



Radio Frequency Exposure

LIMIT

For 2.4G Band: 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.

For 5.0G Band: According to FCC §1.1310, The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in § 1.1307(b).

EUT Specification

EUT	Dual-Band Wireless AC/N VDSL2 Combo WAN Gigabit Gateway with USB
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☒ WLAN: 5.150GHz ~ 5.250GHz ☒ WLAN: 5.745GHz ~ 5.825GHz ☐ Bluetooth: 2.402GHz ~ 2.480 GHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation)
Exposure classification	☐ Occupational/Controlled exposure ($S = 5\text{mW/cm}^2$) ☒ 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 for 2.4G Band	IEEE802.11b: 24.47 dBm (0.2799W) IEEE802.11g: 23.40 dBm (0.2188W) IEEE802.11n HT20: 25.30 dBm (0.3388W) IEEE802.11n HT40: 25.89 dBm (0.3882W)
Max. output power for 5.150-5.250GHz	IEEE802.11a: 25.37 dBm (0.3443W) IEEE802.11ac(20MHz): 26.07 dBm (0.4046W) IEEE802.11ac(40MHz): 25.48 dBm (0.3532W) IEEE802.11ac(80MHz): 19.45 dBm (0.0881W)
Max. output power for 5.745-5.850GHz	IEEE802.11a: 26.24 dBm (0.4207W) IEEE802.11ac(20MHz): 25.88 dBm (0.3873W) IEEE802.11ac(40MHz): 25.14 dBm (0.3266W) IEEE802.11ac(80MHz): 25.49 dBm (0.3540W)
Antenna gain (Max)	3.4dBi for 2.4G Band 5.45dBi for 5.150-5.250GHz 6.63dBi for 5.745-5.850GHz
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A



Remark:

1. The maximum output power is 25.89dBm (0.3882W) at 2437MHz (with numeric 2.188antenna gain.) for 2.4G band
The maximum output power is 26.07dBm (0.4046W) at 5240MHz (with numeric 3.508antenna gain.)
The maximum output power is 26.24dBm (0.4207W) at 5785MHz (with numeric 4.603antenna 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 mW/cm^2 even if the calculation indicates that the power density would be larger.

*Note: Simultaneous transmission is not applicable for this EUT.

**TEST RESULTS FOR 2.4G BAND**

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:

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

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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

Modulation Mode	Frequency band (MHz)	Max. Conducted output power(dBm)	Antenna gain (dBi)	Distance (cm)	Power density (mW/cm2)	Limit (mW/cm2)
IEEE802.11b	2412-2462	24.47	3.4	20	0.1219	1
IEEE802.11g	2412-2462	23.40	3.4	20	0.0953	1
IEEE802.11n HT20	2412-2462	25.30	3.4	20	0.1475	1
IEEE802.11n HT40	2422-2452	25.89	3.4	20	0.1690	1

**TEST RESULTS FOR 5150-5250MHZ**

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:

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

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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

Modulation Mode	Frequency band (MHz)	Max. Conducted output power(dBm)	Antenna gain (dBi)	Distance (cm)	Power density (mW/cm2)	Limit (mW/cm2)
IEEE802.11a	5180-5240	25.37	5.45	20	0.2403	1
IEEE802.11ac(20MHz)	5180-5240	26.07	5.45	20	0.2823	1
IEEE802.11ac(40MHz)	5190-5230	25.48	5.45	20	0.2465	1
IEEE802.11ac(80MHz)	5210	19.45	5.45	20	0.0615	1

**TEST RESULTS FOR 5745-5825MHZ**

No non-compliance noted.

Calculation

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

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:

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

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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

Modulation Mode	Frequency band (MHz)	Max. Conducted output power(dBm)	Antenna gain (dBi)	Distance (cm)	Power density (mW/cm2)	Limit (mW/cm2)
IEEE802.11a	5745-5825	26.24	6.63	20	0.3854	1
IEEE802.11ac(20MHz)	5745-5825	25.88	6.63	20	0.3546	1
IEEE802.11ac(40MHz)	5755-5795	25.14	6.63	20	0.2990	1
IEEE802.11ac(80MHz)	5775	25.49	6.63	20	0.3241	1

NOTE:

Total (Chain0+Chain1) , the formula of calculated the MPE is:

$$\text{CPD1} / \text{LPD1} + \text{CPD2} / \text{LPD2} + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density