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Solveig Övrebö

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Date

2020-04-30

Issue

A1

Document ID

7000 120-076

Classification Company Confidentiality

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RF exposure calculation for R60

Revision History

Rev	Date	Prepared	Description
A1	2020-04-30	solov	New Document

1 Background

Calculation of radiation from R60, if connected to antenna as available via TransponderTech sales kits. For safety distance calculations and mandatory for certifications.

The main aim is to determine if a recommended safety distance to VHF antenna is sufficient.

2 Data

2.1 Transmitter characteristics

R60 Tx Power: max 12.5W

Transmission characteristics for R60 is various types of TDMA modulation, i.e. short-duration transmissions corresponding to occupied slots.

Normal usage duty factor is expected to be in the order of 2%. An extreme worst-case scenario could possibly be 30%, but with severe implications on link performance.

Used frequency range: 155-162.5 MHz

Recommended safety distance from antenna according to user documentation: 1m



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2.2 Antennas

Antenna alternatives:

Antenna	Gain (dBi)	Horizontal 3dB bandwidth (deg)	Vertical 3dB bandwidth (deg)	Frequency band (MHz)
AV 1312-2	2 - 4	70		146-174
AV 1431	7	40		146-174
BA102	5.1	onmidirectional	35	156-163

For antenna data, see Refs 1-3.

To cover worst-case, the maximum gain is used in the calculation. Hence any directivity of the antenna can be disregarded in the purpose of this analysis. This simplification is conservative.

2.3 Limits

Electric field strength: $E_{\max} = 28 \text{ V/m}$, (10-400 MHz) see Ref. 4

3 Model

The far-field model is assumed to be applicable and is used:

Power density (W/m²): $S = \frac{P}{4\pi r^2}$ Electric field, free space (V/m): $E = \frac{\sqrt{30PG(\theta, \phi)}}{r}$ Safety distance r_{\min} for antenna, considering duty factor is then, in worst direction:

$$r_{\min} = \frac{\sqrt{30 * P * G * DF}}{E_{\max}}$$



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4 Results

Above model gives the resulting E-field strength as presented below

Antenna	max Gain	max Power (W)	Duty factor	E(limit) (V/m)	r(safety) (m)
AV1312-_2	4	12,5	0,3	28	0,76
AV1431	7	12,5	0,3	28	1,00
BA102	5,1	12,5	0,3	28	0,86

5 Conclusions

A recommendation of minimum 1m distance from the antenna is sufficient with respect to health.

6 References

[1]	VHF Antenna AV1312-2 datasheet
[2]	VHF Antenna AV1431 datasheet
[3]	VHF Antenna BA102 datasheet
[4]	Council Recommendation 1999/519/EC, Annex III