






RF EXPOSURE EVALUATION REPORT

For: Apple Inc.

Product: A1862

FCC ID: BCGA1862

RF Exposure Evaluation Report Serial No.:
UL/REGA1/MPE11838557B

This RF Exposure Evaluation Report Is Issued Under The Authority Of Nick Hooper, Head of Inspection:  PP	
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Report Copy No: PDF01	Issue Date: 29 November 2017

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RF Exposure Evaluation for the A1862

The A1862 is a desktop computer which contains 2.4GHz and 5GHz WIFI and 2.4GHz Bluetooth BR/EDR and LE transmitters.

WLAN supports 3x3 MIMO operation, and there can be simultaneous transmission between all of the transmitters.

The following FCC Rule Parts and procedures are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits

Part 2.1091 – Radiofrequency radiation exposure evaluation: mobile devices

KDB447498 D01 v06

Mobile and Portable Devices RF Exposure Procedures and Equipment Authorisation Policies

MAXIMUM TRANSMITTER POWER

WLAN 2.4GHz:

Power conducted = 20.5dBm max (SISO)

Antenna Gain WF2: +4.1dBi

Antenna Gain WF3: +3.1dBi

Antenna Gain WF4: +5.1dBi

$EIRP_{SISO2} = 24.6\text{dBm} = 288.4\text{ mW}$

$EIRP_{SISO3} = 23.6\text{dBm} = 229.1\text{ mW}$

$EIRP_{SISO4} = 25.6\text{dBm} = 363.1\text{ mW}$

$$\begin{aligned} EIRP_{MIMO} &= \sum EIRP_{SISO2} + EIRP_{SISO3} + EIRP_{SISO4} \\ &= 880.6\text{mW} \end{aligned}$$

WLAN 5GHz:

Power conducted = 22.0dBm max (SISO)

Antenna Gain WF2: +4.2dBi

Antenna Gain WF3: +2.3dBi

Antenna Gain WF4: +2.8dBi

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$$\text{EIRP}_{\text{SISO2}} = 26.2\text{dBm} = 416.9 \text{ mW}$$

$$\text{EIRP}_{\text{SISO3}} = 24.3\text{dBm} = 269.2 \text{ mW}$$

$$\text{EIRP}_{\text{SISO4}} = 24.8\text{dBm} = 302.0 \text{ mW}$$

$$\begin{aligned} \text{EIRP}_{\text{MIMO}} &= \sum \text{EIRP}_{\text{SISO2}} + \text{EIRP}_{\text{SISO3}} + \text{EIRP}_{\text{SISO4}} \\ &= 988.1\text{mW} \end{aligned}$$

Bluetooth (Basic Rate, EDR & Low Energy) 2.4GHz

Power conducted = 12.5dBm

Antenna Gain: 6.0dBi

$$\text{EIRP} = 18.5\text{dBm} = 70.8 \text{ mW}$$

MPE CALCULATIONS

The MPE calculation used to calculate the safe operating distance for the user is.

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

Where

- S = Power density
- EIRP = Effective Isotropic Radiated Power (EIRP = P x G)
- P = Conducted Transmitter Power
- G = Antenna Gain (relative to an isotropic radiator)
- R = distance to the centre of radiation of the antenna (20cm requirement).

For WLAN 2.4GHz

Values:

Transmitter frequency range = 2412 MHz to 2472MHz

Max. $\text{EIRP}_{\text{SISO}} = 363.1 \text{ mW}$

$\text{EIRP}_{\text{MIMO}} = 880.6 \text{ mW}$

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 2.4GHz

$$S_{\text{req1}} = 1.0 \text{ mW/cm}^2$$

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Calculation:

$$S = \text{EIRP}_{\text{SISO}} / 4 \pi R^2$$

$$S = 363.1 / (12.56 \times 20^2)$$

$$S = 363.1 / (5024)$$

$$S_{1 \text{ SISO}} = 0.072 \text{ mW/cm}^2 (< 1.0 \text{ mW/cm}^2)$$

Similarly for MIMO: $S_{1 \text{ MIMO}} = 0.18 \text{ mW/cm}^2 (< 1.0 \text{ mW/cm}^2)$

This equates to minimum safe operating distance (MIMO operation) of 8.4 cm at the RF exposure limit of 1.0 mW/cm^2

For WLAN 5GHz

Values:

Transmitter frequency range = 5150 MHz to 5850MHz

Max. $\text{EIRP}_{\text{SISO}} = 302.0 \text{ mW}$

$\text{EIRP}_{\text{MIMO}} = 988.1 \text{ mW}$

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 5GHz

$$S_{\text{req2}} = 1.0 \text{ mW/cm}^2$$

Calculation:

$$S = \text{EIRP}_{\text{SISO}} / 4 \pi R^2$$

$$S = 302 / (12.56 \times 20^2)$$

$$S = 302 / (5024)$$

$$S_{2 \text{ SISO}} = 0.060 \text{ mW/cm}^2 (< 1.0 \text{ mW/cm}^2)$$

Similarly for MIMO: $S_{2 \text{ MIMO}} = 0.20 \text{ mW/cm}^2 (< 1.0 \text{ mW/cm}^2)$

This equates to minimum safe operating distance (MIMO operation) of 8.9 cm at the RF exposure limit of 1.0 mW/cm^2

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For Bluetooth 2.4 GHz

Values:

Transmitter frequency range = 2402 MHz to 2480MHz

EIRP = 70.8 mW

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of
FCC Rule Part 1.1310 for 5GHz

$$S_{\text{req3}} = 1.0 \text{ mW/cm}^2$$

Calculation:

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

$$S = 70.8/(12.56 \times 20^2)$$

$$S = 70.8/(5024)$$

$$S_3 = 0.014\text{mW/ cm}^2 (<1.0 \text{ mW/cm}^2)$$

This equates to a safe operating distance of 2.4cm at the RF exposure limit of 1.0 mW/cm²

KDB447498 D01 v05 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

Worst case summation of calculated MPE ratios for 2.4GHz/ 5GHz WLAN and 2.4GHz BT simultaneously transmitting transmitters from each respective antenna is:

$$\text{ie: } \sum \text{MPE}_{\text{ratios}} = (S_1 \text{ SISO}/ S_{\text{req1}}) + (S_2 \text{ SISO}/ S_{\text{req2}}) + (S_3 \text{ SISO}/ S_{\text{req3}})$$

$$= (0.072/1.0) + (0.060/1.0) + (0.014/1.0)$$

$$= 0.146$$

\sum of MPE ratios < 1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for the WLAN and Bluetooth transmitters.

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Conclusion

The required 20cm RF exposure limits for General Population/ Uncontrolled Exposure will not be exceeded for the A1862 using antennas having a maximum gain of +5.1dBi for 2.4 WLAN, +4.2dBi for 5 GHz WLAN and +6.0dBi for, Bluetooth operation.
