

# Test report

**298754-7TRFWL**

Date of issue: November 27, 2015

Applicant:

**Kantech, a division of Tyco Safety Products Canada Ltd.**

Product:

**Smart Card Reader**

Model:

**KT-SG-MT-KP**

FCC ID:

**V8515KTSGMTKP**

Model variant:

**KT-SG-MT**

IC Registration number:

**5690B-KTSGMTKP**

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

|              |                                                                                    |
|--------------|------------------------------------------------------------------------------------|
| 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                                                                    |
| 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

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### 1.1 Applicant and manufacturer

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|                 |                                                         |
|-----------------|---------------------------------------------------------|
| 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

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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

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None

### 1.5 Test report revision history

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| 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 <sup>1</sup> |
| §15.203    | Antenna requirement       | Pass <sup>2</sup> |
| §15.215(c) | 20 dB bandwidth           | Pass              |

Notes: <sup>1</sup> 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

<sup>2</sup> 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: <sup>1</sup> 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

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### 3.1 Sample information

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|                        |                 |
|------------------------|-----------------|
| Receipt date           | October 8, 2015 |
| Nemko sample ID number | 133-000472      |

### 3.2 EUT information

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|                  |                             |
|------------------|-----------------------------|
| Product name     | Smart Card Reader           |
| Brand name       | <b>KANTECH</b>              |
| Model            | KT-SG-MT-KP                 |
| Model variant    | KT-SG-MT                    |
| Serial number    | None                        |
| Hardware version | UA665 Rev. 02/UA669 Rev. 03 |
| Software version | 1.0                         |

### 3.3 Technical information

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|                           |                                                                                                                   |
|---------------------------|-------------------------------------------------------------------------------------------------------------------|
| 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 <sub>DC</sub> via 120 V <sub>AC</sub> 60 Hz power supply                                                     |
| Emission designator       | F1D                                                                                                               |
| Antenna information       | Integrated antenna<br>The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. |

### 3.4 Product description and theory of operation

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These are Smart Card readers that are capable to read Kantech loProx (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

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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

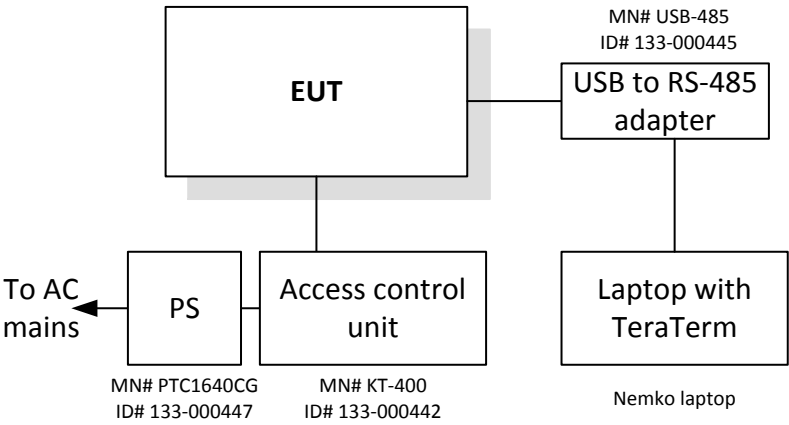


Figure 3.6-1: Setup diagram

## Section 4. Engineering considerations

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### 4.1 Modifications incorporated in the EUT

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

### 4.2 Technical judgment

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The tested sample with model#: KT-SG-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

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No deviations were made from laboratory procedures.

# Section 5. Test conditions

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## 5.1 Atmospheric conditions

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|                   |               |
|-------------------|---------------|
| 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

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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

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## 6.1 Uncertainty of measurement

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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  $\mu$ H/50  $\Omega$  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,<br>MHz | Conducted limit, dB $\mu$ 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     | 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.

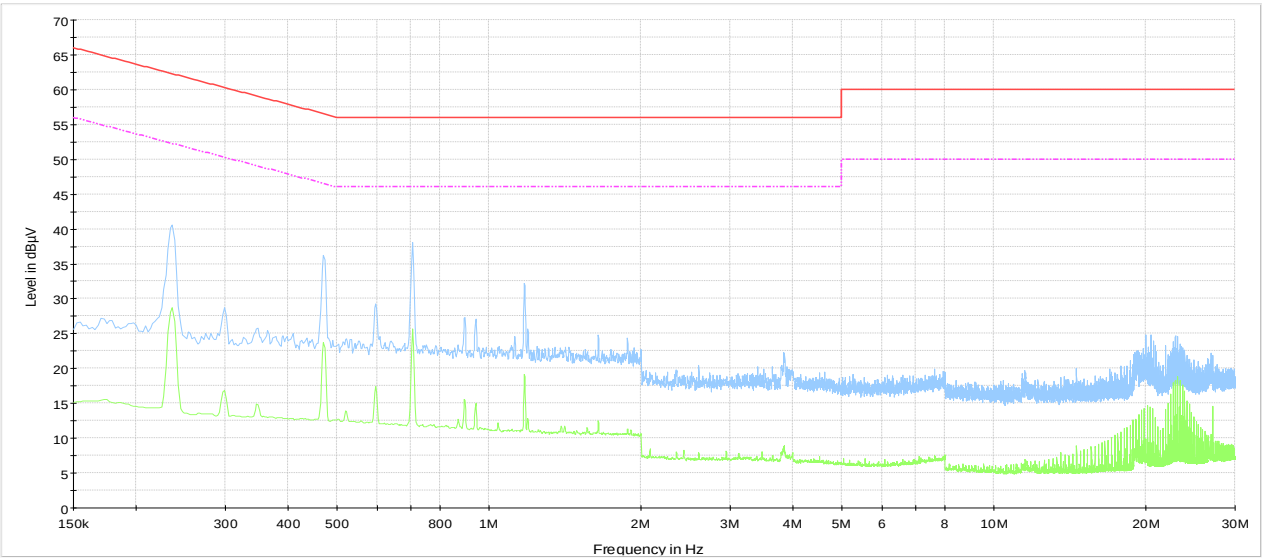
The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

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:

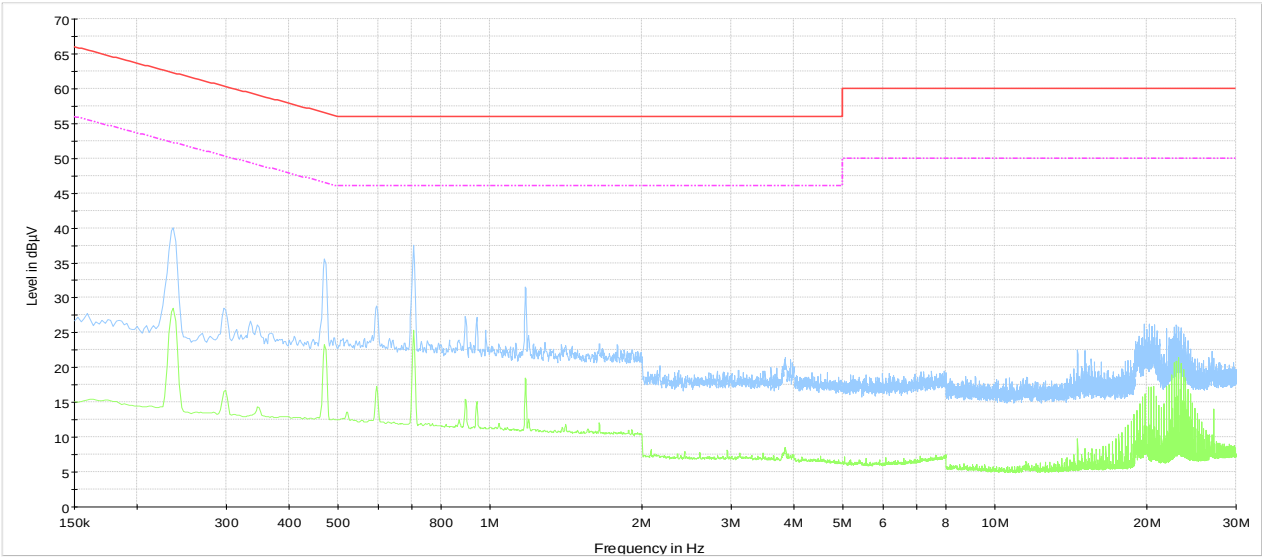
|                      |                                                                  |
|----------------------|------------------------------------------------------------------|
| Frequency span       | 150 kHz to 30 MHz                                                |
| Detector mode        | 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



Conducted Emissions on Phase line  
— 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



Conducted emissions on Neutral line  
— 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

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### 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 %      |

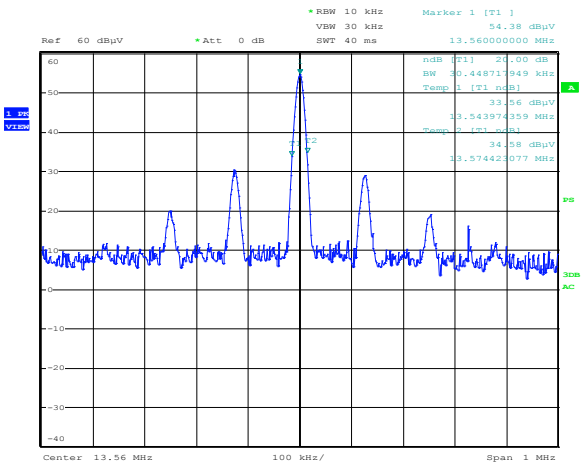
### 8.2.3 Observations, settings and special notes

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Spectrum analyzer settings:

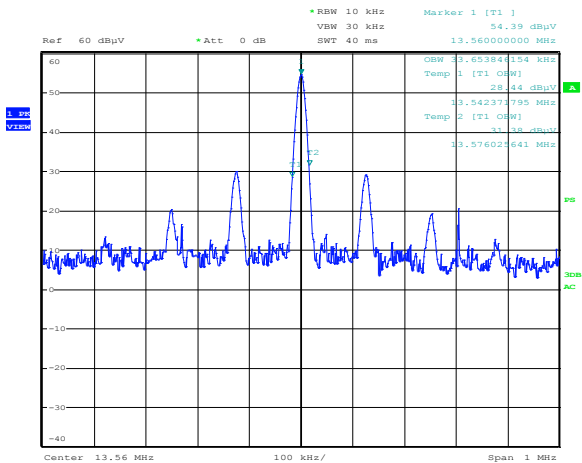
|                      |              |
|----------------------|--------------|
| Detector mode        | Peak         |
| Resolution bandwidth | ≥1 % of span |
| Video bandwidth      | RBW × 3      |
| Trace mode           | Max Hold     |

8.2.4 Test data



Date: 7.OCT.2015 12:49:34

Figure 8.2-1: 20 dB bandwidth



Date: 7.OCT.2015 12:50:24

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  $\mu\text{V/m}$  (84 dB $\mu\text{V/m}$ ) 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  $\mu\text{V/m}$  (50.5 dB $\mu\text{V/m}$ ) 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  $\mu\text{V/m}$  (40.5 dB $\mu\text{V/m}$ ) at 30 m.

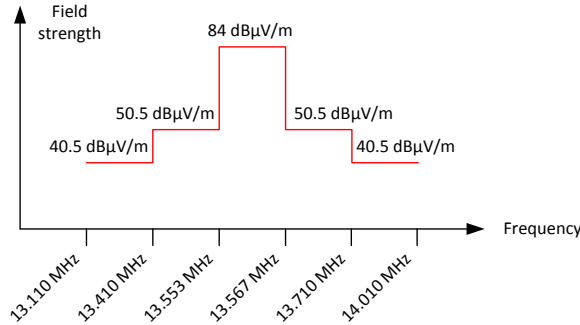


Figure 8.3-1: In-band spurious emissions limit at 30 m

#### 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 dB $\mu\text{V/m}$  + 40 dB = 80.5 dB $\mu\text{V/m}$

Within 13.41–13.553 MHz and 13.567–13.71 MHz frequency ranges: 50.5 dB $\mu\text{V/m}$  + 40 dB = 90.5 dB $\mu\text{V/m}$

Within 13.553–13.567 MHz frequency range: 84 dB $\mu\text{V/m}$  + 40 dB = 124 dB $\mu\text{V/m}$

Spectrum analyzer settings:

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

8.3.4 Test data

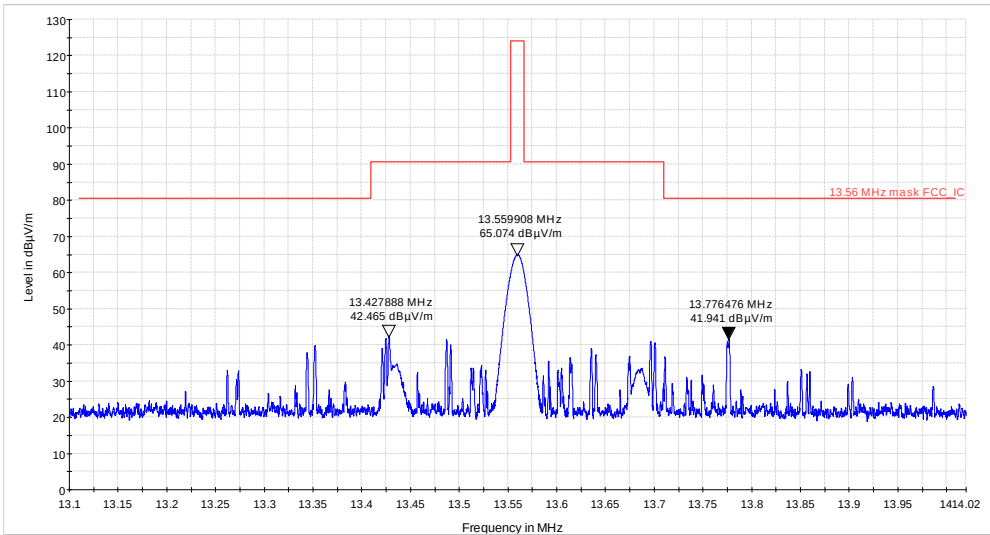


Figure 8.3-2: Field strength within 13.11–14.01 MHz band

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 <sub>3 m</sub> , dBµV/m | Margin, dB |
|----------------|------------------------|-------------------------------|------------|
| 13.43          | 42.47                  | 90.50                         | 48.03      |
| 13.56          | 65.07                  | 124.00                        | 58.93      |
| 13.78          | 41.94                  | 80.50                         | 38.56      |

## 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,<br>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

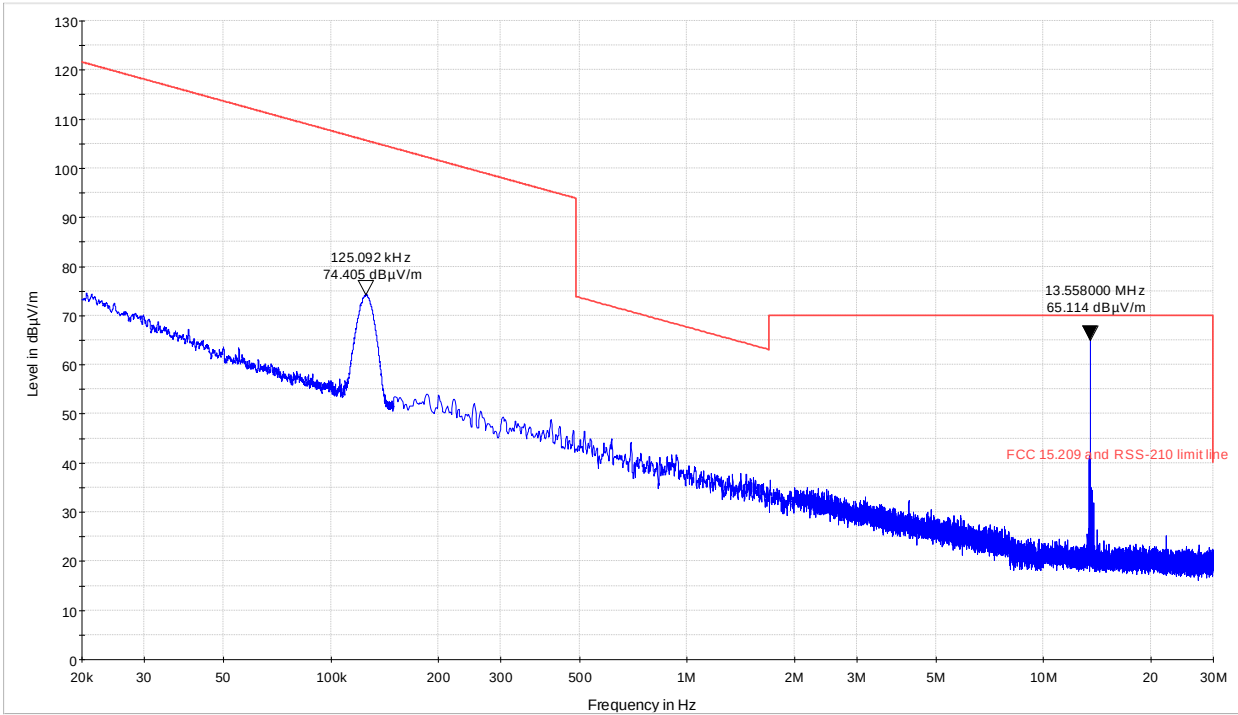


Figure 8.4-1: Field strength of spurious emissions below 30 MHz

Note: 125.092 kHz emission is an intentional radiation from secondary RFID transmitter.

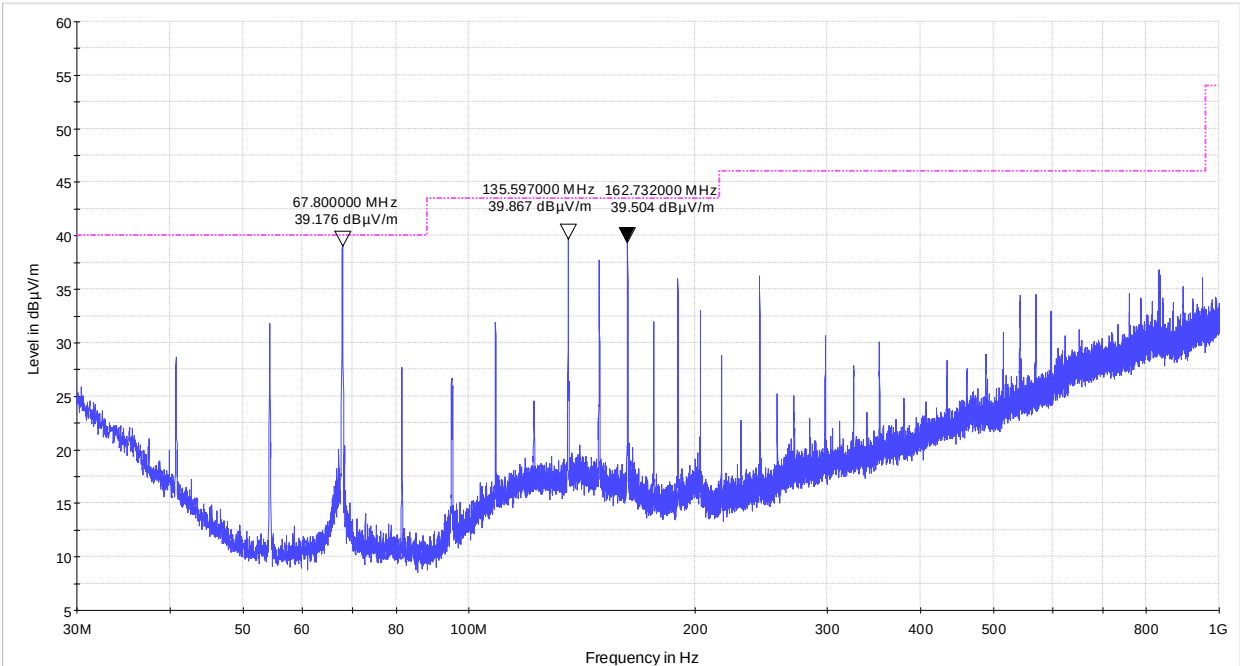


Figure 8.4-2: Field strength of spurious emissions above 30 MHz

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 |
|----------------|-----------------------------|--------------------------|------------|
| 67.80          | 39.18                       | 40.00                    | 0.82       |
| 135.59         | 39.87                       | 43.50                    | 3.63       |
| 162.73         | 39.50                       | 43.50                    | 4.00       |

## 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  $\pm 0.01\%$  ( $\pm 100$  ppm) of the operating frequency over a temperature variation of  $-20\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$  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  $20\text{ }^{\circ}\text{C}$ . 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 $^{\circ}\text{C}$ |
| 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 | $\geq 1\%$ of emission bandwidth |
| Video bandwidth      | RBW $\times 3$                   |
| Trace mode           | Max Hold                         |

### 8.5.4 Test data

**Table 8.5-1: Frequency drift measurements results**

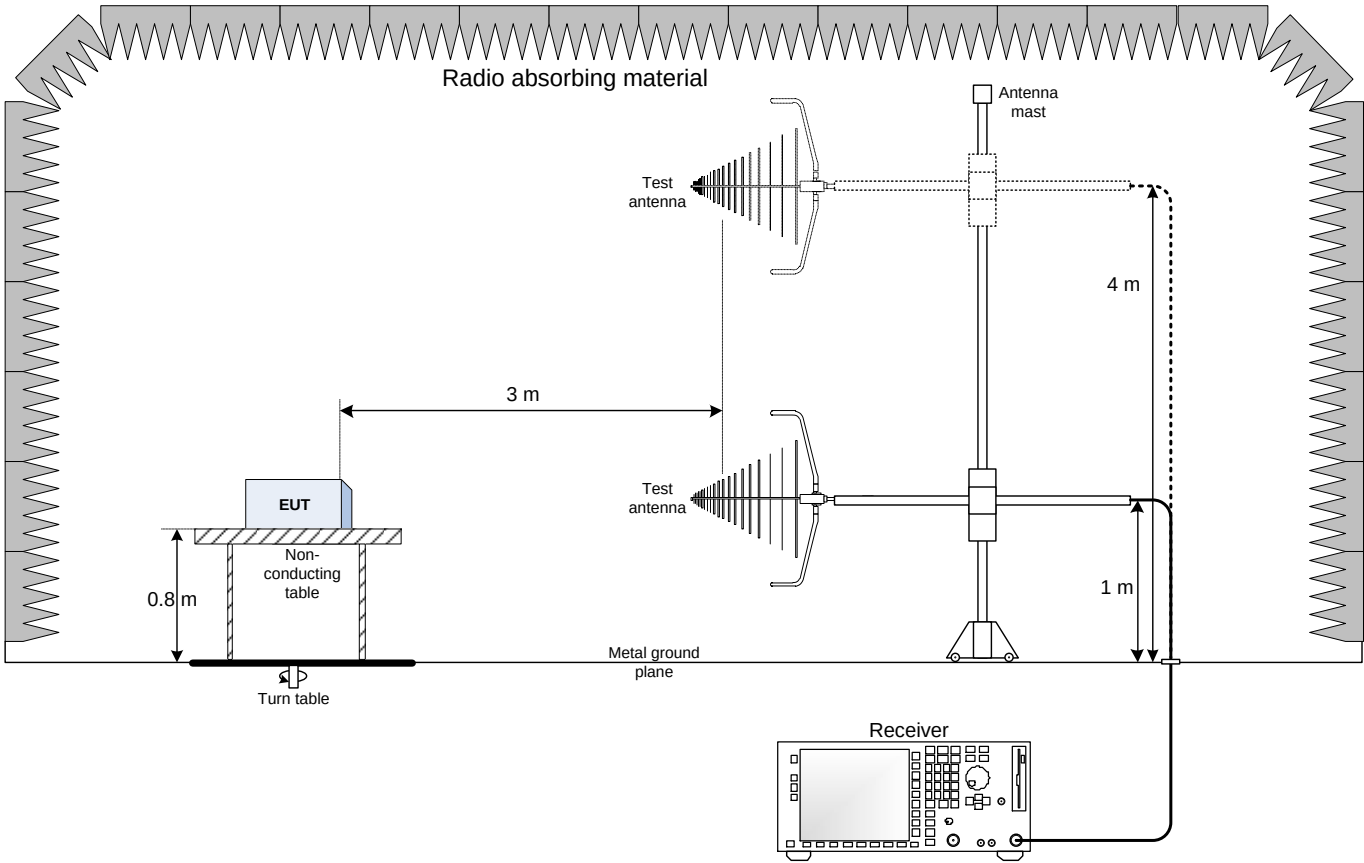
| Test conditions                  | Frequency, MHz | Frequency drift, ppm | Limit, $\pm$ ppm | Margin, ppm |
|----------------------------------|----------------|----------------------|------------------|-------------|
| +50 $^{\circ}\text{C}$ , Nominal | 13.559811      | -7.15344086          | 100              | 92.8465591  |
| +20 $^{\circ}\text{C}$ , +15 %   | 13.559724      | -13.5694136          | 100              | 86.4305864  |
| +20 $^{\circ}\text{C}$ , Nominal | 13.559908      | Reference            | Reference        | Reference   |
| +20 $^{\circ}\text{C}$ , -15 %   | 13.560122      | 15.78181799          | 100              | 84.218182   |
| -20 $^{\circ}\text{C}$ , Nominal | 13.560100      | 14.15938810          | 100              | 85.840612   |

Note: frequency drift was calculated as follows:

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

# Section 9. Block diagrams of test set-ups

## 9.1 Radiated emissions set-up



## 9.2 Conducted emissions set-up

