

## FCC §15.247 (i), §2.1091 – RF Exposure

FCC ID: 2BBVL-IEC151N302X

### Applied procedures / limit

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

### Limits for Occupational / Controlled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|------------------------------------------------------------------|
| 0.3-3.0               | 614                               | 1.63                              | (100)*                                   | 6                                                                |
| 3.0-30                | 1842 / f                          | 4.89 / f                          | (900 / f)*                               | 6                                                                |
| 30-300                | 61.4                              | 0.163                             | 1.0                                      | 6                                                                |
| 300-1500              |                                   |                                   | F/300                                    | 6                                                                |
| 1500-100,000          |                                   |                                   | 5                                        | 6                                                                |

Note: f is frequency in MHz

\* = Power density limit is applicable at frequencies greater than 100 MHz

### Limits for General Population / Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|------------------------------------------------------------------|
| 0.3-1.34              | 614                               | 1.63                              | (100)*                                   | 30                                                               |
| 1.34-30               | 824/f                             | 2.19/f                            | (180/f)*                                 | 30                                                               |
| 30-300                | 27.5                              | 0.073                             | 0.2                                      | 30                                                               |
| 300-1500              |                                   |                                   | F/1500                                   | 30                                                               |
| 1500-100,000          |                                   |                                   | 1.0                                      | 30                                                               |

Note: f = frequency in MHz

\* = Plane-wave equivalent power density

## MPE PREDICTION

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna, R=20cm

## Test Result of RF Exposure Evaluation

|                | Modes & Channel Freq. (MHz) | Tune up Produce power | Maximum peak output power (dBm) | Output power to antenna (mW) | Antenna Gain (numeric) | Power Density (S) (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) | Result |
|----------------|-----------------------------|-----------------------|---------------------------------|------------------------------|------------------------|-----------------------------------------|-----------------------------|--------|
| BLE 1M         | GFSK & HCH                  | 5 ± 1                 | 6                               | 3.9811                       | 1.5885 (2.01dBi)       | 0.0013                                  | 1                           | Pass   |
| BLE 2M         | GFSK & HCH                  | 5 ± 1                 | 6                               | 3.9811                       | 1.5885 (2.01dBi)       | 0.0013                                  | 1                           | Pass   |
| EDR            | 8DPSK & HCH                 | 7 ± 1                 | 8                               | 6.3096                       | 1.5885 (2.01dBi)       | 0.002                                   | 1                           | Pass   |
| 2.4G WIFI ANT1 | 802.11n(H T20)&2462         | 14 ± 1                | 15                              | 31.6228                      | 1.5885 (2.01dBi)       | 0.01                                    | 1                           | Pass   |
| 2.4G WIFI ANT2 | 802.11n(H T20)&2412         | 14 ± 1                | 15                              | 31.6228                      | 3.0479 (4.84dBi)       | 0.0192                                  | 1                           | Pass   |
| 5.2GWIFI ANT1  | 802.11n(H T40)&5230         | 14 ± 1                | 15                              | 31.6228                      | 2.6062 (4.16dBi)       | 0.0164                                  | 1                           | Pass   |
| 5.2GWIFI ANT2  | 802.11n(H T20)&5200         | 13 ± 1                | 14                              | 25.1189                      | 2.0941 (3.21dBi)       | 0.0105                                  | 1                           | Pass   |
| 5.3GWIFI ANT1  | 802.11n(H T40)&5270         | 16 ± 1                | 17                              | 50.1187                      | 1.7824 (2.51dBi)       | 0.0178                                  | 1                           | Pass   |
| 5.3GWIFI ANT2  | 802.11a&5260                | 11 ± 1                | 12                              | 15.8489                      | 2.0941 (3.21dBi)       | 0.0066                                  | 1                           | Pass   |
| 5.6GWIFI ANT1  | 802.11n(H T40)&5670         | 13 ± 1                | 14                              | 25.1189                      | 2.3823 (3.77dBi)       | 0.0119                                  | 1                           | Pass   |
| 5.6GWIFI ANT2  | 802.11n(H T20)&5500         | 12 ± 1                | 13                              | 19.9526                      | 2.1777 (3.38dBi)       | 0.0086                                  | 1                           | Pass   |
| 5.8GWIFI ANT1  | 802.11ac80&5775             | 12 ± 1                | 13                              | 19.9526                      | 1.7022 (2.31dBi)       | 0.0068                                  | 1                           | Pass   |

|                  |                  |      |    |         |                     |        |           |      |
|------------------|------------------|------|----|---------|---------------------|--------|-----------|------|
| 5.8GWIFI<br>ANT2 | 802.11a&5<br>825 | 12±1 | 13 | 19.9526 | 1.5668<br>(1.95dBi) | 0.0062 | 1         | Pass |
| NFC              | 13.56MHz         | 2±1  | 3  | 1.9953  | 1.2589<br>(1dBi)    | 0.0005 | 0.00<br>9 | Pass |

13.56MHz: Note:dbm=dbuv/m-95.2-2.15=101.11-95.2-2.15=3.76dBm(ERP), so the conduct peak power=3.76-1=2.76dBm

#### For the Max simultaneous transmission MPE:

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table (A) and Table (B). To comply with the MPE, the fraction of the MPE in terms of E2, H2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i}$$

| Tech<br>nolo<br>gy       | Tune up<br>Produce<br>power(dBm) |          | Maximum<br>Tune-up<br>(dBm) |          | Antenna<br>Gain(ANT<br>1/ANT 2)<br>(numeric)                 | Power Density<br>(S)<br>(mW/ cm2) |        | MPE<br>Limit<br>(mW/<br>cm2) | Σ<br>MPE<br>Ratio | Σ<br>MPE<br>Ratio<br>Limit | Result |
|--------------------------|----------------------------------|----------|-----------------------------|----------|--------------------------------------------------------------|-----------------------------------|--------|------------------------------|-------------------|----------------------------|--------|
|                          | ANT<br>1                         | ANT<br>2 | ANT<br>1                    | ANT<br>2 |                                                              | ANT 1                             | ANT 2  |                              |                   |                            |        |
| 2.4G<br>WIFI<br>MIM<br>O | 14<br>±1                         | 14<br>±1 | 15                          | 15       | ANT1:<br>1.5885<br>(2.01dBi)<br>ANT2:<br>3.0479<br>(4.84dBi) | 0.01                              | 0.0192 | 1                            | 0.0292            | 1                          | Pass   |

| Tech<br>nolo<br>gy     | Tune up<br>Produce<br>power(dBm) |          | Maximum<br>Tune-up<br>(dBm) |          | Antenna<br>Gain(ANT<br>1/ANT 2)<br>(numeric)                 | Power Density<br>(S)<br>(mW/ cm2) |        | MPE<br>Limit<br>(mW/<br>cm2) | Σ<br>MPE<br>Ratio | Σ<br>MPE<br>Ratio<br>Limit | Result |
|------------------------|----------------------------------|----------|-----------------------------|----------|--------------------------------------------------------------|-----------------------------------|--------|------------------------------|-------------------|----------------------------|--------|
|                        | ANT<br>1                         | ANT<br>2 | ANT<br>1                    | ANT<br>2 |                                                              | ANT 1                             | ANT 2  |                              |                   |                            |        |
| 5G<br>WIFI<br>MIM<br>O | 16<br>±1                         | 11±<br>1 | 17                          | 12       | ANT1:<br>1.7824<br>(2.51dBi)<br>ANT2:<br>2.0941<br>(3.21dBi) | 0.0178                            | 0.0066 | 1                            | 0.0244            | 1                          | Pass   |

BT+WIFI+NFC supported simultaneous transmission:

EDR +2.4GWIFI MIMO+NFC: Σ MPE Ratio =0.002/1+0.0292/1+0.0005/0.009=0.0868≤1,  
So passed.

EDR +5GWIFI MIMO+NFC: Σ MPE Ratio =0.002/1+0.0244/1+0.0005/0.009=0.082≤1,  
So passed.