

RF Exposure Estimation

1. Introduction

Applicant:	Qingdao RONCO Mechanic Electronic Technology Co., Ltd.
Address:	No.43 Yanqing Rd, Huanxiu Sub-District, Jimo District Qingdao, Shandong, China
Product:	Smart Controller
FCC ID:	2A3UM-RE500
IC:	30162-RE500
Model No.:	RE500
Reference RF report #	709502301261-00A
Contains Transmitter module	FCC ID: 2ANDL-CBU, approve date: 2020-12-31 IC: 23243-CBU, approve date: 2021-08-06

2. 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.

3. RF Exposure Evaluation

Per the test report included herein, for 433.92MHz

According to C63.10 Annex G

$EIRP = p_t \times g_t = (E \times d)^2 / 30$, so $p_t = (E \times d)^2 / 30 \times g_t$

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)

transmitter output power for 433.92MHz Function

Field strength (E):	79.22 (dBuV/m) = 0.0091 (V/m)
Measurement distance (D):	3 (m)
Antenna Gain, typical (dBi):	2.0
Numerical gain of the transmit antenna (g_t):	1.58
Transmitter output power (TP):	0.000016(W)
Transmitter output power (TP):	0.016(mW)

Assessment with certified Wi-Fi & BT Module:

According to the MPE report of the approved WiFi & Bluetooth modular (FCC ID: 2ANDL-CBU, approve date: 2020-12-31), the power density of 433.92, 2.4G Wi-Fi and Bluetooth are as below table:

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)
433.92	433.92	2.0	--	0.000016	0.016	0.00000318	1.000
2.4G WLAN	2412	2.21	18.00	20.21	0.105	0.021	1.000
Bluetooth	2402	2.21	7.00	9.21	0.008	0.002	1.000

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);

Simultaneous Transmission MPE

Simultaneous transmission configuration	Power density	MPE Limit
2.4GHz Wi-Fi +433.92MHz Function	$0.021+0.00000318=0.02100318$	1.0
Bluetooth +433.92Hz Function	$0.002+0.00000318=0.00200318$	1.0

Maximum Power Density at 20cm = $0.00000318+0.021=0.02100318$ mW/cm² still less than 1.0 mW/cm² limit, when 2.4GHz Wi-Fi and 433.92MHz simultaneous transmission.

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

Innovation, Science and Economic Development Canada (ISED) MPE / Health Hazard Requirement

Electric field strength levels, magnetic field strength levels and power density levels (10 MHz to 300 GHz)

According to RSS-102 § (5.3.2), the electric and magnetic field strength reference levels, power density reference levels, and associated reference period for devices employed by the general public (uncontrolled environment) and controlled-use devices (controlled environment) are specified in table 7 and table 8. Note that the power density limits specified in these tables apply to whole body exposure conditions.

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V_{RMS}/m)	Magnetic field (A_{RMS}/m)	Power density (W/m^2)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.

According to the MPE report of the approved WiFi & Bluetooth modular (IC: 23243-CBU, approve date: 2021-08-06), the power density of 433.92, 2.4G Wi-Fi and Bluetooth are as below table:

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (W)	Power Density at 20cm (W/cm ²)	Limit (W/cm ²)	Worst-Case MPE Ratios (%)	Sum of MPE Ratios (%)	Limit
433.92	433.92	2.0	--	0.000016	0.0000318	1.662	0.0019	4.203	100 %
2.4G WLAN	2412	2.21	18.00	20.21	0.209	5.366	3.8911		
Bluetooth	2402	2.21	7.00	9.21	0.017	5.351	0.3100		

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

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, 20.00 cm (0.20 m));

Simultaneous Transmission MPE

According to RSS-102 issue 6, the device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum MPE ration at the distance of 20cm is 4.203% Limit is 100%.

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

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-----End of Test Report-----