

RF Exposure evaluation for multi-transmitter product

In mobile exposure conditions, simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated power density, is ≤ 1.0 , i.e.

$$\sum_{i=1}^n \frac{S_i}{(MPE)_i} \leq 1$$

Where S_i is the Power Density on the given distance for $i=1, 2, 3, \dots, n$,

n – number of antennas transmitting simultaneously,

$(MPE)_i$ is the Limit of MPE for the given transmitting frequency.

The $\frac{S_i}{(MPE)_i}$ is the MPE ratio of power density to MPE limit of each antenna, determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device.

Calculation of Power Density at a given distance

Power Density (S mW/cm^2) is calculated as

$$S = \frac{EIRP}{4\pi d^2}$$

Where $EIRP$ – Average Equivalent Isotropic Radiated Power (in mW),

$$EIRP = P_a \times G$$

$$P_a = P \times DC$$

DC – Source-based Duty Cycle (numeric)

G – Gain of the antenna in the direction of interest relative to an isotropic radiator (numeric),

d – Distance to the center of radiation of the antenna (in cm).

The Qolsys FCC ID: 2AAJXQS-IQPANEL2 contains several transmitters / antennas:

- 1) 2.4 GHz BLE and Wi-Fi Part 15 radios (equipment Class DTS),
- 2) 5 GHz Wi-Fi Part 15 radio (equipment Class NII),
- 3) 824 – 849 MHz Part 22H radio (equipment Class PCB),
- 4) 1850 – 1910 MHz Part 24E radio (equipment Class PCB),
- 5) 698–716 MHz, 777–787 MHz, 704–716 MHz, 1710–1755 MHz Part 27 radio (equipment Class PCB).
- 6) Zigbee Module FCC ID: 2AAJXQS-IS certified previously.

Transmitter 1) doesn't transmit simultaneously with 2), but 1) or 2) can transmit simultaneously with 3), 4) or 5).

Transmitters 3), 4) and 5) don't transmit simultaneously.

Transmitter 6) can transmit simultaneously with any of listed above transmitters.

Transmitter 2.4 GHz BLE has a very low RF power – about 3 dBm EIRP and can be excluded from RF Exposure calculation.

The following calculation of RF exposure is performed:

Number of transmitter	Band/Uplink, MHz	FCC Part/ Equipment Class	Power input to antenna, mW	Source-based Duty Cycle, numeric	Antenna gain, dBi/num	Power Density S (mW/cm ²) at 20 cm	FCC MPE limit, * mW/cm ²	$\frac{S}{MPE}$
1	2402-2480	FCC Part 15/ DTS	1.33	1	0.5/1.12	10 ⁻⁴	1.0	10 ⁻⁴
2	2412-2462	FCC Part 15/ DTS	78.0	1	0.5/1.12	0.023	1.0	0.022
3	5180-5240	FCC Part 15/ NII	66.8	1	1.2/1.3	0.017	1.0	0.017
4	5260-5320	FCC Part 15/ NII	77.6	1	2.2/1.7	0.026	1.0	0.026
5	5500-5580	FCC Part 15/ NII	62.5	1	2.7/1.9	0.024	1.0	0.024
6	5660-5720	FCC Part 15/ NII	59.3	1	2.7/1.9	0.022	1.0	0.022
7	5745-5825	FCC Part 15/ NII	70.8	1	2.5/1.8	0.025	1.0	0.025
8	1850–1910 (band 2)	FCC Part 24E/ PCB	239	1	2.1/1.6	0.079	1.0	0.079
9	1710–1755 (band 4)	FCC Part 27/ PCB	428	1	1.9/1.5	0.324	1.0	0.324
10	824–849 (band 5)	FCC Part 22H/ PCB	569	1	3.6/2.3	0.260	0.55	0.473
11	699–716 (band 12)	FCC Part 27/ PCB	497	1	1.8/1.5	0.148	0.47	0.316
12	777–787 (band 13)	FCC Part 27/ PCB	366	1	4.1/2.6	0.109	0.52	0.210
13	704–716 (band 17)	FCC Part 27/ PCB	471	1	1.8/1.5	0.140	0.47	0.300
14 **	912 - 924	FCC Part 15/ DSS	8.5	1	2.0/1.6	0.003	0.61	0.005
							Worst case Σ	0.342

* Limit for Occupational /uncontrolled environment

** Previously certified Zigbee Module to be installed into the IQPANEL2.

$$\sum_{i=1}^n \frac{S_i}{(MPE)_i} = 0.34$$

Since the result is less than 1, FCC requirements for RF Exposure are met for Occupational /Uncontrolled environment.