Prediction of MPE

This device is to be used only for fixed and mobile applications.

The antenna(s) used for this transmitter 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.

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

Based on the above table the limits are:

For 850 MHz frequency band device: 0.57 mW/cm^2
For 1900 MHz frequency band device: 1 mW/cm^2

§ 2.1091:
The limit for 850 MHz mobile operations where no routine evaluation is required is: 1.5W ERP
The limit for 1700 / 1900 MHz mobile operations where no routine evaluation is required is: 3W EIRP

Max permissive power according to §24.232 : 2W EIRP
Max permissive power according to §§22.913 (a): 7W ERP

Using the equation from page 19 of OET Bulletin 65, Edition 97-01:

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

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 MPE limits can be guaranteed as the calculation below shows:

850 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	31.8 dBm	1514	25%	378
EDGE			25%	
WCDMA			100%	
HSDPA			100%	
HSUPA			100%	

P	Maximum power input to the antenna:	378	mW
R	Distance:	20	cm
S	MPE limit for uncontrolled exposure:	0,57	mW/cm^2

G_1	Antenna gain (dBi) to comply with MPE limits:	**7.6**	**dBi**
ERP power limit according to §2.1091:		1,5	W ERP
G_2	Antenna gain (dBi) to comply with ERP limits: (ERP = Equivalent conducted output power x Antenna gain / 1,64)	**6.4**	**dBi**
ERP power limit according to §22.913:		7	W ERP
G_3	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain / 1,64)	**7.5**	**dBi**
$G_{850\ MHz\ band}$	Min (G_1, G_2, G_3)	**6.4**	**dBi**

Therefore the maximum antenna gain for mobile operation to comply with MPE and ERP limits shall not exceed **6.4 dBi**.

Max EIRP is 31.8 dBm or 1514 mW
S = 1514 mW / $4\pi(20cm)^2$
S = 0.301 mW/cm^2

Device complies with MPE limits.

1900 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	29.4	871	25%	218
EDGE			25%	
WCDMA			100%	
HSDPA			100%	
HSUPA			100%	

P	Maximum power input to the antenna:	218	mW
R	Distance:	20	cm
S	MPE limit for uncontrolled exposure:	1	mW/cm^2
G_1	Antenna gain (dBi) to comply with MPE limits:	**23.0**	**dBi**
EIRP power limit according to §2.1091:		3	W EIRP
G_2	Antenna gain (dBi) to comply with ERP limits: (EIRP = Equivalent conducted output power x Antenna gain)	**13.7**	**dBi**

ERP power limit according to §24.232:		2	W EIRP
G_3	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain)	**2.2**	**dBi**
$G_{1900\ MHz\ band}$	Min (G_1, G_2, G_3)	**2.2**	**dBi**

Therefore the maximum antenna gain for mobile operation to comply with MPE and ERP limits shall not exceed **2.2 dBi**.

Max EIRP is 29.4 dBm or 871 mW

$S = 871\ mW / 4\pi(20cm)^2$

$S = 0.173\ mW/cm^2$

Device complies with MPE limits.

Signed,

Christopher Torio

Digitally signed by Christopher Torio
DN: cn=Christopher Torio, c=US, o=Celtecom, Inc, ou=Compliance, email=christopher.torio@celtecomusa.com
Date: 2011.05.02 14:25:36 -07'00'

Christopher Torio
EMC Test Engineer
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