

Maximum Permissible Exposure (MPE) & Exposure evaluation

Report identification number: 1-0596/20-02-14 MPE (FCC_ISED)

Certification numbers and labeling requirements	
FCC ID	MFRCR100
ISED number	5782A-RCR100
HVIN (Hardware Version Identification Number)	01
PMN (Product Marketing Name)	RC-R-100
FVIN (Firmware Version Identification Number)	-/-
HMN (Host Marketing Name)	-/-

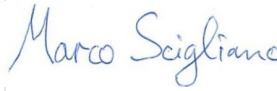
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EUT technologies:

Technologies:	Max. power [dBm]		Antenna gain max.: [dBi]	#
	conducted	EIRP		
Zigbee 2450 MHz	-0.85	5.62	6.47	A
WLAN 5GHz	18.4	21.1	2.7	B,C

Details and origins of the measurements shown in the table above:

#	Results from:	Additional information
A	1-0596/20-02-10 CTC advanced GmbH report	Antenna gain page 22, Max conducted page 25
B	FCC RF Test Report RF170513E01-1 (Bureau Veritas)	Max conducted page 7
C	proAnt - On Board WLAN Datasheet Rev 1.2 (2019-09-25)	Max Ant Gain 2.7 dBi, page 1

Prediction of MPE limit at given distance - FCC

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG / 4\pi R^2$$

where: S = Power density
 P = Power input to the antenna
 G = Antenna gain
 R = Distance to the center of radiation of the antenna
 PG = Output Power including antenna gain

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled "Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure"

Frequency Range (MHz)	Power Density (mW/cm ²)	Averaging Time (minutes)
300 -1500	f/1500	30
1500 - 100000	1.0	30

where f = Frequency (MHz)

Prediction: worst case

Technologies:		Zigbee	WLAN	
	Frequency (MHz)	2450	5000	
PG	Declared max power (EIRP)	5.62	21.1	dBm
R	Distance	20	20	cm
S	MPE limit for uncontrolled exposure	1	1	mW/cm ²
	Calculated Power density:	0.0007	0.0256	mW/cm ²
	Calculated percentage of Limit:	0.07%	2.56%	
Collocation:				
	Scenario 1: Zigbee + WLAN			
	Calculated percentage of Limit:	2.64%		

This prediction demonstrates the following:

The power density levels for FCC at a distance of 20 cm are below the maximum levels allowed by regulations.

Prediction of MPE limit at given distance - ISED

RSS-102, Issue 5, 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

Prediction: worst case

		Zigbee	WLAN	
	Frequency	2450	5000	MHz
R	Distance	20	20	cm
P	Max power input to the antenna	-0.85	18.4	dBm
G	Antenna gain	6.47	2.7	dBi
PG	Maximum EIRP	5.62	21.1	dBm
PG	Maximum EIRP	3.6	128.8	mW
	Exclusion Limit from above:	0.60	4.42	W
	Calculated percentage of Limit:	0.61%	2.92%	
Collocation:				
	Scenario 1: Zigbee + WLAN			
	Calculated percentage of Limit:	3.52%		

Conclusion: RF exposure evaluation is not required.