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MPE Calculations

Systems operating under the provision of 47 CFR 1.1307(b)(1) shall be operated in a manor that ensures that the public is not exposed to radio frequency energy levels in excess of the FCC guidelines.

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b). The MPE calculation for this exposure is shown below.

Using the Antennas with highest output power: Ethertronics Shanghai Universe Communication Electron Co., Ltd Antennas

The peak radiated output power (EIRP) is calculated as follows:

Antenna	*Frequency (GHz)*	*Power input to the antenna (P) (dBm)*	*Power gain of the antenna (G) (dBi)*	*EIRP (P+G) (dBm)*	*EIRP $Log^{-1(dBm/10)}$ (mW)*
Shanghai Universe (Chain A)	2.4	23.89	3.24	27.13	516.42
Shanghai Universe (Chain A)	5	25.30	4.97	30.27	1064.14
Shanghai Universe (Chain B)	2.4	24.35	3.24	27.59	574.12
Shanghai Universe (Chain B)	5	22.40	4.97	27.37	545.76
Shanghai Universe (Chain C)	2.4	23.83	3.24	27.07	509.33
Shanghai Universe (Chain C)	5	22.58	4.97	27.55	568.85

EIRP = P + G
Where
P = Power input to the antenna (mW).
G = Power gain of the antenna (dBi)

The numeric gain (G) of the antenna with a gain specified in dB is determined by:

Antenna	*Frequency (GHz)*	*Antenna Gain (G) (dBi)*	*Numeric Antenna Gain $Log^{-1(dBm/10)}$ (dB)*
Shanghai Universe (Chain A)	2.4	3.24	2.11
Shanghai Universe (Chain A)	5	4.97	3.14
Shanghai Universe (Chain B)	2.4	3.24	2.11
Shanghai Universe (Chain B)	5	4.97	3.14
Shanghai Universe (Chain C)	2.4	3.24	2.11
Shanghai Universe (Chain C)	5	4.97	3.14

$G = Log^{-1}$ (dB antenna gain/10)

Power density at the specific separation:

Antenna	*Frequency (GHz)*	*Power input to the antenna (P) (mW)*	*Numeric Power Gain of the Antenna (G) (dB)*	*Maximum Power Spectral Density $S=PG/(4R^2\pi)$ (mW/cm^2)*	*Maximum Power Spectral Density Limit (mW/cm^2)*
Shanghai Universe (Chain A)	2.4	244.91	2.11	0.103	1.00
Shanghai Universe (Chain A)	5	338.84	3.14	0.212	1.00
Shanghai Universe (Chain B)	2.4	272.27	2.11	0.114	1.00
Shanghai Universe (Chain B)	5	173.78	3.14	0.109	1.00
Shanghai Universe (Chain C)	2.4	241.55	2.11	0.101	1.00
Shanghai Universe (Chain C)	5	181.13	3.14	0.113	1.00

$S = PG/(4R^2\pi)$
Where
S = Maximum power density (mW/cm^2)
P = Power input to the antenna (mW).
G = Numeric power gain of the antenna
R = Distance to the center of the radiation of the antenna (20cm = limit for MPE)

The maximum permissible exposure (MPE) for the general population is $1mW/cm^2$.

The power density at 20cm does not exceed the $1mW/cm^2$ limit. Therefore, the exposure condition is compliant with FCC rules.

Aggregate Maximum Power Spectral Density:

Antenna	*Frequency (GHz)*	*Maximum Power Spectral Density Chain A (dBi)*	*Maximum Power Spectral Density Chain B (dBi)*	*Maximum Power Spectral Density Chain C (dBi)*	*Maximum Power Spectral Density Aggregate Chain A, B, & C (dBi)*	*Maximum Power Spectral Density Limit (mW/cm^2)*
Shanghai Universe	2.4	0.103	0.114	0.101	0.106	1.00
Shanghai Universe	5	0.212	0.109	0.113	0.144	1.00