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	Industrial Access Point and Router
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☐ Others: Bluetooth: 2.402GHz ~ 2.480GHz
Device category	☒ Portable (<20cm separation) ☐ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm2) ☒ General Population/Uncontrolled exposure (S=1mW/cm2)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11b mode: 21.84 dBm(152.75mW) IEEE 802.11g mode: 22.73 dBm(187.49mW) IEEE 802.11n HT 20 MHz mode: 22.55 dBm(179.88mW) IEEE 802.11n HT 40 MHz mode: 20.82 dBm(120.78mW)
Antenna gain (Max)	Gain: 2.18 dBi (Numeric gain: 1.65) MIMO: 2.18 dBi + 10 log (2) = 5.18 dBi (Numeric gain: 3.29)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation ☐ N/A
Remark: *The maximum output power is 22.73dBm (187.49mW) at 2412MHz (with 1.65 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 = 152.75 mW

Numeric Antenna gain = 1.65

→ *Power density = 0.0501 mW / cm^2*

IEEE 802.11g mode:

EUT output power = 187.49 mW

Numeric Antenna gain = 1.65

→ *Power density = 0.0615 mW / cm^2*

IEEE 802.11n HT 20 MHz mode:

EUT output power = 179.88 mW

Numeric Antenna gain = 3.29

→ *Power density = 0.1177 mW / cm^2*

IEEE 802.11n HT 40 MHz mode:

EUT output power = 120.78 mW

Numeric Antenna gain = 3.29

→ *Power density = 0.0790 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.)

EUT Specification

EUT	Industrial Access Point and Router
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☒ WLAN: 5.725GHz ~ 5.850GHz ☐ Others: Bluetooth: 2.402GHz ~ 2.480GHz
Device category	☒ Portable (<20cm separation) ☐ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm2) ☒ General Population/Uncontrolled exposure (S=1mW/cm2)
Antenna diversity	☒ Single antenna ☐ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☐ Tx/Rx diversity
Max. output power	IEEE 802.11a mode: 25.56 dBm (359.74mW) IEEE 802.11n HT 20 MHz mode: 25.80 dBm(380.18mW) IEEE 802.11n HT 40 MHz mode: 23.73 dBm(236.04mW)
Antenna gain (Max)	Gain: 3.58 dBi (Numeric gain: 2.28) MIMO: 3.58 dBi + 10 log (2) = 6.58 dBi (Numeric gain: 4.54)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation ☐ N/A
Remark: *The maximum output power is 25.56 dBm (359.74mW) at 5785MHz (with 2.28 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 802.11a mode:

EUT output power = 359.74 mW

Numeric Antenna gain = 2.28

→ *Power density* = 0.1632 mW / cm^2

IEEE 802.11n HT 20 MHz mode:

EUT output power = 380.18 mW

Numeric Antenna gain = 4.54

→ *Power density* = 0.3434 mW / cm^2

IEEE 802.11n HT 40 MHz mode:

EUT output power = 236.04 mW

Numeric Antenna gain = 4.54

→ *Power density* = 0.2132 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.)