

APPENDIX

Exhibit 4

System Validation Dipole - D2450V2, S/N: 714

Calibration Data

Client

JQA (MITC)

CALIBRATION CERTIFICATE

Object(s)

D2450V2 - SN:714

Calibration procedure(s)

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

Calibration date:

February 4, 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
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

Calibrated by:

Name

Nico Vetterli

Function

Technician

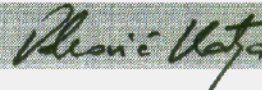
Signature



Approved by:

Katja Pokovic

Laboratory Director



Date issued: February 6, 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: 714

Manufactured: July 5, 2002

Calibrated: February 4, 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 permittivity	37.4	$\pm 5\%$
Conductivity	1.88 mho/m	$\pm 10\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.1 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and 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. The included distance holder 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 $250\text{mW} \pm 3\%$. 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 ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	52.0 mW/g
averaged over 10 cm^3 (10 g) of tissue:	23.5 mW/g

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:	1.161 ns	(one direction)
Transmission factor:	0.997	(voltage transmission, one direction)

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

Feedpoint impedance at 2450 MHz:	$\text{Re}\{Z\} = \mathbf{51.7\ \Omega}$
	$\text{Im}\{Z\} = \mathbf{4.2\ \Omega}$
Return Loss at 2450 MHz	- 27.0 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 permittivity	51.1	$\pm 5\%$
Conductivity	2.05 mho/m	$\pm 10\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 4.7 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and 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. The included distance holder 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 ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm ³ (1 g) of tissue:	54.4 mW/g
averaged over 10 cm ³ (10 g) of tissue:	24.8 mW/g

6. Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	$\text{Re}\{Z\} = 48.1 \Omega$
	$\text{Im}\{Z\} = 6.1 \Omega$
Return Loss at 2450 MHz	- 23.8 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 Section 1. 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.

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN714_SN1507_HSL2450_040203.da4

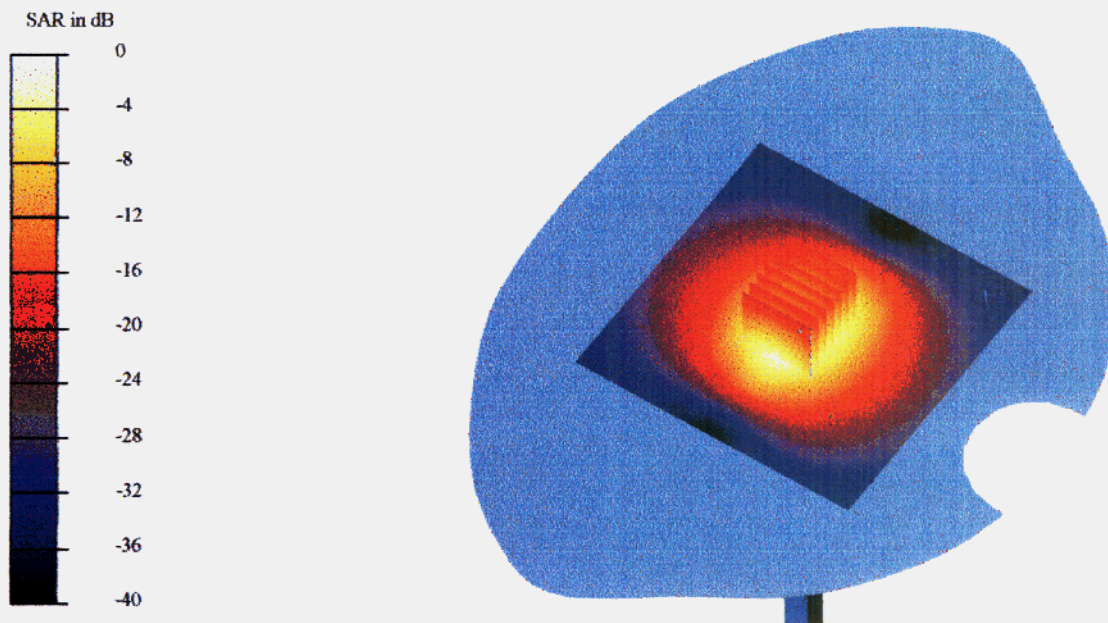
DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN714
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL 2450 MHz ($\sigma = 1.88$ mho/m, $\epsilon = 37.4$, $\rho = 1000$ kg/m³)
Phantom section: FlatSection

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.1, 5.1, 5.1); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN410; Calibrated: 1/14/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 96.7 V/m
Peak SAR = 26.2 mW/g
SAR(1 g) = 13 mW/g; SAR(10 g) = 5.87 mW/g
Power Drift = -0.007 dB



4 Feb 2003 14:07:05

CH1 S11 1 U FS

1: 51.691 α 4.1875 α 272.02 μ H

2 450.000 000 MHz

Y

Del

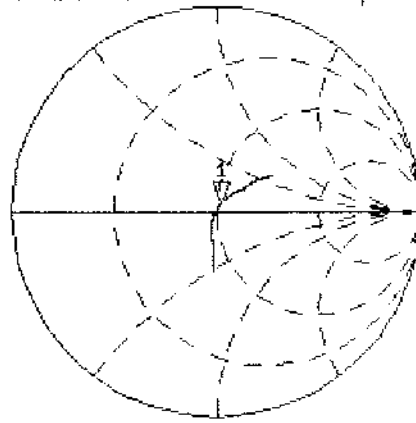
PRm

Cor

Avg

15

↑

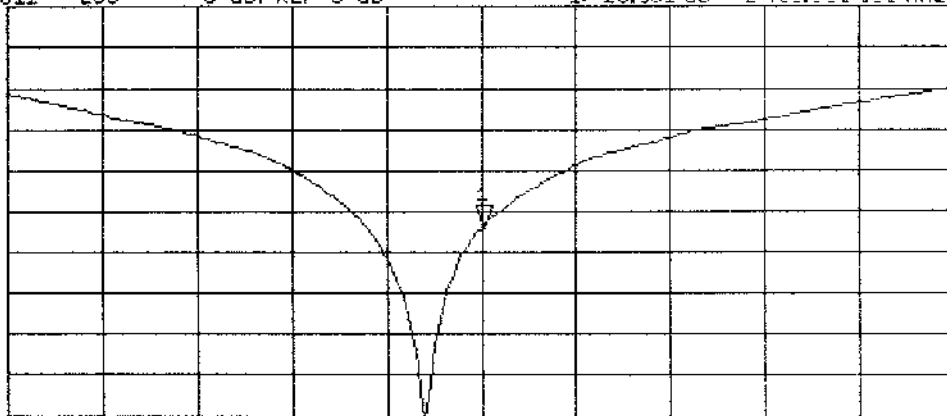


CH2 S11 LOG 5 dB/REF 0 dB 1: -26.961 dB 2 450.000 000 MHz

PRm

Cor

↑



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN714_SN1507_M2450_040203_1.da4

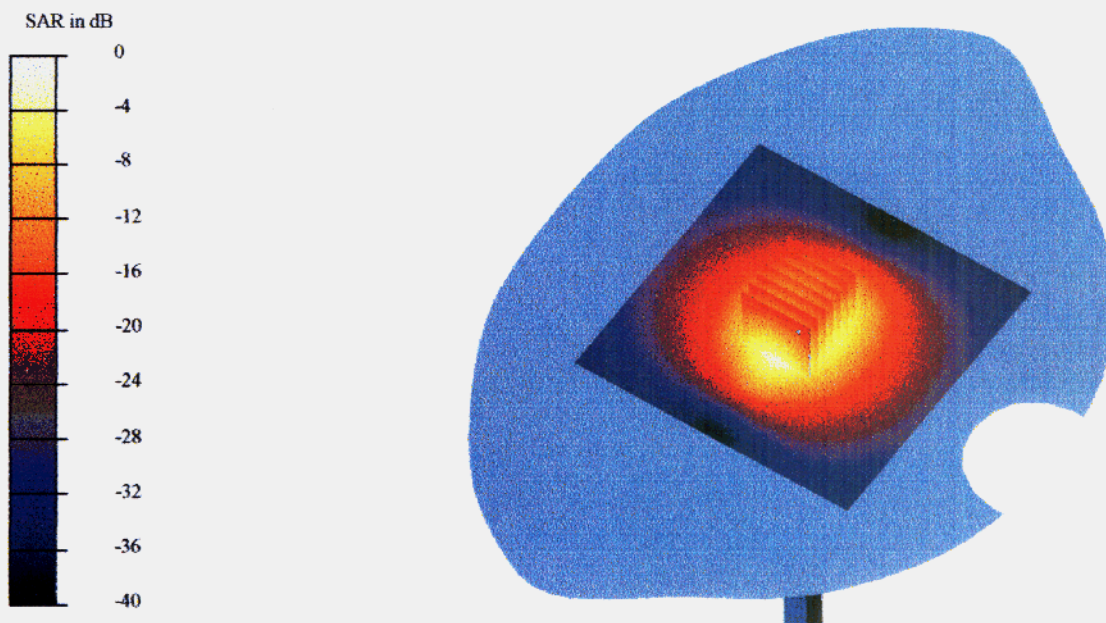
DUT: Dipole 2450 MHz Type & Serial Number: D2450V2 - SN714
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Muscle 2450 MHz ($\sigma = 2.05$ mho/m, $\epsilon = 51.05$, $\rho = 1000$ kg/m³)
Phantom section: FlatSection

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.7, 4.7, 4.7); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN410; Calibrated: 1/14/2003
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 93.1 V/m
Peak SAR = 28.4 mW/g
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.21 mW/g
Power Drift = -0.002 dB



2450 Muscle

4 Feb 2003 15:57:32

CH1 S11 1 U FS

1: 48.096 Ω 6.0586 Ω 393.57 μ H

2 450.000 000 MHz

De1

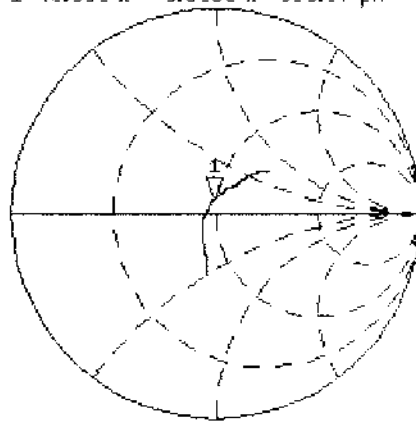
PRm

Cor

avg

16

↑

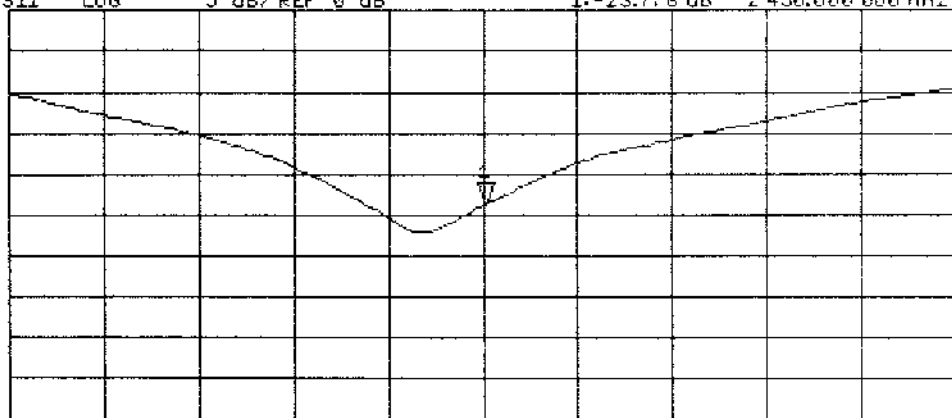


CH2 S11 LOG 5 dB/REF 0 dB 1: -23.776 dB 2 450.000 000 MHz

PRm

Cor

↑



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz