5 FCC §2.1091 & ISED RSS-102 - RF Exposure

5.1 Applicable Standard

According to FCC §2.1091 and FCC §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 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)
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

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

As per ISED RSS-102 §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[6] 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 x 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).

5.2 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

Antennas & Cable Kits

Antenna Part #	Description	Cable	Maximum Antenna Gain (dBi)	Minimum Cable loss Below 0.9 GHz in dB	Minimum Cable loss Above 1.7 GHz in dB	Net gain Below 0.9 GHz (dBi)	Net gain Above 1.7 GHz (dBi)
SEM2THL series	Antenna	25 ft. C205	0	-3.0	-5.1	-3.0	-5.1
SEM11THL series	Antenna	25 ft. C205	2	-3.0	-5.1	-1.0	-2.1
SEM14THL series	Antenna	25 ft. C205	3	-3.0	-5.1	0.0	-2.1
SEM26THL series	Antenna	25 ft. C205	3	-3.0	-5.1	0.0	-2.1
SEMO series	Antenna	20 ft. C205	0	-2.5	-4.1	-2.5	-4.1
SEMDP1 series	Antenna	50 ft. LMR400	3	-2.0	-2.8	1.0	0.2
SEMD1 series	Antenna	50 ft. LMR400	3	-2.0	-2.8	1.0	0.2
SEMDA2 series	Antenna	50 ft. LMR400	3	-2.0	-2.8	1.0	0.2
SEMDYD series	Antenna	100 ft. LMR400	6	-3.9	-5.5	**2.1**	**0.5**

5.3 MPE Results

Uplink:

Band 5:

Maximum peak output power at antenna input terminal (dBm):	26.1
Maximum peak output power at antenna input terminal (mW):	407.38
Prediction distance (cm):	20
Prediction frequency (MHz):	834
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.1314
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.556

Band 12 & Band 17

Maximum peak output power at antenna input terminal (dBm):	25.9
Maximum peak output power at antenna input terminal (mW):	389.05
Prediction distance (cm):	20
Prediction frequency (MHz):	702.5
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.126
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.468

Band 13:

Maximum peak output power at antenna input terminal (dBm):	25.6
Maximum peak output power at antenna input terminal (mW):	363.08
Prediction distance (cm):	20
Prediction frequency (MHz):	781
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.117
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.5207

Band 2 & Band 25

Maximum peak output power at antenna input terminal (dBm):	28.8
Maximum peak output power at antenna input terminal (mW):	758.58
Prediction distance (cm):	20
Prediction frequency (MHz):	1867
Maximum Antenna Gain, typical (dBi):	0.5
Maximum Antenna Gain (numeric):	1.122
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.169
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Band 4:

Maximum peak output power at antenna input terminal (dBm):	29.3
Maximum peak output power at antenna input terminal (mW):	851.138
Prediction distance (cm):	20
Prediction frequency (MHz):	1733.5
Maximum Antenna Gain, typical (dBi):	0.5
Maximum Antenna Gain (numeric):	1.122
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.19
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.19 mW/cm^2. Limit is 1.0 mW/cm^2.

For ISED, based on the output power and antenna net gain, routine RF exposure can be exempted.

Downlink:

Band 5:

Maximum peak output power at antenna input terminal (dBm):	10.5
Maximum peak output power at antenna input terminal (mW):	11.22
Prediction distance (cm):	20
Prediction frequency (MHz):	877
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00362
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.585

Band 12 & Band 17

Maximum peak output power at antenna input terminal (dBm):	5.4
Maximum peak output power at antenna input terminal (mW):	3.47
Prediction distance (cm):	20
Prediction frequency (MHz):	741.6
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0011
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.4944

Band 13:

Maximum peak output power at antenna input terminal (dBm):	4.8
Maximum peak output power at antenna input terminal (mW):	3.02
Prediction distance (cm):	20
Prediction frequency (MHz):	748.5
Maximum Antenna Gain, typical (dBi):	2.1
Maximum Antenna Gain (numeric):	1.622
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00097
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.499

Band 2 & Band 25

Maximum peak output power at antenna input terminal (dBm):	11.4
Maximum peak output power at antenna input terminal (mW):	13.8
Prediction distance (cm):	20
Prediction frequency (MHz):	1956
Maximum Antenna Gain, typical (dBi):	0.5
Maximum Antenna Gain (numeric):	1.122
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0031
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Band 4:

Maximum peak output power at antenna input terminal (dBm):	5.8
Maximum peak output power at antenna input terminal (mW):	3.802
Prediction distance (cm):	20
Prediction frequency (MHz):	2120
Maximum Antenna Gain, typical (dBi):	0.5
Maximum Antenna Gain (numeric):	1.122
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00085
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.19 mW/cm^2. Limit is 1.0 mW/cm^2.

For ISED, based on the output power and antenna net gain, routine RF exposure can be exempted.