

Uppgjord (även faktaansvarig om annan) - Prepared (also subject responsible if other)		Nr - No.	
LD/ECS/GT/NFA Ramadan Plicanic		GT/NFA 00:016	
Dokansv/Godk - Doc respons/Approved	Kontr - Checked	Datum - Date	Rev
LD/ECS/GT/NFAC Thomas Bolin		2000-03-10	A

SAR Test Report: R290 Satellite

Date of test: October 28, 1999

Laboratory: Electromagnetic Near Field and Radio Frequency Dosimetry
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Statement of Compliance

Ericsson Mobile Communications AB, declares under its sole responsibility that the product

OHL R290 SAT (Ericsson R290 Satellite)

to which this declaration relates, is in conformity with the requirements of FCC Report and Order ET Docket No. 93-62 for the uncontrolled exposure environment. It also declares that the product was tested in accordance with the guideline FCC OET Bulletin 65, Supplement C(edition 97-01) under its classification as a portable device.

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1 Introduction

Under Federal Communications Commission rules set forth in 1996[1], portable radio transmitters, such as the device under test (DUT) in this test report, "are subject to routine environmental evaluation RF exposure prior to equipment authorization or use." According to these rules, the DUT is classified as a "portable device" and must comply with exposure limits for the general population, or "uncontrolled exposure" environment. Compliance is demonstrated by determining that the spatial peak SAR does not exceed 1.6 W/kg as averaged over 1 gram cube of tissue.

In this test report, compliance of the Ericsson R290 Satellite portable telephone with the above-mentioned exposure limits is demonstrated. The device was tested in accordance with FCC guideline [2]. Detailed procedures of the test are described in the *Ericsson SAR Measurement Specifications* [3].

2 Device Under Test

2.1 Antenna description

Type	Swivel	
Location	Left and back	
Dimension	Length	120mm
	Diameter at base	12mm
Configuration		

2.2 Device description

Device model	R290 Satellite
Serial number	GA2BO454t4
Mode	Satellite
Multiple Access Scheme	CDMA
Maximum Output Power Setting	26dBm
Factory Tolerance in Power Setting	±0.5dB
Maximum Peak Output Power	26.5dBm
Duty Cycle	1
Transmitting Frequency Range	1610.73–1625.49MHz
Prototype or Production Unit	Prototype

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3 Test Equipment

3.1 Dosimetric System

SAR measurements were made using the DASY3 professional system (software version 3.1c) manufactured by Schmid & Partner Engineering AG and installed June, 1996. The total SAR assessment uncertainty (K=1) of the system is $\pm 16\%$ and includes a +15% offset (overestimation). The extended uncertainty (K=2) is $\pm 32\%$ with a +15% offset. This results in a total uncertainty range of -1% to $+31\%$ for K=1, or -17% to $+47\%$ for K=2. The equipment list is given below.

<u>Description</u>	<u>Serial Number</u>	<u>Due Date</u>
DASY3 DAE V2	215	2000/04
E-Field Probe ETDV4	1101	2000/04
Dipole Validation Kit D900V2	004	2000/04
Dipole Validation Kit, D1800V2	228	2000/04

3.2 Additional Equipment

<u>Description</u>	<u>Serial Number</u>	<u>Due Date</u>
Signal Generator		
Power Amplifier		
Dielectric Probe Kit HP 85070B	Inv. 443029	2000/04
Network Analyzer HP 8753C	Inv. 421670	2000/12
Power Meter R&S NRVD	Inv. 483920	2001/12
Power Sensor R&S NRV-Z5	Inv. 2334	2001/12
Base Station Simulator Wavetek 4106 GPP	Inv. 462991	2000/04

4 Electrical Parameters of the Tissue Simulating Liquid

Prior to conducting SAR measurement, the relative permittivity, ϵ_r , and the conductivity, σ , of the tissue simulating liquid were measured with the dielectric probe kit. The mass density, ρ , used by the DASY3 program is also given. These values are shown in the table below. FCC recommended limits for maximum permittivity, minimum conductivity and maximum mass density are also shown [4]. It is seen that the measured parameters satisfy the recommended limits, resulting in an overestimation of SAR.

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f(MHz)	Limits/Measured	Dielectric Parameters		
		ϵ_r	σ (S/m)	ρ (g/cm ³)
1800	Measured	38.2	1.68	1.03
	Recommended Limits[4]	43.5	1.15	1.03
	Difference	- 9.9%	+ 46.1%	0%

5 System Accuracy Verification

A system accuracy verification of the DASY3 was performed using the dipole validation kit listed in Section 3.1. The system verification test was conducted on the same day as the measurement of the DUT. The obtained results are displayed in the table below. It is seen that the system is operating within its specification, as the results are within $\pm 5\%$ of the reference values obtained from the system manufacturer [5]. The SAR distribution also compares well with that provided by the system manufacturer (see Appendix 1).

f(MHz)	Measured	SAR(W/kg) 1 gram	Dielectric Parameters			Temp. (°C)
	Reference		ϵ_r	σ (S/m)	ρ (g/cm ³)	
1800	Measured	38.1	38.2	1.68	1.03	24.1
	Reference[5]	39.1	41.2	1.71	1.00	?

6 Test Results

The conducted output power and the SAR values are shown in table below. The device was tested on both the right hand phantom and left hand phantom, on one frequency for three different antenna positions. The SAR results shown are maximum SAR values averaged over 1g of tissue. A test program was used to control the device during the SAR measurement. The phone was supplied with power box under test. The temperature of the test facility during the tests was 24 ± 1 °C, and the depth of the tissue simulating liquid was 12.9cm.

Mode	f(MHz)	Antenna Position	Output Power (dBm)	SAR (W/kg) in 1g mass	
				Right Hand Section	Left Hand Section
Satellite	1618.11	90deg Left	27.4	0.0097	0.0187
		45deg Left	27.4	0.0094	0.0048
		45deg Right	27.4	0.0124	0.0066

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References

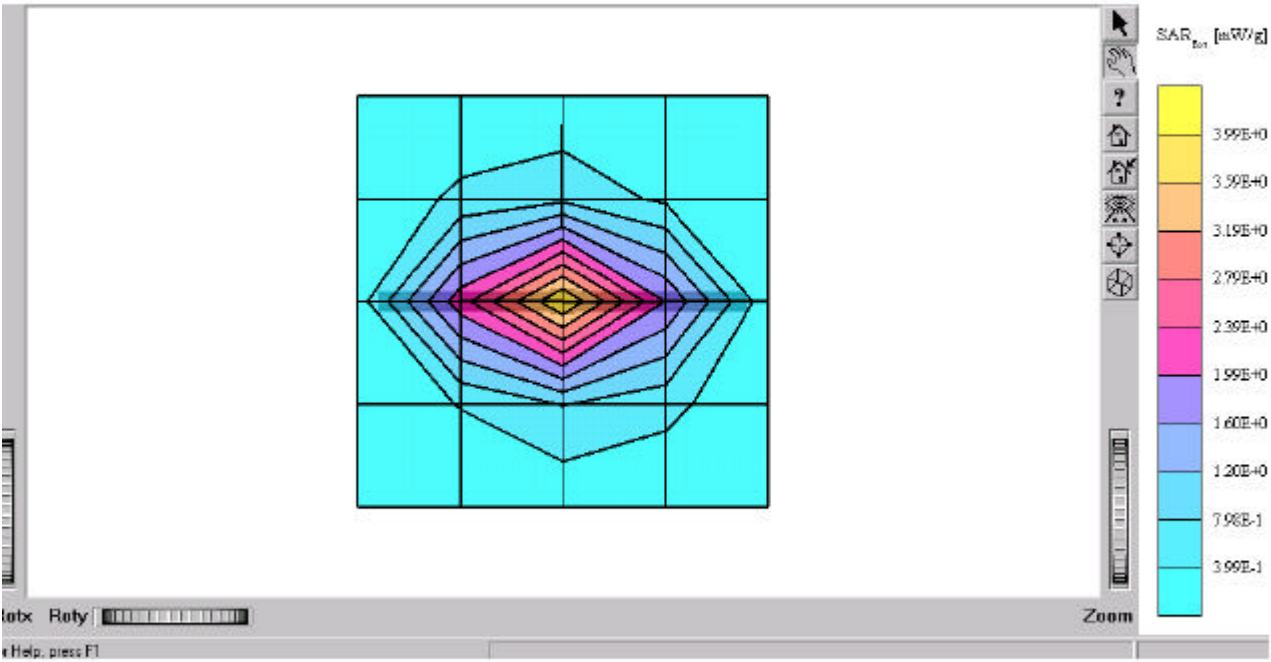
- [1] Federal Communications Commission, "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation", Report and Order ET Docket No. 93-62, August, 1996.
- [2] Kwok Chan, Robert F. Cleveland, Jr. and David L. Means, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," Office of Engineering and Technology Bulletin 65, Edition 97-01, December, 1997.
- [3] C. Törnevik, M. Siegbahn, T. Persson, M. Douglas and R. Plicanic, "Ericsson SAR Measurement Specification", Internal Document ERA/T/U-98:442, February 1999.
- [4] Federal Communications Commission, "Tissue Dielectric Properties", <http://www.fcc.gov/fcc-bin/dielec.sh> .
- [5] Schmid and Partner Engineering AG, "DASY Dipole Validation Kit", Type: D1800V2, SN:228, Mars, 1998.

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Appendix 1: SAR Distribution Comparison for System Accuracy Verification

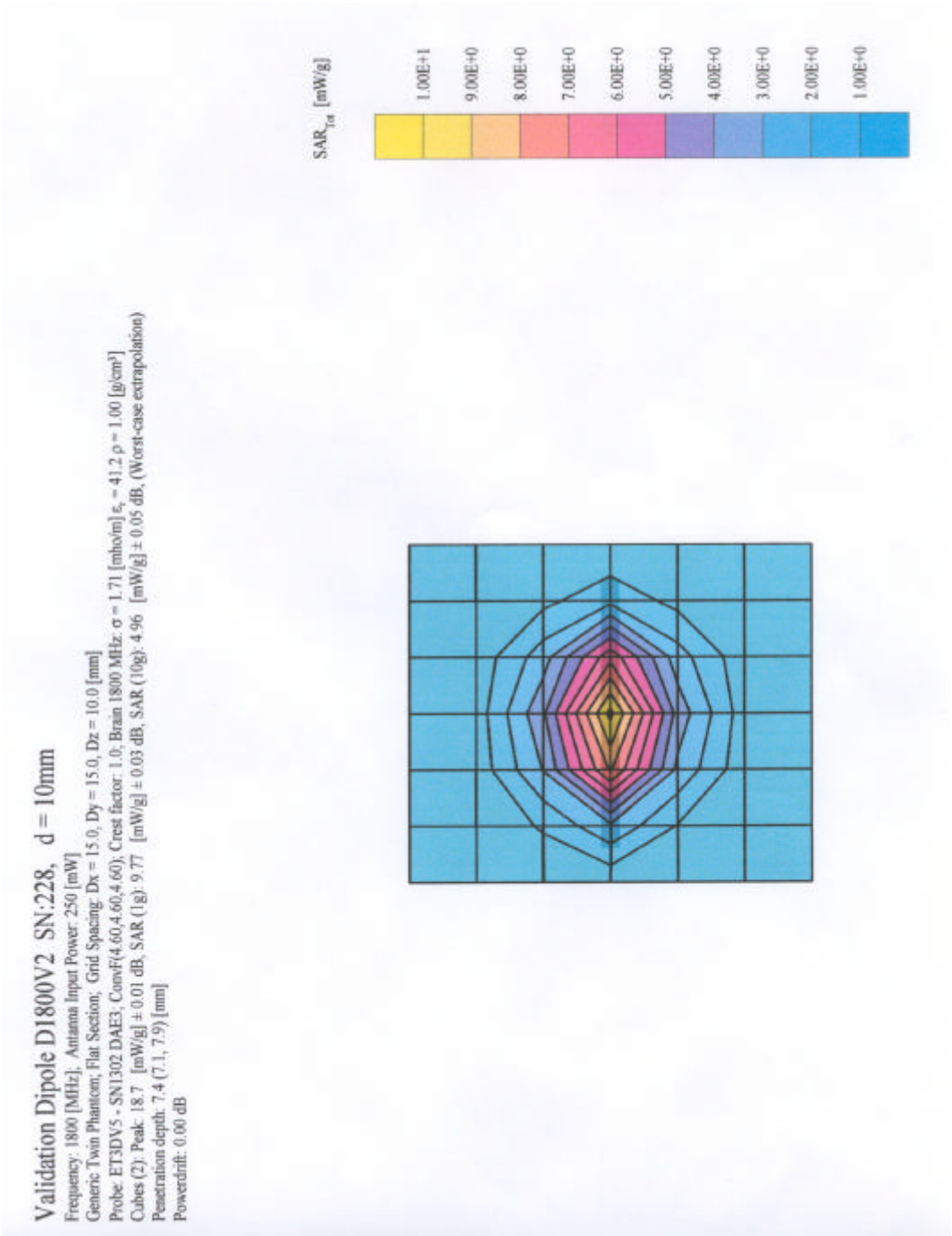
Dipole 1800 MHz

Generic Twin Phantom, Flat Section, Position: (90°,90°), Frequency: 1800 MHz
Probe: ET3D74 - SN1101; ConvF(5.20,5.20,5.20); Crest factor 1.0; Brain 1800 MHz: $\sigma = 1.68 \text{ mho/m}$, $\rho = 38.2 \text{ g/cm}^3$
Cube Size: SAR (1g): 3.81 mW/g, SAR (10g): 1.94 mW/g. (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdelt: -0.01 dB
F=100mW, d=10mm
Calibrated values: 1g mass 39.1mW/g, 10g mass 19.8mW/g
Measured values: 1g mass 38.1mW/g(-2.55%), 10g mass 19.4mW/g(-2.02%)



SAR distribution of validation dipole antenna from system accuracy verification test.

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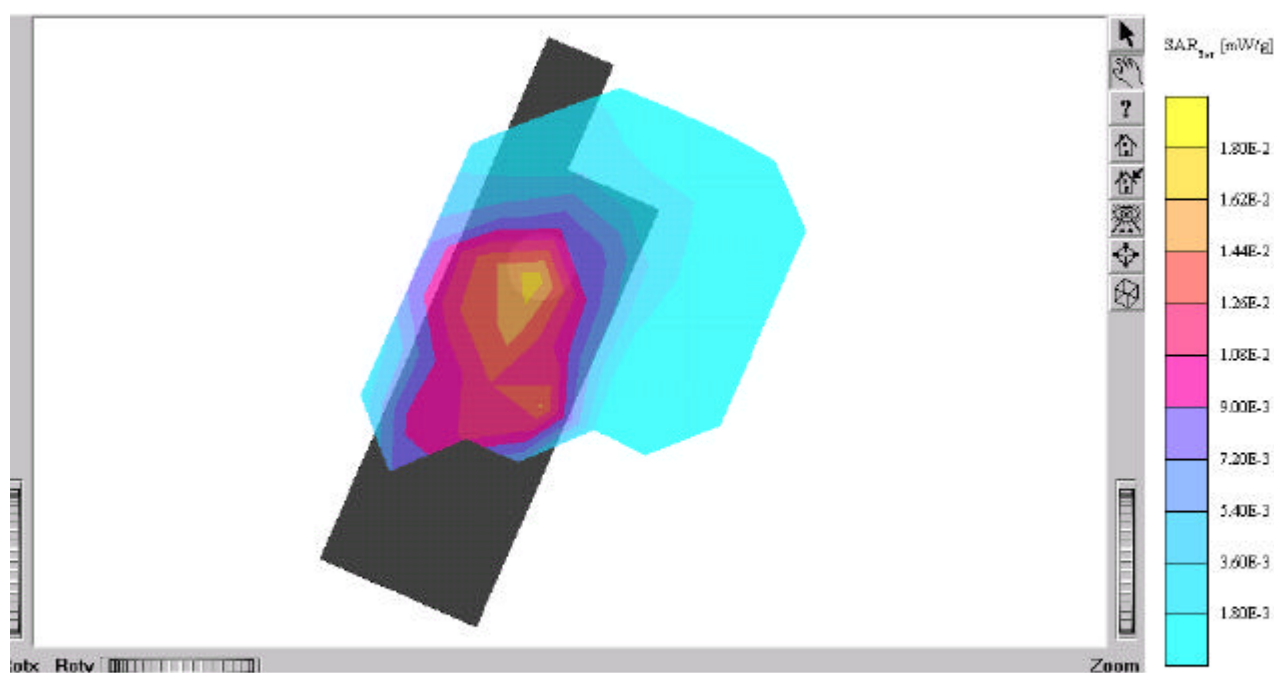
SAR distribution of validation dipole antenna provided by system manufacturer.

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Appendix 2: SAR Distribution Plot

R290 Satellite

Generic Twin Phantom, Left Hand Section, Position: (72°, 65°), Frequency: 1618 MHz
Probe: ET3DU4-SN1101; ConnF(5.20,5.20,5.20); Crest factor: 1.0; Brain: 1800 MHz; $\sigma = 1.68$ mho/m; $\eta = 38.2$ $\rho = 1.03$ g/cm³
Cube 5x5x7: SAR(1g): 0.0187 mW/g; SAR(10g): 0.0113 mW/g (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Power drift: -0.00 dB



Distribution of worst case SAR

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Appendix 3: Photographs of the Device Under Test



Front view of device

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Side view of device

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Appendix 4: Position of Device on Generic Twin Phantom



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Appendix 5: Probe Calibration Parameters for ET3DV4 SN:1101

ET3DV4 SN:1101

DASY2 - Parameters of Probe: ET3DV4 SN:1101

Sensitivity in Free Space

NormX	1.23 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.36 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.17 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	80 mV
DCP Y	80 mV
DCP Z	80 mV

Sensitivity in Tissue Simulating Liquid

450 MHz	ConvF X	6.2	extrapolated
	ConvF Y	6.2	extrapolated
	ConvF Z	6.2	extrapolated
	Alpha	0.65	
	Depth	2.00	

$\epsilon_r =$	48 $\pm$ 5%
$\sigma =$	0.50 $\pm$ 10% mho/m
(brain tissue simulating liquid)	

900 MHz	ConvF X	5.9	$\pm$ 10%
	ConvF Y	5.9	$\pm$ 10%
	ConvF Z	5.9	$\pm$ 10%
	Alpha	0.65	
	Depth	2.00	

$\epsilon_r =$	42.5 $\pm$ 5%
$\sigma =$	0.86 $\pm$ 10% mho/m
(brain tissue simulating liquid)	

1500 MHz	ConvF X	5.4	interpolated
	ConvF Y	5.4	interpolated
	ConvF Z	5.4	interpolated
	Alpha	0.65	
	Depth	2.00	

$\epsilon_r =$	41 $\pm$ 5%
$\sigma =$	1.32 $\pm$ 10% mho/m
(brain tissue simulating liquid)	

1800 MHz	ConvF X	5.2	$\pm$ 10%
	ConvF Y	5.2	$\pm$ 10%
	ConvF Z	5.2	$\pm$ 10%
	Alpha	0.65	
	Depth	2.00	

$\epsilon_r =$	41 $\pm$ 5%
$\sigma =$	1.69 $\pm$ 10% mho/m
(brain tissue simulating liquid)	

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Surface to Probe Tip	1.9 $\pm$ 0.2	mm