

## MAXIMUM PERMISSIBLE EXPOSURE (MPE)(FCC)

### 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.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 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

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## Maximum Permissible Exposure (MPE) Evaluation

CH	Frequency (MHz)	Max. output power including tune-up tolerance (dBm)	Required Limit
1	2412	14.95	1 Watt = 30 dBm
6	2437	14.94	1 Watt = 30 dBm
11	2462	14.93	1 Watt = 30 dBm

### MPE Prediction (802.11b 2412~2462)

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

Max. output power including tune-up tolerance:	14.95	(dBm)
Max. output power including tune-up tolerance:	31.260794	(mW)
Duty cycle:	100	(%)
Maximum Pav :	31.260794	(mW)
Peak Antenna gain (Maximum):	2.14	(dBi)
Peak Antenna gain (linear):	1.6368165	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.010	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.01 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412MHz.

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CH	Frequency (MHz)	Max. output power including tune-up tolerance (dBm)	Required Limit
1	2412	14.98	1 Watt = 30 dBm
6	2437	14.95	1 Watt = 30 dBm
11	2462	14.85	1 Watt = 30 dBm

### MPE Prediction (802.11g 2412~2462)

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

Max. output power including tune-up tolerance:	14.98	(dBm)
Max. output power including tune-up tolerance:	31.477483	(mW)
Duty cycle:	100	(%)
Maximum Pav :	31.477483	(mW)
Peak Antenna gain (Maximum):	2.14	(dBi)
Peak Antenna gain (linear):	1.6368165	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.010	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.01 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412MHz.

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CH	Frequency (MHz)	Max. output power including tune-up tolerance (dBm)	Required Limit
1	2412	14.92	1 Watt = 30 dBm
6	2437	14.94	1 Watt = 30 dBm
11	2462	14.82	1 Watt = 30 dBm

### MPE Prediction (802.11n\_20M 2412~2462)

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

Max. output power including tune-up tolerance:	14.94	(dBm)
Max. output power including tune-up tolerance:	31.188896	(mW)
Duty cycle:	100	(%)
Maximum Pav :	31.188896	(mW)
Peak Antenna gain (Maximum):	2.14	(dBi)
Peak Antenna gain (linear):	1.6368165	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.010	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.01 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2437MHz.

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CH	Frequency (MHz)	Max. output power including tune-up tolerance (dBm)	Required Limit
3	2422	14.98	1 Watt = 30 dBm
6	2437	14.93	1 Watt = 30 dBm
9	2452	13.65	1 Watt = 30 dBm

### MPE Prediction (802.11n\_40M 2422~2452)

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

Max. output power including tune-up tolerance:	14.98	(dBm)
Max. output power including tune-up tolerance:	31.477483	(mW)
Duty cycle:	100	(%)
Maximum Pav :	31.477483	(mW)
Peak Antenna gain (Maximum):	2.14	(dBi)
Peak Antenna gain (linear):	1.6368165	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2422	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.010	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.01 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2422MHz.

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## MAXIMUM PERMISSIBLE EXPOSURE (MPE)(IC)

### Standard Applicable:

According to RSS 102 March 19,2015 issue 5 §2.5.2 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;

This is a Mobile device, at which separation distance between the user and the device's antenna is 20cm. Therefore, section 2.5.2 shall be complied with

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## Maximum Permissible Exposure (MPE) Evaluation

802.11 b:

Max. output power including tune-up tolerance:	14.95	(dBm)
Max. output power including tune-up tolerance:	31.260794	(mW)
Antenna gain (Peak):	2.14	(dBi)
Maximum antenna gain:	1.6368165	(numeric)
Frequency	2412	MHz
Limit	2.6840	W

### Evaluation Result

The radiated power is  $14.95 + 2.14 = 17.09$  dBm(EIRP) =  $51.168$  mW =  $0.051168$  W that is less than or equal to  $2.684$  W. Hence, following section 2.5.2 of RSS102 issue 5 RF exposure evaluation is no longer required.

802.11 g:

Max. output power including tune-up tolerance:	14.98	(dBm)
Max. output power including tune-up tolerance:	31.477483	(mW)
Antenna gain (Peak):	2.14	(dBi)
Maximum antenna gain:	1.6368165	(numeric)
Frequency	2412	MHz
Limit	2.6840	W

### Evaluation Result

The radiated power is  $14.98 + 2.14 = 17.12$  dBm(EIRP) =  $51.523$  mW =  $0.051523$  W that is less than or equal to  $2.684$  W. Hence, following section 2.5.2 of RSS102 issue 5 RF exposure evaluation is no longer required.

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**802.11n\_HT20:**

Max. output power including tune-up tolerance:	14.94	(dBm)
Max. output power including tune-up tolerance:	31.188896	(mW)
Antenna gain (Peak):	2.14	(dBi)
Maximum antenna gain:	1.6368165	(numeric)
Frequency	2437	MHz
Limit	2.7030	W

**Evaluation Result**

The radiated power is  $14.94 + 2.14 = 17.08$  dBm(EIRP) =  $51.05$  mW =  $0.05105$  W that is less than or equal to  $2.703$  W. Hence, following section 2.5.2 of RSS102 issue 5 RF exposure evaluation is no longer required.

**802.11n HT40:**

Max. output power including tune-up tolerance:	14.98	(dBm)
Max. output power including tune-up tolerance:	31.477483	(mW)
Antenna gain (Peak):	2.14	(dBi)
Maximum antenna gain:	1.6368165	(numeric)
Frequency	2422	MHz
Limit	2.6916	W

**Evaluation Result**

The radiated power is  $14.98 + 2.14 = 17.12$  dBm(EIRP) =  $51.523$  mW =  $0.051523$  W that is less than or equal to  $2.692$  W. Hence, following section 2.5.2 of RSS102 issue 5 RF exposure evaluation is no longer required.

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