ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

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Test Report No.	: OT-21O-RWD-032
Reception No.	: 2109004237
Applicant	: NATURELINK INC.
Address	: 1206, D-dong, 30, Songdomirae-ro, Yeonsu-gu, Incheon, 21990, South Korea
Manufacturer	: NATURELINK INC.
Address	: 1206, D-dong, 30, Songdomirae-ro, Yeonsu-gu, Incheon, 21990, South Korea
Type of Equipment	: RF Module(BLE Module)
FCC ID.	: 2AQWI-PBLN51822
Model Name	: PBLN51822
Serial number	: N/A
Total page of Report	: 7 pages (including this page)
Date of Incoming	: September 27, 2021
Date of issue	: October 22, 2021

SUMMARY

The equipment complies with the regulation; *FCC 47 CFR Part 1, 1.1310*

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.
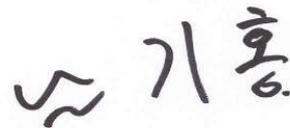
Tested by	Reviewed by	Approved by
Si-eon Lee / Assistant Manager	Tae-Ho, Kim / Senior Manager	Ki-Hong, Nam / General Manager
ONETECH Corp.	ONETECH Corp.	ONETECH Corp.

CONTENTS

PAGE

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-21O-RWD-032	October 22, 2021	Initial Release	All

OTC-TRF-RF-001(0)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

1. VERIFICATION OF COMPLIANCE

Applicant   : NATURELINK INC.

Address   : 1206, D-dong, 30, Songdomirae-ro, Yeonsu-gu, Incheon, 21990, South Korea

Contact Person : Do hyun, Lee / Senior director

Telephone No. : +82-2-853-2240

FCC ID   : 2AQWI-PBLN51822

Model Name   : PBLN51822

Brand Name   : -

Serial Number : N/A

Date   : October 22, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	RF Module(BLE Module)
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC 47 CFR Part 1, 1.1310
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. GENERAL INFORMATION

2.1 Product Description

The NATURELINK INC., Model PBLN51822 (referred to as the EUT in this report) is a RF Module(BLE Module). The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	RF Module(BLE Module)
OPERATING FREQUENCY	2 402 MHz ~ 2 480 MHz
MODULATION TYPE	GFSK
RF OUTPUT POWER	0.51 dBm
NUMBER OF CHANNEL	40 Channel
ANTENNA TYPE	PCB Antenna
ANTENNA GAIN	0.50 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	16 MHz

2.2 Alternative type(s)/model(s); also covered by this test report.

-. None

3. EUT MODIFICATIONS

-. None

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4. RF EXPOSURE EVALUATION

4.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment are f/1500 mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² exposure is calculated as follows:

$$E = \sqrt{(30 * P * G)} / d, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm², Z = Impedance of free space, 377 Ω

E = Electric filed strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combing equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * 10 S)}$$

Changing to units of mW and cm, using P (mW) = P (W) / 1 000, d (cm) = 0.01 * d (m)

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm²

4.2 EUT Description

Kind of EUT	RF Module(BLE Module)
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ■ Others
Exposure Evaluation Applied	■ MPE ☐ SAR ☐ SAR Test Exclusion Evaluation

4.3 Calculated MPE Safe Distance for Bluetooth LE

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/ cm²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	Bluetooth LE	-0.04 ± 1.0	0.96	1.25	0.50	1.12	0.33	0.000 3	1.00

Note. - Bluetooth and GFSK not transmit simultaneously.

According to above table, for 2 402 ~ 2480 MHz Band(LE), safe distance,

$D = 0.282 * \sqrt{(1.25 * 1.12)/1.00} = 0.33$ cm.

For getting power density at 20 cm separation in above table, following formula was used.

$S = P * G / (4\pi * R^2) = 1.25 * 1.12 / (4 * \pi * 20^2) = 0.000 3$

Where:
S = Power Density,
P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),
G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

4.4 Calculated MPE Safe Distance for GFSK

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/ cm²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	GFSK	0.51 ± 1.0	1.51	1.42	0.50	1.12	0.36	0.000 3	1.00

Note. - Bluetooth and GFSK not transmit simultaneously.

According to above table, for 2 402 ~ 2480 MHz Band(GFSK), safe distance,

$D = 0.282 * \sqrt{(1.42 * 1.12)/1.00} = 0.36$ cm.

For getting power density at 20 cm separation in above table, following formula was used.

$S = P * G / (4\pi * R^2) = 1.42 * 1.12 / (4 * \pi * 20^2) = 0.000 3$

Where:
S = Power Density,
P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),
G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna