Prediction of human exposure to RF radiation during operation of SATEL-TA23 radio modem module

1. Background information

Industry Canada requirements and measurement techniques used to evaluate radio frequency exposure compliance of radiocommunication apparatus are given in the Radio Standards Specification (RSS) 102.

Limits for maximum permissible exposure are set in the chapter 4 of the same standard (RSS-102).

2. Prediction methods applied

Minimum safe distances have been calculated by using the following formulas.

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

where:

S = power density [W/m^2]

P = power input to the antenna [W], average value in 6 minutes period

G = power gain of the antenna system (incl. the feeder, connectors, filters, etc.) in direction of interest, relative to an isotropic radiator [numeric]

R = distance to the centre of radiation of the antenna [m]

$$S = \frac{PG}{4\pi R^2} \Rightarrow R = \sqrt{\frac{PG}{4\pi S}}$$

3. Initial data for the calculations

The operating frequency range of SATEL-TA23 radio modem module is 403-473 MHz, and the options for transmitter output power are 100 mW, 200 mW, 500 mW, and 1 W.

TX duty cycle is determined by the terminal device and can be up to 100 %.

The maximum gain of the antennas used with SATEL-TA23 radio modem module is limited to 14 dBi in practice.

4. Applicable limits for maximum permissible exposure

Based on the above technical parameters and according to the tables 4.2 and 4.4 (pages 7-8) of the Canadian regulatory standard RSS-102, the following limits of power density shall apply:

RF exposure limit for devices used by the General Public: (f / 150) W/m^2 (averaging time 6 minutes)

RF exposure limit for Controlled Use devices: (f /30) W/m^2 (averaging time 6 minutes)

5. Calculations for the minimum safe distances

5.1 Calculations in case of General Public use

$$R = \sqrt{\frac{PG}{4\pi\left(f/150\,W/m^2\right)}}$$

⇨ Minimum distances to the antenna for typical setups in General Public use

Tx output power [W]	*Antenna system gain [dBi / numeric]*	*Tx duty cycle [%], 6 min. average*	*Frequency [MHz]*	*Minimum safe distance [cm]*
1.0	14 / 25.12	100	403/473	86.3/79.6
		50	403/473	61.0/56.3
		20	403/473	38.6/35.6
		10	403/473	27.3/25.2
	8 / 6.310	100	403/473	43.2/39.9
		50	403/473	30.6/28.2
		20	403/473	20
		10	403/473	20
	6 / 3.981	100	403/473	34.3/31.7
		50	403/473	24.3/22.4
		20	403/473	20
		10	403/473	20
	2 / 1.585	100	403/473	21.7/20.0
		50	403/473	20
		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
0.5	6 / 3.981	100	403/473	24.3/22.4
		50	403/473	20
		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20

		50	403/473	20
		20	403/473	20
		10	403/473	20
0.2	6 / 3.981	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
0.1	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20

5.2 Calculations in case of Controlled use

$$R = \sqrt{\frac{PG}{4\pi\left(f/30\,W/m^2\right)}}$$

⇨ Minimum distances to the antenna for typical setups in **Controlled** use

Tx output power [W]	*Antenna system gain [dBi / numeric]*	*Tx duty cycle [%], 6 min. average*	*Frequency [MHz]*	*Minimum safe distance [cm]*
1.0	14 / 25.12	100	403/473	38.6/35.6
		50	403/473	27.3/25.2
		20	403/473	20
		10	403/473	20
	8 / 6.310	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
	6 / 3.981	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
	2 / 1.585	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
0.5	6 / 3.981	100	403/473	20
		50	403/473	20

		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
0.2	6 / 3.981	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20
0.1	0 / 1.000	100	403/473	20
		50	403/473	20
		20	403/473	20
		10	403/473	20

6. Conclusion

SATEL-TA23 radio modem module users in Canada shall be advised of the safe distances based on the above calculations in the appropriate documentation.

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