

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in KDB 447498 D01 V06 and §1.1307(b)

CFR Title 47 §2.1091(b): (b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC ID: **2AKXB-W108021000**

EUT Specification

EUT	SwitchBot Hub 4
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.24GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☒ Others: 2.402GHz~2.480GHz BT
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others ____
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm ²) ☒ General Population/Uncontrolled exposure (S=1mW/cm ²)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☐ Tx/Rx diversity
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation

Limits for Maximum Permissible Exposure(MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm ²)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300-1500	--	--	F/1500	6
1500-100000	--	--	1	30

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

P_d the limit of MPE, 1mW/cm². If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

Measurement Result

BDR&EDR (Chip: FR5086D) worst case:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits (mW/cm ²)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/ cm ²)	
8DPSK	2402	-0.32	-0.32±1	0.68	2.67	0.0004	1

BLE 1 (Chip: FR5086D) worst case:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits (mW/cm ²)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/ cm ²)	
1M	2402	-0.02	-0.02±1	0.98	2.67	0.0005	1

BLE 2 (Chip: NRF52833) worst case:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits (mW/cm ²)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/ cm ²)	
2M	2440	2.58	2.58±1	3.58	4.45	0.0013	1

2.4GHz WiFi (Chip: ESP32-S3R8) worst case:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits (mW/cm ²)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/ cm ²)	
802.11g	2412	14.35	14.35±1	15.35	3.14	0.0141	1

Evaluate the condition of different modules work simultaneously

The requirement of Simultaneous Transmission evaluation has also been considered and has complied with the following conditions of the worst case:

$MPE1/Limit1 + MPE2/Limit2 + \dots \leq 1$.

Simultaneous Transmission Combination	RF Chip(s)	Power Density Ratio Sum	Limit	Result
BLE 1 + BLE 2	FR5086D + NRF52833	$0.0005/1 + 0.0013/1 = 0.0018$	< 1	Pass
BLE 1 + 2.4GHz WiFi	FR5086D + ESP32-S3R8	$0.0005/1 + 0.0141/1 = 0.0146$	< 1	Pass
BLE 2 + 2.4GHz WiFi	NRF52833 + ESP32-S3R8	$0.0013/1 + 0.0141/1 = 0.0154$	< 1	Pass
BLE 1 + BLE 2 + 2.4GHz WiFi	FR5086D + NRF52833 + ESP32-S3R8	$0.0005/1 + 0.0013/1 + 0.0141/1 = 0.0159$	< 1	Pass

The worst-case situation is 0.0159, which is less than “1”. This confirmed that the device comply with KDB 447498 D01 V06 Power limit.

Note: RF transmitters implemented by different RF chips are evaluated for simultaneous transmission. For FR5086D, BDR&EDR and BLE 1 are operating modes of the same chip; therefore, the worst-case mode (BLE 1, 0.0005 mW/cm²) is used for the simultaneous transmission evaluation.

Test Result: Pass