FBRFD23 RF Exemption

WiFi Module

	Model:	FBRFD23	Test Number:	230819		
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)		459.00			
	Transmitter maximum Output power operating at 100% (Watts)		0.4590			
	Percent Duty Cycle operation (%)		0.06	(3ms out of 5000ms)	Antenna Gain (dBi)	3.4
	Output Power for actual duty Cycle operation (Watts)		0.0003		Antenna Gain (Numeric)	2.19
Tx Frequency (MHz)	2412	Calcualtion power (Watts)	0.0003	dBd + 2.17 = dBi	dBi to dBd	2.2
					Antenna Gain (dBd)	1.23
Cable Loss (dB)	0.0	Adjusted Power (dBm)	-5.60		Antenna minus cable (dBi)	3.40
	Calculated ERP (mw)	0.366				
	Calculated EIRP (mw)	0.603			EIRP = Po(dBM) + Gain (dB)	
					Radiated (EIRP) dBm	-2.200
	Power density (S) mW/cm^2 = EIRP / (4 p r^2)				ERP = EIRP - 2.17 dB	
					Radiated (ERP) dBm	-4.370
	r (cm) EIRP (mW)					

		FCC radio frequency radiation exposure limits per 1.1310		
	Occupational Limit			
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			

		IC radio frequency radiation exposure limits per RSS-102		
	Occupational Limit			
$0.6455f^{0.5}$	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
39.5	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

f = Transmit Frequecny (MHz)			f (MHz) =	2412	MHz
P_I = Power Input to Antenna (mW)			P_T (mW) =	459.0000	mW
Duty cycle (percentage of operation)			% =	0.06	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)			P_A (mW) =	0.28	mW
G_N = Numeric Gain of the Antenna			GN (numeric) =	2.19	numeric
S_{20} = Power Density of device at 20cm (mW/m^2)		$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (mW/m^2) =	0.00	mW/m^2
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) =	0.00	W/m^2
S_L = Power Density Limit (W/m^2)			S_L (W/m^2)=	5.366	W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm)		$R_C=\sqrt{(P_AG_N/4\pi s_L)}$	R_C (cm) =	0.3	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2)		$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.37	W/m^2
R_{20} = 20cm			R20=	20	cm
For Complaince with Canada General Population Limits, User Manual must indicate a minimum seperation distance of				0.3	cm

900 MHz & Summary

	HVIN FBRFD23			Test Number:	230819	
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)		23.9			
	Peak Transmitter Output power (W)		0.024			
tput Power for 100% duty Cycle operation (Watts)		100	0.0239	Antenna Gain (dBi)		1
	Output Power for actual duty Cycle operation (Watts)		0.0239	Antenna Gain (Numeric)		1.26
Tx Frequency (MHz)	912	Calculation power (Watts)	0.0239	dBd + 2.17 = dBi	dBi to dBd	2.2
				Antenna Gain (dBd)		-1.17
Cable Loss (dB)	0.0	Adjusted Power (dBm)	13.78	Antenna minus cable (dBi)		1.00
				Antenna Gain (Numeric)		1.26
	Calculated ERP (mw)	18.239		EIRP = Po(dBM) + Gain (dB)		
	Calculated EIRP (mw)	30.061		Radiated (EIRP) dBm		14.780
				ERP = EIRP - 2.17 dB		
				Radiated (ERP) dBm		12.610

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

r (cm) EIRP (mW)

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

		IC radio frequency radiation exposure limits per RSS-102		
	Occupational Limit			
$0.6455f^{0.5}$	W/m^2			
24.3	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	
2.8	W/m^2	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

f = Transmit Frequecny (MHz)		f (MHz) =	912	MHz
P_T = Power Input to Antenna (mW)		P_T (mW) =	23.8781	mW
Duty cycle (percentage of operation)		% =	100	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)		P_A (mW) =	23.88	mW
G_N = Numeric Gain of the Antenna		GN (numeric) =	1.26	numeric
S_{20} = Power Density of device at 20cm (mW/m^2)	$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (mW/m^2) =	0.01	mW/m^2
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) =	0.06	W/m^2
S_L = Power Density Limit (W/m^2)		S_L (W/m^2)=	2.761	W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm)	$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	2.9	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2)	$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	2.76	W/m^2
R_{20} = 20cm		R20=	20	cm

For Complaince with Canada General Population Limits, User Manual must indicate a minimum seperation distance of	2.9	cm
Or in Meters for Complaince with Canada General Population Limits, a minimum seperation distance of	0.03	Meters

Summary: Standalone MPE Calculations and Summary								
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)
912	100	912	23.88	1.26	2.761	0.06	2.9	2.76
Band 2, (MHz)	Tx Duty Cycle (%)	Tx Frequeny (MHz)	Power Total (mW)	Antenna Gain (dBi)	SL (W/m2)	S20 (W/m2)	RC (cm)	SC (W/m2)
2400-2483.5	0.9	2412	459.00	2.19	5.366	0.00	0.3	5.37

Simlutaneous MPE Calculation					
	Transmitter 1	Transmitter 2	Transmitter 3	Transmitter 4	
Tx Frequeny (MHz)	912	2412			
S_{20} (W/m^2)	0.06	0.00			
S_L (W/m^2)	2.761	5.366			
Power Ratio (S_L / S_{20})	0.022	0.000			
Sum of Power Ratios at 20cm				0.022	
Requirement = Σ of MPE Ratio ≤ 1					Therefore the design is Exempt