

## FCC §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34                                            | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30                                             | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

The sample contain a Z-WAVE module (FCC ID: D87-ZM5304-U) which has been certified on 2013-08-23 by Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch. According the report RF130710C16, the max ERP was 92.9 dBuV/m on 908.42MHz, antenna gain was 1 dBi, so the max output power= ERP-95.3-1+2.15= -1.25 dBm

| Frequency (MHz) | Antenna Gain |           | max output power |      | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|-----------------|--------------|-----------|------------------|------|--------------------------|-------------------------------------|---------------------------------|
|                 | (dBi)        | (numeric) | (dBm)            | (mW) |                          |                                     |                                 |
| 908.4-916       | 1            | 1.26      | -1.25            | 0.75 | 20                       | 0.0002                              | 0.61                            |

For the sample which contain the LTE module 1(FCC ID: QIPELS31-V):

| Frequency (MHz) | Antenna Gain |           | Conducted Power |        | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|-----------------|--------------|-----------|-----------------|--------|--------------------------|-------------------------------------|---------------------------------|
|                 | (dBi)        | (numeric) | (dBm)           | (mW)   |                          |                                     |                                 |
| 2412-2462       | 2            | 1.58      | 21.5            | 141.25 | 20                       | 0.04                                | 1.0                             |
| 1710-1755       | 2            | 1.58      | 24              | 251.19 | 20                       | 0.08                                | 1.0                             |
| 777-787         | 2            | 1.58      | 24              | 251.19 | 20                       | 0.08                                | 0.52                            |

Note: LTE Data please refer to LTE module 1's FCC ID: QIPELS31-V which has been certified on 2015-12-16 by Shenzhen CETECOM Inc.

Simultaneous transmitting consideration for LTE & WIFI & Z-Wave:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.04/1 + 0.08/0.52 + 0.0002/0.61 = 0.19 < 1.0$$

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**

For the sample which contain the LTE module 2(FCC ID: N7NMC7355):

| Mode | Frequency (MHz) | Antenna Gain |           | Conducted Power |         | Duty cycle | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|------|-----------------|--------------|-----------|-----------------|---------|------------|--------------------------|-------------------------------------|---------------------------------|
|      |                 | (dBi)        | (numeric) | (dBm)           | (mW)    |            |                          |                                     |                                 |
| WIFI | 2412-2462       | 2            | 1.58      | 21.5            | 141.25  | 1.0        | 20                       | 0.04                                | 1.0                             |
| GPRS | 824-849         | 2            | 1.58      | 33              | 1995.26 | 0.25       | 20                       | 0.16                                | 0.55                            |
|      | 1850-1910       | 2            | 1.58      | 30              | 1000.00 | 0.25       | 20                       | 0.08                                | 1.0                             |
| EDGE | 824-849         | 2            | 1.58      | 28              | 630.96  | 0.25       | 20                       | 0.05                                | 0.55                            |
|      | 1850-1910       | 2            | 1.58      | 27              | 501.19  | 0.25       | 20                       | 0.04                                | 1.0                             |
| CDMA | 824-849         | 2            | 1.58      | 25              | 316.23  | 1.0        | 20                       | 0.10                                | 0.55                            |
|      | 1850-1910       | 2            | 1.58      | 25              | 316.23  | 1.0        | 20                       | 0.10                                | 1.0                             |
|      | 817-824         | 2            | 1.58      | 25              | 316.23  | 1.0        | 20                       | 0.10                                | 0.54                            |
| UMTS | 824-849         | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 0.55                            |
|      | 1710-1755       | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 1.0                             |
|      | 1850-1910       | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 1.0                             |
| LTE  | 704-716         | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 0.47                            |
|      | 777-787         | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 0.52                            |
|      | 824-849         | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 0.55                            |
|      | 1710-1755       | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 1.0                             |
|      | 1850-1910       | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 1.0                             |
|      | 1850-1915       | 2            | 1.58      | 24              | 251.19  | 1.0        | 20                       | 0.08                                | 1.0                             |

Note: LTE Data please refer to LTE module 2's FCC ID: N7NMC7355 which has been certified on 2012-11-28 by UL VERIFICATION SERVICES, INC.

Simultaneous transmitting consideration for above table, the worst case is WIFI and GPRS 850 band and Z-Wave:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.04/1 + 0.16/0.55 + 0.0002/0.61 = 0.33 < 1.0$$

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**