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	Wireless VoIP Router
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☒ WLAN: 5.150GHz ~ 5.250GHz ☒ WLAN: 5.725GHz ~ 5.850GHz ☐ Bluetooth: 2.402GHz ~ 2.480 GHz
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	802.11b: 21.46 dBm (139.97 mW) 802.11g: 25.15 dBm (327.02 mW) 802.11n (20MHz): 25.91 dBm (390.07 mW) 802.11n (40MHz): 25.96 dBm (394.48 mW) 802.11a (5150-5250): 15.79 dBm (37.9mW) 802.11an (20MHz)(5150-5250): 16.11 dBm (40.8 mW) 802.11an (40MHz)(5150-5250): 16.10 dBm (40.7 mW) 802.11ac (20MHz)(5150-5250): 16.05 dBm (40.3 mW) 802.11ac (40MHz)(5150-5250): 15.94 dBm (39.3 mW) 802.11ac (80MHz)(5150-5250): 18.38 dBm (68.9 mW) 802.11a (5725-5850): 16.60 dBm (45.7 mW) 802.11an (20MHz)(5725-5850): 16.50 dBm (44.7 mW) 802.11an (40MHz)(5725-5850): 16.57 dBm (45.4 mW) 802.11ac (20MHz)(5725-5850): 16.38 dBm (43.5 mW) 802.11ac (40MHz)(5725-5850): 16.63 dBm (46.0 mW) 802.11ac (80MHz)(5725-5850): 16.34 dBm (43.1 mW)
Antenna gain (Max)	ANT A, B: 2 dBi for 2412 ~ 2462MHz, 2.23 dBi for 5150 ~ 5250MHz, 1.68 dBi for 5725 ~ 5850MHz Directional antenna gain for N mode: 5 dBi for 2412 ~ 2462MHz 5.23 dBi for 5150 ~ 5250MHz 4.68 dBi for 5725 ~ 5850MHz
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A

Remark:
1. *The maximum output power is 25.96 dBm (394.48 mW) at 2422 MHz (with numeric 10.77 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 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

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 / 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)
		ANT A	ANT B	ANT A+B			ANT A+B	
802.11b	2412-2462	18.45	18.45	21.46	2	20	0.044	1
802.11g	2412-2462	22.20	22.07	25.15	2	20	0.103	1
802.11n (20MHz)	2412-2462	22.80	23.00	25.91	2	20	0.123	1
802.11n (40MHz)	2422-2452	22.95	22.95	25.96	2	20	0.124	1
802.11a	5150-5250	11.73	13.62	15.79	2.23	20	0.01195	1
802.11an (20MHz)	5150-5250	11.92	14.02	16.11	2.23	20	0.01286	1
802.11an (40MHz)	5150-5250	11.72	14.13	16.10	2.23	20	0.01285	1
802.11a	5725-5850	13.66	13.51	16.60	1.68	20	0.01440	1
802.11an (20MHz)	5725-5850	13.62	13.35	16.50	1.68	20	0.01408	1
802.11an (40MHz)	5725-5850	13.56	13.56	16.57	1.68	20	0.01431	1
802.11ac (20MHz)	5150-5250	11.78	14.02	16.05	2.23	20	0.01339	1
802.11ac (40MHz)	5150-5250	11.60	13.95	15.94	2.23	20	0.01150	1
802.11ac (80MHz)	5150-5250	15.04	15.68	18.38	2.23	20	0.02289	1
802.11ac (20MHz)	5725-5850	13.29	13.44	16.38	1.68	20	0.01273	1
802.11ac (40MHz)	5725-5850	13.33	13.89	16.63	1.68	20	0.01348	1
802.11ac (80MHz)	5725-5850	13.45	13.21	16.34	1.68	20	0.01431	1

NOTE:

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

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density