# EMI – TEST REPORT

**- FCC Part 90.217 -**

DAkkS Deutsche Akkreditierungsstelle D-PL-12030-01-01

| **Test Report No. :** | **T35704-00-05KJ** | 30 October 2012<br>Date of issue |
|---|---|---|

**Type / Model Name** : LOG GSM-3-M

**Product Description** : Interface between the logger network and control centre

**Applicant** : Seba Dynatronic Mess- und Ortungstechnik GmbH

Address : Dr.-Herbert-Iann-Str. 6
96148 BAUNACH, GERMANY

**Manufacturer** : Seba Dynatronic Mess- und Ortungstechnik GmbH

Address : Dr.-Herbert-Iann-Str. 6
96148 BAUNACH, GERMANY

**Licence holder** : Seba Dynatronic Mess- und Ortungstechnik GmbH

Address : Dr.-Herbert-Iann-Str. 6
96148 BAUNACH, GERMANY

| **Test Result** according to the standards listed in clause 1 test standards: | **POSITIVE** |
|---|---|

# Contents

# 1 TEST STANDARDS

The tests were performed according to following standards:

| | |
|---|---|
| FCC 47 CFR Part 2: 2011 | Frequency allocations and radio treaty matters; General rules and regulations |
| FCC 47 CFR Part 15: 2011 | Radio frequency devices |
| FCC 47 CFR Part 90: 2011 | Private land mobile radio services |
| ANSI/TIA-603-C: 2004 | Land Mobile FM or PM-Communications Equipment - Measurement and Performance Standards |
| ANSI C63.4: 2003 | Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| OET Bulletin 65: Edition 97-01, August 1997 | Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields. |
| KDB 412172 D01: 2010 | Determining ERP and EIRP |
| KDB 447498 D01: 2009 | RF Exposure Procedures and Equipment Authorization Policies |

## 1.1 Test result summary

Wireless repeater using digital modulation:

Operating in the frequency band from 902 MHz to 928 MHz:

| Description | FCC Rule Part | Test Procedure | Result |
|---|---|---|---|
| AC power line conducted emissions | 15.107(a) | ANSI C63.4:2003 | passed |
| Maximum output power | 90.217 | ANSI/TIA-603-C-2004 | passed |
| Spurious emissions radiated | 90.217(a) | ANSI/TIA-603-C-2004 | passed |
| Modulation characteristics | 90.217(a) | ANSI/TIA-603-C-2004 | passed |
| Occupied bandwith | General | ANSI/TIA-603-C-2004 | passed |
| Frequency stability | 90.213(a)(b) | ANSI/TIA-603-C-2004 | passed |
| Receiver spurious emissions | 15.109 | ANSI C63.4:2003 | passed |
| Co-location, Co-transmission | 1.1310 | OET Bulletin 65 | passed |

# 2 General remarks

| Items | | Description |
|---|---|---|
| Power supply - internal<br>- external | | 7.2 V DC (2x Lithium battery)<br>110-240 V AC; 50-60 HZ; 700 mA; 12 V DC |
| Type of modulation | | FSK |
| Operating frequency | | 913.02 MHz |
| Frequency band | | 902 MHz to 928 MHz |
| Data rate | | 9.6 kBd |
| Channel spacing | | - |
| Number of channels | | 1 |
| Antenna type | RF module<br>GSM | External<br>External |
| Antenna connector | RF module<br>GSM | F<br>SMA |
| Antenna gain | RF module<br>GSM | 2.1 dBi Dipole antenna (lambda ¼ antenna)<br>2.1 dBi Dipole antenna (lambda ¼ antenna) |
| Lowest internal frequency | | 32.768 kHz |
| Highest internal frequency | | 25.0 MHz |

The system consists of a certificated GSM module with FCC ID: UDV0606020080117.

## 2.1 Final assessment

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 30. November 2011

Testing concluded on : 05. June 2012

Checked by:

Klaus Gegenfurtner
I confirm the correctness and
Integrity of this documents
2012.10.30 14:23:45 +01'00'

Klaus Gegenfurtner
Dipl. Ing.(FH)
Manager: Radio Group

Tested by:

Josef Knab
I'm the autor of this
document
2012.10.30 13:52:19
+01'00'

Josef Knab
Radio Senior Expert

# 3 EQUIPMENT UNDER TEST

## 3.1 Power supply system utilised

Internal Power supply voltage : 7.2 V DC (2x Lithium battery)

AC/DC Adapter supply voltage : $V_{nom}$= 12.0 V
$V_{min}$= 10.2 V
$V_{max}$= 13.8 V

Max. current: TX mode 96 mA
RX mode 27 mA

## 3.2 Short description of the equipment under test (EUT)

LOG GSM-3-M is a permanently mounted device that is used for data collection and transmission. The incoming data contains measurement values, sent by noise level loggers that are used for leak detection on water pipes.
LOG GSM-3-M receives data via 913 MHz short range radio either directly from the noise level loggers or from repeaters that are installed for range extension. The configuration of LOG GSM-3-M is also done by 913 MHz short range radio. The transmission of collected measurement data is done via GSM/GPRS by a GSM/GPRS quad band modem.
LOG GSM-3-M contains an internal whip antenna for 913 MHz and another internal whip antenna for GSM/GPRS transmission.
LOG GSM-3-M is supplied by two internal 3.6V lithium batteries or optional by external power supply with 12V.

Number of tested samples: 1
Serial number: 1000041987

## EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- cont. TX at 913.02 MHz (unmodulated)

- cont. TX at 913.02 MHz (modulated)

- cont. RX mode

## EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

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

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

# 4 TEST ENVIRONMENT

## 4.1 Address of the test laboratory

**mikes-testingpartners gmbh**
**Ohmstrasse 2-4**
**94342 STRASSKIRCHEN**
**GERMANY**

## 4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature: | 15-35 °C |
| Humidity: | 30-60 % |
| Atmospheric pressure: | 86-106 kPa |

## 4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

## 4.4 Measurement protocol for FCC

### 4.4.1 General information

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by ANSI/TIA 603-C as shown under section 1 of this report.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left without termination. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

# 5 TEST CONDITIONS AND RESULTS

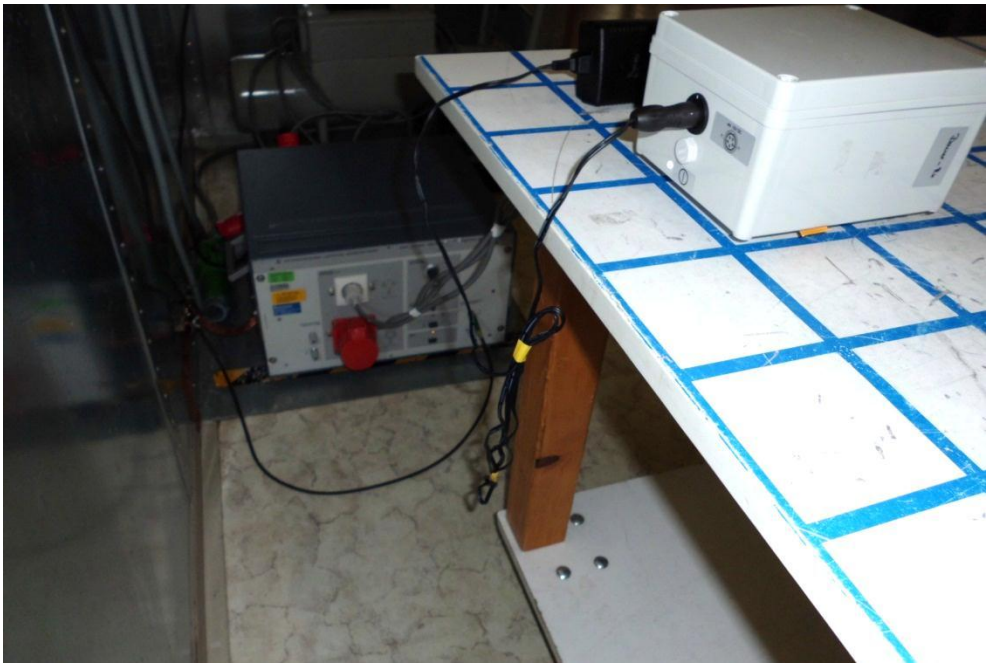
## 5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

### 5.1.1 Description of the test location

Test location: Shielded Room S2

### 5.1.2 Photo documentation of the test set-up



### 5.1.3 Applicable standard

According to FCC Part 15, Section 15.107(a):
Except for Class A devices, for equipment 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 given limits.

### 5.1.4 Description of Measurement

Conducted emission on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 µH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

The final level in dBµV level is compared directly to the FCC limit or to the CISPR limit.
To convert between dBµV and µV, the following conversions apply:

dBµV = 20*log(µV)
µV = 10^(dBµV/20)

### 5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin > 20 dB

Limit according to FCC Part 15, Section 15.107(a):

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

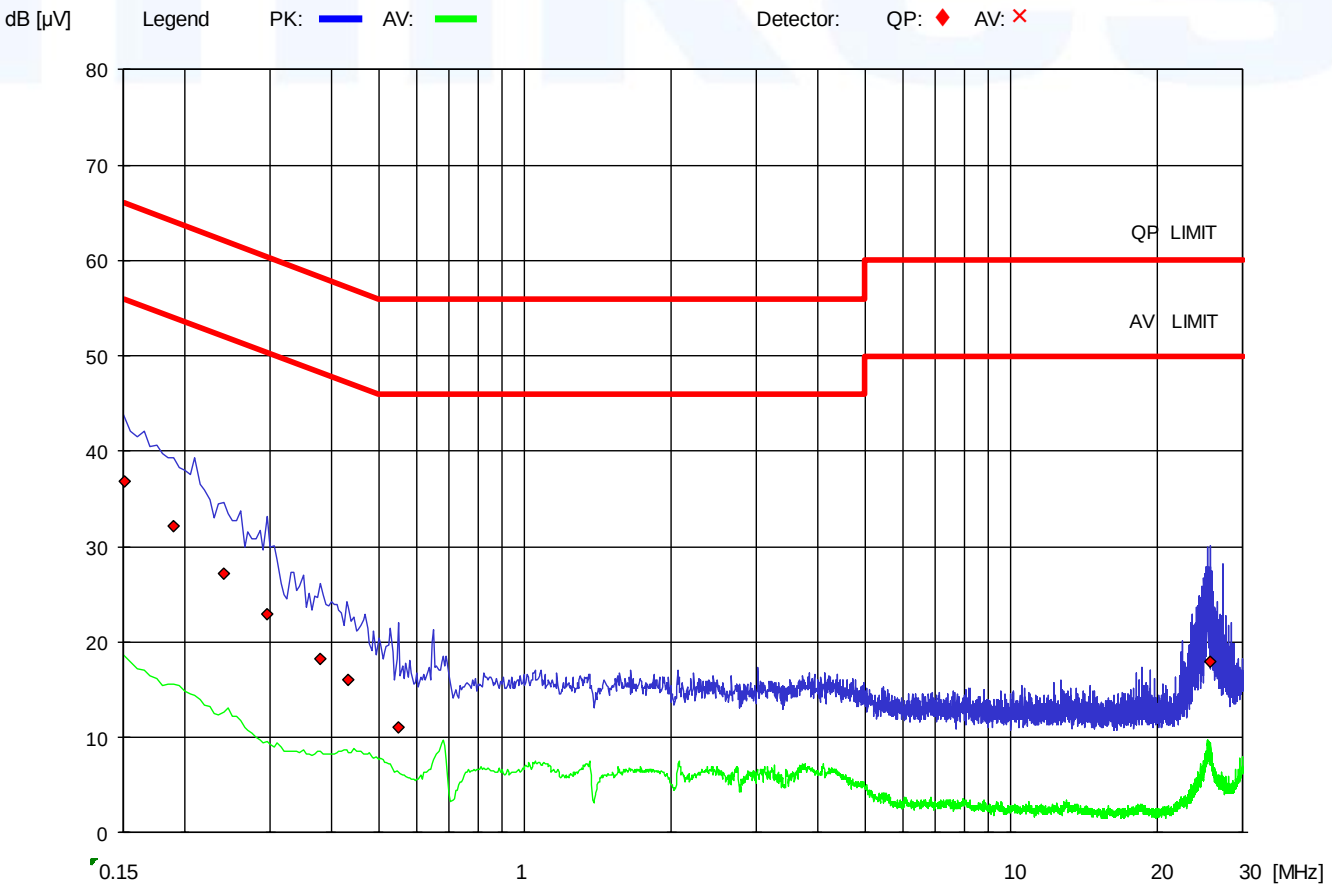
**Remarks:** For detailed test result please refer to following test protocols.

### 5.1.7 Test protocol

Test point L1 Result: passed
Operation mode: cont. TX at 913.02 MHz (unmodulated)
Remarks: -

| Freq | QP- L | D -Limit | Freq | AV-L | D -Limit |
|---|---|---|---|---|---|
| kHz | dB[µV] | QP [dB] | kHz | dB[µV] | AV [dB] |
| 150 | 36.9 | -29.1 | no Result | | |
| 190 | 32.2 | -31.8 | | | |
| 240 | 27.2 | -34.9 | | | |
| 295 | 23 | -37.4 | | | |
| 380 | 18.2 | -40.1 | | | |
| 435 | 16 | -41.2 | | | |
| 550 | 11 | -45.0 | | | |
| 25655 | 18 | -42.0 | | | |

| Freq | QP- L | D -Limit | Freq | AV-L | D -Limit |
|---|---|---|---|---|---|
| kHz | dB[µV] | QP [dB] | kHz | dB[µV] | AV [dB] |



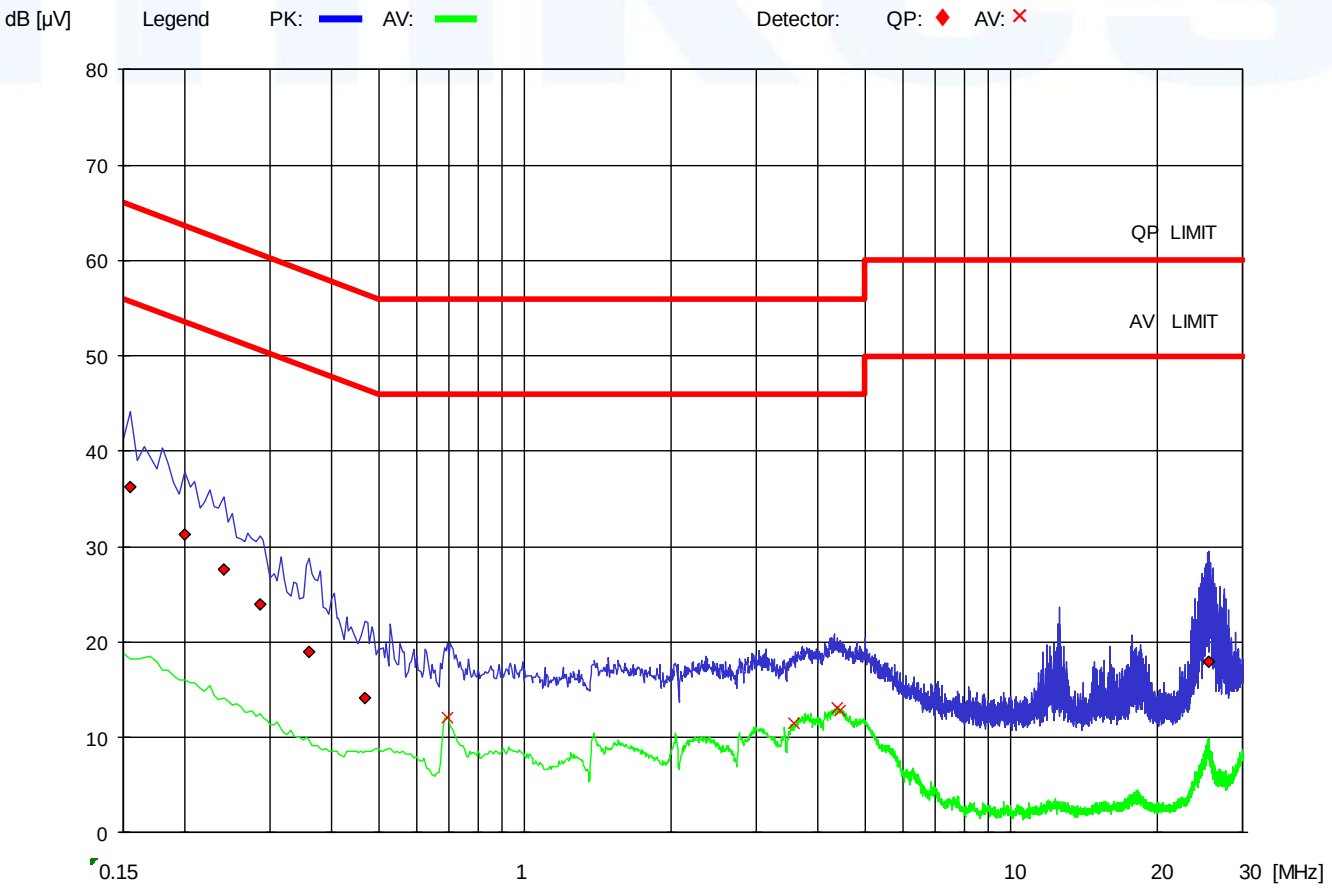
# FCC: OV8-LOGGSM3

Test point: N
Operation mode: cont. TX at 913.02 MHz (unmodulated)
Remarks: -

Result: passed

| Freq kHz | QP- L dB[µV] | D -Limit QP [dB] | Freq kHz | AV-L dB[µV] | D -Limit AV [dB] |
|---|---|---|---|---|---|
| 155 | 36.2 | -29.5 | 695 | 12.1 | -33.9 |
| 200 | 31.3 | -32.3 | 3580 | 11.5 | -34.5 |
| 240 | 27.6 | -34.5 | 4390 | 13.1 | -32.9 |
| 285 | 23.9 | -36.8 | 4460 | 12.9 | -33.1 |
| 360 | 19 | -39.7 | | | |
| 470 | 14.2 | -42.3 | | | |
| 25515 | 17.9 | -42.1 | | | |

| Freq kHz | QP- L dB[µV] | D -Limit QP [dB] | Freq kHz | AV-L dB[µV] | D -Limit AV [dB] |
|---|---|---|---|---|---|
| | | | | | |



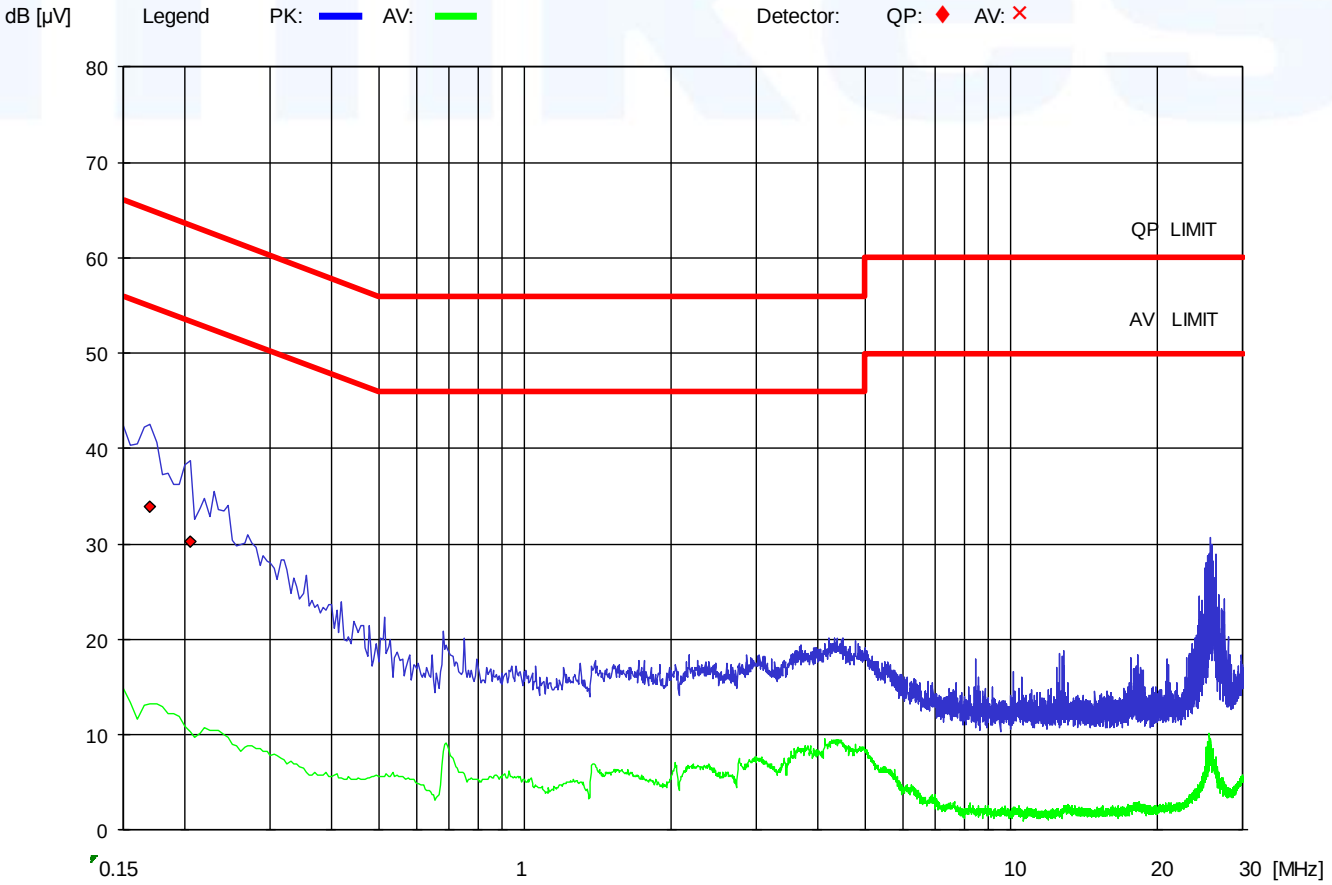
# FCC: OV8-LOGGSM3

Test point: L1
Operation mode: cont. RX mode
Remarks: -

Result: passed

| Freq kHz | QP- L dB[µV] | D -Limit QP [dB] | Freq kHz | AV-L dB[µV] | D -Limit AV [dB] |
|---|---|---|---|---|---|
| 170 | 33.9 | -31.1 | no Result | | |
| 205 | 30.2 | -33.2 | | | |

| Freq kHz | QP- L dB[µV] | D -Limit QP [dB] | Freq kHz | AV-L dB[µV] | D -Limit AV [dB] |
|---|---|---|---|---|---|



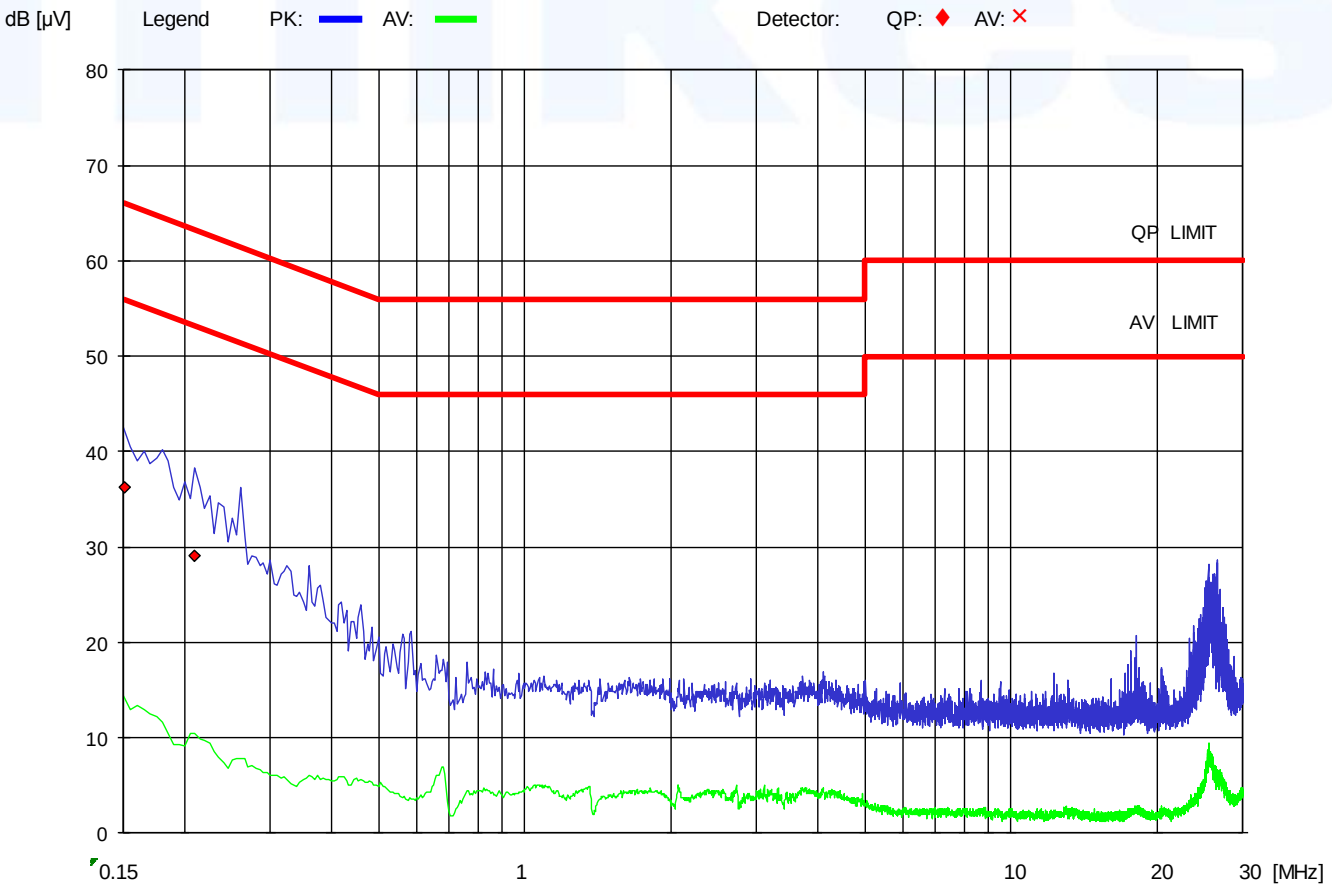
# FCC: OV8-LOGGSM3

Test point: N
Operation mode: cont. RX mode
Remarks: -

Result: passed

| Freq | QP- L | D -Limit | Freq | AV-L | D -Limit |
|---|---|---|---|---|---|
| kHz | dB[µV] | QP [dB] | kHz | dB[µV] | AV [dB] |
| 150 | 36.3 | -29.7 | no Result | | |
| 210 | 29.1 | -34.1 | | | |

| Freq | QP- L | D -Limit | Freq | AV-L | D -Limit |
|---|---|---|---|---|---|
| kHz | dB[µV] | QP [dB] | kHz | dB[µV] | AV [dB] |



## 5.2 Maximum output power radiated

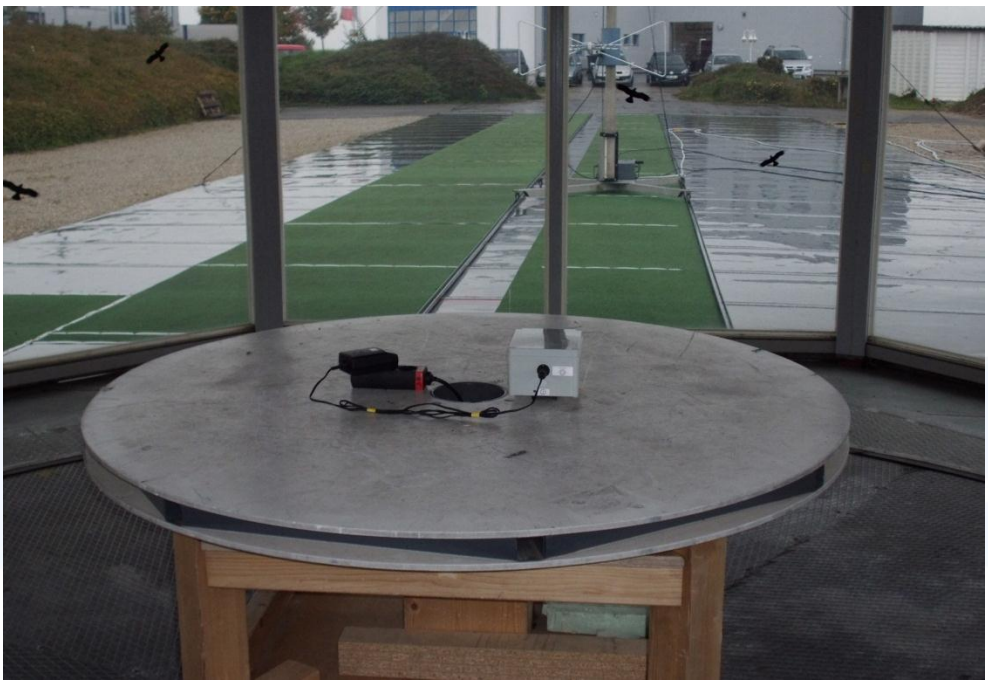
For test instruments and accessories used see section 6 Part **CPR 2**.

### 5.2.1 Description of the test location

Test location: OATS 1

Test distance: 10 m

### 5.2.2 Photo documentation of the test set-up



### 5.2.3 Applicable standard

According to FCC Part 90.217:
Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart, but must instead comply with the following:
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.2.4 Description of Measurement

The maximum output power from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBm is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The substitution antenna is used to replace the EUT for test the effective radiated. For measurements in the frequency band 30 MHz to 1 000 MHz, the substitution antenna is a ½ wave dipole antenna. The centre of this antenna should coincide with either the phase centre or volume centre. A signal generator is connected to the dipole and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain.

The radiated power of the fundamental emission from the EUT is measured in a test setup following the procedures set out in ANSI/TIA-603-C Section 2.2.17.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: RBW: 120 kHz

### 5.2.5 Test result

| Frequency (MHz) | Level PK (dBµV) | Bandwidth (kHz) | Correct. factor (dB) | Corrected power ERP (dBm) | Power limit (dBm) | Delta (dB) |
|---|---|---|---|---|---|---|
| 913.02 | 71.1 | 120 | -61.1 | 10.0 | 20.8 | 10.8 |

Power limit according to FCC Part 90.217:

| Frequency | Radiated power limit | |
|---|---|---|
| (MHz) | (dBm) | (mW) |
| >800 | 20.8 | 120 |

The requirements are **FULFILLED.**

**Remarks:** _____

_____

## 5.3 Spurious emissions radiated (electric field)

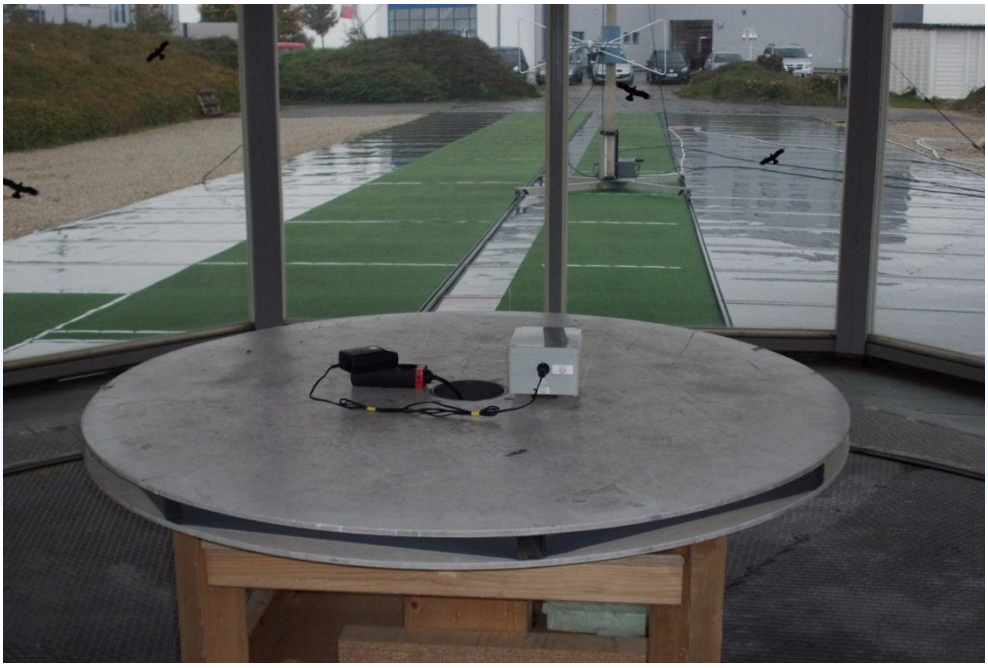
For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

### 5.3.1 Description of the test location

Test location: OATS 1
Test distance: 10 m

Test location: Anechoic chamber 2
Test distance: 3 m

### 5.3.2 Photo documentation of the test set-up



### 5.3.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.3.4 Description of Measurement

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBm is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

Spurious emission from the EUT are measured in the frequency range 1 GHz up to 12.75 GHz, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

The final level in dBm is calculated by taking the reading from the spectrum analyser (Level dBm) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The substitution antenna is used to replace the EUT for test the effective radiated power and spurious emissions. For measurements in the frequency band 30 MHz to 1 000 MHz, the substitution antenna is a ½ wave dipole antenna. For measurements above 1000 MHz, a waveguide horn is taken. The centre of this antenna should coincide with either the phase centre or volume centre. A signal generator is connected to the dipole (horn antenna for frequencies above 1 GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain; the power (dBm) into an ideal ½ wave dipole antenna is determined for each radiated spurious emission.

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI/TIA-603-C Section 2.2.12.

Instrument settings:

| | |
|---|---|
| 30 MHz – 1000 MHz: | RBW: 120 kHz |
| 1000 MHz – 10000 MHz | RBW: 1 MHz |

### 5.3.5 Test result

**f < 1 GHz:**

| Frequency (MHz) | Level PK (dBµV) | Bandwidth (kHz) | Correct. factor (dB) | Corrected power ERP (dBm) | Power limit (dBm) | Delta (dB) |
|---|---|---|---|---|---|---|
| 30 - 1000 | - | - | - | - | -20.0 | >10 |

**f > 1 GHz:**

| Frequency (MHz) | Level PK (dBm) | Bandwidth (kHz) | Correct. factor (dB) | Corrected power ERP (dBm) | Power limit (dBm) | Delta (dB) |
|---|---|---|---|---|---|---|
| 1852.75 | -10.2 | 1000 | -10.1 | -20.3 | -20.0 | 0.3 |
| 2738.88 | -14.0 | 1000 | -8.0 | -22.0 | -20.0 | 2.0 |
| 3652.00 | -17.3 | 1000 | -4.6 | -21.9 | -20.0 | 1.9 |
| 4564.75 | -35.9 | 1000 | 7.2 | -28.7 | -20.0 | 8.7 |
| 5478.25 | -31.7 | 1000 | 8.2 | -23.5 | -20.0 | 3.5 |
| 6391.75 | -48.2 | 1000 | 10.6 | -37.6 | -20.0 | 17.6 |
| 7304.13 | -39.6 | 1000 | 11.3 | -28.3 | -20.0 | 8.3 |
| 8217.63 | -47.6 | 1000 | 15.0 | -32.6 | -20.0 | 12.6 |
| 9130.00 | -57.2 | 1000 | 15.6 | -41.6 | -20.0 | 21.6 |
| 10043.50 | -52.1 | 1000 | 15.0 | -37.1 | -20.0 | 17.1 |
| 10957.00 | -60.9 | 1000 | 15.7 | -45.2 | -20.0 | 25.2 |
| 11869.38 | -60.7 | 1000 | 16.2 | -44.5 | -20.0 | 24.5 |
| 12784.00 | -63.5 | 1000 | 6.2 | -57.3 | -20.0 | 37.3 |

Spurious emission limit according to FCC Part 90.217:

| Spurious emission limit (dBm) | |
|---|---|
| 30 dB down | -20.0 |

The requirements are **FULFILLED.**

**Remarks:** _____

_____

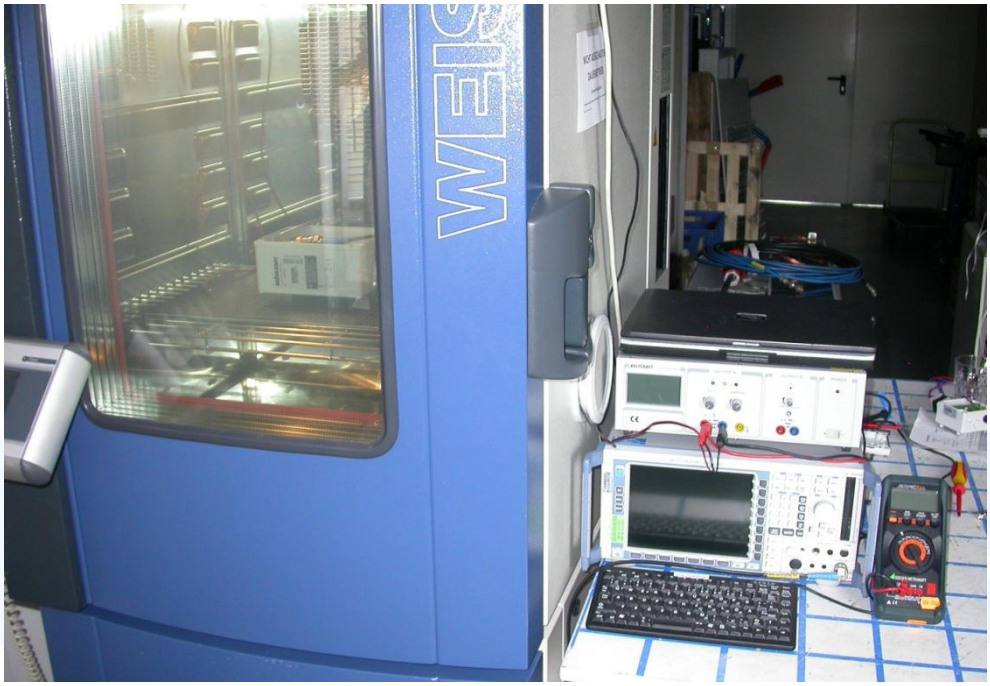
## 5.4 Modulation characteristics

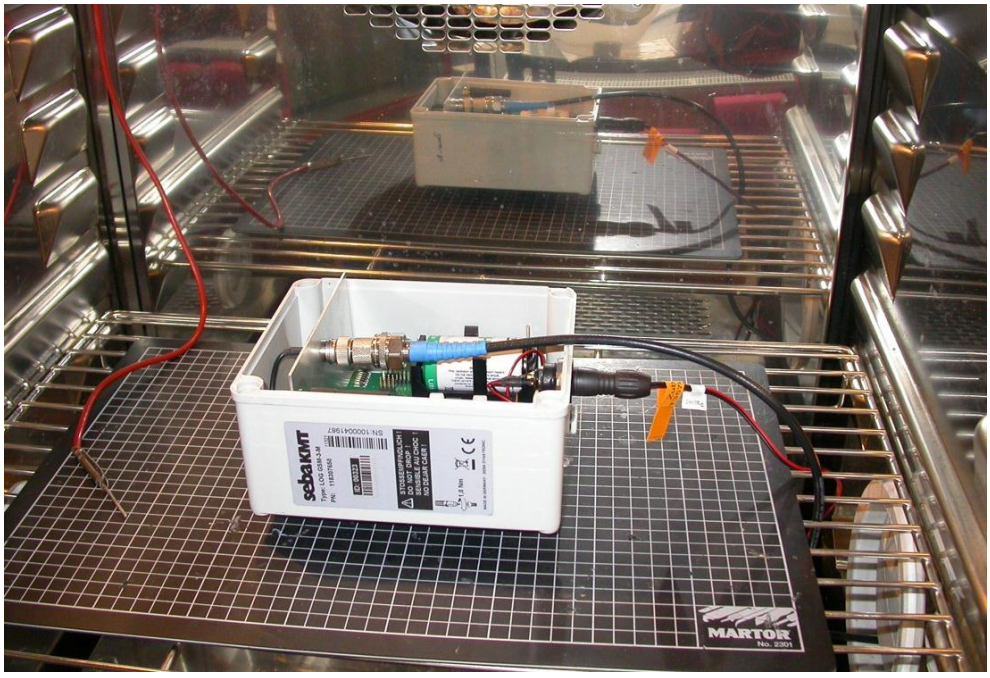
For test instruments and accessories used see section 6 Part **MB**.

### 5.4.1 Description of the test location

Test location: METROLOGY

### 5.4.2 Photo documentation of the test set-up





### 5.4.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

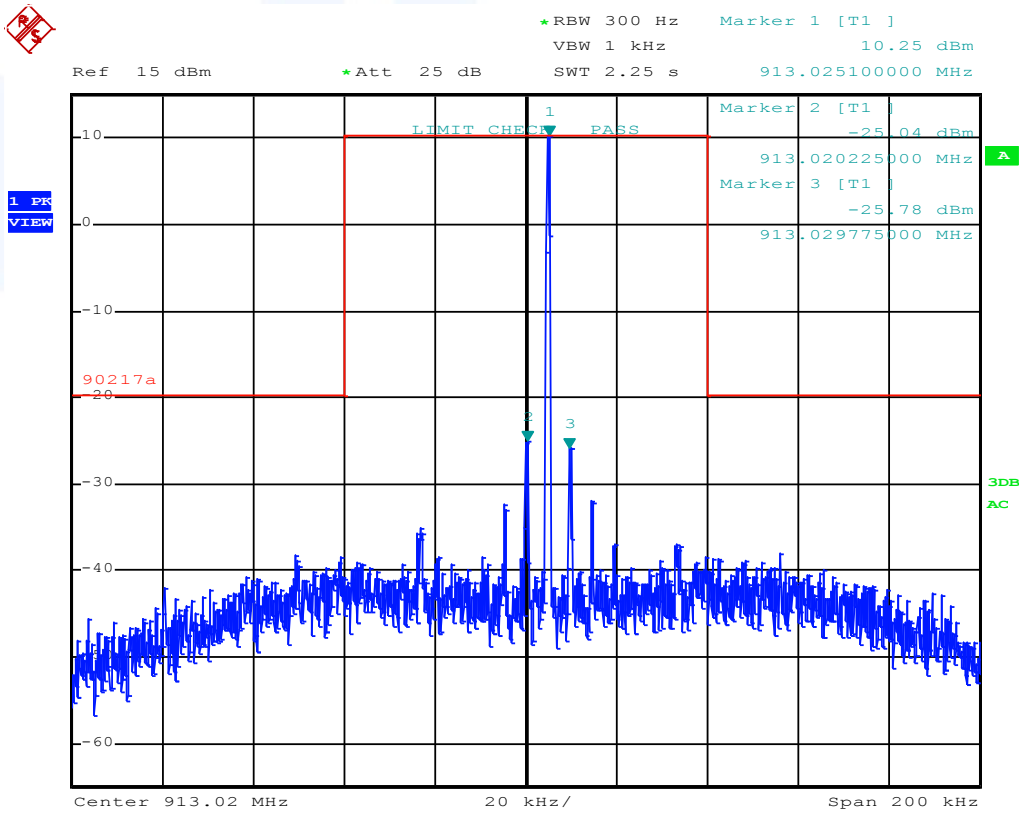
### 5.4.4 Description of Measurement

The measurement was performed conducted with intentional modulation on and off. The emission mask defined for 25 kHz channel bandwidth devices is shown on each plot. The 0 dB reference for the mask is the measured output power of the unmodulated carrier at that frequency.

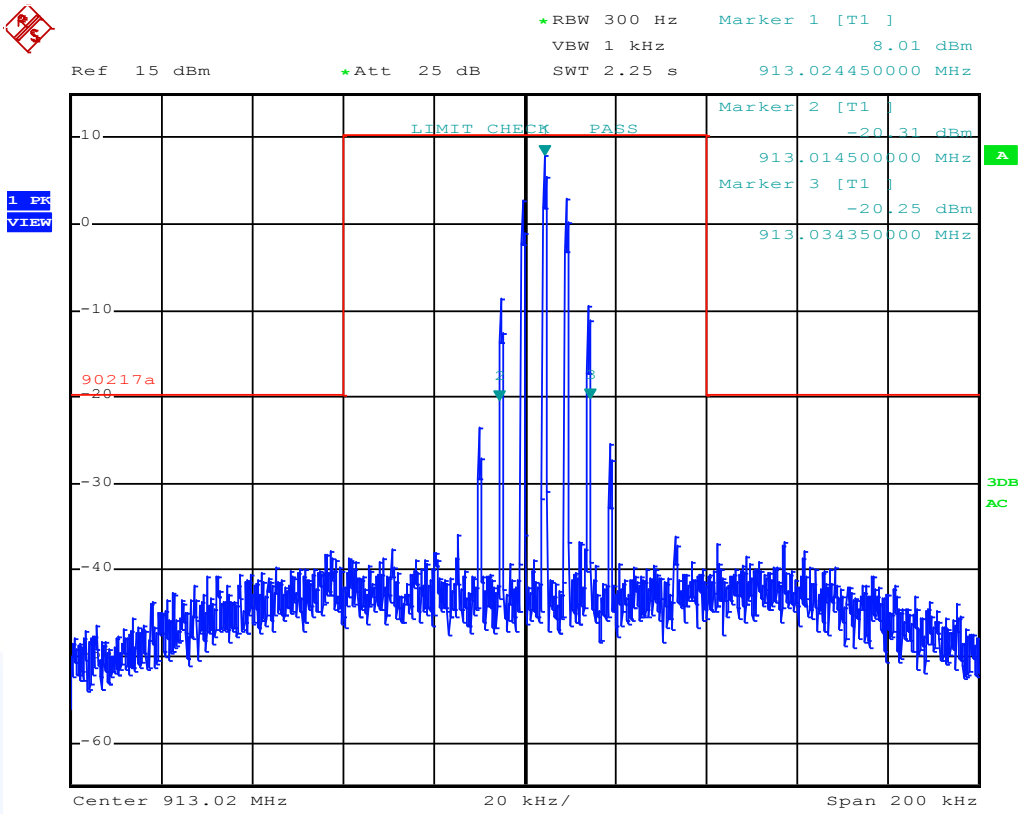
Spectrum analyser settings:
RBW: 300 Hz, VBW: 1 kHz, Detector: PK sampling detector, Sweep time: auto

### 5.4.5 Test result

**Cont. TX without modulation**



## Cont. TX with modulation




Peak power limit according to FCC Part 90.217(a):

| Limit | Lower envelope point minimum frequency | Upper envelope point maximum frequency |
|---|---|---|
| 30 dB down | 912.98 MHz ($f_{e,\ lower}$ - 40 kHz) | 913.06 MHz ($f_{e,\ upper}$ + 40 kHz) |

The requirements are **FULFILLED.**

**Remarks:** _____

_____

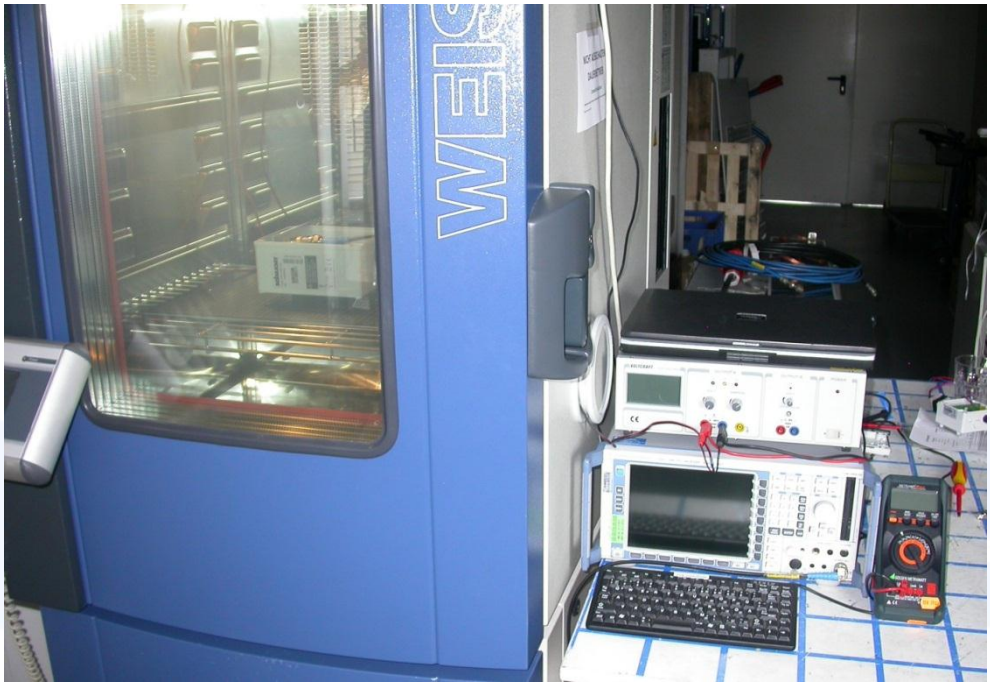
## 5.5 Occupied bandwidth

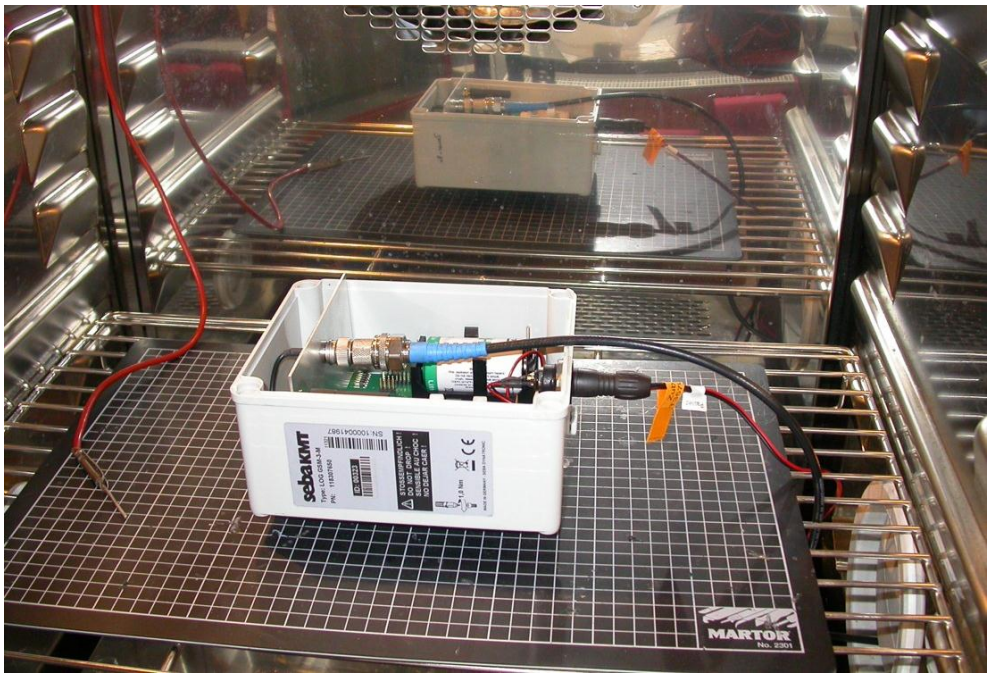
For test instruments and accessories used see section 6 Part **MB**.

### 5.5.1 Description of the test location

Test location: METROLOGY

### 5.5.2 Photo documentation of the test set-up





### 5.5.3 Applicable standard

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 per cent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:
Transmitters in which the modulating baseband comprises not more than three independent channels—when modulated by the full complement of signals for which the transmitter is rated. The level of modulation for each channel should be set to that prescribed in rule parts applicable to the services for which the transmitter is intended. If specific modulation levels are not set forth in the rules, the tests should provide the manufacturer's maximum rated condition.

### 5.5.4 Description of Measurement

The bandwidth was measured conducted with the function “bandwidth measurement” of the spectrum analyser.

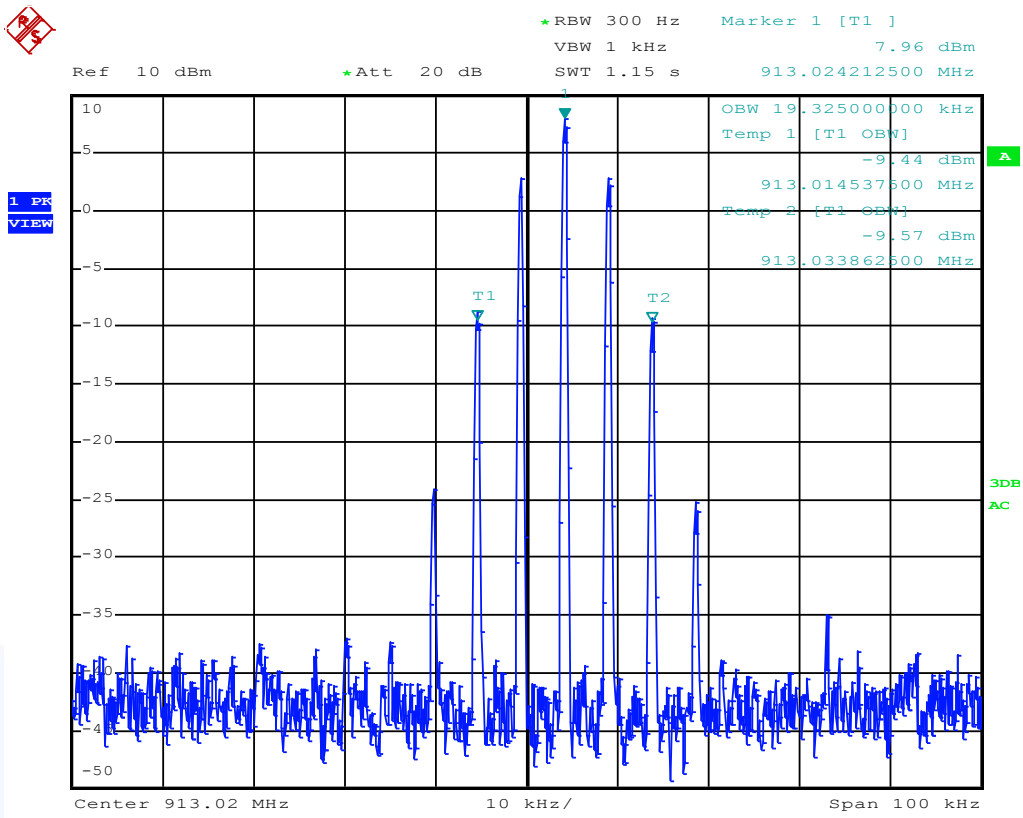
Spectrum analyser settings:
RBW: 300 Hz, VBW: 1 kHz, Detector: PK sampling detector, Sweep time: auto

### 5.5.5 Test result

| Channel number | Fundamental frequency (MHz) | 99 % Bandwidth (kHz) |
|---|---|---|
| 1 | 913.02 | 19.33 |

### 5.5.6 Test protocol

99% Bandwidth measurement plots




The requirements are **FULFILLED.**

**Remarks:** _____

_____

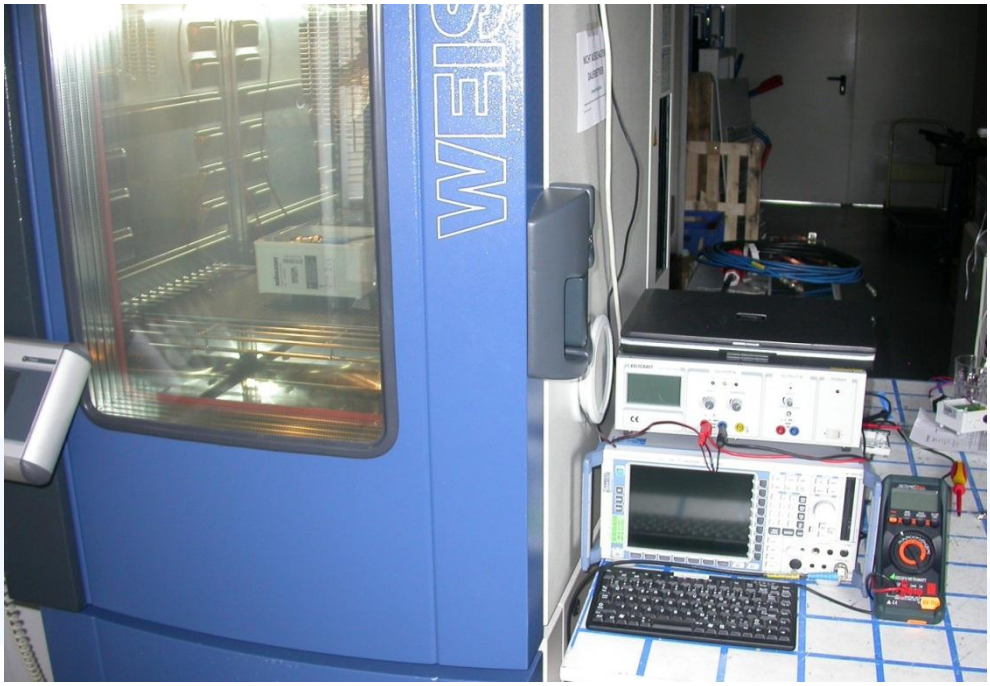
## 5.6 Frequency stability

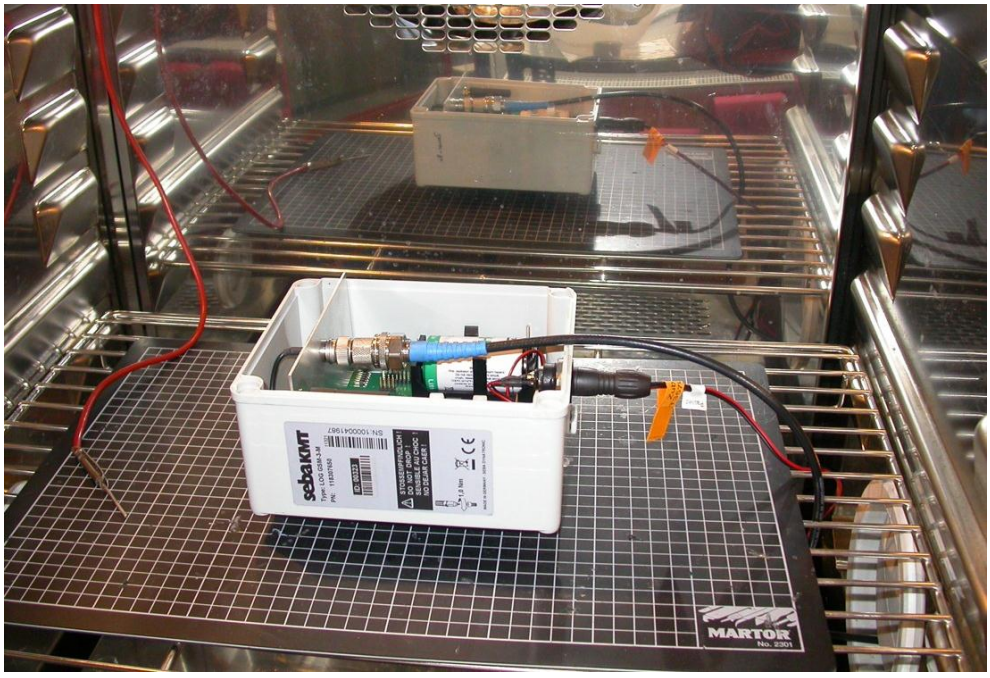
For test instruments and accessories used see section 6 Part **MB**.

### 5.6.1 Description of the test location

Test location: METROLOGY

### 5.6.2 Photo documentation of the test set-up





### 5.6.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

### 5.6.4 Description of Measurement

This test has been performed over variations in temperature and voltage. The temperature stability was measured with the EUT in a climatic chamber and was powered DC voltage supplied externally. The frequency stability of the transmitter was examinedat the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured conducted with a spectrum analyser.

### 5.6.5 Test result

| Test conditions | | Test result | |
|---|---|---|---|
| | | Frequency reading (MHz) | Frequency error (kHz) |
| T (50°C) | $V_{min}$ | 913.02000 | 0.00 |
| | $V_{nom}$ | 913.02000 | 0.00 |
| | $V_{max}$ | 913.01998 | -0.02 |
| T (40°C) | $V_{min}$ | 913.02171 | 1.71 |
| | $V_{nom}$ | 913.02170 | 1.70 |
| | $V_{max}$ | 913.02170 | 1.70 |
| T (30°C) | $V_{min}$ | 913.02400 | 4.00 |
| | $V_{nom}$ | 913.02405 | 4.05 |
| | $V_{max}$ | 913.02410 | 4.10 |
| $T_{nom}$ (20°C) | $V_{min}$ | 913.02660 | 6.60 |
| | $V_{nom}$ | 913.02661 | 6.61 |
| | $V_{max}$ | 913.02658 | 6.58 |
| T (10°C) | $V_{min}$ | 913.02870 | 8.70 |
| | $V_{nom}$ | 913.02870 | 8.70 |
| | $V_{max}$ | 913.02871 | 8.71 |
| T (0°C) | $V_{min}$ | 913.02975 | 9.75 |
| | $V_{nom}$ | 913.02974 | 9.74 |
| | $V_{max}$ | 913.02975 | 9.75 |
| T (-10°C) | $V_{min}$ | 913.02957 | 9.57 |
| | $V_{nom}$ | 913.02958 | 9.58 |
| | $V_{max}$ | 913.02956 | 9.56 |
| T (-20°C) | $V_{min}$ | 913.02758 | 7.58 |
| | $V_{nom}$ | 913.02758 | 7.58 |
| | $V_{max}$ | 913.02757 | 7.57 |
| T (-30°C) | $V_{min}$ | 913.02326 | 3.26 |
| | $V_{nom}$ | 913.02322 | 3.22 |
| | $V_{max}$ | 913.02319 | 3.19 |
| Measurement uncertainty | | ± 3 dB | |

Measured frequency 30 dB down nearest at the lower frequency (see page 21):

$f_L$ + FE $_{min}$ = 913.01450 MHz + -0.02 kHz = **913.01448 MHz**

Measured frequency 30 dB down nearest at the higher frequency (see page 22):

$f_H$ + FE $_{max}$ = 913.03435 MHz + 9.75 kHz = **913.04410 MHz**

Bandwidth limit according to FCC Part 90.217(a):

| Limit | Lower envelope point minimum frequency | Upper envelope point maximum frequency |
|---|---|---|
| 30 dB down | 912.98 MHz ($f_{e, lower}$ - 40 kHz) | 913.06 MHz ($f_{e, upper}$ + 40 kHz) |

The requirements are **FULFILLED.**

**Remarks:** _____

_____

## 5.7 Receiver spurious emissions, radiated

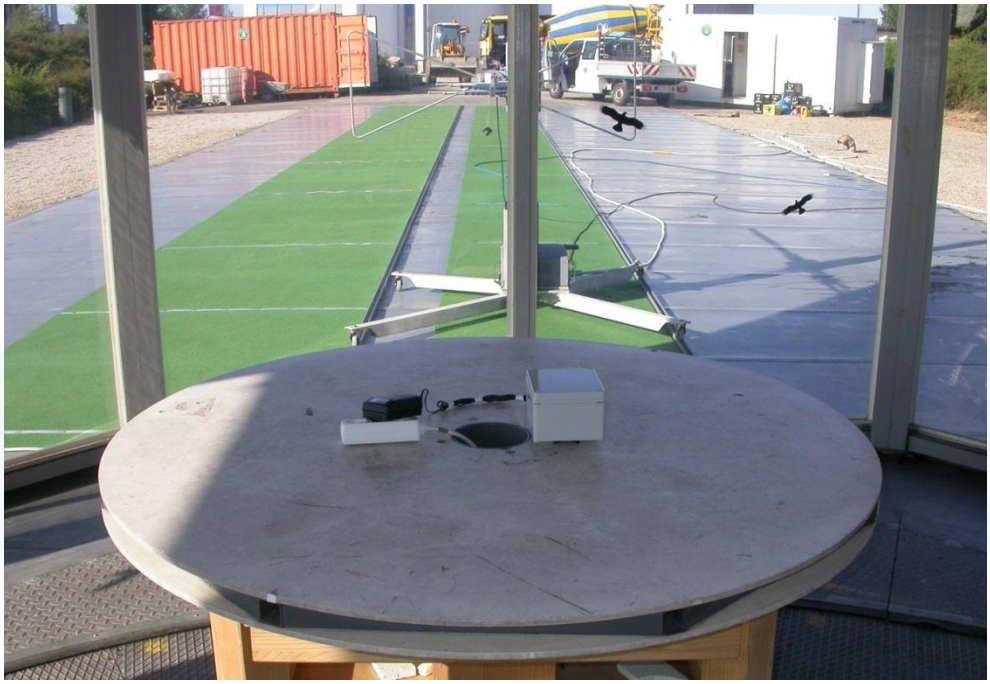
For test instruments and accessories used see section 6 Part **SER 2 and SER 3**.

### 5.7.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 2

Test distance: 3 m

### 5.7.2 Photo documentation of the test set-up



### 5.7.3 Applicable standard

According to ANSI/TIA-603-C Section 3.1.1 and FCC Part 15B, Section 15.109 (a) and:
Except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 m shall not exceed the given limit.

### 5.7.4 Description of Measurement

Spurious emission from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

Spurious emission from the EUT are measured in the frequency range 1 GHz up to 12.75 GHz, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

Instrument settings:

| | |
|---|---|
| 30 MHz – 1000 MHz: | RBW: 120 kHz |
| 1000 MHz – 5000 MHz | RBW: 1 MHz |

### 5.7.5 Test result

**f < 1 GHz:**

| Frequency (MHz) | Level QP (dBµV) | Level AV (dBµV) | Bandwidth (kHz) | Correct. factor (dB) | Level QP (dBµV/m) | Level AV (dBµV/m) | Limit (dBµV/m) | Delta (dB) |
|---|---|---|---|---|---|---|---|---|
| 30 - 1000 | - | | - | - | - | - | 40.0 | >10 |

**f > 1 GHz:**

| Frequency (MHz) | Level PK (dBµV) | Level AV (dBµV) | Bandwidth (kHz) | Correct. factor (dB) | Level PK (dBµV/m) | Level AV (dBµV/m) | Limit AV (dBµV/m) | Delta (dB) |
|---|---|---|---|---|---|---|---|---|
| 1000 - 5000 | - | | - | - | - | - | 54.0 | >10 |

Limit according to FCC Part 15B, Section 15.109(a):

| Frequency (MHz) | Limit (µV/m) | Limit (dBµV/m) |
|---|---|---|
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

The requirements are **FULFILLED.**

**Remarks:** The measurement was performed according to FCC Part 15A, Section 15.33(b), up to the 5 MHz.

## 5.8 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPR 2**.

### 5.8.1 Description of the test location

Test location: OATS 1

### 5.8.2 Applicable standard

The test methods used comply with ANSI/IEEE C95.1, “IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”.
This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

### 5.8.3 Description of Measurement

The maximum total power input to the antenna has been measured radiated as described in clause 5.2 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula: $$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

where
$P_d$ =power density (mW/cm$^2$)
$P_{out}$ = output power to antenna (mW)
$G$ = gain of antenna (linear scale)
$r$ = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. ($r$ = 20 cm)

### 5.8.4 Test result

**GSM Module:**

As tested under FCC Identifier: **UDV0606020080117** (incl. antenna gain)

| Frequency | Max power output to antenna | | Antenna gain | Power density | Limit of power density |
|---|---|---|---|---|---|
| (MHz) | (dBm) | (mW) | (dBi) | (mW/cm$^2$) | (mW/cm$^2$) |
| 824.17 – 848.59 | 33.42 | 2198 | - | 0.4373 | 0.55 |

**RF Module:**

As tested under clause 5.2 of this test report (incl. antenna gain)

| Frequency | Max power output to antenna | | Antenna gain | Power density | Limit of power density |
|---|---|---|---|---|---|
| (MHz) | (dBm) | (mW) | (dBi) | (mW/cm$^2$) | (mW/cm$^2$) |
| 913.02 | 10 | 10 | - | 0.0020 | 0.61 |

Limits for maximum permissible exposure (MPE):

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| **(B) Limits for General Population / Uncontrolled Exposure** | | | | |
| 0.3 – 3.0 | 614 | 1.63 | 100 | 30 |
| 3.0 – 30 | 824/*f* | 2.19/*f* | $180/f^2$ | 30 |
| 30 - 300 | 27.5 | 0.073 | 0.2 | 30 |
| **300-1500** | **---** | **---** | ***f*/1500** | **30** |
| 1500-100000 | --- | --- | 1.0 | 30 |

*f* = Frequency in MHz

### 5.8.5 Compliance regarding co-location and co-transmission

According to EN 62311, clause 8.5:
When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the ME toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source (expressed as a plane-wave equivalent power density) to the corresponding ME for the frequency of each source is evaluated. The exposure complies with the ME if the sum of the ratios is less than unity, i.e.

$$\sum_{i=1}^{n} \frac{S_{E_i}(duty\,factor)}{MPE_{E_i}} < 1$$

For mixed or broadband fields at a number of frequencies for which there are different values of the MPE, the fraction of the MPE (in terms of E, H, or power density (S)) occurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity (1.0, or 100 % in terms of percentage.

1. MPE of GSM-Module: $S_1 = 0.44\ mW/cm^2$
   Limit: $0.55\ mW/cm^2$
   Fraction of MPE: 80.0 %

2. MPE of Effective Range Module: $S_2 = 0.002\ mW/cm^2$
   Limit: $0.61\ mW/cm^2$
   Fraction of MPE: 0.3 %

3. Sum of total power density $S_1 + S_2 = 80.3\ \% < 100\ \%$

The requirements are **FULFILLED.**

**Remarks:** SAR evaluation is not applicable, because the equipment is used in fixed installation.

# 6 USED TEST EQUIPMENT AND ACCESSORIES

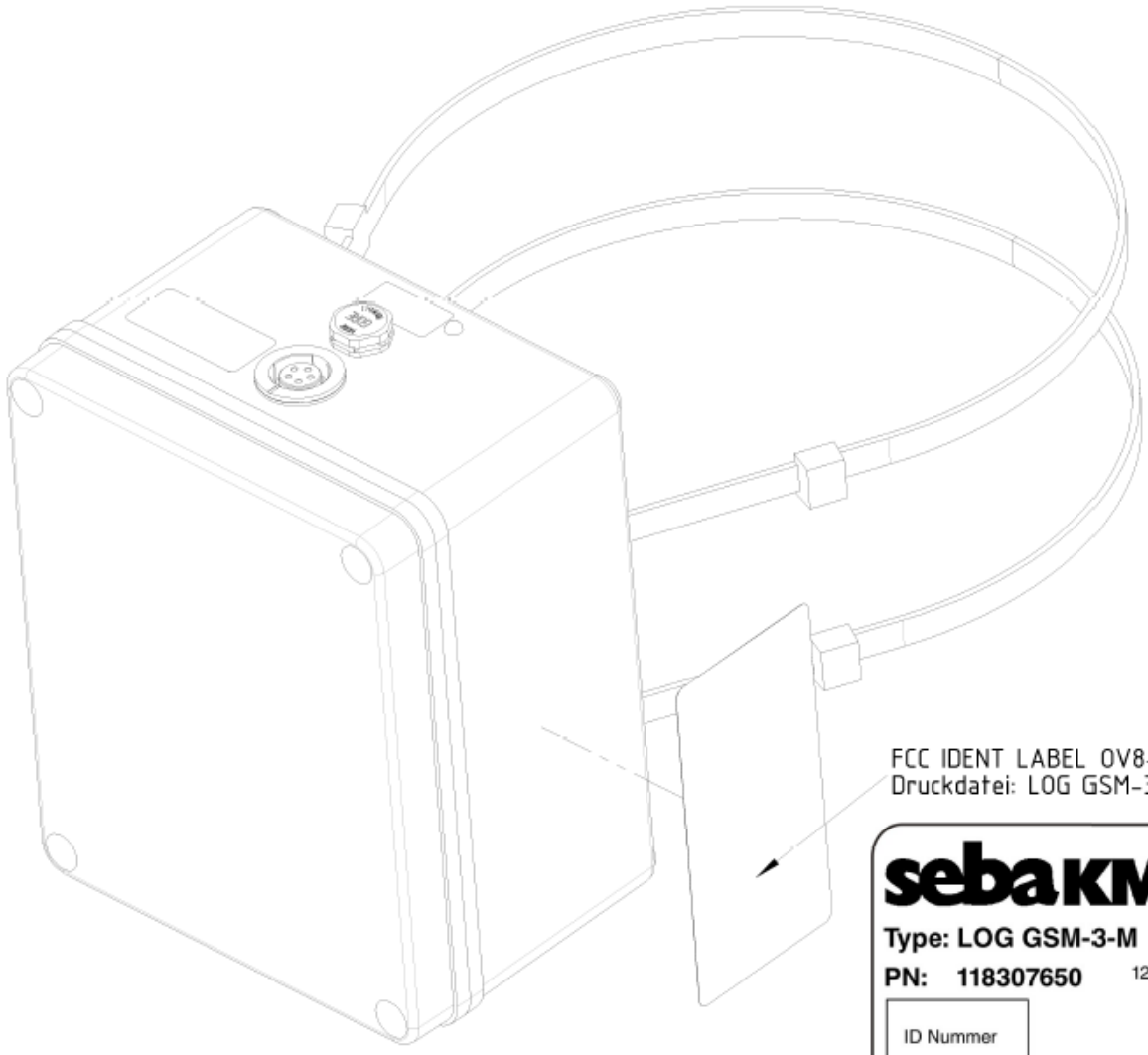
All test instruments used are calibrated and verified regularly. The calibration history is available on request.

| Test ID | Model Type | Equipment No. | Next Calib. | Last Calib. | Next Verif. | Last Verif. |
|---|---|---|---|---|---|---|
| A 4 | ESHS 30 | 02-02/03-05-002 | 11/07/2013 | 11/07/2012 | | |
| | ESH 2 - Z 5 | 02-02/20-05-004 | 12/05/2013 | 12/05/2011 | 12/03/2013 | 12/09/2012 |
| | N-4000-BNC | 02-02/50-05-138 | | | | |
| | N-1500-N | 02-02/50-05-140 | | | | |
| | ESH 3 - Z 2 | 02-02/50-05-155 | | | 02/04/2013 | 02/10/2012 |
| | SP 103 /3.5-60 | 02-02/50-05-182 | | | | |
| CPR 2 | ESVS 30 | 02-02/03-05-006 | 26/06/2013 | 26/06/2012 | | |
| | VULB 9168 | 02-02/24-05-005 | 16/03/2013 | 16/03/2012 | 08/04/2013 | 08/10/2012 |
| | S10162-B | 02-02/50-05-031 | | | | |
| | NW-2000-NB | 02-02/50-05-113 | | | | |
| | KK-EF393/U-16N-21N_20m | 02-02/50-12-018 | | | | |
| MB | ESCI | 02-02/03-05-005 | 21/11/2012 | 21/11/2011 | | |
| | RF Antenna | 02-02/24-05-032 | | | | |
| | MetraHIT World | 02-02/32-10-001 | 09/08/2012 | 09/08/2011 | | |
| | WK-180/40 | 02-02/45-08-001 | 31/05/2012 | 31/05/2011 | 03/03/2013 | 03/09/2012 |
| | VLP-1405 PRO | 02-02/50-10-014 | | | | |
| SER 2 | ESVS 30 | 02-02/03-05-006 | 26/06/2012 | 26/06/2011 | | |
| | VULB 9168 | 02-02/24-05-005 | 16/03/2013 | 16/03/2012 | 08/04/2013 | 08/10/2012 |
| | S10162-B | 02-02/50-05-031 | | | | |
| | NW-2000-NB | 02-02/50-05-113 | | | | |
| | KK-EF393/U-16N-21N_20m | 02-02/50-12-018 | | | | |
| SER 3 | FSP 30 | 02-02/11-05-001 | 18/10/2012 | 18/10/2011 | | |
| | AFS4-01000400-10-10P-4 | 02-02/17-05-003 | | | | |
| | AMF-4F-04001200-15-10P | 02-02/17-05-004 | | | | |
| | AFS5-12001800-18-10P-6 | 02-02/17-06-002 | | | | |
| | 3117 | 02-02/24-05-009 | 16/02/2013 | 16/02/2012 | | |
| | WHJS 1000-10EE | 02-02/50-05-070 | | | | |
| | Sucoflex N-1600-SMA | 02-02/50-05-073 | | | | |
| | Sucoflex N-2000-SMA | 02-02/50-05-075 | | | | |

# 7 Photo documentation

## 7.1 External photos of the EUT

Label view / lable placement



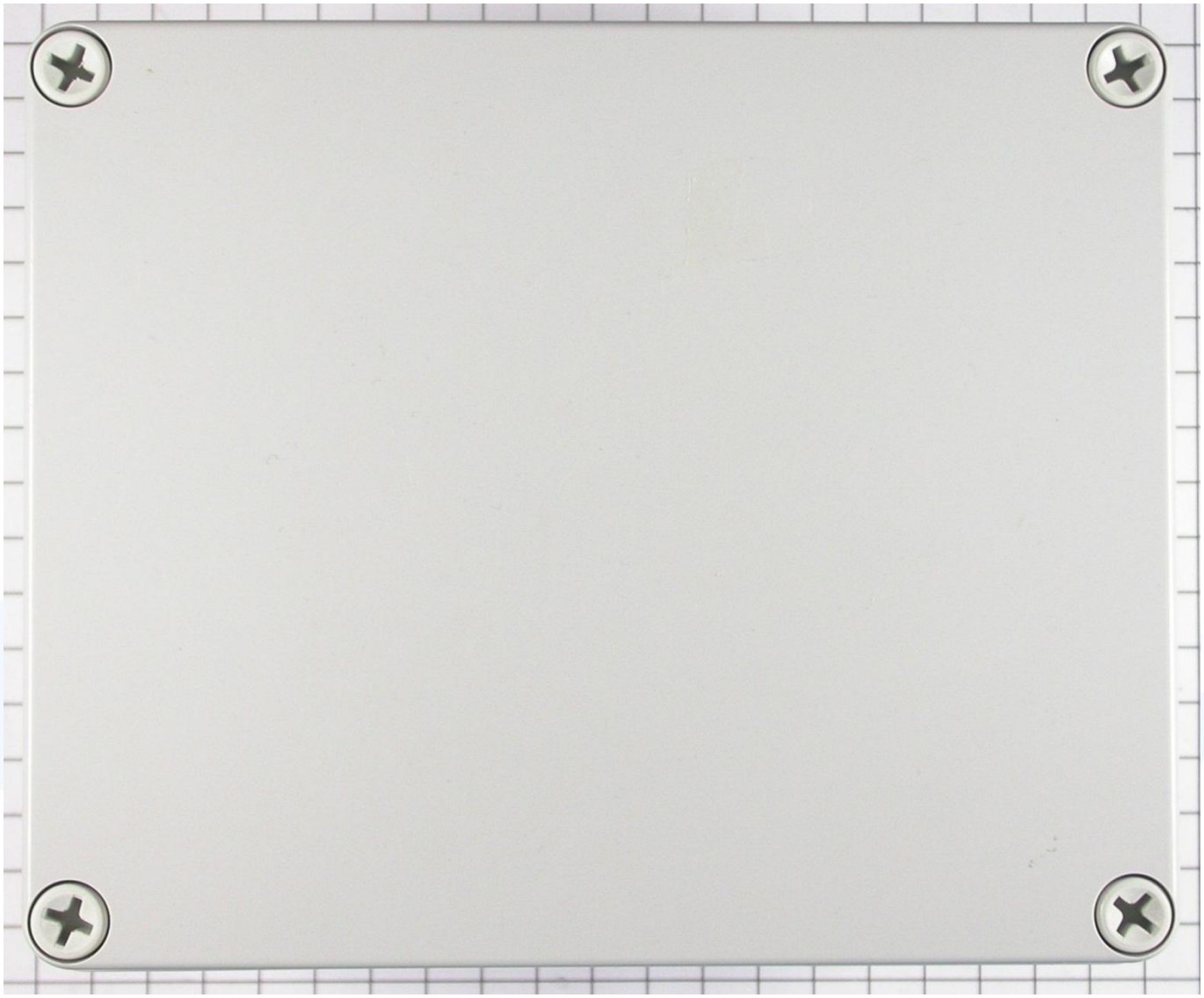
FCC IDENT LABEL OV8-LOGGSM3
Druckdatei: LOG GSM-3-M-FCC.lbl


M 1:1

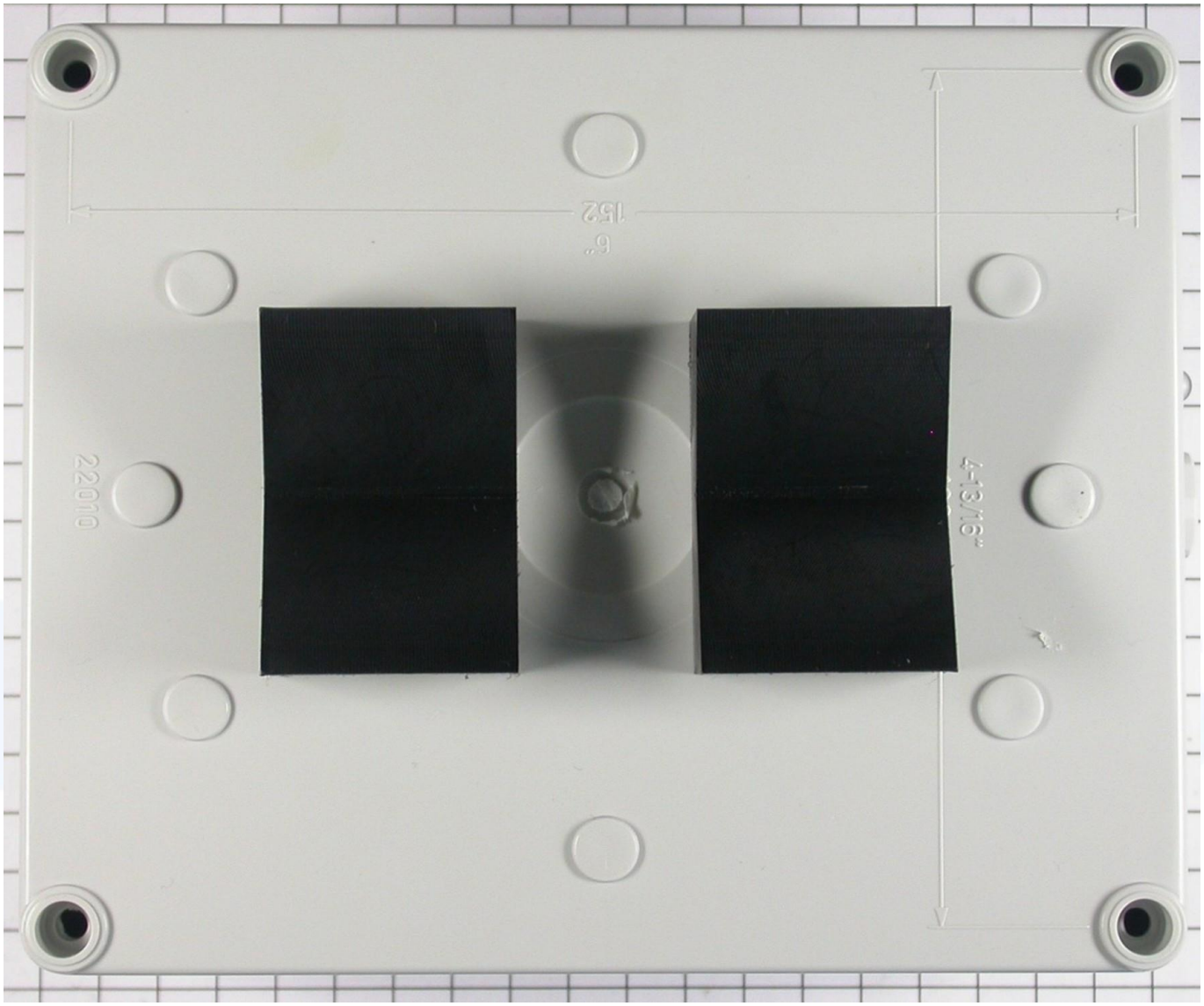
Test setup overview with additional AC/DC power supply

# FCC: OV8-LOGGSM3

Top view



Bottom view



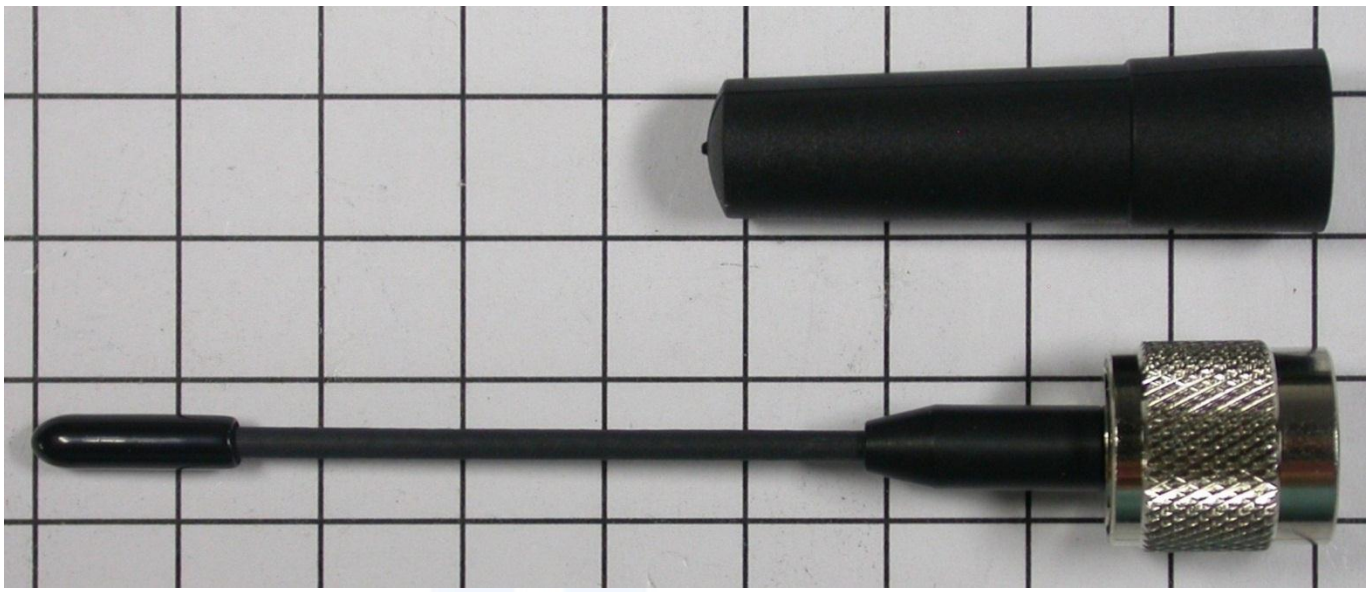
Left view
(Label for European market)

Right view

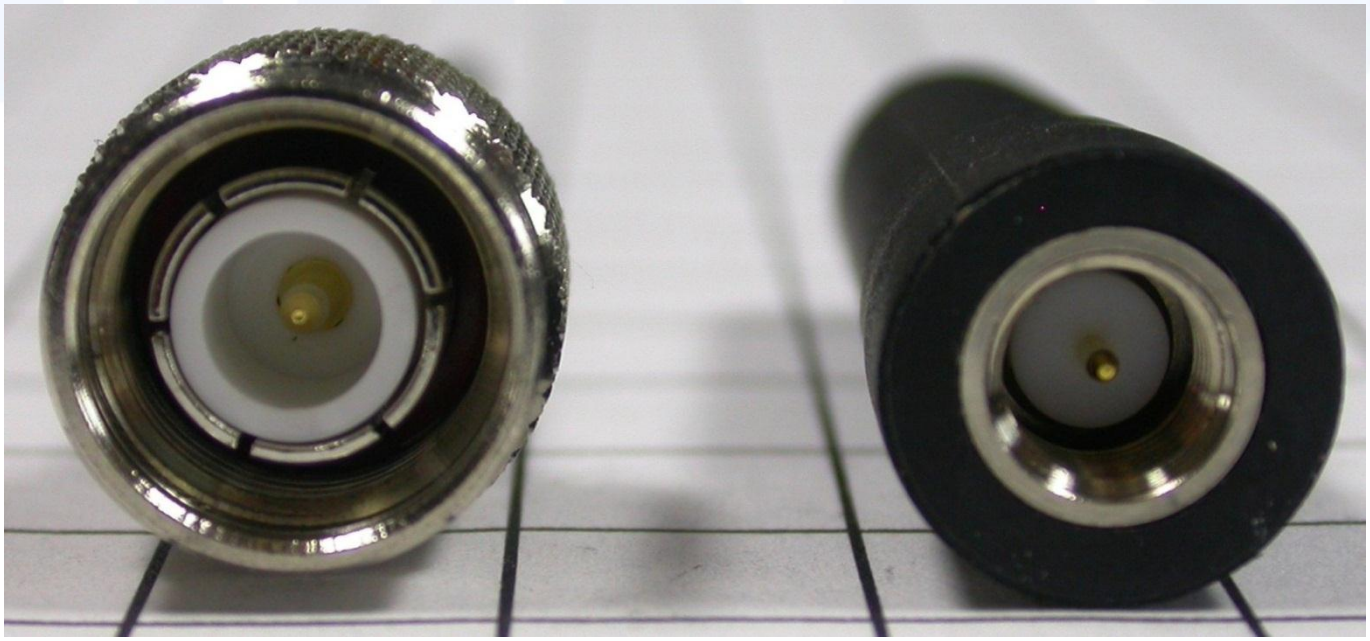
Front view

Rear view

Antennas
(up = GSM; down = F socket antenna for 913.02 MHz)



Antenna connectors
(left side = F socket antenna for 913.02 MHz; right side = SMA socket antenna for GSM)



# FCC: OV8-LOGGSM3

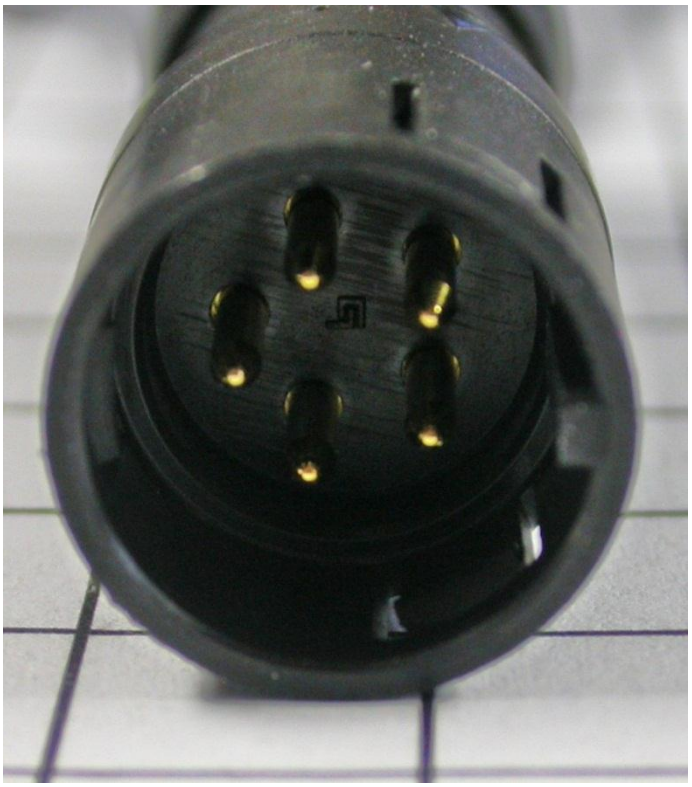
Top view – AC/DC adapter


Bottom view – AC/DC adapter

Side view – AC/DC adapter

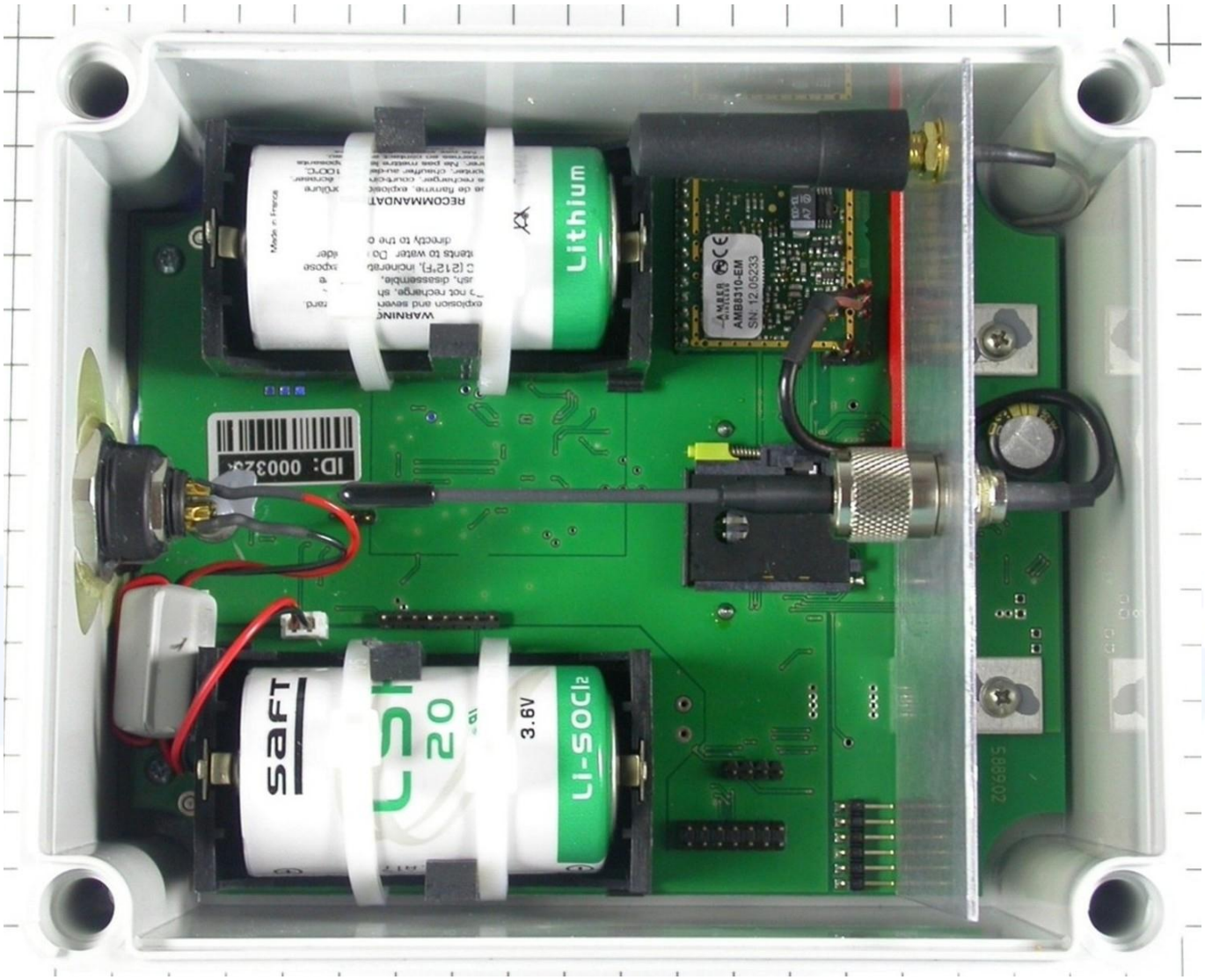
Top view – DC plug

Front view – DC plug



## 7.2 Internal photos of the EUT

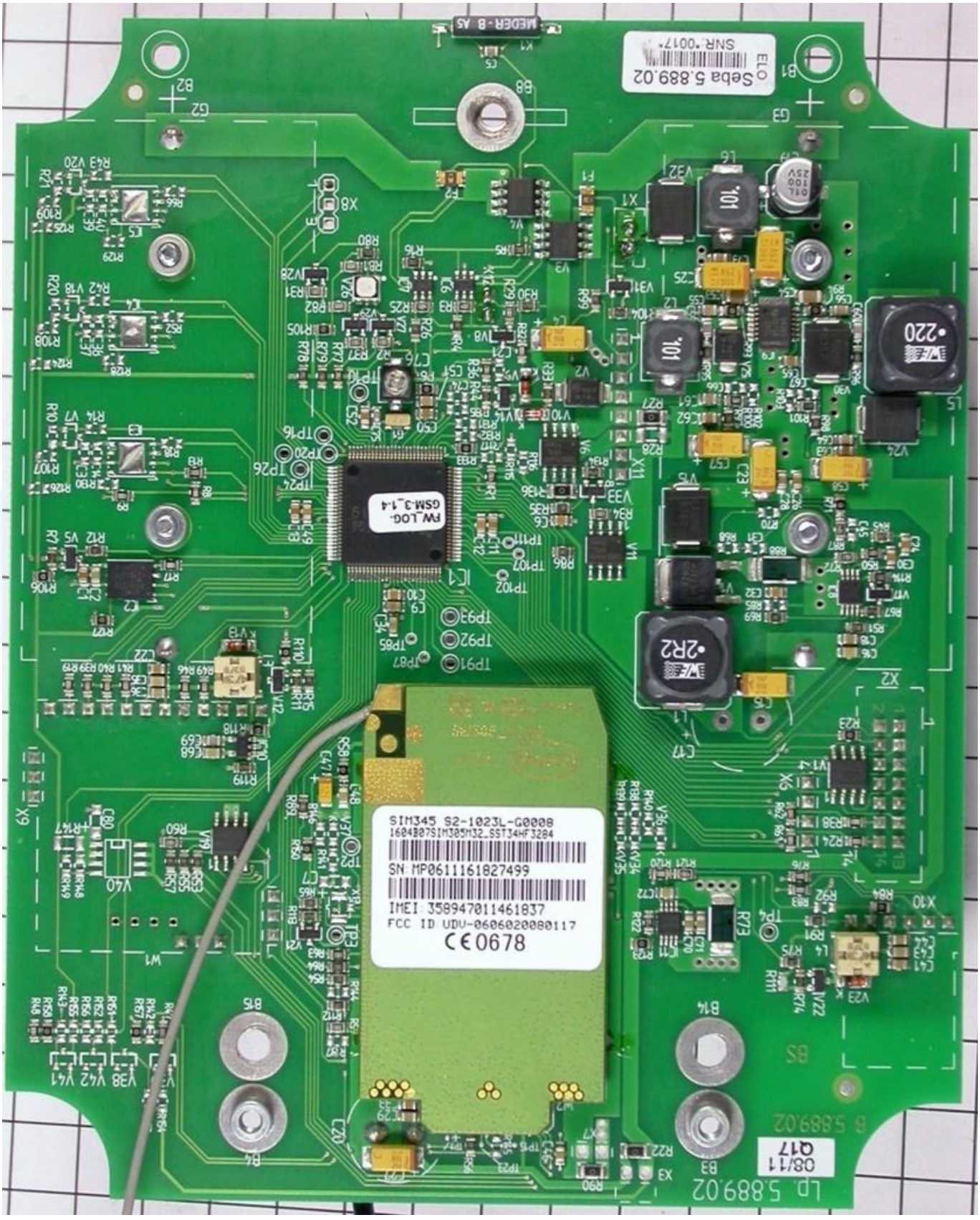
Open casing




Label view – battery pack

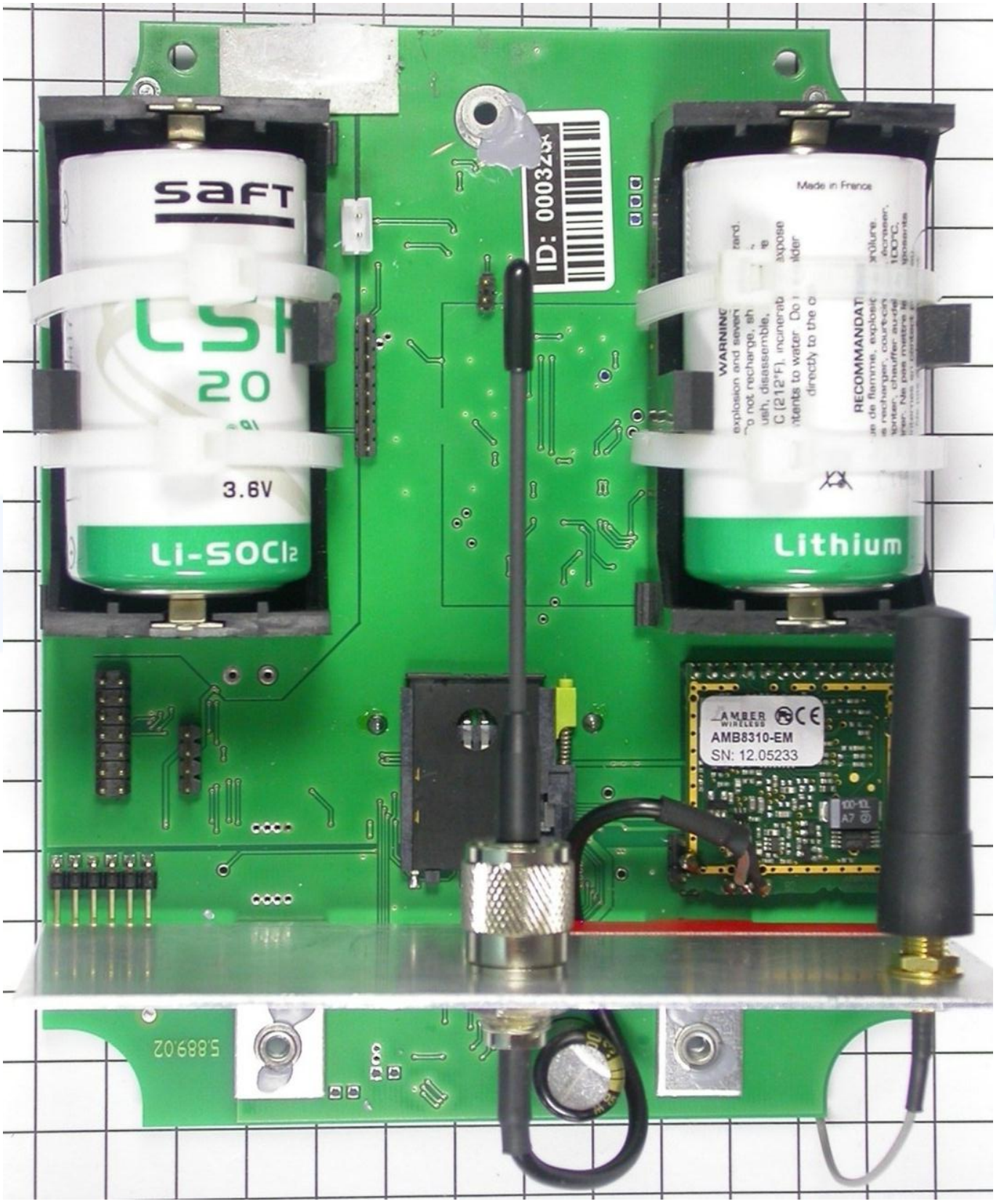

# FCC: OV8-LOGGSM3

PCB top view



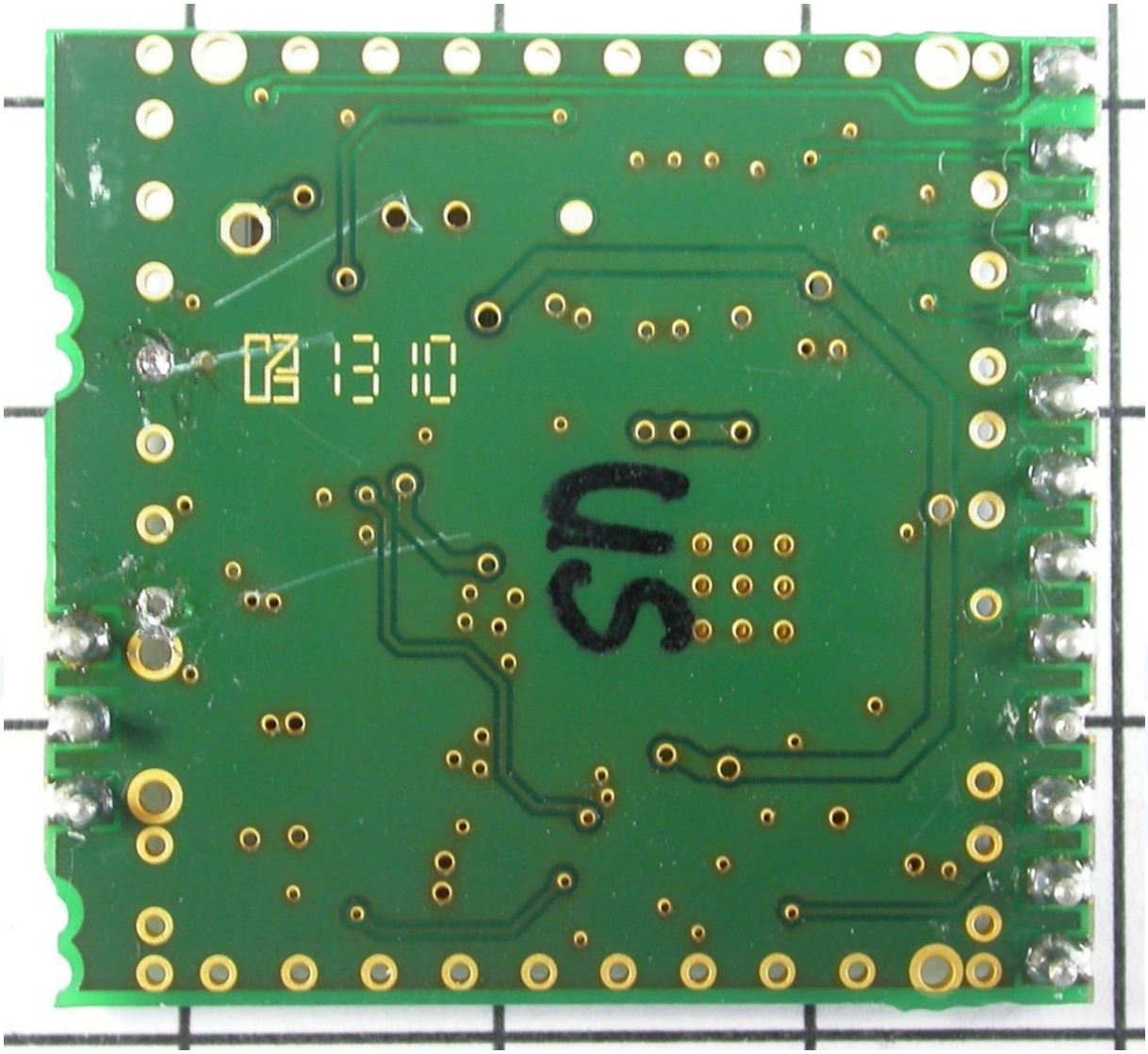
# FCC: OV8-LOGGSM3

PCB bottom view



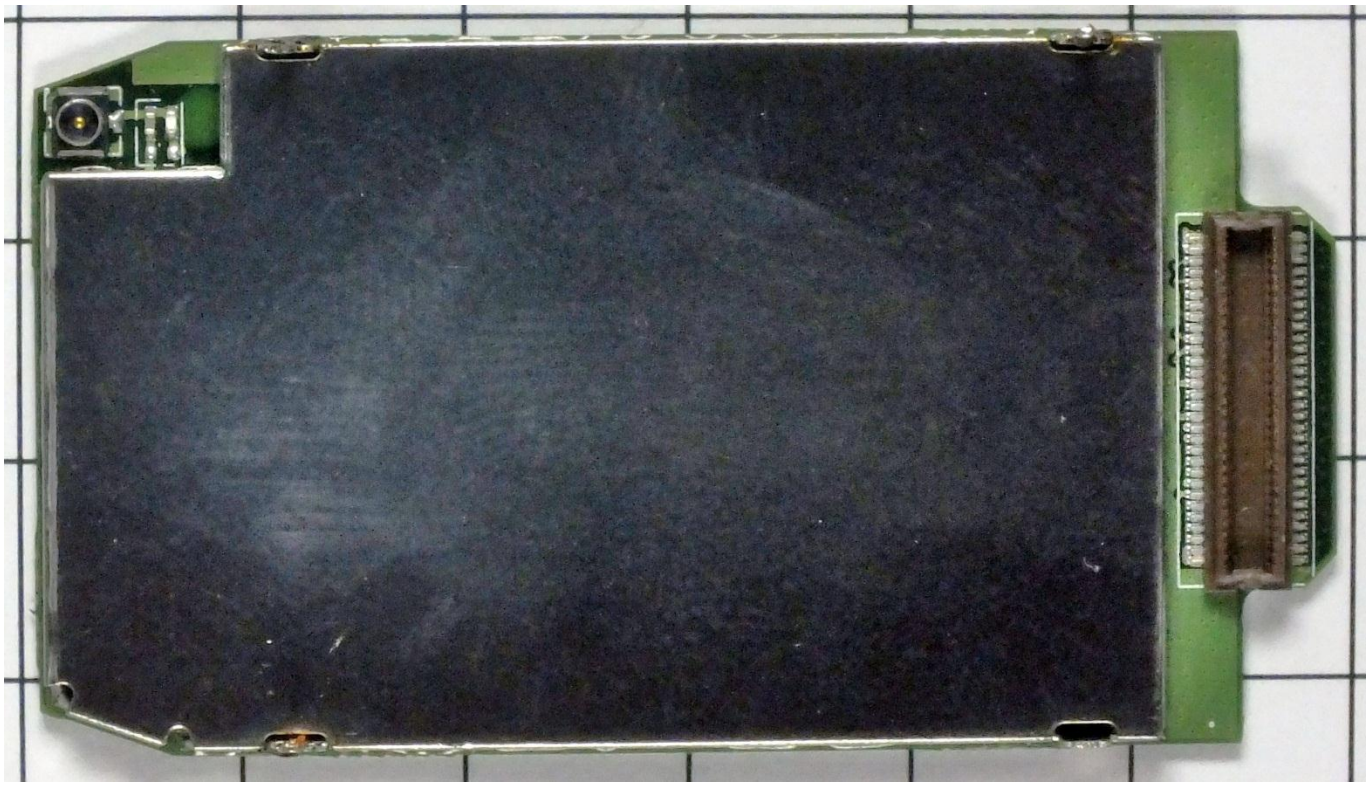
Top view – RF module

Bottom view – RF module



Top view – GSM module


Bottom view – GSM module



Bottom view (without shielding) – GSM module