

# RF Exposure Evaluation Report

**APPLICANT** : Nokia Shanghai Bell Co., Ltd.  
**EQUIPMENT** : Nokia FastMile 5G Receiver  
**BRAND NAME** : Nokia  
**MODEL NAME** : 5G16-B  
**FCC ID** : 2ADZR5G16B  
**STANDARD** : 47 CFR Part 2.1091  
FCC KDB 447498 D01 v06

The product evaluation date was started from Jul. 22, 2024 and completed on Jul. 22, 2024. We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.



Approved by: Si Zhang

**Sporton International Inc. (Kunshan)**

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People's Republic of China**



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## **1. Administration Data**

### **1.1. Testing Laboratory**

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<b>Testing Laboratory</b>			
<b>Test Firm</b>	Sporton International Inc. (Kunshan)		
<b>Test Site Location</b>	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Designation No.</b>	<b>FCC Test Firm Registration No.</b>
	SAR01-KS	CN1257	314309

<b>Applicant</b>	
<b>Company Name</b>	Nokia Shanghai Bell Co., Ltd.
<b>Address</b>	388#, Ningqiao Road, China (Shanghai) Pilot Free Trade Zone, Shanghai 201206, China

<b>Manufacturer</b>	
<b>Company Name</b>	Nokia Solutions and Networks Oy
<b>Address</b>	Karakaari 7, 02610 Espoo, Finland

## 2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Nokia FastMile 5G Receiver
Brand Name	Nokia
Model Name	5G16-B
FCC ID	2ADZR5G16B
Wireless Technology and Frequency Range	LTE Band 2 : 1850 MHz ~ 1910 MHz LTE Band 4 : 1710 MHz ~ 1755 MHz LTE Band 5 : 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12 : 699 MHz ~ 716 MHz LTE Band 13 : 777 MHz ~ 787 MHz LTE Band 25 : 1850 MHz ~ 1915 MHz LTE Band 26 : 814 MHz ~ 849 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 42: 3450 MHz ~3550 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66 : 1710 MHz ~ 1755 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n7 : 2500 MHz ~ 2570 MHz 5G NR n12 : 699 MHz ~ 716 MHz 5G NR n25 : 1850 MHz ~1915 MHz 5G NR n26 : 814 MHz ~ 849 MHz 5G NR n38 : 2570 MHz ~ 2620 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n66 : 1710 MHz ~ 1780 MHz 5G NR n71 : 663 MHz ~ 698 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR : CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM Bluetooth LE
Antenna Type	WWAN: Monopole Antenna for Ant0/1, Dipole Antenna for Ant4/5 Bluetooth: PCB Antenna
HW Version	3TG02508Axxx(x:A~Z)
SW Version	5GReceiver-HG-2_D240200BieT0001E0643
EUT Stage	Identical Prototype

**Remark:**

- The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
- 5G NR n2/5/7/12/25/26/38/41/48/66/71/77 supports NSA and SA mode.
- The intra-band/inter-band ULCA and EN-DC mode combination could be referred to the product spec.
- This device supports intra-band ULCA and EN-DC mode combination, due to intra-band ULCA and non-CA power is same, so non-CA MPE analysis can represent ULCA MPE analysis.
- This device supports HPUE for LTE Band 38/41 and 5G NR n38/41/77 with class 2, so HPUE has been performed to do MPE analysis.
- The device supports HPUE (power class 2) under SISO mode and HPUE (power class 1.5) under UL MIMO mode for 5G NR n41/n77, so HPUE (power class 1.5) has been performed MPE calculation.
- 5G NR n38/41/48/77 support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.



**Comments and Explanations:**

1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

**For Antenna Gain:**

Technical	Band	ANT0 Gain (dBi)	ANT1 Gain (dBi)	ANT4 Gain (dBi)	ANT5 Gain (dBi)	MIMO Gain(dBi)
4G LTE	Band 2	3.5	2.9	/	/	/
	Band 4	3.3	2.9	/	/	/
	Band 5	2.3	/	/	/	/
	Band 7	2.8	2.0	/	/	/
	Band 12	1.8	/	/	/	/
	Band 13	1.0	/	/	/	/
	Band 25	3.5	2.9	/	/	/
	Band 26	2.3	/	/	/	/
	Band 38	2.8	2.0	/	/	/
	Band 41	2.8	2.0	/	/	/
	Band 42	/	/	8.5	8.5	/
	Band 48	/	/	8.5	8.8	/
	Band 66	3.3	2.9	/	/	/
Band 71	1.0	/	/	/	/	
5G NR	FR1 n2	3.5	2.9	/	/	/
	FR1 n5	2.3	/	/	/	/
	FR1 n7	2.8	2.0	/	/	/
	FR1 n12	1.8	/	/	/	/
	FR1 n25	3.5	2.9	/	/	/
	FR1 n26	2.3	2.9	/	/	/
	FR1 n66	3.3	2.9	/	/	/
	FR1 n71	1.0	/	/	/	/
	FR1 n38	2.8	2.0	/	/	1.8
	FR1 n41	2.8	2.0	/	/	1.8
	FR1 n48	/	/	8.1	8.8	8.1
FR1 n77	/	/	9.3	10.0	9.3	
<b>Technical</b>	<b>Band</b>	<b>Gain (dBi)</b>				
BLE	Bluetooth	3.62				



3. Maximum RF average output tune up power among production units

<LTE>

Mode	Maximum Average power(dBm)	
LTE	Band 2	24.5
LTE	Band 4	24.0
LTE	Band 5	23.5
LTE	Band 7	23.5
LTE	Band 12	23.5
LTE	Band 13	23.5
LTE	Band 25	24.5
LTE	Band 26	23.5
LTE	Band 38 PC3	24.0
LTE	Band 38 PC2	26.0
LTE	Band 41 PC3	24.0
LTE	Band 41 PC2	26.0
LTE	Band 42	23.5
LTE	Band 48	14.0
LTE	Band 66	24.0
LTE	Band 71	23.5

<5G NR>

Mode	Maximum Average power(dBm)	
5G NR	n2	24.5
5G NR	n5	24.5
5G NR	n7	24.5
5G NR	n12	24.5
5G NR	n25	24.5
5G NR	n26	24.5
5G NR	n38 PC3	24.0
5G NR	n38 PC2	27.0
5G NR	n41 PC3	24.0
5G NR	n41 PC2	27.0
5G NR	n48	14.0
5G NR	n66	24.5
5G NR	n71	24.5
5G NR	n77 PC3	24.0
5G NR	n77 PC2	27.0



**<MIMO>**

Mode	Maximum Average power(dBm)
n38	27.0
n41	30.0
n48	14.0
n77	30.0

Note: WWAN support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.

**<Bluetooth>**

Mode	Maximum Average power(dBm)
Bluetooth LE	6.0





### 4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 27 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna



## 5. Radio Frequency Radiation Exposure Evaluation

### 5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Duty cycle	Antenna Gain (dBi)	Maximum Power (dBm)	Average EIRP (dBm)	Average EIRP (mW)	Power Density at 27cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Power Density / Limit
LTE Band 2	1850.0	100%	3.50	24.50	28.000	630.957	0.069	1.000	0.069
LTE Band 4	1710.0	100%	3.30	24.00	27.300	537.032	0.059	1.000	0.059
LTE Band 5	824.0	100%	2.30	23.50	25.800	380.189	0.042	0.549	0.076
LTE Band 7	2500.0	100%	2.80	23.50	26.300	426.580	0.047	1.000	0.047
LTE Band 12	699.0	100%	1.80	23.50	25.300	338.844	0.037	0.466	0.079
LTE Band 13	777.0	100%	1.00	23.50	24.500	281.838	0.031	0.518	0.059
LTE Band 25	1850.0	100%	3.50	24.50	28.000	630.957	0.069	1.000	0.069
LTE Band 26	814.0	100%	2.30	23.50	25.800	380.189	0.042	0.543	0.077
LTE Band 38	2570.0	100%	2.80	26.00	28.800	758.578	0.083	1.000	0.083
LTE Band 41	2496.0	100%	2.80	26.00	28.800	758.578	0.083	1.000	0.083
LTE Band 42	3450.0	100%	8.50	23.50	32.000	1584.893	0.173	1.000	<b>0.173</b>
LTE Band 48	3550.0	100%	8.80	14.00	22.800	190.546	0.021	1.000	0.021
LTE Band 66	1710.0	100%	3.30	24.00	27.300	537.032	0.059	1.000	0.059
LTE Band 71	663.0	100%	1.00	23.50	24.500	281.838	0.031	0.442	0.070
5G NR n2	1850.00	100%	3.50	24.50	28.000	630.957	0.069	1.000	0.069
5G NR n5	824.00	100%	2.30	24.50	26.800	478.630	0.052	0.549	0.095
5G NR n7	2500.00	100%	2.80	24.50	27.300	537.032	0.059	1.000	0.059
5G NR n12	699.00	100%	1.80	24.50	26.300	426.580	0.047	0.466	0.100
5G NR n25	1850.00	100%	3.50	24.50	28.000	630.957	0.069	1.000	0.069
5G NR n26	814.00	100%	2.90	24.50	27.400	549.541	0.060	0.543	<b>0.111</b>
5G NR n38	2570.00	100%	2.80	27.00	29.800	954.993	0.104	1.000	0.104
5G NR n38 MIMO	2570.00	100%	1.80	27.00	28.800	758.578	0.083	1.000	0.083
5G NR n41	2496.00	100%	2.80	27.00	29.800	954.993	0.104	1.000	0.104
5G NR n41 MIMO	2496.00	100%	1.80	30.00	31.800	1513.561	0.165	1.000	0.165
5G NR n48	3550.00	100%	8.80	14.00	22.800	190.546	0.021	1.000	0.021
5G NR n48 MIMO	3550.00	100%	8.10	14.00	22.100	162.181	0.018	1.000	0.018
5G NR n66	1710.00	100%	3.30	24.50	27.800	602.560	0.066	1.000	0.066
5G NR n71	663.00	100%	1.00	24.50	25.500	354.813	0.039	0.442	0.088
5G NR n77	3450.00	100%	10.00	27.00	37.000	5011.872	0.547	1.000	<b>0.547</b>
5G NR n77 MIMO	3450.00	100%	9.30	30.00	39.300	8511.380	0.930	1.000	<b>0.930</b>
Bluetooth	2402.0	100%	3.62	6.00	9.620	9.162	0.001	1.000	<b>0.001</b>

**Note:**

- For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
- Chose the maximum RF output tune up power and the maximum antenna gain of all antennas among same frequency WWAN bands to perform MPE calculation conservatively.
- 5GNR n38/n41/n78/n77 supports MIMO mode, MIMO MPE using single each antenna MPE summed together as MIMO MPE is more conservatively.
- The MIMO mode is completely correlated, so selected the MIMO gain among all antennas as MIMO gain to perform MPE calculation.



5.2. Collocated Power Density Calculation

Table with 3 columns: WWAN Power Density / Limit, Bluetooth Power Density / Limit, and Σ(Power Density / Limit) of WWAN + Bluetooth. Values: 0.930, 0.001, 0.931

Table with 4 columns: LTE Power Density / Limit, LTE Power Density / Limit, Bluetooth Power Density / Limit, and Σ(Power Density / Limit) of LTE + LTE + Bluetooth. Values: 0.173, 0.173, 0.001, 0.347

Table with 4 columns: 5GNR Power Density / Limit, 5GNR (except n77) Power Density / Limit, Bluetooth Power Density / Limit, and Σ(Power Density / Limit) of 5GNR + 5GNR + Bluetooth. Values: 0.547, 0.111, 0.001, 0.659

Table with 4 columns: LTE Power Density / Limit, 5GNR Power Density / Limit, Bluetooth Power Density / Limit, and Σ(Power Density / Limit) of LTE + 5GNR + Bluetooth. Values: 0.173, 0.547, 0.001, 0.721

Note:

- 1. For colocation analysis, LTE Band 42 is chosen for summation due to the highest (power density/limit) among all LTE Band modes.
2. For colocation analysis, 5GNR FR1 n77 is chosen for summation due to the highest (power density/limit) among all 5GNR FR1 modes.
3. For 5GNR EN-DC mode, always chose the highest LTE power density and the highest 5GNR power density to sum as EN-DC conservatively.
4. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WWAN + Bluetooth.
5. Considering all transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE collocated transmitters is compliant.

Conclusion:

According to 47 CFR §2.1091, the equipment at least 27 cm to show compliance with the power density limit, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

-----THE END-----