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

Test Report No.	**: OT-19D-RWD-019**
AGR No.	**: A19NA-198**
Applicant	**: AMOSENSE**
Address	**: 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea**
Manufacturer	**: AMOSENSE**
Address	**: 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea**
Type of Equipment	**: MUSE-R**
FCC ID.	**: 2AS9T-SB12**
Model Name	**: SB12**
Serial number	**: N/A**
Total page of Report	**: 8 pages (including this page)**
Date of Incoming	**: November 25, 2019**
Date of issue	**: December 06, 2019**

SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.225, 15.247***

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.

Reviewed by: Tae-Ho, Kim / Senior Manager, ONETECH Corp.

Approved by: Ki-Hong, Nam / Chief Engineer, ONETECH Corp.

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

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-19D-RWD-019	December 06, 2019	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : AMOSENSE

Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea

Manufacturer : AMOSENSE

Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea

Contact Person : UIHAN JEONG / Research Engineer

Telephone No. : +82-010-4948-5676

FCC ID : 2AS9T-SB12

Model Name : SB12

Brand Name : -

Serial Number : N/A

Date : December 06, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	MUSE-R
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 558074 D01 15.247 Meas Guidance v05r02
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 AMOSENSE, Model SB12 (referred to as the EUT in this report) is a MUSE-R. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	MUSE-R	
Temperature Range	-20 ℃ ~ 50 ℃	
OPERATING FREQUENCY	NFC	13.56 MHz
	Sig Fox	902.137 5 MHz ~ 904.662 5 MHz
	Bluetooth LE	2 402 MHz ~ 2 480 MHz
MODULATION TYPE	NFC	ASK
	Sig Fox	DBPSK
	Bluetooth LE	GFSK
RF OUTPUT POWER	NFC	39.79 dBuV/m at 3 M
	Sig Fox	22.14 dBm
	Bluetooth LE	0.84 dBm
ANTENNA TYPE	NFC: FPCB Antenna Sig Fox : Chip + Metal Antenna Bluetooth LE : Chip Antenna	
ANTENNA GAIN	Bluetooth LE : -0.02 dBi Sig Fox : 0.57 dBi	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32.768 kHz, 32 MHz, 50 MHz	

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

-. None

3. EUT MODIFICATIONS

-. None

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4. MAXIMUM PERMISSIBLE EXPOSURE

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:

$E = \sqrt{(30 * P * G)} / d$, and $S = E^2 / Z = E^2 / 377$, because 1 mW/cm² = 10 W/m²

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

Kind of EUT	MUSE-R
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ■ Others
Exposure Evaluation Applied	■ MPE ☐ SAR ☐ N/A

Tested by: Hyung-Kwon, Oh / Assistant Manager

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4.2 Test Result for Bluetooth LE

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	Bluetooth LE	1.0 ± 0.5	1.50	1.41	-0.02	1.00	0.33	0.000 3	1.00

According to above table, for 2 402 MHz ~ 2 480 MHz Band, safe distance,

$D = 0.282 * \sqrt{(1.41 * 1.00)} / 1.00 = 0.33$ cm

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

$S = P * G / (4\pi * R^2) = 1.41 * 1.00 / (4 * 3.14 * 20^2) = 0.000\ 3$

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

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4.3 Test Result for Sig Fox

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
		(dBm)	(dBm)	(mW)	Log	Linear			
902 ~ 928	Sig Fox	22.5 ± 0.5	23.00	199.53	0.57	1.14	4.25	0.045 3	1.00

According to above table, for 902 MHz ~ 928 MHz Band, safe distance,

D = 0.282 * √ (199.53 * 1.14) / 1.00 = 4.25 cm

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

S = P * G / (4π * R²) = 199.53 * 1.14 / (4 * 3.14 * 20^2) = 0.045 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

Tested by: Hyung-Kwon, Oh / Assistant Manager

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