MPE Calculation / RF Exposure

Product: THEUS C-V2X RSU
Applicant: Ettifos Co.
Model: ETF-PRO-RC02
Address: 405, 41, Beolmal-ro 50beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
FCC ID: 2BHJL-ETF-PRO-RC02

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310 is listed in below table. According to FCC §1.1310: the criteria listed in the following tables shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* (180/f²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm²)
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, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

MPE Prediction Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

Classfication The antenna of this product is at least 20 cm away from the body of the user. So this product is classified as mobile device.

- **RSU**

Frequency (GHz)	Max. Tune up EIRP		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBm)	(mW)			
5.915	24	251.19	20	0.04997	1

Note1) The Max. Tune up EIRP value includes an antenna gain of 10 dBi.

Note2) The EUT does not support transmit MIMO.

Results: Compliant

This confirms compliance to the required radio frequency radiation exposure limit of 1.0 mW/cm^2 at 20 cm operation.

- **Wi-Fi**

Max. tune-up power(dBm)

2.4 GHz

802.11b	802.11g	802.11n(HT20)	802.11n(HT40)
17.05	20.61	**21.87**	20.50

5.1 GHz

802.11a	802.11n(HT20)	802.11n(HT40)	802.11ac(VHT20)	802.11ac(VHT40)	802.11ac(VHT80)
19.80	17.47	17.34	17.31	17.23	18.19

5.8 GHz

802.11a	802.11n(HT20)	802.11n(HT40)	802.11ac(VHT20)	802.11ac(VHT40)	802.11ac(VHT80)
17.56	**19.40**	17.51	17.48	17.45	18.22

$$S = ERP/4 \pi R^2$$
$$\text{In other words, } R = \sqrt{ERP/4\pi} \times S(Pd)$$

Where

S = Power density

ERP = Effective Radiated Power

R = distance to the centre of radiation of the antenna

Values

S = 1.0 mW/cm^2 for General population uncontrolled exposure (FCC Part 1.1310 Radiofrequency radiation exposure limits)

S = 1.0 mW/cm^2

PT = 21.87 dBm (153.82 mW) : measured maximum output power

G = Antenna gain = 2.20 dBi (1.660 in linear terms)

EIRP = PT x G

R = 20 cm

Calculation

EIRP = 153.82 x 1.660 = 255.27 mW

S = 255.27/12.56 x (20)^2 = 255.27/5024

S = 0.050 78 mW/cm^2

Conclusion

This confirms compliance to the required radio frequency radiation exposure limit of 1.0 mW/cm^2 at 20 cm operation.

- **BLE**

Max. tune-up power(dBm)

GFSK	π 4/-DQPSK	8DPSK	BLE
5.57	**6.53**	5.78	-0.82

$$S = ERP/4 \pi R^2$$
$$\text{In other words, } R = \sqrt{ERP/4\pi} \times S(Pd)$$

Where
S = Power density
ERP = Effective Radiated Power
R = distance to the centre of radiation of the antenna

Values
S = 1.0 mW/cm^2 for General population uncontrolled exposure (FCC Part 1.1310 Radiofrequency radiation exposure limits)
S = 1.0 mW/cm^2
PT = 6.53 dBm (4.50 mW) : measured maximum output power
G = Antenna gain = 2.20 dBi (1.660 in linear terms)
EIRP = PT x G
R = 20 cm

Calculation
EIRP = 4.50 x 1.660 = 7.46 mW
S = 7.46/12.56 x (20)^2 = 7.46/5024
S = 0.001 49 mW/cm^2

Conclusion
This confirms compliance to the required radio frequency radiation exposure limit of 1.0 mW/cm^2 at 20 cm operation.

◘ Simultaneously MPE

Simultaneously MPE = PSD1/Limit1 + PSD2/Limit2 + PSD2/Limit3

UWB+BLE+Wi-Fi

Simultaneously MPE = (0.049 97 mW/cm^2 / 1) + (0.050 78 mW/cm^2 / 1) + (0.001 49 mW/cm^2 / 1)
= 0.102 24 mW/cm^2

Results: Compliant

This confirms compliance to the required radio frequency radiation exposure limit of 1.0 mW/cm^2 at 20 cm operation.