Prediction of MPE limit at given distance

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

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

where: S = power density
P = power input to the antenna
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

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 – 100.000	1.0	30

where f = frequency in MHz

Prediction

Antenna Type: 0dBi Antenna / 3dBi Antenna / 6 dBi Antenna

	GSM 850		GSM 1900	
Maximum peak output power at antenna input terminal:	30.7	dBm	27.1	dBm
Maximum peak output power at antenna input terminal:	1174,9	mW	512.86	mW
Antenna gain(typical):	0	dBi	0	dBi
Maximum antenna gain:	1	numeric	1	numeric
Prediction distance:	20	cm	20	cm
Prediction frequency:	839	MHz	1880	MHz
MPE limit for uncontrolled exposure at prediction frequency:	**1**	$\frac{mW}{cm^2}$	**1**	$\frac{mW}{cm^2}$
Power density at prediction frequency: with Antenna Gain of **0dBi**	**0,234**	$\frac{mW}{cm^2}$	**0,102**	$\frac{mW}{cm^2}$
Power density at prediction frequency: with Antenna Gain of **3dBi**	**0,467**	$\frac{mW}{cm^2}$	**0,204**	$\frac{mW}{cm^2}$
Power density at prediction frequency: with Antenna Gain of **6dBi**	**0,934**	$\frac{mW}{cm^2}$	**0,408**	$\frac{mW}{cm^2}$
Maximum allowable antenna gain:	**6.31**	dBi	**9.9**	dBi

This predictions demonstrate the following:

1) The power density levels at a distance of 20 cm with typical antennas of 0-6dBi are below the maximum levels allowed by the FCC regulations.
2) The antenna gain where 1 $\frac{mW}{cm^2}$ would be reached at 20 cm distance, is
G= 6.31 dBi for GSM 850
G= 9.9 dBi for GSM 1900

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