



RADIO FREQUENCY EXPOSURE

LIMIT

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §15.247(b)(4) and §1.1307(b)(1) of this chapter.

EUT Specification

EUT	54M Wireless Router
Frequency band (Operating)	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5825GHz <input type="checkbox"/> Others _____
Device category	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others _____
Exposure classification	<input type="checkbox"/> Occupational/Controlled exposure ($S = 5mW/cm^2$) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ($S=1mW/cm^2$)
Antenna diversity	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input checked="" type="checkbox"/> Tx/Rx diversity
Max. output power	23.36 dBm (216.77mW)
Antenna gain (Max)	5 dBi (Numeric gain: 3.16)
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation

Note:

1. The maximum output power is 23.36 dBm (216.77mW) at 2462MHz (with 3.16 numeric antenna gain.)
2. For mobile or fixed location transmitters, no SAR consideration applied. The minimum separation generally be used is at least 20 cm, even if the calculations indicate that the MPE distance would be lesser.

TEST RESULT

No non-compliance noted.



Calculation

Given $E = \sqrt{\frac{30 \times P \times G}{d}}$ & $S = \frac{E^2}{3770}$

Where $E =$ Field Strength in Volts / meter
 $P =$ Power in Watts
 $G =$ Numeric antenna gain
 $d =$ Distance in meters
 $S =$ Power Density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$d = \sqrt{\frac{30 \times P \times G}{3770 \times S}}$$

Changing to units of mW and cm, using:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = 100 * d (m)$$

Yields

$$d = 100 \times \sqrt{\frac{30 \times (P / 1000) \times G}{3770 \times S}} = 0.282 \times \sqrt{\frac{P \times G}{S}}$$

Where $d =$ distance in cm
 $P =$ Power in mW
 $G =$ Numeric antenna gain
 $S =$ Power Density in mW / cm²

Substituting the logarithmic form of power and gain using:

$$P (mW) = 10 ^ (P (dBm) / 10) \text{ and}$$

$$G (numeric) = 10 ^ (G (dBi) / 10)$$

Yields

$$d = 0.282 \times \frac{10^{(P+G)/20}}{\sqrt{20}}$$

Equation 1

Where $d =$ MPE safe distance in cm



P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW / cm²

Maximum Permissible Exposure (2.4 GHz Band)

S = Maximum power density (mW/cm²)

P = Power input to the antenna (mW). = 216.77

G = Numeric power gain of the antenna = 3.16

R = Distance to the center of the radiation of the antenna (20cm = limit for MPE) = 0.02²

The maximum permissible exposure (MPE) for the general population is 1.00 mW/cm².

$$(216.77 * 3.16) / (4\pi * 0.02^2) = 0.136 \text{ mW/cm}^2$$

The power density at 20cm does not exceed the 1 mW/cm² limit. Therefore, the exposure condition is compliant with FCC rules.