

## \* RF Exposure

FCC ID: 2AP7FRMCU-OG2

### 1. Regulation

#### Regulation

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 Table 1-1. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Table 1 – Limits for Maximum Permissible Exposure (MPE)

| Frequency Range<br>(MHz)                                  | Electric Field Strength<br>[V/m] | Magnetic Field Strength<br>[A/m] | Power Density<br>[mW/cm <sup>2</sup> ] | Averaging Time<br>[minute] |
|-----------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------------|----------------------------|
| (A) Limits for Occupational / Controlled Exposure         |                                  |                                  |                                        |                            |
| 0.3 ~ 3.0                                                 | 614                              | 1.63                             | *100                                   | 6                          |
| 3.0 ~ 30                                                  | 1842/f                           | 4.89/f                           | *900/f <sup>2</sup>                    | 6                          |
| 30 ~ 300                                                  | 61.4                             | 0.163                            | 1.0                                    | 6                          |
| 300 ~ 1 500                                               | /                                | /                                | f/300                                  | 6                          |
| 1 500 ~ 15 000                                            | /                                | /                                | 5                                      | 6                          |
| (B) Limits for General Population / Uncontrolled Exposure |                                  |                                  |                                        |                            |
| 0.3 ~ 1.34                                                | 614                              | 1.63                             | *100                                   | 30                         |
| 1.34 ~ 30                                                 | 824/f                            | 2.19/f                           | *180/f <sup>2</sup>                    | 30                         |
| 30 ~ 300                                                  | <u>27.5</u>                      | <u>0.073</u>                     | <u>0.2</u>                             | <u>30</u>                  |
| 300 ~ 1 500                                               | /                                | /                                | f/1 500                                | 30                         |
| 1 500 ~ 15 000                                            | /                                | /                                | 1.0                                    | 30                         |

f=frequency in MHz, \*= plane-wave equivalent power density

Per the guidance of KDB 680106, the E-field and H-field limits shown in the table above are extended down to 100 kHz

in Appendix C):

- 1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by  $[1 + \log(100/f(\text{MHz}))]$
- 2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by 1/2
- 3) SAR measurement procedures are not established below 100 MHz.  
When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any SAR test results below 100 MHz to be acceptable.

## 2. Result

### MPE (Maximum Permissible Exposure) Prediction

Prediction of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad (\Rightarrow R = \sqrt{PG / 4\pi S})$$

S = power density [mW/cm<sup>2</sup>]

P = Power input to antenna [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 [cm]

### RF Exposure Compliance Issue

The information should be included in the user's manual:

This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

#### **Note.**

1. The power density P<sub>d</sub> (5th column) at a distance of 20 cm calculated from the Friis transmission Formula is far below the limit of 1 mW/cm<sup>2</sup>.
2. Unequal antenna gains, with equal transmit powers. For antenna gains given by G<sub>1</sub>, G<sub>2</sub>, ..., G<sub>N</sub> dBi (i) If transmit signals are correlated, then Directional gain = 10 log[(10G<sub>1</sub>/20 + 10G<sub>2</sub>/20 + ... + 10G<sub>N</sub>/20)<sup>2</sup>/NANT] dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]
3. According to §1.1310 of the FCC rules "Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over the specified averaging time in Table 1 is less than the limits". For General Population/Uncontrolled Exposure the averaging time is 30 minutes.

This unit transmits 38.3dBm (at antenna output connector). This device is limited by regulatory limitation to 9 seconds of transmissions in any 900 seconds (15 minutes). Even though the actual transmit rate is lower this worst case scenario shall be used. Thus the unit can transmit a most 18 seconds in any 30 minute (1800seconds) interval. The averaging power reduction would equal:

$$10\log * (18(s)/1800(s)) = 10\log * 0.01 = -20 \text{ dB power reduction}$$

Using this reduction the MPE source based time averaged power output would be 18.34 dBm (38.34 dBm continuous power minus 20 dB duty cycle reduction).

18.34 dBm will be used in the following exposure table for output power.

### Calculation Result of RF Exposure

| Mode      | Frequency<br>[MHz] | Max<br>Tune-up<br>Power<br>[dBm] | Max<br>Tune-up<br>Power<br>[mW] | Ant<br>Gain<br>[dBi] | Power<br>density<br>at 20 cm<br>[mW/cm <sup>2</sup> ] | Limit<br>[mW/cm <sup>2</sup> ] |
|-----------|--------------------|----------------------------------|---------------------------------|----------------------|-------------------------------------------------------|--------------------------------|
| Satellite | 148.998 75         | 18.50                            | 70.79                           | 2.70                 | 0.026 23                                              | 0.20                           |