

RF EXPOSURE ASSESSMENT

In addition to an MPE calculation report on Nordic ID UHF RFID reader module model NUR-05WL2 this RF exposure assessment also takes account of some assumed co-location designs incorporating the NUR-05WL2 together with the following transmitters: WLAN, Bluetooth, and WWAN.

THE BASIS FOR ASSESSMENT

Assessment of RF exposure is based on the squared permitted limits (MPE) the FCC OET65 (Edition 97-01) shows in the Table 1 B of Appendix A, and the RSS-102 (Issue 4, March 2010) shows in the Section 4.2.

To calculate the maximum power density of the transmitter with its antenna at the distance of 20 cm the following formula is used:

$$S \text{ (mWcm}^{-2}\text{)} = PG / 4\pi d^2$$

S = power density

P (mW) = power input to the antenna

G (linear value) = power gain (ratio) of the antenna in the direction of maximum gain relative to an isotropic radiator

d (cm) = distance to the center of radiation of the antenna

To assess simultaneous RF exposure from different transmitters at the distance of 20 cm the following formula is used:

$$\sum_{i=1}^n S_i / \text{MPE}_i \leq 1$$

S (mWcm⁻²) = calculated maximum power density of the transmitter at the distance of 20 cm

MPE (mWcm⁻²) = Maximum Permitted Exposure

CALCULATED MPE REPORTS

NUR-05WL2 TRANSMITTER

Operating Frequency Range = 902 – 928 MHz

Maximum conducted power (P) = +26.00 dBm

Maximum antenna gain (G) = 8 dBi

Maximum Permitted Exposure (MPE) = $f/1500 \text{ (mWcm}^{-2}\text{)} = 915/1500 = 0.61 \text{ mWcm}^{-2}$

S / MPE = 0.8192

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
915	398.1072	6.3096	20	0.499724	0.61

ASSUMED WLAN AND BLUETOOTH TRANSMITTERS

WLAN 2400 MHz

Operating Frequency Range = 2400 - 2473 MHz

Maximum conducted power (P) = +18.0 dBm

Maximum antenna gain (G) = 10 dBi

Maximum Permitted Exposure (MPE) = 1.0 mWcm⁻²

$$S / MPE = 0.1255$$

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
2400	63.0957	10.0	20	0.125525	1.0

WLAN 5150 MHz

Operating Frequency Range = 5150 - 5250 MHz

Maximum conducted power (P) = +13.0 dBm

Maximum antenna gain (G) = 4 dBi

Maximum Permitted Exposure (MPE) = 1.0 mWcm⁻²

$$S / MPE = 0.01$$

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
5150	19.9526	2.5119	20	0.009971	1.0

WLAN 5250/5470 MHz

Operating Frequency Ranges = 5250 – 5350 MHz and 5470 - 5725 MHz

Maximum conducted power (P) = +14,0 dBm

Maximum antenna gain (G) = 10 dBi

Maximum Permitted Exposure (MPE) = 1.0 mWcm⁻²

$$S / MPE = 0.05$$

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
5250/5470	25.1189	10.0	20	0.049972	1.0

WLAN 5725 MHz

Operating Frequency Range = 5725 - 5825 MHz

Maximum conducted power (P) = +14.0 dBm

Maximum antenna gain (G) = 15 dBi

Maximum Permitted Exposure (MPE) = 1.0 mWcm⁻²

$$S / MPE = 0.1580$$

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
5725	25.1189	31.6228	20	0.158027	1.0

Bluetooth

Operating Frequency Range = 2400 - 2473 MHz

Maximum conducted power (P) = +4.0 dBm

Maximum antenna gain (G) = 3 dBi

Maximum Permitted Exposure (MPE) = 1.0 mWcm⁻²

S / MPE = 0.001

Frequency (MHz)	P (mW)	G (linear)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
2400	2.5119	1.9953	20	0.000997	1.0

ASSUMED WWAN TRANSMITTERS**PCS-1900**

Operating Frequency Range (from the mobile device to the network) = 1850 – 1910 MHz

Maximum conducted power (P) = +24.0 dBm

Maximum antenna gain (G) = 1.7 dBi

Maximum Permitted Exposure (MPE) = 1 mWcm⁻²

S / MPE = 0.0739

Frequency (MHz)	P (mW)	G (lin)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
1850	251.1886	1.4791	20	0.073915	1.0

GSM-850

Operating Frequency Range (from the mobile device to the network) = 824 – 849 MHz

Maximum conducted power (P) = +24.0 dBm

Maximum antenna gain (G) = 1.7 dBi

Maximum Permitted Exposure (MPE) = $f/1500$ (mWcm⁻²) = $836.5/1500 = 0.557667$ mWcm⁻²

S / MPE = 0.1325

Frequency (MHz)	P (mW)	G (lin)	d (cm)	S (mW/cm ²)	MPE (mW/cm ²)
836.5	251.1886	1.4791	20	0.073915	0.557667

NUR-05WL2 AND THEORETICAL CO-LOCATION ASSESSMENTS

NUR-05WL2 TRANSMITTER

NUR-05WL2: S / MPE = 0.8192

$$\underline{0.8192 < 1}$$

NUR-05WL2 AND WLAN 2400 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192

WLAN 2400 MHz: S / MPE = 0.1255

$$\underline{0.8192 + 0.1255 = 0.9447 < 1}$$

NUR-05WL2, WLAN 2400, AND BLUETOOTH TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192

WLAN 2400 MHz: S / MPE = 0.1255

Bluetooth: S / MPE = 0.001

$$\underline{0.8192 + 0.1255 + 0.001 = 0.9457 < 1}$$

NUR-05WL2, WLAN 2400 MHz, AND WLAN 5150 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192

WLAN 2400 MHz: S / MPE = 0.1255

WLAN 5150 MHz: S / MPE = 0.01

$$\underline{0.8192 + 0.1255 + 0.01 = 0.9547 < 1}$$

NUR-05WL2 AND WLAN 5150 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192

WLAN 5150 MHz: S / MPE = 0.01

$$\underline{0.8192 + 0.01 = 0.8292 < 1}$$

NUR-05WL2, WLAN 5150, AND BLUETOOTH TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192

WLAN 5150 MHz: S / MPE = 0.01

Bluetooth: S / MPE = 0.001

$$\underline{0.8192 + 0.01 + 0.001 = 0.8302 < 1}$$

NUR-05WL2 AND WLAN 5250/5470 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
WLAN 5250/5470 MHz: S / MPE = 0.05

$$\underline{0.8192 + 0.05 = 0.8692 < 1}$$

NUR-05WL2, WLAN 5250/5470, AND BLUETOOTH TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
WLAN 5250/5470 MHz: S / MPE = 0.05
Bluetooth: S / MPE = 0.001

$$\underline{0.8192 + 0.05 + 0.001 = 0.8702 < 1}$$

NUR-05WL2 AND WLAN 5725 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
WLAN 5725 MHz: S / MPE = 0.1580

$$\underline{0.8192 + 0.1580 = 0.9772 < 1}$$

NUR-05WL2, WLAN 5725, AND BLUETOOTH TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
WLAN 5725 MHz: S / MPE = 0.1580
Bluetooth: S / MPE = 0.001

$$\underline{0.8192 + 0.1580 + 0.001 = 0.9782 < 1}$$

NUR-05WL2 AND PCS 1900 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
PCS 1900: S / MPE = 0.0739

$$\underline{0.8192 + 0.0739 = 0.8931 < 1}$$

NUR-05WL2, PCS 1900, AND WLAN 5150 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
PCS 1900: S / MPE = 0.0739
WLAN 5150 MHz: S / MPE = 0.01

$$\underline{0.8192 + 0.0739 + 0.01 = 0.9031 < 1}$$

NUR-05WL2, PCS 1900, WLAN 5150 AND BLUETOOTH TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
PCS 1900: S / MPE = 0.0739
WLAN 5150 MHz: S / MPE = 0.01
Bluetooth: S / MPE = 0.001

$$0.8192 + 0.0739 + 0.01 + 0.001 = 0.9041 < 1$$

NUR-05WL2 AND GSM 850 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
GSM 850: S / MPE = 0.1325

$$0.8192 + 0.1325 = 0.9517 < 1$$

NUR-05WL2, GSM 850, AND WLAN 5150 TRANSMITTERS CO-LOCATED

NUR-05WL2: S / MPE = 0.8192
GSM 850: S / MPE = 0.1325
WLAN 5150 MHz: S / MPE = 0.01

$$0.8192 + 0.1325 + 0.01 = 0.9617 < 1$$

NUR-05WL2, GSM 850, WLAN 5150, AND BLUETOOTH TRANSMITTERS CO-LOCATED

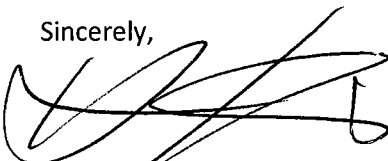
NUR-05WL2: S / MPE = 0.8192
GSM 850: S / MPE = 0.1325
WLAN 5150 MHz: S / MPE = 0.01
Bluetooth: S / MPE = 0.001

$$0.8192 + 0.1325 + 0.01 + 0.001 = 0.9627 < 1$$

CONCLUSION

The Nordic ID UHF RFID reader module model NUR-05WL2 is within the limit of the Maximum Permitted Exposure (MPE) given by the FCC OET65 (Edition 97-01) and by the Industry Canada RSS-102 (Issue 4, March 2010). In addition, it is possible to co-locate the NUR-05WL2 module with the transmitters according to the MPE reports and the theoretical co-location assessments above.

Sincerely,



Hannu Heino
Technical Director
Nordic ID Oy
hannu.heino@nordicid.com