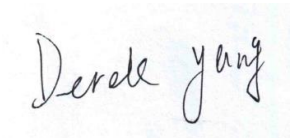
# RF Exposure Evaluation Report

| | |
|---|---|
| **Application No.**: | ZR/2019/C0003 |
| **Applicant:** | ThingsMatrix Inc. |
| **Address of Applicant:** | 9442 North Capital of Texas Hwy,Plaza One, Suite 500,Austin, TX 78759 |
| **Manufacturer:** | ThingsMatrix Inc. |
| **Address of Manufacturer:** | 9442 North Capital of Texas Hwy,Plaza One, Suite 500,Austin, TX 78759 |
| **EUT Description:** | GPS Tracker |
| **Model No.:** | TMY03 |
| **Trade Mark:** | ThingsMatrix |
| **FCC ID:** | 2ATV9TMY03 |
| **Standards:** | 47 CFR Part 2.1091<br>FCC KDB 447498 D01 v06 |
| **Date of Receipt:** | 2019/12/7 |
| **Date of Test:** | 2019/12/7 to 2020/1/6 |
| **Date of Issue:** | 2020/1/6 |
| **Test Result:** | **PASS*** |

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Derek Yang
Wireless Laboratory Manager

# 1 Version

| Revision Record | | | | |
|---|---|---|---|---|
| **Version** | **Chapter** | **Date** | **Modifier** | **Remark** |
| 00 | | 2020/1/6 | | Original |
| | | | | |
| | | | | |

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|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| | | Mike Hu<br>**Mike Hu /Project Engineer** | | 2020/1/6 |
| | | David Chen<br>**David Chen /Reviewer** | | 2020/1/6 |

# Contents

# 2 General Information

## 2.1 Client Information

| | |
|---|---|
| Applicant: | ThingsMatrix Inc. |
| Address of Applicant: | 9442 North Capital of Texas Hwy,Plaza One, Suite 500,Austin, TX 78759 |
| Manufacturer: | ThingsMatrix Inc. |
| Address of Manufacturer: | 9442 North Capital of Texas Hwy,Plaza One, Suite 500,Austin, TX 78759 |

## 2.2 Test Location

| | |
|---|---|
| Company: | SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch |
| Address: | No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China |
| Post code: | 518057 |
| Telephone: | +86 (0) 755 2601 2053 |
| Fax: | +86 (0) 755 2671 0594 |
| E-mail: | ee.shenzhen@sgs.com |

## 2.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

## 2.4 General Description of EUT

| | |
|---|---|
| EUT Description: | GPS Tracker |
| Model No.: | TMY03 |
| Trade Mark: | ThingsMatrix |
| Hardware Version: | TMY03V01 |
| Software Version: | TMY03V01.191230 |
| Antenna Gain: | GSM 850: -0.16dBi;<br>GSM1900: 0.41dBi;<br>NB1 Band 2: 0.41dBi;<br>NB1 Band 5: -0.16dBi;<br>NB1 Band 12: -0.25dBi;<br>NB1 Band 13: -0.23dBi;<br>NB1 Band 26: -0.22dBi;<br>CatM1 Band 2: 0.41dBi;<br>CatM1 Band 4: 0.45dBi;<br>CatM1 Band 5: -0.16dBi;<br>CatM1 Band 12: -0.25dBi;<br>CatM1 Band 13: -0.23dBi;<br>CatM1 Band 26: -0.22dBi; |

# 3 RF Exposure Evaluation

## 3.1 RF Exposure Compliance Requirement

### 3.1.1 Limits

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm2) | Averaging time (minutes) |
|---|---|---|---|---|
| **(A) Limits for Occupational/Controlled Exposures** | | | | |
| 0.3-3.0 | 614 | 1.63 | *(100) | 6 |
| 3.0-30 | 1842/f | 4.89/f | *(900/f2) | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | / | / | f/300 | 6 |
| 1500-100,000 | / | / | 5 | 6 |
| **(B) Limits for General Population/Uncontrolled Exposure** | | | | |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *(180/f2) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100,000 | / | / | 1.0 | 30 |

F=frequency in MHz
*=Plane-wave equivalent power density
RF exposure compliance will need to be determined with respect to 1.1307(c) and (d) of the FCC rules. The emissions should be within the limits at 300kHz in Table 1 of 1.1310(use the 300kHz limits for 150kHz:614V/m,1.63A/m).

Friis Formula

Friis transmission formula: Pd = (Pout*G)/(4* Pi * R 2)

Where

Pd = power density in mW/cm2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

Pd id the limit of MPE, 1 mW/cm2 . If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

### 3.1.2 Test Procedure

Software provided by client enabled the EUT to transmit data at lowest, middle and highest channel individually.

| Operating Band | Frequency (MHz) | Antenna Gain (dBi) | Max Conducted Average Output Power (dBm) | Output Power to Antenna (dBm) | EIRP(ERP) Limit (dBm) | Output Power to Antenna (mw) | Power Density at R = 20 cm (mW/cm2) | Limit (mW/cm2) | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| GSM850 | 824.2 | -0.16 | 33.00 | 30.69 | 38.45 | 1995.2623 | 0.3826 | 0.5495 | Pass |
| GSM1900 | 1850.2 | 0.41 | 30.00 | 30.41 | 33.00 | 1000.0000 | 0.2186 | 1.0000 | Pass |
| NB Band 2 | 1880.1 | 0.41 | 24.00 | 24.41 | 33.00 | 251.1886 | 0.0549 | 1.0000 | Pass |
| NB Band 5 | 824.10 | -0.16 | 24.00 | 21.69 | 38.45 | 251.1886 | 0.0482 | 0.5494 | Pass |
| NB Band 12 | 699.10 | -0.25 | 24.00 | 21.60 | 34.77 | 251.1886 | 0.0472 | 0.4661 | Pass |
| NB Band 13 | 777.10 | -0.23 | 24.00 | 21.62 | 34.77 | 251.1886 | 0.0474 | 0.5181 | Pass |
| NB Band 26(814-824) | 814.1 | -0.22 | 24.00 | 21.63 | 50.00 | 251.1886 | 0.0475 | 0.5427 | Pass |
| LTE B26(824-849) | 824.1 | -0.16 | 24.00 | 21.69 | 38.45 | 251.1886 | 0.0482 | 0.5494 | Pass |
| LTE B2 | 1880.7 | 0.41 | 24.00 | 24.41 | 33.00 | 251.1886 | 0.0549 | 1.0000 | Pass |
| LTE B4 | 1710.7 | 0.45 | 23.00 | 23.45 | 30.00 | 199.5262 | 0.0440 | 1.0000 | Pass |
| LTE B5 | 824.70 | -0.16 | 24.00 | 21.69 | 38.45 | 251.1886 | 0.0482 | 0.5498 | Pass |
| LTE B12 | 699.70 | -0.25 | 24.00 | 21.60 | 34.77 | 251.1886 | 0.0472 | 0.4665 | Pass |
| LTE B13 | 779.50 | -0.23 | 24.00 | 21.62 | 34.77 | 251.1886 | 0.0474 | 0.5197 | Pass |
| LTE B26(814-824) | 814.7 | -0.22 | 24.00 | 21.63 | 50.00 | 251.1886 | 0.0475 | 0.5431 | Pass |
| LTE B26(824-849) | 824.7 | -0.16 | 24.00 | 21.69 | 38.45 | 251.1886 | 0.0482 | 0.5498 | Pass |

### 3.1.3 EUT RF Exposure Evaluation

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.0 / 2.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Remark: Refer to report No. ZR/2019/C000302 for EUT test Max Conducted Output Power value.

### 3.1.4 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table(A) and Table(B). To comply with the MPE, the fraction of the MPE in terms of E2, H2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

The product may support the following simultaneous working states:

| Simultaneous Tx Combination | Configuration | Whether to support |
|---|---|---|
| 1 | GSM+LTE CAT M1 | NO |
| 2 | GSM+LTE NB iot | NO |
| 3 | LTE CAT M1+ LTE NB iot | NO |
| 4 | GSM+LTE CAT M1+LTE NB iot | NO |