DEKRA Testing and Certification, S.A.U.
Parque Tecnologico de Andalucía,
C/ Severo Ochoa 2
29590 Campanillas
Málaga, España

Subject: RF exposure analysis for the equipment with FCC ID: **XKM-MESHLIUM-V1**; IC: **8472A-MESHLIUMV1**

The device model: **Meshlium 4G 802.15.4 AP 900 US** (FCC ID: **XKM-MESHLIUM-V1**; IC: **8472A-MESHLIUMV1**) is designed to be installed in and used in mobile exposure conditions.

The antennas used for this device must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

MPE exposure limits

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	Power density (mW/cm^2)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100.000	1,0	30

The table below is excerpted from RSS-102, Issue 5, section 4, titled “RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)”:

Frequency Range (MHz)	Power density (W/m^2)	Reference Period (minutes)
300 – 6000	$0.02619 f^{0.6834}$	6
6000 - 15000	10	6
15000 - 150000	10	$616000 / f^{1.2}$

Using the equation $S = \frac{PG}{4\pi R^2}$ to calculate the exposure to electromagnetic fields

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Compliance with FCC and ISED maximum permissive exposure limits is demonstrated based on the following calculations:

1. Standalone operations analysis

Frequency Band	Mode	Frequency Range (MHz)	Maximum conducted output power (per tune-up) (dBm)	Duty cicle (%)	Antenna gain (dBi)	EIRP (W)	FCC EIRP limit per §22.913, §24.232 and §27.50 §15.247 (W)	ISED EIRP limit per SRSP-503, SRSP-510 and SRSP-518 RSS-247 (W)	Evaluation distance for compliance with MPE limits (cm)	$S = \frac{PG}{4\pi R^2}$ (mW/cm2)	MPE limit (FCC/ISED worst case) (mW/cm^2)	MPE Ratio (S/MPE limit)
FDD 17	LTE Cat. 3 - 5 MHz BW	706,5-713,5	25,00	100%	*0,34*	*0,3420*	4,92	5,00	20	0,06803	0,23200	0,29325
	LTE Cat. 3 - 10 MHz BW	709-711	25,00	100%	*0,34*	*0,3420*	4,92	5,00	20	0,06803	0,23200	0,29325
GSM 850	GSM/GPRS/EDGE	824,2-848,2	33,50	25%	*0,03*	*2,2542*	11,48	11,50	20	0,11212	0,25800	0,43456
FDD V	UMTS/HSPA	826,4-846,6	25,00	100%	*0,03*	*0,3184*	11,48	11,50	20	0,06335	0,25800	0,24553
FDD 5	LTE Cat. 3 - 5 MHz BW	826,5-846,5	25,00	100%	*0,03*	*0,3184*	11,48	11,50	20	0,06335	0,25800	0,24553
	LTE Cat. 3 - 10 MHz BW	829-844	25,00	100%	*0,03*	*0,3184*	11,48	11,50	20	0,06335	0,25900	0,24459
FDD 4	LTE Cat. 3 - 5 MHz BW	1712,5-1752,5	25,00	100%	*0,67*	*0,3690*	1,00	1,00	20	0,07341	0,42500	0,17272
	LTE Cat. 3 - 10 MHz BW	1715,0-1750,0	25,00	100%	*0,67*	*0,3690*	1,00	1,00	20	0,07341	0,42500	0,17272
	LTE Cat. 3 - 20 MHz BW	1720,0-1745,0	25,00	100%	*0,67*	*0,3690*	1,00	1,00	20	0,07341	0,42600	0,17231
GSM 1900	GSM/GPRS/EDGE	1850,2-1909,8	30,50	25%	*-0,07*	*1,1041*	2,00	2,00	20	0,05491	0,44800	0,12257
FDD II	UMTS/HSPA	1852,4-1907,6	25,00	100%	*-0,07*	*0,3112*	2,00	2,00	20	0,06191	0,44800	0,13818
FDD 2	LTE Cat. 3 - 5 MHz BW	1852,5-1907,5	25,00	100%	*-0,07*	*0,3112*	2,00	2,00	20	0,06191	0,44800	0,13818
	LTE Cat. 3 - 10 MHz BW	1855-1905	25,00	100%	*-0,07*	*0,3112*	2,00	2,00	20	0,06191	0,44800	0,13818
	LTE Cat. 3 - 20 MHz BW	1860-1900	25,00	100%	*-0,07*	*0,3112*	2,00	2,00	20	0,06191	0,44900	0,13787

Frequency band(MHz)	Mode	Frequency Range (MHz)	CONDUCTED OUTPUT POWER (dBm)	Antenna gain (dBi)	Antenna gain (numerical)	Duty cycle (%)	Evaluation distance (cm)	Power density (mW/cm^2)	FCC/ISED MPE limit (mW/cm^2)	MPE RATIO
2400-2483,5	**802.11 b**	2412-2462	22,42	*4,00*	2,51	100,0%	20	0,0872	0,5404	0,1614
	802.11 g	2412-2462	21,42	*4,00*	2,51	100,0%	20	0,0693	0,5469	0,1267
	802.11 n (HT20)	2412-2462	21,39	*4,00*	2,51	100,0%	20	0,0688	0,5469	0,1258

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2410-2465	DTS	2410-2465	19,40	*5,00*	3,16	100%	20	0,0548	0,5404	0,1014

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902.4-927.6	DSS	902.4-927.6	24,74	2,00	1,58	100%	20	0,0939	0,5404	0,1738

Under all conditions the equipment complies with the FCC/ISED MPE limits and the maximum MPE ratio obtained is 0,8712.

2. Co-location analysis

2.1. Co-location with other transmitter in mobile exposure conditions

According to KDB 447498 D01 General RF Exposure Guidance v06, 7.2:

> *Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is ≤ 1.0.*

As the maximum calculated MPE ratio for the device is **0,8712**, the product can be co-located with other antennas providing that the sum of the MPE ratios for all the other simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density is ≤ **1.0 – 0.8712=0.1288.**

2.2. Co-location with other transmitter in mixed mobile and portable host platform exposure conditions

According to KDB 447498 D01 General RF Exposure Guidance v06, 7.2:

> *When one of the following test exclusion conditions is satisfied for all combinations of simultaneous transmission configurations, further equipment approval is not required to incorporate transmitter modules in host devices that operate in the mixed mobile and portable host platform exposure conditions. The grantee is responsible for documenting this according to Class I permissive change requirements. Antennas that qualify for standalone SAR test exclusion must apply the estimated standalone SAR to determine simultaneous transmission test exclusion.*
>
> - *The [∑ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) / 1.6 W/kg] + [∑ of MPE ratios] is ≤ 1.0.*
> - *The SAR to peak location separation ratios of all simultaneous transmitting antenna pairs operating in portable exposure conditions are all ≤ 0.04 and the [∑ of MPE ratios] is ≤ 1.0.*

As the maximum calculated MPE ratio for the device is **0.8712**, the equipment can be co-located with other transmitters in a mixed mobile and portable conditions providing that the exposure of the co-located transmitter complies with:

- The [∑ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) / 1.6 W/kg] + [∑ of MPE ratios] is ≤ 1.0 **– 0.8712=0.1288.**

OR

- The SAR to peak location separation ratios of all simultaneous transmitting antenna pairs operating in portable exposure conditions are all ≤ 0.04 and the [∑ of MPE ratios] is ≤ 1.0 **– 0.8712=0.1288.**

Signed on behalf of **Libelium Comunicaciones Distribuidas S.L.**on 31/05/2017

P.A

By: David Gascón
Title: Chief Technical Officer
Company: Libelium Comunicaciones Distribuidas S.L.
Telephone: +34 976 54 74 92
e-mail: d.gascon@libelium.com


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