

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:
Pass
Test Specification

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

➤ **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)		
BLE (ESP)	18.7	74.131	3.97	22.67	184.927	0.037	1.0
BLE (WBR1)	5.4	3.467	4.88	10.28	10.666	0.002	1.0
2.4GHz Wi-Fi	24.5	281.838	4.88	29.38	866.962	0.17	1.0

b) EUT RF Exposure Evaluation simultaneous transmission operations

Simultaneous transmission mode	The sum of the ratios	Result
BLE(ESP32) + BLE (WBR1) + 2.4GHz Wi-Fi	$0.037/1 + 0.17/1 < 1$	Pass

➤ **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)
BLE (ESP)	18.7	74.131	3.97	22.67	184.927
BLE (WBR1)	5.4	3.467	4.88	10.28	10.666
2.4GHz Wi-Fi	24.5	281.838	4.88	29.38	866.962

b) EUT RF Exposure Evaluation simultaneous transmission operations

Simultaneous transmission mode	The sum of the ratios	Result
BLE(ESP32) + BLE (WBR1) + 2.4GHz Wi-Fi	$0.18/2.67 + 0.867/2.67 < 1$	Pass

The e.i.r.p. for BLE and DTSSs are 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.”