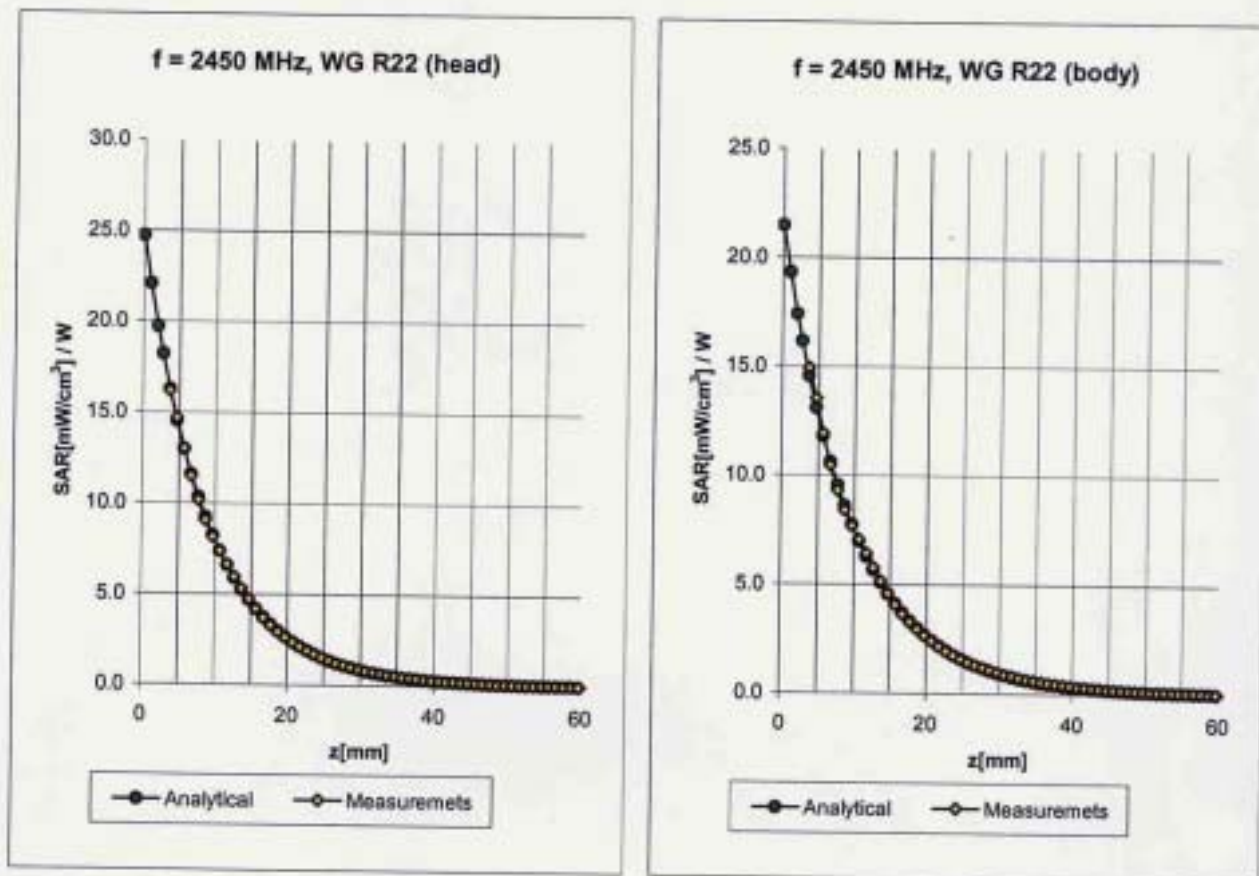


Conversion Factor Assessment



Head 2450 MHz $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	$4.7 \pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	$4.7 \pm 8.9\%$ (k=2)	Alpha	1.00
ConvF Z	$4.7 \pm 8.9\%$ (k=2)	Depth	1.89

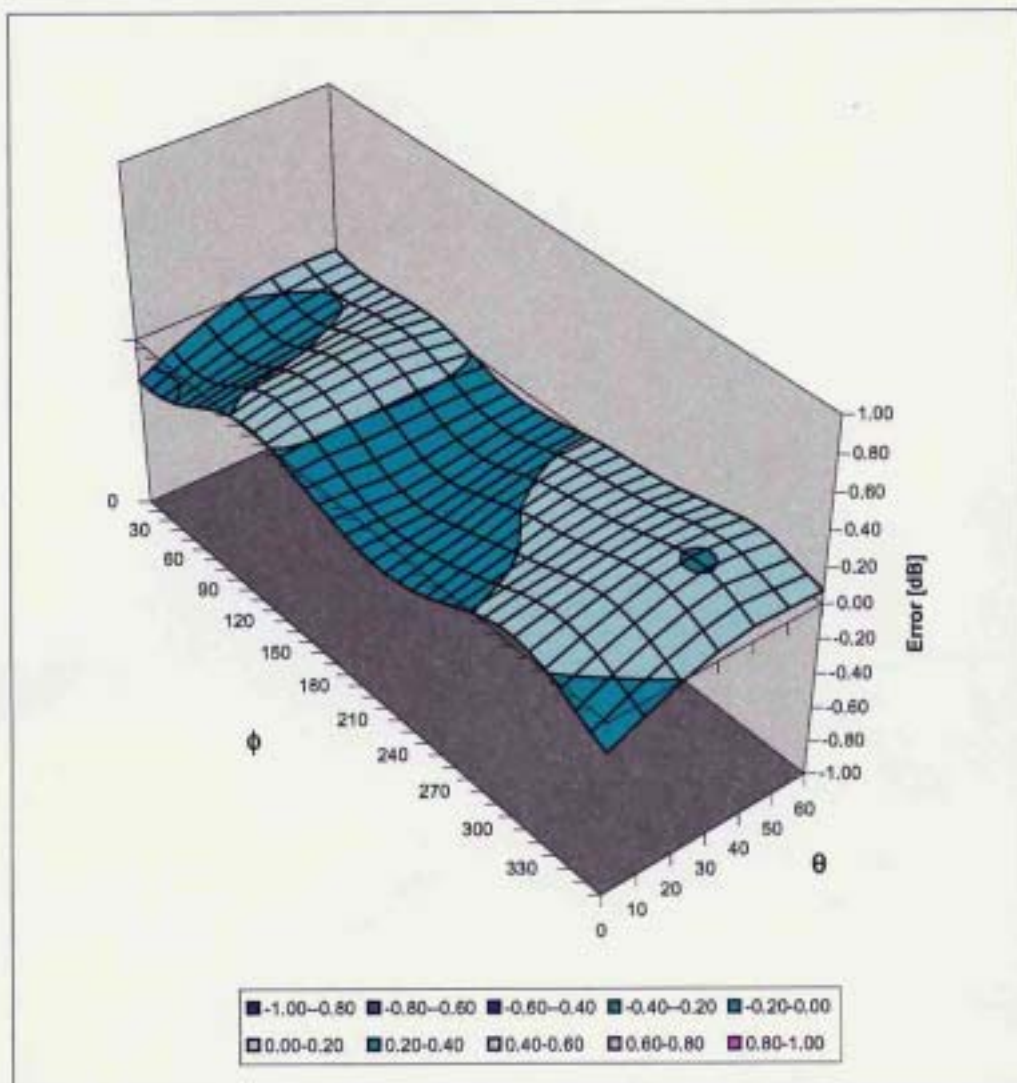
Body 2450 MHz $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	$4.4 \pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	$4.4 \pm 8.9\%$ (k=2)	Alpha	1.21
ConvF Z	$4.4 \pm 8.9\%$ (k=2)	Depth	1.59

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



D3: DAE

Client

CALIBRATION CERTIFICATE

Object(s) DAE3 - SN:579

Calibration procedure(s) QA CAL-06.v3
Calibration procedure for the data acquisition unit (DAE)

Calibration date: August 15, 2003

Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 ± 2 degrees Celsius and humidity $< 75\%$

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

	Name	Function	Signature
Calibrated by:	Philip Storchenegger	Technician	
Approved by:	Fin Bernholt	R&D Director	

Date issued: August 15, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

1. Cal Lab. Incoming Inspection & Pre Test

Modification Status	Note Status here → → → →	BC
Visual Inspection	Note anomalies.....	None
		
Pre Test	Indication	Yes/No
Probe Touch	Function	Yes
Probe Collision	Function	Yes
Probe Touch&Collision	Function	Yes

2. DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = $6.1\mu\text{V}$, full range = 400 mV
 Low Range: 1LSB = 61nV , full range = 4 mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range rounded to 7 digits	404.5370401	404.5593911	404.3923437
Low Range rounded to 6 digits	3.9686	3.9584	3.95
Connector Angle to be used	in DASY System 311°		

High Range	Input	Reading in μV	% Error
Channel X + Input	200mV	199999.6	0.00
	20mV	19998.2	-0.01
Channel X - Input	20mV	-19995.3	-0.02
Channel Y + Input	200mV	199999.8	0.00
	20mV	19998.3	-0.01
Channel Y - Input	20mV	-19993.6	-0.03
Channel Z + Input	200mV	200000.6	0.00
	20mV	19997.8	-0.01
Channel Z - Input	20mV	-19994.3	-0.03

Low Range	Input	Reading in μV	% Error
Channel X + Input	2mV	1999.99	0.00
	0.2mV	199.66	-0.17
Channel X - Input	0.2mV	-200.21	0.11
Channel Y + Input	2mV	1999.89	-0.01
	0.2mV	199.20	-0.40
Channel Y - Input	0.2mV	-201.14	0.57
Channel Z + Input	2mV	1999.99	0.00
	0.2mV	199.18	-0.41
Channel Z - Input	0.2mV	-202.26	1.13

3. Common mode sensitivity

DASY measurement parameters:

Auto Zero Time: 3 sec,

Measuring time: 3 sec

High/Low Range

in μV	Common mode Input Voltage	High Range Reading	Low Range Reading
Channel X	200mV	5.15	5.17
	- 200mV	-4.35	-4.88
Channel Y	200mV	9.00	8.70
	- 200mV	-10.57	-10.21
Channel Z	200mV	8.93	8.00
	- 200mV	-10.74	-10.51

4. Channel separation

DASY measurement parameters:

Auto Zero Time: 3 sec,

Measuring time: 3 sec

High Range

in μV	Input Voltage	Channel X	Channel Y	Channel Z
Channel X	200mV	-	0.87	-0.39
Channel Y	200mV	0.80	-	2.29
Channel Z	200mV	-2.73	-0.30	-

5. AD-Converter Values with inputs shorted

in LSB	Low Range	High Range
Channel X	16102	16311
Channel Y	16055	16139
Channel Z	15811	15833

6. Input Offset Measurement

DASY measurement parameters:

Auto Zero Time: 3 sec,

Measuring time: 3 sec

Number of measurements:

100, Low Range

Input 10M Ω

in μV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	0.25	-1.75	1.20	0.43
Channel Y	-1.47	-2.17	0.46	0.35
Channel Z	-1.64	-2.78	0.28	0.45

6. Input Offset Measurement (cont'd)

Input shorted

in μV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	-0.02	-0.85	0.97	0.27
Channel Y	-0.69	-2.12	0.97	0.35
Channel Z	-0.96	-2.39	0.43	0.35

7. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

8. Input Resistance

In MOhm	Calibrating	Measuring
Channel X	0.2001	199.9
Channel Y	0.1999	203.3
Channel Z	0.2000	200.4

9. Low Battery Alarm Voltage

in V	Alarm Level
Supply (+ Vcc)	7.72
Supply (- Vcc)	7.55

10. Power Consumption

in mA	Switched off	Stand by	Transmitting
Supply (+ Vcc)	0.00	8.71	14.4
Supply (- Vcc)	-0.01	-8.03	-9.20



D4: 2450MHZ SYSTEM VALIDATION DIPOLE

Client Auden > Chunghwa Telecom

CALIBRATION CERTIFICATE

Object(s) D2450V2 - SN:737

Calibration procedure(s) QA CAL-05.v2
Calibration procedure for dipole validation kits

Calibration date: August 27, 2003

Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 ± 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check; Mar-05
Power sensor HP 8481A	MY41032317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Power meter EPME442	GB37430704	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Network Analyzer HP 8713E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: August 28, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

DASY

Dipole Validation Kit

Type: D2450V2

Serial: 737

Manufactured: August 26, 2003

Calibrated: August 27, 2003

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating solution** of the following electrical parameters at 2450 MHz:

Relative Dielectricity	38.2	$\pm 5\%$
Conductivity	1.89 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, Conversion factor 4.8 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW $\pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3013 and applying the advanced extrapolation are:

averaged over 1 cm ³ (1 g) of tissue:	55.2 mW/g $\pm 16.3\%$ (k=2) ¹
averaged over 10 cm ³ (10 g) of tissue:	24.8 mW/g $\pm 16.2\%$ (k=2) ¹

¹ validation uncertainty

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay	1.162 ns	(one direction)
Transmission factor:	0.983	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	$\text{Re}\{Z\} = 52.5 \Omega$
	$\text{Im}\{Z\} = 5.4 \Omega$
Return Loss at 2450 MHz	-24.8 dB

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating solution** of the following electrical parameters at 2450 MHz:

Relative Dielectricity	50.8	$\pm 5\%$
Conductivity	2.03 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, Conversion factor 4.2 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW $\pm 3\%$ The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3013 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: **55.2 mW/g ± 16.8 % (k=2)²**

averaged over 10 cm³ (10 g) of tissue: **25.4 mW/g ± 16.2 % (k=2)²**

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 2450 MHz: **Re{Z} = 48.5 Ω**

Im {Z} = 6.1 Ω

Return Loss at 2450 MHz **-23.9 dB**

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Sections 1 and 4. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

9. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

² validation uncertainty

Test Laboratory: SPEAG, Zurich, Switzerland

File Name: SN737_SN3013_HSL2450_270803.dat

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737

Program: Dipole Calibration

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL 2450 MHz ($\sigma = 1.89$ mho/m, $\epsilon_r = 38.19$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 1/19/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 90.7 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 15.2 mW/g

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

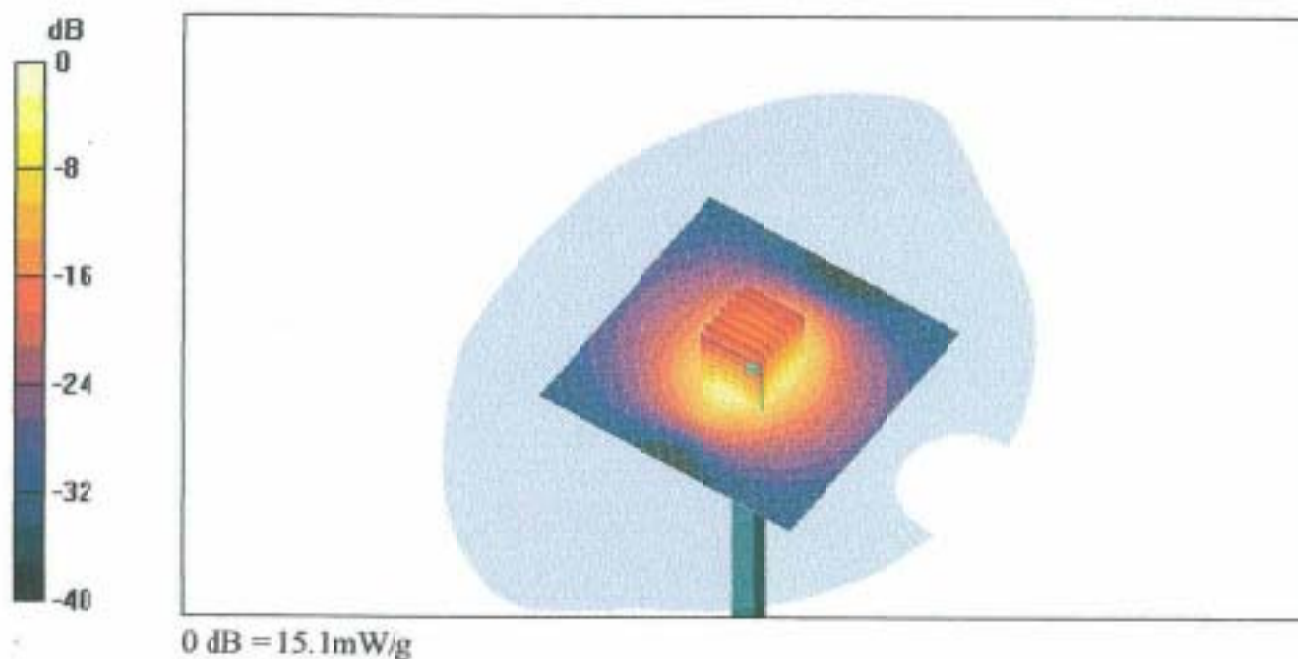
Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.2 mW/g

Reference Value = 90.7 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 15.1 mW/g



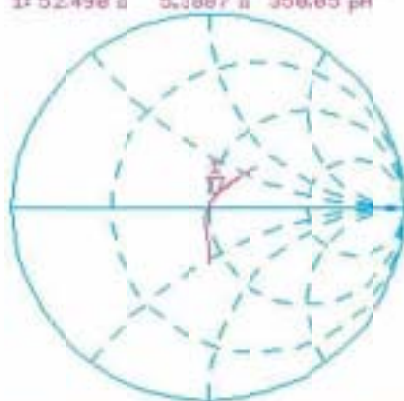
27 Aug 2003 09:59:05
 CH1 S11 1 U 75 1: 52.490 d 5.1887 d 350.85 pH 2 450.000 000 MHz

Del

Cor

Avs
36

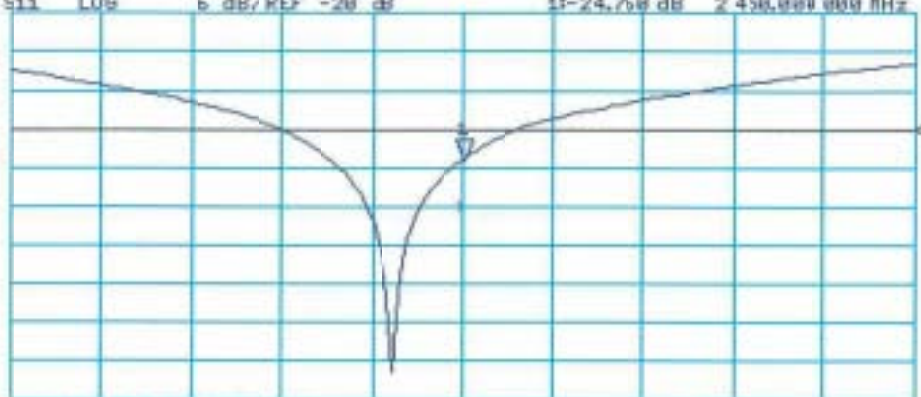
f



CH2 S11 LOG 6 dB/ REF -20 dB 1: -24.750 dB 2 450.000 000 MHz

Cor

f



CENTER 2 450.000 000 MHz

SPAN 400.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland
 File Name: SN737_SN3013_M2450_270803.da4

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737
Program: Dipole Calibration

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: Muscle 2450 MHz ($\sigma = 2.03$ mho/m, $\epsilon_r = 50.75$, $\rho = 1000$ kg/m³)

Phantom: section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration

- Probe: ES3DV2 - SN3013; ConvF(4.2, 4.2, 4.2); Calibrated: 1/19/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP.1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 90.4 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 15.7 mW/g

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

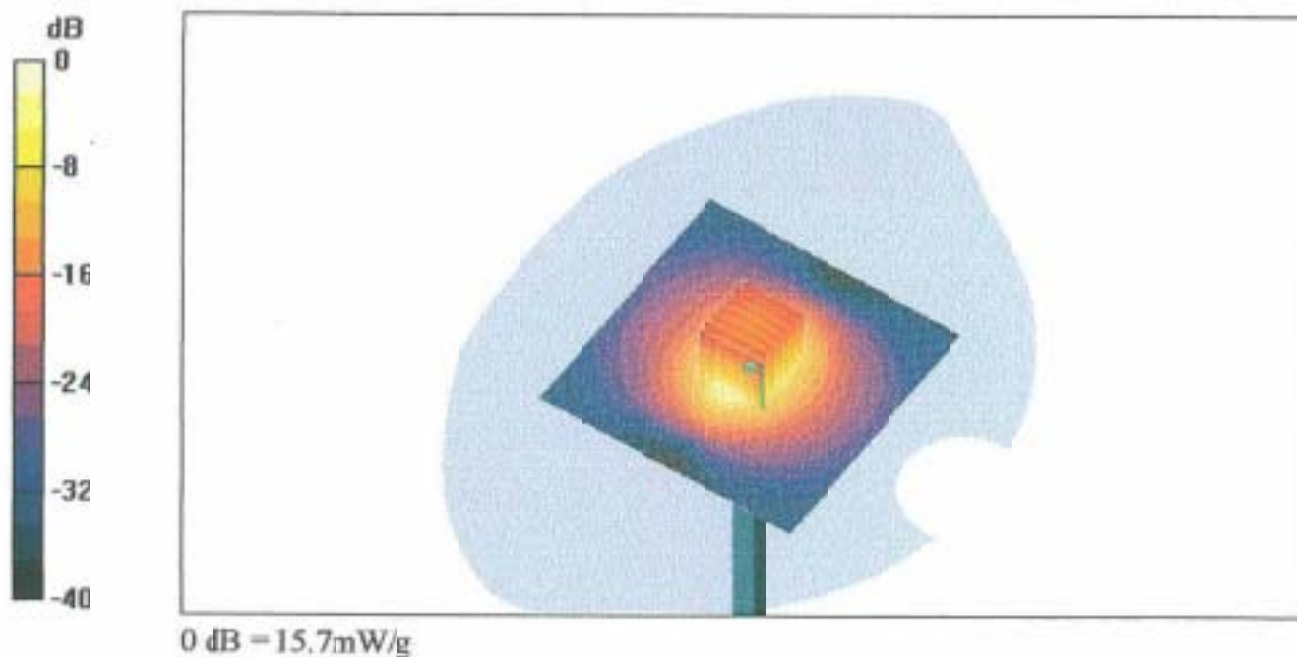
Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.36 mW/g

Reference Value = 90.4 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 15.7 mW/g



737
Body

27 Aug 2003 13:31:47
CH1 S11 1 U FS 1: 48.492 ω 6.1389 ω 398.27 μ H 2 450.000 000 MHz

Del
Cor
Avg
15
f

