

Appendix A: RF Exposure - FCC Rules and Regulations Part 1.1307, 1.1310, 2.1091, 2.1093, and ISSED RSS-102 Issue 6, Maximum Permissible Exposure (MPE) Assessment

1 Equipment Description

The Equipment Under Test (EUT) is a 10.5 GHz FMCW radar transmitter operating with a 50 MHz bandwidth (50M9P0N). The device transmits continuously using Frequency Modulated Continuous Wave (FMCW) modulation. Because the transmitter operates continuously during normal operation, a 100% duty cycle is conservatively assumed for the RF exposure evaluation. The radar is intended for fixed installation environments where the device may be located in areas accessible to the general public.

The RF exposure evaluation is performed in accordance with:

- 47 CFR §1.1310
- FCC OET Bulletin 65
- FCC KDB 447498 D01 – General RF Exposure Guidance
- ISSED: RSS-102 Issue 6 (March 2023); Safety Code 6 (2015)

2 Technical Parameters

Parameter	Value
Operating Frequency	10.0 GHz
Emission Designator	50M9P0N
Maximum Conducted Output Power	29 dBm
Antenna Gain	8.98 dBi
Maximum ERP	35.83 dBm
Maximum EIRP	37.98 dBm
Maximum EIRP (Linear)	6.28 W
Duty Cycle	100%
Largest Antenna Dimension (D)	10.4 cm
Exposure Category	General Population / Uncontrolled

3 Applicable RF Exposure Limits

According to FCC 47 CFR §1.1310, and ISSED: RSS-102 Issue 6 (March 2023); Safety Code 6 (2015) the Maximum Permissible Exposure limits for frequencies between 1.5 GHz and 100 GHz are:

Exposure Environment	FCC Limit (mW/cm ²)	FCC Limit (W/m ²)	ISED Limit (mW/cm ²)	ISED Limit (W/m ²)
General Population / Uncontrolled	1.0	10.0	1.0	10.0
Occupational / Controlled	5.0	50.0	5.0	50.0
Average time (uncontrolled)	30 minutes	30 minutes	6 minutes	6 minutes

4 RF Exposure Evaluation Method

The power density is calculated using the **far-field equation from OET Bulletin 65**:

$$S = \frac{EIRP}{4\pi R^2}$$

Where:

Symbol	Definition
S	Power density (W/m ²)
EIRP	Equivalent isotropic radiated power (W)
R	Distance from antenna (m)

Worst-case EIRP = 6.28 W is used.

5 RF Exposure Summary Table

Parameter	Value
Maximum EIRP	37.98 dBm
Maximum EIRP (Linear)	6.28 W
Minimum Separation Distance	0.5 m
Calculated Power Density	0.20 mW/cm ²
FCC Limit	1.0 mW/cm ²
Compliance Margin	5× below limit
Result	PASS

6 Power Density vs Distance

Distance (m)	Power Density (W/m ²)	Power Density (mW/cm ²)	FCC Limit (mW/cm ²)	Result
0.1	49.98	4.998	1.0	Fail
0.2	12.49	1.25	1.0	Fail
0.3	5.55	0.555	1.0	Pass
0.5	2.00	0.20	1.0	Pass
0.75	0.89	0.084	1.0	Pass
1.0	0.50	0.05	1.0	Pass
2.0	0.125	0.013	1.0	Pass

7 Power Density vs Distance Graph

A power density vs distance curve derived from the above data demonstrates that RF exposure decreases rapidly with increasing separation distance.

Key observation:

- At 0.5 m separation, power density is already 5× below the FCC limit.
- At 1 m separation, exposure drops to 0.05 mW/cm², which is 20× below the limit.

This confirms substantial compliance margin for typical installation distances.

8 Far-Field Boundary Determination

To confirm the applicability of the far-field equation, the far-field boundary is estimated using:

$$R_{FF} = \frac{2D^2}{\lambda}$$

Where:

Parameter	Value
Largest Antenna Dimension (D)	0.104 m
Wavelength at 10.5 GHz	0.03 m

$$R_{FF} = \frac{2(0.104)^2}{0.03}$$

$$R_{FF} \approx 0.72 \text{ m}$$

Distance	Region
0.5 m	Radiating Near Field
0.75 m	Transition Region
1.0 m	Far Field

The calculation method provides a conservative estimate of RF exposure.

9 Installation Requirement

To ensure compliance with FCC RF exposure limits, the following conditions must be observed:

The antenna must be installed and operated with a minimum separation distance of 50 cm between the antenna and all persons.

10 ISED Installation Requirement

To ensure compliance with ISED RSS-102 Issue 6 and Safety Code 6 RF exposure limits, the following conditions must be observed:

The antenna must be installed and operated with a minimum separation distance of 50 cm between the antenna and all persons. This separation distance ensures that RF exposure levels remain below the ISED general population / uncontrolled exposure limit of 1.0 mW/cm² when averaged over any 6-minute period, as specified in Safety Code 6 (2015).

11 Compliance Statement

The maximum calculated power density at the minimum separation distance of 0.5 m is:

$$0.20 \text{ mW/cm}^2$$

This value is five times below the FCC general population / uncontrolled exposure limit of 1.0 mW/cm² (47CFR§1.1310) and five times below the ISED general population / uncontrolled exposure limit of 1.0 mW/cm² (RSS-102 Issue 6; Safety Code 6, 2015). Therefore, the equipment complies with the RF exposure requirements of both FCC 47CFR§1.1310 and ISED RSS-102 Issue 6 / Health Canada Safety Code 6. No RF exposure measurements are required since compliance is demonstrated through conservative analytical calculations using maximum operating conditions.

12 Conclusion

The maximum calculated power density at the minimum separation distance of 0.5 m is 0.20 mW/cm². Because the transmitter operates with a 100% duty cycle (FMCW continuous transmission), the time-averaged power density is equal to the peak power density regardless of the averaging interval. Therefore, the calculated value of 0.20 mW/cm² applies to both the FCC 30-minute averaging period (47CFR§1.1310) and the ISED 6-minute averaging period (RSS-102 Issue 6; Safety Code 6, 2015). This value is five times below the general population/uncontrolled exposure limit of 1.0 mW/cm² under both FCC and ISED requirements.

Therefore, the equipment complies with the RF exposure requirements of FCC 47CFR§1.1310 and ISED RSS-102 Issue 6/Health Canada Safety Code 6 (2015). No RF exposure measurements are required since compliance is demonstrated through conservative analytical calculations using maximum operating conditions and worst-case continuous duty cycle assumptions.

13 References

1. 47CFR§1.1310 – Radiofrequency Radiation Exposure Limits
2. FCC OET Bulletin 65 – Evaluating Compliance with FCC Guidelines for Human Exposure to RF Fields
3. FCC KDB 447498 D01 – General RF Exposure Guidance
4. ISED: RSS-102 Issue 6 (March 2023); Safety Code 6 (2015)