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Test report issued by an Accredited Testing Laboratory

EMF Test Report: RBS 2409 V1 (KRC 161 175/3)

Document number:	EAB-08:076421 Uen Rev A	**Date of report:**	2008-11-14
Testing laboratory:	Ericsson EMF Research laboratory Ericsson AB SE-164 80 Stockholm Sweden	**Company/Client:**	Qing Lin (CBC/XRX) Phone: +86 10 84767400 No.5 Lize East Street, Chaoyang District 100102 Beijing China
Tests performed by:	Björn Hansson	**Date of tests:**	10/11/08 PCS 1900
Manufacturer and market name(s) of device:	Ericsson RBS 2409 V1		
Testing has been performed in accordance with:	European standards: EN 50383, EN 50384, EN 50385		
Test results:	The tested equipment complies with the requirements in respect of all parameters subject to the test.		
Additional information:	Compliance assessments against both ICNIRP guidelines (1998) and IEEE C95.1 (2006) SAR limits. By inclusion of recommended EMF health and safety information (attached to this report) in the product documentation the tested equipment complies with the documentation requirements listed in clause 7 of EN 50384 and EN 50385		

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Summary of test results[1]

Equipment under test (EUT)

Product name	Ericsson RBS 2409 V1
Product number	KRC 161 175/3
Type	Pico Radio Base Station
Frequency range (MHz)	1930.2 – 1989.8 (PCS 1900)

Results

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

Configuration		**Compliance distance[2] (mm)**	
Band	**Antenna**	**GP**	**O**
PCS 1900	Default antenna (internal)	<7	<7

Expanded uncertainty[3] (k=2) 95 %	± 21.9 % (1g SAR) ± 21.4 % (10g SAR)

[1] This page contains a summary of the test results. The full report provides a complete description of all test details and results.
[2] This distance is defined as the minimum distance to the tested device, i.e. to the device front cover.
[3] The uncertainty refers to SAR measurements (see Section 6)

1 General information

The test results presented in this report define compliance boundaries for the Ericsson RBS 2409 V1 at downlink transmission in the PCS 1900 frequency band, in accordance with Ericsson RF exposure requirements [1]. All tests were performed using maximum output power (GMSK mode and BCCH filling, i.e. 8 timeslots). Outside of the presented compliance boundaries the radio frequency (RF) exposure levels are below the appropriate recommendations and limits [2] - [6] .

The tests were performed by measurements in accordance with the Ericsson SAR measurement procedure for base stations [7] and the European standard EN 50383[4] [8].

2 Equipment under test

The table below summarizes the technical data for the equipment under test.
Photographs of the device are presented in Appendix A.

Product name	RBS 2409 V1
Product number	KRC161 175/3
Serial number of tested unit	CB47672912
Mode(s) covered by this report	GSM 1900, GMSK, 8-PSK
Antenna(s)	Default antenna (internal)
Maximum output power level[5] (dBm)	GSM 1900, GMSK: 25.0 GSM 1900, 8-PSK: 25.0
Duty cycle(s)	1-8 timeslots, tested at 8, i.e. duty cycle = 1
Transmitter frequency range (MHz)	GSM 1900: 1930.2 – 1989.8
Hardware revision	R1A

[4] EN50383 covers radio base stations and fixed terminal stations.
[5] Conservative measure of the maximum possible output power level at the antenna port i.e. the nominal output power level plus the tolerance in production.

3 Test equipment

The SAR measurements were performed using a flat phantom from APREL Laboratories together with the DASY4 professional near-field scanner by Schmid & Partner Engineering AG. An uncertainty budget including total uncertainty (k=1) and expanded uncertainty (k=2) for 1g and 10g SAR assessments is found in section 6.

The equipment list is given below in Tables 1-2. In Appendix C, calibration parameters for the SAR test probe is listed.

Table 1. SAR test equipment.

Description	Asset number	Calibration due date
DASY4 DAE3	S/N 422	14/4/09
E-field probe, ES3DV3	S/N 3113	14/9/09
Dipole validation kit, D2000V2	S/N 1003	NA
Universal flat phantom	S/N 513C-145-5	NA

Table 2. Additional equipment.

Description	Asset number	Calibration due date
Dielectric probe kit, HP 85070C	S/N US99360060	NA
Network analyzer, Agilent E5071C	S/N MY46104892	02/07/09
Power meter, R&S NRVS	S/N 848888/052	28/05/09
Power sensor, R&S NRV-Z5	S/N 849895/030	28/05/09
Thermometer, EBRO TFX-392SKWT	S/N 10130918	20/10/09
Digital radio tester, R&S CMU-200	S/N 107639	27/05/09
Spectrum analyzer, R&S FSIQ 26	Inv no: 633275	16/05/09

4 Electrical parameters of the tissue simulating liquid

The parameters of the tissue simulating liquid were measured with the dielectric probe kit prior to the SAR measurements and the results are shown in Table 3.

The measured values were within 5% of the specified values in IEC 62209 [9] and the mass density of the liquid entered into the DASY4 program was 1000 kg/m^3. The depth of the tissue liquid in the phantom was 100 mm ±5%.

Table 3. Measured and specified parameter values for the tissue simulating liquid.

Frequency (MHz)	Measured/Specified	ε_r	σ (S/m)	Liquid Temp (°C)
2000	Measured values	38.6	1.46	22.5
	Specified values [9]	40.0	1.4	--
	Difference (%)	-3.5	+4.3	--

5 System performance check

A system performance check of the SAR test system was conducted prior to the SAR measurements, using the D2000v2 dipole validation kit. The obtained results are displayed in Table 4 and the results are within ±10% of the calculated reference values [10] as required in CENELEC EN 50383 [8]. The temperature of the test facility during the tests was 21°C to 23°C.

Table 4. Measured and specified SAR levels for the system performance check.

Frequency (MHz)	Measured/ Reference	SAR 1g (W/kg)	SAR 10g (W/kg)	ε_r	σ (S/m)	Date
2000	Measured	12.5	7.2	38.6	1.46	10/11/08
	Reference [9]	13.8	8.0	40.0	1.4	--
	Difference (%)	-9.2	-9.4	-3.5	+4.3	--

6 Uncertainty evaluation of SAR measurement system DASY4 according to IEC 62209-1 [9] and IEEE 1528 [11]

Uncertainty Component	Section in IEEE 1528	Uncer. (%)	Prob Dist.	Div.	$C_{i,1g}$	$C_{i,10g}$	Std. Uncer. (1g) (%)	Std. Uncer. (10g) (%)
Measurement System								
Probe Calibration	E2.1	±5.9	N	1	1	1	±5.9	±5.9
Axial Isotropy	E2.2	±4.7	R	√3	0.7	0.7	±1.9	±1.9
Spherical Isotropy	E2.2	±9.6	R	√3	0.7	0.7	±3.9	±3.9
Boundary Effect	E2.3	±1.0	R	√3	1	1	±0.6	±0.6
Linearity	E2.4	±4.7	R	√3	1	1	±2.7	±2.7
System Detection Limits	E2.5	±1.0	R	√3	1	1	±0.6	±0.6
Readout electronics	E2.6	±0.3	N	1	1	1	±0.3	±0.3
Response time	E2.7	±0.8	R	√3	1	1	±0.5	±0.5
Integration time	E2.8	±2.6	R	√3	1	1	±1.5	±1.5
RF Ambient Noise	E6.1	±3.0	R	√3	1	1	±1.7	±1.7
RF Ambient Reflections	E6.1	±3.0	R	√3	1	1	±1.7	±1.7
Probe Positioner	E6.2	±0.4	R	√3	1	1	±0.2	±0.2
Probe Positioning	E6.3	±2.9	R	√3	1	1	±1.7	±1.7
Max. SAR Evaluation	E5	±1.0	R	√3	1	1	±0.6	±0.6
Measurement System Uncertainty							±8.6	±8.6
Test Sample Related								
Device positioning	E4.2	±2.9	N	1	1	1	±2.9	±2.9
Device holder uncertainty	E4.1	±3.6	N	1	1	1	±3.6	±3.6
Power drift	6.6.3	±5.0	R	√3	1	1	±2.9	±2.9
Test Sample Related Uncertainty							±5.5	±5.5
Phantom and Tissue Parameters								
Phantom uncertainty	E3.1	±4.0	R	√3	1	1	±2.3	±2.3
Liquid conductivity (meas uncertainty)	E3.3	±2.5	N	1	0.64	0.43	±1.6	±1.1
Liquid conductivity (target)	E3.2	±5.0	R	√3	0.64	0.43	±1.8	±1.2
Liquid Permittivity (meas uncertainty)	E3.3	±2.5	N	1	0.6	0.49	±1.5	±1.2
Liquid Permittivity (target)	E3.2	±5.0	R	√3	0.6	0.49	±1.7	±1.4
Phantom and Tissue Parameters Uncertainty							±4.9	±3.4
Combined standard uncertainty							**±10.9**	**±10.7**
Extended standard uncertainty (k=2)							**±21.9**	**±21.4**

7 Test configurations

The EUT, using its internal default antenna, was first tested at the middle channel of the frequency band for the two requested transmission modes GMSK and 8-PSK. For the mode giving the highest SAR value the EUT was then tested at the lowest and the highest traffic channel. The EUT was positioned horizontally with the front facing upwards as close as possible to the phantom, i.e. the minimum separation between the EUT and the liquid surface was 7 mm (phantom shell thickness 6.9±0.2mm). Other test positions were not considered since the RF emissions in those directions are insignificant. Pictures of the EUT positioned for SAR measurements are shown in Appendix A.

Radio parameters such as output power, channel setting and timeslot configuration were controlled using RBS Master 2[6]. This system was connected to the EUT via an Ethernet interface during all tests.

8 Results

Table 5 shows the 1g and 10g averaged SAR results for the EUT when tested for the different modes and channels. In addition to measured SAR, values normalized to maximum output power including tolerances are given. All SAR values include a correction factor of two as defined in [8]. Appendix B includes pictures of the SAR distributions measured for each tested mode.

Table 5. Measured SAR in the PCS 1900 frequency band.

Configuration	EUT position	Distance to phantom (mm)	Channel	Measured output power (dBm)	Max SAR_{1g} (W/kg)	
					Measured	Normalized to max power, 25.0 dBm
PCS 1900 (8TX, 8-PSK) Default antenna	Horizontal	0	661	23.3	0.62	0.91
PCS 1900 (8TX, GMSK) Default antenna	Horizontal	0	512	23.2	0.78	1.18
			661	23.1	0.76	1.18
			810	23.3	0.70	1.04

All SAR results for device-phantom distance 0 mm were in compliance with the applicable exposure limits. This gives an actual compliance distance less than the phantom thickness, see Table 6.

Table 6. Compliance distances for general public (GP) and occupational (O) exposure for the specified configurations.

Configuration		Compliance distance[7] (mm)	
Band	**Antenna**	**GP**	**O**
PCS 1900	Default antenna	<7	<7

[6] Ericsson equipment for setting output power, modulation, frequency, etc.
[7] This distance is defined as the minimum distance to the tested device, i.e. to the device front cover.

9 Conclusion

The tests show that the Ericsson RBS 2409 V1 operating in the GSM 1900 band is in compliance with the general public and occupational RF exposure limits at a distance of less than 7 mm.

10 References

[1] EAB-05:013996, “RF exposure assessment requirements for Ericsson RBS products”.

[2] ICNIRP, “Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)”, International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Physics, vol. 74, pp 494-522, April 1998.

[3] ANSI/IEEE Std C95.1-2005 (Revision of IEEE Std C95.1-1991), “Safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz”, The Institute of Electrical and Electronics Engineers Inc., New York, 2006.

[4] Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 HZ to 300 GHz) (Official Journal L 197 of 30 July 1999).

[5] CENELEC EN 50384, “Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) – Occupational”, European Committee for Electrotechnical Standardization (CENELEC), August 2002.

[6] CENELEC EN 50385, “Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) – General public”, European Committee for Electrotechnical Standardization (CENELEC), August 2002.

[7] ERA/TF-02:058, “Ericsson SAR Measurement Specification of Radio Base Stations”.

[8] CENELEC EN 50383, “Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz – 40 MHz)”, European Committee for Electrotechnical Standardization (CENELEC), August 2002.

[9] IEC 62209-1, “Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)”, International Electrotechnical Commission (IEC), February 2005.

[10] EAB/TF-03:062, “Calculation of reference SAR values for system performance checks using the Universal flat phantom”.

[11] IEEE, Standard 1528, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.”, The Institute for Electrical and Electronics Engineers (IEEE) Inc., June 2003.

APPENDIX A: Photographs of the EUT

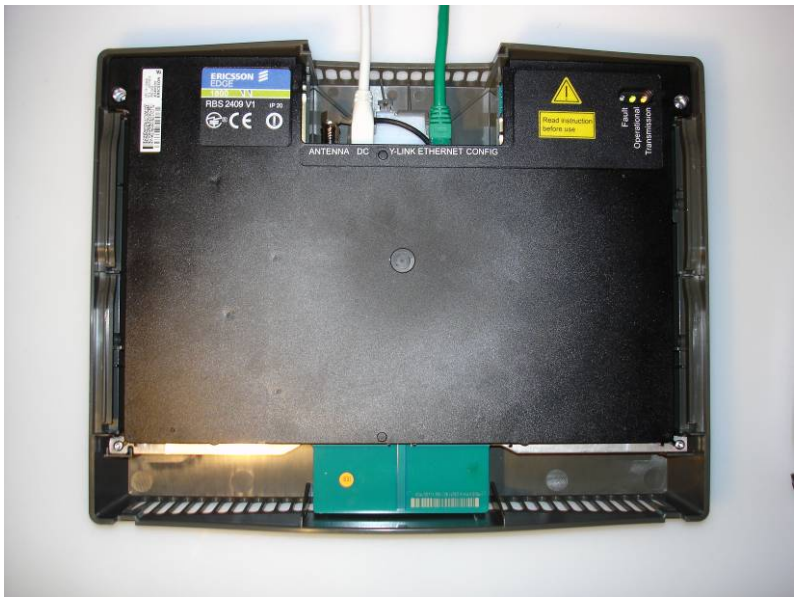
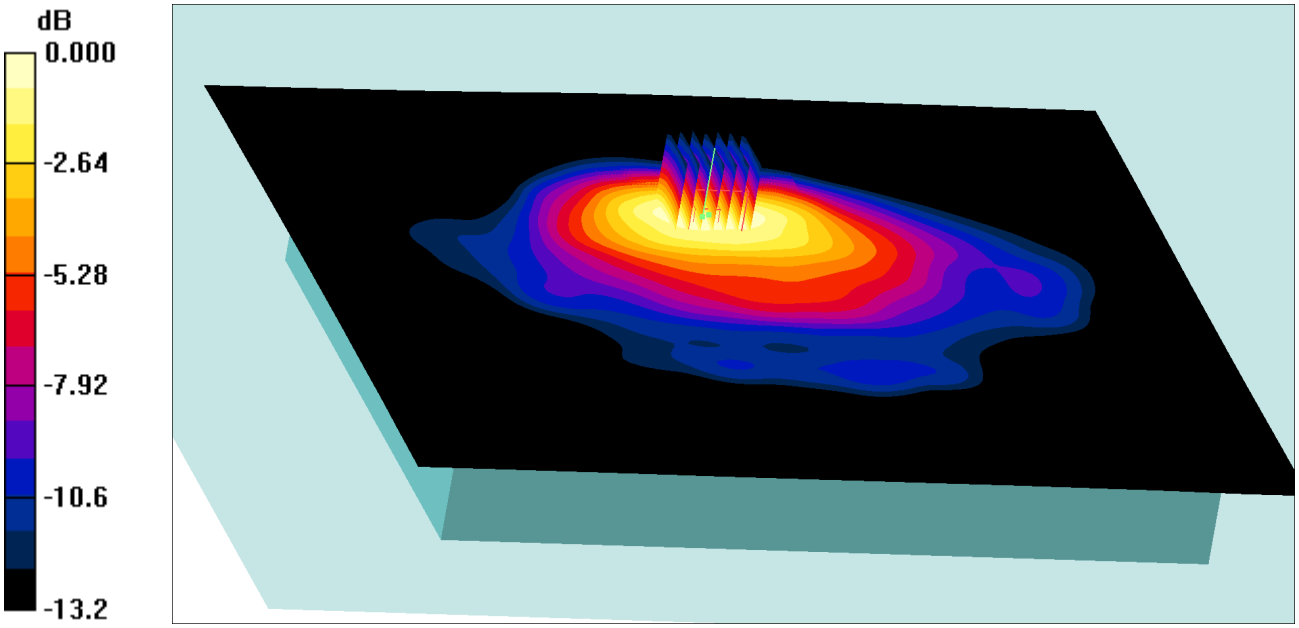


Figure A.1 Picture of the EUT with housing cover removed.

Figure A.2 View from above with the EUT, equipped with Default antenna, positioned horizontally touching the phantom shell.

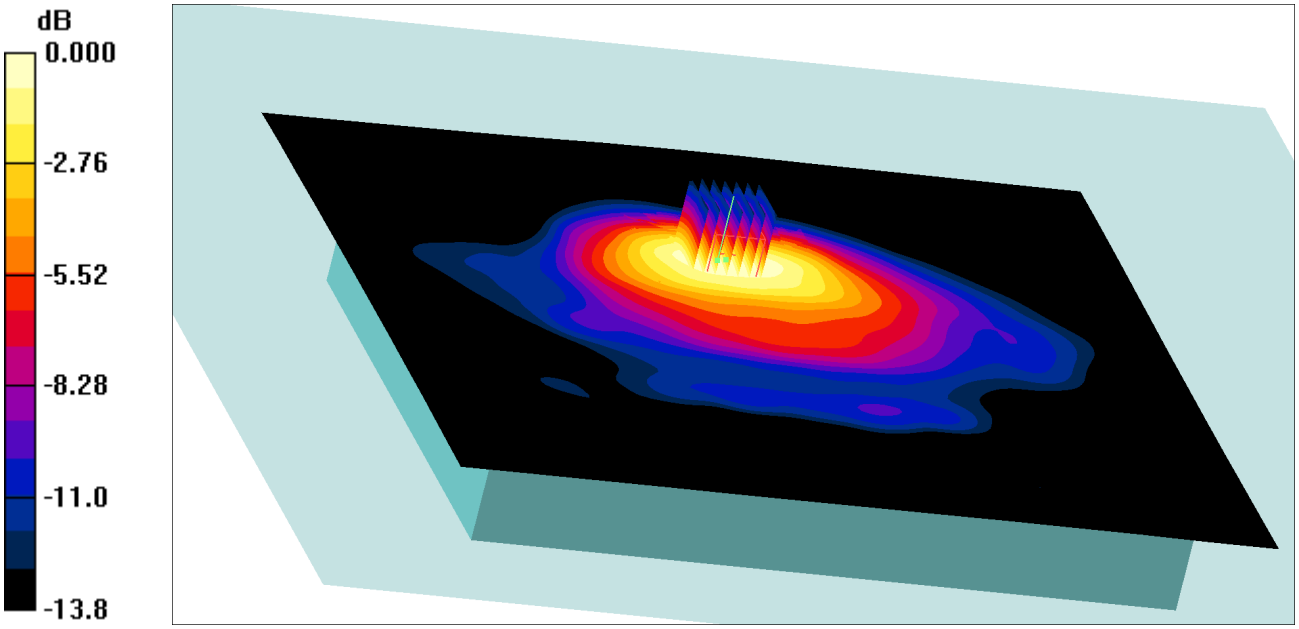
Figure A.3 View from below with the EUT positioned horizontally touching the phantom shell.

APPENDIX B: SAR distribution plots



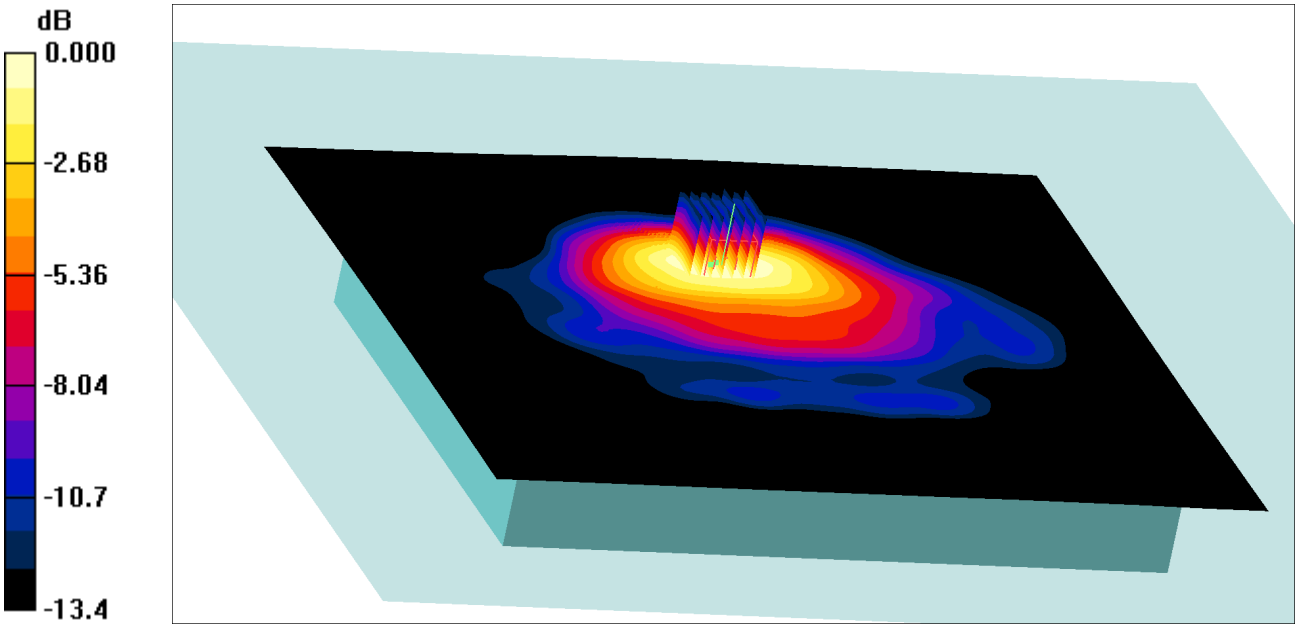
0 dB = 0.42mW/g

Figure B.1 Front view of the EUT showing the SAR distribution and volume scan for GMSK transission at channel 512 in the PCS 1900 band. The EUT was positioned horizontally touching the phantom shell.



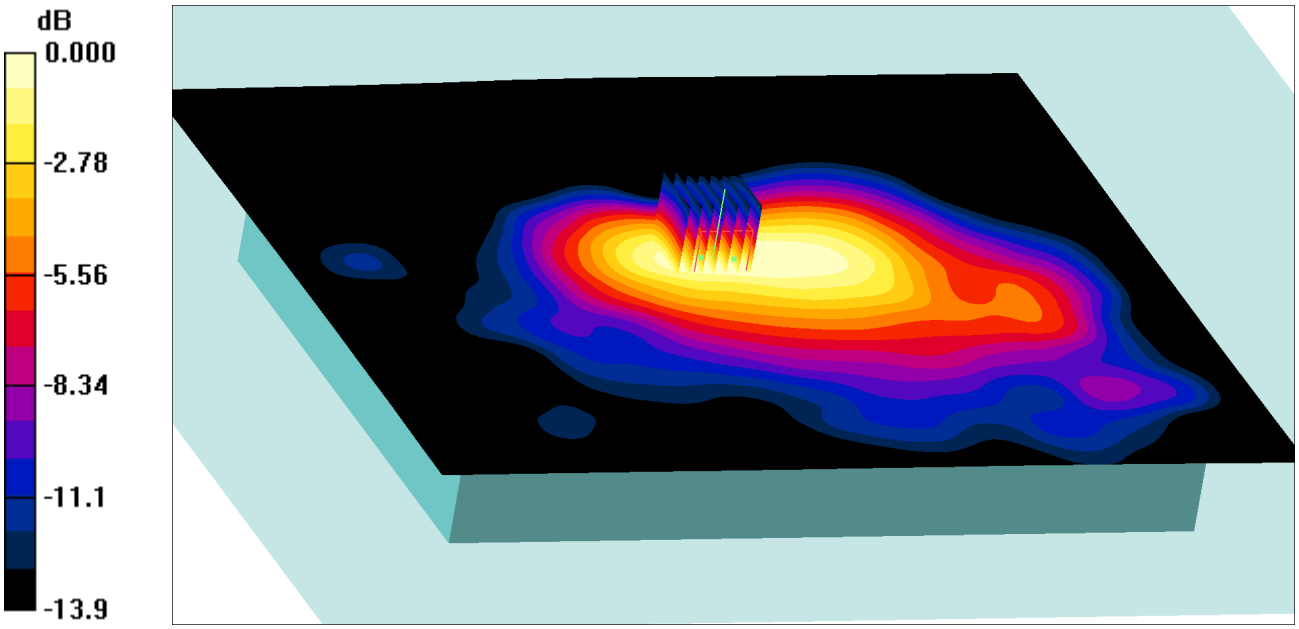
0 dB = 0.41mW/g

Figure B.2 Front view of the EUT showing the SAR distribution and volume scan for GMSK transission at channel 661 in the PCS 1900 band. The EUT was positioned horizontally touching the phantom shell.



0 dB = 0.38mW/g

Figure B.3 Front view of the EUT showing the SAR distribution and volume scan for GMSK transission at channel 810 in the PCS 1900 band. The EUT was positioned horizontally touching the phantom shell.



0 dB = 0.33mW/g

Figure B.4 Front view of the EUT showing the SAR distribution and volume scan for 8-PSK transission at channel 661 in the PCS 1900 band. The EUT was positioned horizontally touching the phantom shell.

Appendix C: Probe calibration parameters for ES3DV3 SN: 3113

Diode compression:

Parameter	Value in mV
DCP X	93
DCP Y	94
DCP Z	94

Sensitivity in free space:

Parameter	Value in $\mu V/(V/m)^2$
Norm X	1.17
Norm Y	1.12
Norm Z	1.28

Sensitivity in tissue simulating liquid:

Head 2000 MHz; ε_r=40.0 ± 5%, σ=1.4± 5% S/m.

Parameter	Value
ConvF X	4.85
ConvF Y	4.85
ConvF Z	4.85

Probe tip to sensor center: 2.0 mm

Appendix D:

Radio Wave Exposure Information

The Ericsson RBS2409 V1 is a Pico radio base station. During use, it emits low levels of radio frequency energy (also known as radio waves or radio frequency fields).

Governments around the world have adopted comprehensive international safety guidelines, developed by scientific organizations, e.g. ICNIRP (International Commission on Non-lonizing Radiation Protection) and IEEE (The Institute of Electrical and Electronics Engineers Inc.) through periodic and thorough evaluation of scientific studies.

These guidelines establish permitted levels of radio wave exposure for the general population. The levels include a safety margin designed to assure the safety of all persons, regardless of age and health, and to account for any variations in measurements.

Specific Absorption Rate (SAR) is the unit of measurement for the amount of radio frequency energy absorbed by the body. The SAR level for this product was determined at the highest certified level in laboratory conditions using a measurement standard published by the European Committee for Electrotechnical Standardization (CENELEC).

With the default internal antenna solution recommended by Ericsson, the maximum radio wave exposure is below the limit in the international safety guidelines within a centimeter from the device. Consequently, for recommended placement of the device, the radio wave exposure levels are below the limits.

More information on radio frequency exposure can be found on:
http://www.ericsson.com/health