ERICSSON ≋

GFTL-19:000827 Uen, Rev E, 2019-09-20

Rapport utfärdad av ackrediterat provningslaboratorium	
Test report issued by an Accredited Testing Laboratory	

Ackred. Nr 1761
Provning
ISO/IEC 17025

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

Document number:	GFTL-19:000827 Uen Rev E	**Date of report:**	2019-09-20
Testing laboratory:	Ericsson EMF Research Laboratory Ericsson AB SE-164 80 Stockholm Sweden	**Company/Client:**	Kui Cui CBC - Ericsson (China) Communications Co. Ltd. Bldg 2, No.1366 Tianfu Avenue Middl Tianfu Software Park 610041 Chengdu China
Tests performed by:	Bo Xu Paramananda Joshi	**Dates of tests:**	2019-07-22 (Rev A) 2019-08-20 (Rev B) 2019-08-28 (Rev C) 2919-09-06 (Rev D and E)
Manufacturer and market name(s) of device:	Ericsson AIR 6488 B48		
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 AIR 6488 B48.		
Additional information:			

Signature:	Test Engineer	Test Engineer	Laboratory and Quality Manager
	_____ Bo Xu Experienced Researcher bo.xu@ericsson.com Tel: +46 10 713 13 84	_____ Paramananda Joshi Senior Researcher paramananda.joshi@ericsson.com Tel: +46 10 711 00 06	_____ Christer Törnevik Senior Expert – EMF and Health christer.tornevik@ericsson.com Tel: +46 10 714 12 35

GFTL-19:000827 Uen, Rev E, 2019-09-20

Summary of EMF Test Report[1]

Equipment under test (EUT)

Product name	AIR 6488 B48		
Product number	KRD 901 160/1, KRD 901 160/11, KRD 901 160/2, KRD 901 160/21		
Supported bands, Tx frequency range (MHz) and standards	B48 (3500)	3550–3700	LTE
Duplexing technology and fraction of downlink transmission time to total time	TDD (75%)		
Exposure environment	General public/uncontrolled, Workers/controlled		
EIRP[2] (dBm) and IEC 62232 installation class [4]	52.6, 63.8	E+, E+	

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 AIR 6488 B48 applicable in the markets employing the FCC exposure limits for maximum output power with power tolerance and TDD downlink duty cycle included.

Mode and output power for AIR 6488 B48					Dimensions of the box-shaped compliance boundary (m)							
					Distance in front of EUT		Width		Height		Distance behind EUT	
Band	Standard	Nominal peak output power from the radio	Power tolerance	TDD DL duty cycle	GP	W	GP	W	GP	W	GP	W
B48	LTE	30.8 dBm	1.5 dB	75 %	1.5	0.7	1.6	0.8	1.3	1.3	0.2	0.2
B48	LTE	42.0 dBm	1.5 dB	75 %	5.3	2.4	5.9	2.7	2.6	1.3	0.2	0.2

For the power levels specified in the table which include tolerances, 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 stated EIRP value is the maximum total EIRP with the TDD downlink duty cycle and without power tolerance included and are obtained using the antenna patterns provided by the client.

GFTL-19:000827 Uen, Rev E, 2019-09-20

1 General information

The test results presented in this report define compliance boundaries for AIR 6488 B48. Outside of 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, the power 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 nominal peak output power from the radio unit (total peak power from all antenna branches) and the total time-averaged power delivered to the antenna for two different power configurations. The total time-averaged power delivered to the antenna includes output power tolerance and TDD downlink duty cycle.

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	AIR 6488 B48	KRD 901 160/1, KRD 901 160/11, KRD 901 160/2, KRD 901 160/21	
Supported bands, Tx frequency range (MHz), and standards	B48 (3500)	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, Workers/controlled		
EIRP[2] (dBm) and IEC 62232 installation class [4]	52.6, 63.8	E+, E+	

Table 2 Properties of the antenna.

Product number	KRE 105 261
Type	Internal AAS
Number of polarizations	2
Gain[3] (dBi)	24.0
Horizontal HPBW[4] (degrees)	22°
Vertical HPBW[4] (degrees)	10°
Number of antenna elements (N_H, N_V)	(8, 8)
Element separation distance (Δ_H, Δ_V) (mm)	(44, 58)
Maximum scan range in horizontal plane (degrees)	±60°
Maximum scan range in vertical plane (degrees)	73°–113°

---

[3] The stated gain value is the maximum gain of the antenna within the tested frequency range.
[4] The stated half-power beam widths are for the broadside beam in the reference direction $(\theta, \phi) = (93°, 0°)$.

ERICSSON

GFTL-19:000827 Uen, Rev E, 2019-09-20

Table 3   EUT configurations with nominal peak output power levels and total time-averaged power levels including an output power tolerance and TDD downlink duty cycle.

Band	Standard	Nominal peak output power from the radio (dBm/W)	Power tolerance (dB)	TDD downlink duty cycle	Total time-averaged power delivered to antenna (dBm/W)
B48	LTE	30.8 / 1.2	1.5	75%	31.1 / 1.3
B48	LTE	42.0 / 16	1.5	75%	42.3 / 16.9

3   Exposure conditions

The EUT is intended to be installed on roof-tops, masts, walls, poles 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.

Different factors, such as beam scanning in elevation and azimuth, RBS utilization, and scheduling time are reasonably foreseeable and will significantly reduce the time-averaged power and the RF exposure. These factors were, however, 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 [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:

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

where $S, P_{\mathrm{a}}, G, r, \theta,$ and ϕ denote the power density, the total time-averaged power accepted by antenna, the antenna gain, the distance from the antenna, and the angular variables in a spherical coordinate system, respectively.

The AIR 6488 B48 DL broadcast and traffic beams can be configured to handle three sector shapes denoted as Macro, Hotspot, and Highrise. Each of these configurations is characterized by different gain values, beamwidths and electrical tilt angles as given in Table 4. The assessment in this report is based on the 3° downtilt Macro sector shape configuration, which provides the same downtilt as the broadside traffic beam, the maximum gain among the broadcast beams, and therefore the largest front compliance distances.

Part of the transmit power, corresponding to 25% of P_{a} is used for the broadcast beam whereas the remaining 75% is used for traffic:

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

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

where $G_{\mathrm{broadcast}}$ and G_{traffic} denote the antenna gain for the broadcast and envelope traffic beams. While the beam for the broadcast channel is fixed, 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 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 Band 48. 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 24.0 dBi. The maximum gain values of the broadcast beams for 3° downtilt Macro sector shape was found to be 17.1 dBi.

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

$$S_{\text{total,sph}} = S_{\text{sph,broadcast}} + S_{\text{sph,traffic}}$$

The compliance distance for the spherical model, $\text{CD}_{\text{sph}}(\theta, \phi)$ 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 $S_{\text{gp,w}}^{\text{lim}}$ denotes the FCC power density reference levels for general public and workers exposure. RF EMF exposure limits are given in Table 5 [1].

Table 4   Beamwidths of DL broadcast beams [5]

Sector Shapes	Vertical Beamwidth	Horizontal Beamwidth	Vertical downtilt
Macro	10°	65°	-8°–8°
Hotspot	30°	65°	3°
Highrise	30°	20°	3°

Table 5   RF EMF exposure limits on power density for the frequency band used by the EUT [1].

Band	$S_{\text{gp}}^{\text{lim}}$ (W/m^2)	$S_{\text{w}}^{\text{lim}}$ (W/m^2)
B48 (3500)	10	50

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 EUT 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.
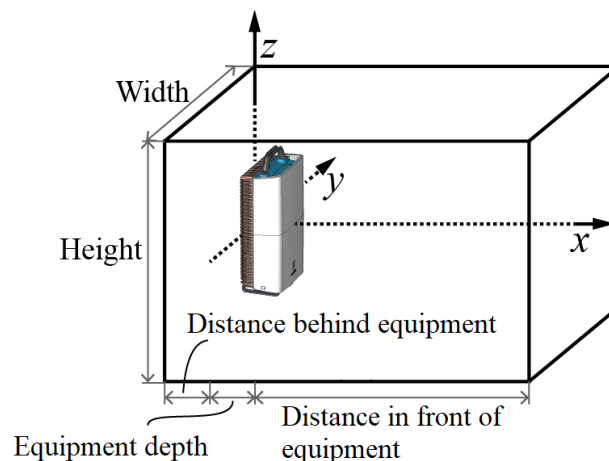

Figure 1   Box-shaped structure specifying the compliance boundary for the tested RBS product.

In Figure 2 and Figure 3, the compliance distance results for general public (blue line) and workers (red line) exposure are given for the power configurations specified in Table 3. The results are provided for the FCC exposure limits. 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 6 rounded upwards to the nearest decimeter.
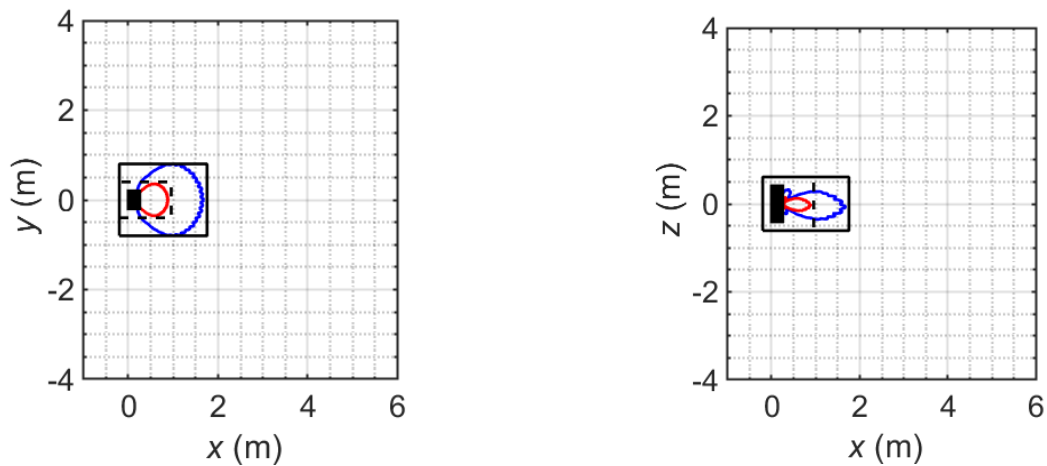
Figure 2 Compliance boundaries for general public (black solid line) and workers (black dashed line) exposure for the markets where the FCC exposure limits apply. The blue solid lines correspond to compliance distance results for general public exposure obtained using the spherical models. The solid red lines indicate the corresponding compliance distance results for workers exposure. The antenna is shown from above (left) and from the side (right) with its backplane located at $x = 0$ m. Mode: B48 (3500 MHz) (LTE). Total time-averaged power delivered to the antenna: 31.1 dBm.
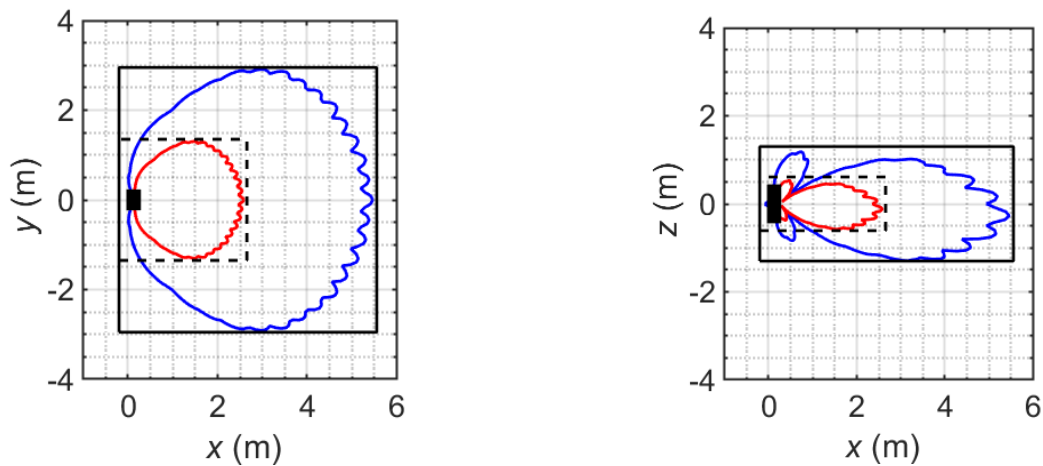

Figure 3 Compliance boundaries for general public (black solid line) and workers (black dashed line) exposure for the markets where the FCC exposure limits apply. The blue solid lines correspond to compliance distance results for general public exposure obtained using the spherical models. The solid red lines indicate the corresponding compliance distance results for workers exposure. The antenna is shown from above (left) and from the side (right) with its backplane located at $x = 0$ m. Mode: B48 (3500 MHz) (LTE). Total time-averaged power delivered to the antenna: 42.3 dBm.

Table 6 Dimensions of the box-shaped compliance boundary for general public (GP) and workers (W) exposure for AIR 6488 B48 applicable in the markets employing the FCC exposure limits for maximum output power with power tolerance and TDD downlink duty cycle included.

Mode and output power for AIR 6488 B48					Dimensions of the box-shaped compliance boundary (m)							
					Distance in front of EUT		Width		Height		Distance behind EUT	
Band	Standard	Nominal peak output power from the radio	Power tolerance	TDD DL duty cycle	GP	W	GP	W	GP	W	GP	W
B48	LTE	30.8 dBm	1.5 dB	75 %	1.5	0.7	1.6	0.8	1.3	1.3	0.2	0.2
B48	LTE	42.0 dBm	1.5 dB	75 %	5.3	2.4	5.9	2.7	2.6	1.3	0.2	0.2

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

GFTL-19:000827 Uen, Rev E, 2019-09-20

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 Conclusion

The Ericsson AIR 6488 B48 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 for two different power configurations 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] 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, 1/155 02-KRD 901 098/11 Uen, "Active antenna system description AIR6488 B48".

[6] 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.

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 exposure condition.

Table A.1 Dimensions of the box-shaped compliance boundary for general public (GP) and occupational (O) exposure for AIR 6488 applicable in USA and markets employing the FCC exposure limits.

Mode and output power for AIR 6488						Dimensions of the box-shaped compliance boundary[1] (m)							
						Distance in front of AIR		Width		Height		Distance behind AIR	
Band	Standard	Nominal peak output power from the AIR	IEC 62232 Installation class	Power tolerance	TDD DL duty cycle	GP	O	GP	O	GP	O	GP	O
B48	LTE	30.8 dBm	E+	1.5 dB	75 %	1.5	0.7	1.6	0.8	1.3	1.3	0.2	0.2
B48	LTE	42.0 dBm	E+	1.5 dB	75 %	5.3	2.4	5.9	2.7	2.6	1.3	0.2	0.2

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

GFTL-19:000827 Uen, Rev E, 2019-09-20

Appendix B. Guidelines on how to install the product

The AIR 6488 B48 product (KRD 901 160/1, KRD 901 160/11, KRD 901 160/2, KRD 901 160/21) 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.

GFTL-19:000827 Uen, Rev E, 2019-09-20

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

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 [6].