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1.0 Maximum Permissible Exposure Evaluation (Supplements the test report.)

The measured power is considered for the intended use of the device and resulting RF exposure to the user.

1.2 Criteria

Section Reference	Date
447498 D01 General RF Exposure Guidance v06 // RSS-102 Issue 5	20 Mar 2019

1.3 Procedure

Using measurement of peak power and considering the intended application, determine the permissible exposure level, applicability of exclusion, or whether additional exposure tests (SAR) are indicated. When applicable justify conclusion for selected exposure level and separation distance.

This device is configured according to the final application requirement. This ranges from being included in a portable “belly box”, on locomotives/cranes, or fixed installations.

Maximum exposure (uncontrolled) = 1.0 mW/cm²

1.4 Power to Exposure Calculation

For 2.4 GHz radio power is determined by conducted measurement. SAR exemption method was applied for 20 cm spacing.

Measured Conducted Power mW	Calculated Peak EIRP dBm	Source Duty Cycle Factor dB	Antenna Gain dBi	Peak to Average Power 63.6% Factor dB	Calculated EIRP dBm	EIRP In Linear Terms mW
602.6	27.8	-7.5	5	-2	23.3	213.8

1.5 SAR Exemption Calculation – FCC

Maximum exposure (uncontrolled) = 1.0 mW/cm²

$$\text{Distance}_{\text{antenna}} = \sqrt{(P \cdot G / 4 \cdot \pi \cdot S)} \text{ given } P_{\text{w}_{\text{avg}}} = 213.8 \text{ mW, Gain} = 1^*, S = 1.0 \text{ mW/cm}^2.$$

**Gain included in term P.*

$$\text{Distance}_{\text{safe}} = \sqrt{(213.8 / 4 \cdot \pi \cdot 1.0)} = 4.13 \text{ cm}$$

Exposure limit is satisfied for distance of 4.13 cm.

1.6 SAR Exemption Calculation – IC

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

Calculated field strength limit for lowest/highest operating frequency from table above and row for 300-6000 MHz:

$$\text{Limit} = 0.02619 f^{0.6834} = 0.02619(2480)^{0.6834} = 5.47 \text{ W/m}^2 = 5470 \text{ mW/m}^2 = 0.547 \text{ mW/cm}^2$$

Find field density at 20 cm for General Population (uncontrolled) exposure:

$$S = (P \cdot G) / (4 \cdot \pi \cdot [\text{Distance}]^2) = \text{given } P_{\text{wr,avg}} = 213.8 \text{ mW}, \text{ Gain} = 1^*, \text{ Distance} = 20 \text{ cm.}$$

*Antenna gain included in power.

$$S = (213.8) / (4 \cdot \pi \cdot [20 \text{ cm}]^2) = 0.043 \text{ mW/cm}^2$$

$$0.043 \text{ mW/cm}^2 \leq 0.547 \text{ mW/cm}^2$$

This device meets the MPE criteria in RSS-102 Table 4.

Signed:

A handwritten signature in black ink, appearing to read "Eric Lifsey". The signature is written in a cursive style with a large, looping initial "E".

Eric Lifsey
