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Testing
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EMF Test Report: Ericsson Radio 4402 B66 (FCC)

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|---|---|---|---|
| Document number: | GFTL-21:000071 Uen Rev D | Date of report: | 2021-04-30 Replaces GFTL-21:000071 Uen C |
| Testing laboratory: | Ericsson EMF Research Laboratory Ericsson AB SE-164 80 Stockholm Sweden | Company/Client: | Ge Li CBC - Ericsson (China) Communications Co. Ltd. Bldg 2, No.1366 Tianfu Avenue Middle Tianfu Software Park 610041 Chengdu China |
| Tests performed by: | Bo Xu | Dates of tests: | 2021-04-30 (Rev D) |
| Manufacturer and market name(s) of device: | Ericsson Radio 4402 B66 | | |
| Testing has been performed in accordance with: | FCC OET Bulletin 65 IEC 62232:2017 | | |
| Test results: | RF exposure compliance boundaries (exclusion zones) related to the limits in FCC 47 CFR 1.1310 to be included in the Customer Product Information (CPI) for Ericsson Radio 4402 B66. | | |
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Summary of EMF Test Report¹

Equipment under test (EUT)

| | | | |
|---|---|-----------|-----------------|
| Product name | Radio 4402 B66 | | |
| Product number | KRC 161 738/1 | | |
| Supported bands, Tx frequency range (MHz) and standards | B66 (1700) | 2110–2200 | LTE, NB-IoT, NR |
| | | 2110–2155 | WCDMA |
| Duplexing technology | FDD | | |
| Exposure environment | General public/uncontrolled, Workers/controlled | | |

Results

RF exposure compliance boundaries, outside of which the exposure is below the general public (GP) and workers (W) exposure limits, are listed below.

Dimensions of the box-shaped compliance boundary for general public (GP) and workers (W) exposure for Radio 4402 B66 applicable in the USA and markets employing the FCC RF exposure limits. The compliance boundaries are determined for maximum output power with 0.6 dB output power tolerance included.

| Mode and output power for Radio 4402 | | | | | Dimensions of the box-shaped compliance boundary (m) | | | | | | | |
|--------------------------------------|-----------------------|----------------------------|---|------------------------------|--|-----|-------|-----|--------|-----|---------------------|-----|
| | | | | | Distance in front of EUT | | Width | | Height | | Distance behind EUT | |
| Band | Standard ² | Single/ Dual Radio version | Maximum nominal output power from the radio | IEC 62232 installation class | GP | W | GP | W | GP | W | GP | W |
| B66 | W/L/I/N | Single | 4 × 5 W | E+ | 1.9 | 0.9 | 1.6 | 0.8 | 1.2 | 0.7 | 0.2 | 0.2 |
| B66 | W/L/I/N | Dual | 4 × 5 W + 4 × 5 W | E+ | 2.7 | 1.2 | 2.3 | 1.1 | 1.7 | 0.9 | 0.2 | 0.2 |

For the power levels specified in the table with tolerances added, and the upward rounding of compliance boundary dimensions to the nearest decimeter, the specified results are conservative.

¹ This page contains a summary of the test results. The full report provides a complete description of all test details and results.

² The standards are abbreviated in this report according to: W for WCDMA, L for LTE, I for NB-IoT, and N for NR.

1 General information

The test results presented in this report define compliance boundaries for Radio 4402 B66. Outside these compliance boundaries, the Radio frequency (RF) exposure levels are below the limits specified by the Federal Communications Commission (FCC) [1]. The tests were performed by calculations in accordance with the Ericsson RF exposure calculation procedure for base stations [2], which is in conformity with the FCC OET Bulletin 65 [3] and IEC 62232:2017 [4].

It should be noted that the test results presented in this test report are valid for the frequency range specified in Table 1, for the antenna properties specified in Table 2, and for the power levels and power tolerance specified in Table 3. These data as well as the applied antenna pattern files were supplied by the client and may affect the validity of the results.

Proposed EMF health and safety information for inclusion in the Customer Product Information (CPI) is provided in Appendices A, B and C.

2 Equipment under test

Tables 1 and 2 below summarize the technical data for the equipment under test (EUT) and the properties of antenna. Table 3 lists the maximum nominal output power from the Radio unit (total peak power from all antenna branches) and the total time-averaged power delivered to the antenna for the specified configurations. The total time-averaged power delivered to the antenna includes output power tolerance.

The EUT related data in Tables 1-3 were supplied by the client.

Table 1 Technical data for the EUT.

| | | | |
|---|--|-----------|-----------------|
| Product name and product number | Radio 4402 B66 | | KRC 161 738/1 |
| Supported bands, Tx frequency range (MHz), and standards | B66 (1700) | 2110–2200 | LTE, NB-IoT, NR |
| | | 2110–2155 | WCDMA |
| Duplexing technology | FDD | | |
| Dimensions, $H \times W \times D$ (mm) | Single Radio: 213.5 × 200 × 125 Dual Radio: 449 × 200 × 130 | | |
| Exposure environment | General public/uncontrolled, Workers/controlled | | |
| IEC 62232 installation class [4]³ | E+ (Single Radio) E+ (Dual Radio) | | |

Table 2 Properties of the antenna.

| | |
|--|--|
| Product number | KRE 105 280/1 |
| Type | Internal antenna, directional, 4 Tx (2 columns, X polarized) |
| Tested band and frequency range (MHz) | B66: 2110–2200 |
| Maximum gain⁴ (dBi) per antenna port | 9.9 |
| Electrical tilt (degrees) | 8 |

³ The stated IEC 62232 installation class was determined based on the total EIRP without power tolerance included. The total EIRP was obtained using the antenna patterns provided by the client.

⁴ Maximum gain per antenna port obtained using the antenna patterns provided by the antenna manufacturer.

Table 3 EUT configurations with maximum nominal output power levels and total time-averaged power levels including output power tolerance.

| Band | Standard | Single/ Dual Radio version | Maximum nominal output power from the radio (dBm/W) | Power tolerance (dB) | Total time-averaged power delivered to antenna (dBm/W) |
|------|----------|----------------------------|---|----------------------|--|
| B66 | W/L/I/N | Single | 43.0 / 20 | 0.6 | 43.6 / 23.0 |
| B66 | W/L/I/N | Dual | 46.0 / 40 | 0.6 | 46.6 / 45.9 |

3 Exposure conditions

The EUT is intended to be installed on walls, poles, ceilings, and similar structures making it possible to ensure that the general public has no access to the EMF compliance boundary. Other installation related exposure conditions are not reasonably foreseeable for the EUT.

The assessments were conducted for maximum power configurations, i.e., by assuming 100% utilization. Effects of real RBS utilization (time-averaged) is reasonably foreseeable and will significantly reduce the time-averaged power and the RF exposure. This factor was not considered in this assessment, which adds to the conservativeness of the obtained compliance boundaries.

4 EMF compliance boundary calculations

The RF exposure was evaluated using calculations performed according to the Ericsson RF Exposure Calculation Procedure for Base Stations [2], which conforms to FCC OET Bulletin 65 [3] and IEC 62232:2017 [4]. The calculations were made using the far-field spherical formula. The first step in calculating the compliance boundary was to use the spherical far-field formula to estimate power density:

$$S_{\text{sph}}(\theta, \phi) = \frac{P_a G(\theta, \phi)}{4\pi r^2},$$

where S, P_a, G, r, θ , and ϕ denote the power density, the power accepted by each antenna port, the antenna gain per port, the distance from the antenna, and the angular variables in a spherical coordinate system, respectively. Antenna far-field measurement data were provided by the client for one frequency, specifically 2170 MHz within Band 66. The procedure described in this section was applied to each of these, and the compliance boundaries were determined as the maximum values for the tested frequencies. The maximum gain values per port were found to be 9.9 dBi (pol. +45) and 9.8 dBi (pol. -45), considering all the tested frequencies within Band 66.

The accepted power per port was taken as the total time-averaged power delivered to the antenna, including output power tolerance, divided by the number of ports. In the frontal hemisphere ($\phi \in [-\frac{\pi}{2}, \frac{\pi}{2}]$), the exposure from antenna ports with the same nominal polarizations (denoted ± 45) were summed in a correlated way to consider spatial multiplexing while the exposure from antenna ports with different nominal polarizations were summed in an uncorrelated manner. Also, in the rear hemisphere ($\phi \notin [-\frac{\pi}{2}, \frac{\pi}{2}]$), uncorrelated exposure was assumed [2]. With the two antenna columns denoted 1 and 2, the total power density as estimated by the spherical far-field formula is thus given by

$$S_{\text{total,sph}} = \begin{cases} \left(\sqrt{S_{\text{sph},1,+45}} + \sqrt{S_{\text{sph},2,+45}} \right)^2 + \left(\sqrt{S_{\text{sph},1,-45}} + \sqrt{S_{\text{sph},2,-45}} \right)^2 & , \phi \in \left[-\frac{\pi}{2}, \frac{\pi}{2} \right] \\ S_{\text{sph},1,+45} + S_{\text{sph},2,+45} + S_{\text{sph},1,-45} + S_{\text{sph},2,-45} & , \phi \notin \left[-\frac{\pi}{2}, \frac{\pi}{2} \right] \end{cases}$$

The compliance distance for the spherical model, $CD_{\text{sph}}(\theta, \phi)$ was obtained by solving the following equation for r :

$$\frac{S_{\text{total,sph}}(r, \theta, \phi)}{S_{\text{gp,w}}^{\text{lim}}} = 1,$$

where $S_{gp,w}^{lim}$ denotes the FCC power density reference levels for general public and workers exposure. For the frequency bands of interest, RF EMF exposure limits are given in Table 4 [1].

Table 4 RF EMF exposure limits on power density for the frequency bands used by the EUT.

| Band | S_{gp}^{lim} (W/m ²) | S_w^{lim} (W/m ²) |
|------------|------------------------------------|---------------------------------|
| B66 (1700) | 10 | 50 |

Since antenna far-field data provided by the client correspond to the Single Radio version, compliance boundaries for the Dual Radio version were obtained in a conservative way by doubling the RF exposure for the Single Radio version. To take into consideration the actual placement of radios in the Dual Radio version (see Appendix D), the distance between the centers of the two radios was added in the obtained compliance boundary height.

Based on the calculated compliance distances, a box-shaped compliance boundary was determined. To comply with the FCC requirement of a minimum test separation distance for a non-portable device of 20 cm, the minimum distance from the antenna to the compliance boundary was set to 20 cm.

5 Results

A box-shaped compliance boundary is used, characterized by its width, height, and the compliance distances behind and in front of the EUT, see Figure 1. Outside of this box, the RF exposure is below the exposure limits.

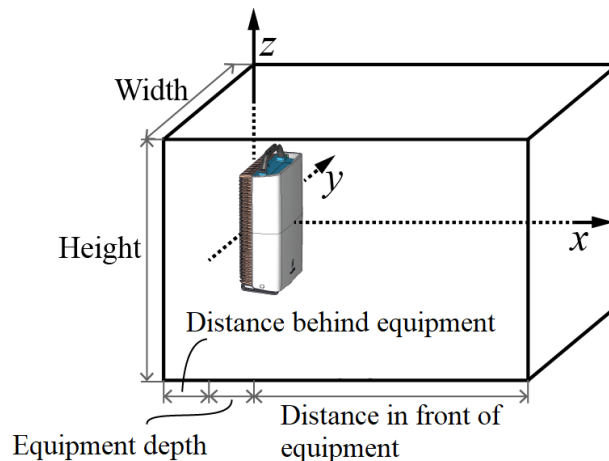


Figure 1 Box-shaped structure specifying the compliance boundary for the EUT.

In Figure 2 and Figure 3, compliance distance results for general public (blue line) and workers (red line) exposure are given for the tested configuration leading to the largest compliance boundary. Also shown are the resulting compliance boundaries (black lines, solid for general public, dashed for workers exposure). The resulting compliance boundary dimensions are given in Table 5 rounded upwards to the nearest decimeter.

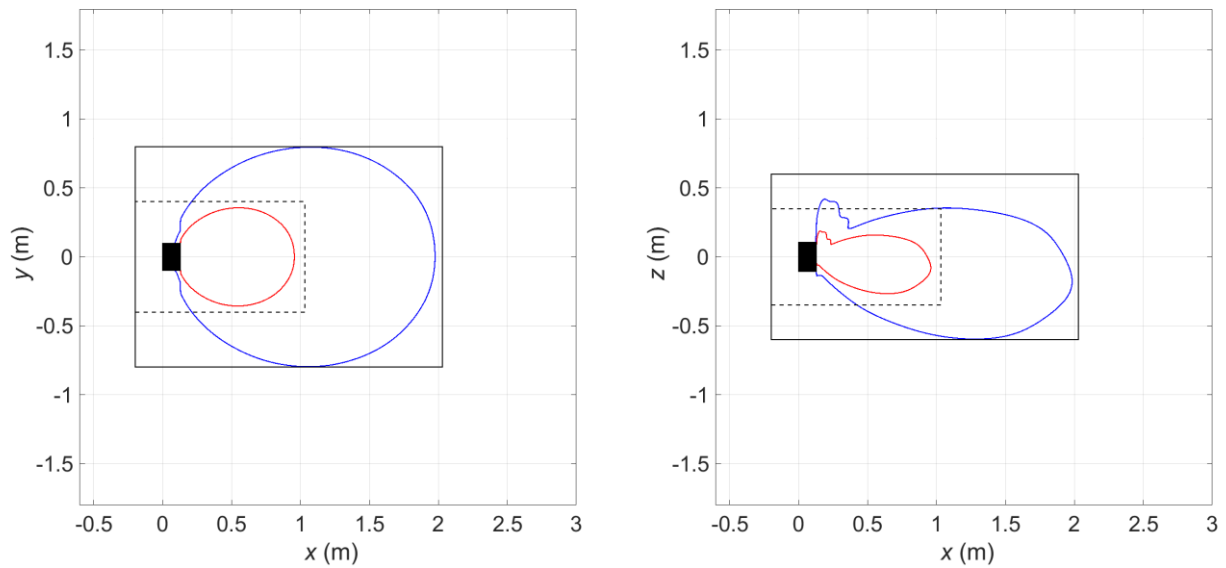


Figure 2 Compliance boundary for general public (black solid line) and workers (black dashed line) exposure for Single Radio. The blue and red solid lines correspond to compliance distance results for general public and workers exposure, respectively, obtained using the spherical model. The EUT is shown from above (left figure) and from the side (right figure) with its back plane located at $x = 0$ m. Mode: B66 (1700) (W/L/I/N). Total power delivered to the antenna: 23.0 W.

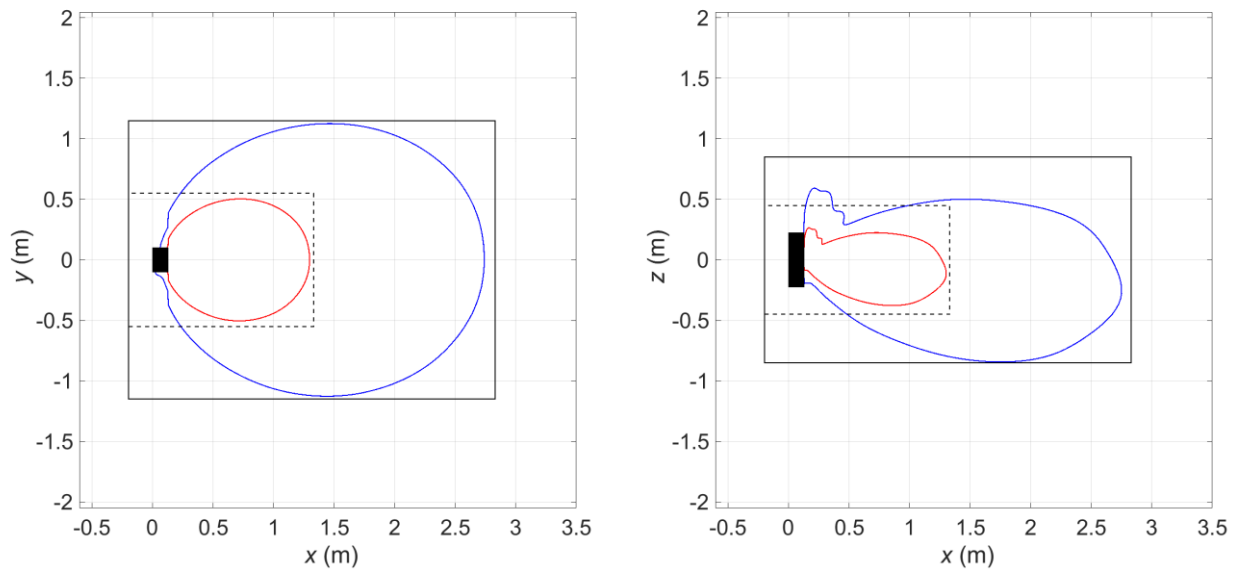


Figure 3 Compliance boundary for general public (black solid line) and workers (black dashed line) exposure for Dual Radio. The blue and red solid lines correspond to compliance distance results for general public and workers exposure, respectively, obtained using the spherical model. The EUT is shown from above (left figure) and from the side (right figure) with its back plane located at $x = 0$ m. Mode: B66 (1700) (W/L/I/N). Total power delivered to the antenna: 45.9 W.

Table 5 Dimensions of the box-shaped compliance boundary for general public (GP) and workers (W) exposure for Radio 4402 applicable in the USA and markets employing the FCC RF exposure limits. The compliance boundaries are determined for maximum output power with 0.6 dB output power tolerance included.

| Mode and output power for Radio 4402 | | | | | Dimensions of the box-shaped compliance boundary (m) | | | | | | | |
|--------------------------------------|-----------------------|----------------------------|---|------------------------------|--|-----|-------|-----|--------|-----|---------------------|-----|
| | | | | | Distance in front of EUT | | Width | | Height | | Distance behind EUT | |
| Band | Standard ² | Single/ Dual Radio version | Maximum nominal output power from the radio | IEC 62232 installation class | GP | W | GP | W | GP | W | GP | W |
| B66 | W/L/I/N | Single | 4 × 5 W | E+ | 1.9 | 0.9 | 1.6 | 0.8 | 1.2 | 0.7 | 0.2 | 0.2 |
| B66 | W/L/I/N | Dual | 4 × 5 W + 4 × 5 W | E+ | 2.7 | 1.2 | 2.3 | 1.1 | 1.7 | 0.9 | 0.2 | 0.2 |

For the power levels specified in the table with tolerances added, and the upward rounding of compliance boundary dimensions to the nearest decimeter, the specified results are conservative.

6 Uncertainty

For the input parameters defined in the test report, the calculated compliance boundary dimensions determined according the approach described in Section 4 results in an exposure assessment which is conservative. The compliance boundary dimensions were determined by comparing the evaluated RF exposure directly with the limits.

7 Conclusions

The Ericsson Radio 4402 B66 has been tested using methods and procedures specified in FCC OET Bulletin 65 [3] and IEC 62232:2017 [4]. The results in Section 5 show the compliance boundary dimensions of the product. Outside of these compliance boundaries, the RF exposure is below the limits specified in [1].

8 References

- [1] FCC, Code of Federal Regulations CFR title 47, part 1.1310 "Radiofrequency radiation exposure limits", Federal Communications Commission (FCC), August 1997.
- [2] Ericsson, GFTE-16:001718 Uen, "Ericsson RF exposure calculation procedure for base stations".
- [3] FCC, "Evaluating compliance with FCC guidelines for human exposure to Radiofrequency electromagnetic fields. OET Bulletin 65. Edition 97-01." Federal Communications Commission (FCC), Office of Engineering and Technology, August 1997.
- [4] IEC 62232:2017, Determination of RF field strength, power density and SAR in the vicinity of Radiocommunication base stations for the purpose of evaluating human exposure, June 2017.
- [5] Ericsson, LME-12:001904 Uen, "Exposure to Radio frequency electromagnetic fields".

9 Revision History

| Rev. | Date | Description |
|------|------------|--|
| A | 2021-01-22 | First revision |
| B | 2021-02-04 | Added test for dual radio configuration |
| C | 2021-02-10 | Corrected WCDMA frequency range |
| D | 2021-04-30 | Corrected the tilt angle. Reconducted calculation using the updated antenna pattern files. |

Appendix A. Information to be included in the CPI

Table A.1 below lists the compliance boundaries (exclusion zones), outside of which the RF EMF exposure from Radio 4402 is below the limits applicable in:

- USA (47 CFR 1.1310).

Table A.1 Dimensions of the box-shaped compliance boundary for general public (GP) and occupational (O) exposure applicable in the USA and markets employing the FCC RF exposure limits (including 0.6 dB output power tolerance).

| Mode and output power for Radio 4402 | | | | | Dimensions of the box-shaped compliance boundary ⁽¹⁾ (m) | | | | | | | |
|--------------------------------------|-------------------------|---------------------------|---|------------------------------|---|-----|-------|-----|--------|-----|-----------------------|-----|
| | | | | | Distance in front of radio | | Width | | Height | | Distance behind radio | |
| Band | Standard ⁽²⁾ | Single/Dual Radio version | Maximum nominal output power from the radio | IEC 62232 Installation class | GP | O | GP | O | GP | O | GP | O |
| B66 | W/L/I/N | Single | 4 × 5 W | E+ | 1.9 | 0.9 | 1.6 | 0.8 | 1.2 | 0.7 | 0.2 | 0.2 |
| B66 | W/L/I/N | Dual | 4 × 5 W + 4 × 5 W | E+ | 2.7 | 1.2 | 2.3 | 1.1 | 1.7 | 0.9 | 0.2 | 0.2 |

(1) The compliance boundaries are determined for maximum output power with power tolerance included.

(2) The standards are abbreviated according to: W for WCDMA, L for LTE, I for NB-IoT, and N for NR.

Appendix B. Guidelines on how to install the product

The Radio 4402 B66 (KRC 161 738/1) shall be installed to make sure that the general public does not have access to the applicable RF EMF compliance boundary. The compliance boundary dimensions were determined for the product transmitting in free space.

Appendix C. Guidelines for workers during installation, maintenance, and repair of the product

For Radio 4402 B66 (KRC 161 738/1), if work needs to be performed within the compliance boundary applicable for workers, the radio equipment shall be powered off, or the power be reduced to a level ensuring that the RF EMF exposure is below the relevant exposure limit for workers.

If work is conducted on behalf of Ericsson, minimum EMF related requirements are provided in [5].

Appendix D. Pictures of Radio 4402 B66

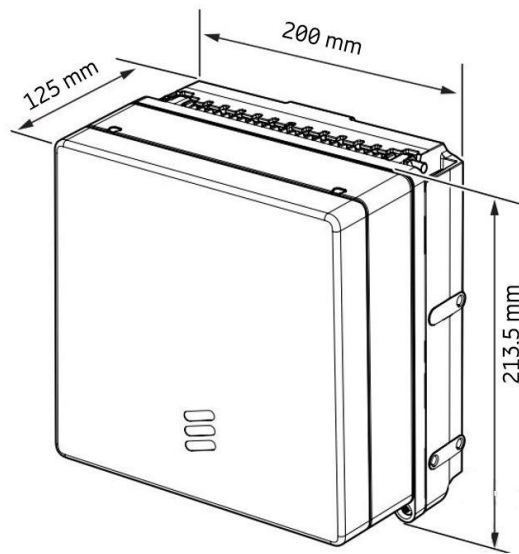


Figure D.1 Picture of Single Radio version of Radio 4402 B66.

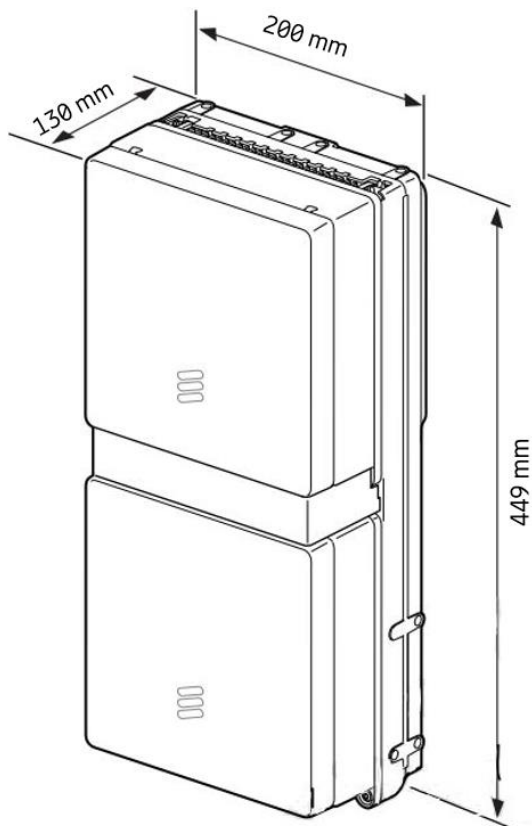


Figure D.2 Picture of Dual Radio version of Radio 4402 B66.