# RF EXPOSURE EVALUATION REPORT

For: Apple Inc.

**Product: A1842**

**FCC ID: BCGA1842**

**RF Exposure Evaluation Report Serial No.:**
UL/REGA1/MPE11782343B

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**This RF Exposure Evaluation Report Is Issued Under The Authority
Of Nick Hooper, Head of Inspection:**

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# RF Exposure Evaluation for the A1842

The A1842 is a TV receiver unit which contains 2.4GHz and 5GHz WIFI and 2.4GHz Bluetooth BR/EDR and LE transmitters.

WLAN supports 2x2 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 = 23.0dBm max (SISO)

Antenna Gain: +0.9dBi

$EIRP_{SISO} = 23.9dBm = 245.47$ mW

$EIRP_{MIMO} = 2 \times EIRP_{SISO} = 490.94$ mW

WLAN 5GHz:

Power conducted = 21.0dBm max (SISO)

Antenna Gain: +1.95dBi

$EIRP_{SISO} = 22.95dBm = 197.24$ mW

$EIRP_{MIMO} = 2 \times EIRP_{SISO} = 394.5$ mW

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

Power conducted = 21.0dBm

Antenna Gain: -0.1dBi

$EIRP = 20.9dBm = 123.0$ mW

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## MPE CALCULATIONS

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

$$S = EIRP/4 \pi R^2$$

**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

$EIRP_{SISO}$ = 245.47 mW

$EIRP_{MIMO}$ = 490.94 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

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

Calculation:

$S = EIRP_{SISO} /4 \pi R^2$

$S = 245.47/(12.56 \times 20^2)$

$S = 245.47/ (5024)$

$$S_{1\ SISO} = 0.049 \text{mW/ cm}^2 \ (<1.0 \text{ mW/cm}^2)$$

Similarly for MIMO:      $S_{1\ MIMO} = 0.098 \text{mW/ cm}^2 \ (<1.0 \text{ mW/cm}^2)$

**This equates to minimum safe operating distance (MIMO operation) of 6.25 cm at the RF exposure limit of 1.0 mW/cm$^2$**

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### For WLAN 5GHz

Values:

Transmitter frequency range = 5150 MHz to 5850MHz

$EIRP_{SISO}$ = 197.24 mW

$EIRP_{MIMO}$ = 394.5 mW

R = 20cm

Power Density Requirement

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

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

Calculation:

$S = EIRP_{SISO} /4 \pi R^2$

$S = 197.24/(12.56 \times 20^2)$

$S = 197.24/(5024)$

$S_{2\ SISO}$ **= 0.039mW/ cm$^2$** (<1.0 mW/cm$^2$)

Similarly for MIMO:  $S_{2\ MIMO}$ **= 0.078mW/ cm$^2$** (<1.0 mW/cm$^2$)

**This equates to minimum safe operating distance (MIMO operation) of 5.6 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 = 123.0 mW

R = 20cm

Power Density Requirement

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

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

Calculation:

        $S = EIRP / 4 \pi R^2$
        $S = 123/(12.56 \times 20^2)$
        $S = 123/(5024)$

        **$S_3$ = 0.024mW/ cm$^2$** (<1.0 mW/cm$^2$)

**This equates to a safe operating distance of 3.1cm at the RF exposure limit of 1.0 mW/cm$^2$**

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### 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:

$$\textbf{ie: } \sum \textbf{MPE}_{ratios} = (S_{1\ SISO}/\ S_{req1}) + (S_{2\ SISO}/\ S_{req2}) + (S_{3\ SISO}/\ S_{req3})$$

$$= (0.049/1.0) + (0.039/1.0) + (0.024/1.0)$$
$$\textbf{= 0.112}$$

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

### Conclusion

The required 20cm RF exposure limits for General Population/ Uncontrolled Exposure will not be exceeded for the A1842 using antennas having a maximum gain of +0.9dBi for 2.4 WLAN, +1.95dBi for 5 GHz WLAN and -0.1dBi for, Bluetooth operation.