

FCC ID: USXF1WE4MSP

**EMI - TEST REPORT**

- FCC Part 15.231 -

**Test Report No. :** T36813-00-02HU

01. October 2013

Date of issue

**Type / Model Name** : Gen2.4 TPMS / F1WE4MSP**Product Description** : Tyre Pressure Monitoring Sensor**Applicant** : bf1systems

Address : Technical Centre, Owen Road, Diss

Norfolk, England, IP22 4ER

**Manufacturer** : bf1system

Address : Technical Centre, Owen Road, Diss

Norfolk, England, IP22 4ER

**Licence holder** : bf1system

Address : Technical Centre, Owen Road, Diss

Norfolk, England IP22 4ER

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

The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test results  
without the written permission of the test laboratory.

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## 1 TEST STANDARDS

The tests were performed according to following standards:

### **FCC Rules and Regulations Part 15, Subpart A - General (October, 2012)**

|                                   |   |
|-----------------------------------|---|
| Part 15, Subpart A, Section 15.31 | Measurement standards                         |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements      |
| Part 15, Subpart A, Section 15.35 | Measurement detector functions and bandwidths |

### **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2012)**

|                                    |   |
|------------------------------------|---|
| Part 15, Subpart C, Section 15.203 | Antenna requirement   |
| Part 15, Subpart C, Section 15.204 | External radio frequency power amplifiers and antenna modifications |
| Part 15, Subpart C, Section 15.205 | Restricted bands of operation                                       |
| Part 15, Subpart C, Section 15.207 | Conducted limits  |
| Part 15, Subpart C, Section 15.209 | Radiated emission limits, general requirements                      |
| Part 15, Subpart C, Section 15.231 | Periodic operation in the band 40.66-40.70 MHz and above 70 MHz     |

|                  |   |
|------------------|---|
| 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. |
|------------------|---|

|                  |  |
|------------------|--|
| ANSI C95.1: 1992 | IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz |
|------------------|--|

|                    |                                |
|--------------------|--------------------------------|
| CISPR 16-4-2: 2003 | Uncertainty in EMC measurement |
|--------------------|--------------------------------|

|                                  |                                  |
|----------------------------------|----------------------------------|
| CISPR 22: 2005<br>EN 55022: 2006 | Information technology equipment |
|----------------------------------|----------------------------------|

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## 2 SUMMARY

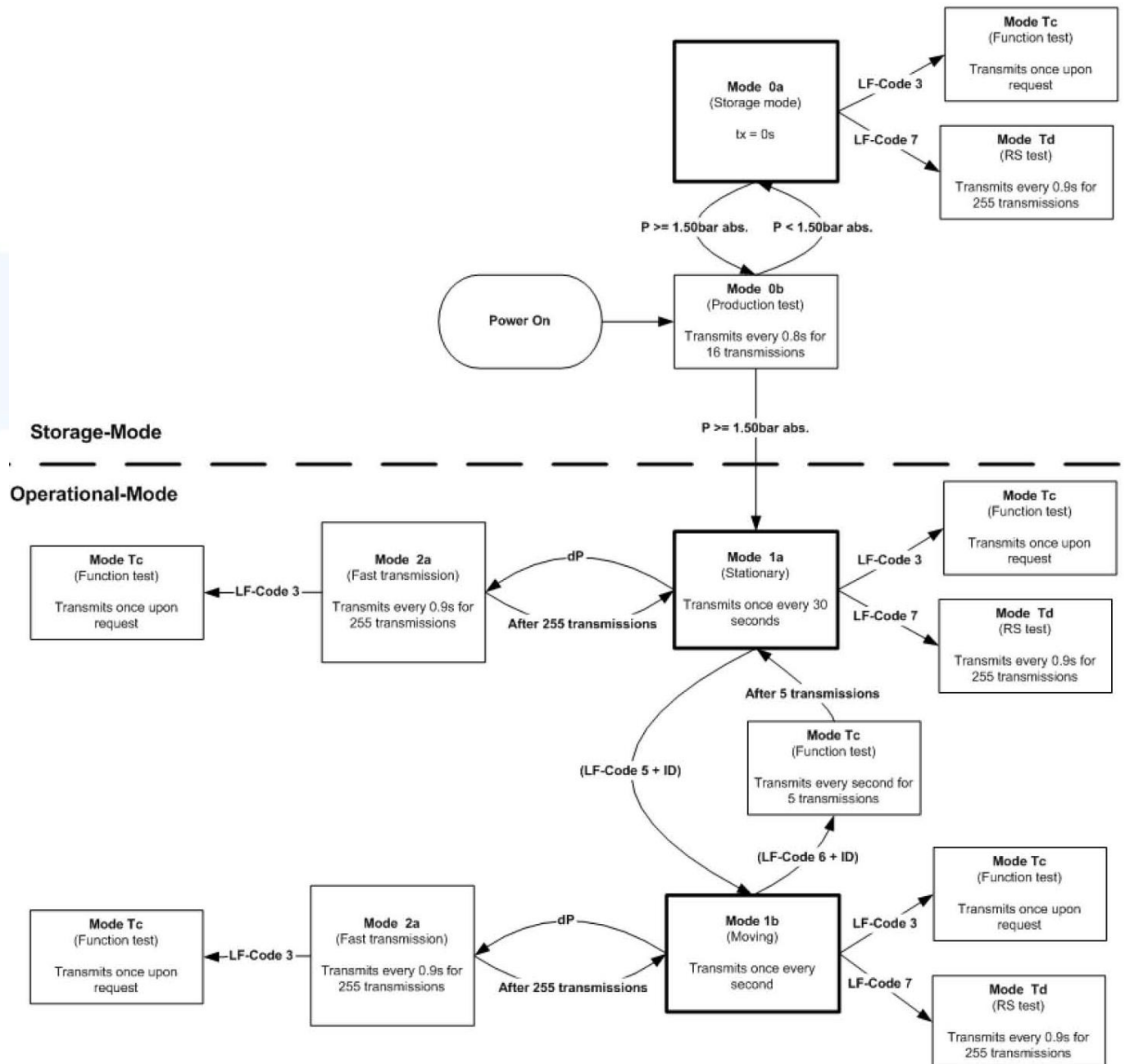
### GENERAL REMARKS:

All radiated tests have been performed on samples which are in original state.

For activating the EuT a “Beru TSS Tester” and a “Pressure Vessel” was used to power up the Wheel Unit Sensor in the different operation modes.

The EuT has an incorporated antenna and is powered by a primary battery.

For testing the manufacturer declares following transmitting intervals:



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The test report covers the following operation modes from the G2.4 TPMS wheel unit sensor:

- Stationary mode: In Stationary mode the sensor will transmit every 30 seconds a datagram. If the sensor sees a pressure change of more than 0.2 bar in a minute it will fall into Fast Transmission mode.
- Moving Mode: In Moving Mode the sensor will transmit every second. When in Moving mode if the sensor sees a pressure change of more than 0.2 bar in a minute it will fall into Fast Transmission mode.
- Fast transmission mode: Fast transmission mode automatically transmits one datagram every 0.8 seconds until 255 datagrams have been sent. After all 255 datagrams the sensor moves back to its previous mode.

### 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 : 20. March 2013

Testing concluded on : 22. April 2013

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Dipl.-Ing.(FH)  
Manager Radio Group

\_\_\_\_\_  
Markus Huber

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### 3 EQUIPMENT UNDER TEST

#### 3.1 Photo documentation of the EUT – See Attachment A

#### 3.2 Power supply system utilised

Power supply voltage : 3.0 V / DC (Lithium battery)

#### 3.3 Short description of the Equipment under Test (EUT)

The wheel unit sensor is a part of a TPMS system embedded on a vehicle.  
The device takes places in the tire, fix on rim of a vehicles wheel.

Number of tested samples: 1  
Serial number: 3029016

#### EUT operation mode:

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

- Tx mode at frequency 433.92 MHz, Fast transmission mode

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- Tx mode at frequency 433.92 MHz, Moving mode

---

- Tx mode at frequency 433.92 MHz, Stationary mode

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#### EUT configuration:

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

- |                            |  |
|----------------------------|--|
| - <u>BERU TSS - Tester</u> | Model : <u>F1-100-1081-098-A, Serial No.: 0031</u> |
| - <u>Pressure Vessel</u>   | Model : <u>Supplied by manufacturer</u>            |
| - _____                    | Model : _____                                      |
| - _____                    | Model : _____                                      |
| - _____                    | Model : _____                                      |
| - _____                    | Model : _____                                      |

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## 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 may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh 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 diversity and modifications in production process of devices may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for the specific test. The manufacturer has the sole responsibility of continued compliance of the EUT.

### 4.4 Measurement Protocol for FCC, VCCI and AUSTEL

#### 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 the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

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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 unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

mikes



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## 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: NONE

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

#### 5.1.3 Applicable standard

According to FCC Part 15C, Section 15.207(a):

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.

| Frequency of Emission (MHz) | Conducted Limit (dB $\mu$ V) |            |
|-----------------------------|------------------------------|------------|
|                             | Quasi-peak                   | Average    |
| 0.15-0.5                    | 66 to 56 *                   | 56 to 46 * |
| 0.5-5                       | 56                           | 46         |
| 5-30                        | 60                           | 50         |

\* Decreases with the logarithm of the frequency

#### 5.1.4 Description of Measurement

The measurements are performed on the power interface 120 V / 60 Hz using a receiver, which has CISPR characteristic bandwidth, quasi-peak detection and line impedance stabilization network with 50 $\Omega$ /50  $\mu$ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 cm above the floor and is positioned 40 cm from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20 \log \mu\text{V}$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

#### 5.1.5 Test result

**Remarks:** The measurement is not applicable.

The EuT has no AC mains connections.

The EuT is separated powered by a 3.0 V battery.

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### 5.2 Field strength of the fundamental wave

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

#### 5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

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



#### 5.2.1 Applicable standard

According to FCC Part 15C, Section 15.231(e):

The field strength of emissions from intentional radiators shall not exceed the effective field strength limits.

#### 5.2.2 Description of Measurement

The radiated power of the fundamental wave from the EUT is measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized 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 metres non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the EUT will be in accordance to ANSI C63.4. 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 screen room located outside the test area. The antenna was positioned 3, 10 or 30 metres horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made in horizontal and vertical antenna polarization's and the EUT is rotated 360 degrees.

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The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz:      RBW:                      120 kHz

Example:

|                    |                       |   |                |   |                         |   |                         |   |               |
|--------------------|-----------------------|---|----------------|---|-------------------------|---|-------------------------|---|---------------|
| Frequency<br>(MHz) | Level<br>(dB $\mu$ V) | + | Factor<br>(dB) | = | Level<br>dB( $\mu$ V/m) | - | Limit<br>dB( $\mu$ V/m) | = | Delta<br>(dB) |
| 170.5              | 5                     | + | 20             | = | 25                      | - | 30                      | = | -5            |

### 5.2.3 Test result

| Frequency<br>(MHz) | Level Pk<br>(dB $\mu$ V) | Level QP<br>(dB $\mu$ V) | Bandwidth<br>(kHz) | Correct.<br>factor<br>(dB) | Duty Cycle<br>Correct.<br>factor<br>(dB) | Level Pk<br>dB( $\mu$ V/m) | Calculated<br>Level Av<br>dB( $\mu$ V/m) | Effective<br>limit<br>dB( $\mu$ V/m) | Delta<br>(dB) |
|--------------------|--------------------------|--------------------------|--------------------|----------------------------|--|----------------------------|--|--------------------------------------|---------------|
| 433.92             | 51.4                     | 48.1                     | 120                | 19.9                       | -19.83                                   | 71.30                      | 51.47                                    | 72.87                                | -21.4         |
|                    |                          |                          |                    |                            |  |                            |  |                                      |               |

Limit according to FCC Section 15.231(e):

| Frequency<br>(MHz) | Field strength of fundamental @ 3m |                    | Effective limit for 433.92 MHz |                |
|--------------------|------------------------------------|--------------------|--------------------------------|----------------|
|                    | ( $\mu$ V/m)                       | dB( $\mu$ V/m)     | ( $\mu$ V/m)                   | dB( $\mu$ V/m) |
| 40.66 – 40.70      | 1000                               | 60                 |                                |                |
| 70 - 130           | 500                                | 54                 |                                |                |
| 130 - 174          | 500 to 1500*                       | 54 to 63.5*        |                                |                |
| 174 - 260          | 1500                               | 63.5               |                                |                |
| <b>260 - 470</b>   | <b>1500 to 5000*</b>               | <b>63.5 to 74*</b> | <b>4398.67</b>                 | <b>72.87</b>   |
| Above 470          | 5000                               | 81.9               |                                |                |

\*Linear interpolation

The requirements are **FULFILLED**.

**Remarks:**      The level of Field Strength are identically in all Tx operation modes.

The test was performed in "Fast Transmission Mode" of the EuT.

                         \_\_\_\_\_

                         \_\_\_\_\_

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### 5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz

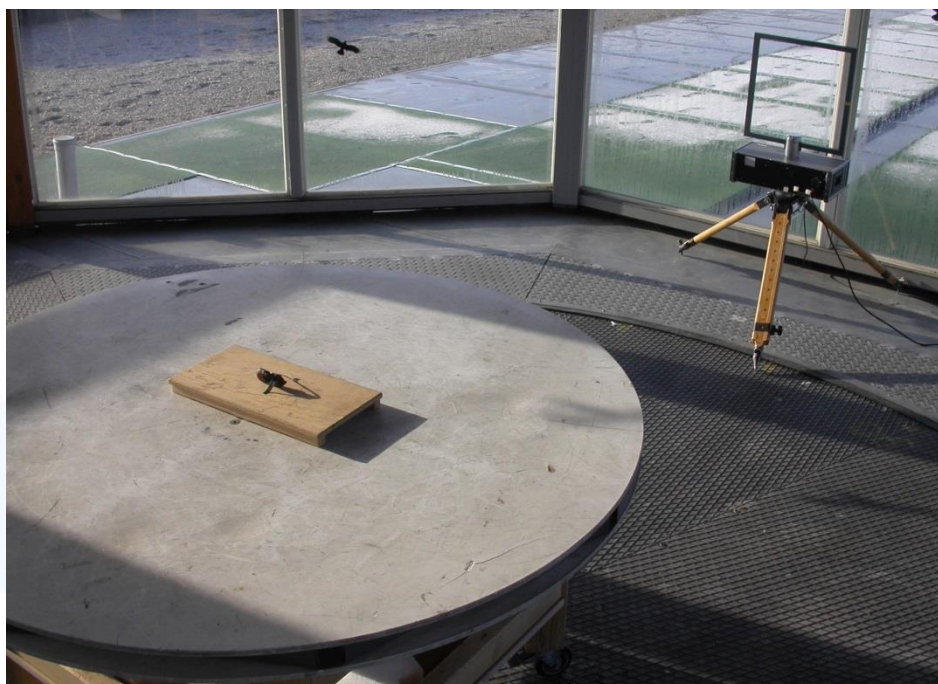
For test instruments and accessories used see section 6 Part SER 1.

#### 5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

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



#### 5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

#### 5.3.4 Description of Measurement

The magnetic field strength from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The set up of the Equipment under test will be in accordance to ANSI C63.4. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2)(2). The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209(d)(2).

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The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz  
 150 kHz – 30 MHz: RBW: 9 kHz

Example:

|                    |                       |   |                |   |                         |   |                         |   |               |
|--------------------|-----------------------|---|----------------|---|-------------------------|---|-------------------------|---|---------------|
| Frequency<br>(MHz) | Level<br>(dB $\mu$ V) | + | Factor<br>(dB) | = | Level<br>dB( $\mu$ V/m) | - | Limit<br>dB( $\mu$ V/m) | = | Delta<br>(dB) |
| 1.705              | 5                     | + | 20             | = | 25                      | - | 30                      | = | -5            |

#### 5.3.5 Test result

Measurement distance: 3 m

| Frequency [MHz] | L: QP [dB $\mu$ V] | L: AV [dB $\mu$ V] | Bandwidth [kHz] | Correct. [dB] | L: QP [dB $\mu$ V/m] | L: AV [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | Delta [dB] |
|-----------------|--------------------|--------------------|-----------------|---------------|----------------------|----------------------|----------------------|------------|
| 0.009-0.150     |                    |                    | 0.2             | 20            |                      |                      |                      | >20        |
| 0.150-30.0      |                    |                    | 9.0             | 20            |                      |                      |                      | >20        |
|                 |                    |                    |                 |               |                      |                      |                      |            |
|                 |                    |                    |                 |               |                      |                      |                      |            |

Limit according to FCC Part 15C Section 15.209(a):

| Frequency (MHz) | Field strength of spurious emissions |                | Measurement distance (metres) |
|-----------------|--------------------------------------|----------------|-------------------------------|
|                 | ( $\mu$ V/m)                         | dB( $\mu$ V/m) |                               |
| 0.009-0.490     | 2400/F(kHz)                          | --             | 300                           |
| 0.490-1.705     | 24000/F (kHz)                        | --             | 30                            |
| 1.705-30.0      | 30                                   | 29.5           | 30                            |

The requirements are **FULFILLED**.

**Remarks:** All unwanted emissions in the frequency range from 9 kHz to 30 MHz are below 10 dB $\mu$ V/m at a test distance of 3 metres.

The level of Field Strength are identically in all Tx operation modes.

The test was performed in "Fast Transmission Mode" of the EuT.



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5.4 Spurious emissions radiated (electric field)

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

5.4.1 Description of the test location

Test location: OATS1  
Anechoic Chamber A2

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up



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### 5.4.3 Applicable standard

According to FCC Part 15C, Section 15.231(e), Section 15.209(a) and Section 15.205(a):  
The emissions from intentional radiators shall not exceed the effective field strength limits.

### 5.4.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized 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 cm above the ground plane. Floor standing equipment is placed directly on the turntable ground plane. The set up of the EUT will be in accordance to ANSI C63.4. The interface cables closer than 40 cm to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 cm away from the ground plane. Cables to simulators/testers are routed through the centre of the table to a screen room located outside the test area. To locate maximum emission from the test sample the antenna is varied in height from 1 to 4 m, measurement scans are made in horizontal and vertical antenna polarization and the EUT is turned 360 degrees.

The radiated power of the spurious emission from the EUT is measured in the frequency range above 1 GHz using a spectrum analyser and appropriate linear polarised antennas. Measurements are made in the horizontal and vertical polarization of the antenna. The set up of the EUT will be in accordance to ANSI C63.4. The interface cables closer than 40 cm to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 cm away from the ground plane. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration results in the highest emission and therefore shall be used for final testing. During the tests the EUT is turned 360 degrees to find the maximum level of emission. For testing above 1 GHz, 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.

The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz:           RBW: 120 kHz  
1000 MHz – 18000 MHz       RBW: 1 MHz

Example:

|                    |                       |   |                |   |                         |   |                         |   |               |
|--------------------|-----------------------|---|----------------|---|-------------------------|---|-------------------------|---|---------------|
| Frequency<br>(MHz) | Level<br>(dB $\mu$ V) | + | Factor<br>(dB) | = | Level<br>dB( $\mu$ V/m) | - | Limit<br>dB( $\mu$ V/m) | = | Delta<br>(dB) |
| 170.5              | 5                     | + | 20             | = | 25                      | - | 30                      | = | -5            |

### 5.4.5 Test result f < 1 GHz

| Frequency<br>(MHz) | Level Pk<br>(dB $\mu$ V) | Level QP<br>(dB $\mu$ V) | Bandwidth<br>(kHz) | Correct.<br>factor<br>(dB) | Duty Cycle<br>Correct.<br>factor<br>(dB) | Level Pk<br>dB( $\mu$ V/m) | Calculated<br>Level Av<br>dB( $\mu$ V/m) | Effective limit<br>dB( $\mu$ V/m) | Delta<br>(dB) |
|--------------------|--------------------------|--------------------------|--------------------|----------------------------|--|----------------------------|--|-----------------------------------|---------------|
| 867.84             | 26.3                     | 24.8                     | 120                | 28.6                       | -19.83                                   | 54.90                      | 35.07                                    | 52.87                             | -17.8         |
|                    |                          |                          |                    |                            |  |                            |  |                                   |               |

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**5.4.6 Test result f > 1 GHz**

| Frequency (MHz) | L: PK (dB $\mu$ V) | L: AV (dB $\mu$ V) | Bandwidth (kHz) | Correct. (dB) | Duty Cycle Correct. factor (dB) | PK level dB( $\mu$ V/m) | Calculated AV level dB( $\mu$ V/m) | Effective limit dB( $\mu$ V/m) | Delta (dB) |
|-----------------|--------------------|--------------------|-----------------|---------------|---------------------------------|-------------------------|------------------------------------|--------------------------------|------------|
| 1301.8          | 61.7               | --                 | 1000            | 3.7           | -19.83                          | 65.4                    | 45.6                               | 54.0                           | -8.4       |
| 1735.7          | 44.6               | --                 | 1000            | 2.7           | -19.83                          | 47.3                    | 27.5                               | 54.0                           | -26.5      |
| 2169.6          | 44.3               | --                 | 1000            | 3.3           | -19.83                          | 47.6                    | 27.8                               | 54.0                           | -26.2      |
| 2603.5          | 46.8               | --                 | 1000            | 4.5           | -19.83                          | 51.3                    | 31.5                               | 54.0                           | -22.5      |
| 3037.4          | 50.1               | --                 | 1000            | 3.7           | -19.83                          | 53.8                    | 34.0                               | 54.0                           | -20.0      |
| 3471.4          | 47.2               | --                 | 1000            | 2.9           | -19.83                          | 50.1                    | 30.3                               | 54.0                           | 23.7       |
| 3905.3          | 51.9               | --                 | 1000            | 3.0           | -19.83                          | 54.9                    | 35.1                               | 54.0                           | -18.9      |

Limit according to FCC Section 15.231(e), Section 15.209(a) and Section 15.205(a):

| Frequency (MHz)  | Field strength of spurious emissions @ 3m |                   | Effective limit for 433.92 MHz |                |
|------------------|---|-------------------|--------------------------------|----------------|
|                  | ( $\mu$ V/m)                              | dB( $\mu$ V/m)    | ( $\mu$ V/m)                   | dB( $\mu$ V/m) |
| 40.66 – 40.70    | 100                                       | 40                |                                |                |
| 70 - 130         | 50  | 34                |                                |                |
| 130 - 174        | 50 to 150*                                | 34 to 43.5*       |                                |                |
| 174 - 260        | 150                                       | 43.5              |                                |                |
| <b>260 - 470</b> | <b>150 to 500*</b>                        | <b>51.4 to 54</b> | <b>439.87</b>                  | <b>52.87</b>   |
| Above 470        | 500                                       | 54                |                                |                |

\*Linear interpolation

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

| Frequency (MHz) | 15.209 Limits ( $\mu$ V/m) | 15.209 Limits dB( $\mu$ V/m) |
|-----------------|----------------------------|------------------------------|
| 30 - 88         | 100                        | 40                           |
| 88 - 216        | 150                        | 43.5                         |
| 216 - 960       | 200                        | 46                           |
| Above 960       | 500                        | 54                           |

Additionally there is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.



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Restricted bands of operation according to FCC Part 15C, Section 15.205(a):

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

| 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    |

The requirements are **FULFILLED**.

**Remarks:** The level of Field Strength are identically in all Tx operation modes.

The test was performed in "Fast Transmission Mode" of the EuT.

## FCC ID: USXF1WE4MSP

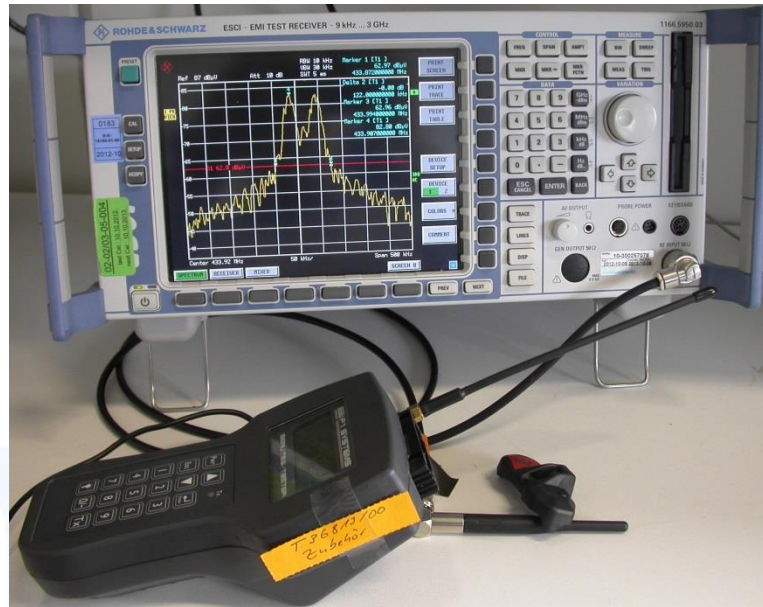
### 5.5 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part DC.

#### 5.5.1 Description of the test location

Test location: AREA 4

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



#### 5.5.3 Applicable standard

According to FCC Part 15C, Section 15.35(c):

The emissions from intentional radiators shall not exceed the effective field strength limits.

#### 5.5.4 Test result

The Duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log \left( \frac{t_B}{100} \right)$$

$KE$ : pulse operation correction factor (dB)  
 $t_B$ : pulse duration for one pulse (ms)

Maximum transmitting duration in every 100ms period:

$$KE = 20 \log \left( \frac{10.20}{100} \right) = -19.83 \text{ dB}$$

Remarks:

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FCC ID: USXF1WE4MSP

5.5.5 Test protocol

Correction for pulse operation (duty cycle)  
FCC Part 15C, Section 15.35(c)

Pulse duration for one pulse (Identically in all Tx operation modes)

Worst case Tx on time:

Fast Transmission Mode automatically transmits one datagram (10.20 ms) every 0.8 seconds until 255 datagrams have been sent. After all 255 datagrams the sensor moves back to its previous mode.

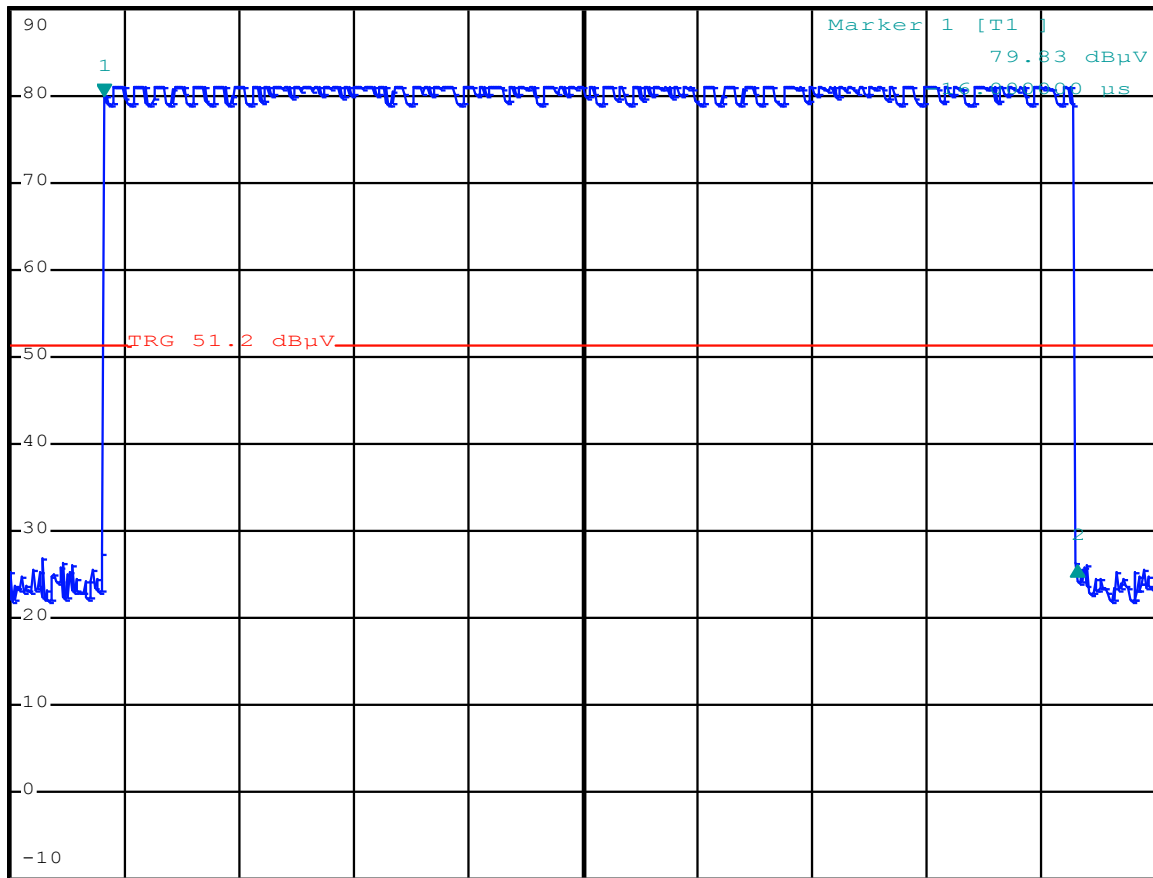


RBW 100 kHz Delta 2 [T1 ]  
VBW 300 kHz -53.71 dB  
SWT 12 ms 10.200000 ms

Ref 90 dBµV

Att 15 dB

1 PK  
VIEW

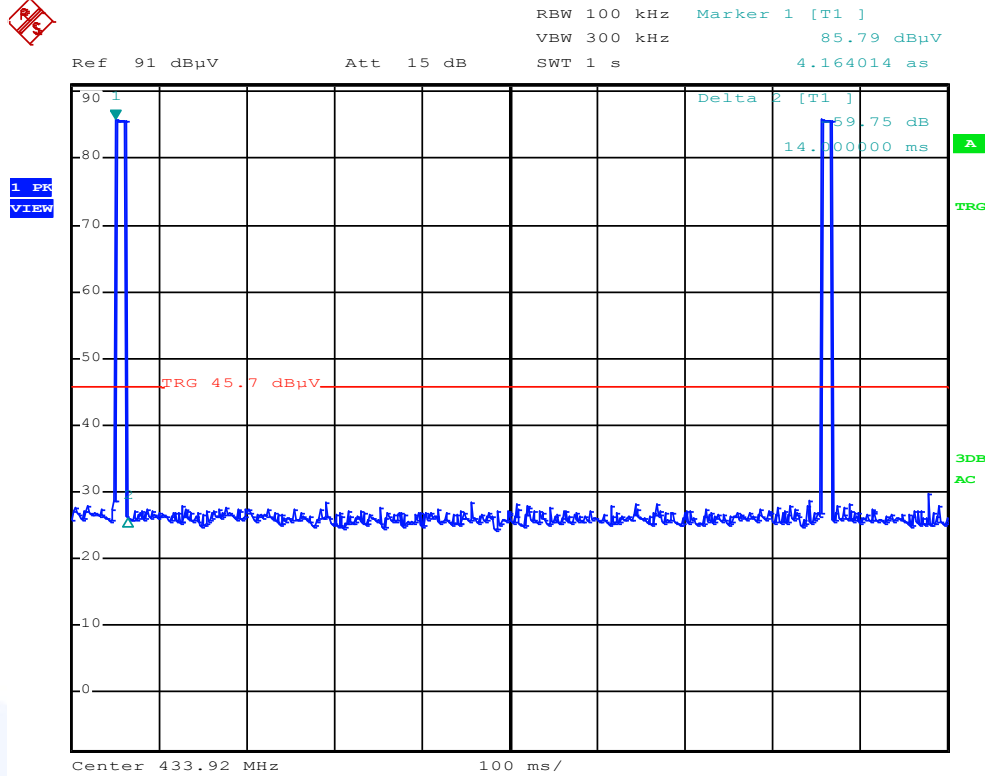


Center 433.92 MHz

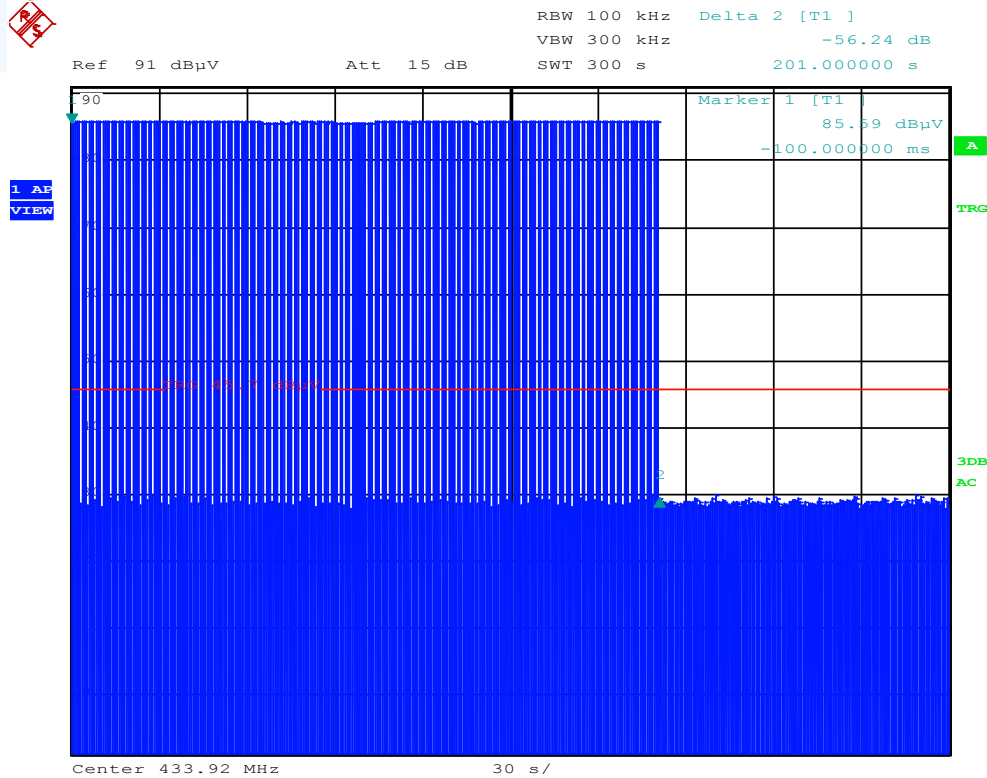
1.2 ms/

FCC ID: USXF1WE4MSP

- Plot shows one datagram every 0.8 seconds:



- Plot shows 255 datagrams:



FCC ID: USXF1WE4MSP

Moving Mode:

The sensor will transmit every second a datagram (10.20 ms). When in Moving mode if the sensor sees a pressure change of more than 0.2 bar in a minute it will fall into Fast Transmission Mode.

- Plot shows one datagram 10.20 ms:

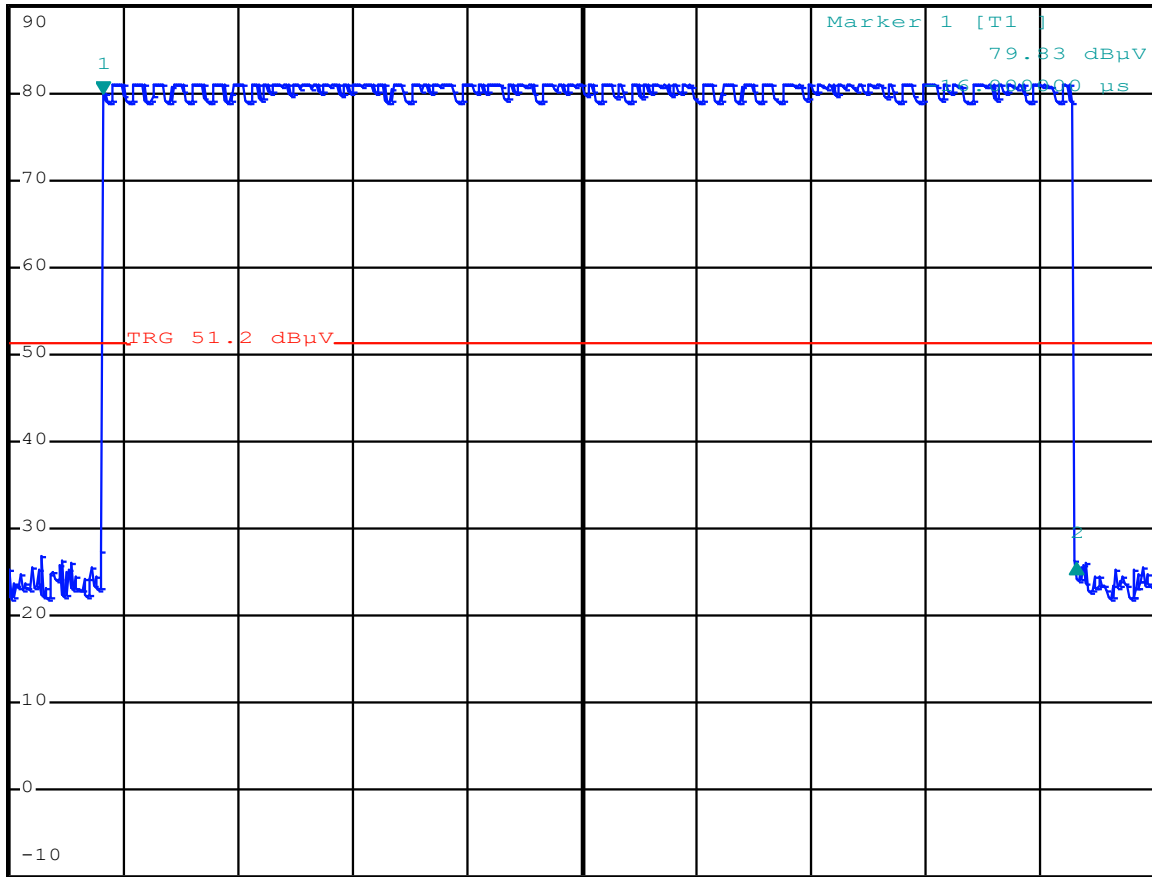


RBW 100 kHz Delta 2 [T1 ]  
 VBW 300 kHz -53.71 dB  
 SWT 12 ms 10.200000 ms

Ref 90 dBµV

Att 15 dB

1 PK  
VIEW

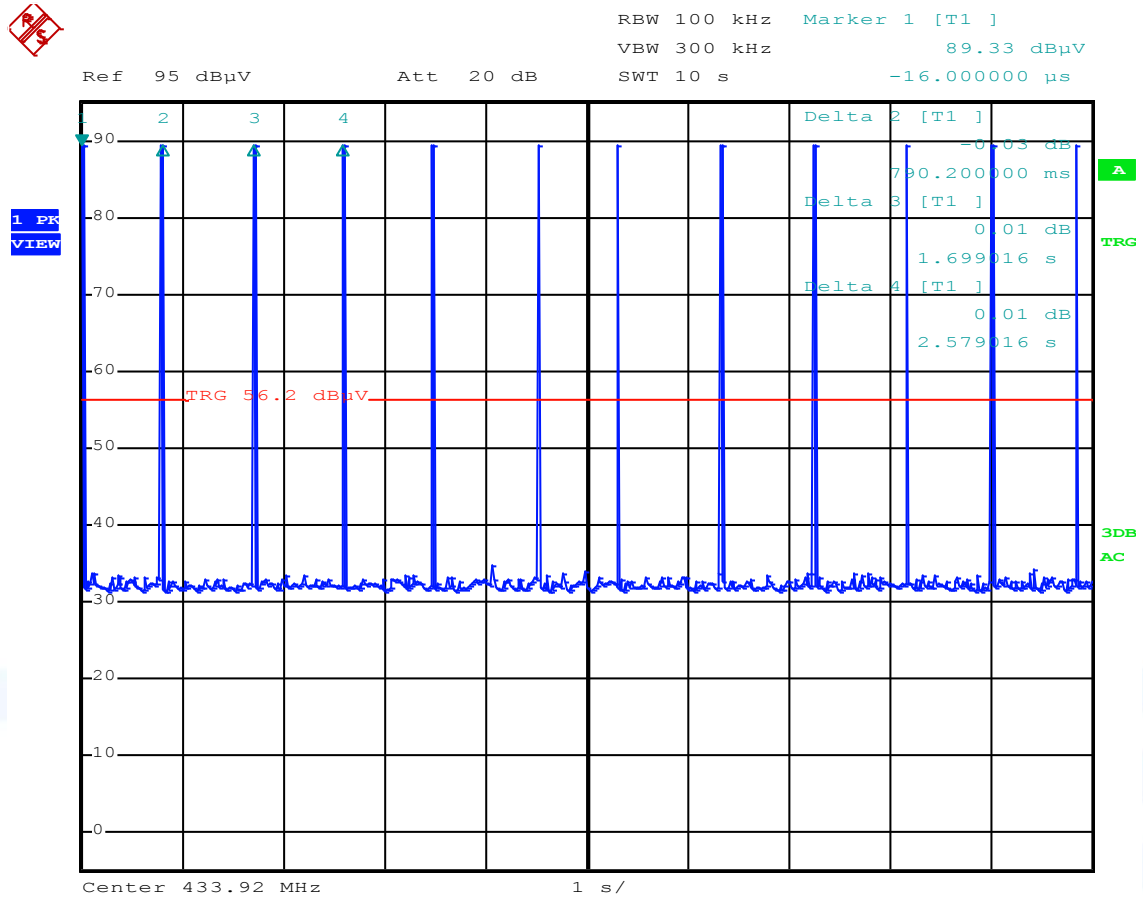


Center 433.92 MHz

1.2 ms/

FCC ID: USXF1WE4MSP

- Plot shows one datagram every 1.0 seconds:



## FCC ID: USXF1WE4MSP

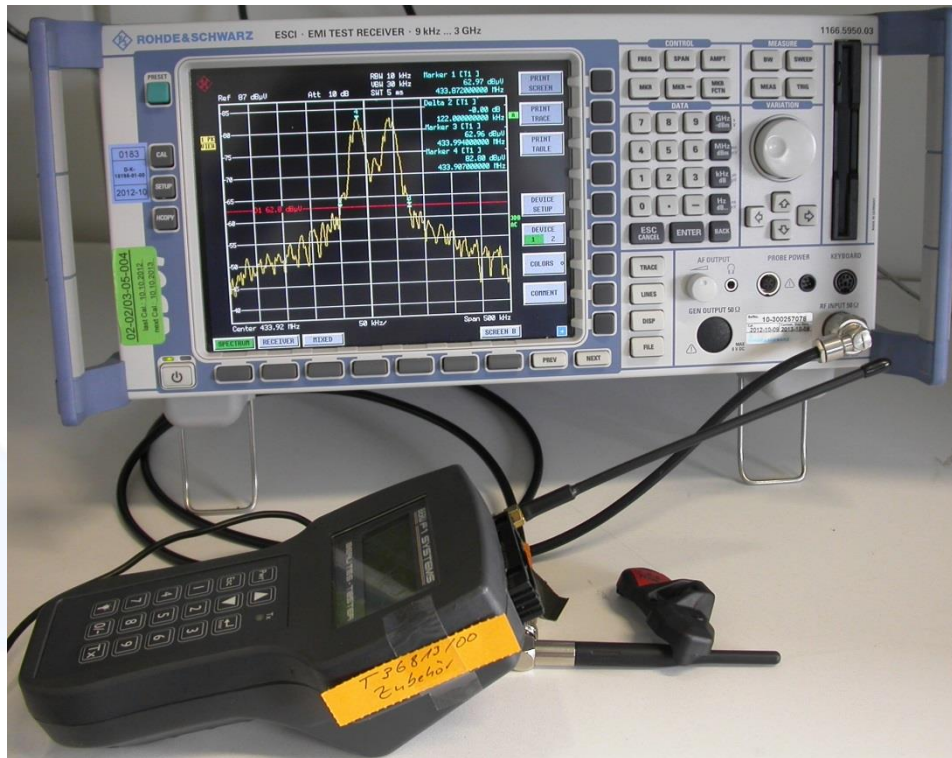
### 5.6 Emission bandwidth

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

#### 5.6.1 Description of the test location

Test location: AREA4

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



#### 5.6.3 Applicable standard

According to FCC Part 15C, Section 15.231(c):  
The bandwidth of the emission shall not exceed the effective limits.

#### 5.6.4 Description of Measurement

The measurement was performed conducted with intentional modulation using a spectrum analyser. The analyser span was set wide enough to capture the most of the power envelope of the signal. The function “20-dB-down” is used to determine the BW. For an overview on the adjacent restricted bands the span was set as wide as needed to show that the restricted bands are not affected.

FCC ID: USXF1WE4MSP

5.6.5 Test result

| Fundamental [MHz] | 20dB Bandwidth F1 [MHz] | 20dB Bandwidth F2 [MHz] | Measured Bandwidth [MHz] | LIMIT Fundamental $f \cdot 0,0025$ [MHz] |
|-------------------|-------------------------|-------------------------|--------------------------|--|
| 433.92            | 433.881                 | 433.989                 | 0.108                    | 1.0848                                   |

Limit according to FCC Part 15C Section 15.231(c):

| Frequency (MHz) | 20 dB BW limit dependent of the carrier (%) |
|-----------------|---|
| 70 – 900        | 0.25  |
| above 900       | 0.50  |

The bandwidth of the emission shall be no wider than 0.25% of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

The requirements are **FULFILLED**.

**Remarks:** For detailed results, please see the test protocol below.

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FCC ID: USXF1WE4MSP

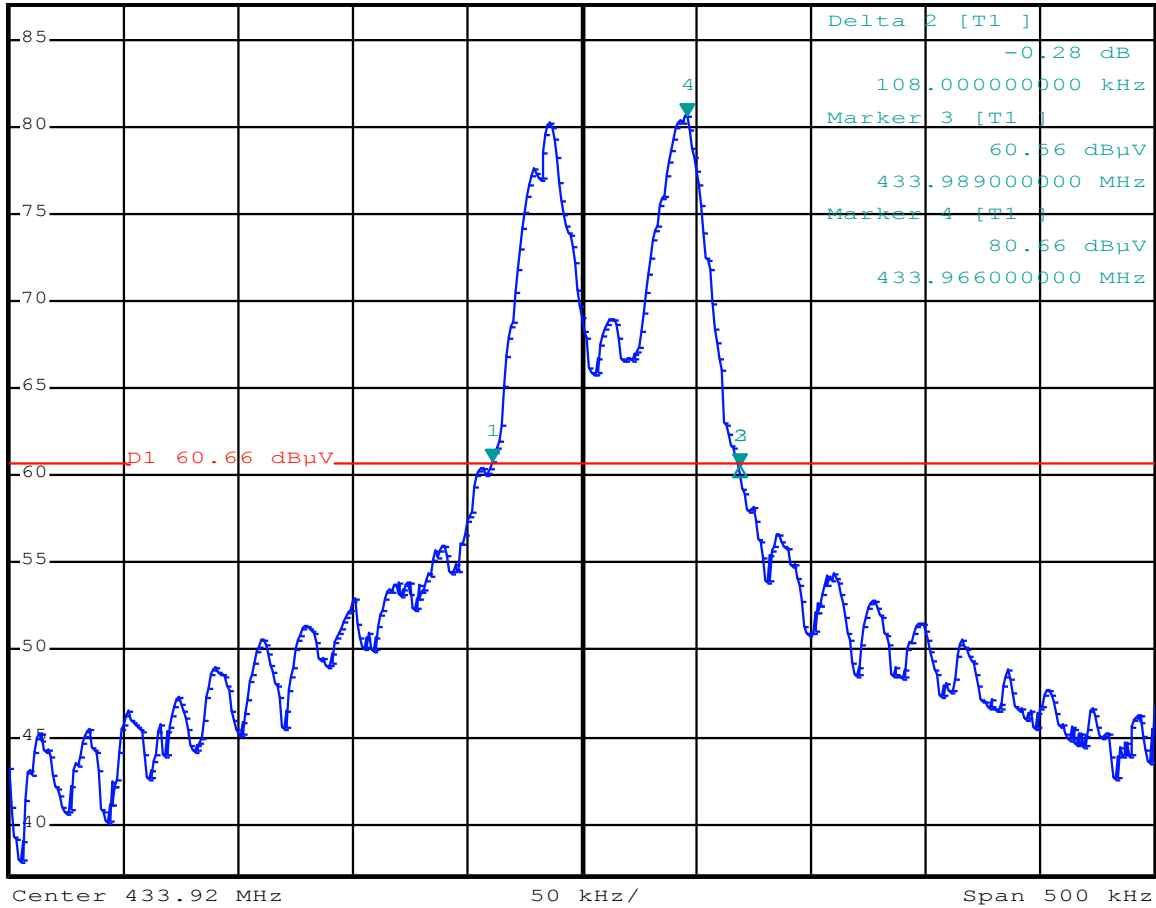
5.6.6 Test protocol

Emission bandwidth  
FCC Part 15C, Section 15.231(c)



Ref 87 dBµV Att 10 dB RBW 10 kHz Marker 1 [T1 ] 60.84 dBµV  
 VBW 30 kHz 433.881000000 MHz  
 SWT 5 ms

1 PK  
VIEW



## FCC ID: USXF1WE4MSP

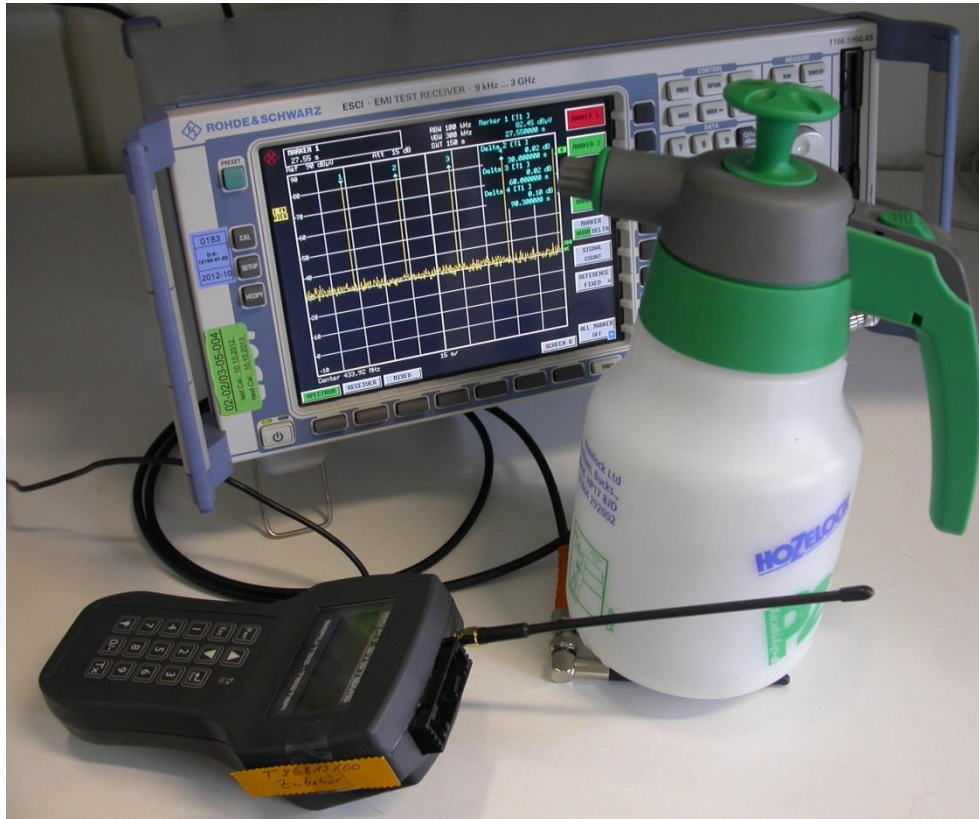
### 5.7 On / Off Period

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

#### 5.7.1 Description of the test location

Test location: AREA 4

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



#### 5.7.3 Applicable standard

According to FCC Part 15C, Section 15.231(e):

#### 5.7.4 Description of Measurement

The duration of transmission is measured with the spectrum analyzer. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the marker of the analyzer is set to maximum amplitude at normal temperature and zero span. The analyser was set to single sweep and triggered on the button, the marker was set to the edges in order to measure the duration time and than recorded.

**FCC ID: USXF1WE4MSP****5.7.5 Test result**

The manufacturer declares following transmitting intervals:

- Stationary mode:

Periodic burst emissions, the sensor will transmit every 30 seconds a datagram (10.20 ms).

| Duration of transmission (ms) | Limit (s) |
|-------------------------------|-----------|
| 10.20                         | 1.0       |

| Silent period (s) | Limit (s) |
|-------------------|-----------|
| 30.0              | > 10.0    |

Limit according to FCC Part 15C, Section 15.231(e):

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

The requirements are **FULFILLED**.

**Remarks:** For detailed test results, please see the test protocol below.

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FCC ID: USXF1WE4MSP

5.7.6 Test protocol

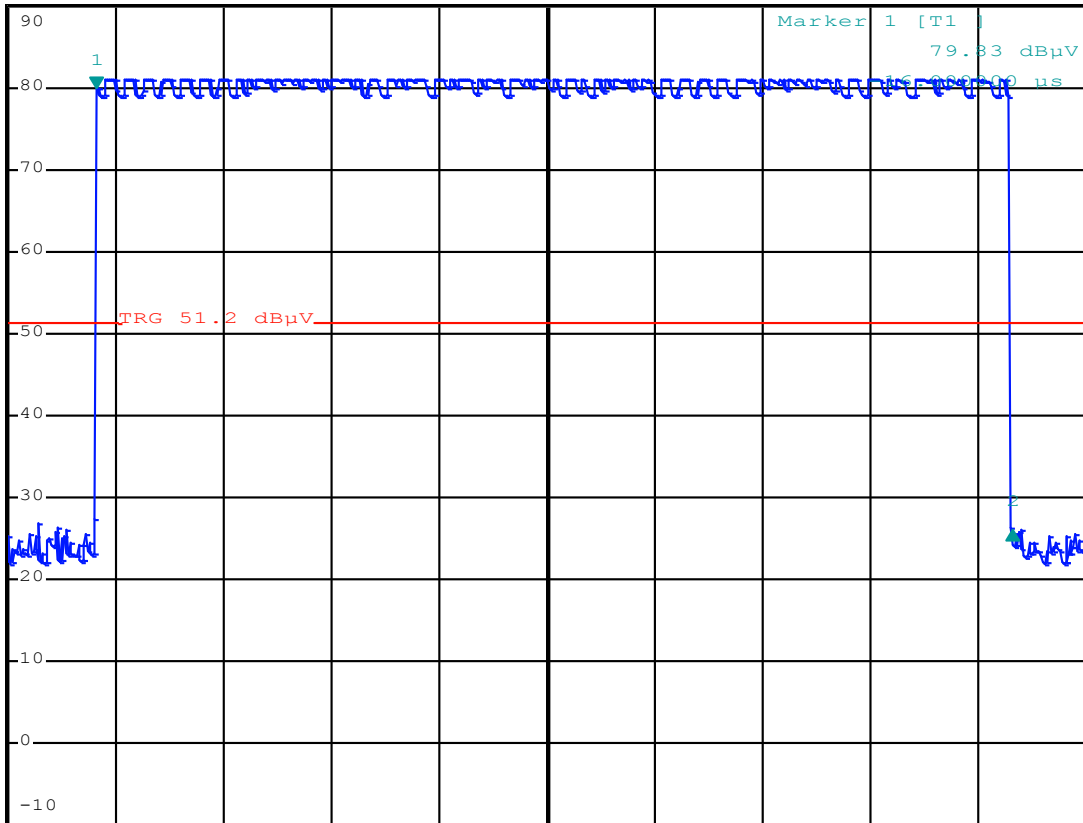
Signal deactivation  
FCC Part 15C, Section 15.231(e)

Pulse duration for one pulse (10.2 ms)



Ref 90 dBµV Att 15 dB RBW 100 kHz Delta 2 [T1] VBW 300 kHz -53.71 dB SWT 12 ms 10.200000 ms

1 PK VIEW



Center 433.92 MHz 1.2 ms/

FCC ID: USXF1WE4MSP

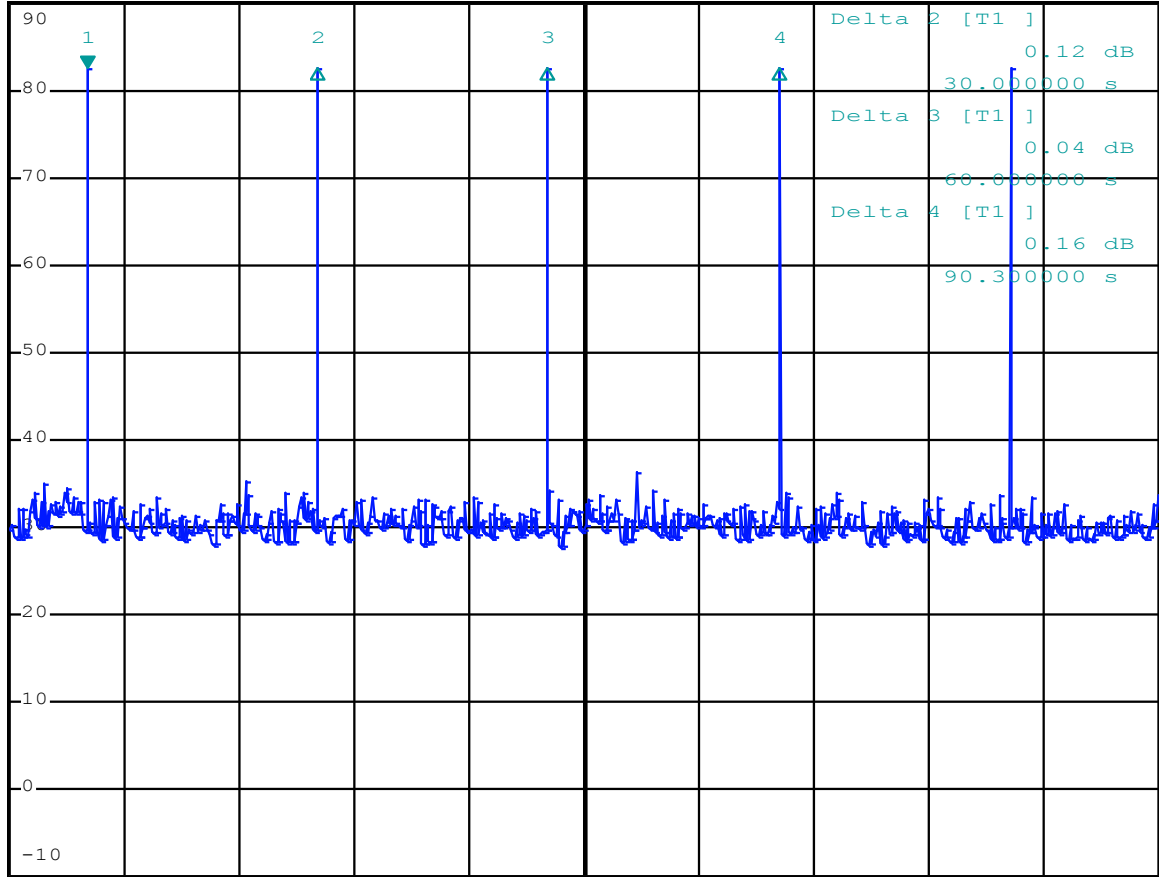


RBW 100 kHz Marker 1 [T1 ]  
 VBW 300 kHz 82.48 dBuV  
 SWT 150 s 10.150000 s

Ref 90 dBuV

Att 15 dB

1 PK VIEW



A

3DB AC

Center 433.92 MHz

15 s/

## FCC ID: USXF1WE4MSP

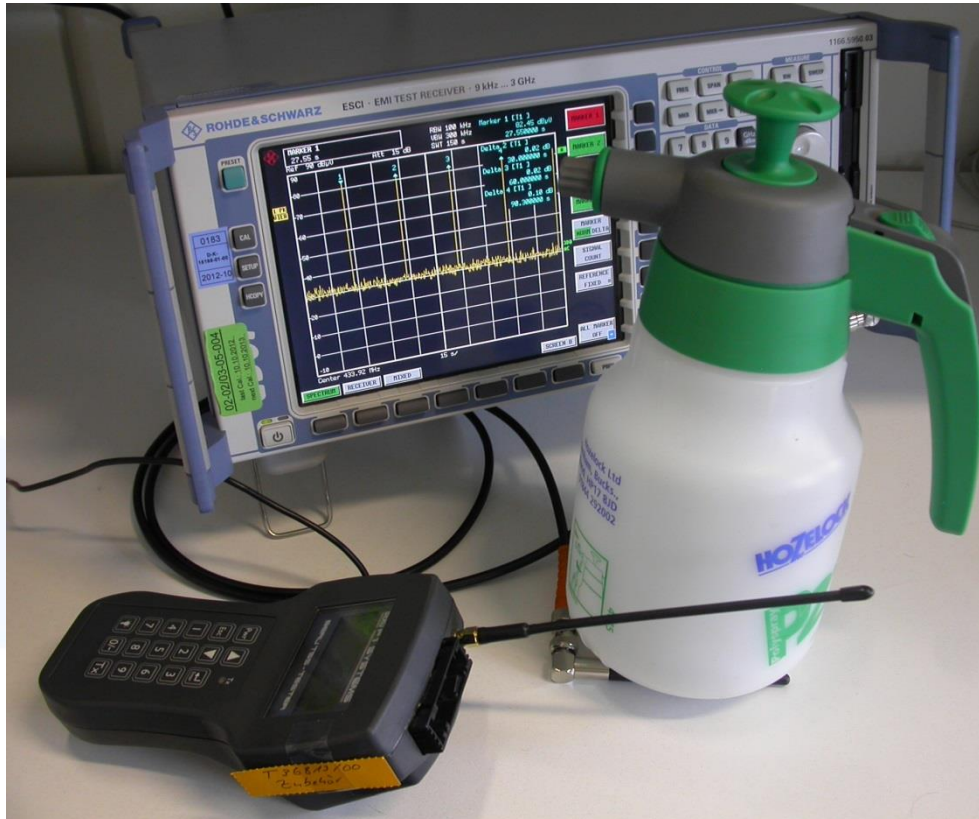
### 5.8 Signal deactivation

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

#### 5.8.1 Description of the test location

Test location: AREA 4

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



#### 5.8.3 Applicable standard

According to FCC Part 15C, Section 15.231(a):

#### 5.8.4 Description of Measurement

The duration of transmission is measured with the spectrum analyzer. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the marker of the analyzer is set to maximum amplitude at normal temperature and zero span. The analyser was set to single sweep and triggered on the button, the marker was set to the edges in order to measure the duration time and then recorded.

**FCC ID: USXF1WE4MSP****5.8.5 Test result**

The manufacturer declares following transmitting intervals:

- Fast Transmission Mode:

Worst case Tx on time:

Fast Transmission Mode automatically transmits one datagram (10.20 ms) every 0.8 seconds until 255 datagrams have been sent. After all 255 datagrams the sensor moves back to its previous mode.

| Duration of transmission (ms) |
|-------------------------------|
| 10.20                         |

Limit according to FCC Part 15C, Section 15.231(a)(4):

- (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released and a transmitter activated automatically shall cease transmission within 5 seconds after activation.
- (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.
- (3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine systems integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds.
- (4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

The requirements are **FULFILLED**.

**Remarks:** For detailed test results, please see the test protocol below.

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FCC ID: USXF1WE4MSP

5.8.6 Test protocol

Signal deactivation  
FCC Part 15C, Section 15.231(a)

Worst case Tx on time:

Fast Transmission Mode automatically transmits one datagram (10.20 ms) every 0.8 seconds until 255 datagrams have been sent. After all 255 datagrams the sensor moves back to its previous mode.

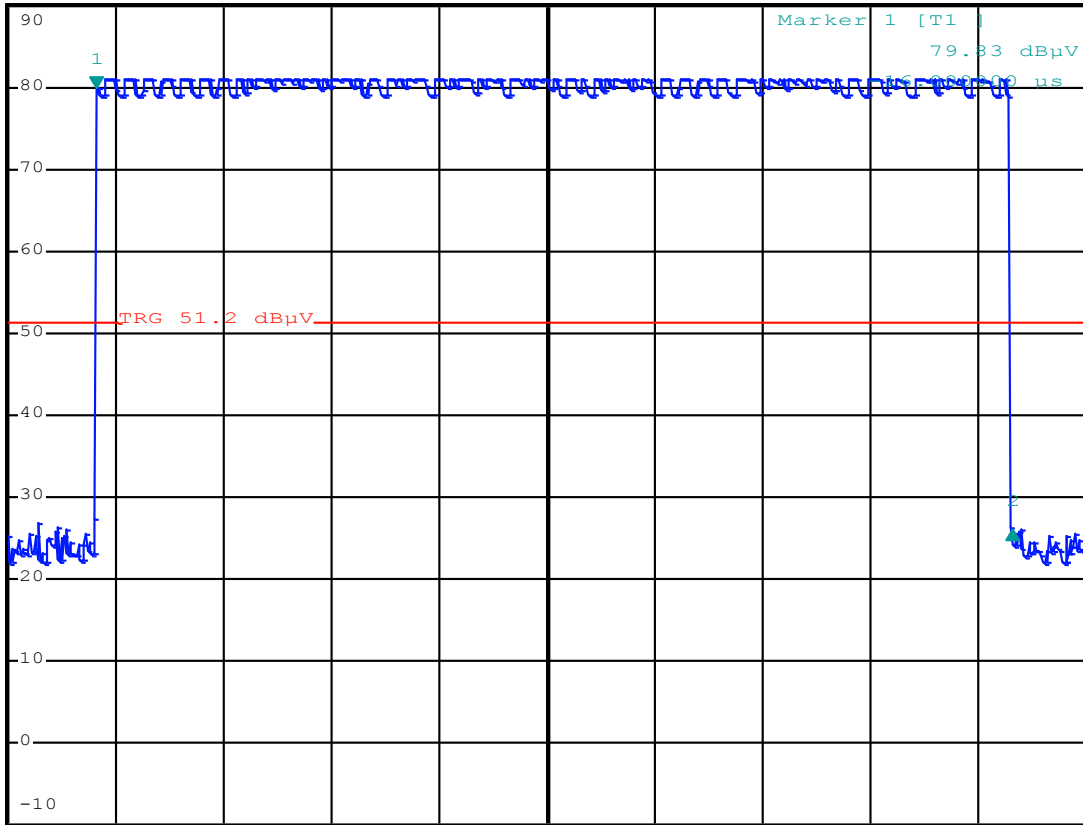


RBW 100 kHz Delta 2 [T1 ]  
VBW 300 kHz -53.71 dB  
SWT 12 ms 10.200000 ms

Ref 90 dBµV

Att 15 dB

1 PK  
VIEW



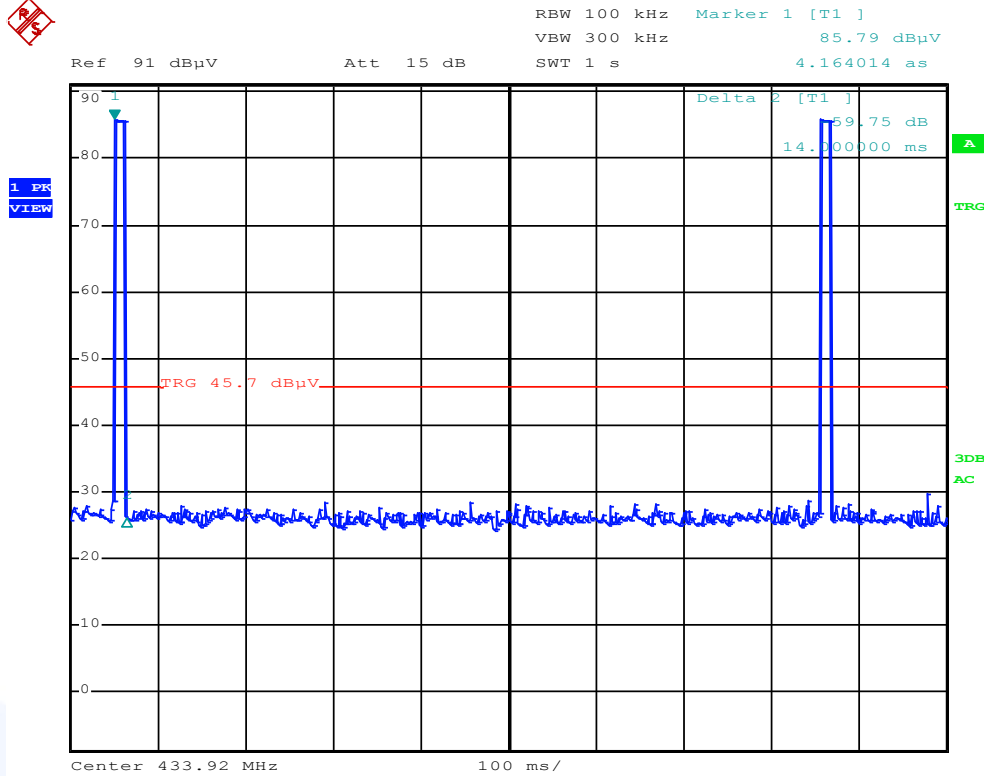
Center 433.92 MHz

1.2 ms/

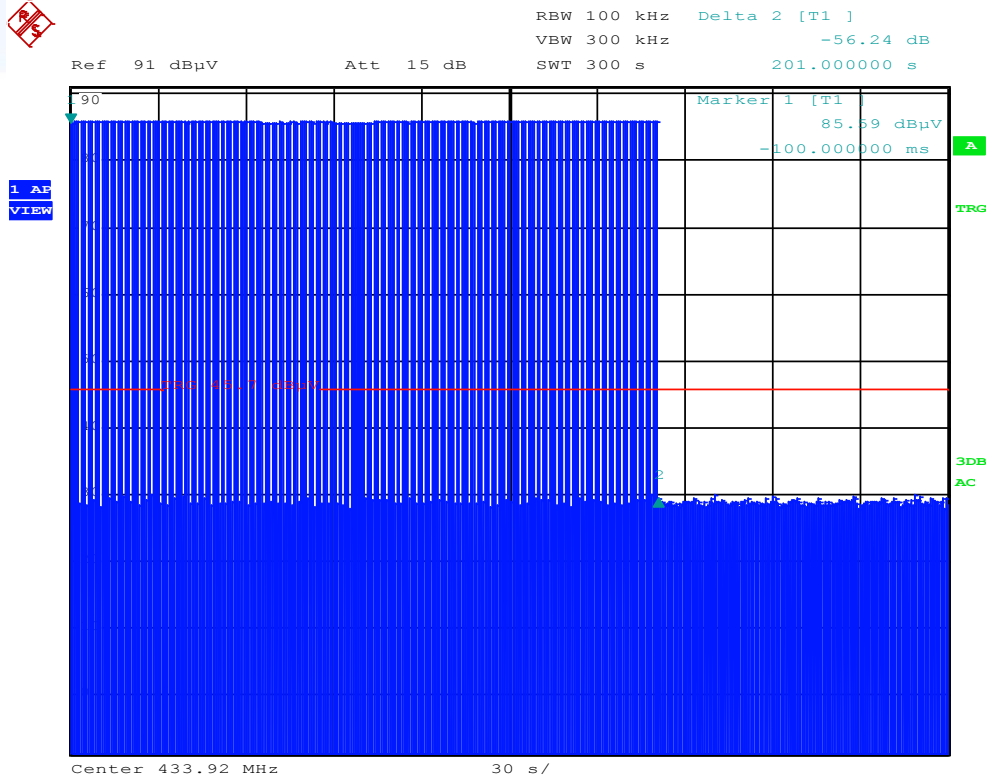


FCC ID: USXF1WE4MSP

- Plot shows one datagram every 0.8 seconds:



- Plot shows 255 datagrams:



**FCC ID: USXF1WE4MSP**
**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. |
|---------|------------------------|-----------------|-------------|-------------|-------------|-------------|
| CPR 2   | ESVS 30                | 02-02/03-05-006 | 26/06/2013  | 26/06/2012  |             |             |
|         | VULB 9168              | 02-02/24-05-005 | 11/04/2014  | 11/04/2013  | 11/10/2013  | 11/04/2013  |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
|         | KK-EF393/U-16N-21N20 m | 02-02/50-12-018 |             |             |             |             |
| MB      | ESCI                   | 02-02/03-05-004 | 10/10/2013  | 10/10/2012  |             |             |
|         | RF Antenna             | 02-02/24-05-032 |             |             |             |             |
| SER 1   | FMZB 1516              | 01-02/24-01-018 |             |             | 14/02/2014  | 14/02/2013  |
|         | ESCI                   | 02-02/03-05-005 | 03/12/2013  | 03/12/2012  |             |             |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | KK-EF393-21N-16        | 02-02/50-05-033 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
| SER 2   | ESVS 30                | 02-02/03-05-006 | 26/06/2013  | 26/06/2012  |             |             |
|         | VULB 9168              | 02-02/24-05-005 | 11/04/2014  | 11/04/2013  | 11/10/2013  | 11/04/2013  |
|         | S10162-B               | 02-02/50-05-031 |             |             |             |             |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
|         | KK-EF393/U-16N-21N20 m | 02-02/50-12-018 |             |             |             |             |
| SER 3   | FSP 30                 | 02-02/11-05-001 | 18/10/2013  | 18/10/2012  |             |             |
|         | 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 | 04/04/2014  | 04/04/2013  |             |             |
|         | Sucoflex N-1600-SMA    | 02-02/50-05-073 |             |             |             |             |
|         | Sucoflex N-2000-SMA    | 02-02/50-05-075 |             |             |             |             |