

Statement of Human Exposure to Radiofrequency Electromagnetic Field

Certified modules:

Type of Equipment	UHF RFID reader
Model	NUR-10W
FCC ID	SCCNUR10W
Manufacturer	Nordic ID Oy

Type of Equipment	WLAN / Bluetooth module
Model	SDC-SSD40NBT
FCC ID	SCC-SDC SSD40NBT
Manufacturer	Nordic ID Oy

Host device

Type of Equipment	Nordic ID Medea ACD
Model	815-2A
Manufacturer	Nordic ID Oy

Standards

- 47 CFR §1.1307, §1.1310, §2.1091
- KDB 4477498 D01 V05R02

RF Exposure compliance calculation for FCC

Host device Nordic ID Medea ACD will not be available / used in public conditions. User(s) of device are employees working for some company and they are trained how to use device either by Nordic ID specialists or partner(s) which are authorized by Nordic ID. Device does not have holster or any other accessory which bring device close to human body. To ensure ergonomic and safe use of device, Nordic ID has prepared training document "Nordic ID Medea ACD RF safety training". This document will be provided to customers and is part of training.

When user hold device in hand, distance from RFID antenna to fingers in pistol grip is 75mm.

From KDB447498 clause 4.3.1

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where $f(\text{GHz})$ is the RF channel transmit frequency in GHz

$$(P_{\text{max}}/d) \cdot \sqrt{0.9 \text{GHz}} \leq 7.5$$

For separation distance > 50 mm we need P_{max} at $d=50$ mm distance

$$P_{\text{max}} \leq (7.5/\sqrt{0.9}) \cdot 50\text{mm} = \underline{\underline{395.3\text{mW}}}$$

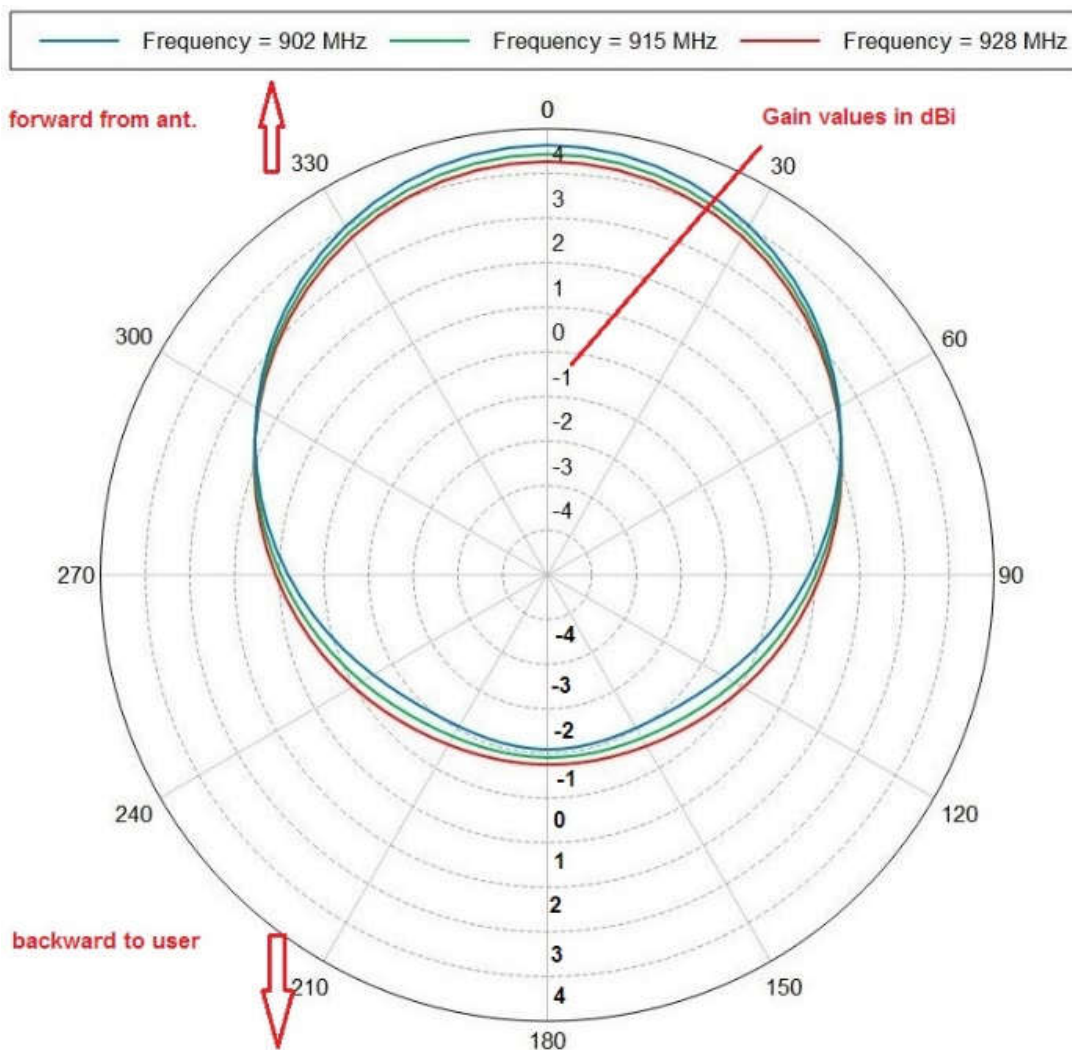
b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):³²
 {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·(f_{MHz}/150)]} mW, for 100 MHz to 1500 MHz

$$= \{ [395.3\text{mW}] + [(75\text{mm} - 50\text{mm}) \cdot (900/150)] \} \text{mW}$$

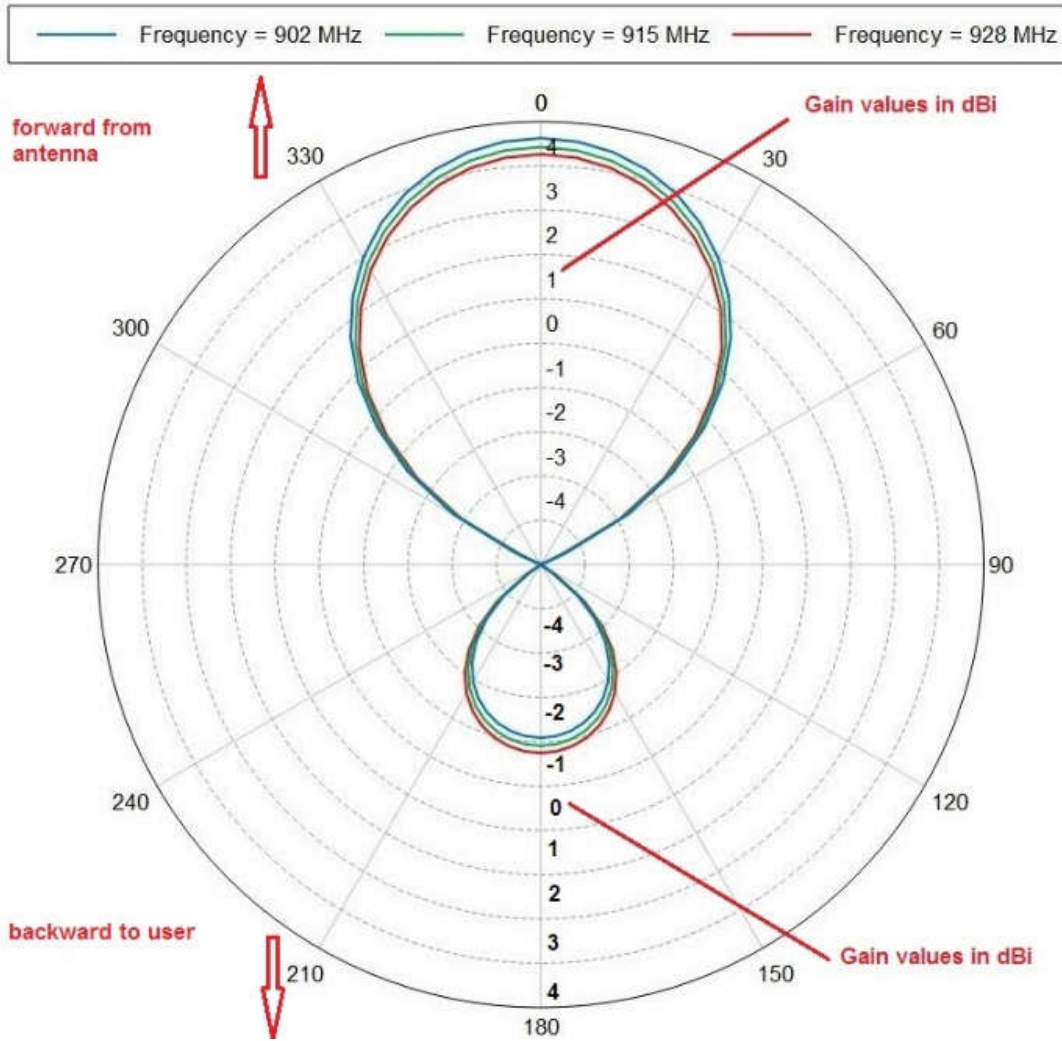
$$= 395.3 + 150 = \mathbf{545.3\text{mW}}$$

RFID Device maximum output power is 670mW at 902.5 – 928.5MHz.

Host device ACD antenna max gain is 5dBi. However, antenna directivity is very good and gain backwards to user fingers in pistol grip is -1dBi which means that most of the energy is going forward as user is pointing towards RFID tag's when searching and reading them. If we count module power 28.26dBm -1dBi gain we get result as 27.26dBm / 532.1mW. This is below exclusion threshold 545.3mW calculated above. See antenna plots in pictures below illustrating max gain and directions.



Pic 1. Medea ACD antenna Phi



Pic 2. Medea ACD antenna Theta

If FCC agrees with Nordic ID explanations, then SAR testing for RFID can be exempted.

When user hold device in hand, distance from WLAN antenna to fingers in pistol grip is 55mm.

WLAN 5GHz

From KDB447498 clause 4.3.1

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{GHz}}}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where f_{GHz} is the RF channel transmit frequency in GHz

For separation distance >50 mm we need Pmax at $d=50$ mm distance

$$P_{\text{max}} \leq (7.5/\sqrt{5.8}) * 50\text{mm} = \underline{\underline{155.7\text{mW}}}$$

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following (also illustrated in Appendix B):³²

{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

$$= \{[155.7\text{mW}] + [(55\text{mm} - 50\text{mm}) * 10]\}$$

$$= 155.7\text{mW} + 50\text{mW} = \underline{\underline{205.7\text{mW is max allowed power.}}}$$

Maximum WLAN 5GHz module power is 37.33mW @5.8GHz

Conclusion is that limb worn SAR testing for 5GHz WLAN can be exempted.

WLAN 2.45GHz

From KDB447498 clause 4.3.1

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{GHz}}}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where f_{GHz} is the RF channel transmit frequency in GHz

For separation distance >50 mm we need Pmax at $d=50$ mm distance

$$P_{\text{max}} \leq (7.5/\sqrt{2.45}) * 50\text{mm} = \underline{\underline{239.62\text{mW}}}$$

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following (also illustrated in Appendix B):³²

{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

$$= \{[239.62\text{mW}] + [(55\text{mm} - 50\text{mm}) * 10]\}$$

$$= 239.62\text{mW} + 50\text{mW} = \underline{\underline{289.62\text{mW is max allowed power.}}}$$

Maximum WLAN/BT 2.4GHz module power is 39mW @2.45GHz WLAN mode b.

Conclusion is that limb worn SAR testing for 2.4GHz WLAN can be exempted.

Bluetooth 2.45

From KDB447498 clause 4.3.1

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{GHz}}}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where f_{GHz} is the RF channel transmit frequency in GHz

For separation distance >50mm we need Pmax at d=50mm distance

$$P_{\max} \leq (7.5/\sqrt{2.45}) * 50\text{mm} = \underline{\underline{155.7\text{mW}}}$$

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):³²

$$\begin{aligned} & \{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot 10]\} \text{ mW,} \\ & \text{for } > 1500 \text{ MHz and } \leq 6 \text{ GHz} \\ & = \{[155.7\text{mW}] + [(55\text{mm} - 50\text{mm}) \cdot 10]\} \\ & = 155.7\text{mW} + 50\text{mW} = \underline{\underline{205.7\text{mW is max allowed power.}}} \end{aligned}$$

Maximum Bluetooth 2.45GHz module power is 1.7mW @2.45GHz

Conclusion is that limb worn SAR testing for 2.4GHz Bluetooth can be exempted.

Simultaneous transmission calculation

Per formula in KDB 447498 4.3.2 b)

RFID:

$[670\text{mW}/50\text{mm}] * [\text{sgrt } 0.9\text{GHz}/18.75] = \mathbf{0.69\text{W/Kg}}$ (670mW is RFID module power)

$[532.1\text{mW}/50\text{mm}] * [\text{sgrt } 0.9\text{GHz}/18.75] = \mathbf{0.54\text{W/kg}}$ (532mW is RFID power towards user fingers with antenna gain)

WLAN 2.45GHz:

$[39\text{mW}/50\text{mm}] * [\text{sgrt } 2.45\text{GHz}/18.75] = \mathbf{0.064\text{W/Kg}}$ (39mW is max WLAN power from module @ 2.45GHz)

Bluetooth 2.45:

$[1.7\text{mW}/50\text{mm}] * [\text{sgrt } 2.45\text{GHz}/18.75] = \mathbf{0.0028\text{W/Kg}}$ (1.7mW is max WLAN power from module @ 2.4GHz)

WLAN 5GHz:

$[39\text{mW}/50\text{mm}] * [\text{sgrt } 5.8\text{GHz}/18.75] = \mathbf{0.1\text{W/Kg}}$ (39mW is max WLAN power from module @ 5.8GHz)

Now we calculate these together:

$0.1\text{W/Kg} + 0.69\text{W/Kg} = \mathbf{0.79\text{W/Kg}}$ (This is with RFID max module power + 5GHz WLAN)

$0.1\text{W/Kg} + 0.54\text{W/Kg} = \mathbf{0.64\text{W/Kg}}$ (This is with ACD RFID antenna + 5GHz WLAN)

$0.064\text{W/Kg} + 0.69\text{W/Kg} = \mathbf{0.75\text{W/Kg}}$ (This is with RFID max module power + 2.45WLAN)

$0.064\text{W/Kg} + 0.54\text{W/Kg} = \mathbf{0.64\text{W/Kg}}$ (This is with ACD RFID antenna + 2.45GHz WLAN)

$0.0028\text{W/Kg} + 0.69\text{W/Kg} = \mathbf{0.69\text{W/Kg}}$ (This is with RFID max module power + 2.45GHz Bluetooth)

Limit is 1W/Kg for 10-g SAR so it's under limit.

Conclusion is that host product Medea ACD meets FCC SAR test exclusion limits and can be exempted.

Sincerely,

Rauno Nikkilä
 Certification Specialist
 Nordic ID Oy