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RF EXPOSURE CALCULATIONS

Requirement:

According to USA CFR 15 §1.1307 (b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy level in excess of the Commission’s guidelines. For Canada, RSS-102 sets out the requirements and measurement techniques used to evaluate radio frequency (RF) exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body.

Maximum Permissible Exposure Calculation:

The General Population / Uncontrolled Exposure limit for mobile devices is **1 mW/cm² at 20 cm** separation distance for the US. For Canada, the Exposure Evaluation EIRP Limit in the 2.4 GHz band is computed to be $1.31 \times 10^{(-2)} \times 2402^{0.6834} = \mathbf{2.68W}$ and is fixed at **1W** for emitters below 20 MHz. Cumulative power density at the 20 cm separation distance and total EIRP rating are computed below and compared to the respective limits.

Freq. (MHz)	E30m Pk (dBuV/m)	E20cm Pk* (dBuV/m)	S20cm** (mW/cm ²)	TOTAL S20cm (mW/cm ²)	TOTAL EIRP**** (mW)
13.56	23.0	91.4	0.000004	0.024770	3.084100
Freq. (MHz)	BLE EIRP (dBm)	BLE EIRP (mW)	S20cm*** (mW/cm ²)		
2400-2483.5	4.89	3.08	0.024767		
FCC 20cm Power Density Limit (mW)				20	
IC EIRP Evaluation Limit (mW)					
13.56 MHz					1000
2400-2483.5 MHz					2680
Complies				Yes	Yes

* E20cm PK computed from E30m Pk using 20 dB/decade Far Field, 40 dB/decade Near-Field:
 $CF = 20 \times \log_{10}(30/3.5) + 40 \times \log_{10}(3.5/0.2) = 68.4 \text{ dB}$.

** Power Density (S) = $E^2/377$.

$$S(\text{mW/cm}^2) = S(\text{W/m}^2) / 10 = (10^{(E(\text{dBuV/m})/20 - 1000)})^2 / 377$$

*** Power Density (S) = $EIRP / (4 \times \text{PI} \times 20\text{cm}^2)$

**** EIRP (mW) = $S(\text{mW/cm}^2) \times 4 \times \text{PI} \times 20\text{cm}^2$

Summary:

The EUT with both transmitters is compliant with both the FCC power density limit and the IC Exposure Evaluation EIRP limit.