



RF Exposure Evaluation Report

Application No.:	ZR/2019/C0005
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.:	TMY02
Trade Mark:	ThingsMatrix
FCC ID:	2ATV9TMY02
Standards:	47 CFR Part 2.1091
	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*
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* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Derek Yang
Wireless Laboratory Manager



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1 Version

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

Authorized for issue by:				
				2020/1/6
		Mike Hu /Project Engineer		
				2020/1/6
		David Chen /Reviewer		

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No.1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, China 518057 t (86-755) 26012053 f (86-755) 26710594 www.sgsgroup.com.cn
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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.

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2.4 General Description of EUT

EUT Description:	GPS Tracker
Model No.:	TMY02
Trade Mark:	ThingsMatrix
Hardware Version:	TMY02V01
Software Version:	TMY02V01.191230
Antenna Gain:	GSM 850: -0.16dBi; GSM1900: 0.41dBi; NB1 Band 2: 0.41dBi; NB1 Band 5: -0.16dBi; NB1 Band 12: -0.25dBi; NB1 Band 13: -0.23dBi; NB1 Band 26: -0.22dBi; CatM1 Band 2: 0.41dBi; CatM1 Band 4: 0.45dBi; CatM1 Band 5: -0.16dBi; CatM1 Band 12: -0.25dBi; CatM1 Band 13: -0.23dBi; CatM1 Band 26: -0.22dBi;

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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/cm ²)	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/f ²)	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/f ²)	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: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

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 is 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

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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/cm ²)	Limit (mW/cm ²)	Conclusion
GSM850	824.2	-0.16	33.00	30.69	38.45	1995.2623	0.3826	0.5495	Pass
GSM900	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/C000502 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

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