VARIANT FCC RF Exposure Test Report

Report No.	:	**PSU-QSU2404090210SA02**
Applicant	:	**NORDIC SEMICONDUCTOR ASA**
Address	:	**OTTO NIELSENS VEI 12, 7052 TRONDHEIM, NORWAY**
Product	:	**CELLULAR IOT MODULE**
FCC ID	:	**2ANPO00NRF9151**
Brand	:	**NRF91**
Model No.	:	**NRF9151**
Standards	:	**FCC Part 2 (Section 2.1091)** **KDB 447498 D01 General RF Exposure Guidance v06**
Sample Received Date	:	**Apr. 12, 2024**
Date of Testing	:	**Apr. 12, 2024 ~ Jun. 14, 2024**
Test Lab	:	**The FCC Site Registration No. is 525120; The Designation No. is CN1171.**
ISSUED BY	:	**Huarui 7layers High Technology (Suzhou) Co., Ltd.**
ADDRESS	:	**Tower N, Innovation Center, 88 Zhuyi Road, High-tech District, Suzhou City, Anhui Province China**

CERTIFICATION: The above equipment have been tested by **Huarui 7Layers High Technology (Suzhou) Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by A2LA or any government agencies.

Prepared By : Chang Gao

(Chang Gao/ Engineer)

Approved By : Simpeibo

(Peibo Sun /Manager)

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Release Control Record

Report No.	Reason for Change	Date Issued
PSU-QSU2404090210SA02	The firm wares are all the same, just different SW name and change Power class from PC3 to PC5.	Jun. 14, 2024
PSU-QSU2404090210SA02	Updated antenna gains and Re-calculation MPE.	Jul. 02, 2024

1. Description of Equipment Under Test

EUT Type*	Cellular IoT module
FCC ID*	2ANPO00NRF9151
Brand Name*	nRF91
Model Name*	nRF9151
Frequency Bands (Unit: MHz)	**CAT-M1:** 1850.7MHz ~ 1909.3MHz (FOR LTE Band2) 1710.7MHz ~ 1754.3MHz (FOR LTE Band4) 824.7MHz ~ 848.3MHz (FOR LTE Band5) 880.7MHz ~ 914.3MHz (FOR LTE Band8A) 699.7MHz ~ 715.3MHz (FOR LTE Band12) 779.5MHz ~ 784.5MHz (FOR LTE Band13) 1850.7MHz ~ 1914.3MHz (FOR LTE Band25) 814.7MHz ~ 848.3MHz (FOR LTE Band26) 1710.7MHz ~ 1779.3MHz (FOR LTE Band66) 700.5MHz ~ 713.5MHz (FOR LTE Band85) **NB-IoT:** 1850.1MHz ~ 1909.9MHz (FOR LTE Band2) 1710.1MHz ~ 1754.9MHz (FOR LTE Band4) 824.1MHz ~ 848.9MHz (FOR LTE Band5) 880.1MHz ~ 914.9MHz (FOR LTE Band8A) 699.1MHz ~ 715.9MHz (FOR LTE Band12) 777.1MHz ~ 786.9MHz (FOR LTE Band13) 704.1MHz ~ 715.9MHz (FOR LTE Band17) 1850.1MHz ~ 1914.9MHz (FOR LTE Band25) 814.2MHz ~ 848.8MHz (FOR LTE Band26) 1710.1MHz ~ 1779.9MHz (FOR LTE Band66) 698.1MHz ~ 715.9MHz (FOR LTE Band85)
Modulations*	**CAT-M/ NB-IoT:** BPSK/QPSK/16QAM
HW VERSION*	nRF9151 LACA AA
SW VERSION*	mfw_nRF91x1_2.0.1
Antenna Type*	FR4 Embedded LTE Antenna
EUT Stage*	Production Unit

Note:

1. *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information , Test Lab is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

2. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

2. MPE(Maximum Permissible Exposure) Assessment

2.1 Introduction

According to 47 CFR §2.1091, a mobile device is defined as a 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 cm is normally maintained between the transmitting antenna and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 cm separation requirement. The limits to be used for MPE evaluation are specified in §1.1310. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

2.2 RF Radiation Exposure Limits

According to 47 CFR §1.1310, the criteria listed in below table shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (min)
(A) Limits for Occupational / Controlled 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 – 1500	-	-	f/300	6
1500 – 100000	-	-	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 – 1500	-	-	f/1500	30
1500 – 100000	-	-	1.0	30

Limits for maximum permissible exposure (MPE)

Notes:

1. f = frequency in MHz
2. Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided they are made aware of the potential for exposure.
3. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

2.3 MPE Assessment Method

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by use of the general Equations below. This equation is generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$\text{Power Density (S)} = \frac{PG}{4\pi R^2} = \frac{EIRP}{4\pi R^2}$$

Where
S = Power Density, unit in mW/cm^2
P = Power input to the antenna, unit in mW
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = Distance to the center of radiation of the antenna, unit in cm
EIRP = Effective isotropically radiated power

2.4 MPE Calculation for Standalone Operations

The manufacturer expects that the radiated component of this device will not close to the human body during normal usage and the warning statement was also stated in the user instruction. Since the transmitting antenna will be kept at least 20 cm away from the human body, the MPE level is calculated based on this condition and the result is listed in below table.

LTE CAT-M1：
CALCULATION FOR MAXIMUM E.I.R.P

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Average EIRP (mW)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit	Result
LTE Band 2	1850.7	**9.0**	21.00	1000.00	0.199	1.000	0.199	Pass
LTE Band 4	1710.7	**6.0**	21.00	501.19	0.100	1.000	0.100	Pass
LTE Band 5	824.7	**7.1**	21.00	645.65	0.129	0.550	0.234	Pass
LTE Band 12	699.7	**6.6**	21.00	575.44	0.115	0.466	0.246	Pass
LTE Band 13	779.5	**6.9**	21.00	616.60	0.123	0.520	0.236	Pass
LTE Band 25	1850.7	**9.0**	21.00	1000.00	0.199	1.000	0.199	Pass
LTE Band 26(Part 22)	824.7	**7.1**	21.00	645.65	0.129	0.550	0.234	Pass
LTE Band 26(Part 90)	814.7	**7.1**	21.00	645.65	0.129	0.543	0.237	Pass
LTE Band 66	1710.7	**6.0**	21.00	501.19	0.100	1.000	0.100	Pass
LTE Band 85	700.5	**6.6**	21.00	575.44	0.115	0.467	0.245	Pass
LTE Band 8A	880.7	**2.7**	21.00	234.42	0.047	0.587	0.079	Pass

NB-IoT：
CALCULATION FOR MAXIMUM E.I.R.P

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Average EIRP (mW)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit	Result
LTE Band 2	1850.1	**9.0**	21.00	1000.00	0.199	1.000	0.199	Pass
LTE Band 4	1710.1	**6.0**	21.00	501.19	0.100	1.000	0.100	Pass
LTE Band 5	824.1	**7.1**	21.00	645.65	0.129	0.549	0.234	Pass
LTE Band 12	699.1	**6.6**	21.00	575.44	0.115	0.466	0.246	Pass
LTE Band 13	777.1	**6.9**	21.00	616.60	0.123	0.518	0.237	Pass
LTE Band 17	704.1	**6.6**	21.00	575.44	0.115	0.469	0.244	Pass
LTE Band 25	1850.1	**9.0**	21.00	1000.00	0.199	1.000	0.199	Pass
LTE Band 26(Part 22)	824.2	**7.1**	21.00	645.65	0.129	0.549	0.234	Pass
LTE Band 26(Part 90)	814.2	**7.1**	21.00	645.65	0.129	0.543	0.237	Pass
LTE Band 66	1710.1	**6.0**	21.00	501.19	0.100	1.000	0.100	Pass
LTE Band 85	698.1	**6.6**	21.00	575.44	0.115	0.465	0.246	Pass
LTE Band 8A	880.1	**2.7**	21.00	234.42	0.047	0.587	0.080	Pass

3. Information on the Testing Laboratories

We, Huarui 7layers High Technology (Suzhou) Co., Ltd. ,were founded in 2020 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Huarui 7Layers High Technology (Suzhou) Co., Ltd.
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Accredited Test Lab Cert 6613.01

The FCC Site Registration No. is 434559; The Designation No. is CN1325.

If you have any comments, please feel free to contact us at the following:

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