

## 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<br>(MHz)                            | Electric Field<br>Strength (V/m) | Magnetic Field<br>Strength (A/m) | Power Density<br>(mW/cm <sup>2</sup> ) | Averaging Time<br>(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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## Maximum Permissible Exposure (MPE) Evaluation

**802.11a operation Power Table**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5180            | 17.12               | 17.12              | 0.05152          | 0.85      |
| 5220            | 16.91               | 16.91              | 0.04909          | 0.85      |
| 5240            | 17.02               | 17.02              | 0.05035          | 0.85      |

### MPE Prediction (802.11a 5150~5250)

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

|                                                      |             |                       |
|------------------------------------------------------|-------------|-----------------------|
| Maximum peak output power at antenna input terminal: | 17.12       | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 51.52286446 | (mW)                  |
| Duty cycle:                                          | 96.94       | (%)                   |
| Maximum Pav :                                        | 49.94626481 | (mW)                  |
| Antenna gain (typical):                              | 6.69        | (dBi)                 |
| Maximum antenna gain:                                | 4.666593803 | (numeric)             |
| Prediction distance:                                 | 20          | (cm)                  |
| Prediction frequency:                                | 5180        | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0463931   | (mW/cm <sup>2</sup> ) |

### Measurement Result

The predicted power density level at 20 cm is 0.04639mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5180MHz.

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**802.11n HT20 MIMO operation (CH 0 + CH 1) Power Table**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5180            | 18.02               | 18.02              | 0.06339          | 0.43      |
| 5220            | <b>18.06</b>        | <b>18.06</b>       | 0.06397          | 0.43      |
| 5240            | 18.04               | 18.04              | 0.06368          | 0.43      |

**MPE Prediction (802.11n\_HT20 5150~5250)**

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

|                                                      |              |                       |
|------------------------------------------------------|--------------|-----------------------|
| Maximum peak output power at antenna input terminal: | <b>18.06</b> | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 63.97348355  | (mW)                  |
| Duty cycle:                                          | <b>93.62</b> | (%)                   |
| Maximum Pav :                                        | 59.8919753   | (mW)                  |
| Antenna gain (typical):                              | <b>6.69</b>  | (dBi)                 |
| Maximum antenna gain:                                | 4.666593803  | (numeric)             |
| Prediction distance:                                 | 20           | (cm)                  |
| Prediction frequency:                                | <b>5220</b>  | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1            | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0556313    | (mW/cm <sup>2</sup> ) |

**Measurement Result**

The predicted power density level at 20 cm is 0.05563mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5220MHz.

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### 802.11n HT40 MIMO operation (CH 0 + CH 1) Power Table

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5190            | 17.92               | 17.92              | 0.06194          | 0.43      |
| 5230            | 17.79               | 17.79              | 0.06012          | 0.43      |

### MPE Prediction (802.11n\_HT40 5150~5250)

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

|                                                      |             |                       |
|------------------------------------------------------|-------------|-----------------------|
| Maximum peak output power at antenna input terminal: | 17.92       | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 61.94410751 | (mW)                  |
| Duty cycle:                                          | 91.01       | (%)                   |
| Maximum Pav :                                        | 56.37533224 | (mW)                  |
| Antenna gain (typical):                              | 6.69        | (dBi)                 |
| Maximum antenna gain:                                | 4.666593803 | (numeric)             |
| Prediction distance:                                 | 20          | (cm)                  |
| Prediction frequency:                                | 5190        | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0523648   | (mW/cm <sup>2</sup> ) |

### Measurement Result

The predicted power density level at 20 cm is 0.05236mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5190MHz.

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### 802.11a operation Power Table

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5745            | 11.89               | 11.89              | 0.01545          | 0.66      |
| 5785            | 12.33               | 12.33              | 0.01710          | 0.66      |
| 5825            | <b>12.68</b>        | <b>12.68</b>       | 0.01854          | 0.66      |

### MPE Prediction (802.11a 5725~5850)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

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

|                                                      |              |                       |
|------------------------------------------------------|--------------|-----------------------|
| Maximum peak output power at antenna input terminal: | <b>12.68</b> | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 18.53531623  | (mW)                  |
| Duty cycle:                                          | <b>96.94</b> | (%)                   |
| Maximum Pav :                                        | 17.96813556  | (mW)                  |
| Antenna gain (typical):                              | <b>7.8</b>   | (dBi)                 |
| Maximum antenna gain:                                | 6.025595861  | (numeric)             |
| Prediction distance:                                 | 20           | (cm)                  |
| Prediction frequency:                                | <b>5825</b>  | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1            | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0215503    | (mW/cm <sup>2</sup> ) |

### Measurement Result

The predicted power density level at 20 cm is 0.02155mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5825MHz.

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### 802.11n HT20 MIMO operation (CH 0 + CH 1) Power Table

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5745            | 18.29               | 18.29              | 0.06745          | 0.33      |
| 5785            | 17.87               | 17.87              | 0.06124          | 0.33      |
| 5825            | 17.90               | 17.90              | 0.06166          | 0.33      |

### MPE Prediction (802.11n\_HT20 5725~5850)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

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

|                                                      |             |                       |
|------------------------------------------------------|-------------|-----------------------|
| Maximum peak output power at antenna input terminal: | 18.29       | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 67.45280277 | (mW)                  |
| Duty cycle:                                          | 93.62       | (%)                   |
| Maximum Pav :                                        | 63.14931395 | (mW)                  |
| Antenna gain (typical):                              | 7.8         | (dBi)                 |
| Maximum antenna gain:                                | 6.025595861 | (numeric)             |
| Prediction distance:                                 | 20          | (cm)                  |
| Prediction frequency:                                | 5745        | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0757389   | (mW/cm <sup>2</sup> ) |

### Measurement Result

The predicted power density level at 20 cm is 0.07574mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5745MHz.

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**802.11n HT40 MIMO operation (CH 0 + CH 1) Power Table**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|-----------------|---------------------|--------------------|------------------|-----------|
| 5755            | 17.05               | 17.05              | 0.05070          | 0.33      |
| 5795            | <b>17.79</b>        | <b>17.79</b>       | 0.06012          | 0.33      |

**MPE Prediction (802.11n\_HT40 5755~5795)**

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

|                                                      |             |                       |
|------------------------------------------------------|-------------|-----------------------|
| Maximum peak output power at antenna input terminal: | 17.79       | (dBm)                 |
| Maximum peak output power at antenna input terminal: | 60.11737375 | (mW)                  |
| Duty cycle:                                          | 91.01       | (%)                   |
| Maximum Pav :                                        | 54.71282185 | (mW)                  |
| Antenna gain (typical):                              | 7.8         | (dBi)                 |
| Maximum antenna gain:                                | 6.025595861 | (numeric)             |
| Prediction distance:                                 | 20          | (cm)                  |
| Prediction frequency:                                | 5795        | (MHz)                 |
| MPE limit for uncontrolled exposure at prediction    | 1           | (mW/cm <sup>2</sup> ) |
| Power density at predication frequency at 20 (cm)    | 0.0656205   | (mW/cm <sup>2</sup> ) |

**Measurement Result**

The predicted power density level at 20 cm is 0.06562mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 5795MHz.

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