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Test report

298754-2TRFWL

Date of issue: November 27, 2015

Applicant:

Kantech, a division of Tyco Safety Products Canada Ltd.

Product:

Smart Card Reader

Model:

KT-MUL-MT-KP

Model variant:

KT-MUL-MT

FCC ID:

V8515KTMULMTKP

IC Registration number:

5690B-KTMULMTKP

Specifications:

FCC 47 CFR Part 15.225

Operation within the band 13.110–14.010 MHz

RSS-210 Issue 8, December 2010, Annex 2.6

Devices operating in 13.110–14.010 MHz frequency band for any application

Test location

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Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC test site registration number: 176392, IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	November 27, 2015
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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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Kantech, a division of Tyco Safety Products Canada Ltd.
Address	9995-L Catania Avenue
City	Brossard,
Province/State	Québec,
Postal/Zip code	J4Z 3V7
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.225	Operation in the 13.110–14.010 MHz
RSS-210 Issue 8, December 2010, Annex 2.6	Devices operating in 13.110–14.010 MHz frequency band for any application

1.3 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.

1.4 Exclusions

None

1.5 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
§15.225(a)	Field strength within 13.553–13.567 MHz band	Pass
§15.225(b)	Field strength within 13.410–13.553 MHz and 13.567–13.710 MHz bands	Pass
§15.225(c)	Field strength within 13.110–13.410 MHz and 13.710–14.010 MHz bands	Pass
§15.225(d)	Field strength outside 13.110–14.010 MHz band	Pass
§15.225(e)	Frequency tolerance of carrier signal	Pass

Notes: None

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
A2.6 (a)	The field strength within the band 13.553–13.567 MHz	Pass
A2.6 (b)	The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz	Pass
A2.6 (c)	The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz	Pass
A2.6 (d)	The field strength outside the band 13.110–14.010 MHz	Pass
A2.6	Carrier frequency stability	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 8, 2015
Nemko sample ID number	133-000471

3.2 EUT information

Product name	Smart Card Reader
Brand name	KANTECH
Model	KT-MUL-MT-KP
Model variant	KT-MUL-MT
Serial number	None
Hardware version	UA593 Rev. 04/UA668 Rev. 03
Software version	1.0

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	ASK
Occupied bandwidth (99 %)	33.65 kHz
Power requirements	12 V_{DC} via 120 V_{AC} 60 Hz power supply
Emission designator	F1D
Antenna information	Integrated antenna The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

These are Smart Card readers that are capable to read Kantech IoProx (125 kHz) and MIFAIR (13.56 MHz) access cards and send credential information to an access control unit for granting access in a protected area. Connection to the ACU is done using Wiegand interface or RS-485 bus (Kantech proprietary). The smart card reader has also an optional keypad that allows using PIN in conjunction with card credential to gain access in the protected area.

3.5 EUT exercise details

EUT was connected to a laptop via USB to RS-485 adapter and TeraTerm session was used to control 13.56 MHz transmitter

3.6 EUT setup diagram

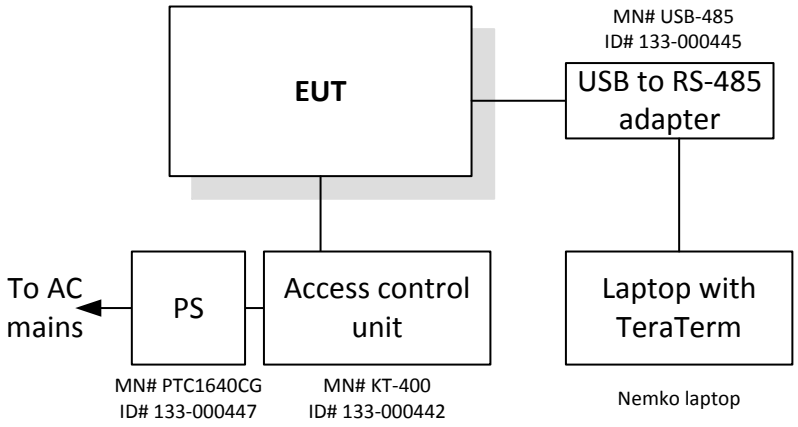


Figure 3.6-1: *Setup diagram*

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

The tested sample with model#: KT-MUL-MT-KP is the most representative of the whole lineup, since all other model variants are depopulated versions of the unit tested. All models contain BLE transmitter. Models MT contain both RFID transmitters: 13.56 MHz and 125 kHz. Models KP have a KeyPad.

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 ±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.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Feb. 25/16
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power source	California Instruments	3001i	FA001021	1 year	Aug. 27/16
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 07/16
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 12/16
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Mar. 27/16
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130	FA002674	1 year	Jan. 13/16
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	Jan. 09/16
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR

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 µH/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, dBµV	
	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	October 20, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1006 mbar
Verdict	Pass	Relative humidity	33 %

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

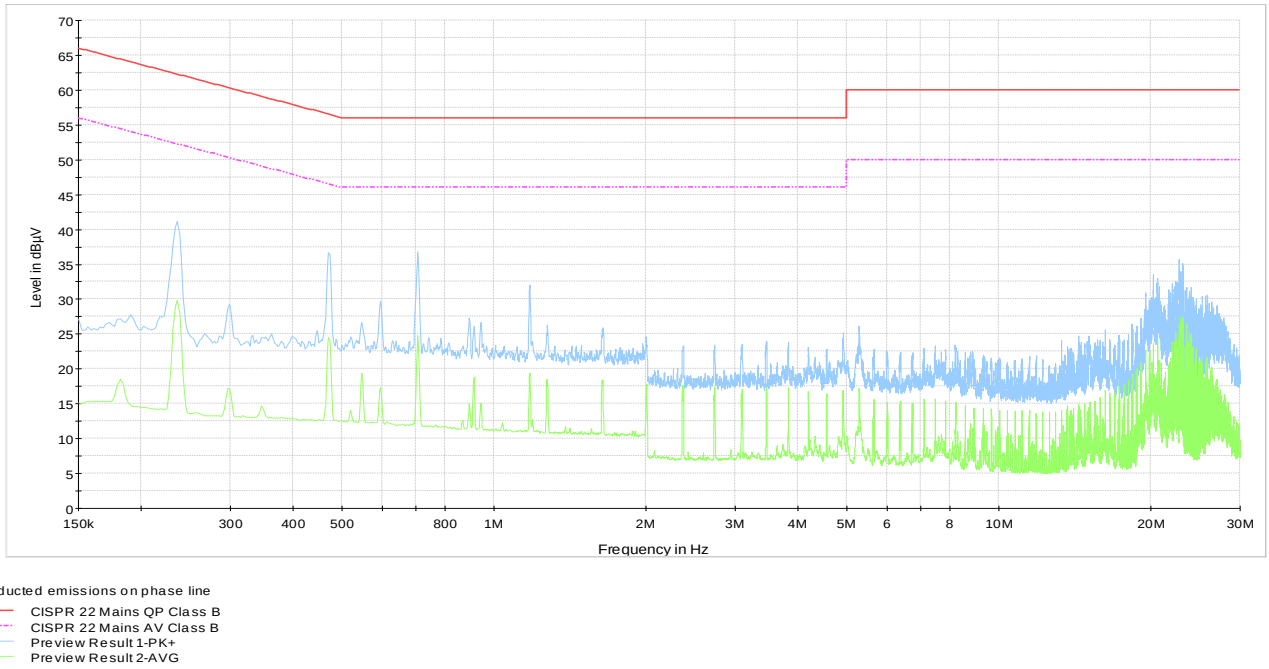
The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

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.

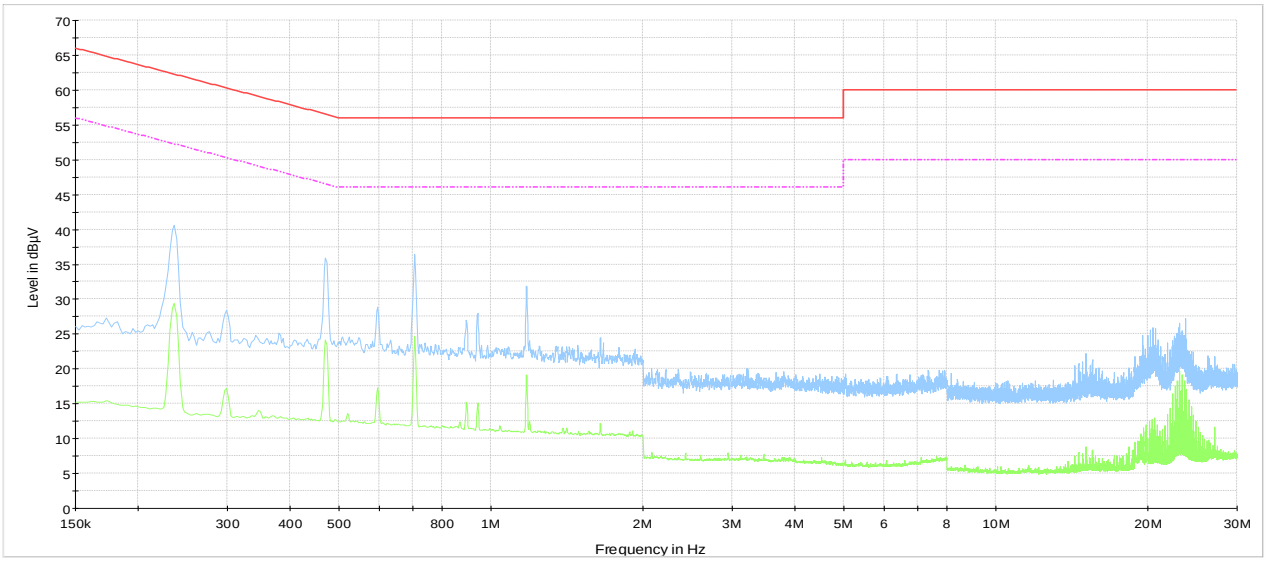
Test receiver settings:

Frequency span	150 kHz to 30 MHz
Detector mode	Peak and Average (preview mode); Quasi-Peak (final measurements)
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	1000 ms

8.1.4 Test data



Plot 8.1-1: *Conducted emissions on phase line*



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	October 7, 2015	Temperature	21 °C
Test engineer	Andrey Adelberg	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	33 %

8.2.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of span
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.4 Test data

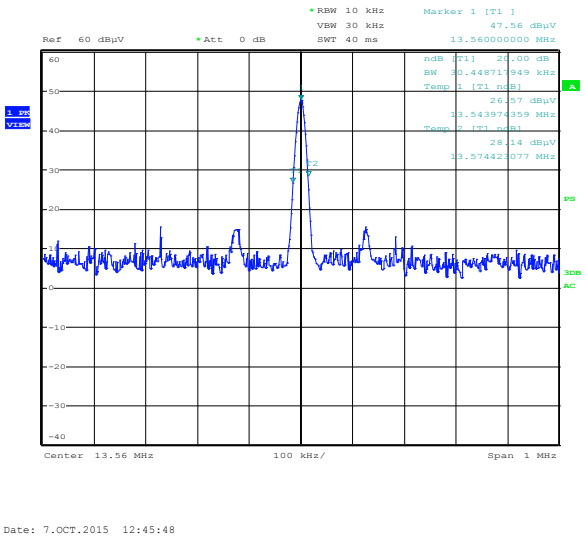


Figure 8.2-1: *20 dB bandwidth*

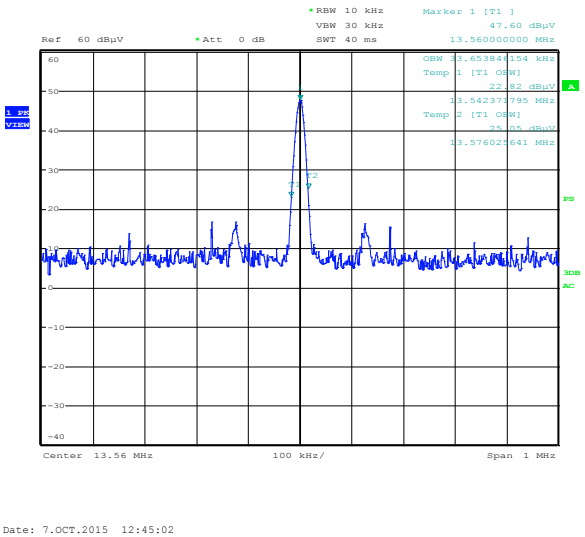


Figure 8.2-2: *99% dB bandwidth*

8.3 FCC 15.225(a–c) and RSS-210 A2.6 (a–c) Field strength within the 13.110–14.010 MHz band

8.3.1 Definitions and limits

a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15848 µV/m (84 dBµV/m) at 30 m.
b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 µV/m (50.5 dBµV/m) at 30 m.
c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 µV/m (40.5 dBµV/m) at 30 m.

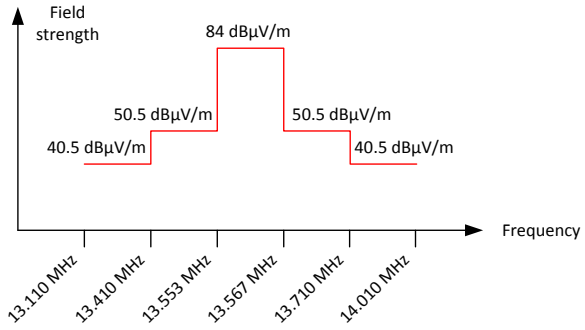


Figure 8.3-1: *In-band spurious emissions limit at 30 m*

8.3.2 Test summary

Test date	October 15, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1020 mbar
Verdict	Pass	Relative humidity	34 %

8.3.3 Observations/special notes

The measurements were performed at the distance of 3 m. 40 dB distance correction factor* was applied to the limit in order to compare with 3 m measurement results.
* 30 m to 3 m distance correction factor calculation (for 13 MHz frequency range):

$$40 \times \text{Log}_{10}(30\text{ m}/3\text{ m}) = 40 \times \text{Log}_{10}(10) = 40\text{ dB}$$

3 m limits were calculated as follows:
Within 13.11–13.41 MHz and 13.71–14.01 MHz frequency ranges: 40.5 dBµV/m + 40 dB = 80.5 dBµV/m
Within 13.41–13.553 MHz and 13.567–13.71 MHz frequency ranges: 50.5 dBµV/m + 40 dB = 90.5 dBµV/m
Within 13.553–13.567 MHz frequency range: 84 dBµV/m + 40 dB = 124 dBµV/m

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold

8.3.4 Test data

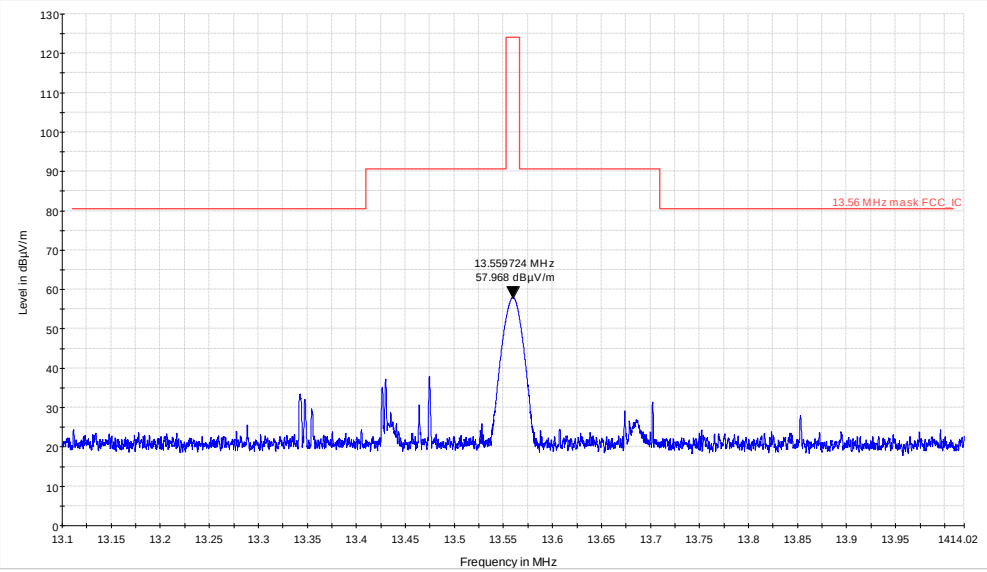


Figure 8.3-2: *Field strength within 13.11–14.01 MHz band*

Table 8.3-1: *Field strength measurement results within 13.11–14.01 MHz band at 3 m distance*

Frequency, MHz	Field strength, dBµV/m	$Limit_{3\,m}$, dBµV/m	Margin, dB
13.56	57.97	124.00	66.03

8.4 FCC 15.225(d) and RSS-210 A2.6(d) Field strength of emissions outside 13.110–14.010 MHz band

8.4.1 Definitions and limits

FCC:
The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.
The field strength of emissions appearing within restricted bands (as specified in §15.205) shall not exceed the limits from §15.209.
IC:
The field strength of any emission outside the band 13.110–14.010 MHz shall not exceed the 30 µV/m (29.5 dBµV/m) at 30 m limit (69.5 dBµV/m at 3 m). In addition to RSS-210, the requirements in RSS-Gen, General Requirements and Information for the Certification of Radio Apparatus, must be met. Category I licence-exempt equipment is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands. These restricted frequency bands are listed in RSS-Gen.

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 table above 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	October 15, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1020 mbar
Verdict	Pass	Relative humidity	34 %

8.4.3 Observations, settings and special notes

The spectrum was searched from 20 kHz to 1 GHz.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 30 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	200 Hz (from 20 kHz frequency) and 9 kHz (from 150 kHz frequency)
Video bandwidth	500 Hz (from 20 kHz frequency) and 30 kHz (from 150 kHz frequency)
Trace mode	Max Hold
Measurement time	100 ms

Spectrum analyzer settings for frequencies above 30 MHz:

Detector mode	Peak
Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.4.4 Test data

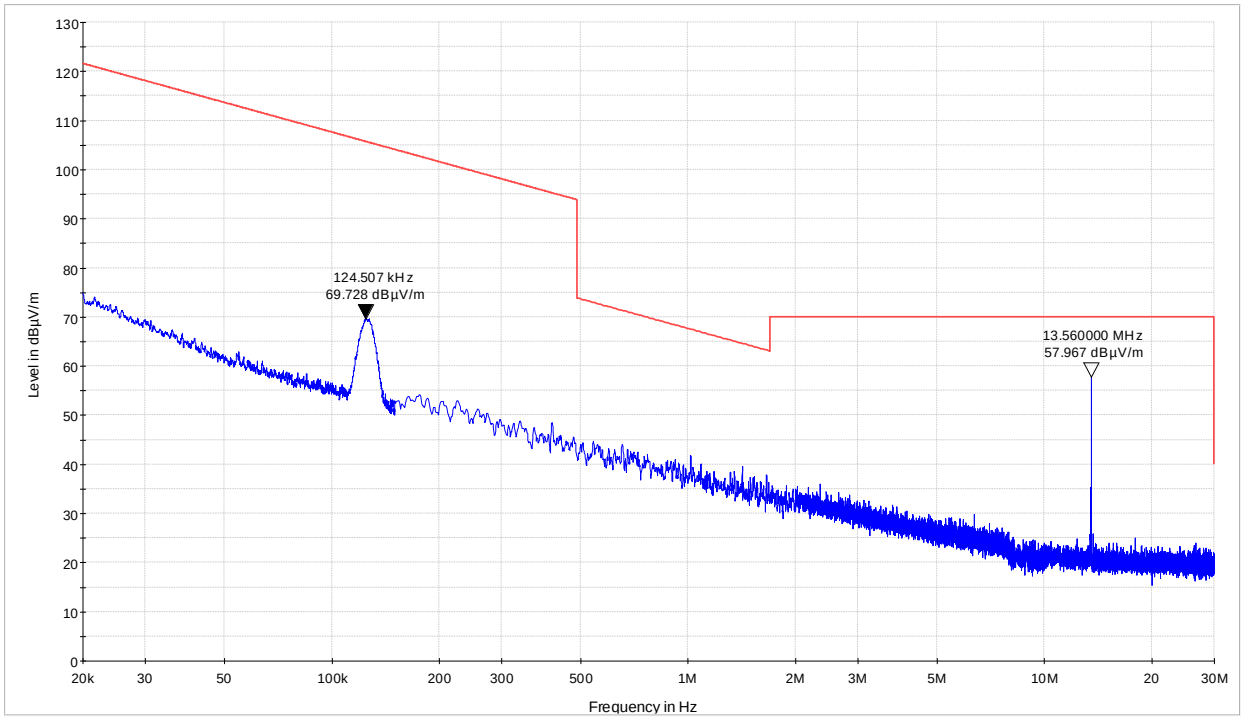


Figure 8.4-1: *Field strength of spurious emissions below 30 MHz*

Note: 124.507 kHz emission is an intentional radiation from secondary RFID transmitter.

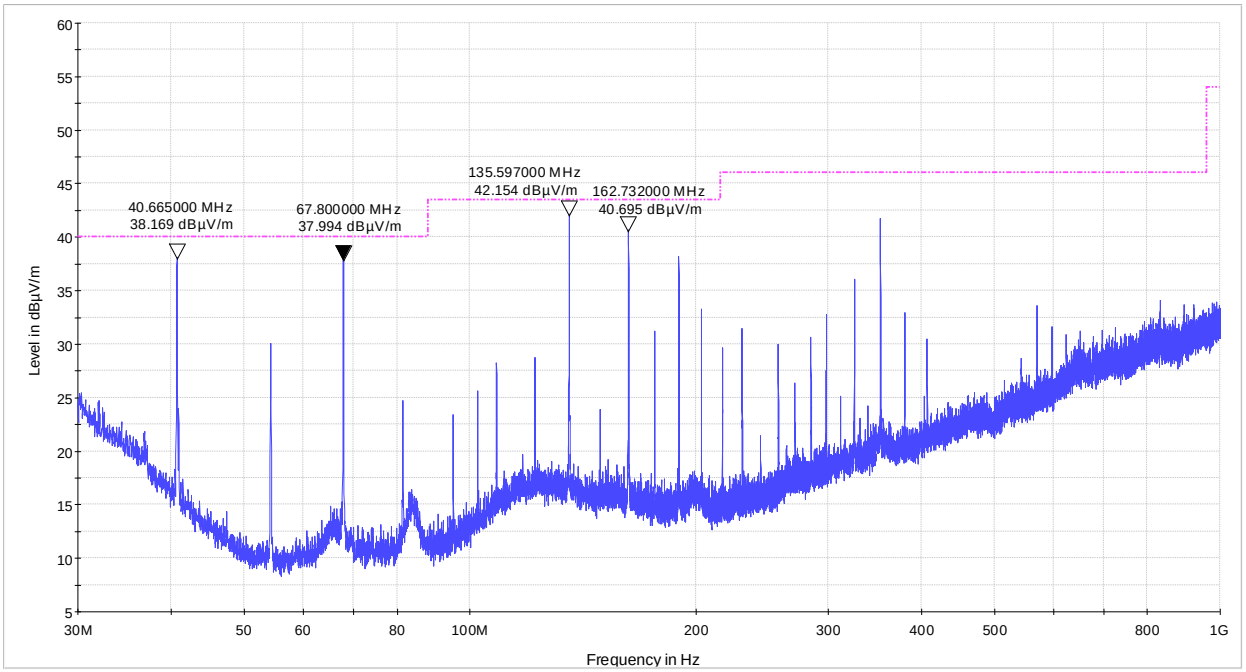


Figure 8.4-2: *Field strength of spurious emissions above 30 MHz*

Note: all measurement results displayed on the plot above were obtained using a peak detector, comply with quasi-peak limit.

Table 8.4-4: *Field strength measurement results outside 13.11–14.01 MHz band at 3 m distance*

Frequency, MHz	Peak field strength, dBµV/m	Quasi peak limit, dBµV/m	Margin, dB
40.66	38.17	40.00	1.83
67.80	37.99	40.00	2.01
135.59	42.15	43.50	1.35
162.73	40.69	43.50	2.81

8.5 FCC 15.225(e) and RSS-210 A2.6 Frequency tolerance of the carrier signal

8.5.1 Definitions and limits

The frequency tolerance of the carrier signal shall be maintained within ±0.01 % (±100 ppm) of the operating frequency over a temperature variation of −20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.5.2 Test summary

Test date	October 20, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1006 mbar
Verdict	Pass	Relative humidity	33 %

8.5.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of emission bandwidth
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.5.4 Test data

Table 8.5-1: *Frequency drift measurements results*

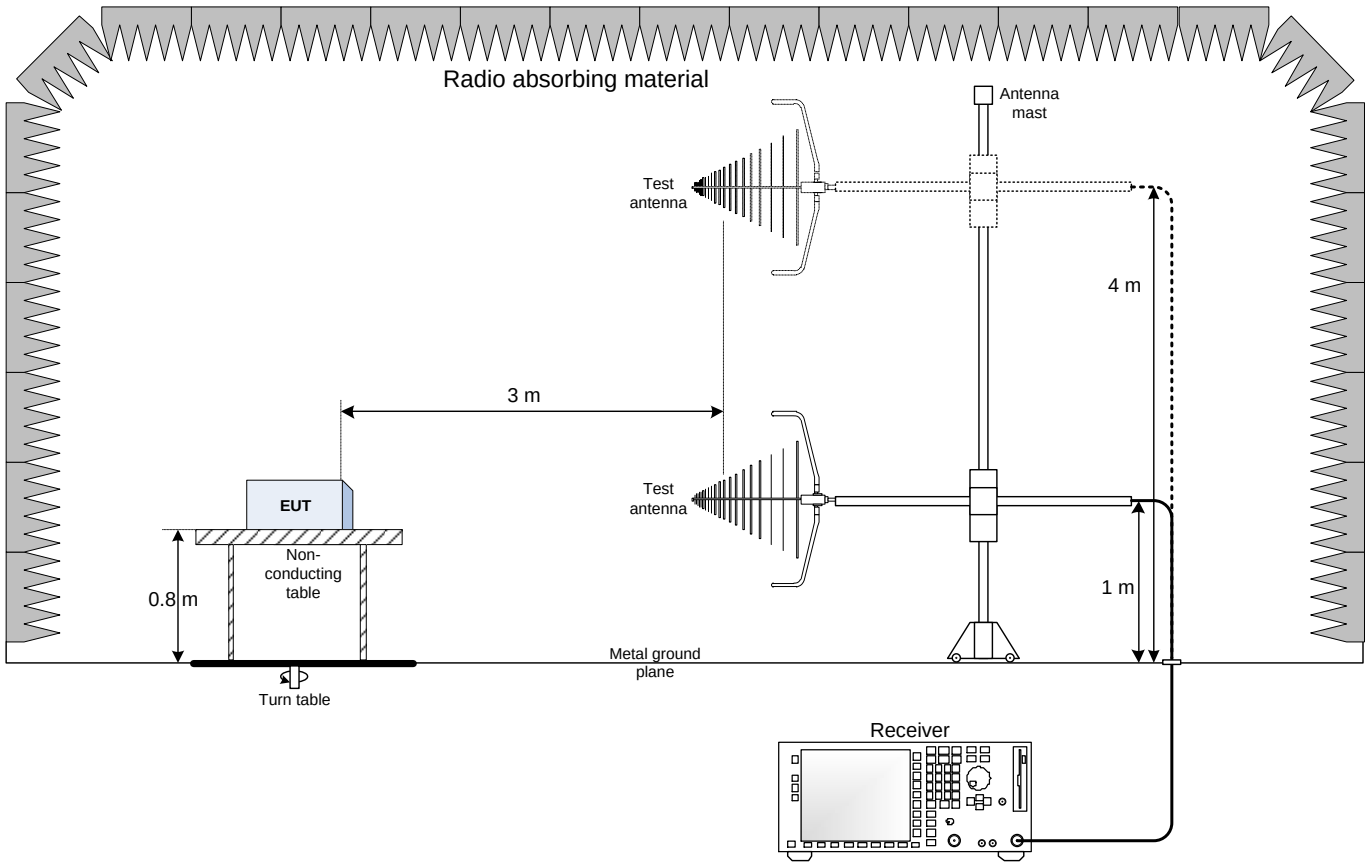
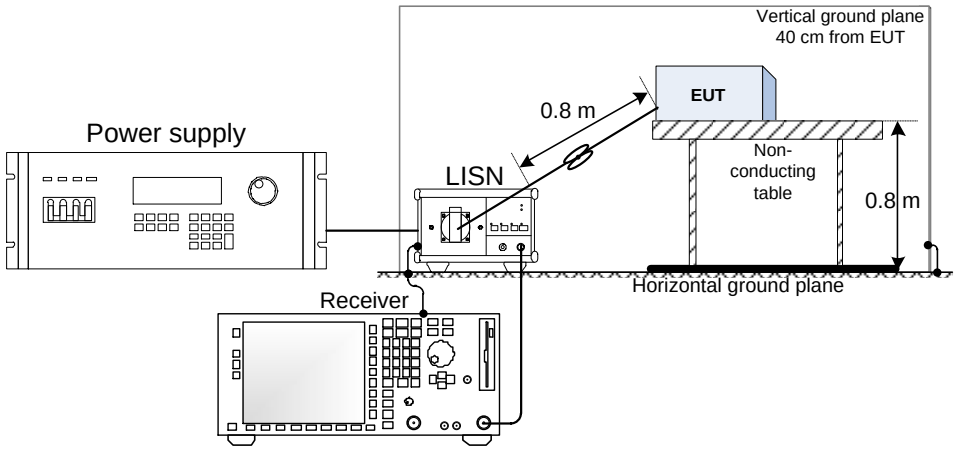
Test conditions	Frequency, MHz	Frequency drift, ±ppm	Limit, ±ppm	Margin, ppm
+50 °C, Nominal	13.559773	3.61364287	100	96.3863571
+20 °C, +15 %	13.559601	-9.07098109	100	90.9290189
+20 °C, Nominal	13.559724	*Reference*	*Reference*	*Reference*
+20 °C, −15 %	13.560122	29.3516299	100	70.6483701
−20 °C, Nominal	13.559926	14.8970584	100	85.1029416

Note: frequency drift was calculated as follows:

Frequency drift (ppm) = $((F_{measured} – F_{reference}) \div F_{reference}) \times 1 \times 10^6$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up