

# Test Report

**Customer:**

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Germany

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## RF test report

160556-AU02+W01



Industry  
Canada Industrie  
Canada

**Continental Automotive GmbH**

**Immobilizer system**

5NA.920.791.A



The test result refers exclusively  
to the tested model.  
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EMV **TESTHAUS** GmbH



Deutsche  
Akkreditierungsstelle  
D-PL-12155-01-00

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## Accreditation:



FCC facility registration number: 221458  
Test Firm Type "2.948 listed": Valid until 2017-04-22  
Test Firm Type "accredited": Valid until 2017-06-09  
MRA US-EU, FCC designation number: DE0010  
BnetzA-CAB-02/21-02/04 Valid until 2018-11-27

Industry Canada test site numbers with registration expiry date:  
3472A-1, expiring 2018-11-09  
3472A-2, expiring 2018-11-12

## Test Laboratory:

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# 1 Test regulations

|   |   |
|---|---|
| 47 CFR Part 2: 10-2015  | Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)           |
| 47 CFR Part 15: 10-2015   | Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)   |
| ANSI C63.10:2013-06   | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices  |
| ICES-003<br>Issue 6, January 2016   | Spectrum Management and Telecommunications<br>Interference-Causing Equipment Standard<br>Information Technology Equipment (ITE) – Limits and methods of measurement       |
| RSS-Gen<br>Issue 4, November 2014   | Spectrum Management and Telecommunications<br>Radio Standards Specification<br>General Requirements and Information for the Certification of Radiocommunication Equipment |
| RSS-210<br>Issue 8, December 2010 with<br>Amendment 1, February 2015,<br>updated May 2015 | Spectrum Management and Telecommunications<br>Radio Standards Specification<br>Licence-exempt Radio Apparatus (All Frequency Bands):<br>Category I Equipment              |



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## 2 Summary of test results

| Standard  | Test result |
|---|-------------|
| 47 CFR Part 15,<br>section 15.209   | Passed      |
| RSS-210 Issue 8 Section 2.5<br>(with appropriate references to RSS-Gen Issue 4) | Passed      |

Straubing, August 24, 2016



Martin Müller  
Test engineer  
EMV **TESTHAUS** GmbH



Rainer Heller  
Head of EMC/Radio department  
EMV **TESTHAUS** GmbH



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### 3 Equipment under Test (EUT)

Product type: Immobilizer system  
Model Name: 5NA.920.791.A  
Applicant: Continental Automotive GmbH  
Manufacturer: Continental Automotive GmbH  
Serial number: #1  
FCC ID: KR55NA920791A  
IC certification number: 7812D-5NA920791A  
Application frequency band: n/a  
Frequency range: 125 kHz  
Operating frequency: 125 kHz  
Number of RF-channels: 1  
Modulation: ASK  
Highest frequency generated or used in the device or on which the device operates or tunes: 4 MHz  
Antenna types: PCB antenna  
☐ detachable ☒ not detachable  
  
Power supply: Battery powered  
nominal: 13.5 VDC  
minimal: 6.5 VDC  
maximal: 17.0 VDC  
  
Temperature range: -40°C to +85°C



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### 3.1 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.  
For photos taken during testing including EUT-positions see annex A.

### 3.2 Short description of the EUT

Immobilizer system for vehicles.

### 3.3 Operation mode

EUT was set to operate at continuous wave (125 kHz).

The EUT was tested in 3 orthogonal positions. These are documented in annex A.



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### 3.4 Configuration

The following peripheral devices and interface cables were connected during the tests:

| Device             | Model:         | Serial or inventory no. |
|--------------------|----------------|-------------------------|
| Immobilizer system | 5NA.920.791.A  | #1                      |
| Power Supply       | Statron 3231.1 | E00017                  |

### 3.5 Used cables

| Port                          | Classification | Cable type | Cable length |                      |
|-------------------------------|----------------|------------|--------------|----------------------|
|                               |                |            | used         | maximum <sup>1</sup> |
| Combined power & control port | dc power       | Shielded   | 1.0 m        | 1.0 m                |
|                               | signal/control |            |              |                      |

<sup>1</sup> As specified by applicant



## 4 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, section 15.205(a), 15.209(a), and RSS-210, section 2.5 with RSS-Gen, sections 8.10 and 8.9

### 4.1 Test Location

- ☒ Scan with peak detector in 3 m CDC.
- ☒ Final CISPR measurement with quasi peak detector on 3 m open area test site.

| Description                | Manufacturer             | Inventory No. |
|----------------------------|--------------------------|---------------|
| CDC                        | Albatross Projects       | E00026        |
| Open area test site (OATS) | EMV <b>TESTHAUS</b> GmbH | E00354        |

### 4.2 Test instruments

|                                     | Description          | Manufacturer    | Inventory No.          |
|-------------------------------------|----------------------|-----------------|------------------------|
| <input type="checkbox"/>            | ESU 26 (AC)          | Rohde & Schwarz | W00002                 |
| <input checked="" type="checkbox"/> | ESCI (CDC & OATS)    | Rohde & Schwarz | E00001                 |
| <input type="checkbox"/>            | ESR7 (SAC)           | Rohde & Schwarz | E00739                 |
| <input checked="" type="checkbox"/> | VULB 9163 (OATS)     | Schwarzbeck     | E00013                 |
| <input checked="" type="checkbox"/> | VULB 9160 (CDC)      | Schwarzbeck     | E00011                 |
| <input type="checkbox"/>            | VULB 9162-041 (SAC)  | Schwarzbeck     | E00643                 |
| <input checked="" type="checkbox"/> | HFH2-Z2 (CDC & OATS) | Rohde & Schwarz | E00060                 |
| <input checked="" type="checkbox"/> | Cable set CDC        | Huber + Suhner  | E00459, E00446         |
| <input type="checkbox"/>            | Cable set AC 3 m     | Huber + Suhner  | W00095, E00432, E00307 |
| <input checked="" type="checkbox"/> | Cable set OATS 3 m   | Huber + Suhner  | E00453, E00456, E00458 |
| <input type="checkbox"/>            | Cable set SAC 3 m    | Huber + Suhner  | E00804, E00806, E00807 |



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## 4.3 Limits

The field strength of any emissions (including spurious emissions) falling into restricted bands as specified in 15.205(a) shall not exceed the general radiated emission limits as specified in 15.209.

| Frequency<br>[MHz] | Field strength Fs<br>[μV/m] | Field strength<br>[dBμV/m] | Measurement<br>distance d<br>[m] |
|--------------------|-----------------------------|----------------------------|----------------------------------|
| 0.009 – 0.490      | 266.6 – 4.9                 | 48.5 – 13.8                | 300                              |
| 0.490 – 1.705      | 48.98 – 14.08               | 33.8 – 22.97               | 30                               |
| 1.705 – 30.0       | 30                          | 29.54                      | 30                               |
| 30 – 88            | 100                         | 40                         | 3                                |
| 88 – 216           | 150                         | 43.5                       | 3                                |
| 216 - 960          | 200                         | 46                         | 3                                |
| Above 960          | 500                         | 54                         | 3                                |

Note:

Limits for 3 m test distance are calculated according to ANSI C63.10, section 6.4.4.2  
“Extrapolation from the measurement of a single point”.

According to 15.35(b) on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions of 20 dB above the maximum permitted average emission limit.



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## 4.4 Test procedure

1. EUT was configured according to ANSI C63.10. It was placed on the top of the turntable 0.8 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a compact diagnostic chamber.
2. EUT and all peripherals were powered on.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 30 MHz to 1000 MHz with peak detector peak and measurement bandwidth set to 120 kHz.
5. The turn table was rotated to 6 different positions ( $360^\circ / 6$ ) and the antenna polarization was changed to horizontal.
6. Test procedure at step 4 and 5 was repeated.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less margin to the limit than 6dB were marked and re-measured with a quasi-peak detector.
8. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization. The highest value was recorded.
10. For emissions below 30 MHz measurements were done using a loop antenna. Prescan was performed with peak detector and final measurements with quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where average detector applies. Antenna height was not changed during this test. Appropriate CISPR bandwidths of 200 Hz for frequencies up to 150 kHz and 9 or 10 kHz for frequencies above were used.



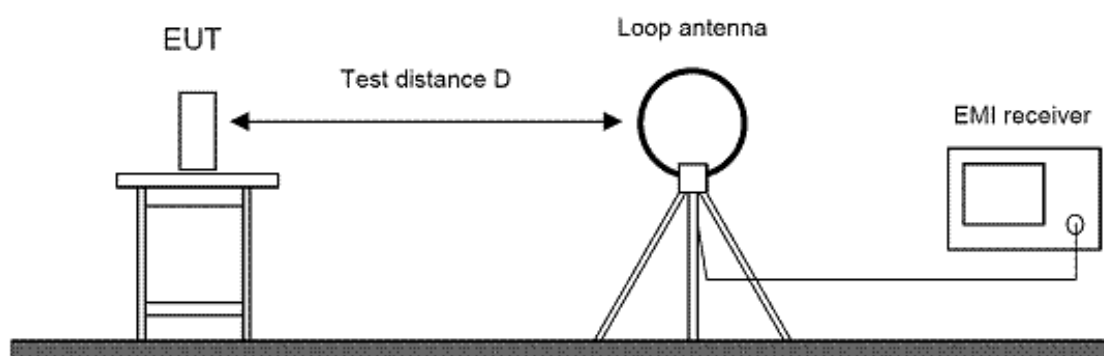
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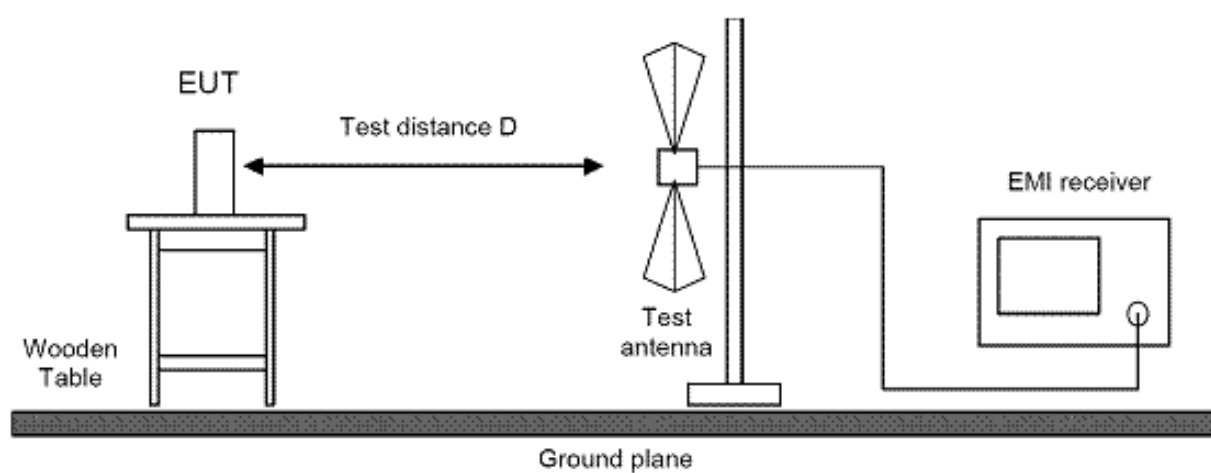
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## 4.5 Test setup



Picture 1: Test setup for radiated emission measurement (< 30 MHz)



Picture 2: Test setup for radiated emission measurement (< 1 GHz)

## 4.6 Test deviation

There is no deviation from the standards referred to.

## 4.7 Test results

|              |               |            |            |
|--------------|---------------|------------|------------|
| Temperature: | 25°C          | Humidity:  | 49%        |
| Tested by:   | Martin Müller | Test date: | 2016-08-09 |

### Radiated Emission Measurement 9 kHz - 30 MHz

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{near field}} / d_{\text{measure}}) - 20 \log(d_{\text{limit}} / d_{\text{near field}})$$

The limits in the graphics and value lists are derived from the general radiated emission limits as specified in 15.209 using the recalculation factor as described above.



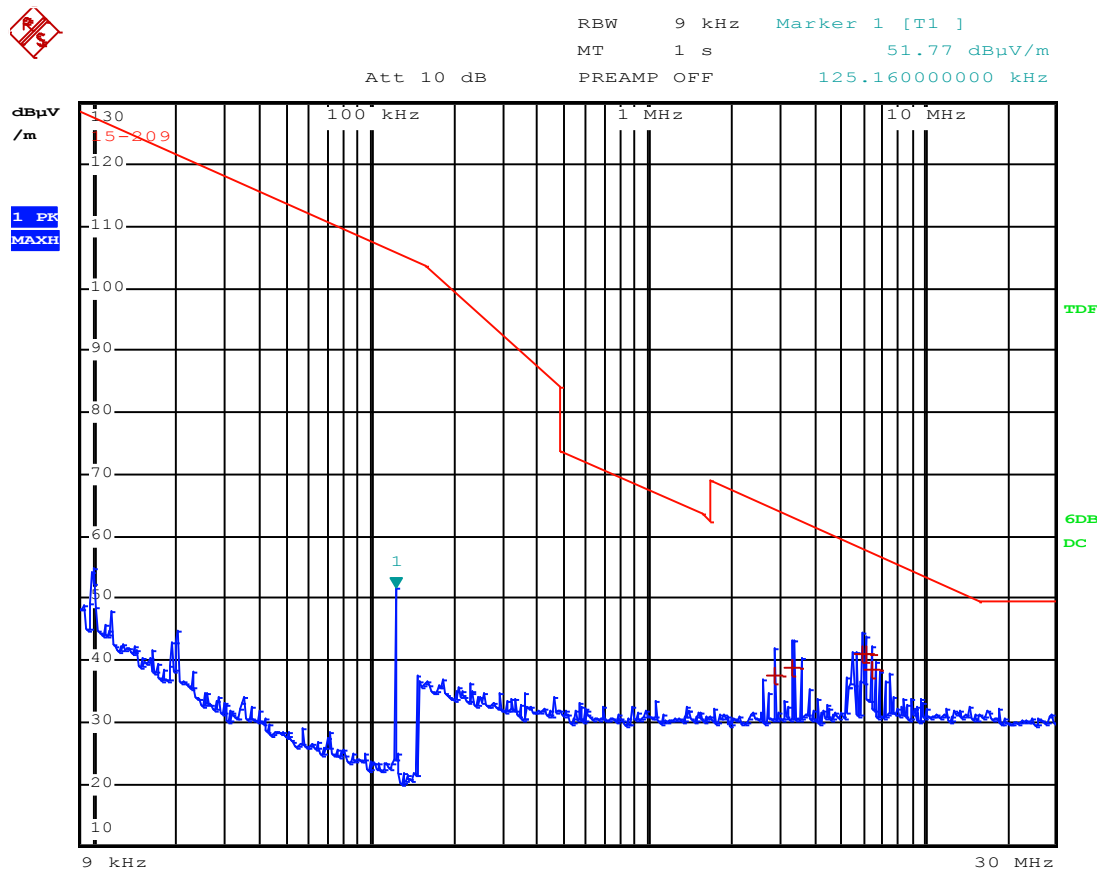
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The following picture shows the worst-case-emissions for the spurious emissions at EUT-position 2, antenna in line.



Picture 3: Radiated emission 9 kHz – 30 MHz @ 3m distance

| Frequency [MHz] | Measured value [dBμV/m] | Detector | Recalculation factor [dB] | Field strength [dBμV/m] | Limit [dBμV/m] | Margin | Result |
|-----------------|-------------------------|----------|---------------------------|-------------------------|----------------|--------|--------|
| 2.878           | 37.53                   | QP       | -34.86                    | 2.67                    | 29.54          | 26.87  | Pass   |
| 3.378           | 38.95                   | QP       | -33.47                    | 5.48                    | 29.54          | 24.06  | Pass   |
| 6.010           | 40.91                   | QP       | -28.46                    | 12.45                   | 29.54          | 17.09  | Pass   |
| 6.258           | 40.94                   | QP       | -28.11                    | 12.83                   | 29.54          | 16.71  | Pass   |
| 6.510           | 38.45                   | QP       | -27.77                    | 10.68                   | 29.54          | 18.86  | Pass   |

Note: See "Restricted band of operation from 0.090 MHz to 0.110 MHz" for evaluation of the carrier



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Determination of recalculation factor:

| $f_{\text{MHz}}$<br>[MHz] | $d_{\text{near field}}$<br>[m] | $d_{\text{measure}}$<br>[m] | $d_{\text{limit}}$<br>[m] | Recalculation<br>factor [dB] |
|---------------------------|--------------------------------|-----------------------------|---------------------------|------------------------------|
| 2.878                     | 16.598                         | 3.0                         | 30.0                      | -34.86                       |
| 3.378                     | 14.142                         | 3.0                         | 30.0                      | -33.47                       |
| 6.010                     | 7.948                          | 3.0                         | 30.0                      | -28.46                       |
| 6.258                     | 7.633                          | 3.0                         | 30.0                      | -28.11                       |
| 6.510                     | 7.338                          | 3.0                         | 30.0                      | -27.77                       |



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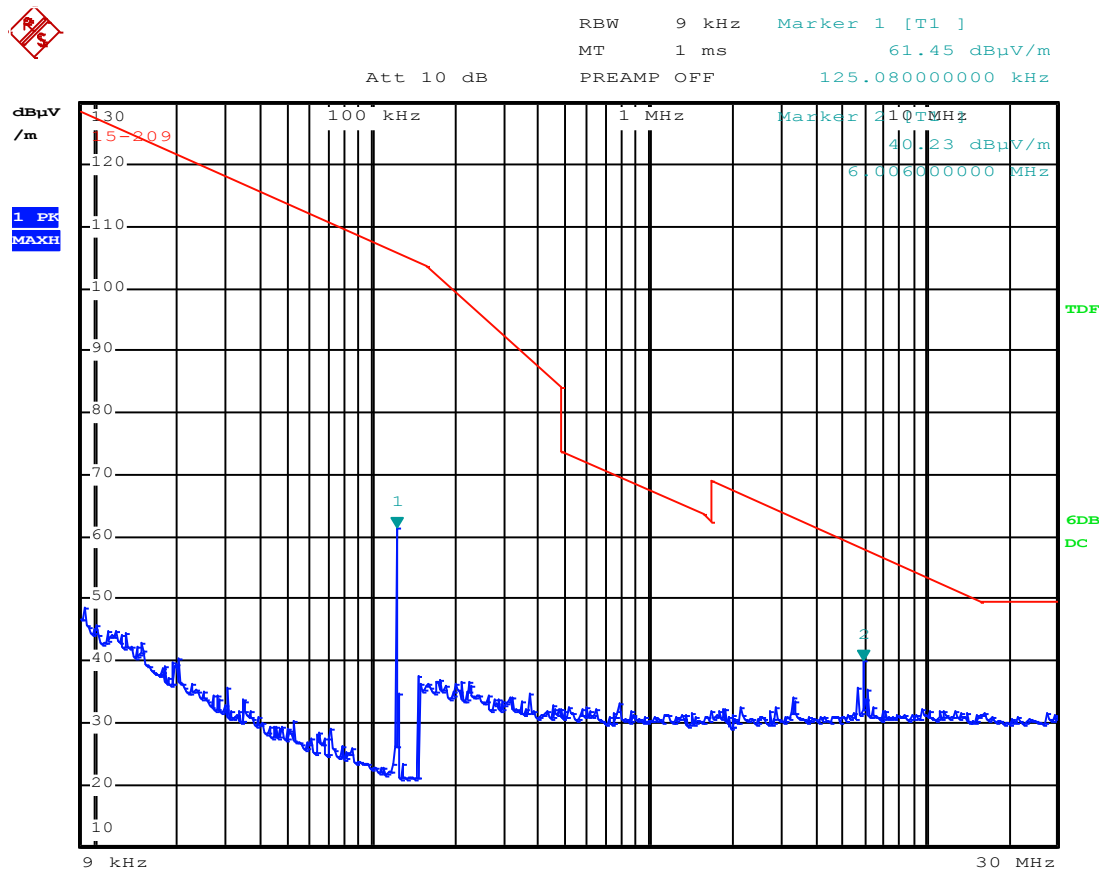
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The following pictures show the worst-case-emissions for the carrier at EUT-position 1, antenna parallel.



Picture 4: Radiated emission 9 kHz – 30 MHz @ 3m distance

| Frequency [MHz] | Measured value [dBμV/m] | Detector | Recalculation factor [dB] | Field strength [dBμV/m] | Limit [dBμV/m] | Margin | Result |
|-----------------|-------------------------|----------|---------------------------|-------------------------|----------------|--------|--------|
| 6.006           | 40.23                   | PK       | -28.47                    | 11.76                   | 29.54          | 17.78  | Pass   |

Note: See “Restricted band of operation from 0.090 MHz to 0.110 MHz” for evaluation of the carrier.

Determination of recalculation factor:

| $f_{\text{MHz}}$ [MHz] | $d_{\text{near field}}$ [m] | $d_{\text{measure}}$ [m] | $d_{\text{limit}}$ [m] | Recalculation factor [dB] |
|------------------------|-----------------------------|--------------------------|------------------------|---------------------------|
| 6.006                  | 7.954                       | 3.0                      | 30.0                   | -28.47                    |



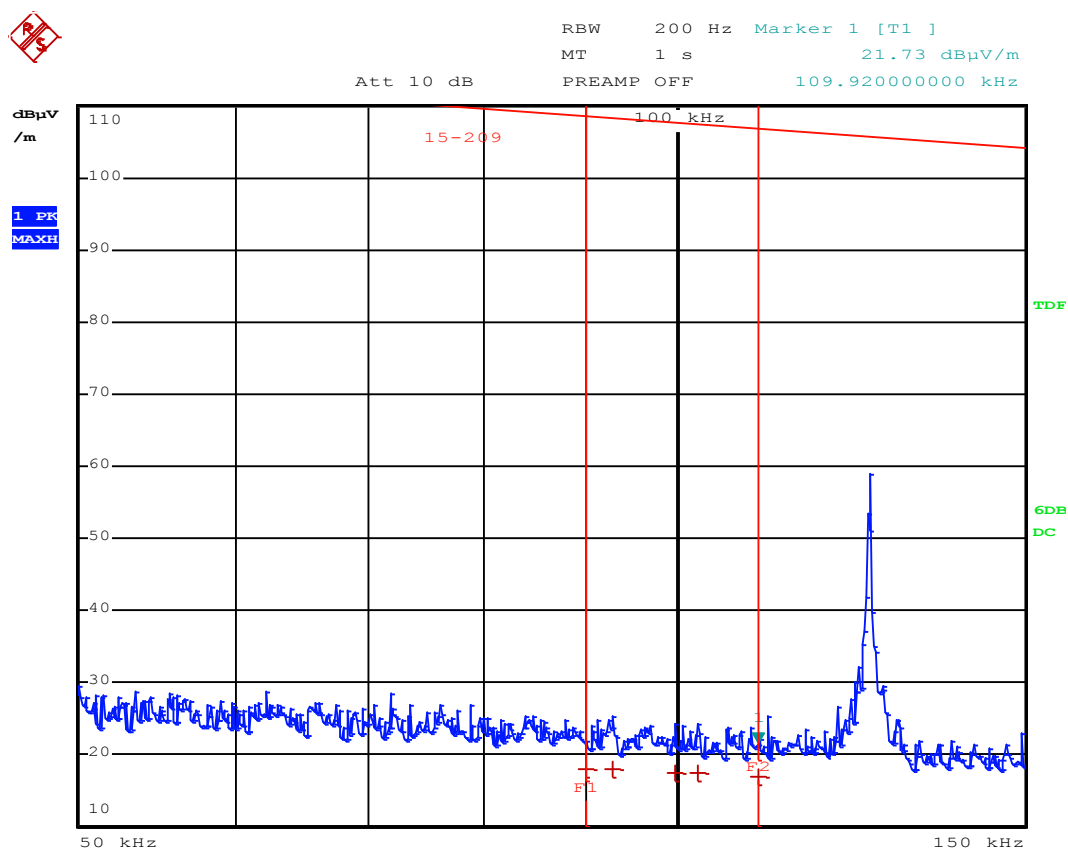
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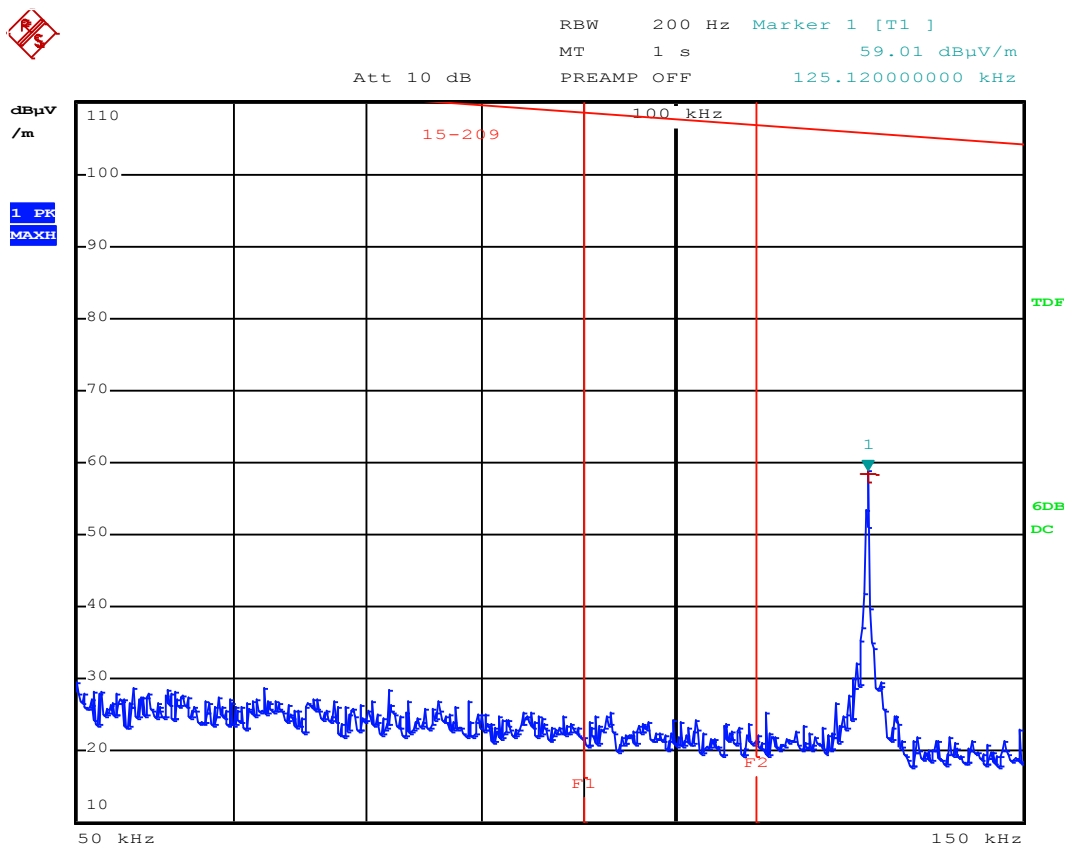
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## Restricted band of operation from 0.090 MHz to 0.110 MHz



Picture 5: Restricted band of operation, QP @ 3m distance

| Frequency [MHz] | Measured value [dBμV/m] | Detector | Recalculation factor [dB] | Field strength [dBμV/m] | Limit [dBμV/m] | Margin | Result |
|-----------------|-------------------------|----------|---------------------------|-------------------------|----------------|--------|--------|
| 0.09000         | 17.93                   | QP       | -80.0                     | -62.07                  | 28.52          | 90.59  | Pass   |
| 0.09280         | 17.89                   | QP       | -80.0                     | -62.11                  | 28.25          | 90.36  | Pass   |
| 0.09984         | 17.38                   | QP       | -80.0                     | -62.62                  | 27.62          | 90.24  | Pass   |
| 0.10248         | 17.44                   | QP       | -80.0                     | -62.56                  | 27.39          | 89.95  | Pass   |
| 0.10992         | 16.97                   | QP       | -80.0                     | -63.03                  | 26.78          | 89.81  | Pass   |



Picture 6: Restricted band of operation, AV @ 3m distance

| Frequency [MHz] | Measured value [dBμV/m] | Detector | Recalculation factor [dB] | Field strength [dBμV/m] | Limit [dBμV/m] | Margin | Result |
|-----------------|-------------------------|----------|---------------------------|-------------------------|----------------|--------|--------|
| 0.12512         | 58.50                   | AV       | -80.0                     | -21.50                  | 25.66          | 47.16  | Pass   |



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Note 1:

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

| $f_{\text{MHz}}$<br>[MHz] | $d_{\text{near field}}$<br>[m] | $d_{\text{measure}}$<br>[m] | $d_{\text{limit}}$<br>[m] | Recalculation<br>factor [dB] |
|---------------------------|--------------------------------|-----------------------------|---------------------------|------------------------------|
| 0.09000                   | 530.778                        | 3.0                         | 300.0                     | -80.0                        |
| 0.09280                   | 514.763                        | 3.0                         | 300.0                     | -80.0                        |
| 0.09984                   | 478.466                        | 3.0                         | 300.0                     | -80.0                        |
| 0.10248                   | 466.140                        | 3.0                         | 300.0                     | -80.0                        |
| 0.10992                   | 434.589                        | 3.0                         | 300.0                     | -80.0                        |
| 0.12512                   | 381.793                        | 3.0                         | 300.0                     | -80.0                        |



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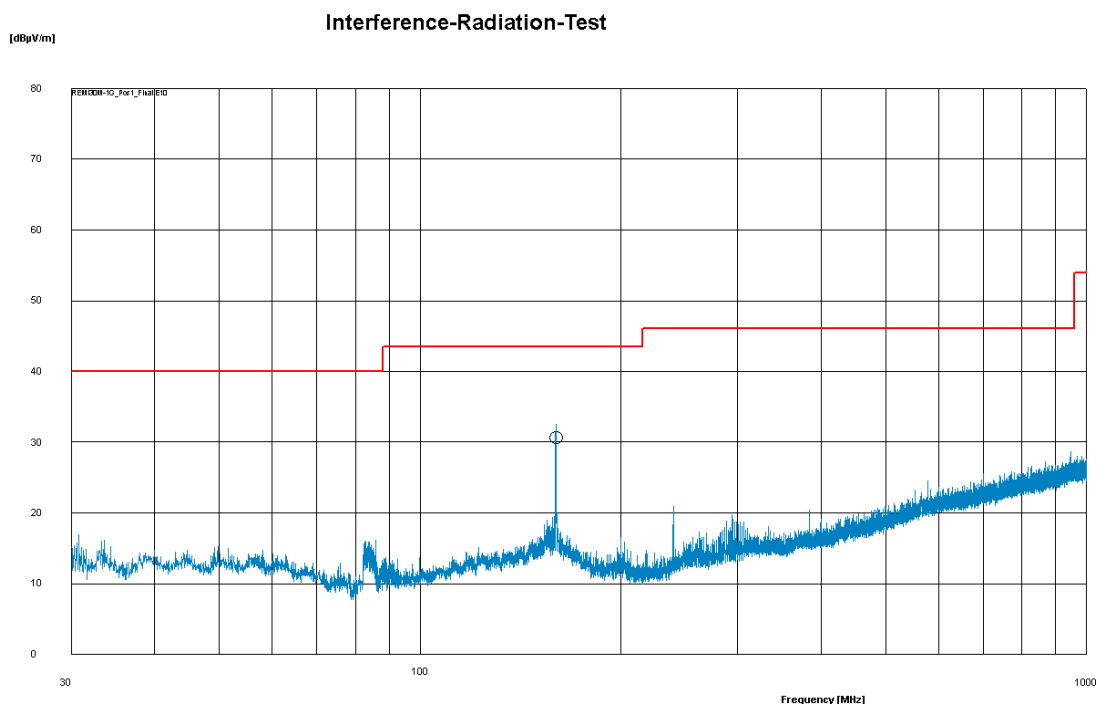
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# Radiated Emission Measurement 30 MHz - 1000 MHz

The following pictures show the worst-case-emissions at EUT-position 1.



| f [MHz] | E <sub>final</sub> [dBV/m] | Limit [dBµV/m] | Height [cm] | TT [°] | Polarisation | Result |
|---------|----------------------------|----------------|-------------|--------|--------------|--------|
| 160.02  | 30.62                      | 43.52          | 149         | 78.4   | H            | Pass   |

Picture 7: Radiated emission 30 MHz - 1000MHz @ 3m distance

## 5 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, section 15.209(a),  
RSS-210, section 2.5 with RSS-Gen, section 8.9

Remark:

This measurement needs not to be applied because

- the intentional radiator operates below 10 GHz and tenth harmonic of the highest fundamental frequency is lower than 1 GHz (see 47 CFR Part 15, section 15.33(a)(1), and RSS-Gen, section 6.13), and
- the digital part of the device does not generate or use internal frequencies higher than 108 MHz (see 47 CFR Part 15 section 15.33(b)(1), and RSS-Gen, section 2.3.3 with ICES-003, section 6.2).



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## 6 Bandwidths

according to CFR 47 Part 2, section 2.202(a), and RSS-Gen, section 6.6

### 6.1 Test Location

See clause 4.1 on page 10.

### 6.2 Test instruments

See clause 4.2 on page 10.

### 6.3 Limits

The bandwidths are recorded only. There are no limits specified in CFR 47 Part 15, and RSS-Gen.

### 6.4 Test setup

See clause 4.5 on page 13.

### 6.5 Test deviation

There is no deviation from the standards referred to.



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## 6.6 Test results

|              |               |            |            |
|--------------|---------------|------------|------------|
| Temperature: | 25°C          | Humidity:  | 49%        |
| Tested by:   | Martin Müller | Test date: | 2016-08-09 |

### Occupied bandwidth (99 %)

#### Test procedure

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth. For this purpose the appropriate measurement function of the spectrum analyzer is used.



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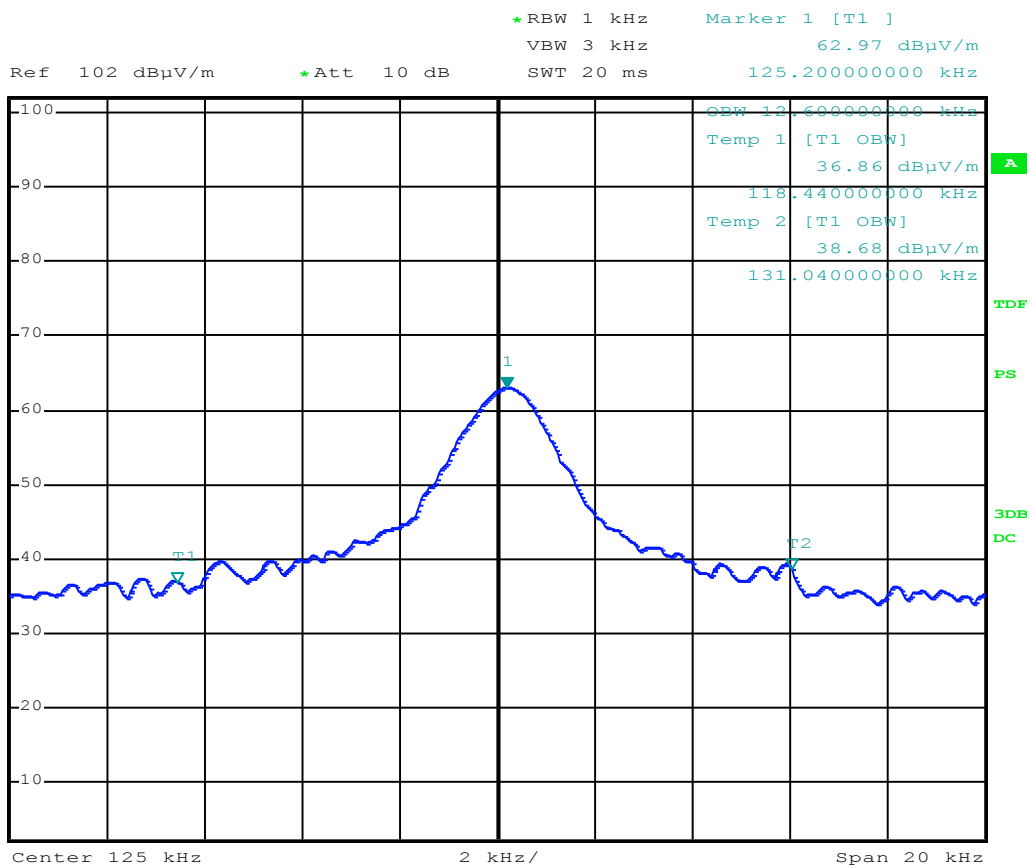
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1 PK  
MAXH



Picture 8: Occupied bandwidth (99 %)

Measured occupied bandwidth (99 %): 12.600 kHz



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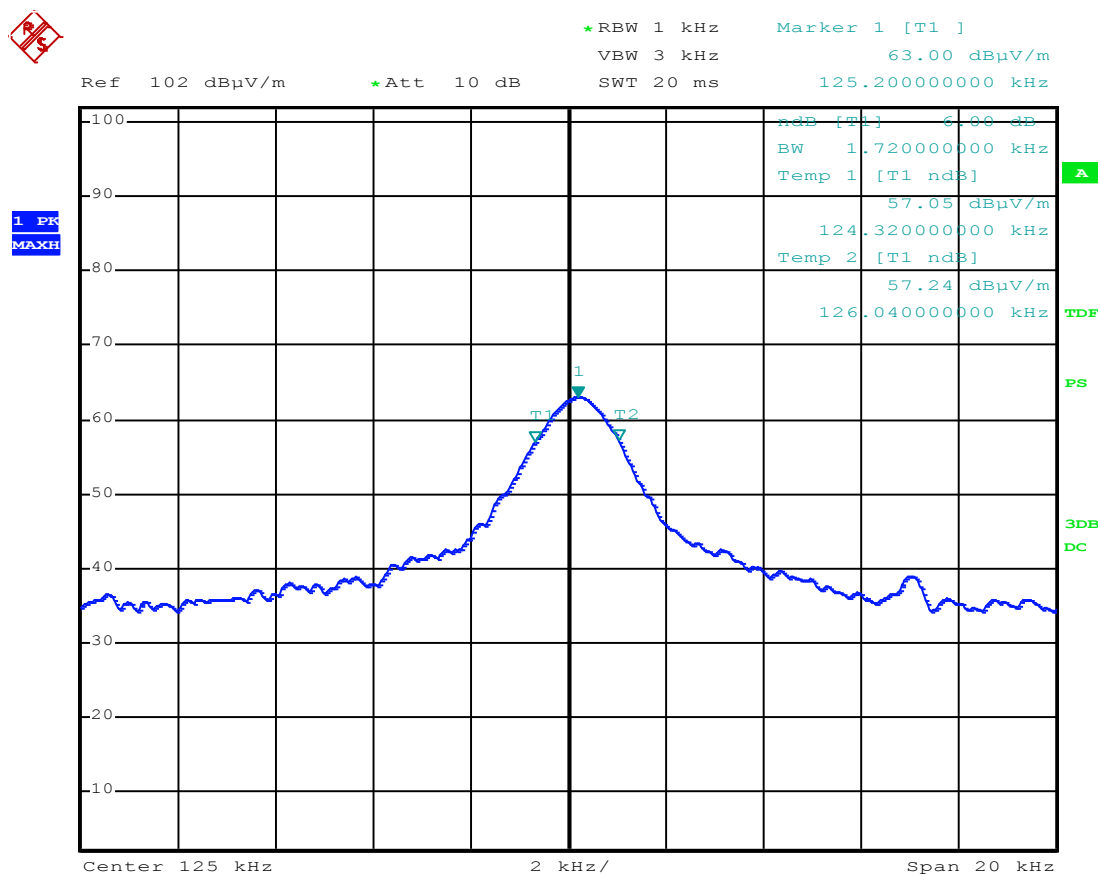
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# -6 dB emission bandwidth

## Test procedure

Where indicated, the -6 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 6 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth



Picture 9: -6 dB emission bandwidth

Measured -6 dB emission bandwidth:    1.720 kHz



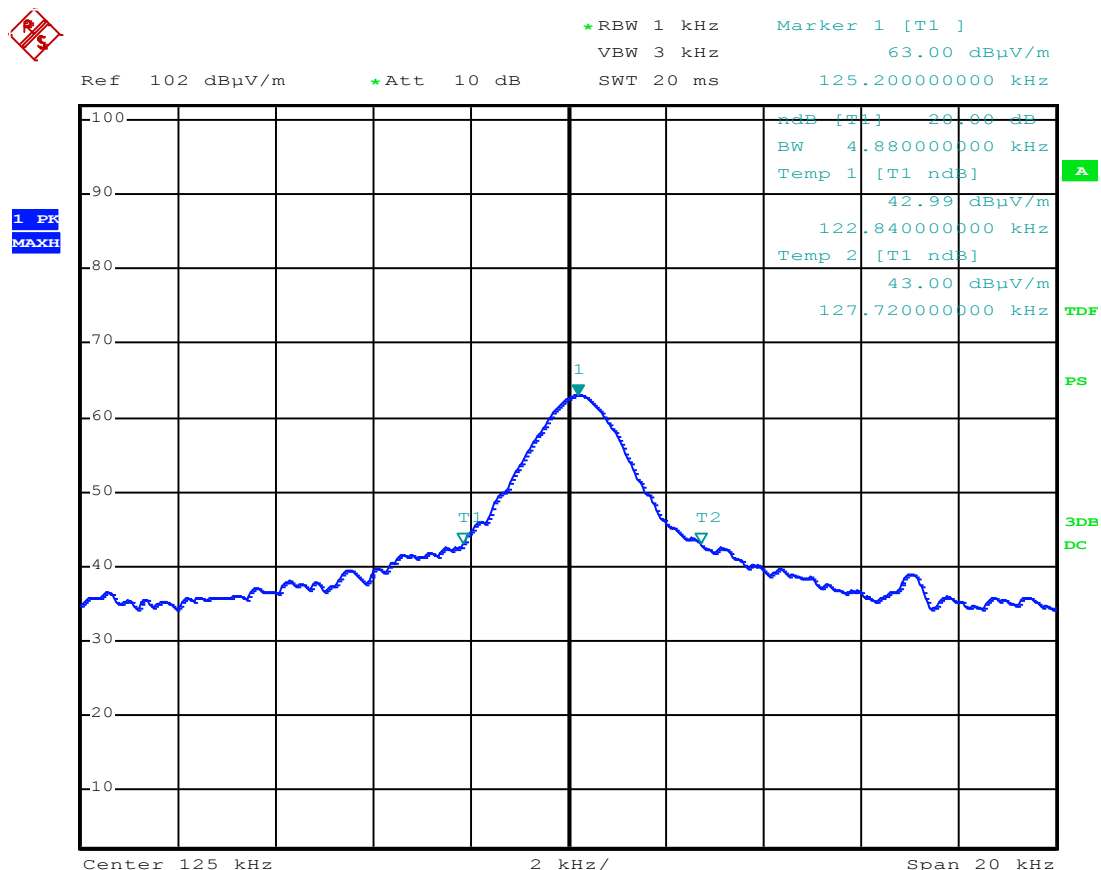
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## -20 dB emission bandwidth

### Test procedure

Where indicated, the -20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.



Picture 10: -20 dB emission bandwidth

Measured -20 dB emission bandwidth: 4.880 kHz

## 7 Equipment calibration status

| Description       | Modell number | Serial number | Inventory number(s) | Last calibration | Next calibration |
|-------------------|---------------|---------------|---------------------|------------------|------------------|
| Test receiver     | ESCI          | 100013        | E00001              | 2016-02          | 2018-02          |
| Broadband antenna | VULB 9160     | 9160-3050     | E00011              | 2014-09          | 2016-09          |
| Broadband antenna | VULB 9163     | 9163-114      | E00013              | 2015-09          | 2017-09          |
| Loop antenna      | HFH2-Z2       | 871398/0050   | E00060              | 2014-09          | 2016-09          |

Table 1: Equipment calibration status

Note 1: Used for relative measurements only

Note 2: Expiry date of measurement facility registration by

- FCC (registration number 221458): 2017-04
- Industry Canada (test site numbers 3472A-1 and 3472A-2): 2018-11



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## 8 Measurement uncertainty

| Description  | Max. deviation | k |
|--|----------------|---|
| Conducted emission AMN<br>(9kHz to 30 MHz)         | $\pm 4.0$ dB   | 2 |
| Radiated emission open field<br>(30 MHz to 1 GHz)  | $\pm 4.5$ dB   | 2 |
| Radiated emission absorber chamber<br>(> 1000 MHz) | $\pm 5.4$ dB   | 2 |

Table 2: Measurement uncertainty

The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.



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## 9 Revision History

| Date       | Description   | Person    | Revision |
|------------|---------------|-----------|----------|
| 2016-08-24 | First edition | M. Müller |          |



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