

Statement of Human Exposure to Radiofrequency Electromagnetic Field

Certified modules:

Type of Equipment	UHF RFID reader
Model	NUR-05WL2
FCC ID	SCCNUR05WL2
Manufacturer	Nordic ID Oy

Type of Equipment	WLAN / Bluetooth module
Model	SDC-SSD40NBT
FCC ID	SCC-SDCSSD40NBT
Manufacturer	Nordic ID Oy

Host device

Type of Equipment	Nordic ID Merlin CD
Model	805-2A
Manufacturer	Nordic ID Oy

Standards

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

RF Exposure compliance calculation for FCC

Nordic ID Merlin CD is a product which is commonly used by employees working in retail shops performing inventory of products or storage handling, in industry e.g. car factory plant or in logistic centre. Merlin CD is not available or used by public customers so it's not consumer product like mobile phones / tablets.

Merlin CD users will receive training before they use device. In training, they are guided how to hold device correctly and how to use it ergonomically. Merlin CD does not have a holster so it would not be operated close to body.

RFID antenna distance to hand grip area is illustrated in photo "Merlin CD RFID antenna distance to hand grip area"

When user hold device in hand, distance from RFID antenna to fingers in pistol grip is 116mm.

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:

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

 f_{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
 $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f_{\text{MHz}}/150)]\} \text{ mW}$, for 100 MHz to 1500 MHz

$$= \{[395.3 \text{ mW}] + [(116 \text{ mm} - 50 \text{ mm}) \cdot (900/150)]\} \text{ mW}$$

$$= 395.3 \text{ mW} + 396 \text{ mW} = \mathbf{791.3 \text{ mW}}$$

RFID Device maximum output power is 388mW at 902.5 – 928.5MHz.

Conclusion is that limb worn SAR testing for RFID can be exempted.

WLAN / Bluetooth antenna distance to hand grip area is illustrated in photo “Merlin CD WLAN_BT antenna distance to hand grip area”

When user hold device in hand, distance from WLAN antenna to fingers in pistol grip is 80mm.

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

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

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

$\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot 10]\} \text{ mW}$, for > 1500 MHz and ≤ 6 GHz
 $= \{[155.7 \text{ mW}] + [(80 \text{ mm} - 50 \text{ mm}) \cdot 10]\}$

$$= 155.7 \text{ mW} + 300 \text{ mW} = \mathbf{455.7 \text{ mW is max allowed power.}}$$

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

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

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
 $=\{[239.62\text{mW}]+[(80\text{mm}-50\text{mm})\cdot 10]\}$
 $=239.62\text{mW}+300\text{mW}=\mathbf{539.62\text{mW}}$ 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
 $f(\text{GHz})$ is the RF channel transmit frequency in GHz

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

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

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
 $=\{[155.7\text{mW}]+[(80\text{mm}-50\text{mm})\cdot 10]\}$
 $=155.7\text{mW}+300\text{mW}=\mathbf{455.7\text{mW}}$ is max allowed power.

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:

$[388\text{mW}/50\text{mm}] * [\text{sgrt } 0.9\text{GHz}/18.75] = \mathbf{0.39\text{W/Kg}}$ (388mW is RFID module power)

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:

$0.1\text{W/Kg} + 0.39\text{W/Kg} = \mathbf{0.49\text{W/Kg}}$ (This is with RFID max module power + 5GHz WLAN)

$0.064\text{W/Kg} + 0.39\text{W/Kg} = \mathbf{0.454\text{W/Kg}}$ (This is with RFID max module power + 2.45WLAN)

$0.0028\text{W/Kg} + 0.39\text{W/Kg} = \mathbf{0.39\text{W/Kg}}$ (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 Merlin CD meets FCC SAR test exclusion limits and can be exempted.

Sincerely,



Rauno Nikkilä
Certification Specialist
Nordic ID Oy