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# RF-EXPOSURE ASSESSMENT REPORT

**FCC 47 CFR Part 2.1091**
**Industry Canada RSS-102**

**RF-Exposure evaluation of mobile equipment**

| | |
|---|---|
| **Report Reference No**.....: | G0M-1602-5388-TFC091ME-V01 |
| **Testing Laboratory**.....: | Eurofins Product Service GmbH |
| Address.....: | Storkower Str. 38c<br>15526 Reichenwalde<br>Germany |
| Accreditation.....: | A2LA Accredited Testing Laboratory, Certificate No.: 1983.01<br>FCC Filed Test Laboratory, Reg.-No.: 96970<br>IC OATS Filing assigned code: 3470A |
| **Applicant's name**.....: | ZIGPOS GmbH |
| Address.....: | Strehlener Str. 12/14<br>01069 Dresden<br>GERMANY |
| **Test specification:** | |
| Standard.....: | 47 CFR 2.1091<br>KDB 447498 D01 v06:2015-10-23<br>RSS-102, Issue 5:2015-03 |
| **Equipment under test (EUT):** | |
| Product description | Temperature Humidity Sensor |
| Model No. | LTHP_v3 |
| Additional Model(s) | None |
| Brand Name(s) | None |
| Hardware version | v3 |
| Firmware / Software version | v1.9 |
| | FCC-ID: 2AHHJ-LTHPV3 IC: N/A |
| **Test result** | **Passed** |

| **Possible test case verdicts:** | |
|---|---|
| - neither assessed nor tested ..... : | N/N |
| - required by standard but not appl. to test object..... : | N/A |
| - required by standard but not tested..... : | N/T |
| - not required by standard for the test object ..... : | N/R |
| - test object does meet the requirement..... : | P (Pass) |
| - test object does not meet the requirement..... : | F (Fail) |

| **Testing:** | | |
|---|---|---|
| Test Lab Temperature ..... : | 20 – 23 °C | |
| Test Lab Humidity ..... : | 32 – 38 % | |
| Date of receipt of test item ..... : | 2016-03-21 | |
| Date (s) of assessment ..... : | 2017-03-15 | |
| Compiled by ..... : | Matthias Handrik | |
| Assessed by (+ signature) ..... : (Responsible for Assessment) | Christian Weber | C. Weber ..... |
| Approved by (+ signature) ..... : (Deputy Head of Lab) | Toralf Jahn | ..... |
| Date of issue ..... : | 2017-03-21 | |
| Total number of pages ..... : | 13 | |

**General remarks:**

**The test results presented in this report relate only to the object tested.**

**The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.**

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

**Additional comments:**

# Version History

| Version | Issue Date | Remarks | Revised by |
|---|---|---|---|
| 01 | 2017-03-21 | Initial Release | |



Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

## REPORT INDEX

## 1 Equipment (Test item) Description

| | |
|---|---|
| **Description** | Temperature Humidity Sensor |
| **Model** | LTHP_v3 |
| **Additional Model(s)** | None |
| **Brand Name(s)** | None |
| **Serial number** | None |
| **Hardware version** | v3 |
| **Software / Firmware version** | v1.9 |
| **PMN** | N/A |
| **HVIN** | LTHP_v3 |
| **FVIN** | N/A |
| **HMN** | N/A |
| **FCC-ID** | 2AHHJ-LTHPV3 |
| **IC** | N/A |
| **Equipment type** | End product |

## 1.1 Reference Documents

| Document type | Document No. | Issued by | Date |
|---|---|---|---|
| Radio Test Report | G0M-1602-5388-TFC247ZB-V01 | Eurofins Product Service GmbH | 2017-03-21 |

## 1.2 Standalone Radiation Sources

| Mode # | Description | |
|---|---|---|
| IEEE 802.15.4-PS | Frequency range [MHz] | 2405 - 2480 |
| | Transmission modes | OQPSK250, OQPSK2000 |
| | Maximum conducted power [dBm] | 4.2 |
| | Maximum radiated power [dBm] | 7.5 |
| | Maximum transmission duty cycle [%] | 100 |
| | Antenna gain [dBi] | 3.3 |
| | Antenna diameter [cm] | 3 |
| | Assessment Frequency [MHz] | 2405 |

### 1.3 Multi-transmitter Modes

No multi-transmitter modes.

## 2 Result Summary

| FCC 47 CFR Part 2.1091, IC RSS-102 | | | |
|---|---|---|---|
| **Product Specific Standard Section** | **Requirement** | **Result** | **Remarks** |
| 47 CFR 2.1091 | Maximum permissible exposure @ 20cm below limit | PASS | |
| RSS-102 2.5.2 | Maximum permissible exposure @ 20cm below limit | PASS | |
| **Remarks:** | | | |

## 3 RF-Exposure Classifications

| Device Types | |
|---|---|
| Fixed | A fixed device is defined as a device physically secured at one fixed location and cannot be easily re-located. |
| Mobile | A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. (47 CFR 2.1091) |
| Portable | A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. (47 CFR 2.1093) |
| **Exposure Categories** | |
| Occupational / Controlled | Limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. |
| General population / uncontrolled | Exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. |

# 4 Assessment

## 4.1 MPE Assessment Conditions – 47 CFR 2.1091 / RSS-102

| MPE ASSESSMENT ACC. TO 47 CFR 2.1091 / ISED RSS-102 | | | | VERDICT: PASS |
|---|---|---|---|---|
| Assessment according to reference | Reference Method | | | |
| | FCC OET Bulletin 65 / RSS-102 & Safety Code 6 | | | |
| Device type | mobile | | | |
| Exposure category | General public | | | |
| **IC Limits – Occupational / Controlled Exposure** | | | | |
| Frequency range [MHz] | Electric field strength [V/M] | Magnetic field strength [A/M] | Power density [W/m$^2$] | Averaging time [min] |
| 0.003-10* | 170 | 180 | - | Instantaneous* |
| 0.1-10 | - | 1.6 / $f$ | - | 6** |
| 1.29-10 | 193 / $f^{0.5}$ | - | - | 6** |
| 10-20 | 61.4 | 0.163 | -10 | 6 |
| 20-48 | 129.8 / $f^{0.25}$ | 0.3444 / $f^{0.25}$ | 44.72 / $f^{0.5}$ | 6 |
| 48-100 | 49.33 | 0.1309 | 6.455 | 6 |
| 100-6000 | 15.60 $f^{0.25}$ | 0.04138 $f^{0.25}$ | 0.6455 $f^{0.5}$ | 6 |
| 6000-15000 | 137 | 0.364 | 50 | 6 |
| 15000-150000 | 137 | 0.364 | 50 | 616000 / $f^{1.2}$ |
| 150000-300000 | 0.354 $f^{0.5}$ | 9.40 x 10$^{-4}$ $f^{0.5}$ | 3.33 x 10$^{-4}$ $f$ | 616000 / $f^{1.2}$ |
| **IC Limits – General Population / Uncontrolled Exposure** | | | | |
| Frequency range [MHz] | Electric field strength [V/M] | Magnetic field strength [A/M] | Power density [W/m$^2$] | Averaging time [min] |
| 0.003-10* | 83 | 90 | - | Instantaneous* |
| 0.1-10 | - | 0.73 / $f$ | - | 6** |
| 1.1-10 | 87 / $f^{0.5}$ | - | - | 6** |
| 10-20 | 27.46 | 0.0728 | 2 | 6 |
| 20-48 | 58.07 / $f^{0.25}$ | 0.1540 / $f^{0.25}$ | 8.944 / $f^{0.5}$ | 6 |
| 48-300 | 22.06 | 0.05852 | 1.291 | 6 |
| 300-6000 | 3.142 $f^{0.3417}$ | 0.008335 $f^{0.3417}$ | 0.02619 $f^{0.6834}$ | 6 |
| 6000-15000 | 61.4 | 0.163 | 10 | 6 |
| 15000-150000 | 61.4 | 0.163 | 10 | 616000 / $f^{1.2}$ |
| 150000-300000 | 0.158 $f^{0.5}$ | 4.21 x 10$^{-4}$ $f^{0.5}$ | 6.67 x 10$^{-5}$ $f$ | 616000 /$f^{1.2}$ |
| * = Based on nerve stimulation<br>** = Bases on specific absorption rate | | | | |

| FCC Limits – Occupational / Controlled Exposure | | | | |
|---|---|---|---|---|
| Frequency range [MHz] | Electric field strength [V/M] | Magnetic field strength [A/M] | Power density [mW/cm$^2$] | Averaging time [min] |
| 0.3 – 3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0 - 30 | 1842 / f | 4.89 / f | (900 / f$^2$)* | 6 |
| 30 - 300 | 61.4 | 0.163 | 1.0 | 6 |
| 300 - 1500 | N/A | N/A | f / 300 | 6 |
| 1500 - 100000 | N/A | N/A | 5.0 | 6 |
| **FCC Limits – General Population / Uncontrolled Exposure** | | | | |
| Frequency range [MHz] | Electric field strength [V/M] | Magnetic field strength [A/M] | Power density [mW/cm$^2$] | Averaging time [min] |
| 0.3 – 1.34 | 614 | 1.63 | (100)* | 30 |
| 1.34 - 30 | 842 / f | 2.19 / f | (180 / f$^2$)* | 30 |
| 30 - 300 | 27.5 | 0.073 | 0.2 | 30 |
| 300 - 1500 | N/A | N/A | f / 1500 | 30 |
| 1500 - 100000 | N/A | N/A | 1.0 | 30 |
| * = Plane wave equivalent power density; f in MHz | | | | |

**Assessment Relations**

$$\lambda[m] = \frac{c\left[\frac{m}{s}\right]}{f[Hz]} \; ; \; R_{FF}[m] \geq \frac{2 \cdot D[m]^2}{\lambda[m]}$$

$$S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2} \; ; \; R[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW/cm^2]}}$$

$$P_R[mW] = P_C[mW] \cdot G \; ; \; P_R[dBm] = P_C[dBm] + G[dBi]$$

$$DCC\ [dB] = 10 \cdot Log_{10}\left(\frac{DC[\%]}{100}\right)$$

**Assessment procedure**

For each radio and frequency band the worst case transmission mode with the highest peak conducted or radiated power is evaluated at the frequency that results in the most restrictive rf-exposure limit. From the peak power values, antenna gains and duty cycles taken from the reference documents, the source average radiated power values are calculated. From the average radiated power the power densities at antenna far-field distance, at 20cm separation distance from the radiation source is calculated. Compliance with the RF-Exposure limit is determined at 20cm separation distance.

### 4.2 Single-Transmitter Assessment – 47 CFR 2.1091 / RSS-102

| Assessment result - IEEE 802.15.4-PS | | |
|---|---|---|
| Transmission mode | | |
| Operating mode frequency range [MHz] | 2405 - 2480 | |
| Assessment frequency (f) [MHz] | 2405 | |
| Transmission duty cycle (DC) [%] | 100 | |
| Peak conducted power ($P_C$) [dBm] | 4.2 | |
| Peak radiated power ($P_R$) [dBm e.i.r.p.] | 7.5 | |
| Peak Antenna gain (G) [dBi] | 3.3 | |
| Maximum Antenna Diameter D [cm] | 3 | |
| Antenna far-field distance | | |
| Transmission frequency wavelength (λ) | 0.125 m | 12.47 cm |
| Antenna far-field distance ($R_{FF}$) | 0.014 m | 1.44 cm |
| Power evaluation | | |
| Peak conducted power ($P_C$) | 2.63 mW | 4.20 dBm |
| Peak Antenna Gain (G) | 2.14 | 3.30 dBi |
| Calculated peak radiated power ($P_{R\text{-}Calc}$) | 5.62 mW | 7.50 dBm |
| Measured peak radiated power ($P_R$) | 5.62 mW | 7.50 dBm |
| Source average Power | | |
| Maximum transmission duty cycle (DC) | 100.0 % | |
| Duty cycle correction (DCC) | 1.00 | 0.00 dB |
| Measured peak radiated power ($P_R$) | 5.62 mW | 7.50 dBm |
| Averaged peak radiated power ($P_{RAVG}$) | 5.62 mW | 7.50 dBm |
| Power density | | |
| Compliance power density limit FCC | 1.000 mW/cm$^2$ | 10.00 W/m$^2$ |
| Compliance power density limit IC | 0.536 mW/cm$^2$ | 5.36 W/m$^2$ |
| Power density @ Antenna far-field distance | 0.215 mW/cm$^2$ | 2.149 W/m$^2$ |
| Power density @ 20cm | 0.001 mW/cm$^2$ | 0.011 W/m$^2$ |
| Distance for compliance power density FCC | 0.007 m | 0.67 cm |
| Distance for compliance power density IC | 0.009 m | 0.91 cm |
| Verdict | | |
| The power density of the EUT at 20cm is below the FCC MPE limit! | | |
| The power density of the EUT at 20cm is below the IC MPE limit! | | |
| **Comments:** | | |