LAB N° 1356 L

Test Report No.:	**IT21K3EN 001 Annex 4**	**Order No.:**	7976449	*Page 1 of 14*
Order date:	17-06-2021			
Client:	Move S.r.l. – Piazza Cavour 7 - 20121 Milano - Italy			
Test item:	Low Power Radio Module			
Identification / Type No.:	**MAMWLE-00** **MAMWLE-01**			
FCC ID:	**2A3LJ-MAMWLE**			
Trademark:	MOVE SOLUTIONS			
Order content:	RF exposure evaluation according to the following standard:			
Test specification:	**47 CFR § 1.1310**			
Date of receipt:	24-08-2021			
Test sample No.:	Storage no.: A003116457-001			
Testing period:	03-09-2021 ÷ 23-12-2021			
Place of testing:	TÜV Rheinland Italia S.r.l. Via E. Mattei, 3 20005 Pogliano Milanese (MI) - IT			
Testing laboratory:	TÜV Rheinland Italia S.r.l. Via E. Mattei,3 20005 Pogliano Milanese (MI) - IT			
Test result:	*Pass*			

Tested by:	Roberto Radice	**Authorized by:**	Andrea Bortolotti
Date: 28-12-2021	(Laboratory technician)	**Date:** 28-12-2021	*(Reviewer)*
Position	Expert	**Position**	Expert
Other:	---		
Condition of the test item at delivery:	*Test item complete and undamaged*		

1	*Description*	Low Power Radio Module
2	*Model name*	**MAMWLE00** **MAMWLE01**
3	*Serial number*	Not present
4	*Manufacturer*	Move S.r.l. - Piazza Cavour 7 - 20121 Milano - Italy
5	*Trademark*	MOVE SOLUTIONS
6	*Power supply*	DC power supply
7	*Rated voltage*	+3,3V
8	*Rated frequency*	D.C.
9	*Rated current*	220mAH
10	*Maximum power consumption*	----
11	*Modulation type*	☐ Frequency hopping (FHSS) equipment ☒ Wideband data transmission (non-FHSS equipment) ☒ Direct Sequence Spread Spectrum (DSSS equipment) ☐ Others:
12	*Hardware version*	MAMWLE_V1.1
13	*Software version*	LoRaWAN_AT_Slave v1.1
14	*Dimensions*	----
15	*Weight*	----
16	*Test sample obtaining*	☒ Sampling by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

17	*Applied basic standards*

Reference document	
47 CFR § 1.1310	Radiofrequency radiation exposure limits
47 CFR § 2.1093	Radiofrequency radiation exposure evaluation: portable devices
47 CFR § 2.1091	Radiofrequency radiation exposure evaluation: mobile devices
447498 D01 General RF Exposure Guidance v06	RF exposure procedures and equipment authorization policies for mobile and portable devices

18 *Used radio technologies and frequencies*

Radio Type	☒ Transreceiver ☐ Receiver only
Radio technology	☐ Short – Range Device ☐ WiFi ☐ Bluetooth Low Energy ☐ GPS / GNSS ☐ GSM/ GPRS (2G) ☐ UTRA (UMTS, 3G) ☐ E-UTRA (LTE, 4G) ☒ Other: Lora module
Equipment type	☒ Without audio speech (data only) ☐ With audio speech
Antenna type	☒ External (dedicated antenna) ☐ Intergrated antenna
Short –Range Band / Frequency	---
WiFi Channel / Frequency	---
Bluetooth Channel / Frequency	---
GPS / GNSS Band / Frequency	---
GSM Bands / Frequency	---
Utra Bands / Frequency	---
E-Utra Bands / Frequency	---
Other Bands / Frequency	902÷928MHz

RF EXPOSURE EVALUATION

19 *Radio module identification (technical data of the Bluetooth low energy)*

Module manufacturer	STMicroelectronics
Module type	STM32WL System-On-Chip
Frequency Band	902 – 915MHz (Upstream) 923 – 928MHz (Downstream)
Number of channel	64 & 8
Channel bandwith	125kHz & 500kHz
Channel Separation	200kHz, 600kHz & 1600kHz
Modulation	LoRa®
Antenna	Dedicated Antenna: Ant. S.r.l. mod. Chinook 868-915- GSM900-GSM1800 (P/N: B01-000)
Antenna Gain	2.15dBi

20	*Operating modes*

No.	***Description***
1	UPSTREAM BAND (DSS configuration) Continuous LORA Modulation RF Transmission (Upstream) RF setting during tests: Frequency: 902.3MHz (low channel); 908.7MHz (mid channel); 914.9MHz (high channel); Modulation: LORA; Bandwidth: 125kHz; Spreading Factor DR0 to DR3 (SF10 to SF7) Power Setting: ⇒ +15dBm (max. power declared)
2	UPSTREAM BAND (DTS configuration) Continuous LORA Modulation RF Transmission (Upstream) RF setting during tests: Frequency: 903MHz (low channel); 909.4MHz (mid channel); 914.2MHz (high channel); Modulation: LORA; Bandwidth: 500kHz; Spreading Factor DR4 (SF8) Power Setting: ⇒ +15dBm (max. power declared)
3	DOWNSTREAM BAND (DTS configuration) Continuous LORA Modulation RF Transmission (Upstream) RF setting during tests: Frequency: 923.3MHz (low channel); 925.3MHz (mid channel); 927.5MHz (high channel); Modulation: LORA; Bandwidth: 500kHz; Spreading Factor DR8 to DR13 (SF12 to SF7) Power Setting: ⇒ +15dBm (max. power declared)

21	***Change history***

Test report number	**List of revisions**	**Date**
IT21K3EN 001 Annex 4	First edition	28-12-2021

RF EXPOSURE EVALUATION

SAR EVALUATION

Test date	23-12-2021
Applied Standard	47 CFR § 2.1091
EUT classification (fixed, mobile or portable devices)	☐ Fixed: device physically secured at one fixed location and cannot be easily re-located. ☒ Mobile: transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons (47 cfr 2.1091) ☐ Portable: transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user (47 cfr 2.1093)
Temperature	22° C
Humidity	42%
Air pressure	1027 mbar
Tested by	Roberto Radice
Model	**MAMWLE-00** **MAMWLE-01**
Test sample No.	N°2 Sample tested
Operating mode	1, 2, 3
Tested terminals	Antenna
Result	PASS

(e) Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

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

f = frequency in MHz * = Plane-wave equivalent power density

FCC SAR limits

Region	Occupational SAR values (W/Kg)	General public SAR values (W/Kg)
Whole body SAR averaging mass = entire body	0,4	0,08
Partial body SAR averaging mass = 1g	8,0	1,6
Hands, wrists, feet and akles SAR averaging mass = 10g	20	4

FCC SAR test exclusion

General SAR test exclusion guidance according to KDB 447498 (Par. 4.3)

Standalone SAR test exclusion considerations:

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition(s), listed below, is (are) satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.The minimum test separation distance defined in 4.1 f) is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified, typically in the SAR measurement or SAR analysis report, by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, according to the required published RF exposure KDB procedures. When no other RF exposure testing

or reporting are required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops and tablets, etc.

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):32

1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

3) SAR measurement procedures are not established below 100 MHz.

When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any SAR test results below 100 MHz to be acceptable.

RF EXPOSURE EVALUATION

OPERATING CONDITION 1 (UPSTREAM BAND – DSS - Bandwidth: 125kHz)								
CH.	**Frequency**	**Max Output Power (P)**		**Antenna Gain**		**Separation distance (r)**	**(S) Power density**	**(S) Power density Limit**
	(MHz)	**(dBm)**	**(mW)**	**dBi**	**Numerical (G)**	**(cm)**	**(mW/cm²)**	**(mW/cm²)**
Low	902.3	14.68	29.38	+2.15	1.641	20	0.00959	0.601
Middle	908.7	14.67	29.31	+2.15	1.641	20	0.00956	0.606
High	914.9	14.65	29.17	+2.15	1.641	20	0.00952	0.610

FORMULA

MPE test exlusion condition:

$$S = \frac{\text{Max. power of channel (mW) x Antenna Gain (numerical)}}{4\Pi \times r^2 \text{ (cm)}}$$

VERDICT

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

RF EXPOSURE EVALUATION

OPERATING CONDITION 2 (UPSTREAM BAND – DTS - Bandwidth: 500kHz)								
CH.	**Frequency**	**Max Output Power (P)**		**Antenna Gain**		**Separation distance (r)**	**(S) Power density**	**(S) Power density Limit**
	(MHz)	**(dBm)**	**(mW)**	**dBi**	**Numerical (G)**	**(cm)**	**(mW/cm²)**	**(mW/cm²)**
Low	903.0	14.65	29.10	+2.15	1.641	20	0.00952	0.602
Middle	909.4	14.63	29.04	+2.15	1.641	20	0.00948	0.606
High	914.2	14.58	28.70	+2.15	1.641	20	0.00937	0.609

FORMULA

MPE test exlusion condition:

$$S = \frac{\text{Max. power of channel (mW) x Antenna Gain (numerical)}}{4\Pi \times r^2 \text{ (cm)}}$$

VERDICT

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

RF EXPOSURE EVALUATION

OPERATING CONDITION 3 (DOWNSTREAM BAND – DTS - Bandwidth: 500kHz)								
CH.	**Frequency**	**Max Output Power (P)**		**Antenna Gain**		**Separation distance (r)**	**(S) Power density**	**(S) Power density Limit**
	(MHz)	**(dBm)**	**(mW)**	**dBi**	**Numerical (G)**	**(cm)**	**(mW/cm²)**	**(mW/cm²)**
Low	923.3	14.62	28.97	+2.15	1.641	20	0.00945	0.615
Middle	925.3	14.58	28.70	+2.15	1.641	20	0.00937	0.617
High	927.5	14.58	28.70	+2.15	1.641	20	0.00937	0.618

FORMULA

MPE test exlusion condition:

$$S = \frac{\text{Max. power of channel (mW) x Antenna Gain (numerical)}}{4\Pi \text{ x } r^2 \text{ (cm)}}$$

VERDICT

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

---END OF TEST REPORT---