

Test report No:
NIE: 66837RAN.001

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091

(*) Identification of item under evaluation	Nokia Industrial MulteFire Router 700H		
(*) Trademark	Nokia		
(*) Model and /or type reference	HWNDUSEB1006		
(*) Other identification of the product	HW version: A101 SW Version: 20210121_01_UESW_MF_DEV_00540_12b1d3b_3f98503 IMEI TAC : 35999539 FCC ID: 2AVO2MFRTR700H1 IC ID: 661AF-MFRTR700H1		
(*) Features	MulteFire 1.0		
(*) Manufacturer	Nokia Innovations US LLC 600-700 Mountain Ave, Murray Hill, NJ, 07974 USA		
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.		
Summary	IN COMPLIANCE		
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager		2021.07.29 09:18:02 +02'00'
Date of issue	2021-07-28		
Report template No	FAN36_02 (*) "Data provided by the client"		

Index

Competences and guarantees3

General conditions3

Data provided by the client.....3

Identification of the client.....3

Document history3

Appendix A: FCC RF Exposure assessment result4

 General description of the device under evaluation5

 RF Exposure Assessment result and verdict5

Appendix B: FCC RF Exposure information6

 RF Exposure evaluation7

 MPE Evaluation8

Competences and guarantees

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification, S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification, S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification, S.A.U. at the time of performance of the test.

DEKRA Testing and Certification, S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Assessment Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification, S.A.U.

General conditions

1. This report is only referred to the item that has undergone the assessment.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification, S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification, S.A.U. and the Accreditation Bodies

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 tested", "Trademark", "Model and/or type reference tested", "Other identification of the product", "Features", "Manufacturer" and "General description of the device").
2. Maximum antenna gain and use distance information.

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

Company name: Nokia Innovations US LLC

Postal address: 600-700 Mountain Ave, Murray Hill, NJ, 07974 USA

Contact person: Gary Goldstein

Telephone / e-mail: +1 (817) 808-6481 / gary.goldstein@nokia.com

Document history

Report number	Date	Description
66837RAN.001	2021-07-28	First release

Appendix A: FCC RF Exposure assessment result

General description of the device under evaluation

The device under evaluation consists of a device who acts as a client device. When connected to an Access Point, it provides wireless data service.

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.

As stated into DEKRA Testing and Certification, S.A.U. test report num. 66837RRF.002, the maximum measured output power levels for each supported technology are:

Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power RMS Burst (Incl. Tune-Up) (dBm)	Antenna peak gain (dBi)	Maximum E.I.R.P. (dBm)	Maximum E.I.R.P. (mW)
MulteFire 1.0 SISO Antenna Port 1	U-NII Low	5150 - 5250	22.04	3.00	25.04	319.15
	U-NII Mid	5260 - 5320	22.30	3.00	25.30	338.84
	ETSI	5500 - 5700	21.92	3.00	24.92	310.46
	U-NII Up	5725 - 5835	23.95	3.00	26.95	495.45
MulteFire 1.0 SISO Antenna Port 2	U-NII Low	5150 - 5250	22.18	3.00	25.18	329.61
	U-NII Mid	5260 - 5320	21.87	3.00	24.87	306.90
	ETSI	5500 - 5700	21.43	3.00	24.43	277.33
	U-NII Up	5725 - 5835	23.50	3.00	26.50	446.68

Table 1: Equipment specifications

RF Exposure Assessment result and verdict

Limits for Maximum Permissible Exposure (MPE) to comply with FCC 47 CFR § 2.1091 are defined in "§1.1310 Radiation Exposure limits, paragraph (e)":

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Power density (mW/cm ²)	FCC General Population Limit (mW/cm ²)	Verdict
MulteFire 1.0 SISO Antenna Port 1	U-NII Low	5150 - 5250	20.00	0.06	1.00	Pass
	U-NII Mid	5260 - 5320	20.00	0.07	1.00	Pass
	ETSI	5500 - 5700	20.00	0.06	1.00	Pass
	U-NII Up	5725 - 5835	20.00	0.10	1.00	Pass
MulteFire 1.0 SISO Antenna Port 2	U-NII Low	5150 - 5250	20.00	0.07	1.00	Pass
	U-NII Mid	5260 - 5320	20.00	0.06	1.00	Pass
	ETSI	5500 - 5700	20.00	0.06	1.00	Pass
	U-NII Up	5725 - 5835	20.00	0.09	1.00	Pass

Table 2: Assessment result and verdict

Appendix B: FCC RF Exposure information

RF Exposure evaluation

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 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)
(A) 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
(B) 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

MPE Evaluation

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

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure towards the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{Lim_i}$$

Where

S_i is the applicable contribution of each source (e.g. power flux density).

Lim_i is the limit for the applicable contribution of each source (e.g. MPE power flux density basic restriction).