

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:
Pass
Test Specification

Test standard : CFR47 FCC Part 2: Section 2.1091
 CFR47 FCC Part 1: Section 1.1310
 FCC KDB Publication 447498 v06, section 7
 RSS-102 Issue 5 February 2021, section 2.5.2

This module has five different antennas, and the maximum e.r.i.p. configuration be evaluated as below:

➤ **FCC requirements**

FCC requirement: 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 level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

MPE Calculation Method according to KDB 447498 v06

Power Density: $S_{(mW/cm^2)} = PG/4\pi R^2$ or $EIRP/4\pi R^2$

Where:

S = power density (mW/cm²)

P = power input to the antenna (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 (cm)

From the peak RF output power, the minimum mobile separation distance, d=20 cm, as well as the antenna gain, the RF power density can be calculated as below:

$$S_{(mW/cm^2)} = PG/4\pi R^2$$

a) EUT RF Exposure Evaluation standalone operations

Test Mode	Maximum conducted Power		Antenna Gain (dBi)	Measured e.i.r.p		$S_{(mW/cm^2)} = PG/4\pi R^2$	Limit (mW/cm ²)
	(dBm)	(mW)		(dBm)	(mW)		
2.4GHz Wi-Fi SISO	20.8	120.23	5.4	26.2	416.87	0.083	1.0
2.4GHz Wi-Fi MIMO	23.52	224.91	5.4*	28.94	779.83	0.155	1.0

➤ **IC requirements:** The EUT shall comply with the requirement of RSS-102 section 2.5.2.

Exemption from Routine Evaluation Limits – 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:

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;

- RF exposure evaluation exempted power: 2.670 W

a) EUT RF Exposure Evaluation standalone operations:

Test Mode	Measured Peak Power		Antenna Gain (dBi)	Measured e.i.r.p (mW)	
	(dBm)	(mW)		(dBm)	(mW)
2.4GHz Wi-Fi SISO	20.8	120.23	5.4	26.2	416.87
2.4GHz Wi-Fi MIMO	23.52	224.91	5.4*	28.94	779.83

The e.i.r.p. is less than the RF exposure evaluation exempted power. So RF exposure evaluation is not required.

“RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.”

* Calculate for MIMO Antenna gain

According to FCC KDB 662911 D01, clause f) 2) f) i):

If all antennas have the same gain, G_{ANT} , Directional gain = $G_{ANT} + \text{Array Gain}$, where Array Gain = 0 dB for $N_{ANT} \leq 4$ for power measurements on IEEE 802.11 devices.

According to FCC KDB 662911 D01, clause f) 2) f) ii):

If antenna gains are not equal, directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

The directional gain calculate as below table:

Ant0 Gain (dBi)	Ant1 Gain (dBi)	directional gain(dBi)
5.4	5.0	5.4
3.0	3.0	3.0
2.0	2.0	2.0