RF Exposure Assessment

On

Communication-Module 4 MID 0101 NA

Type 1589.3

FCC ID: 2AJW515893

Assessment Reference: MDE_CONTI_2134_MPE_03

Date: 2024-10-18

Test Laboratory:
7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany

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 = 20 cm

(approved by)	(responsible for report)
Imad Hjije	Melanie Anastassiou

2 Revision History

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2024-10-18	--	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:	Melanie Anastassiou
Date of Report:	2024-10-18

3.3 Applicant Data

Company Name:	Continental Automotive Technologies GmbH
Address:	Heinrich-Hertz-Straße 45 78052 Villingen-Schwenningen Germany
Contact Person	Patrick Seng

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 CM4 is a communication module with several wired interfaces to the vehicle. Additional functions as GNSS, mobile communication, WiFi and Bluetooth are provided.
Product name(s)	Communication-Module 4 MID 0101 NA
Type(s)	Type 1589.3
Integrated transmitter	Cellular, WiFi, Bluetooth, GNSS.

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.

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 Calculation

5.4.1 Cellular Single-frequency exposures

Prediction Distance d in cm =>	20	Prediction freq.	Avarage (temporal) power (log.)	Avarage (temporal) power (lin)	Max. Gain (log.)	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_i	P_{dBm}	P_{mW}	g_{dBi}	G_i	S_i	ERL_i	S_i / ERL_i	-	-
Radio technology	Band	MHz	dBm	mW	dBi	-	mW/cm²	mW/cm²	-	-	-
UMTS	FDDII	1850,0	23,5	223,87	6	3,98	0,177	1,000	0,177	0,177	Pass
UMTS	FDDV	824,0	23,5	223,87	6	3,98	0,177	0,549	0,323	0,323	Pass
LTE	eFDD2	1850,0	23,0	199,53	7	5,01	0,199	1,000	0,199	0,199	Pass
LTE	eFDD4	17010,0	23,0	199,53	7	5,01	0,199	1,000	0,199	0,199	Pass
LTE	eFDD5	824,0	23,0	199,53	7	5,01	0,199	0,549	0,362	0,362	Pass
LTE	eFDD7	2500,0	23,0	199,53	7	5,01	0,199	1,000	0,199	0,199	Pass
LTE	eFDD12	699,0	23,0	199,53	7	5,01	0,199	0,466	0,427	0,427	Pass
LTE	eFDD13	777,0	23,0	199,53	7	5,01	0,199	0,518	0,384	0,384	Pass
LTE	eFDD14	788,0	23,0	199,53	7	5,01	0,199	0,525	0,379	0,379	Pass
LTE	eTDD41	2496,0	23,0	199,53	7	5,01	0,199	1,000	0,199	0,199	Pass
Bluetooth LE	2.4 GHz ISM	2402,0	-1,1	0,78	4,4	2,75	0,000	1,000	0,000	0,000	Pass
Bluetooth Classic	2.4 GHz ISM	2402,0	3,2	2,09	4,4	2,75	0,001	1,000	0,001	0,001	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412,0	11,9	15,49	4,4	2,75	0,008	1,000	0,008	0,008	Pass
WLAN 5 GHz	U-NII Subband 1	5180,0	7,5	5,62	5	3,16	0,004	1,000	0,004	0,004	Pass
Bold marked = worst case band of the radio technology											
Information: 10 W m-2 = 1 mW cm-2											

5.4.2 Calculation of multi-frequency exposures

Prediction Distance d in cm =>	20	Prediction freq.	Avarage (temporal) power (log.)	Avarage (temporal) power (lin)	Max. Gain (log.)	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_i	P_{dBm}	P_{mW}	g_{dBi}	G_i	S_i	ERL_i	S_i / ERL_i	-	-
Radio technology	Band	MHz	dBm	mW	dBi	-	mW/cm²	mW/cm²	-	-	-
LTE	eFDD12	699	23	199,53	7	5,01	0,199	0,466	0,427	0,439	Pass
WLAN 2.4 GHz	2.4 GHz ISM	2412	11,9	15,49	4,4	2,75	0,008	1,000	0,008		
WLAN 5 GHz	U-NII Subband 1	5180	7,5	5,62	5	3,16	0,004	1,000	0,004		
Information: 10 W m-2 = 1 mW cm-2											

END OF REPORT