

## 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 §1.1307(b)

FCC ID: 2APN5-DONGLEM

### EUT Specification

<b>EUT</b>	Zigbee/Thread PoE Dongle
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> Zigbee: 2.405GHz ~ 2.480GHz <input checked="" type="checkbox"/> WIFI: 2.412GHz ~ 2.462GHz
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation)
<b>Exposure classification</b>	<input type="checkbox"/> Occupational/Controlled exposure ( $S = 5\text{mW/cm}^2$ ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ( $S=1\text{mW/cm}^2$ )
<b>Antenna diversity</b>	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
<b>Max. output power</b>	Zigbee: 4.57 dBm 2.4G WIFI 802.11b: 18.68 dBm 802.11g: 17.91 dBm 802.11n HT20: 18.01 dBm 802.11n HT40: 17.64 dBm
<b>Antenna gain (Max)</b>	Zigbee: 4.95 dBi 2.4G WIFI 4.75 dBi for antenna 1
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation

Limits for Maximum Permissible Exposure(MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density( $\text{mW/cm}^2$ )	Average Time
<b>(A) Limits for Occupational/Control Exposures</b>				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6
<b>(B) Limits for General Population/Uncontrol Exposures</b>				
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/cm<sup>2</sup>,  $P_{out}$ =output power to antenna in mW.

$G$ = gain of antenna in linear scale,  $\pi=3.1416$

$R$ = distance between observation point and center of the radiator in cm=20cm  
 $P_d$  the limit of MPE, 1mW/cm<sup>2</sup>. 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.

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation

$$\sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

$Evaluated_k$ : the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure\ Limit_k$ : either the general population/uncontrolled maximum permissible exposure (MPE) or specific Absorption rate (SAR) limit for each fixed, mobile, or portable RF source k.

## Measurement Result

### Zigbee:

Mode	Max Measured Power (dBm)	Tune up tolerance (dBm)	Max tune up conducted power(dBm)	Output Peak power (mW)	Ant. Gain (dBi)	Ant. Gain (numeric)	Power density at 20cm (mW/ cm <sup>2</sup> )	Power density Limits (mW/ cm <sup>2</sup> )
Zigbee	4.57	4±1	5	3.162	4.95	3.126	0.00197	1

**2.4G WIFI:**

Mode	Max Measured Power (dBm)	Tune up tolerance (dBm)	Max tune up conducted power(dBm)	Output Peak power (mW)	Ant. Gain (dBi)	Ant. Gain (numeric)	Power density at 20cm (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
802.11b	18.68	18±1	19	79.433	4.75	2.985	0.04718	1
802.11g	17.91	17±1	18	63.096	4.75	2.985	0.03747	1
802.11n HT20	18.01	18±1	19	79.433	4.75	2.985	0.04718	1
802.11n HT40	17.64	17±1	18	63.096	4.75	2.985	0.03747	1

Maximum Simultaneous transmission MPE Ratio for Zigbee &amp; 2.4G WIFI

Maximum MPE ratio (Zigbee)	Maximum MPE ratio (2.4G WIFI)	$\sum$ MPE ratios	Limit	Results
0.00197	0.04718	0.04915	1.000	Pass

Signature:



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 Shawn Wen

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