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MPE (for FCC) and RF Exposure (for ISED) Calculation

Project: C5986

Report number: 14292TR3 Customer Details

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MPE and RF Exposure Calculation for Ice Robotics

MPE Calculation – FCC

Mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and generally to be used in such a way that a separation distance of 20cm is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limit. As the 20cm separation may not be achievable under normal operating conditions, an RF exposure calculation is used to demonstrate the minimum distance required to be less than the power density limit, as required under FCC rules.

FCC rule part:47CFR2.1091(3)

Power density (S) relates to Equivalent Isotropic Radiated power (EIRP) according to the following:

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

Where,

R is the distance to the centre of radiation of the antenna (cm)

S is power density in mW/cm^2

Rearranging,

$$R = \sqrt{\frac{EIRP}{S4\pi}}$$

Using the measured value of EIRP (derived from electric field strength, and using the limit for S, it is possible to determine the value R i.e. distance from the EUT, where the limit is met.

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The distance R is calculated as:

WMO86916 High Gain Omni Antenna

Frequency (MHz)	Conducted power (mW)	Antenna gain (dBi) (Note 1)	Antenna gain (linear units)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2) 47CFR1.1310 Table 1 (Notes 2 and 3)	Distance (R) (cm) required to be less than S
903.2	0.171	5.8	3.8	0.65	0.60	0.29
914.4	0.176	5.8	3.8	0.669	0.61	0.3
926.3	0.175	5.8	3.8	0.665	0.62	0.29

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Frequency (MHz)	Conducted power (mW)	Antenna gain (dBi) (Note 1)	Antenna gain (Linear units)	Maximum EIRP (mW) (Note 2)	Power density limit (S) (mW/cm^2) 47CFR1.1310 Table 1 (Note 3)	Distance (R) (cm) required to be less than S
903.2	0.171	0.6	1.15	0.197	0.60	0.16
914.4	0.176	0.6	1.15	0.202	0.61	0.16
926.3	0.175	0.6	1.15	0.201	0.62	0.16

Note 1:

Example antenna gain converted to linear units:

Antenna gain (linear, dimensionless = $10^{(\text{dBi value}/10)} = 10^{(0.6/10)} = 1.15$

Note 2

Maximum EIRP (mW) = conducted power (mW) x antenna gain (Linear units)

Note 3:
Limits for General Population / Uncontrolled Exposure.

Note 4:
The limit is defined in Table 1 of 47CFR1.1310(e)(1) as:

Between 300 and 1500MHz as f/1500mW/cm^2

Where f is frequency in MHz

Conclusion
The product met the 20cm distance requirement.

Reference: 14292TR3

MPE and RF Exposure Calculation for Ice Robotics

RF Exposure Evaluation - ISED

RSS Standard:

RSS-102 Issue 5 Posted on Industry Canada website: March 19, 2015

Clause: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:

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

$$1.31 \times 10^{-2} \, f^{0.6834} \text{ W}$$

(adjusted for tune-up tolerance),

where f is in MHz

Evaluation

WMO86916 High Gain Omni Antenna

Frequency (MHz)	Conducted power (mW) Measured	Antenna gain Linear	Maximum EIRP (mW) Measured	Maximum EIRP (W) permitted calculated from above formula	Maximum ERP (mW) permitted calculated from above formula
903.2	0.171	3.8	0.65	1.37	1370
914.4	0.176	3.8	0.67	1.38	1380
926.3	0.175	3.8	0.67	1.4	1400

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Frequency (MHz)	Conducted power (mW) Measured	Antenna gain Linear	Maximum EIRP (mW) Measured	Maximum EIRP (W) permitted calculated from above formula	Maximum ERP (mW) permitted calculated from above formula
903.2	0.171	1.15	0.197	1.37	1370
914.4	0.176	1.15	0.202	1.38	1380
926.3	0.175	1.15	0.201	1.4	1400

Note 1

Antenna gain (dBi) = 10log(Linear gain)

Antenna gain (linear, dimensionless = $10^{(\text{dBi value}/10)} = 10^{(0.6/10)} = 1.15$

Note 2

Maximum EIRP (mW) = conducted power (mW) x antenna gain (1.15)

Conclusion

The apparatus meets the exclusion requirements for RF exposure.