Test Report No.:
FCC2024-0013-H

# TEST REPORT

| | | |
|---|---|---|
| **FCC ID** | : | 2BFSZ-3818201X9D01 |
| **Applicant** | : | ShenZhen Autotech Electronics Ltd. |
| **Product Name** | : | TPMS Sensor |
| **Mode No.** | : | 3818201X9D01(E74U) |
| **Classification Of Test:** | | **COMMISSION TEST** |

## CVC Testing Technology Co., Ltd.

| | | | |
|---|---|---|---|
| Product Name | TPMS Sensor | Trade Mark | 永奥图 |
| Type/Model | 3818201X9D01(E74U) | Sample Status | — |
| Applicant | ShenZhen Autotech Electronics Ltd. | | |
| Applicant Address | 7/F, 8/F Area 1, Factory 3, Jiaan Technology Park, Liuxian 1st Road, Baoan 67th, Shenzhen, Guangdong, China | | |
| Manufacturer | ShenZhen Autotech Electronics Ltd. | | |
| Manufacturer Address | 7/F, 8/F Area 1, Factory 3, Jiaan Technology Park, Liuxian 1st Road, Baoan 67th, Shenzhen, Guangdong, China | | |
| Producer | ShenZhen Autotech Electronics Ltd. | | |
| Producer Address | 7/F, 8/F Area 1, Factory 3, Jiaan Technology Park, Liuxian 1st Road, Baoan 67th, Shenzhen, Guangdong, China | | |
| Quantity of sample | 2 pcs | Sample Identification | 2-1, 2-2 |
| Tested According To | FCC Part 2 (Section 2.1093)<br>KDB 447498 D04<br>IEEE C95.1 | Test Item | RF Exposure |
| Receiving Date | 2024.04.17 | Completing Date | 2024.05.31 |
| Test conclusion | The equipment under test was found to comply with the requirements of the standards applied.<br>Final Verdict：Pass.<br><br>Seal of CVC<br><br>Date of issue: 2024.06.19 | | |

Note 1: This test report relates only to the EUT, and shall not be reproduced except in full, without written approval of **CVC**.

| Approved by: | Reviewed by: | Tested by: |
|---|---|---|
| **Chen Huawen** | **Xu Zhenfei** | **Lu Weiji** |

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# 1. General Product Information

## 1.1 General information

| | |
|---|---|
| Product Name | TPMS Sensor |
| Model No. | 3818201X9D01(E74U) |
| Additional model | 3818200X9D01(E07U) |
| Power Supply | DC 3V |
| Serial Number(SN) | E74UM40 |
| Antenna Type | Rubber-wrapped rod antenna(External Antenna) |
| Antenna Gain | 3dBi(provided by client) |
| Beamforming gain | Unsupported (provided by client) |
| Frequency Range | 433.04~434.79MHz |
| Operate Temp.Range | -40~125℃ |

Note：
1. The information of the EUT is declared by the manufacturer.
2. The laboratory is not responsible for the product technical specification provided by the client.

# 2. Human Exposure Assessment

## 2.1 RF Exposure Test Exemptions for Single Source

### 2.1.1 1-mW Test Exemption

The 1 mW Test Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.
The 1 mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A).
The 1 mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

### 2.1.2 SAR-Based Exemption

A more comprehensive exemption, considering a variable power threshold that depends on both the *separation distance* and power, is provided in § 1.1307(b)(3)(i)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with *test separation distances* between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions.
Accordingly, a RF source is considered an *RF exempt device* if its available maximum time averaged (matched conducted) power or its effective radiated power (ERP), whichever is greater, are below a specified threshold. This exemption threshold was derived based on general population 1-g SAR requirements.

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

The table applies to any RF source (i.e., single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.
For mobile devices that are not exempt per Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 is necessary if the ERP of the device is greater than $ERP_{20cm}$ in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)]

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES
SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

| **RF Source Frequency** | | | **Minimum Distance** | | | **Threshold ERP** |
|---|---|---|---|---|---|---|
| $f_L$ MHz | | $f_H$ MHz | $\lambda_L / 2\pi$ | | $\lambda_H / 2\pi$ | W |
| 0.3 | - | 1.34 | 159m | - | 35.6m | $1920R^2$ |
| 1.34 | - | 30 | 35.6m | - | 1.6m | $3450R^2/f^2$ |
| 30 | - | 300 | 1.6m | - | 159mm | $3.83R^2$ |
| 300 | - | 1500 | 159mm | - | 31.8mm | $0.0128R^2/f^2$ |
| 1500 | - | 100000 | 31.8mm | - | 0.5mm | $19.2R^2$ |
| Subscripts L and H are low and high; λ is wavelength.<br>From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns. | | | | | | |

### 2.1.3 MPE-Based Exemption

An alternative to the SAR-based exemption is provided in § 1.1307(b)(3)(i)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to λ/2π, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power.[10] For this case, a RF source is an *RF exempt device* if its ERP (watts) is no more than a frequency-dependent value, as detailed tabular form in Appendix B. These limits have been derived based on the basic specifications on Maximum Permissible Exposure (MPE) considered for the FCC rules in § 1.1310(e)(1).

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.
If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.
As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.
The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.
The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold $P_{th}$ (mW). This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). $P_{th}$ is given by Formula (B.2).

$$\mathrm{ERP}_{20\mathrm{cm}}(\mathrm{mW}) = \begin{cases} 2040\mathrm{f}_{(\mathrm{GHz})} & 0.3\mathrm{GHz} \le \mathrm{f} \le 1.5\mathrm{GHz} \\ 3060 & 1.5\mathrm{GHz} \le \mathrm{f} \le 6\mathrm{GHz} \end{cases} \qquad \text{(B. 1)}$$

$$Pth(mW) = \begin{cases} ERP_{20cm}(d_{(cm)}/20cm)^x & d \leq 20cm \\ ERP_{20cm} & 20cm < d \leq 40cm \end{cases} \quad (B.2)$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f_{(GHz)}}}\right)$$

and *f* is in GHz, *d* is the separation distance (cm), and $ERP_{20cm}$ is per Formula (B.1).

### 2.1.4 MPE exposure limits

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. Mobile devices, as defined in § 2.1091 along with their applicable RF exposure limits, are characterized by the requirement of maintaining a minimum *test separation distance* ≥ 20 cm between any radiating structure of the device and nearby persons; to apply only mobile device (MPE) exposure limits. This *test separation distance* requirement must be defined for the most conservative exposure conditions, and must be fully supported for all the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2).

$$S = \frac{PG}{4\pi R^2}$$

Where
S:power density in $mW/cm^2$
P:power input to the antenna in mW
G:power gain of the antenna in the direction of interest relative to an isotropic radiator.
R:distance to the center of radiation of the antenna in cm
Note:
1. Mobile or fixed location transmitters,minmum separation distance is 20 cm,even if calculations indicate MPE distance is less.
2. The Numenric Gain calculated by 10^(ant.Gain*(dBi)/10).
3. Each band max power which perform MPE of any configurations.

Table 1 to § 1.1310(e)(1) - 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) |
|---|---|---|---|---|
| (i)Limits for Occupational/Controlled Exposure | | | | |
| 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 | | | f/300 | ＜6 |
| 1500~100000 | | | 5 | ＜6 |
| (ii)Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3~1.34 | 614 | 1.63 | *(100) | ＜30 |
| 1.34~30 | 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；*=Plane wave equivalent power density. | | | | |

## 2.2 RF Exposure Test Exemptions for Simultaneous Transmission Sources

### 2.2.1 1-mW Test Exemption for Multiple Sources

As discussed in § 1.1307(b)(3)(ii)(A), the 1-mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:
a) When maximum available power each individual transmitting antenna within the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm.
b) When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period.
This exemption may not be combined with any other exemption.

### 2.2.2 Simultaneous Transmission with both SAR-based and MPE-Based Test Exemptions

This case is described in detail in § 1.1307(b)(3)(ii)(B) and covers the situations where both SAR-based and MPE-based exemption may be considered for test exemption in fixed, mobile, or portable device exposure conditions. For these cases, a device with multiple RF sources transmitting simultaneously will be considered an *RF exempt device* if the condition of Formula (1) is satisfied.

The sum of the ratios of the applicable terms for SAR-based, MPE-based and measured SAR or MPE shall be less than 1, to determine simultaneous transmission exposure compliance.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{\text{Evaluated}_k}{\text{Exposure Limit}_k} \leq 1$$

Where
a is number of fixed, mobile, or portable RF sources claiming exemption using the §1.1307(b)(3)(i)(B) formula for $P_{th}$, including existing exempt transmitters and those being added.
b is number of fixed, mobile, or portable RF sources claiming exemption using the applicable § 1.1307(b)(3)(i)(C) Table 1 formula for Threshold ERP, including existing exempt transmitters and those being added.
c is number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.
$P_i$ is the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).
$P_{th,i}$ is the exemption threshold power (Pth) according to the § 1.1307(b)(3)(i)(B) formula for fixed, mobile, or portable RF source i.
$ERP_j$ is the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j.
$ERP_{th,j}$ is exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least $\lambda/2\pi$, according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.
$\text{Evaluated}_k$ is the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation.
$\text{Exposure Limit}_k$ is either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources, as applicable.

## 2.3 CLASSIFICATION

The antenna of this product, under normal use condition, is 5mm away from the body of the user. So, this device is classified as Portable Device.

The antenna of this product, under normal use condition, is 20cm away from the body of the user. So, this device is classified as Mobile Device.

| Method in name of | calculation method |
|---|---|
| Method 1 | 1-mW Test Exemption |
| Method 2 | SAR-Based Exemption |
| Method 3 | MPE-Based Exemption |
| Method 4 | MPE exposure limits |
| Method 5 | 1-mW Test Exemption for Multiple Sources |
| Method 6 | Simultaneous Transmission with both SAR-based and MPE-Based Test Exemptions |

# 3. RF Output Power

The tuned conducted Average Power (declared by client)

| Mode | Frequency (MHz) | Target Power (dBm) | Tolerance (dBm) | Lower Tolerance (dBm) | Upper Tolerance (dBm) |
|---|---|---|---|---|---|
| Transmitting | 433.92 | -33.00 | ±1.00 | -34.00 | -32.00 |

The conducted power turn-up tolerance reference manufacturer specification.

| TestMode | Antenna | Channel | Result[dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|---|
| Transmitting | Antenna 1 | 433.92MHz | -33.22dBm | — | — |

Note: The relevant measured result has the offset with cable loss already.

Field strength = 61.1 dBuV/m @3m (according to test report)

Ant gain 3 dBi; so Ant numeric gain= 2

So $p_t=\{[10^{(61.1/20)}/10^6\times 3]^2/(30 \times 2)\}\times 1000mW$ =0.0002 mW

= -37dBm < -33 dBm (declared)

# 4. Test Results

| Mode | Maximum source-based time averaged conducted output power (dBm) | Maximum source-based time averaged conducted output power (mW) | Minimum separation distance (cm) | Select calculation method | Limit for Exemption (mW) | Verdict |
|---|---|---|---|---|---|---|
| Transmitting | -33.22dBm | 0.00048 | 20 | Method 1 | 1 | Exempt from SAR/MPE |

**Note:** The product only has a single antenna and different modes cannot be transmitted at the same time.

Therefore this device complies with FCC's RF radiation exposure limits for general population without SAR evaluation.

The End

# Important

1. The test report is invalid without the official stamp of CVC;
2. Any part photocopies of the test report are forbidden without the written permission from CVC;
3. The test report is invalid without the signatures of Author and Reviewer;
4. The test report is invalid if altered;
5. Objections to the test report must be submitted to CVC within 15 days;
6. Generally, commission test is responsible for the tested samples only;
7. As for the test result, "—" or " N" means "not applicable", " / "means "not testing", "P" means "pass" and "F" means "fail".

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