RF Exposure Assessment

On

NetModule AG

NB2800/NB2810

contains FCC ID: RI7LN920 (Cellular)
contains FCC ID: TKWLE600VX (Wifi)

Assessment Reference: MDE_NETMO_2302_MPE_01

Date: 2023-09-29

Test Laboratory:
7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany

Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

Contents

1 Summary

The RF-exposure assessment according to KDB 447498 D01 General RF Exposure Guidance v06 shows, that the worst-case RF exposure values of the assessed radio technologies and bands are below the Limits for General Population/Uncontrolled Exposure:

- Table 1 (II) to § 1.1310(E)(1) of 47 CFR Ch. I (10–1–21 Edition).

COMMENTS:

- Assessment limited to supported North American frequency bands
- Prediction Distance R = 40 cm

(approved by) Patrick Lomax	(responsible for report) Andreas Tübel

2 Revision History

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2023-09-29	--	valid
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3 Administrative Data

3.1 Testing Laboratory

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany
Report Template Version:	2022-10-21

3.2 Project Data

Responsible for report:	Andreas Tübel
Date of Report:	2023-09-29

3.3 Applicant Data

Company Name:	NetModule AG
Address:	Maulbeerstrasse 10, 3011 Bern Switzerland
Contact Person: Phone Email	Mr. Matthias Fricker +41 31 537 09 25 Matthias.Fricker@netmodule.com

3.4 Manufacturer Data

Company Name:	please see Applicant Data
Address: Contact Person:	

4 Test object Data

Declared EUT data by the supplier	
Kind of Device product description	The NB2800/NB2810 is a vehicle router with Ethernet ports and optional extensions. Wireless technologies include LTE, UMTS, WLAN and GNSS.
Product name	Vehicle Router NB2800/NB2810
Type	NB2800-2Lp2Wac* NB2810-2Lp2Wac* 2Lp: 2x LTE/UMTS (Telit LN920A12-WW) 2Wac:2x WLAN (Compex WLE600VX) *other non-relevants options (e.g. storage,GNSS)
Integrated transmitter	
Cellular Radio Module Telit LN920A12-WW	
supported Radio technologies	UMTS/HSPA(+) and LTE
Supplied document(s)	SGS, RF Exposure Report, ER/2021/A0031-01, 2022-03-16
WLAN Radio Module Compex WLE600VX	
supported Radio technologies	WLAN 2.4 GHz and 5 GHz
Supplied document(s)	MRT Technology (Suzhou) Co., Ltd, RF Exposure Evaluation Declaration, 2103RSU076-U3, V01, 2021-08-15

5 Assessment

5.1 Assessment method and subject of assessment

Calculation of power density and comparison with reference levels for general public exposure. Applicability area and limitations: Power density can be calculated in far field region.

Applied Standards:

- IEEE Std C95.3-2021, D.4.2 Antennas – Main beam on-axis, general method for determining the power density at points in the radiating near-field and far-field antenna regions.
- IEEE Std C95.1-2019, D.2 Multifrequency exposures (exposures to multiple sources)

Specific information:

- Values used for calculation are based on supplied documents and supplied RF exposure reports.
- Output power values are based on the supplied RF exposure reports.

Worst case considerations:

- Main beams of the antennas are directed to the same point in the prediction distance.
- Output power values are based on the manufacturer technical data sheet + tolerances.
- Antenna gain values are based on values declared by the manufacturer.
- Cable loss of internal antenna cables set to 0.
- Duty cycle factor WLAN 2.4 GHz and 5GHz = 1,
- Duty cycle factor UMTS = 1,
- Duty cycle factor LTE = 1.
- The radio modules can transmit independently from each other:
  (1 cellular band + WLAN 2,4 GHz).
  (1 cellular band + WLAN 5 GHz).
- Selected bands for multi frequency exposure calculations:
  worst case of each cellular technology + WLAN 2.4 GHz and + worst case of each cellular technology + WLAN 5 GHz
- WiFi module is Compex WLE600VX (WiFi 2.4 GHz and WiFi 5GHz cannot transmit together on the same time slot).

5.2 Exposure limits

Extract of

- Table 1 (II) to § 1.1310(E)(1) of 47 CFR Ch. I (10–1–21 Edition).

Frequency range	*Power density*	*Power density*
MHz	*W/m²*	*mW/cm²*
300 – 1500	f/150	f/1500
1500 - 100000	10	1

Note:
f in MHz

5.3 Formulas used for calculation

5.3.1 Single-frequency exposures (exposures to one source)

Table D.2—Determining power density on antenna main beam axis

$$S_{FF} = \frac{G_i P_{in}}{4\pi d^2}$$

In this report is the power density S_i at frequency i calculated in mW/cm^2.
G_i is the (isotropic) far-field antenna gain (power ratio) at frequency i.
P_{in} is the power into the antenna in mW => P_{mW}.
d is the distance to the antenna in cm.

5.3.2 Multi-frequency exposures (exposures to multiple sources)

Summation based on IEEE Std C95.1-2019, D.2

$$\sum_{i=1}^{n} \frac{exposure_i}{ERL_i} < 1$$

In this report is the power density calculated. In the tables below is "*exposure*" = S_i = power density at frequency i.
ERL_i is the corresponding exposure reference level at frequency i.

IEEE Std C95.1-2019:
exposure reference level (ERL): The maximum exposure level relative to ambient electric and/or magnetic field strength or power density, induced and/or contact current, or contact voltage.
NOTE 1— ERLs provide an adequate margin of safety against established adverse health effects.
NOTE 6— In some documents, ERLs are called reference levels, derived limits, permissible exposure limits, maximum permissible exposure values, action levels, or investigation levels.

5.4 Module(s) single-frequency exposures used for multi-frequency calculation

5.4.1 Cellular Single-frequency exposures

Prediction Distance d in cm =>	40	TX frequ. band	Prediction frequ.	Average (temporal) power (log.)	Average (temporal) power (lin.)	Max Antenna Gain Allowed Gain (log.)	Max Antenna Gain Allowed Gain (lin.)	Power density at distance d	Power density limit at frequency f_i	Ratio to exposure reference level	Sum of S_i / ERL_i	Compliance, if Sum of S_i / ERL_i < 1
		f_{Band}	f_i	P_{dBm}	P_{mW}	g_{dBi}	G_i	S_i	ERL_i	S_i / ERL_i	-	-
Radio technology	Band	MHz	MHz	dBm	mW	dBi	-	mW/cm²	mW/cm²	-	-	-
UMTS	FDD II	1850 - 1910	1852.4	24.5	281.84	9.00	7.94	0.111	1.000	0.111	0.111	Pass
UMTS	FDD IV	1710 - 1755	1712.4	24.5	281.84	9.00	7.94	0.111	1.000	0.111	0.111	Pass
UMTS	FDD V	824 - 849	826.4	24.5	281.84	7.00	5.01	0.070	0.551	**0.128**	0.128	Pass
LTE	eFDD2	1850 - 1910	1850.7	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eFDD4	1710 - 1755	1710.7	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eFDD5	824 - 849	824.7	23.5	223.87	7.00	5.01	0.056	0.550	0.101	0.101	Pass
LTE	eFDD7	2500 - 2570	2502.5	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eFDD12	699 - 716	699.7	23.5	223.87	7.00	5.01	0.056	0.466	**0.120**	0.120	Pass
LTE	eFDD13	777 - 787	779.5	23.5	223.87	7.00	5.01	0.056	0.520	0.107	0.107	Pass
LTE	eFDD14	788 - 798	788	23.5	223.87	7.00	5.01	0.056	0.525	0.106	0.106	Pass
LTE	eFDD17	704 - 716	704	23.5	223.87	7.00	5.01	0.056	0.469	0.119	0.119	Pass
LTE	eFDD25	1850 - 1915	1850.7	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eFDD26 Part 90	814 - 824	814.7	23.5	223.87	7.00	5.01	0.056	0.543	0.103	0.103	Pass
LTE	eFDD26	824 - 849	824.7	23.5	223.87	7.00	5.01	0.056	0.550	0.101	0.101	Pass
LTE	eFDD30	2305 - 2315	2307.5	23	199.53	9.00	7.94	0.079	1.000	0.079	0.079	Pass
LTE	eTDD38	2570 - 2620	2572.5	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eTDD41	2496 - 2690	2498.5	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE	eTDD41 (HPUE)	2496 - 2690	2498.5	26.5	446.68	9.00	7.94	0.176	1.000	**0.176**	0.176	Pass
LTE	eTDD48	3550 - 3700	3550	22	158.49	9.00	7.94	0.063	1.000	0.063	0.063	Pass
LTE	eFDD66	1710 - 1780	1710.7	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass

LTE	eFDD71	663 - 698	665.5	23.5	223.87	7.00	5.01	0.056	0.444	0.126	0.126	Pass
LTE CA	5C	824 - 849	824.7	24	251.19	7.00	5.01	0.063	0.550	**0.114**	0.114	Pass
LTE CA	7C	2500 - 2570	2502.5	24	251.19	9.00	7.94	0.099	1.000	0.099	0.099	Pass
LTE CA	38C	2570 - 2620	2572.5	23.5	223.87	9.00	7.94	0.088	1.000	0.088	0.088	Pass
LTE CA	41C	2496 - 2690	2498.5	24	251.19	9.00	7.94	0.099	1.000	0.099	0.099	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412 - 2472	2412	23	199.53	7.00	5.01	0.050	1.000	**0.050**	0.050	Pass
WLAN 5 GHz	5 GHz ISM	5180 - 5240 5260 - 5320 5500 - 5720 5745 - 5825	5180	21.5	141.25	7.00	5.01	0.035	1.000	**0.035**	0.035	Pass

Bold marked = worst case band of the radio technology

Information: 10 W m^{-2} = 1 mW cm^{-2}

5.5 Calculation

5.5.1 Calculation of multi-frequency exposures

Prediction Distance d in cm =>	**40**	TX frequ. band	Prediction frequ.	Average (temporal) power (log.)	Average (temporal) power (lin.)	Max Antenna Gain Allowed Gain (log.)	Max Antenna Gain Allowed Gain (lin.)	Power density at distance d	Power density limit at frequency f_i	Ratio to exposure reference level	Sum of S_i / ERL_i	Compliance, if Sum of S_i / ERL_i < 1
		f_{Band}	f_i	P_{dBm}	$\mathbf{P_{mW}}$	g_{dBi}	$\mathbf{G_i}$	S_i	ERL_i	S_i / ERL_i	-	-
Radio technology	Band	MHz	MHz	dBm	mW	dBi	-	mW/cm²	mW/cm²	-	-	-
UMTS	FDD V	824 - 849	826.4	24.5	281.84	7.00	5.01	0.070	0.551	0.128	0.177	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412 - 2472	2412	23	199.53	7.00	5.01	0.050	1.000	0.050		
UMTS	FDD V	824 - 849	826.400	24.5	281.838	7.00	5.01	0.070	0.551	0.128	0.163	Pass
WLAN 5 GHz	5 GHz ISM	5180 - 5240 5260 - 5320 5500 - 5720 5745 - 5825	5180	21.5	141.25	7.00	5.01	0.035	1.000	0.035		
LTE	eFDD12	699 - 716	699.7	23.5	223.87	7.00	5.01	0.056	0.466	0.120	0.169	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412 - 2472	2412	23	199.53	7.00	5.01	0.050	1.000	0.050		
LTE	eFDD12	699 - 716	699.7	23.5	223.87	7.00	5.01	0.056	0.466	0.120	0.155	Pass
WLAN 5 GHz	5 GHz ISM	5180 - 5240 5260 - 5320 5500 - 5720 5745 - 5825	5180	21.5	141.25	7.00	5.01	0.035	1.000	0.035		
LTE	eTDD41 (HPUE)	2496 - 2690	2498.500	26.5	446.684	9.00	7.94	0.176	1.000	0.176	0.226	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412 - 2472	2412	23	199.53	7.00	5.01	0.050	1.000	0.050		
LTE	eTDD41 (HPUE)	2496 - 2690	2498.500	26.5	446.684	9.00	7.94	0.176	1.000	0.176	0.212	Pass
WLAN 5 GHz	5 GHz ISM	5180 - 5240 5260 - 5320 5500 - 5720 5745 - 5825	5180	21.5	141.25	7.00	5.01	0.035	1.000	0.035		

LTE CA	5C	824 - 849	824.7	24	251.19	7.00	5.01	0.063	0.550	0.114	0.164	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412 - 2472	2412	23	199.53	7.00	5.01	0.050	1.000	0.050		
LTE CA	5C	824 - 849	824.7	24	251.19	7.00	5.01	0.063	0.550	0.114	0.149	Pass
WLAN 5 GHz	5 GHz ISM	5180 - 5240 5260 - 5320 5500 - 5720 5745 - 5825	5180	21.5	141.25	7.00	5.01	0.035	1.000	0.035		

Information: 10 W m^{-2} = 1 mW cm^{-2}

END OF REPORT