SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

No. 1 Workshop, M-10, Middle section, Science & Technology Park,
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RF Exposure Evaluation Report

Application No.:	SZEM1704003853CR
Applicant:	The Things Products.
Address of Applicant:	Herengracht 182, 1016BR Amsterdam, The Netherlands
Manufacturer:	The Things Products.
Address of Manufacturer:	Herengracht 182, 1016BR Amsterdam, The Netherlands
Factory:	EMBEST TECHNOLOGY CO., LTD
Address of Factory:	Tower B 4/F, Shanshui Building, Nanshan Yungu Innovation Industry Park, Liuxian Ave. No. 1183, Nanshan District, Shenzhen, Guangdong, China
Equipment Under Test (EUT):	
EUT Name:	THE THINGS GATEWAY
Model No.:	TTN-001-915-1.0
FCC ID:	2AJX4-GATEWAY
Standards:	47 CFR Part 1.1307
	47 CFR Part 1.1310
	KDB447498D01 General RF Exposure Guidance v06
Date of Receipt:	2017-05-04
Date of Test:	2017-06-15 to 2017-06-23
Date of Issue:	2017-08-29
Test Result :	**PASS***

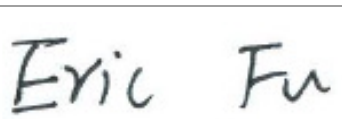
* In the configuration tested, the EUT complied with the standards specified above.

Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
01		2017-08-29		Original

Authorized for issue by:				
				
		Hank Yan /Project Engineer		
				
		Eric Fu /Reviewer		

3 Contents

4 General Information

4.1 General Description of EUT

Power supply:	DC 12V/2A
LoRa:	
Frequency Range:	903MHz to 927.5MHz
Modulation Technique:	LoRa
Antenna Type:	Omni-Directional
Antenna Gain:	5.0dBi
BLE:	
Frequency Range:	2402MHz to 2480MHz
Modulation Type:	GFSK
Number of Channels:	40
Antenna Type:	Chip Antenna
Antenna Gain:	0.1dBi
WiFi:	
Operation Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2472MHz
	IEEE 802.11n(HT40): 2422MHz to 2462MHz
Modulation Type:	IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK)
	IEEE for 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE for 802.11n(HT20)/n(HT40): OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Numbers:	IEEE 802.11b/g, IEEE 802.11n HT20: 13 Channels
	IEEE 802.11n(HT40): 9 Channels
Antenna Type:	PCB Antenna
Antenna Gain:	-1dBi

4.2 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China 518057

Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594

No tests were sub-contracted.

4.3 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 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-823, R-4188, T-1153 and C-2383 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.

4.4 Deviation from Standards

None.

4.5 Abnormalities from Standard Conditions

None.

4.6 Other Information Requested by the Customer

None.

5 RF Exposure Evaluation

5.1 RF Exposure Compliance Requirement

5.1.1 Limits

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

TABLE 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)
(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

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.

5.1.2 Test Procedure

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

5.1.3 EUT RF Exposure Evaluation

1) exposure conditions for standalone operations

For LoRa

Antenna Gain: 5dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 3.16 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Channel	Frequency (MHz)	Max. Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit	MPE Ratios	Result
Lowest	903	23.920	246.604	0.155	0.60	0.258	PASS

Note: Refer to MPE report of the certified module (FCC ID:T9JLG9271) for EUT test Max Conducted Peak Output Power value. The distancer (5th column) calculated from the Fries transmission formula is far greater than 20 cm separation requirement.

For BLE

Antenna Gain: 0.1dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.02 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

GSM850

Channel	Frequency (MHz)	Max. Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit	MPE Ratios	Result
Lowest	2402	0.940	1.242	0.0003	1.00	0.0003	PASS

Note: Refer to MPE report of the certified module (FCC ID: A8TBM71S2) for EUT test Max Conducted Peak Output Power value. The distancer (5th column) calculated from the Fries transmission formula is far greater than 20 cm separation requirement.

For WiFi

Antenna Gain: -1dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 0.794 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Channel	Frequency (MHz)	Max. Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 20 cm (mW/cm^2)	Limit	MPE Ratios	Result
Middle	2437	16.900	48.978	0.008	1.00	0.008	PASS

Note: Refer to MPE report of the certified module (FCC ID: 2AJX4-GATEWAY) for EUT test Max Conducted Peak Output Power value. The distancer (5th column) calculated from the Fries transmission formula is far greater than 20 cm separation requirement.

2) exposure conditions for simultaneous transmission operations

Simultaneous transmission MPE test is not required,because the Max. sum of the MPE ratios for LoRa, BLE and WiFi is 0.258+0.0003+0.008=0.2663＜1