RF Exposure / MPE Calculation

No.	:	12069761H-A
Applicant	:	Komatsu Ltd.
Type of Equipment	:	KOMTRAX terminal
Model No.	:	KDTG105
FCC ID	:	X4QKDTG105

Komatsu Ltd. declares that Model: KDTG105 complies with FCC radiation exposure requirement specified in the FCC Rule 2.1091 (for mobile).

RF Exposure Calculations:

The following information provides the minimum separation distance for the highest gain antenna provided with the "KDTG105" as calculated from (B) Limits for General Population / Uncontrolled Exposure of TABLE 1- LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) of §1.1310 Radiofrequency radiation exposure limits.

[WLAN (2.4 GHz) part]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 17.30 mW (Maximum average output power)

☐ Time average was used for the above value in consideration of 6-minutes time-averaging

☑ Burst power average was used for the above value in consideration of worst condition.

G = 2.559 Numerical Antenna gain; equal to 4.08dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.00881 mW/cm^2**

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KDTG105 contains certified cellular module (FCC ID: QIPALAS3K-US *1)).
The WLAN(2.4 GHz) module and the cellular module both transmit simultaneously in their respective bands. Compliance for simultaneous transmission are shown by the following calculations.
*1) FCC ID: QIPALAS6A-US was changed ID to FCC ID: QIPALAS3K-US.
Therefore, the output power value listed in this declaration adopted from the value of RF Exposure Calculation Report (FCC ID: QIPALAS6A-US).

Reference:
[GSM850]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 1119.44 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 0.640 Numerical Antenna gain; equal to -1.94 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.14247 mW/cm^2**

Reference:
[GSM1900]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 561.05 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 1.663 Numerical Antenna gain; equal to 2.21 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.18567 mW/cm^2**

Reference:
[WCDMA Band 2]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 281.84 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 1.663 Numerical Antenna gain; equal to 2.21 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.09327 mW/cm^2**

Reference:
[WCDMA Band 4]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 281.84 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 1.503 Numerical Antenna gain; equal to 1.77 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.08428 mW/cm^2**

Reference:
[WCDMA Band 5]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 281.84 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 0.640 Numerical Antenna gain; equal to -1.94 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.03587 mW/cm^2**

Reference:
[LTE Band 2]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 223.87 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 1.663 Numerical Antenna gain; equal to 2.21 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.07408 mW/cm^2**

Reference:
[LTE Band 4]
This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 223.87 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 1.503 Numerical Antenna gain; equal to 1.77 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.06695 mW/cm^2**

Reference:
[LTE Band 5]
This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 223.87 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 0.640 Numerical Antenna gain; equal to -1.94 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.02849 mW/cm^2**

Reference:
[LTE Band 12]

This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1mW/cm^2 uncontrolled exposure limit. The Friis formula used was:

$$S = \frac{P \times G}{4 \times \pi \times r^2}$$

Where

P = 223.87 mW (Maximum average output power)

☑ Time average was used for the above value in consideration of 6-minutes time-averaging

☐ Burst power average was used for the above value in consideration of worst condition.

G = 0.998 Numerical Antenna gain; equal to -0.01 dBi

r = 20 cm (Separation distance)

Power Density Result S = **0.04444 mW/cm^2**

Therefore, if WLAN 2.4GHz and GSM850 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.14247 mW/cm^2
=0.15128 mW/cm^2

Therefore, if WLAN 2.4GHz and GSM1900 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.18567 mW/cm^2
=0.19448 mW/cm^2

Therefore, if WLAN 2.4GHz and WCDMA Band 2 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.09327 mW/cm^2
=0.10208 mW/cm^2

Therefore, if WLAN 2.4GHz and WCDMA Band 4 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.08428 mW/cm^2
=0.09309mW/cm^2

Therefore, if WLAN 2.4GHz and WCDMA Band 5 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.03587 mW/cm^2
=0.04468 mW/cm^2

Therefore, if WLAN 2.4GHz and LTE Band 2 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.07408 mW/cm^2
=0.08289 mW/cm^2

Therefore, if WLAN 2.4GHz and LTE Band 4 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.06695 mW/cm^2
=0.07576 mW/cm^2

Therefore, if WLAN 2.4GHz and LTE Band 5 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.02849 mW/cm^2
=0.0373 mW/cm^2

Therefore, if WLAN 2.4GHz and LTE Band 12 transmit simultaneously,
S=0.00881 mW/cm^2 + 0.04444 mW/cm^2
=0.05325 mW/cm^2

Even taking into account the tolerance, this device can be satisfied with the limits.

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