

MPE Calculation

Applicant:	Hangzhou Huacheng Software Technology Co., Ltd.
Address:	15th Floor, Building 3, No. 582, Liye Road, Changhe Street, Binjiang District, China
Product:	IMOU Smart Lock
FCC ID:	2BQWU-CUBO1-A1
Model No.:	Cubo1
Reference RF report #	709502606879-00A, 6128626044601, 6128626044101

447498 D04 Interim General RF Exposure Guidance v01

B.2 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance. The 1 mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A). The 1 mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

According to subpart 15.247(i) and subpart §1.1307(b)(1), 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 of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

30–300	27.5	0.073	0.2	30
300–1,500	/	/	f/1500	30
1,500–100,000	/	/	1.0	30

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

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

For BLE (Report number: 6128626044101) Stamped metal antenna

Maximum peak output power at antenna input terminal (dBm):	8.17
Maximum peak output power at antenna input terminal (mW):	6.56
Output power tune-up tolerance (dB)	± 1.0
Maximum tune-up conducted power(dBm):	9.17
Maximum tune-up conducted power(mW):	8.26
Prediction distance (cm):	20
Antenna Gain, typical (dBi):	-0.46
Maximum Antenna Gain (numeric):	0.8995
The worst case is power density at predication frequency at 20 cm (mW/cm ²):	0.00148
MPE limit for general population exposure at prediction frequency (mW/cm ²):	1.00

Note: The maximum tune-up conducted power (9.17 dBm) was declared by the manufacturer.

The max power density 0.00148 (mW/cm²) < 1 (mW/cm²)

Result: Compliant

For 2.4GHz Wi-Fi (Report number: 6128626044601) Stamped metal antenna

Maximum peak output power at antenna input terminal (dBm):	23.06
Maximum peak output power at antenna input terminal (mW):	202.30
Output power tune-up tolerance (dB)	± 1.0
Maximum tune-up conducted power(dBm):	24.06
Maximum tune-up conducted power(mW):	254.68
Prediction distance (cm):	20
Antenna Gain, typical (dBi):	-0.46
Maximum Antenna Gain (numeric):	0.8995
The worst case is power density at predication frequency at 20 cm (mW/cm ²):	0.04558
MPE limit for general population exposure at prediction frequency (mW/cm ²):	1.00

Note: The maximum tune-up conducted power (24.06 dBm) was declared by the manufacturer.

The max power density 0.04558 (mW/cm²) < 1 (mW/cm²)

Result: Compliant

For 13.56MHz NFC (Report number: 709502606879-00A)

Calculation method for 13.56MHz

Per the test report included herein, for 13.56MHz

According to C63.10-2020 Annex G

$$\text{EIRP} = p_t \times g_t = (E \times d)^2 / 30 \quad (\text{G.1})$$

where

p_t is the transmitter output power in watts

g_t is the numeric gain of the transmitting antenna (dimensionless)

E is the electric field strength in V/m

d is the measurement distance in meters (m)

$$\text{ERP} = \text{EIRP} / 1.64 = (E \times d)^2 / (30 \times 1.64) = (E \times d)^2 / 49.2 \quad (\text{G.2})$$

Transmitter output power for 13.56MHz Function

Field strength (E):	42.71 (dBuV/m) = 0.0001 (V/m)
Measurement Distance(dMeas):	3 (m)
ERP (mW):	0.000003mW

We used the maximum ERP/EIRP to perform RF exposure exemption evaluation.

	Evaluation method	Exempt Limit (mW)	Verdict
■	Blanket 1 mW Blanket Exemption	1mW	Yes
□	MPE-based Exemption (ERP)	7mW (ERP)	N/A
□	SAR-based Exemption (P _{th})	3060mW	N/A



Simultaneous transmission of MPE test exclusion for worst case configuration

2.4G Wi-Fi and BLE can't transmit simultaneously.

BLE: the ratio is 0.00148/1

2.4GHz Wi-Fi: the ratio is 0.04558/1

13.56MHz: the ratio is 0.000003 /1

The sum of the MPE ratios for all simultaneous transmitting antennas:

$0.04558 + 0.000003 = 0.045583$

As the sum of MPE ratios for all simultaneous transmitting antennas is ≤ 1.0 , simultaneous transmission MPE test exclusion will be applied.

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