Exposure Evaluation Declaration

FCC ID:	2BAEZMR201910BG95M3
Applicant:	Arctic Systems ApS
Product:	RATMO® 2.5 NBIoT
Model No.:	RATMO® 2.5 NBIoT / RATMO® 2.5 / RATMO® NBIoT
Brand Name:	RATMO®
FCC Rule Part(s):	FCC Part 2.1091
Result:	Complies
Received Date:	2023-01-18

Reviewed By: Sunny Sun

Approved By: Robin Wu

Revision History

Report No.	Version	Description	Issue Date	Note
2301RSU045-U3	Rev. 01	Initial Report	2023-04-20	Valid

CONTENTS

1. General Information

1.1. Applicant

Arctic Systems ApS

Daemningen 67 st, 2610 Roedovre, DK-Denmark

1.2. Manufacturer

Arctic Systems ApS

Daemningen 67 st, 2610 Roedovre, DK-Denmark

1.3. Testing Facility

☐	**Test Site – MRT Suzhou Laboratory**				
	Laboratory Location (Suzhou - Wuzhong) D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China **Laboratory Location (Suzhou - SIP)** 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China				
	Laboratory Accreditations				
	A2LA: 3628.01		CNAS: L10551		
	FCC: CN1166		ISED: CN0001		
	VCCI:	☐R-20025	☐G-20034	☐C-20020	☐T-20020
		☐R-20141	☐G-20134	☐C-20103	☐T-20104
☐	**Test Site – MRT Shenzhen Laboratory**				
	Laboratory Location (Shenzhen) 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China				
	Laboratory Accreditations				
	A2LA: 3628.02		CNAS: L10551		
	FCC: CN1284		ISED: CN0105		
☐	**Test Site – MRT Taiwan Laboratory**				
	Laboratory Location (Taiwan) No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)				
	Laboratory Accreditations				
	TAF: L3261-190725				
	FCC: 291082, TW3261		ISED: TW3261		

1.4. Product Information

Product Name	RATMO® 2.5 NBIoT
Model No.	RATMO® 2.5 NBIoT / RATMO® 2.5 / RATMO® NBIoT
Brand Name	RATMO®
EUT Identification No.	RSD – 0472, RSD - 0474
GSM	850, 1900
LTE Cat M1	FDD Band: 2, 4, 5, 12, 13, 25, 26, 66, 85
LTE Cat NB2	FDD Band: 2, 4, 5, 12, 13, 25, 66, 71, 85
Operating Temperature	-22 ~ 50 °C
Integrated WWAN Modular Information	
FCC ID	XMR201910BG95M3
Model No.	BG95M3
Brand Name	Quectel

Remark:

1. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.
2. This device is based on the certification module FCC ID “XMR201910BG95M3” to assess the radiated spurious emission.
3. The model difference is different marketing purposes.

1.5. Antenna Details

Technology	Frequency Range (MHz)	Antenna Type	MaxPeak Gain (dBi)
GSM 850	824 ~ 849		-1.09
PCS 1900	1850 ~ 1910		3.59
Band 2	1850 ~ 1910		3.59
Band 4	1710 ~ 1755		2.79
Band 5	824 ~ 849		-1.09
Band 12	699 ~ 716		-2.70
Band 13	777 ~ 787		-2.70
Band 25	1850 ~ 1915		3.59
Band 26	814 ~ 849		-1.09
Band 66	1710 ~ 1780		2.79
Band 71	663 ~ 698		-2.70
Band 85	698 ~ 716		-2.70

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

1.6. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 2.1091 & KDB 447498 D04 Interim General RF Exposure Guidance v01

2. RF Exposure Evaluation

2.1. Test Limits

According to FCC §1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b)

Limits For Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (Minutes)
(A) Limits for Occupational/ Control Exposures				
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 Exposures				
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.

2.2. MPE Exemptions

For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph §1.1307(b)(2) of this section): A single RF source is exempt if:

(Option A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph §1.1307(b)(3)(ii)(A) of this section.
Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(ii)(A);

(Option B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P is given by:

$P\,th(mW) = \{ERP_{20cm}(d\ /\ 20cm)^x$ d ≤ 20cm

$P\,th(mW) = \{ERP_{20cm}$ 20cm < d ≤ 40cm

Where

$x = -log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f}}\right)$ and f is in GHz;

and

$ERP_{20cm}(mW) = \{2040f$ 0.3GHz ≤ f < 1.5GHz

$ERP_{20cm}(mW) = \{3060$ 1.5GHz ≤ f ≤ 6GHz

(Option C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to §1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1920R^2$
1.34-30	$3450R^2/f^2$
30-300	$3.83R^2$
300-1,500	$0.0128R^2f$
1,500-100,000	$19.2R^2$

For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph §1.1307(b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for P_{th}, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

$\boldsymbol{P_i}$ = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source *i* at a distance between 0.5 cm and 40 cm (inclusive).

$\boldsymbol{P_{th,i}}$ = the exemption threshold power (P_{th}) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed,

mobile, or portable RF source *i*.

ERP$_j$ = the ERP of fixed, mobile, or portable RF source *j*.

ERP$_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source *j*, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section.

Evaluated$_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source *k* either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit$_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source *k*, as applicable from §1.1310 of this chapter.

2.3. Device Classification

According to the user manual, the antenna of this device is at least 20cm away from the body of the user, this device is classified as a fixed Device. So, the RF exposure evaluation requirements of § 2.1091 for mobile device exposure conditions subject to MPE limits.

2.4. Calculated Result

Product	RATMO® 2.5 NBIoT
Test Item	RF Exposure Evaluation

Test Mode	Frequency Band (MHz)	Max Tune-up Power (dBm)	Antenna Gain (dBi)	Max ERP (dBm)
GSM 850	824 ~ 849	26.00	-1.09	22.76
PCS 1900	1850 ~ 1910	23.00	3.59	24.44
Band 2	1850 ~ 1910	22.00	3.59	23.44
Band 4	1710 ~ 1755	22.00	2.79	22.64
Band 5	824 ~ 849	22.00	-1.09	18.76
Band 12	699 ~ 716	22.00	-2.70	17.15
Band 13	777 ~ 787	22.00	-2.70	17.15
Band 25	1850 ~ 1915	22.00	3.59	23.44
Band 26	814 ~ 849	22.00	-1.09	18.76
Band 66	1710 ~ 1780	22.00	2.79	22.64
Band 71	663 ~ 698	22.00	-2.70	17.15
Band 85	698 ~ 716	22.00	-2.70	17.15

Remark:

1. The Max Conducted power was extracted from the Modular tune-up power.
2. The Max ERP (dBm) = Max Conducted Total Power (dBm) + Antenna Gain (dBi) - 2.15.

For single RF source, Option C

Test Mode	Frequency Band (MHz)	λ / 2 π (m)	R (m)	Max ERP (W)	Threshold ERP (W)
GSM 850	824 ~ 849	0.0579	0.20	0.1888	0.7680
PCS 1900	1850 ~ 1910	0.0258	0.20	0.2780	0.7680
Band 2	1850 ~ 1910	0.0258	0.20	0.2208	0.4219
Band 4	1710 ~ 1755	0.0279	0.20	0.1837	0.3579
Band 5	824 ~ 849	0.0579	0.20	0.0752	0.3978
Band 12	699 ~ 716	0.0683	0.20	0.0519	0.7680
Band 13	777 ~ 787	0.0614	0.20	0.0519	0.4168
Band 25	1850 ~ 1915	0.0258	0.20	0.2208	0.7680
Band 26	814 ~ 849	0.0587	0.20	0.0752	0.3395
Band 66	1710 ~ 1780	0.0279	0.20	0.1837	0.3574
Band 71	663 ~ 698	0.0720	0.20	0.0519	0.7680
Band 85	698 ~ 716	0.0684	0.20	0.0519	0.7680
Remark: R is from user manual.					

Therefore, the device qualifies for RF exposure test exemption.

The End