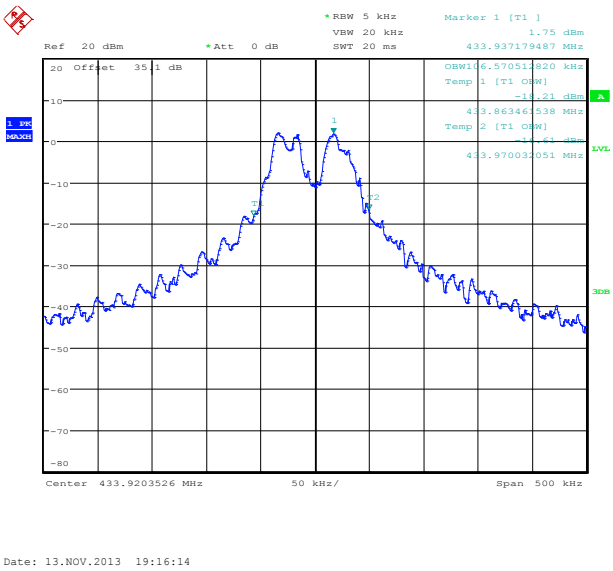


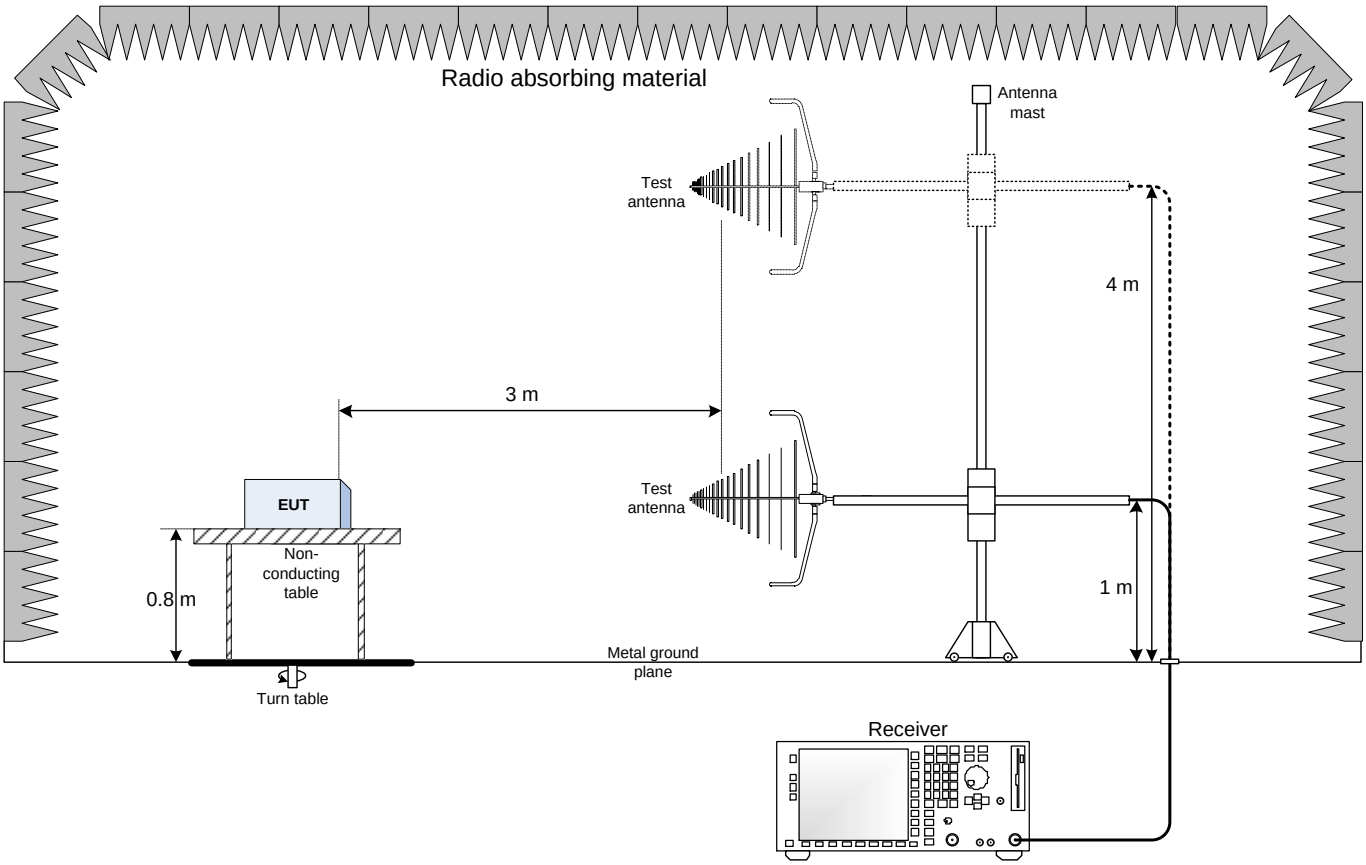
Figure 8.3-2: 99% bandwidth (106.57 kHz)

Table 8.3-1: 20 dB bandwidth

20 dB bandwidth (kHz)	Limit (MHz)	Margin (kHz)
101.7	1.0848	983.1

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



Section 10 EUT photos

10.1 External photos

10.1.1 EUT front view

10.1.2 EUT rear view