

Test report No:
 NIE: 69264RAN.002

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091; FCC 47 CFR Part 2.1093 FCC 47 CFR Part 1.1307; FCC 47 CFR Part 1.1310

(*) Identification of item under evaluation	Prototyping Platform
(*) Trademark	Nordic Thingy:53
(*) Model and /or type reference	Thingy:53
(*) Other identification of the product	HW version: v0.8.0 SW version: v1.0.0 FCC ID: 2ANPOTHINGY53 IC: Not provided
(*) Features	Bluetooth LE, 802.15.4
(*) Manufacturer	Prototyping Platform
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. FCC 47 CFR Part 2.1093. Radiofrequency radiation exposure evaluation: portable devices. FCC 47 CFR Part 1.1307: Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared. FCC 47 CFR Part 1.1310: Radiofrequency radiation exposure limits.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2022-06-09
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Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item under evaluation", "Trademark", "Model and/or type reference", "General description of the device", "Other identification of the product").
2. Maximum antenna gain, duty cycle, use distance and maximum recommended handheld time use.
3. The device under evaluation consists of a Battery operated prototyping platform based around the nRF5340 nRF5340 is an ultra-low power wireless System on Chip (SoC) with a multiprotocol 2.4 GHz transceiver.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results

Identification of the client

Nordic Semiconductor ASA
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Document history

Report number	Date	Description
69264RAN.002	2022-06-09	First release

Appendix A: FCC RF Exposure assessment result

General description of the device under evaluation

The device under evaluation consists of a Battery operated prototyping platform based around the nRF5340 nRF5340 is an ultra-low power wireless System on Chip (SoC) with a multiprotocol 2.4 GHz transceiver.

According to the manufacturer, during its normal use, the separation distance between the radiating structures of the device and nearby users will be greater than 20 cm. In order to perform the assessment a conservative evaluation distance of 20 cm has been used.

The device does not support simultaneous transmission.

The equipment specifications for each supported technology are shown in Table 1. Values corresponding to maximum antenna gain and duty cycle have been declared by the manufacturer. Values corresponding to maximum conducted output power have been measured and stated into DEKRA Testing and Certification, S.A.U. test report num. 65881RRF.002s:

Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power (dBm)	Duty Cycle (%)	Time Averaged Conducted Power (dBm)	Antenna peak gain (dBi)	Maximum Averaged E.R.P (dBm)	Maximum Averaged E.R.P (mW)
Bluetooth Ant1	2.4 GHz	2402 - 2480	17.00	50.00	13.99	1.15	12.99	19.91
Bluetooth Ant2	2.4 GHz	2402 - 2480	1.63	50.00	-1.38	-0.11	-3.64	0.43
Zigbee Ant1	2.4 GHz	2405 - 2480	17.23	100.00	17.23	1.15	16.23	41.98
Zigbee Ant2	2.4 GHz	2405 - 2480	1.64	100.00	1.64	-0.11	-0.62	0.87

Table 1: Equipment specifications

Additionally the equipment could also be used held in the hand for a short period of time. According to the manufacturer this handheld use shall be limited for a maximum period of 60 seconds each 15 minutes. According to this, the equipment specifications for a 30 minutes handheld use period will be:

Technology / Mode	Band	Frequency (MHz)	TX time for a 30 min period (s)	Time Averaged Conducted Power (dBm)	Antenna peak gain (dBi)	Maximum Averaged E.R.P (dBm)	Maximum Averaged E.R.P (mW)
Bluetooth Ant1	2.4 GHz	2402 - 2480	120.00	2.23	1.15	1.23	1.33
Bluetooth Ant2	2.4 GHz	2402 - 2480	120.00	-13.14	-0.11	-15.40	0.03
Zigbee Ant1	2.4 GHz	2405 - 2480	120.00	5.47	1.15	4.47	2.80
Zigbee Ant2	2.4 GHz	2405 - 2480	120.00	-10.12	-0.11	-12.38	0.06

Table 2: Equipment specifications for 30 minutes handheld use period.

Evaluation Results

For mobile use conditions, the evaluation according to FCC 47 CFR Part 1.1307 will be:

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Maximum Averaged E.R.P (mW)	§1.1307(b)(3).i.(C) Exposure Limit (mW)	Verdict
Bluetooth Ant1	2.4 GHz	2402 - 2480	20.00	19.91	768.00	Pass
Bluetooth Ant2	2.4 GHz	2402 - 2480	20.00	0.43	768.00	Pass
Zigbee Ant1	2.4 GHz	2405 - 2480	20.00	41.98	768.00	Pass
Zigbee Ant2	2.4 GHz	2405 - 2480	20.00	0.87	768.00	Pass

Table 3: FCC Evaluation Results

The computed value(s) are below the limit(s), so these modes meet the requirements stated in FCC 47 CFR Part 1.1307.

For handheld use, the evaluation according to the minimum intended use distance of 5 mm will be as follow:

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Time Averaged Conducted Power (mW)	§ 1.1307(b)(3).i.(B) Exposure Limit (mW)	Verdict
Bluetooth Ant1	2.4 GHz	2402 - 2480	0.50	1.67	6.79	Pass
Bluetooth Ant2	2.4 GHz	2402 - 2480	0.50	0.05	6.79	Pass
Zigbee Ant1	2.4 GHz	2405 - 2480	0.50	3.52	6.79	Pass
Zigbee Ant2	2.4 GHz	2405 - 2480	0.50	0.10	6.79	Pass

Table 4: Evaluation Result and verdict for handheld use.

The computed value(s) are below the limit(s), so according to KDB 447498 D01 – General RF Exposure Guidance, these modes meet the RF Exposure test exemption for single source.

Appendix B: FCC RF Exposure information

RF Exposure determination of exemption

According to FCC 47 CFR §1.1307 (b)(3) Determination of exemption:

(i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2), a single RF source is exempt if:

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

(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_{th} (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_{th} is given by:

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

Where

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

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

(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 $\lambda/2\pi$, 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 $\lambda/4$ 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	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

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

Pi = 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).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = 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,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.

RF Exposure evaluation

Limits for Maximum Permissible Exposure (MPE) for RF sources are defined in FCC 47 CFR “§1.1310 Radiation Exposure limits, paragraph (e)”:

TABLE 1 TO §1.1310(E)(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)
(i) 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
(ii) 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.

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst-case" or conservative prediction:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

$$P_{E.I.R.P.} = P_T + G_T - L_C$$

Where:

P_T = transmitter output power (including tune-up tolerance)

G_T = gain of the transmitting antenna

L_C = signal attenuation in the connecting cable between the transmitter and the antenna if applicable