

## ■ Validation Data (1900 MHz Head)

Test Laboratory: HCT CO., LTD  
Input Power 100 mW (20 dBm)  
Liquid Temp: 21.3 °C  
Test Date: Mar. 29, 2011

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 – SN:5d032

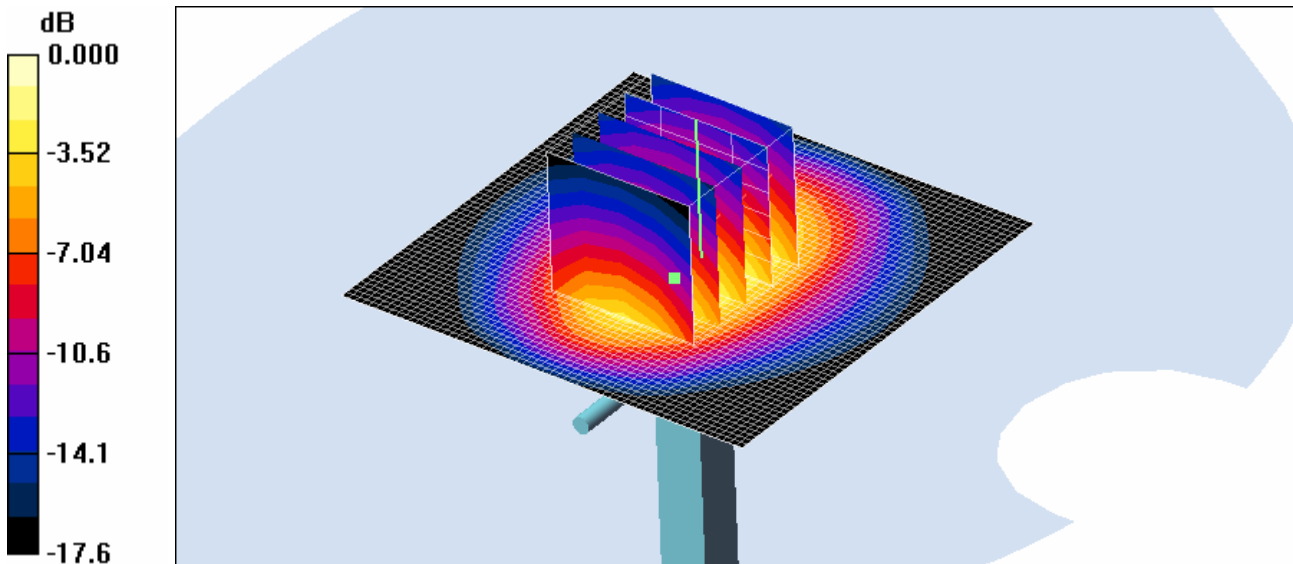
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.44$  mho/m;  $\epsilon_r = 39.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: ET3DV6 – SN1630; ConvF(5.12, 5.12, 5.12); Calibrated: 2010-05-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2010-09-21
- Phantom: SAM 835/900 MHz; Type: SAM

Dipole 1900MHz Validation/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 4.49 mW/g

Dipole 1900MHz Validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 58.6 V/m; Power Drift = -0.017 dB  
Peak SAR (extrapolated) = 6.78 W/kg  
SAR(1 g) = 4.03 mW/g; SAR(10 g) = 2.25 mW/g  
Maximum value of SAR (measured) = 4.44 mW/g



0 dB = 4.44mW/g

## ■ Validation Data (1900 MHz Body)

Test Laboratory: HCT CO., LTD  
Input Power 100 mW (20 dBm)  
Liquid Temp: 21.3 °C  
Test Date: Mar. 29, 2011

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 – SN:5d032

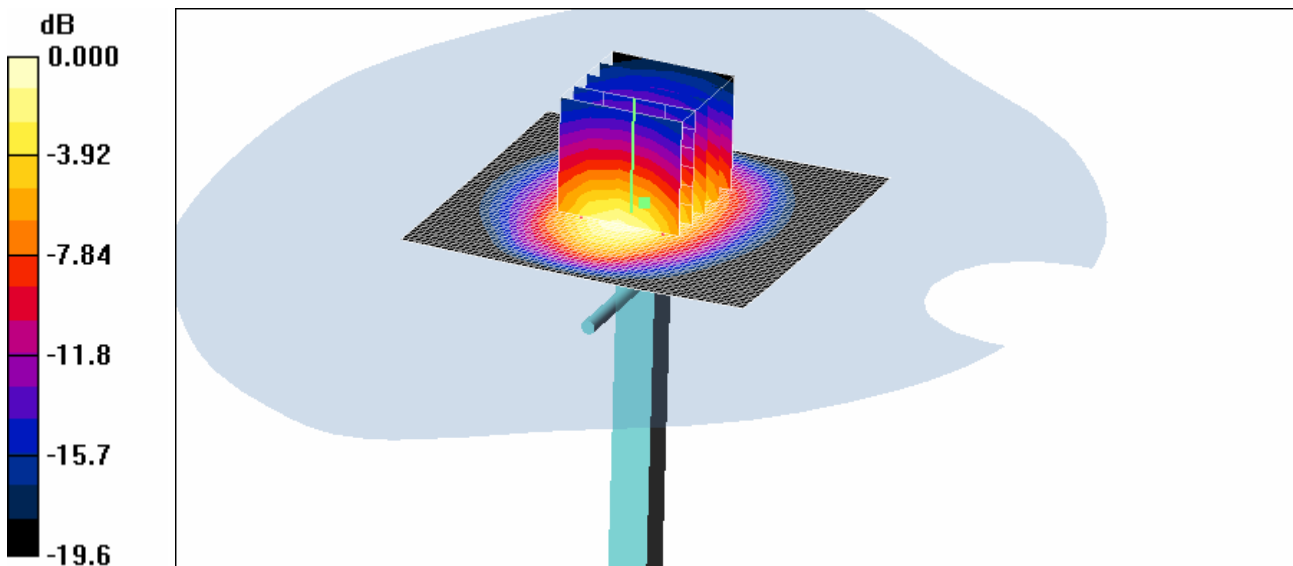
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.49$  mho/m;  $\epsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

DASY4 Configuration:

- Probe: ET3DV6 – SN1630; ConvF(4.55, 4.55, 4.55); Calibrated: 2010-05-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2010-09-21
- Phantom: SAM 1800/1900 MHz; Type: SAM

Dipole 1900MHz Validation/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 5.03 mW/g

Dipole 1900MHz Validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 60.7 V/m; Power Drift = 0.039 dB  
Peak SAR (extrapolated) = 6.78 W/kg  
**SAR(1 g) = 4.24 mW/g; SAR(10 g) = 2.24 mW/g**  
Maximum value of SAR (measured) = 4.80 mW/g



0 dB = 4.80mW/g

**■ Dielectric Parameter (835 MHz Head)**

Title P5000  
SubTitle GSM850(Head)  
Test Date Mar. 28, 2011

Frequency	e'	e''
800000000.0000	43.6426	18.7960
805000000.0000	43.5592	18.7500
810000000.0000	43.4164	18.7000
815000000.0000	43.3123	18.7419
820000000.0000	43.1921	18.7030
825000000.0000	43.0897	18.7024
830000000.0000	43.0068	18.6542
835000000.0000	42.9113	18.6314
840000000.0000	42.8034	18.6337
845000000.0000	42.7330	18.6879
850000000.0000	42.6414	18.6650
855000000.0000	42.6282	18.6764
860000000.0000	42.5777	18.6986
865000000.0000	42.5287	18.7050
870000000.0000	42.4530	18.7040
875000000.0000	42.4853	18.7216
880000000.0000	42.4368	18.6874
885000000.0000	42.3929	18.7326
890000000.0000	42.3845	18.7266
895000000.0000	42.3058	18.7172
900000000.0000	42.2429	18.7231

**■ Dielectric Parameter (835 MHz Body)**

Title P5000  
SubTitle GSM850(Body)  
Test Date Mar. 28, 2011

Frequency	e'	e''
800000000.0000	56.9879	21.3239
805000000.0000	56.9846	21.2610
810000000.0000	56.9897	21.2122
815000000.0000	56.9313	21.1888
820000000.0000	56.9540	21.1856
825000000.0000	56.9197	21.1678
830000000.0000	56.8946	21.1314
835000000.0000	56.8366	21.1317
840000000.0000	56.8006	21.0794
845000000.0000	56.7284	21.0569
850000000.0000	56.7170	20.9648
855000000.0000	56.6075	20.9826
860000000.0000	56.5566	20.8964
865000000.0000	56.4739	20.9315
870000000.0000	56.3723	20.8537
875000000.0000	56.2840	20.8270
880000000.0000	56.2263	20.8053
885000000.0000	56.1936	20.7563
890000000.0000	56.1400	20.7596
895000000.0000	56.0433	20.7317
900000000.0000	56.0739	20.7251

**■ Dielectric Parameter (1900 MHz Head)**

Title P5000  
SubTitle 1900 MHz (Head)  
Test Date Mar. 29, 2011

Frequency	e'	e''
1850000000.0000	39.7845	13.6556
1855000000.0000	39.8314	13.6293
1860000000.0000	39.8693	13.6175
1865000000.0000	39.8964	13.6695
1870000000.0000	39.8722	13.6876
1875000000.0000	39.7672	13.5825
1880000000.0000	39.7084	13.6018
1885000000.0000	39.5332	13.5785
1890000000.0000	39.3979	13.5603
1895000000.0000	39.2688	13.5744
1900000000.0000	39.1318	13.5938
1905000000.0000	38.9647	13.5970
1910000000.0000	38.8483	13.6278
1915000000.0000	38.7522	13.6666
1920000000.0000	38.6760	13.7080
1925000000.0000	38.5532	13.7493
1930000000.0000	38.5479	13.7990
1935000000.0000	38.5793	13.8784
1940000000.0000	38.6268	13.9269
1945000000.0000	38.7131	14.0032
1950000000.0000	38.8563	14.0161

**■ Dielectric Parameter (1900 MHz Body)**

Title P5000  
SubTitle 1900 MHz (Body)  
Test Date Mar. 29, 2011

Frequency	e'	e''
1800000000.0000	54.5887	13.6032
1810000000.0000	54.5386	13.7092
1820000000.0000	54.4734	13.7587
1830000000.0000	54.3926	13.8453
1840000000.0000	54.3497	13.9015
1850000000.0000	54.2790	13.9171
1860000000.0000	54.1860	13.9542
1870000000.0000	54.0974	14.0213
1880000000.0000	54.0214	14.0442
1890000000.0000	53.9079	14.1033
1900000000.0000	53.8121	14.1356
1910000000.0000	53.7700	14.1953
1920000000.0000	53.7341	14.2938
1930000000.0000	53.6611	14.3509
1940000000.0000	53.6137	14.4320
1950000000.0000	53.6035	14.4997
1960000000.0000	53.5224	14.5261
1970000000.0000	53.4799	14.5635
1980000000.0000	53.4851	14.5913
1990000000.0000	53.4283	14.6438
2000000000.0000	53.3765	14.6845

## **Attachment 3. – Probe Calibration Data**

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **ET3-1630\_May10**

**CALIBRATION CERTIFICATE**

Object: **ET3DV6 - SN:1630**

Calibration procedure(s): **QA CAL-01.v6, QA CAL-12.v6, QA CAL-23.v3 and QA CAL-25.v2  
Calibration procedure for dosimetric E-field probes**

Calibration date: **May 25, 2010**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-09)	In house check: Oct10

Calibrated by:	Name	Function	Signature
	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 25, 2010

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



**Calibration Laboratory of  
Schmid & Partner  
Engineering AG**  
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**S** Schweizerischer Kalibrierdienst  
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Accreditation No.: **SCS 108**

**Glossary:**

TSL tissue simulating liquid  
 NORM<sub>x,y,z</sub> sensitivity in free space  
 ConvF sensitivity in TSL / NORM<sub>x,y,z</sub>  
 DCP diode compression point  
 CF crest factor (1/duty\_cycle) of the RF signal  
 A, B, C modulation dependent linearization parameters  
 Polarization  $\varphi$   $\varphi$  rotation around probe axis  
 Polarization  $\vartheta$   $\vartheta$  rotation around an axis that is in the plane normal to probe axis (at measurement center),  
 i.e.,  $\vartheta = 0$  is normal to probe axis

**Calibration is Performed According to the Following Standards:**

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

**Methods Applied and Interpretation of Parameters:**

- *NORM<sub>x,y,z</sub>*: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). *NORM<sub>x,y,z</sub>* are only intermediate values, i.e., the uncertainties of *NORM<sub>x,y,z</sub>* does not effect the  $E^2$ -field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)<sub>x,y,z</sub>* = *NORM<sub>x,y,z</sub>* \* *frequency\_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCP<sub>x,y,z</sub>*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *A<sub>x,y,z</sub>*; *B<sub>x,y,z</sub>*; *C<sub>x,y,z</sub>*; *VR<sub>x,y,z</sub>*: *A*, *B*, *C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF* and *Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORM<sub>x,y,z</sub>* \* *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

ET3DV6 SN:1630

May 25, 2010

# Probe ET3DV6

## SN:1630

Manufactured:	October 12, 2001
Last calibrated:	August 25, 2008
Recalibrated:	May 25, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1630

May 25, 2010

**DASY/EASY - Parameters of Probe: ET3DV6 SN:1630**
**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu V/(V/m)^2$ ) <sup>A</sup>	1.65	1.63	1.63	± 10.1%
DCP (mV) <sup>B</sup>	93.1	92.2	92.5	

**Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc <sup>E</sup> (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300.0	± 1.5%
			Y	0.00	0.00	1.00	300.0	
			Z	0.00	0.00	1.00	300.0	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

ET3DV6 SN:1630

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### DASY/EASY - Parameters of Probe: ET3DV6 SN:1630

#### Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>c</sup>	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	43.5 ± 5%	0.87 ± 5%	7.20	7.20	7.20	0.21	2.26 ± 13.3%
835	± 50 / ± 100	41.9 ± 5%	0.89 ± 5%	6.25	6.25	6.25	0.50	2.09 ± 11.0%
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	6.13	6.13	6.13	0.52	2.09 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	5.38	5.38	5.38	0.51	2.57 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.12	5.12	5.12	0.72	2.10 ± 11.0%
1950	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.96	4.96	4.96	0.76	2.02 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.58	4.58	4.58	0.99	1.63 ± 11.0%

<sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

ET3DV6 SN:1630

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### DASY/EASY - Parameters of Probe: ET3DV6 SN:1630

#### Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>c</sup>	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	56.7 ± 5%	0.94 ± 5%	7.48	7.48	7.48	0.15	2.30 ± 13.3%
835	± 50 / ± 100	55.2 ± 5%	0.97 ± 5%	6.17	6.17	6.17	0.42	2.43 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	4.77	4.77	4.77	0.66	2.88 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.55	4.55	4.55	0.87	2.41 ± 11.0%
1950	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.64	4.64	4.64	0.94	2.32 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.15	4.15	4.15	0.99	1.47 ± 11.0%

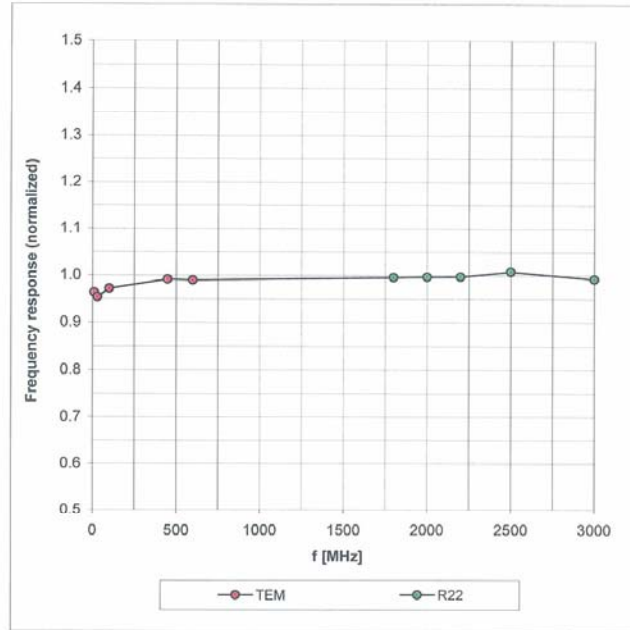
<sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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May 25, 2010

### Frequency Response of E-Field

(TEM-Cell: ifi110 EXX, Waveguide: R22)

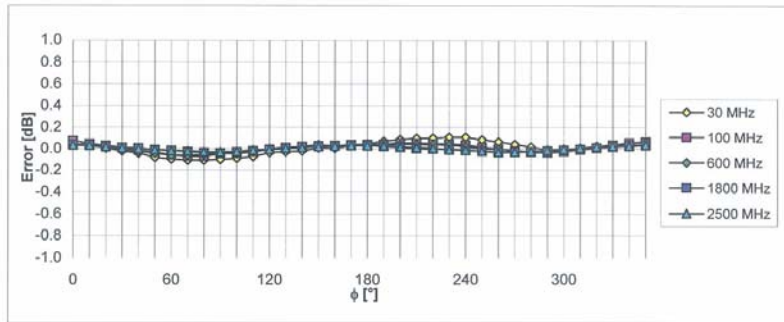
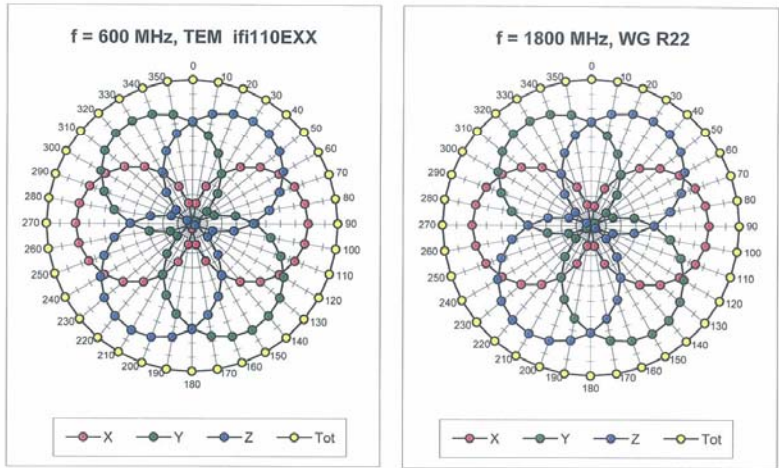


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

ET3DV6 SN:1630

May 25, 2010

**Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$**



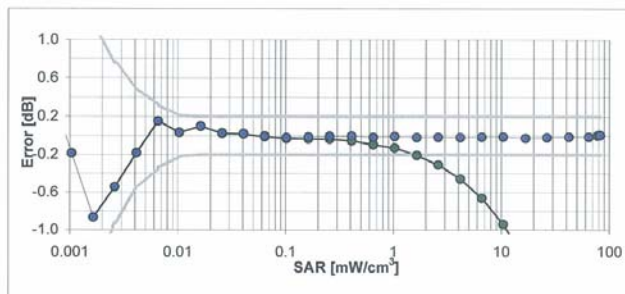
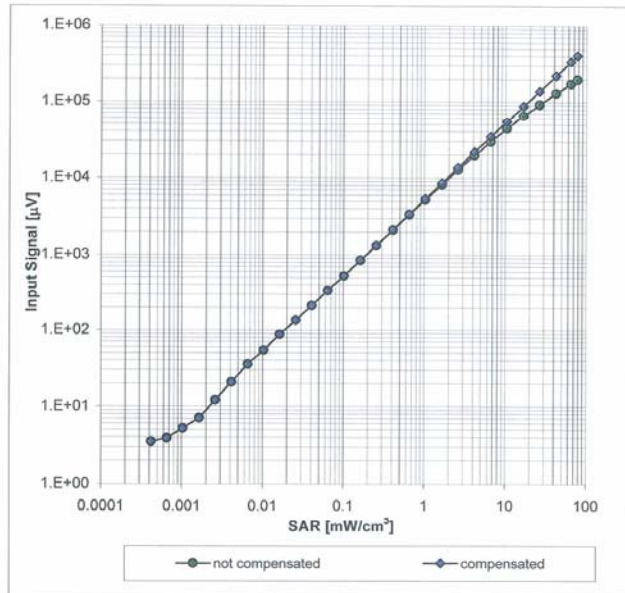
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)



ET3DV6 SN:1630

May 25, 2010

**Dynamic Range  $f(SAR_{head})$**   
(Waveguide R22,  $f = 1800$  MHz)



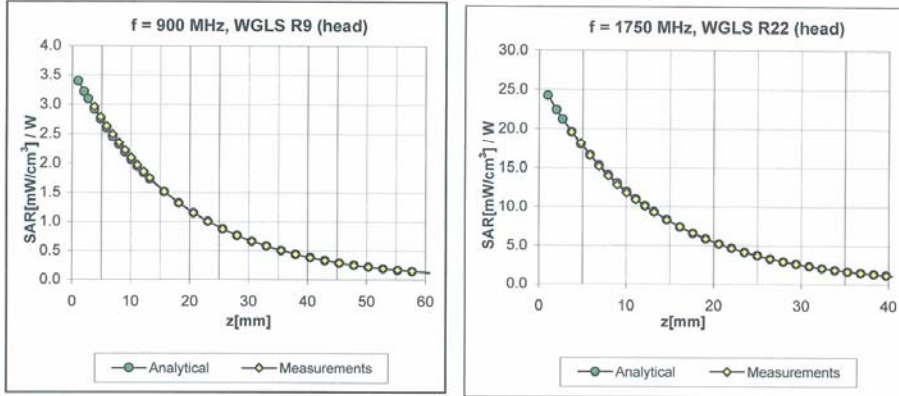
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )



ET3DV6 SN:1630

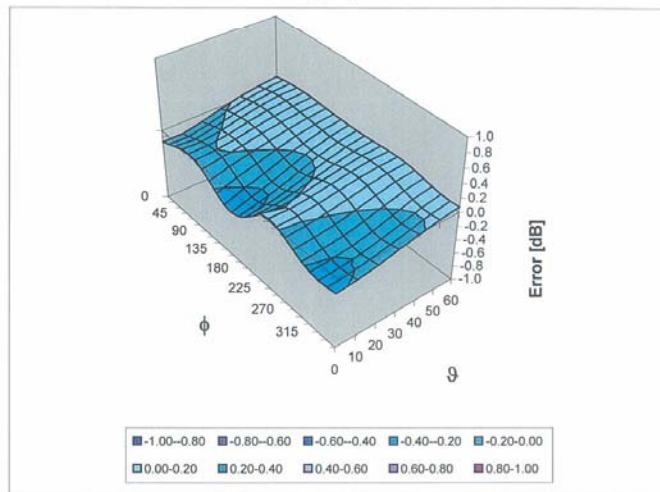
May 25, 2010

### Conversion Factor Assessment



### Deviation from Isotropy in HSL

Error ( $\phi, \theta$ ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  (k=2)

ET3DV6 SN:1630

May 25, 2010

**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

Schmid &amp; Partner Engineering AG

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Phone +41 44 245 9700, Fax +41 44 245 9779  
info@speag.com, http://www.speag.com

### Additional Conversion Factors for Dosimetric E-Field Probe

Type:

**ET3DV6**

Serial Number:

**1630**

Place of Assessment:

**Zurich**

Date of Assessment:

**July 9, 2010**

Probe Calibration Date:

**May 25, 2010**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the recalibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1750 MHz.

Assessed by:

Schmid & Partner Engineering AG

**s p e a g**

Zeughausstrasse 43, 8004 Zurich, Switzerland  
Phone +41 44 245 9700, Fax +41 44 245 9779  
info@speag.com, http://www.speag.com

**Dosimetric E-Field Probe ET3DV6 - SN:1630**

Conversion factor ( $\pm$  standard deviation)

750  $\pm$  50 MHz      *ConvF*      6.44  $\pm$  7%

$\epsilon_r = 41.9 \pm 5\%$   
 $\sigma = 0.89 \pm 5\%$  mho/m  
(head tissue)

750  $\pm$  50 MHz      *ConvF*      6.30  $\pm$  7%

$\epsilon_r = 55.5 \pm 5\%$   
 $\sigma = 0.96 \pm 5\%$  mho/m  
(body tissue)

**Important Note:**

**For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.**

**Please see also DASY Manual.**

## **Attachment 4. – Dipole Calibration Data**

**Calibration Laboratory of  
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Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D835V2-441\_May10**

**CALIBRATION CERTIFICATE**

Object: **D835V2 - SN: 441**

Calibration procedure(s): **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

Calibration date: **May 21, 2010**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	02-Mar-10 (No. DAE4-601_Mar10)	Mar-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

	Name	Function	Signature
Calibrated by:	Jeton Kastrioti	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 21, 2010

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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**S** Servizio svizzero di taratura  
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The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

**Measurement Conditions**

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V5.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.7 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	---	---

**SAR result with Head TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 mW / g
SAR normalized	normalized to 1W	9.72 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>9.66 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 mW / g
SAR normalized	normalized to 1W	6.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>6.29 mW / g ± 16.5 % (k=2)</b>



**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.2 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	---	---

**SAR result with Body TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.51 mW / g
SAR normalized	normalized to 1W	10.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>9.92 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.64 mW / g
SAR normalized	normalized to 1W	6.56 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>6.51 mW / g ± 16.5 % (k=2)</b>

**Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	55.2 $\Omega$ - 8.2 j $\Omega$
Return Loss	- 20.8 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	45.3 $\Omega$ - 9.4 j $\Omega$
Return Loss	- 19.2 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.375 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	March 09, 2001

**DASY5 Validation Report for Head TSL**

Date/Time: 21.05.2010 09:55:07

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:441**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.91$  mho/m;  $\epsilon_r = 41.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 61

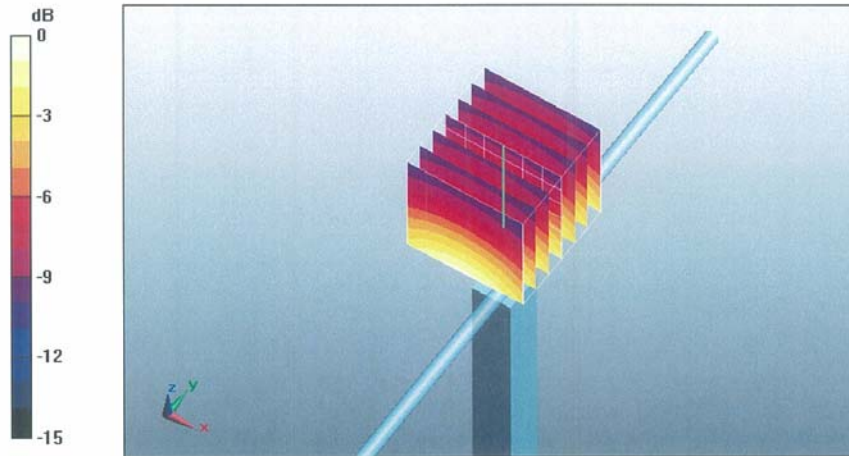
**Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement**  
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.3 V/m; Power Drift = -0.023 dB

Peak SAR (extrapolated) = 3.63 W/kg

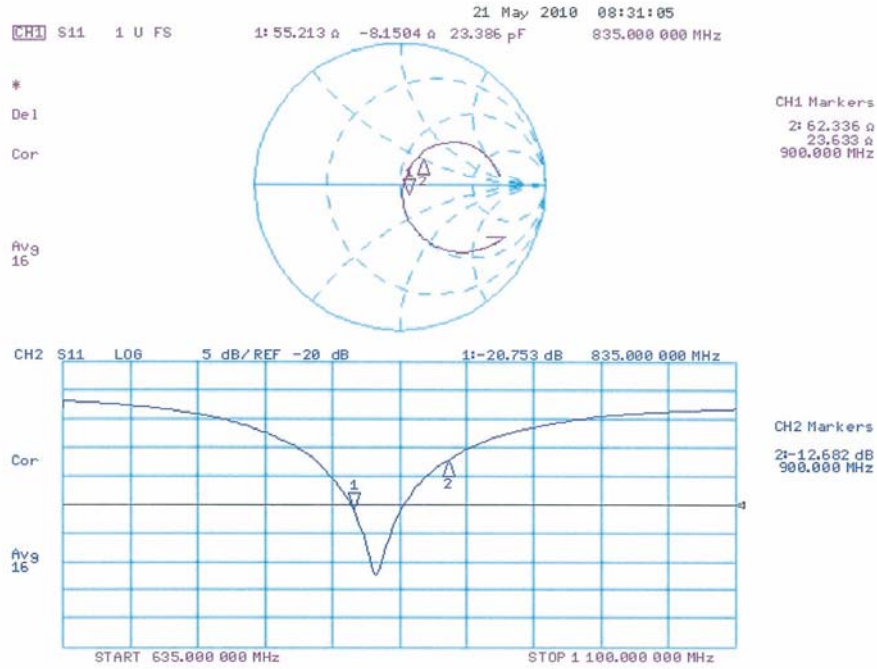
**SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.58 mW/g**

Maximum value of SAR (measured) = 2.83 mW/g



0 dB = 2.83mW/g

**Impedance Measurement Plot for Head TSL**



**DASY5 Validation Report for Body**

Date/Time: 20.05.2010 09:50:16

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:441**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.98$  mho/m;  $\epsilon_r = 54.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.86, 5.86, 5.86); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 61

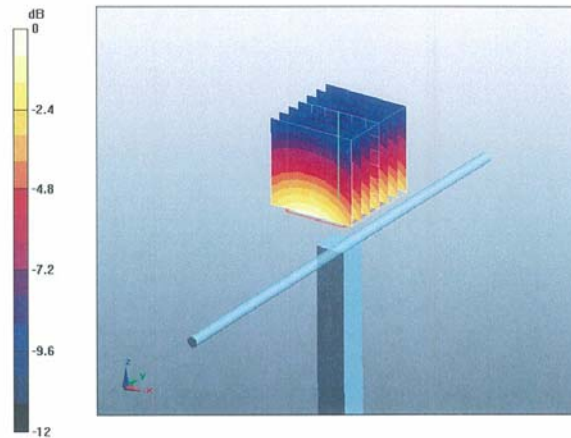
**Pin250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement**  
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.4 V/m; Power Drift = 0.000719 dB

Peak SAR (extrapolated) = 3.69 W/kg

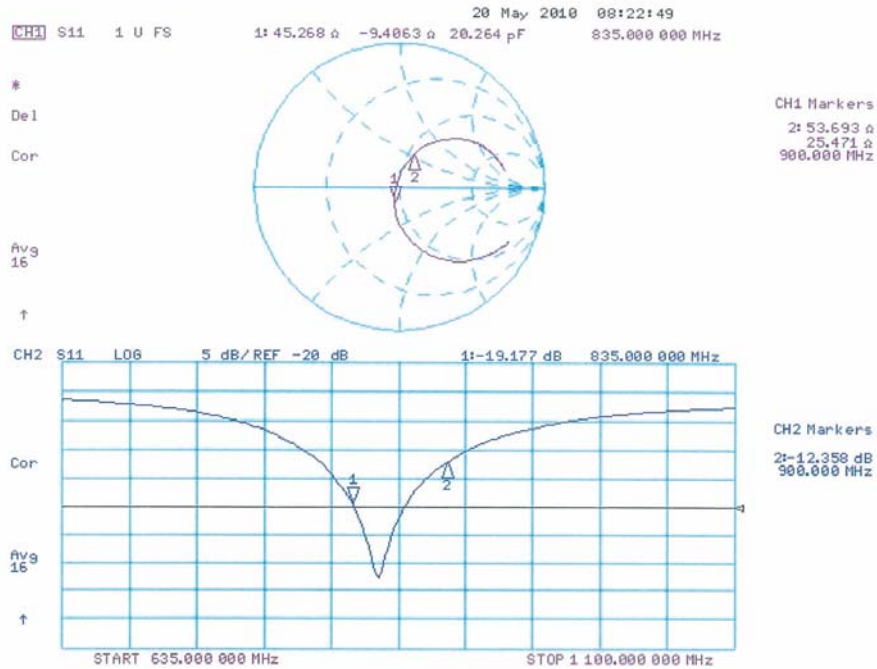
**SAR(1 g) = 2.51 mW/g; SAR(10 g) = 1.64 mW/g**

Maximum value of SAR (measured) = 2.93 mW/g



0 dB = 2.93mW/g

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d032\_Jul10**

CALIBRATION CERTIFICATE			
Object	D1900V2 - SN: 5d032		
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits		
Calibration date:	July 16, 2010		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10
Calibrated by:	Name Dimce Iliev	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: July 19, 2010
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Accreditation No.: **SCS 108**

**Glossary:**

TSL tissue simulating liquid  
ConvF sensitivity in TSL / NORM  $x,y,z$   
N/A not applicable or not measured

**Calibration is Performed According to the Following Standards:**

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.



**Measurement Conditions**

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.3 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(22.6 ± 0.2) °C	----	----

**SAR result with Head TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR normalized	normalized to 1W	40.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>39.9 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.26 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>20.9 mW / g ± 16.5 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	1.55 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	---	---

**SAR result with Body TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.5 mW / g
SAR normalized	normalized to 1W	42.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>41.5 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.63 mW / g
SAR normalized	normalized to 1W	22.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>22.4 mW / g ± 16.5 % (k=2)</b>

**Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	51.6 $\Omega$ + 6.2 j $\Omega$
Return Loss	- 24.0 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	50.3 $\Omega$ + 7.0 j $\Omega$
Return Loss	- 23.1 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.177 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	March 17, 2003

**DASY5 Validation Report for Head TSL**

Date/Time: 16.07.2010 12:15:48

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement**

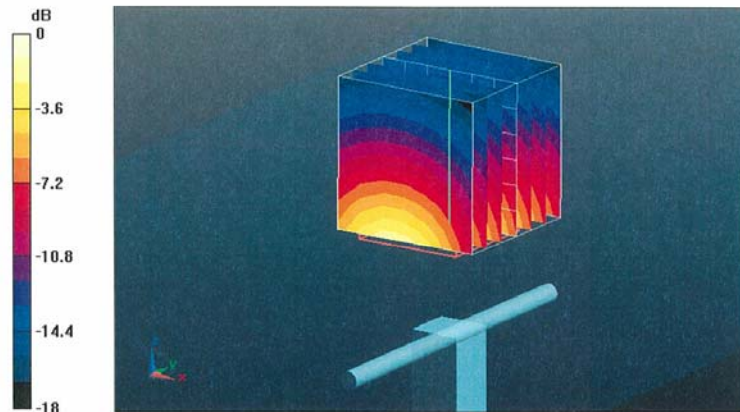
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.4 V/m; Power Drift = 0.039 dB

Peak SAR (extrapolated) = 18.3 W/kg

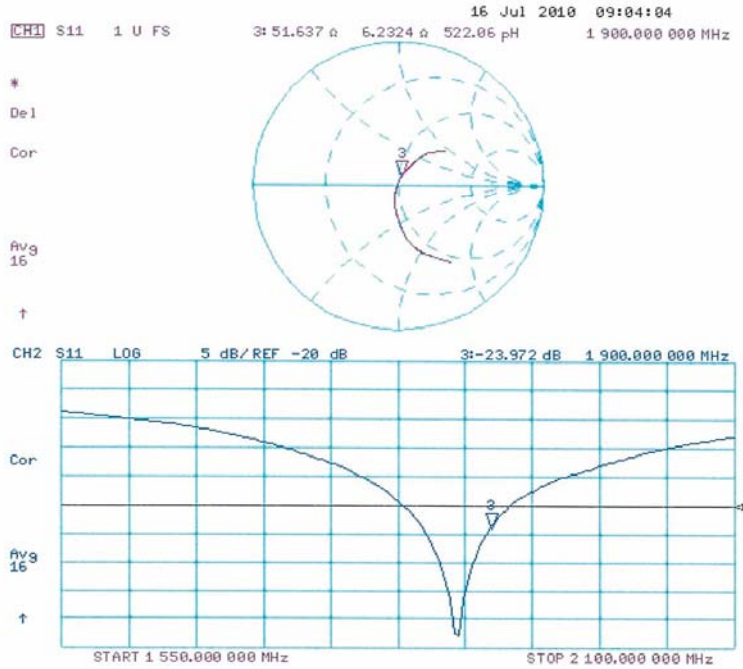
**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.26 mW/g**

Maximum value of SAR (measured) = 12.3 mW/g



0 dB = 12.3mW/g

Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body**

Date/Time: 13.07.2010 12:14:01

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U11 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.55$  mho/m;  $\epsilon_r = 53.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

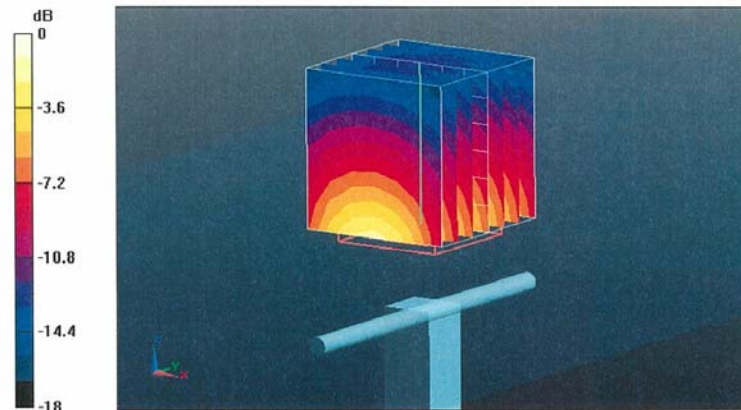
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.1 V/m; Power Drift = 0.00127 dB

Peak SAR (extrapolated) = 17.6 W/kg

**SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.63 mW/g**

Maximum value of SAR (measured) = 13.2 mW/g



0 dB = 13.2mW/g



Impedance Measurement Plot for Body TSL

