RF Exposure Compliance Requirement

1. Standard requirement

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 level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2m normally can be maintained between the user and the device. So, the EUT belongs to limit (b).

(a) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S)(mW/cm^2)	Averaging Times $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100000			5	6

(b) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S)(mW/cm^2)	Averaging Times $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/500	30
1500-100000			1.0	30

Note: f=frequency in MHz; *Plane-wave equivalent power density

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2. MPE Calculation Method

S (mW/cm ^{2})=P*G/4Pi*R ^{2}

S= Power Density (mW/cm ^{2})

P=Peak RF conducted output Power (W)

G=EUT Antenna numeric gain (numeric)

R= Separation distance between radiator and human body (cm);

R= $\sqrt{(P*G)/4Pi*S}$

From the maximum EUT RF output power, as well as the gain of the used antenna, according to the RF power density limit above, the minimum distance between the antenna and human body will be calculated.

3. Calculated Result

3.1 For downlink: 617MHz to 652MHz

The max antenna gain is 12.5dBi for single antenna declared by manufacture,

The Directional gain for the 2x2 MIMO system is:
Directional gain= G+10lg2=12.5+3=15.5dBi
The max total power for two antenna port MIMO is P(all):

P(all)=P1+P2

This device takes table b Limits for General Population / Uncontrolled Exposure as recommend exposure limit.

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For 5M Modulation:

Frequency (MHz)	Maximum Antenna Gain (dBi)	Maximum Antenna Gain (Numeric)	Peak Output Power (dBm)		Peak Output Power (mW)	Limit of Power Density (S) (mW/cm^2)	Minimum Distance to human body (cm)
619.5	15.5	35.5	Port1	46.28dBm (42462mW)	83482	1.239	436.4
			Port 2	46.13dBm (41020mW)			
634.5	15.5	35.5	Port1	46.46dBm (44.259W)	87810	1.269	442.2
			Port 2	46.39dBm (43.551W)			
649.5	15.5	35.5	Port1	46.27dBm (42.364W)	84437	1.299	428.6
			Port 2	46.24 dBm (42.073W)			

For 10M Modulation

Frequency (MHz)	Maximum Antenna Gain (dBi)	Maximum Antenna Gain (Numeric)	Peak Output Power (dBm)		Total Peak Output Power (mW)	Limit of Power Density (S) (mW/cm^2)	Minimum Distance to human body (cm)
622	15.5	35.5	Port1	46.22dBm (41.879W)	82994	1.244	434.2
			Port 2	46.14 dBm (41.115W)			
634.5	15.5	35.5	Port1	46.06dBm (40.365W)	81385	1.269	425.8
			Port 2	46.13dBm (41.020W)			
647	15.5	35.5	Port1	46.16dBm (41.305W)	83572	1.294	427.3
			Port 2	46.26 dBm			

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				(42.267W)			

For 15M Modulation

Frequency (MHz)	Maximum Antenna Gain (dBi)	Maximum Antenna Gain (Numeric)	Peak Output Power (dBm)		Total Peak Output Power (mW)	Limit of Power Density (S) (mW/cm²)	Minimum Distance to human body (cm)
624.5	15.5	35.5	Port1	46.18dBm (41.495W)	83473	1.244	434.6
			Port 2	46.23 dBm (41.978W)			
634.5	15.5	35.5	Port1	46.14dBm (41.115W)	83871	1.269	432.2
			Port 2	46.31 dBm (42.756W)			
644.5	15.5	35.5	49.0	46.32dBm (42.855W)	86507	1.294	435.5
			Port 2	46.40 dBm (43.652W)			

For 20M Modulation

Frequency (MHz)	Maximum Antenna Gain (dBi)	Maximum Antenna Gain (Numeric)	Peak Output Power (dBm)		Total Peak Output Power (mW)	Limit of Power Density (S) (mW/cm²)	Minimum Distance to human body (cm)
627	15.5	35.5	Port1	46.19dBm (41.495W)	82233	1.244	430.5
			Port 2	46.10dBm (40.738W)			
634.5	15.5	35.5	Port1	46.06dBm (40.365W)	81385	1.269	425.8
			Port 2	46.13dBm (41.020W)			

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642	15.5	35.5	Port1	46.08dBm (40.551W)	82624	1.294	426.5
			Port 2	46.24dBm (42.073W)			

Conclusion:

So the recommend use distance away from EUT external antenna is larger than 442.2 cm.

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