

MPE / SAR exemption letter 22-1-0119701T012a

MPE / SAR exemption letter according Interim procedure KDB 447498 D04

Customer	Product	Model	Type	HW Status	SW status	FCC ID
Grundfos Holding A/S Poul Due Jensens Vej 7 DK-8850 Bjerringbro Denmark	Cellular module	CIM 290-MA LPWAN GiC	N/A	R03	MCU: 92875953V00.00.00.00018 _CIM290_R_Merged BLE FW: V06.00.03.00001 Cellular FW: M0C.400004	OG3- CIM290LPWAN

Declared minimum distance to human body according to customer ≥ 20 cm according customer's document "MPE Information Requirements - all EU & AMERICA bands V0928 to adjust GSM rated power".

The customer thus declares that the device is not body-worn.

RF Exposure Test Exemptions for Single Source

MPE-based Exemption

According 1.1307(b)(3)(i)(C) Option C – ERP at frequencies above 300 kHz but at distances $R > \lambda/2\pi$ can be exempted as follows:

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES
SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R ²
1.34	–	30	35.6 m	–	1.6 m	3,450 R ² /f ²
30	–	300	1.6 m	–	159 mm	3.83 R ²
300	–	1,500	159 mm	–	31.8 mm	0.0128 R ² f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R ²
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

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SAR-based Exemption

According 1.1307(b)(3)(i)(B) Option B – Available maximum time-averaged power or effective radiated power (ERP) at frequencies above 300 kHz and below 6 GHz, but with distances from 0.5 cm to 40 cm may be exempted as follows:

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (\text{B.1})$$

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B.2})$$

11/29/2021

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)									
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

Calculation based on external document

“MPE Information Requirements - all EU & AMERICA bands V0928 to adjust GSM rated power”
provided by customer.

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GSM

MPE-based Exemption

Exemption acc. TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION																
Band	Technology	Frequency	$\lambda/2\pi$	R	R ≥ $\lambda/2\pi$ fulfilled	Maximum Rated Conducted Output Power (dBm)	Maximum Tolerance	Minimum Path Loss to Antenna connector	Minimum Path Loss in Antenna cable	Maximum Antenna Gain	Duty Cycle	EIRP	ERP	ERP	Threshold ERP	MPE Exemption fulfilled
		(MHz)	(m)	(m)			(dB)	(dB)	(dB)	(dBi)	(%)	(dBm)	(dBm)	(W)	(W)	
GSM 850	GPRS 1UL slot	824.2	0.058	0.200	yes	32.5	2.0	0.0	0.5	2.0	12.5	27.0	24.8	0.303	0.422	yes
		836.5	0.057	0.200	yes							27.0	24.8	0.303	0.428	yes
		848.8	0.056	0.200	yes							27.0	24.8	0.303	0.435	yes
	GPRS 2UL slot	824.2	0.058	0.200	yes	32.5	2.0	0.0	0.5	2.0	25.0	30.0	27.8	0.607	0.422	no
		836.5	0.057	0.200	yes							30.0	27.8	0.607	0.428	no
		848.8	0.056	0.200	yes							30.0	27.8	0.607	0.435	no
	GPRS 3UL slot	824.2	0.058	0.200	yes	29.0	2.0	0.0	0.5	2.0	37.5	28.2	26.1	0.406	0.422	yes
		836.5	0.057	0.200	yes							28.2	26.1	0.406	0.428	yes
		848.8	0.056	0.200	yes							28.2	26.1	0.406	0.435	yes
	GPRS 4UL slot	824.2	0.058	0.200	yes	27.0	2.0	0.0	0.5	2.0	50.0	27.5	25.3	0.342	0.422	yes
		836.5	0.057	0.200	yes							27.5	25.3	0.342	0.428	yes
		848.8	0.056	0.200	yes							27.5	25.3	0.342	0.435	yes
	EGPRS 1UL slot	824.2	0.058	0.200	yes	27.0	2.0	0.0	0.5	2.0	12.5	21.5	19.3	0.085	0.422	yes
		836.5	0.057	0.200	yes							21.5	19.3	0.085	0.428	yes
		848.8	0.056	0.200	yes							21.5	19.3	0.085	0.435	yes
	EGPRS 2UL slot	824.2	0.058	0.200	yes	27.0	2.0	0.0	0.5	2.0	25.0	24.5	22.3	0.171	0.422	yes
		836.5	0.057	0.200	yes							24.5	22.3	0.171	0.428	yes
		848.8	0.056	0.200	yes							24.5	22.3	0.171	0.435	yes
	EGPRS 3UL slot	824.2	0.058	0.200	yes	26.0	2.0	0.0	0.5	2.0	37.5	25.2	23.1	0.204	0.422	yes
		836.5	0.057	0.200	yes							25.2	23.1	0.204	0.428	yes
		848.8	0.056	0.200	yes							25.2	23.1	0.204	0.435	yes
	EGPRS 4UL slot	824.2	0.058	0.200	yes	25.0	2.0	0.0	0.5	2.0	50.0	25.5	23.3	0.216	0.422	yes
		836.5	0.057	0.200	yes							25.5	23.3	0.216	0.428	yes
		848.8	0.056	0.200	yes							25.5	23.3	0.216	0.435	yes

SAR-based Exemption

Exemption acc. Formula of § 1.1307(b)(3)(i)(B)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION															
Band	Technology	Frequency	R	$R \geq 0.5$ cm and $R \leq 40$ cm fulfilled	Maximum Rated Conducted Output Power (dBm)	Maximum Tolerance (dB)	Minimum Path Loss to Antenna connector (dB)	Minimum Path Loss in Antenna cable (dB)	Maximum Antenna Gain (dBi)	Duty Cycle (%)	EIRP (dBm)	ERP (dBm)	ERP (mW)	Threshold ERP (mW)	MPE Exemption fulfilled
GSM 850	GPRS 2UL slot	824.2	0.200	yes	32.5	2.0	0.0	0.50	2.0	25.0	30.0	27.8	606.653	1681.368	yes
		836.5	0.200	yes							30.0	27.8	606.653	1706.460	yes
		848.8	0.200	yes							30.0	27.8	606.653	1731.552	yes

MPE-based Exemption

Exemption acc. TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION																
Band	Technology	Frequency	$\lambda/2\pi$	R	R ≥ $\lambda/2\pi$ fulfilled	Maximum Rated Conducted Output Power (dBm)	Maximum Tolerance	Minimum Path Loss to Antenna connector	Minimum Path Loss in Antenna cable	Maximum Antenna Gain	Duty Cycle	EIRP	ERP	ERP	Threshold ERP	MPE Exemption fulfilled
		(MHz)	(m)	(m)			(dB)	(dB)	(dB)	(dBi)	(%)	(dBm)	(dBm)	(W)		
GSM 1900	GPRS 1UL slot	1850.2	0.026	0.200	yes	29.5	2.0	0.0	0.5	2.0	12.5	24.0	21.8	0.152	0.768	yes
		1880.0	0.025	0.200	yes							24.0	21.8	0.152	0.768	yes
		1909.8	0.025	0.200	yes							24.0	21.8	0.152	0.768	yes
	GPRS 2UL slot	1850.2	0.026	0.200	yes	29.5	2.0	0.0	0.5	2.0	25.0	27.0	24.8	0.304	0.768	yes
		1880.0	0.025	0.200	yes							27.0	24.8	0.304	0.768	yes
		1909.8	0.025	0.200	yes							27.0	24.8	0.304	0.768	yes
	GPRS 3UL slot	1850.2	0.026	0.200	yes	29.0	2.0	0.0	0.5	2.0	37.5	28.2	26.1	0.406	0.768	yes
		1880.0	0.025	0.200	yes							28.2	26.1	0.406	0.768	yes
		1909.8	0.025	0.200	yes							28.2	26.1	0.406	0.768	yes
	GPRS 4UL slot	1850.2	0.026	0.200	yes	28.0	2.0	0.0	0.5	2.0	50.0	28.5	26.3	0.430	0.768	yes
		1880.0	0.025	0.200	yes							28.5	26.3	0.430	0.768	yes
		1909.8	0.025	0.200	yes							28.5	26.3	0.430	0.768	yes
	EGPRS 1UL slot	1850.2	0.026	0.200	yes	26.0	2.0	0.0	0.5	2.0	12.5	20.5	18.3	0.068	0.768	yes
		1880.0	0.025	0.200	yes							20.5	18.3	0.068	0.768	yes
		1909.8	0.025	0.200	yes							20.5	18.3	0.068	0.768	yes
	EGPRS 2UL slot	1850.2	0.026	0.200	yes	26.0	2.0	0.0	0.5	2.0	25.0	23.5	21.3	0.136	0.768	yes
		1880.0	0.025	0.200	yes							23.5	21.3	0.136	0.768	yes
		1909.8	0.025	0.200	yes							23.5	21.3	0.136	0.768	yes
	EGPRS 3UL slot	1850.2	0.026	0.200	yes	25.0	2.0	0.0	0.5	2.0	37.5	24.2	22.1	0.162	0.768	yes
		1880.0	0.025	0.200	yes							24.2	22.1	0.162	0.768	yes
		1909.8	0.025	0.200	yes							24.2	22.1	0.162	0.768	yes
	EGPRS 4UL slot	1850.2	0.026	0.200	yes	24.0	2.0	0.0	0.5	2.0	50.0	24.5	22.3	0.171	0.768	yes
		1880.0	0.025	0.200	yes							24.5	22.3	0.171	0.768	yes
		1909.8	0.025	0.200	yes							24.5	22.3	0.171	0.768	yes

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LTE Cat M1

MPE-based Exemption

Exemption acc. TABLE 1 TO § 1.1307(b)(3)(i)(C) —SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION																
Band	Technology	Frequency	$\lambda/2\pi$	R	$R \geq \lambda/2\pi$ fulfilled	Maximum Rated Conducted Output Power	Maximum Tolerance	Minimum Path Loss to Antenna connector	Minimum Path Loss in Antenna cable	Maximum Antenna Gain	Duty Cycle	ERP	ERP	ERP	Threshold ERP	MPE Exemption fulfilled
		(MHz)	(m)	(m)		(dBm)	(dB)	(dB)	(dB)	(dBi)	(%)	(dBm)	(dBm)	(W)	(W)	
B2	LTE Cat M1	1850.0	0.026	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.768	yes
		1880.0	0.025	0.200	yes							26.5	24.4	0.272	0.768	yes
		1910.0	0.025	0.200	yes							26.5	24.4	0.272	0.768	yes
B4	LTE Cat M1	1710.0	0.028	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.768	yes
		1732.5	0.028	0.200	yes							26.5	24.4	0.272	0.768	yes
		1755.0	0.027	0.200	yes							26.5	24.4	0.272	0.768	yes
B5	LTE Cat M1	824.0	0.058	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.422	yes
		836.5	0.057	0.200	yes							26.5	24.4	0.272	0.428	yes
		849.0	0.056	0.200	yes							26.5	24.4	0.272	0.435	yes
B12	LTE Cat M1	699.0	0.068	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.358	yes
		707.5	0.067	0.200	yes							26.5	24.4	0.272	0.362	yes
		716.0	0.067	0.200	yes							26.5	24.4	0.272	0.367	yes
B13	LTE Cat M1	777.0	0.061	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.398	yes
		782.0	0.061	0.200	yes							26.5	24.4	0.272	0.400	yes
		787.0	0.061	0.200	yes							26.5	24.4	0.272	0.403	yes
B25	LTE Cat M1	1850.0	0.026	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.768	yes
		1882.5	0.025	0.200	yes							26.5	24.4	0.272	0.768	yes
		1915.0	0.025	0.200	yes							26.5	24.4	0.272	0.768	yes
B26	LTE Cat M1	814.0	0.059	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.417	yes
		831.5	0.057	0.200	yes							26.5	24.4	0.272	0.426	yes
		849.0	0.056	0.200	yes							26.5	24.4	0.272	0.435	yes
B66	LTE Cat M1	1710.0	0.028	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.768	yes
		1745.0	0.027	0.200	yes							26.5	24.4	0.272	0.768	yes
		1780.0	0.027	0.200	yes							26.5	24.4	0.272	0.768	yes
B85	LTE Cat M1	698.0	0.068	0.200	yes	23.0	2.0	0.0	0.5	2.0	100	26.5	24.4	0.272	0.357	yes
		707.0	0.068	0.200	yes							26.5	24.4	0.272	0.362	yes
		716.0	0.067	0.200	yes							26.5	24.4	0.272	0.367	yes

BLE

MPE-based Exemption

Exemption acc. TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION																
Band	Technology	Frequency	$\lambda/2\pi$	R	$R \geq \lambda/2\pi$ fulfilled	Maximum Rated Conducted Output Power (dBm)	Maximum Tolerance (dB)	Minimum Path Loss to Antenna connector (dB)	Minimum Path Loss in Antenna cable (dB)	Maximum Antenna Gain (dBi)	Duty Cycle (%)	EIRP (dBm)	ERP (dBm)	ERP (W)	Threshold ERP (W)	MPE Exemption fulfilled
2.4 GHz	Bluetooth LE	2402.0	0.020	0.200	yes	5.0	0.0	0.00	0.00	2.15	100	7.2	5.0	0.003	0.768	yes
		2442.0	0.020	0.200	yes							7.2	5.0	0.003	0.768	yes
		2480.0	0.019	0.200	yes							7.2	5.0	0.003	0.768	yes

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Simultaneous Transmission

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

		Bluetooth LE
	Ratio of Value/Limit	0.004118
GSM 850	0.963227	0.967345
GSM 1900	0.560543	0.564660
LTE Cat M1 B2	0.354518	0.358636
LTE Cat M1 B4	0.354518	0.358636
LTE Cat M1 B5	0.645361	0.649479
LTE Cat M1 B12	0.760769	0.764887
LTE Cat M1 B13	0.684398	0.688516
LTE Cat M1 B25	0.354518	0.358636
LTE Cat M1 B26	0.653289	0.657407
LTE Cat M1 B66	0.354518	0.358636
LTE Cat M1 B85	0.761859	0.765977

Remark: only maximum value in band / mode is shown

Maximum Value	=	0.967345
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Conclusion

MPE-/ SAR Based Exemption fulfilled

Dipl.-Ing. Niels Jeß

B.Eng. Martin Nunier

Version	Applied changes	Date of release
--	Initial release	2023-Oct-13