

**Collocated MPE analysis:**

The modem may transmit simultaneously with other collocated radio transmitters within a host device, provided the following conditions are met:

- Each collocated radio transmitter has been certified by FCC/IC for mobile application (that will be met since SQNS module will have its own FCC ID and host device will have its own FCC ID)
- At least 20 cm separation distance between the antennas of the collocated transmitters and the user's body must be maintained at all times (host installation should taking care of that)

The output power and antenna gain in a collocated configuration must not exceed the limits and configurations stipulated in the following table 1. The power density calculations for the individual transmitters per wireless technology at an exposure minimum separation distance of 20cm.

**Exclusion of test condition:**

*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 calculated or measured field strengths or power density, is  $\leq 1.0$ .*

$$\sum MPE\ ratio1 + MPE\ ratio2 + MPE\ ratio3 \leq 1.0$$

*The spreadsheet as FCC deduces, and releases is employed to conduct the measurement:*

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Table 1 : Collocated MPE Calculation (Worse-case table)

Technology	Frequency (MHz)	Max Conducted Power (dBm)	Max Gain (dBi)	Duty Cycle	FCC Power Density @20cm (mW/cm <sup>2</sup> )	IC Power Density @20cm (W/m <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	IC MPE Limit (W/m <sup>2</sup> )
Zigbee	2480	4.16	3.6	0.05	0	0.001	1.000	5.469
2.4GHz WLAN (SISO)	2462	8.58	3.6	0.96	0.003	0.032	1.000	5.442
2.4GHz WLAN (MIMO)	2412	11.52	6.61	0.93	0.012	0.12	1.000	5.366
5GHz WLAN (SISO)	5500	15.53	4.7	0.95	0.02	0.199	1.000	9.425
5GHz WLAN (MIMO)	5580	15.16	7.71	0.95	0.037	0.366	1.000	9.519

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**(FCC)**

*Scenario 1:*

**Zigbee +2.4GHz WLAN (SISO) + 5GHz WLAN (SISO)**

Zigbee (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(Zigbee) / MPE limit	WLAN (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN) / MPE limit	WLAN A (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN A) / MPE limit	(Zigbee +WLAN + WLAN A)	FCC Limit (mW/cm <sup>2</sup> )
0	1.000	0	0.003	1.000	0.003	0.02	1.000	0.02	0.023	1.000

*Scenario 2:*

**Zigbee +2.4GHz WLAN (SISO) + 5GHz WLAN (MIMO)**

Zigbee (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(Zigbee) / MPE limit	WLAN (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN) / MPE limit	WLAN A MIMO (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN A MIMO) / MPE limit	(Zigbee +WLAN + WLAN A MIMO)	FCC Limit (mW/cm <sup>2</sup> )
0	1.000	0	0.003	1.000	0.003	0.037	1.000	0.037	0.04	1.000

*Scenario 3:*

**Zigbee +2.4GHz WLAN (MIMO) + 5GHz WLAN (SISO)**

Zigbee (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(Zigbee) / MPE limit	WLAN MIMO (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN MIMO) / MPE limit	WLAN A (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN A) / MPE limit	(Zigbee +WLAN MIMO+ WLAN A)	FCC Limit (mW/cm <sup>2</sup> )
0	1.000	0	0.012	1.000	0.012	0.02	1.000	0.02	0.032	1.000

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Scenario 4:

Zigbee +2.4GHz WLAN (MIMO) + 5GHz WLAN (MIMO)

Zigbee (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(Zigbee) / MPE limit	WLAN MIMO (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN MIMO) / MPE limit	WLAN A MIMO (mW/cm <sup>2</sup> )	FCC MPE limit (mW/cm <sup>2</sup> )	(WLAN A MIMO) / MPE limit	(Zigbee +WLAN + WLAN A MIMO)	FCC Limit (mW/cm <sup>2</sup> )
0	1.000	0	0.012	1.000	0.012	0.037	1.000	0.037	0.049	1.000

(IC)

Scenario 1:

Zigbee +2.4GHz WLAN (SISO) + 5GHz WLAN (SISO)

Zigbee (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(Zigbee) / MPE limit	WLAN (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN) / MPE limit	WLAN A (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN A) / MPE limit	(Zigbee +WLAN + WLAN A)	IC Limit (W/m <sup>2</sup> )
0.001	5.469	0.00018	0.032	5.442	0.0059	0.199	9.425	0.0211	0.0272	1.000

Scenario 2:

Zigbee +2.4GHz WLAN (SISO) + 5GHz WLAN (MIMO)

Zigbee (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(Zigbee) / MPE limit	WLAN (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN) / MPE limit	WLAN A MIMO (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN A MIMO) / MPE limit	(Zigbee +WLAN + WLAN A MIMO)	IC Limit (W/m <sup>2</sup> )
0.001	5.469	0.00018	0.032	5.442	0.0059	0.366	9.519	0.0384	0.0445	1.000

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Scenario 3:

Zigbee +2.4GHz WLAN (MIMO) + 5GHz WLAN (SISO)

Zigbee (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(Zigbee) / MPE limit	WLAN MIMO (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN MIMO) / MPE limit	WLAN A (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN A) / MPE limit	(Zigbee +WLAN MIMO+ WLAN A)	IC Limit (W/m <sup>2</sup> )
0.001	5.469	0.00018	0.12	5.366	0.0224	0.199	9.425	0.0211	0.0437	1.000

Scenario 4:

Zigbee +2.4GHz WLAN (MIMO) + 5GHz WLAN (MIMO)

Zigbee (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(Zigbee) / MPE limit	WLAN MIMO (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN MIMO) / MPE limit	WLAN A MIMO (W/m <sup>2</sup> )	IC MPE limit (W/m <sup>2</sup> )	(WLAN A MIMO) / MPE limit	(Zigbee +WLAN MIMO+ WLAN A MIMO)	IC Limit (W/m <sup>2</sup> )
0.001	5.469	0.00018	0.12	5.366	0.0224	0.366	9.519	0.0384	0.0610	1.000

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