



## MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Standard Applicable

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

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

### Limits for Maximum Permissive Exposure (MPE)

| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (minute) |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|-------------------------|
| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                         |
| 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                      |
| 1500-15000                                          | /                             | /                             | 1.0                                 | 30                      |

F = frequency in MHz

\* = Plane-wave equipment power density

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No.134,WuKungRoad,NewTaipeiIndustrialPark,WukuDistrict,NewTaipeiCity,Taiwan24803/新北市五股區新北產業園區五工路 134 號

t (886-2) 2299-3279

f (886-2) 2298-0488

[www.tw.sgs.com](http://www.tw.sgs.com)

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## Maximum Permissible Exposure (MPE) Evaluation

| 802.11b_MIMO |                 |           |                         |       |       |       |                                                   |                                                  |                    |        |
|--------------|-----------------|-----------|-------------------------|-------|-------|-------|---------------------------------------------------|--------------------------------------------------|--------------------|--------|
| CH           | Frequency (MHz) | Data Rate | Peak Output Power (dBm) |       |       |       | Total Peak Output Power (dBm)                     | Total Peak Output Power (mW)                     | Limit              | RESULT |
|              |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                                                   |                                                  |                    |        |
| 1            | 2412            | 1         | 14.35                   | 12.93 | 13.14 | 12.88 | 19.39                                             | 86.88                                            | 1 Watt = 30.00 dBm | PASS   |
| 6            | 2437            | 1         | 15.59                   | 14.23 | 14.56 | 14.02 | 20.66                                             | 116.52                                           | 1 Watt = 30.00 dBm | PASS   |
| 11           | 2462            | 1         | 15.31                   | 14.17 | 14.68 | 14.21 | 20.64                                             | 115.82                                           | 1 Watt = 30.00 dBm | PASS   |
| 802.11b_MIMO |                 |           |                         |       |       |       |                                                   |                                                  |                    |        |
| CH           | Frequency (MHz) | Data Rate | Avg. Output Power (dBm) |       |       |       | Max. Output include tune up tolerance Power (dBm) | Max. Output include tune up tolerance Power (mW) | Limit              | RESULT |
|              |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                                                   |                                                  |                    |        |
| 1            | 2412            | 1         | 11.93                   | 10.53 | 11.12 | 10.57 | 17.10                                             | 51.24                                            | 1 Watt = 30.00 dBm | PASS   |
| 6            | 2437            | 1         | 13.02                   | 12.01 | 12.16 | 11.96 | 18.33                                             | 68.08                                            | 1 Watt = 30.00 dBm | PASS   |
| 11           | 2462            | 1         | 13.19                   | 11.88 | 12.46 | 11.87 | 18.41                                             | 69.26                                            | 1 Watt = 30.00 dBm | PASS   |

### MPE Prediction (802.11b 2412~2462)

Prediction of MPE limit at a given distance

Equation from page 18 of 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

|                                                                                   |           |                       |
|-----------------------------------------------------------------------------------|-----------|-----------------------|
| Max. output power including tune-up tolerancel:                                   | 18.41     | (dBm)                 |
| Max. output power including tune-up tolerancel:                                   | 69.342581 | (mW)                  |
| Duty cycle:                                                                       | 100       | (%)                   |
| Maximum Pav :                                                                     | 69.342581 | (mW)                  |
| Peak Antenna gain (Maximum):                                                      | 5.18      | (dBi)                 |
| Peak Antenna gain (linear):                                                       | 3.2960971 | (numeric)             |
| Prediction distance:                                                              | 20        | (cm)                  |
| Prediction frequency:                                                             | 2462      | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction                                 | 1         | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)                                 | 0.045     | (mW/cm <sup>2</sup> ) |
| <b>Measurement Result</b>                                                         |           |                       |
| The predicted power density level at 20 cm is 0.045 mW/cm <sup>2</sup> .          |           |                       |
| This is below the uncontrolled exposure limit of 1 mW/cm <sup>2</sup> at 2462MHz. |           |                       |

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f (886-2) 2298-0488

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| 802.11g_MIMO |                 |           |                         |       |       |       |                               |                              |                    |        |
|--------------|-----------------|-----------|-------------------------|-------|-------|-------|-------------------------------|------------------------------|--------------------|--------|
| CH           | Frequency (MHz) | Data Rate | Peak Output Power (dBm) |       |       |       | Total Peak Output Power (dBm) | Total Peak Output Power (mW) | Limit              | RESULT |
|              |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 1            | 2412            | 6         | 20.33                   | 18.87 | 19.54 | 19.06 | 25.51                         | 355.47                       | 1 Watt = 30.00 dBm | PASS   |
| 6            | 2437            | 6         | 22.27                   | 21.42 | 21.73 | 21.44 | 27.75                         | 595.58                       | 1 Watt = 30.00 dBm | PASS   |
| 11           | 2462            | 6         | 20.41                   | 19.15 | 19.66 | 19.13 | 25.64                         | 366.44                       | 1 Watt = 30.00 dBm | PASS   |
| 802.11g_MIMO |                 |           |                         |       |       |       |                               |                              |                    |        |
| CH           | Frequency (MHz) | Data Rate | Avg. Output Power (dBm) |       |       |       | Avg. Output Power (dBm)       | Avg. Output Power (mW)       | Limit              | RESULT |
|              |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 1            | 2412            | 6         | 10.31                   | 9.12  | 9.48  | 9.44  | 15.63                         | 36.57                        | 1 Watt = 30.00 dBm | PASS   |
| 6            | 2437            | 6         | 12.79                   | 11.55 | 12.23 | 11.91 | 18.16                         | 65.53                        | 1 Watt = 30.00 dBm | PASS   |
| 11           | 2462            | 6         | 10.21                   | 9.02  | 9.82  | 9.31  | 15.63                         | 36.60                        | 1 Watt = 30.00 dBm | PASS   |

### MPE Prediction (802.11g 2412~2462)

Prediction of MPE limit at a given distance

Equation from page 18 of 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

|                                                                       |           |           |
|-----------------------------------------------------------------------|-----------|-----------|
| Max. output power including tune-up tolerancel:                       | 18.16     | (dBm)     |
| Max. output power including tune-up tolerancel:                       | 65.463617 | (mW)      |
| Duty cycle:                                                           | 82.67     | (%)       |
| Maximum Pav :                                                         | 54.118773 | (mW)      |
| Peak Antenna gain (Maximum):                                          | 5.18      | (dBi)     |
| Peak Antenna gain (linear):                                           | 3.2960971 | (numeric) |
| Prediction distance:                                                  | 20        | (cm)      |
| Prediction frequency:                                                 | 2437      | (MHz)     |
| MPE limit for uncontrolled exposure at prediction                     | 1         | (mW/cm^2) |
| Power density at predication frequency at 20 (cm)                     | 0.036     | (mW/cm^2) |
| <b>Measurement Result</b>                                             |           |           |
| The predicted power density level at 20 cm is 0.036 mW/cm2.           |           |           |
| This is below the uncontrolled exposure limit of 1 mW/cm2 at 2437MHz. |           |           |

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f (886-2) 2298-0488

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| 802.11n_HT20M MIMO |                 |           |                         |       |       |       |                               |                              |                    |        |
|--------------------|-----------------|-----------|-------------------------|-------|-------|-------|-------------------------------|------------------------------|--------------------|--------|
| CH                 | Frequency (MHz) | Data Rate | Peak Output Power (dBm) |       |       |       | Total Peak Output Power (dBm) | Total Peak Output Power (mW) | Limit              | RESULT |
|                    |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 1                  | 2412            | MCS2      | 20.87                   | 19.76 | 20.33 | 20.45 | 26.39                         | 435.62                       | 1 Watt = 27.81 dBm | PASS   |
| 6                  | 2437            | MCS2      | 20.80                   | 19.76 | 20.23 | 20.45 | 26.35                         | 431.21                       | 1 Watt = 27.81 dBm | PASS   |
| 11                 | 2462            | MCS2      | 20.86                   | 19.68 | 20.39 | 20.32 | 26.35                         | 431.84                       | 1 Watt = 27.81 dBm | PASS   |
| 802.11n_HT20M MIMO |                 |           |                         |       |       |       |                               |                              |                    |        |
| CH                 | Frequency (MHz) | Data Rate | Avg. Output Power (dBm) |       |       |       | Avg. Output Power (dBm)       | Avg. Output Power (mW)       | Limit              | RESULT |
|                    |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 1                  | 2412            | MCS2      | 12.48                   | 11.65 | 12.29 | 11.84 | 18.10                         | 64.54                        | 1 Watt = 27.81 dBm | PASS   |
| 6                  | 2437            | MCS2      | 12.56                   | 11.73 | 12.37 | 11.82 | 18.15                         | 65.39                        | 1 Watt = 27.81 dBm | PASS   |
| 11                 | 2462            | MCS2      | 12.57                   | 11.68 | 12.64 | 11.74 | 18.20                         | 66.09                        | 1 Watt = 27.81 dBm | PASS   |

### MPE Prediction (802.11n20 2412~2462)

Prediction of MPE limit at a given distance

Equation from page 18 of 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

$$\text{MIMO gain} = \text{Directional gain} = 10 \log [(10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(GN/20)})^2 / N_{\text{ANT}}] = 8.19 \text{ dBi}$$

|                                                                       |           |           |
|-----------------------------------------------------------------------|-----------|-----------|
| Max. output power including tune-up tolerancel:                       | 18.20     | (dBm)     |
| Max. output power including tune-up tolerancel:                       | 66.069345 | (mW)      |
| Duty cycle:                                                           | 55.02     | (%)       |
| Maximum Pav :                                                         | 36.351354 | (mW)      |
| Peak Antenna gain (Maximum):                                          | 8.19      | (dBi)     |
| Peak Antenna gain (linear):                                           | 6.591739  | (numeric) |
| Prediction distance:                                                  | 20        | (cm)      |
| Prediction frequency:                                                 | 2462      | (MHz)     |
| MPE limit for uncontrolled exposure at prediction                     | 1         | (mW/cm^2) |
| Power density at predication frequency at 20 (cm)                     | 0.048     | (mW/cm^2) |
| <b>Measurement Result</b>                                             |           |           |
| The predicted power density level at 20 cm is 0.048 mW/cm2.           |           |           |
| This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462MHz. |           |           |

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|--------------------|-----------------|-----------|-------------------------|-------|-------|-------|-------------------------------|------------------------------|--------------------|--------|
| CH                 | Frequency (MHz) | Data Rate | Peak Output Power (dBm) |       |       |       | Total Peak Output Power (dBm) | Total Peak Output Power (mW) | Limit              | RESULT |
|                    |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 3                  | 2422            | MCS2      | 19.98                   | 19.37 | 19.86 | 19.36 | 25.67                         | 369.16                       | 1 Watt = 27.81 dBm | PASS   |
| 6                  | 2437            | MCS2      | 20.92                   | 20.37 | 21.06 | 20.54 | 26.75                         | 473.37                       | 1 Watt = 27.81 dBm | PASS   |
| 9                  | 2452            | MCS2      | 20.98                   | 20.25 | 21.02 | 20.42 | 26.70                         | 467.87                       | 1 Watt = 27.81 dBm | PASS   |
| 802.11n_HT40M MIMO |                 |           |                         |       |       |       |                               |                              |                    |        |
| CH                 | Frequency (MHz) | Data Rate | Avg. Output Power (dBm) |       |       |       | Avg. Output Power (dBm)       | Avg. Output Power (mW)       | Limit              | RESULT |
|                    |                 |           | CH 0                    | CH 1  | CH 2  | CH 3  |                               |                              |                    |        |
| 3                  | 2422            | MCS2      | 11.58                   | 10.73 | 11.33 | 11.01 | 17.19                         | 52.42                        | 1 Watt = 27.81 dBm | PASS   |
| 6                  | 2437            | MCS2      | 12.76                   | 11.88 | 12.52 | 12.18 | 18.37                         | 68.68                        | 1 Watt = 27.81 dBm | PASS   |
| 9                  | 2452            | MCS2      | 12.61                   | 12.09 | 12.76 | 12.24 | 18.45                         | 70.05                        | 1 Watt = 27.81 dBm | PASS   |

## MPE Prediction (802.11n40 2412~2452)

Prediction of MPE limit at a given distance

Equation from page 18 of 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

$$\text{MIMO gain} = \text{Directional gain} = 10 \log [(10^{(G1/20)} + 10^{(G2/20)} + \dots + 10^{(GN/20)})^2 / N_{\text{ANT}}] = 8.19 \text{ dBi}$$

|                                                                                   |           |                       |
|-----------------------------------------------------------------------------------|-----------|-----------------------|
| Max. output power including tune-up tolerancel:                                   | 18.45     | (dBm)                 |
| Max. output power including tune-up tolerancel:                                   | 69.9842   | (mW)                  |
| Duty cycle:                                                                       | 39.77     | (%)                   |
| Maximum Pav :                                                                     | 27.832716 | (mW)                  |
| Peak Antenna gain (Maximum):                                                      | 8.19      | (dBi)                 |
| Peak Antenna gain (linear):                                                       | 6.591739  | (numeric)             |
| Prediction distance:                                                              | 20        | (cm)                  |
| Prediction frequency:                                                             | 2437      | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction                                 | 1         | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)                                 | 0.037     | (mW/cm <sup>2</sup> ) |
| <b>Measurement Result</b>                                                         |           |                       |
| The predicted power density level at 20 cm is 0.037 mW/cm <sup>2</sup> .          |           |                       |
| This is below the uncontrolled exposure limit of 1 mW/cm <sup>2</sup> at 2437MHz. |           |                       |

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