APPENDIX I
RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

EUT Specification

EUT	ZigBee Home Monitoring Gateway
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☐ Others
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm^2) ☒ General Population/Uncontrolled exposure (S=1mW/cm^2)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11b mode: 21.03 dBm(126.7652mW) IEEE 802.11g mode: 25.68 dBm(369.8282mW) IEEE 802.11n HT 20 MHz mode: 26.71 dBm(468.8134mW) IEEE 802.11n HT 40 MHz mode: 26.94 dBm(494.3107mW)
Antenna gain (Max)	3.8 dBi (Numeric gain: 2.39) MIMO Mode: 3.8 dBi + 10 log (2) = 6.81 dBi (Numeric gain: 4.79)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A
Remark: *The maximum output power is 26.94dBm (494.3107mW) at 2437MHz (with 4.79 numeric antenna gain.)*	

TEST RESULTS

No non-compliance noted.

MPE EVALUATION

No non-compliance noted.

Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

Where *E = Field strength in Volts / meter*
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) = d(m) / 100

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$ ***Equation 1***

Where *d = Distance in cm*
P = Power in mW
G = Numeric antenna gain
S = Power density in mW / cm^2

Maximum Permissible Exposure

Substituting the MPE safe distance using d = 20 cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where *P = Power in mW*
G = Numeric antenna gain
S = Power density in mW / cm^2

IEEE 802.11b mode:

EUT output power = 126.7652 mW

Numeric Antenna gain = 2.39

→ *Power density = 0.060291 mW / cm^2*

IEEE 802.11g mode:

EUT output power = 369.8282 mW

Numeric Antenna gain = 2.39

→ *Power density = 0.175894 mW / cm^2*

IEEE 802.11n HT 20 MHz mode:

EUT output power = 468.8134 mW

Numeric Antenna gain = 4.79

→ *Power density = 0.446878 mW / cm^2*

IEEE 802.11n HT 40 MHz mode:

EUT output power = 494.3107 mW

Numeric Antenna gain = 4.79

→ *Power density = 0.471182 mW / cm^2*

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm^2 even if the calculation indicates that the power density would be larger.)