

### 13. MAXIMUM PERMISSIBLE EXPOSURE

#### 13.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment is  $f/1500 \text{ mW/cm}^2$  for the frequency range between 300 MHz and 1500 MHz.

The electric field generated for a  $1 \text{ mW/cm}^2$  exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in  $\text{mW/cm}^2$ , Z = Impedance of free space,  $377 \Omega$

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * S)}$$

Changing to units of mW and cm, using  $P (\text{mW}) = P (\text{W}) / 1000$ ,  $d (\text{cm}) = 100 * d (\text{m})$

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in  $\text{mW/cm}^2$

#### 13.2 Calculated MPE Safe Distance

According to above equation, the following result was obtained.

Peak Output Power		Antenna Gain		Safe Distance	Power Density ( $\text{mW/cm}^2$ )	FCC Limit
(dBm)	(mW)	Log	Linear	(cm)	@ 20 cm Separation	( $\text{mW/cm}^2$ )
30.00	1000	2.0	1.58	14.9	0.32	0.57

According to above table, safe distance,  $D = 0.282 * \sqrt{1000 * 1.58 / 0.57} = 14.9 \text{ cm}$ .

For getting power density at 80 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 1000 * 1.58 / (4 * 3.14 * 20^2) = 0.32$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

Note: End users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance, because the applicant does not provide an antenna for sale with the EUT.