SAR SYSTEM VALIDATION DATA

(Additional Information for GigaWaveTech Pte Ltd)

Reference to Test Report Nos.: 56S030405/01_CORR01

TEST FACILITY Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd
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JOB NUMBER 56S030405

TEST PERIOD 15 Oct 2003

PREPARED BY

Gary Ng Ah Chye
Associate Engineer

Date prepared 15 Oct 2003

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SAR System re-validation on 15 Oct 2003

TEMPERATURE AND HUMIDITY

Ambient Temperature:	24 ± 1^0 C
Tissue Temperature:	24 ± 1^0 C
Humidity:	53% to 58%

ELECTRICAL CHARACTERISTIC MEASUREMENT SETUP

- **Description of the Agilent 85070D Dielectric Probe Kit**

The 85070D is a dielectric probe that is used to measure the intrinsic electrical properties of materials in the RF and microwave frequency bands. The 85070D software allows you to measure the complex dielectric constant (also called permittivity) of liquids and semi-solids, incuding the dielectric loss factor of loss tangent.

To obtain data at hundreds of frequencies in seconds, simply immerse the probe into liquids or semi-solids - no special fixtures or containers are required. The 85070D must be used in conjunction with an Agilent network analyzer. The network analyzer provides the high frequency stimulus, and measures the reflected response.

The probe transmits a signal into the material under test (MUT). The measured reflected response from the materials is then related to its dielectric properties. A computer controls the system, and runs software that guides the user through a measurement sequence. An effort is made to keep the results dielectric constant and conductivity within 5 % of published data.

TEST INSTRUMENTATION

The following test equipment were used during the SAR System Re-validation at 2450MHz Head and Body System Validation.

Instrument	Model	S/No	Cal Due Date	
Boonton RF Power Meter (Dual Channel)	4532	97701	25 June 2004	✓
Boonton Power Sensor (used as reference)	51075	31534	-	✓
Boonton Power Sensor	51075	32002	25 June 2004	✓
HP Spectrum Analyzer	8593E	3831u02087	1 Sept 2004	✓
S-Parameter Network Analyzer (30kHz – 6GHz)	8753ES	MY40001026	3 Oct 2004	✓
Agilent 85070D Dielectric Probe Kit	85075D	21356	-	✓
HP Signal Generator (10MHz – 20GHz)	83620A	250A0159A	16 July 2005	✓
Amplifier Research Power Amplifier (800MHz – 4.2GHz)	25S1G4A	29346	-	✓
Agilent Dual Directional Coupler	HP778D	18289	-	✓
2450MHz System Validation Dipole	D2450V2	715	25 Sept 2004	✓
Data Acquisition Electronics (DAE)	DAE3V1	475	11 Nov 2003	✓
Dosimetric E-field Probe	ET3DV6	1645	9 Oct 2004	✓

TISSUE SIMULANT DATA SHEETS

Type of Tissue	Head	Body
Target Frequency (MHz)	2450	2450
Target Dielectric Constant	39.2	52.7
Target Conductivity (S/m)	1.80	1.95
Composition (by weight)	Ultra Pure Water (55.67 %) Ethanol (42.52%) Sugar (0%) Salt (0%) HEC (0%) Preventol D7 (1.81%)	Ultra Pure Water (71.19%) Ethanol (26.83%) Sugar (0%) Salt (0.11%) HEC (0%) Preventol D7 (1.87%)
Measured Dielectric Constant	40.24	54.43
Measured Conductivity (S/m)	1.8566	2.0017

Probe Name	Dosimetric E-field Probe ET3DV6	Dosimetric E-field Probe ET3DV6
Probe Serial Number	1645	1645
Sensor Offset (mm)	2.7	2.7
Conversion Factor	5.1 ± 9.5%	4.7 ± 9.5%
Probe Calibration Due Date (DD/MM/YY)	9 Oct 2004	9 Oct 2004

TISSUE SIMULANT DATA SHEETS

Head Tissue at 2450MHz

Frequency	e'	e''	Conductivity
2440000000	40.28	13.62	1.8460
2441000000	40.26	13.61	1.8457
2442000000	40.27	13.61	1.8461
2443000000	40.26	13.61	1.8478
2444000000	40.26	13.62	1.8499
2445000000	40.26	13.64	1.8525
2446000000	40.25	13.63	1.8521
2447000000	40.26	13.63	1.8535
2448000000	40.24	13.64	1.8551
2449000000	40.24	13.64	1.8556
2450000000	**40.24**	**13.64**	**1.8566**
2451000000	40.22	13.65	1.8586
2452000000	40.22	13.64	1.8587
2453000000	40.22	13.66	1.8613
2454000000	40.23	13.65	1.8606
2455000000	40.22	13.65	1.8619
2456000000	40.21	13.66	1.8644
2457000000	40.21	13.66	1.8645
2458000000	40.22	13.66	1.8655
2459000000	40.20	13.66	1.8662
2460000000	40.20	13.65	1.8661
2461000000	40.18	13.66	1.8671
2462000000	40.18	13.66	1.8680
2463000000	40.18	13.67	1.8706
2464000000	40.18	13.67	1.8715
2465000000	40.17	13.69	1.8745
2466000000	40.18	13.68	1.8742
2467000000	40.16	13.68	1.8743
2468000000	40.17	13.68	1.8753
2469000000	40.16	13.69	1.8776
2470000000	40.15	13.69	1.8781
2471000000	40.15	13.69	1.8796
2472000000	40.14	13.70	1.8817
2473000000	40.14	13.69	1.8814
2474000000	40.14	13.70	1.8835
2475000000	40.12	13.70	1.8839
2476000000	40.14	13.70	1.8852
2477000000	40.12	13.71	1.8868
2478000000	40.13	13.71	1.8875
2479000000	40.10	13.72	1.8889
2480000000	40.12	13.74	1.8928

(e' = Dielectric Constant)
(e'' = Loss Factor)

Tested by: NAC
Date : 15th Oct 2003
Frequency: 2450MHz
Mixture: Head Tissue
Tissue temp: 24°C

Composition		
Tap Water	0.0g	0.00%
Ultra Pure Water	20000.0g	55.67%
Sugar	0.0g	0.00%
Glyco	15278.0g	42.52%
Salt	0.0g	0.00%
Preventol D7	650.0g	1.81%
Total Weight	35928.0g	100.0%

Result (FCC)	Dielectric Constant	Conductivity
Measured	40.24	1.8566
Target (FCC)	39.2	1.8
Low Limit	37.24	1.71
High Limit	41.16	1.89
% Off Target	2.65	3.14

TISSUE SIMULANT DATA SHEETS

Body Tissue at 2450MHz

Frequency	e'	e''	Conductivity
2440000000	54.49	14.88	2.0165
2441000000	54.48	14.86	2.0157
2442000000	54.49	14.84	2.0128
2443000000	54.49	14.82	2.0115
2444000000	54.49	14.82	2.0123
2445000000	54.49	14.79	2.0093
2446000000	54.49	14.79	2.0091
2447000000	54.47	14.75	2.0057
2448000000	54.46	14.74	2.0049
2449000000	54.44	14.71	2.0007
2450000000	**54.43**	**14.71**	**2.0017**
2451000000	54.41	14.68	1.9984
2452000000	54.39	14.66	1.9963
2453000000	54.37	14.62	1.9921
2454000000	54.35	14.62	1.9930
2455000000	54.31	14.60	1.9914
2456000000	54.29	14.56	1.9870
2457000000	54.25	14.56	1.9874
2458000000	54.22	14.52	1.9833
2459000000	54.20	14.50	1.9813
2460000000	54.16	14.49	1.9797
2461000000	54.12	14.47	1.9778
2462000000	54.09	14.45	1.9761
2463000000	54.05	14.43	1.9747
2464000000	54.01	14.40	1.9712
2465000000	53.96	14.38	1.9686
2466000000	53.91	14.35	1.9664
2467000000	53.87	14.34	1.9656
2468000000	53.83	14.32	1.9639
2469000000	53.80	14.30	1.9608
2470000000	53.74	14.29	1.9604
2471000000	53.71	14.28	1.9598
2472000000	53.66	14.27	1.9604
2473000000	53.62	14.25	1.9584
2474000000	53.58	14.25	1.9581
2475000000	53.51	14.23	1.9567
2476000000	53.48	14.20	1.9539
2477000000	53.46	14.21	1.9548
2478000000	53.39	14.20	1.9546
2479000000	53.37	14.20	1.9553
2480000000	53.34	14.19	1.9553

(e' = Dielectric Constant)
(e'' = Loss Factor)

Tested by: NAC
Date : 15th Oct 2003
Frequency: 2450MHz
Mixture: Body Tissue
Tissue temp: 24°C

Composition		
Tap Water	0.0g	0.00%
Ultra Pure Water	25500.0g	71.19%
Sugar	0.0g	0.00%
Glyco	9610.0g	26.83%
Salt	38.4g	0.11%
Preventol D7	670.0g	1.87%
Total Weight	35818.4g	100.0%

Result (FCC)	Dielectric Constant	Conductivity
Measured	54.43	2.0017
Target (FCC)	52.7	1.95
Low Limit	50.065	1.8525
High Limit	55.335	2.0475
% Off Target	3.29	2.65

SAR VALIDATION RESULTS

Re-validation on 15 Oct 2003 – Head Tissue at 2450MHz
Antenna Input Power: 250mW

Ambient Temperature:	**24 ± 1^0 C**
Tissue Temperature:	**24 ± 1^0 C**
Humidity:	**53% to 58%**

Date: 10/15/03

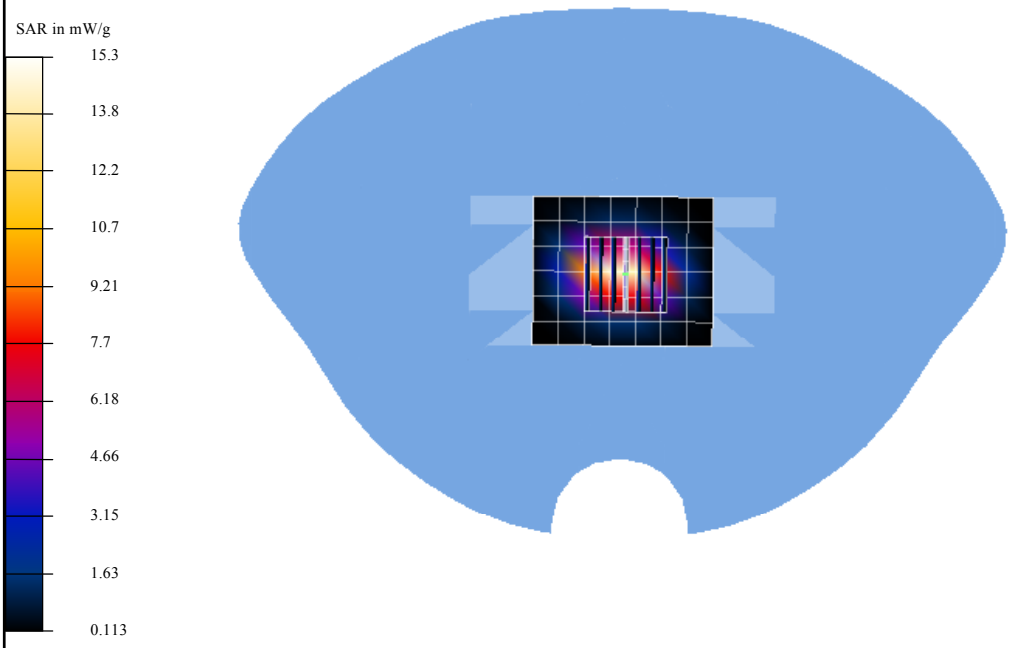
Test Laboratory: Telecom & EMC Testing Group
File Name: TCB Request_2450MHz Head_Dipole Validation.da4

DUT: Dipole 2450MHz Type & Serial Number: 715
Program: Dipole Validation; 2450Mhz dipole validation

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Head 2450 MHz (σ = 1.8566 mho/m, ε = 40.24, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(5.1, 5.1, 5.1); Calibrated: 10/9/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 96.4 V/m
Peak SAR = 27.6 mW/g
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.16 mW/g
Power Drift = -0.01 dB



SAR VALIDATION RESULTS

Re-validation on 15 Oct 2003 – Body Tissue at 2450MHz
Antenna Input Power: 250mW

Ambient Temperature:	**24 ± 1^0 C**
Tissue Temperature:	**24 ± 1^0 C**
Humidity:	**53% to 58%**

Date: 10/15/03

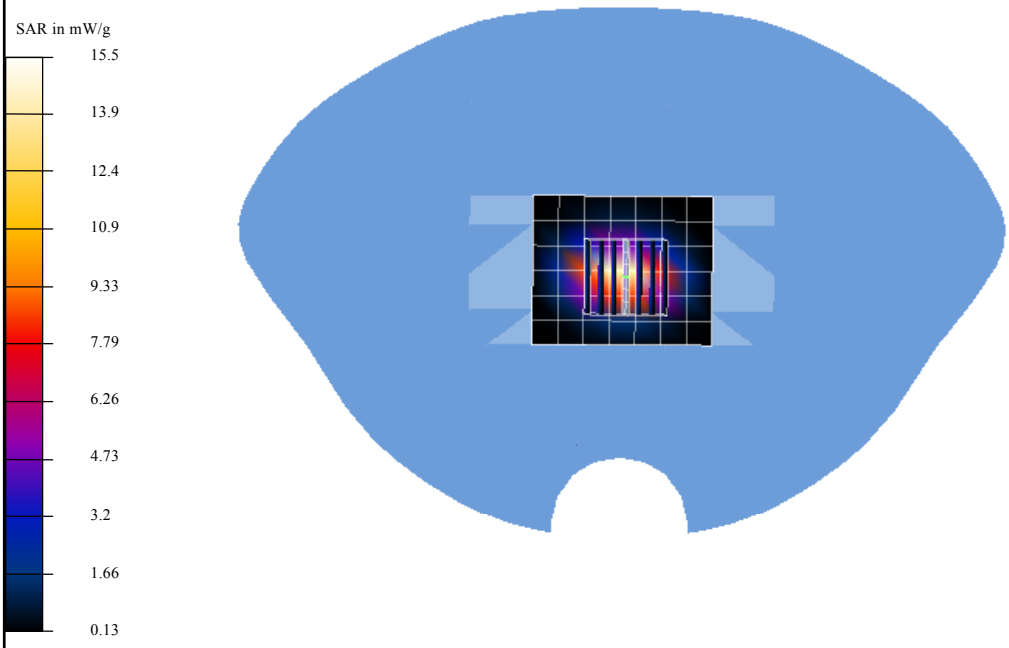
Test Laboratory: Telecom & EMC Testing Group
File Name: TCB Request_2450MHz Body_Dipole Validation.da4

DUT: Dipole 2450MHz Type & Serial Number: 715
Program: Dipole Validation; 2450Mhz Body dipole validation_Body Tissue

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 2.0017 mho/m, ε = 54.43, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 10/9/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 91.9 V/m
Peak SAR = 29.5 mW/g
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.1 mW/g
Power Drift = -0.006 dB



SAR VALIDATION RESULTS

SUMMARY

SAR System Validation Target & Measured:

System Validation D835MHz: S/Nos.: 447	Target SAR W/kg (1g)	2450MHz Head	2450MHz Body
		Measured Target W/kg (1g) (Deviation %)	Measured Target W/kg (1g) (Deviation %)
	13.1[Note 1]	13.51[Note 1] (+3.05%)	13.61[Note 1] (+3.82%)

Note 1 - Dipole forward power = 250mW

VALIDATION DIPOLE CALIBRATION CERTIFICATES

&

SAR PROBE CALIBRATION CERTIFICATES
(Re-calibrated on 9 Oct 2003)

CALIBRATION CERTIFICATES

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

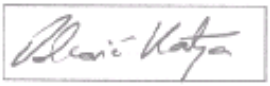
Calibration Certificate

2450 MHz System Validation Dipole

Type:	**D2450V2**
Serial Number:	**715**
Place of Calibration:	**Zurich**
Date of Calibration:	**September 25, 2002**
Calibration Interval:	**24 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	
Approved by:	

CALIBRATION CERTIFICATES

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D2450V2

Serial: 715

Manufactured: July 5, 2002
Calibrated: September 25, 2002

CALIBRATION CERTIFICATES

1. Measurement Conditions

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

Relative permitivity	**37.7**	± 5%
Conductivity	**1.88 mho/m**	± 10%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.0 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 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2.1. SAR Measurement with DASY3 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 worst-case extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**56.8 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**26.2 mW/g**

2.2 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:	**53.6 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**25.0 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:	**1.155 ns**	(one direction)
Transmission factor:	**0.980**	(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:	Re{Z} = **52.3 Ω**
	Im {Z} = **1.5 Ω**
Return Loss at 2450 MHz	**- 31.3 dB**

4. 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.

5. 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.

6. Power Test

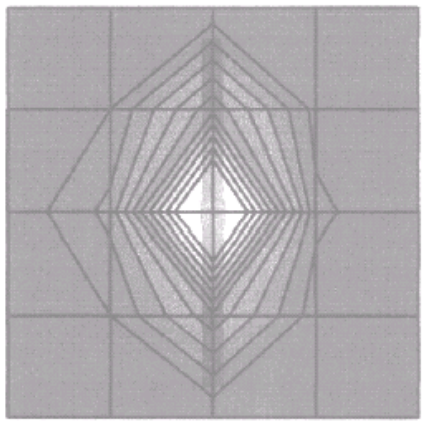
After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

CALIBRATION CERTIFICATES

09/25/02

Validation Dipole D2450V2 SN715, d = 10 mm

Frequency: 2450 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.00,5.00,5.00) at 2450 MHz; IEEE1528 2450 MHz σ = 1.88 mho/m ε_r = 37.7 ρ = 1.00 g/cm^3
Cubes (2): Peak: 26.7 mW/g ± 0.00 dB, SAR (1g): 13.4 mW/g ± 0.01 dB, SAR (10g): 6.26 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 6.8 (6.7, 7.0) [mm]
Powerdrift: -0.04 dB



Schmid & Partner Engineering AG, Zurich, Switzerland

CALIBRATION CERTIFICATES

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **PSB**

CALIBRATION CERTIFICATE

Object(s) ET3DV6 - SN:1645

Calibration procedure(s) QA CAL-01 v2
Calibration procedure for dosimetric E-field probes

Calibration date: October 9, 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
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: October 9, 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.

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CALIBRATION CERTIFICATES

Schmid & Partner Engineering AG

s p e a g

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Probe ET3DV6

SN:1645

Manufactured:	November 7, 2001
Last calibration:	November 20, 2002
Recalibrated:	October 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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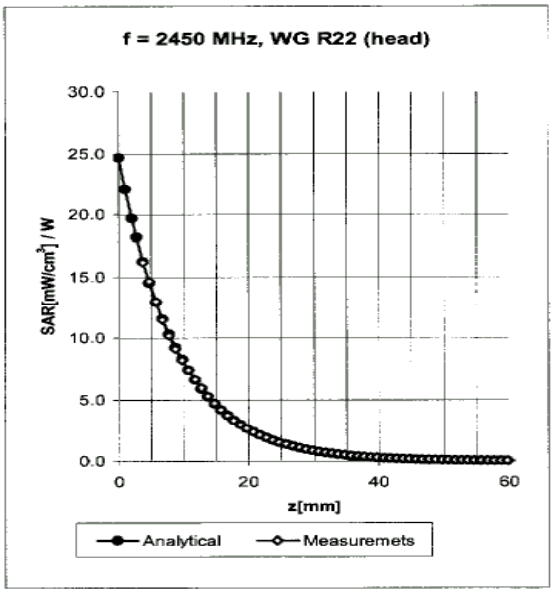
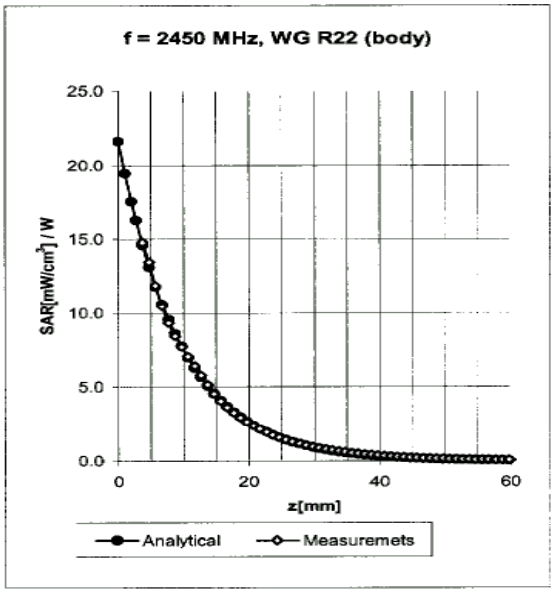
ET3DV6 SN:1645 October 9, 2003

Conversion Factor Assessment





Head 2450 MHz ε_r = 39.2 ± 5% σ = 1.80 ± 5% mho/m

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

ConvF X	5.1 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.1 ± 9.5% (k=2)	Alpha	**0.97**
ConvF Z	5.1 ± 9.5% (k=2)	Depth	**1.91**

Body 2450 MHz ε_r = 52.7 ± 5% σ = 1.95 ± 5% mho/m

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

ConvF X	4.7 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	4.7 ± 9.5% (k=2)	Alpha	**1.25**
ConvF Z	4.7 ± 9.5% (k=2)	Depth	**1.65**

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