

# 1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

## 1.1 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 §2.1091 RF exposure is calculated.

Limits for Maximum Permissible 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

## 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

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## 802.11a Max. output power (Worst Case)

### 802.11n\_HT20\_MIMO

| CH  | Frequency (MHz) | Data Rate | Avg. POWER (dBm) |       | TOTAL POWER (dBm) | REQUIRED LIMIT (dBm)            | RESULT |
|-----|-----------------|-----------|------------------|-------|-------------------|---------------------------------|--------|
|     |                 |           | CH 0             | CH 1  |                   |                                 |        |
| 36  | 5180            | MCS8      | 12.82            | 12.69 | <b>15.99</b>      | 23.98                           | PASS   |
| 44  | 5220            | MCS8      | 12.79            | 12.66 | 15.96             | 23.98                           | PASS   |
| 48  | 5240            | MCS8      | 12.78            | 12.64 | 15.94             | 23.98                           | PASS   |
| 52  | 5260            | MCS8      | 12.74            | 12.6  | <b>15.90</b>      | 23.98 or $11+10\log(B) = 22.74$ | PASS   |
| 60  | 5300            | MCS8      | 12.65            | 12.53 | 15.82             | 23.98 or $11+10\log(B) = 22.74$ | PASS   |
| 64  | 5320            | MCS8      | 12.63            | 12.49 | 15.79             | 23.98 or $11+10\log(B) = 22.74$ | PASS   |
| 100 | 5500            | MCS8      | 12.75            | 12.61 | 15.91             | 23.98 or $11+10\log(B) = 22.34$ | PASS   |
| 116 | 5580            | MCS8      | 12.74            | 12.58 | 15.90             | 23.98 or $11+10\log(B) = 22.34$ | PASS   |
| 140 | 5700            | MCS8      | 12.82            | 12.67 | <b>15.98</b>      | 23.98 or $11+10\log(B) = 22.34$ | PASS   |
| 149 | 5745            | MCS8      | 12.83            | 12.68 | <b>15.99</b>      | 30                              | PASS   |
| 157 | 5785            | MCS8      | 12.82            | 12.68 | 15.98             | 30                              | PASS   |
| 165 | 5825            | MCS8      | 12.81            | 12.67 | 15.97             | 30                              | PASS   |

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

|  |              |           |
|--|--------------|-----------|
| Average output power at antenna input terminal:              | <b>15.99</b> | (dBm)     |
| Average output power at antenna input terminal:              | 39.719155    | (mW)      |
| Duty cycle:  | <b>97.34</b> | (%)       |
| Maximum Pav :  | 38.662625    | (mW)      |
| Peak Antenna gain (Maximum):                                 | <b>4.3</b>   | (dBi)     |
| Peak Antenna gain (linear):                                  | 2.6915348    | (numeric) |
| Prediction distance:   | 20           | (cm)      |
| Prediction frequency:  | <b>5745</b>  | (MHz)     |
| MPE limit for uncontrolled exposure at prediction frequency: | 1            | (mW/cm2)  |
| Power density at predication frequency at 20 (cm) distance   | 0.021        | (mW/cm2)  |

### Measurement Result

The predicted power density level at 20 cm is 0.021 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5745MHz.

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## 802.11n\_HT40 Max. output power (Worst Case)

### 802.11n\_HT40\_MIMO

| CH  | Frequency (MHz) | Data Rate | Avg. POWER (dBm) |       | TOTAL POWER (dBm) | REQUIRED LIMIT (dBm)            | RESULT |
|-----|-----------------|-----------|------------------|-------|-------------------|---------------------------------|--------|
|     |                 |           | CH 0             | CH 1  |                   |                                 |        |
| 38  | 5190            | MCS8      | 12.59            | 12.37 | 15.92             | 23.98                           | PASS   |
| 46  | 5230            | MCS8      | 12.54            | 12.32 | 15.87             | 23.98                           | PASS   |
| 54  | 5270            | MCS8      | 12.63            | 12.44 | 15.98             | 23.98 or $11+10\log(B) = 25.95$ | PASS   |
| 62  | 5310            | MCS8      | 12.65            | 12.45 | 15.99             | 23.98 or $11+10\log(B) = 25.95$ | PASS   |
| 102 | 5510            | MCS8      | 12.66            | 12.43 | 15.99             | 23.98 or $11+10\log(B) = 25.58$ | PASS   |
| 110 | 5550            | MCS8      | 12.62            | 12.39 | 15.95             | 23.98 or $11+10\log(B) = 25.58$ | PASS   |
| 134 | 5670            | MCS8      | 12.64            | 12.41 | 15.97             | 23.98 or $11+10\log(B) = 25.58$ | PASS   |
| 151 | 5755            | MCS8      | 12.62            | 12.34 | 15.92             | 30                              | PASS   |
| 159 | 5795            | MCS8      | 12.63            | 12.42 | 15.97             | 30                              | PASS   |

## MPE Prediction (802.11n\_HT40 5250~5350MHz)

|  |           |           |
|--|-----------|-----------|
| Average output power at antenna input terminal:              | 15.99     | (dBm)     |
| Average output power at antenna input terminal:              | 39.719155 | (mW)      |
| Duty cycle:  | 90.56     | (%)       |
| Maximum Pav :  | 35.969667 | (mW)      |
| Peak Antenna gain (Maximum):                                 | 4.4       | (dBi)     |
| Peak Antenna gain (linear):                                  | 2.7542287 | (numeric) |
| Prediction distance:   | 20        | (cm)      |
| Prediction frequency:  | 5510      | (MHz)     |
| MPE limit for uncontrolled exposure at prediction frequency: | 1         | (mW/cm2)  |
| Power density at predication frequency at 20 (cm) distance   | 0.020     | (mW/cm2)  |

### Measurement Result

The predicted power density level at 20 cm is 0.02 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5510MHz.

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## 802.11ac\_VHT80 Max. output power (Worst Case)

### 802.11ac\_VHT80\_MIMO

| CH  | Frequency (MHz) | Data Rate | Avg. POWER (dBm) |       | TOTAL POWER (dBm) | REQUIRED LIMIT (dBm)            | RESULT |
|-----|-----------------|-----------|------------------|-------|-------------------|---------------------------------|--------|
|     |                 |           | CH 0             | CH 1  |                   |                                 |        |
| 42  | 5210            | MCS8      | 12.64            | 12.39 | <b>15.99</b>      | 23.98                           | PASS   |
| 58  | 5290            | MCS8      | 12.44            | 12.23 | <b>15.81</b>      | 23.98 or $11+10\log(B) = 29.07$ | PASS   |
| 106 | 5530            | MCS8      | 12.56            | 12.3  | 15.91             | 23.98 or $11+10\log(B) = 28.65$ | PASS   |
| 122 | 5610            | MCS8      | 12.65            | 12.38 | <b>15.99</b>      | 23.98 or $11+10\log(B) = 28.72$ | PASS   |
| 155 | 5775            | MCS8      | 12.64            | 12.36 | <b>15.98</b>      | 30                              | PASS   |

## MPE Prediction (802.11ac\_VHT80 5725~5850MHz)

|  |              |           |
|--|--------------|-----------|
| Average output power at antenna input terminal:              | <b>15.99</b> | (dBm)     |
| Average output power at antenna input terminal:              | 39.719155    | (mW)      |
| Duty cycle:  | <b>89.88</b> | (%)       |
| Maximum Pav :  | 35.699576    | (mW)      |
| Peak Antenna gain (Maximum):                                 | <b>4.4</b>   | (dBi)     |
| Peak Antenna gain (linear):                                  | 2.7542287    | (numeric) |
| Prediction distance:   | 20           | (cm)      |
| Prediction frequency:  | <b>5610</b>  | (MHz)     |
| MPE limit for uncontrolled exposure at prediction frequency: | 1            | (mW/cm2)  |
| Power density at predication frequency at 20 (cm) distance   | 0.020        | (mW/cm2)  |

### Measurement Result

The predicted power density level at 20 cm is 0.02 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5610MHz.

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