

Test report

284093-1TRFWL

Date of issue: December 10, 2015

Applicant:

Mobysens Technologies Inc

Product:

SenseDoc 2.0

Model:

SD2R1

FCC ID:

2ADVPSD2R1

IC Registration number:

12615A-SD2R1

Specifications:

◆ **FCC 47 CFR Part 15 Subpart C, §15.249**

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz and 24.0–24.25 GHz

◆ **RSS-210, Issue 8, December 2010, Annex 2.9**

Devices operating in 902–928, 2400–2483.5 and 5725–5875 MHz frequency bands for any application

Test location

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Website	www.nemko.com
Site number	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist and Avul Nzenza EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Review date	December 10, 2015
Reviewer 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.

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Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods.....	4
1.4 Statement of compliance	4
1.5 Exclusions.....	4
1.6 Test report revision history	4
Section 2. Summary of test results.....	5
2.1 FCC Part 15 Subpart C, general requirements test results.....	5
2.2 FCC Part 15 Subpart C, intentional radiators test results.....	5
2.3 IC RSS-GEN, Issue 4, test results	5
2.4 IC RSS-210, Issue 8, 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.....	6
3.6 EUT setup diagram	7
3.7 EUT sub assemblies	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 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits	12
8.2 FCC 15.215(c) and RSS-Gen 6.6 Occupied (Emission) bandwidth	16
8.3 FCC 15.249(a) RSS 210 A2.9(a) Field strength of emissions not in restricted bands	18
8.4 FCC 15.249(d) RSS 210 A2.9(b) Spurious emissions (except for harmonics).....	21
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.....	25
9.3 Conducted emissions set-up	25

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Mobysens Technologies Inc
Address	2177 rue Masson Suite 414
City	Montreal
Province/State	Quebec
Postal/Zip code	H2H 1B1
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.249	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz and 24.0–24.25 GHz
RSS-210, Issue 8 Annex 2.9	Devices operating in 902–928, 2400–2483.5 and 5725–5875 MHz frequency bands for any application

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
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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 Exclusions

None

1.6 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, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²
§15.215(c)	20 dB bandwidth	Pass

Notes: ¹ Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

² The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.249(a)	Radiated emissions not in restricted bands	Pass
§15.249(b)	Fixed Point-to-Point operation in the 24.0–24.25 GHz band	Not applicable
§15.249(d)	Spurious emissions (except harmonics)	Pass

2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
6.6	Occupied bandwidth	Pass
7.1.2	Receiver radiated emission limits	Not applicable
7.1.3	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Pass

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 8, test results

Part	Test description	Verdict
§A2.9(a)	Radiated emissions not in restricted bands	Pass
§A2.9(b)	Spurious emissions (except harmonics)	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	June 29, 2015
Nemko sample ID number	133-000154

3.2 EUT information

Product name	SenseDoc 2.0
Model	SD2R1
Serial number	SD2R1-00xxx

3.3 Technical information

Frequency band	2400–2483.5 MHz
Frequency range	2457 MHz (ANT+) and 2410–2475 MHz (OB)
Field strength of fundamental (average), Units @ 3 m	38.60 dB μ V/m (ANT+) and 38.26 dB μ V/m (OB)
Channel bandwidth	1 MHz (ANT+) and 2 MHz (OB)
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ 3 m	52.19 dB μ V/m (ANT+) and 52.11 dB μ V/m (OB)
Power requirements	Internal rechargeable battery or via Power adapter 120 V _{AC} 60 Hz
Antenna information	Johanson Tech. p/n: 2450AT43A100E 0.5 dBi gain The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The EUT is Safety Extra Low Voltage (SELV) device with rechargeable lithium battery that operates in 2.4 GHz band and using ANT+ and OB technology for communication. In addition EUT has Cell/PCS capabilities (not covered in this report)

3.5 EUT exercise details

EUT was set to transmit on low, mid and high channel for OB protocol application. As per ANT+ application the only frequency was set to transmit continuously.

3.6 EUT setup diagram

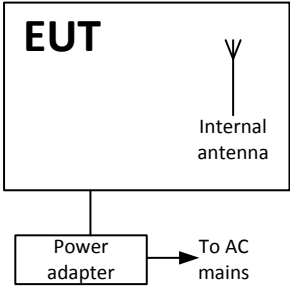


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
Power supply	Globetek	GTM41078-0605-USB	–

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

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

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	April. 06/16
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Aug. 29/15
Horn antenna (1–18 GHz)	EMCO	3115	FA001452	1 year	Aug. 26/15
Horn antenna (18–40 GHz)	EMCO	3116	FA002487	1 year	July 09/15
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	Oct. 07/15
Pre-amplifier (26–40 GHz)	COM-POWER	PAM-840	FA002508	1 year	July 09/15
LISN	Rohde & Schwarz	ENV216	FA002515	1 year	July 14/15
Power source	California Instruments	5001ix	FA002494	1 year	Jan. 22/16

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.1-1: Conducted emissions limit

Frequency of emission, MHz	Conducted limit, dB μ V	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - The level decreases linearly with the logarithm of the frequency.

** - A linear average detector is required.

8.1.2 Test summary

Test date	June 29, 2015	Temperature	24 °C
Test engineer	Avul Nzenza	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	47 %

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. 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.

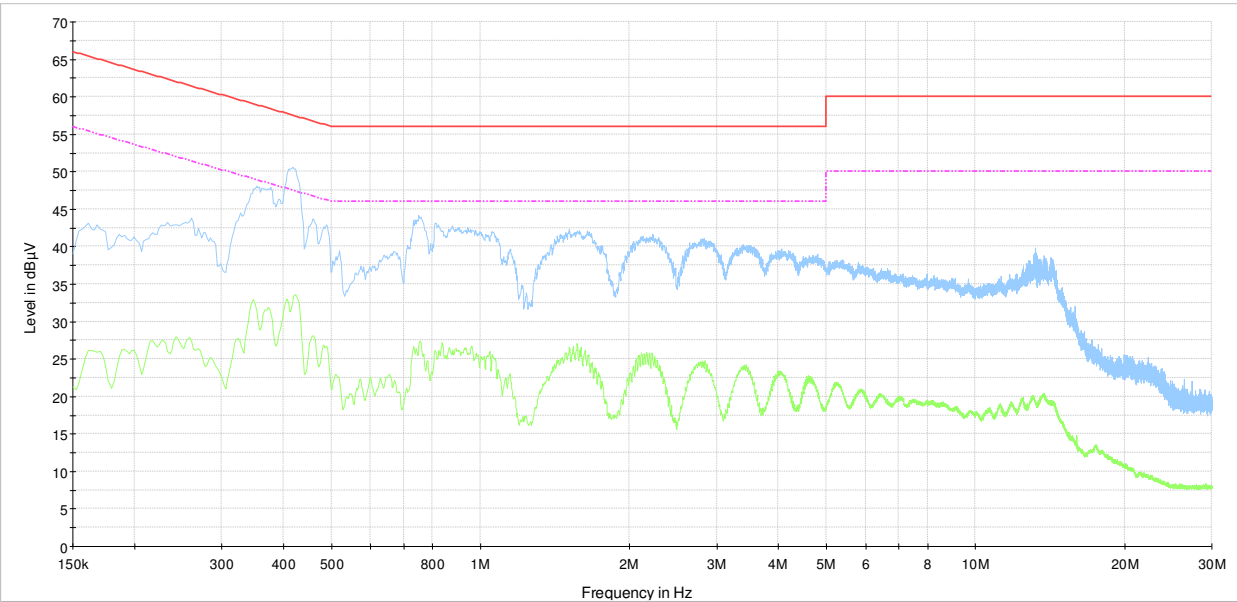
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

Receiver settings for final measurements:

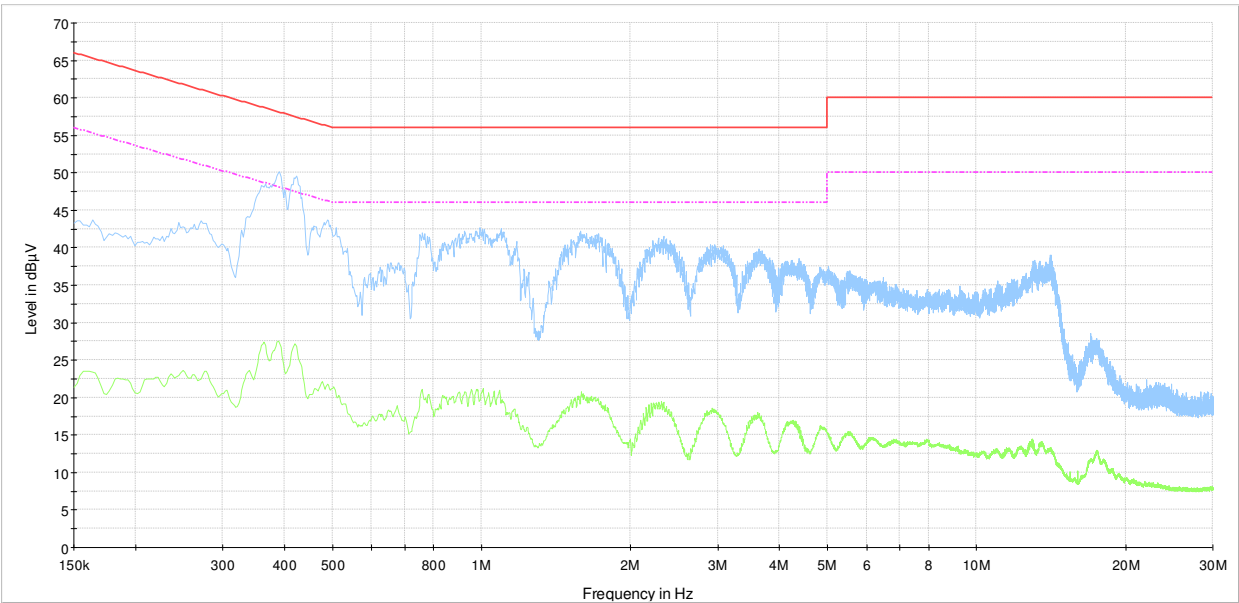
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Quasi-Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

8.1.4 Test data



NEX-284093_June 29, 2015_Cond Em_Phase_230Vac
— CISPR 22 Mains QP Class B
- - - CISPR 22 Mains AV Class B
— Preview Result 1-PK+
— Preview Result 2-AVG

Plot 8.1-1: Conducted emissions on phase line



NEX-284093_June 29, 2015_Con d Em_Neutral_230Vac

- CISPR 22 Mains QP Class B
- CISPR 22 Mains AV Class B
- Preview Result 1-PK+
- Preview Result 2-AVG

Plot 8.1-2: Conducted emissions on neutral line

8.2 FCC 15.215(c) and RSS-Gen 6.6 Occupied (Emission) bandwidth

8.2.1 Definitions and limits

FCC

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

IC

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

8.2.2 Test summary

Test date	July 2, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	31 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

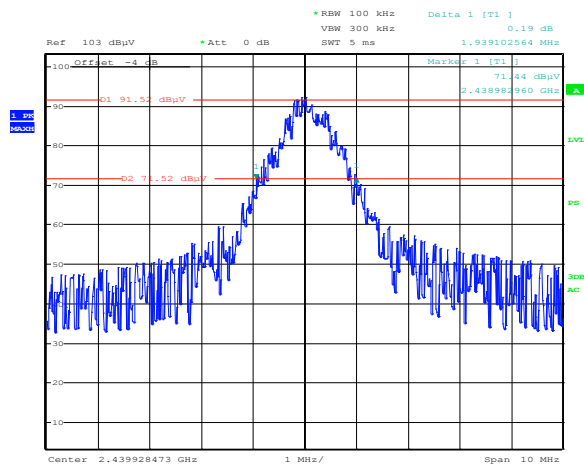
Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	10 MHz
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

20 dB bandwidth results for OB protocol is 1.939 MHz
99% occupied bandwidth results for OB protocol is 1.730 MHz

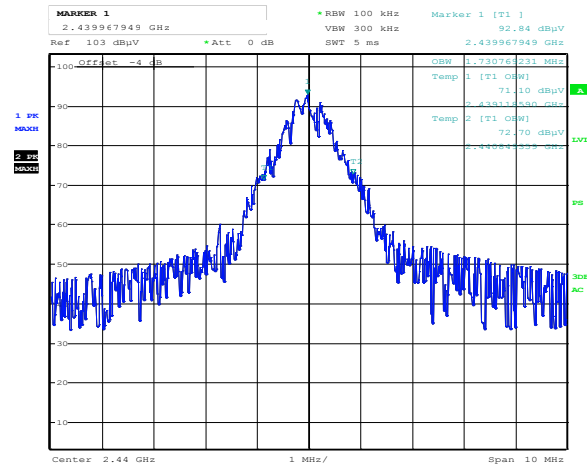
20 dB bandwidth results for ANT+ protocol is 1.089 MHz
99% occupied bandwidth results for ANT+ protocol is 1.009 MHz

Testing data
FCC 15.215(c) and RSS-Gen 6.6 Occupied (Emission) bandwidth
FCC 15 Subpart C and RSS-Gen, Issue 4



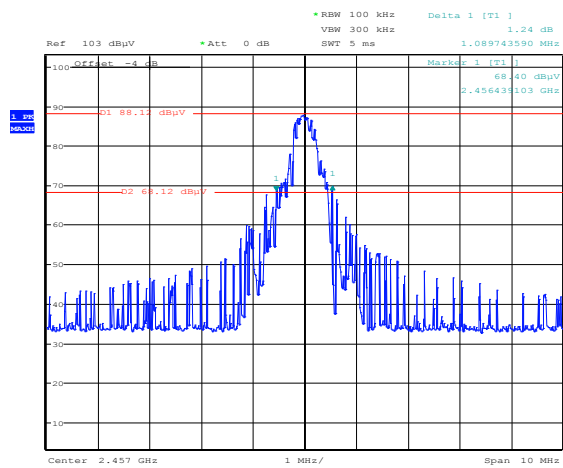
Date: 2.JUL.2015 12:22:23

Figure 8.2-1: 20 dB bandwidth for OB protocol, sample plot



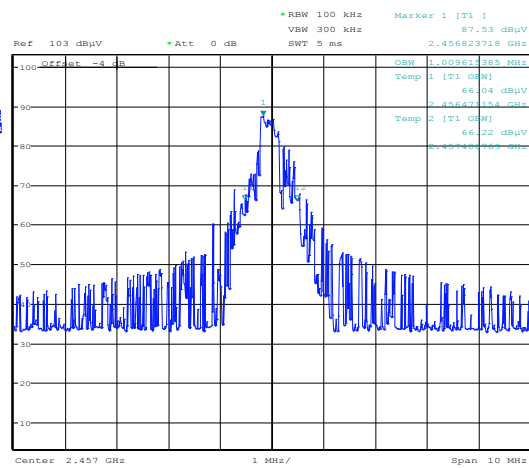
Date: 2.JUL.2015 14:24:31

Figure 8.2-2: 99% dB bandwidth for OB protocol, sample plot



Date: 2.JUL.2015 12:51:26

Figure 8.2-3: 20 dB bandwidth for ANT+ protocol



Date: 2.JUL.2015 12:56:33

Figure 8.2-4: 99% dB bandwidth for ANT+ protocol

8.3 FCC 15.249(a) RSS 210 A2.9(a) Field strength of emissions not in restricted bands

8.3.1 Definitions and limits

In addition to the provisions of §15.205 and RSS-Gen the field strength of emissions from intentional radiators operated under this section shall not exceed the following table.

Table 8.3-1: Field strength limits

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength of fundamental (dBμV/m)	Field strength of spurious emissions (μV/m)	Field strength of spurious emissions (dBμV/m)
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24.0–24.25	250	108	2500	68

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter (128 dBμV/m) at 3 meters along the antenna azimuth.

8.3.2 Test summary

Test date	July 2, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	31 %

8.3.3 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.
Spectrum analyzer settings for peak radiated measurements:

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

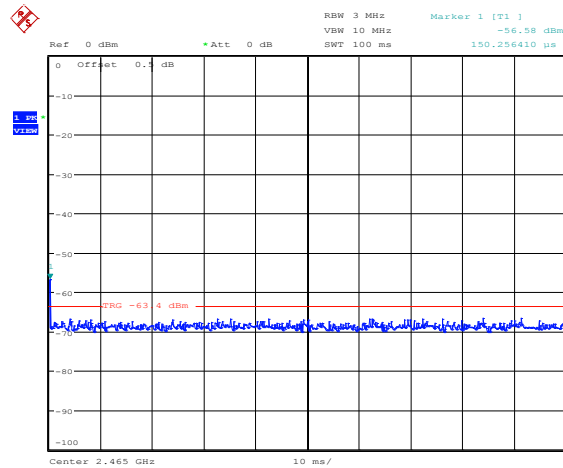
Section 8
Test name
Specification

Testing data
FCC 15.249(a) RSS 210 A2.9(a) Field strength of emissions not in restricted bands
FCC Part 15 Subpart C and RSS-210, Issue 8



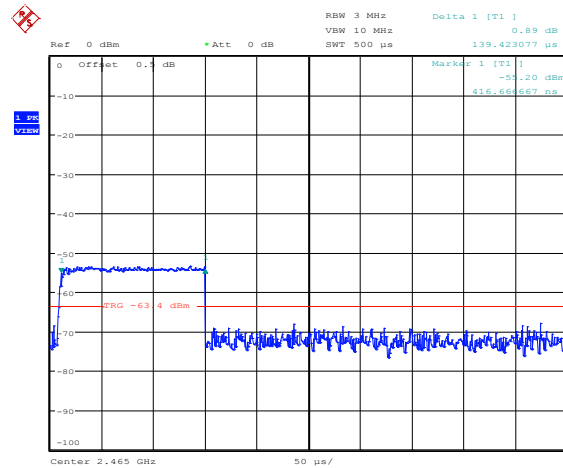
Duty cycle correction factor (DCCF) was calculated as follows:

$$\text{DCCF (dB)} = 20 \times \log_{10} (\text{Tx}_{100 \text{ ms}} / 100 \text{ ms})$$



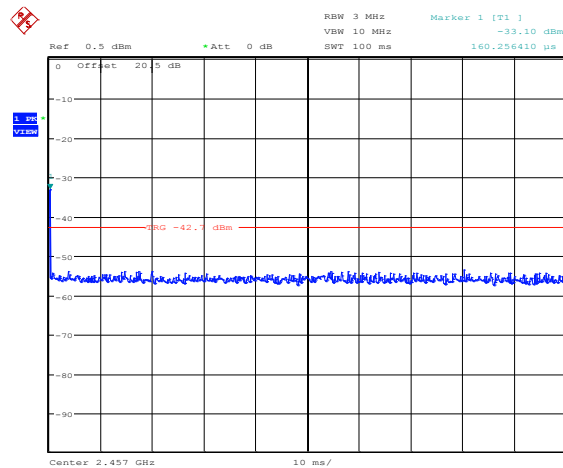
Date: 2.JUL.2015 09:20:05

Figure 8.3-1: 100 ms transmission time frame for OB protocol



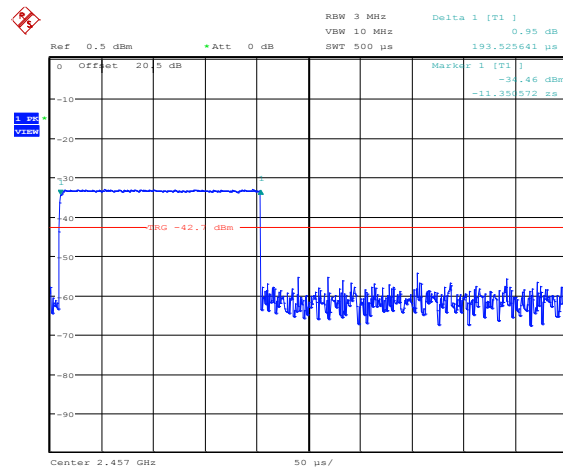
Date: 2.JUL.2015 09:19:38

Figure 8.3-2: Pulse width for OB protocol



Date: 2.JUL.2015 09:05:08

Figure 8.3-3: 100 ms transmission time frame for ANT+ protocol



Date: 2.JUL.2015 09:07:38

Figure 8.3-4: Pulse width for ANT+ protocol

$$\text{DCCF}_{\text{OB}} (\text{dB}) = 20 \times \log_{10} (\text{Tx}_{100 \text{ ms}} / 100 \text{ ms}) = 20 \times \log_{10} (0.139 / 100) = -57.14 \text{ dB}$$

$$\text{DCCF}_{\text{ANT+}} (\text{dB}) = 20 \times \log_{10} (\text{Tx}_{100 \text{ ms}} / 100 \text{ ms}) = 20 \times \log_{10} (0.193 / 100) = -54.26 \text{ dB}$$

8.3.4 Test data

Table 8.3-2: Radiated field strength of fundamental measurement results for OB protocol

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Calculated	Limit	
Low	2410	95.40	114.00	18.60	38.26	94.00	55.74
Mid	2440	93.88	114.00	20.12	36.14	94.00	57.26
High	2475	93.24	114.00	20.76	36.10	94.00	57.90

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

Calculated Average results were calculated as follows: Peak Field strength + DCCF_{OB}

Table 8.3-3: Radiated field strength of fundamental measurement results for ANT+ protocol

Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
	Measured	Limit		Calculated	Limit	
2457	92.86	114.00	21.14	38.60	94.00	55.40

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

Calculated Average result was calculated as follows: Peak Field strength + DCCF_{ANT+}

No harmonics of the fundamental frequencies were detected above the noise floor.

8.4 FCC 15.249(d) RSS 210 A2.9(b) Spurious emissions (except for harmonics)

8.4.1 Definitions and limits

FCC:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

IC:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Table 8.4-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: 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 8.4-2: IC restricted frequency bands

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

Note: Certain frequency bands listed in **Error! Reference source not found.** and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.4-3: 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			

8.4.2 Test summary

Test date	July 2, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	31 %

8.4.3 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

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

8.4.4 Test data

Table 8.4-4: Radiated field strength of band edge measurement results for OB protocol

Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
	Measured	Limit		Calculated	Limit	
2390	49.18	74.00	24.82	-7.96	54.00	61.96
2483.5	52.11	74.00	21.89	-5.03	54.00	59.03

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Calculated Average results were calculated as follows: Peak Field strength + $DCCF_{OB}$

Table 8.4-5: Radiated field strength of band edge measurement results for ANT+ protocol

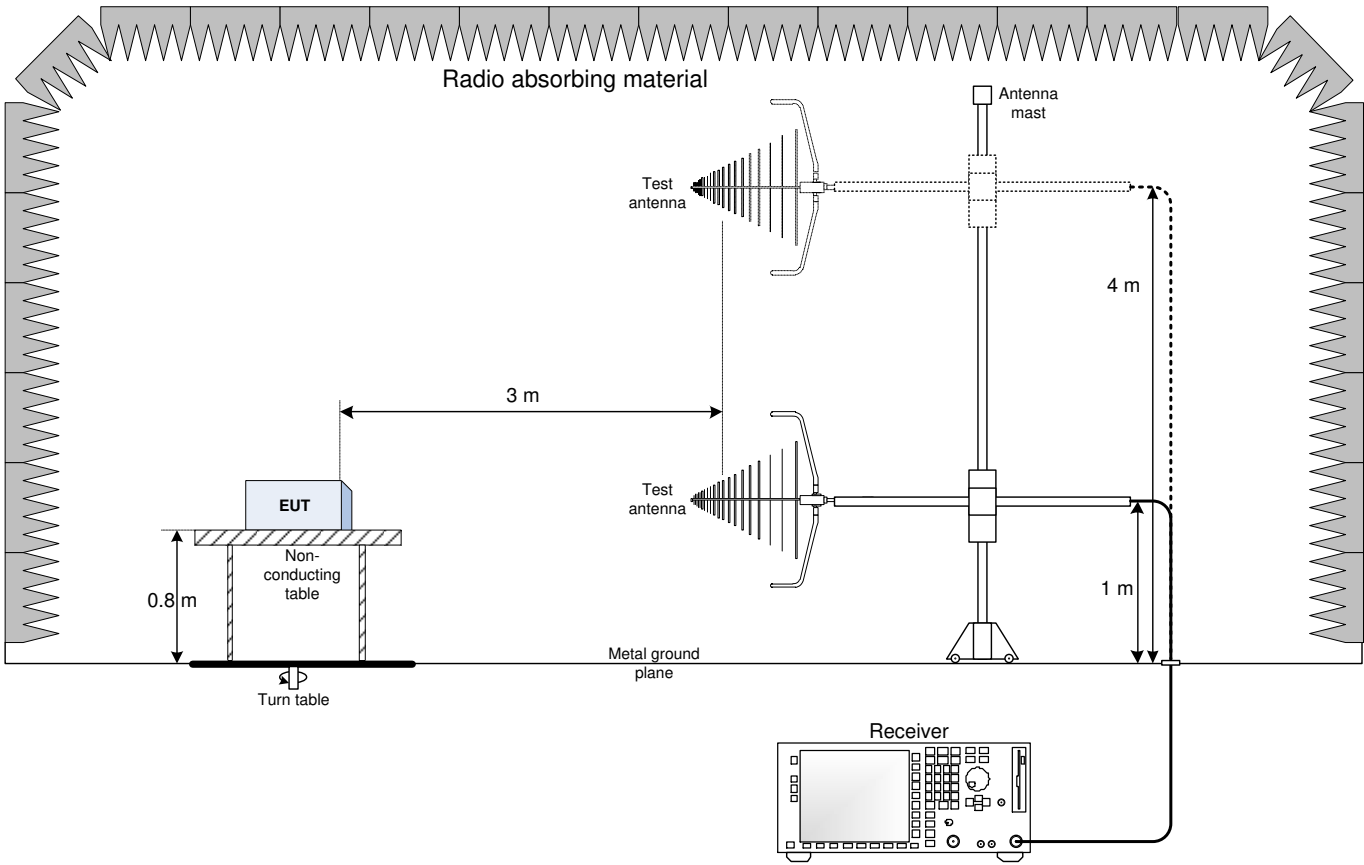
Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
	Measured	Limit		Calculated	Limit	
2390	48.77	74.00	25.23	-5.49	54.00	59.49
2483.5	52.19	74.00	21.81	-2.07	54.00	56.07

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Calculated Average result was calculated as follows: Peak Field strength + $DCCF_{ANT+}$

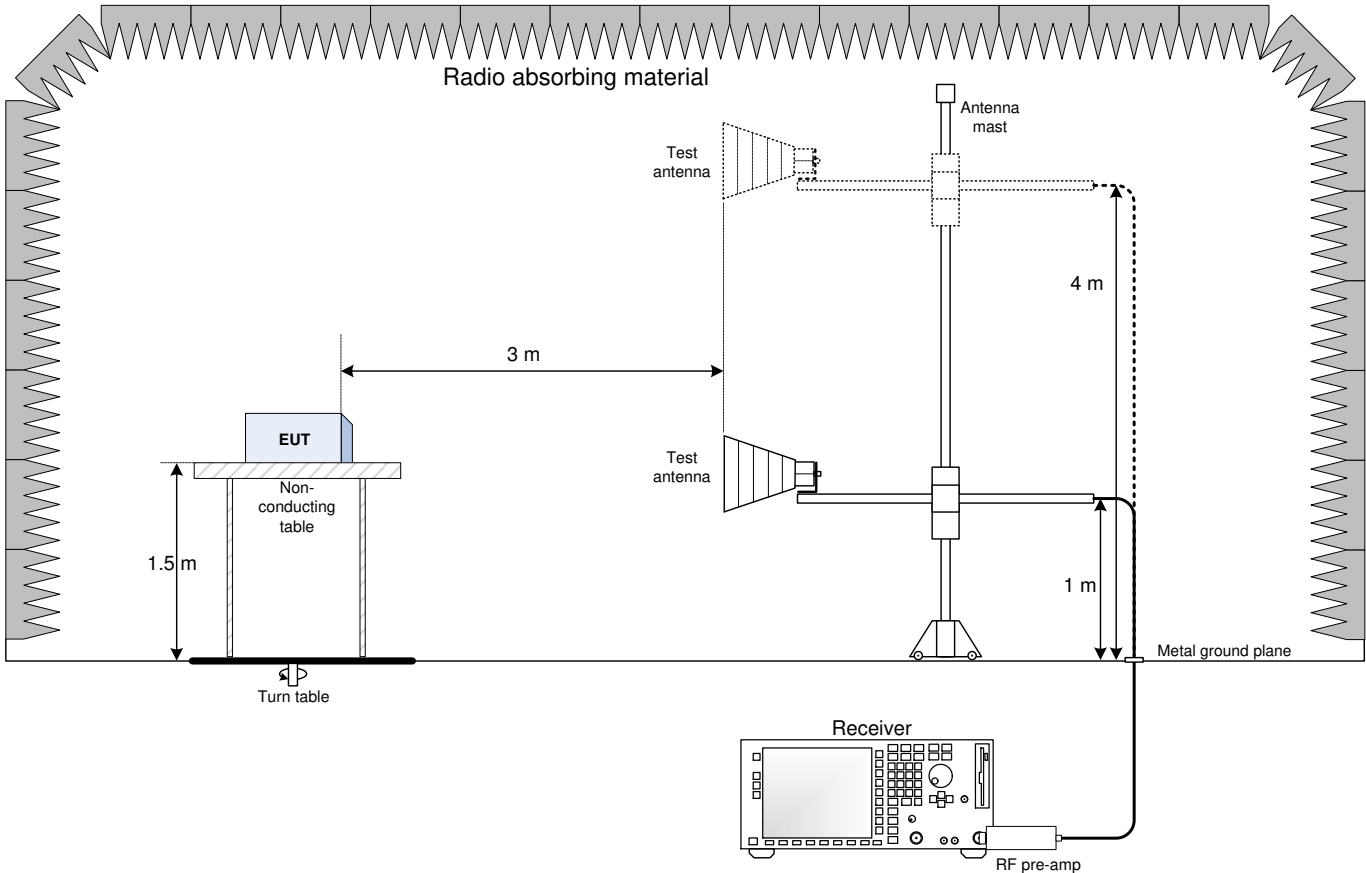
All other emissions were more than 20 dB below the limit.

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



9.3 Conducted emissions set-up

