

4 FCC §15.247(f) §2.1091 & ISED RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC §2.1091 (Mobile Devices) RF exposure is calculated.

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 (minute)
Limits for General Population/Uncontrolled Exposure				
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
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: f = frequency in MHz

* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

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

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

4.3 Test Results

For transmission with RFID 900 MHz, WLAN and Bluetooth 2.4 GHz, and WLAN 5 GHz Radios

RFID 900 MHz Radio (FCC ID: I28-RFIDM6EMTT)

<u>Maximum peak output power at antenna input terminal (dBm):</u>	28.11
<u>Maximum peak output power at antenna input terminal (mW):</u>	647.14
<u>Prediction distance (cm):</u>	20
<u>Predication frequency (MHz):</u>	902.75
<u>Maximum Antenna Gain, typical (dBi):</u>	-36
<u>Maximum Antenna Gain (numeric):</u>	0.00025
<u>Power density of prediction frequency at prediction distance (mW/cm²):</u>	0.000032
<u>FCC limit (mW/cm²):</u>	0.602

WLAN 2.4 GHz Radio (FCC ID: I28MD-FXLAN11AC)

Maximum peak output power at antenna input terminal (dBm):	16.77
Maximum peak output power at antenna input terminal (mW):	47.53
Prediction distance (cm):	20
Predication frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	3
Maximum Antenna Gain (numeric):	2.00
Power density of prediction frequency at prediction distance (mW/cm ²):	0.019
FCC limit (mW/cm ²):	1.00

WLAN 5 GHz Radio (FCC ID: I28MD-FXLAN11AC)

Maximum peak output power at antenna input terminal (dBm):	14.76
Maximum peak output power at antenna input terminal (mW):	29.92
Prediction distance (cm):	20
Predication frequency (MHz):	5550
Maximum Antenna Gain, typical (dBi):	5
Maximum Antenna Gain (numeric):	3.16
Power density of prediction frequency at prediction distance (mW/cm ²):	0.019
FCC limit (mW/cm ²):	1.0

Classic Bluetooth Radio (FCC ID: I28-ZBRZQ3BT)

Maximum peak output power at antenna input terminal (dBm):	7.40
Maximum peak output power at antenna input terminal (mW):	5.50
Prediction distance (cm):	20
Predication frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	1.69
Maximum Antenna Gain (numeric):	1.48
Power density of prediction frequency at prediction distance (mW/cm ²):	0.0016
FCC limit (mW/cm ²):	1.0

For colocation of RFID and WLAN 2.4G:

MPE ratio sum: $(0.000032/0.602) + (0.019/1.0) = 0.019053 < 1.0$

For colocation of RFID and WLAN 5G:

MPE ratio sum: $(0.000032/0.602) + (0.019/1.0) = 0.019053 < 1.0$

For colocation of RFID and Classic Bluetooth:

MPE ratio sum: $(0.000032/0.602) + (0.0016/1.0) = 0.001653 < 1.0$

Note: Please refer to SIEMIC reports: FCC_RF_SL13110101-ZBR-051_RFID, FCC_RF_SL15072901-ZBR-024_UNII Rev. 2.0, FCC_RF_SL15072901-ZBR-024_DTS_2.4G Rev.2.0 and FCC_IC_RF_SL17060501-ZBR-021_DSS_Rec 2.0.

Results

For the different combination of transmitters, a separation distance of 20 cm complies with the MPE simultaneous transmission limit of ≤ 1.0 .

4.4 According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

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 MHz⁶ 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).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.5 RF exposure evaluation exemption for IC

RFID

$$28.11 + (-36) \text{ dBi} = -7.89 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 1.371 \text{ W} = 31.370 \text{ dBm}$$

2.4 GHz Wi-Fi

$$16.77 + 3.0 \text{ dBi} = 19.77 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.684 \text{ W} = 34.288 \text{ dBm}$$

Classic Bluetooth

$$7.40 + 1.69 \text{ dBi} = 9.09 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 2.676 \text{ W} = 34.275 \text{ dBm}$$

5 GHz Wi-Fi

$$14.76 + 5.0 \text{ dBi} = 19.76 \text{ dBm} < 1.31 \times 10^{-2} f^{0.6834} = 4.744 \text{ W} = 36.761 \text{ dBm}$$

Therefore the RF exposure is not required.