

# 1 Cover Page

## ***RF Exposure Evaluation Report***

**Application No.:** SHCR2302000266AT  
**FCC ID:** 2ACDM-SNG4  
**IC:** 11983A-SNG4  
**Applicant:** Parker Hannifin Corp  
**Address of Applicant:** 8145 Lewis Road, Mpls, MN 55427  
**Manufacturer:** Parker Hannifin Corp  
**Address of Manufacturer:** 8145 Lewis Road, Mpls, MN 55427  
**Factory:** Parker Hannifin Corp  
**Address of Factory:** 8145 Lewis Road, Mpls, MN 55427  
**Equipment Under Test (EUT):**  
**EUT Name:** SensoNEXT  
**Model No.:** QX-008-798  
**Trade Mark:** SensoNODE™  
**Standard(s) :** FCC Rules 47 CFR §2.1091  
 KDB 447498 D04 interim General RF Exposure Guidance v01  
 RSS-102 Issue 5 Amendment 1 (February 2, 2021)  
**Date of Receipt:** 2023-02-14  
**Date of Test:** 2023-03-20 to 2023-03-23  
**Date of Issue:** 2023-03-24

<b>Test Result:</b>	<b>Pass*</b>
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\* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan

Parlam Zhan  
Laboratory Manager



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00	Original	2023-03-24	/

Authorized for issue by:			
		Bill Wu	
		Bill Wu/Project Engineer	
		Parlam Zhan	
		Parlam Zhan /Reviewer	



## 2 Contents

	Page
<b>1 COVER PAGE .....</b>	<b>1</b>
<b>2 CONTENTS .....</b>	<b>3</b>
<b>3 GENERAL INFORMATION .....</b>	<b>4</b>
3.1 GENERAL DESCRIPTION OF E.U.T.....	4
3.2 DETAILS OF E.U.T.....	4
3.3 SEPARATION DISTANCE.....	4
3.4 TEST LOCATION .....	5
3.5 TEST FACILITY .....	5
<b>4 FCC RADIOFREQUENCY RADIATION EXPOSURE LIMITS.....</b>	<b>6</b>
4.1 BLANKET 1 MW BLANKET EXEMPTION.....	6
4.2 MPE-BASED EXEMPTION.....	6
4.3 SAR-BASED EXEMPTION .....	7
4.4 RF EXPOSURE TEST EXEMPTIONS FOR SIMULTANEOUS TRANSMISSION .....	8
<b>5 IC RADIOFREQUENCY RADIATION EXPOSURE LIMITS .....</b>	<b>10</b>
<b>6 MEASUREMENT AND CALCULATION.....</b>	<b>11</b>
6.1 MAXIMUM TRANSMIT POWER .....	11
6.2 RF EXPOSURE CALCULATION .....	11



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### 3 General Information

#### 3.1 General Description of E.U.T.

Power supply:	DC 2.7V to 3.3V
Test Voltage:	DC 3V
Product Type:	<input type="checkbox"/> Portable device
	<input type="checkbox"/> Mobile device
	<input checked="" type="checkbox"/> Fixed device

#### 3.2 Details of E.U.T.

BLE

Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	Antenna 1:Dipole Antenna Antenna 2:Chip Antenna
Antenna Gain:	Antenna 1:3.4dBi (Provided by manufacturer) Antenna 2:2.6dBi (Provided by manufacturer)
Note:	Two antennas are optional and can not used simultaneously

902.4MHz to 927.6MHz

Operation Frequency:	902.4MHz to 927.6MHz
Modulation Type:	2GFSK
Number of Channels:	64
Channel Spacing:	400KHz
Antenna Type:	Dipole Antenna
S/N:	622EC4
Firmware Version:	QX-008-894

#### 3.3 Separation Distance

Separation distance between the antenna to person (R):	>20cm
Remark: This minimum test separation distance 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. R has been stated in user manual.	



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### 3.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab  
588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc ) is provided by the applicant. (if applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

### 3.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

• **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.

Company Number: 8617A

• **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.



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## 4 FCC Radiofrequency radiation exposure limits

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

### 4.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

### 4.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

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  $\lambda/2\pi$ , where  $\lambda$  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  $\lambda/4$  or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).



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**Table B.1—Thresholds For Single RF Sources Subject to Routine Environmental Evaluation**

RF Source Frequency			Minimum Distance			Threshold ERP
$f_L$ MHz		$f_H$ MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	—	1.34	159 m	—	35.6 m	1,920 R <sup>2</sup>
1.34	—	30	35.6 m	—	1.6 m	3,450 R <sup>2</sup> /f <sup>2</sup>
30	—	300	1.6 m	—	159 mm	3.83 R <sup>2</sup>
300	—	1,500	159 mm	—	31.8 mm	0.0128 R <sup>2</sup> f
1,500	—	100,000	31.8 mm	—	0.5 mm	19.2R <sup>2</sup>

Subscripts L and H are low and high;  $\lambda$  is wavelength.  
R: Separation distance between the antenna to person

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least  $\lambda/2\pi$ . The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

Limit calculation				
Frequency range	Frequency(MHz)	$\lambda/2\pi$ (m)	R(m)	Threshold ERP(W)
1.34~30MHz	13.56	3.5229	0.2000	0.751
300~1500MHz	<b>902</b>	0.0530	0.2000	0.462
1500~100000MHz	<b>2480</b>	0.0193	0.2000	0.768
1500~100000MHz	<b>5825</b>	0.0082	0.2000	0.768

### 4.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of  $\lambda/4$ .

As for devices with antennas of length greater than  $\lambda/4$  where the gain is not well defined, but always less than that of a half-wave dipole (length  $\lambda/2$ ), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known. The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of §1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold  $P_{th}$  (mW).



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This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive).  $P_{th}$  is given by Formula (B.2).

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B.2})$$

where

$$x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

and  $f$  is in GHz,  $d$  is the separation distance (cm), and  $ERP_{20 \text{ cm}}$  is per Formula (B.1).

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
0.3~1.5	<b>0.915</b>	1.474	<b>20</b>	<b>1866.600</b>
1.5~6	<b>2.48</b>	1.905	<b>20</b>	<b>3060.000</b>

#### 4.4 RF Exposure Test Exemptions for Simultaneous Transmission

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 (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated $k$  term) shall be used to determine exemption for simultaneous transmission. 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 (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 (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.

**P<sub>i</sub>** = 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).

**P<sub>th,i</sub>** = the exemption threshold power (P<sub>th</sub>) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source *i*.

**ERP<sub>j</sub>** = the ERP of fixed, mobile, or portable RF source *j*.

**ERP<sub>th,j</sub>** = exemption threshold ERP for fixed, mobile, or portable RF source *j*, at a distance of at least  $\lambda / 2 \pi$  according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

**Evaluated<sub>k</sub>** = 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<sub>k</sub>** = 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.



## 5 IC Radiofrequency radiation exposure limits

According to RSS-102 section 2.5.2, RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $4.49/f^{0.5}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;

- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);

- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;

- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

For 2.4G device, the limit of worse case is 2.68 W

For 902-928MHz device, the limit of worse case is 1.37 W



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## 6 Measurement and Calculation

### 6.1 Maximum transmit power

For BLE

The Power Data is based on the RF Test Report SHCR230200026601.

TestMode	Antenna	Channel	Result [dBm]	Result [mW]
BLE_1M	Ant1	2402	2.74	1.88
		2442	3.31	2.14
		2480	<b>3.54</b>	<b>2.26</b>

For 902.4MHz to 927.6MHz

The Power Data is based on the RF Test Report SHCR230200026602.

TestMode	Antenna	Channel	Result [dBuV/m@3m]	Result [dBm]	Result [mW]
902.4MHz to 927.6MHz	Ant1	902.3	104.80	<b>9.60</b>	<b>9.12</b>
		915.2	104.38	9.18	8.28
		927.6	103.79	8.59	7.23

### 6.2 RF Exposure Calculation

For FCC

For BLE

The Max Conducted Peak Output Power is 0.60 mW. The best case gain of the antenna is 3.4dBi.

3.4dBi logarithmic terms convert to numeric result is nearly 2.19.

According to the formula, calculate the EIRP test result:

$$\text{EIRP} = P \times G = 2.26 \text{ mW} \times 2.19 = 4.95\text{mW} < 768\text{mW}$$

For 902.4MHz to 927.6MHz

$$\text{EIRP} = 9.12\text{mW} < 462\text{mW}$$

**Remark:** we used the maximum power between the conducted power and ERP/EIRP to perform RF exposure exemption evaluation.

	Evaluation method	Separation distance between the antenna to person (R)
<input type="checkbox"/>	Blanket 1 mW Blanket Exemption	Regardless of separation distance
<input checked="" type="checkbox"/>	MPE-based Exemption(ERP)	$R \geq (\lambda / 2 \pi)$
<input type="checkbox"/>	SAR-based Exemption( $P_{th}$ )	$0.5\text{cm} < R < 40\text{cm}$



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For IC

For BLE

The Max Conducted Peak Output Power is 0.60 mW. The best case gain of the antenna is 3.4dBi.

3.4dBi logarithmic terms convert to numeric result is nearly 2.19.

According to the formula. calculate the EIRP test result:

$EIRP = P \times G = 2.26 \text{ mW} \times 2.19 = 4.95 \text{ mW} < 2680 \text{ mW}$

For 902.4MHz to 927.6MHz

$EIRP = 9.12 \text{ mW} < 1370 \text{ mW}$

So, the device is to qualify for FCC & IC SAR test exemption, the exemption report is in lieu of the SAR report.

**--End of the Report--**



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