



APPENDIX L

: RF EXPOSURE EVALUATION



1. RF Exposure Evaluation

Test Result of RF Exposure Evaluation

According to the KDB-447498 D01 V06, FCC 47CFR § 2.1093 the following RF exposure evaluation shall to demonstrate RF exposure compliance

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}]$$

Frequency	Average Conducted Output Power(dBm)	Target Power /tolerance (dBm)	Maximum Average Output Power(dBm)	Maximum Average Output Power(mW)	Separation Distance (mm)	RF Exposure
2402	6.5	7 ± 1	8	6.31	5	1.96
2440	6.5	7 ± 1	8	6.31	5	1.97
2480	6.1	7 ± 1	8	6.31	5	1.99

The Max RF exposure is 1.99

Threshold at which no SAR required is $\ll 3$ for 1-g SAR, Separation distance is 5 mm

Conclusion:

So no SAR is required.



Radiofrequency radiation exposure limits.

Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) of this part within the frequency range of 100 kHz to 6 GHz (inclusive).

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1,500-100,000			5	<6
(ii) 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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

f = frequency in MHz. * = Plane-wave equivalent power density.

Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * r^2)$

where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance r.



RTL8762EJF (Realtek)

Mode	Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
BLE	2 402	6.5	4.47	1.50	20	0.001 334	1.0
	2 440	6.5	4.47	1.50	20	0.001 334	1.0
	2 480	6.1	4.07	1.50	20	0.001 215	1.0

ESP32-WROOM-32UE (Espressif)

Mode	Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
802.11b	2 412 to 2 462	26.0	398.11	2.25	20	0.178 203	1.0
802.11g	2 412 to 2 462	25.5	354.81	2.25	20	0.158 821	1.0
802.11n-HT20	2 412 to 2 462	25.5	354.81	2.25	20	0.158 821	1.0
802.11n-HT40	2 422 to 2 452	26.0	398.11	2.25	20	0.178 203	1.0
BLE	2 402 to 2 480	8.0	6.31	2.25	20	0.002 824	1.0
BT	2 402 to 2 480	10.0	10.00	2.25	20	0.004 476	1.0

Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

RF Function	Power Density At 20 cm (mW/cm ²)	Limits (mW/cm ²)
RTL8762EJF BLE	0.001 334	1.0
ESP3-WROOM-32UE Wi-Fi 802.11b	0.178 203	1.0

Confirm the sum result of individual MPEs ratio is ≤ 1.0 ;
RTL8762EJF(BLE) + ESP3-WROOM-32UE(Wi-Fi 802.11b):
 $(0.001\ 334 / 1.0) + (0.178\ 203 / 1.0) = 0.179\ 537 \leq 1.0$

So, this device meets the KDB447498 D01 v06 section 7.2 requirement of “Simultaneous transmission MPE test exclusion”.