

# MPE Calculation : LTE Band 13

- Frequency range : 782 MHz
- Maximum antenna gain(PK): 0.59 dBi
- EIRP calculation using target power and tolerance
  - Target power : 21 dBm ± 1 dB ( Max. 22 dBm & Min. 20 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 22.59 dBm
- Measured ERP : 20.94 dBm
  - Conversion EIRP = Measured ERP + 2.1 = 23.09 dBm
  - Measured conducted output power 21.12 dBm
  - Max. EIRP : 21.82 dBm  
( Max. EIRP = Conversion EIRP + ( Target power + Positive tolerance - Measured conducted output power

<b>Maximum EIRP = 22.59 dBm = 181.552 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = \text{EIRP} / ( 4 R^2 \pi )</math> <math>= 181.552 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.036119} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
--	--

- Requirement = 0.521 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE)

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

## MPE Calculation : LTE Band 4

- Frequency range : 1715 MHz ~ 1750 MHz
- Maximum antenna gain(PK): 2.50 dBi
- EIRP calculation using target power and tolerance
  - Target power : 20 dBm  $\pm$  1 dB ( Max. 21 dBm & Min. 19 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 23.50 dBm
- Measured EIRP : 22.28 dBm
  - Measured conducted output power 20.77 dBm
  - Max. EIRP : 22.51 dBm  
( Max. EIRP = Measured EIRP + ( Target power + Positive tolerance - Measured conducted output power )

<b>Maximum EIRP = 23.50 dBm = 223.873 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.

The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

$$S = \text{EIRP} / (4 R^2 \pi)$$

$$= 223.873 / (4 \times 20^2 \times \pi)$$

$$= \underline{0.044539} \text{ mW/cm}^2$$

- Note

S = Maximum power density(mW/cm<sup>2</sup>)

EIRP = Equivalent Isotropic Radiated Power(mW)

R = Distance to the center of the radiation of the antenna(20cm)

- Requirement = 1.000 mW/cm<sup>2</sup>

(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE))

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

# MPE Calculation : LTE Band 25

- Frequency range : 1855 MHz ~ 1910 MHz
- Maximum antenna gain(PK): 3.14 dBi
- EIRP calculation using target power and tolerance
  - Target power : 19 dBm ± 1 dB ( Max. 20 dBm & Min. 18 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 23.14 dBm
- Measured EIRP : 20.99 dBm
  - Measured conducted output power 19.17 dBm
  - Max. EIRP : 21.82 dBm  
( Max. EIRP = Measured EIRP + ( Target power + Positive tolerance - Measured conducted output power )

<b>Maximum EIRP = 23.14 dBm = 206.063 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = \text{EIRP} / ( 4 R^2 \pi )</math> <math>= 206.063 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.040995} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
--	--

- Requirement = 1.000 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE))

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

# MPE Calculation : CDMA 1x

- Frequency range : 824.70 MHz ~ 848.31 MHz
- Maximum antenna gain(PK): 0.81 dBi
- EIRP calculation using target power and tolerance
  - Target power : 23 dBm ± 1 dB ( Max. 24 dBm & Min. 22 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 24.81 dBm
- Measured ERP : 24.66 dBm
  - Conversion EIRP = Measured ERP + 2.1 = 26.81 dBm
  - Measured conducted output power 23.82 dBm
  - Max. EIRP : 24.84 dBm  
( Max. EIRP = Conversion EIRP + ( Target power + Positive tolerance - Measured conducted output power

Maximum EIRP = 24.84 dBm = 304.79 mW
--------------------------------------

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = EIRP / ( 4 R^2 \pi )</math> <math>= 304.790 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.060637} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
---	--

- Requirement = 0.549 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE))

Conclusion : The exposure condition of this device is compliant with FCC rules.

# MPE Calculation : CDMA 1x

- Frequency range : 1851.25 MHz ~ 1908.75 MHz
- Maximum antenna gain(PK): 3.27 dBi
- EIRP calculation using target power and tolerance
  - Target power : 23 dBm ± 1 dB ( Max. 24 dBm & Min. 22 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 27.27 dBm
- Measured EIRP : 25.15 dBm
  - Measured conducted output power 23.93 dBm
  - Max. EIRP : 25.22 dBm  
( Max. EIRP = Measured EIRP + ( Target power + Positive tolerance - Measured conducted output power )

<b>Maximum EIRP = 27.27 dBm = 533.335 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = \text{EIRP} / ( 4 R^2 \pi )</math> <math>= 533.335 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.106104} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
--	--

- Requirement = 1.000 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE))

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

# MPE Calculation : CDMA EVDO

- Frequency range : 824.70 MHz ~ 848.31 MHz
- Maximum antenna gain(PK): 1.23 dBi
- EIRP calculation using target power and tolerance
  - Target power : 23 dBm ± 1 dB ( Max. 24 dBm & Min. 22 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 25.23 dBm
- Measured ERP : 23.44 dBm
  - Conversion EIRP = Measured ERP + 2.1 = 25.59 dBm
  - Measured conducted output power 23.25 dBm
  - Max. EIRP : 24.19 dBm  
( Max. EIRP = Conversion EIRP + ( Target power + Positive tolerance - Measured conducted output power

<b>Maximum EIRP = 25.23 dBm = 333.427 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = \text{EIRP} / ( 4 R^2 \pi )</math> <math>= 333.427 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.066334} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
--	--

- Requirement = 0.549 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE)

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

# MPE Calculation : CDMA EVDO

- Frequency range : 1851.25 MHz ~ 1908.75 MHz
- Maximum antenna gain(PK): 3.14 dBi
- EIRP calculation using target power and tolerance
  - Target power : 21 dBm ± 1.5 dB ( Max. 22.5 dBm & Min. 19.5 dBm )
  - EIRP = Target power + positive tolerance + Maximum antenna peak gain(dB) 25.64 dBm
- Measured EIRP : 23.54 dBm
  - Measured conducted output power 22.26 dBm
  - Max. EIRP : 23.78 dBm  
( Max. EIRP = Measured EIRP + ( Target power + Positive tolerance - Measured conducted output power )

<b>Maximum EIRP = 25.64 dBm = 366.438 mW</b>
--

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user.  
The MPE calculation for this exposure is shown below.

- Calculation of power density at the specific separation

<ul style="list-style-type: none"><li>▪ <math>S = \text{EIRP} / ( 4 R^2 \pi )</math> <math>= 366.438 / ( 4 \times 20^2 \times \pi )</math> <math>= \underline{0.072901} \text{ mW/cm}^2</math></li></ul>	<ul style="list-style-type: none"><li>- Note  S = Maximum power density(mW/cm<sup>2</sup>)  EIRP = Equivalent Isotropic Radiated Power(mW)  R = Distance to the center of the radiation of the antenna(20cm)</li></ul>
--	--

- Requirement = 1.000 mW/cm<sup>2</sup>  
(FCC Part 1.1310 Table 1 Limits for maximum permissible exposure(MPE))

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

# MPE Calculations(WLAN: 802.11b)

- Frequency range : 2412 MHz ~ 2462 MHz
- Measured RF output power : 21.42 dBm
- Target Power & Tolerance : 21.00 dBm ± 1.5 dB ( Max. 22.5 dBm & Min. 19.5 dBm )
- Maximum antenna peak gain : 1.73 dBi
- Maximum output power for the calculatio 22.50 dBm

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the

The MPE calculation for this exposure is shown below.

<div>▪ <b>EIRP</b> = P + G</div> <div>= 22.50 dBm + 1.73 dBi</div> <div>= <b>24.23 dBm</b> = <b>264.851 mW</b></div>	<div>- <b>Note</b></div> <div>P = Power input to the antenna(dBm)</div> <div>G = Power gain of the antenna(dBi)</div>
--	---

- Power density at the specific separation

<div>▪ <b>S</b> = EIRP / ( 4 R<sup>2</sup> π )</div> <div>= <b>264.851</b> / ( 4 X 20<sup>2</sup> X π )</div> <div>= <u><b>0.052691</b></u> mW/cm<sup>2</sup></div>	<div>- <b>Note</b></div> <div>S = Maximum power dencity(mW/cm<sup>2</sup>)</div> <div>EIRP = Equivalent Isotropic Radiated Power(mW)</div> <div>R = Distance to the center of the radiation of the antenna(20cm)</div>
---	--

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

The maximum permissible exposure(MPE) of the general population/Uncontrolled for this device is 1.0 mW/cm<sup>2</sup>.



# MPE Calculations(WLAN: 802.11g)

- Frequency range : 2412 MHz ~ 2462 MHz
- Measured RF output power : 24.01 dBm
- Target Power & Tolerance : 23.00 dBm ± 1.5 dB ( Max. 24.5 dBm & Min. 21.5 dBm )
- Maximum antenna peak gain : 1.73 dBi
- **Maximum output power for the calculatio 24.50 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the

The MPE calculation for this exposure is shown below.

<div>▪ <b>EIRP</b> = P + G</div> <div>= 24.50 dBm + 1.73 dBi</div> <div>= <b>26.23 dBm = 419.759 mW</b></div>	<div>- <b>Note</b></div> <div>P = Power input to the antenna(dBm)</div> <div>G = Power gain of the antenna(dBi)</div>
---	---

- **Power density at the specific separation**

<div>▪ <b>S</b> = EIRP / ( 4 R<sup>2</sup> π )</div> <div>= <b>419.759</b> / ( 4 X 20<sup>2</sup> X π )</div> <div>= <u><b>0.083509</b></u> mW/cm<sup>2</sup></div>	<div>- <b>Note</b></div> <div>S = Maximum power dencity(mW/cm<sup>2</sup>)</div> <div>EIRP = Equivalent Isotropic Radiated Power(mW)</div> <div>R = Distance to the center of the radiation of the antenna(20cm)</div>
---	--

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

The maximum permissible exposure(MPE) of the general population/Uncontrolled for this device is 1.0 mW/cm<sup>2</sup>.

## MPE Calculations(WLAN: 802.11n HT20)

- Frequency range : 2412 MHz ~ 2462 MHz
- Measured RF output power : 25.34 dBm
- Target Power & Tolerance : 24.50 dBm  $\pm$  1.5 dB ( Max. 26 dBm & Min. 23 dBm )
- Maximum antenna peak gain : 1.73 dBi
- **Maximum output power for the calculation 26.00 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the

The MPE calculation for this exposure is shown below.

<ul style="list-style-type: none"> <li>▪ <b>EIRP</b> = P + G</li> <li>= 26.00 dBm + 1.73 dBi</li> <li>= <b>27.73 dBm = 592.926 mW</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Note</b></li> <li>P = Power input to the antenna(dBm)</li> <li>G = Power gain of the antenna(dBi)</li> </ul>
--	--

### - Power density at the specific separation

<ul style="list-style-type: none"> <li>▪ <b>S</b> = <math>EIRP / (4 R^2 \pi)</math></li> <li>= <b>592.926</b> / ( 4 X 20<sup>2</sup> X <math>\pi</math> )</li> <li>= <b>0.117959</b> mW/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Note</b></li> <li>S = Maximum power density(mW/cm<sup>2</sup>)</li> <li>EIRP = Equivalent Isotropic Radiated Power(mW)</li> <li>R = Distance to the center of the radiation of the antenna(20cm)</li> </ul>
---	---

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

The maximum permissible exposure(MPE) of the general population/Uncontrolled for this device is 1.0 mW/cm<sup>2</sup>.

# MPE Calculations(WLAN: 802.11n HT40)

- Frequency range : 2422 MHz ~ 2452 MHz
- Measured RF output power : 25.29 dBm
- Target Power & Tolerance : 24.50 dBm ± 1.5 dB ( Max. 26 dBm & Min. 23 dBm )
- Maximum antenna peak gain : 1.73 dBi
- **Maximum output power for the calculatio 26.00 dBm**

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the

The MPE calculation for this exposure is shown below.

<div>▪ <b>EIRP</b> = P + G</div> <div>= 26.00 dBm + 1.73 dBi</div> <div>= <b>27.73 dBm = 592.926 mW</b></div>	<div>- <b>Note</b></div> <div>P = Power input to the antenna(dBm)</div> <div>G = Power gain of the antenna(dBi)</div>
---	---

- **Power density at the specific separation**

<div>▪ <b>S</b> = <math>EIRP / ( 4 R^2 \pi )</math></div> <div>= <b>592.926</b> / ( 4 X 20<sup>2</sup> X <math>\pi</math> )</div> <div>= <u><b>0.117959</b></u> mW/cm<sup>2</sup></div>	<div>- <b>Note</b></div> <div>S = Maximum power dencity(mW/cm<sup>2</sup>)</div> <div>EIRP = Equivalent Isotropic Radiated Power(mW)</div> <div>R = Distance to the center of the radiation of the antenna(20cm)</div>
---	--

**Conclusion :** The exposure condition of this device is compliant with FCC rules.

The maximum permissible exposure(MPE) of the general population/Uncontrolled for this device is 1.0 mW/cm<sup>2</sup>.

## RF Exposure Compliance for simultaneous operations

### ▪ Configurations for simultaneous operations

- **Configuration 1:** LTE + CDMA 1x + 2.4GHz WLAN
- **Configuration 2:** CDMA EVDO + CDMA 1x + 2.4GHz WLAN
- **Configuration 3:** LTE + 2.4GHz WLAN
- **Configuration 4:** CDMA EVDO + 2.4GHz WLAN
- **Configuration 5:** CDMA 1x + 2.4GHz WLAN

Note: Above configuration was declared from applicant.

### ▪ Result :

RF function	LTE			CDMA EVDO		CDMA 1x		802.11b	802.11g	802.11n (HT20)	802.11n (HT40)	Total Power Density (mW/cm <sup>2</sup> )
Band	Band 13	<b>Band 4</b>	Band 25	Cellular	<b>PCS</b>	Cellular	<b>PCS</b>	2.4GHz	2.4GHz	2.4GHz	2.4GHz	
Power Density (mW/cm <sup>2</sup> )	0.036119	<b>0.044539</b>	0.040995	0.066334	<b>0.072901</b>	0.060637	<b>0.106104</b>	0.052691	0.083509	0.117959	<b>0.117959</b>	
Configuration 1		<b>0</b> <b>0.044539</b>					<b>0</b> <b>0.106104</b>				<b>0</b> <b>0.117959</b>	<b>0.268602</b>
Configuration 2					<b>0</b> <b>0.072901</b>		<b>0</b> <b>0.106104</b>				<b>0</b> <b>0.117959</b>	<b>0.296964</b>

Note 1: The maximum power density in each RF function was used for above table.

And the worst case configuration is calculated.