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# ***TT210 RF Exposure Assessment (MPE)***

*June 25, 2011*

**80-JC010-5 Rev A**

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### ***Revision History***

| <b>Date</b> | <b>Change Description</b> | <b>Revision</b> | <b>Editor(s)</b> |
|-------------|---------------------------|-----------------|------------------|
| 06/24/2011  | Initial Release           | A               | John Forrester   |

## 1. Introduction

This Maximum Permissible Exposure (“MPE”) report demonstrates compliance for the TT210 with FCC CFR 47 §1.1310 and 2.1091 and RSS GEN for standalone and collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table 2 used for analysis.

Any collocated Bluetooth transmitter must have a valid FCC ID documenting equivalent or degraded RF characteristics with the collocated parameters defined in this MPE analysis.

The mobile classification applies when 20 cm or more separation distance is maintained between the end user and both Bluetooth and WLAN transmission antennas.

The WWAN MPE calculations in the filing are based on measured radiated values extracted from the radiated emissions report for this filing. The Bluetooth transmit power calculations use a conservative 10dBm EIRP value.

Portable user conditions or additional collocated modules not allowed based on this RF exposure analysis require a Class II permissive change and updated MPE or SAR report.

## 2. Product Declarations

Table 1 Summarizes transmitter parameters associated with this application.

FCC ID J9CTT210Q1WW

IC: 2723A-TT210Q1WW

**Table 1 WWAN Transmitter Declarations**

| Mode      | Equipment Category                   | Max Transmitter Duty Cycle | Band Name             | Available in U.S. | Transmitter Range (MHz) | Maximum EIRP |      |
|-----------|--------------------------------------|----------------------------|-----------------------|-------------------|-------------------------|--------------|------|
|           |                                      |                            |                       |                   |                         | (dBm)        | (W)  |
| GPRS/EDGE | GSM/ GPRS Cat 10 (Max 2 UL TX Slots) | 25%                        | 850 MHz - US Cellular | Yes               | 824-849                 | 33.2         | 2.09 |
|           |                                      |                            | 1900 MHz - US PCS     | Yes               | 1850-1910               | 32.4         | 1.73 |

**2.1 Collocated Transmitters**

This MPE analysis is applicable to any collocated Bluetooth transmitter with maximum transmit power less than or equal to 10 dBm. A 100% duty cycle is used for calculations to present a worst-case analysis.

**3. Transmitter Summary**

Table 2 summarizes transmitter parameters associated with this application and a conservative Bluetooth transmitter to represent a worst case collocated environment.

**Table 2 WWAN and WLAN Declared Transmitter Parameters**

| Technology                       | Frequency (MHz) | Maximum EIRP (dBm) | Maximum EIRP Power (W) | Duty Cycle |
|----------------------------------|-----------------|--------------------|------------------------|------------|
| GPRS 2 UL                        | 824             | 33.2               | 2.09                   | 0.25       |
| GPRS 2 UL                        | 1850            | 33.4               | 1.73                   | 0.25       |
| Bluetooth (Conservative Example) | 2400            | 10                 | 0.01                   | 1.00       |

## 4. RF Exposure Limits and Equations

According to FCC CFR 47 §1.1310, the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b).

**Table 3 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> ) | Average Time (Minutes) |
|---|-------------------------------|-------------------------------|-------------------------------------|------------------------|
| (A) Limits For Occupational / Control Exposures (f = frequency)           |                               |                               |                                     |                        |
| 30-300  | 61.4                          | 0.163                         | 1.0                                 | 6                      |
| 300-1500  | ...                           | ...                           | f/300                               | 6                      |
| 1500-100,000  | ...                           | ...                           | 5.0                                 | 6                      |
| (B) Limits For General Population / Uncontrolled Exposure (f = frequency) |                               |                               |                                     |                        |
| 30-300  | 27.5                          | 0.073                         | 0.2                                 | 30                     |
| 300-1500  | ...                           | ...                           | f/1500                              | 30                     |
| 1500-100,000  | ...                           | ...                           | 1.0                                 | 30                     |

Friis transmission formula:

$$P_d = \frac{P_{out} \times G}{4\pi R^2}$$

Where,

$P_d$  = power density (mW/cm<sup>2</sup>)

$P_{out}$  = output power to antenna (mW)

G = gain of antenna in linear scale

R = distance between observation point and center of the radiator (cm)

Table 4 shows duty cycles for typical technologies.

**Table 4 Technology Duty Cycles for MPE Calculations**

| Technology                            | Duty Cycle |
|---------------------------------------|------------|
| CDMA2000                              | 100%       |
| WCDMA                                 | 100%       |
| GSM                                   | 12.5%      |
| GPRS Cat 10 (2 Uplink Transmit Slots) | 25.0%      |

## 5. MPE Calculations

### 5.1 Stand Alone Transmitter Calculations

The power density calculations for standalone transmitters at an exposure separation distance of 20 cm are shown in Table 5 per the transmit power and antenna gain values declared in Table 2.

For frequency dependent limits, the lowest transmitter frequency was used to represent the lowest MPE limit (e.g. 824MHz = 0.549 mW/cm<sup>2</sup>).

The WLAN power levels listed represent the worst-case values for the corresponding frequency ranges given.

**Table 5 WWAN and Bluetooth Standalone MPE Calculations**

| Technology | Frequency (MHz) | Maximum EIRP (dBm) | Maximum EIRP (W) | Duty Cycle | Average EIRP (dBm) | Average EIRP (W) | Power Density @ 20cm (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) |
|------------|-----------------|--------------------|------------------|------------|--------------------|------------------|--|-------------------------------------|
| GPRS 2 UL  | 824             | 33.2               | 2.09             | 0.25       | 27.18              | 0.52             | 0.104                                      | 0.549                               |
| GPRS 2 UL  | 1850            | 32.4               | 1.73             | 0.25       | 26.36              | 0.43             | 0.086                                      | 1.000                               |
| Bluetooth  | 2400            | 10.00              | 0.010            | 1.00       | 10.00              | 0.01             | 0.002                                      | 1.000                               |

### 5.2 Collocated MPE Calculations

Per OET 65, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

**Table 6 WWAN 850 MHz Collocation Power Density**

| Band    | Bluetooth Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN Pd) / (MPE Limit) | 850 MHz WWAN Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 850 MHz) / MPE Limit | (850 MHz WWAN fraction) + (Bluetooth fraction) | Limit | Pass/Fail |
|---------|------------------------------------|-------------------------------------|-------------------------|---------------------------------------|-------------------------------------|----------------------------|--|-------|-----------|
| 2.4 GHz | 0.002                              | 1.000                               | 0.002                   | 0.104                                 | 0.549                               | 0.189                      | 0.191  | 1     | Pass      |

**Table 7 WWAN 1900 MHz Collocation Power Density**

| Band    | Bluetooth Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WLAN Pd) / (MPE Limit) | 1900 MHz Pd (mW/cm <sup>2</sup> ) | FCC MPE Limit (mW/cm <sup>2</sup> ) | (WWAN 1900 MHz) / MPE Limit | (1900 MHz WWAN fraction) + (Bluetooth fraction) | Limit | Pass/Fail |
|---------|------------------------------------|-------------------------------------|-------------------------|-----------------------------------|-------------------------------------|-----------------------------|---|-------|-----------|
| 2.4 GHz | 0.002                              | 1.000                               | 0.002                   | 0.086                             | 1.000                               | 0.086                       | 0.088   | 1     | Pass      |