

Maximum Permissible Exposure (MPE) & Exposure evaluation

Report identification number: 1-6031/18-01-08

Certification numbers and labeling requirements for: eBox Professional	
FCC ID	2ASKCACCU205 ELS61-US (WWAN-module) UXS-SMR-3X4 (radar module)
IC number	-/-
HVIN (Hardware Version Identification Number)	-/-
PMN (Product Marketing Name)	-/-
FVIN (Firmware Version Identification Number)	-/-
HMN (Host Marketing Name)	-/-

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Document authorised:

Alexander Hnatovskiy
Lab Manager
Radio Communications & EMC

Thomas Vogler
Lab Manager
Radio Communications & EMC

EUT technologies:

Technologies:	Max. AVG output power [dBm])*	Antenna gain [dBi])**	Max. EIRP [dBm]	Frequency range (MHz)
LTE FDD 2	23.0 +/- 2	2.8	27.8	1900
LTE FDD 4	23.0 +/- 2	1.0	26.0	1750
LTE FDD 5	23.0 +/- 2	-1.3	23.7	835
LTE FDD 12	23.0 +/- 2	0.9	25.9	710
UMTS FDD II	24.0 +1/-3	2.8	27.8	1900
UMTS FDD IV	24.0 +1/-3	1.0	26.0	1750
UMTS FDD V	24.0 +1/-3	-1.3	23.7	835
WLAN 802.11b	15 +/- 1.9	4.6	21.3	2450
WLAN 802.11g	15 +/- 1.9	4.6	21.3	2450
WLAN 802.11n	15 +/- 1.9	4.6	21.3	2450
BT Basic Rate	13 +/- 2	4.6	19.6	2450
BT BR-EDR (Pi/4 DPSK)	13 +/- 2	4.6	19.6	2450
Proximity Radar	unknown	unknown	20 +/-2	24100
RFID/NFC	Exempted from routine evaluation			13.56

)* declared by manufacturer according to tune-up info

)** measured values for UMTS/LTE, otherwise declared by manufacturer

Prediction of MPE limit at given distance - FCC

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2$$

where: S = Power density

P = Power input to the antenna

G = Antenna gain

R = Distance to the center of radiation of the antenna

PG = Output Power including antenna gain

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/1500	30
1500 - 100000	1.0	30

where f = Frequency (MHz)

Prediction: worst case

WWAN Technologies		FDD 2	FDD 4	FDD 5	FDD 12	FDD II	FDD IV	FDD V	
	Frequency (MHz)	1850	1710	824	699	1850	710	824	
PG	Declared max. EIRP (dBm)	27.8	26.0	23.7	25.9	27.8	26.0	23.7	dBm
R	Distance	20	20	20	20	20	20	20	cm
S	MPE limit for uncontrolled exposure	1.00	1.00	0.55	0.47	1.00	1.00	1.00	mW/cm ²
	Calculated Power density:	0.12	0.08	0.05	0.08	0.12	0.08	0.05	mW/cm ²
	Calculated percentage of Limit:	11.99%	7.92%	8.49%	16.62%	11.99%	7.92%	4.67%	

Collocation of all technologies		WWAN	WLAN	BT	Radar	
	Frequency (MHz)	699	2412	2402	24100	
PG	Declared max. EIRP (dBm)	25.9	21.3	19.6	22.0	dBm
R	Distance	20	20	20	20	cm
S	MPE limit for uncontrolled exposure	0.47	1.00	1.00	1.00	mW/cm ²
	Calculated Power density:	0.08	0.03	0.02	0.03	mW/cm ²
	Calculated percentage of Limit:	16.62%	2.69%	1.82%	3.15%	
Collocation:						
	Scenario: all transmitters active	24.27%				
	Calculated percentage of Limit:					

Note: This calculation represents a worst-case assumption with all radiating elements at the same place.

This prediction demonstrates the following:

The power density levels for FCC at a distance of 20 cm are below the maximum levels allowed by regulations.

Prediction of MPE limit at given distance - IC

RSS-102, Issue 5, 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}W$ (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834} W$ (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

Prediction: worst case

WWAN Technologies		FDD 2	FDD 4	FDD 5	FDD 12	FDD II	FDD IV	FDD V	
	Frequency (MHz)	1850	1710	824	699	1850	710	824	
R	Distance	20	20	20	20	20	20	20	cm
PG	Declared max. EIRP (dBm)	27.8	26.0	23.7	25.9	27.8	26.0	23.7	dBm
PG	Declared max. EIRP (mW)	602.6	398.1	234.4	389.0	602.6	398.1	234.4	mW
	Exclusion Limit from above	2.24	2.12	1.29	1.15	2.24	1.16	1.29	W
	Calculated percentage of Limit:	26.91%	18.76%	18.20%	33.79%	26.91%	34.21%	18.20%	

Collocation of all technologies		WWAN	WLAN	BT	Radar	
	Frequency	699	2412	2402	24100	MHz
R	Distance	20	20	20	20	cm
PG	Declared max. EIRP (dBm)	25.9	21.3	19.6	22	dBm
PG	Declared max. EIRP (mW)	389.0	134.9	91.2	158.5	mW
	Exclusion Limit from above:	1.15	2.68	2.68	5.00	W
	Calculated percentage of Limit:	33.79%	5.03%	3.41%	3.17%	
Collocation:						
	Scenario: all transmitters active					
	Calculated percentage of Limit:	45.40%				

Note: This calculation represents a worst-case assumption with all radiating elements at the same place.

Conclusion: RF exposure evaluation is not required.

For applications where minimum distance to radiating element is 20cm Annex C of RSS-102 should be filled out.