



9. 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	Dual-Band Wireless VPN Router with GbE Switch
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 ($S = 5\text{mW/cm}^2$) ☒ General Population/Uncontrolled exposure ($S=1\text{mW/cm}^2$)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11b: 19.26 dBm (84.33mW) IEEE 802.11g: 20.74 dBm (118.58mW) draft 802.11n Standard-20 MHz Channel mode: 20.65 dBm (116.14mW) draft 802.11n Wide-40 MHz Channel mode: 18.79 dBm (75.68mW)
Antenna gain (Max)	1. Dipole Antenna / 2 dBi (Numeric gain: 1.58) MIMO: $2\text{dBi} + 10 \log(2) = 5 \text{ dBi}$ (Numeric gain: 3.16) 2. PIFA Antenna / 6.6 dBi (RX only)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:

- The maximum output power is 20.74dBm (118.57mW) at 2437MHz (with 1.58 numeric antenna gain.)
- DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
- 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.

RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm, except when the device operates:

- at or above 1.5 GHz and the e.i.r.p. of the device is equal to or less than 5 W.

Remark: Please refer to the Annex A -B RF Technical Brief Cover Sheet.

**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:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = d(m) / 100$$

Yields

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

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

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 P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²



IEEE 802.11b mode:

EUT output power = 84.33mW

Numeric Antenna gain = 1.58

→ Power density = 0.02651 mW / cm²

IEEE 802.11g mode:

EUT output power = 118.58 mW

Numeric Antenna gain = 1.58

→ Power density = 0.0372 mW / cm²

draft 802.11n Standard-20 MHz Channel mode:

EUT output power = 116.14 mW

Numeric Antenna gain = 3.16

→ Power density = 0.07303 mW / cm²

draft 802.11n Wide-40 MHz Channel mode:

EUT output power = 75.68 mW

Numeric Antenna gain = 3.16

→ Power density = 0.04759 mW / cm²

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)

**EUT Specification**

EUT	Dual-Band Wireless VPN Router with GbE Switch
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 ($S=5\text{mW}/\text{cm}^2$) ☒ General Population/Uncontrolled exposure ($S=1\text{mW}/\text{cm}^2$)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11a: 23.92 dBm (246.60mW) draft 802.11n Standard-20 MHz Channel mode: 24.52 dBm (283.14mW) draft 802.11n Wide-40 MHz Channel mode: 23.82 dBm (240.99mW)
Antenna gain (Max)	1. Dipole Antenna / 2 dBi (Numeric gain: 1.58) MIMO: $2\text{dBi} + 10 \log(2) = 5 \text{ dBi}$ (Numeric gain: 3.16) 2. PIFA Antenna / 6.6 dBi (RX only)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:

1. The maximum output power is 23.92dBm (246.60mW) at 5745MHz (with 1.58 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is $1.0 \text{ mW}/\text{cm}^2$ even if the calculation indicates that the power density would be larger.

TEST RESULTS

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:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = d(m) / 100$$

Yields

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

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

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 P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²



IEEE 802.11a mode:

EUT output power = 246.60 mW

Numeric Antenna gain = 1.58

→ Power density = 0.07753 mW / cm²

draft 802.11n Standard-20 MHz Channel mode:

EUT output power = 283.14 mW

Numeric Antenna gain = 3.16

→ Power density = 0.17804 mW / cm²

draft 802.11n Wide-40 MHz Channel mode:

EUT output power = 240.99 mW

Numeric Antenna gain = 3.16

→ Power density = 0.15154 mW / cm²

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)