

9 Annex A (MPE)

Prediction of MPE

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

It has integrated internal antennas. External connectors are provided which allows connection of external antennas. Connection of external antennas automatically disconnects the internal antennas.

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 5900 MHz frequency band device: 1 mW/cm²

§ 2.1091:

The limit for 5900 MHz mobile operations, where no routine evaluation is required, is: 3W EIRP

Max permissive power according to §90.377:

5855 MHz to 5895 MHz : 33 dBm

5895 MHz to 5915 MHz : 23 dBm

5915 MHz to 5925 MHz : 33 dBm

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 calculations below show:

Internal Antennas

Band	Maximum radiated output power (dBm)	Maximum radiated output power (mW)	Duty cycle	Equivalent radiated output power (Maximum radiated output power x duty cycle) (mW)
5855 MHz to 5895 MHz	29.6	912	100%	912
5895 MHz to 5915 MHz	19.3	86	100%	86
5915 MHz to 5925 MHz	29.9	978	100%	978

Maximum output power considerations:

P x G ₁	Maximum power input to the antenna x Antenna gain (dBi) to comply with MPE limits:	979	mW
R	Distance:	20	cm
S	MPE limit for uncontrolled exposure:	0.20	mW/cm ²

Internal antenna configuration **complies** with MPE limits.

External Antennas

Band	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
5855 MHz to 5895 MHz	19.3	86	100%	86
5895 MHz to 5915 MHz	9.4	9	100%	9
5915 MHz to 5925 MHz	18.9	78	100%	78

Maximum output power considerations:

P	Maximum power input to the antenna:	9	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:	37.4	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 = Maximum conducted output power x Antenna gain)	25.3	dBi
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ERP power limit according to §90.377:	0.2	W EIRP
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G ₃	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain)	13.6	dBi
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G _{5900 MHz band}	Min (G ₁ , G ₂ , G ₃)	13.6	dBi
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Therefore the maximum antenna gain for mobile operation to comply with MPE and EIRP limits shall not exceed **13.6 dBi**.