

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 ²)	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 ²)	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 $22.48/f^{0.5} \text{ W}$ (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 $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (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/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

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/cm² which is less than 1 mW/cm².

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 ²)

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

The predicted power density level at 20 cm is 0.01138mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

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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