

RF Exposure Evaluation Report

Product : LoRaWAN Data Logger
Trade mark : seeed studio
Model/Type reference : S2100
Serial Number : N/A
Report Number : EED32O81631405
FCC ID : Z4T-S2100
Date of Issue : Nov. 25, 2022
: 47 CFR Part 1.1307
: 47 CFR Part 2.1091
Test Standards : KDB447498D01 General
: RF Exposure Guidance v06
Test result : PASS

Prepared for:

Seeed Technology Co., Ltd.

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Nanshan District, Shenzhen, Guangdong Province, P.R.C**

Prepared by:

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Check No.: 6013171022



2 Version

Version No.	Date	Description
00	Nov. 25, 2022	Original

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4 General Information

4.1 Client Information

Applicant:	Seed Technology Co., Ltd.
Address of Applicant:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C
Manufacturer:	Seed Technology Co., Ltd.
Address of Manufacturer:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C
Factory:	Shenzhen Xinxian Technology Co., Limited
Address of Factory:	F5, Building B17, Hengfeng Industrial City, No. 739 Zhoushi Rd, Baoan District, Shenzhen, Guangdong, P.R.C.

4.2 General Description of EUT

Product Name:	LoRaWAN Data Logger
Model No.:	S2100
Trade mark:	seed studio

4.3 Product Specification subjective to this standard

Frequency Range:	Bluetooth: 2402MHz to 2480MHz FHSS/DTS LORA: 902MHz~928MHz
Modulation Type:	Bluetooth: GFSK, $\pi/4$ DQPSK, 8DPSK FHSS/DTS: LORA Chirp Spread Spectrum
Test Power Grade:	Default
Antenna Type	Bluetooth: Chip Antenna LORA: Shrapnel Antenna
Antenna Gain	Bluetooth: 1.32 dBi LORA FHSS/DTS: 1.70 dBi
Power Supply:	DC 3.6V or DC 12V
Max Conducted Peak Output Power:	BLE: -3.53 dBm, BT: -10.08dBm, FHSS: 20.44dBm, DTS: 20.47dBm The Max Conducted Peak Output Power data refer to the report EED32O81631401, EED32O81631402, EED32O81631403, EED32O81631404.
Sample Received Date:	Oct. 17, 2022
Sample tested Date:	Oct. 17, 2022 to Oct. 31, 2022
Company Name and Address shown on Report, the sample(s) and sample Information was/ were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified. The product has three different sensors,its model is: 1.LoRaWAN EC Sensor 2.LoRaWAN pH Sensor 3.SenseCAP S2110 Grove to MODBUS RS485 Converter the report only shows the worst mode.	

4.4 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd

Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China

Telephone: +86 (0) 755 33683668 Fax: +86 (0) 755 33683385

No tests were sub-contracted.

FCC Designation No.: CN1164

4.5 Deviation from Standards

None.

4.6 Abnormalities from Standard Conditions

None.

4.7 Other Information Requested by the Customer

None.

5 RF Exposure Evaluation

5.1 RF Exposure Compliance Requirement

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{377}$

Where E = Field strength in Volts / meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{377 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

5.2 Maximum Permissible Exposure

Substituting the MPE safe distance using $d = 20$ cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

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
300-1,500			f/300	<6
1,500-100,000			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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

1) For BLE

Measurement Data:

BLE:

GFSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-3.53	-4±0.5	-3.5	0.447
Middle(2440MHz)	-3.83	-4±0.5	-3.5	0.447
Highest(2480MHz)	-4.32	-4±0.5	-3.5	0.447

BT Classic:

GFSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-10.16	-11±0.5	-10.5	0.089
Middle(2441MHz)	-10.75	-11±0.5	-10.5	0.089
Highest(2480MHz)	-11.18	-11±0.5	-10.5	0.089

$\pi/4$ DQPSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-10.12	-11±1	-10	0.100
Middle(2441MHz)	-10.72	-11±1	-10	0.100
Highest(2480MHz)	-11.85	-11±1	-10	0.100

8DPSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-10.08	-11±0.5	-10.5	0.089
Middle(2441MHz)	-10.71	-11±0.5	-10.5	0.089
Highest(2480MHz)	-11.16	-11±0.5	-10.5	0.089

FHSS:

LORA mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(902.3MHz)	20.44	20±0.5	20.5	112.202
Middle(908.5MHz)	20.41	20±0.5	20.5	112.202
Highest(914.9MHz)	20.37	20±0.5	20.5	112.202

DTS: 500K

LORA mode(Worst)				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(903MHz)	20.43	20±0.5	20.5	112.202
Middle(907.8MHz)	20.47	20±0.5	20.5	112.202
Highest(914.2MHz)	20.41	20±0.5	20.5	112.202

BLE:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm ²)
0	2402	0.444	1.355	20	0.00012	1

BT Classic:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm ²)
0	2402	0.098	1.355	20	0.00003	1

LORA FHSS:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm ²)
1	902.3	110.662	1.479	20	0.0326	0.6

LORA DTS:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm ²)
4	907.8	111.429	1.479	20	0.0328	0.6

Note: 1. Refer to report No. EED32O81002001, EED32O81002002, EED32O81002003, EED32O81002004.

2. BLE and LoRa that simultaneous transmission is not possible.

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*** End of Report ***