

Equipment Identification:

FCC ID:	Y90-DTSC2
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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/cm²

For 1900 MHz frequency band device: 1 mW/cm²

§ 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/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

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:

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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	32.3 dBm	1698.2	25%	424.6
EDGE	27.8 dBm	602.6	25%	150.6
WCDMA	27 dBm	501.2	100%	501.2
HSDPA			100%	
HSUPA			100%	

P	Maximum power input to the antenna:	1659.6	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:	7.5	dBi
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ERP power limit according to §2.1091:	1,5	W ERP
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G ₂	Antenna gain (dBi) to comply with ERP limits: (ERP = Equivalent conducted output power x Antenna gain / 1,64)	6.9	dBi
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ERP power limit according to §22.913:	7	W ERP
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G ₃	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain / 1,64)	8.3	dBi
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G _{850 MHz band}	Min (G ₁ , G ₂ , G ₃)	6.9	dBi
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Therefore the maximum antenna gain for mobile operation to comply with MPE and ERP limits shall not exceed **6.9 dBi**.

Prediction for Part 22Maximum radiated power EIRP: **31.8dBm (1514 mW) @ 836.6MHz**

Lowest limit for 850 MHz fixed operations (@20cm) where no routine evaluation is required is § 1.1310: $(f/1500)\text{mW/cm}^2 = \mathbf{0.5659\text{ mW/cm}^2}$

Calculated at distance of 20cm for reference antenna:

$$\text{Power density} = 1514 / (4 \times \pi \times 20^2) = \mathbf{0.3013\text{ mW/cm}^2}$$

Result: Configuration complies with rules as power density is below MPE limit.

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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	30	1000	25%	250
EDGE	28	630.9	25%	157.7
WCDMA	26.9	489.8	100%	489.8
HSDPA			100%	
HSUPA			100%	

P	Maximum power input to the antenna:	489.8	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:	10.1	dBi
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EIRP power limit according to §2.1091:	3	W EIRP
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G ₂	Antenna gain (dBi) to comply with ERP limits: (EIRP = Equivalent conducted output power x Antenna gain)	10	dBi
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EIRP power limit according to §24.232:	2	W EIRP
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G ₃	Antenna gain (dBi) to comply with EIRP limits: (EIRP = Maximum conducted output power x Antenna gain)	3	dBi
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G _{1900 MHz band}	Min (G ₁ , G ₂ , G ₃)	3	dBi
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Therefore the maximum antenna gain for mobile operation to comply with MPE and ERP limits shall not exceed **3 dBi**.

Prediction for Part 24Maximum radiated power EIRP: **32.2 dBm (1660mW) @1880MHz**

Lowest limit for 1900 MHz fixed operations (@20cm) where no routine evaluation is required is § 1.1310: **1 mW/cm²**

Calculated at distance of 20cm:

$$\text{Power density} = 1660 / (4 \times \pi \times 20^2) = \mathbf{0.3303 \text{ mW/cm}^2}$$
Result: Configuration complies with rules as power density is below MPE limit.

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