

## Maximum Permissible Exposure (MPE)

### Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to §1.1310 and §2.1091 RF exposure is calculated.

### Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

\* = Plane-wave equipment power density

According to RSS 102 issue 5.

### **2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation**

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $22.48/f_{0.5} W$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f_{0.6834} W$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

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Maximum Permissible Exposure (MPE) Evaluation: The worst case of Average power

Power measurement: refer to Part15.247 report for details.

Wi-Fi	Frequency Range (MHz)	Channels	Peak / Average Power	Modulation Technology
802.11b	2412 – 2462(DTS)	11	14.30 dBm (AV)	DSSS
802.11g	2412 – 2462(DTS)	11	14.15 dBm (AV)	OFDM
802.11n	HT20 2412 – 2462(DTS)	11	13.76 dBm (AV)	
Tune up power (Average)		14 dBm +/- 0.5 dBm		

Maximum output power at antenna input terminal:	14	(dBm)
Maximum output power at antenna input terminal:	25.11886432	(mW)
Tune-Up power Tolerance:	0.5	dB
Duty cycle:	100	(%)
Maximum Pav :	28.18382931	(mW)
Antenna gain (typical):	2.88	(dBi)
Maximum antenna gain:	1.940885878	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.0108881	(mW/cm^2)

Prediction of MPE limit at a given distance

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

$$S = PG/4\pi R^2$$

Where: S = Power density

P = Power input to 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

### Measurement Result:

The predicted power density level at 20 cm is 0.01089 mW/cm<sup>2</sup>.. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup>.

**Power measurement:**

IC EIRP level

Frequency:	2412	MHz
Maximum output power at antenna input terminal:	14	(dBm)
Tune-Up power Tolerance:	0.5	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.88	(dBi)
EIRP:	54.702	mW
EIRP:	0.05470	W
EIRP Limit	2.684	W

**Measurement Result:**

The EIRP level is 0.00345 W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

**BT mode:**

Maximum Permissible Exposure (MPE) Evaluation: The worst case of Average power

Power measurement: refer to Part15.247 report for details.

**Tune-Up Power:**

Frequency Range:	2402 – 2480MHz	
Tune-Up Power:	0dBm +/- 1.0 dBm	
Antenna Gain:	2.88dBi	

Maximum output power at antenna input terminal:	0	(dBm)
Maximum output power at antenna input terminal:	1	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	1.258925412	(mW)
Antenna gain (typical):	2.88	(dBi)
Maximum antenna gain:	1.940885878	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.0004864	(mW/cm^2)

Prediction of MPE limit at a given distance

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

$$S = PG/4\pi R^2$$

Where: S = Power density

P = Power input to 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

**Measurement Result:**

The worst power density is 0.00049 mW/cm^2 which is less than 1 mW/cm^2.

**Power measurement:**

IC EIRP level

Frequency:	2402	MHz
Maximum output power at antenna input terminal:	0	(dBm)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Antenna gain (typical):	2.88	(dBi)
EIRP:	2.443	mW
EIRP:	0.00244	W
EIRP Limit	2.676	W

**Measurement Result:**

The EIRP level is 0.00244 W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

**Simultaneous transmission mode**

WiFi 2.4GHz mode + BT 2.4GHz Mode:

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Prediction frequency:	2.4	(GHz)
Power density at predication frequency at 20 (cm)	0.0108900	(mW/cm <sup>2</sup> )

Prediction frequency:	2.4	(GHz)
Power density at predication frequency at 20 (cm)	0.0004900	(mW/cm <sup>2</sup> )
2.4GHz + 2.4GHz Power density at predication frequency at 20 (cm) distance	0.0113800	(mW/cm <sup>2</sup> )
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )

The predicted power density level at 20 cm is 0.01138mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup>.

IC:

Prediction frequency:	2.4	(GHz)
EIRP	0.0547000	W

Prediction frequency:	2.4	(GHz)
EIRP	0.0024400	W
BT+WLAN EIRP	0.0571400	W
EIRP Limit	2.676	W

The EIRP level is 0.05714 W which less than RSS102 section 2.5.2 Exemption Limits above 300 MHz and below 6 GHz condition.

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