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EMF Test Report: Ericsson AIR 6488 B48 LTE (FCC)

Document number:	GFTL-19:000827 Uen Rev G	**Date of report:**	2024-07-15 This document replaces GFTL-19:000827 Uen Rev F.
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Tests performed by:	Bo Xu	**Dates of tests:**	2024-07-04 (Rev G)
Manufacturer and market name(s) of device:	Ericsson AIR 6488 B48		
Testing has been performed in accordance with:	FCC OET Bulletin 65 IEC 62232:2022		
Test results:	RF exposure compliance boundaries (exclusion zones) in conformity with FCC 47 CFR 1.1310 to be included in the Customer Product Information (CPI) for Ericsson AIR 6488 B48 .		
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Summary of EMF Test Report[1]

Equipment under test (EUT)

Product name	AIR 6488 B48		
Product number	KRD 901 160/11, KRD 901 160/1		
Supported bands, Tx frequency range (MHz) and standards	B48	3550 - 3700	LTE
Duplexing technology and fraction of downlink transmission time to total time	TDD (75%)		

Results

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

Dimensions of the box-shaped compliance boundary for general public (GP) and occupational (O) exposure for AIR 6488 B48 applicable in the USA and markets employing the FCC RF exposure limits. The compliance boundaries are determined for maximum total EIRP[2] with EIRP tolerance and TDD downlink duty cycle included.

Mode and EIRP AIR 6488						**Dimensions of the box-shaped compliance boundary (m)**							
						Distance in front of EUT		**Width**		**Height**		**Distance behind EUT**	
Band	**Standard**	**Maximum EIRP**	**EIRP tolerance**	**TDD DL duty cycle**	**Exposure condition**	**GP**	**O**	**GP**	**O**	**GP**	**O**	**GP**	**O**
B48	LTE	56 dBm	1 dB	75 %	Theoretical maximum	1.8	0.8	1.9	0.9	1.3	1.3	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] Effective Isotropic Radiated Power.

1 General information

The test results presented in this report define compliance boundaries for AIR 6488 B48 LTE. Outside of these compliance boundaries the radio frequency (RF) exposure levels are below the exposure limits specified 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 62232:2022 [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 total EIRP level, the EIRP tolerance, and TDD downlink duty cycle 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

Table 1 and Table 2 below summarize the technical data for the equipment under test (EUT) and the properties of the integrated antenna. Table 3 lists the maximum nominal output power from the radio unit and the total time-averaged power delivered to the antenna. The total time-averaged power delivered to the antenna includes the output power tolerance and TDD downlink duty cycle.

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

The product supports LTE, NR and LTE+NR mixed mode. This report is applicable only for LTE. For LTE+NR mixed mode, the report for NR [6] is applicable.

Table 1 Technical data for the EUT.

Product name and product number	AIR 6488 B48		KRD 901 160/11, KRD 901 160/1
Supported bands, Tx frequency range (MHz), and standards	B48	3550 - 3700	LTE
Antenna	KRE 105 261		
Dimensions, H × W × D (mm)	819 × 400 × 256		
Duplexing technology and fraction of downlink transmission time to total time	TDD (75 %)		
Exposure environment	General public/uncontrolled, Occupational/controlled		
IEC 62232 installation class[3]	E+		

[3] The stated IEC 62232 installation class was determined based on the total EIRP without power tolerance included and considering the TDD downlink duty cycle. The total EIRP was obtained using the antenna patterns provided by the client.

Table 2 Properties of the antenna.

Product number	KRE 105 261
Type	Internal AAS
Number of polarizations	2
Gain[4] (dBi)	24.0
Antenna configuration (no. of subarray rows, subarray columns and polarizations)	4 × 8 × 2
Subarray configuration	2 × 1
Antenna pattern files	1/155 70-KRD 901 098/11-1 (MastRev1434)
Maximum scan range in horizontal plane (degrees)	±60
Maximum scan range in vertical plane (degrees)	73 – 113

Table 3 EUT configurations with the maximum EIRP level and the total time-averaged EIRP level including the EIRP tolerance and the TDD downlink duty cycle.

Band	Standard	Maximum EIRP	EIRP tolerance	TDD downlink duty cycle	Total time-averaged EIRP
B48	LTE	56 dBm	1 dB	75 %	55.8 dBm

3 Exposure conditions

The EUT is intended to be used outdoor and installed on poles, walls, masts, towers, 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 maximum TDD downlink duty cycle was considered to obtain the maximum time-averaged EIRP.

Other factors, such as beam scanning in elevation and azimuth, RBS utilization, and scheduling time are reasonably foreseeable and will significantly reduce the time-averaged EIRP and the RF exposure. A theoretical maximum exposure condition assessment was conducted, in which these factors were not considered, which makes the obtained compliance boundaries very conservative.

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 [4]. The calculations were made using the Ericsson in-house MATLAB-based tool called MSI compliance analyzer (release 2024-05) [5]. The first step in calculating the compliance boundary was to use the spherical far-field formula to estimate power density:

$$S_{\mathrm{sph}}(\theta,\phi) = \frac{P_{\mathrm{a}} G(\theta,\phi)}{4\pi r^2},$$

[4] The stated gain value is the maximum gain of the antenna within the frequency band(s) supported by the product and obtained using the antenna patterns provided by the client. The patterns used are based on theoretical modelling of the antenna and may differ slightly from the measured ones.

where $S, P_a, G, r, \theta,$ and ϕ denote the power density, the total time-averaged power accepted by the antenna, the antenna gain, the distance from the antenna, and the angular variables in a spherical coordinate system, respectively. The EIRP, i.e., $P_a G(\theta, \phi)$, includes the tolerance and the TDD downlink duty cycle. . The EUT is connected to a baseband unit with a dynamic power control feature that limits the maximum EIRP including tolerance to ensure it is not exceeding 56 dBm. A fraction of 25% of the total available DL resources are used for broadcast beam whereas the remaining 75% is used for traffic. Therefore, during the EMF calculation, P_a was scaled down for the broadcast beam and traffic, denoted P_{br} and P_{tr}, respectively. Neither $P_{br}G_{broadcast}$ nor $P_{tr}G_{traffic}$ exceeds $56 + 1 + 10\log_{10} 0.75$ dBm[5], where $G_{broadcast}$ and $G_{traffic}$ denote the antenna gain for the broadcast and traffic beams.

The power density for 25% of DL resources used for the broadcast beam and the power density for remaining 75% used for traffic are calculated as:

$$S_{sph,broadcast}(\theta, \phi) = \frac{0.25 P_{br} G_{broadcast}(\theta, \phi)}{4\pi r^2},$$

$$S_{sph,traffic}(\theta, \phi) = \frac{0.75 P_{tr} G_{traffic}(\theta, \phi)}{4\pi r^2}.$$

While the beam for the broadcast channel is fixed[6], the traffic beam is steered in different directions depending on the location of the users requesting service. Therefore, $G_{traffic}$ in the equation above corresponds to the envelope of the antenna gain for all possible beams. The antenna gain patterns for broadcast beams and the envelope of antenna gains for all possible traffic beams were provided by the client based on theoretical modelling of the antenna. The use of these antenna gain patterns, together with the applied tolerance, provides an upper bound for the compliance boundary. The broadcast beam patterns and the envelope traffic beam patterns were provided by the client for four different frequencies, specifically 3550 MHz, 3600 MHz, 3650 MHz, and 3700 MHz within B48. Maximum gain values corresponding to the maximum of all the broadcast beam patterns and envelope traffic beam patterns, respectively, were used in the above equations to estimate power density. The maximum gain value of the envelope traffic beams was found to be 24 dBi. The maximum gain value of the broadcast beams was found to be 17.1 dBi.

The total power density as estimated by the spherical far-field formula is thus given by:

$$S_{sph} = S_{sph,broadcast} + S_{sph,traffic}.$$

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

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

where $S_{gp,o}^{lim}$ denotes the FCC power density limits for general public and occupational exposure [1].

The power density limits for the frequency bands of interest are given in Table 4.

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

Band	S_{gp}^{lim} (W/m^2)	S_o^{lim} (W/m^2)
B48	10.0	50.0

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] $10\log_{10} 0.75$ added in the expression to consider TDD DL duty cycle, 1 added in the expression to consider the EIRP tolerance.
[6] The AIR 6488 B48 broadcast beam can be configured to handle two different UE distribution scenarios, denoted Macro and Hotspot. Either of these configurations is characterized by different gain values, beamwidths and electrical tilt angles. The assessment in this report is based on all possible broadcast beam patterns.

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.

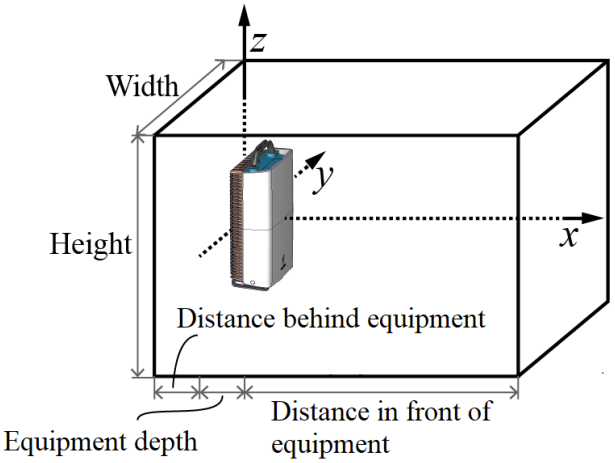

Figure 1 Box-shaped structure specifying the compliance boundary for the tested RBS product.

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

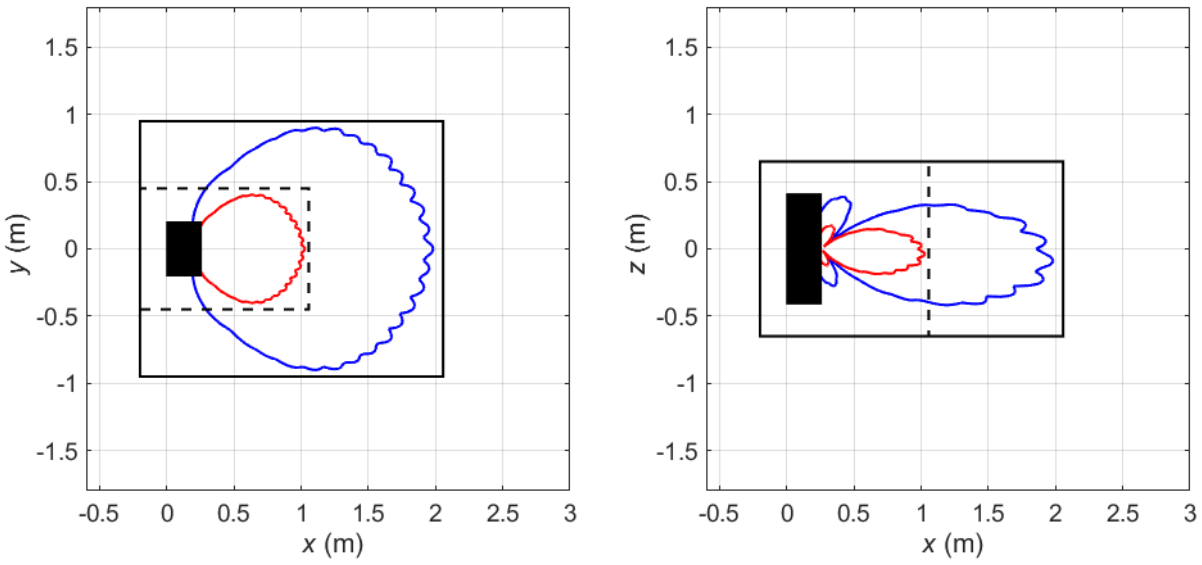

Figure 2 Compliance boundaries for general public exposure (black solid line) and occupational exposure (black dashed line) for the markets where the FCC limits apply. The blue solid lines correspond to compliance distance results for general public exposure obtained using the spherical models. The red solid lines indicate the corresponding compliance distance results for occupational exposure. The EUT is shown from above (left) and from the side (right) with its backplane located at $x = 0$ m. Mode: B48 (LTE). Maximum EIRP including tolerance and TDD DL duty cycle: 55.8 dBm.

Table 5 Dimensions of the box-shaped compliance boundary for general public (GP) and occupational (O) exposure for AIR 6488 B48 applicable in the USA and markets employing the FCC RF exposure limits. The compliance boundaries are determined for maximum total EIRP level with EIRP tolerance and TDD downlink duty cycle included.

Mode and EIRP AIR 6488						Dimensions of the box-shaped compliance boundary (m)							
						Distance in front of EUT		Width		Height		Distance behind EUT	
Band	Standard	Maximum EIRP	EIRP tolerance	TDD DL duty cycle	Exposure condition	GP	O	GP	O	GP	O	GP	O
B48	LTE	56 dBm	1 dB	75 %	Theoretical maximum	1.8	0.8	1.9	0.9	1.3	1.3	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 to 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 Conclusion

The Ericsson AIR 6488 B48 has been tested using methods and procedures specified in FCC OET Bulletin 65 [3] and IEC 62232:2022 [4]. The results in Section 5 show the compliance boundary dimensions of the product to be included in the Customer Product Information (CPI). 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), April 2020.

[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 Edition 3.0, “Determination of RF field strength, power density and SAR in the vicinity of base stations for the purpose of evaluating human exposure”, October 2022.

[5] Ericsson, GFTL-19:000424 Uen, "User manual of MSI compliance analyzer".

[6] Ericsson, GFTL-24:000928 Uen, “EMF Test Report: Ericsson AIR 6488 B48 NR (FCC)”.

[7] Ericsson, LME-12:001904 Uen, "Exposure to radio frequency electromagnetic fields".

9 Revision history

Rev.	Date	Description
A	2019-07-23	First revision
B	2019-08-20	Updated nomial peak output power from the radio, changed the compliance distance behind the EUT to be conistent with FCC requirements, and made some editorial changes in the test report.
C	2019-08-28	Added results for radio output power of 30.8 dBm (1.2 W).
D	2019-09-06	Updated compliance height results to have minimum separation distance of 20 cm from the EUT.
E	2019-09-20	Editorial changes to Appendix A.
F	2019-10-21	Editoral changes.
G	2024-07-15	Reconducted test based on 56 dBm maximum EIRP and 1 dB EIRP tolerance.

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 AIR 6488 is below the limits applicable in:

- USA (47 CFR 1.1310)

Information is provided for the theoretical maximum

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.

Mode and EIRP							Dimensions of the box-shaped compliance boundary[1][2][3](m)							
							Distance in front of AIR		Width		Height		Distance behind AIR	
Product	Standard	Maximum EIRP	IEC 62232 installation class	EIRP tolerance	TDD DL duty cycle	Exposure condition	GP	O	GP	O	GP	O	GP	O
AIR 6488 B48	LTE	56 dBm	E+	1 dB	75 %	Theoretical maximum	1.8	0.8	1.9	0.9	1.3	1.3	0.2	0.2

(1) The compliance boundaries are determined for maximum total EIRP with EIRP tolerance and TDD downlink duty cycle included.

(2) For LTE, the compliance boundaries are determined for 75% of the downlink resources allocated to traffic beams and 25% to the broadcast beam.

(3) For NR+LTE mixed mode, the results for NR apply.

Appendix B. Guidelines on how to install the product

The AIR 6488 B48 product (KRD 901 160/11, KRD 901 160/1) 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 the AIR 6488 B48 product (KRD 901 160/11, KRD 901 160/1), 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 [7].

Appendix D. Photograph/Sketch of the EUT