RF Exposure Evaluation Report

Product	:	Air Temperature and Humidity Sensor
Trade mark	:	seeed studio
Model/Type reference	:	S2101
Serial Number	:	N/A
Report Number	:	EED32O81002005
FCC ID	:	Z4T-S210X
Date of Issue	:	Jul. 25, 2022
Test Standards	:	47 CFR Part 1.1307 47 CFR Part 2.1091 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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CENTRE TESTING INTERNATIONAL GROUP CO.,LTD. CTI Report Seal

2 Version

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

3 Contents

4 General Information

4.1 Client Information

Applicant:	Seeed Technology Co., Ltd.
Address of Applicant:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C
Manufacturer:	Seeed 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:	Air Temperature and Humidity Sensor
Model No.:	S2101
Trade mark:	seeed studio

4.3 Product Specification subjective to this standard

Frequency Range:	Bluetooth: 2402MHz to 2480MHz FHSS/DTS LORA: 902MHz~928MHz
Modulation Type:	Bluetooth: GFSK, π/4DQPSK, 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
Max Conducted Peak Output Power:	BLE: -15.09 dBm, BT: -9.99dBm, FHSS: 19.29dBm, DTS: 19.33dBm
	The Max Conducted Peak Output Power data refer to the report EED32O81002001, EED32O81002002, EED32O81002003, EED32O81002004.
Sample Received Date:	Jul. 07, 2022
Sample tested Date:	Jul. 07, 2022 to Jul. 18, 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.	

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 (mW) = P (W) / 1000 and

d (cm) = d(m) / 100

Yields

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

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm^2

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 / cm^2

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)	-15.3	-15±1	-14	0.040
Middle(2440MHz)	-15.41	-15±1	-14	0.040
Highest(2480MHz)	-15.09	-15±1	-14	0.040

BT Classic:

GFSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-9.99	-10±1	-9	0.126
Middle(2441MHz)	-10.07	-10±1	-9	0.126
Highest(2480MHz)	-10	-10±1	-9	0.126

π/4DQPSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-10.09	-10±1	-9	0.126
Middle(2441MHz)	-10.16	-10±1	-9	0.126
Highest(2480MHz)	-10.13	-10±1	-9	0.126

8DPSK mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(2402MHz)	-10.1	-10±1	-9	0.126
Middle(2441MHz)	-10.24	-10±1	-9	0.126
Highest(2480MHz)	-10.22	-10±1	-9	0.126

FHSS:

LORA mode				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(902.3MHz)	19.19	19±1	20	100
Middle(908.5MHz)	19.28	19±1	20	100
Highest(914.9MHz)	19.29	19±1	20	100

DTS: 500K

LORA mode(Worst)				
Test channel	Peak Output Power (dBm)	Tune up tolerance (dBm)	Maximum tune-up Power	
			(dBm)	(mW)
Lowest(903MHz)	19.26	19±1	20	100
Middle(907.8MHz)	19.29	19±1	20	100
Highest(914.2MHz)	19.33	19±1	20	100

BLE:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm^2	Limit (mW/cm^2)
39	2480	0.04	1.355	20	0.00001	1

BT Classic:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm^2	Limit (mW/cm^2)
1	2402	6.126	1.355	20	0.0017	1

LORA FHSS:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm^2	Limit (mW/cm^2)
64	914.9	100	1.479	20	0.0294	0.6

LORA DTS:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm^2	Limit (mW/cm^2)
8	914.2	100	1.479	20	0.0294	0.6

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

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

*** End of Report ***