

A04684 RF Exposure Exhibit

BT BLE (and simultaneous MPE Calculation)

Model: B04684		Test Number: 230821B	
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 (dBm)	3.11	
	Transmitter Output power (mW)	2.05	
Output Power for % duty Cycle operation (Watts)	100	0.0020	Antenna Gain (dBi) 2.2
	Output Power for 100% duty Cycle operation (Watts)	0.002	Antenna Gain (Numeric) 1.66
Tx Frequency (MHz)	2402	Calculation power (Watts) 0.002	dBd + 2.17 = dBi dBi to dBd 2.17
		Calculation power (EIRP mW) 3.40	Antenna Gain (dBd) 0.03
Cable Loss (dB)	0.0	Adjusted Power (dBm) 3.11	Antenna minus cable (dBi) 2.20
	Calculated ERP (mw) 2.061		EIRP = Po(dBm) + Gain (dB)
	Calculated EIRP (mw) 3.396		Radiated (EIRP) dBm 5.310
	Power density (S) mW/cm ² = $\frac{\text{EIRP}}{4\pi r^2}$		ERP = EIRP - 2.17 dB
	r (cm) EIRP (mW)		Radiated (ERP) dBm 3.140
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 ^{0.6934}	W/m ²	48-300	1.291
5.4	W/m ²	300-6,000	0.02619f ^{0.6934}
		6,000-15,000	10
f = Transmit Frequency (MHz)		f (MHz) = 2402 MHz	
P _T = Power Input to Antenna (mW)		P _T (mW) = 2.05 mW	
Duty cycle (percentage of operation)		% = 100 %	
P _A = Adjusted Power due to Duty cycle or Cable Loss (mW)		P _A (mW) = 2.05 mW	
G _N = Numeric Gain of the Antenna		G _N (numeric) = 1.66 numeric	
S ₂₀ = Power Density of device at 20cm (mW/m ²)		S ₂₀ (mW/m ²) = 0.0007 mW/cm ²	
S ₂₀ = Power Density of device at 20cm (W/m ²)		S ₂₀ (W/m ²) = 0.0068 W/m ²	
S ₁ = Power Density Limit (W/m ²)		S ₁ (W/m ²) = 5.351 W/m ²	
R _C = Minimum distance to the Radiating Element for Compliance (cm)		R _C (cm) = 0.7 cm	
S _C = Power Density of the device at the Compliance Distance R _C (W/m ²)		S _C (W/m ²) = 5.35 W/m ²	
R ₂₀ = 20cm		R ₂₀ = 20 cm	
For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of		0.7 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			
Band (MHz)	Tx Duty Cycle (%)	Tx Frequency (MHz)	Power Total (mW) Antenna Gain (numeric) S ₁ (W/m ²) S ₂₀ (W/m ²) R _C (cm) S _C (W/m ²)
2402-2480 BLE	100	2402	2.05 1.66 5.351 0.0068 0.7 5.35
2402-2480 WiFi	100	2412	37.84 1.66 5.366 0.1249 3.1 5.37
5150-5250	100	5240	26.61 2.17 9.119 0.0902 2.2 9.12
5725-5850	100	5745	47.21 2.17 9.710 0.2038 2.9 9.71
Simultaneous MPE Calculation			
	BLE	5.7 G	
Tx Frequency (MHz)	2402	5745	
S ₂₀ (W/m ²)	0.0068	0.2038	
S ₁ (W/m ²)	5.351	9.710	
Power Ratio (S ₁ / S ₂₀)	0.001	0.021	
Sum of Power Ratios at 20cm (Tx1 + Tx2)		0.022	
Requirement = Σ of MPE Ratio ≤ 1			
Note: The only possible simultaneous transmit combinations in this design are: BLE and 5.1G WiFi BLE and 5.7G WiFi * * Worst case BLE and 5.7G WiFi combination still below the limit of 1 for sum of MPE Ratios			

2.4GHz

		Model: B04684		Test Number: 230821B				
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 (dBm)		15.78				
		Transmitter Output power (mW)		37.84				
Output Power for % duty Cycle operation (Watts)		100		0.0378		Antenna Gain (dBi)	2.2	
Output Power for 100% duty Cycle operation (Watts)				0.038		Antenna Gain (Numeric)	1.66	
Tx Frequency (MHz)	2412	Calculation power (Watts)		0.038		dBd + 2.17 = dBi	dBi to dBd	2.17
		Calculation power (EIRP mW)		62.81		Antenna Gain (dBd)		0.03
Cable Loss (dB)	0.0	Adjusted Power (dBm)		15.78		Antenna minus cable (dBi)		2.20
		Calculated ERP (mw)		38.107		EIRP = Po(dBm) + Gain (dB)		
		Calculated EIRP (mw)		62.806		Radiated (EIRP) dBm		17.980
						ERP = EIRP - 2.17 dB		
						Radiated (ERP) dBm		15.810

5.1 GHz

	Model: B04684	Test Number: 230821B					
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 (dBm)	14.25					
	Transmitter Output power (mW)	26.61					
Output Power for % duty Cycle operation (Watts)	100	0.0266		Antenna Gain (dBi)	2.8		
Output Power for 100% duty Cycle operation (Watts)		0.03		Antenna Gain (Numeric)	1.91		
Tx Frequency (MHz)	5240	Calculation power (Watts)	0.03	dBd + 2.17 = dBi	dBi to dBd	2.17	
		Calculation power (EIRP mW)	50.70		Antenna Gain (dBd)	0.63	
Cable Loss (dB)	0.0	Adjusted Power (dBm)	14.25		Antenna minus cable (dBi)	2.80	
					Antenna Gain (Numeric)	1.91	
	Calculated ERP (mw)	30.761			EIRP = Po(dBm) + Gain (dB)	1.55	
	Calculated EIRP (mw)	50.699			Radiated (EIRP) dBm	17.050	
	$\text{Power density (S) mW/cm}^2 = \frac{\text{EIRP}}{4\pi r^2}$ $r \text{ (cm)} = \sqrt{\frac{\text{EIRP (mW)}}{4\pi S}}$				ERP = EIRP - 2.17 dB		
					Radiated (ERP) dBm	14.880	
	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	0.3	0.1			
1	mW/cm ²	1,500-10,000	0.5	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)			
58.2	W/m ²	100-6,000	0.6455f ^{0.5}				
	General Public Limit	6,000-15,000	50				
0.02619f ^{-0.6934}	W/m ²	48-300		1.291			
9.1	W/m ²	300-6,000		0.02619f ^{-0.6934}			
		6,000-15,000	50	10			
f = Transmit Frequency (MHz)				f (MHz) =	5240 MHz		
P _T = Power Input to Antenna (mW)				P _T (mW) =	26.6073 mW		
Duty cycle (percentage of operation)				% =	100 %		
P _A = Adjusted Power due to Duty cycle or Cable Loss (mW)				P _A (mW) =	26.61 mW		
G _N = Numeric Gain of the Antenna				G _N (numeric) =	2.17 numeric		
S ₂₀ = Power Density of device at 20cm (mW/m ²)		S ₂₀ =(P _A G _N)/(4πR ₂₀) ²		S ₂₀ (mW/m ²) =	0.0115 mW/cm ²		
S ₂₀ = Power Density of device at 20cm (W/m ²)		S ₂₀ =(P _A G _N)/(4πR ₂₀) ²		S ₂₀ (W/m ²) =	0.1149 W/m ²		
S _L = Power Density Limit (W/m ²)				S _L (W/m ²) =	9.119 W/m ²		
R _C = Minimum distance to the Radiating Element for Compliance (cm)		R _C =√(P _A G _N /4πS _L)		R _C (cm) =	2.2 cm		
S _C = Power Density of the device at the Compliance Distance R _C (W/m ²)		S _C =(P _A G _N)/(4πR _C) ²		S _C (W/m ²) =	9.119 W/m ²		
R ₂₀ = 20cm				R ₂₀ =	20 cm		
For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of					2.2 cm		
Or in Meters for Compliance with Canada General Population Limits, a minimum separation distance of					0.02 Meters		
Summary: Standalone MPE Calculations and Summary							
Band (MHz)	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)
5150-5250	100	5240	26.61	2.17	9.119	0.1149	2.2
							9.12

Rogers Labs, a division of The Compatibility Center LLC

7915 Nieman Road FCC ID: IPH-04684 IC: 1792A-04684

Lenexa, KS 66214 Test: 230821A SN's: 3444728073, 3448985366, 3459196235, 3459196260

Phone/Fax: (913) 660-0666 Test to: 47CFR 15C, RSS-Gen RSS-247, RSS-102 Date: June 18, 2024

Revision 1

File: A04684 RF Exposure

Garmin International, Inc.

PMN: A04684

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5.7 GHz

Model: B04684		Test Number: 230821B	
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 (dBm)	16.74	
	Transmitter Output power (mW)	47.21	
Output Power for % duty Cycle operation (Watts)	100	0.0472	Antenna Gain (dBi) 2.8
Output Power for 100% duty Cycle operation (Watts)		0.05	Antenna Gain (Numeric) 1.91
Tx Frequency (MHz)	5745	Calculation power (Watts) 0.05	dBd + 2.17 = dBi dBi to dBd 2.17
		Calculation power (EIRP mW) 89.95	Antenna Gain (dBd) 0.63
Cable Loss (dB)	0.0	Adjusted Power (dBm) 16.74	Antenna minus cable (dBi) 2.80
			Antenna Gain (Numeric) 1.91
	Calculated ERP (mw) 54.576		EIRP = Po(dBm) + Gain (dB) 1.55
	Calculated EIRP (mw) 89.950		Radiated (EIRP) dBm 19.540
			ERP = EIRP - 2.17 dB
			Radiated (ERP) dBm 17.370
	Power density (S) mW/cm² = ----- 4 π r² 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	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	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)
60.9	W/m²	100-6,000	0.6455f ^{0.5}
	General Public Limit	6,000-15,000	50
0.02619f ^{0.6834}	W/m²	48-300	1.291
9.7	W/m²	300-6,000	0.02619f ^{0.6834}
		6,000-15,000	10
f = Transmit Frequency (MHz)		f (MHz) = 5745 MHz	
P _T = Power Input to Antenna (mW)		P _T (mW) = 47.2063 mW	
Duty cycle (percentage of operation)		% = 100 %	
P _A = Adjusted Power due to Duty cycle or Cable Loss (mW)		P _A (mW) = 47.21 mW	
G _N = Numeric Gain of the Antenna		G _N (numeric) = 2.17 numeric	
S ₂₀ = Power Density of device at 20cm (mW/m²)		S ₂₀ = (P _A G _N)/(4πR ₂₀)² S ₂₀ (mW/m²) = 0.0204 mW/cm²	
S ₂₀ = Power Density of device at 20cm (W/m²)		S ₂₀ (W/m²) = 0.2038 W/m²	
S _L = Power Density Limit (W/m²)		S _L (W/m²) = 9.710 W/m²	
R _C = Minimum distance to the Radiating Element for Compliance (cm)		R _C = √(P _A G _N /4πS _L) R _C (cm) = 2.9 cm	
S _C = Power Density of the device at the Compliance Distance R _C (W/m²)		S _C = (P _A G _N)/(4πR _C)² S _C (W/m²) = 9.710 W/m²	
R ₂₀ = 20cm		R ₂₀ = 20 cm	
For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of			2.9 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			
Band (MHz)	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)
5725-5850	100	5745	47.21 2.17 9.710 0.2038 2.9 9.71

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