

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 |
| Date of issue | 2021-07-28 |
| Report template No | FAN36_02 (* "Data provided by the client") |

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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 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

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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).