

# Test report

**377878TRFWL**

Date of issue: 2019-07-17

Applicant:

**MATICA Technologies AG**

**Theresienhoehe 30 – 80339 Munich – Germany**

Product:

**Professional CARD printer**

Model:

**MC 660**

FCC ID:

**2AT78-MC660**

IC Registration number:

**25413-MC660**

Specifications:

**FCC 47 CFR Part 15.225**

Operation within the band 13.110–14.010 MHz

**RSS-210 Issue 9, August 2016, Annex B.6**

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

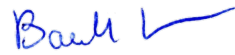
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*The test report merely corresponds to the tested sample.*

*The phase of sampling / collection of equipment under test is carried out by the customer.*

#### Test location

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| Company name | Nemko Spa                                                                         |
| Address      | Via del Carroccio, 4                                                              |
| City         | Biassono                                                                          |
| Province     | MB                                                                                |
| Postal code  | 20853                                                                             |
| Country      | Italy                                                                             |
| Telephone    | +39 039 220 12 01                                                                 |
| Facsimile    | +39 039 220 12 21                                                                 |
| Website      | www.nemko.com                                                                     |
| Site number  | FCC test site registration number: 682159, IC: 9109A (10 m semi anechoic chamber) |

|                                               |             |                   |                                                                                       |
|-----------------------------------------------|-------------|-------------------|---------------------------------------------------------------------------------------|
| Tested by<br>(name, function and signature)   | P. Barbieri | (project handler) |   |
| Reviewed by<br>(name, function and signature) | D. Guarnone | (verifier)        |  |
| Date                                          | 2019-07-17  |                   |                                                                                       |

#### 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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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# Table of contents

|                                                                                                 |           |
|-------------------------------------------------------------------------------------------------|-----------|
| <b>Table of contents</b>                                                                        | <b>3</b>  |
| <b>Section 1. Report summary</b>                                                                | <b>4</b>  |
| 1.1 Applicant and manufacturer                                                                  | 4         |
| 1.2 Test specifications                                                                         | 4         |
| 1.3 Statement of compliance                                                                     | 4         |
| 1.4 Exclusions                                                                                  | 4         |
| 1.5 Test report revision history                                                                | 4         |
| <b>Section 2. Summary of test results</b>                                                       | <b>5</b>  |
| 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 5, test results                                                           | 5         |
| 2.4 IC RSS-210, Issue 9, test results                                                           | 5         |
| <b>Section 3. Equipment under test (EUT) details</b>                                            | <b>6</b>  |
| 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         |
| <b>Section 4. Engineering considerations</b>                                                    | <b>8</b>  |
| 4.1 Modifications incorporated in the EUT                                                       | 8         |
| 4.2 Technical judgment                                                                          | 8         |
| 4.3 Deviations from laboratory tests procedures                                                 | 8         |
| <b>Section 5. Test conditions</b>                                                               | <b>9</b>  |
| 5.1 Atmospheric conditions                                                                      | 9         |
| 5.2 Power supply range                                                                          | 9         |
| <b>Section 6. Measurement uncertainty</b>                                                       | <b>10</b> |
| 6.1 Uncertainty of measurement                                                                  | 10        |
| <b>Section 7. Test equipment</b>                                                                | <b>11</b> |
| 7.1 Test equipment list                                                                         | 11        |
| <b>Section 8. Testing data</b>                                                                  | <b>12</b> |
| 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 6.7 Occupied (Emission) bandwidth                                 | 15        |
| 8.3 FCC 15.225(a–c) and RSS-210 B.6 (a–c) Field strength within the 13.110–14.010 MHz band      | 18        |
| 8.4 FCC 15.225(d) and RSS-210 B.6(d) Field strength of emissions outside 13.110–14.010 MHz band | 20        |
| 8.5 FCC 15.225(e) and RSS-210 B.6 Frequency tolerance of the carrier signal                     | 25        |
| <b>Section 9. Block diagrams of test set-ups</b>                                                | <b>26</b> |
| 9.1 Radiated emissions set-up                                                                   | 26        |
| 9.2 Conducted emissions set-up                                                                  | 27        |
| <b>Section 10. Photos</b>                                                                       | <b>28</b> |
| 10.1 Photos of the test set-up                                                                  | 28        |
| 10.2 Photos of the EUT                                                                          | 30        |

## Section 1. Report summary

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### 1.1 Applicant and manufacturer

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|                 |                        |
|-----------------|------------------------|
| Company name    | MATICA Technologies AG |
| Address         | Theresienhoehe 30      |
| City            | Munich                 |
| Province/State  | Germany                |
| Postal/Zip code | 80339                  |

### 1.2 Test specifications

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|                                              |                                                                           |
|----------------------------------------------|---------------------------------------------------------------------------|
| FCC 47 CFR Part 15, Subpart C, Clause 15.225 | Operation in the 13.110–14.010 MHz                                        |
| RSS-210 Issue 9, August 2016, Annex B.6      | Devices operating in 13.110–14.010 MHz frequency band for any application |
| RSS-Gen Issue 5, March 2019                  | General Requirements for Compliance of Radio Apparatus                    |

### 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 |
|-------------|----------------------------------------|
| 377878TRFWL | 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 5, 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 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

### 2.4 IC RSS-210, Issue 9, test results

| Annex   | Test description                                                            | Verdict |
|---------|-----------------------------------------------------------------------------|---------|
| B.6 (a) | The field strength within the band 13.553–13.567 MHz                        | Pass    |
| B.6 (b) | The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz | Pass    |
| B.6 (c) | The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz | Pass    |
| B.6 (d) | The field strength outside the band 13.110–14.010 MHz                       | Pass    |
| B.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           | 2019-07-15 |
| Nemko sample ID number | 377878-1/2 |

### 3.2 EUT information

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|               |                           |
|---------------|---------------------------|
| Product name  | Professional CARD printer |
| Model         | MC 660                    |
| Serial number | MTDW00600425              |

### 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 %) | 224 Hz                                                                                      |
| Power requirements        | -45.47 dBm EIRP                                                                             |
| Emission designator       | 224HA1D                                                                                     |
| Antenna information       | 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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The EUT is a Desktop Card Printers Equipped with RFID Kit Smart Ribbon.

### 3.5 EUT exercise details

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The EUT use a dedicated internal software to put the radio module in continues transmission mode. After pressing the MENU button for few second, from Optional Mode menu, select the item IC R/W1 with the SET buttons. After pressing SET button on the item Card Feed Test, the EUT starts to read the cards continuously.

3.6 EUT setup diagram

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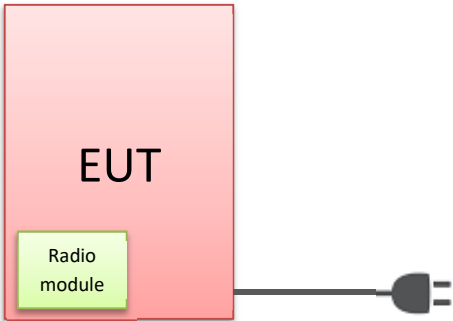


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

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Table 3.7-1: EUT sub assemblies

| Description | Brand name | Model/Part number | Serial number |
|-------------|------------|-------------------|---------------|
| --          | --         | --                | --            |



**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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None

**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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Unless different values are declared in the test case, following ambient conditions apply for the tests:

|                   |               |
|-------------------|---------------|
| Temperature       | 18–33 °C      |
| Relative humidity | 30–60 %       |
| Air pressure      | 980–1060 mbar |

Test equipment used for the monitoring of the environmental conditions

| Equipment                     | Manufacturer | Model no. | Asset no.    | Cal cycle | Next cal. |
|-------------------------------|--------------|-----------|--------------|-----------|-----------|
| Thermohygrometer data loggers | Testo        | 175-H2    | 20012380/305 | 2019-01   | 2021-01   |
| Thermohygrometer data loggers | Testo        | 175-H2    | 38203337/703 | 2019-01   | 2021-01   |
| Barometer                     | MSR          | MSR145B   | 330080       | 2019-05   | 2020-05   |

### 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

### 6.1 Uncertainty of measurement

| EUT         | Type      | Test                                                                                          | Range and Setup features | Measurement Uncertainty | Notes |
|-------------|-----------|-----------------------------------------------------------------------------------------------|--------------------------|-------------------------|-------|
| Transmitter | Conducted | Frequency error                                                                               | 0.001 MHz ÷ 40 GHz       | 0.08 ppm                | (1)   |
|             |           | Carrier power<br>RF Output Power                                                              | 10 kHz ÷ 30 MHz          | 1.0 dB                  | (1)   |
|             |           |                                                                                               | 30 MHz ÷ 18 GHz          | 1.5 dB                  | (1)   |
|             |           |                                                                                               | 18 MHz ÷ 40 GHz          | 3.0 dB                  | (1)   |
|             |           | Adjacent channel power                                                                        | 1 MHz ÷ 18 GHz           | 1.6 dB                  | (1)   |
|             |           | Conducted spurious emissions                                                                  | 10 kHz ÷ 26 GHz          | 3.0 dB                  | (1)   |
|             |           |                                                                                               | 26 GHz ÷ 40 GHz          | 4.5 dB                  | (1)   |
|             |           | Intermodulation attenuation                                                                   | 1 MHz ÷ 18 GHz           | 2.2 dB                  | (1)   |
|             |           | Attack time – frequency behaviour                                                             | 1 MHz ÷ 18 GHz           | 2.0 ms                  | (1)   |
|             |           | Attack time – power behaviour                                                                 | 1 MHz ÷ 18 GHz           | 2.5 ms                  | (1)   |
|             |           | Release time – frequency behaviour                                                            | 1 MHz ÷ 18 GHz           | 2.0 ms                  | (1)   |
|             |           | Release time – power behaviour                                                                | 1 MHz ÷ 18 GHz           | 2.5 ms                  | (1)   |
|             |           | Transient behaviour of the transmitter–<br>Transient frequency behaviour                      | 1 MHz ÷ 18 GHz           | 0.2 kHz                 | (1)   |
|             |           | Transient behaviour of the transmitter –<br>Power level slope                                 | 1 MHz ÷ 18 GHz           | 9%                      | (1)   |
|             |           | Frequency deviation - Maximum<br>permissible frequency deviation                              | 0.001 MHz ÷ 18 GHz       | 1.3%                    | (1)   |
|             |           | Frequency deviation - Response of the<br>transmitter to modulation frequencies<br>above 3 kHz | 0.001 MHz ÷ 18 GHz       | 0.5 dB                  | (1)   |
|             |           | Dwell time                                                                                    | -                        | 3%                      | (1)   |
|             |           | Hopping Frequency Separation                                                                  | 0.01 MHz ÷ 18 GHz        | 1%                      | (1)   |
|             |           | Occupied Channel Bandwidth                                                                    | 0.01 MHz ÷ 18 GHz        | 2%                      | (1)   |
|             |           | Modulation Bandwidth                                                                          | 0.01 MHz ÷ 18 GHz        | 2%                      | (1)   |
|             | Radiated  | Radiated spurious emissions                                                                   | 10 kHz ÷ 26.5 GHz        | 6.0 dB                  | (1)   |
|             |           |                                                                                               | 26.5 GHz ÷ 40 GHz        | 8.0 dB                  | (1)   |
|             |           | Effective radiated power transmitter                                                          | 10 kHz ÷ 26.5 GHz        | 6.0 dB                  | (1)   |
| Receiver    | Radiated  | Radiated spurious emissions                                                                   | 26,5 GHz ÷ 40 GHz        | 8.0 dB                  | (1)   |
|             |           |                                                                                               | 10 kHz ÷ 26.5 GHz        | 6.0 dB                  | (1)   |
|             | Radiated  | Sensitivity measurement                                                                       | 1 MHz ÷ 18 GHz           | 6.0 dB                  | (1)   |
|             |           |                                                                                               | 10 kHz ÷ 26 GHz          | 3.0 dB                  | (1)   |
|             | Conducted | Conducted spurious emissions                                                                  | 26 GHz ÷ 40 GHz          | 4.5 dB                  | (1)   |

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2$  which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %

## 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. |
|------------------------------------|-----------------|---------------------------|-------------|-----------|-----------|
| EMI receiver (20 Hz ÷ 8 GHz)       | Rohde & Schwarz | ESU8                      | 100202      | 2019-01   | 2020-01   |
| EMI receiver (                     | Rohde & Schwarz | ESW44                     | 101620      | 2018-05   | 2019-07   |
| Trilog Broadband Antenna           | Schwarzbeck     | VULB 9162                 | 9162-025    | 2018-07   | 2021-07   |
| Loop antenna                       | Teseq           | HLA6121+PI6121            | 45749       | 2017-07   | 2020-07   |
| Antenna mast                       | Rohde & Schwarz | HCM                       | 836 529/05  | NCR       | NCR       |
| Controller                         | Rohde & Schwarz | HCC                       | 836 620/7   | NCR       | NCR       |
| Hydraulic revolving platform       | Nemko           | RTPL 01                   | 4.233       | NCR       | NCR       |
| Semi-anechoic chamber              | Nemko           | 10m semi-anechoic chamber | 530         | 2018-09   | 2021-09   |
| LISN three phase (9 kHz to 30 MHz) | Rohde & Schwarz | ESH2-Z5                   | 872 460/041 | 2018-09   | 2019-09   |
| Shielded room                      | Siemens         | 10m control room          | 1947        | NCR       | NCR       |
| Climatic chamber                   | MSL             | EC5000DA                  | 15022       | 2019-01   | 2020-01   |

Note: NCR - no calibration required, VOU - verify on use

## 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 | Quasi-peak | Conducted limit, dB $\mu$ V | 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     | 2019-07-16  | Temperature       | 25 °C     |
| Test engineer | P. Barbieri | Air pressure      | 1015 mbar |
| Verdict       | Pass        | Relative humidity | 60 %      |

#### 8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

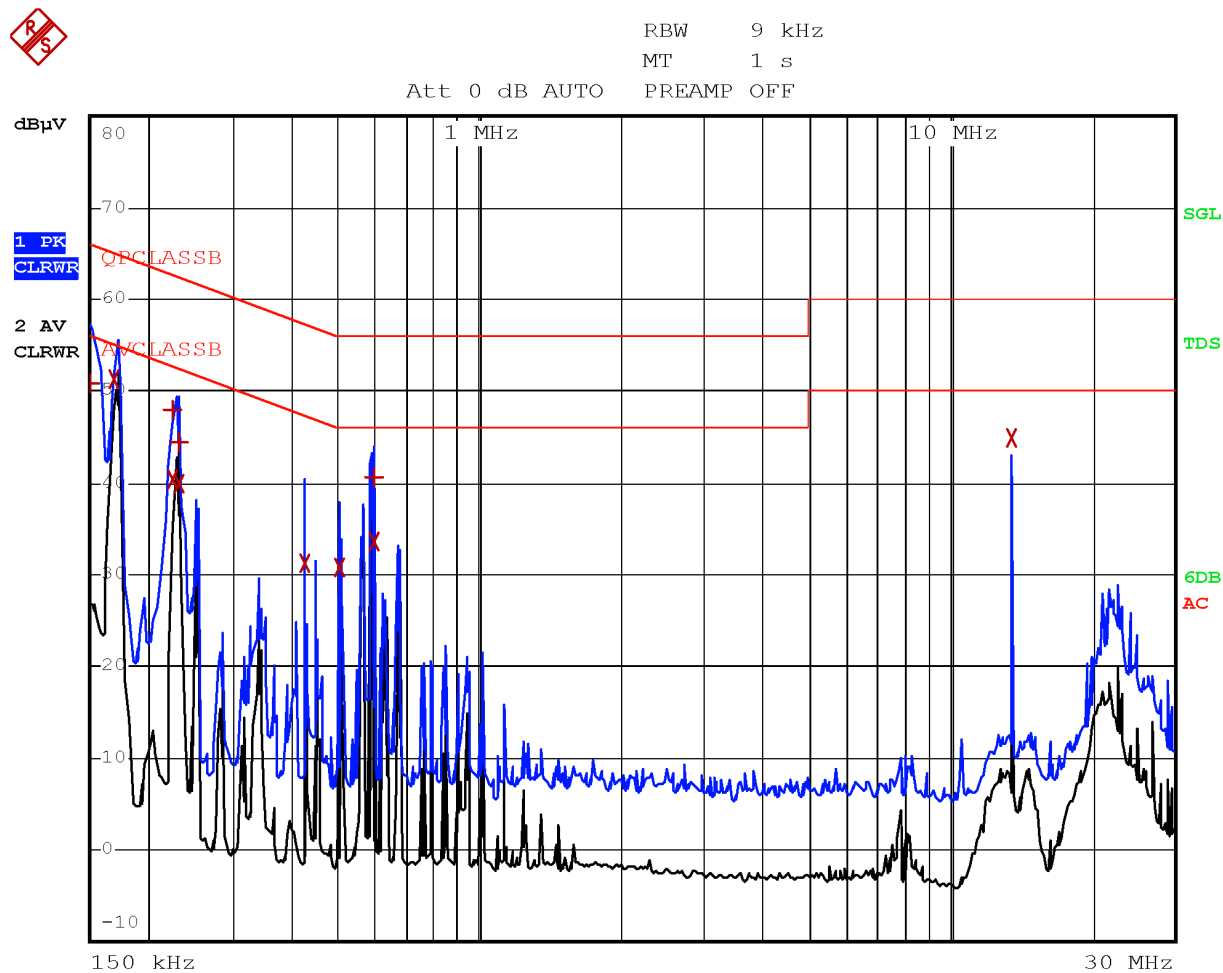
The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

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:

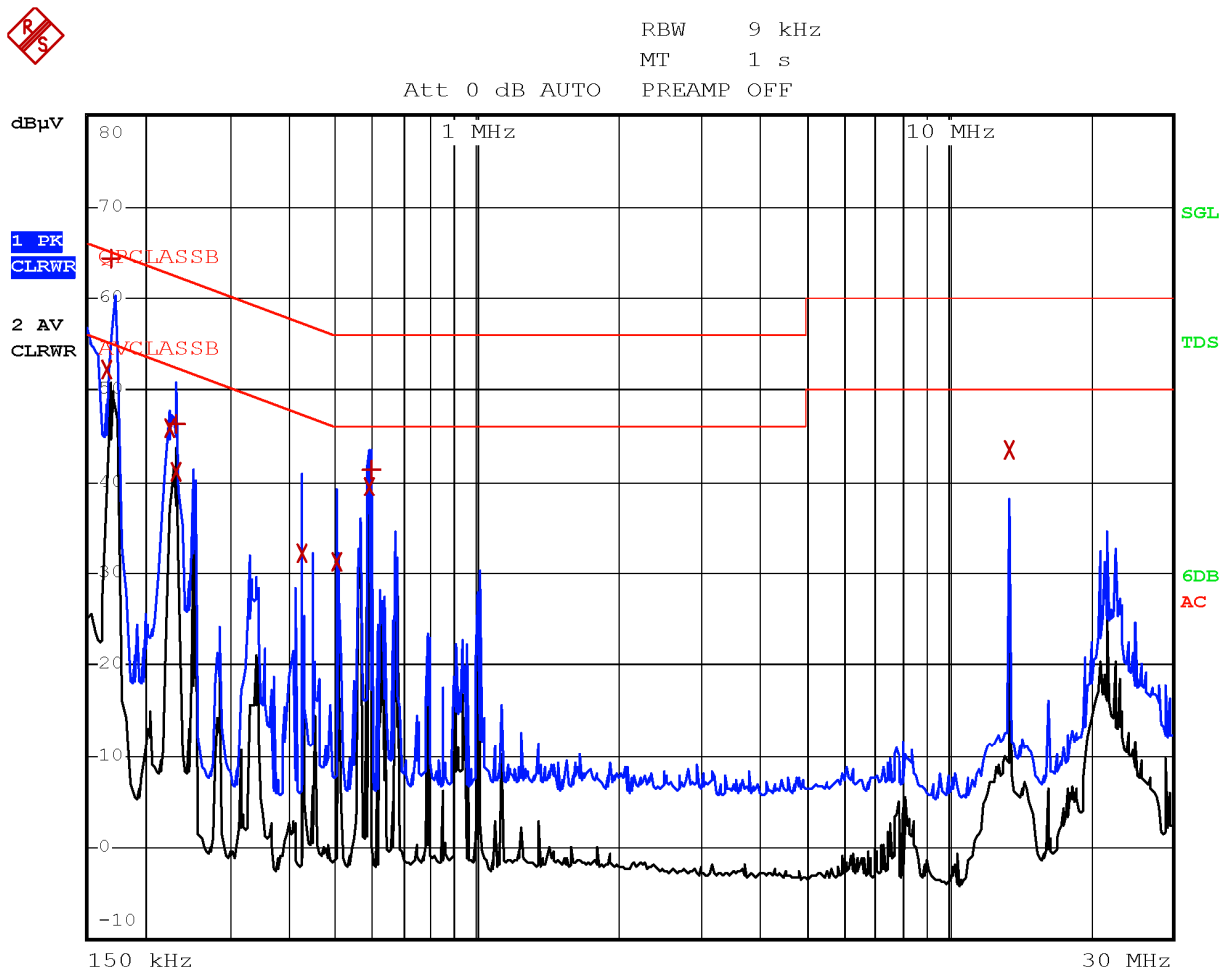
|                      |                                                                  |
|----------------------|------------------------------------------------------------------|
| Frequency span       | 150 kHz to 30 MHz                                                |
| Detector mode        |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

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 0.1500          | 50.9           | 66.0           | -15.1       | QP       |
| 0.1700          | 51.4           | 55.0           | -3.6        | Av       |
| 0.2260          | 47.9           | 62.6           | -14.6       | QP       |
| 0.2260          | 40.6           | 52.6           | -12.0       | Av       |
| 0.2300          | 44.6           | 62.4           | -17.9       | QP       |
| 0.2300          | 40.0           | 52.4           | -12.5       | Av       |
| 0.4260          | 31.3           | 47.3           | -16.0       | Av       |
| 0.5060          | 30.7           | 46.0           | -15.3       | Av       |
| 0.5940          | 40.8           | 56.0           | -15.2       | QP       |
| 0.5940          | 33.5           | 46.0           | -12.5       | Av       |
| 13.5620         | 44.9           | 50.0           | -5.1        | Av       |



Plot 8.1-2: Conducted emissions on neutral line

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 0.1660          | 52.3           | 55.2           | -2.9        | Av       |
| 0.1700          | 64.2           | 65.0           | -0.7        | QP       |
| 0.2260          | 46.0           | 52.6           | -6.6        | Av       |
| 0.2300          | 46.3           | 62.4           | -16.1       | QP       |
| 0.2300          | 41.3           | 52.4           | -11.2       | Av       |
| 0.4260          | 32.2           | 47.3           | -15.1       | Av       |
| 0.5060          | 31.4           | 46.0           | -14.6       | Av       |
| 0.5900          | 39.5           | 46.0           | -6.5        | Av       |
| 0.5940          | 41.3           | 56.0           | -14.7       | QP       |
| 13.5620         | 43.6           | 50.0           | -6.4        | Av       |

## 8.2 FCC 15.215(c) and RSS-Gen 6.7 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     | 2019-07-16  | Temperature       | 25 °C     |
| Test engineer | P. Barbieri | Air pressure      | 1015 mbar |
| Verdict       | Pass        | Relative humidity | 60 %      |

### 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

**Table 8.2-1: Lower 20 dBc frequency cross result**

| Fundamental frequency, MHz | Lower 20 dBc frequency cross, MHz | Limit, MHz | Margin, kHz |
|----------------------------|-----------------------------------|------------|-------------|
| 13.560                     | 13.5598                           | 13.553     | -6.8        |

**Table 8.2-2: Upper 20 dBc frequency cross result**

| Fundamental frequency, MHz | Upper 20 dBc frequency cross, MHz | Limit, MHz | Margin, kHz |
|----------------------------|-----------------------------------|------------|-------------|
| 13.560                     | 13.5601                           | 13.567     | -6.9        |

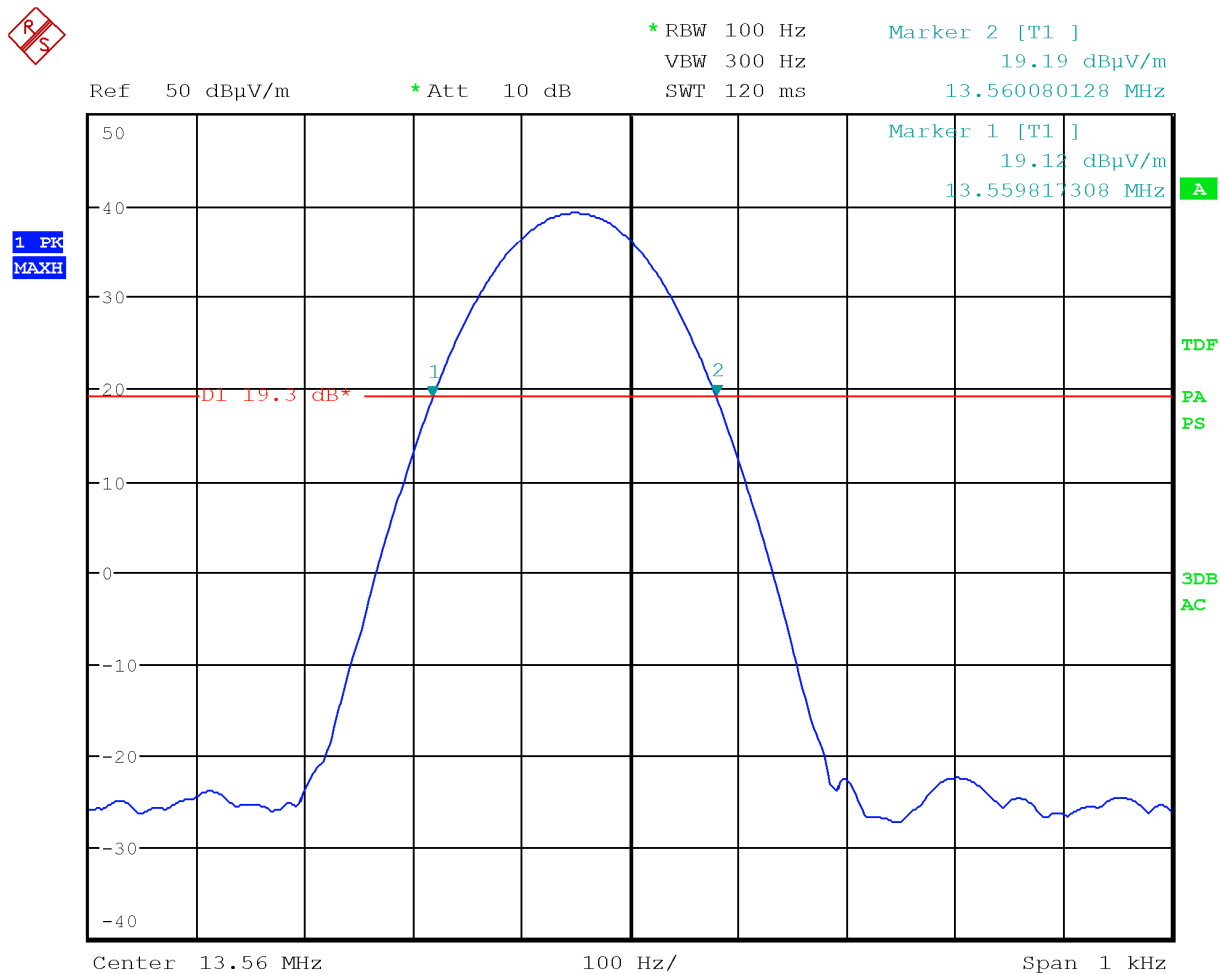


Figure 8.2-1: 20 dB bandwidth

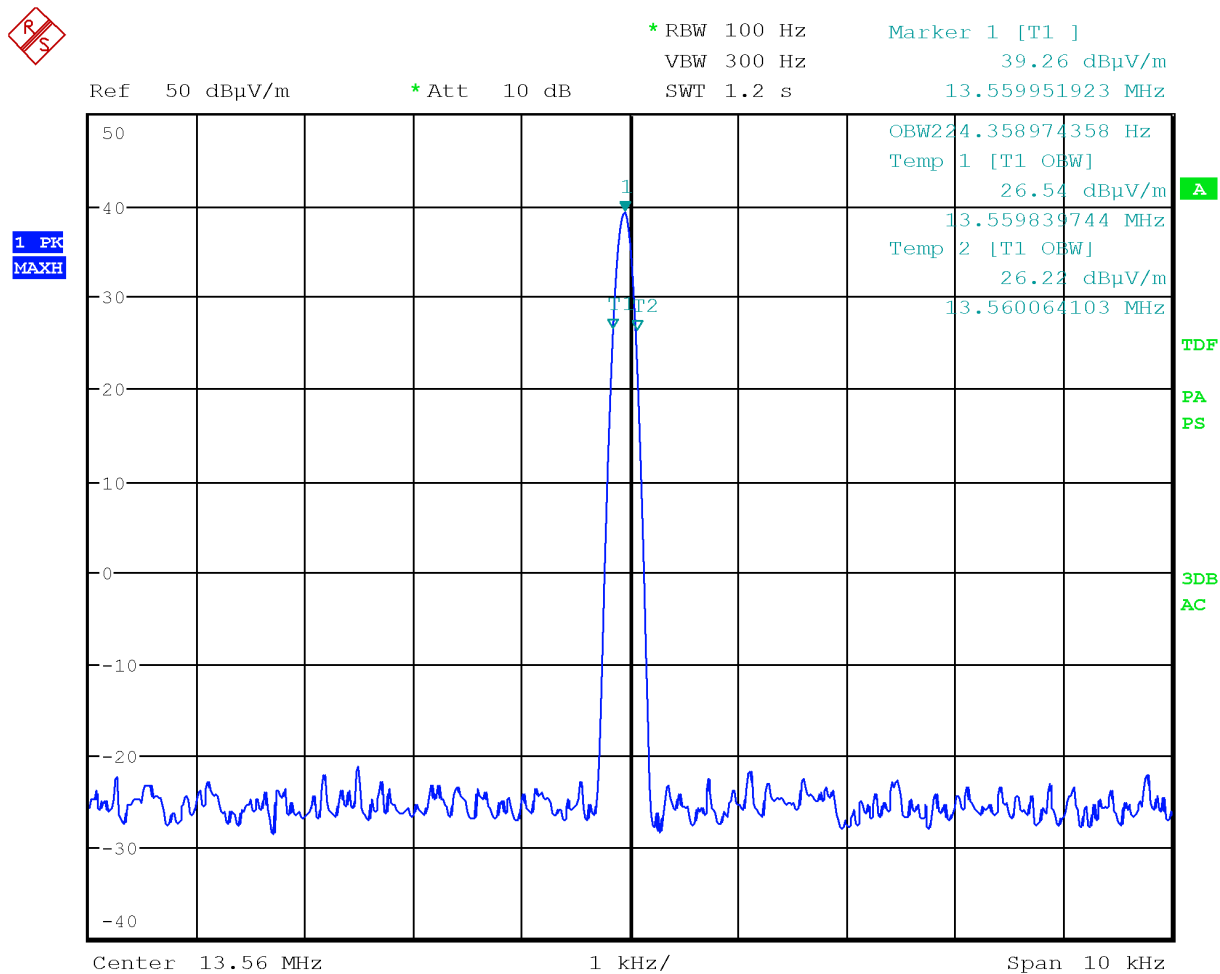


Figure 8.2-2: 99% dB bandwidth

### 8.3 FCC 15.225(a-c) and RSS-210 B.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.

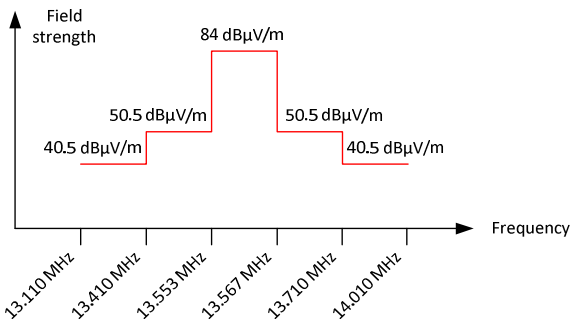


Figure 8.3-1: In-band spurious emissions limit

#### 8.3.2 Test summary

|               |             |                   |       |
|---------------|-------------|-------------------|-------|
| Test date     | 2019-07-15  | Temperature       | 23 °C |
| Test engineer | P. Barbieri | Air pressure      | 1010  |
| Verdict       | Pass        | Relative humidity | 59 %  |

#### 8.3.3 Observations/special notes

The measurements were performed at the distance of 10 m. 40 dB distance correction factor\* was applied to the measurement result in order to comply with 30 m limits.

\* 30 m to 10 m distance correction factor calculation (for 13 MHz band):

$$40 \times \text{Log}_{10} (10 \text{ m}/30 \text{ m}) = 40 \times \text{Log}_{10} (0.33) = -19.1 \text{ dB}$$

Spectrum analyzer settings:

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

8.3.4 Test data

Table 8.3-1: Field strength measurements results

| Frequency range, MHz | Frequency, MHz | Field strength at 10 m, dBµV/m | Calculated field strength at 30 m, dBµV/m | Limit, dBµV/m | Margin, dB |
|----------------------|----------------|--------------------------------|-------------------------------------------|---------------|------------|
| 13.553–13.567        | 13.56          | 39.3                           | 20.2                                      | 84.0          | -63.8      |
| 13.410–13.553        | 13.48          | 19.3                           | 0.2                                       | 50.5          | -50.3      |
| 13.567–13.710        | 13.67          | 20.4                           | 1.3                                       | 50.5          | -42.9      |
| 13.110–13.410        | 13.24          | 20.4                           | 1.3                                       | 40.5          | -39.0      |
| 13.710–14.010        | 13.78          | 19.5                           | 0.4                                       | 40.5          | -40.1      |

Note: Calculated field strength at 30 m = Measured field strength at 10 m – 19.1 dB

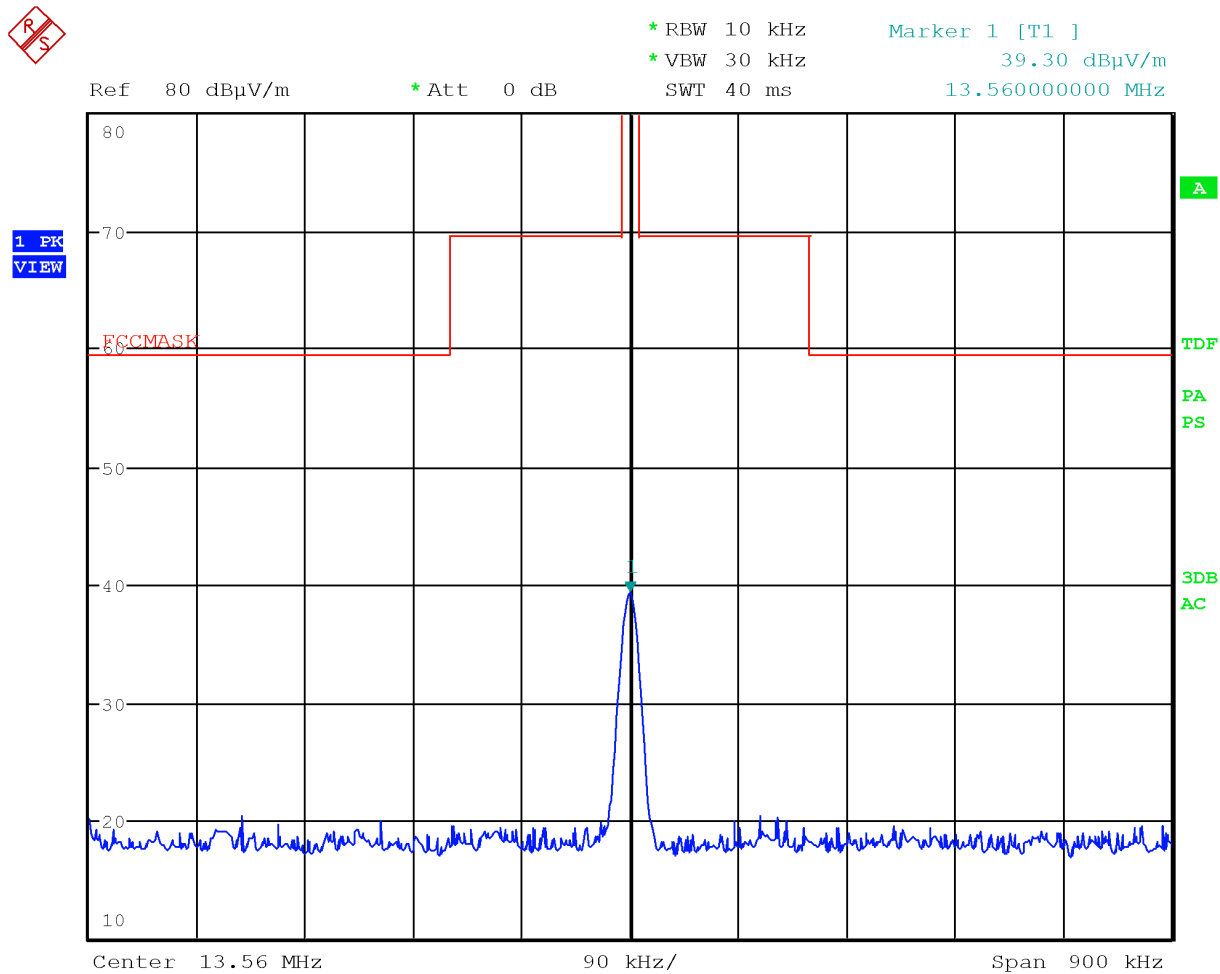


Figure 8.3-2: Field strength within 13.110–14.010 MHz band

## 8.4 FCC 15.225(d) and RSS-210 B.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.

**ISED:**

RSS-Gen general field strength limits for frequencies outside the band 13.110–14.010 MHz.

**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       | 12.57675–12.57725   | 399.9–410     | 7.25–7.75   |
| 0.495–0.505       | 13.36–13.41         | 608–614       | 8.025–8.5   |
| 2.1735–2.1905     | 16.42–16.423        | 960–1427      | 9.0–9.2     |
| 3.020–3.026       | 16.69475–16.69525   | 1435–1626.5   | 9.3–9.5     |
| 4.125–4.128       | 16.80425–16.80475   | 1645.5–1646.5 | 10.6–12.7   |
| 4.17725–4.17775   | 25.5–25.67          | 1660–1710     | 13.25–13.4  |
| 4.20725–4.20775   | 37.5–38.25          | 1718.8–1722.2 | 14.47–14.5  |
| 5.677–5.683       | 73–74.6             | 2200–2300     | 15.35–16.2  |
| 6.215–6.218       | 74.8–75.2           | 2310–2390     | 17.7–21.4   |
| 6.26775–6.26825   | 108–138             | 2483.5–2500   | 22.01–23.12 |
| 6.31175–6.31225   | 149.9–150.05        | 2655–2900     | 23.6–24.0   |
| 8.291–8.294       | 156.52475–156.52525 | 3260–3267     | 31.2–31.8   |
| 8.362–8.366       | 156.7–156.9         | 3332–3339     | 36.43–36.5  |
| 8.37625–8.38675   | 162.0125–167.17     | 3345.8–3358   | Above 38.6  |
| 8.41425–8.41475   | 167.72–173.2        | 3500–4400     |             |
| 12.29–12.293      | 240–285             | 4500–5150     |             |
| 12.51975–12.52025 | 322–335.4           | 5.35–5.46     |             |

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

**Section 8**  
**Test name**  
**Specification**

Testing data  
FCC 15. 225(d) and RSS-210 B6(d) Field strength of emissions outside 13.110–14.010 MHz band  
FCC Part 15 Subpart C and RSS-210 Issue 9



**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     | 2019-07-15  | Temperature       | 23 °C     |
| Test engineer | P. Barbieri | Air pressure      | 1010 mbar |
| Verdict       | Pass        | Relative humidity | 59 %      |

#### 8.4.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to 1 GHz.  
Radiated measurements were performed at a distance of 10 m below 30 MHz and 3 m above 30 MHz.

Spectrum analyzer settings for frequencies below 30 MHz:

|                      |            |
|----------------------|------------|
| Detector mode        | Quasi-Peak |
| Resolution bandwidth | 9 kHz      |
| Trace mode           | Max Hold   |
| Measurement time     | 1 s        |

Spectrum analyzer settings for frequencies above 30 MHz:

|                      |            |
|----------------------|------------|
| Detector mode        | Quasi-Peak |
| Resolution bandwidth | 120 kHz    |
| Trace mode           | Max Hold   |
| Measurement time     | 1 s        |

8.4.4 Test data

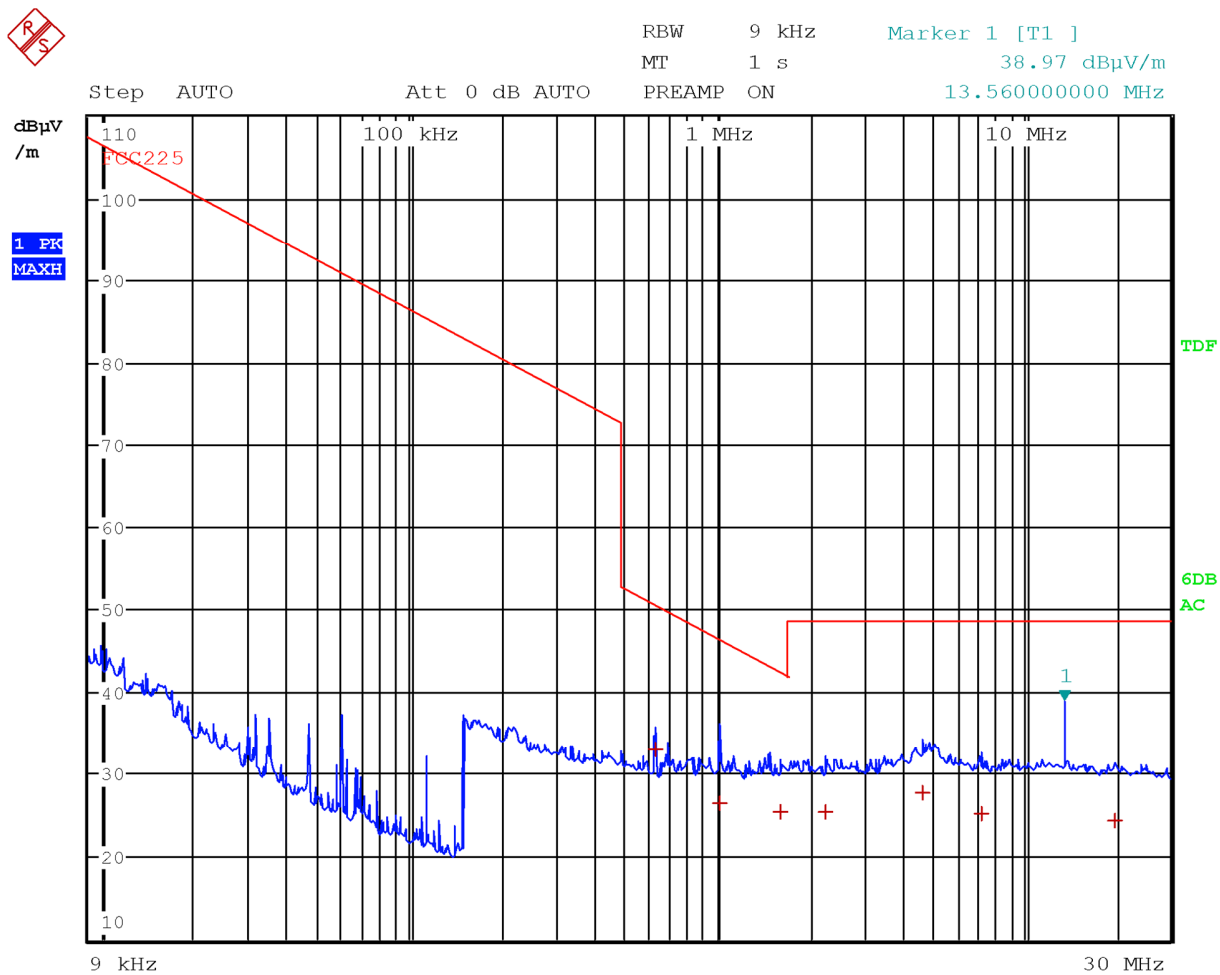
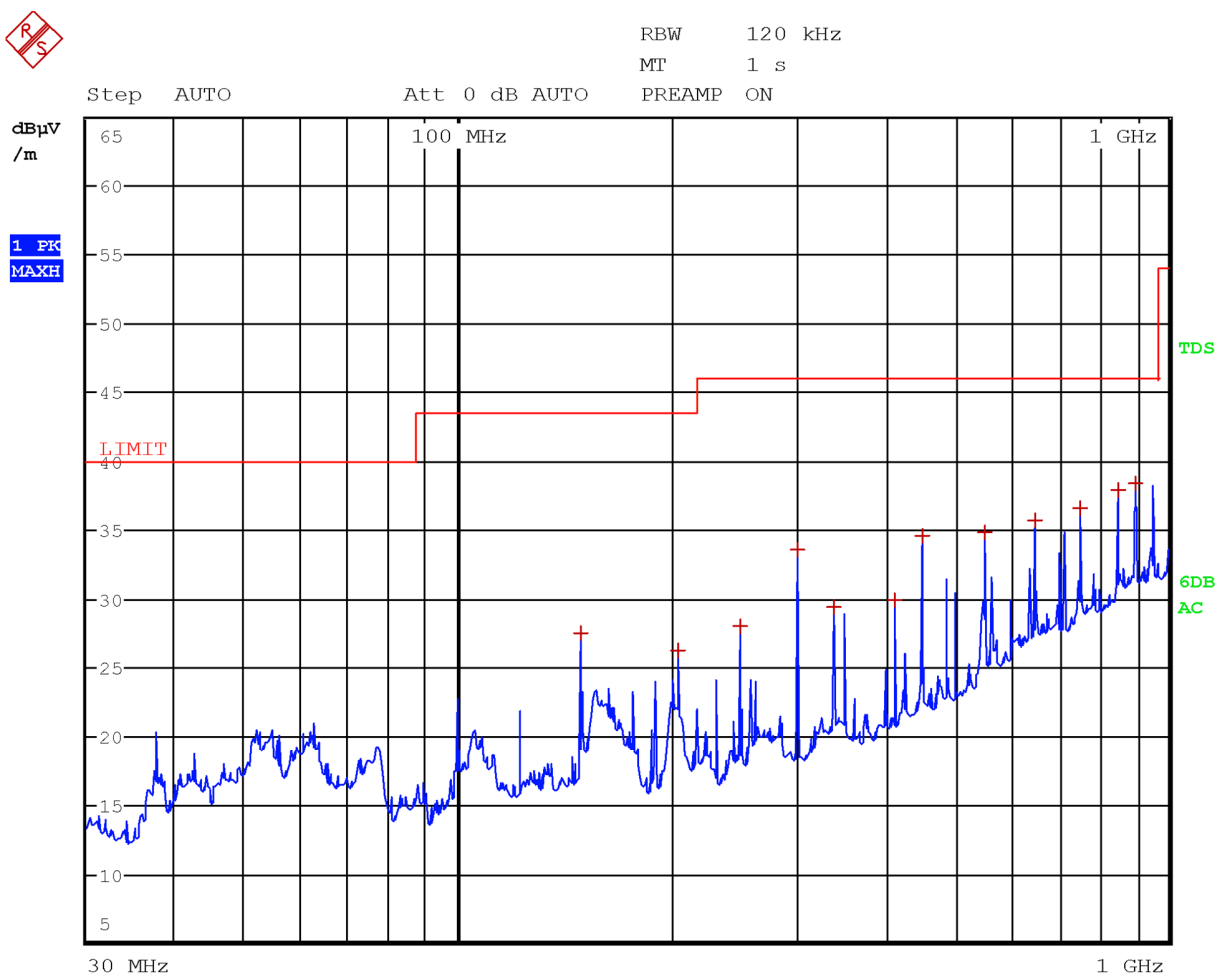


Figure 8.4-1: Field strength of spurious emissions below 30 MHz

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 0.6270          | 33.0           | 50.8           | -17.8       | QP       |
| 1.0163          | 26.4           | 46.6           | -20.1       | QP       |
| 1.6013          | 25.6           | 42.6           | -17.1       | QP       |
| 2.2560          | 25.6           | 48.6           | -23.0       | QP       |
| 4.6680          | 27.7           | 48.6           | -20.9       | QP       |
| 7.2510          | 25.2           | 48.6           | -23.4       | QP       |
| 19.7160         | 24.4           | 48.6           | -24.2       | QP       |

| Test name | Specification |
|-----------|---------------|
|-----------|---------------|

Testing data  
FCC 15. 225(d) and RSS-210 B6(d) Field strength of emissions outside 13.110–14.010 MHz band  
FCC Part 15 Subpart C and RSS-210 Issue 9



**Figure 8.4-2:** Field strength of spurious emissions above 30 MHz with antenna in horizontal polarization

| Frequency<br>(MHz) | Level<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) | Detector |
|--------------------|-------------------|-------------------|----------------|----------|
| 149.1600           | 27.6              | 43.5              | -15.9          | QP       |
| 203.4000           | 26.2              | 43.5              | -17.3          | QP       |
| 249.9900           | 28.1              | 46.0              | -17.9          | QP       |
| 300.0000           | 33.6              | 46.0              | -12.4          | QP       |
| 337.5000           | 29.4              | 46.0              | -16.6          | QP       |
| 412.5000           | 30.0              | 46.0              | -16.0          | QP       |
| 450.0000           | 34.6              | 46.0              | -11.4          | QP       |
| 549.9900           | 34.9              | 46.0              | -11.1          | QP       |
| 650.0100           | 35.8              | 46.0              | -10.2          | QP       |
| 750.0000           | 36.6              | 46.0              | -9.4           | QP       |
| 849.9900           | 38.0              | 46.0              | -8.0           | QP       |
| 900.0000           | 38.7              | 46.0              | -6.9           | QP       |

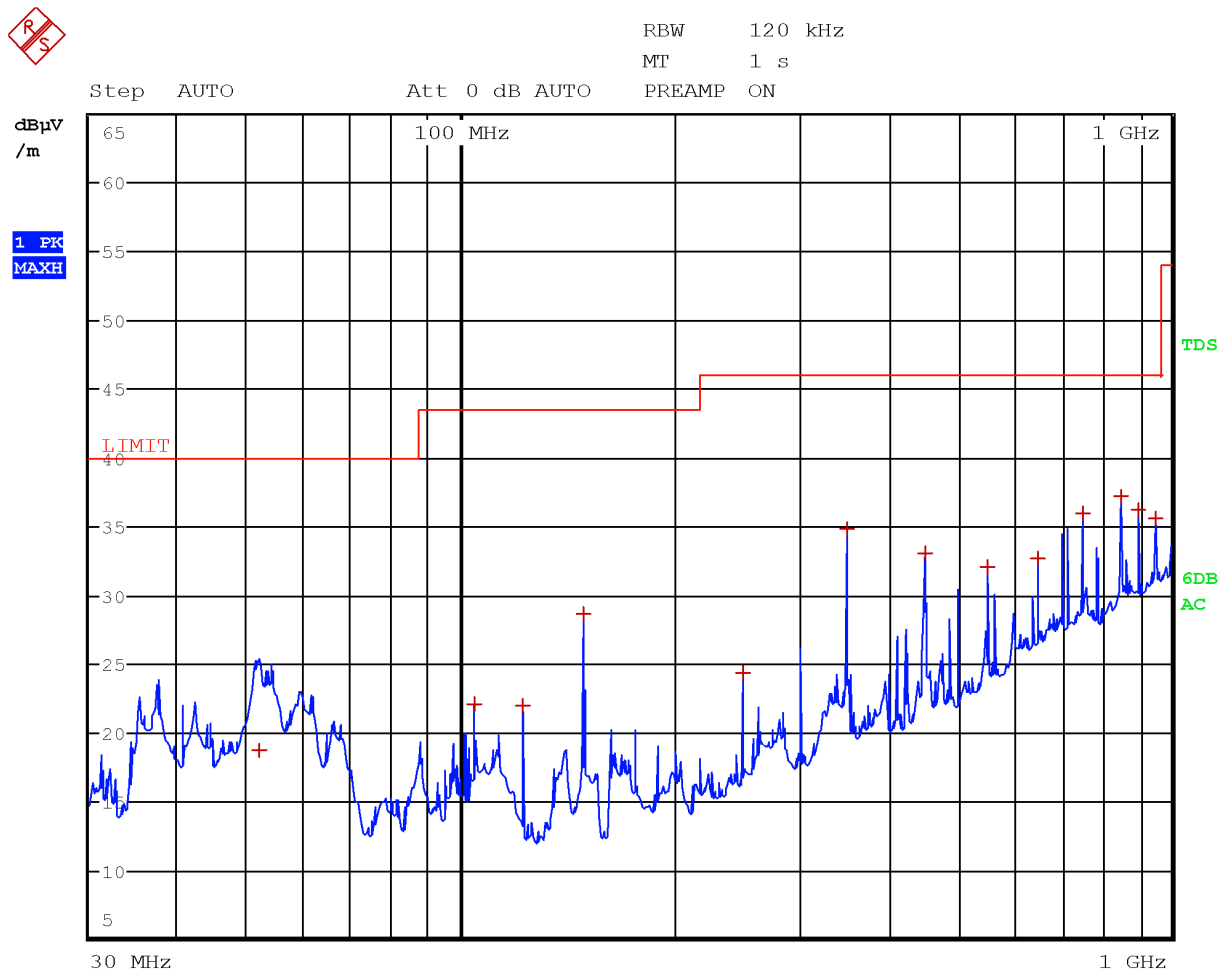


Figure 8.4-3: Field strength of spurious emissions above 30 MHz with antenna in vertical polarization

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 52.0800         | 18.7           | 40.0           | -21.3       | QP       |
| 104.4900        | 22.2           | 43.5           | -21.3       | QP       |
| 122.0400        | 22.0           | 43.5           | -21.5       | QP       |
| 149.1600        | 28.7           | 43.5           | -14.8       | QP       |
| 250.0200        | 24.4           | 46.0           | -21.6       | QP       |
| 350.0100        | 34.9           | 46.0           | -11.1       | QP       |
| 450.0000        | 33.1           | 46.0           | -12.9       | QP       |
| 549.9900        | 32.0           | 46.0           | -14.0       | QP       |
| 650.0100        | 32.8           | 46.0           | -13.2       | QP       |
| 750.0000        | 36.0           | 46.0           | -10.0       | QP       |
| 849.9900        | 37.2           | 46.0           | -8.8        | QP       |
| 900.0000        | 36.3           | 46.0           | -9.7        | QP       |
| 949.9800        | 35.7           | 46.0           | -10.3       | QP       |

## 8.5 FCC 15.225(e) and RSS-210 B.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     | 2019-07-16  | Temperature       | 25 $^{\circ}\text{C}$ |
| Test engineer | P. Barbieri | Air pressure      | 1015 mbar             |
| Verdict       | Pass        | Relative humidity | 60 %                  |

### 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

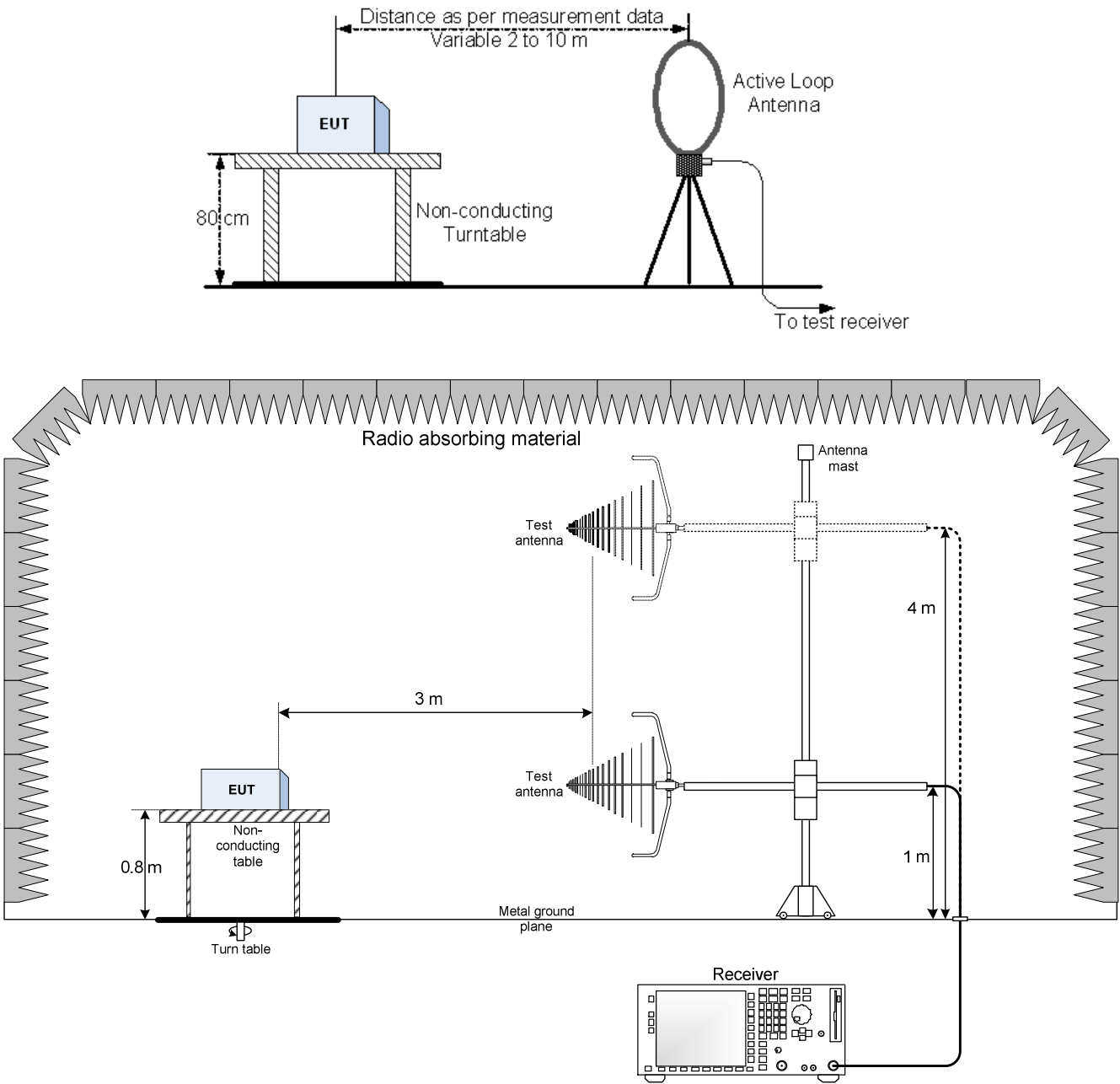
| Test conditions                  | Frequency, MHz | Frequency drift, $\pm$ ppm | Limit, $\pm$ ppm | Margin, ppm |
|----------------------------------|----------------|----------------------------|------------------|-------------|
| +50 $^{\circ}\text{C}$ , Nominal | 13.559920      | 3.3                        | 100              | -96.7       |
| +20 $^{\circ}\text{C}$ , +15 %   | 13.559964      | 0                          | 100              | -100        |
| +20 $^{\circ}\text{C}$ , Nominal | 13.559964      | Reference                  | Reference        | Reference   |
| +20 $^{\circ}\text{C}$ , -15 %   | 13.559964      | 0                          | 100              | -100        |
| -20 $^{\circ}\text{C}$ , Nominal | 13.560024      | 4.5                        | 100              | -95.5       |

Note: frequency drift was calculated as follows:

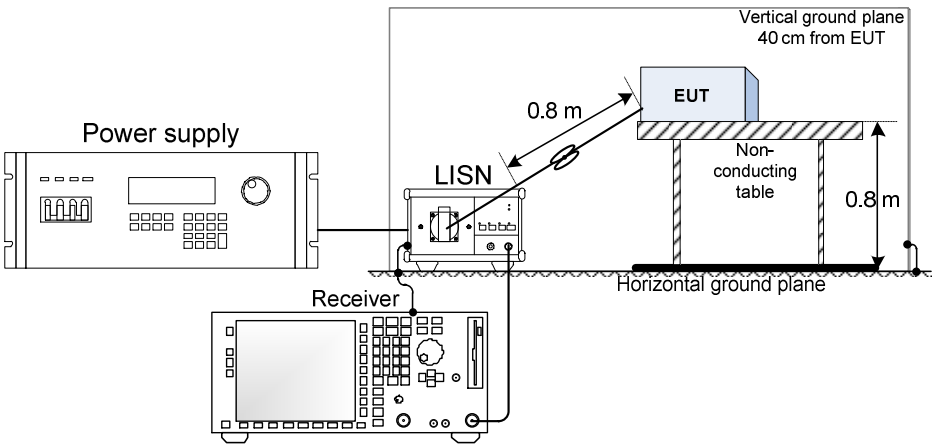
$$\text{Frequency drift (ppm)} = ((F_{\text{measured}} - F_{\text{reference}}) \div F_{\text{reference}}) \times 1 \times 10^6$$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up

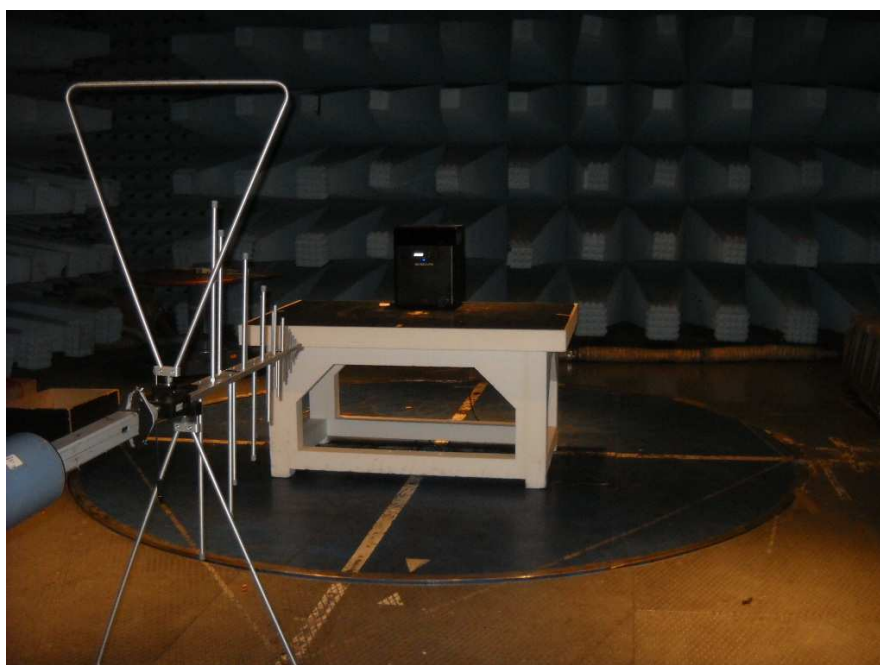
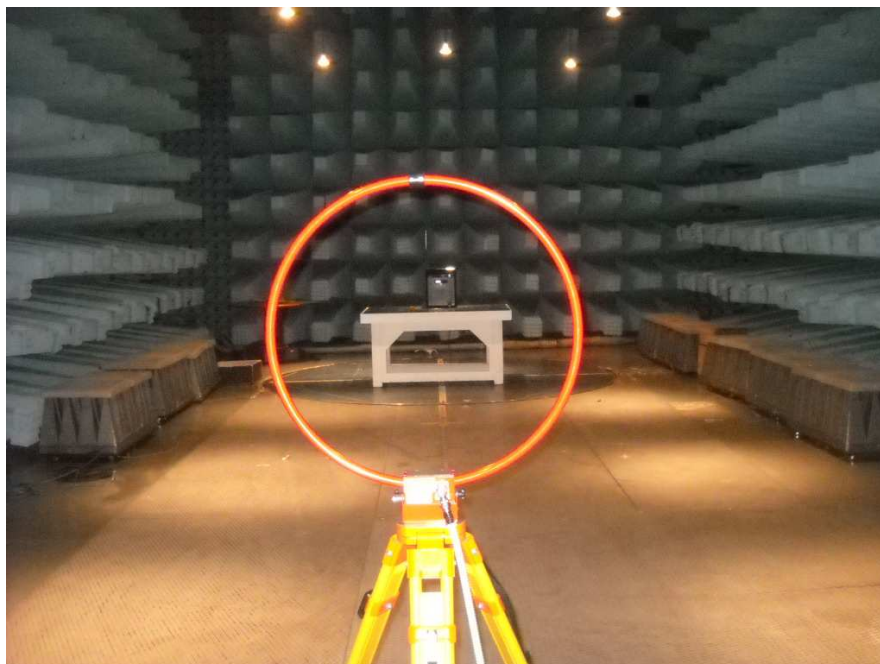


## Section 10. Photos

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### 10.1 Photos of the test set-up

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10.2 Photos of the EUT

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End of report