A04438 RF Exposure Exhibit

RSS-102 Issue 5 / 47 CFR 1.1310

ANT (and simultaneous MPE Calculation)

	HVIN A04438			Test Number: 240304			
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.						
	dBi = dB gain compared to an isotropic radiator.						
	S = power density in mW/cm^2						
	Peak Transmitter Output power (mW)		1.8				
	Peak Transmitter Output power (W)		0.002				
Output Power for 100% duty Cycle operation (Watts)	100		0.0018	Antenna Gain (dBi)		3.28	
	Output Power for 0.417% duty Cycle operation (Watts)		0.0018	Antenna Gain (Numeric)		2.13	
Tx Frequency (MHz)	2402	Calcualtion power (Watts)	0.0018	dBd + 2.17 = dBi	dBi to dBd	2.2	
				Antenna Gain (dBd)		1.11	
Cable Loss (dB)	0.0	Adjusted Power (dBm)	2.46	Antenna minus cable (dBi)		3.28	
				Antenna Gain (Numeric)		2.13	
	Calculated ERP (mw) 2.275			EIRP = Po(dBM) + Gain (dB)			
	Calculated EIRP (mw) 3.750			Radiated (EIRP) dBm		5.740	
				ERP = EIRP - 2.17 dB			
				Radiated (ERP) dBm		3.570	

Power density (S) mW/cm^2 = EIRP / (4 p r^2)

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm^2	Frequency (MHz)	Occupational Limit (mW/cm^2)	Public Limit (mW/cm^2)
50	W/m^2	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm^2	1,500-10,000	5	1
10	W/m^2			

	Occupational Limit	IC radio frequency radiation exposure limits per RSS-102		
$0.6455f^{0.5}$	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
39.4	W/m^2	100-6,000	$0.6455f^{0.5}$	
	General Public Limit	6,000-15,000	50	
$0.02619f^{0.6834}$	W/m^2	48-300		1.291
5.4	W/m^2	300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

			General Public	Occupational	
f = Transmit Frequecny (MHz)		f (MHz) =	2402	2402	MHz
P_T = Power Input to Antenna (mW)		P_T (mW) =	1.7620	1.7620	mW
Duty cycle (percentage of operation)		% =	100	100	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)		P_A (mW) =	1.76	1.76	mW
G_N = Numeric Gain of the Antenna		GN (numeric) =	2.13	2.13	numeric
S20 = Power Density of device at 20cm (mW/cm2)	$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S20 (mW/cm2) =	0.001	0.001	mW/cm2
S_{20} = Power Density of device at 20cm (W/m^2)	$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (W/m^2) =	0.01	0.01	W/m^2
S_L = Power Density Limit (W/m^2) FCC		S_L (W/m^2)=	10.000	50.000	W/m^2
S_L = Power Density Limit (W/m^2) Canada		S_L (W/m^2)=	5.351	39.376	W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm) FCC	$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	0.5	0.2	cm
R_C = Minimum distance to the Radiating Element for Compliance (cm) Canada	$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	0.7	0.3	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) FCC	$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	10.00	50.00	W/m^2
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) Canada	$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.35	39.38	W/m^2
R_{20} = 20cm		R20=	20	20	cm

For Complaince with Canada General Population Limits, User Manual must indicate a minimum seperation distance of 0.7 cm

Or in Meters for Complaince with Canada General Population Limits, a minimum seperation distance of 0.01 Meters

Summary: Standalone MPE Calculations and Summary					**Public Limit**		**Public**	
Band 1, (MHz)	**Tx Duty Cycle (%)**	**Tx Frequeny (MHz)**	**Power Total (mW)**	**Antenna Gain (numeric)**	**S_L (W/m^2)**	**S_{20} (W/m^2)**	**R_C (cm)**	**S_C (W/m^2)**
ANT 2400-2483.5	100	2402	1.76	2.13	5.351	0.01	0.7	5.35
Band 2, (MHz)	**Tx Duty Cycle (%)**	**Tx Frequeny (MHz)**	**Power Total (mW)**	**Antenna Gain (numeric)**	**SL (W/m2)**	**S20 (W/m2)**	**RC (cm)**	**SC (W/m2)**
BT 2400-2483.5	100	2402	7.89	1.24	5.351	0.02	1.2	5.35
Band 3, (MHz)	**Tx Duty Cycle (%)**	**Tx Frequeny (MHz)**	**Power Total (mW)**	**Antenna Gain (numeric)**	**SL (W/m2)**	**S20 (W/m2)**	**RC (cm)**	**SC (W/m2)**
WiFi 2400-2483.5	100	2412	17.82	2.61	5.366	0.09	2.6	5.37

Simlutaneous MPE Calculation				
	Transmitter 1	Transmitter 2	Transmitter 3	
Tx Frequeny (MHz)	2402	2402	2412	
S_{20} (W/m^2)	0.01	0.02	0.09	
S_L (W/m^2)	5.351	5.37	5.366	
Power Ratio (S_L / S_{20})	0.001	0.004	0.017	
Sum of Power Ratios at 20cm				0.022
Requirement = Σ of MPE Ratio ≤ 1				Therefore the design is Exempt

	HVIN: A04438			Test Number: 240304			
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.						
	dBi = dB gain compared to an isotropic radiator.						
	S = power density in mW/cm^2						
		Transmitter Output power (mW)	7.9				
		Transmitter Output power (W)	0.008				
Output Power for 100% duty Cycle operation (Watts)	100		0.008		Antenna Gain (dBi)	0.94	
	Output Power for 100% duty Cycle operation (Watts)		0.008		Antenna Gain (Numeric)	1.24	
Tx Frequency (MHz)	2402	Calculation power (Watts)	0.008	dBd + 2.17 = dBi	dBi to dBd	2.17	
					Antenna Gain (dBd)	-1.23	
Cable Loss (dB)	0.0	Adjusted Power (dBm)	8.97		Antenna minus cable (dBi)	0.94	
					Antenna Gain (Numeric)	1.24	
	Calculated ERP (mw) 5.943				EIRP = Po(dBm) + Gain (dB)		
	Calculated EIRP (mw) 9.795				Radiated (EIRP) dBm	9.910	
					ERP = EIRP - 2.17 dB		
					Radiated (ERP) dBm	7.740	

Power density (S) mW/cm² = EIRP / (4 p r^2)

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm²	Frequency (MHz)	Occupational Limit (mW/cm²)	Public Limit (mW/cm²)
50.0	W/m²	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm²	1,500-10,000	5	1
10.0	W/m²			

	Occupational Limit	IC radio frequency radiation exposure limits per RSS-102		
$0.6455f^{0.5}$	W/m²	Frequency (MHz)	Occupational Limit (W/m²)	Public Limit (W/m²)
31.6	W/m²	**General Public Limit**	100-6,000	$0.6455f^{0.5}$
$0.02619f^{0.6834}$	W/m²	6,000-15,000	50	
5.35	W/m²	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

			General Public	Occupational	
f = Transmit Frequency (MHz)		f (MHz) =	2402	2402	MHz
P_T = Power Input to Antenna (mW)		P_T (mW) =	7.8886	7.8886	mW
Duty cycle (percentage of operation)		% =	100	100	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)		P_A (mW) =	7.89	7.89	mW
G_N = Numeric Gain of the Antenna		GN (numeric) =	1.24	1.24	numeric
S20 = Power Density of device at 20cm (mW/cm2)	$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S20 (mW/cm2) =	0.002	0.002	mW/cm2
S_{20} = Power Density of device at 20cm (W/m²)	$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (W/m²) =	0.02	0.02	W/m²
S_L = Power Density Limit (W/m²) FCC		S_L (W/m²)=	10.000	50.000	W/m²
S_L = Power Density Limit (W/m²) Canada		S_L (W/m²)=	5.351	31.636	W/m²
R_C = Minimum distance to the Radiating Element for Compliance (cm) FCC	$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	0.9	0.4	cm
R_C = Minimum distance to the Radiating Element for Compliance (cm) Canada	$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	1.2	0.5	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m²) FCC	$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m²) =	10.00	50.00	W/m²
S_C = Power Density of the device at the Compliance Distance R_C (W/m²) Canada	$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m²) =	5.35	31.64	W/m²
R_{20} = 20cm		R20=	20	20	cm

For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of 1.2 cm

Or in Meters for Compliance with Canada General Population Limits, a minimum separation distance of 0.01 Meters

Summary: Standalone MPE Calculations and Summary					Public Limit		Public	
	Tx Duty Cycle (%)	Tx Frequency (MHz)	Power Total (mW)	Antenna Gain (numeric)	S_L (W/m²)	S_{20} (W/m²)	R_C (cm)	S_C (W/m²)
FCC	100	2402	8	1.24	10.000	0.02	0.9	10.00
Canada	100	2402	8	1.24	5.351	0.02	1.2	5.35

		Limit	Overall Minimum (cm)	Overall Minimum (inches)
	Public	Occupational		
FCC (cm)	0.9	0.4		
FCC (inches)	1.0	1.0		
Canada (cm)	1.2	0.5		
Canada (inches)	1.0	1.0		

Overall Minimum Limit Public	Overall Minumu Limit Occuppational
2 cm	1 cm
1 inches	1 inches

	HVIN: A04438			Test Number: 230405D			
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.						
	dBi = dB gain compared to an isotropic radiator.						
	S = power density in mW/cm^2						
		Transmitter Output power (mW)	17.8				
		Transmitter Output power (W)	0.018				
	Output Power for % duty Cycle operation (Watts)	100	0.018		Antenna Gain (dBi)	4.16	
	Output Power for 100% duty Cycle operation (Watts)		0.018		Antenna Gain (Numeric)	2.61	
Tx Frequency (MHz)	2412	Calculation power (Watts)	0.018	dBd + 2.17 = dBi	dBi to dBd	2.17	
					Antenna Gain (dBd)	1.99	
Cable Loss (dB)	0.0	Adjusted Power (dBm)	12.51		Antenna minus cable (dBi)	4.16	
					Antenna Gain (Numeric)	2.61	
	Calculated ERP (mw)	28.184			EIRP = Po(dBm) + Gain (dB)		
	Calculated EIRP (mw)	46.452			Radiated (EIRP) dBm	16.670	
					ERP = EIRP - 2.17 dB		
					Radiated (ERP) dBm	14.500	

Power density (S) mW/cm² = EIRP / (4 p r^2)

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm^2	Frequency (MHz)	Occupational Limit (mW/cm^2)	Public Limit (mW/cm^2)
50.0	W/m^2	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm^2	1,500-10,000	5	1
10.0	W/m^2			

	Occupational Limit			
$0.6455f^{0.5}$	W/m^2	IC radio frequency radiation exposure limits per RSS-102		
31.7	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
	General Public Limit	100-6,000	$0.6455f^{0.5}$	
$0.02619f^{0.6834}$	W/m^2	6,000-15,000	50	
5.37	W/m^2	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

					General Public	Occupational
f = Transmit Frequency (MHz)				f (MHz) =	2412	2412 MHz
P_T = Power Input to Antenna (mW)				P_T (mW) =	17.8238	17.8238 mW
Duty cycle (percentage of operation)				% =	100	100 %
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)				P_A (mW) =	17.82	17.82 mW
G_N = Numeric Gain of the Antenna				GN (numeric) =	2.61	2.61 numeric
S20 = Power Density of device at 20cm (mW/cm2)			$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S20 (mW/cm2) =	0.009	0.009 mW/cm2
S_{20} = Power Density of device at 20cm (W/m^2)			$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (W/m^2) =	0.09	0.09 W/m^2
S_L = Power Density Limit (W/m^2) FCC				S_L (W/m^2)=	10.000	50.000 W/m^2
S_L = Power Density Limit (W/m^2) Canada				S_L (W/m^2)=	5.366	31.702 W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm) FCC			$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	1.9	0.9 cm
R_C = Minimum distance to the Radiating Element for Compliance (cm) Canada			$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	2.6	1.1 cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) FCC			$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	10.00	50.00 W/m^2
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) Canada			$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.37	31.70 W/m^2
R_{20} = 20cm				R20=	20	20 cm

For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of 2.6 cm

Or in Meters for Compliance with Canada General Population Limits, a minimum separation distance of 0.03 Meters

Summary: Standalone MPE Calculations and Summary					Public Limit		Public	
	Tx Duty Cycle (%)	Tx Frequency (MHz)	Power Total (mW)	Antenna Gain (numeric)	S_L (W/m^2)	S_{20} (W/m^2)	R_C (cm)	S_C (W/m^2)
FCC	100	2412	18	2.61	10.000	0.09	1.9	10.00
Canada	100	2412	18	2.61	5.366	0.09	2.6	5.37

		Limit	Overall Minimum (cm)	Overall Minimum (inches)
	Public	Occupational		
FCC (cm)	1.9	0.9		
FCC (inches)	1.0	1.0		
Canada (cm)	2.6	1.1		
Canada (inches)	2.0	1.0		

Overall Minimum Limit Public	Overall Minumu Limit Occuppational
3 cm	2 cm
2 inches	1 inches