APPENDIX I
RADIO FREQUENCY EXPOSURE

LIMIT

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 §15.247(i) and §1.1307(b)(1) of this chapter.

EUT Specification

EUT	Wireless LAN ,Bluetooth Comb Module
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☒ Bluetooth: 2.402GHz ~ 2.480 GHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation)
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	3.14 dBm (2.06mW)
Antenna gain (Max)	1.98 dBi (Numeric gain: 1.58)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:
The maximum output power is 3.14 dBm (2.06mW) at 2480MHz (with 1.58 numeric antenna gain.)

TEST RESULTS

No non-compliance noted.

MPE EVALUATION

No non-compliance noted.

Calculation

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

$\quad\quad$ Where $\quad$ E = Field strength in Volts / meter

$\quad\quad\quad\quad\quad\quad$ P = Power in Watts

$\quad\quad\quad\quad\quad\quad$ G = Numeric antenna gain

$\quad\quad\quad\quad\quad\quad$ d = Distance in meters

$\quad\quad\quad\quad\quad\quad$ 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:

$\quad\quad$ *P (mW) = P (W) / 1000 and*

$\quad\quad$ *d (cm) = d(m) / 100*

Yields

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

$\quad\quad$ Where $\quad$ d = Distance in cm

$\quad\quad\quad\quad\quad\quad$ P = Power in mW

$\quad\quad\quad\quad\quad\quad$ G = Numeric antenna gain

$\quad\quad\quad\quad\quad\quad$ S = Power density in mW / cm^2

Maximum Permissible Exposure

EUT output power = 2.06mW

Numeric Antenna gain = 1.58

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

Yields

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

Where $\quad$ *P = Power in mW*

$\quad\quad\quad\quad$ *G = Numeric antenna gain*

$\quad\quad\quad\quad$ *S = Power density in mW / cm^2*

$\rightarrow$ *Power density = 0.000647 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.)

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.

According to RSS-Gen §5.5, before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

EUT Specification

EUT	Wireless LAN ,Bluetooth Comb Module
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ 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/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	9.80dBm (9.54 mW)
Antenna gain (Max)	1.98 dBi (Numeric gain: 1.58)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A
Remark: *The maximum output power is 9.80 dBm (9.54 mW) at 2441MHz (with 1.58 numeric antenna gain.)*	

TEST RESULTS

No non-compliance noted.

(SAR evaluation is not required for the PORTABLE device while its maximum output power is lower than the general population low threshold: $60/f_{(GHz)}=60/2.441=24.58mW$)

Calculation

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

    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:

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

Chainging to units of mW and cm, using:

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

    d (cm) = d(m) / 100

Yields

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

    Where   *d = Distance in cm*

       P = Power in mW

       G = Numeric antenna gain

       S = Power density in mW / cm^2

Maximum Permissible Exposure

EUT output power = 9.54 mW

Numeric Antenna gain = 1.58

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

$\rightarrow$ *Power density = 0.0029 mW / cm2*

  (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.)

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.

According to RSS-Gen §5.5, before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

EUT Specification

EUT	Wireless LAN ,Bluetooth Comb Module
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: 19.87 dBm (97.05 mW) IEEE 802.11g mode: 23.93 dBm (247.17 mW) IEEE 802.11n HT 20 MHz mode: 24.06 dBm (254.68 mW)
Antenna gain (Max)	Gain: 1.98 dBi (Numeric gain: 1.57)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:

The maximum output power is <u>*24.06dBm (254.68mW) at 2442MHz (with 1.57 numeric antenna gain*</u>*.)*

TEST RESULTS

No non-compliance noted.

MPE EVALUATION

No non-compliance noted.

Calculation

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

Where $\quad$ *E = Field strength in Volts / meter*

$\qquad$ *P = Power in Watts*
$\qquad$ *G = Numeric antenna gain*
$\qquad$ *d = Distance in meters*

$\qquad$ *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:

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

Chainging to units of mW and cm, using:

$\qquad$ *P (mW) = P (W) / 1000 and*

$\qquad$ *d (cm) = d(m) / 100*

Yields

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

Where $\quad$ *d = Distance in cm*

$\qquad$ *P = Power in mW*

$\qquad$ *G = Numeric antenna gain*

$\qquad$ *S = Power density in mW / cm^2*

Maximum Permissible Exposure

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

Yields

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

Where $\quad$ *P = Power in mW*

$\qquad$ *G = Numeric antenna gain*

$\qquad$ *S = Power density in mW / cm^2*

IEEE 802.11b mode:

EUT output power = 97.05 mW

Numeric Antenna gain = 1.57

→ *Power density = 0.0303 mW / cm2*

IEEE 802.11g mode:

EUT output power = 247.17 mW

Numeric Antenna gain = 1.57

→ *Power density = 0.0772 mW / cm2*

IEEE 802.11n HT 20 MHz mode

EUT output power = 254.68 mW

Numeric Antenna gain = 1.57

→ *Power density = 0.0795 mW / cm2*

(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	Wireless LAN ,Bluetooth Comb Module
Frequency band (Operating)	☐ Bluetooth: 2.402GHz ~ 2.480GHz ☐ WLAN: 2.412GHz ~ 2.462GHz ☒ WLAN: 5.745GHz ~ 5.825GHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation)
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 802.11a mode: 19.45 dBm (88.10mW) IEEE 802.11n HT 20 MHz mode: 19.06 dBm (80.53mW)
Antenna gain (Max)	Gain: 2.89 dBi (Numeric gain: 1.94)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:

The maximum output power is <u>*19.45dBm (88.10mW) at 5825Hz (with 1.94 numeric antenna gain.)*</u>

TEST RESULTS

No non-compliance noted.

MPE EVALUATION

No non-compliance noted.

Calculation

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

   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:

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

Changing to units of mW and cm, using:

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

   d (cm) = d(m) / 100

Yields

$$S = \dfrac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \dfrac{P \times G}{d^2} \qquad \textbf{\textit{Equation 1}}$$

   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 = 88.10 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.0340 mW / cm2*

IEEE 802.11n HT 20 MHz mode

EUT output power = 80.53 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.0310 mW / cm2*

(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.)

APPENDIX I
RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.407(f), U-NII devices are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

EUT Specification

EUT	Wireless LAN ,Bluetooth Combo Module				
Frequency band (Operating)	☐ WLAN: 2412 MHz ~ 2462 MHz ☒ WLAN: 5150 MHz ~ 5350 MHz ☒ WLAN: 5500 MHz ~ 5700 MHz ☐ WLAN: 5725 MHz ~ 5850 MHz				
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others: _____				
Exposure classification	General Population/Uncontrolled exposure *(S=1mW/cm^2)*				

Antenna diversity	☐ Single antenna
	☒ Multiple antennas
	   ☐ Tx diversity
	   ☐ Rx diversity
	   ☒ Tx/Rx diversity				

Max. output power		**Mode**	**Frequency Range (MHz)**	**Output Power (dBm)**	**Output Power (mw)**
	UNII Band I	IEEE 802.11a	5180 – 5240	11.87	15.3815
		IEEE 802.11n HT 20 MHz	5180 – 5240	11.50	14.1254
	UNII Band II	IEEE 802.11a	5260 - 5320	12.04	15.9956
		IEEE 802.11n HT 20 MHz	5260 - 5320	11.55	14.2889
	UNII Band III	IEEE 802.11a	5500 - 5700	11.20	13.1826
		IEEE 802.11n HT 20 MHz	5500 – 5700	11.55	14.2889
Antenna gain (Max)	Gain: 2.89 dBi (Numeric gain: 1.94)				
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A				

Remark:
1. *The maximum output power is 12.04dBm (15.99mW) at 5320MHz (with 1.94 numeric antenna gain.)*
2. *For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm^2 even if the calculation indicates that the power density would be larger.*

TEST RESULTS

No non-compliance noted.

Calculation

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

$\quad\quad$ *Where $\quad$ E = Field strength in Volts / meter*

$\quad\quad\quad\quad$ *P = Power in Watts*
$\quad\quad\quad\quad$ *G = Numeric antenna gain*
$\quad\quad\quad\quad$ *d = Distance in meters*

$\quad\quad\quad\quad$ *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:

$\quad\quad$ *P (mW) = P (W) / 1000 and*
$\quad\quad$ *d (cm) = d(m) / 100*

Yields

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

$\quad\quad$ *Where $\quad$ d = Distance in cm*
$\quad\quad\quad\quad\quad$ *P = Power in mW*
$\quad\quad\quad\quad\quad$ *G = Numeric antenna gain*
$\quad\quad\quad\quad\quad$ *S = Power density in mW / cm2*

Maximum Permissible Exposure

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

Yields
$$S = 0.000199 \times P \times G$$
Where $\quad$ P = Power in mW

$\quad\quad\quad\quad$ *G = Numeric antenna gain*
$\quad\quad\quad\quad$ *S = Power density in mW / cm^2*

UNII Band I

IEEE 802.11a mode:

EUT output power = 15.3815 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.005938mW / cm2*

IEEE 802.11n HT 20 MHz mode:

EUT output power = 14.1254 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.005453mW / cm2*

UNII Band II

IEEE 802.11a mode:

EUT output power = 15.9956 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.006175mW / cm2*

IEEE 802.11n HT 20 MHz mode:

EUT output power = 14.2889 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.005516mW / cm2*

UNII Band III

IEEE 802.11a mode:

EUT output power = 13.1826 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.005089mW / cm2*

IEEE 802.11n HT 20 MHz mode:

EUT output power = 14.2889 mW

Numeric Antenna gain = 1.94

→ *Power density = 0.005516 mW / cm2*
(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.)